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**Sussex County**

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## PLEASE NOTE

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May 20, 2022

**VIA: Hand Delivery**

The Honorable Michael H. Vincent  
The Honorable Cynthia Green  
The Honorable Mark Schaeffer  
The Honorable Douglas B. Hudson  
The Honorable John L. Rieley  
c/o Todd F. Lawson, Sussex County Administrator  
Sussex County Building  
2 The Circle  
Georgetown, DE 19947

Re: Mitchells Corner  
CZ #1967, CZ # 1968, CU #2334  
Sussex County Tax Parcel No. 335-8.00-37.00  
Source Water Protection, Sussex County Code, Chapter 89

Dear Council Members:

I represent the the applicant/developer, Henlopen Properties, LLC as well as the property owner, Mitchell Family, LLC. Both the property owner and the developer thank this Council for its attention to this project and the discussion that occurred during the public hearing on April 26th. As the Council likely recalls, the developer hired the Verdantas firm to complete a study to determine whether the project complied with Chapter 89, Source Water Protection, of the Sussex County Code, because a small part of the project is in the wellhead protection area that surrounds the Lewes wellfield.

Section 89-3 of Chapter 89 describes the purpose of the County's Source Water Protection as follows:

The purpose of this chapter is to ensure that land use activities are conducted in such a way as to minimize the impact on and reduce the risk of contamination of excellent groundwater recharge areas and wellhead protection areas which are the source of public drinking water throughout the County.

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In its simplest terms, Chapter 89 requires a property owner to balance their climatic water budget to ensure that post-development recharge quantity will meet or exceed the existing (predevelopment) recharge quantity. (See § 89-6.F(2).) The Environmental Assessment Report prepared by Verdantas for the Mitchells Corner project and included at Tab “S” in the Project Books demonstrated that the budget would be balanced.

During the public hearing before the Planning Commission, the City of Lewes Board of Public Works (“BPW”) presented concerns about the City of Lewes wellfield. To ensure that those concerns had been appropriately addressed, the applicant asked Verdantas to confirm the Chapter 89 requirements were being met. As was set forth in the Supplemental Report prepared by Verdantas and submitted during the public hearing before County Council, the climatic budget is not only balanced (that is post-development recharge quantity meets pre-development recharge quantity), but there is an annual surplus of approximately four million gallons of additional, pre-treated recharge to the wellfield’s aquifer.

During the hearing before this Council, BPW requested additional time to have its professionals complete a report about the project. Council provided BPW with approximately two weeks to provide its report and similarly provided the property owner and developer an additional two weeks to respond to the report obtained by BPW. Attached to this letter is the response of the professional geologists at Verdantas regarding the comments and report from BPW and its expert, Barton & Loguidice, D.P.C. (“B&L Report”).

Three things stand out about the B&L Report. First, the B&L Report indicates that its professional services were outlined in a proposal dated March 31, 2022 and subsequently authorized by BPW on April 8, 2022. This is three years after the initial applications for the Mitchells Corner project were filed, almost a month after the public hearing before the Planning Commission and, less than a month before the public hearing conducted by County Council.

Second, assuming arguendo that one accepts the hypothetical expansion of the wellhead protection area in the B&L Report, even though it differs from the mapped area used by Sussex County and all agencies, the impervious area of the Mitchell Farm is only 2.05% of that area. Remarkably, even though the Mitchells Corner project is such a small fraction of the wellhead protection area, it proposes to add approximately four million gallons of treated stormwater to the Lewes well field annually.

Third, the B&L Report does not challenge or contradict the balancing of the climatic water budget or that the Mitchells Corner meets the requirements of Chapter 89 as set forth in detail in each of the reports prepared by Verdantas. Instead, the B&L Report and BPW commentary are speculative concerns or a series of “what ifs” and policy discussions about addressing those possibilities. Like the statements made by BPW during the public hearing, the B&L Report as well as BPW’s prefatory comments to that report are more ideological in nature than an objection to the Mitchells Corner project.

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These hypothetical and ideological concerns are summarized by statements made by the BPW at the public hearings and then reiterated in the report and commentary about things that the property owner and Developer of Mitchells Corner cannot control, *i.e.*, the development of other properties within the wellhead protection area, and of course the dualization of Kings Highway. The developer can only control its compliance with Chapter 89 on its property.

In addition, BPW and B&L repeatedly express concern about a need for a holistic process and approach to source water protection in the wellhead protection area. The good news for Sussex County and its residents is that a holistic approach to source water protection is already codified in the Sussex County Code. All properties in Sussex County that are within a wellhead protection area must meet the requirements found in Chapter 89 of the Sussex County Code. Simply stated, this means that all properties that are developed within the wellhead protection area for the Lewes wellfield will have to comply with the same requirements and protections.

On a more specific and practical level, the proposed design of the Mitchells Corner project, readily complies with the requirements of Chapter 89 resulting in an annual surplus of four million gallons of pretreated water being added to the aquifer for the Lewes wellfield. This is a real-life demonstration that the process and requirements set forth in the Sussex County Code are working.

Everyone agrees that sources of clean drinking water should be protected. As set forth in the unchallenged expert reports from Verdantas, the Mitchells Corner project does not have a negative impact on the wellhead protection area and will, for the first time in the history of the property, pretreat the water infiltrating into the ground and provide significantly more pretreated water from the surface than exists today.

Respectfully submitted,

MORRIS JAMES LLP

  
David C. Hutt, Esquire

Enclosure (Verdantas May 20, 2022 Letter Response)

Cc: Todd F. Lawson (Email to [tlawson@sussexcountycle.gov](mailto:tlawson@sussexcountycle.gov))  
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May 20, 2022

Sussex County Council  
2 The Circle  
P.O. Box 589  
Georgetown, DE 19947

Re: Sussex County Tax Parcel 335-8.00-37.00  
Henlopen Properties LLC (the Applicant)  
CZ 1967, CZ 1968, and CU 2334 (the Applications)  
Verdantas Project No. 14447

Dear Council President Vincent and Members:

Verdantas, LLC (Verdantas) appreciates the opportunity to respond to comments by the Lewes Board of Public Works (BPW) and its consultant Barton and Loguidice, D.P.C. (B&L) concerning the proposed development of the Mitchell Farm Property. As you are aware, a small portion of the Mitchell Farm Property lies within the boundary of the mapped Wellhead Protection Area (WHPA) for the City of Lewes Wellfield, but beyond the incorporated boundary of the City. This letter is in response to comments from BPW and B&L concerning the proposed development of the Mitchell Farm Property and is a further supplement to Verdantas' February 2022 Environmental Assessment Report and April 25, 2022 Supplemental Letter Report.

The Verdantas reports anticipate no adverse impact to the WHPA and, in fact, anticipate a substantial and beneficial surplus of post-development recharge to replenish the aquifer within the WHPA. The Applicant proposes to develop the referenced property in accordance with applicable Sussex County Code and Delaware Department of Natural Resources and Environmental Control (DNREC) Regulations. Per the Verdantas water budget calculations for the Mitchell Farm property, post-development recharge exclusively within the WHPA will be increased by almost four million gallons annually. The proposed treatment and management of stormwater will exceed stormwater Best Management Practices (BMPs) and will include pretreatment structures. Additionally, the Applicant intends to develop an inspection, maintenance, and contingency emergency plan for the recharge structure which will be maintained initially by the Applicant and then, in perpetuity, by the property owners association.

On behalf of the Developer, Henlopen Properties, LLC, we are pleased to provide a written response to the BPW cover page comments and those provided by B&L. We offer the following in response to those comments:

#### **Board of Public Works Cover Page Comments and Responses**

- The WHPA is defined as an estimate 5-year time-of-travel, wherein it could take up to 5 years for water originating from rain above the WHPA, to enter the wells themselves. In actuality, the BPW wellfield draws from, and thus is susceptible to contamination of, groundwater from a larger surrounding area.

***Response - The 5-year travel time boundary is predicted by a groundwater model developed using a number of assumptions and variables employed by the Delaware Geological Survey to map the boundaries of the WHPA shown on the Source Water Protection maps used by Sussex County and state agencies. BPW does not cite to a***

*scientific source for its proposition that the BPW wellfield draws from a larger surrounding area. To our knowledge, there have been no investigations to measure and assess groundwater flow characteristics to determine the actual zone of influence from pumping the supply wells. Thus, the zone of influence may extend past the 5-year boundary; it may be limited to a smaller area within the 5-year boundary; or the extent may vary from larger to smaller than the 5-year travel boundary depending on conditions around the wellfield.*

- The creation of impervious surfaces associated with the land use changes introduces risks to the long-term sustainable capacity of the BPW wellfield. The 2003 WHPA model presumes availability of natural groundwater recharge amounts from the development site in question, in perpetuity.

*Response – The addition of impervious surfaces does not necessarily result in a loss of recharge volume. In fact, as designed and proposed by the Mitchell Farm applicant, the proposed post development recharge will result in a SURPLUS of approximately four million gallons annually when compared to predevelopment recharge volumes. This is partly because stormwater that would otherwise be lost as runoff or consumed through evapotranspiration from agricultural fields can be collected from impervious surfaces and recharged into the subsurface.*

- WHPA edges, whether or not coincident with groundwater divides, do not necessarily correlate with existing land surface topographic drainage divides, and those divides may themselves shift in response to grading during land development.

*Response –As set forth in the prior Verdantas reports and at the public hearing, the stormwater management design for the proposed project is intended to shift the topographic drainage so that stormwater will be treated, establish a SURPLUS recharge of four million gallons annually, and reduce runoff.*

- The expansion of imperviousness within the WHPA may effectively "pull" additional water from Ebenezer Branch (of possibly inferior natural quality) into the aquifer. In doing so, the unconfined aquifer could receive more (possibly seawater-influenced) surface water than it otherwise would, affecting water quality results by introducing increased surficial contaminants, particularly during storm events.

*Response –Ebenezer Branch is located 1,800 feet southwest of the Mitchell Farm, and on the opposite side of the Lewes wellfield. Considering that distance and the substantial surplus in post-development recharge proposed by the Mitchell Farm project, we do not anticipate any interference from the Applicant's property with surface water conditions in Ebenezer Branch. In addition, Ebenezer Branch is not influenced by tide in the vicinity of the wellfield. The extent of tidal influence (and "sea water") does not extend past the dam-like structure located at Donovan's Road, approximately 2,700 feet downstream of the wellfield (Figure 1 attached).*

- Effective treatment of stormwater through processes such as sand filters and carbon polishing often is regarded as expensive. The available documents B&L reviewed make no mention of plans or commitments for said treatment. Absent assured treatment (and its funding) over time, the risk remains of groundwater discharge of potential contaminants from these proposed stormwater facilities.

*Response – The recharge basin planned for the Mitchell Farm property will include two pretreatment facilities recommended in the Delaware Groundwater Recharge Design*

***Manual (revised 2017) cited by B&L. The pre-treatment facilities will include a forebay and water quality inlets described in the manual as "Traps in stormwater inlets designed to remove debris, grease, oil, and sediment". Pretreatment facilities recommended in the referenced manual do not include carbon filters which are not a standard practice for treating stormwater. Considering the depth to groundwater (10-15 feet) and the consistency of the sandy soils on the Mitchell Farm property, the unsaturated soils above the water table will act as a natural sand filter.***

- Each planned stormwater facility within the WHPA introduces the prospect of groundwater contamination hazards from stormwater entrainment of roadway deicers and vehicle drippings, which may enter and be discharged from stormwater management facilities. Moreover, the future use of fertilizers, pesticides and herbicides on landscaped grounds within the WHPA could introduce groundwater contaminants. Best would be their restricted or prohibited use.

***Response –This statement, while true, ignores the fact that these same prospects and conditions exist today in the WHPA through the existing stormwater facilities, the existing agricultural activities, the major roadway that runs through the wellhead protection area, and the significant areas of impervious surface that exist in closer proximity to the wellfields (Cape Henlopen High School). This statement suggests that BPW would advocate prohibiting or restricting soil and plant amendments for all properties within the wellhead area, which activities have been occurring to a greater extent through existing agricultural activities and through the known history of developed properties in the WHPA. Verdantas suggests that BPW consider and understand that impact to the WHPA may encompass numerous commercial properties, hundreds of homes, a major highway, and a large high school campus and associated paved areas.***

#### **Text of Barton & Loguidice Report with Responses**

Barton & Loguidice, D.P.C. (B&L), was retained by the Lewes Board of Public Works (BPW) to re-assess the combined, potential hydrogeologic effects on the BPW wellfield from several planned land use changes within the delineated wellhead protection area (WHPA). These proposed land use changes entail both land development and highway widening.

Herein, we considered the proposed Village Center Cottages (VCC) development, the proposed re-zoning and development of the former Mitchell Farm and the widening of US Route 9. We did so in the context of a planned increase in groundwater withdrawals from the BPW wellfield. This letter of opinion fulfills our professional services proposal dated March 31, 2022 as authorized by the BPW on April 8, 2022.

#### **Basis for Renewed BPW Concern**

In 2015, we (as Advanced Land and Water, prior to its 2019 acquisition by B&L) prepared a hydrogeologic evaluation of potential groundwater supply effects from a then-proposed commercial development project (then called Village Center, but differing in spatial position from the now-proposed VCC) that was partially in the WHPA. Due to its design and the nature of the aquifer, the wellfield is particularly susceptible to contamination and capacity reduction from land uses and impervious expansion in its WHPA.

We came to recommend that the original Village Center site remain agricultural as the best means of protection for the wellfield. This remains our ideal recommendation, but this letter of opinion was prepared in recognition that the land development projects discussed herein are unlikely to be disapproved in their entirety.

***Response: Verdantas outlined in its Environmental Assessment Report and supplemental letter report that surface water and groundwater quality is typically improved when changing from agricultural land use to well-designed residential and light commercial use. Verdantas also noted that the proposed development of the Mitchell Farm is consistent with current land use within the WHPA.***

Earlier this year the BPW contacted us anew to advise on similar concerns arising from updated land use plans differing in detail (the VCC, the Mitchell Farm parcel, and the widening of US Route 9). As before, proposed development within the WHPA would increase impervious area, lessen groundwater recharge available for withdrawal and may increase the risk of groundwater contamination (i.e., roadway deicers and vehicle drippings) from planned stormwater management facilities.

***Response: The Mitchell Farm project will result in a net surplus of groundwater recharge of approximately four million gallons of water annually within the mapped WHPA. Management of stormwater will exceed requirements in DNREC's Standard Guidelines for Operation and Maintenance of Stormwater Best Management Practices (2019), including pretreatment structures upstream of the basin.***

### **Background Information**

Lewes BPW makes use of five public water supply wells, located south of Cape Henlopen High School (see large blue dots on attached figure). Two of these wells have a screened interval deeper than 100 feet below ground surface, while the other three are screened more shallowly. The five wells are completed in the unconfined aquifer, which means they are particularly:

1. Susceptible to contamination arising from incompatible land uses and activities within and near their WHPAs and;
2. Dependent for sustainable capacity, on local groundwater recharge from precipitation falling within and near the WHPA.

In December of 2003, the Delaware Geological Survey (DGS) published a Source Water Assessment Report, documenting the application of a numerical groundwater flow model which the agency used to delineate the five-year time-of-travel capture zone for the BPW wellfield (Andres & al., 2003). One of the key input parameters was water demand; DGS and DNREC used information then available to the agencies.

Based on the 2003 DGS model, groundwater (and prospective contaminants therein) within this capture zone could enter the wells within five years of precipitation and/or release within the WHPA. As a matter of policy, the five-year time-of-travel zone was deemed one preferentially worthy of protection both from a water quality (i.e., contamination risk) and quantity (sustainable recharge) perspective, and established this as the WHPA. A 100 meter buffer was applied to modeled extent of the 5-year capture zone as an additional measure conservatism in light of intrinsic uncertainties in groundwater modeling.



The BPW now expects further growth in population and thus, in groundwater withdrawals. For the period between the time of the DGS WHPA delineation and 2025, for example, groundwater use of this wellfield has increased (or will increase) approximately 25%.

Irrespective of the static position of the five-year DGS-delineated WHPA boundary, the actual area from which the wellfield captures groundwater varies based on a combination of factors and circumstances:

- Seasonal withdrawal fluctuations,
- Natural variability in recharge rates based on precipitation variance,
- Changes in land use within and near the capture zone, and
- Changes in stream stage within surface bodies hydrologically connected to the aquifer and other factors.

Notwithstanding this variability, the area encompassed by the WHPA is static, and reflects computer model input parameters (such as groundwater recharge rates and imperviousness) selected and assigned in 2003. It is our understanding that the agency is not in the regular and customary practice of updating WHPAs (or by extension, executing new computer models) when factors such as land use, imperviousness and water demand change, all of which are factors that may come to affect the shape and size of the groundwater capture zone.

#### **Forecasted Expansion in Future WHPA**

For this effort, B&L approximated the potential future areal extent of the WHPA under the hypothesis that it was re-delineated to reflect proposed conditions circa 2025 (i.e., increased groundwater withdrawals). For simplicity, B&L assumed a proportionate increase in WHPA size, equally in all directions, by 25% in overall area.

The updated WHPA delineation is not official and merely is offered for illustrative purposes. As is the case with the original DGS delineation, a 100-meter (m) buffer is included in the updated WHPA. The attached figure (Figure 1) outlines the original WHPA and its updated, projected extent to reflect water demand changes. We also illustrate the positions of the VCC, the Mitchell farm and US-9 for context.

Absent the assuredness of the continuity of groundwater recharge in its pre-development quantity as discussed further below, if the wellfield withdrawal rates are held constant and irrespective of the absence of WHPA re-delineations, one can assume that the actual 5-year capture zone would expand in approximate proportion to the lost pervious area.

***Response: The assumption is made that that the addition of impervious cover will automatically result in lost recharge and expansion of the 5-year capture zone. This assumption is incorrect as the development of the Mitchell Farm property will result in substantial post-development recharge of water to the aquifer and WHPA.***

Note that BPW advises that discussions with DNREC about an updated delineation have commenced. B&L recommends that such efforts continue and result in a conservatively prepared, updated WHPA delineation reflective of increased groundwater withdrawals and decreased pervious land cover arising from the land development projects discussed herein.

**Response:** Any updated modelling should include calculated post-development surplus recharge where property owners within the WHPA develop water budgets per Sussex County Code, as is proposed for the Mitchell Farm property.

### **Effect of Impervious Surfaces on Groundwater Recharge**

The hydrologic consequence of increased impervious surface cover is a decrease in overall groundwater recharge within the WHPA. Even if stormwater discharges at the proposed development sites are intended to reenter the groundwater system through infiltration systems that may seem appropriately engineered initially, there likely exists no assurance that such systems would be free of siltation and/or biofouling over time. This is particularly true of stormwater facilities that are not properly maintained.

**Response:** Per the water budget calculations for the Mitchell Farm property, post-development recharge exclusively within the WHPA will be increased by almost four million gallons annually. Additional recharge from outside the WHPA on the Mitchell property would be available to further enhance the surplus of recharge within the WHPA. Verdantas acknowledges that stormwater structures require routine maintenance and recommends regular inspection and maintenance of the recharge basin. Pretreatment structures will reduce the potential for siltation and biofouling of the basin itself. Coarse-grained soils in the WHPA provide excellent media for filtration and recharge. An example of a well-functioning stormwater structure within the WHPA is the stormwater basin serving Cape Henlopen High School.

The creation of impervious surfaces associated with the land use changes introduces risks to the long-term sustainable capacity of the BPW wellfield. The 2003 WHPA model presumes availability of natural groundwater recharge amounts from the development site in question, in perpetuity. The expansion of impervious surfaces associated with the land use changes will violate this model input criterion. The 5-year capture area may respond by enlargement in orientations and by degrees, which would require an updated model to predict.

The capture zone associated with the wellfield may entrain groundwater (whether or not contaminated) that now otherwise may support base-flow to streams. The ultimate capacity of the wellfield may diminish, the evidence for this long-term imperilment would be greater pumping cycle drawdowns, longer-duration pumping cycles or both. We believe that these potentialities require detailed planning before the development projects proposed within the WHPA otherwise could be countenanced.

The resulting effect of this loss of potential recharge area easily may cause:

1. An expansion of the 5-year capture zone, beneath more of the proposed development projects;
2. A potential for increased surface water capture from Ebenezer Branch, a tributary of Canary Creek, into the underlying unconfined aquifer;
3. Expansion of the 5-year capture zone to include otherwise excluded areas that have point source hazards and/or contaminated sites.



**Response:** *The Mitchell Farm project will result in a net surplus of groundwater recharge within the mapped WHPA. The Mitchell Farm property is located approximately 1,800 feet southwest of Ebenezer Branch, on the opposite side of the Lewes wellfield. We do not foresee development on the Mitchell Farm property contributing to the concerns listed above.*

B&L performed a geospatial analysis of land use in the WHPA to approximate the post-development extent of impervious area. Site plans or concept renderings for each of the three development projects identified in the table below, were provided by Lewes BPW, along with other relevant materials that spoke to the matter of site imperviousness. Impervious areas were approximated for these three development projects within the expanded WHPA by either using a manual tracing method in ArcGIS, or from other materials shared by Lewes BPW.

As with the DGS report, a 100-meter buffer was included in the expanded WHPA. The table below outlines the increase in impervious area and the associated percentage of the WHPA from each of the three projects. Note that we did not include the proposed Village Center shopping center or other possible projects which may come to exist elsewhere in the WHPA.

| Planned Land Use Change              | Impervious Area in Expanded WHPA (acres)* | Impervious Area as a Percentage of Expanded WHPA |
|--------------------------------------|---|--|
| WHPA Land Use as of 2021             | 85.31                                     | 30.55  |
| Mitchell Farm                        | 5.72                                      | 2.05   |
| US 9 Widening                        | 6.03                                      | 2.16   |
| Village Center Cottages              | 25.39                                     | 9.09   |
| <b>Sum of These Land Use Changes</b> | <b>37.14</b>                              | <b>13.3</b>                                      |
| <b>Total</b>                         | <b>122.45</b>                             | <b>44</b>  |
| *Total area of WHPA is 279 acres     |   |  |

### Wellfield Capture Zone Boundaries

B&L cautions that the outer edge of the WHPA (present or projected future) does not bound the area from which the BPW wellfield draws groundwater from recharge. The WHPA is defined as an estimate 5-year time-of-travel, wherein it could take up to 5 years for water originating from rain above the WHPA, to enter the wells themselves. In actuality, the BPW wellfield draws from, and thus is susceptible to contamination of, groundwater from a larger surrounding area.

**Response:** *Verdantas agrees that the actual area from which the supply wells draw groundwater is not necessarily coincident with the 5-year travel time boundary predicted by groundwater modelling. However, to our knowledge no field investigations have been completed to determine the actual extent and shape of the zone of pumping influence or "capture zone" around the wellfield, and whether the zone of influence extends past the 5-year boundary or comprises a smaller area within the 5-year boundary.*

### WHPA Edges are Not Groundwater Divides and Do Not Mirror Surface Topography

WHPA edges, whether or not coincident with groundwater divides, do not necessarily correlate with existing land surface topographic drainage divides, and those divides may themselves shift in response to grading during land development.

### **Proposed Stormwater Infiltration Facilities Entail Risks as Well as Benefits**

Proponents of the above-listed land development projects have suggested that stormwater management facilities will be designed to promote groundwater recharge of stormwater, in a manner to mitigate wellfield impacts from imperviousness.

In general, for a stormwater facility within the WHPA (or outside it but still within the groundwater capture zone), even its purposeful design to promote recharge at the time of its construction does not assure its functionality in perpetuity. Sedimentation, siltation, biofouling and other processes typically reduce effectiveness of artificial recharge through time. A purposeful program of regular maintenance is needed to help provide continued function of recharging stormwater facilities over time.

***Response: Verdantas agrees that maintenance plans for recharge facilities within the WHPA would be beneficial, and Henlopen Properties, LLC plans to develop an inspection, maintenance, and emergency contingency plan for the recharge basin on its property.***

### **Groundwater Quality Concerns Related to Development In/Near the WHPA**

Each planned stormwater facility within the WHPA introduces the prospect of groundwater contamination hazards from stormwater entrainment of roadway deicers and vehicle drippings, which may enter and be discharged from stormwater management facilities. Moreover, the future use of fertilizers, pesticides and herbicides on landscaped grounds within the WHPA could introduce groundwater contaminants. Best would be their restricted or prohibited use.

Depending on the specifics of their capture areas and designs, the proposed stormwater facilities may concentrate and subsequently discharge (to groundwater) surface pollutants from roads, parking areas, lawns, and gardens. One or more of these planned stormwater facilities may be planned and designed to introduce stormwater into the unconfined aquifer near the BPW wellfield.

***Response: Verdantas outlined in its Environmental Assessment Report and supplemental letter report that surface water and groundwater quality is typically improved when changing from agricultural land use to well-designed residential and light commercial use. The proposed development is consistent with current land use within the WHPA. Verdantas encourages the dissemination of public service information to provide recommendations for the proper use of deicers, pesticides, herbicides, and fertilizers. However, prohibition of using the aforementioned land applications would require an amendment to the Sussex County Code.***

For example, one stormwater facility associated with the US-9 highway widening project is especially close to the wellfield itself. Inasmuch as distance may help lessen deleterious effects from such artificial groundwater recharge, for such a facility to be very close to the wellfield warrants an especially conservative approach (if it cannot be relocated). Noting the linear expanse of US-9, B&L recommends that the Delaware Department of Transportation find an alternative stormwater facility location outside the WHPA.

***Response: This issue does not apply to the Mitchells Corner Application.***

**Response:** The recharge basin planned for the Mitchell Farm property will include two pretreatment facilities recommended in the Delaware Groundwater Recharge Design Manual (revised 2017) cited by B&L. The pre-treatment facilities will include a forebay and water quality inlets described in the manual as "Traps in stormwater inlets designed to remove debris, grease, oil, and sediment". Pretreatment facilities recommended in the referenced manual do not include carbon filters which are not a standard practice for treating stormwater. Considering the depth to groundwater (10-15 feet) and the consistency of the sandy soils, the unsaturated soils above the water table will act as a natural sand filter.

*Response – Contrary to the description provided above, it is our understanding that most streams in the coastal plain are not “losing” streams, but actually “gaining” streams that are supplied baseflow by the discharge of groundwater from the aquifer into the streambed. Ebenezer Branch is not influenced by tide in the vicinity of the wellfield. The extent of tidal influence (and “sea water”) does not extend upstream past the dam-like structure located at Donovan’s Road, approximately 2,700 feet downstream of the wellfield.*

*The Mitchell Farm property is located approximately 1,800 feet northeast of Ebenezer Branch, on the opposite side of the Lewes wellfield. Considering the distance and position of the Mitchell Farm property in relation to Ebenezer Branch, and the substantial surplus in post-development recharge planned for the property, we do not anticipate activities on the Mitchell Farm property would contribute to potential lowering of the water table in the vicinity of the wellfield or Ebenezer Branch (Figure 1 attached).*

An environmental assessment report for the Mitchell Farm property was completed by Verdantas in February 2022. (We were not provided such reports for the VCC or US-9 projects). The Verdantas report concluded that the development of the Mitchell Farm property can be constructed without adversely impacting the BPW supply wells. We also reviewed a May 2018 geotechnical report for Mitchell Farm.

Notwithstanding its purported intent to fulfill certain Sussex County Code requirements, we find that the Verdantas report could have been more thorough, and conservative had it considered the following:

1. **Groundwater Quality** - The City of Lewes Water Supply Wells section of the Verdantas report mentions that historical water quality data for the BPW wellfield entrained nitrates, sulfates, and chlorides detected on a regular basis. Verdantas attributes nearby agricultural activities as the likely source for nitrates but remained silent in discussing potential sources of chloride. While the presence of chloride can occur naturally in the environment, chloride can increase in concentration from the anthropogenic application of deicers and road salt in the WHPA. Due to the history of chloride in the Lewes water system, and the projected increase in impervious roadways, we recommend that treatment for deicing salts also be incorporated into the stormwater design of new facilities in the WHPA. While we agree with Verdantas' recommendation to install pretreatment structures to target debris and potential petroleum releases prior to discharge into the basin, deicers should also be included in the pretreatment measures recommended.

*Response: Verdantas focused on nitrates because it is regulated as a Primary Drinking Water Standard by EPA which is enforceable and was the one contaminant reported at concentrations approaching the EPA permissible Maximum Contaminants Level (MCL). Chlorides can be naturally occurring and are classified by the EPA under the Secondary Drinking Water Standards that are considered for aesthetics and not enforceable like the Primary Drinking Water Standards. In addition to being a natural occurrence, chlorides detected in the Lewes supply wells may originate in part from deicing salts applied on the nearest paved surfaces, including Kings Highway and parking surfaces at the adjacent Cape Henlopen High School.*

2. **Basin Design and Maintenance** - The Verdantas report briefly mentions maintenance with the statement that stormwater facilities should be inspected on a regular basis to ensure that they are adequately infiltrating water and not being overrun by debris and bio-matter. We concur that maintenance is vital to the efficiency and effectiveness of the stormwater facilities' ability to infiltrate and treat as designed and therefore recommend that developers of stormwater facilities in the WHPA be required to prepare and implement a maintenance plan. For example, accumulated sediment removal is a necessary component of infiltration basin maintenance that if neglected can cause the basin to fail.

*Response: B&L and Verdantas agree that the regular inspection and maintenance are important measures to ensure the effectiveness of recharge facilities. Verdantas agrees that maintenance plans for recharge facilities within the WHPA would be beneficial, and Henlopen Properties, LLC plans to develop an inspection, maintenance, and emergency contingency plan for the recharge basin on its property and provide for that maintenance in perpetuity through the property owners association for the project.*

3. **Groundwater Recharge** - While it is true that the drainage basin divide along Kings Highway would carry surface water away from the WHPA under natural conditions, post-development drainage patterns may differ and impervious acreage could increase beyond the limit suggested by pre-development topography. Due to the



gently sloping topography, it is reasonable to assume that pumping from the Lewes water supply wells could overcome the subtle, natural gradient and "pull" water from the other side of the present drainage divide.

**Response:** *Verdantas indicated in the supplemental letter-report "It is likely that groundwater beneath the Property follows natural topography and flows towards the headwaters of Canary Creek and the canal, unless artificially drawn to the wellfield because of pumping from the Lewes supply wells".*

4. **Site Characterization Considerations** - While the geotechnical borings and infiltration testing included as an attachment to the Environmental Assessment Report are generally helpful to characterize the Mitchell Farm site, a more focused effort would be required to assess the feasibility of stormwater infiltration and treatment at the specific location where the planned stormwater management facility eventually would be constructed. Additional borings, infiltration tests and soil test pits should be completed per standard state requirements (e.g., 5101 Sediment and Stormwater Regulations) such that both groundwater recharge potential and proper treatment for parking lot-related contaminants (e.g., vehicle drippings, deicing materials, etc.) are considered.

**Response:** *Verdantas agrees and is aware that additional infiltration testing will be completed at the planned basin location per the current Delaware Sediment and Stormwater Regulations with the results reviewed by the Sussex Conservation District. This is part of the standard process for the creation of stormwater management facilities in Delaware.*

#### **Review of April 2022 Verdantas Supplemental Report**

Verdantas also prepared a letter-report dated April 25, 2022 as a follow up. This letter-report updates certain elements of its earlier assessment, seemingly in an effort to respond to BPW concerns including some of those raised herein. Specifically it discusses topography, water budget, the purported benefits of groundwater recharge via stormwater discharge within the WHPA, and water quality effects of developing agricultural lands.

We reviewed this supplemental information and B&L remains of the opinion that our initial concerns about proposed land use changes in the WHPA remain unaddressed and thus, persist for the following reasons:

1. **Verdantas Topographic Re-Analysis Is Unpersuasive** - The topography of the Lewes area is relatively flat and natural topographic gradients are minor compared to groundwater gradients within the WHPA arising from BPW withdrawals. Changes in the dynamic position of the outer edge of the groundwater capture zone surrounding the wellfield easily may differ from those suggested by the very subtle natural topography. Impervious surface creation may cause the edges of this capture zone to cross and transcend subtle topographic drainage divides. For this reason, the direction of surficial topographic drainage does not lessen the risk posed by land use changes within (what easily may be) a larger groundwater capture area.

**Response:** *The intent of the "Topographic Re-Analysis" was to clarify and provide better-defined detail of topography and natural drainage in the area of the Mitchell Farm and the wellfield. Again, we note that surface water and groundwater flow would likely drain under natural conditions to the north and not in the direction of the wellfield, unless artificially drawn to the wellfield because of pumping from the Lewes supply wells."*

2. **Verdantas' Suggestions for Stormwater Treatment Remain Inadequate** - The Verdantas follow-up report recommends pre-treatment for runoff entering the stormwater management pond, located on the southern portion of the site. B&L agrees that pre-treatment is more protective than its absence, but our page 3 (of this document) concerns remain unaddressed. Neither Verdantas nor its client offer any assurance that the planned stormwater infrastructure will be properly maintained to avoid biofouling and siltation over time.

***Response: The Applicants will develop an inspection, maintenance, and emergency contingency plan for the planned recharge facilities. The proposed conditions of approval for CU 2334 require the formation of a property owners association to be responsible for the maintenance of stormwater management areas (condition "M").***

B&L did not note a Verdantas suggestion or recommendation for periodic sampling and analysis of stormwater discharges (to groundwater) over time. We reviewed the Delaware Groundwater Recharge Design Manual (dated May 2005) for stormwater infiltration in the context of source water protection. The Manual has a section that lists parameters that should be sampled semi-annually, though the actual frequency, parameter list and number/locations of sampling points seem to be the subject of technical discussion, negotiation and agreement between affected parties. The Manual references the frequency of water level measurements as semi-annually, though it makes better sense to do this with greater frequency initially, to have enough data to make a defensible evaluation of possible future impacts.

B&L recommends that (1) the aforementioned Manual provisions be applied to each of these proposed projects and (2) that Lewes BPW be permitted (by the County) the opportunity to comment on developer plans via-a-vis stormwater management in the WHPA.

***Response: The referenced manual (revised 2017) was developed to provide recommendations for recharge facilities and is not a regulatory document. Sussex County Code does not include the requirements suggested by B&L, but two pretreatment structures recommended in the manual are proposed to be implemented at the Mitchell Farm property, including a forebay and traps in stormwater inlets designed to remove debris, grease, oil, and sediment.***

### **Benefit of Perpetual Stormwater Management Agreement**

BPW needs to rely on the continuity of the quantity and quality of groundwater available to its wellfield in perpetuity. BPW cannot risk a reduction in groundwater quantity or quality, arising from discretionary land development within or near its WHPA.

***Response: Groundwater quantity will be increased through surplus recharge, and we do not anticipate a degradation of groundwater quality from the Mitchell Farm development.***

If land use changes cannot be prohibited, BPW, Sussex County and affected development interests should enter into a water management agreement providing for the ongoing review, monitoring and maintenance of facilities designed for artificial reintroduction of stormwater into the capture area.



***Response: The WHPA boundary does not reflect the actual "capture zone" or areal extent from which the Lewes supply wells draw water from the surrounding aquifer. As such, whether the capture zone is larger or smaller in area than the 5-year travel time boundary is not known. To our knowledge, no investigations have been completed to assess the current capture zone of the wellfield. Implementing water management agreements without knowing the "capture area" would face many challenges.***

Diminished functionality of artificial groundwater recharge systems due to siltation easily may happen should the system not be properly maintained. Without a provision for the funding and execution of regular monitoring and maintenance efforts, the long-term efficacy of artificial groundwater recharge systems is uncertain and should not be relied upon unless accomplished through a perpetual water management agreement.

B&L notes that some wellhead protection ordinances (e.g., the Lewes Ordinance) imply the use of escrowed developer funds as a tool for financing potential mitigation measures in the circumstance an adverse impact comes to manifest. A challenge for the parties entails the perpetual risk of impairment of the implicit temporary nature of many escrow arrangements.

We believe that a well-reasoned and fair agreement include a provision for escrowing developer funds to be held for use in impact mitigation. The escrow concept is a complex one and its full development transcends the scope of this assessment. The amount needs to be fair and reasonable, and capped by the probable cost of likely mitigation measures (i.e., replacement well(s) and additional treatment if water from a deeper aquifer is of inferior natural quality).

Given that the risk posed by the land development projects is both perpetual and difficult to isolate to a specific project in terms of impact causation, B&L recommends that consideration be given to requiring annual economic contributions to a mitigation fund in perpetuity, by the future owners of impervious land in the WHPA.

***Response: Sussex County Code does not require water management agreements or escrows established for properties developed within water resource protection areas. We agree with B&L that "The escrow concept is a complex one and its full development transcends the scope of this assessment."***

## Summary

B&L represents that, within the parameters established by the scope of work, this preliminary hydrogeologic impact assessment has been undertaken and performed in a professional manner, in accordance with generally accepted practices in effect at the time and in the locality that this assessment was performed. Subject to these provisions, B&L's professional opinions are as follows:

- 1. Lewes BPW Concerns are Legitimate and Should Be Honored by the County-** Inasmuch as Lewes residents are County residents, and what happens to the Lewes BPW wellfield affects County residents, the County should honor and prioritize the source water protection concerns of the Lewes BPW as though they affected County citizens and taxpayers as a whole.

2. **Lewes BPW Wellfield Potentially Will Be Affected by Land Use Changes** – The proposed land use changes represent water quality and supply adequacy risks for the BPW wellfield. Of these, groundwater recharge intercept and reduction presents the greatest threat, but the possibility of groundwater quality impairments (deicers, fertilizers, pesticides, herbicides, etc.) cannot be ignored. Neither design elements of the concerning stormwater management facilities, nor provisions of the County Ordinance adequately protect from foreseeable risks and impacts. At minimum, the developer of the new stormwater facilities should be required to maintain and monitor them in perpetuity.
3. **Long-Term Impact Mitigation Agreement (With Funding) Recommended** – Neither State nor County policies and ordinances provide an assured means (other than via lawsuit) through which Lewes BPW can seek compensation or relief in the circumstance that the identified impacts do materialize. Herein, we suggest a system of developer escrow payments to seed a fund for impact mitigation measures, gradually replaced by annual fees paid by owners of impervious land in the WHPA. We acknowledge that the details will be complex, requiring deft negotiation by the affected parties. We believe that the careful crafting of an investment in such an Agreement would do more for long-term protection of BPW interests than would (for example) a handful of monitoring wells.

*Response: These summary points were addressed previously.*

#### **B&L Recommendations for BPW**

- A monitoring well between the wellfield and Ebenezer Creek, screened akin to the production wells, may provide data useful for the early warning of saltwater intrusion.
- Vocal participation in Delaware Department of Transportation meetings and hearings concerning US-9 widening may result in the repositioning of the now-planned stormwater facility to a location outside the WHPA.
- High-quality water quality data should be collected from the raw water entering each well and analyzed for parameters indicative of stormwater influence. Such data collection should begin without delay for baseline purposes, and should include, at minimum, conductivity, temperature, sodium, chlorides and nitrates. If funds allow, consideration could be given to adding volatile and semi-volatile organic compounds of possible automotive and herbicide origin.
- BPW should ask Sussex County to accept and implement as development approval conditions, the County-directed recommendations listed herein.

*Response: Intended for BPW and not Sussex County Council.*

#### **B&L Recommendations for Sussex County**

- The County should consult with DNREC and EPA to develop a plan for prohibited or restricted fertilizers, pesticides and herbicide use on community and commercial land in the WHPA. Such compounds should be prohibited unless applied by a licensed commercial landscaper in accordance with conservatively-developed manufacturer's recommendations for drinking water protection areas. Future residents should be educated about the risks of using such compounds (in time-of-purchase documents and/or utility bill inserts).

- The Verdantas recommendation to install pretreatment structures to target debris and VOCs should (1) be expanded to include roadway deicers; and (2) apply to all planned stormwater facilities in the WHPA.

**Response: please note that Verdantas did not recommend pretreatment for VOCs (volatile organic compounds).**

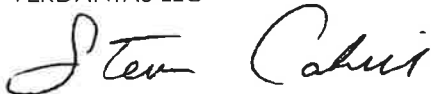
- The developers and DEL-DOT should enter into an agreement with BPW and the County to establish a permanent contingency account to fund (1) periodic maintenance and repair of stormwater facilities; and (2) wellfield improvements necessitated by the impacts described herein coming to materialize, in whole or in part. As buildout becomes complete, developer contributions could be replaced by homeowners' association contributions. The existence of this perpetual financial obligation should be disclosed to perspective owners of properties within the WHPA at the time of sale.

**Response: Verdantas offers no comments on the regulatory aspects or viability of these recommendations because they are not found within the Sussex County Code or other applicable regulations.**

In summary, Verdantas has carefully reviewed the comments provided by the BPW and B&L and maintains the opinion that no adverse impacts are anticipated to the Lewes wellfield by developing the Mitchell Farm as proposed. In addition, a substantial and beneficial surplus of post-development recharge, that has undergone pretreatment, would be made available to replenish the aquifer within the WHPA.

Sincerely,

VERDANTAS LLC



Steve Cahill, P.G.  
Senior Project Manager and Hydrologist



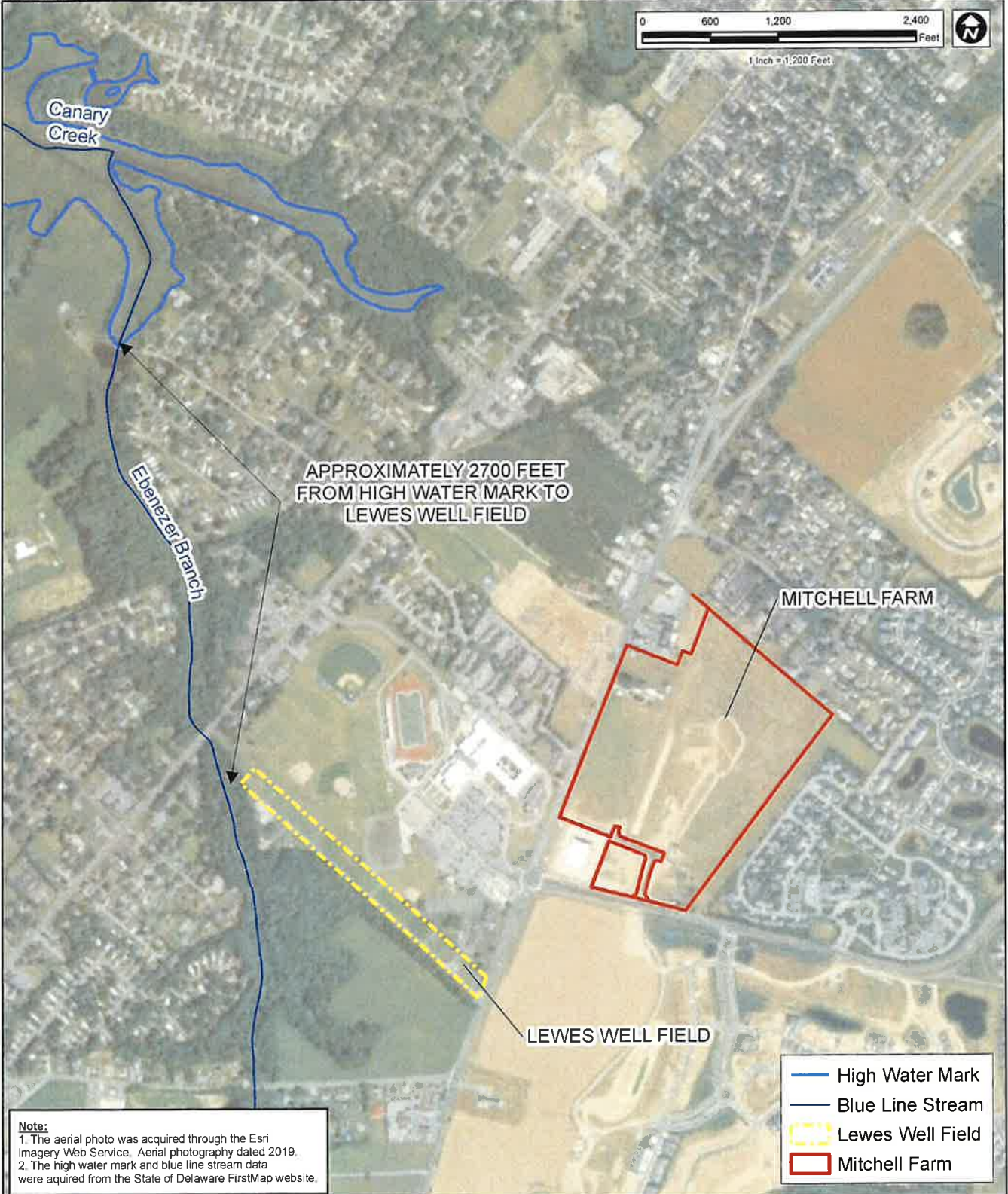
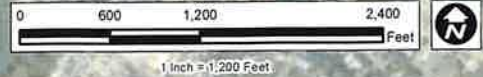
Jennifer L. Gresh, P.G.  
Mid-Atlantic Environmental Practice Leader

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Version\Verdantas Letter\_Final Response\_052022.docx

Attachments: Figure 1 – Highwater Mark Sketch

cc: Mr. Ring Lardner, Davis Bowen and Friedel, Inc.





**Note:**

1. The aerial photo was acquired through the Esri Imagery Web Service. Aerial photography dated 2019.
2. The high water mark and blue line stream data were acquired from the State of Delaware FirstMap website.

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May 2022

Mitchell Farm

Figure

High Water Mark Sketch

1

Lewes, Sussex County, Delaware





May 6, 2022

Mr. Austin Calaman, General Manager  
City of Lewes, DE Board of Public Works  
107 Franklin Avenue  
Lewes, Delaware 19958

Re: Effect of Proposed Land Use Changes and Increased Water Use on Lewes BPW Wellfield;  
File: 2228.002.001

Dear Mr. Calaman:

Barton & Loguidice, D.P.C. (B&L), was retained by the Lewes Board of Public Works (BPW) to re-assess the combined, potential hydrogeologic effects on the BPW wellfield from several planned land use changes within the delineated wellhead protection area (WHPA). These proposed land use changes entail both land development and highway widening.

Herein, we considered the proposed Village Center Cottages (VCC) development, the proposed re-zoning and development of the former Mitchell Farm and the widening of US Route 9. We did so in the context of a planned increase in groundwater withdrawals from the BPW wellfield. This letter of opinion fulfills our professional services proposal dated March 31, 2022 as authorized by the BPW on April 8, 2022.

#### **Basis for Renewed BPW Concern**

In 2015, we (as Advanced Land and Water, prior to its 2019 acquisition by B&L) prepared a hydrogeologic evaluation of potential groundwater supply effects from a then-proposed commercial development project (then called Village Center, but differing in spatial position from the now-proposed VCC) that was partially in the WHPA. Due to its design and the nature of the aquifer, the wellfield is particularly susceptible to contamination and capacity reduction from land uses and impervious expansion in its WHPA.

We came to recommend that the original Village Center site remain agricultural as the best means of protection for the wellfield. This remains our ideal recommendation, but this letter of opinion was prepared in recognition that the land development projects discussed herein are unlikely to be disapproved in their entirety.

Earlier this year the BPW contacted us anew to advise on similar concerns arising from updated land use plans differing in detail (the VCC, the Mitchell Farm parcel, and the widening of US Route 9). As before, proposed development within the WHPA would increase impervious area, lessen groundwater recharge available for withdrawal and may increase the risk of groundwater contamination (i.e., roadway deicers and vehicle drippings) from planned stormwater management facilities.

## Background Information

Lewes BPW makes use of five public water supply wells, located south of Cape Henlopen High School (see large blue dots on attached figure). Two of these wells have a screened interval deeper than 100 feet below ground surface, while the other three are screened more shallowly. The five wells are completed in the unconfined aquifer, which means they are particularly:

1. Susceptible to contamination arising from incompatible land uses and activities within and near their WHPAs and;
2. Dependent for sustainable capacity, on local groundwater recharge from precipitation falling within and near the WHPA.

In December of 2003, the Delaware Geological survey (DGS) published a Source Water Assessment Report, documenting the application of a numerical groundwater flow model which the agency used to delineate the five-year time-of-travel capture zone for the BPW wellfield (Andres & al., 2003). One of the key input parameters was water demand; DGS and DNREC used information then available to the agencies.

Based on the 2003 DGS model, groundwater (and prospective contaminants therein) within this capture zone could enter the wells within five years of precipitation and/or release within the WHPA. As a matter of policy, the five-year time-of-travel zone was deemed one preferentially worthy of protection both from a water quality (i.e., contamination risk) and quantity (sustainable recharge) perspective, and established this as the WHPA. A 100 meter buffer was applied to modeled extent of the 5-year capture zone as an additional measure conservatism in light of intrinsic uncertainties in groundwater modeling.

The BPW now expects further growth in population and thus, in groundwater withdrawals. For the period between the time of the DGS WHPA delineation and 2025, for example, groundwater use of this wellfield has increased (or will increase) approximately 25%.

Irrespective of the static position of the five-year DGS-delineated WHPA boundary, the actual area from which the wellfield captures groundwater varies based on a combination of factors and circumstances:

- Seasonal withdrawal fluctuations,
- Natural variability in recharge rates based on precipitation variance,
- Changes in land use within and near the capture zone, and
- Changes in stream stage within surface bodies hydrologically connected to the aquifer and other factors.

Notwithstanding this variability, the area encompassed by the WHPA is static, and reflects computer model input parameters (such as groundwater recharge rates and imperviousness) selected and assigned in 2003. It is our understanding that the agency is not in the regular and customary practice of updating WHPAs (or by extension, executing new computer models) when factors such as land use, imperviousness and water demand change, all of which are factors that may come to affect the shape and size of the groundwater capture zone.



### **Forecasted Expansion in Future WHPA**

For this effort, B&L approximated the potential future areal extent of the WHPA under the hypothesis that it was re-delineated to reflect proposed conditions circa 2025 (i.e., increased groundwater withdrawals). For simplicity, B&L assumed a proportionate increase in WHPA size, equally in all directions, by 25% in overall area.

The updated WHPA delineation is not official and merely is offered for illustrative purposes. As is the case with the original DGS delineation, a 100-meter (m) buffer is included in the updated WHPA. The attached figure (Figure 1) outlines the original WHPA and its updated, projected extent to reflect water demand changes. We also illustrate the positions of the VCC, the Mitchell farm and US-9 for context.

Absent the assuredness of the continuity of groundwater recharge in its pre-development quantity as discussed further below, if the wellfield withdrawal rates are held constant and irrespective of the absence of WHPA re-delineations, one can assume that the actual 5-year capture zone would expand in approximate proportion to the lost pervious area.

Note that BPW advises that discussions with DNREC about an updated delineation have commenced. B&L recommends that such efforts continue and result in a conservatively prepared, updated WHPA delineation reflective of increased groundwater withdrawals and decreased pervious land cover arising from the land development projects discussed herein.

### **Effect of Impervious Surfaces on Groundwater Recharge**

The hydrologic consequence of increased impervious surface cover is a decrease in overall groundwater recharge within the WHPA. Even if stormwater discharges at the proposed development sites are intended to reenter the groundwater system through infiltration systems that may seem appropriately engineered initially, there likely exists no assurance that such systems would be free of siltation and/or biofouling over time. This is particularly true of stormwater facilities that are not properly maintained.

The creation of impervious surfaces associated with the land use changes introduces risks to the long-term sustainable capacity of the BPW wellfield. The 2003 WHPA model presumes availability of natural groundwater recharge amounts from the development site in question, in perpetuity. The expansion of impervious surfaces associated with the land use changes will violate this model input criterion. The 5-year capture area may respond by enlargement in orientations and by degrees, which would require an updated model to predict.

The capture zone associated with the wellfield may entrain groundwater (whether or not contaminated) that now otherwise may support base-flow to streams. The ultimate capacity of the wellfield may diminish, the evidence for this long-term imperilment would be greater pumping cycle drawdowns, longer-duration pumping cycles or both. We believe that these potentialities require detailed planning before the development projects proposed within the WHPA otherwise could be countenanced.

The resulting effect of this loss of potential recharge area easily may cause:

1. An expansion of the 5-year capture zone, beneath more of the proposed development projects;
2. A potential for increased surface water capture from Ebenezer Branch, a tributary of Canary Creek, into the underlying unconfined aquifer;
3. Expansion of the 5-year capture zone to include otherwise excluded areas that have point source hazards and/or contaminated sites.

B&L performed a geospatial analysis of land use in the WHPA to approximate the post-development extent of impervious area. Site plans or concept renderings for each of the three development projects identified in the table below, were provided by Lewes BPW, along with other relevant materials that spoke to the matter of site imperviousness. Impervious areas were approximated for these three development projects within the expanded WHPA by either using a manual tracing method in ArcGIS, or from other materials shared by Lewes BPW.

As with the DGS report, a 100-meter buffer was included in the expanded WHPA. The table below outlines the increase in impervious area and the associated percentage of the WHPA from each of the three projects. Note that we did not include the proposed Village Center shopping center or other possible projects which may come to exist elsewhere in the WHPA.

| Planned Land Use Change              | Impervious Area in Expanded WHPA (acres)* | Impervious Area as a Percentage of Expanded WHPA |
|--------------------------------------|---|--|
| WHPA Land Use as of 2021             | 85.31                                     | 30.55  |
| Mitchell Farm                        | 5.72                                      | 2.05   |
| US 9 Widening                        | 6.03                                      | 2.16   |
| Village Center Cottages              | 25.39                                     | 9.09   |
| <b>Sum of These Land Use Changes</b> | <b>37.14</b>                              | <b>13.3</b>                                      |
| <b>Total</b>                         | <b>122.45</b>                             | <b>44</b>  |
| *Total area of WHPA is 279 acres     |   |  |

#### **WHPA Edges are Not Wellfield Capture Zone Boundaries**

B&L cautions that the outer edge of the WHPA (present or projected future) does not bound the area from which the BPW wellfield draws groundwater from recharge. The WHPA is defined as an estimate 5-year time-of-travel, wherein it could take up to 5 years for water originating from rain above the WHPA, to enter the wells themselves. In actuality, the BPW wellfield draws from, and thus is susceptible to contamination of, groundwater from a larger surrounding area.

#### **WHPA Edges are Not Groundwater Divides and Do Not Mirror Surface Topography**

WHPA edges, whether or not coincident with groundwater divides, do not necessarily correlate with existing land surface topographic drainage divides, and those divides may themselves shift in response to grading during land development.

#### **Proposed Stormwater Infiltration Facilities Entail Risks as Well as Benefits**

Proponents of the above-listed land development projects have suggested that stormwater management facilities will be designed to promote groundwater recharge of stormwater, in a manner to mitigate wellfield impacts from imperviousness.

In general, for a stormwater facility within the WHPA (or outside it but still within the groundwater capture zone), even its purposeful design to promote recharge at the time of its construction does not assure its functionality in perpetuity. Sedimentation, siltation, biofouling and other processes typically reduce effectiveness of artificial recharge through time. A purposeful program of regular maintenance is needed to help provide continued function of recharging stormwater facilities over time.

### **Groundwater Quality Concerns Related to Development In/Near the WHPA**

Each planned stormwater facility within the WHPA introduces the prospect of groundwater contamination hazards from stormwater entrainment of roadway deicers and vehicle drippings, which may enter and be discharged from stormwater management facilities. Moreover, the future use of fertilizers, pesticides and herbicides on landscaped grounds within the WHPA could introduce groundwater contaminants. Best would be their restricted or prohibited use.

Depending on the specifics of their capture areas and designs, the proposed stormwater facilities may concentrate and subsequently discharge (to groundwater) surface pollutants from roads, parking areas, lawns, and gardens. One or more of these planned stormwater facilities may be planned and designed to introduce stormwater into the unconfined aquifer near the BPW wellfield.

For example, one stormwater facility associated with the US-9 highway widening project is especially close to the wellfield itself. Inasmuch as distance may help lessen deleterious effects from such artificial groundwater recharge, for such a facility to be very close to the wellfield warrants an especially conservative approach (if it cannot be relocated). Noting the linear expanse of US-9, B&L recommends that the Delaware Department of Transportation find an alternative stormwater facility location outside the WHPA.

Effective treatment of stormwater through processes such as sand filters and carbon polishing often is regarded as expensive. The available documents B&L reviewed make no mention of plans or commitments for said treatment. Absent assured treatment (and its funding) over time, the risk remains of groundwater discharge of potential contaminants from these proposed stormwater facilities.

The proposed land use changes also raises a water quality concern originating from surface water. Ebenezer Branch is a short distance southwest of the wellfield, within the WHPA. Portions of Ebenezer Branch are brackish and/or tidally influenced. Streams on the coastal plain usually are in direct hydrologic contact with underlying, unconfined aquifers (i.e., losing streams). The expansion of imperviousness within the WHPA may effectively “pull” additional water from Ebenezer Branch (of possibly inferior natural quality) into the aquifer. In doing so, the unconfined aquifer could receive more (possibly seawater-influenced) surface water than it otherwise would, affecting water quality results by introducing increased surficial contaminants, particularly during storm events. If base flow of Ebenezer Branch is reduced as a consequence of such groundwater capture, downstream aquatic habitats also could be adversely affected.

### **Review of February 2022 Verdantas Environmental Assessment Report**

An environmental assessment report for the Mitchell Farm property was completed by Verdantas in February 2022. (We were not provided such reports for the VCC or US-9 projects). The Verdantas report concluded that the development of the Mitchell Farm property can be constructed without adversely impacting the BPW supply wells. We also reviewed a May 2018 geotechnical report for Mitchell Farm.

Notwithstanding its purported intent to fulfill certain Sussex County Code requirements, we find that the Verdantas report could have been more thorough and conservative had it considered the following:

1. **Groundwater Quality** - The City of Lewes Water Supply Wells section of the Verdantas report mentions that historical water quality data for the BPW wellfield entrained nitrates, sulfates, and chlorides detected on a regular basis. Verdantas attributes nearby agricultural activities as the likely

source for nitrates but remained silent in discussing potential sources of chloride. While the presence of chloride can occur naturally in the environment, chloride can increase in concentration from the anthropogenic application of deicers and road salt in the WHPA. Due to the history of chloride in the Lewes water system, and the projected increase in impervious roadways, we recommend that treatment for deicing salts also be incorporated into the stormwater design of new facilities in the WHPA. While we agree with Verdantas' recommendation to install pretreatment structures to target debris and potential petroleum releases prior to discharge into the basin, deicers should also be included in the pretreatment measures recommended.

2. **Basin Design and Maintenance** - The Verdantas report briefly mentions maintenance with the statement that stormwater facilities should be inspected on a regular basis to ensure that they are adequately infiltrating water and not being overrun by debris and bio-matter. We concur that maintenance is vital to the efficiency and effectiveness of the stormwater facilities' ability to infiltrate and treat as designed and therefore recommend that developers of stormwater facilities in the WHPA be required to prepare and implement a maintenance plan. For example, accumulated sediment removal is a necessary component of infiltration basin maintenance that if neglected can cause the basin to fail.
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zone to cross and transcend subtle topographic drainage divides. For this reason, the direction of surficial topographic drainage does not lessen the risk posed by land use changes within (what easily may be) a larger groundwater capture area.

2. **Verdantas' Suggestions for Stormwater Treatment Remain Inadequate** - The Verdantas follow-up report recommends pre-treatment for runoff entering the stormwater management pond, located on the southern portion of the site. B&L agrees that pre-treatment is more protective than its absence, but our page 3 (of this document) concerns remain unaddressed. Neither Verdantas nor its client offer any assurance that the planned stormwater infrastructure will be properly maintained to avoid biofouling and siltation over time.

B&L did not note a Verdantas suggestion or recommendation for periodic sampling and analysis of stormwater discharges (to groundwater) over time. We reviewed the Delaware Groundwater Recharge Design Manual (dated May 2005) for stormwater infiltration in the context of source water protection. The Manual has a section that lists parameters that should be sampled semi-annually, though the actual frequency, parameter list and number/locations of sampling points seem to be the subject of technical discussion, negotiation and agreement between affected parties. The Manual references the frequency of water level measurements as semi-annually, though it makes better sense to do this with greater frequency initially, to have enough data to make a defensible evaluation of possible future impacts.

B&L recommends that (1) the aforementioned Manual provisions be applied to each of these proposed projects and (2) that Lewes BPW be permitted (by the County) the opportunity to comment on developer plans via-a-vis stormwater management in the WHPA.

### **Benefit of Perpetual Stormwater Management Agreement**

BPW needs to rely on the continuity of the quantity and quality of groundwater available to its wellfield in perpetuity. BPW cannot risk a reduction in groundwater quantity or quality, arising from discretionary land development within or near its WHPA.

If land use changes cannot be prohibited, BPW, Sussex County and affected development interests should enter into a water management agreement providing for the ongoing review, monitoring and maintenance of facilities designed for artificial reintroduction of stormwater into the capture area.

Diminished functionality of artificial groundwater recharge systems due to siltation easily may happen should the system not be properly maintained. Without a provision for the funding and execution of regular monitoring and maintenance efforts, the long-term efficacy of artificial groundwater recharge systems is uncertain and should not be relied upon unless accomplished through a perpetual water management agreement.

B&L notes that some wellhead protection ordinances (e.g., the Lewes Ordinance) imply the use of escrowed developer funds as a tool for financing potential mitigation measures in the circumstance an adverse impact comes to manifest. A challenge for the parties entails the perpetual risk of impairment of the implicit temporary nature of many escrow arrangements.

We believe that a well-reasoned and fair agreement include a provision for escrowing developer funds to be held for use in impact mitigation. The escrow concept is a complex one and its full development transcends the scope of this assessment. The amount needs to be fair and reasonable, and capped by

the probable cost of likely mitigation measures (i.e., replacement well(s) and additional treatment if water from a deeper aquifer is of inferior natural quality).

Given that the risk posed by the land development projects is both perpetual and difficult to isolate to a specific project in terms of impact causation, B&L recommends that consideration be given to requiring annual economic contributions to a mitigation fund in perpetuity, by the future owners of impervious land in the WHPA.

### Summary

B&L represents that, within the parameters established by the scope of work, this preliminary hydrogeologic impact assessment has been undertaken and performed in a professional manner, in accordance with generally accepted practices in effect at the time and in the locality that this assessment was performed. Subject to these provisions, B&L's professional opinions are as follows:

1. **Lewes BPW Concerns are Legitimate and Should Be Honored by the County** – Inasmuch as Lewes residents are County residents, and what happens to the Lewes BPW wellfield affects County residents, the County should honor and prioritize the source water protection concerns of the Lewes BPW as though they affected County citizens and taxpayers as a whole.
2. **Lewes BPW Wellfield Potentially Will Be Affected by Land Use Changes** – The proposed land use changes represent water quality and supply adequacy risks for the BPW wellfield. Of these, groundwater recharge intercept and reduction presents the greatest threat, but the possibility of groundwater quality impairments (deicers, fertilizers, pesticides, herbicides, etc.) cannot be ignored. Neither design elements of the concerning stormwater management facilities, nor provisions of the County Ordinance adequately protect from foreseeable risks and impacts. At minimum, the developer of the new stormwater facilities should be required to maintain and monitor them in perpetuity.
3. **Long-Term Impact Mitigation Agreement (With Funding) Recommended** – Neither State nor County policies and ordinances provide an assured means (other than via lawsuit) through which Lewes BPW can seek compensation or relief in the circumstance that the identified impacts do materialize. Herein, we suggest a system of developer escrow payments to seed a fund for impact mitigation measures, gradually replaced by annual fees paid by owners of impervious land in the WHPA. We acknowledge that the details will be complex, requiring deft negotiation by the affected parties. We believe that the careful crafting of an investment in such an Agreement would do more for long-term protection of BPW interests than would (for example) a handful of monitoring wells.

### B&L Recommendations for BPW

- A monitoring well between the wellfield and Ebenezer Creek, screened akin to the production wells, may provide data useful for the early warning of saltwater intrusion.
- Vocal participation in Delaware Department of Transportation meetings and hearings concerning US-9 widening may result in the repositioning of the now-planned stormwater facility to a location outside the WHPA.
- High-quality water quality data should be collected from the raw water entering each well and analyzed for parameters indicative of stormwater influence. Such data collection should begin without delay for baseline purposes, and should include, at minimum, conductivity, temperature, sodium, chlorides and nitrates. If funds allow, consideration could be given to



adding volatile and semi-volatile organic compounds of possible automotive and herbicide origin.

- BPW should ask Sussex County to accept and implement as development approval conditions, the County-directed recommendations listed herein.

#### **B&L Recommendations for Sussex County**

- The County should consult with DNREC and EPA to develop a plan for prohibited or restricted fertilizers, pesticides and herbicide use on community and commercial land in the WHPA. Such compounds should be prohibited unless applied by a licensed commercial landscaper in accordance with conservatively-developed manufacturer's recommendations for drinking water protection areas. Future residents should be educated about the risks of using such compounds (in time-of-purchase documents and/or utility bill inserts).
- The Verdantas recommendation to install pretreatment structures to target debris and VOCs should (1) be expanded to include roadway deicers; and (2) apply to all planned stormwater facilities in the WHPA.
- The developers and DEL-DOT should enter into an agreement with BPW and the County to establish a permanent contingency account to fund (1) periodic maintenance and repair of stormwater facilities; and (2) wellfield improvements necessitated by the impacts described herein coming to materialize, in whole or in part. As buildout becomes complete, developer contributions could be replaced by homeowners' association contributions. The existence of this perpetual financial obligation should be disclosed to perspective owners of properties within the WHPA at the time of sale.

Thank you for this opportunity to have served the needs of BPW once again. Please contact is if you have any questions.

Respectfully submitted,

BARTON & LOGUIDICE, D.P.C.



Mark W. Eisner, P.G.  
Vice President



David L. Pielmeier  
Senior Project Manager



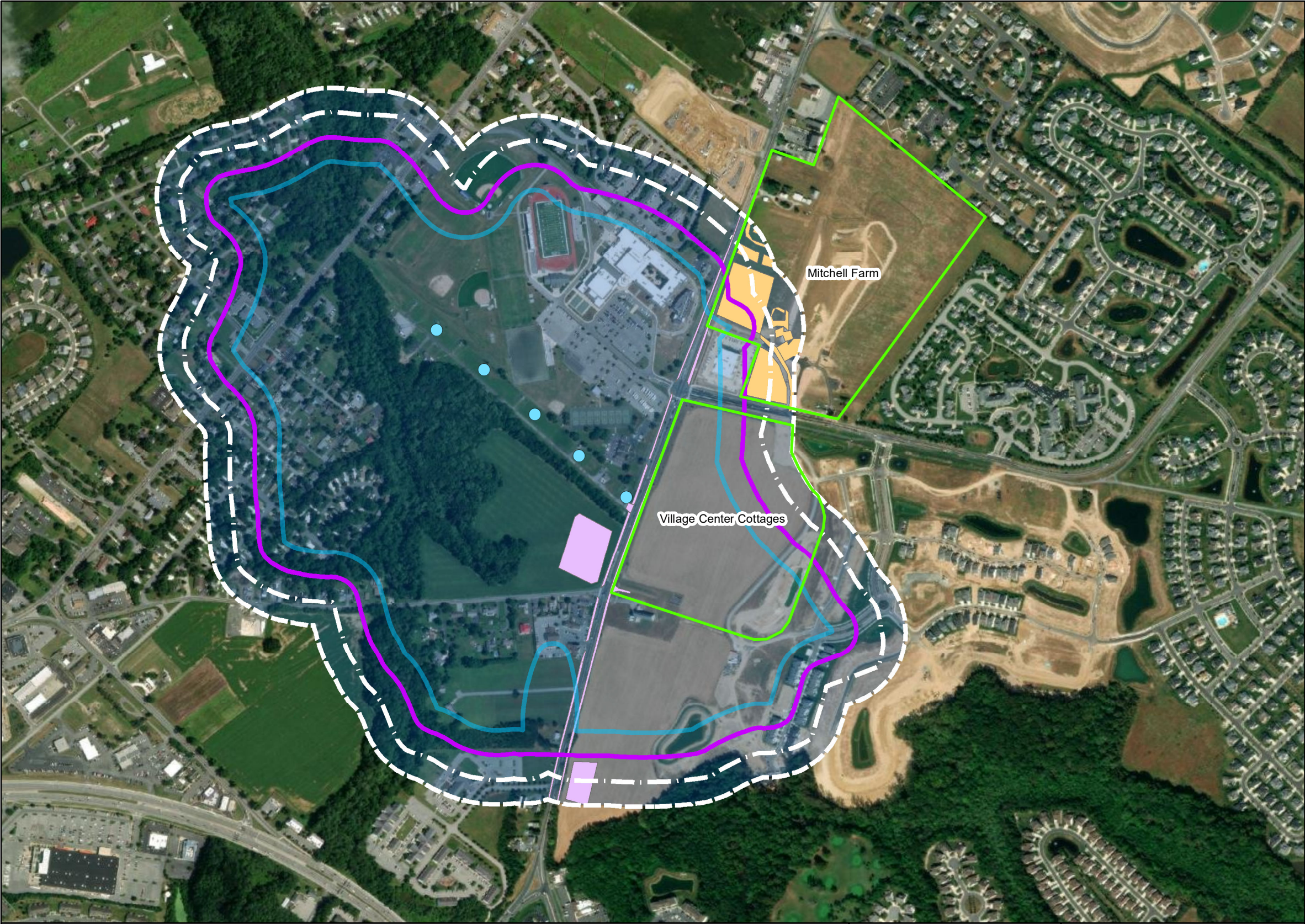
MWE/DLP/LKL/tmj  
Attachment



**References:**

Andres, A. S., Duffy, C. A., & Costas, E. M. (2003). *Wellhead Protection Area Delineations for the Lewes-Rehoboth Beach Area, Delaware*. Newark, DE: Delaware Geological Survey.



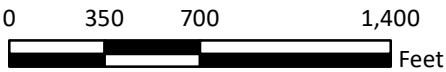


EXPLANATION:

- Lewes Production Well
- Proposed Development Parcel
- Original DGS Delineated WHPA
- Original DGS WHPA 100 Meter Buffer
- Expanded WHPA (After Increased Water Usage Without DGS 100m Buffer)
- Expanded WHPA (After Increased Water Usage with DGS 100m buffer)
- Approximate Natural Groundwater Recharge Intercept from US 9 Widening
- Approximate Natural Groundwater Recharge Intercept from Mitchell Farm Development

| Effect of Village Center Cottages, Mitchell Farm, and US 9 Widening on Impervious Area | Impervious Area in WHPA (acres)* | Impervious Area as a Percentage of WHPA |
|--|----------------------------------|---|
| Development as of 2021   | 85.31                            | 30.55                                   |
| Mitchell Farm  | 5.72                             | 2.05                                    |
| US 9 Widening  | 6.03                             | 2.16                                    |
| Village Center Cottages  | 25.39                            | 9.09                                    |
| <b>Effect of These 3 Projects</b>  | <b>37.14</b>                     | <b>13.30</b>                            |
| <b>Total</b>   | <b>122.45</b>                    | <b>44</b>                               |

\*Total area of WHPA is 279 acres



Notes:

1. Basemap from digital files made available by ESRI.
2. Site boundary, well locations and site development provided by client. Digitized site features approximated from client-provided site plans. Development from Village Center Cottages is assumed to be 73% impervious, as provided by client. Analysis assumes that stormwater management facilities intercept and redirect natural groundwater recharge beneath their footprints.
3. Original delineated WHPA sourced from DGS report (Andres et, al., 2003, WHPA Delineations for the Lewes-Rehoboth Beach Area, DE).
4. Project future water demand increase of 25% provided by client. B&L presumed a proportionate increase in WHPA size, equally in all directions.
5. This figure is integral to written correspondence and should only be used in that context. The updated WHPA delineation is unofficial, and is a simplified approximation.

Client:

Lewes Board of Public Works

PROJECT NO. 2228.002.001

Project:

Lewes DE Wellhead Protection Area Impact Evaluation

Lewes, Sussex County, DE



Figure 1:

Expanded WHPA Concept Map

April 25, 2022





May 6, 2022

*Sussex County Council*

Attached you will find the Geotechnical Report produced by Barton and Loguidice (B&L). The Lewes Board of Public Works (BPW) would like to highlight some of the main points in the B&L Report.

- The WHPA is defined as an estimate 5-year time-of-travel, wherein it could take up to 5 years for water originating from rain above the WHPA, to enter the wells themselves. In actuality, the BPW wellfield draws from, and thus is susceptible to contamination of, groundwater from a larger surrounding area
- The creation of impervious surfaces associated with the land use changes introduces risks to the long-term sustainable capacity of the BPW wellfield. The 2003 WHPA model presumes availability of natural groundwater recharge amounts from the development site in question, in perpetuity.
- WHPA edges, whether or not coincident with groundwater divides, do not necessarily correlate with existing land surface topographic drainage divides, and those divides may themselves shift in response to grading during land development.
- The expansion of imperviousness within the WHPA may effectively "pull" additional water from Ebenezer Branch (of possibly inferior natural quality) into the aquifer. In doing so, the unconfined aquifer could receive more (possibly seawater-influenced) surface water than it otherwise would, affecting water quality results by introducing increased surficial contaminants, particularly during storm events.
- Effective treatment of stormwater through processes such as sand filters and carbon polishing often is regarded as expensive. The available documents B&L reviewed make no mention of plans or commitments for said treatment. Absent assured treatment (and its funding) over time, the risk remains of groundwater discharge of potential contaminants from these proposed stormwater facilities.
- Each planned stormwater facility within the WHPA introduces the prospect of groundwater contamination hazards from stormwater entrainment of roadway deicers and vehicle drippings, which may enter and be discharged from stormwater management facilities. Moreover, the future use of fertilizers, pesticides and herbicides on landscaped grounds within the WHPA could introduce groundwater contaminants. Best would be their restricted or prohibited use.

In accordance with standard industry practices, the BPW feels that the installation of monitoring wells located upstream and downstream of the infiltration basin, with regular testing, would provide advance notice of potential issues related to the BPW production wells.

The BPW greatly appreciates the willingness of the Sussex County Council to allow an extended comment period so that the BPW could submit B&L's final report.



May 6, 2022

Mr. Austin Calaman, General Manager  
City of Lewes, DE Board of Public Works  
107 Franklin Avenue  
Lewes, Delaware 19958

Re: Effect of Proposed Land Use Changes and Increased Water Use on Lewes BPW Wellfield;  
File: 2228.002.001

Dear Mr. Calaman:

Barton & Loguidice, D.P.C. (B&L), was retained by the Lewes Board of Public Works (BPW) to re-assess the combined, potential hydrogeologic effects on the BPW wellfield from several planned land use changes within the delineated wellhead protection area (WHPA). These proposed land use changes entail both land development and highway widening.

Herein, we considered the proposed Village Center Cottages (VCC) development, the proposed re-zoning and development of the former Mitchell Farm and the widening of US Route 9. We did so in the context of a planned increase in groundwater withdrawals from the BPW wellfield. This letter of opinion fulfills our professional services proposal dated March 31, 2022 as authorized by the BPW on April 8, 2022.

#### **Basis for Renewed BPW Concern**

In 2015, we (as Advanced Land and Water, prior to its 2019 acquisition by B&L) prepared a hydrogeologic evaluation of potential groundwater supply effects from a then-proposed commercial development project (then called Village Center, but differing in spatial position from the now-proposed VCC) that was partially in the WHPA. Due to its design and the nature of the aquifer, the wellfield is particularly susceptible to contamination and capacity reduction from land uses and impervious expansion in its WHPA.

We came to recommend that the original Village Center site remain agricultural as the best means of protection for the wellfield. This remains our ideal recommendation, but this letter of opinion was prepared in recognition that the land development projects discussed herein are unlikely to be disapproved in their entirety.

Earlier this year the BPW contacted us anew to advise on similar concerns arising from updated land use plans differing in detail (the VCC, the Mitchell Farm parcel, and the widening of US Route 9). As before, proposed development within the WHPA would increase impervious area, lessen groundwater recharge available for withdrawal and may increase the risk of groundwater contamination (i.e., roadway deicers and vehicle drippings) from planned stormwater management facilities.





### **Background Information**

Lewes BPW makes use of five public water supply wells, located south of Cape Henlopen High School (see large blue dots on attached figure). Two of these wells have a screened interval deeper than 100 feet below ground surface, while the other three are screened more shallowly. The five wells are completed in the unconfined aquifer, which means they are particularly:

1. Susceptible to contamination arising from incompatible land uses and activities within and near their WHPAs and;
2. Dependent for sustainable capacity, on local groundwater recharge from precipitation falling within and near the WHPA.

In December of 2003, the Delaware Geological survey (DGS) published a Source Water Assessment Report, documenting the application of a numerical groundwater flow model which the agency used to delineate the five-year time-of-travel capture zone for the BPW wellfield (Andres & al., 2003). One of the key input parameters was water demand; DGS and DNREC used information then available to the agencies.

Based on the 2003 DGS model, groundwater (and prospective contaminants therein) within this capture zone could enter the wells within five years of precipitation and/or release within the WHPA. As a matter of policy, the five-year time-of-travel zone was deemed one preferentially worthy of protection both from a water quality (i.e., contamination risk) and quantity (sustainable recharge) perspective, and established this as the WHPA. A 100 meter buffer was applied to modeled extent of the 5-year capture zone as an additional measure conservatism in light of intrinsic uncertainties in groundwater modeling.

The BPW now expects further growth in population and thus, in groundwater withdrawals. For the period between the time of the DGS WHPA delineation and 2025, for example, groundwater use of this wellfield has increased (or will increase) approximately 25%.

Irrespective of the static position of the five-year DGS-delineated WHPA boundary, the actual area from which the wellfield captures groundwater varies based on a combination of factors and circumstances:

- Seasonal withdrawal fluctuations,
- Natural variability in recharge rates based on precipitation variance,
- Changes in land use within and near the capture zone, and
- Changes in stream stage within surface bodies hydrologically connected to the aquifer and other factors.

Notwithstanding this variability, the area encompassed by the WHPA is static, and reflects computer model input parameters (such as groundwater recharge rates and imperviousness) selected and assigned in 2003. It is our understanding that the agency is not in the regular and customary practice of updating WHPAs (or by extension, executing new computer models) when factors such as land use, imperviousness and water demand change, all of which are factors that may come to affect the shape and size of the groundwater capture zone.

### **Forecasted Expansion in Future WHPA**

For this effort, B&L approximated the potential future areal extent of the WHPA under the hypothesis that it was re-delineated to reflect proposed conditions circa 2025 (i.e., increased groundwater withdrawals). For simplicity, B&L assumed a proportionate increase in WHPA size, equally in all directions, by 25% in overall area.

The updated WHPA delineation is not official and merely is offered for illustrative purposes. As is the case with the original DGS delineation, a 100-meter (m) buffer is included in the updated WHPA. The attached figure (Figure 1) outlines the original WHPA and its updated, projected extent to reflect water demand changes. We also illustrate the positions of the VCC, the Mitchell farm and US-9 for context.

Absent the assuredness of the continuity of groundwater recharge in its pre-development quantity as discussed further below, if the wellfield withdrawal rates are held constant and irrespective of the absence of WHPA re-delineations, one can assume that the actual 5-year capture zone would expand in approximate proportion to the lost pervious area.

Note that BPW advises that discussions with DNREC about an updated delineation have commenced. B&L recommends that such efforts continue and result in a conservatively prepared, updated WHPA delineation reflective of increased groundwater withdrawals and decreased pervious land cover arising from the land development projects discussed herein.

### **Effect of Impervious Surfaces on Groundwater Recharge**

The hydrologic consequence of increased impervious surface cover is a decrease in overall groundwater recharge within the WHPA. Even if stormwater discharges at the proposed development sites are intended to reenter the groundwater system through infiltration systems that may seem appropriately engineered initially, there likely exists no assurance that such systems would be free of siltation and/or biofouling over time. This is particularly true of stormwater facilities that are not properly maintained.

The creation of impervious surfaces associated with the land use changes introduces risks to the long-term sustainable capacity of the BPW wellfield. The 2003 WHPA model presumes availability of natural groundwater recharge amounts from the development site in question, in perpetuity. The expansion of impervious surfaces associated with the land use changes will violate this model input criterion. The 5-year capture area may respond by enlargement in orientations and by degrees, which would require an updated model to predict.

The capture zone associated with the wellfield may entrain groundwater (whether or not contaminated) that now otherwise may support base-flow to streams. The ultimate capacity of the wellfield may diminish, the evidence for this long-term imperilment would be greater pumping cycle drawdowns, longer-duration pumping cycles or both. We believe that these potentialities require detailed planning before the development projects proposed within the WHPA otherwise could be countenanced.

The resulting effect of this loss of potential recharge area easily may cause:

1. An expansion of the 5-year capture zone, beneath more of the proposed development projects;
2. A potential for increased surface water capture from Ebenezer Branch, a tributary of Canary Creek, into the underlying unconfined aquifer;
3. Expansion of the 5-year capture zone to include otherwise excluded areas that have point source hazards and/or contaminated sites.





B&L performed a geospatial analysis of land use in the WHPA to approximate the post-development extent of impervious area. Site plans or concept renderings for each of the three development projects identified in the table below, were provided by Lewes BPW, along with other relevant materials that spoke to the matter of site imperviousness. Impervious areas were approximated for these three development projects within the expanded WHPA by either using a manual tracing method in ArcGIS, or from other materials shared by Lewes BPW.

As with the DGS report, a 100-meter buffer was included in the expanded WHPA. The table below outlines the increase in impervious area and the associated percentage of the WHPA from each of the three projects. Note that we did not include the proposed Village Center shopping center or other possible projects which may come to exist elsewhere in the WHPA.

| Planned Land Use Change              | Impervious Area in Expanded WHPA (acres)* | Impervious Area as a Percentage of Expanded WHPA |
|--------------------------------------|---|--|
| WHPA Land Use as of 2021             | 85.31                                     | 30.55  |
| Mitchell Farm                        | 5.72                                      | 2.05   |
| US 9 Widening                        | 6.03                                      | 2.16   |
| Village Center Cottages              | 25.39                                     | 9.09   |
| <b>Sum of These Land Use Changes</b> | <b>37.14</b>                              | <b>13.3</b>                                      |
| <b>Total</b>                         | <b>122.45</b>                             | <b>44</b>  |
| *Total area of WHPA is 279 acres     |   |  |

#### **WHPA Edges are Not Wellfield Capture Zone Boundaries**

B&L cautions that the outer edge of the WHPA (present or projected future) does not bound the area from which the BPW wellfield draws groundwater from recharge. The WHPA is defined as an estimate 5-year time-of-travel, wherein it could take up to 5 years for water originating from rain above the WHPA, to enter the wells themselves. In actuality, the BPW wellfield draws from, and thus is susceptible to contamination of, groundwater from a larger surrounding area.

#### **WHPA Edges are Not Groundwater Divides and Do Not Mirror Surface Topography**

WHPA edges, whether or not coincident with groundwater divides, do not necessarily correlate with existing land surface topographic drainage divides, and those divides may themselves shift in response to grading during land development.

#### **Proposed Stormwater Infiltration Facilities Entail Risks as Well as Benefits**

Proponents of the above-listed land development projects have suggested that stormwater management facilities will be designed to promote groundwater recharge of stormwater, in a manner to mitigate wellfield impacts from imperviousness.

In general, for a stormwater facility within the WHPA (or outside it but still within the groundwater capture zone), even its purposeful design to promote recharge at the time of its construction does not assure its functionality in perpetuity. Sedimentation, siltation, biofouling and other processes typically reduce effectiveness of artificial recharge through time. A purposeful program of regular maintenance is needed to help provide continued function of recharging stormwater facilities over time.

### **Groundwater Quality Concerns Related to Development In/Near the WHPA**

Each planned stormwater facility within the WHPA introduces the prospect of groundwater contamination hazards from stormwater entrainment of roadway deicers and vehicle drippings, which may enter and be discharged from stormwater management facilities. Moreover, the future use of fertilizers, pesticides and herbicides on landscaped grounds within the WHPA could introduce groundwater contaminants. Best would be their restricted or prohibited use.

Depending on the specifics of their capture areas and designs, the proposed stormwater facilities may concentrate and subsequently discharge (to groundwater) surface pollutants from roads, parking areas, lawns, and gardens. One or more of these planned stormwater facilities may be planned and designed to introduce stormwater into the unconfined aquifer near the BPW wellfield.

For example, one stormwater facility associated with the US-9 highway widening project is especially close to the wellfield itself. Inasmuch as distance may help lessen deleterious effects from such artificial groundwater recharge, for such a facility to be very close to the wellfield warrants an especially conservative approach (if it cannot be relocated). Noting the linear expanse of US-9, B&L recommends that the Delaware Department of Transportation find an alternative stormwater facility location outside the WHPA.

Effective treatment of stormwater through processes such as sand filters and carbon polishing often is regarded as expensive. The available documents B&L reviewed make no mention of plans or commitments for said treatment. Absent assured treatment (and its funding) over time, the risk remains of groundwater discharge of potential contaminants from these proposed stormwater facilities.

The proposed land use changes also raises a water quality concern originating from surface water. Ebenezer Branch is a short distance southwest of the wellfield, within the WHPA. Portions of Ebenezer Branch are brackish and/or tidally influenced. Streams on the coastal plain usually are in direct hydrologic contact with underlying, unconfined aquifers (i.e., losing streams). The expansion of imperviousness within the WHPA may effectively "pull" additional water from Ebenezer Branch (of possibly inferior natural quality) into the aquifer. In doing so, the unconfined aquifer could receive more (possibly seawater-influenced) surface water than it otherwise would, affecting water quality results by introducing increased surficial contaminants, particularly during storm events. If base flow of Ebenezer Branch is reduced as a consequence of such groundwater capture, downstream aquatic habitats also could be adversely affected.

### **Review of February 2022 Verdantas Environmental Assessment Report**

An environmental assessment report for the Mitchell Farm property was completed by Verdantas in February 2022. (We were not provided such reports for the VCC or US-9 projects). The Verdantas report concluded that the development of the Mitchell Farm property can be constructed without adversely impacting the BPW supply wells. We also reviewed a May 2018 geotechnical report for Mitchell Farm.

Notwithstanding its purported intent to fulfill certain Sussex County Code requirements, we find that the Verdantas report could have been more thorough and conservative had it considered the following:

1. **Groundwater Quality** - The City of Lewes Water Supply Wells section of the Verdantas report mentions that historical water quality data for the BPW wellfield entrained nitrates, sulfates, and chlorides detected on a regular basis. Verdantas attributes nearby agricultural activities as the likely



source for nitrates but remained silent in discussing potential sources of chloride. While the presence of chloride can occur naturally in the environment, chloride can increase in concentration from the anthropogenic application of deicers and road salt in the WHPA. Due to the history of chloride in the Lewes water system, and the projected increase in impervious roadways, we recommend that treatment for deicing salts also be incorporated into the stormwater design of new facilities in the WHPA. While we agree with Verdantas' recommendation to install pretreatment structures to target debris and potential petroleum releases prior to discharge into the basin, deicers should also be included in the pretreatment measures recommended.

2. **Basin Design and Maintenance** - The Verdantas report briefly mentions maintenance with the statement that stormwater facilities should be inspected on a regular basis to ensure that they are adequately infiltrating water and not being overrun by debris and bio-matter. We concur that maintenance is vital to the efficiency and effectiveness of the stormwater facilities' ability to infiltrate and treat as designed and therefore recommend that developers of stormwater facilities in the WHPA be required to prepare and implement a maintenance plan. For example, accumulated sediment removal is a necessary component of infiltration basin maintenance that if neglected can cause the basin to fail.
3. **Groundwater Recharge** - While it is true that the drainage basin divide along Kings Highway would carry surface water away from the WHPA under natural conditions, post-development drainage patterns may differ and impervious acreage could increase beyond the limit suggested by pre-development topography. Due to the gently sloping topography, it is reasonable to assume that pumping from the Lewes water supply wells could overcome the subtle, natural gradient and "pull" water from the other side of the present drainage divide.
4. **Site Characterization Considerations** - While the geotechnical borings and infiltration testing included as an attachment to the Environmental Assessment Report are generally helpful to characterize the Mitchell Farm site, a more focused effort would be required to assess the feasibility of stormwater infiltration and treatment at the specific location where the planned stormwater management facility eventually would be constructed. Additional borings, infiltration tests and soil test pits should be completed per standard state requirements (e.g., 5101 Sediment and Stormwater Regulations) such that both groundwater recharge potential and proper treatment for parking lot-related contaminants (e.g., vehicle drippings, deicing materials, etc.) are considered.

#### **Review of April 2022 Verdantas Supplemental Report**

Verdantas also prepared a letter-report dated April 25, 2022 as a follow up. This letter-report updates certain elements of its earlier assessment, seemingly in an effort to respond to BPW concerns including some of those raised herein. Specifically it discusses topography, water budget, the purported benefits of groundwater recharge via stormwater discharge within the WHPA, and water quality effects of developing agricultural lands.

We reviewed this supplemental information and B&L remains of the opinion that our initial concerns about proposed land use changes in the WHPA remain unaddressed and thus, persist for the following reasons:

1. **Verdantas Topographic Re-Analysis Is Unpersuasive** - The topography of the Lewes area is relatively flat and natural topographic gradients are minor compared to groundwater gradients within the WHPA arising from BPW withdrawals. Changes in the dynamic position of the outer edge of the groundwater capture zone surrounding the wellfield easily may differ from those suggested by the very subtle natural topography. Impervious surface creation may cause the edges of this capture



zone to cross and transcend subtle topographic drainage divides. For this reason, the direction of surficial topographic drainage does not lessen the risk posed by land use changes within (what easily may be) a larger groundwater capture area.

2. **Verdantas' Suggestions for Stormwater Treatment Remain Inadequate** - The Verdantas follow-up report recommends pre-treatment for runoff entering the stormwater management pond, located on the southern portion of the site. B&L agrees that pre-treatment is more protective than its absence, but our page 3 (of this document) concerns remain unaddressed. Neither Verdantas nor its client offer any assurance that the planned stormwater infrastructure will be properly maintained to avoid biofouling and siltation over time.

B&L did not note a Verdantas suggestion or recommendation for periodic sampling and analysis of stormwater discharges (to groundwater) over time. We reviewed the Delaware Groundwater Recharge Design Manual (dated May 2005) for stormwater infiltration in the context of source water protection. The Manual has a section that lists parameters that should be sampled semi-annually, though the actual frequency, parameter list and number/locations of sampling points seem to be the subject of technical discussion, negotiation and agreement between affected parties. The Manual references the frequency of water level measurements as semi-annually, though it makes better sense to do this with greater frequency initially, to have enough data to make a defensible evaluation of possible future impacts.

B&L recommends that (1) the aforementioned Manual provisions be applied to each of these proposed projects and (2) that Lewes BPW be permitted (by the County) the opportunity to comment on developer plans via-a-vis stormwater management in the WHPA.

#### **Benefit of Perpetual Stormwater Management Agreement**

BPW needs to rely on the continuity of the quantity and quality of groundwater available to its wellfield in perpetuity. BPW cannot risk a reduction in groundwater quantity or quality, arising from discretionary land development within or near its WHPA.

If land use changes cannot be prohibited, BPW, Sussex County and affected development interests should enter into a water management agreement providing for the ongoing review, monitoring and maintenance of facilities designed for artificial reintroduction of stormwater into the capture area.

Diminished functionality of artificial groundwater recharge systems due to siltation easily may happen should the system not be properly maintained. Without a provision for the funding and execution of regular monitoring and maintenance efforts, the long-term efficacy of artificial groundwater recharge systems is uncertain and should not be relied upon unless accomplished through a perpetual water management agreement.

B&L notes that some wellhead protection ordinances (e.g., the Lewes Ordinance) imply the use of escrowed developer funds as a tool for financing potential mitigation measures in the circumstance an adverse impact comes to manifest. A challenge for the parties entails the perpetual risk of impairment of the implicit temporary nature of many escrow arrangements.

We believe that a well-reasoned and fair agreement include a provision for escrowing developer funds to be held for use in impact mitigation. The escrow concept is a complex one and its full development transcends the scope of this assessment. The amount needs to be fair and reasonable, and capped by

the probable cost of likely mitigation measures (i.e., replacement well(s) and additional treatment if water from a deeper aquifer is of inferior natural quality).

Given that the risk posed by the land development projects is both perpetual and difficult to isolate to a specific project in terms of impact causation, B&L recommends that consideration be given to requiring annual economic contributions to a mitigation fund in perpetuity, by the future owners of impervious land in the WHPA.

### Summary

B&L represents that, within the parameters established by the scope of work, this preliminary hydrogeologic impact assessment has been undertaken and performed in a professional manner, in accordance with generally accepted practices in effect at the time and in the locality that this assessment was performed. Subject to these provisions, B&L's professional opinions are as follows:

1. **Lewes BPW Concerns are Legitimate and Should Be Honored by the County** – Inasmuch as Lewes residents are County residents, and what happens to the Lewes BPW wellfield affects County residents, the County should honor and prioritize the source water protection concerns of the Lewes BPW as though they affected County citizens and taxpayers as a whole.
2. **Lewes BPW Wellfield Potentially Will Be Affected by Land Use Changes** – The proposed land use changes represent water quality and supply adequacy risks for the BPW wellfield. Of these, groundwater recharge intercept and reduction presents the greatest threat, but the possibility of groundwater quality impairments (deicers, fertilizers, pesticides, herbicides, etc.) cannot be ignored. Neither design elements of the concerning stormwater management facilities, nor provisions of the County Ordinance adequately protect from foreseeable risks and impacts. At minimum, the developer of the new stormwater facilities should be required to maintain and monitor them in perpetuity.
3. **Long-Term Impact Mitigation Agreement (With Funding) Recommended** – Neither State nor County policies and ordinances provide an assured means (other than via lawsuit) through which Lewes BPW can seek compensation or relief in the circumstance that the identified impacts do materialize. Herein, we suggest a system of developer escrow payments to seed a fund for impact mitigation measures, gradually replaced by annual fees paid by owners of impervious land in the WHPA. We acknowledge that the details will be complex, requiring deft negotiation by the affected parties. We believe that the careful crafting of an investment in such an Agreement would do more for long-term protection of BPW interests than would (for example) a handful of monitoring wells.

### B&L Recommendations for BPW

- A monitoring well between the wellfield and Ebenezer Creek, screened akin to the production wells, may provide data useful for the early warning of saltwater intrusion.
- Vocal participation in Delaware Department of Transportation meetings and hearings concerning US-9 widening may result in the repositioning of the now-planned stormwater facility to a location outside the WHPA.
- High-quality water quality data should be collected from the raw water entering each well and analyzed for parameters indicative of stormwater influence. Such data collection should begin without delay for baseline purposes, and should include, at minimum, conductivity, temperature, sodium, chlorides and nitrates. If funds allow, consideration could be given to



adding volatile and semi-volatile organic compounds of possible automotive and herbicide origin.

- BPW should ask Sussex County to accept and implement as development approval conditions, the County-directed recommendations listed herein.

#### **B&L Recommendations for Sussex County**

- The County should consult with DNREC and EPA to develop a plan for prohibited or restricted fertilizers, pesticides and herbicide use on community and commercial land in the WHPA. Such compounds should be prohibited unless applied by a licensed commercial landscaper in accordance with conservatively-developed manufacturer's recommendations for drinking water protection areas. Future residents should be educated about the risks of using such compounds (in time-of-purchase documents and/or utility bill inserts).
- The Verdantas recommendation to install pretreatment structures to target debris and VOCs should (1) be expanded to include roadway deicers; and (2) apply to all planned stormwater facilities in the WHPA.
- The developers and DEL-DOT should enter into an agreement with BPW and the County to establish a permanent contingency account to fund (1) periodic maintenance and repair of stormwater facilities; and (2) wellfield improvements necessitated by the impacts described herein coming to materialize, in whole or in part. As buildout becomes complete, developer contributions could be replaced by homeowners' association contributions. The existence of this perpetual financial obligation should be disclosed to perspective owners of properties within the WHPA at the time of sale.

Thank you for this opportunity to have served the needs of BPW once again. Please contact is if you have any questions.

Respectfully submitted,

BARTON & LOGUIDICE, D.P.C.



Mark W. Eisner, P.G.  
Vice President



David L. Pielmeier  
Senior Project Manager



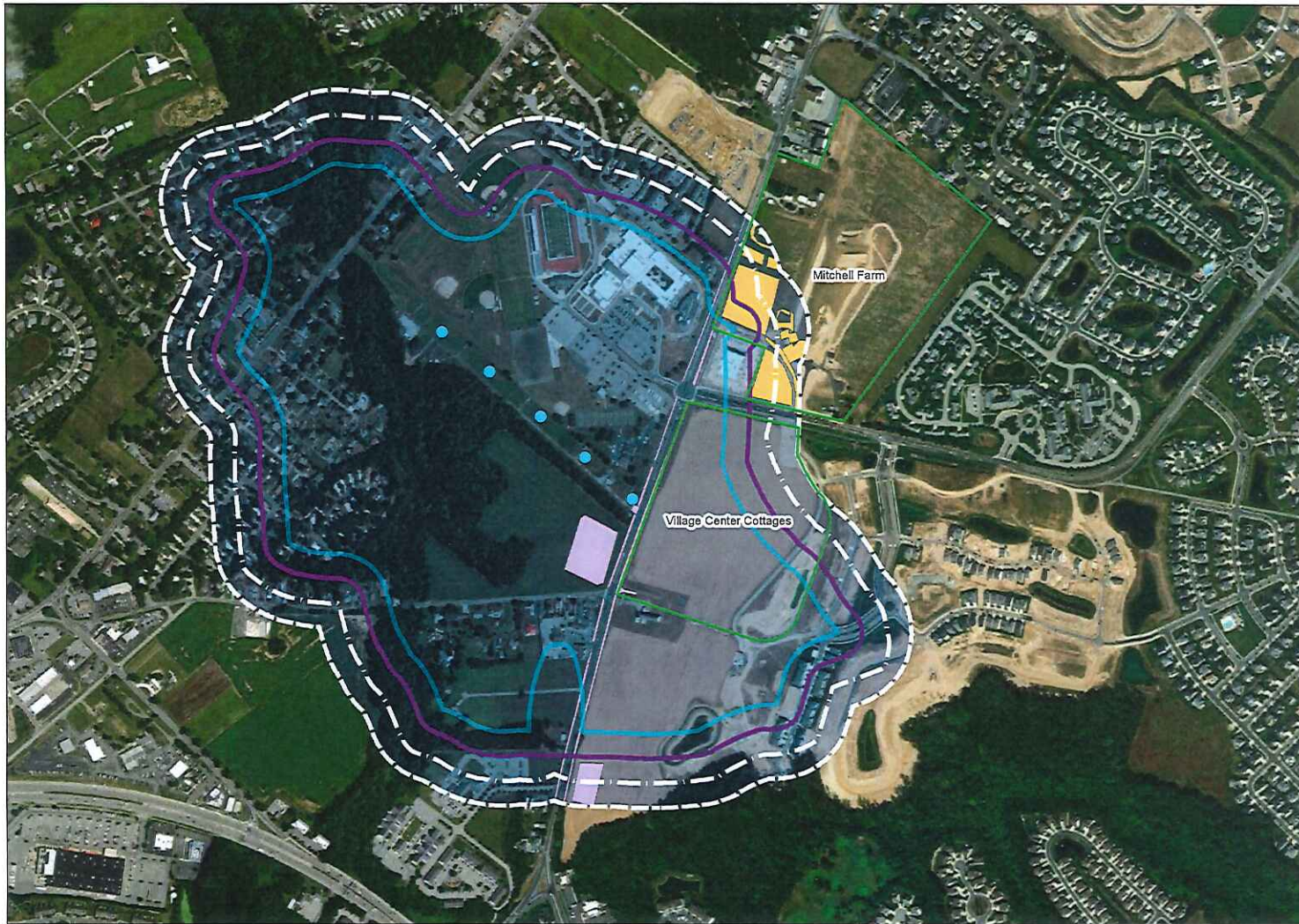
MWE/DLP/LKL/tmj  
Attachment



**References:**

Andres, A. S., Duffy, C. A., & Costas, E. M. (2003). *Wellhead Protection Area Delineations for the Lewes-Rehoboth Beach Area, Delaware*. Newark, DE: Delaware Geological Survey.





#### EXPLANATION:

- Lewes Production Well
- Proposed Development Parcel
- Original DGS Delineated WHPA
- Original DGS WHPA 100 Meter Buffer
- Expanded WHPA (After Increased Water Usage Without DGS 100m Buffer)
- Expanded WHPA (After Increased Water Usage with DGS 100m buffer)
- Approximate Natural Groundwater Recharge Intercept from US 9 Widening
- Approximate Natural Groundwater Recharge Intercept from Mitchell Farm Development

| Effect of Village Center Cottages, Mitchell Farm, and US 9 Widening on Impervious Area | Impervious Area in WHPA (acres)* | Impervious Area as a Percentage of WHPA |
|--|----------------------------------|---|
| Development as of 2021   | 85.31                            | 30.55                                   |
| Mitchell Farm  | 5.72                             | 2.05                                    |
| US 9 Widening  | 6.03                             | 2.16                                    |
| Village Center Cottages  | 25.39                            | 9.09                                    |
| <b>Effect of These 3 Projects</b>  | <b>37.14</b>                     | <b>13.30</b>                            |
| <b>Total</b>   | <b>122.45</b>                    | <b>44</b>                               |

\*Total area of WHPA is 279 acres



#### Notes:

1. Basemap from digital files made available by ESRI.
2. Site boundary, well locations and site development provided by client. Digitized site features approximated from client-provided site plans. Development from Village Center Cottages is assumed to be 73% Impervious, as provided by client. Analysis assumes that stormwater management facilities intercept and redirect natural groundwater recharge beneath their footprints.
3. Original delineated WHPA sourced from DGS report (Andres et al., 2003, WHPA Delineations for the Lewes-Rehoboth Beach Area, DE).
4. Project future water demand increase of 25% provided by client. B&L presumed a proportionate increase in WHPA size, equally in all directions.
5. This figure is integral to written correspondence and should only be used in that context. The updated WHPA delineation is unofficial, and is a simplified approximation.

Client:

Lewes Board of  
Public Works

PROJECT NO. 2228.002.001

Project:

Lewes DE  
Wellhead Protection Area  
Impact Evaluation

Lewes, Sussex County, DE

**Barton  
& Loguidice**

Figure 1:

Expanded WHPA  
Concept Map

April 25, 2022



April 25, 2022

**Via Electronic Mail**

Mr. Ring Lardner, P.E.  
Principal  
Davis, Bowen & Fridel, Inc.  
1 Park Avenue  
Milford, Delaware

RE: Project Number 14447  
Supplemental Information to Environmental Assessment Report dated February 2022  
Mitchell Farm, Tax Parcel 335-8.00-37.00

Dear Mr. Lardner:

Per your request, we have prepared this letter-report to supplement an Environmental Assessment Report (EAR) prepared by Verdantas LLC titled "Environmental Assessment Report, Tax Parcel 335-8.00-37.00, Lewes, Delaware", dated February 2022. The February 2022 EAR determined solely the post-development rooftop area needed to balance the water budget. Geotechnical information included in the EAR was based on the since rescinded application but is still applicable to assessing this project. Verdantas understands that the size and location of the stormwater basin (recharge facility) for this application was based on better infiltration rates than those for the original design and the proximity to the existing outfall pipe beneath Gills Neck Road (positive drainage) from the property.

The Sussex County Code (the Code) indicates "Impervious cover of that portion of a tax parcel within the wellhead protection area which is greater than 35% but no more than 60% is allowed, provided the applicant demonstrates through an environmental assessment report (EAR) prepared by a registered professional geologist or registered professional engineer familiar with the hydrogeologic characteristics of Sussex County and using a climatic water budget that will insure that post-development recharge quantity will meet or exceed the existing (predevelopment) recharge quantity."

The referenced tax parcel (the Property) covers approximately 48± acres, including 6.34 acres located within a mapped Wellhead Protection Area (WPA) designated for the City of Lewes water supply well field. Per the EAR, stormwater facilities planned for the Property will also serve the adjacent Lewes Medical Center on tax parcel (335-8.00-37.01). Accordingly, the water budget analysis included the existing Medical Center, resulting in a total area for both properties of 51.01 acres, with 9.34 total acres within the WPA. The impervious cover planned for the combined parcels is 4.89 acres or 52% of the WPA as permitted by Code. Planned post-development recharge will far exceed pre-development recharge and will provide a substantial increase in water supply to the Lewes wellfield.

Additionally, the purpose of this supplemental information to the February 2022 EAR is as follows.

- Provide updated mapping related to local drainage basins and anticipated surface water drainage and groundwater flow.

- Address typographical errors in the initial EAR.
- Provide revisions to the water budget based on changes made for post-development planning and handling of stormwater for recharge.
- Discuss the benefits of increasing the quantity of water recharged to the wellhead area.
- Provide documentation that water quality can be maintained and even improved when developing agricultural lands.

## **SURFACE WATER DRAINAGE AND GROUNDWATER FLOW**

Verdantas updated a review of the drainage basin mapping for the Property using the United States Geological Survey (USGS) Hydrologic Unit Code 12 (HUC 12). The HUCs range from HUC 2 to HUC 12 with the higher number (12) providing more detailed, local sub-watershed levels including tributary systems. The HUC 12 mapping shows the Property to be located within the Canary Creek-Broadkill River Drainage Basin and just west of the Wolfe Glade-Rehoboth Canal Drainage Basin. The boundary between the two drainage basins and topography indicates that surface drainage on the Property would be conveyed under natural conditions in a northwesterly direction towards the headwaters of Canary Creek or to the northeast in the direction of the Lewes-Rehoboth Canal. It is likely that groundwater beneath the Property follows natural topography and flows towards the headwaters of Canary Creek and the canal, unless artificially drawn to the wellfield because of pumping from the Lewes supply wells (see Figure 1).

## **WATER BUDGET AND WATER QUANTITY**

The climatic water budget prepared for the February 2022 EAR was based on using the existing stormwater basin and calculating the rooftop area needed for recharge to equal or exceed pre-development recharge. Total post-development recharge available from all impervious cover within the WPA was not determined.

Pre and post development recharge summary tables derived from the body of the February 2022 EAR are provided below. There were typographical errors in these summary tables that did not affect the totals for the water budget calculations or affect the report conclusions. Those corrected values are highlighted on the tables.

| <b>Pre-development Recharge</b>       |            |              |                   |                               |                           |
|---------------------------------------|------------|--------------|-------------------|-------------------------------|---------------------------|
| Cover Type                            | Soil Group | Area (acres) | Recharge (Inches) | Recharge Volume (acre-inches) | Recharge Volume (gallons) |
| Agricultural                          | B          | 9.34         | 11.02             | 103                           | 2,796,891                 |
| Stormwater Basin                      | A          | NA           | NA                | NA                            | NA                        |
| Impervious Cover (sidewalks/pavement) | NA         | NA           | NA                | NA                            | NA                        |
| Total                                 |            | 9.34         |                   | 103                           | <b>2,796,891</b>          |



| <b>Post-development Recharge</b>   |            |                |                   |                               |                           |
|------------------------------------|------------|----------------|-------------------|-------------------------------|---------------------------|
| Cover Type                         | Soil Group | Area (acres)   | Recharge (Inches) | Recharge Volume (acre-inches) | Recharge Volume (gallons) |
| Grass/Landscape                    | B          | 4.12           | 12.93             | 53                            | 1,439,177                 |
| Stormwater Basin                   | A          | 0.33           | 13.87             | 5                             | 135,711<br>(135,771)      |
| Impervious Cover (Buildings, etc.) | NA         | 4.89           | NA                | NA                            | NA                        |
| Total                              |            | 9.52<br>(9.34) |                   | 44 (58)                       | <b>1,574,948</b>          |

The water budget for the EAR indicated that 50,223 square feet of rooftop area would be required to balance the water budget but did not include post-development recharge that would be provided by other impervious surfaces within the WPA.

The water budget has been updated using a revised preliminary post-development site plan with the recharge basin located within the WPA and covering an area of 0.85 acres. A revised "Preliminary Post-Development Plan" prepared by Davis, Bowen & Fridel, Inc. is attached as Exhibit 1. Stormwater from all impervious surfaces within the WPA will be conveyed to this basin for recharge to the subsurface. Revised spreadsheets presenting the climatic water balance are included as Exhibit 2. Summaries of the pre-development and post-development surface cover and estimated recharge volumes are presented below.

| <b>Pre-development Recharge</b>       |            |              |                   |                               |                           |
|---------------------------------------|------------|--------------|-------------------|-------------------------------|---------------------------|
| Cover Type                            | Soil Group | Area (acres) | Recharge (Inches) | Recharge Volume (acre-inches) | Recharge Volume (gallons) |
| Agricultural                          | B          | 9.34         | 11.02             | 103                           | 2,796,891                 |
| Stormwater Basin                      | A          | NA           | NA                | NA                            | NA                        |
| Impervious Cover (sidewalks/pavement) | NA         | NA           | NA                | NA                            | NA                        |
| Total                                 | -          | 9.34         |                   | 103                           | <b>2,796,891</b>          |

| <b>Post-development Recharge</b>   |            |              |                   |                               |                           |
|------------------------------------|------------|--------------|-------------------|-------------------------------|---------------------------|
| Cover Type                         | Soil Group | Area (acres) | Recharge (Inches) | Recharge Volume (acre-inches) | Recharge Volume (gallons) |
| Grass/Landscape                    | B          | 3.60         | 12.93             | 47                            | 1,276,251                 |
| Stormwater Basin                   | A          | 0.85         | 13.87             | 12                            | 325,851                   |
| Impervious Cover (Buildings, etc.) | NA         | 4.89         | 39*               | 191                           | 5,186,468                 |
| Total                              | -          | 9.34         | 65.8              | 250                           | <b>6,788,570</b>          |

\*Assume 10% evaporation of annual 43.37 inches of precipitation conveyed for recharge.

The pre and post development calculations result in the following.

|   |                          |
|---|--------------------------|
| Pre-Development Annual Recharge                                 | 2,796,891 gallons        |
| Post-Development Annual Recharge                                | 6,788,570 gallons        |
| <b>Annual Surplus Recharge from Impervious Cover within WPA</b> | <b>3,991,679 gallons</b> |



Post-development recharge will surpass pre-development recharge by almost four million gallons per year solely from stormwater collected within the WPA. Stormwater from areas of the Property outside the WPA may also be conveyed to the recharge basin, providing substantial supplemental recharge and water supply to the Lewes wellfield. This proposed recharge provides an excellent opportunity to help offset the potential lowering of groundwater levels in the wellfield from ever increasing water demands anticipated by the City of Lewes.

Where stormwater from paved surfaces is conveyed into the recharge basin, Verdantas recommends installing pretreatment structures to contain debris and potential petroleum releases prior to discharge into the basin. These structures are typically designed with dual chambers separated by a baffle wall to contain floating debris and petroleum within the primary chamber while allowing water to flow beneath the baffle wall and through the secondary chamber.

## **CHANGE IN LAND USE AND WATER QUALITY**

The planned development is in character with land uses already within the WPA, but with the addition of Green Technology Best Management Practices (BMPs). The Lewes supply wells have historically provided acceptable drinking water with the following land uses present within the WPA:

- A number of commercial properties and more than 200 homes, many of which were served by septic systems before a sanitary sewer system was provided.
- Kings Highway runs directly adjacent to the wellfield with traffic totals exceeding 12,000 vehicles per day with no treatment of stormwater conveyed into the wellhead area. Future planning includes expanding Kings Highway into a dual highway.
- Cape Henlopen High School is located directly adjacent to the well field. BMPs were not utilized until the school was re-developed beginning in 2009. Impervious cover at the high school and district office exceeds one million square feet. The impervious cover includes approximately 600 parking spaces, bus parking, an above ground diesel fuel tank, and a greenhouse. We estimate that 50,000 to 100,000 vehicles park on the paved areas of the high school and school district office annually. This does not consider truck traffic, fuel deliveries, and other service and maintenance vehicles.

These land uses, along with the water quality data for the Lewes supply wells, suggest that the subsurface soils above the water table and the aquifer effectively renovate groundwater migrating to the supply wells. The only contaminant that has been reported near EPA Maximum Concentration limits (MCLs) allowable for public drinking water systems in the Lewes water supply is Nitrates. Nitrates reported in the Lewes water system are likely the result of agricultural land use in the vicinity of the well field. Nitrates, herbicides, pesticides, and coliform bacteria can pose a threat to the supply wells from agricultural land use and should be reduced with residential and commercial land use and Green Technology BMPs. Studies have found that development of agricultural land often improves the quality of surface water and groundwater.

A publication titled "Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs" <sup>(1)</sup> indicates that properly designed basins with favorable subsurface soil conditions



can adequately infiltrate stormwater and reduce pollutants. BMPs serve a dual purpose by providing effective management of stormwater flow and controlling non-point source pollution. The referenced study also indicated the following:

- The greatest sediment loads are produced from larger intensely developed watersheds that are not utilizing BMPs.
- Artificial groundwater recharge is an effective BMP to reduce the frequency and severity of downstream floods.
- "Infiltration BMPs are an excellent means of providing for groundwater recharge, which is often lost as a consequence of watershed development. Natural levels of recharge can be duplicated by diverting a significant fraction of the runoff from frequent small and moderate storms back into the soils."
- "Infiltration practices have a moderate to high removal capability for both particulate and soluble urban pollutants."
- Long-term studies of pollutant migration in soils beneath infiltration practices indicate only limited downward migration of pollutants through the soil (EPA 1983).

The University of Delaware Water Resources Agency prepared a report for the New Castle County Department of Land Use titled "Report on Water Resource Protection Areas, New Castle County, Delaware" <sup>(2)</sup> dated March 14, 2011. Approximately 180 Water Resource Protection Area (WRPA) projects were reviewed for the report. Twenty-two of the WRPA projects included Water Management Agreements that required pre and post development groundwater monitoring with laboratory analysis of groundwater samples. The Water Resources Agency indicated in the cover page of the report that "groundwater quality and quantity have largely been preserved under the WRPA provisions of New Castle County Code." Data in the report also indicated that groundwater quality typically improved following development. New Castle County has permitted recharge basins in Water Resource Protection Areas to receive both rooftop water and stormwater from paved surfaces, typically with pretreatment structures for water conveyed from the paved surfaces.

In 2016, a Sussex County Planning and Zoning Commissioner sent an inquiry to DNREC regarding the Lewes WPA water quality when considering a rezoning application for the planned Village Center located south of the project site.<sup>(3)</sup> One of the questions asked of DNREC was "Has the purity of the water changed and/or have any new pollutants been detected?" DNREC's response was "Based on the sample results from the last 5-10 years made available to DNREC by the ODW there has been no change in water quality." This is an important observation as the proposed development of the Property is consistent with historical and existing land use within the WPA. ODW refers to the Delaware Department of Public Health, Office of Drinking Water.

## RECOMMENDATIONS

Considering the Sussex County Code (Chapter 89 Source Water Protection) and BMPs, Verdantas recommends the following practices when developing the Property, per the original EAR.





- Install pre-treatment structures where water from paved surfaces will be conveyed into the recharge basin within the WPA. Pre-treatment structures typically function to control debris and potential petroleum releases.
- Discharge from roof drains, containment areas or structures that contain mechanical systems should be discharged using best management practices, such as the use of bio-swales.
- Aboveground and underground storage tanks (USTs) containing petroleum or hazardous substances listed in 40 CFR 116 in an aggregate quantity equal to or greater than a reportable quantity as defined in 40 CFR 117 are not permitted in a designated wellhead protection area unless such facilities meet the aboveground and underground storage tank regulations as applicable to the State of Delaware.
- Stormwater management oversight shall be referred to and governed by the Sussex County Conservation District within wellhead protection areas.
- Structures used to recharge stormwater should be inspected on a regular basis to ensure that the structures are adequately infiltrating water and not becoming fouled by sediment, debris, or bio-matter.

This report is based on our professional judgement of site conditions represented by available maps, plans, reports, and correspondence. While this evaluation was performed to characterize the hydrogeology of the project site, subsurface conditions are in fact unknown. It is important to note that latent conditions and other contingencies bearing upon the results of this study may become evident in the future. Calculations prepared by Verdantas were based on areas of existing and planned impervious and pervious cover provided to Verdantas by DBF.

If you have any questions regarding this supplemental report, please contact us.

Sincerely,

Verdantas LLC

A handwritten signature in black ink that reads 'Steven Cahill'.

Steven Cahill, P.G.  
Senior Project Manager

## REFERENCES

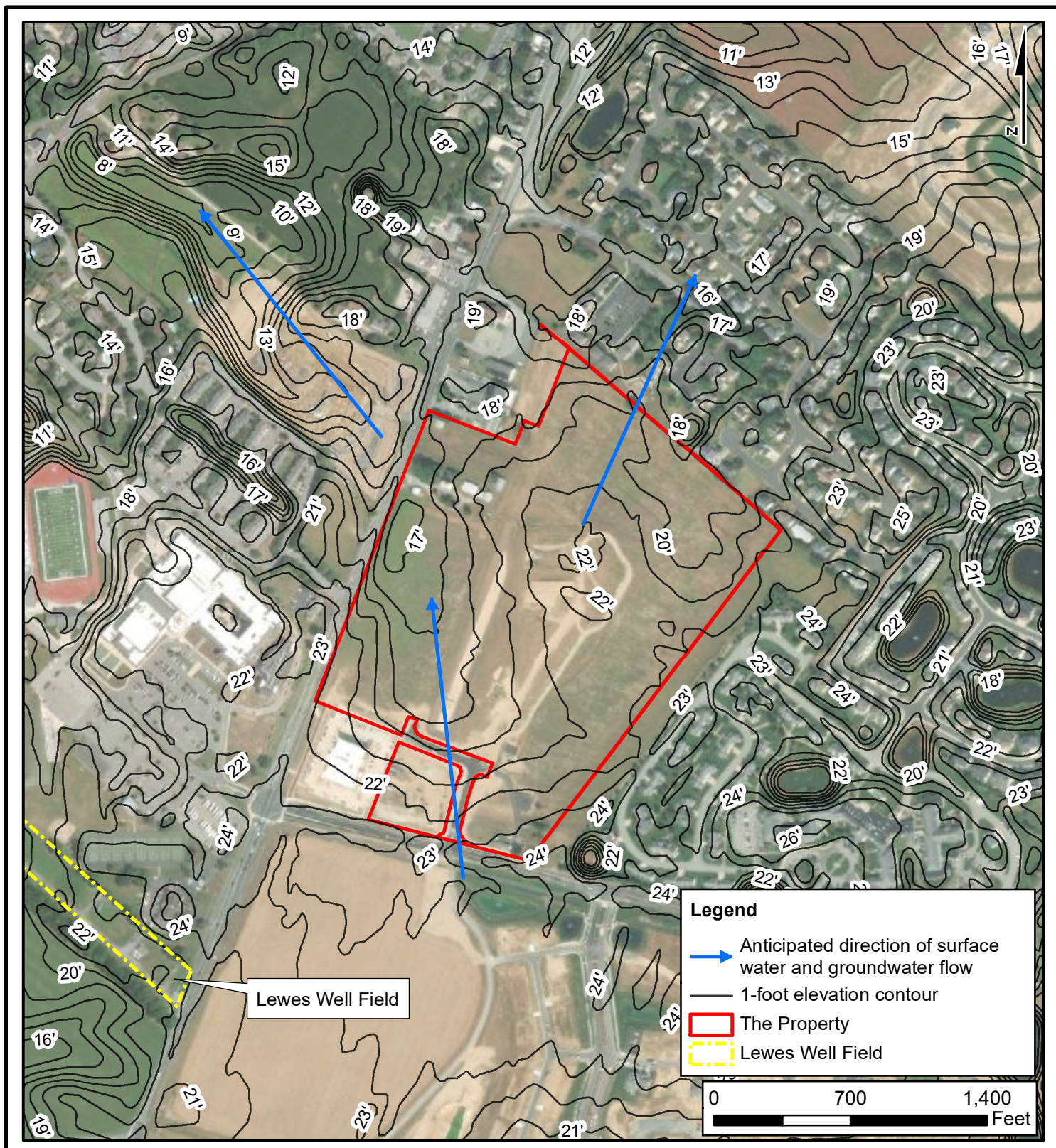
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1. Schueler, T., 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs., Metropolitan Washington Council of Governments, Washington, DC.
2. Homesy and Kauffman, 2011, Report on Water Resource Protection Areas, New Castle County, Delaware, March 14, 2011.
3. Electronic mail dated October 31, 2016, from Anne Mundel (DNREC) to Kevin Coyle (DNREC), Anita Beckel (DNREC), and Michael Tholstrup (DNREC) regarding inquiries from Janelle Cornwell (Sussex County Planning and Zoning Manager))

**FIGURE 1: SURFACE WATER AND GROUNDATER FLOW**

---





|                      |   |                                  |  |
|----------------------|---|----------------------------------|--|
| Date:<br>04/2022     | <b>ESTIMATED NATURAL SURFACE<br/>WATER AND GROUNDWATER<br/>DRAINAGE DIRECTION</b><br><br><b>MITCHELL FARM</b><br><br>LEWES~SUSSEX COUNTY~DELAWARE | DESIGNED BY: KLS                 | <br>5400 LIMESTONE ROAD<br>WILMINGTON, DE 19808-1232<br>TEL. (302)239-6634<br>FAX (302)239-8485<br><br>OFFICES IN PENNSYLVANIA,<br>SOUTHERN DELAWARE,<br>MARYLAND AND NEW JERSEY<br><br>EMAIL: DUFFIELD@DUFFNET.COM |
| SCALE:<br>AS SHOWN   |   | DRAWN BY: KLS                    |  |
| PROJECT NO.<br>14447 |   | CHECKED BY: SFC                  |  |
| SHEET:<br>FIGURE 3   |   | FILE:<br>14447-FlowDirection.mxd |  |

## EXHIBIT 1: PRELIMINARY POST DEVELOPMENT PLAN

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## EXHIBIT 2: WATER BUDGET CALCULATION SHEETS

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**Table 1 - Site Description**  
**Mitchell Farm, Lewes, DElaware**

|  |  |       |       |
|--|--|-------|-------|
| <b>Name of development:</b>                      | Mitchell/Zwaanandael Farm                    |       |       |
| <b>Calculations by:</b>                          | Steve Cahill, P.G.                           |       |       |
| <b>Name of watershed:</b>                        | North Rehoboth Bay                           |       |       |
| <b>Landuse/landcover</b>                         |  |       |       |
| <b>Existing site:</b>                            | Agricultural with Stormwater Basin Installed |       |       |
| <b>Proposed site:</b>                            | Commercial and Residential Development       |       |       |
| <b>Type of WRPA:</b>                             | Wellhead Area per Sussex County Code         |       |       |
| <b>Project area</b>                              | <b>*Includes Lewes Medical Center</b>        |       |       |
| <b>Entire property:</b>                          | 51.01  | acres |       |
| <b>Area within WRPA:</b>                         | 9.34   | acres |       |
| <b>Impervious cover</b>                          |  |       |       |
| <b>Existing within WRPA:</b>                     | 2.48   | acres | 26.0% |
| <b>Proposed within WRPA:</b>                     | 4.89   | acres | 52%   |
| <b>Proposed Groundwater recharge facilities:</b> | Infiltration basin                           |       |       |

**\*Although the existing impervious cover = 26% within the WPA, calculations assume no predevelopment impervious cover to reflect all predevelopment conditions.**



## Climatic Water Balance Predevelopment, Agricultural Areas

CLIMATIC WATER BALANCE IN SOIL GROUP B FOR AGRICULTURAL USE  
SOIL MOISTURE STORAGE = 8 inches

|                       | JAN  | FEB  | MAR  | APR  | MAY   | JUN   | JUL   | AUG   | SEP   | OCT  | NOV  | DEC  | ANNUAL |
|-----------------------|------|------|------|------|-------|-------|-------|-------|-------|------|------|------|--------|
| Precipitation (P)     | 3.03 | 3.16 | 3.44 | 3.09 | 3.42  | 3.69  | 4.83  | 4.87  | 3.93  | 4.37 | 2.47 | 3.07 | 43.37  |
| Runoff Coeff. (RC)    | 0.10 | 0.10 | 0.10 | 0.10 | 0.10  | 0.10  | 0.10  | 0.10  | 0.10  | 0.10 | 0.10 | 0.10 |        |
| Runoff (RO=RC*P)      | 0.30 | 0.32 | 0.34 | 0.31 | 0.34  | 0.37  | 0.48  | 0.49  | 0.39  | 0.44 | 0.25 | 0.31 | 4.34   |
| Infiltration (P-RO)   | 2.73 | 2.84 | 3.10 | 2.78 | 3.08  | 3.32  | 4.35  | 4.38  | 3.54  | 3.93 | 2.22 | 2.76 |        |
| PET                   | 0.00 | 0.00 | 0.62 | 2.00 | 3.72  | 5.25  | 6.10  | 5.31  | 3.74  | 2.02 | 0.75 | 0.00 |        |
| Infiltration-PET      | 2.73 | 2.84 | 2.48 | 0.78 | -0.64 | -1.93 | -1.75 | -0.93 | -0.20 | 1.91 | 1.47 | 2.76 |        |
| Cumulative Water Loss | 0.00 | 0.00 | 0.00 | 0.00 | -0.64 | -2.57 | -4.32 | -5.25 | -5.45 | 0.00 | 0.00 | 0.00 |        |
| Storage (ST)          | 8.00 | 8.00 | 8.00 | 8.00 | 7.38  | 5.79  | 4.66  | 4.14  | 4.04  | 5.95 | 7.42 | 8.00 |        |
| Change ST             | 0.00 | 0.00 | 0.00 | 0.00 | -0.62 | -1.59 | -1.13 | -0.52 | -0.10 | 1.91 | 1.47 | 0.58 |        |
| AET                   | 0.00 | 0.00 | 0.62 | 2.00 | 3.70  | 4.91  | 5.48  | 4.90  | 3.64  | 2.02 | 0.75 | 0.00 | 28.02  |
| Percolation           | 2.73 | 2.84 | 2.48 | 0.78 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00 | 0.00 | 2.18 | 11.02  |

Values are in inches except for RC, which is unitless.

Assume Corn and Grain Crop Use with Soil Group B

PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

References:

- Delaware Environmental Observing System, Historical Monthly Station Summary Retrieval
- Georgetown-Delaware Coastal Airport, Weather Station, Mean Monthly Precipitation 2010 to 2021
- Thornwaite, C.W. & J.R. Mather, 1957. "Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." Drexel Institute of Technology, Publications in Climatology, Centeron, New Jersey.
- WRA, 2005. "Delaware Ground-Water Recharge Design Manual; Supplement 1 to the Source Water Protection Guidance Manual for the Local Governments of Delaware." March 2004, revised May 2005, revised June 2017. University of Delaware, Water Resources Agency (WRA).

## Climatic Water Balance Predevelopment, Stormwater Basin

CLIMATIC WATER BALANCE IN SOIL GROUP A FOR SWM Basin  
SOIL MOISTURE STORAGE = 14 inches

|                       | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEP   | OCT   | NOV   | DEC   | ANNUAL |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Precipitation (P)     | 3.03  | 3.16  | 3.44  | 3.09  | 3.42  | 3.69  | 4.83  | 4.87  | 3.93  | 4.37  | 2.47  | 3.07  | 43.37  |
| Runoff Coeff. (RC)    | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |        |
| Runoff (RO=RC*P)      | 0.03  | 0.03  | 0.03  | 0.03  | 0.03  | 0.04  | 0.05  | 0.05  | 0.04  | 0.04  | 0.02  | 0.03  | 0.43   |
| Infiltration (P-RO)   | 3.00  | 3.13  | 3.41  | 3.06  | 3.39  | 3.65  | 4.78  | 4.82  | 3.89  | 4.33  | 2.45  | 3.04  |        |
| PET                   | 0.00  | 0.00  | 0.62  | 2.00  | 3.72  | 5.25  | 6.10  | 5.31  | 3.74  | 2.02  | 0.75  | 0.00  |        |
| Infiltration-PET      | 3.00  | 3.13  | 2.79  | 1.06  | -0.33 | -1.60 | -1.32 | -0.49 | 0.15  | 2.31  | 1.70  | 3.04  |        |
| Cumulative Water Loss | 0.00  | 0.00  | 0.00  | 0.00  | -0.33 | -1.93 | -3.25 | -3.74 | 0.00  | 0.00  | 0.00  | 0.00  |        |
| Storage (ST)          | 14.00 | 14.00 | 14.00 | 14.00 | 13.67 | 12.20 | 11.10 | 10.71 | 10.86 | 13.17 | 14.00 | 14.00 |        |
| Change ST             | 0.00  | 0.00  | 0.00  | 0.00  | -0.33 | -1.47 | -1.10 | -0.39 | 0.15  | 2.31  | 0.83  | 0.00  |        |
| AET                   | 0.00  | 0.00  | 0.62  | 2.00  | 3.72  | 5.25  | 6.10  | 5.31  | 3.74  | 2.02  | 0.75  | 0.00  | 29.51  |
| Percolation           | 3.00  | 3.13  | 2.79  | 1.06  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.87  | 3.04  | 13.87  |

Values are in inches except for RC, which is unitless.

Assume Soil Group A, Sandy Soils with Meadow-Type Vegetation

PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

References:

Delaware Environmental Observing System, Historical Monthly Station Summary Retrieval

Georgetown-Delaware Coastal Airport, Weather Station, Mean Monthly Precipitation 2010 to 2021

Thornwaite, C.W. & J.R. Mather, 1957. "Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." Drexel Institute of Technology, Publications in Climatology, Centeron, New Jersey.

WRA, 2005. "Delaware Ground-Water Recharge Design Manual; Supplement 1 to the Source Water Protection Guidance Manual

for the Local Governments of Delaware." March 2004, revised May 2005, revised June 2017. University of Delaware, Water Resources Agency (WRA).

# **Climatic Water Balance** **Post Development, Grass Landscape Areas**

CLIMATIC WATER BALANCE IN SOIL GROUP B FOR GRASS COVERED AREAS POST DEVELOPMENT

SOIL MOISTURE STORAGE = 10 inches

|                       | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEP  | OCT  | NOV   | DEC   | ANNUAL |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|-------|-------|--------|
| Precipitation (P)     | 3.03  | 3.16  | 3.44  | 3.09  | 3.42  | 3.69  | 4.83  | 4.87  | 3.93 | 4.37 | 2.47  | 3.07  | 43.37  |
| Runoff Coeff. (RC)    | 0.04  | 0.04  | 0.04  | 0.04  | 0.04  | 0.04  | 0.04  | 0.04  | 0.04 | 0.04 | 0.04  | 0.04  |        |
| Runoff (RO=RC*P)      | 0.12  | 0.13  | 0.14  | 0.12  | 0.14  | 0.15  | 0.19  | 0.19  | 0.16 | 0.17 | 0.10  | 0.12  | 1.73   |
| Infiltration (P-RO)   | 2.91  | 3.03  | 3.30  | 2.97  | 3.28  | 3.54  | 4.64  | 4.68  | 3.77 | 4.20 | 2.37  | 2.95  |        |
| PET                   | 0.00  | 0.00  | 0.62  | 2.00  | 3.72  | 5.25  | 6.10  | 5.31  | 3.74 | 2.02 | 0.75  | 0.00  |        |
| Infiltration-PET      | 2.91  | 3.03  | 2.68  | 0.97  | -0.44 | -1.71 | -1.46 | -0.63 | 0.03 | 2.18 | 1.62  | 2.95  |        |
| Cumulative Water Loss | 0.00  | 0.00  | 0.00  | 0.00  | -0.44 | -2.14 | -3.61 | -4.24 | 0.00 | 0.00 | 0.00  | 0.00  |        |
| Storage (ST)          | 10.00 | 10.00 | 10.00 | 10.00 | 9.57  | 8.10  | 7.01  | 6.57  | 6.60 | 8.78 | 10.00 | 10.00 |        |
| Change ST             | 0.00  | 0.00  | 0.00  | 0.00  | -0.43 | -1.47 | -1.09 | -0.44 | 0.03 | 2.18 | 1.22  | 0.00  |        |
| AET                   | 0.00  | 0.00  | 0.62  | 2.00  | 3.71  | 5.01  | 5.73  | 5.12  | 3.74 | 2.02 | 0.75  | 0.00  | 28.70  |
| Percolation           | 2.91  | 3.03  | 2.68  | 0.97  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00 | 0.00 | 0.40  | 2.95  | 12.93  |

Values are in inches except for RC, which is unitless.

Assume Grass as Pervious Cover with Group B Soils

PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

Assume Grass as Pervious Cover

References:

Delaware Environmental Observing System, Historical Monthly Station Summary Retrieval

Georgetown-Delaware Coastal Airport, Weather Station, Mean Monthly Precipitation 2010 to 2021

Thornwaite, C.W. & J.R. Mather, 1957. "Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." Drexel Institute of Technology, Publications in Climatology, Centeron, New Jersey.

WRA, 2005. "Delaware Ground-Water Recharge Design Manual; Supplement 1 to the Source Water Protection Guidance Manual

for the Local Governments of Delaware." March 2004, revised May 2005, revised June 2017. University of Delaware, Water Resources Agency (WRA).



## Recharge Volumes Mitchell/Zwaanendael Farm

### PRE-DEVELOPMENT RECHARGE VOLUME

| Cover Type                      | Soil Group | Surface Cover<br>(percent) | Area<br>(acres) | Recharge<br>(inches) | Recharge<br>Volume<br>(acre-inches) | Recharge<br>Volume<br>(gallons) |
|---------------------------------|------------|----------------------------|-----------------|----------------------|-------------------------------------|---------------------------------|
| Agricultural Land               | B          | 100%                       | 9.34            | 11.02                | 103                                 | 2,796,891                       |
| Stormwater Basin                | A          | 0%                         | 0.00            | 0.00                 | 0                                   | -                               |
| Impervious (sidewalks/pavement) | N/A        | 0%                         | 0.00            | N/A                  | N/A                                 | N/A                             |
| Total                           |            | 100%                       | 9.34            | 11.02                | 103                                 | 2,796,891                       |

### POST-DEVELOPMENT RECHARGE VOLUME (ROOFTOPS ONLY)

| Cover Type                      | Soil Group | Surface Cover<br>(percent) | Area<br>(acres) | Recharge<br>(inches) | Recharge<br>Volume<br>(acre-inches) | Recharge<br>Volume<br>(gallons) |
|---------------------------------|------------|----------------------------|-----------------|----------------------|-------------------------------------|---------------------------------|
| Pervious, Grass/Landscape Areas | B          | 39%                        | 3.60            | 12.93                | 47                                  | 1,276,251                       |
| Stormwater Basin                | A          | 9%                         | 0.85            | 13.87                | 12                                  | 325,851                         |
| Building/other impervious       | N/A        | 12%                        | 1.10            | 39.00                | 43                                  | 1,167,634                       |
| Total                           |            | 60%                        | 5.55            |                      | 102                                 | 2,769,736                       |

### POST-DEVELOPMENT RECHARGE VOLUME (ALL IMPERVIOUS)

| Cover Type                      | Soil Group | Surface Cover<br>(percent) | Area<br>(acres) | Recharge<br>(inches) | Recharge<br>Volume<br>(acre-inches) | Recharge<br>Volume<br>(gallons) |
|---------------------------------|------------|----------------------------|-----------------|----------------------|-------------------------------------|---------------------------------|
| Pervious, Grass/Landscape Areas | B          | 39%                        | 3.60            | 12.93                | 47                                  | 1,276,251                       |
| Stormwater Basin                | A          | 9%                         | 0.85            | 13.87                | 12                                  | 325,851                         |
| Building/other impervious       | N/A        | 52%                        | 4.89            | 39.00                | 191                                 | 5,186,468                       |
| Total                           |            | 100%                       | 9.34            |                      | 250                                 | 6,788,570                       |

### NET GAIN IN RECHARGE DUE TO DEVELOPMENT

| Status            |            |     | Recharge<br>Volume<br>(acre-inches) | Recharge<br>Volume<br>(gallons) |
|-------------------|------------|-----|-------------------------------------|---------------------------------|
| Predevelopment    | Impervious | 0%  | 103                                 | 2,796,891                       |
| Postdevelopment   | Impervious | 52% | 250                                 | 6,788,570                       |
| Net Recharge Gain |            |     |                                     | 3,991,679                       |

The recharge facility should be designed to infiltrate the Net Recharge Loss within the Wellhead Area. Pre-development calculations assume no starting impervious cover. All lands were originally agricultural.