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June 28, 2019

VIA HAND DELIVERY

Hearing Officer Lisa A. Vest
Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, Delaware 19901

Re: Artesian Water Company, Inc. Written Public Comments Regarding Delaware Recyclable Products, Inc. Permit Modification Application

Dear Hearing Officer Vest:

Earlier today I emailed you a link through which you can access an electronic copy of Artesian Water Company, Inc.'s written public comments regarding Delaware Recyclable Products, Inc.'s pending permit modification application for the Minquadale landfill. That link is:

https://drive.google.com/open?id=14CD_BOSeBpbFmjmQjGoRxHnkwyvETqe6

Please find enclosed for your convenience two (2) printed copies of Artesian's comments. One copy is bound and the other is not in case the Department would like to make its own electronic scan of the document.

Very truly yours,

Karl G. Randall

General Counsel
Artesian Water Company, Inc.
664 Churchmans Road
Newark, Delaware 19702
Direct Dial: (302) 453-7309
Email: krandall@artesianwater.com

Enclosure
cc: File

To: Hearing Officer Lisa A. Vest
Secretary Shawn M. Garvin
Delaware Recyclable Products, Inc.

From: Artesian Water Company, Inc.

Date: June 28, 2019

Re: Permit Modification Application of Delaware Recyclable Products, Inc. relating to DRPI Landfill, New Castle, Delaware

Introduction

Artesian Water Company, Inc. (Artesian) submits these public comments in opposition to the Permit Modification Application (Application) of Delaware Recyclable Products, Inc. (DRPI). Information in the Application itself demonstrates that the landfill sits atop an aquifer, the Potomac, from which Artesian draws public drinking water for many thousands of Delawareans. Despite that reality, DRPI inexplicably claims that the Potomac is not a "valuable aquifer" within the meaning of Delaware's Regulations Governing Solid Waste (DRGSW). Part VI of Application, Page VI-6. As DRPI starts from this incorrect premise, its Application fails to provide any recent analyses that demonstrate current conditions at the site or the potential impact of granting the pending modification request. As explained herein, the omission of new analyses is inexplicable given the mandatory DRGSW requirements when seeking permission to construct a new cell of industrial waste – which is precisely what DRPI requests. Moreover, the Application itself discloses the vital importance of analyzing whether granting the modification will adversely impact conditions at the site. DRPI itself estimates that adding 60 feet to the height of the landfill will cause up to 6.1 feet of compression in the lower cells of waste.[1] Based on information in the Application, the lower cells of industrial waste that will be compressed are the oldest at the site, have no liner beneath them, and are in direct contract with the Upper Potomac aquifer.[2]

Until the truth about conditions at the Minquadale landfill are known and a meaningful analysis of the possible consequences of allowing six additional stories of waste has been undertaken, ***no one*** is in a position to know what steps must be taken to ensure contaminants are not released into the public drinking water below.

Artesian's comments are organized into four parts. Part I addresses two issues. The first is irregularities that have occurred in the Department of Natural Resources and Environmental Control (DNREC) making information relating to DRPI's Application

[1] Application Part VI at VI-15 to VI-16.

[2] Part VIII of Application, Page VIII-7 of Environmental Assessment Report, 3.3.2 Groundwater Quality (noting Cells 1 – 3 were unlined); Volume 3 of the Application, Page 16 of 46 (page 6 of 22 of Hydrogeologic Assessment Report - Blazosky Associates, Inc. 2004 revised 2005) (stating "The Columbia, however, was extensively mined for its sand and gravels beginning in the 1950s. Therefore much of it has been removed from the DRPI site and portions of the proposed expansion area leaving the Potomac Formation at the surface.").

publicly available. The second issue raised in Part I is an analysis of how DRPI seeks permission to construct a new cell of industrial waste, but has failed to undertake the mandatory analyses required by the DRGSW.

Part II of Artesian's comments is a report prepared by Mr. Peter M. Demicco, P.G., of Groundwater Associates, LLC. Mr. Demicco is a professional hydrogeologist whose *curriculum vitae* is attached to his report. His report explains a number of issues with the Application, including its failure to recognize the underlying aquifer as one that is valuable; how the site of the landfill could not be worse for the Potomac aquifer, particularly given its history as a borrow pit; concerns about DRPI's conclusions regarding the direction of groundwater flow based on problematic, old data; problems with the location, number and type of monitoring wells and what they are being used to test for; and indicia in DRPI's own data that is indicative of contaminant releases from the landfill.

Part III of Artesian's comments is a report that was prepared and reviewed by Mr. Jeffrey M. Bross, P.E., LEED AP, F. ACEC, and Mr. James F. Cloonan, P.E., LEED AP, of Duffield Associates, LLC (Duffield) and whose *curriculum vitae* are provided. This section focuses on DRPI's proposed leachate and liner systems, as well as certain other aspects of DRPI's application.

Part IV of Artesian's comments is a report prepared by Mr. Mr. Jeffrey M. Bross, P.E., LEED AP, F. ACEC, and Mr. Christopher C. Whallon, Esq., P.G., of Duffield. Mr. Whallon's *curriculum vitae* is provided. This report further analyzes problems and shortcomings with DRPI's application with respect to both hydrogeology and other mandatory analyses that have not been provided.

Unless and until DNREC require DRPI to undertake the mandatory analyses required by the DRGSW, no one is in a position to say that contaminants from the landfill cannot reach the valuable aquifer below. The Application must be delayed or denied until DRPI has demonstrated that its request should be granted. ***This is absolutely critical***. DRPI's proposal is to finish burying the oldest, unlined industrial wastes at the site. If DNREC fails to require an exploration of current conditions and analyses of the potential impacts of granting DRPI's request now, ***there will never be a practical opportunity to ever do so again***.

PART I

I. Application information was tardily made public without telling everyone.

Artesian is troubled by the timing with which important information about the Application was made publicly available. The public comment session in this proceeding occurred May 29, 2019. The normal process, of course, is for all pertinent information about an application to be publicly available before the public comment session, so the public has a full and fair opportunity to review and comment upon the materials. Artesian learned about the Application approximately a week before the public comment session, and promptly filed with DNREC a Freedom of Information Act (FOIA) request for relevant materials. Artesian also engaged the experts who are providing comments herein to assess the Application. One of Artesian's consultants immediately realized that DNREC had not made Volume III of the Application – the volume that contained all of the Application's hydrogeological data – publicly available. In response to our enquiry about that volume, DNREC publicly posted it to its website with the other Application materials ***one day before the public comment session***. DRPI's hydrogeological report has hundreds of pages and contains dense data, effectively precluding Artesian from presenting refined comments during the public session.

Artesian was also concerned that it would not receive information in response to its FOIA request in time to offer meaningful comment by June 28, 2019. The FOIA regulations afford 15 business days to respond, which could have led to a production in mid-June. Artesian asked DNREC on June 4th if it could produce documents on a rolling basis. The initial response Artesian received was that all responsive materials were already publicly available through DNREC's website for the Application. Artesian had heard, though, that DNREC had hired a consultant to assist with its review of the Application, and no information from such a consultant was publicly posted. On June 5th Artesian asked DNREC to confirm that no additional materials were available. That afternoon DNREC posted additional information about the application, including a report that a consultant had prepared.

On June 6th Artesian sent a letter to the presiding Hearing Officer relating these facts, a copy of which is attached hereto. Artesian expressed two concerns. The first was that Artesian would have insufficient time to review and prepare comments about the additional materials. The second was that no other member of the public may realize that additional relevant information is now publicly available. Accordingly, we asked the Hearing Officer to extend the public comment period beyond June 28th and to issue a public notice that additional information is now available. The Hearing Officer declined to take either step.

II. For the new cell of industrial waste that DRPI wants approved, it should provide all information required by the application regulations.

DRPI's Application seeks a major modification to its existing permit for the construction and operation of the Minquadale landfill. The proposed modification would result in the construction of what is functionally a new cell of industrial waste: segregated from all other cells by liner and provided with a separate leachate system, monitoring system, and eventually its own cap. DRPI, however, styles this entirely segregated, separately designed cell as merely being an expansion of a preexisting cell (even though they will be separated by design). DRPI appears to take this position in an effort to avoid performing mandatory analyses required by the DRGSW that apply to new cells. DNREC should disregard DRPI's self-serving attempt at avoiding disclosure about current conditions and projected impacts of DRPI's request, and instead require DRPI to submit all information required by the Delaware Regulations Governing Solid Waste (DRGSW) § 4.2.1. The necessary information includes, among other things, a hydrogeological assessment (DRGSW § 4.2.1.5) and an environmental assessment (DRGSW § 4.2.1.6). Similarly, DRGSW § 6.1.3.9 provides:

> 6.1.3 No new cell of industrial landfill shall be located in an area such that solid waste would at any time be deposited:
>
> 6.1.3.9 In areas where valuable aquifers would be threatened by contaminant releases, unless viable alternatives have been dismissed and stringent design measures have been incorporated to minimize the possibility and magnitude of releases.

Indeed, DRGSW 6.1.2 provides that "All industrial landfill facilities shall be constructed to at least the minimum design requirements as contained in subsection 6.2. ***More stringent designs will be required where deemed necessary by the Department for the protection of groundwater resources***" (emphasis added).

Despite its comments that it merely seeks expansion of an existing cell, DRPI implicitly acknowledges that it must provide all information required by DRGSW §§ 4.2.1 and 6.1 in connection with its current permit modification application, in that it has submitted responses that correspond to each subsection of that regulation. What DRPI has submitted, however, is insufficient to satisfy the regulations. DRPI provided stale and incomplete Hydrogeological and Environmental assessments. This is functionally the equivalent of failing to submit these assessments at all. If hereafter DNREC requires DRPI to provide current and responsive information about site conditions, Artesian would like the opportunity to review the revised submission. After an opportunity to review the revised Application, which presumably will include information about current hydrogeological and ecological conditions in and around the DRPI facility, it is likely that Artesian will have additional comments.

There is a related issue with DPRI's application. By submitting its Application, DRPI has ***certified*** that all the information it provided is "***true, accurate, and complete***". (DRGSW - Title 7, § 4.2.1 and 4.2.1.1). The pertinent regulation provides:

> 4.2.1 Any person desiring to construct or operate a sanitary or industrial landfill or cell must submit a letter of intent to the Department. The letter should indicate the projected design and usage of the proposed facility. The letter of intent shall be followed by the submission, by the applicant, of the following additional information:
>
> 4.2.1.1 A Solid Waste Management Facility Application, provided by the Department. All information provided by the applicant is certified to be true, accurate, and complete by the applicant's signature on the provided application.

The written comments Artesian submits today cite numerous inconsistencies and omissions in DRPI's Application. With the age of DRPI's submitted studies and evaluations, there can be no reasonable dispute that the Application fails to meet the standard set forth in Section 4.2.1.1, because it does not present a clear picture of current conditions at the site or the projected impacts on proposed area that would be impacted. From Artesian's perspective, perhaps the most troubling aspect of the Application is DRPI's response to DRGSW § 6.1.3.9, where DRPI claims that the landfill "is not located above a valuable aquifer". Application Part VI at VI-6. As explained in other parts of Artesian's comments, the landfill is not only above, but in actual contact with, the Upper Potomac aquifer, from which Artesian draws public drinking water for tens of thousands of customers. In fact, Artesian has four nearby water treatment plants drawing from the Potomac, rendering the aquifer *invaluable*. Because of DRPI's incorrect assumption about the aquifer, however, it has undertaken no analysis of whether there are "viable alternatives" and whether there are "stringent design measures" that could "minimize the possibility and magnitude of releases" as DRGSW § 6.1.3.9 requires.

With respect to the subparts of DRGSW § 4.2.1 that require hydrogeological and environmental assessments, DRPI's submission merely incorporates by reference studies that were undertaken in 2004 (updated in 2005), and other reports that are even older. DRPI's contention in its 2018 application is that it has not undertaken any further analysis, and therefore it is not aware of any additional information that must be considered. DRPI's belief appears to be that, because this is a modification of an existing cell and permit rather than a new application for a new cell and permit, it need not undertake all the analyses required by the regulations in order to get its permit modification approved.

It would be arbitrary, capricious, and an abuse of discretion for DNREC to approve DRPI's 2018 permit modification application without requiring new analyses that satisfy all of the requirements of DRGSW §§ 4.2.1 and 6.1, including with respect to the necessary hydrogeological and environmental assessments, for the new industrial waste cell DRPI wishes to construct.

1. **On the face of DRPI's 2018 application, it has failed to undertake mandatory analyses required by DRGSW § 4.2.1 regarding the potential impact of the proposed modified facility.**

DRGSW § 4.2.1 provides, in pertinent part, "Any person desiring to construct or operate a[n] ...industrial ... cell must submit a letter of intent to the Department. The letter should indicate the projected design and usage of the proposed facility. The letter of intent ***shall*** be followed by the submission, by the applicant, of the following ***additional information*** ..." (emphasis added). DRPI's 2018 application seeks permission to construct a new industrial waste cell at the facility. Under the plain language of this applicable regulation, therefore, the mandatory additional information must be tailored to the specific proposed facility that the applicant wishes to construct.

DRGSW § 4.2.1.5 requires a hydrogeological assessment of the proposed site: "A hydrogeological investigation ***must*** be performed at the ***proposed*** site and approved by the Department before a construction permit will be issued" (emphasis added). Obviously, the hydrogeological investigation that DRPI undertook in 2004 did not contemplate the new cell of industrial waste that would expand the landfill from a maximum height of 130 feet to 190 feet. Therefore, the 2004 report is insufficient to support the current application and it would be an abuse of discretion for DNREC to approve the application in the absence of this mandatory report.

Similarly, DRGSW § 4.2.1.6 provides that "An environmental assessment shall be performed to provide a detailed analysis of the ***potential impact of the proposed facility on the environment***" (emphasis added). The factors to be considered include:

- Air quality.
- Water quality.
- Stream flow.
- Fish and wildlife.
- Plants.
- Threatened or endangered species.
- Water uses.
- Land use.
- Aesthetics.
- Traffic.
- Public health and safety.
- Cultural, recreational, and natural areas.
- Historic sites.
- Social and economic factors.
- Soil quality.

If the applicant or the Department determines that the proposed facility may cause a threat to human health or the environment, the applicant must provide a written explanation of how he or she plans to mitigate the potential harm."

It is indisputable that the environmental impact analysis that DRPI undertook in 2004/2005 did not contemplate the creation of a new cell of industrial waste that would expand the height of the landfill by nearly 50%, to 190 feet. DRPI has simply not complied with the regulation that requires "a detailed analysis of the potential impact of the proposed facility on the environment", emphasis added, as required by DRGSW § 4.2.1.6. Given the required analysis of the proposed facility's impacts, DRPI's position that it is not aware of any impacts – because it has intentionally not looked for any in the last 15 years – is indefensible.

2. Even if DRPI's 2004/2005 hydrogeological and environmental assessments analyzed the potential impacts of the proposed facility that DRPI seeks today, which they do not, the 2004/2005 assessments are stale and fail to account for other changed circumstances.

DRPI relies upon hydrogeological and environmental assessments prepared in 2004/2005 as a basis for granting a permit modification that will allow the construction of a new cell of industrial waste what will expand the height of the facility from 130 feet to 190 and extend the use of the facility, in DRPI's estimation, up to 21 years (2018 Application p.21). It would be inappropriate to rely upon such dated information in 2019 because circumstances at the landfill have demonstrably changed since DRPI's assessments were prepared back in 2004.

- One indication that it is inappropriate to rely upon 15 year old data to justify a permit modification in 2019 is reading DRGSW § 4.2.1 in conjunction with DRGSW § 4.1.5.1. DRGSW § 4.1.5.1 provides that "Solid waste facility operating permits … shall not be issued for periods greater than 10 years." That being the case, there should be no instance where the information that justifies the construction and operation of a solid waste landfill is older than approximately one decade. Here, however, DRPI wants 15 year old (and older) information to justify new construction at the facility so the landfill can take waste up to 45 years after the purportedly justifying information was created.

- Another clear sign that DRPI has failed to assess current conditions or the potential impacts of what is requested today is DRPI cites solid waste regulations ***that existed in 2004***, apparently unaware that they have been revised and re-codified. For example, when characterizing the aquifer below the landfill as purportedly not being one that is valuable, DRPI cites to DRGSW § 6.1.3 (f), which is what existed in 2004. Part VI of Application, Page VI-6. That regulation has new language and is now designated DRGSW § 6.1.3.9.

- Certain circumstances around DRPI's landfill have indisputably changed since its 2004/2005 assessments were prepared. For example, two aspects of the environmental assessment required by DRGSW § 4.2.1.6 are the potential impacts on public health and safety, and on cultural,

recreational and natural areas. In September 2018 the state celebrated the opening of the Jack A. Markell Trail, which runs right next to DRPI's landfill. Patently, DRPI's 2004/2005 analysis could not have taken into account the potential impact of increasing the height and longevity of the landfill on a public recreational trail that did not yet exist. Similarly, Artesian Water Company, Inc. stated at the public hearing on May 29, 2019 for DRPI's current application that it was making different, increased use of public drinking water wells that draw water from the aquifers below DRPI's landfill than was the case in 2004/2005. Both the hydrogeological and environmental assessments required by DRGSW § 4.2.1 would allow a determination of whether the potential impacts of DRPI's application may adversely impact public drinking water. If there is a potential, DRGSW § 4.2.1 requires DRPI to have a plan in advance to mitigate the possible harm. Given these and other changes in circumstances, it would be an abuse of discretion not to require DRPI to undertake new analyses of the potential impacts of the specific project it proposes, as the regulations require.

- Similar to the changed circumstances around DRPI's landfill that have occurred since it prepared hydrogeological and environmental analyses in 2004/2005, DRPI's current application anticipates ***changing existing conditions within the landfill***. Specifically, DRPI itself anticipates that approval of the increased height of the landfill to 190 feet will result in up to 6.1 feet of compaction in the lower cells of industrial waste at the site. Application Volume 2 pages VI-15 to VI-16. That amount of compaction is significant, because the lowest cell below the proposed new cell is unlined industrial waste that was dumped at the landfill at some point between the late 1970s and the early 1980s (different portions of DRPI's own application give different dates). Although there purportedly is some form of leachate system at or around this oldest industrial waste, leachate systems typically are lined to ensure capture of all leachate. Because DRPI has not undertaken the hydrogeological and environmental analyses required by DRGSW § 4.2.1, there is no information in DRPI's application about what the potential impacts at the site and on the surrounding environment will be of compacting that oldest, unlined waste. DRPI cannot plausibly claim that the anticipated compaction will not adversely impact its leachate system or result in discharges of contaminants, because it has deliberately avoided the hydrogeological and environmental analyses that would determine that issue.

- There are many red flags in DRPI's current application and in the 2004/2005 assessments indicating that new analyses under DRGSW § 4.2.1 must be required before DRPI's application should be granted. These include:
  - In the 2004 environmental assessment that DRPI incorporates into its 2018 application, DRPI's engineer specifically recommended getting a determination from the U.S. Army Corps of Engineers whether any waters of the United States or wetlands would be

impacted by the proposed use of the landfill. Nothing in the record demonstrates that DRPI acted upon its own engineer's recommendation. That is particularly curious as DRPI's 2018 application references "inundated wetlands" as an integral part of the landfill's "security measures" that keep unauthorized people out of the site. 2018 application Vol. 1, Part V, page V-5.

- Even with the limited number of "indicator parameters" DRPI tests for in its monitoring wells, elevated quantities of iron and manganese have been detected, which is indicative of a release. DRPI Permit SW-15/02 at p.12-13. Despite having this information, or perhaps because of it, DRPI chose not to undertake new analyses of hydrogeological and environmental conditions at the site for the present application and instead relies upon 15 year old data.
- DRPI's permit is for disposal of "Dry Waste", but on at least one occasion DRPI received a Notice of Violation from DELCORA for "an exceedance of ***FOG (Fats, Oil & Grease) from trucked leachate*** to the DELCORA treatment plant based in May 2015" (emphasis added).

For all of the foregoing reasons, DNREC should require all mandatory assessments required by DRGSW § 4.2.1, and it would be arbitrary, capricious and an abuse of discretion not to do so. DRPI's failure to analyze the potential impacts of its present, specific proposed modifications to the landfill are impermissible, and DRPI's deliberate attempt to rely upon stale data is inappropriate. The mere fact that DRPI seeks a modification of an existing permit, rather than the issuance of a new one, does not justify use of stale data that was created in connection with a different proposed construction plan. The regulations provide that permission to construct new industrial waste cells is dependent upon providing additional information. As previously mentioned, it is imperative that this information is gathered now, because DRPI's plan is to bury the oldest waste at the site. If DRPI does not provide this information now and the application is granted, there will never be another opportunity to determine the facts.

June 6, 2019

VIA ELECTRONIC AND FIRST CLASS MAIL

Hearing Officer Lisa A. Vest
Office of the Secretary
Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, Delaware 19901
lisa.vest@state.de.us

Re: Delaware Recyclable Products, Inc. (DRPI) Permit Modification

Dear Hearing Officer Vest:

I write on behalf of Artesian Water Company, Inc. (Artesian) regarding the Permit Modification application filed by Delaware Recyclable Products, Inc. (DRPI). Artesian is concerned about the manner in which information about the application has been made available to the public. For the reasons stated below, Artesian respectfully requests that mailed and additional notice be provided advising interested persons and the public that new information about the application is now available. Artesian also requests that the record remain open for public comment beyond the current deadline of June 28, 2019, until July 29, 2019.

Artesian only became aware of DRPI's Minquadale application and the scheduled May 29 public comment session shortly before Memorial Day, May 27. As Artesian has concerns about any potential adverse impacts that the expansion of the landfill could have on aquifers from which we draw water from to serve our customers, we promptly engaged hydrogeologists to begin assessment of the application. Our consultants quickly realized that Volume III of DRPI's application – the volume with all of the hydrological information – had not been made publicly available through the webpage that the Department of Natural Resources and Environmental Control (DNREC) created for this proceeding. It was only after Artesian's consultant contacted DNREC about this that DNREC publicly posted Volume III – one day before the May 29, 2019 public comment session. Volume III of the application contains hundreds of pages, much of which is technical data that takes time to properly assess, and which Artesian is still studying.

Unfortunately, it is now apparent that Volume III was not the only pertinent information that was not publicly available before the May 29 session. Upon learning that DRPI had filed the application, Artesian submitted a Freedom of Information Act (FOIA) request on May 22, 2019 seeking "Any reports, studies, data related to the hydrogeological conditions (including soils and groundwater) at Delaware Recyclable Landfill and Recycling Center (DRPI) industrial waste

landfill." The FOIA regulations afford DNREC fifteen (15) business days to respond to the request. On June 4, Artesian emailed DNREC's FOIA Coordinator about the status of our request, because a mid-June response does not give Artesian adequate time to review any information that will be produced (let alone time to prepare written comment on such information).

The response Artesian received from DNREC on June 4 was "After review of your request, DNREC has determined that the material you seek is publicly available online using the following link …." But this was not correct.

Artesian had been informed that DNREC had engaged a consultant to assist with its review of the application, and we could not find information from such a consultant through the referenced link. As a result, on June 5 Artesian pressed DNREC as to why no additional consultant information was available. At 11:00 a.m. yesterday morning, June 5, we were finally told by DNREC that additional information, including from DNREC's consultant, exists. That information was posted to DNREC's website for the application yesterday afternoon. A copy of the email chain reflecting this dialogue is enclosed for your convenience.

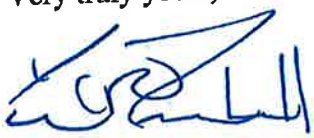
This is not the only information that is presently unavailable to the public. Various documents that people submitted for the record during the May 29 hearing have also not been posted. Artesian understood that you intended to have those documents uploaded promptly, so all members of the public could be informed about the comments, statements and objections submitted at the hearing. That was particularly important here, because each speaker at the hearing was limited to just three minutes to speak. We do not see any such materials posted on the DNREC website for this application. Artesian (and interested members of the public) need a meaningful opportunity to review those materials prior to any deadline for written comments.

In light of the failure of DNREC to provide its consultant's information in a timely fashion and the fact that other documentation presented at the hearing has not been posted, Artesian believes that an extension of the current June 28 public comment deadline is necessary. Artesian wants sufficient time for its consultants and professionals to review, assess and respond in writing to the additional information, and we believe other interested parties and the public should have adequate time to do so as well.

It is the normal and appropriate process to ensure that all relevant information about an application is publicly available before convening a public comment hearing, thereby allowing everyone to make informed comments about the application. Here, that clearly has not occurred. Artesian, other interested parties, and the public are significantly disadvantaged as a consequence. Artesian believes that a separate mailed notice to interested parties of record and a published notice for the public should be provided, informing everyone that additional information about the application, including from DNREC's consultant, has belatedly been made available. Artesian expects that such notices would only be given after the written submissions given during the May 29 session are posted and publicly available.

Because DNREC withheld information prior to the hearing, we believe that closing the record on June 28 deprives Artesian and other interested persons of an adequate opportunity to properly assess the information and provide appropriate written comment. Therefore, we request that the record remain open until July 29.

Very truly yours,



Karl G. Randall

General Counsel
Artesian Water Company, Inc.
664 Churchmans Road
Newark, Delaware 19702
Dial: (302) 453-6900

Enclosure

cc: Secretary Shawn Garvin (*via email*)
Mr. Virgil Holmes (*via email*)
File

Karl Randall

From: Sobocinski, Lee (DNREC) <Lee.Sobocinski@delaware.gov>
Sent: Wednesday, June 5, 2019 11:00 AM
To: Andrew Prosser; Sara Miskowic
Cc: Karl Randall; FOIA, DNREC (MailBox Resources)
Subject: RE: FOIA Request 452 Response

Follow Up Flag: Follow up
Flag Status: Flagged

Good morning. I have been advised that the information will be uploaded to the website today.

Thank you,

Lee

S. Lee Sobocinski
DNREC FOIA Coordinator
Department of Natural Resources and
Environmental Control
89 Kings Highway
Dover, DE 19901
(P) 302-739-9365
(F) 302-739-6242
lee.sobocinski@delaware.gov
Effective January 25, 2019, my email address changed to lee.sobocinski@delaware.gov. Please update your contact information accordingly.

From: Andrew Prosser <AProsser@artesianwater.com>
Sent: Wednesday, June 5, 2019 10:17 AM
To: Sobocinski, Lee (DNREC) <Lee.Sobocinski@delaware.gov>; Sara Miskowic <SMiskowic@artesianwater.com>
Cc: Karl Randall <KRandall@artesianwater.com>; FOIA, DNREC (MailBox Resources) <DNREC.FOIA@delaware.gov>
Subject: RE: FOIA Request 452 Response

Good Morning Lee,

Thank you for the prompt response! We would like to confirm that all materials are posted on the site you provided. Artesian had heard that DNREC hired an outside consultant or engineering firm to review DRPI's application. After reviewing the links on the site you provided, we cannot find any materials from such a consultant/firm. Was Artesian misinformed?

Thank you,

Andrew T. Prosser, P.E.
Engineer
office.(302) 453-5831
cell.(302) 803-1227

From: Sobocinski, Lee (DNREC) <Lee.Sobocinski@delaware.gov>
Sent: Tuesday, June 04, 2019 4:20 PM
To: Sara Miskowic <SMiskowic@artesianwater.com>
Cc: Andrew Prosser <AProsser@artesianwater.com>; Karl Randall <KRandall@artesianwater.com>; FOIA, DNREC (MailBox Resources) <DNREC.FOIA@delaware.gov>
Subject: FOIA Request 452 Response

Dear Ms. Miskowic:

This email is in response to your Freedom of Information Act (FOIA) request on May 22, 2019. You requested:

> *"Any reports, studies, data related to the hydrological conditions (including soils and groundwater) at Delaware Recyclable Landfill and Recycling Center(DRPI) industrial waste landfill."*

After review of your request, DNREC has determined that the material you seek is publicly available online using the following link: http://www.dnrec.delaware.gov/dwhs/SHWMB/Pages/SolidWasteFacilities.aspx.

Thank you for your FOIA inquiry to DNREC. DNREC considers your request closed at this time.

S. Lee Sobocinski
DNREC FOIA Coordinator
Department of Natural Resources and
Environmental Control
89 Kings Highway
Dover, DE 19901
(P) 302-739-9365
(F) 302-739-6242
lee.sobocinski@delaware.gov
Effective January 25, 2019, my email address changed to lee.sobocinski@delaware.gov. Please update your contact information accordingly.

ARTESIAN WATER COMPANY, INC. COMMENTS RE

Permit Modification Application of Delaware Recyclable Products, Inc.
relating to DRPI Landfill, New Castle, Delaware

PART II

Comments by:

Peter M. Demicco, P.G.
Groundwater Associates, LLC

Re: Review Hydrogeological Assessment
DRPI Landfill Expansion

This is an assessment of the Delaware Recyclable Products, Inc. (DRPI) Permit Modification Application, Hydrogeological Assessment Report (HAR). The HAR must meet specific requirements of Delaware Regulations Governing Solid Waste (DRGSW). The DRPI Permit Modification Application presents the HAR as Part VII of the application.

Documents beyond the Part VII HAR were reviewed as part of this analysis. The documents include:

- DRPI Permit Application Part I, Executive Summary
- DRPI Permit Application Part V, Operation and Maintenance Plan
- DRPI Permit Application Part VI, Engineering Report
- Delaware Geological Survey (DGS), Hydrogeologic Map Series No. 3 Geohydrology of the Greater Wilmington Area
- DGS, Geologic Map No. 4 Geology of the Wilmington Area

Permit Modification Requirements

The hydrogeological assessment must meet the requirements specified in DRGSW subsection 4.2.1.5.

> 4.2.1.5 A hydrogeological assessment. A hydrogeological investigation must be performed at the proposed site and approved by the Department before a construction permit will be issued. This investigation and report shall be prepared and signed by a Professional Geologist registered in Delaware. This investigation shall include a series of test borings and wells, constructed to a depth and in a number sufficient to identify:
>
> 4.2.1.5.1 The occurrence and characteristics of the unconfined and first confined aquifers;
>
> 4.2.1.5.2 Groundwater flow directions;
>
> 4.2.1.5.3 Background groundwater quality, using a minimum of eight (8) independent samples for each background and downgradient well;
>
> 4.2.1.5.4 Potential pathways of contaminants to points of groundwater discharge;
>
> 4.2.1.5.5 Approximate groundwater flow rates and travel times from the facility to points of discharge (including wells and/or surface water); and
>
> 4.2.1.5.6 A delineation of the anticipated maximum elevation of the seasonal high water table.

Summary Statement

This report presents five (5) items of critical concern with the DRPI Application. These Items are:

1. Reliance on a 15-year old hydrogeological assessment report
2. DRPI statement that "the aquifer underlying the DRPI Landfill is not classified as a valuable aquifer" (Page VI-6 - Part VI Engineering Report)
3. Strikingly similar site history and geologic setting to the Superfund sites Army Creek and Delaware Sand and Gravel
4. DRPI Monitoring wells do not account for the complexity of site geology and historic excavations/landfilling operations
5. Water quality analysis by DRPI is not testing for the full suite of compounds required for public drinking supplies, which should apply

In connection with the five major concerns, other concerns about contradictory statements in basic data and lack of analysis of the data available are also discussed.

Critical Concern Number 1

DRPI's Permit Modification Application inappropriately relies upon fifteen (15) year old data, does not present what is required by the DRGSW, and does not analyze the consequences of granting what DRPI requests today.

The DPRI Permit Modification Application HRA is based on a 2004 (Revised 2005) report by Blazosky Associates, Inc. and "summary tables for historical groundwater elevation and quality data from 1995 through 2017 from the DRPI Industrial Waste Landfill 2017 Annual Report prepared by Taylor Geoservices on February 28, 2018...." Current groundwater contour maps from the 2017 Annual Report (Taylor, 2018) are also included in Attachment VII-11.

In my opinion, the 15-year-old report upon which DRPI relies – without any updated analysis – does not show current conditions at the site and is not adequate to meet the requirements of Section 4.2.1.5. Similarly, DRPI presented more recent data, but with no analysis of what the new information means. There is a requirement for a series of test borings and wells, constructed to a depth and in a number sufficient to meet requirements of Section 4.2.1.5. No additional borings were conducted in connection with the current application, which was filed in 2018. The 2004 report only included three new borings converted into three wells. Other wells were removed with the expansion of Cell 6.

The focus of the HAR, as stated in the title of the report, is the "Proposed Disposal Cell 6 Expansion." This hydrogeological analysis is not specifically reviewing the current proposed project, a Permit Modification for Vertical Expansion. Use of a report not specifically addressing the permit modification application, in my opinion, is not appropriate. A professional geologist report that focused on one previous specific permit

modification should not be represented as a comprehensive report on a different, much larger permit modification. A focused hydrogeological analysis of all cells and areas where new wastes are being placed is required by Section 4.2.1.5.

A new analysis of the data should include the following:

- Review of the 2004/2005 report with respect to new technologies and investigation techniques
- Analysis of the new water quality data from 2004 to 2018 (14 years of data)
- Analysis of the new water elevation data from 2004 to 2018 (14 years of data)
- Review of projected impacts on newly covered Cells 1, 2 and 3 and detailed analysis of underlying materials, especially with respect to changing water levels in previously deposited waste
- Review of potential impacts of covering the Petrillo Landfill on the old wastes and water level in that waste
- New engineering data that overlaps with hydrogeological data

Review of the new data through the use of new technologies and improved investigation methodologies would compensate for inadequacies in the 2004 report. This report details some of the inadequacies that have been identified, to date.

It should be noted that this review is limited to reports prepared for the recent application as supplied by DNREC. The 2004 Blazosky HAR attached to DRPI's application identifies older reports that Blazosky relied upon for its analysis. These reports have not been provided by DRPI or DNREC, and therefore I have not reviewed them as of the date of these comments. Review and analysis of these reports may impact conclusions reached in this report.

Critical Concern Number 2

DRPI's Permit Modification Application incorrectly assumes that no valuable aquifer will be impacted if the modification is granted, and therefore does not present sufficient information from which to determine what must be done to protect the groundwater. Moreover, the application's own data is inconsistent with itself.

The Engineering Report (Part VI) in DRPI's application, ***citing the Delaware solid waste regulations that were in effect in 2004***, notes specific siting requirements within DRGSW 6.1.3. Specifically, the application repeats the hydrogeologic requirements in in superseded Section 6.1.3(f), which formerly provided:

> No new well shall be located in areas where valuable aquifers would be threatened by continuous releases, unless viable alternatives have been dismissed and stringent design measures have been incorporated to minimize the possibility and magnitude of releases.

The current regulation, which has revised text, is codified as DRGSW § 6.1.3.9. DRPI's response to this siting requirement (page VI-6 Engineering Report) is as follows:

> As described in the Hydrogeological Assessment, the aquifer underlying the DRPI Landfill is not classified as a valuable aquifer.

First, a statement on the classification of the Upper Potomac as a valuable aquifer (or not a valuable aquifer) could not be located in the Hydrogeological Assessment.

Second, multiple critical well fields owned and operated by Artesian Water Company, Inc. are directly down dip of the DRPI landfill in the Upper Potomac aquifer.

Background data on the Upper Potomac aquifer are required. The Upper Potomac aquifer is the critical water supply aquifer for the northern New Castle County Artesian distribution system. Four well fields (Collins Park, Castle Hills, Wilmington Manor Gardens and Jefferson Farms) are all located within 2 miles of DRPI Landfill. The Upper Potomac aquifer is a mapped geologic unit that extends from the DRPI Landfill to these Artesian Wellsfields southeast to south of the landfill site.

The nature and extent of the Potomac aquifer system has been the subject of Delaware Geological Survey (DGS) mapping in New Castle County. Specifically, the Hydrogeologic Map Series 3 report by Woodruff (1981) addresses this area of Wilmington. Upper Potomac sands are mapable over extended distances in this region of Delaware (see attached Figure 1a and 1b from Woodruff, 1981). The maps and cross-sections illustrate an approximate top of the Upper Potomac aquifer near 0 feet mean sea level (msl) in the Minquadale area. In addition, these maps illustrate the Upper Potomac aquifer subcropping in the Minquadale area (Figure 2a and 2b). This area is an important recharge area to the Upper Potomac aquifer. The map and cross sections (Figures 1a and 1b) also illustrate the relationship of the landfill to the well fields. The

publication "Geology of the Wilmington Area, Delaware (Woodruff and Thompson (1975) illustrate the thickness of the Columbia Formation and shows rapid changes across the DRPI site. (Figure 3). The map illustrates a channel in the Columbia Formation to the southeast of the site that, in places, removed the upper Potomac confining layer (Figure 2b and 3). Basic geologic data illustrate the hydraulic connection of the Minquadale area to critical Artesian Wellfields. These basic geologic and hydrogeologic data with the relationship to public supply water wells are not presented in the HAR document.

To characterize the Upper Potomac aquifer as unimportant is simply inconsistent with the reality of its importance to all of northern New Castle County.

It should be noted that the DPRI permit modification makes no mention of the Artesian wells. The DRPI well search for the application was only ¼ mile from the site. Impact to water supply wells is specifically addressed in the Delaware regulations as follows:

> 4.1.10 Replacement of Contaminated Water Supplies
> If the Department determines, based on information obtained by or submitted to the Department or the Division of Public Health, that any drinking water supply well has become contaminated as a result of the construction or operation of a solid waste facility, the owner or operator of the facility will be required to construct and maintain, at his or her expense, a permanent alternative water supply of comparable quantity and quality to the source before it was contaminated. Such a determination will be subject to the review procedures contained in 7 Del.C. Ch. 60.

Hydrogeological Assessment Report (Blazosky Associates, Inc., 2004. Revised 2005)

Site Overview

The proposed vertical expansion of the landfill will result in compaction of underlying waste. The possible new releases of chemical compounds in old, largely undocumented wastes has not been addressed. In addition, the history of the gravel removal operation has unresolved questions on the potential exposure of the important regional Upper Potomac aquifer, to groundwater contamination.

The first comment on the HAR report is the lack of due diligence on pre-existing site operations. The report states that DRPI has been an active landfill since approximately 1983 (Part VII – 1.0 Introduction, page 1). The statement appears to reference only the active DRPI activities since that 1983 date (cells 1 through 5). Cell 6 is covering the Petrillo Brothers, Inc. landfill. The Petrillo landfill operated from the late 1970's into the late 1980's (See Part VII – 2.0 Petrillo Site History, page 2). In addition, "two other industrial properties also exist between the DRPI and Petrillo sites." (See Part VII – 3.0 Regional and Local Setting, page 3).

One of these industrial sites is the Summit Steel Corporation. Only the removal of waste ash in the Summit Steel Corporation site was documented. There appears to be no closure or documented closure report of the steel fabrication facility and its environmental history. Numerous solvent cleaning materials and metal wastes are typically associated with historical steel fabrication operations. What remained on this site in the way of solvent wastes appears to be totally unknown. Now this site is buried under DRPI's landfill. The second industrial property is not discussed or may have been part Summit Steel, but it is neither defined nor reviewed in the HAR report.

The apparent lack of due diligence on the two industrial sites covered by waste does not meet Section 4.2.1.5 hydrogeological requirements. Specifically:

> 4.2.1.5.3 Background groundwater quality, using a minimum of eight (8) independent samples for each background and downgradient well.

Some degree of background monitoring for the industrial sites is required. However, the three wells installed for the HAR back in 2004 and existing wells at the site today are not screened at a depth and location to definitively show that the current monitoring wells capture the conditions from these sites.

Page 4 of 12 of the HAR report reviews historical reports on the DRPI Landfill and the Petrillo property (no mention of the other two industrial properties). The following statement is presented:

> In summary, the work documented in these reports demonstrate that unconsolidated sands, silts and clays of the Columbia and Potomac Formation underlie the proposed Cell 6 expansion area. These formations unconformably overlie the Wissahickon schist. Sands and gravels of the Colombia Formation remain in thin remnants across the Petrillo property and are absent from most of the DRPI property as a result of decades of surface mining. As documented in several above reports, the Potomac Formations consists of sands, silts and clays and is divided into two separate units, the Upper Potomac and the Lower Potomac. As described further in the following section of this summary, much of the upper unit is absent from the area of concern.

Several aspects of the foregoing quote about the site's geology require consideration.

The impact of thin remnants of Columbia aquifer is one item. As the Columbia Formation is a coarse sand and gravel often resting on very low permeability Potomac clay, these sand stringers could have enormous impact on migration of water horizontally beneath the landfill. The lack of new Colombia monitoring wells (none installed for this study) is not consistent with the Section 4.2.1.5 requirements.

There is also the statement that much of the upper Potomac unit is absent from the area of concern. Based on the fence diagram in the 2004 report, this statement appears to

be representing that the sands that create the Upper Potomac aquifer are missing, not the entire upper Potomac Formation. There are simple inconsistencies in DRPI's data and well logs that question this interpretation.

The HAR specifically provides data where the Upper Potomac sand is missing and presumed not to be continuous. One location is well MS-101(S), one of the three wells drilled for the 2004 investigation. First comment is that MW-101(S) is shown to be screened in clay on the fence diagram in the 2004 report (fence diagram within Attachment 1 hereto). However, their graphic log illustrates the well is screened in a sand at roughly 0 feet msl. This inconsistency needs explanation as it has serious implications on hydrogeologic interpretation of the site. Remember, 0 feet msl is the elevation on Figure 1b of the DGS cross sections where the Upper Potomac aquifer is located in Minquadale.

More inconsistencies in DRPI's own data can be noted on the well logs. The graphic log of MW-101(S) shows fill material resting upon stiff red clay at 8 feet in depth. However, the monitoring well descriptive (written) log describes a split spoon taken at 8 to 10 feet in depth (roughly 14 feet msl) that describes grey gravel that is referenced as fill. (Logs are in Attachment 1 hereto). The typical color and texture of the Upper Potomac Formation is grey sand with gravel. In either case, the graphic log and the descriptive log do not match. This has serious implications on the interpretation of site geology.

A second question about the MW-101(S) descriptive log is at a depth of 22 – 24 feet. The lithologic description is a "fine-grained clay". By definition, all clays are fine grained. Looking at blow counts and sample recovery, a more likely material is "fine grained sand". The noted elevation of the "fine grained clay" is just above 0 feet msl, the expected elevation of the Upper Potomac aquifer. As stated above, the fence diagram does show the screened interval of MW-101(S) as a clay zone, not an aquifer. But Well MW-101(S) is screened in an aquifer zone. Again, questionable basic data in well logs has serious implications on the conclusions of the report.

Another significant disparity between descriptive logs and graphic logs is illustrated by comparison of MW-101(S) and MW-101(D). MW101(S) illustrates and describes a gray sand from 32 to 39 feet deep. The immediately adjacent well MW-101(D) descriptive log only notes a sand lens at 28.5 feet deep. Lenses are typically a zone of material a few inches thick. These two wells are very close to one another, based on survey coordinates shown, yet the logs have very different descriptions.

Similar descriptive and graphic log inconsistencies can also be shown on MW-102(S). The descriptive log states 0 to 38 feet is wood, concrete and clay fill. However, the graphic log shows fill to a depth of only 34 feet and a second unit of mottled gray clay from 34 to 38 feet. Further, the descriptive log is blank from 38 to 45 feet while the graphic log shows a tan silty sand. The top of the tan silty sand is 20 feet msl, 20 feet above the mapped top of the Upper Potomac aquifer. Is this a second sand zone of the upper Potomac unit? Interestingly, the gray gravel noted in MW-101(S) is also nearly at this same elevation. Do these units correlate? Do these data indicate the removal of

Potomac sands by the quarry operation? These disparities between the graphic and descriptive logs are a significant problem for appropriate hydrogeologic assessment as the nature and extent of aquifers and confining units are not properly described.

Even more confusing is the notation on the fence diagram of a "lower" Upper Potomac sand unit at well MW-102(S). This implies that the sand and gravel unit, as shown, is an upper Upper Potomac aquifer. The fence diagram shows this upper Upper Potomac sand coming to grade in an area of fill. This strongly implies that the upper Upper Potomac sand was excavated with the Columbia sands and gravels. This was not discussed in site background that Potomac sands were removed.

A significant question is brought up by these data: Did the quarry excavation remove Upper Potomac sand and gravel where available? Also, was the upper Upper Potomac aquifer quarried out where the erosional channel of the Columbia Formation, discussed above, removed the Potomac confining clay? The report says only Columbia materials were removed by quarry operations. The data presented in the 2004 report and fence diagram questions this assumption. The data and interpretations presented in the HAR does not address this question, let alone try to answer it. Potential removal of Potomac sand and gravel is discussed below with a discussion on the Army Creek and Delaware Sand and Gravel operations.

In summary, questions exist on the basic geologic units that are in contact with the waste materials. Details on the depth and exposure of the upper Upper Potomac aquifer is questionable. These Upper Potomac sands create the aquifer system Artesian uses in this region of Delaware. Again, DRGSW § 6.1.3.9, addressing siting requirements, has a specific statement on siting landfills in valuable aquifers as follows:

> No new cell of industrial landfill shall be located in an area such that solid waste would at any time be deposited: In areas where valuable aquifers would be threatened by contaminant releases, unless viable alternatives have been dismissed and stringent design measures have been incorporated to minimize the possibility and magnitude of releases.

Critical Concern Number 3

The site history for the Minquadale landfill is strikingly similar to the history of the Army Creek and Delaware Sand and Gravel Superfund sites, where the Columbia was excavated and industrial waste was placed on the Upper Potomac Formation. The U.S. Environmental Protection Agency has determined that contaminant releases from the latter sites have reached Artesian wellfields nearly a mile away.

Site History

The timing and history of the landfill operation must be placed into perspective with other landfills in northern New Castle County. One of these quarries was the Army Creek site. This quarry was filled (uncontrolled) from 1960 to 1968 with two million cubic yards of industrial & municipal wastes. (Five-Year Review Report for Army Creek Landfill Superfund Site, New Castle County, Delaware, September 8, 2014, at p.11.)

Immediately adjacent to Army Creek was the Delaware Sand & Gravel (DS&G) quarry. DS&G was filled from 1968 to 1976 with 550,000 cubic yards and 13,000 chemical drums. (Five-Year Review Report for Delaware Sand & Gravel Landfill Superfund Site, New Castle County, Delaware, August 28, 2015, at p.17.)

Both of these sites quarried Columbia sands and gravels where Upper Potomac sands are found very close to and at the base of the Columbia Formation. Both of these sites have impacted the Upper Potomac aquifer and have resulted in contamination of the Artesian Llangollen Wellfield. This is particularly striking as the Llangollen Wellfield is approximately three-quarters of a mile from the Army Creek and DS&G sites, whereas DRPI only undertook a quarter-mile assessment for its application. (Amendment No. 2 to the 1988 Record of Decision for the Delaware Sand & Gravel Landfill Superfund Site, New Castle County, Delaware, December 2017, at page 2-1.) The U.S. Environmental Protection Agency (EPA), through a process that involves DNREC, has received such clear evidence that the wellfield is being impacted by those landfills that in 2017 the EPA amended the Record of Decision for Delaware Sand and Gravel to expressly state that Artesian's removal of contaminants at its wellfield officially constitutes remediation of landfill's contaminant release. (Amendment No. 2 to the 1988 Record of Decision for the Delaware Sand & Gravel Landfill Superfund Site, New Castle County, Delaware, December 2017, at pp.2-38 to 2-39.)

The result of the excavation of the Columbia Formation at Army Creek and DS&G, followed by placement of industrial waste, was introduction of contamination into the Upper Potomac aquifer. Multiple and expensive water treatment systems have been installed at Llangollen to remove the contaminants and assure the drinking water meets all public drinking water quality standards. Both Army Creek and DS&G have been designated as Superfund sites. It is interesting to note that the Upper Potomac aquifer is divided into an upper Upper and a lower Upper Potomac aquifer at the Llangollen site.

The DRPI Landfill essentially started in the same manner as Army Creek and DS&G. The site was a sand and gravel quarry reported from the late 1940's into the 1950's. The Petrillo Landfill, which eventually was covered by Cell 6, commenced in the late 1970s. It must be noted that the Petrillo Landfill filling was begun at roughly the same time as DS&G was filled and stopped receiving wastes.

The unlined DRPI Cell 1 was first created circa 1983. However, a layer up to 30 feet thick of "Concrete rubble/debris" (Part VI-C, JCA engineering soil report, 1994) reportedly partially filled the areas of proposed Cells 1 and 2. Cross sections from the JCA report are attached to illustrate the location and thickness of the wastes (Attachment 2 hereto). The HAR (Blazosky, 2005) states active landfilling started around 1983 or maybe earlier. More detail on this pre-1983 waste is required. In addition, Landfill Gas System Details II by Golder (DRPI Part VI – A to D35) also shows that the Petrillo Landfill has waste thicknesses on the order of 30 feet (Attachment 2).

Three significant questions arise from these data:

- Is this Cell 1 and 2 pre-construction fill material the same type of waste that went to Army Creek and DS&G?
- Cross sections show waste was removed from Cells 1 and 2 at DRPI, but where did this waste go and what types of waste were taken and remain?
- Is the Petrillo Landfill filled with the same type of waste that went to Army Creek and DS&G?

An updated hydrogeologic assessment should have been conducted in connection with DRPI's current application that answer these questions.

Critical Concern Number 4

DRPI's monitoring wells do not account for the complex geology of the site and produce unreliable data. The data in DRPI's application does not support the conclusions presented in it with respect to groundwater.

Additional Site Characterization Data

The JCA (1994) report included in the Engineering Report presents results of drilling at the site. JCA installed eight (8) test borings, but many were moved as augers failed to penetrate debris. The borings include standard penetration tests (SPT) using split spoon samplers and sieve analysis.

JCA divided the material encountered into three groups referenced as stratums. Stratum 1 was further divided into three sub-stratums as follows:

- 1A debris material layer up to 30+ feet
- 1B interbedded clayey/silty/gravelly sand and some silty clay
- 1C organic rich silt and clay with peat moss (Not sampled by JCA)

Stratum 2 was gray/tan/and brown silty sandy clay with some zones of silty sand and sandy silt. The unit had low to medium plasticity. The unit was found at elevations of 0 to -10 feet msl, similar to the elevation noted for the Upper Potomac aquifer.

Stratum 3 was a red-tan clay/plastic stiff clay of the upper Potomac confining layer.

It should be noted that layer 1C was an organic material and was not characterized by JCA for landfill design parameters. This may have engineering implications for landfill compaction issues to be reviewed by engineers at Duffield Associates.

Some geologic data within the JCA report are important to note. First, Borings 7 and 8 show significant sand units 5 to 12 feet below grade (Unit 1B) that are close to the ground surface. The statement is included in the JCA report (Section 7.1) that "the Potomac is exposed at the ground surface". Also in that section is the statement: "The clay deposits are laterally discontinuous and are reported to increase in frequency downdip." Section 7.3 presents a summary of groundwater conditions that is also critical (emphasis added):

> Groundwater at the site was encountered in Test Borings B3, B5, B7 and B8 and varied significantly in depth ranging from twelve to twenty-five feet below grade. Based on our samples and the review of existing data/reports, **there are interconnected layers of sand that provide conduits for the subsurface water to travel**.

The variation in texture (grain size) and the groundwater conditions described in the JCA report illustrate a complexity to the site geology not detailed in the HAR in 2004/2005. In fact, the preface to Appendix VI-C "Soil Characterization Summary" of the HAR presents

a statement that is almost the opposite of what JCA concluded – that "soil stratigraphy is consistent throughout the DRPI Landfill property."

To illustrate the actual complexity, attached to DRPI's application Appendix VI-C were GeoSyntec Consultants cross sections. The exact reference is unclear and better copies of these documents could not be located on the DNREC web-page for this proceeding. However, these copies are attached to these comments. (Attachment 2). **It is absolutely critical to note the complex geology and highly variable depth of the wells shown in the sections.** The varying depths, lengths and placement of the wells' screens makes contouring of ground water elevations almost meaningless. This is discussed further below.

Section 6.4 of the HAR provides a small discussion of some of the complexities. Shallow well 101(S) was noted to have a water level closer to the Lower Potomac, although screened in the Upper Potomac aquifer. Complications with well screening depths are noted for this well. The following statement from Section 6.4 is provided below (emphasis added):

> The groundwater level at Well MW-101(S) was also found to be somewhat inconsistent with the shallow flow zone. As seen in Table 1, the groundwater levels in MW-101(S) are at elevations ranging between 5.76 feet msl to 8.27 feet msl. In comparison, groundwater levels at the nearby gas monitoring probe GP5-2 range from 15.72 feet msl and 17.52 feet msl. Historic groundwater elevations in the previously existing well MW-4(S), which was located just to the north of GP5-2, were also more similar to those observed in GP5-2 (around 20 ft msl). **The difference in the groundwater elevations between wells MW-101(S), and GP5-2 and the old MW-4(S) are attributed to well MW-101(S) being screened at a greater depth (28 to 39 feet) than GP5-2 (5 ft to 23 ft) and MW-4(S) (9 to 14 feet). Additionally, well MW-101(S) is also screened within a sandy layer that was not encountered in GP5-2 and MW-4(S).**

Well Construction Review

Complex stratigraphy is not the only item that obscures analysis of DRPI's hydrogeologic data. Well construction can also impact water level data and water quality samples obtained for hydrogeologic analyses. Several well installation issues were identified in the reports.

Well MW-1(S) is the first example. Page 12 of 22 in the HAR states:

> Although partially screened through a thin remnant zone of the overlying Columbia Formation sands, well MW-1(S) is representative of the shallow Potomac Aquifer.

Appropriate monitoring wells have relatively short screens (5 feet best) placed definitively into one sand unit. Any well screened into the gravel of the Columbia Formation cannot be strictly representative of one unit. Screening two units for monitoring does not conform to industry standards.

Another example is well MW-2(D). Page 12 of 22 in the HAR states:

> Also, well MW-2(D) is screened to the base of the Upper Potomac Formation but has a borehole sandpack that extends beneath the bottom of the screen down into the Lower Potomac Formation.

This well, besides not conforming to industry standards, **violates DNREC well drilling regulations** by interconnecting two separate aquifer units. The zone between the Lower and Upper Potomac Formation should have been grouted shut. This well should have been abandoned and replaced immediately upon analysis of the well construction. DRPI's HAR indicates that a conduit between the Upper Potomac and Lower Potomac has been created.

Other well completion records (see the application's Compliance and Groundwater monitoring well completion reports) show construction items that call into question the data obtained from these wells. The most significant issue is the large lengths of screens, up to 20 feet in length, potentially interconnecting adjacent sand units. Typical industry standard screen lengths should be limited to 5 feet and up to 10 feet across the water table.

Groundwater Elevation Analysis

Review of the hydrogeological report to this point has questioned the basic installation of the wells and data derived from these wells. The groundwater elevation and flow direction maps also have questionable interpretations that need review.

Groundwater elevation and flow direction maps were presented for the Shallow Zone and Deep Zone in the HAR. Page 3 of 22, referencing the Delaware and Christina Rivers as two points, states:

> Based on topography of the site and observed groundwater flow directions within the upper most flow zone, shallow groundwater and surface water ultimately discharge to these two points.

That is not what the shallow flow map shows (Map included in Appendix 1). Most of the shallow ground water flow is into a 0-foot closed contour interval around Cells 4 and 5. The measured ground water elevations range from 6 to 36 feet msl in the Upper Potomac Formation. No monitoring well indicates water elevations near 0 feet msl. Much more groundwater elevation data are needed to justify a 0-foot closed contour area of this size. First, the 0-foot contour is extensive, requiring an extremely high transmissive zone to maintain a no flow gradient over an area this size. The closed contour indicates all flow

into that area. Water must removed by some mechanism. Alternatively, it could be flowing into the Upper Potomac Aquifer. It should be noted that the 0-foot ground water elevation matches the DGS elevation of the Upper Potomac aquifer beneath the DRPI site.

The Engineering Report in the application, specifically Part V Operation and Maintenance Plan, provides some minimal data on a groundwater underflow layer beneath Cells 4 and 5. Section 3.10.1 presents the following:

> A groundwater control system has been constructed underneath the liner in Cells 4 and 5 in order to maintain groundwater levels below the landfill liner and subgrade elevation (**Drawing 8**). This system, which is shown on the Permit Drawings, consists of a 6-in. sand drainage blanket that discharges into collection trenches that flow to sumps along the perimeter of Cells 4 and 5. From these sumps, a submersible pump removes the collected groundwater. A portion of the groundwater underdrains discharge into perimeter drainage channels that convey flow to the stormwater management ponds, and a portion discharge to the leachate force main.
>
> In addition, a groundwater interceptor trench was constructed along the eastern limit of Cell 5 to collect potentially contaminated groundwater from a toe drain on the western edge of Cells 1 through 3 (which are unlined) at the DRPI Landfill. Liquids collected in the groundwater interceptor trench are managed as leachate in the leachate management system described above. In 2007, a groundwater interceptor trench and barrier wall were approved for installation along the eastern border of Cell 4B, the eastern and southern border of Cells 1-3 and along the southern border of Cell 5E. The intent of the trench is to reduce groundwater flow beneath Cells 1 through 5 and reduce the amount of pumping at other facility drains. The drain will consist of approximately 4,000 feet of 12 inch diameter perforated pipe placed in an aggregate filled trench. The drain line elevation will drop from approximately 23' MSL at its highest point to approximately 13' MSL at the discharge point near the southwest corner of Cell 5E. A barrier wall measuring approximately 1,000 feet will be installed in conjunction with the trench along the east side of Cell 4B and Cell 3. The first phase of interceptor trench measuring approximately 1,500 feet was built in 2007 from the outfall to a point east of the Cell 6-1A construction limits.
>
> The second phase of interceptor trench measuring an additional 1,500 feet was constructed in 2012 from the tie-in of the first phase to the eastern corner of Cell 1. The third phase will be constructed at the time of landfill closure. The outfall is sampled in accordance with the requirements identified in the current Solid Waste Facility Permit.

Data measuring a 0-foot control elevation of ground water in the under drain and sumps were not located in the application's materials. The lowest groundwater elevation on the

map is at C5-W2S; 6.77 feet msl. A 6-inch sand blanket is cited as the control mechanism. In general, a 6-inch sand blanket does not have the hydraulic conductivity to justify a large area of no flow gradient. There is just no supporting data to justify the extensive 0-foot msl contour shown on the shallow zone water level map.

In addition, groundwater flow rates and quality data for these discharges were not located in the DNREC supplied files. References indicate sampling is conducted. Water quality data would certainly illustrate the source of water to the sump. The volume of discharge would also illustrate the extent of groundwater entering the sumps.

Five-foot Groundwater Separation Requirement

As detailed above, the monitoring wells have been located at various depths in potentially different sand zones within both the Upper Potomac and Lower Potomac Formations. The complex stratigraphy impacts interpretations of water elevation data. The Section 3.10.1 presented above indicates potential issues with the elevation of groundwater relative to the liner elevations. Many of the older monitoring wells have long screen intervals complicating water level data. There does not appear to be any piezometers dedicated to evaluating the separation of seasonal high groundwater and the landfill liners. DRPI's current permit requires a five-foot separation.

A total review of liner and ground water separation distances is recommended. DRPI anticipates that granting its requested permit modification will result in up to 6.1' of compaction in lower materials. (Application Volume 2 pages VI-15 to VI-16). DRPI, however, presents no analysis of what that compaction of waste and soils will cause with respect to ground water elevations. Of particular concern is whether ground water elevations will reach the unlined waste in Cells 1, 2 and 3 given the additional 60' of waste (and attendant weight) that DRPI proposes. Finally, it is imperative to determine the ground water elevation in the Petrillo wastes buried **under** Cell 6.

All these questions and reviews should be required prior to approval of the Permit Modification.

Critical Concern Number 5

The monitoring wells at the Minquadale landfill are not testing for everything they should given the waste at the site appears to be in contact with the Upper Potomac aquifer, which is a major source of public drinking water.

Aquifer Testing Results

The HAR section of DRPI's application includes a section on Aquifer Testing. DRPI's aquifer testing consisted of single well pumping and slug testing on 6 wells. The tests were for expansion of Cell 6, rather than conditions for the entire landfill site. These tests will typically underestimate the hydraulic conductivity of the aquifer by their very nature. A true "aquifer" test requires observation wells to measure aquifer response away from the pumping well. Observation wells are the industry standard for aquifer testing. Otherwise, it is just a well test. Therefore, DRPI's methodology for testing the aquifer was substandard from the outset.

Two wells tested essentially had no change in depth to water. One well was MW-1S. The well log of MW-1S had no descriptive log, but was "partially screened through a thin remnant zone of overlying Columbia Formation." No drawdown when pumping this well at the very low rates used (just 2 gpm) is almost the expected result as the screen intercepts the extremely transmissive Columbia Formation.

Well MW-2(D) was also used for testing. I discussed this well above because it improperly interconnects the Upper and Lower Potomac aquifers. It should not have been considered for testing.

In two monitoring wells, response was so slow as to make aquifer testing unfeasible. Wells P-1(S) and P-3R(S) were cited with slow response. The following statement is presented:

> A review of water level measurements collected from these two piezometers on March 4, 2002 showed a return of the water levels to near historic static conditions as measured in January and February.

The testing was on February 11 and 12, 2004. Wells within an aquifer system should recover within hours from a few hours of pumping, not months. The geologic fence diagram shows monitor wells screened in clay. If wells are screened in Potomac clay, then water levels could take a month to recover. If monitoring wells are screened within aquifer material and do not respond to pumping, the data obtained from these wells is not "representative" of aquifer materials. Again, full review of every site monitoring well is mandatory to see if the wells meet industry standards.

The "aquifer test" results must be further evaluated. The results are highly variable, probably as a consequence of well construction, not aquifer hydraulics. In addition, the report specifically states there were no measurable connections between wells or

aquifers. The HAR does not present data to support the "no measurable connections" statement. Instead, plots of the time versus drawdown data do indicate vertical leakage. Vertical leakage is indicated when the rate of water level change declines. Vertical leakage indicates hydraulic connections between various units. Alternatively, the vertical leakage could be a response from water entering the well from gravel pack dewatering. DRPI's results are uncertain.

Water Quality Results

Only a brief statement on water quality is presented. The Landfill monitoring basically only evaluates indicator parameters for landfill leachate impacts. Even in the limited data presented, however, elevated iron and manganese concentrations, and elevated specific conductance, all indicate leachate impact to groundwater. Multiple wells display impact.

More troubling is the discharge of groundwater into the leachate collection system. Water quality of that water should have been detailed.

Multiple wells and the ground water collected into the leachate system should be evaluated for Primary and Secondary drinking water standards and the USEPA proposed Unregulated Contaminant Monitoring Rule lists. The DRGSW give DNREC the discretion to require any testing parameters that it deems appropriate. (DRGSW § 6.7.3.2.1.) Given the information in DRPI's own application that industrial waste is in contact with the Upper Potomac Formation, which is a major source of public drinking water, it is appropriate to determine whether any drinking water constituents of concern are reaching the aquifer at the site.

Conclusion

In summary, our opinion is the HAR upon which DRPI relies for its requested major modification of its permit does not meet the requirements of Section 4.2.1.5. First and foremost, the report dates to 2004 and was focused on only the Cell 6 expansion, not the current project. *This fact alone should require a totally new HAR be conducted for the site prior to approval of the Proposed Permit Modification.* Review of each requirement of 4.2.1.5 illustrates other significant shortcomings, which would have to be addressed in a revised HAR as follows:

4.2.1.5.1 The occurrence and characteristics of the unconfined and first confined aquifers

The monitoring well construction and site stratigraphy is confusing at best and the unconfined and first aquifer are not completely delineated. Further refinements of the number and locations of individual sands and delineation of specific units is incomplete. A complete review of monitoring well construction is required. Wells not meeting current industry standards or DNREC regulations should be abandoned, replaced or reevaluated based on their construction.

4.2.1.5.2. Groundwater flow directions

As discussed above, a complete re-evaluation of the groundwater flow system and water elevation maps are required. Screen zones of individual wells have to be reevaluated to insure only one aquifer zone is being contoured at a time and wells screened across multiple sands are not used. The existence and extent of the 0-foot msl groundwater contour requires reevaluation as a 6-inch sand layer cannot produce the effects shown.

4.2.1.5.3 Background groundwater quality, using a minimum of eight (8) independent samples for each background and downgradient well

First, the analytical list of compounds is focused on indicator parameters only. Landfill leachate has impacted background groundwater quality. Once leachate impacts are indicated, an expanded list of chemical analysis is needed. In addition, delineation of downgradient wells are required. The shallow groundwater contour map shows the largest extent of "downgradient" is the 0-foot msl closed contour area beneath the landfill. Independent samples (8) of the groundwater being pumped from this area is required

4.2.1.5 Potential pathways of contaminants to points of groundwater discharge.

This section is completely unanswered. The HAR text states groundwater discharge is directed to the Christiana and Delaware Rivers. DRPI's groundwater contour map shows most of the water discharge going to a 0-foot msl closed contour area and being removed by pumps into the leachate collection system or stormwater system. As the groundwater contour map requires significant review to isolate individual aquifer zones, no statement on the points of groundwater discharge can be made at this time. One potential point of

discharge not discussed are the Artesian water supply wells. The Artesian wells have become the discharge point to a large percentage of flow of water in the Upper Potomac aquifer.

4.3.1.5.5 Approximate groundwater flow rates and travel times from the facility to points of discharge (including wells and/or surface waters).

The "aquifer" well tests were inadequate to evaluate the hydraulic parameters needed to calculate groundwater flow rates. The hydraulic gradients within individual sand zones have not been defined. Therefore, rates and travel times from the facility have not been defined.

4.3.1.5.6 Delineation of the anticipated maximum elevation of the seasonal high-water table

Also, this had not been delineated due to the nature and construction of the monitoring wells. Specifically, long screened wells in the shallow water zone need to be evaluated. Reevaluation of maximum elevation of seasonal high ground water is required.

References:

U. S. EPA, 2014, Five-year review report for Army Creek landfill superfund site, New Castle County, Delaware: U. S. EPA Region 3, Philadelphia, Pennsylvania,

U. S. EPA, 2015, Five-year review report for Delaware Sand and Gravel landfill superfund site, New Castle County, Delaware: U. S. EPA Region 3, Philadelphia, Pennsylvania,

Woodruff, K. D., 1981, Geohydrology of the Wilmington area, Delaware: Delaware Geological Survey, Hydrologic Map Series, No.3, Four Sheets, Maps 1:24,000 scale with discussion, Newark, Delaware

Woodruff, K. D., and Thompson, A. M., 1975, Geology of the Wilmington area, Delaware: Delaware Geological Survey, Geologic Map Series No. 4, Map, 1:24:000 scale with discussion, Newark, Delaware.

Figures 1 through 3

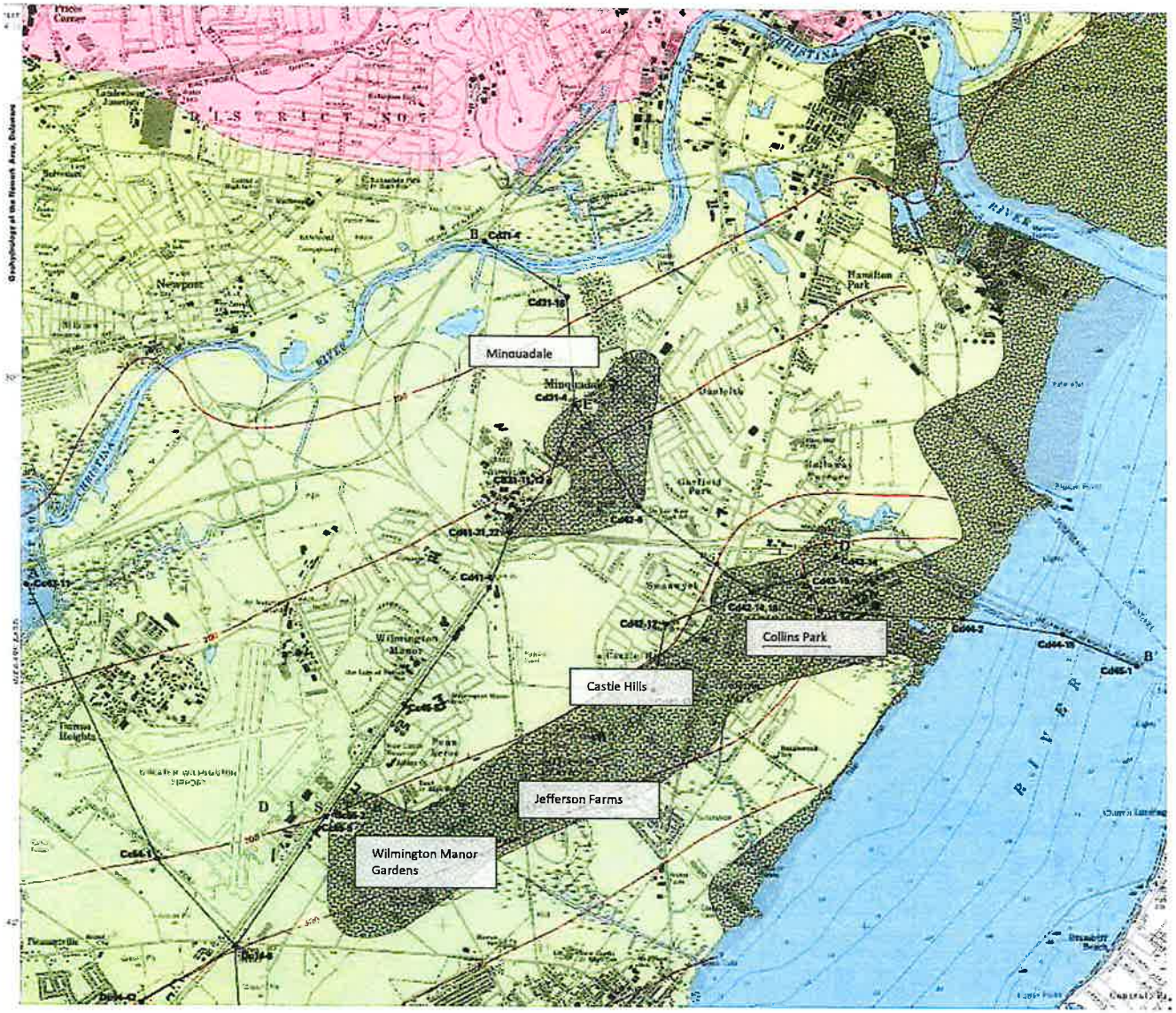


Figure 1a, Section of Hydrologic Map Series, No. 3 sheet 1 Basic Geology (Woodruff, 1981)

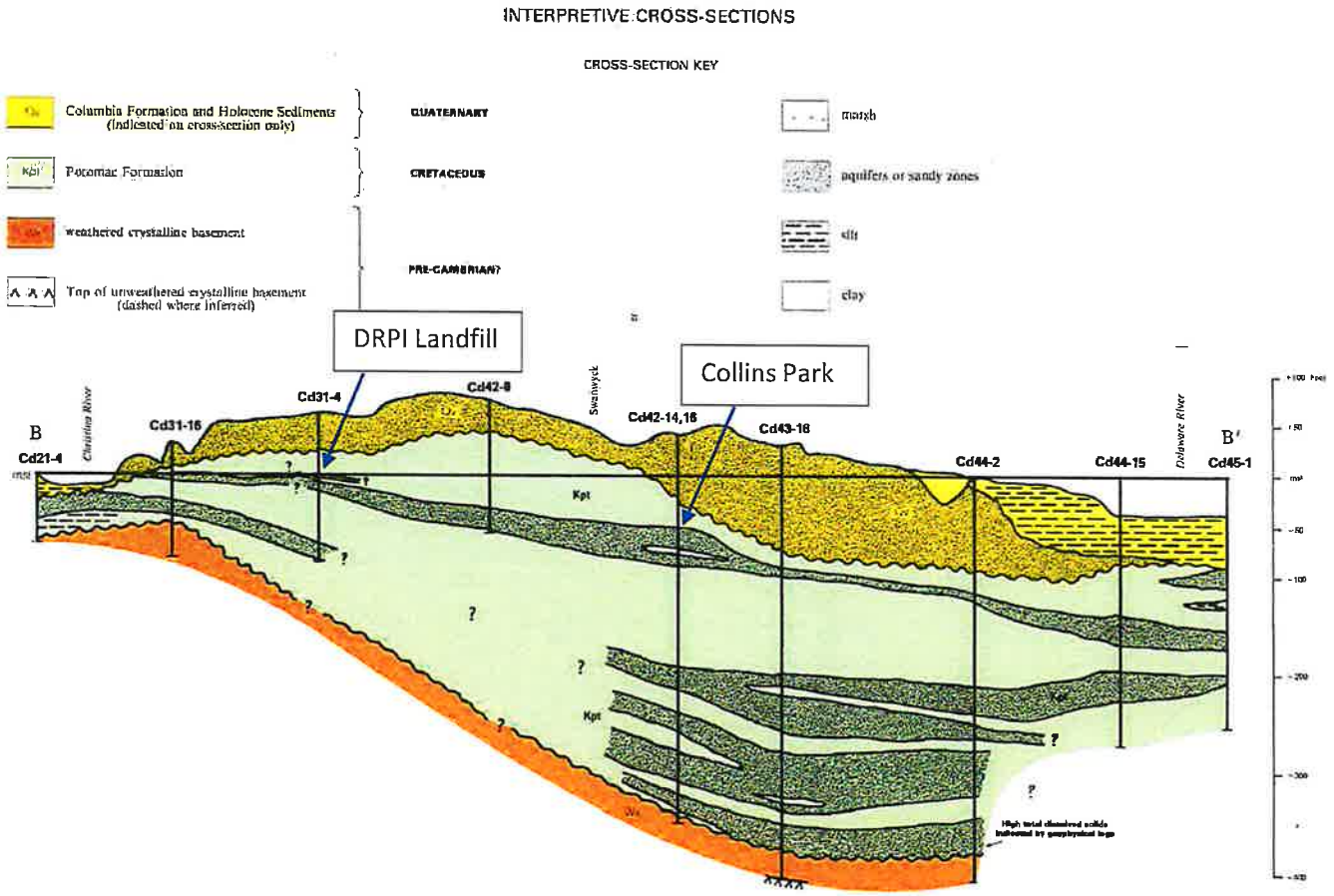
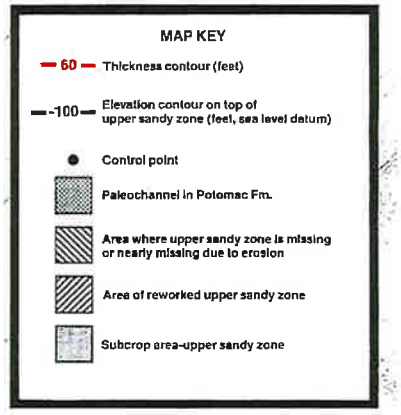


Figure 1b, Cross Section B – B' from Hydrologic Map Series, No. 3 sheet 1 Basic Geology (Woodruff, 1981)

Note: Well Cd31-4 is very close to the Minquadale Landfill and Well Cd42-4, 16 is close to the Collins Park Well Field

Figure 2a, Isopach and Thickness Map: From Hydrologic Map Series, No. 3 sheet 4 Structural Geology (Woodruff, 1981)



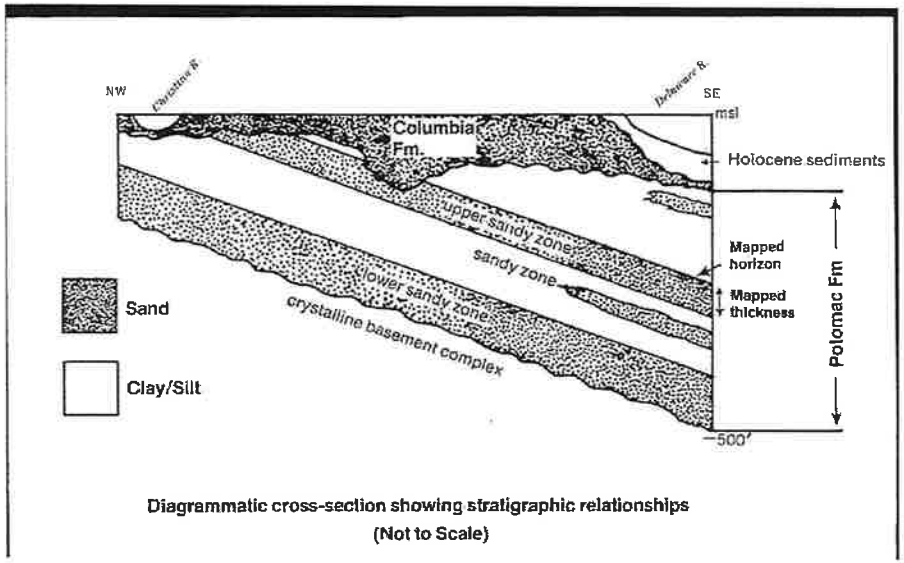


Figure 2b, Generalized Cross-section

Figure 3, isopach (Thickness) Map of the Columbia Formation

(From, Woodruff and Thompson, 1975, Geology of the Wilmington Area, Delaware)

Attachment 1

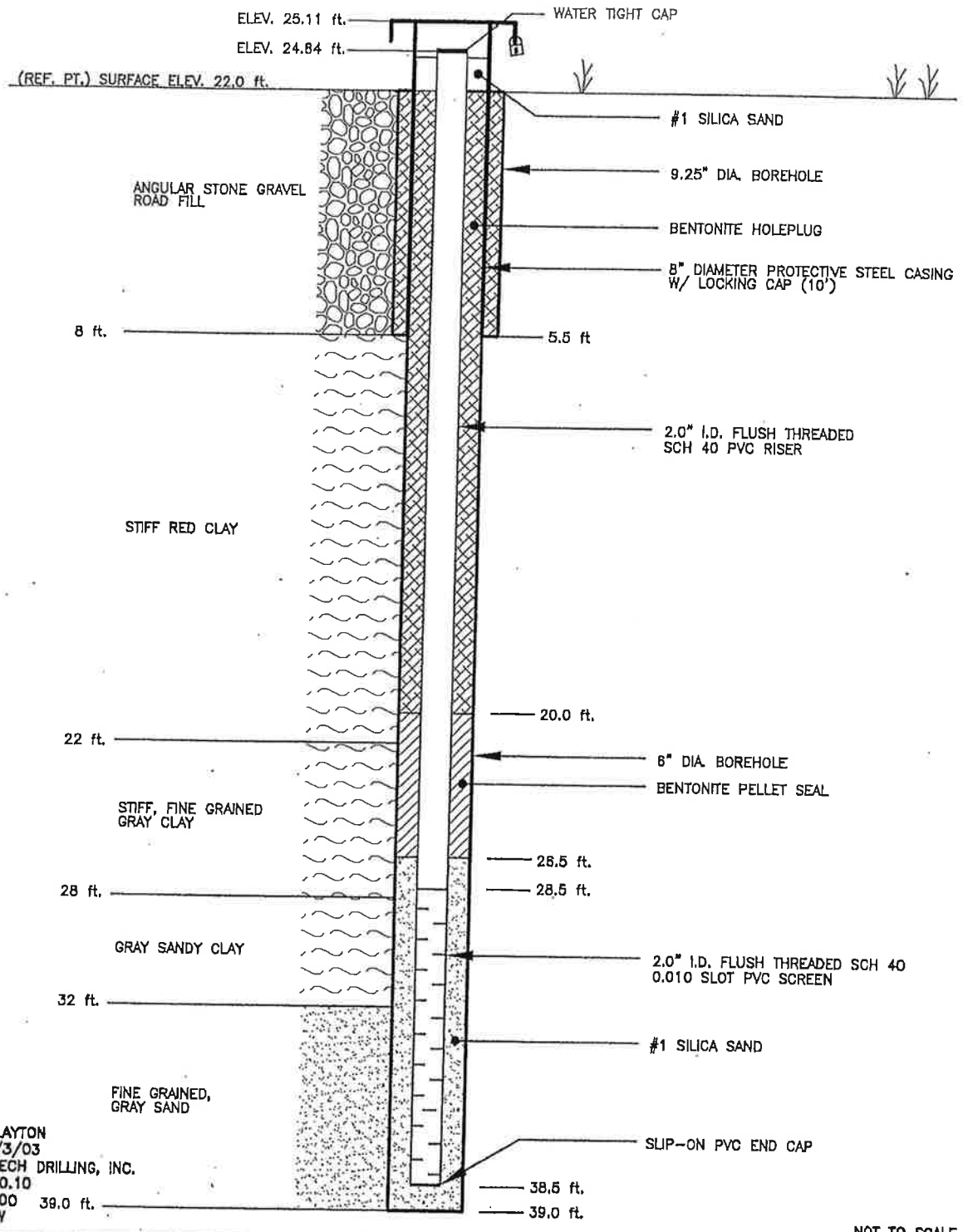
from

Hydrogeologic Assessment Report

(Well logs, Water Elevation Map, Fence diagram)

WMI-186A001

12/18/03



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EASTING: 454840.00
PERMIT #197823-W

NOT TO SCALE

BLAZOSKY Associates • INC.
Balanced Environmental Solutions

DELAWARE RECYCLABLE PRODUCTS, INC.

WASTE MANAGEMENT, INC.

MINQUADALE BOROUGH NEW CASTLE COUNTY DELAWARE

MONITORING WELL MW-101S

BALANCED ENVIRONMENTAL SOLUTIONS
State College, PA.,Telephone:814/238-2060; Delaware Valley, PA.,Telephone:610/783-0125

DELAWARE RECYCLABLE PRODUCTS, INC.
WASTE MANAGEMENT, INC.

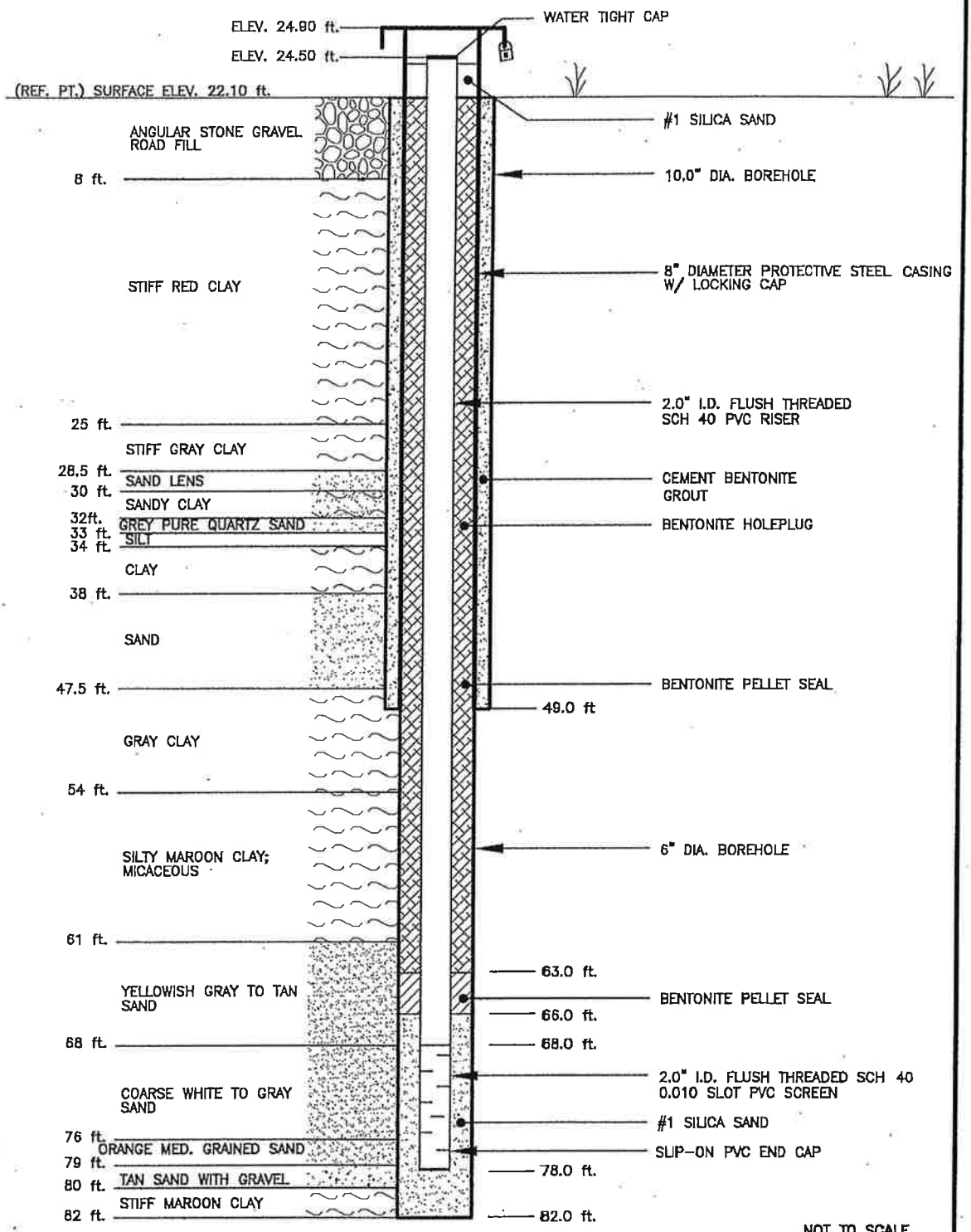
DISPOSAL CELL 6 EXPANSION

Monitoring Well
MW-101(S)

DEPTH (ft.)	DESCRIPTION	ELEV. (ft MSL)
0-2	Drilled from 0' to 2' below ground surface. Blow count 50 over 12". No recovery.	22 -20
5-7	Gravel fill material, angular stone, poorly sorted. Blow count 34 over 12". Recovery=8".	17-15
8-10	3"= light grey gravel fill 9"= dark loam fill 3"= grey clay Blow count= 4/4/6/4 (over 24"). Recovery 15".	14 - 12
12-14	Stiff red clay. Blow count 29 over 18". Recovery= 4".	10 - 8
16-18	Stiff red clay. Recovery=10".	6 - 4
22-24	Stiff grey fine-grained clay. Blow count 21 over 18". Recovery= 16".	0 - -2
28-30	Grey sandy clay. Blow Count =15/14/21 (over 18"). Recovery= 15".	-6 - -8
32-34	Grey very fine sand. Blow Count =75.	-10 - -12
34-36	Grey fine grained sand. Blow Count =100.	-12 - -14

Date Drilled: 11/25/2003
Drilled By: Uni-tech, Malaga, NJ.
Drilling Method: Mud Rotary
Total Drilled Depth: 36ft
Borehole Diameter: 0-36ft, 6-inch
Surface Elevation: 22.0 MSL
Bottom Elevation: -16 ft MSL
Grid Location: N 621740.1 E 454640.0
Logged By: E. Layton, **Blazosky Associates, Inc.**

WMI-186A002 12/18/03



NOT TO SCALE

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DRILLED BY:
UNITECH DRILLING, INC.
NORTHING: 621730.10
EASTING: 454647.50
PERMIT #197624-W

BLAZOSKY Associates INC.
Balanced Environmental Solutions

DELAWARE RECYCLABLE PRODUCTS, INC.

WASTE MANAGEMENT, INC.

MINQUADALE BOROUGH NEW CASTLE COUNTY DELAWARE

MONITORING WELL MW-101D

BALANCED ENVIRONMENTAL SOLUTIONS
State College, PA.,Telephone:814/238-2060; Delaware Valley, PA.,Telephone:610/783-0125

DELAWARE RECYCLABLE PRODUCTS, INC.
WASTE MANAGEMENT, INC.

DISPOSAL CELL 6 EXPANSION

Monitoring Well
MW-101 (D)

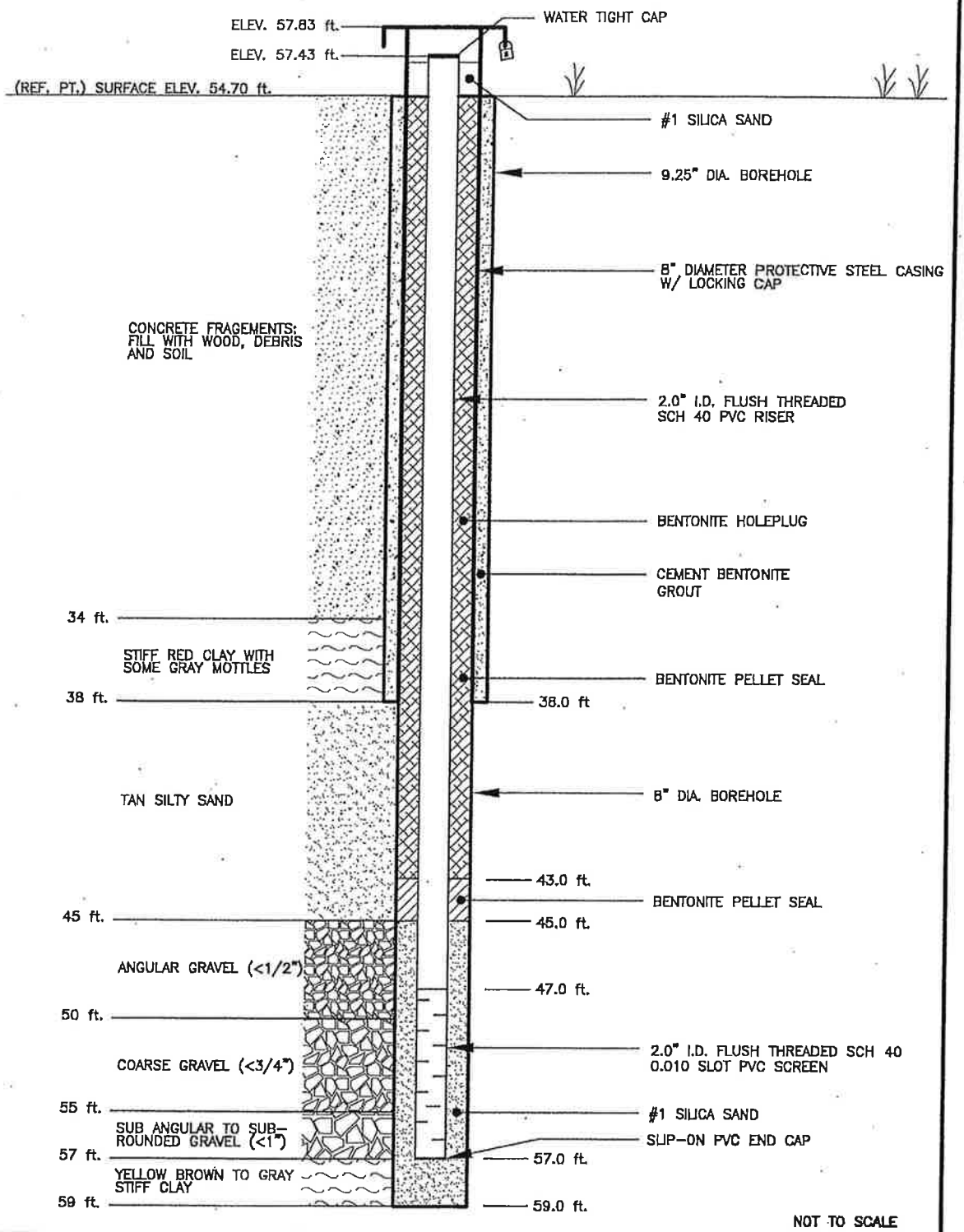
DEPTH (ft.)	DESCRIPTION	ELEV. (ft MSL)
0-25	Drilled from 0' to 25' below ground surface.	22.1 - -2.9
25-27	Stiff grey clay, moist but not saturated. Blow count=12 over 18". Recovery=16".	-2.9 - -4.9
28.5	Sand lens.	-6.4
30-32	Grey sandy clay, sand is very fine. Blow count 75 over 18". Recovery=10".	-7.9 - -9.9
32-34	3"= grey pure quartz sand well sorted. 4"= dark grey poorly sorted clay-like silt with some sand 5"= stiff gray clay Blow count 100 over 16". Recovery= 12"	-9.9 - -11.9
38-40	Grey medium sand. Blow count 100 over 15". Recovery=11".	-15.9 - -17.9
40-42	6"= grey medium to fine silty sand 1"= dark grey coarse sand 0.5"= red sand with clay 2"= yellow sand 0.5"= white sand Blow count 100 over 16". Recovery= 10".	-17.9 - -19.9
42-44	8"= reddish to pink fine to medium sand, 1" oxidized zone 3"= grey medium sand Blow count 59 over 18". Recovery= 11".	-19.9 - -21.9
44-47	Drilled through sand	-21.9 - -24.9

47.5-49.5	Stiff grey clay. Blow count 35 over 18". Recovery=11".	-25.4 - -27.4
52-54	Stiff grey clay. Blow count 24 over 12". Recovery=8".	-29.9 - -31.9
54-56	Red silty micaceous clay. Blow count 70 over 16". Recovery= 16".	-31.9 - -33.9
60-62	2"= red silty, micaceous clay 10"= yellow to tan medium grained sand, some mica and darker minerals. Blow count 40 over 12". Recovery= 12".	-37.9 - -39.9
62-64	4" layer of stiff grey clay. 12" interbedded grey and yellow medium to coarse well-sorted pure sand, grey sand layers contain some mica. Blow count 100 over 18". Recovery= 16".	-39.9 - -41.9
68-70	Coarse white sand grading down the spoon into a grey silt. Bottom of spoon exhibits a 1" coarse sand layer. Blow count 100 over 12". Recovery= 16".	-45.9 - -47.9
76-78	4"= orange medium-grained sand 6"= tan find-grained, well-sorted sand 6"= tan poorly sorted sand with gravel, gravel is angular (<1/8"), qtz fragments) Blow count 65 over 18". Recovery= 16".	-53.1 - -55.1
80-82	Stiff red clay. Recovery= 11".	-57.9 – -59.9

Date Drilled: 11/24/2003-11/25//2003
Drilled By: Uni-tech, Malaga, NJ.
Drilling Method: Mud Rotary
Total Drilled Depth: 82 ft
Borehole Diameter: 0-82 ft, 6-inch and 10-inch
Surface Elevation: 22.1 MSL
Bottom Elevation: -59.9 ft MSL
Grid Location: N 621730.1 E 454647.5
Logged By: E. Layton, **Blazosky Associates, Inc.**

WMI-186A003

12/18/03



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NORTHING: 620712.30
EASTING: 455949.70
PERMIT #197625-W

NOT TO SCALE

BLAZOSKY Associates Inc.
Balanced Environmental Solutions

DELAWARE RECYCLABLE PRODUCTS, INC.

WASTE MANAGEMENT, INC.

MINQUADALE BOROUGH NEW CASTLE COUNTY DELAWARE

MONITORING WELL MW-102S

BALANCED ENVIRONMENTAL SOLUTIONS
State College, PA.,Telephone:814/238-2060; Delaware Valley, PA.,Telephone:610/783-0125

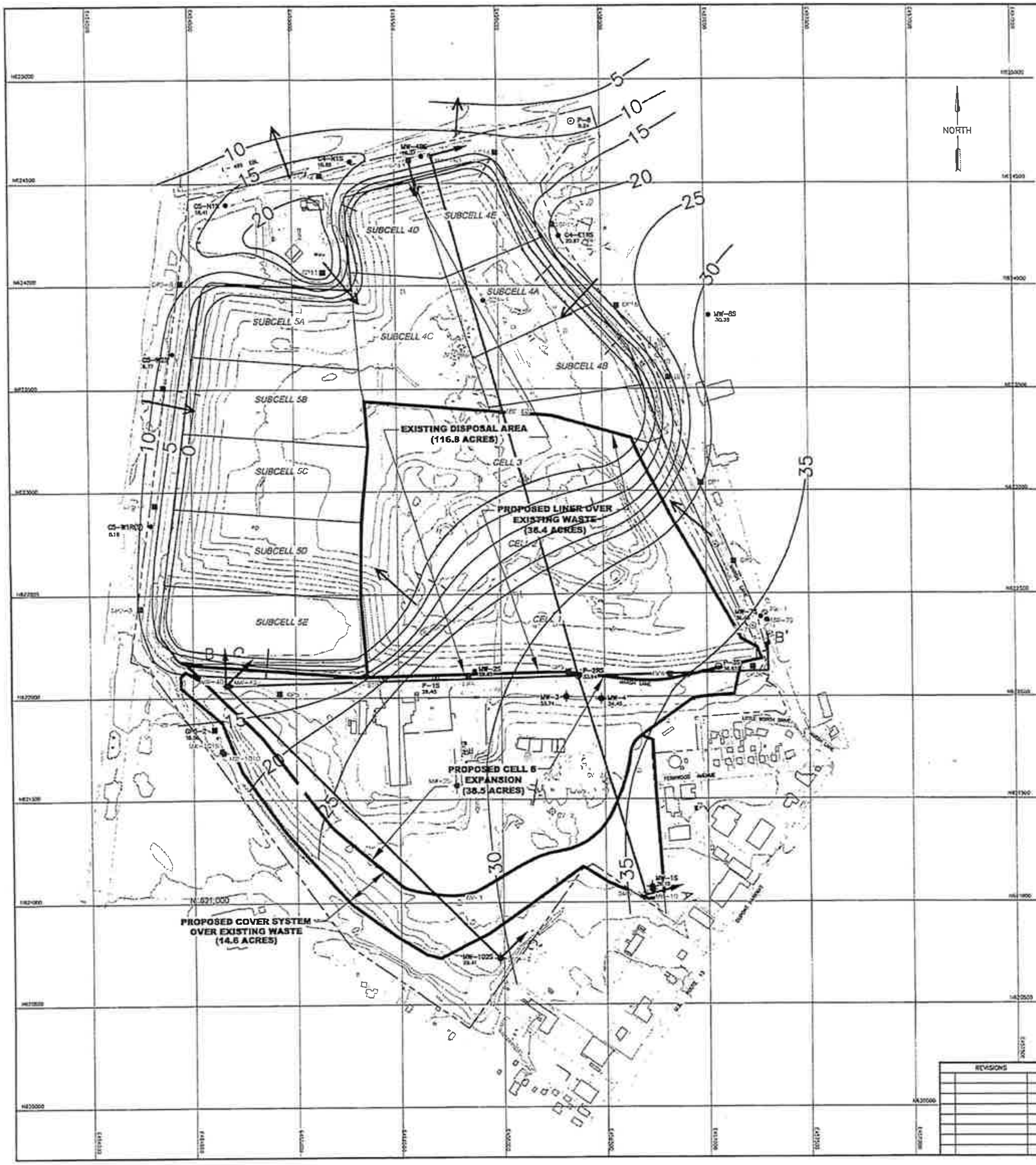
DELAWARE RECYCLABLE PRODUCTS, INC.
WASTE MANAGEMENT, INC.

DISPOSAL CELL 6 EXPANSION

Monitoring Well
MW-102(S)

DEPTH (ft.)	DESCRIPTION	ELEV. (ft MSL)
0-38	Drilled from 0' to 38' below ground surface. Encountered wood, concrete, and clay.	54.7-16.7
45-47	Coarse angular gravel. Blow count= 33/33/33/37. Recovery= 17"	9.7-7.7
50-52	Gravel- impure, poorly sorted, subangular to rounded Tan and white quartz, feldspar, green serpentine Blow count= 12/18/20/3. Recovery= 17"	4.7-2.7
55-57	Gravel- angular to subangular	-0.3 - -2.3
57-59	Tight red clay, weathered green/olive mottling; grey mottling. Recovery= 14"	-2.3 - -4.3

Date Drilled: 11/26/2003, 12/01/2003, 12/02/2003
Drilled By: Uni-tech, Maloga, NJ
Drilling Method: Mud Rotary
Total Drilled Depth: 59 ft
Borehole Diameter: 59 ft, 6-inch
Surface Elevation: 54.7 ft MSL
Bottom Elevation: -4.3 ft MSL
Grid Location: N 620712.3 E 455949.7
Logged By: E. Layton, **Blazosky Associates, Inc.**



NOTES

1. BASE MAP COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED 12-31-03 BY AIR SURVEY, DULLES, VIRGINIA.
2. HORIZONTAL GRID IS DELAWARE STATE PLANE COORDINATE SYSTEM.
3. DATUM IS N.G.V.D. 1929.
4. ONLY INSTALLATIONS IDENTIFIED IN RED WERE USED TO COMPILE THIS CONTOUR MAP.
5. WELLS MW-4S AND MW-4D LOCATED TO THE SOUTH OF CELL 5E WERE ABANDONED IN APRIL OF 2003 AS PART OF THE CELL 5E CONSTRUCTION.
6. WELL MW-8S IS LOCATED INSIDE THE CORRADO AMERICAN, INC. MAINTENANCE BUILDING AND IS FLUSH MOUNTED WITH THE CONCRETE FLOOR IN THE BUILDING.

GROUNDWATER ELEVATIONS

(4/27/04)

DRPI INSTALLATIONS

OBSERVATION POINT	GROUNDWATER ELEVATION (N.G.V.D.)	SURFACE ELEVATION	TOP OF CASING	NORTHING	EASTING
MW-2(S)	29.80	33.29	34.28	[illegible]	[illegible]
MW-4R(S)	19.37	25.79	28.33	[illegible]	[illegible]
MW-7(S)	36.40	37.07	38.24	[illegible]	[illegible]
MW-8(S)	30.38	36.51	38.28	[illegible]	[illegible]
P-1(S)	26.43	24.50	38.87	[illegible]	[illegible]
P-2R(S)	33.54	33.60	35.64	[illegible]	[illegible]
P-3(S)	39.63	40.00	42.46	[illegible]	[illegible]
P-8(S)	9.24	23.00	25.04	[illegible]	[illegible]
C4-E1R(S)	20.87	28.10	30.51	[illegible]	[illegible]
C4-N1(S)	18.86	22.00	24.70	[illegible]	[illegible]
C5-W2(S)	8.77	17.80	20.48	[illegible]	[illegible]
C5-N1(S)	16.41	29.80	32.98	[illegible]	[illegible]
C5-W1R(S)	8.18	17.48	15.74	[illegible]	[illegible]
GP5-2	16.56	18.33	21.33	[illegible]	[illegible]

PETRILLO INSTALLATIONS

OBSERVATION POINT	GROUNDWATER ELEVATION (N.G.V.D.)	SURFACE ELEVATION	TOP OF CASING	NORTHING	EASTING
MW-1(S)	36.15	61.80	63.83	[illegible]	[illegible]
MW-3	33.74	35.50	38.14	[illegible]	[illegible]
MW-4	34.45	27.30	39.79	[illegible]	[illegible]
MW-1025	38.41	34.70	37.42	[illegible]	[illegible]

LEGEND

- PROPERTY BOUNDARY
- EXISTING CONTOUR (C.I.=10')
- EXISTING FENCE
- EXISTING ROADWAY
- 35 GROUNDWATER CONTOUR (C.I.=5')
- PIEZOMETER (DRPI)
- SHALLOW ZONE MONITORING WELL (DRPI)
- GAS MONITORING PROBE (DRPI)
- DEEP ZONE MONITORING WELL (DRPI)
- PETRILLO PIEZOMETER/WELL
- PETRILLO MONITORING WELL
- PETRILLO GAS MONITORING PROBE

GRAPHIC SCALE

(IN FEET)
1 inch = 200 ft.

WASTE MANAGEMENT

REVISIONS

BLAZOSKY ASSOCIATES INC.

DELAWARE RECYCLABLE PRODUCTS, INC.

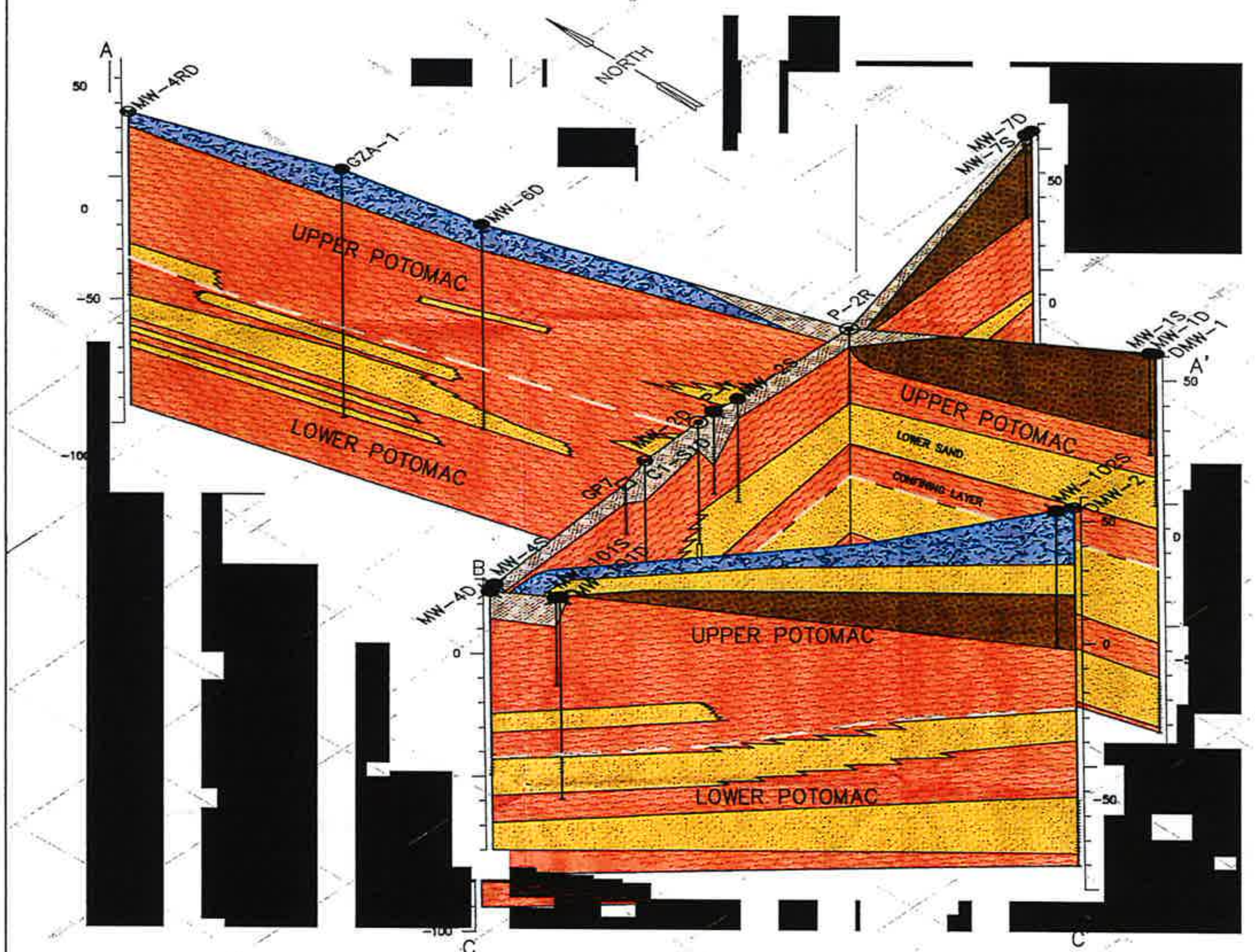
DRPI INDUSTRIAL WASTE LANDFILL
CELL 6 EXPANSION AREA

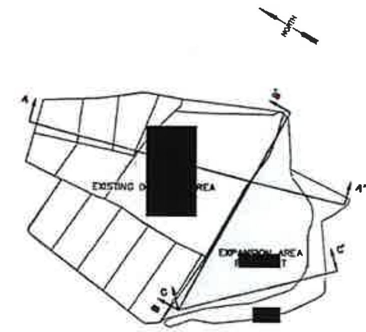
NEW CASTLE COUNTY — DELAWARE

SHALLOW-ZONE GROUNDWATER CONTOUR MAP
APRIL 27, 2004

BALANCED ENVIRONMENTAL SOLUTIONS

DATE: 2/18/04
DRAWN BY: DA
CHECKED: EJL
BAI DRAWING NO: WM-188E003
SHEET NO: 1 OF 3





CROSS SECTION LOCATION KEY

1" = 800'

NOTES

1. HORIZONTAL GRID IS DELAWARE STATE PLANE COORDINATE SYSTEM.
2. DATUM IS N.G.V.D. 1929.
3. BORINGS HAVE BEEN BROUGHT INTO CROSS SECTIONS PERPENDICULAR TO THE CROSS SECTION.
4. BORINGS ARE SHOWN AT ACTUAL ELEVATION AND TOTAL DEPTHS.
5. MW-101(S) AND MW-101(D) HAVE BEEN PROJECTED 240' NORTHEAST INTO CROSS-SECTION C-C'.
6. GP-7 HAS BEEN PROJECTED 60' SOUTH INTO CROSS-SECTION B-B'.
7. MW-2D HAS BEEN PROJECTED 580' NORTH INTO CROSS-SECTION B-B'.
8. MW-7(S) AND MW-7(D) HAVE BEEN PROJECTED 250' SOUTH INTO CROSS-SECTION B-B'.

LEGEND

- CLAY
- SAND
- WASTE
- SAND AND GRAVEL
- FILL
- INTERPRETED UPPER/ LOWER POTOMAC FORMATION BOUNDARY

HORIZONTAL GRAPHIC SCALE

(IN FEET)
1 inch = 160 ft.

VERTICAL GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

EDWARD J. LAYTON

WASTE MANAGEMENT

REVISIONS		

BLAZOSKY Associates Inc.

DELAWARE RECYCLABLE PRODUCTS, INC.
DRPI INDUSTRIAL WASTE LANDFILL
CELL 6 EXPANSION AREA
NEW CASTLE COUNTY DELAWARE

GEOLOGIC FENCE DIAGRAM

BALANCED ENVIRONMENTAL SOLUTIONS

DATE:	2/18/04
DRAWN BY:	DA
CHECKED:	E.L.
BA DRAWING NO.:	1188-1986D01
SHEET NO.:	3 OF 3

ORIGINAL

FIVE-YEAR REVIEW REPORT FOR ARMY CREEK LANDFILL SUPERFUND SITE NEW CASTLE COUNTY, DELAWARE

Prepared by

U.S. Environmental Protection Agency
Region 3
Philadelphia, Pennsylvania

Cecil Rodrigues

Cecil Rodrigues, Director
Hazardous Site Cleanup Division

9/8/2014

Date

County generates during utility excavations, pipe installation and repair and maintenance of stormwater management ponds, is tested to ensure that it meets EPA's standards for protection of human health and the environment. Trees will be planted upon completion of the filling operation in order to reforest the area.

The current land use for the surrounding area is residential and commercial. The Llangollen Estates housing development is located southwest of Llangollen Boulevard, between Dupont Highway and River Road. Additional private homes are located along River Road and Grantham Lane. It is anticipated that a mix of land uses similar to that described will continue into the future.

The Upper Potomac Aquifer underlying the two Superfund sites is a primary source of water for Artesian Water Company. The natural groundwater flow direction in the Upper Potomac Aquifer is toward the Delaware River. Near the Site, the groundwater flow direction is toward Artesian's Llangollen well field which is the largest pumping center in the area. Artesian Water Company supplies water to all area homes and businesses.

History of Contamination

The 50-acre Army Creek Landfill is an abandoned sand and gravel quarry that was operated by New Castle County (the County) from 1960 through 1968 for the disposal of two million cubic yards of municipal and industrial waste. Groundwater contamination was initially detected in 1971, when landfill leachate constituents were discovered in a residential well in the Llangollen Estates housing development which lies south of, and adjacent to, the landfill. In 1972, the County embarked on a groundwater monitoring program that identified a plume of landfill leachate indicator chemicals and hazardous substances migrating toward receptors down gradient of the landfill.

Initial Response

New Castle County initiated a groundwater monitoring program to determine the nature and extent of groundwater contamination in the Upper Potomac Aquifer in 1972. In 1973, the County installed a series of groundwater recovery wells in the Upper Potomac Aquifer between the landfills and the public water supply wells in order to intercept and contain the contaminant plume. In 1980, the County replaced some of these wells with new recovery wells located closer to the landfills in an effort to increase the rate of contaminant removal while reducing the rate of withdrawal of uncontaminated groundwater. In addition, Artesian's State-permitted withdrawal rate was reduced and capped and Artesian's water supply lines were extended to residences in Langollen Estates and along Grantham Lane.

The Site was proposed for the National Priorities List (NPL) in October of 1981 and finalized on the NPL on September 8, 1983. In August 1984, New Castle County entered into an Administrative Order on Consent with EPA, under which the County performed a Feasibility Study (FS) for the Site. The purpose of the FS was to review the data collected during prior investigations at the Site and to evaluate alternatives for controlling the sources of contamination as well as additional options for controlling the groundwater plume. In August 1986, the FS was made available to the public, starting the period for public comment. EPA identified its preferred remedial alternative for OU1 during a public meeting on September 10, 1986.

ORIGINAL

FIVE-YEAR REVIEW REPORT FOR DELAWARE SAND & GRAVEL LANDFILL SUPERFUND SITE NEW CASTLE COUNTY, DELAWARE

September 2015

Prepared By:
United States Environmental Protection Agency
Region 3
Philadelphia, Pennsylvania

Cecil Rodrigues

Cecil Rodrigues, Director
Hazardous Site Cleanup Division
U.S. EPA, Region III

8/28/2015

Date

3.2 Land and Resource Use

The former landfill has various current land uses. A 5-acre portion of the 11-acre, fenced Inert Area (the Surface Barrier Area) is used for storage of impounded vehicles, propane tanks and salvage material. The owner of most of the site property maintains a residence adjacent to the Grantham South Area. Portions of the site property are fenced and unused, including a 3-acre area containing the Drum Disposal Area (DDA), where ongoing remediation work presently precludes use of the land, and the steeply sloped 2-acre Grantham South Area.

Land uses around the landfill include commercial/light industrial uses to the east, residential areas to the south, wildlife habitat at the Army Creek Landfill Superfund site to the west, and open space to the north. EPA expects that a similar mix of land uses will continue into the future.

The Upper Potomac Aquifer is used regionally as a drinking water supply. Locally, Artesian operates an active well field one half-mile south of the landfill (see Figure 1). The company supplies water to area homes and businesses.

3.3 History of Contamination

The landfill is a former sand and gravel quarry that was later operated as a permitted landfill from 1968 until 1976. The Site consists of four major areas of contamination. Three of these – the Grantham South Area, the DDA and the Inert Area – were unlined gravel pits into which materials, including hazardous substances, were deposited. The fourth area, known as the Ridge Area, was used for temporary storage of chemical wastes and was affected by the spillage of hazardous substances. About 550,000 cubic yards of industrial and municipal wastes and construction rubble were disposed of at the Site, including at least 13,000 drums containing liquids and sludge from chemical production, manufacturing and petroleum refining processes.

The degradation of groundwater quality due to releases from the Site and from Army Creek Landfill was initially detected in 1971, when landfill leachate constituents were discovered in a residential well near the landfills.

3.4 Initial Response

New Castle County started a groundwater monitoring program to determine the nature and extent of groundwater contamination in the Upper Potomac Aquifer in 1972. In 1973, the County installed a series of groundwater recovery wells in the Upper Potomac Aquifer between the landfills and the public water supply wells to intercept and contain the contaminant plume.

In 1975, DNREC installed several monitoring wells at the Site. In the same year, the State of Delaware initiated enforcement action against the Delaware Sand & Gravel Company, owner and operator of the landfill, for violations of the state solid waste permit. The State Attorney General's office ordered the landfill's closure in 1976.

In 1980, the County replaced some recovery wells with recovery wells closer to the landfills in an effort to increase the rate of contaminant removal while reducing the rate of uncontaminated

use and unrestricted exposure. To manage the cleanup, EPA divided the Site into six operable units (OUs):

- OU1: Grantham South Area.
- OU2: Drum Disposal Area (DDA) and Ridge Area (superseded by OUs 4 and 5).
- OU3: Inert Area.
- OU4: DDA and Ridge Area – excavation and preparation of contaminated soil for on-site bioremediation; excavation and off-site disposal of drums.
- OU5: DDA and Ridge Area – construction and operation of a bioremediation system.
- OU6: DDA Source and Groundwater – will be addressed in a future Record of Decision (ROD).

This FYR Report addresses OUs 1 through 5. OU6 is not addressed because a remedy has not yet been selected, and no remedial action has been undertaken.

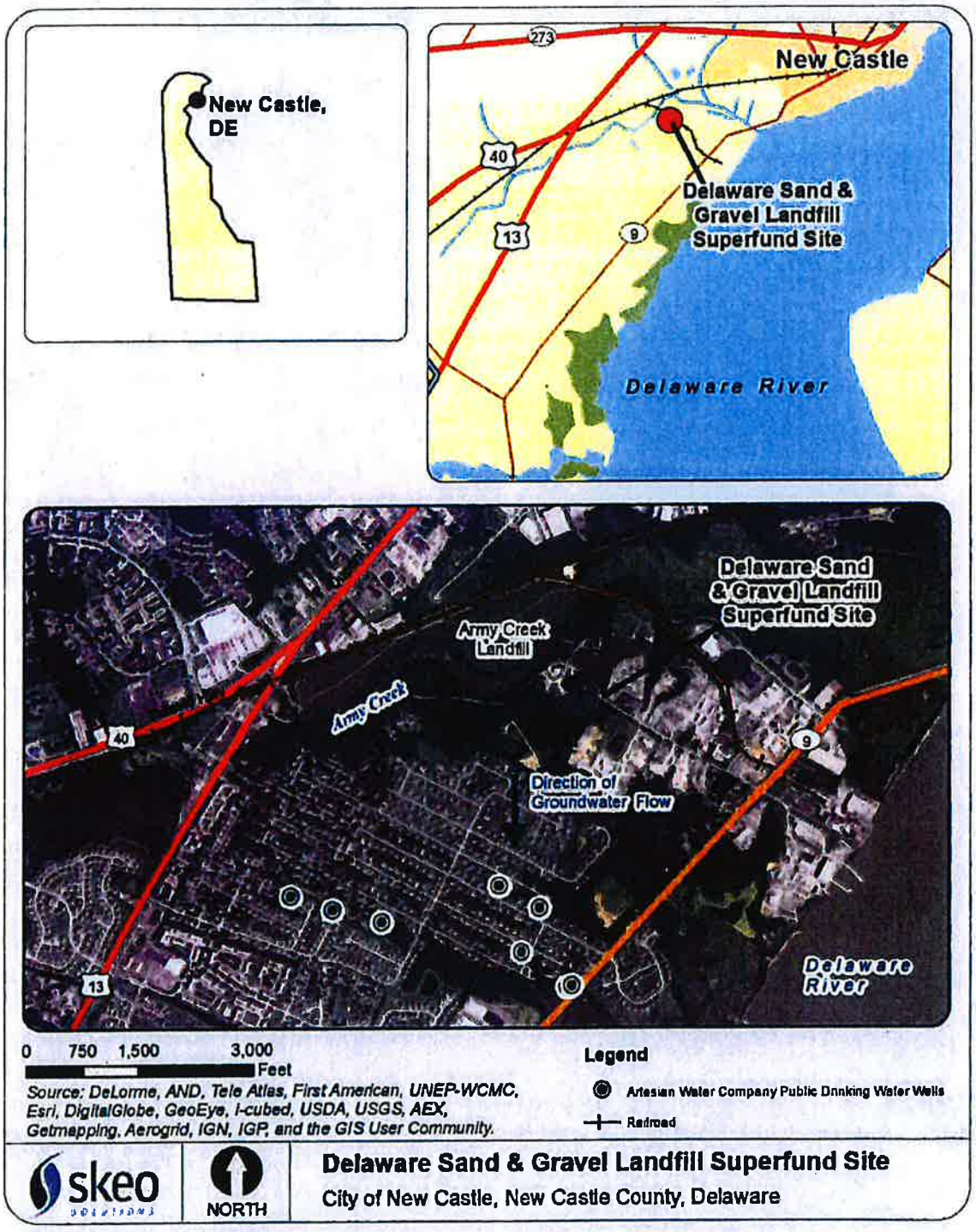
2.0 Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1: Chronology of Site Events

Event	Date
Industrial waste and construction debris accepted for disposal into unlined sand and gravel pits	1968-1976
Contaminants found in residential well water located downgradient from Army Creek Landfill and DS&G Landfill	1971
New Castle County installed groundwater recovery wells to prevent contaminated groundwater beneath Army Creek Landfill and DS&G Landfill from reaching Artesian Water Company's Llangollen well field	1973
EPA placed Site on Superfund program's National Priorities List (NPL)	September 8, 1983
EPA and the State performed emergency removal of more than 1,600 drums from surface of DDA and Ridge Area	March-May 1984
DNREC conducted remedial investigation and feasibility study	1984-1987
EPA issued Record of Decision (ROD) documenting selection of cleanup plan	April 22, 1988
EPA began remedial design for Grantham South Area	August 26, 1988
EPA approved final remedial design for Grantham South Area	June 30, 1989
U.S. Army Corps of Engineers' contractor, on behalf of EPA, began construction of Grantham South Area landfill cap	September 1989
EPA conducted final inspection of Grantham South Area landfill cap and signed Remedial Action Completion Report for Grantham South Area (OU1 remedial action completed)	September 30, 1991
On behalf of EPA, U.S. Army Corps of Engineers conducted pre-design studies at DDA and Ridge Area. Findings led to 1993 ROD Amendment	1991-1993
EPA determined that buried drums in DDA posed an imminent threat	March 23, 1992
EPA entered into Administrative Order on Consent (AOC) with 22 PRPs, who agreed to design and construct slurry wall around DDA as an interim action and to design multi-layer cap for Inert Area	June 12, 1992
PRPs initiated remedial design for Inert Area	June 26, 1992

Figure 1: Site Location Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

AMENDMENT NO. 2
TO THE 1988 RECORD OF DECISION FOR THE
DELAWARE SAND & GRAVEL LANDFILL SUPERFUND SITE
NEW CASTLE, DELAWARE

Prepared by:

Environmental Protection Agency Region III
1650 Arch Street
Philadelphia, PA 19103

December 2017

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

The Site is located two miles south of the City of New Castle, New Castle County, Delaware. The Site property is located along Grantham Lane, east of U.S. Highway 13 (Dupont Highway) and west of Delaware Route 9 (River Road) (see Figure 1). It consists of approximately 27 acres in an area of residential and light-industrial land use and is bounded to the north and northeast by the Norfolk Southern Railroad tracks and to the west by Army Creek which discharges into the Delaware River less than one mile east of the Site. Artesian's Llangollen well field is located approximately three quarters of a mile southwest of the Site.[1]

The Site property is a former sand and gravel quarry that was later operated as a permitted landfill from 1968 until 1976. It includes four waste disposal areas (see Figure 2). Three of these – the Grantham South Area, the Drum Disposal Area (DDA) and the Inert Area – were unlined gravel pits into which waste materials, including hazardous substances, were disposed. The fourth area, known as the Ridge Area, was used for temporary storage of chemical waste and was impacted by the spillage of hazardous substances. Approximately 550,000 cubic yards of industrial and municipal wastes and construction rubble were disposed of at the Site, including approximately 15,000 drums containing liquids and sludge from chemical production, manufacturing and petroleum refining processes.

The Army Creek Landfill Superfund Site (Army Creek Landfill) is located immediately west of the Site on the opposite bank of Army Creek. The 50-acre Army Creek Landfill is an abandoned sand and gravel quarry that was operated as an unlined landfill for the disposal of 1.9 million cubic yards of municipal and industrial waste from 1960 through 1968. In September 1986, EPA issued a Record of Decision (ROD) for the Army Creek Landfill, selecting a source control and aquifer restoration remedy; in June 1990, EPA issued a ROD for Operable Unit 2 at the Army Creek Landfill, which called for treatment to remove iron from recovered groundwater prior to its discharge to Army Creek.

In addition to the Site property, the Site includes areas to the south and southwest where hazardous substances have been transported in groundwater.

The CERCLA identification number for the Site is DED000605972.

EPA is the lead agency for Site activities, and DNREC is the support agency. The United States, on behalf of EPA, and the State of Delaware, on behalf of DNREC, have reached prior settlements with potentially responsible parties (PRPs) under which the PRPs have performed, and are performing, the response actions selected in the 1988 ROD and ROD Amendment No. 1.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Local officials first discovered groundwater degradation in the Upper Potomac Aquifer in 1971 when landfill leachate constituents were detected in a residential well near the Army Creek

[1] The production wells in Artesian's Llangollen well field are shown in Figure 8 of this ROD Amendment No. 2.

in-situ treatment of soil at the BRA. As discussed in the *Supplemental Site Characterization Report – Revision 2*, a comparison of laboratory analytical data for soil samples collected at the DDA between 2011 and 2013 with principal threat soil screening levels indicates a low potential for remaining principal threat material at the DDA. EPA expects that the remaining contamination at the DDA source area can be reliably controlled in place through the installation of a composite barrier cap above the slurry-wall enclosure and enhanced hydraulic control measures, which are components of the Selected Remedy.

2.12 SELECTED REMEDY

Following review and consideration of the information in the Administrative Record, the requirements of CERCLA and the NCP, and public comment, EPA has selected the remedy identified as EPA's Preferred Alternative in the Proposed Plan *(Alternative C - DDA Enhanced Containment and Groundwater Extraction from UPCUTZ and Upper Potomac Aquifer with Direct Discharge to POTW)* to address contamination remaining at the Site which was not adequately addressed by the Previously Selected Remedy.

Summary of the Rationale for the Selected Remedy

EPA expects that the Selected Remedy will be protective of human health and the environment, will cost-effectively achieve the RAOs, including restoration of groundwater throughout the Area of Attainment within a reasonable time frame, and will comply with ARARs.

The Selected Remedy consists of components of the remedial action for the Site, which are categorized as follows:

1) Remedial components that were previously selected in the prior decision documents referenced above, but which are not being modified by this ROD Amendment No. 2 (each identified below as an "Existing Component");

2) Remedial components that were previously selected in the prior decision documents, but which are being modified by this ROD Amendment No. 2 (each identified below as a "Modified Component"); and

3) New remedial components that were not previously selected in the prior decision documents (each identified below as a "New Component").

Specifically, this ROD Amendment No. 2 selects the following components of the Selected Remedy:

1. Slurry-wall system (Existing Component);
2. Pre-design investigations to develop supplemental information regarding source and extent of contamination in the Upper Potomac Aquifer and hydraulic connections between hydrostratigraphic units within the Upper Potomac Aquifer, and confirm target capture zones within the Upper Potomac Aquifer (New Component);
3. Hydraulic control of contaminated groundwater within the slurry-wall enclosure using an enhanced low-flow groundwater extraction system (eLFExS) (Modified Component);

4. A composite barrier cap to minimize infiltration of precipitation through contaminated soil contained within the slurry wall surrounding the DDA (Existing Component);
5. Installation and operation of extraction wells in areas determined to optimize capture and remove contaminant mass from the more highly-impacted areas of the Upper Potomac Aquifer, including the UPCUTZ (Modified Component);
6. Discharge of groundwater pumped from the DS&G extraction wells to the Wilmington Wastewater Treatment Plant (Modified Component);
7. Continued groundwater extraction at Artesian's Llangollen well field with treatment utilizing existing systems for BCEE and 1,4-dioxane and, if necessary, additional treatment systems targeting other COCs (New Component);
8. A groundwater monitoring program to ensure that the remedial action is meeting the short-term goal of plume containment and will meet the long-term goal of aquifer restoration in the Area of Attainment within a reasonable time frame (New Component);
9. Institutional controls to prevent direct contact with contaminated soil, the installation of drinking water wells on the Site property and other future uses of the Site property which could compromise the effectiveness of the Selected Remedy (Existing Component); and
10. Institutional controls to prevent potential future exposure to Site contaminants in indoor air (New Component).

The Selected Remedy and mandatory performance standards are described in detail below.

2.12.1 Slurry-wall System

The existing slurry wall, constructed in 1994 and keyed into the underlying UPCU, will remain in place as a passive containment system at the DDA, with added instrumentation, as indicated in Section 2.12.3, below, to monitor performance.

2.12.2 Pre-design Investigations

Areas of uncertainty at the Site identified in the Feasibility Study will be addressed during pre-design investigations which will include but not be limited to the following activities:

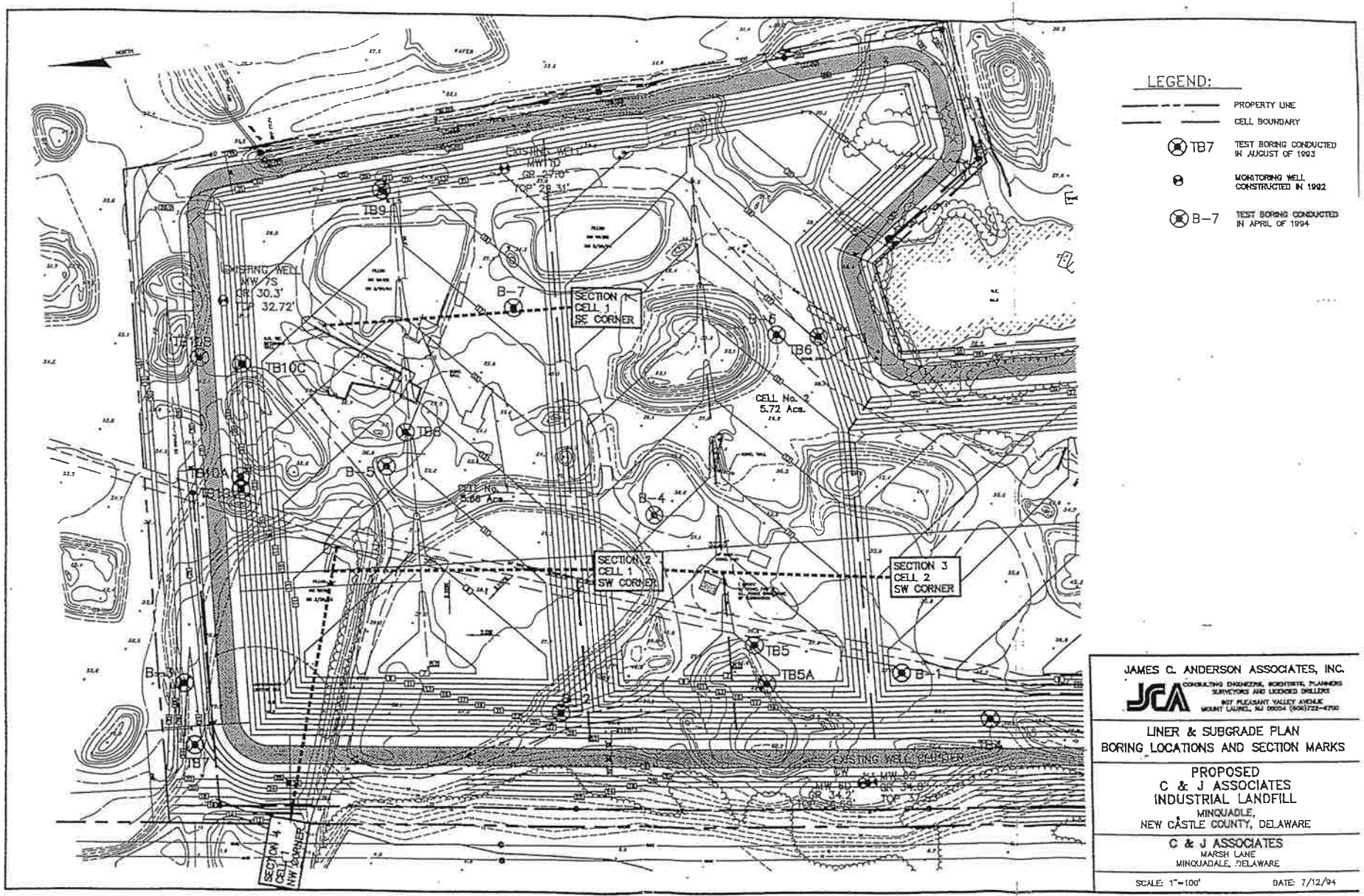
- Delineation of the extent of contamination in the UPCUTZ;
- Verification of target capture zones for extraction wells to be installed in the UPCUTZ and the upper and lower sand units of the Upper Potomac Aquifer;
- Evaluation of the interaction between the UPCUTZ and Upper Potomac Aquifer upper sand, including the area of greatest contaminant mass flux from the UPCUTZ to the Upper Potomac Aquifer;
- Evaluation of the continuity and/or extent of the UPDC and the connection between the upper and lower sand units of the Upper Potomac Aquifer between source areas and the Llangollen well field;
- Additional characterization to evaluate the simulated silt feature near well P-6 in the Site-specific groundwater flow model;

Attachment 2

from

DRPI Appendix VI-C

Soil Characterization Summary



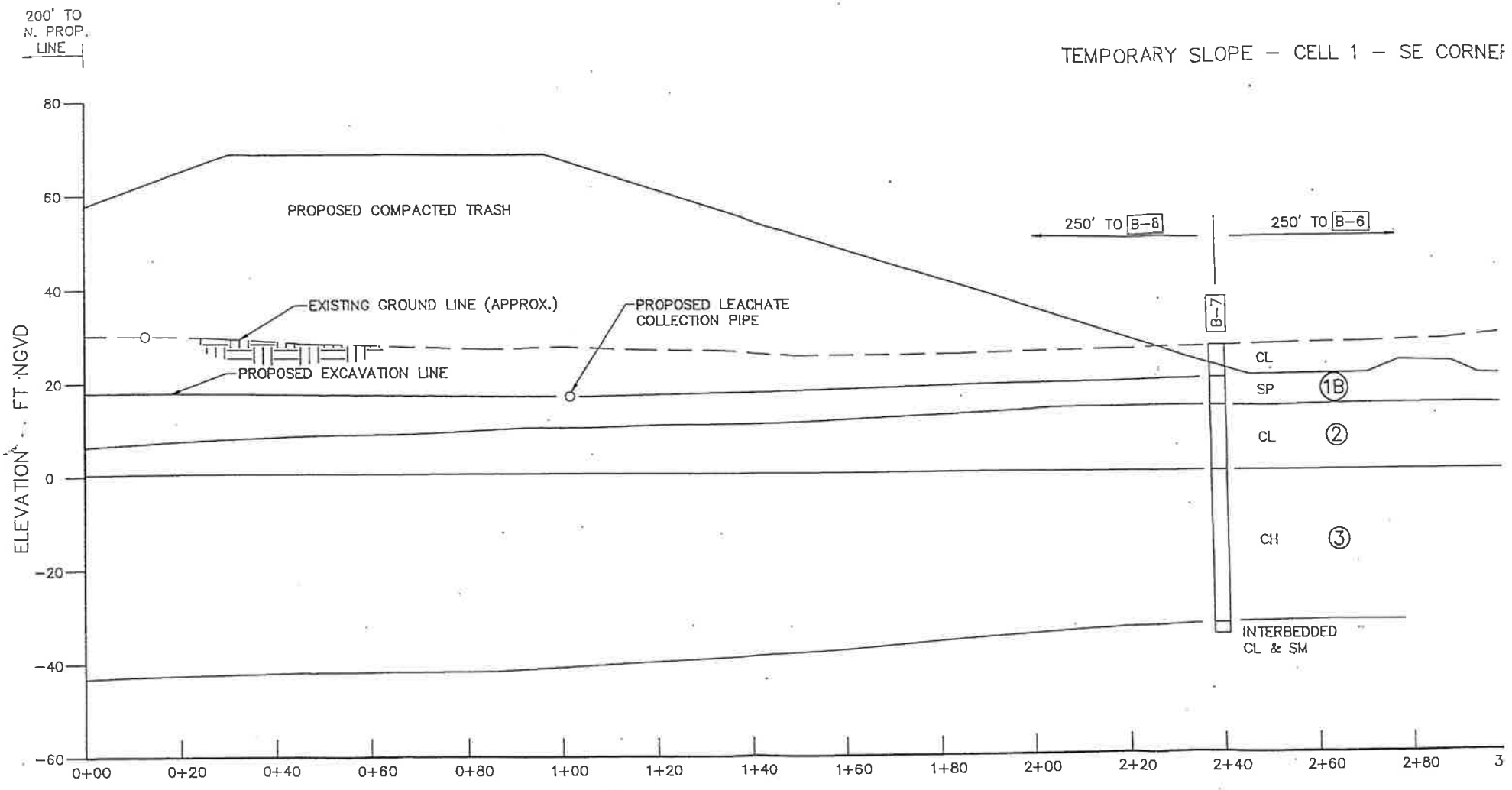
JAMES C. ANDERSON ASSOCIATES, INC.
CONSULTING ENGINEERS, HYDROLOGISTS, PLANNERS SURVEYORS AND LICENSED DRILLERS
807 PLEASANT VALLEY AVENUE MOUNT LAUREL, NJ 08054 (609)722-4700

LINER & SUBGRADE PLAN
BORING LOCATIONS AND SECTION MARKS

PROPOSED
C & J ASSOCIATES
INDUSTRIAL LANDFILL
MINQUADLE,
NEW CASTLE COUNTY, DELAWARE

C & J ASSOCIATES
MARSH LANE
MINQUADALE, DELAWARE

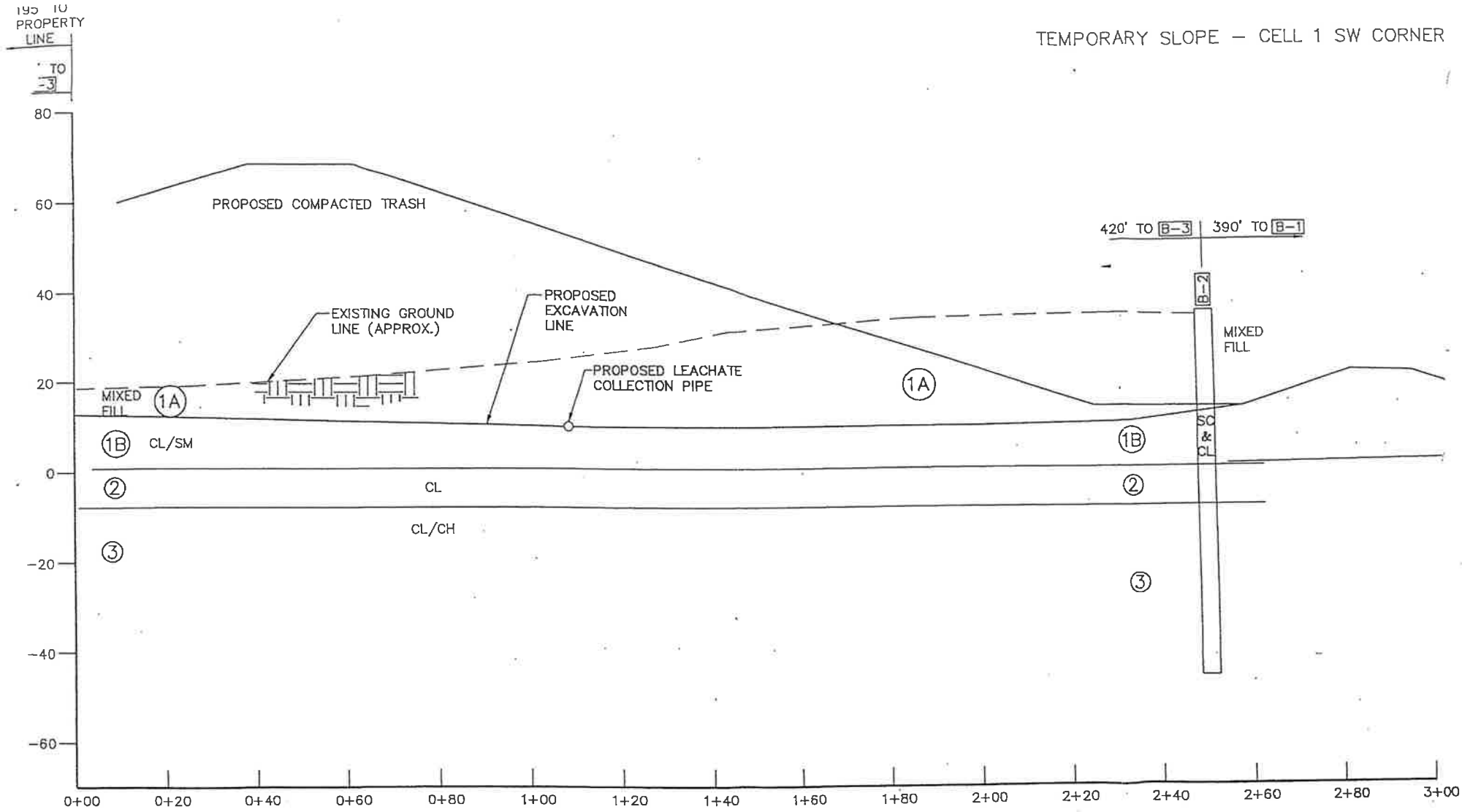
SCALE: 1"=100' DATE: 7/12/94



① STRATUM NO.

C & J LANDFILL

SECTION 1



C & J LANDFILL
SECTION 2
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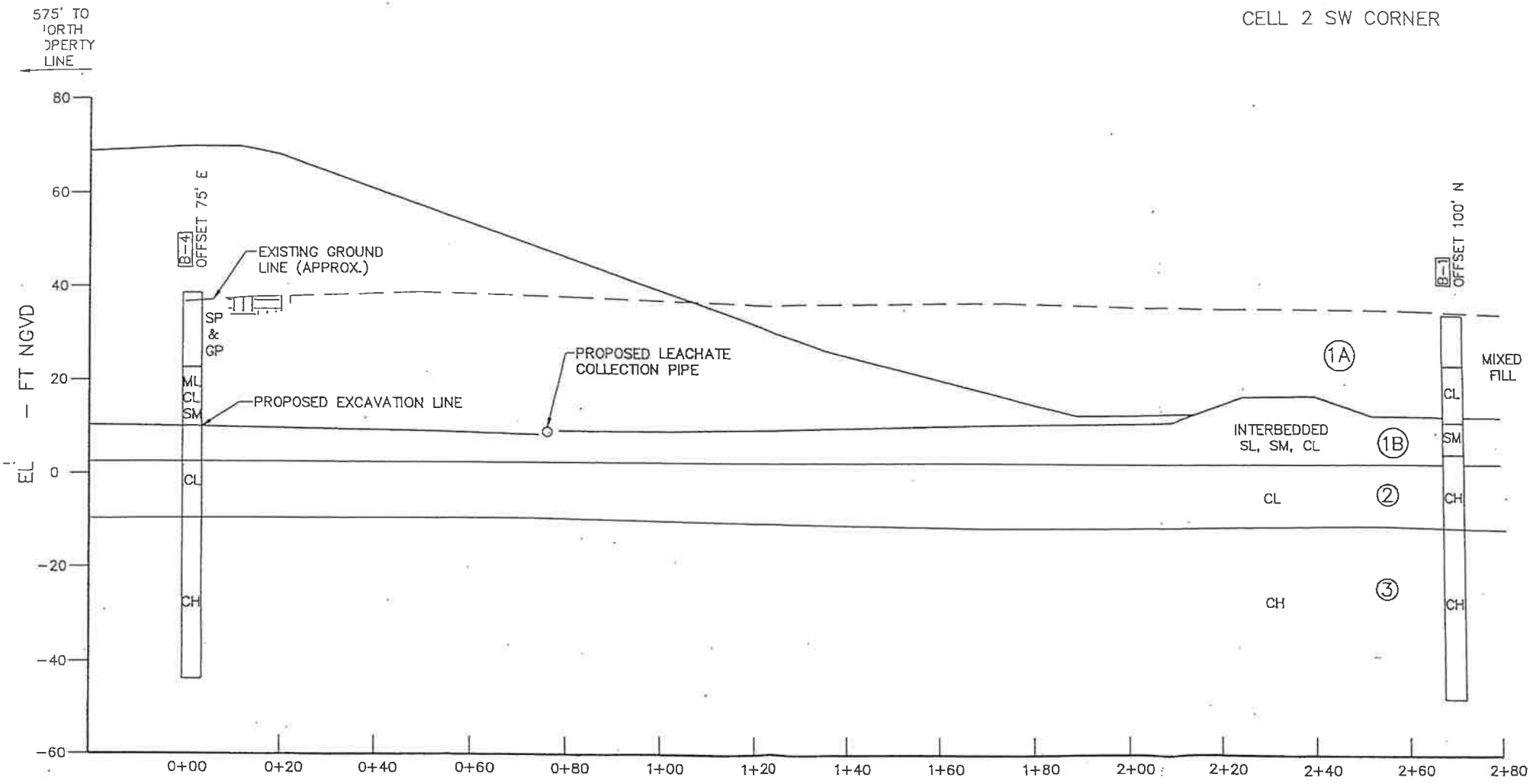

NOTE: THIS SECTION IS AN EXTENSION OF SECTION 2 LINE FOR SW CORNER – CELL 1.

① STRATUM NO.

C & J LANDFILL

SECTION 3

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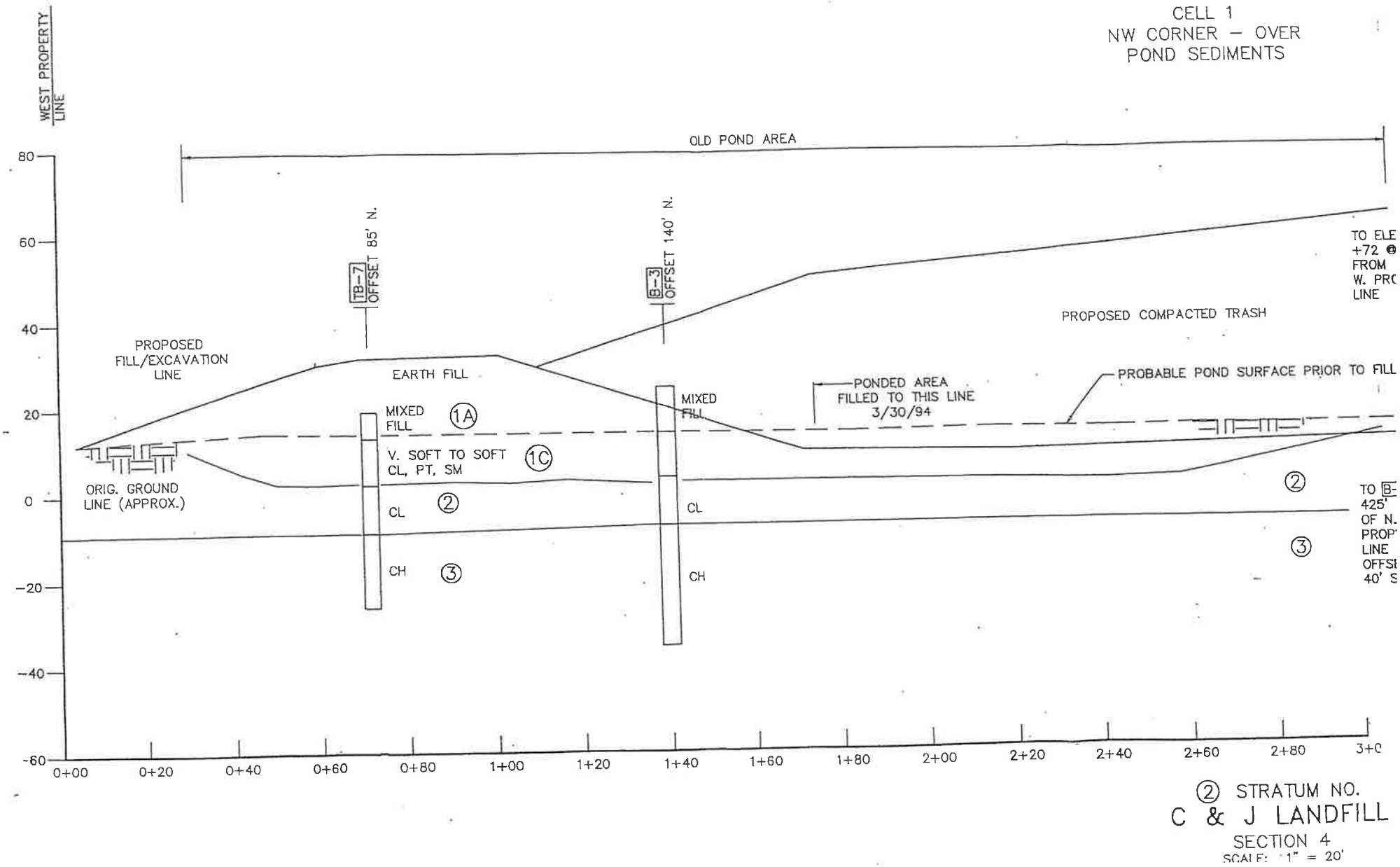

② STRATUM NO.

C & J LANDFILL

SECTION 4

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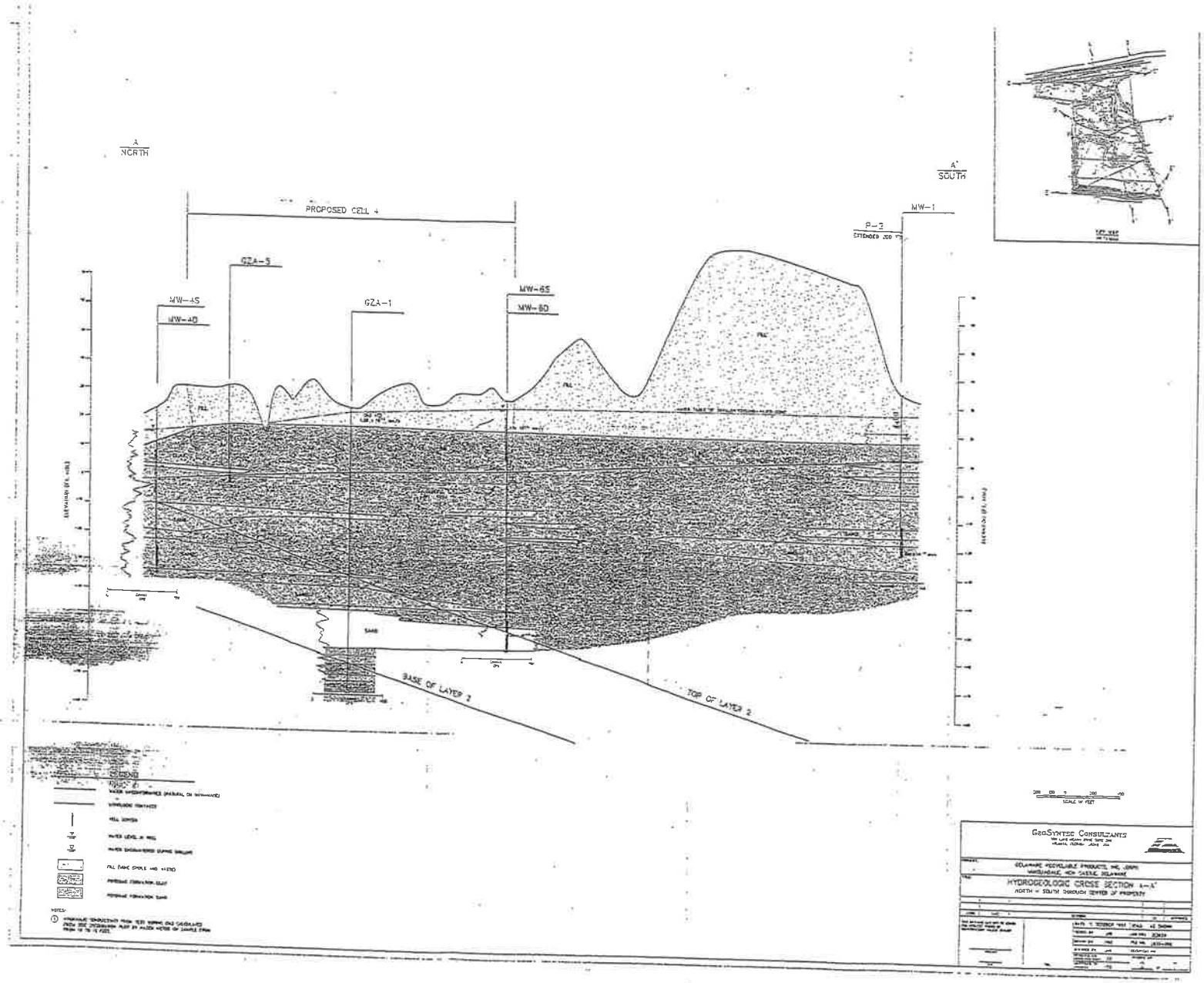
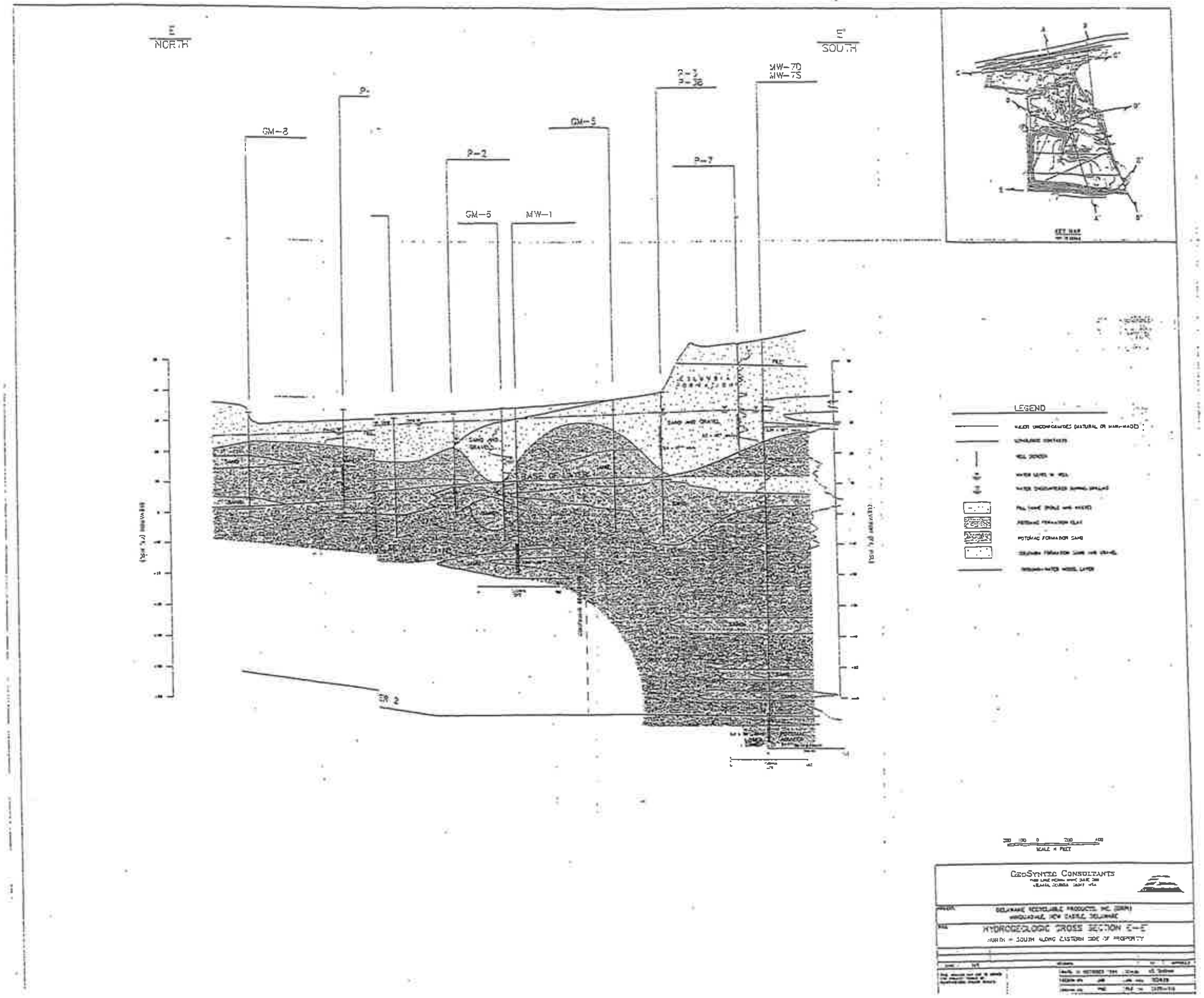
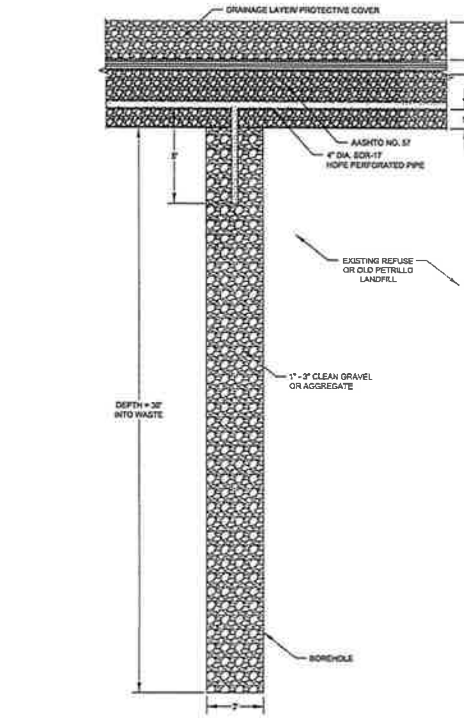
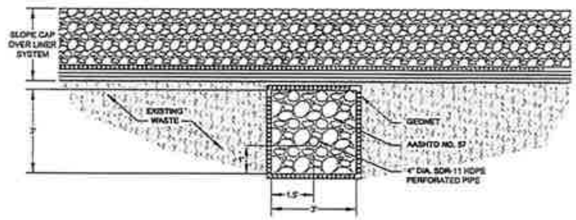

A
NORTH
A'
SOUTH
PROPOSED CELL 4
P-2
EXTENDED 200 FT
MW-1
GZA-5
MW-4S
MW-4D
GZA-1
MW-6S
MW-6D
FILL
SAND
BASE OF LAYER 2
TOP OF LAYER 2
LEGEND
NOTES:
GeoSyntec Consultants
HYDROGEOLOGIC CROSS SECTION A-A'
NORTH - SOUTH THROUGH CENTER OF PROPERTY

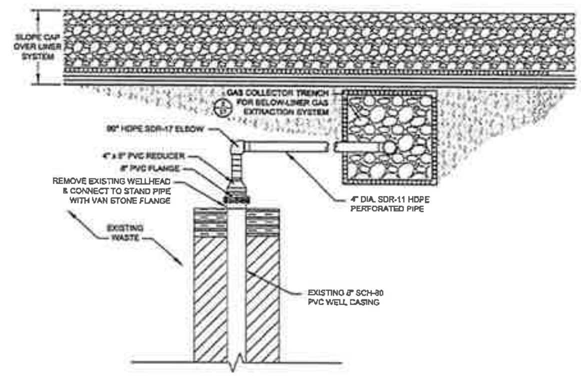

E
NORTH
E'
SOUTH
GM-8
P-
P-2
GM-6
MW-1
GM-5
P-3
P-3B
P-7
MW-7D
MW-7S
SAND AND GRAVEL
BASE OF LAYER
ER 2
KEY MAP
LEGEND
SCALE IN FEET
GeoSyntec Consultants
HYDROGEOLOGIC CROSS SECTION E-E'



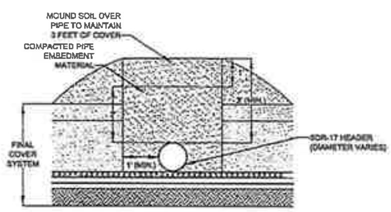
1 / 24 STONE COLUMN FOR BELOW-LINER GAS EXTRACTION SYSTEM
NOT TO SCALE



2 / 24 GAS COLLECTOR TRENCH FOR BELOW-LINER GAS EXTRACTION SYSTEM
NOT TO SCALE



3 / 24 TIE-IN TO EXISTING WELLS FOR BELOW-LINER GAS EXTRACTION SYSTEM
NOT TO SCALE



4 / 25 GAS HEADER PIPE TRENCH (ABOVE CAP)
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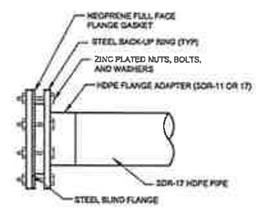

5 / - BLIND FLANGE
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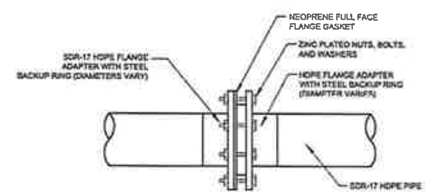
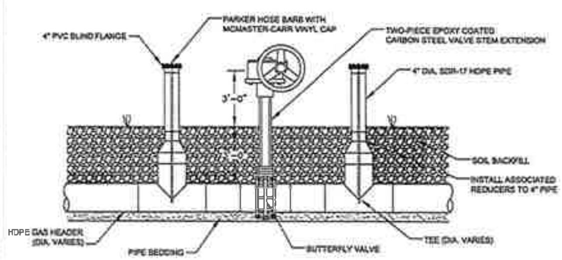


6 / - FLANGE TO FLANGE CONNECTION
NOT TO SCALE



7 / 25 TYPICAL ISOLATION VALVE WITH CLEANOUTS
NOT TO SCALE

NOTE:

1. ORIGINAL DRAWING TAKEN FROM GEOSYNTEC CONSULTANTS FILE 0319-427, DATED SEPTEMBER 2004.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	10/27/14	JS	ALL GAS DETAILS REVISED PER CURRENT DESIGN	GLS	JS	PAW

PROJECT
Waste Management
DELAWARE RECYCLABLE PRODUCTS, INC.
PERMIT RENEWAL FOR CELL 6 EXPANSION
NEW CASTLE, DELAWARE

TITLE
LANDFILL GAS SYSTEM DETAILS II

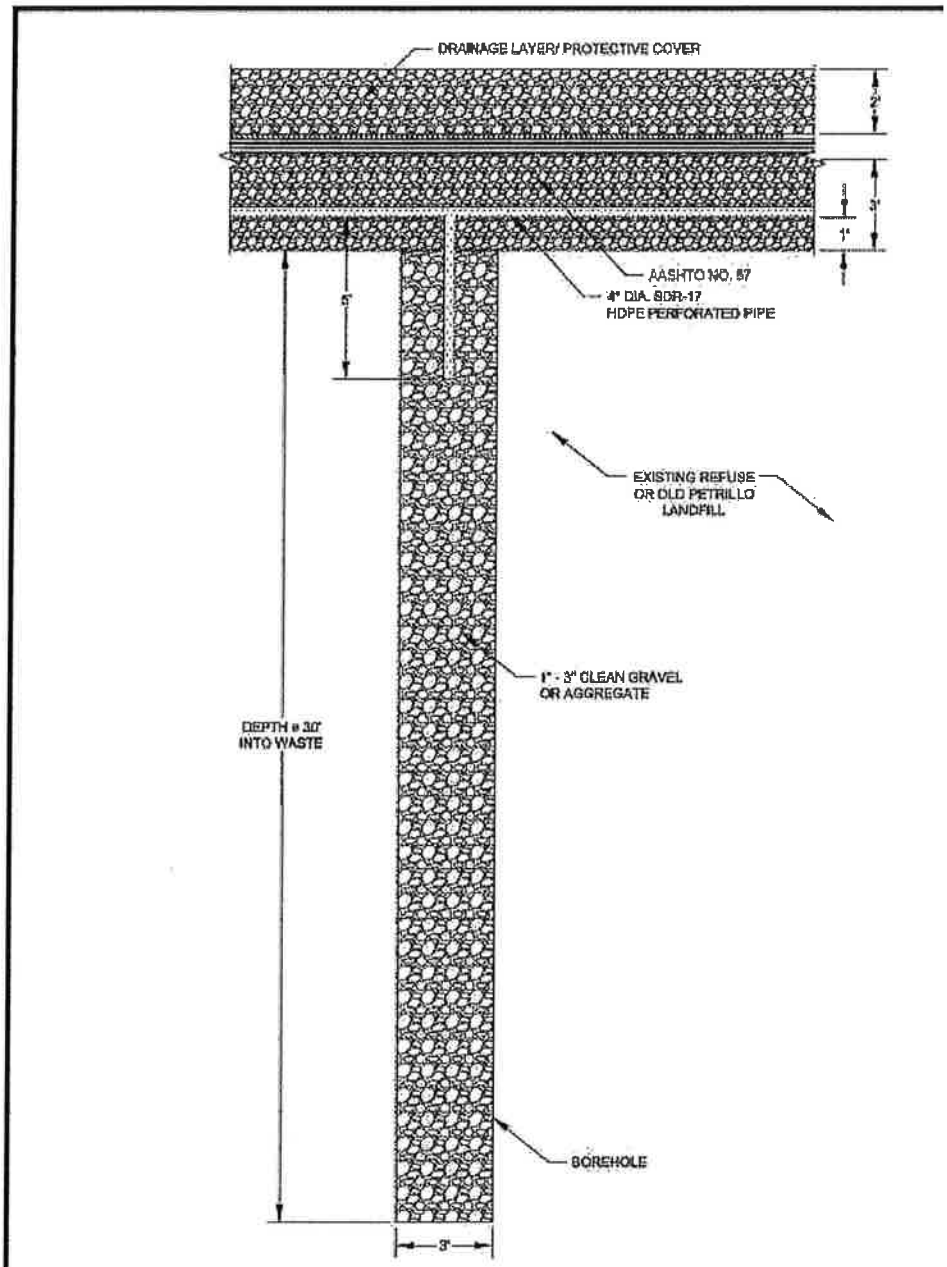
Golder Associates
Bristol, Pennsylvania

PROJECT No.	14-00742		FILE No.	14007428026
DESIGN	JS	10/27/14	SCALE AS SHOWN	REV. 0
CADD	GLS	10/27/14		
CHECK	JS	10/27/14		
REVIEW	PAW	10/27/14		

DRAWING 27

PAUL A. WHITE LICENSED 13009 DELAWARE PROFESSIONAL ENGINEER
SIGNATURE
10/27/14
DATE

Drawing from "Landfill Gas System Details II, Drawing 27



24.00 in

CV for Peter M. Demicco

PETER M. DEMICCO, P.G.
310 Newark Road.
Landenberg, PA 19350
(908) 507-9992

Education

M.S. Geology, University of Delaware, 1982
B.S. Geology and Geophysics, University of Connecticut, 1980

Registrations

Registered Professional Geologist, State of Delaware, #S40000406
Registered Professional Geologist, State of Pennsylvania, #PG-003690-E
Certified Professional Geologist, State of Virginia, #2801001817.
Certified Geologist, American Institute Professional Geologist, #7160

Technical/Professional Expertise

Water Resource Evaluations
Water Well Design, Well Hydraulics and Aquifer Testing
Aquifer Storage and Recovery (ASR) Systems
Groundwater Flow Modeling
Wastewater Infiltration Analysis and Modeling
Groundwater-Surface Water Interaction
Analysis of Fractured Rock Groundwater Flow
Groundwater-Surface Water Interaction
Groundwater Geochemistry Analyses

Professional Appointments and Awards

Member, NJDEP Well Drillers Licensing Board 2004 – 2008, Public Member
New Jersey Senate Citation for the 23rd New Jersey Legislature District for work related to the Hunterdon County Planning Board. 2006.
New Jersey General Assembly Citation for the 23rd New Jersey Legislature District for East Amwell Sourland Mountain Master Plan. 2006.
Hunterdon County Planning Board Hermia Lechner 16th Annual Planning & Design Awards Program, Sourland Mountain, East Amwell Master Plan, 2006.
Mayor, 2001, Franklin Township, Hunterdon County, New Jersey
Franklin Township, Township Committee, 1999 – 2001
Numerous years on Planning Boards, Land Use Boards and Environmental Commissions.

Professional Profile

Mr. Peter Demicco is the Principal Hydrogeologist and President of Ground Water Associates, LLC. Mr. Demicco has over 36 years of experience in the fields of water supply and ground water remediation.

Mr. Demicco's technical expertise in water resource development includes Groundwater Resource Planning, Water Allocation permits for municipal and industrial water users, Aquifer Storage and Recovery (ASR) projects, extensive single and multiple well aquifer testing projects, ground water flow modeling for well head protection, regional water resource planning, surface water induced infiltration projects and in-ground iron and manganese removal projects. Mr. Demicco has also evaluated sites for the installation of high capacity horizontal collector wells and has conducted extended 30- and 60-day aquifer tests for the evaluation of induced infiltration. Major projects have included analysis of ground water recharge, surface water runoff, and stream base flow to evaluate impacts of development on stream hydrology.

Mr. Demicco's experience includes analysis of water reuse projects primarily focusing on the recharge of waste water for municipalities and public and private utilities. This work has focused on large volume rapid infiltration basins for disposal projects up to 1.5 Million Gallons per Day (MGD). These projects include ground water flow models of the mounding effects beneath the basins, evaluation of geochemistry changes within the aquifer, and seasonal changes in aquifer water elevations.

Mr. Demicco's consulting management experience has included oversight of over 50 major water allocation projects from single wells to multiple well installations. Mr. Demicco has managed many projects related to NJDEP critical aquifers in both Critical Areas 1 and 2. His experience includes one of the only alternative water supply plans approved in Critical Area 2. He has extensive experience in interfacing with the NJDEP Bureau of Water Allocation and the Bureau of Safe Drinking Water. His project works includes consulting for municipal planning and health boards.

Mr. Demicco's expertise also extends to ground water remediation of both water supply systems and industrial site remediation. He has managed projects on nitrate and VOC contamination of municipal and industrial wells, as well as remedial investigations and remedial action projects under NJDEP Technical Requirements for Site Remediation. Mr. Demicco has assisted clients in developing natural attenuation remedial action plans and groundwater Classification Exception Areas (CEA). Mr. Demicco also has managed multi-discipline teams in remedial projects related to NJDEP ACO, ISRA and UST programs, and federal EPA Superfund Program.

Project Experience

Water Allocation

- Project Manager of an extended 30-day aquifer test to prove induced infiltration from the Delaware River for acquisition of an Alternative Water Source in NJDEP Critical Area 2,

Potomac-Raritan-Magothy Aquifer. This project included NJDEP approval of the aquifer test plan and oversight by U.S. Geological Survey of the testing procedures and final hydrogeologic report.

- Developed Aquifer Testing Plan, production well location and design and 72-hour aquifer tests for a major new water supply in Cecil County Maryland. Project included the modification of the water appropriation permit for these new sources in the Potomac Group Aquifer.

- Project Manager of the development and allocation permitting of a new 3.5 MGD well field in southern New Castle County, Delaware in the Potomac Formation aquifer. Oversight of the project included evaluation of 7 new well installations, 72 hour aquifer testing, and computer modeling to illustrate the overall impact of the new wells on the future productivity of the aquifer system. The allocation permit included analysis of regional impacts using a MODFLOW model and public testimony at the permit hearing.

- Project Manager for a project involving the transfer of roughly 10 MGD of water allocation rights between two industrial clients in NJDEP Critical Area No. 1. The project focus was the regulatory oversight and obtaining of approvals needed to secure transfer the diversion permits. Previous work at both sites included extended aquifer testing and analysis for induced infiltration to increase diversion permits in Critical Area 1.

- Submittal of several hydrogeologic reports and allocation permit applications for golf courses most recently including Baltusrol, Shore Gate and Suburban Golf Clubs. Also provided oversight to East Amwell Township Planning Board and Board of Health on the application for the Ridge at Back Brook golf course.

- Prepared and provided public testimony for a new water supply system for Aqua New Jersey in Woolwich Township, New Jersey. Work included a multiple well stress test and extensive investigation of impact of the proposed new wells on existing users and on contaminated sites. Public testimony included comment on USGS regional ground water flow model for this region of New Jersey.

Water Resource Evaluations

- Provided single and multiple well aquifer tests, regional analysis of aquifer impacts and public testimony for a new water supply system in Gloucester County, New Jersey in the PRM Aquifer System. Analysis included reviews and comments on a regional model of the PRM aquifer produced by the U. S. Geological Survey.

- As Professional Geologist, provided oversight for the expansion of a major water purveyor in the State of Delaware. Projects include the development of a new 2.0 million gallon per day (MGD) well site in west-central New Castle County, technical assistance for new well exploration in both New Castle, Kent Counties and Sussex Counties, development of a water supply system in multiple aquifers for an estimated 5 to 6 MGD needed for development in

Southern New Castle County, assistance with 72-hour allocation permit aquifer tests and well efficiency step tests, and technical assistance with ASR sites in New Castle County.

- Oversaw multiple Horizontal Collector Well test and individual site tests for a 45 MGD facility at a nuclear power facility along the Mississippi River in the State of Mississippi. Site testing involved the evaluation of induced infiltration for estimating yield of individual collector well sites along the banks of the Mississippi River. The multiple well test involved operating three collector wells at steady rates and then testing the fourth new collector well for a 96 hour period. Report preparation included estimating total well yield with all four horizontal collector wells operating at low-river stage.

- Provided Expert Witness testimony for a legal case involving a municipal zoning ordinance on domestic water supply well and septic systems on appropriate housing density. The court case focused on regional ground water recharge rates and nitrate dilution of septic system discharge.

- Well redevelopment and evaluation of sand production from a 1,300 foot deep Potomac-Raritan-Magothy well in Jackson Township, New Jersey. Project included location of the sand producing interval of the screen. Different techniques of redevelopment applied to reduce sand production from the interval identified as producing sand.

- Project Geologist for development of new water resources for Henrico County, Virginia. Reviewed available surface and ground water resources, evaluated existing well system, development of well maintenance criteria, and selection of sites for new ground water exploration.

Waste Water Recharge

- Ground water flow model for waste water disposal of a 400 home subdivision in Sussex County Delaware using the USGS Modflow model and the Surfact unsaturated flow package. The results of the model were uses to obtain regulatory approval for a subsurface drip irrigation system through modeling of the potential mounding beneath each site. The project included small scale well tests to evaluate shallow subsurface hydraulic conductivity of the sediment as part of the inputs to the model.

- Analysis of waste water disposal for a 1.5 MGD expansion of a municipal wastewater system in southern New Castle County, Delaware. Analysis included detailed hydraulic analysis for 40 to 60 rapid infiltration basins including seasonal high ground water mounding analysis and detailed geochemistry of the recharge-ground water interaction. A Modflow model of seasonal high ground water elevations is currently underway.

- Analysis of several rapid infiltration basins for residential developments in New Castle and Sussex Counties, Delaware for expansion and permitted capacity increases. These projects focused on analysis of seasonal high ground water elevations due to expanded capacities through ground water flow modeling.

Aquifer Storage and Recovery

- Technical oversight and field testing on ASR demonstration project in New Castle County, Delaware at two (2) facilities in the upper and lower Potomac Aquifer. Reviews for the project included well design criteria, review and modification to groundwater geochemistry cycle testing, conduct the field geochemical testing, regulatory compliance issues, elevated iron levels in the receiving aquifer, and salt water intrusion in the receiving aquifer from existing use of the well field. Currently, this project includes on-going review of compliance monitoring results for geochemical changes in the aquifer, well plugging and MODFLOW modeling of the migration of the injected water.

- Planning, development and testing of a new ASR system in NJDEP Critical Area 1 in Lakewood, New Jersey using an existing Englishtown Aquifer well. Project is through field-testing and is currently waiting regulatory approvals from the Bureaus of Water Allocation, Safe Drinking Water, and Nonpoint Pollution Control. The project included aquifer yield testing, development of a Ground Water Protection Plan and field and laboratory testing of water quality through three injection and recovery test cycles. The project also included geochemical modeling of the injected and recovered water using the U. S. Geological Survey model PHREEQC.

- Review of maintenance procedures for the existing ASR system in Brick Township, New Jersey. Work included development of a monitoring plan for water quality collection on recovery, geochemical modeling using PHREEQC and suggestions on modification of backwash frequency and injected water quality to reduce precipitation of calcite in the well screen, pump and recovered water transmission lines. On-going work will include further analysis of iron levels and approval from NJDEP Bureau of Safe Drinking Water for direct discharge of most of the recovered water to the distribution system without retreatment.

- Technical oversight on the preliminary feasibility and aquifer testing for a new ASR system in New Jersey Critical Area No. 2. Primary focus of this study was the geochemical evaluation of mixing surface source water and aquifer waters. This project included an economic assessment of ASR versus development costs of new water supply wells, regulatory approvals for test drilling and recharges test cycles.

- Technical oversight and field analysis for an ASR system operation and maintenance plan in Critical Area No. 1 of New Jersey in the PRM Aquifer. The ASR system was not being utilized due to on-going issues with the levels of iron in the recovered water. Primary issues were compliance with NJDEP Bureau of Safe Drinking Water, developing a maintenance plan for the ASR well, and monitoring water quality of recovered water.

- Project Manager for the evaluation of an existing ASR system in the Cohansey and Kirkwood Aquifer systems in Coastal New Jersey to improve system maintenance and operational to prevent damage to the system wells by over-pressure during recharge cycles. Work included cycle testing of geochemical reaction and rates of plugging on four existing wells. Work was concluded in the late 1980's with operation and maintenance plan for the recharge wells.

Ground Water Modeling

- Project Manager for a ground water flow and contaminant transport model for a EPA Superfund site in Region 2. The project included developing a MODFLOW and MT3D model for the design of a ground water treatment system. The model included several cleanup scenarios from natural attenuation to a 1 MGD recovery system. Oversight on the project included personnel from EPA Region II and the U.S. Geological Survey.

- Project Manager on a groundwater MODFLOW model of a petroleum facility. The goals of the project were to evaluate maximum petroleum recovery while minimizing ground water pumping and maintaining hydraulic control.

- Project Manager on an evaluation of induced infiltration into a water table aquifer in central New Jersey to increase the facility's water allocation in NJDEP Critical Area No. 1. The goal of the project was to evaluate the maximum sustainable yield of the water table aquifer from within the property boundaries of the facility with a minimum of new well installations.

- Project Manager for a ground water flow model projecting capture and recovery volumes of ground water contaminants in a fractured rock aquifer in central New York State. The goal of the project was to estimate the minimum rates of recovery needed for complete plume recovery and estimate the impact of ground recovery on flow gradients beneath the landfill contaminant source.

NJDEP Spill Fund Sites

- Project Manager on a diesel fuel remediation project that included RI and RA phases of work under a NJDEP ACO. Project included obtaining a NJPDES permit for discharge to ground water as part of the site remediation. The project also included the installation of a multiple well recovery system with free product recovery equipment and development of an iron removal step in the treatment system. Project required regular compliance monitoring sampling and reporting.

- Project Manager on a DNAPL investigation and recovery well installation with treatment system at an industrial facility in Newark, New Jersey. The DNAPL investigation led to a detailed investigation of site geology as the DNAPL migrated from an outwash sand and gravel into a glacial till. A small lacustrine sand unit within the till become the conduit of migration of the DNAPL and recovery well installation focused on the mapping the lacustrine unit.

Publications

Demicco, P. M., Price, B. C., and Penman, R. E., 2010, Well field resource optimization, six years of successful aquifer storage and recovery (ASR) cycles for the Delaware Coastal Plain: Sixth International Conference on Sustainable Water Environment, University of Delaware, Newark, Delaware, 10 p.

Demicco, P. M., Carbaugh, B. C., and Deputy, Morris, 2010, Detailed Hydrogeochemistry of rapid infiltration basins under normal and stressed recharged conditions in Middletown, Delaware: Sixth International Conference on Sustainable Water Environment, University of Delaware, Newark, Delaware, 10 p.

Mulhall, M, J., and Demicco, P. M., 2005, Evaluation of groundwater resources of the Sourland Mountain region of Central New Jersey: in Smart Growth Planning and Management Project for the Sourland Mountain, Sourland Planning Council, 59 p.

Demicco, P.M., Waters, B.B. and Rambo, D.E., 1998, Ground-water Modeling of the Coastal Plain Aquifers as a tool to map water resources for Water Allocation Permitting: 1998 Maryland State-County Water Symposium, Maryland Dept. of the Environment; Baltimore, Maryland; abs. with attachments.

Demicco, P. M. and Zinkevich, Andre, 1994, "Challenges of Aquifer Storage and Recovery (ASR) Applications in Sand and Gravel Aquifers": in *Proceedings of American Water Works Association Annual Meeting*, New York, New York pp 423-435.

Demicco, P. M. and Schmidt, C.A., 1988, "Groundwater Contamination Impacts on a Municipal Water Supply in a Fractured Media: Second National Outdoor Action Conference, NGWA, Las Vegas, Nevada, 23 p.

Groot, J.J., Demicco, P.M., and Cherry, P.J., 1983, "Ground Water Availability in Southern New Castle County, Delaware": Delaware Geological Survey Open File Report No. 23, 20 p.

Groot, J.J., Demicco, P.M., and Cherry, P.J., 1983, "Saturated Thickness of the Water Table Aquifer in Southern New Castle County, Delaware": Delaware Geological Survey Open File Report No. 24, Map with Discussion, Scale 1:24,000.

Groot, J.J., Demicco, P.M., and Cherry, P.J., 1983, "Saturated Thickness of the Columbia Formation in Southern New Castle County, Delaware": Delaware Geological Survey Open File Report No. 25, Map with Discussion, Scale 1:24,000.

Demicco, P. M., 1982, "Hydrogeology of the Southern Half of the Marydel Quadrangle, Delaware": Unpublished Masters Thesis, University of Delaware, 124p.

Record of Employment

2013- Present	Co-Owner Ground Water Associates, LLC, Newark Delaware
2011 – 2013	President, Demicco & Associates, LLC, Pittstown, New Jersey
2007 – 2012	Director of Ground Water Resources, Artesian Water Company, Newark, Delaware.
1999 – 2007	President and Principal Hydrogeologist, Demicco & Associates, Inc., Pittstown, NJ
1998 – 1999	Principal Geoscientist, McLaren/Hart, Inc., Warren, NJ.
1998 – 1998	Supervising Geoscientist, McLaren/Hart, Inc., Warren, NJ.

1989 – 1998	District and Technical Manager, Ground Water Associates, Inc., Bridgewater, NJ
1988 – 1989	Environmental Scientist, JCP&L Environmental Affairs Dept., Morristown, NJ
1987 – 1988	Project Manager, The Earth Technology Corporation, Somerset, NJ
1985 – 1987	Sr. Project Hydrogeologist, Ground Water Associates, Inc., Bridgewater, NJ
1983 – 1985	Project Hydrogeologist, Ground Water Associates, Inc., Westerville, OH
1982	Geologist, Delaware Geological Survey, Newark, DE
1980 – 1982	Teaching Assistant/Instructor, University of Delaware

ARTESIAN WATER COMPANY, INC. COMMENTS RE

Permit Modification Application of Delaware Recyclable Products, Inc. relating to DRPI Landfill, New Castle, Delaware

PART III

Comments by:

James F. Cloonan, P.E., LEED AP
Duffield Associates, LLC

Jeffrey M. Bross, P.E., LEED AP, F. ACEC
Duffield Associates, LLC

The DRPI Permit Modification Application "Part VI – Engineering Report" includes Appendix VI-A through Appendix VI-K, which provide the details and summary of Geosyntec's engineering evaluation, as well as the design drawings, technical specifications, and vertical expansion construction quality assurance plan. Duffield Associates reviewed the engineering analysis sections and drawing details and provides the following comments:

1) Leachate Collection system: Appendix VI-E "Leachate Management System Calculations" concludes that the existing or currently designed leachate collection system is adequate to handle the peak flow due to proposed vertical expansion. Application Drawings 8 and 9 detail the leachate collection system modifications and connection to the existing system required for the proposed Landfill expansion. No discussion or documentation is provided concerning the condition of the existing leachate collection system, which can be impacted by landfill settlement, leachate deposits, degradation, etc. A recent CCTV survey would be appropriate to document the vertical and horizontal alignment and hydraulic functionality of the existing system piping and to determine if additional improvements or maintenance of the leachate collection system is needed.

2) The Application notes that with the exception of a limited area of Cells 1, 2, and 3, the landfill is currently lined. Several appendices document the proposed new liner system materials and stability (relative to material strain, sliding and slope stability). Application drawing details indicate that the proposed new liner membrane will be welded to the existing liner. However, no information regarding design criteria, construction techniques and materials used for existing liner systems has been provided. To evaluate proposed tie-in to the proposed expansion system, this information should be appended to the application.

3) The geotechnical report, prepared by JCA in August of 1994, focused on a 28 acre area at the northwest corner of the 146 acre landfill. One of the borings performed encountered a thin layer of soft compressible soils. This area has received fill for many years and is outside where the bulk of future landfilled material will be placed. This soils compressible soil layer was not observed in the remaining test borings logs included with the 1994 report.

The shear strength estimates included in the JCA report were based on just 2 triaxial tests. After reviewing the SPT, N data from the numerous test borings logs included in the report, it appears that the shear strength estimates were underestimated and conservative. The strength parameters established from the two shear strength test (inadequate for a landfill of this size) were carried through in the Geosyntec subgrade stability analysis. Assuming the subsurface conditions observed in the JCA test borings

are consistent across the site, we agree that it does not appear that the stability of the subgrade will be an issue. However, there will be settlement (thus our concerns with the continued function of the currently existing leachate collection system).

As noted, one thing that is lacking is the establishment of engineering parameters for the greater area of the landfill. There is too much reliance on, and extrapolation of, the JCA data, which evaluated less than 20% of the proposed landfill area. Since the landfill is mostly lined and existing, it is too late to obtain this information using conventional standards of care and practice. That being said, a careful review and possible additional investigation/analysis is warranted given a) the limited geotechnical information presented across most of the landfill; b) the significant additional landfill height increase being proposed; and c) the projected significant consolidation resulting from the proposed vertical increase.

JAMES F. CLOONAN, P.E., LEED AP

Principal, Senior Consultant

Registration

Professional Engineer – PA, DE, NJ, MD

Education

M.C.E., Geotechnical Engineering, Drexel University, 1988

B.C.E., Virginia Polytechnic Institute and State University, 1984

A.S., Civil Technology, Broome Community College, 1979

B.A., Geography, SUNY State University College at Geneseo, 1974

Memberships

American Society of Civil Engineers

American Society for Testing and Materials

Unique Strengths:

- ABC
- XYZ

Background/Skill Set

Mr. Cloonan is former Director of the Geotechnical & Foundations Division. He has been with the firm for over 30 years. As a Senior Consultant, Mr. Cloonan is responsible for coordination of the Company's design-build projects, contract development, and client interface. He is also responsible for the firm's geosynthetic (geomembrane, geotextile and geogrid) projects. Project Manager responsibilities include all phases of site development, construction management, subsurface soil condition analysis, report preparation, and construction review for the purpose of foundation, pavement and earthwork design and construction, and materials testing. Mr. Cloonan previously managed Duffield Associates' AASHTO and U.S. Corps of Engineers Certified Materials Testing Laboratory. Mr. Cloonan has performed geotechnical and pavement forensic evaluations and regularly provides QA/QC for geotechnical designs and evaluations and multidiscipline projects. Since 1996, Mr. Cloonan has been the primary geotechnical and construction services contact for Duffield Associates' services contract with the State of Delaware Division of Facilities Management. His past responsibilities have included managing Duffield Associates, Inc. previous Cecil County, Maryland office.

Selected Projects

Construction Quality Assurance Officer, Cecil County Central Landfill, MD

Duffield Associates was retained by Cecil County Department of Public Works to provide full-time on-site administrative and technical review, in addition to quality assurance testing, during Cell No. 5 municipal landfill construction. Construction included a composite clay, clay/geosynthetic; and 50-mil PVC geomembrane liner system. Mr. Cloonan's responsibilities included supervision of Duffield Associates' field personnel, coordination of laboratory testing, and report preparation.

Project Manager, Industrial Waste Sludge Landfill, Columbia, MD

Duffield Associates was retained by the owner (and owner's engineer) to review the construction of clay cap required for closure of an industrial waste sludge disposal site. Mr. Cloonan supervised the personnel who were responsible for reviewing the construction of the clay cap and providing quality assurance. Duffield Associates also provided geotechnical consultation to the owner, documentation of construction activities, and interface between the contractor, owner and design team.

Project Quality Assurance Officer, Star Enterprise Industrial Waste Landfill, Delaware City, DE

Mr. Cloonan served as Project Quality Assurance Officer responsible for design of the geosynthetic liner components and technical specification preparation components for the 800,000 cubic yard industrial landfill at this mid-Atlantic oil refinery. Design included a double HDPE liner with clay/geosynthetic under liner at stress concentration points. The cap design was a combination of clay and PVC liners. Mr. Cloonan functioned as Construction Quality Assurance Officer during project construction.

Senior Geotechnical Engineer , Dredge Material Stabilization & Management, Texas
Slope failure of a section of perimeter dike at a dredge material containment facility in Texas resulted in the release of more than 100,000 cubic yards of recently placed dredge material. Duffield Associates was contracted by the site remediation lead engineer, a marine engineering firm, to provide geotechnical engineering consultation. Mr. Cloonan has coordinated the test boring program, laboratory testing and engineering analysis of the failure area as well as the remaining perimeter dikes. Recommendations have been provided concerning dike stability, failure area repairs and the managed use of the facilities, which has been in operation since the 1940s, for the future placement of dredge material.

Sr. Project Manager, ACF Environmental, DE, FL, MD, CT, VA, MD, PA, NY, NC, NJ, MA, ME, OH, DC
ACF Environmental, Inc. is an east coast supplier of geosynthetic materials (geotextiles, geogrids, geocells, geomembrane liners, geofoam, articulating concrete blocks, etc.). As part of their "full service" approach, ACF is often requested to provide value engineering design services for their geosynthetic applications. For over 20 years Duffield Associates and Mr. Cloonan have provided engineering consultation and design services to ACF concerning geotechnical issues and geosynthetics applications. At Duffield Associates, Mr. Cloonan has either designed or supervised the design of over 100 projects for ACF including, mechanically stabilized retaining structures, geosynthetic liners, slope protection, temporary access over marsh areas, streambank stabilization, geocells, dam spillways, geofoam fills, among others.

Project Manager, Star Repowering Project, Delaware City, DE
Duffield Associates was retained by the project design-builder to provide the geotechnical evaluation for a coke-fired, electric generation facility. Various structures constructed as part of this facility included a gas separation unit, power block, acid gas removal unit, gasification structure, elevated ball mill, process tower, cooling tower with 23-foot deep sump area, and miscellaneous underground piping. Based on the observed subsurface conditions, Duffield Associates provided recommendations to assist in the design of conventional, shallow, spread and mat foundation systems bearing at varying depths for increased allowable bearing capacity. In addition, Duffield Associates also provided soil parameters to assist in designing foundations subject to dynamic loading conditions.

Project Engineer, Cherry Island Utility Corridor, Wilmington, DE
Mr. Cloonan served as geotechnical project engineer team member in the design and implementation of an instrumentation program to evaluate the subsurface conditions related to dike instability at the existing Cherry Island dredged materials disposal area operated by the Army Corps of Engineers. Instrumentation was installed by Duffield Associates in two phases, in the vicinity of electric transmission Tower 13 and along the I-495 petroleum pipeline utility corridor, to monitor the effects of ongoing Corps of Engineers dredged materials and dike construction. The instrumentation consisted of 5 inclinometers, and 20 piezometers.

Project Manager, Engineering Report and Design Services, Toledo Express Airport, Toledo, OH
This project included field observations and comments concerning the existing secondary containment concrete pad at a jet fuel storage facility located at the Toledo Express Airport. Duffield Associates was retained because of the possibility of fuel entering the soil though cracks in the concrete containment pad. Recommendations were made and design services provided.

Project Manager, Stevensville Elevated Water Tank, Queen Anne's County, Maryland
Mr. Cloonan provided a geotechnical evaluation for this proposed 250,000 gallon elevated water storage tank. As part of this evaluation, Duffield Associates developed foundation alternatives for supporting the proposed tank over approximately 150 feet of soft, under consolidated clay soils. The tank was ultimately designed to be supported by a deep foundation system. These services were provided by Duffield Associates as a subconsultant to McCrone, Inc.

Project Manager/Design Engineer, Streambank Stabilization, Old Public Road, DE
Stormwater discharge from suburban development resulted in the creation of a narrow, steeply incised drainage swale up to 10 feet deep and 500 feet long through 3 residential properties in a west New Castle County community, creating a safety concern. Working with the New Castle Conservation District, Mr. Cloonan developed the design and construction documents to mitigate this erosion problem. Competed in 2013, the solution included a combination of rock check dams, regrading, riprap bank stabilization and vegetated slopes.

Project Manager/Design Engineer, Streambank Stabilization, Little Mill Creek, Newport, DE
Upland storm events regularly cause high stream flows along the Little Mill Creek and downstream erosion where the Creek passes through an industrial park constructed over non-engineered fills including incinerator ash. Working with the New Castle Conservation District, Mr. Cloonan prepared the design and construction documents for the stabilization of the 15' high embankment where erosion was undermining the foundations of an industrial building. The helical earth anchor and stone-filled geocells solution continues to maintain the stability of this stream bank 15 years after installation.

Project Manager/Design Engineer, Streambank Stabilization White Clay, Delaware Park, Wilmington, DE
Duffield provides a wide range of engineering services for Delaware Park. The White Clay Creek, which passes through the Park, regularity floods, eroding stream banks and areas of the Park. For over 15 years, Duffield has coordinated permitting, design and construction with the goal of stabilizing streambanks while minimally impacting the Creek. This has included a wide array of techniques including rock vanes and weirs, boulders and log vanes, native vegetation and geosynthetic solutions. Currently Mr. Cloonan is preparing the construction documents for stabilizing four stream bank areas severely eroded by a May 2014 storm event.

Senior Consultant, Engineering Assessment of Infiltration Testing Guidelines & Practices, Philadelphia, PA
Mr. Cloonan performed a study of existing infiltration practices to assist the Philadelphia Water Department (PWD) in developing an enhanced infiltration test guidance document for PWD personnel. This study considered the concerns of PWD, the current Philadelphia Stormwater Manual, infiltration practices in other urban areas and States, and field infiltration testing performed as part of this study in preparing conclusions and recommendations for developing an enhanced infiltration test guidance document. In evaluating project infiltration test results, PWD has observed a wide variation in testing procedures, equipment, and report formats within approved test methods resulting in difficulty in assessing the adequacy or validity of reported infiltration rates. Other complexities include variations between adjacent infiltration testing performed at the same site, the impact of construction on "preconstruction" determined infiltration characteristics, and the highly variable and often disturbed soils of urban Philadelphia. The findings and conclusions of this study were summarized in a draft report currently under review by PWD.

Senior Geotechnical Engineer, Assessment of Infiltration Testing Guidelines & Practices, Philadelphia Streets
Mr. Cloonan preformed a study to assist the Philadelphia Water Department (PWD) in developing an enhanced infiltration test guidance document for PWD personnel. In evaluating project infiltration test results, PWD has observed a wide variation in testing procedures, equipment, and report formats within approved test methods resulting in difficulty in assessing the adequacy or validity of reported infiltration rates. This study considered the concerns of PWD, the current Philadelphia Stormwater Manual, infiltration practices in other urban areas and States, and field infiltration testing performed as part of this study in preparing conclusions and recommendations for developing an enhanced infiltration test guidance document. Results of the study were presented to PWD in a training seminar and a draft report summarizing our conclusion recommendations concerning report standardization, requiring site geotechnical evaluations, and modifications and standardization of field infiltration test methods.

Project Manager, New Dover High School, Kent County, DE (2014)
Geotechnical evaluation for the new three-story high school encompassing a total footprint of approximately 235,000 square feet, a one-story field house and remote athletic structure both encompassing footprints of approximately 10,000 square feet each, associated driveways and parking areas, and stormwater management facilities.

Senior Geotechnical Engineer, Wissahickon Charter School, Philadelphia, PA (2014)
Old industrial site consisting of disturbed urban fill and numerous rock outcrops. Mr. Cloonan was Senior Geotechnical Engineer for site geotechnical evaluation and consultation to the design team during design development and construction planning.

Senior Geotechnical Engineer, Polytechnic High School Additions, Kent County, DE
Evaluated site pavements and provided pavement and maintenance improvement alternatives implemented as part of recent major school construction.

Senior Consultant, Longwood Gardens East Conservatory Plaza Addition, Kennett Square, PA (2011)
Duffield Associates provided geotechnical engineering and Construction Review Services for an approximately 180-foot-long addition connected to the conservatory vestibule including 18 restroom "pods". Duffield Associates also provided consultation on the terraced lawn surrounding the plaza.

Senior Geotechnical Engineer, Leeds Road Bridge Replacement, Cumberland County, PA (2008)
The Leeds Road Bridge, a 2-lane single span bridge over the Yellow Breeches Creek in Penn Township, was replaced with a reinforced concrete box culvert structure, approximately 25-feet long, and small wing walls. Duffield Associates provided a subsurface evaluation and recommendations for the foundation system.

Principal-in-Charge, Acorn Lane Pump Station, Dover, DE
Duffield Associates performed a geotechnical evaluation for the proposed Acorn Lane Pump Station to be located in Dover, Delaware. The pump station consists of a one-story building with an 8-foot diameter well that is 22-feet deep. Based on the data from the test borings performed, Duffield Associates developed design recommendations for the well and building. Due to shallow groundwater conditions and sand stratigraphy, design and construction recommendations to manage potential "quick" sand conditions and buoyant "uplift" forces were provided.

Senior Geotechnical Engineer, Stones Throw Pump Station, Wilmington, DE
Duffield Associates performed a geotechnical evaluation for the proposed Stones Throw Pump Station to be located along Old Cooches Bridge Road, south of Newark, Delaware. The pump station consists of a one-story building with an 8-foot diameter well that is 25-feet deep. Based on the data from the test borings performed, Duffield Associates developed design recommendations for the well and building. Due to shallow groundwater conditions and sand stratigraphy, design and construction recommendations to manage potential "quick" sand conditions and buoyant "uplift" forces were provided.

Senior Consultant, BL England Solar Array, Beesley's Point, NJ (2010)
Duffield Associates provided stormwater management design and analysis for the proposed BL England Solar Array to be located at the former BL England Golf Course, which is adjacent to the BL England Power Generating Facility. The proposed development included the conversion of the existing golf course into an alternative energy, solar energy facility, along with a publicly accessible "Solar Park" area for daytime educational and recreational use. Mr. Cloonan consulted on site geotechnical issues and provided senior QA review and comment on permit drawings before issue.

Senior Geotechnical Engineer, Tri-M Headquarters Solar Farm Subsurface Evaluation, Kennett Square, PA (2010)
The Duffield Associates' team performed a subsurface evaluation for design of this proposed solar farm site. The purpose of these services was to review the subsurface stratigraphy in the general area of the proposed solar panel arrays and provide Tri-M with soil strength parameters to be utilized for foundation design.

Senior Geotechnical Engineer, Carlisle Area School District 1 MW Solar Photovoltaic Facility, Chambersburg, PA (2009)
It was proposed to construct an approximately 1-megawatt (MW) solar photovoltaic facility to the north of the existing elementary school. Duffield Associates had previously performed 22 standard penetration test borings and 278 auger probes as part of the geotechnical evaluation for the existing elementary school. The subsurface information from this evaluation was used to develop the design and construction recommendation for a deep foundation system socked in limestone bedrock for support of the solar panel system.

Project Manager, Geotechnical Evaluation Laurel Public Library Addition, Laurel, DE (2004)
This project included geotechnical consulting services for this two-story, 18,700-square-foot building addition. The purpose was to evaluate the subsurface conditions at the site of the proposed addition to the existing Laurel Public Library and provide recommendations for the design and construction of its foundations.

Project Manager, City of Vineland Substation Oil Spill Containment, Vineland, NJ (2010)
On this project, Mr. Cloonan served as Project Manager for the design of an oil spill containment structure for the Central Substation transformer in the City of Vineland. This was part of the city's update to their individual substation Spill Prevention Control and Countermeasure (SPCC) Plans.

Sr. Geotechnical Engineer, Bosler Library Addition, Carlisle, PA (2010)
Mr. Cloonan was responsible for the geotechnical evaluation for the proposed addition to the Bosler Library. The project included the evaluation of the subsurface conditions and recommendations for the design and construction of the building foundations and slab-on-grade to be constructed over soft residual soils overlying karst (limestone) geology subject to "sinkhole" development. The two-story addition was proposed to be constructed in the existing at-grade parking lot and driveway.

Principal-in-Charge, University of Pennsylvania New Bolton Center Equine Arena, Kennett Square, PA
Mr. Cloonan served as Principal-in-Charge for the construction review services for a new 9,900 square-foot equine riding arena at the University of Pennsylvania New Bolton Center. Duffield Associates' scope included subgrade review, laboratory testing, review of fill placement, review of reinforcing steel, review of reinforcing concrete, structural timber review, construction consultation and documentation.

Principal-in-Charge, Edward H. Rosen Center for Jewish Life at Temple University, Philadelphia, PA
Mr. Cloonan served as Principal-in-Charge for the review of construction activities during the construction of a new student center at Temple University. The scope included review of construction activities for three tier tie-back underpinning system of the adjacent structure to facilitate basement construction using helical anchors; structural fill placement and earthwork construction; foundation construction including review of foundation subgrade soils; reinforced concrete placement throughout "cold weather" conditions; laboratory testing of soils, concrete, mortar, and grout; masonry construction; structural steel erection; light gauge steel construction; and spray-applied fire-resistive material construction.

Principal-in-Charge, University of Delaware Interdisciplinary Science & Engineering Building (ISE), Newark, DE
Mr. Cloonan served as Principal-in-Charge for the geotechnical engineering and construction review services at University of Delaware for the new ISE Building. Construction Review Services included review of the deep foundation, site excavations, structural fill placement, reinforced concrete, floor flatness testing, waterproofing membrane application, structural steel, and masonry construction.

Principal-in-Charge, Indefinite Delivery Contract for State of Delaware Division of Facilities Management (DFM), Statewide, DE
Mr. Cloonan has served as Principal-in-Charge for Duffield Associates' open-ended contract with DFM for the past 15 years. He has overseen engineering and construction services for dozens of tasks under this contract. Construction services have varied from full service review to providing Resident Project Representatives, responsible for all aspects of successful project completion, at three building development sites.

Principal-in-Charge, Delaware State University Optical Science Center for Applied Research, Dover, DE
Mr. Cloonan served as Principal-in-Charge for the geotechnical engineering and construction services for the new 27,000 square-foot, $23 million building. Construction Review Services included site excavation and fill placement, auger-cast pile load testing, auger-cast production pile installation, elevated slab construction, structural steel erection, masonry construction, spray-applied fireproofing, certified construction review, and pavement construction.

Principal-in-Charge, University of Delaware Life Science Research Facility, Newark, DE
Mr. Cloonan served as Principal-in-Charge for the geotechnical engineering and Construction Review Services for the new two-story multidisciplinary research facility at the University of Delaware. Construction Review Services included the review of site excavation and fill placement, reinforced concrete construction, elevated slab construction, structural steel erection, masonry construction, subsurface stormwater management facility installation, and pavement construction.

Principal-in-Charge, Pennsylvania State University Freshman Housing, Harrisburg, PA
Mr. Cloonan oversaw the geotechnical investigation and engineering as well as the Construction Review Services for the construction of a 101-unit, four-story freshman dormitory on the Harrisburg Campus. Duffield Associates oversaw the construction review for this project, including laboratory testing, review of earthwork construction and compaction

testing, review of footing and slab subgrade conditions, reinforcing steel review, concrete review and testing, structural masonry review, pre-cast structural concrete plank review, structural steel review, construction consultation and documentation.

Project Manager, Public Archives Building, Dover, DE (2001)
During construction of the new State of Delaware Public Archives building, services provided included review of auger-cast pile installation, concrete construction, and site work activities for conformance with contract documents. In addition, Duffield Associates provided environmental consultation during coordination with the state regulatory agencies and the removal of environmentally regulated soils. Duffield Associates also provided specialized construction review and structural engineering services for the improvements to the adjacent existing archives building.

Geotechnical Engineer, Assessment of the Suitability of Infiltration Practices in Philadelphia Streets, PA
Duffield Associates provides Philadelphia Water Department (PWD) with geotechnical consulting services on a variety of projects, including providing opinions of geotechnical reports submitted as part of the stormwater review process, and performing an evaluation of infiltration criteria. Mr. Cloonan, Senior Geotechnical Engineer, performed a study evaluating the increased use of infiltration practices on Philadelphia streets, primarily to reduce the frequency of combined sewer overflows (CSOs). The study included a review of existing data provided by PWD and identified through a literature search. Based on our evaluation of that data, we prepared a draft report summarizing our professional opinion regarding specific criteria which could be applied on a city-wide basis to identify areas where infiltration is not recommended. In areas that we considered acceptable for infiltration, the draft report also provided guidelines and procedures for further consideration.

Senior Consultant, Assessment of the Suitability of Infiltration Practices in Philadelphia Streets, PA
Mr. Cloonan performed a study evaluating the increased use of infiltration practices on Philadelphia streets, primarily to reduce the frequency of combined sewer overflows (CSOs). The study included a review of existing data provided by PWD and identified through a literature search. The draft report summarized our professional opinion regarding specific criteria for field evaluation as well as guidelines to identify areas where infiltration is not recommended.

Project Manager, Geotechnical and Construction Review Services, Various Fire Stations
Mr. Cloonan has been the Project Manager for geotechnical and Construction Review Services for new buildings and building additions at fire stations and fire training facilities throughout the mid-Atlantic region.

Project Manager, Sussex County Division of Motor Vehicles (DMV) Building Flooring Review, Georgetown, DE (2008)
Shortly following construction, the DMV building began experiencing peeling carpet tiles throughout the building. An engineering evaluation, including test cores through the building slab, revealed that moisture was being trapped in a sand layer between the bottom of the floor slab and the slab vapor barrier. Repairs to the carpet tile system required consideration of the increased moisture vapor pressure environment.

Project Manager, Sussex County Division of Motor Vehicles (DMV), Georgetown, DE (2005)
Duffield Associates provided geotechnical and construction review consulting services for the new Division of Motor Vehicles (DMV) facilities. The new DMV facilities consist of two, one-story slab-on-grade structures, including an office and administration structure and an inspection lanes building located adjacent to the existing DMV facilities. Following completion of the inspection lanes building, the existing DMV facility was demolished.

Senior Consultant, New Jersey Dam Failures, Burlington County, NJ
Mr. Cloonan provided engineering consulting and expert witness services as part of a class action suit concerning the failure of multiple earthen dams in this central New Jersey community. A significant rain event in July 2004 resulted in the failure of over 20 earthen dam structures. As part of the services provided, Mr. Cloonan evaluated the dam structures in the field, reviewed the history of their construction, maintenance and inspection records, available USACE Phase I Inspection Reports, FEMA Taskforce findings, compliance with State inspection and maintenance requirements, and the probable causes of their failure and prepared an expert summary report.

Project Manager, Delaware Emergency Management Agency (DEMA) Center
Within five years following construction the Delaware Emergency Management Agency Center, DEMA began experiencing water intrusion around the perimeter of the structure located adjacent to wetlands in Smyrna, Delaware. Field evaluation by Duffield Associates revealed that the discharge location for the building's perimeter under-drain system had become clogged with vegetation. As-part of our "turn key" services, Duffield unclogged the system and installed surface access clean-outs to address future concerns.

Project Manager, Forensic Mental Health Facility, Herman Holloway Center, Wilmington, DE
A newly constructed building for the criminally insane at the Herman Holloway Center in Wilmington, Delaware was experiencing flooring problems throughout the building. A site evaluation and review of the design documents by Duffield Associates revealed that water from the roof drains was being introduced to the coarse-grained sand backfill underlying the building. Moisture was subsequently being introduced in the building through the differential in vapor pressure induced by the HVAC system. Following completion of this study, efforts were initiated by the owner to alleviate this problem.

Project Manager, PHI Transformer Containment Project, Mid-Atlantic Region
PHI was in the process of installing oil containment for approximately 294 substation transformers located in 150 substations of the PHI services territory. Mr. Cloonan served as Project Manager and technical supervisor during field review and design document preparation of the containment structures.

Project Manager, Newark High School Gymnasium, Newark, DE (2007)
The gymnasium floor within this several decade old building had regularly been experiencing "bubbling" of the membrane floor which had been installed on a concrete slab installed over the original wood flooring system. A site evaluation by Duffield Associates indicated that water intrusion from outside the building was unlikely. In addition, several concrete cores were obtained through the floor and into the subsurface soils and high moisture conditions were not observed. It was concluded that oxidation of steel angles installed along the control joints in the concrete slab coupled with expansion and contraction in the concrete slab likely resulted in the observed flooring problems. Based on this, the architect initiated design for improvements.

Senior Project Manager, New Castle County Courthouse, Wilmington, DE (2003)
Mr. Cloonan was responsible for the geotechnical, environmental and construction services for a new, approximately 550,000 square-foot, 12-story courthouse in downtown Wilmington. Test borings revealed highly variable site conditions including a layer of miscellaneous fill and debris overlying interlayered silt, clay, sandy soils, and terminating bedrock. After evaluating a number of foundation alternatives, Duffield Associates recommended a deep foundation system bearing on the "Brandywine Blue Granite" bedrock. A concrete-filled steel pipe pile system was selected for the project.

Project Manager, Delaware Correctional Center Expansion Project, Smyrna, DE (1998)
Mr. Cloonan served as Project Manager for Construction Review Services at this site involving extensive infrastructure expansion and construction of numerous buildings. Duffield Associates also assisted DAS/DFM with review of the design team foundation drawings and determination of approximate mix design and testing procedures for the flowable fill. Additional services directed by Mr. Cloonan included review of the site contractor quantities and "Request for Payment", and certified construction review (CCR) of the site sediment and erosion control procedures for conformance with DNREC requirements.

Project Manager, Hearns Pond Dam Break, Sussex County, DE
An 8-inch storm event caused a 100-foot breach in this 400-foot long earthen dam draining the pond, causing significant damage to the mill's intake structure, and eroding a downstream highway. Responding to an emergency request by DNREC, engineers from Duffield Associates were on site within hours of the breach to evaluate the failure. The dam's owner, DNREC's Division of Fish and Wildlife, authorized Duffield Associates to prepare construction documents for the emergency repair of the breach. This project was designed, constructed and returned to service in record time and within budgetary constraints. Mr. Cloonan was the Project Manager on this award-winning project.

Project Manager, Christiana Executive Campus, Stanton, DE
As Project Manager, Mr. Cloonan was responsible for supervising review of the earthwork construction, site preparation, installation of utilities, and construction of foundations for a $30 million project consisting of four multi-story office buildings and a four-story hotel on a 21-acre site. The highly heterogeneous sand and silt materials encountered, along with the relatively large cuts and fills required for the structures, created challenging earthwork conditions. Testing services provided by Duffield Associates included earthwork monitoring, concrete testing, and steel construction review. Mr. Cloonan was also responsible for preparing the subsurface evaluation for this multi-phase project prior to final building design and construction activity.

Project Manager, White Clay Creek Golf Course, Wilmington, DE
Duffield Associates provided a wide range of engineering services for this new golf course. Stormwater ponds were proposed to be used to retain water for turf irrigation. Based on the findings of a detailed subsurface evaluation, Duffield Associates' team of engineers recommended the construction of a bentonite clay slurry trench around the pond perimeters. Mr. Cloonan oversaw the geotechnical evaluation, slurry wall design and contract document preparation, and construction review services.

Project Manager, State of DE Emergency Operations Center and Transportation Management Center, Smyrna, DE
Mr. Cloonan was responsible for the geotechnical, resident project engineer and construction services for the Delaware Emergency Operations Center (EOC) and the new Transportation Management Center (TMC) complexes. The geotechnical evaluation performed by Duffield Associates for the new EOC indicated a deep deposit of soft compressible soils underlying the proposed building area. Following the review of general foundation alternatives, Duffield Associates recommended supporting the building with a reinforced concrete mat foundation, bearing over the soft soils, as a practical and cost-effective alternative to a deep pile foundation. During earthwork activities and concrete construction, Duffield Associates also provided construction review and consulting services.

Project Administrator/Principal-in Charge, Glenville Flood Abatement Design/Build, Stanton, DE (2006)
The Glenville project was a complex, multi-phase effort involving the demolition and removal of flood-damaged houses in the former Glenville subdivision, construction of wetlands and flood storage, and redevelopment of the remaining portions of the subdivision and the neighboring Pipefitter's Union Hall property. This design/build project was a cooperative effort between New Castle County and DelDOT. Duffield Associates successfully coordinated the FEMA grant applications. Permitting requirements for this project included historical studies, USACE permitting, flood studies, extensive community interfacing, and coordination of all contractors and development of future funding and management of construction over several years. This was a landmark project that included the demolition of 160 houses.

Project Administrator/Principal-in Charge, Emily Bissell and Delcastle Stormwater Management, Wilmington, DE
Duffield Associates was retained by New Castle County following the county-wide flooding event of September 2004 to participate in and manage a flood mitigation program. Mr. Cloonan oversaw a team that included our internal water resource, geotechnical, and environmental engineers and scientists as well as two engineering sub-consultants and a contractor. Duffield Associates responded on an emergency basis to catalog reported flooding conditions, conceptually identify solutions and associated estimated costs, and assign priorities for future remediation. A substantial public outreach program was undertaken to supplement government records of flooding, understand historical flooding patterns, and gauge public support for various solutions. Simultaneously, Duffield Associates reached out to the local, state and federal regulatory agencies to establish protocols for permitting the proposed improvements, with significant attention placed on operating under pre-existing "blanket" permits, or similar permits, with some modification. The extent of permitting duration was factored into prioritization.

Project Administrator/Principal-in Charge, Tweeds Park, Hockessin, DE (2008)
Duffield Associates was retained to assist the Delaware Department of Transportation in planning, designing, and constructing a recreation park that includes the addition of multi-purpose athletic fields and the relocation and restoration of the historic two-story Tweed's Tavern dating from 1796. Duffield Associates provided "Green

Technologies" for control of the runoff from the park and upland drainage basin, such as reforestation, wetlands creation, bio-retention and bio-swales. This design-build park project consisted of an historic tavern, a regional stormwater management facility, three multi-purpose athletic fields, a Tot-lot, parking and access improvements for adjoining properties. Project components also included Phase I and II Environmental Site Assessments; coordination of permitting and interface with local, state, and federal authorities, including the historic review board; selective demolition of the 1970's structure encapsulating Tweeds Tavern; and overall site development and construction management.

Senior Consultant, Rockland Mills Condominium, Wilmington, DE
Coordinated the design and preparation of construction documents for construction of new waterproofing membrane and paver system for the elevated access walkway to the residences located in this historic mill structure. In addition, provided design recommendations for new column supports for the deteriorating mill structure. Designed and coordinated the infill of abandoned basement areas with "flowable fill" alleviating decades of flooding from the adjacent Brandywine River.

Project Designer, Building Rehabilitation, Newark, DE
Principal-in-Charge for the evaluation and reclamation of former retail businesses converted to restaurant use. The deteriorated flooring system of the water damaged building was infilled with "flowable fill." The remainder of the brick building was cleaned, repointed and painted to improve water resistance of the building envelope on this rapid design-build project. Mr. Cloonan was project administrator and principal designer.

Project Manager, Geotechnical Evaluation, Newark Senior Center, Newark, DE
Mr. Cloonan oversaw the geotechnical evaluation for an addition to the Newark Senior Center. Duffield Associates provided field and laboratory testing programs and provided recommendations for the design and construction of the foundations, floor slabs, and basement for the proposed building additions.

Senior Engineering Consultant, Mosaica Charter School, Wilmington, DE
Services included the subsurface evaluation for the temporary and permanent school structures. Design recommendations, based on the evaluations, were made for deep pile foundations for both buildings.

Project Manager, Downes Elementary School, Newark, DE
Duffield Associates provided design services including site and stormwater management. Construction services included overseeing the bid review process, reviewing contractor submittals and proposed alternates, reviewing installation and construction procedures, and addressing technical and engineering questions.

Project Manager, Friends School, Wilmington, DE
Mr. Cloonan served as Project Manager for subsurface evaluations of building additions at this private school.

Project Engineer/Manager, Ferris School Additions, Wilmington, DE
Mr. Cloonan oversaw the geotechnical engineering and Construction Review Services for numerous campus building additions for Ferris School.

Project Manager, Police Athletic League, Wilmington, DE
Mr. Cloonan was responsible for the geotechnical evaluation and Construction Review Services for this two-story building, approximately 30,000 square feet in plan area to be used for youth programs.

Project Manager, Smyrna Opera House Restoration, Smyrna, DE
The former Smyrna Opera House consists of a two-story brick masonry building constructed in the late 1860's. Proposed restoration included reconstruction of a third story destroyed by fire in 1948 and conversion of this historic landmark structure into a multipurpose community center. Duffield Associates evaluated the existing foundation system of the aging building and developed recommendations for restoration including site improvements and underpinning of the brick foundations.

Engineering Consultant, ACF Environmental, Inc.
ACF Environmental, Inc. (ACF) is an East Coast supplier of geosynthetic materials (geotextiles, geogrids, geocells, geomembrane liners, etc.). As part of their "full service" approach, ACF is often requested to provide value engineering design services for their geosynthetic applications. For over 20 years, Duffield Associates and Mr. Cloonan have provided engineering consultation and design services to ACF concerning geotechnical issues and geosynthetic applications. At Duffield Associates, Mr. Cloonan has either designed or supervised the design of over 100 projects for ACF including mechanically stabilized earth walls, geosynthetic liners, temporary construction roads over marsh areas, streambank stabilization, and geocells, among others.

Project Manager, Ronald McDonald House, Wilmington, DE
The full basement of this facility encountered significant groundwater seepage and post-rain-event flooding soon after construction. Duffield Associates provided post-construction site evaluation and design services which resulted in the construction of an interceptor trench along one side of the building, the installation of two high-capacity sump pumps with back-up electrical and alarm systems, and various site and building improvements.

Sr. Consultant/Reviewer, School Additions, Cecil County, MD
Mr. Cloonan provided senior review services for the geotechnical engineering evaluation on North East Elementary and Bainbridge Elementary School additions. The team developed recommendations for support of the building foundations on a shallow foundation system.

Project Manager, Geotechnical Consulting Services, Palmetto Management & Engineering, Singapore, China & Brazil
Since 2004, Duffield Associates has provided engineering consulting services to Palmetto Management & Engineering on projects involving the overseas development of new textile facilities and improvements to existing facilities. Services provided have included the preparation of engineering specifications for the solicitations of geotechnical evaluations, the review of engineering proposals, and the review of geotechnical evaluation reports for specific improvements or additions at these sites. The services provided have included existing or proposed facilities in Singapore; Shanghai and QuingPu, China; and Paulina, Brazil.

Project Manager, Riverfront Market, Wilmington, DE
More than 100 years ago, several "temporary" warehouses were constructed on the soft sediments along the Christina River in Wilmington, Delaware. These structures were targeted for preservation as part of a program to revitalize the riverfront area. Duffield Associates was retained to identify effective solutions to develop stable foundations for these historic structures. Our engineers performed extensive subsurface evaluations to determine the type and condition of the existing foundations. A variety of application-specific foundations were designed to stabilize the existing structures and support new construction. Mr. Cloonan oversaw the evaluation and construction phases of this unique project.

Geotechnical Engineer, Oil Recovery Berth and Support Facilities, DE
Mr. Cloonan served as Geotechnical Engineer for this new berth on the Delaware River for a 240-foot long oil spill recovery vessel. He was involved in the geotechnical design of a 200-foot anchored sheet pile bulkhead and dock; a dredging study; dredging analysis of the Delaware River; geotechnical design of reinforcement for an adjacent sheet pile bulkhead; design of the proposed onshore warehouse and support facility; and an analysis of dredge material disposal area.

Project Manager, Chiquita Brand Maintenance Facility, Port of Wilmington, DE
Mr. Cloonan served as Project Manager during the subsurface evaluation, site preparation, and foundation construction for the Chiquita Brands maintenance terminal at the Port of Wilmington. This facility was constructed on a shallow foundation system consisting of a reinforced concrete mat, supported by a layer of compacted structural fill over an area of highly compressible river sediments in excess of 100 feet in depth. The site was preconsolidated following the installation of over 1000 wick drains and a 25-foot surcharge, including over 10 feet of settlement. Mr. Cloonan was responsible for designing and implementing a geotechnical instrumentation monitoring program as part of construction.

Project Manager, Motiva Refinery Coke Storage Area, Delaware City, DE
In 1999, Motiva Oil Refinery developed a previous soil borrow area for the storage of petroleum coke, an industrial by-product of the refining process. Duffield Associates provided the geotechnical evaluation, site design, and construction review services for the 500,000 ton capacity project. To maximize capacity, numerous areas of the interior slope of the containment area were steepened and designed to be stabilized with multiple layers of geotextile materials. Due to the fine grained, highly erodible characteristics of the petroleum coke, the exterior slopes of the containment berms were stabilized with a permanent synthetic erosion control mat. ACF Environmental provided the geosynthetic materials.

Project Manager, Neutralization Study, Courthouse Point, Cecil County, MD
A previous evaluation of sediments dredged from the C&D Canal indicated potential for formation of acid leachate as a result of oxidizing of sulfites in the sediment. Due to the potential detrimental effect on ground water quality, the Army Corps of Engineers authorized Duffield Associates to obtain and analyze samples of dredged material from the Courthouse Point Containment Area, as well as material from the C&D Canal. Mr. Cloonan coordinated the effort to obtain and analyze samples and develop guidelines for neutralization during dredging events or facilities maintenance.

Geotechnical Project Engineer, Energy Generating Station Instrumentation, NSWF-1, New Castle, DE
Project geotechnical engineer for the geotechnical-related design and earthwork/foundation construction of a 105,000 square-foot, $60 million plant at NSWF-1 (Pigeon Point). Project included the construction of embankments as high as 25 feet over soft soils, using vertical drains to accelerate consolidation. Responsible for the design, field installation and monitoring of instrumentation which included 9 piezometers, 5 Borros points, and 6 settlement plates. Interpreted data and prepared recommendations. Decisions on surcharge removal and construction sequence were made as a result of Duffield Associates' recommendations.

Project Manager, Barley Mill Road Dam Study, Wilmington, DE
Services for this 29-foot high earthen dam included field reconnaissance, including the visual review of the embankment and spillway, Standard Penetration Test (SPT) borings through the earthen dam, as-built measurements of the dam, and concrete test cores along the spillway structure. Duffield Associates' engineers developed a report including alternatives for improving the stability of the dam and development of a dam maintenance program along with recommendations/design sketches for repair of the deteriorated joints and localized spalled and undermined areas of the concrete spillway.

Project Manager/Design Manager, Nemours Dam Restoration, Wilmington, DE
The project included evaluation of the 25-foot high stone masonry dam's stability and environmental evaluation of accumulated sediments from the adjoining reservoir. The evaluation concluded that the dam was stable, but required maintenance including structural crack filling and repointing. The reservoir's capacity was restored through excavation of the accumulated sediments. Duffield Associates provided complete evaluation and design services including preparation of construction drawings and specifications. Duffield Associates received the Delaware Consulting Engineers' Merit Award for this project.

Principal-in-Charge/Senior Consultant, DNREC Dam Inspections, DE
Duffield Associates was retained by the Delaware Department of Natural Resources and Environmental Control (DNREC) to provide inspections for six dams considered to be significant hazard structures. Services included data collection, visual review, photo documentation, and a dam inspection report for each dam, along with recommendations for maintenance and an emergency action plan.

Project Engineer/Project Manager, Rockland Mills Dam, Wilmington, DE
This project included a feasibility evaluation and recommendations for repairs to the existing Rockland Mills Dam on the Brandywine Creek. Tasks included a review of historic issues, field reconnaissance, regulatory review, a stability analysis of the structure, recommendations for repair and restoration, and a preliminary cost estimate for repair work.

Project Manager, Whites Basin and Raccoon Island Dredged Material Containment Area, Bridgeport, NJ
Mr. Cloonan coordinated the geotechnical feasibility study to evaluate long-term use of the 2162 acre Whites Basin and Raccoon Island dredged material containment area. This site is proposed as the primary disposal area for approximately 80 million cubic yards of material to be dredged over a 50-year period as part of the proposed Delaware River Deepening Project.

Project Engineer, Cherry Island Utility Corridor, Wilmington, DE
Mr. Cloonan served as a geotechnical engineer team member in the design and implementation of an instrumentation program to evaluate the subsurface conditions related to dike instability at the existing Cherry Island dredged materials disposal area operated by the Army Corps of Engineers. Instrumentation was installed by Duffield Associates in two phases, in the vicinity of Tower 13 and along the utility corridor, to monitor the effects of ongoing Corps of Engineers dredged materials and dike construction. The instrumentation consisted of 5 inclinometers, and 20 piezometers.

Project Manager, Pearce Creek Dredged Material Containment Area, MD
As part of a three-year contract with the U.S. Army Corps of Engineers, Duffield Associates completed a feasibility study of the long-term utilization of the Pearce Creek dredged material containment area. The purpose of the study was to review the long-term utilization of the site to provide containment for 20-years and 50-years of capacity. Mr. Cloonan was responsible for overseeing the geotechnical evaluation, analysis of existing perimeter dike, and design of increased dike evaluation.

Project Manager, Extended Stay America, Rutherford, NJ
The proposed parking area of this new hotel was to be constructed over highly compressible organic soils and miscellaneous fill adjacent to a tidal marsh. Duffield Associates designed a perimeter retaining wall for the parking area, consisting of a geogrid-reinforced earth wall with a vegetated face. Light-weight fill (coal bottom ash) was used for backfill of the geogrid-reinforced area to help control settlement over the compressible subgrade soils. Wire baskets and erosion control matting were used to provide an open mesh wall face to allow a vegetative growth interface with the tidal marsh. ACF Environmental provided material and construction consulting services.

Project Manager, Peninsula United Methodist Homes, Cokesbury Village, Hockessin, DE
Mr. Cloonan oversaw the Construction Review Services for the headquarters for this retirement community. Services included review of auger-cast pile installation, foundation subgrade, reinforcing steel and concrete, earthwork and concrete construction, retaining wall backfill, structural steel erection, and fireproofing.

Project Manager, City of Wilmington Flood Gates, Wilmington, DE
Duffield Associates assisted the City of Wilmington with the evaluation of a 50-year old tide gate and stormwater drainage control system located along Christina Avenue near the Port of Wilmington. The initial phase of this study assessed the condition of this deteriorated control structure and identified alternatives for its remediation or replacement. The next phase includes developing the design for these improvements and will include a limited hydrologic study of the drainage area contributing to the storm drainage system which outlets into the Lobdell Canal and the Delaware River.

Project Manager, Star Repowering Project, Delaware City, DE
Duffield Associates was retained by the project design-builder to provide the geotechnical evaluation for a coke-fired, electric generation facility. Various structures constructed as part of this facility included a gas separation unit, power block, acid gas removal unit, gasification structure, elevated ball mill, process tower, cooling tower with 23-foot deep sump area, and miscellaneous underground piping. Based on the observed subsurface conditions, Duffield Associates provided recommendations to assist in the design of conventional, shallow, spread and mat foundation systems bearing at varying depths for increased allowable bearing capacity. In addition, Duffield Associates also provided soil parameters to assist in designing foundations subject to dynamic loading conditions.

Project Manager, Wheatley Road Bridge Replacement, Cecil County, MD
Duffield Associates was retained by the Cecil County Department of Public Works to prepare the design of a replacement structure for a failing bridge over West Branch, a tributary of Little Northeast Creek in Cecil County, Maryland. Mr. Cloonan oversaw the geotechnical evaluation, construction administration, and Construction Review Services.

Principal, Barksdale Road Bridge, Elkton, MD
Duffield Associates' geotechnical team performed a subsurface evaluation for the proposed Locust Point Road arch culvert and the Barksdale Road Bridge in Elkton, Maryland. Subsurface data was obtained at each of the referenced sites through the performance of two test borings at each site. Duffield Associates provided the test boring data to the project design team for use in the culvert and bridge design.

Project Engineer, Scarborough Road, Dover, DE
Scarborough Road, a new 4-lane "by-pass" road, required a pile-supported bridge to cross the regulated wetlands of Fork Branch north of Dover. Duffield Associates, retained as a consultant, performed a geotechnical evaluation along the proposed alignment. Mr. Cloonan coordinated the design and construction of the access road stabilized with multiple layers of geotextile materials. Construction services were provided by ACF Environmental and Duffield Associates to assist the contractor with the geotextile installation and the placement of fill material through standing water over the soft wetland deposits. Following bridge construction, the temporary road was removed and the disturbed wetlands restored.

Senior Geotechnical Manager, Warehouse Addition Collapse Remediation, Downingtown, PA
The owner of a new warehouse observed failure of the wall and buckling of some roof-framing members. Duffield Associates was retained to review the wall design and construction, and provide "fast track" repair recommendations to allow the new facilities to open on schedule. Our evaluation indicated that the wall was under-designed for the backfill lateral loads. Construction repairs included excavation behind and structural repairs to the wall, and construction of a mechanically stabilized earth (MSE) slope reinforced with geotextiles. To further reduce lateral loads, a lightweight "geofoam" inclusion layer provided a stress relief layer between the MSE slope and the wall.

Project Manager, Mechanically Stabilized Earth Slope, Blair County Convention Center, Blair County, PA
The Blair County Convention Center was proposed to be constructed on the site of a steep slope in the middle of the Appalachian Mountains. It was determined that a geosynthetic mechanically stabilized earth (MSE) slope was required to maintain site stability. ACF Environmental was awarded the contract to design and supply the geosynthetic materials for the construction. Duffield Associates provided design and consulting services.

Project Manager, Petro Truck Stop, Elkton, MD
Mr. Cloonan provided the design recommendations and construction review for a new concrete exit road and extensive repairs to the existing asphaltic concrete pavement at this major truck stop located adjacent to I-95. The high volume of trucks serviced by this facility caused rapid deterioration of the existing pavement. Recommended repairs included an extensive series of underdrains and perimeter drainage ditches, and asphaltic concrete pavement patches. The exit road was designed as fiber mesh reinforced concrete. In addition, Duffield Associates has provided construction review and contract administrative services for ongoing pavement maintenance at this facility since 1989.

Project Manager, Tennis Court Repairs, New Castle County, DE
Mr. Cloonan provided consultation to the New Castle County Department of Parks and Recreation concerning tennis court repairs throughout the County. Previous County maintenance of the tennis courts had included frequent temporary repairs. At three recreation centers, Mr. Cloonan recommended repairs consisting of a combination of bituminous concrete patches and overlays, reinforced with a high-strength fiberglass geosynthetic material to provide structural repairs to the cracked areas. Using this innovative approach, Duffield Associates coordinated the repair of the Delcastle Recreation Center tennis courts to full playability. ACF Environmental supplied the geosynthetic material. This unique project was featured in the April 1997 issue of *Public Works* magazine in an article co-authored by Mr. Cloonan.

Project Manager, Delaware State University, Alumni Field Track, Dover, DE
Duffield Associates provided a subsurface evaluation for a new alumni field track. The purpose was to evaluate the subsurface conditions at the site and provide recommendations regarding the existing soil and pavement conditions related to the construction of a new running track.

Project Manager, Super Fresh Supermarket, Wilmington, DE
Mr. Cloonan served as Project Manager for the geotechnical evaluation for a new Super Fresh supermarket. To provide access for delivery vehicles, a vertical retaining wall up to 25 feet in height was proposed along the south side of the site to support the access road. Duffield Associates designed the wall as a mechanically stabilized earth (MSE) wall, reinforced with geogrids. The less visible areas of the retaining wall were designed with a wire basket supported vegetated face. The remainder of the wall was provided with a masonry architectural face. ACF Environmental was the material supplier for the vegetated face, wire basket, and geogrid-reinforced wall.

Project Manager, Geotechnical Evaluation, Hangar, New Castle County Airport, DE
Mr. Cloonan oversaw the geotechnical evaluation for a proposed hangar to be constructed at the New Castle County Airport. The 39,000 square-foot hangar was a pre-engineered, steel-framed building with metal siding and a roof height of approximately 60 feet to house two corporate aircraft.

Project Engineer, Right Turn Lane, SR-1009, Blair County, PA
ACF Environmental was contracted to provide the engineering design and geosynthetic material for a 60-foot high mechanically stabilized earth (MSE) slope proposed to support the new right turn lane for SR-1009, at the intersection of Park Avenue in Blair County, PA. As a consultant for ACF Environmental, Duffield Associates designed a 1-1/2:1 MSE slope stabilized with geogrids. Permanent erosion control mats were installed on the face of the slope to allow vegetation growth. The backfill of the slope consisted of locally available crushed shale soils.

Project Manager, Engineering Report and Design Services, Toledo Express Airport, Toledo, OH
This project included field observations and comments concerning the existing secondary containment concrete pad at a jet fuel storage facility located at the Toledo Express Airport. Duffield Associates was retained because of the possibility of fuel entering the soil though cracks in the concrete containment pad. Recommendations were made and design services provided.

Project Manager, Tidewater Utilities Water Tanks, Various Locations, DE
Mr. Cloonan provided geotechnical engineering services for several water tanks throughout Delaware. Tanks included a 100,000 gallon tank in the Chimney Hill Development in Felton, DE; a 30,000 gallon water tank in Kent County, DE; and a 200,000 gallon water storage tank in Middletown, DE.

Project Manager, Stevensville Elevated Water Tank, Queen Anne's County, MD
Mr. Cloonan provided a geotechnical evaluation for this proposed 250,000 gallon elevated water storage tank. As part of this evaluation, Duffield Associates developed foundation alternatives for supporting the proposed tank over approximately 150 feet of soft, under consolidated clay soils. The tank was ultimately designed to be supported by a deep foundation system. These services were provided by Duffield Associates as a subconsultant to McCrone, Inc.

Project Geotechnical Engineer, Delaware Route 9, Army Creek Bridge Approaches, New Castle, DE
Mr. Cloonan was responsible for the installation of six pneumatic piezometers used to monitor the pore water response to the construction of an embankment over soft marsh soils. Services included monitoring piezometers and providing reports to the contractor and DelDOT.

Project Manager, Sterling Hotel Geotechnical Evaluation, Delaware City, DE
Mr. Cloonan oversaw the geotechnical services for obtaining subsurface conditions at the site of this historic hotel. This included reviewing the existing building foundation size and type, and providing recommendations for the design and construction of the renovations and proposed building addition.

DUFFIELD ASSOCIATES
Soil, Water & the Environment

Project Manager, PENNDOT SR 322 MSW WALL DESIGN

Senior Geotechnical Engineer , DOPACO MSE SLOPE CONSTRUCTION

Principal, Swedesford Road Vault- East Whiteland, PA

Principal, Geotechnical Services for Swedesford Road Vault

Principal, Brandywine River Museum Renovations, Additions and New Building

Principal, Building Renovations for Walnut Street, Philadelphia, PA

Principal, CB-4 Warehouse Pottsville Permit Report

Principal, CB-4 WAREHOUSE POTTSVILLE GEOTECHNICAL

Principal, CB-4 Proposed Warehouse Design Phase Geotechnical Evaluation, Pottsville, PA

Principal, CB-5 Warehouse- Lewistown, PA - Geotechnical

Principal, Intergeo PENNDOT SR 222 MSE Wall

Principal, Intergeo PENNDOT SR95 MSE Wall

Principal, Intergeo Germany Hill MSE Wall

Project Manager, Townhouse for Shurs Land Manayunk Avenue, Philadelphia, PA

Principal, Sunoco Case Wharf Design Phase I

Principal, 241 - 243 Chestnut Street Geotechnical Evaluation, Philadelphia, PA

Project Manager, Lyceum Avenue Proposed Townhouse, Philadelphia, PA

Project Manager, 251 Gay Street Retaining Wall Design Manayunk, PA

Project Manager, Rizk Residence Geotechnical Evaluation, Stewartstown, PA

ACF

Principal, ACF - ST 0041 MSE SLOPE

Senior Consultant, ACF Penn State Retaining Wall

Principal, ACF 2301 Renaissance Blvd

Project Manager, ACF SR-1009 MSE SLOPE

Project Manager, ACF SR-228

Project Manager, ACF BLAIR COUNTY CONVENTION CENTER

Principal, ACF Atwater

Principal, ACF BETHLEHEM PIKE/SEPTA

Principal, ACF, VELDUCCI SLOPE STABILIZATION

Principal, ACF WESTTOWN TWNSHP MSE WALLS

Principal, ACF THE GUARDIAN OF REFLECTION

Project Manager, ACF MILLCREEK

Project Manager, ACF 300 FOUR FALLS

Project Manager, ACF, GETTYSBURG PIKE INTERCHANGE

DUFFIELD ASSOCIATES
Soil, Water & the Environment

Principal, ACF CHILDRENS HOSPITAL PHILADELPHIA TEMP MSE WALL

Principal, ACF PHILADELPHIA AIRPORT EMPLOYEE LOT

Principal, ACF PAPA & LAUTZ DEVELOPMENT MSEW

Principal, ACF PA SR 006 RES

Principal, ACF, PA STATE RET 219 - MSC SLOPE

Project Manager, ACF PA TURNPIKE RSS4 SLOPE

Principal, ACF-CARNEGIE MELLON SCI CTR

Principal, ACF, NEW INDIAN VALLEY HIGH SCHOOL

Principal, ACF WORTHINGTON EROSION CONTROL

Principal, ACF, PA STATE RTE 345 REINFORCE SLOPE

Principal, ACF IMPERIAL DRAINAGE SWALE 3A

Principal, Drury Street Geotechnical Evaluation

Principal, Naamans Creek Center Retaining Wall

Senior Geotechnical Engineer, Leeds Road Bridge Replacement

Senior Geotechnical Engineer, Stryker Brigade Facilities Hazleton

Principal, The Stone Barn Building Addition

Principal, Pursuit Driving Training Facility Foundation Consulting

Project Manager, Lawrence Court Development Geotechnical Evaluation

Senior Geotechnical Engineer, SR 2017, SEC 005/BRIDGE OVER MANADA CRK

Senior Geotechnical Engineer, BLOOMSBURG HIGH SCHOOL BLEACHER PROJECT

Project Manager, AWWTP Screenings/Grit Removal Project

Project Manager, LONGWOOD GARDENS CONSERV

Project Manager, NAGY RESIDENCE- GARRETT MILL RD

Senior Geotechnical Engineer, N NEWTON TWP BRIDGE / FISH HATCHERY ROAD

Principal, Haverford Township Maintenance Building Geotechnical Evaluation

Project Manager, UPPER MORELAND HIGH SCHL WATER INTRUSION

Principal, WOOD STREET #1223 (PHILA) GEOTECH

Project Manager, TRINITY HIGH SCHL GEOTECH SINKHOLE

Principal, ACF-NY WESTCHESTER AVE

Principal, ACF, HOMER DAM ACB EVALUATION

Project Manager,HAYES LARGE-MIFFLINBURG HS-GEOTECH-UNION

Project Manager,CHAMBERSBURG SALT STORAGE BLDG

Principal, AMERICAN MINT GEOT.

Principal, Washington Crossing Visitor's Center Well Testing

DUFFIELD ASSOCIATES
Soil, Water & the Environment

Project Manager, RED ROSE TRANSIT 2, LANCASTER

Project Manager, CenterPoint Eng Red Lion High School Tennis Courts

Principal, GETTYSBURG STATION INFILTRATION TESTING

ARTESIAN WATER COMPANY, INC. COMMENTS RE

Permit Modification Application of Delaware Recyclable Products, Inc. relating to DRPI Landfill, New Castle, Delaware

PART IV

Comments by:

Jeffrey M. Bross, P.E., LEED AP, F. ACEC
Duffield Associates, LLC

Christopher C. Whallon, Esq., P.G.
Duffield Associates, LLC

Delaware Recyclable Products, Inc. ("DRPI" or "Applicant") submitted an application to the Delaware Department of Natural Resources and Environmental Control, Solid and Hazardous Waste Management Section (DNREC-SHWMS) to modify its existing Industrial Waste Landfill operating permit. The Permit Modification Application ("Application") was prepared to support a proposed vertical expansion of the DRPI Landfill, located in New Castle, Delaware. DRPI intended the Application to address, among other criteria, the requirements of Sections 4.0 and 6.0 of the Delaware's Regulations Governing Solid Waste (DRGSW). Some of the information provided by DRPI in its Application is outdated, inconsistent, incomplete, or incorrect. Reliance on this misleading information will preclude a meaningful evaluation of whether the facility, or DRPI's operations there, have or will cause undue damage to Delaware's environment or its critical natural resources.

As is discussed in the following comments, most of the information presented by DRPI to address various ecological and hydrogeologic requirements of the DRGSW is approximately 15 years out-of-date, and much of it is significantly older. **It is very important that DNREC recognize and address the deficiencies in the Application at this juncture.** If the proposed Vertical Expansion Application is approved, DRPI will operate the facility going forward through a series of compliance-based renewals of its operating permit. If this happens, DNREC and the public will no longer have the opportunity to evaluate whether the facility, or DRPI's operations there, have or will cause undue damage to Delaware's environment or its critical natural resources.

Please note that in some parts of its Application, DRPI refers to various sections of the DRGSW using citations to previous and outdated version of the regulations. For clarity, in comment 5, Artesian has inserted citations to the current version of the DRGSW.

The following comments provide examples where the Application presents outdated, inconsistent, incomplete, or incorrect information. For each comment, excerpts from the Application are presented block quote format, followed by a brief discussion.

Comment One – DRPI's Application is based upon an Environmental Assessment Report that fails to provide current information regarding air quality; water quality; stream flow; fish and wildlife; plants; threatened and endangered species; water uses; land uses; aesthetics; traffic; public health and safety; cultural, recreational, and natural areas; historic sites; social and economic factors; or soil quality.

> **Part VIII of Application, Page VIII-5 of Environmental Assessment Report, 3.1 Introduction**
> In accordance with DRGSW §4.2.1.6, the environmental assessment must include a detailed assessment of fifteen factors, as identified in Section 1.2 of this EAR. This section presents a summary of the findings of the assessment for each of these factors based on information presented in previous EARs and recent evaluations. Except for data obtained as part of the hydrogeologic assessment and included in the assessment of groundwater quality impacts, field data collection, such as sampling and analysis of environmental media or subsurface investigation, was not performed as part of this environmental assessment.

In the Environmental Assessment Report (EAR), submitted as part of the Landfill Expansion Application, DRPI explains that, in addressing the environmental assessment requirements of the Delaware's Regulations Governing Solid Waste (DRGSW), it did not conduct any new environmental evaluations. Except for recent groundwater monitoring data (required to be collected by its existing permit), Applicant DRPI elected not to provide any current information regarding: air quality; water quality; stream flow; fish and wildlife; plants; threatened and endangered species; water uses; land uses; aesthetics; traffic; public health and safety; cultural, recreational, and natural areas; historic sites; social and economic factors; or soil quality. Instead, the Applicant chose to rely on an EAR prepared in 2004 (updated in 2005) in connection with the previously proposed expansion of cell 6. Much of the information contained in the EAR was actually generated in the 1990s. DRPI estimates that the proposed landfill expansion will add approximately twenty years to the operating life of the facility. For this reason, DNREC should consider whether its evaluation of the Application should be based on environmental information that is arguably stale, and which is likely not representative of current conditions and fails to incorporate current standards and techniques. Moreover, it is reasonable to assume that by 2040, when this landfill is nearing capacity, the factors affecting the evaluation of local air quality, traffic, land use, water use, aesthetics, public health and safety, and cultural, recreational, and natural areas may differ significantly from those that existed in the 1990s. At a minimum, the Applicant should be required to demonstrate that the information presented in the EAR is both accurate and representative of the current conditions in the vicinity of the facility with some credible effort at projecting impacts during the next 20 years of operation. Given the scope and anticipated duration of the proposed expansion, it is incumbent on DNREC to request the Applicant also evaluate whether the

proposed expansion is likely to create or exacerbate environmental impacts in the vicinity of the facility by the end of its operating life.

Comment Two – DRPI should be required to extend the planned low-permeability cover system to all waste-containing areas of the site that will not be affected by the proposed Vertical Expansion as a precondition of approval of the Application.

> **Part VIII of Application, Page VIII-7 of Environmental Assessment Report, 3.3.2 Groundwater Quality**
> A protective liner barrier was placed over Cells 1 through 3, which were originally unlined, such that filling above these areas could proceed as part of a previous expansion. Additional buffer was provided in the Cell 6-2 reduction and an environmental cap was placed to prevent infiltration into any unlined areas. Following closure of the landfill, a low-permeability cover system will be constructed over the entire Vertical Expansion area. The low-permeability cover system will also be expanded to encompass the limits of waste in the former waste disposal area on the adjacent property. This design feature will enhance containment of site wastes and is expected to significantly reduce leachate generation versus the existing conditions. Therefore, the Vertical Expansion is expected to provide better protection of groundwater quality at and near the DRPI Landfill versus the current conditions.

This statement suggests that the Vertical Expansion will not include the unlined portions of the facility where industrial and/or chemical wastes were reportedly disposed. If the low-permeability cover system will provide better protection of groundwater quality than current conditions, the Applicant should be required to install the low permeability cover system over all areas that will not be included in the Vertical Expansion as a prerequisite for approval of its application. This is a reasonable request, given that DPRI plans to install the low-permeability cover over both the areas of the facility affected by the vertical expansion and the former waste-containing areas at the site.

Comment Three – DRPI should be required to conduct a comprehensive wetland evaluation prior to the Application being considered.

> **Part VIII of Application, Page VIII-8 of Environmental Assessment Report, 3.4.1 Wetlands**
> In some areas of the DRPI Landfill property, particularly outside of the presumed existing limits of waste, wetland areas are present. However, as discussed previously, the Vertical Expansion area will be built over the existing permitted waste cells. No wetlands are present at the existing waste cells and no impacts to wetlands are expected from the vertical expansion. A wetlands evaluation report is included as Appendix VIII-A.

The Wetlands evaluation included in Appendix VIII-A contains a letter report (based on very limited fieldwork) prepared in February of 2005 by Great Valley Environmental, Inc. This letter report recommends that a Jurisdictional Determination be performed by the US Army Corps of Engineers to concur with Great Valley's findings. The Application contains no documentation that this Jurisdictional Determination was obtained. In addition, Great Valley recommends additional investigation of the southern portion of the property be performed in the spring "to determine if jurisdictional wetlands or waters [of the United States] occur along the property boundaries." There is no documentation showing that the recommended evaluations were performed. The remaining on-site wetlands delineation work at the facility appears to consist of a study completed in December of 1991 and summarized in a December 1991 report prepared by WIK Associates, Inc.

The Applicant's referral to "presumed existing limits of waste" is troubling as it suggests that DRPI is not completely certain where wastes have been disposed at the facility. Given that the recommendations for additional delineation of wetlands and waters of the United States have not been implemented, the substantial period of time that has passed since wetlands/water of the United States were assessed at the property, and the Applicant's uncertainty regarding the limits of waste disposal, its statement that "no impacts to wetlands are expected from the vertical expansion" is difficult to substantiate. This is especially true given DRPI's plan to install a low-permeability cover system on all waste-containing areas as part of facility closure. Prior to considering the Application, DNREC should request the Applicant to 1) identify all areas of the facility where waste has been disposed, 2) delineate all current and prior jurisdictional wetlands and waters of the US on or adjacent to the property, and obtain a Jurisdictional Determination and/or concurrence from the USACE, and 3) evaluate whether the Vertical Expansion (including closure and post-closure requirements) will adversely affect wetlands and waters of the United States.

Comment Four – DRPI should be required to conduct a comprehensive hydrogeologic evaluation prior to the Application being considered.

> **Part VIII of Application, Page VIII-10 of Environmental Assessment Report, 3.8.2 Groundwater**
> On 14 February 2018, Geosyntec issued FOIA request to DNREC Water Resources Division requesting that a search of groundwater wells be performed within a ¼-mile radius from the Vertical Expansion area. On 19 February 2018, Geosyntec received a response to that request, which is provided as Appendix VIII-B to this EAR. A total of 140 wells were identified of which 88 are active, pending, or completed (i.e., 52 are abandoned, expired or voided). A number of the wells are identified by property address and thus several wells may be located at a single point shown within a given parcel. Of the wells identified, no domestic or public use wells were identified by DNREC. One industrial well identified in the search results (located on the Certified Concrete property), is on one of the properties on which the Vertical Expansion is located. Waste Management has no record of this well on their property and assumes, based on inspections and available information, that it has been decommissioned in accordance with the Delaware Regulations Governing the Construction and Use of Wells. Therefore, the Vertical Expansion is not anticipated to impact groundwater uses in the DRPI Landfill area.
>
> **Volume 3 of the Application, Page 16 of 46 (page 6 of 22 of Hydrogeologic Assessment Report - Blazosky Associates, Inc. 2004 revised 2005)** (emphasis added)
> 5.2 Columbia Formation … The Columbia, however, was extensively mined for its sand and gravels beginning in the 1950s. Therefore much of it has been removed from the DRPI site and portions of the proposed expansion area **leaving the Potomac Formation at the surface**.

The Applicant's reliance on a ¼-mile radius search as the basis for its assessment of the potential impact of facility operations on groundwater quality is inappropriate given that the Hydrogeologic Assessment it has offered in support of the Application explains that the overlying Columbia Formation has been removed from much of the DRPI site, exposing the Potomac Formation at the surface. As is explained in greater detail in Artesian's comments regarding hydrogeology, the Potomac Formation is a major source of drinking water for New Castle County. Because chemical and/or industrial wastes are present in unlined cells 1-3, and the Applicant has proposed a major expansion of its operations, DNREC should require the Applicant to demonstrate (through data collected from appropriately located and constructed monitoring wells and hydrogeologic modeling), that the facility, both currently and as proposed to be expanded, poses no risk to Delaware's drinking water aquifers as well as demonstrating that the proposed

expansion poses no risks to Delaware's drinking water aquifers for both the expected operating life of the facility and its post-closure period. Further, the DRGSW requires:

4.2.1.5 A hydrogeological investigation must be performed at the proposed site and approved by the Department before a construction permit will be issued. This investigation and report shall be prepared and signed by a Professional Geologist registered in Delaware. This investigation shall include a series of test borings and wells, constructed to a depth and in a number sufficient to identify:

- 4.2.1.5.1 The occurrence and characteristics of the unconfined and first confined aquifers;
- 4.2.1.5.2 Groundwater flow directions;
- 4.2.1.5.3 Background groundwater quality, using a minimum of eight (8) independent samples for each background and downgradient well;
- 4.2.1.5.4 Potential pathways of contaminants to points of groundwater discharge;
- 4.2.1.5.5 Approximate groundwater flow rates and travel times from the facility to points of discharge (including wells and/or surface water); and
- 4.2.1.5.6 A delineation of the anticipated maximum elevation of the seasonal high water table.

The materials provided by DRPI in its Hydrogeologic Assessment fail to address the requirements of the DRGSW and therefore, DNREC should reject the Application.

Comment 5 – DRPI should be required to adequately address and comply with the siting criteria set forth in the applicable regulations prior to the Application being considered.

> **PART XII of Application, Page XII-1, SITING CRITERIA.**
> Delaware Regulations Governing Solid Waste (DRGSW) Section 4.2.1.9 ***[§4.2.1.11 in current regulations]*** requires that an application to operate an industrial landfill include "proof that the facility meets the siting criteria required by Section 6.1". The siting requirements, and the manner in which these requirements are addressed, are presented in Section 2.2 of the Engineering Report (Part VI).
>
> **Part VI of Application, Page VI-5, 2.2 Siting Requirements, DRGSW § 6.1.3 (b) *[§6.1.3.2 in current regulations]***
> No new cell shall be located in an area that may cause or contribute to the degradation of any state or federally regulated wetlands unless it is demonstrated that there is no impact to the wetland or the impact is mitigated. As described in the Environmental Assessment Report, the vertical expansion is located over the existing permitted cells. Therefore, the vertical expansion design is in compliance with this requirement.
>
> **Part VIII of Application, Page VIII-11 of Environmental Assessment Report, 3.8 Land Use**
> The Vertical Expansion includes construction of a modern, lined landfill cell that will be constructed over existing unlined waste disposal cells. The Vertical Expansion includes construction of a final cover system over the entire permitted area and is considered a Brownfield Development where historical environmental impairments are mitigated and the property is returned to productive use.

DRPI has explained in Part VIII of the Application (Page VIII-11 of Environmental Assessment Report, 3.8 Land Use) cited above, that the Vertical Expansion envisions the construction of modern lined landfill cells. Therefore, it is required to demonstrate that the proposed expansion will not adversely impact any regulated wetlands or that the impact has been mitigated. DPRI's conclusory assertion that the expansion will create no adverse impact because the new cells will be constructed over existing cells does not meet that burden. This deficiency is especially noteworthy because, as was discussed in Comment 3 above, the Applicant is relying on wetlands evaluations conducted in 1991 and 2005, and that the additional evaluations and jurisdictional determination recommended by the most recent of those studies have not been implemented.

Moreover, DRPI has expressed some uncertainty regarding the actual limits of waste disposed or existing at its facility, and therefore cannot state with certainty whether regulated wetlands may be adversely affected by facility expansion, operations, closure and post-closure activities. DNREC should require the Applicant to collect and submit data that demonstrates that no wetlands have been or will be adversely affected by facility operations, expansion, or closure activities.

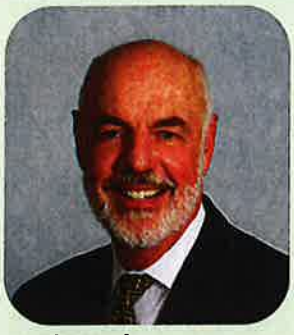
> **Part VI of Application, Page VI-6, 2.2 Siting Requirements, DRGSW §6.1.3 (c)** ***[§6.1.3.3 in current regulations]***
> No new cell shall be located within one mile of any state or federal wildlife refuge, wildlife area, or park, unless specifically exempted from this requirement by the Department. The DRPI landfill is located within approximately 0.25 miles from the Russell Peterson Wildlife Refuge, across the Christina River. However, no new cells are proposed, and the vertical expansion is located over the existing permitted cells, and therefore the vertical expansion design is in compliance with this requirement.

DRPI has explained in Part VIII of the Application (Page VIII-11 of Environmental Assessment Report, 3.8 Land Use) cited above, that the Vertical Expansion envisions the construction of modern lined landfill cells. Its conclusory assertion that no exemption is needed because the new cells will be constructed over existing cells does not meet that burden. Therefore, it is required to obtain an exemption from DNREC.

> **Part VI of Application, Page VI-6, 2.2 Siting Requirements, DRGSW § 6.1.3 (f)** ***[§6.1.3.9 in current regulations]***
> No new cell shall be located in areas where valuable aquifers would be threatened by contaminant releases, unless viable alternatives have been dismissed and stringent design measures have been incorporated to minimize the possibility and magnitude of releases. As described in the Hydrogeological Assessment, the aquifer underlying the DRPI Landfill is not classified as a valuable aquifer. Furthermore, a state-of-the practice composite liner system is in place in the cells underlying the vertical expansion and an overlay composite liner system will be constructed over unlined cells. Therefore, the vertical expansion design, which is: (i) not located above a valuable aquifer; and (ii) includes measures to minimize releases to groundwater, complies with this requirement.

DRPI has explained in Part VIII of the Application (Page VIII-11 of Environmental Assessment Report, 3.8 Land Use) cited above, that the Vertical Expansion envisions the construction of modern lined landfill cells. As was discussed in Comment Four, above, the Hydrogeologic Assessment Report offered by DRPI in support of the Application states that previously conducted mining of the Columbia Formation has exposed the Potomac Formation at much of the site – which has subsequently been covered by wastes

in the unlined cells 1-3 and the newer lined cells. Both the unlined cells and the newer cells will be affected by the construction, operation, and closure of the proposed Vertical Expansion. Given the widespread use of the Potomac as a drinking water source in New Castle County and beyond, the Applicant's assertion that the Potomac Aquifer is not a valuable one defies reason. Also, DRPI does not dispute that industrial wastes, possibly including chemical wastes, were historically disposed in the unlined cells and remain in contact with the Potomac under the facility. DNREC should require the Applicant to rigorously demonstrate through data collected from appropriately located and constructed monitoring wells and hydrogeologic modeling, that the facility, both currently and as proposed to be expanded, poses no undue risk to Delaware's drinking water aquifers for both the expected operating life of the facility and its post-closure period.



JEFFREY M. BROSS, P.E., LEED AP, F. ACEC

Senior Consultant

Registration
Professional Engineer - PA, DE, NE, MD, NJ

Education
B.C.E., University of Delaware, 1969

Memberships

Jury Chairperson/Board member of the Delaware Valley Smart Growth Alliance and former Jury member for 10,000 Friends of Pennsylvania Commonwealth Awards

Past-Chair and member of the National American Council of Engineering Companies and Associated General Contractor's Construction Liaison Committee

Member of American Society of Civil Engineers

Member of Consulting Engineers Council of Delaware

Member of National Society of Professional Engineers

Member of American Public Works Association

Unique Strengths:

- ABC
- XYZ

Background/Skill Set

Mr. Bross has consulting and project management responsibility for civil engineering, coastal engineering, water resources, environmental, hazardous waste, and regulatory agency projects. He has extensive experience in the preparation and attainment of permits and the development of requisite mitigation associated with permitting for difficult and challenging projects. Mr. Bross has been a principal regulatory negotiator and has a strong working relationship with local, state, and federal regulatory agencies throughout the Mid-Atlantic region. He has authored numerous technical articles and papers, and is a featured speaker on issues involving environmental and construction matters. Mr. Bross was named Delaware's Engineer of the Year in 2006 by the Delaware Council of Engineering Societies.

Selected Projects

Project Manager, Northern Solid Waste Facility-1 (NSWF-1)
Mr. Bross served as the Project Manager to the Delaware Solid Waste Authority for over 20 individual projects during a 9-year period at the NSWF-1 including landfill expansion, leachate collection, stormwater management access roadways, cover studies, compaction studies, monitor well installation, gas well installation, gas venting/collection; QC/QA monitoring, and closure.

Project Manager/Principal-In-Charge, Northern Solid Waste Facility-2 (NSWF-2)
Mr. Bross served as Project Manager or Principal-In-Charge for over 10 projects during a 5-year period at the Delaware Solid Waste Authority's NSWF-2 landfill. These projects included: geotechnical studies; compaction/cover studies; environmental monitoring; access roads; and cell closure.

Principal-in-Charge, Cavaliers Country Club Residential Redevelopment, Newark, DE
Project for approximately 720-unit mixed residential redevelopment of a former 140-acre golf course. Responsibilities include coordination oversight and direction of civil site and roadway design, environmental remediation, wastewater pumping station design, and regulatory and agency approvals.

Principal-in-Charge, Fort DuPont Redevelopment Project, Delaware City, DE
Duffield Associates' engineers and scientists are assisting the Fort DuPont Redevelopment and Preservation Corporation with comprehensive planning and design for wastewater and drinking water; stormwater planning and design for the 325-acre site; development of flooding mitigation and flood proofing design for the site; traffic studies and highway entrance design; geotechnical investigations; permitting and design consultation for a 150-slip; and permitting and design consultation for development of a living shoreline to mitigate wave and ship wake erosion along the Delaware River shoreline.

Principal-in-Charge, Three Forts Crossing Master Plan, DE and NJ
Duffield Associates provided engineering services to support the development of a Master Plan for this Delaware River & Bay Authority (DRBA) project. Base maps were

Memberships (cont.)

Member of Environmental Business Action Coalition

Founder/Past Co-Chairman and member of the New Castle County Economic Development Council

Former President and Board member of the Committee of 100

Appointed member of the State of Delaware Workforce Investment Board

Appointed member of the Surface Water Management Task Force

Appointed member of the New Castle County Executive's Task Force on Redevelopment

Appointed member of the Livable Delaware, Infill and Redevelopment Subcommittee

Appointed Chair of the Clean Water Advisory Council

Appointed member of the Delaware Redevelopment Authority

Member of the Delaware Geological Survey, Geologic Mapping Advisory Committee

Former Chairman of Delaware EPSCoR State Committee

Member of the DENIN External Advisory Board

Board member of the Faithful Friends Animal Society

2010 Award Recipient of the Samuel S. Baxter Memorial Award.

created for five sites designated to be included in the Master Plan. These sites were: Delaware City, Old New Castle and The City of Wilmington, Delaware; and Pennsville and Penns Grove, New Jersey. Our team also evaluated permitting issues and developed a briefing memo and an order-of-magnitude.

Project Manager, Fort DuPont Emergency Staging, Delaware City, DE
Mr. Bross served as a Project Manager for a DEMA funded study to utilize Fort DuPont as a catastrophic disaster staging area. Services included conducting planning workshops.

Project Manager - Fort DuPont Offshore Wind Assembly/Staging, Delaware City, DE
Mr. Bross was Project Manager for the evaluation of Fort DuPont for use as an assembly and staging facility for offshore wind facilities in the Mid-Atlantic region. This work was done under a Memorandum of Understanding with the State of Delaware Department of Natural Resources and Environmental Control and included reviewing site utilization, transportation access, water access/benthes, zoning and natural/cultural resource protection.

Principal-in-Charge, Delaware City Marina, Delaware City, DE
Duffield Associates evaluated, designed and permitted a major bank stabilization project along the old canal marina banks to reduce erosion and improve water quality.

Principal-In-Charge/Senior Consultant, Nemours Dam Restoration, Wilmington, DE
Mr. Bross was Principal-in-Charge and a Senior Consultant for this project that included evaluation of a 25 foot high stone masonry dam's integrity/stability and environmental evaluation of accumulated sediments in the adjoining reservoir. Recommendations and construction drawings were prepared for grouting cracks and joints to restore dam and excavation/disposal of accumulated reservoir sediments. Duffield Associates provided evaluation/design services, preparation of construction drawings and specifications and construction review/testing. Duffield Associates received the Delaware Consulting Engineers' Merit Award for this project.

Principal-In-Charge, Eleutherian Dam, Hagley Museum and Library, Wilmington, DE
This project involved the restoration of an approximately 200-year old masonry/timber dam and adjacent millrace on the Brandywine River. Project included a detailed structural review of the dam's and mill race's existing condition as well as designing structural repairs for the proposed renovation. Extensive coordination and permitting between multiple federal, state, and local agencies was required to develop the restoration. The restoration consisted of constructing a new concrete support slab and adding wooden planking to the dam face. Due to the complexities with the project and operating in a river environment, Duffield Associates provided construction services through our affiliate, CGC Geoservices, Inc.

Principal-in-Charge - Energy Plant Permitting Assistance, New Castle County, DE (2011)
Mr. Bross served as a Principal-in-Charge for a project to assist an energy company acquire a State of Delaware Coastal Zone Permit and an Underground Injection Control Permit in support of a new power production facility in New Castle County, Delaware. Services provided included environmental and natural resources assessments in support of the project, estimation of specific environmental impacts

Memberships (cont.)

Member of Environmental Business Action Coalition

Founder/Past Co-Chairman and member of the New Castle County Economic Development Council

Former President and Board member of the Committee of 100

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Member of the DENIN External Advisory Board

Board member of the Faithful Friends Animal Society

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(as defined by the Coastal Zone regulations), developing offset proposals for those impacts, and negotiating with regulatory agency personnel on the client's behalf.

Project Manager, Stone Harbor Bird Sanctuary Separator Dike, Stone Harbor, NJ (2007)

Mr. Bross was Project Manager for this landmark ecologic renovation project which involved the study and design of a tidal regulator structure and the construction of an approximately 400 foot long earthen dike and pedestrian path to isolate salt water and fresh water impoundments within the sanctuary.

Principal-in-Charge, Delaware City Flood Mitigation, Delaware City, DE (2004)
Mr. Bross was Principal-in-Charge for two flooding mitigation projects in Delaware City spanning over 30 years. The initial project involved the construction of flood mitigation dikes and flood walls and the subsequent project involved the raising and extension of both the flood/storm surge walls and dike system to mitigate prevailing flood design elevations.

Principal-in-Charge, Bay View Beach, Bay View Beach, DE (2010)
Duffield Associates performed a review of an existing concrete retaining wall that currently acts as a bulkhead due to continual beach loss and scour at the toe of the structure. As part of our evaluation, we visually reviewed the conditions, provided recommendations for repair and/or replacement, provided conceptual cost estimates, and assisted them in contacting agencies that could possibly provide financial assistance for their failing wall.

Principal-in-Charge, Former Automobile Assembly Plant, DE (2010 – Present)
Duffield Associates is working for the site owner and closely with DNREC-SIRB to perform Environmental Site Assessments and provide assistance with the master planning for site redevelopment of an automotive assembly plant that encompasses over 200 acres, which is among the largest certified Brownfield sites in the region. Environmental conditions have been and will be evaluated under DNREC-SIRB procedures. The services provided by Duffield Associates are useful for maintaining public communication, planning site redevelopment, financing, achieving regulatory compliance and, if necessary, performing site cleanup.

Principal-In-Charge, Asbestos Abatement Associated with Redevelopment Projects (2001 – 2011)
Mr. Bross directed sampling, regulatory approvals, and field abatement in accordance with State of Delaware regulations. Six buildings, which were slated for demolition or extensive renovation, ranged in size from 3000 sf to 33,000 sf.

Managing Principal, Shellpot Creek Watershed Study, New Castle County, DE (2000)
The watershed study, which was funded and directed by a consortium of governmental agencies, had the goal of identifying and mitigating basin-wide flooding problems and developing water quality measures and neighborhood programs to enhance riparian areas and improve water quality. This study, which will result in the implementation of over several million dollars in mitigation measures, will become a model for future watershed studies in New Castle County. Mr. Bross implemented a number of innovative and effective methods for gathering citizen input and disseminating information to residents affected by this study. These methods included public workshop sessions enabling citizen discussion directly with key project staff; preparation of a pre-study informational bulletin, and use of a web site to keep residents abreast of study progress and enable them to ask questions and receive answers by e-mail.

Principal-In-Charge/Senior Consultant, Rancocas Creek Dam Failures & Flooding Evaluation (2005)
Mr. Bross was the Principal-In-Charge of this project for professional engineering and science services related to multiple dam and dike failures and resultant flooding on the Rancocas Creek and its tributary branches. Duffield Associates was responsible for with evaluating potential causes and resultant damage impacts brought about by the failure of up to 10 impoundment structures.

Principal-In-Charge/Senior Consultant, Red Clay Creek Hydraulic Modeling (2006)
Mr. Bross is Principal-In-Charge and DelDOT liaison for the hydraulic modeling of the entire Red Clay Creek in Delaware for New Castle County. The purpose of this modeling is to evaluate the flood plain and flood level impacts/mitigation which result from selective structural (bridges and dams) removal and/or enlargement and which result from selective channel improvements. The model will also be utilized to assess downstream impacts to existing flooding conditions.

Principal-In-Charge - Brandywine State Park Greenway, Wilmington, DE (1997)
Mr. Bross served as Principal-in-Charge during the design of a one and one-half mile long greenway trail through Brandywine Creek State Park, an environmentally sensitive area. This project was designed in accordance with DelDOT Appendix H, Plans, Specifications and Estimates and ISTEA requirements and included design of trail grading, trail head parking lot design, bridge replacement, watershed analysis, stormwater quality management, a HEC-RAS floodplain study, and the development of plans for submission to the DelDOT and DNREC. Mr. Bross served as liaison during the project's permitting efforts, which included wetlands permits, floodplain approval, and erosion and sediment control permits.

Principal-In-Charge, Budd Metal, Brownfield/Superfund Project, New Castle, DE (2008)
Mr. Bross served as a Technical Consultant and Principal-In-Charge for a state Superfund site. Under his guidance, negotiations were successful in placing the site as a "flagship" brownfield site for Delaware's Voluntary Cleanup Program. The approximately 15 acre former metal fabricating plant required remediation of metals and PCBs in soils. The project team developed a remedial program which included excavation, chemical stabilization, and replacement on-site of contaminated soils.

Principal-In-Charge, Frawley Stadium, Brownfield Project, New Castle, DE
The Delaware Department of Natural Resources and Environmental Control (DNREC) was planning to investigate the former ship building site as a Superfund site. The City and the developer, with concurrence from DNREC, contacted Duffield Associates to perform an environmental site investigation and risk assessment. The environmental investigation, reporting and negotiations with DNREC were completed in just 13 weeks and for 1/3 of the original budget. The outcome was that the stadium site was not classified as a Superfund site and the ball park construction started immediately.

Project Manager, Oil Spill Remediation, Major East Coast Refinery
Mr. Bross was Project Manager for investigations and remedial design of oil seeping into the Delaware River from a dredge disposal impoundment. The project included hydrogeologic and geotechnical evaluations; development of containment systems, including geosynthetic liners, slurry walls, and sheet piles; and development of groundwater suppression, interceptor systems, and oil recovery processes. The project was performed on a "fast track" delivery basis to address regulatory orders and was completed.

Project Manager, Hewlett Packard, Little Falls Site, DE
Duffield Associates provided geotechnical, environmental, wetland, and other critical natural area evaluations as part of the planning and design process for their 100-acre office campus. Mr. Bross served as the Environmental Project Manager responsible for site assessments and natural resource inventories. He also directed the development and implementation of permitting, natural resources protection and creation, and environmental mitigation programs.

Principal-In-Charge Project Manager, Resource Extraction Projects
Mr. Bross has served as the Principal and Project Manager for the design and licensing of all privately operated resource extraction projects operating in New Castle County including projects near Middletown, Delaware City and Bear, Delaware. Mr. Bross was responsible for site investigations, site design, including site access and circulation, hydrogeologic evaluations and permitting.

Principal-In-Charge, Multipurpose Dock Study, Port of Wilmington, DE
Mr. Bross served as Principal-In-Charge and Sr. Consultant for a feasibility study of a new RO/RO and multipurpose double berth dock. The study included: bathymetric surveys; offshore geotechnical evaluations; environmental and wetlands studies; modeling to evaluate maintenance dredging requirements; preliminary design of dock structure and causeway; preliminary design of access roadways and utilities; regulatory liaison; cost estimates; and schedule preparation.

Principal-In-Charge, Stone Harbor Bird Sanctuary Rejuvenation, Borough of Stone Harbor, NJ (2005 – Present)
Assisting the Borough with a rejuvenation effort for the Sanctuary to restore habitat for wading birds (7000+ nests) that historically nested at this barrier island dune/marsh mosaic. Services include wetlands delineation, USACE/NJDEP permitting, mitigation design for wetlands, protected species consultation, invasive species management, protected species habitat management for this National Natural Landmark.

Project Manager, Mid-Atlantic Offshore Wind Project
This project involved a feasibility evaluation and development of preliminary costs for the permitting and construction of multiple land based staging locations for off loading wind turbines from ocean going vessels, assembling various turbine components and loading onto barges/workboats for transporting to offshore wind farm.

Senior Consultant, Lantana/Valley Road/Tweeds Park, Hockessin, DE (2007)
Duffield Associates was retained to assist the Delaware Department of Transportation in planning, designing, and constructing a recreation park that includes the relocation and restoration of the historic two-story Tweed's Tavern dating from 1796. Duffield Associates provided "Green Technologies" for control of the runoff from the park, such as reforestation, wetlands creation, bio-retention and bio-swales. This turn-key design build park project consisted of one or two historic structures, 3 multi-purpose athletic fields, a Tot-lot, parking and access improvements for adjoining properties.

Project Manager/Engineer, On-Site Wastewater Disposal System Feasibility and Design
As a Class C licensed on-site wastewater system designer and registered professional engineer, Mr. Bross has done over 100 feasibility studies, design and operational/repair consultations for new systems, expanded systems and repair systems for residential, industrial, institutional, commercial and community applications. From 1970 until 1975, Mr. Bross was the co-owner of Site Investigations, Inc. a firm which performed feasibility studies and on-site wastewater system design for over 150 systems of varying sizes.

Project Manager - Indian River Inlet North Channel Closure, DE
Mr. Bross was Project Manager for the North Channel Closure Project at the Indian River Inlet for the Delaware Department of Natural Resources and Environmental Control. This project involved hydraulic modeling; sediment sampling and transport analysis; geotechnical evaluation; design; permitting; and construction review.

Principal-In-Charge - Oil Recovery Vessel Berth and Support Facilities, DE
Mr. Bross served as Principal-In-Charge for the feasibility studies, permit preparation, and design of a new berth on the Delaware River for a 240 foot long spill recovery vessel. This $1.5 million project was completed for the Marine Spill Response Corporation of Washington, DC. Duffield Associates' work included: design of a 200 foot long sheet pile dock; preparation of dredging study and design of dredging of the Delaware River to accommodate vessel and to access navigable waters; reinforcing of an adjacent sheet pile bulkhead; sediment environmental analysis; design of onshore warehouse and support facility; analysis of dredge material disposal area; preparation and processing of all permits; and management construction.

Project Manager - Mary Elmer Lake Dam and Spillway, Bridgeton, NJ
Mr. Bross was the Project Manager for the reconstruction of this dam - a composite earth embankment and semicircular concrete spillway that impounded a large freshwater lake. The original embankment and spillway were washed away during a hurricane because of hydraulic under capacity and deteriorated embankments. Responsibilities included geotechnical investigation, hydraulic design, embankment design, permitting, and construction review.

Principal-In-Charge– Hoopes Reservoir Emergency Action Plan Update
Mr. Bross is Principal-In-Charge for this dam breach evaluation of the State of Delaware's largest dam and reservoir. The project included the evaluation of a "sunny day" failure of the 110-foot high masonry structure and the dynamic routing of the ensuing flood wave through the downstream Red Clay Creek valley.

Principal-In-Charge - United Water Delaware Tidal Capture Structure, Stanton, DE
Mr. Bross served as Principal-In-Charge and Senior Consultant for a project to develop a reliable 30 million gallon a day (MGD) raw water withdrawal from the White Clay Creek at United Water Delaware's Stanton, Delaware Water Treatment Plant. He directed Duffield Associates' team of engineers and scientists in developing a unique solution to this problem that involved the design of a water inflated bladder structure, which impounded the creek and prolonged the availability of water during the twice daily high tides. The project was permitted in record time and constructed within budget.

Senior Consultant - Wilmington Harbor South, DE
This project included the construction of a 7,000-ft long containment dike for dredge spoil disposal in the Delaware River. Construction of the dike required the placement of a high-strength geotextile reinforcement to provide adequate stability. Mr. Bross was responsible for providing technical guidance and oversight.

Project Manager, Fort Delaware State Park, Delaware City, DE
Mr. Bross served as Project Manager for the Fort Delaware Bicentennial Improvement Project which included the design and construction review of: new docks in Delaware City and on Pea Patch Island; a new access road on Pea Patch Island; a comfort station and new water supply system at Fort Delaware; a maintenance building in Delaware City; new bulkhead and boat boarding facilities in Delaware City; a pedestrian plaza; and restoration of an historic lock on the old C and D Canal.

Project Manager, Beach Erosion and Hurricane Protection, Delaware Coastline
Mr. Bross served as Project Manager and Key Technical Member for the first Phase II General Design Memorandum prepared for the Philadelphia District Army Corps of Engineer. This study utilized predictive models to evaluate littoral movement, storm surges, and wave action along Delaware's Atlantic Coast. The study evaluated and recommended a combination of structural, operational, and institutional solutions to protect natural resources and public/private property, as well as to enhance recreational opportunities. Extensive evaluations were performed on groins, jetties, bulkheads, nearshore and offshore beach nourishment, sand bypass, dune reconstruction, and revegetation. The study also required detailed topographic, bathymetric, geotechnical and vibracore surveys and investigations. Benefit-cost analyses were performed using economic studies developed as part of the study.

Project Manager, Groin Design, Atlantic Coast, DE
Over the last 25 years, Mr. Bross served as Project Engineer and Project Manager for multiple beach erosion control projects, groin design and reconstruction projects, and groin studies at many locations along Delaware's Atlantic Coast. This work included littoral and wave studies, geotechnical evaluations, design, permitting, and community involvement.

Principal-in-Charge, Corestates Bank, Wilmington, DE
Duffield Associates was retained by the project architect to provide civil, environmental and structural engineering services for the design of an approximately 4,300 square foot branch bank facility in Wilmington, Delaware. As part of their services, Duffield Associates performed an environmental assessment, a geotechnical evaluation, a wetland delineation, and flood studies; agency negotiation and construction review services. This project was done concurrently with a large restaurant expansion on an adjacent parcel for which Duffield Associates provided civil engineering design services. The Duffield Team successfully designed, achieved Department of Transportation approvals, and implemented a shared access onto a major arterial highway for these projects and an adjoining shopping center.

Principal-In-Charge, Bellevue State Park Greenway, Wilmington, DE
Services provided by the design team overseen by Mr. Bross, included design of trails, delineation and protection of freshwater wetlands, design of drainage improvements, landscape design, and design of visual and informational amenities. Under Mr. Bross' direction the greenway was designed and constructed in accordance with DelDOT Appendix H, Plans, Specifications and Estimates (PS and E) and ISTEA requirements.

Senior Consultant - Championship Golf Course, Wilmington, DE
Mr. Bross served as the lead permitting professional for the development and construction of a championship golf course situated on both sides of the White Clay Creek, a designated Wild and Scenic River. In addition, the entire golf course project was located in a regulated flood plain and encompassed numerous regulated resource protection areas such as riparian buffer, steep slopes and forest. Under Mr. Bross' guidance, all necessary local, state, and federal permits, approvals, and variances were obtained within a one-year period. Identification of and liaison with special interest environmental organizations was successfully implemented and was a key element in the approval process.

Project Manager - Flood Studies, New Castle County, DE
Mr. Bross served as Project Manager for flood studies in 18 major watersheds throughout New Castle County. These studies included the acquisition of topographic and structural surveys, hydrologic computations, flood plain modeling, and recommendations for flooding mitigation. Watershed basins included White Clay Creek, Belltown Run, Hyde Run, Cool Run, South Branch Naamans Creek, White Clay Creek, Appoquinimink River, Christina River, Shellpot Creek, Silverbrook Run, Matson Run, Little Mill Creek, Magazine Ditch, Broad Dyke, Buttonwood Ditch, Red Lion Creek, and Dragon Run Creek.

Principal-in-Charge, Hockessin Athletic Club, Hockessin, DE
Duffield Associates was retained to provide land development and site engineering consulting services to assist in the design of the new Hockessin Athletic Center on an approximate 12-acre site in Hockessin. This project consisted of a 80,000 square feet multi-story structure, outdoor swimming pools and recreation areas, and associated parking. Mr. Bross was Principal-in-Charge of this project which also included providing design/build services on behalf of the Delaware Department of Transportation for the surrounding Tweeds Park which incorporates, wetlands, regional stormwater management facilities, athletic fields, and hydraulic control structures.

Principal-In-Charge - AstraZeneca Pharmaceutical Research Campus Expansion, Wilmington, DE
Mr. Bross served as Principal-in-Charge for environmental studies and provided consultation, guidance and design for compliance with the environmental provisions of the New Castle County Unified Development Code.

Principal-In-Charge, Keene Elementary School, Glasgow, DE
Duffield Associates was retained by the Christina School District to perform multidiscipline services for the design of this 64,600 sf elementary school. These services included structural engineering, geotechnical engineering and civil engineering services. Civil engineering services included site design, processing of land development approvals, design of stormwater management facilities, site grading, and erosion and sediment control.

Project Manager, Belltown Run Interceptor Sewer, New Castle County, DE
This sewer line was instrumental in eliminating failing septic systems in an area of New Castle County that had been designated for future planned development. The approximate 3.5 miles of large diameter sewer were designed and constructed under challenging conditions including soft soils, running sands, and high groundwater tables. In spite of these challenging issues, this project was constructed within budget.

Principal-In-Charge, Weatherhill Sanitary Sewer, Wilmington, DE
Mr. Bross served as Principal-In-Charge for this value added project that included the design of a grinder pump system to divert sewer flow from an existing office building from entering the Mill Creek System to the Pike Creek System. This provided additional capacity in the Mill Creek System to accommodate flow from a new office building. This included negotiations/liaison with New Castle County, Department of Special Services, New Castle County, Department of Land Use, and the Delaware Department of Transportation for sewer design approval, sewer agreement approval, and right-of-way construction permit approval.

Project Manager - Belltown Run Basin Study, New Castle County, DE
This study represented County Government's first successful effort to perform a basin-wide study to plan and develop sewer infrastructure, stormwater management and environmental protection standards on a comprehensive basis in advance of full-scale basin-wide development. This study served as the standard for future studies and stormwater management and sediment/erosion control efforts now widely used throughout the County. It also provided a mechanism for public/private partnerships to construct necessary wastewater conveyance systems.

Principal-In-Charge, Farm Meadows Mixed Used Development, Wilmington, DE
This project included determining the closest available public sewer system and whether capacity existed. 2 concepts were developed for connecting to the nearby sewer and regulatory and technical feasibility of providing wastewater treatment/ disposal on site.

Principal-In-Charge, New Castle Conservation District Operations Center and Office, Glasgow, DE
Duffield Associates was retained by the New Castle County Conservation District to assist in rezoning, community liaison, geotechnical engineering, land development planning, natural resource inventories, record plan preparation, civil, site design and structural engineering for this approximately 25 acre site. The site was one of the first major office/multi-use projects to be developed under the Unified Development Code (UDC) of New Castle County. It includes a multi-story office building, parking designed to accommodate public access, nature interpretive area, extensive landscaping, and a separate operation maintenance and storage facility.

Principal-In-Charge, Wilmington Trust Operations Center, Wilmington, DE
Duffield Associates, Inc. provided complete environmental, geotechnical and structural engineering services on this approximately 70,000 square foot operations center located outside of Wilmington, Delaware. Mr. Bross, as Project Manager and Principal-In-Charge, oversaw the subsurface investigation, site assessment, and analysis and design of the foundation and superstructure.

Principal-In-Charge/Senior Consultant, Evaluation of Flood Relief Bypass Channel Glenville Community
This evaluation report was prepared at the request of the Delaware Emergency Management Agency (DEMA) to further review the efficacy costs and issues associated with a proposed mitigation project to reduce flooding to the Glenville Community and surrounding area. The mitigation project is the construction of a flood relief bypass channel.

Project Manager - Energy Generating Facility, Pigeon Point, DE
Duffield Associates was retained to provide geotechnical, structural, civil, environmental and construction engineering services for construction of the facility. Mr. Bross served as Project Manager. The energy generating facility (EGF) was a structure which, because of the extremely soft soil conditions, was constructed on a combination of both shallow and deep (pile) foundations. It was necessary to construct embankments over the very soft soils. The installation of over 5300 prefabricated vertical drains ("wick drains") and use of a soil surcharge were used to stabilize the soft soils during construction and reduce settlements after construction. The use of wick drains allowed the use of shallow foundations under portions of the building, which significantly reduced foundation costs for these portions of the building.

Project Manager and Key Technical Member - River Flood Damage Inventory Studies, DE
This project was performed for the Philadelphia District Corps of Engineers on the Brandywine Creek and the Christina River. These studies involved flood damage field surveys, interviews with affected parties and governmental agencies, preparation of damage cost estimates, data compilation, and report preparation.

Principal-In-Charge/Senior Consultant, Glenville Community Flood Mitigation Evaluation
Duffield Associates was retained by New Castle County to evaluate the advisability, feasibility and cost of purchasing some or all of the homes in the Glenville Community as a permanent solution to the flooding problems which have impacted this community for many years.

Principal-In-Charge - Petroleum Hydrocarbon Remediation
Duffield Associates was retained to evaluate the possible source and potential remedial actions of oily substances leaking into a marsh and river at a major mid-Atlantic refinery. Mr. Bross served as Principal-In-Charge to oversee the remediation.

Principal-In-Charge/Senior Consultant, Reservoir/Pumped Storage
Mr. Bross served as a Senior Consultant for a major water utility company in the study for a 500 million-gallon pumped storage reservoir, a 6 MGD pumping station and a 30-inch diameter transmission main. The pumping system is designed to both skim flows to fill the reservoir during periods of high stream flow and to pump water from the lower reservoir operating levels into the nearby water treatment plant.

Principal-In-Charge - Becks Pond Water Quality Study, New Castle County, DE
Mr. Bross served as the Principal-in-Charge for a project funded by the New Castle Conservation District that examined water quality issues in Becks Pond in New Castle County, Delaware. Duffield Associates was retained to evaluate water quality issues and recommend in-pond and basin-wide mitigation measures to improve water quality and enhance recreational uses.

Project Manager, Cool Spring Reservoir, City of Wilmington, Department of Public Works, DE
Duffield Associates performed an evaluation for the City of Wilmington involving determination and confirmation of leakage of treated water from a masonry-lined reservoir. As Project Manager, Mr. Bross oversaw the geotechnical evaluation, design and construction review services of a new shotcrete lining and cap for portion of the reservoir, design of a system to control leakage, as well as other appurtenant rehabilitative work.

Senior Consultant, Porter Reservoir Expansion Study, Wilmington, DE
This project involved the preparation of a concept layout and design for a 250-400 million gallon finished water reservoir across from the existing Porter Reservoir and a 200-350 million-gallon finished water reservoir adjacent to Porter Reservoir. Each of the reservoirs included embankments of approximately a mile in length and maximum embankment heights of 30 to 40 feet. The project included concept plans, concept cost estimates, a summary report on the feasibility of various alternatives, preparation of a 3-dimensional rendering and assistance to the City of Wilmington in presenting the concept to the Governor's Drought Task Force Committee.

Principal-In-Charge, Bread and Cheese Island Reservoir Study, Stanton, DE
Mr. Bross is the Principal-In-Charge for the evaluation and design of this 0.5 billion-gallon potable water supply reservoir. This project included three miles of embankment varying in height from 15 to 40 feet, and the identification and resolution of environmental issues and local, state and federal permitting.

Principal-In-Charge, May B. Leasure Elementary School, Bear, DE
Duffield Associates was retained by the project architect to perform the analysis and design of both the foundation and superstructure systems for this 64,600-square foot elementary school. Duffield Associates provided geotechnical engineering, site and stormwater management design, environmental site assessment, and structural engineering services for the design and construction of this new school.

CHRISTOPHER C. WHALLON, ESQ., P.G.

Senior Environmental Consultant

Registration

Professional Geologist – DE
Member of Bar – DE (as in-house counsel) and PA

Education

J.D., Law, Widener University School of Law, 1994

B.S., Geology, University of Miami, 1980

Memberships

Member, HSCA Advisory Committee (cooperative effort comprised of DNREC and the private sector, charged with developing programmatic, policy and regulatory improvements to handling redevelopment projects arising under the Delaware's HSCA statute).

Member, ASFE Legal Affairs Committee and ASFE Advocates Assembly.

Background/Skill Set

Mr. Whallon has over thirty-five years of diverse environmental experience including positions in the law, consulting, contracting, and state government. His experience includes management of multi-disciplinary redevelopment and cleanup projects, programs and initiatives; site assessments and characterizations; remedial designs and oversight; permitting, compliance and environmental auditing; emergency response. His environmental management experience includes positions as a practice group manager in an environmental consulting firm, GeoSciences department manager (Northeast Region) for a national environmental contractor, program management for multi-project clients and project manager. His legal experience includes representing clients in numerous environmental disputes under remedial and regulatory statutes, property transfer matters, environmental and risk management counseling.

Selected Projects

Project Manager, Sunday Breakfast Mission, Brownfield Cleanup / Women's & Children's Annex, Wilmington, DE

Brownfields certification, investigation of soils and groundwater and associated reporting, design and oversight of soils remediation (excavation, engineering and institutional controls), UST removal, and regulatory closure.

Project Manager, Redevelopment of Former Industrial Properties, Newark & Wilmington, DE

Mr. Whallon has overseen the planning, investigation, remedial and redevelopment of multiple industrial properties under the Delaware's HSCA and VCP programs. Elements of these projects include preparation and implementation of Phase I Environmental/Preliminary Assessments, Phase II Targeted Facility Assessments, Facility Investigations, Remedial Work Plans, soil and groundwater sampling, testing, and analysis, and included planning and budgeting, contractor and subconsultant management and scheduling, agency coordination and preparation/submission of electronic data and digital products, demolition of structures and asbestos abatement, excavation and removal of USTs and impacted soils, implementation of engineering and institutional controls, and public participation.

Project Manager, Property Redevelopment, New Castle County, DE – Confidential Clients

Mr. Whallon has overseen the planning, investigation, cleanup and redevelopment of numerous commercial properties under Delaware's HSCA (Brownfield and VCP) and UST/AST programs. These sites range in size and complexity from small former gasoline service stations to former large former automobile assembly plants and the projects involve planning and budgeting, contractor and sub-consultant management and scheduling, agency coordination, site characterization including health risk and ecological risk analyses, interim response actions such as excavation and removal of

impacted soils and USTs, remedial actions such as cleanup and implementation of engineering/institutional controls, provisions for long-term stewardship and public participation.

Sr. Consultant, Brandywine Fibre and Wholesale Electronics Brownfield Remediation Project, Wilmington, DE
Assisted Project Manager with Brownfield public meeting, DNREC coordination, and program compliance.

Sr. Consultant, Sussex Lumber Site, Lewes, DE
Assisting PM with VCP plan for soils characterization, reporting and program compliance.

Project Manager, WSFS Regional Headquarters, Wilmington, DE
Design and manage due diligence, Brownfields certification, investigation of soils and groundwater and associated reporting, redevelopment and soils management, administrative and institutional controls, ongoing groundwater monitoring.

Project Manager, Sunrise Cleaners, Hockessin, DE
Design and manage due diligence, VCP program entry, preliminary investigation of soils and groundwater and associated reporting.

Project Manager, Chrysler Site, Newark, DE
Design and manage due diligence, Brownfield certification, preliminary investigation of soils and groundwater and associated reporting.

Project Manager, Redevelopment of Brownfield Properties, New Castle County, DE – Confidential Clients
Mr. Whallon has overseen the planning, investigation, remedial and redevelopment of vacant, underutilized or abandoned industrial and commercial properties under the Delaware's HSCA and VCP programs. These sites range in size and complexity from small former gasoline service stations to former large former automobile assembly plants and the projects involve planning and budgeting, contractor and sub-consultant management and scheduling, agency coordination, site characterization including health risk and ecological risk analyses, interim response actions such as excavation and removal of impacted soils and USTs, remedial actions such as cleanup and implementation of engineering/institutional controls, provisions for long-term stewardship and public participation.

Project Manager, Beneficial Reuse Evaluation of Staged Dredged Material, Gloucester County, NJ – Confidential Clients
Mr. Whallon designed and oversaw the environmental evaluation of staged dredged materials for potential beneficial reuse (e.g. as fill for redevelopment projects) in coordination with the New Jersey Office of Dredging and Sediment Technology. Elements of the project include design of sampling strategy and analytical requirements, meetings and coordination with the state, project planning and budgeting, contractor management and scheduling, and reporting.

Project Manager, UST Closure Activities at Mobile Home Park, Cecil County, MD
Mr. Whallon managed the post-removal soil evaluation and cleanup associated with excavation and disposal of former underground heating oil tanks from mobile home park. Project activities included: observation of the excavation process; collection, analyses and evaluation of post-excavation soil samples; coordination of impacted soil excavation and staging; and reporting.

Project Manager, Environmental Investigations of Soil and Groundwater at Municipal Airport, Georgetown, DE
Mr. Whallon has overseen the planning, investigation and reporting associated with the discovery of petroleum products during several construction (airport upgrade) projects conducted at the airport. These investigations of soil and groundwater were conducted in coordination with Delaware DNREC Tank Management Branch and/or the Emergency Response Branch and have included the development of investigative approaches and budgets, preparation of work plans, contractor management and scheduling, coordination with the oversight agencies and the client, and report preparation.

Project Manager, Expedited Environmental Investigations, Wilmington and Milford, DE – Confidential Clients
Mr. Whallon has coordinated and overseen the contracting and implementation of environmental investigations conducted on an expedited basis to minimize delay to construction projects and commercial transactions. Projects included the design site-specific sampling methodologies, retention of drilling contractors and analytical laboratories, collection and analyses of environmental samples and preparation of reports within tightly compressed schedules.

Environmental Professional, Phase I Environmental Site Assessments, DE – Confidential Clients
As the responsible Environmental Professional, Mr. Whallon has overseen the performance of numerous Phase I Environmental Site Assessments (ESAs) conducted at industrial, commercial, and mixed use facilities throughout Delaware. These ESAs, performed as part of pre-acquisition due diligence or to support owner refinancing/lending, identified recognized environmental conditions that merited subsequent investigation of which indicated potential environmental liabilities.

Program Manager, Gas Station Transfers, Philadelphia, PA
Mr. Whallon oversaw the completion of an assessment program of 70 retail gasoline stations being transferred between oil companies as part of a divestiture. The scope of work included the assessment of operating history, soils and groundwater quality at a number of sites in the Philadelphia area and was required to be completed within a 90-day window. The work was successful due to the functional approach to the program, assigning project teams by type of work (e.g. research, drilling, sampling, report preparation) rather than by site location.

Program Manager, Gas Station Remedial Program, the Philadelphia/South New Jersey Area
Mr. Whallon managed a successful assessment and remedial program involving 16 retail gasoline station sites owned by a single client in the Philadelphia/South New Jersey area. The program achieved a significant reduction in the costs of mobilization, field work, data reduction and report writing by negotiating regulatory pre-approval for a phased approach to site work and standardization of deliverables for the sites involved.

Technical Manager, Investigation and Remedial Response to Train Derailment, Harrisburg, PA
As GeoSciences Department Manager, Mr. Whallon reconfigured the groundwater recovery and reinjection system for the remediation of ethylene glycol and mineral oil impacts to groundwater resulting from a train derailment near Harrisburg Pennsylvania. Mr. Whallon designed, obtained regulatory approval of, and managed the implementation of modifications to pumping rates/reinjection locations that minimized the effects of relic subsurface topography on local groundwater flow and enhanced system performance leading to on-time completion of the project within the estimated budget.

Project Manager, Bulk Fuel Storage Facility, Woodbury, NJ
Mr. Whallon managed the assessment and cleanup of at a bulk fuel storage facility located in Woodbury, NJ under the state ISRA program. Cleanup at the facility included UST removals, bioremediation and off-site disposal to address fuel-impacted soils, NPDES permitting issues, and groundwater monitoring.

Project Manager, CERCLA Removal Actions, Various Locations
As Project Manager, Mr. Whallon oversaw the successful performance of numerous CERCLA removal actions varying widely in scope, location and circumstances. For example, Mr. Whallon managed a removal action at an abandoned batch chemical plant in Virginia that included RCRA classification and disposal of unidentified lab chemicals and gas cylinders, excavation bulking and disposal of thousands of buried drums, construction of an interim containment facility for contaminated soils, treatment of hundreds of thousands gallons of lagoon wastes, and on-site neutralization of water-reactive chemicals. In another response action, Mr. Whallon designed the scope of work, budget, and managed the technical and contract personnel and a logistically difficult project involving point-of-use treatment of domestic drinking water wells impacted by chlorinated solvents. Other CERCLA responses managed by

Mr. Whallon included oil spills, fires and explosions, and releases at uncontrolled waste sites, manufacturing plants or public facilities.

Project Manager, Locomotive Fueling Facility, Altoona, PA
As Project Manager, Mr. Whallon designed, obtained approval for, and managed the installation of innovative remediation and subsurface fuel recovery system for locomotive fueling facility located near Altoona, PA. Remedial actions, which included lateral drilling techniques and installation of an interceptor system under active fueling pads, were accomplished with virtually no adverse impact on facility operations.

Project Manager, Flood Mitigation / Abatement & Redevelopment Design Build, Glenville, DE
Mr. Whallon managed this complex and multi-disciplinary project which included numerous contractors, consultants and participating stakeholders. This fast-track project involved utility disconnections, permitting, asbestos and environmental hazards abatement, demolition of over 160 homes, backfilling, grading and restoration over a 5-month period, design and construction oversight for compensatory forested wetlands totaling approximately 7 acres and a riparian buffer comprising approximately 3 acres of reforested flood plain; preparation of applications for FEMA grants and draft future use restrictions; preparation of a draft Mitigation Bank Instrument, coordination of review and evaluation process with the Delaware Mitigation Bank Task Force, and preparation of a 40% design and conceptual plans for the mitigation bank and associated upland buffer system.

Regional Liaison
Selected as regional Technical Assistance Team representative for several sensitive environmental/law enforcement collaborative efforts including: participating in an investigation where representatives of the FBI and EPA's National Emergency Response Team utilized bottom-profiling sonar and remote submersibles to assess the disposal of drummed waste in water-filled quarries near Hazleton, PA; and participating with FBI, EPACID, MD State Police in the raid and seizure of an illegal waste disposal facility near Oakland, MD.

Field Operations Coordinator, Emergency Response
Mr. Whallon developed and oversaw the implementation of a methodology to manage field operations during an emergency response to the dumping of waste laboratory reagents, including shock-sensitive and water-reactive materials, throughout a residential area in Virginia. The response teams, consisting primarily of local police and firefighters, successfully classified and removed thousands of containers without incident or injury under intense media scrutiny.

Environmental Advocate and Counselor
As an environmental attorney, Mr. Whallon successfully represented plaintiff, defendants and multi-party groups in numerous federal and private party cost recovery actions under federal and state law. In addition, Mr. Whallon counseled clients on regulatory compliance, permitting, property transfer, environmental auditing/investigations, and risk management matters. Mr. Whallon negotiated of scopes of work/consent orders/memoranda of agreement under numerous regulatory/remedial frameworks including CERCLA (and state equivalents), RCRA (permitting, UST and corrective action), CWA, and various state property transfer laws addressing issues such as: site investigation and cleanup; installation, modification and closure of plant and facility infrastructure; and permit conditions and compliance schedules.

Project Lead, Various Geophysical Investigations
Mr. Whallon developed investigative approaches and oversaw the implementation and interpretation of magnetometer and ground-penetrating radar evaluations of buried drums and compressed gas cylinders containing chemical and radioactive wastes at number of site including locations in: Newport, DE; Culpepper, VA; Pulaski, PA; Waynesboro, VA; Lancaster, PA. The resulting geophysical data was used to design and implement remedial actions appropriate to the individual site settings.

Project Manager, Field Operations Coordinator, Point-of-Rocks, VA
Mr. Whallon developed and oversaw the implementation of a methodology to manage field operations during an emergency response to the dumping of waste laboratory reagents, including shock-sensitive and water-reactive materials, throughout a residential area in Virginia. The response teams, consisting primarily of local police and firefighters, successfully classified and removed thousands of containers without incident or injury under intense media scrutiny.