



# Illinois Environmental Protection Agency

Bureau of Land & Field Operations Section & Champaign Regional Office

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0390055036—DeWitt County  
Clinton/Clinton Landfill 3  
Groundwater File  
Inspection Date: 1–2 April 2014  
Inspector: Jeff Turner

## Landfill Groundwater Inspection

### Introduction

I conducted a groundwater inspection at this operating landfill. The purpose of the inspection was to determine the site's compliance with applicable groundwater provisions of the Illinois Environmental Protection Act, the Title 35 Illinois Administrative Code regulations, and the site's Illinois EPA-issued permit, 2005-070-LF. I conducted the inspection in accordance with authority granted under sections 4(c) and 4(d) of the Illinois Environmental Protection Act and Standard Condition 4 of the site's permit.

### Documents evaluated

Documents evaluated as part of the inspection process included pertinent parts of the facility's approved permit application, including the sampling and analysis plan; groundwater monitoring reports; notifications of observed and confirmed increases; electronic groundwater data; past inspection reports; and miscellaneous other information from Illinois EPA files.

### Field activities

The focus of the field inspection was to evaluate the maintenance of the groundwater monitoring system, conduct sampling oversight, and split samples. I conducted these activities on 1 April 2014 from 8:00 A.M. to 5:30 P.M. and on 2 April from 10:00 A.M. to 11:45 A.M. (times approximate). During the inspection, I interviewed Robert Zinser, Lead Sampling Technician, PDC Laboratories; James Daily, Field Sampling Technician; David Bryant, Clinton Landfill Facility Manager; Joyce Day, Senior Hydrogeologist, PDC Technical Services; Gail Schindler, Groundwater Project Manager/Field Sampling Supervisor, PDC Laboratories; Lisa Grant, Project Manager, PDC Laboratories; and Ron Welk, Vice President, Clinton Landfill, Inc. Also present from the Illinois EPA on 1 April were Mike Summers, a geologist with the Groundwater Unit of the Permit Section, who reviews the groundwater portion of the facility's permit applications, and Chris Liebman, the manager of the Solid Waste Unit of the Permit Section, who supervises the unit that reviews the non-groundwater portion of the facility's permit applications. Weather conditions were sunny and very windy, with

temperatures climbing from the mid-30s to the mid-50s on 1 April and overcast with calmer wind on 2 April. I took forty-seven photographs and collected groundwater split samples from four wells.

## Office evaluation

### Site history and description

Clinton Landfill, Inc. is a subsidiary of Peoria Disposal Company (PDC). The complex of three landfills lies just east of US Route 51 south of Clinton.<sup>1</sup> The first landfill, listed in the Bureau of Land Site Inventory System as Clinton Landfill Inc (site #0398080005) but informally referred to as Clinton Landfill 1, began accepting waste in the mid-1970s and was certified closed in 1990. It remains in an extended post-closure care period, conducting corrective action for groundwater exceedances. Clinton Landfill 2 (site #0398080007), located immediately east of Clinton #1, began in 1990 and ceased accepting waste in mid-2010. Its closure certification application was approved by the Permit Section on 22 May 2013; its minimum 30-year post closure care period began 12 May 2011 and will therefore last until at least 12 May 2041.

Clinton Landfill 3 lies directly east of Clinton Landfill 2. The majority of Clinton Landfill 3 lies within the southwest quarter of Section 11, and the North one-half of the Northwest quarter of Section 14, Township 19 North, Range 2 East of the 3<sup>rd</sup> Principal Meridian, DeWitt County, Illinois. The property comprises approximately 225 acres of what was formerly primarily crop land and timber land. A 5-acre residential parcel (owned by CLI) exists in the eastern portion of the site. Land use in the region is predominately agricultural, (i.e., row crops and livestock) with some rural single family dwellings scattered throughout the area.

Clinton Landfill 3 is the currently active facility in the Clinton Landfill complex. Its development was approved by Permit 2005-070-LF on 2 March 2007. The total footprint for waste will be approximately 157.451 acres, according to the permit.

Permit Modification 9 (8 January 2010) authorized the reconfiguration of the facility into two units, the Municipal Solid Waste Unit (MSWU) and the Chemical Waste Unit (CWU). Neither the MSWU nor the CWU is permitted to accept RCRA<sup>2</sup> hazardous waste.

Part of the MSWU will overlie the CWU. A separation berm will separate the two units horizontally and a separation layer will separate them vertically. The overlying portion of the MSWU is to be emplaced after the CWU is filled to capacity and the separation layer has been constructed. Although

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<sup>1</sup> Not to be confused with similarly named sites such as Clinton Municipal #s 1–2, City of Clinton #s 1–2, etc. The only connections that I could determine between the current, privately owned complex and any of the other sites is that the site formerly known as Clinton Municipal #3 ultimately became Clinton Landfill, Inc. (#1), 0398080005. Similarly, the site formerly known as Clinton Municipal (0398080001) was on property now occupied by Clinton Landfill 2, 0398080007.

<sup>2</sup> “RCRA” refers to the federal Resource Conservation and Recovery Act of 1976, the principal federal law regulating the disposal of solid waste and hazardous waste in the United States. RCRA regulations define whether a waste is “hazardous” or not.

the MSWU and CWU are permitted for different types of waste, they are part of the same landfill, have the same groundwater monitoring network, will eventually have to be certified closed as one landfill, and will have the same post-closure care period.

## General regulatory information

Clinton Landfill 3 is subject to 35 Ill. Adm. Code Parts 811–813, as applicable. It is also subject to its permit, 2005-070-LF, first issued on 2 March 2007 and most recently modified on 6 March 2014 (modification 44, which approved enhancements to the leachate recirculation system, among other things). As noted previously, Modification 9, issued on 8 January 2010, approved the reconfiguration of the facility into two units, a Municipal Solid Waste Unit (MSWU) of 146.453 acres and a Chemical Waste Unit (CWU) of 22.495 acres.

The MSWU is permitted for municipal solid waste and non-hazardous special waste. It first accepted waste in July 2009.

The CWU will occupy 22.495 of the southwest corner of the overall landfill footprint and is being constructed to a more stringent design standard. The CWU may accept non-hazardous special waste, inert waste, putrescible waste, and chemical wastes, including manufactured gas plant waste.<sup>3</sup> The CWU first accepted waste on 28 April 2011, according to permit application Log 2011-448.

If approved by USEPA, who holds permitting authority for polychlorinated biphenyls (PCBs) under the Toxic Substances Control Act (TSCA),<sup>4</sup> the CWU will be allowed to accept PCB wastes whose total PCB concentration is not greater than 500 parts per million. The federal public comment period has ended but USEPA has not yet issued a final decision on whether PCBs will be allowed.

Groundwater regulatory requirements will be discussed later in this report in the section “Groundwater monitoring reports and responses to increases.”

## Waste management units subject to groundwater monitoring

For the purposes of groundwater monitoring, closure, and post-closure, Clinton Landfill 3 is considered one unit. In other words, both the MSWU and the CWU are monitored by the same well network. Both units will be certified closed as one facility, subject to a post-closure care period of thirty years minimum.

### Construction details

The MSWU is a solid waste landfill constructed according to the Illinois Pollution Control Board’s RCRA Subtitle D regulations at 35 Ill. Adm. Code Part 811, including liners, leachate collection, and

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<sup>3</sup> Manufactured gas plant waste may exceed the toxicity thresholds of §721.124(b) without being a RCRA hazardous waste unless it is hazardous for ignitibility, corrosivity, or reactivity, per 35 Ill. Adm. Code §721.124(a).

<sup>4</sup> The Toxic Substances Control Act of 1976 is a separate law from RCRA. Unlike RCRA, which primarily regulates waste, TSCA also regulates materials that are not waste. PCBs are regulated under TSCA.

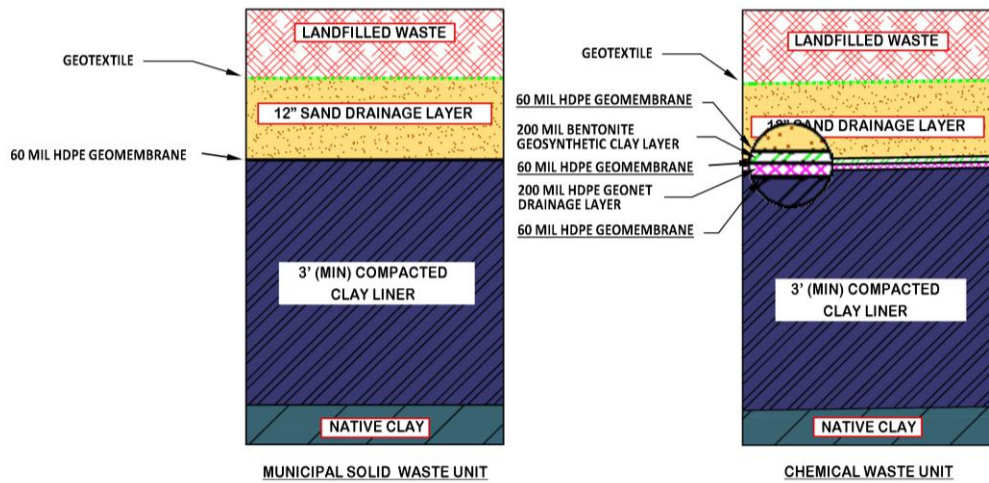
surface water management facilities. The CWU is constructed to a more stringent standard. The following information and diagram stem from the Illinois EPA's Clinton Landfill 3 Internet portal (<http://www.epa.state.il.us/community-relations/fact-sheets/clinton-3/index.html>).

The design of the liner and leachate drainage systems for the MSWU is one that is frequently used at non-hazardous waste landfills in Illinois. Starting from the bottom and going up, the liner consists of a layer of compacted clay three feet thick overlain by a 60-mil high density polyethylene (HDPE) geomembrane. The purpose of the liner is to stop leachate from migrating out of the waste and into the surrounding environment. On top of the liner is the leachate drainage layer, which consists of a one foot layer of sand overlain by a geotextile to exclude fine particles. The purpose of the sand layer, in conjunction with a network of pipes within it (known as the leachate collection system), is to prevent the height (or head) of leachate standing on the liner from exceeding one foot. The pipes conduct the leachate to a sump where it is pumped out of the landfill and into storage tanks. It may be solidified and placed back into the landfill or transported off-site for treatment. The current permit (Modification 44) authorized the installation of leachate recirculation wells in the MSWU only.

The design for the CWU exceeds Illinois' requirements for liner and leachate drainage systems in non-hazardous waste landfills. Under CWU design, again starting at the bottom, there is a three foot layer of compacted clay and a 60-mil HDPE geomembrane. These two layers constitute the secondary liner. On top of the secondary liner, there is a 200-mil HDPE geonet that serves as the secondary leachate drainage layer. On top of the geonet is a 200-mil bentonite geosynthetic clay liner (GCL) sandwiched between two layers of 60-mil HDPE geomembrane. This geomembrane/GCL/geomembrane sandwich serves as the primary liner system. Finally, on top of the primary liner system is the primary leachate drainage system composed of a foot of sand overlain by a geotextile.

The CWU design provides redundancy in the form of the secondary liner. If the primary liner system were to leak, the secondary liner is there to prevent leachate from escaping into the environment. Also, if leachate constituents were found in the secondary leachate drainage system, it would provide an early warning that the primary liner system has failed. For this reason, the secondary leachate drainage system is sometimes called the witness zone.

## CLINTON LANDFILL NO. 3 - TYPICAL FLOOR LINER SECTIONS



## History of known failures or releases

There have been no known failures of or releases from the facility, in the context of releases to groundwater.

## Other facility components that could affect groundwater quality

The property also includes two older landfills, Clinton Landfill, Inc. (a/k/a Clinton Landfill 1) and Clinton Landfill 2. Clinton Landfill, Inc. operated under the Part 807 regulations and Clinton Landfill 2 operated under Part 811. Both landfills are closed and currently in post-closure care, and both have independent groundwater monitoring networks to detect any releases from the respective facilities. Clinton Landfill, Inc. is currently in corrective action for groundwater exceedances.

## Compliance history

The facility's compliance has generally been quite good. The last indication in Bureau of Land records of any apparent violations at the facility was in late 2009, when small amounts of uncovered waste from the previous operating day were seen in inspections. This operating practice issue was seen to have been corrected in a 16 February 2010 inspection and has not been cited as an apparent violation since then. No other problems or issues have been cited as apparent violations, and there are no court, administrative, or Illinois Pollution Control Board orders on this site.

## Geology and hydrogeology

This information is derived largely from the facility's permit application, itself based on a review of available literature, in part from the work of Hansel & Johnson (1996) and Killey (2007).

### Regional geology

The site is located within the Bloomington Ridged Plain Region of the Till Plains Section of the Central Lowland Physiographic Province. It is situated in an area of glaciated uplands, bordering Salt Creek. Salt Creek is located approximately 600 feet south of the subject facility. The area surrounding the landfill site has a surface water drainage flow direction to the southwest leading into Salt Creek. Relief at the site ranges from a maximum elevation of 729 feet Above Mean Sea Level (AMSL) to approximately 660 feet AMSL.

The surficial deposits in the DeWitt county region consist of an average of approximately two hundred feet of overburden soils resulting from glacial activity that occurred during the Pleistocene Epoch. Underlying these glacial-derived soils is Pennsylvanian-aged bedrock of the Bond and Modesto Formations. During the Pleistocene Epoch, glaciers from the earliest glacial advancements eroded deep valleys into the bedrock in central Illinois. One of these valleys is known as the Mahomet Bedrock Valley, which occupies a major portion of east-central Illinois and directly underlies the Clinton Landfill site. Subsequent glaciation from the Wisconsinan, Illinoian and pre-Illinoian glacial stages filled in and buried the Mahomet Bedrock Valley.

Three episodes of glaciation, Wisconsin, Illinois, and pre-Illinois, deposited an array of sediments in this region. The various units possibly present in this region are discussed below.

### *Recent deposits*

#### Modern soil

The topsoil expected to cover most of the site consists of a weathered organic profile developed in loess overlying the glacial deposits. It ranges in thickness from several inches to several feet.

#### Cahokia Alluvium

This is the youngest deposit mapped in DeWitt County. It ranges from five to twenty feet in thickness and occurs along river valleys. It consists of silt, sand, and organic material or the products of erosion and slope wash from upland deposits.

#### Wisconsin Glacial Episode

The deposits of the Wisconsin Episode are classified into two groups, the clay-rich diamictons (tills) of the Wedron Group and the sorted, pro-glacial sediments of the Mason Group. The units below are listed roughly in descending stratigraphic order. However, repeated advances and retreats of the ice margin during the episode resulted in intertonguing between the Wedron and Mason Groups, so it should not be interpreted that Mason deposits always overlie those of the Wedron.

### **Mason Group**

#### *Peoria Silt*

This unit consists of yellow-tan massive loess, with the Modern Soil developed upon its surface. Locally, the loess may be clay-enriched by the B-zone of the Modern Soil or by slope wash and colluvi-

um deposited with the loess. It grades from sandy silt in the bluffs to clayey silt away from the bluff, where it is thinner and weathered. It exists throughout Illinois and from Minnesota north to Louisiana, south and east to Ohio, and west to Kansas. This unit has 28-80% expandable clay mineral content, 15-74% illite, and 5-20% kaolinite and chlorite.

#### Morton Tongue of the Peoria Silt

This consists of a gray to tan calcareous, massive, fossiliferous silt, bounded by sharp contacts at the top and bottom. Locally, it appears as a thin, grayish silt layer between deposits of the Tiskilwa Formation and the underlying Robein Member of the Roxana Silt. The Morton Tongue exists as a belt that is about thirty miles wide and stretches from Bureau County in the north to Shelby County in the south. It has 46-76% expandable clay minerals, 12-30% illite, and 11-24% kaolinite and chlorite.

#### *Henry Formation*

This formation consists of well-sorted, well-bedded sand and gravel outwash deposited in valley trains from glaciation. Lenses of clay, silt, organic debris, wood, and shells can locally occur in this formation. The formation also includes terrace deposits of former valley trains. This formation extends from Wisconsin south into McHenry County, trending southwest to Peoria County, where it trends southeast to Shelby County and eastward into Indiana.

#### *Roxana Silt*

This formation is primarily loess but it locally contains some sand, and the basal unit is commonly composed of silt, sand, and clay colluvium. It is pinkish-tan to yellow-gray. It is present throughout the state of Illinois. This formation has 46-54% expandable clay minerals, 8-15% illite, and 38-42% kaolinite and chlorite.

#### Robein Silt Member

This member consists of silts, sandy silts, organic silts, and peat. It is usually a rich, dark brown or black color. The organic silts generate methane gas, which is reported to be frequently present in wells in the area. It is generally less than five feet thick and is discontinuous in the subsurface over a majority of Illinois. This member has 9-77% expandable clay minerals, 8-65% illite, and 14-50% kaolinite and chlorite. Due to its distinctive appearance and wide areal extent, the Robein is often considered a marker for the bottom of the Wisconsin Episode deposits.

### **Wedron Group**

#### *Tiskilwa Formation*

This formation consists of calcareous, red gray to gray, medium textured clay, containing lenses of gravel, sand, silt, and clay. It typically oxidizes to red-brown, brown, or yellow brown. It is the largest formation of the Wedron Group and was deposited as part of the Shelbyville moraine in the site vicinity. This formation consists of an upper boundary member (Piatt Member) and a lower boundary member (Delavan Member), which are quite similar and do not always occur together. The Tiskilwa Formation trends from Kane County in the north to McLean County in the south and as far west as Bureau County. The typical textural composition for this formation is as follows: 27-30% sand, 34-38% silt, and 34-37% clay. It contains 6-20% expandable clay minerals, 64-72% illite, and 12-30% kaolinite and chlorite.

## Sangamon Interglacial Episode

### **Sangamon Geosol**

This is characterized by a brown to black organic-rich soil, which was formed by the accumulation of organic debris and silt from sheetwash and possibly eolian deposits. It ranges from one to five feet in thickness and is present in most of Illinois.

## Illinois Glacial Episode

### **Glasford Formation**

#### *Berry Clay Member*

This member is an accreted soil consisting of clay, silt, and sparse small pebbles, and it is commonly two to five feet thick. This member is greenish-blue in color. It occurs at isolated localities throughout the Illinoian drift. This member has 73-82% expandable clay minerals, 10-21% illite, and 6-8% kaolinite and chlorite.

#### *Radnor Till Member*

This member is a gray silty clay that is compact and has a high illite content. It exists throughout central and east central Illinois, with a typical textural composition of 15-29% sand, 46-55% silt, and 25-30% clay. This member has 2-16% expandable clay minerals, 66-84% illite, and 8-29% kaolinite and chlorite.

#### *Roby Silt Member*

This member contains silt, clay, sand, and locally contains mollusk fossils. This member can be up to thirteen feet in thickness and is in the earliest part of the Jubileean Substage of the Illinoian stage. It is a proglacial deposit of the advancing glacier that deposited the Radnor Till and was subsequently overridden by that glacier.

#### *Vandalia Till Member*

This member is a sandy, gray, compact clay till with lenticular bodies of silt, sand, and gravel. It is commonly twenty-five to fifty feet thick but can be sometimes thicker in valleys. It occurs widely in south central and east central Illinois.

#### *Smithboro Till Member*

This member consists of gray, compact, silty clay till. It is bounded below by its contact with the Yarmouth Soil, or older soils, and at the top by the Mulberry Grove Member (if present) or the Vandalia Till Member. It occurs in south central and east central Illinois.

## Yarmouth Interglacial Episode

### **Yarmouth Soil**

This is an in-situ soil profile that is deeply developed in the tills of the Banner Formation. It consists of accretionary deposits of fine sediment and organic material, and it occurs in the western and central parts of Illinois.

## Pre-Illinois Glacial Episode

### **Tilton Till Member**

This member is a gray, calcareous, hard, silty, sandy clay till. It contains considerable silt, sand, and gravel near its upper and lower boundaries.



### **Hillary Till Member**

This member is a reddish-brown, calcareous, massive, hard clay till. The lower part of the unit is slightly darker and its upper part contains streaks of silt. It occurs in east central Illinois.

### **Harmattan Till Member**

This member is a gray, calcareous, dense, hard clay till but its upper part contains lenticular bodies of gravelly sand. It is present mostly in eastern portions of Illinois.

### **Mahomet Sand Member**

During the Pleistocene, glaciers from the earliest glacial advancements eroded deep valleys into the bedrock in central Illinois. One of these valleys is the Mahomet Bedrock Valley, which is areally extensive in east-central Illinois and directly underlies the Clinton Landfill facility. Subsequent glaciation filled in and buried the valley. This member consists of proglacial sand and gravel outwash, and it contains many silt beds. It exists in the deep bedrock valleys of central and east central Illinois, and can be as thick as 150 feet. Thinner deposits of basal sand and gravel outwash of pre-Illinoian or Illinoian age may overlie bedrock outside of the bedrock valleys. Both the Mahomet and the basal sands and gravels form good aquifers.

### **Bedrock**

Bedrock of the Bond and Modesto Formations of the Pennsylvanian System directly underlie the glacial deposits at the site. These formations consist of shale and sandstone, with some thin beds of limestone and coal. The formations range in thickness from 350 to 800 feet. Underlying these formations is a sequence of interbedded shales, sandstones, limestones, and dolomites of the Lower Chesterian, Valmeyeran, and Kinderhookian Series of the Mississippian system. The top portion of the Mississippian System is eroded beneath the Pennsylvanian System strata in DeWitt County and has a thickness of about 800 feet.

### **Structural Features**

Few regional bedrock structural features have been identified in the site region. The nearest identified features are the Clinton syncline and Downs anticline located about three and seven miles northeast of the site, respectively. No evidence of faulting has been found in the region of the site. The nearest known or suspected active faults are associated with the Wabash Valley and Rend Lake Fault systems located about 135 miles southeast and south of the site, respectively.

Site seismicity is controlled by earthquakes that originate in the fault systems of southern Illinois and southeastern Missouri. However, because of the distance of these active fault systems from the site, relatively mild ground shaking (expressed as horizontal acceleration) would be expected at the site due to seismic activity.

### **Regional Hydrogeology**

Withdrawal of groundwater from the glacial material in the region is limited. These deposits often contain well-stratified, alternating high and low hydraulic conductivity layers that commonly produce numerous perched and/or confined flow conditions. These conditions are only found when a well is screened in large sand/gravel seam within the glacial silty clay. Although generally the yield from these perched aquifers is low, probabilities of larger yields from sand and gravel deposits are higher along bedrock valleys where the sand and gravel deposits are much thicker. Speculation on regional groundwater flow is difficult because of hydraulic anisotropy within the glacial sediments.

Records of wells in the vicinity of the site were obtained from the ISGS, ISWS, and Dewitt County Health Department and reviewed. The water well logs indicate that the bedrock is seldom accessed for domestic water supplies in this area due in part to the thickness and higher yield capacity of the Mahomet Sand aquifer that overlies the Pennsylvanian bedrock. Withdrawal from the bedrock aquifers at greater depths would be too highly mineralized for consumption.

The City of Clinton derives its community water supply from the Mahomet Sand Member aquifer. According to the ISWS, the City of Clinton has eleven wells all of which are screened in sand and gravel at depths ranging from 328 to 361 feet bgs. These wells are located approximately 8,600 to 10,500 feet north and north-west of Clinton Landfill 3. Weldon Springs, located east north-east of the site, has twelve wells according to the ISWS. These wells are located approximately 3,900 to 6,700 feet east northeast of the site. These wells are screened in sand and gravel at depths ranging from 38 feet to 141 feet below ground surface.

## Exploration program

### Boring program

Site geologic and hydrogeologic conditions have been investigated by drilling twenty-nine soil borings on the Clinton Landfill 3 site and correlating geologic information from ten soil borings previously drilled at the adjacent existing Clinton Landfill 2 site. The twenty-nine soil borings drilled on the proposed expansion area were conducted in six phases. The drilling program was conducted under the direction of an Illinois Licensed Professional Engineer with field activities and soil descriptions conducted by an Illinois Licensed Professional Geologist.

Boring #s EX-1 through EX-3 were drilled at the site in December 1996 by SKS Engineers (SKS) under the direction of a PDC professional geologist. These borings were drilled using 8-inch outside diameter hollow stem augers (HSA) to depths of approximately 100 to 109.5 feet below ground surface (bgs). Samples were collected at continuous intervals utilizing a standard 5-foot split spoon sampler. The samples were logged in the field by PDC who selected representative samples for laboratory testing. The borings were grouted closed by pumping either a cement/bentonite or bentonite slurry through the augers using a tremie pipe while the augers were slowly extracted.

Boring #s EX-4 through EX-7 were drilled at the site in March through April 2000 by SKS under the direction of a PDC professional geologist. Boring EX-4 was drilled near the topographical low area of the site and borings EX-5 and EX-6 were drilled near the topographical high areas of the site. These borings were drilled using 8-inch outside diameter HSA to approximately 59 to 94 feet bgs. Samples were collected at continuous intervals utilizing a 5-foot standard split spoon sampler or thin-wall Shelby tube. These borings (EX-4 through EX-7) were converted into piezometers. These piezometers were labeled with the same nomenclature as the borings (e.g., EX-4 for boring EX-4).

Boring #s EX-8 and EX-9 were drilled in April 2001. These borings were drilled by SKS under the direction of a PDC professional geologist. The borings were drilled using 8-inch outside diameter HSA. These borings were converted into piezometers at their completion. Piezometers EX-8S and EX-8D are nested piezometers and are within ten feet of each other. Prior to the installation of the

nest, the deeper boring (EX-8D) was advanced first with the geology recorded from continuous sampling activities utilizing a 5-foot standard split spoon sampler. At the completion of the boring, the piezometer was installed. Next, a review of the boring log indicated a potential need for a shallow piezometer to monitor a water-bearing unit at a higher elevation. The boring for the shallow piezometer (EX-85) was then advanced within ten feet of the deeper boring with no samples being collected. Once the boring was completed to the desired depth/elevation, the piezometer was installed.

Boring #s EX-10 and EX-11 were drilled in December 2001 and February 2002, respectively. These borings were drilled by SKS under the direction of a PDC professional geologist. The borings were drilled using 8 inch outside diameter HSA to depths of approximately 48 to 76 feet bgs. Samples were collected at continuous intervals utilizing a standard 5-foot split spoon sampler. The samples were logged in the field by PDC personnel who selected representative samples for laboratory testing. Boring EX-10 was converted into a piezometer at completion. Boring EX-11 was grouted closed by pumping a bentonite slurry through the augers using a tremie pipe while the augers were slowly extracted.

Boring #s EX-12 through EX-24 were drilled in December 2002 through February 2003. These borings were drilled by SKS under the direction of a PDC professional geologist. The borings were drilled using 8-inch outside diameter HSA to depths of approximately 41 to 99.5 feet below ground surface (bgs). Samples were collected at continuous intervals utilizing a standard 5-foot split spoon sampler. The samples were logged in the field by PDC who selected representative samples for laboratory testing. Borings EX-12, EX-13, EX-14, EX-15, EX-17, EX-19, EX-20, EX-21, EX-22, EX-23, and EX-24 were converted into piezometers at their completion. A shallow well was installed within 10 feet of existing wells EX-12, EX-22, and EX-23, resulting in a nested pair of wells (shallow and deep) at each location. Borings EX-16 and EX-18 were grouted closed after their completion by pumping a bentonite slurry through the augers using a tremie pipe while the augers were slowly extracted.

The most recent phase of drilling (prior to the original permit application) was conducted in October 2003. Boring #s EX-25 through EX-29 and the installation of piezometer EX-21S were done under the direction of a PDC professional geologist. The borings were drilled around the southeastern portion of the proposed facility. The borings were drilled using 8-inch outside diameter HSA to depths of approximately 69 to 79.5 feet bgs. Samples were collected at continuous intervals utilizing a standard 5-foot split spoon sampler. Borings EX-25 through EX-29 were grouted closed by pumping a bentonite slurry through the augers using a tremie pipe while the augers were slowly extracted.

Boring CSM-1 was drilled near the center of the adjacent Clinton Landfill 2 site in June 1995 by SKS under the direction of PDC. The purpose of this boring was to document the subsurface geology beyond elevation 590 Mean Sea Level (MSL) and to document the presence of the Mahomet Sand which was believed to be present below the facility. The soil boring confirmed the subsurface geology with the literature (ISGS publications) and with nearby well logs. The geologic units were uniform and correlated with the geology recorded on the adjacent well logs and with regional geologic literature. The boring was drilled using 8-inch HSA at a starting elevation of approximately 636 MSL to a final depth of approximately 156 feet bgs, or 480 MSL, and was continuously sampled utilizing a 5-

foot long continuous sampler and a 2-foot long split spoon. The samples were logged in the field by PDC who selected representative samples for laboratory testing. The boring was grouted closed by pumping a cement/bentonite slurry through the augers using a tremie pipe while the augers were slowly extracted.

Boring #s B22, G46D, G51D, P223D, G40D, B20, GMD8, G39D, and B-11 were previously drilled along the eastern edge of the adjacent Clinton Landfill 2 facility (or western edge of the proposed facility) as part of permitting and monitoring of the existing facility. Information from these nine borings was used to interpolate the geology of the proposed expansion area.

## Site Geology

### Overburden

Soil stratigraphy beneath the site is complex, as would be expected in a glaciated region. These soils were deposited through several modes of deposition which accounts for the complexity of the stratifications. Soil types encountered during the field investigations primarily consist of clays, silts, organic deposits, and sands. In review of the boring data for the site, there appears to be distinct stratigraphic units on site, although each unit may not be continuous across the site.

The upper-most (Wisconsin Episode) soil stratigraphy beneath the site is relatively complex. These soils were deposited during several periods of deposition that account for the complexity of the stratifications. The uppermost units are interpreted as consisting of surficial loessial deposits (Peoria Silt) and Wisconsinan deposits (brown and gray silty clays, clayey silts and sands of the Tiskilwa Formation).

The Tiskilwa Formation is approximately seventy feet thick except where eroded in the present day drainages. The Tiskilwa Formation soils encountered at the site are primarily described as brown, stiff to hard silty clay. The lower portions of this formation are described as gray, medium stiff to very stiff clay. Outwash deposits, consisting of dense to a very dense saturated sands and silts, of the Tiskilwa Formation were encountered at approximate elevation 695 to 705 feet AMSL along the northern edge of the facility, 655 to 675 feet AMSL at the northwestern edge of the facility, and at approximate elevation 668 to 675 feet AMSL at boring EX-3 located at approximately the center of the facility. Eight vertical laboratory hydraulic conductivity tests were performed on the clayey soils of the Tiskilwa Formation. The vertical hydraulic conductivity ( $k_v$ ) ranged from  $2.73 \times 10^{-8}$  to  $8.6 \times 10^{-9}$  centimeters per second (cm/sec).

The Roxana Silt and Robein Silt Member of the Mason Group of the Wisconsinan Stage underlie the Tiskilwa Formation. This unit consists of dark brown medium stiff to stiff organic silty clay and silt, with peat. This unit was encountered at an approximate elevation of 673 to 658 feet AMSL over the majority of the site except along the south-eastern portion of the facility where it appears to have eroded away. This unit is a marker for the division between deposits of the Wisconsin and Illinois Stages. Four vertical laboratory hydraulic conductivity tests were performed on the soils of the Roxana Silt and Robein Silt Member. The vertical hydraulic conductivity ( $k_v$ ) ranged from  $4.13 \times 10^{-8}$  to  $1.55 \times 10^{-8}$  cm/sec. Groundwater was not noted in the Roxana Silt and Robein Silt Member as

evidenced in Piezometer EX-10, which is screened in this unit. Numerous excavations at Clinton Landfill 2 also did not encounter water in this unit, based upon observations and conversations with the site manager.

Glacial deposits of the Sangamonian substage were encountered beneath the Roxana Silt and Robein Silt Member. These soils primarily consist of hard silty clays, with few interbeds of clayey silts and sand deposits. The sand deposits associated with these soils are interpreted as being outwash deposits. Most of these outwash units appear to be discontinuous across the site. The upper-most unit encountered in the deposits is interpreted as the Berry Clay Member. This unit is distinguishable due to its blue-green/blue-gray color. The Berry Clay unit ranges in thickness from 0 to 10 feet at the facility. Nine vertical laboratory hydraulic conductivity tests were performed on the clayey soils of this formation. The  $k_v$  ranged from  $8.43 \times 10^{-8}$  cm/sec to  $1.35 \times 10^{-8}$  cm/sec. This unit is somewhat continuous across the site except where it has been eroded.

The next unit encountered is interpreted as the Radnor Till Member. Nine vertical laboratory hydraulic conductivity tests were performed on the clayey soils of this formation. The  $k_v$  ranged from  $9.36 \times 10^{-8}$  cm/sec to  $1.64 \times 10^{-8}$  cm/sec. The few sand deposits associated with these soils are interpreted as being outwash deposits. Two outwash sand units were identified in the Radnor Till Member at the site. The first unit, termed herein as the Upper Radnor Till Sand, was encountered in the south-eastern portion of the facility at the site at approximate elevation 653 to 650 ft. AMSL. This unit was encountered in borings EX-3, EX-5, EX-6, EX-21, EX-22, EX-23, and EX-28. Three piezometers were installed to monitor this unit, EX-21S, EX-22S, and EX-23S. In situ slug testing on these piezometers revealed hydraulic conductivities in the Upper Radnor Till sand to range from  $1.26 \times 10^{-4}$  cm/sec to  $7.94 \times 10^{-6}$  cm/sec.

The next outwash sand unit encountered in the Radnor Till Member is termed herein as the Lower Radnor Till Sand. This unit was encountered in many of the borings at the site around the approximate elevation 644 to 640 ft. AMSL at the site. However, this unit is not continuous across the facility. In situ slug testing was conducted on piezometers which are screened in the Lower Radnor Till Sand. The results ranged from  $1.28 \times 10^{-3}$  cm/sec to  $3.17 \times 10^{-5}$  cm/sec.

The next unit encountered (in most boring locations) is interpreted as an intra-till organic soil within the Radnor Till Member and is termed herein as the Organic Soil. This unit is unnamed according to literature research. It most likely represents an inter-glacial substage during Illinoian glaciation between the Jubileean and Monican Substages. The unit consists of organic deposits (with peat), silt, clay, and sand that range in thickness from 1.3 to 10 feet across the site. This deposit is present at the site at an approximate elevation of 637 to 627 feet AMSL. In situ slug testing revealed hydraulic conductivity values ranging from  $2.66 \times 10^{-3}$  to  $9.04 \times 10^{-6}$  cm/sec.

The next unit that is encountered is interpreted as consisting of silty clays, clayey silts, silts and outwash sands of the Vandalia Till Member. This unit is interpreted to be encountered at an approximate elevation 630 AMSL. Two laboratory  $k_v$  tests were performed on the clayey soils in this unit; the results ranged from  $1.87 \times 10^{-8}$  to  $1.7 \times 10^{-8}$  cm/sec.

The Smithboro Till Member, the Yarmouth Soil, which is a marker between the Illinoian and pre-Illinoian (Kansan) glaciation period, the Tilton Till Member, Hillary Till Member, and finally the

Mahomet Sand Member of the Kansan Banner Formation were encountered during the drilling of boring CSM-1 at Clinton Landfill 2. These units are well below the invert of Clinton Landfill 3.

The last unit encountered is interpreted as the Mahomet Sand Member of the Kansan Banner Formation. This unit was encountered at approximate elevation 487 ft. AMSL during drilling activities of boring CSM-1 at Clinton Landfill 2.

### **Bedrock**

Bedrock was not encountered during drilling activities at the site. The bedrock is assumed to be present at elevations ranging from 400 to 450 ft. MSL. Bedrock was encountered at approximate elevation 400 ft. AMSL at water well 14-1, which is located approximately 1700 feet southeast of the facility.

## **Site Hydrogeology**

### **Aquifer designations**

The overburden deposits comprise the uppermost aquifers at Clinton Landfill 3. Four water-bearing units of interest within the overburden deposits have been identified. While other water-bearing units are present at the site, three of the four units identified are interpreted as being the upper-most water-bearing units below the landfill floor, and the fourth is intersected by and/or occurs higher than the landfill floor.

#### *Roxana Silt-Robein Member*

The Roxana Silt was present in most areas of the landfill. It is often found to be dry. It was to be removed within the landfill footprint down to the level of the Berry Clay, a unit occurring between it and the Radnor Till. The excavation between the landfill invert and the Berry Clay was then to be filled with recomacted clay of a maximum hydraulic conductivity of  $1 \times 10^{-7}$  cm/sec to improve the foundation of the landfill.

#### *Upper Radnor Till Sand*

The first unit below the landfill floor, interpreted as an outwash sand of the Radnor Till Member, is located at an approximate elevation of 653 to 647 feet AMSL and is termed herein the Upper Radnor Till Sand. The Upper Radnor Till Sand attains a maximum thickness of 2.8 feet at piezometer EX-22S. Piezometers EX-21S, EX-22S, and EX-23S are screened in this unit, the “upper-most aquifer,” in the southeastern portion of the facility. Water level measurements were obtained from these piezometers during the four quarters of 2003 and 2004. Potentiometric contour maps show the groundwater flow of the Upper Radnor Till Sand is toward the southeast. During the initial period monitored, the potentiometric elevations in the individual wells ranged from as high as 677.42 ft. AMSL in piezometer EX-23S to as low as 660.32 ft. AMSL in EX-21S. Because of its limited lateral extent and proximity to the landfill floor, the Upper Radnor Till Sand was to be excavated and removed within the landfill footprint.

### *Lower Radnor Till Sand*

The next unit, also interpreted as an outwash sand, is present at an approximate elevation of 644 to 637 feet AMSL beneath the facility and is termed herein the Lower Radnor Till Sand. The Lower Radnor Till Sand attains a maximum thickness of 5.3 feet at piezometer EX-7S. Piezometers EX-4, EX-5, EX-6, EX-7, EX8S, EX-12S, EX-19, and EX-21S are screened in this unit at the facility. Water level measurements were obtained from these piezometers during the four quarters of 2003 and 2004. Four contour maps showing the potentiometric surface in this sand unit during the four quarters of 2004 were prepared. The potentiometric contour maps show the groundwater flow of the Lower Radnor Till Sand is toward the southeast. For the time period monitored, the potentiometric elevations in the individual wells range from as high as 691.82 in piezometer EX-15 to as low as 639.89 in EX-19.

### *Organic Soil*

The final unit encountered is an organic soil which is at an approximate elevation of 643 to 627 feet AMSL across the site and is termed the Organic Soil. The Organic Soil attains a maximum thickness of 10 feet at well G23D on the west side of the site. Piezometers EX-11, EX-12D, EX-13, EX-7, EX-14, EX-17, EX-20, and EX-24 are screened in this unit. Water level measurements were obtained from these piezometers during the four quarters of 2003 and 2004. Four contour maps showing the potentiometric surface in this sand unit during the four quarters of 2004 were prepared. The potentiometric contour maps show the groundwater flow of the Organic Soil is toward the southwest. For the time period monitored, the potentiometric elevations in the individual wells range from as high as 675.77 in piezometer EX-24 to as low as 657.19 in EX-20.

### **Aquitard determinations**

In general, the tills overlying and interbedded between the designated aquifers would tend to serve as aquitards. The groundwater impact assessment in the approved permit application covers in depth the modeling used to demonstrate that any leakage through the landfill liner would be limited in its migration through the surrounding geology.

### **Hydraulic conductivity tests**

#### *Laboratory*

Laboratory testing of hydraulic conductivity, grain-size distribution, Atterberg limits, density, porosity, ion/cation exchange capacity, total organic carbon and other parameters was conducted in phases corresponding to the exploration phases. The tests were performed using American Society for Testing and Materials (ASTM) test protocols.

#### *Field*

PDC has performed in-situ aquifer testing on the piezometers at the Clinton Landfill 3 facility. The aquifer testing consisted of rising head and falling head slug tests which were performed to estimate the hydraulic conductivity of the saturated unit in which each well is screened.

Falling head slug test procedures consisted of displacing the water level within a well to an elevation higher than the static level. Stainless steel pressure transducers/data recorders were installed within the wells to monitor and record changes in head pressure/water level. These transducers monitored

and recorded the water level changes over time until the wells recovered to within 95 percent of the static level. This water level data over time was stored within a portable computer for retrieval and analysis at a later time.

Rising head tests procedures consisted of depressing the water levels within a well below the static level. Stainless steel pressure transducers/data recorders were installed within the well to monitor and record changes in head pressure/water level. These transducers monitored and recorded the water level changes over time until the levels recovered to within 95% of the static level. This water level data over time was stored within a portable computer for retrieval and analysis at a later date.

Once the slug tests were complete, the test data were entered into the software program titled Aquifer Test by Waterloo Hydrogeologic, Inc. This program estimates the hydraulic conductivity of the aquifer at the well from the time-recharge data recorded by the data recorders. The hydraulic conductivities of the wells were estimated using the Hvorslev Method.

### Determination of flow rates and directions

Flow rates within the Upper Radnor Till Sand, Lower Radnor Till Sand, and Organic Soil under the site were calculated using Darcy's Law in the forms  $V = KI$  to estimate average flow velocity and  $V = KI/n_c$  to estimate interstitial flow velocity. The flow rate ( $v$ ) was calculated using the geometric mean hydraulic conductivity value ( $k$ ) from the in situ hydraulic conductivity test data. An effective porosity ( $n_c$ ) of 0.35 (USEPA, 1990) was used. The average hydraulic gradients ( $I$ ) used and flow velocities calculated were as follows.

Unit	Average I	Flow velocity		Flow direction
Upper Radnor Till Sand	$1.20 \times 10^{-2}$	$4.97 \times 10^{-3}$ ft/day	$5.53 \times 10^{-1}$ m/yr	Southwest
Lower Radnor Till Sand	$8.92 \times 10^{-3}$	$1.47 \times 10^{-2}$ ft/day	1.63 m/yr	Southwest
Organic Soil	$6.28 \times 10^{-3}$	$1.16 \times 10^{-3}$ ft/day	$1.29 \times 10^{-1}$ m/yr	Southwest

### Monitoring Wells

The four hydrostratigraphic units monitored at Clinton Landfill #3 are the Roxana Silt (which may be the Robein Member), the Upper Radnor Till Sand, the Lower Radnor Till Sand, and the Organic Soil. Not all units are necessarily laterally continuous across the site or monitored at each monitoring point. The Organic Soil occurs within the Radnor Till Member of the Glasford Formation, as do, obviously, the Upper and Lower Radnor Till Sands. Well names are linked to the unit monitored by the last letter of the well name, as follows.

Letter	Meaning	Unit
R	Roxana/Robein	Roxana Silt/Robein Member
S	shallow	Upper Radnor Till Sand
M	middle	Lower Radnor Till Sand
D	deep	Organic Soil



The well network at Clinton 3 is phased in accordance with the landfill's ongoing development. New MSWU cells are constructed proceeding southward from the northwest corner of the landfill. Because these early phases of the MSWU are remote from compliance boundary wells G39R, G39M, G39D, and G54S, temporary wells are installed downgradient (south) of the MSWU cells. As additional new MSWU cells are constructed, temporary wells and/or piezometers within their footprint and associated with the previous cell must be plugged and abandoned, per Note iv. of the phasing schedule. Prior to abandonment, the facility discusses the upcoming abandonments with the Permit Section. A formal permit modification is not required and wells can be verbally approved for abandonment prior to written approval of pending alternate source demonstrations (if any). The facility must time the abandonment such that the quarterly samples have been taken prior to abandonment, so that the quarter is not missed. As part of the development of the new cell, new temporary wells are installed in its downgradient zone of attenuation.

As a result of this phasing process, wells at this site can be considered as belonging to one of two groups: permanent wells that stand outside the north, east, and west boundaries of the overall site plus south of the CWU, and temporary wells that come and go within the footprint of the MSWU. The phasing plan contained in the permit reflects that.

At landfills with phased networks, abandonment of wells within new cell footprints and installation of replacement wells are considered approved by the issuance of operating authorization for the new cell, even though changes to the well network may not be spelled out in the introductory part of the permit where changes approved by the new permit are identified. Additionally, the well list in the permit may occasionally become out of sync with the actual network. For example, the permit currently lists fifty-four monitoring wells and twelve piezometers but it has not been updated to incorporate changes to the network resulting from the construction of MSWU Cell 5A. In actuality, there are now fifty-eight wells and fourteen piezometers at the site.<sup>5</sup>

For informational purposes, I compiled a table that summarizes pertinent information—depths, elevations, construction materials, and so forth—for each well or piezometer at the site. The information was compiled from well completion reports and soil boring logs submitted by the facility over the years. Initially, I tried to list the wells in the order listed in the permit, where they are grouped first by aquifer and then by upgradient vs. downgradient. This itself would have yielded a somewhat random-looking list of wells since they would not have been in simple numeric order, although they would have been grouped by series: R, S, M, or D. As I began to encounter and enter documentation for wells newer than the permit, and needed to delete information for wells that I had entered prior to learning they had been abandoned, even the grouping by depth series broke down. Unfortunately, tables in Microsoft Word do not lend themselves to rearrangement of columns, at least in a somewhat complicated table such as this where the columns contain many split cells. The end result is a table that seems to have little order; however, all the wells should be in it.

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<sup>5</sup> In general, the distinction between a monitoring well and a piezometer is that a monitoring well is used for the collection of groundwater samples, while a piezometer is used only for water level readings. Typically, the construction is the same. The designation of whether a given well is a monitoring well or a piezometer is made in the permit. In the context of this discussion and for purposes of the well summary table I compiled (attached), I believe that certain new wells (not yet designated by the permit) will probably be designated piezometers based on their distance from the waste boundary. This was really only for my convenience in presenting this discussion and compiling the attached table; neither the Permit Section nor the facility is beholden to use this designation.

After compiling the table, I updated the “top of casing elevation” parameter using facility well resurvey results conducted on 25 September 2012. In most cases, the resurvey result was very close to the completion report result—a couple hundredths of a foot to a couple of inches in difference, small differences easily accounted for by minor frost heave, settling, the addition of a pump, or small errors in survey. In such cases, I did not update the original surveyed ground surface elevation. Ground surface elevation is a subjective measurement because the ground is not uniform and level, even over a small area such as the immediate vicinity of a well. As such, the elevation can be greatly influenced by the choice of the point chosen for the measurement. In contrast, the tops of casings and pump heads are generally much more level in comparison.

In a few instances, differences in top of casing elevation were in the five to ten foot range. These include the G16 cluster, the G20 cluster, and well G40M. The significant differences in elevation stem from the addition of well extensions necessitated by the building up of the ground surface near them. The G16 and G20 clusters are near roads, which have been built up over time. G40M is an exploration program well that predates the construction of Clinton Landfill 3 and it had to be extended during the construction of the CWU.

For these wells, I updated the ground elevation information based on the 2012 survey. Clinton Landfill 3 generally revises the well completion reports to reflect the new elevations and depths but had not submitted them to the Illinois EPA, as it is not explicitly required by the permit. However, Joyce Day with PDC forwarded the revised reports to me and to Illinois EPA headquarters, so I was able to update the table.

### **Upgradient locations (see also attached map)**

Wells designated as upgradient include G07S (for the Upper Radnor Till Sand); G01M, G04M, G05M, and G08M (for the Lower Radnor Till Sand); G01D, G02D, G03D, G07D, and G08D (for the Organic Soil); and G02R, G04R, G07R, R17R, and G58R (for the Roxana Silt). Most of these are along the north or northwest sides, except G07R (east of the southeast quarter of the site) and G58R (west of Cell 1A of the CWU).

### **Downgradient locations (see also attached map)**

Downgradient (zone of attenuation and compliance boundary) wells occur outside the east, west, and south site boundaries, and south of the currently active MSWU cell (5A) within the overall site footprint.

### **Other information**

#### *Construction materials*

Almost all wells at the site are of hybrid construction: PVC casing above the water table and Schedule 304 stainless steel below it, with a stainless steel screen. For a very few wells, there were information gaps in the records (indicated by “?” in the table), but based on the prevalence of the hybrid casing/steel screen construction, it is still accurate to say that most of the wells at the site are of that construction. The reader is referred to the attached table for (potential) exceptions.

### *Screen lengths, screened intervals, and total depths*

Some wells at this site have (approximate) ten-foot screens while others have (approximate) five-foot screens. The “approximate” enters the description in that the segment comprising the screen is either five or ten feet long, but the distance from the first slot to the last slot varies slightly from screen to screen.

Total depths and screened intervals range according to the water-bearing zone monitored and the topography of the site. The reader is referred to the attached table for more specific information.

### *Past performance*

There was insufficient time to do an exhaustive review on the issue of performance, i.e., the ability of the well to provide a sample, but to my knowledge most of the wells perform adequately. There has been at least one instance where a well had to be replaced due to damage from site equipment. Additionally, some of the Roxana Silt wells may yield lesser amounts of water than the deeper wells at the site. PDC’s hydrogeologists are familiar with the yield history of the wells at this site and were able to provide valuable input on that basis into my selection of wells for the split event.

## **Review of documents and data**

### **Groundwater sampling and analysis plan**

I did not review the groundwater sampling and analysis plan for adequacy in conjunction with this inspection. However, I did read and provide comments on the most recent plan at the time it was submitted as Log 2012-484 in the fall of 2012. That is the plan currently approved by the permit.

### **Groundwater monitoring reports and responses to increases**

All wells at this site are required to be sampled on a quarterly basis for List G1 parameters (field measurements and inorganic parameters), with collection to occur within the first two months of the quarter and reporting to occur by the fifteenth day of the following quarter. In addition, semi-annual sampling is required at all wells for List G2 (organic) parameters and at CWU wells for List G3 (additional organic) parameters, with collection to occur in April/May and October/November and reporting by 15 July and 15 January, respectively. Facility-submitted data in the Illinois EPA’s groundwater database show that most sampling did occur in the first two months of the respective quarters. There was a certain amount of sampling in the third month of the various quarters; some of this was resampling to confirm exceedances, while other events were sampling of newly installed wells or merely sampling of existing wells that had been delayed due to weather or other scheduling difficulties.

The permit sets four conditions that define “observed increases” beyond permitted limits when constituent concentrations are at or above the practical quantitation limit (PQL) and one or more of the four conditions are exceeded. These four trigger conditions are as follows.

- a. The concentration of any constituent in List G1 (indicator parameters and dissolved metals) of Condition VIII.12. shows a progressive increase over eight consecutive quarters.

- b. The concentration of any constituent monitored in accordance with List G1, List G2 (organics), or List G3 (more organics) of Condition VIII.12. exceeds the MAPC<sup>6</sup> at an established monitoring point within the zone of attenuation.<sup>7</sup>
- c. The concentration of any organic constituent in List G2 or List G3 exceeds the preceding measured concentration at any established point.
- d. The concentration of any constituent monitored at or beyond the edge of the zone of attenuation (compliance boundary<sup>8</sup>) exceeds its AGQS<sup>9</sup> or pursuant to 811.320(d), any constituent monitored at an upgradient well exceeds its AGQS.

An increase observed by any of the four conditions requires follow-up. Conditions VIII.14. and VIII.15. of the permit state the following.

For each round of sampling described in Condition 10 of this Section, the operator must determine if an observed increase has occurred within 90 days of the date initial sampling. If an observed increase is identified, the operator must also notify the Illinois EPA in writing and follow the confirmation procedures of 35 Ill. Adm. Code, 811.319(a)(4)(B). Furthermore, the operator must complete the confirmation procedures within 180 days of the initial sampling event.

Upon confirmation of a monitored increase and within 180 days of the initial sampling date, the operator shall submit a permit application for a significant modification to demonstrate an alternate source per 35 Ill. Adm. Code 811.319(a)(4)(b)(iii) or begin an assessment monitoring program in order to determine whether the solid waste disposal facility is the source of the contamination and to provide information needed to carry out a groundwater impact assessment in accordance with 35 Ill. Adm. Code 811.319(b).

In other words, the landfill must re-sample the exceeding parameters in their respective wells to verify the exceedance. The mere detection of a parameter or exceedance of a limit in a sample does not automatically indicate that these same conditions exist in the aquifer. Various factors can affect sample results: sampling technique, contaminated sampled bottles, airborne contamination during sampling, cross-contamination in the laboratory, analytical variability, and so forth. Therefore, the regulations and permit use confirmation sampling to demonstrate the *repeatability* of the measurement, to lessen the likelihood that it resulted from or was impacted by something other than an actual change in groundwater chemistry. If the exceedance is re-observed during confirmation sampling, it is referred to as a “confirmed increase.” Even a confirmed increase does not automati-

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<sup>6</sup> MAPC = Maximum allowable predicted concentration. MAPCs are applicable to wells within the zone of attenuation.

<sup>7</sup> §810.103 states, “‘Zone of attenuation’ means the three dimensional region formed by excluding the volume occupied by the waste placement from the smaller of the volumes resulting from vertical planes drawn to the bottom of the uppermost aquifer at the property boundary or 100 feet from the edge of one or more adjacent units. Stated more simply, this is a buffer zone outside the waste footprint.

<sup>8</sup> §811.318(b)(5) states, “A minimum of at least one monitoring well shall be established at the edge of the zone of attenuation and shall be located downgradient with respect to groundwater flow and not excluding the downward direction, from the unit. Such well or wells shall be used to monitor any statistically significant increase in the concentration of any constituent, in accordance with Section 811.320(e) and shall be used for determining compliance with an applicable groundwater quality standard of Section 811.320.”

<sup>9</sup> AGQS = Applicable groundwater quality standard. AGQSs are applicable to upgradient wells and compliance boundary wells. Both AGQSs and MAPCs are statistically derived from concentration data from multiple sampling events to represent expected background concentrations, i.e., natural conditions. Statistical methods used for this purpose are generally designed to allow a certain percentage of false positive results. In other words, it is expected that some exceedances will occur that are not actually statistically different from background concentrations.

cally represent an impact from the facility, but the landfill must submit an application for a significant permit modification to address confirmed increases.

The significant permit modification application can either: 1) propose to demonstrate that an alternate source (i.e., something other than a release of waste constituents from the landfill) is responsible for the exceedance, or 2) propose groundwater assessment monitoring to determine the source of the exceedance. If the Illinois EPA approves the alternate source demonstration, the monitoring well returns to routine detection monitoring. Otherwise, the Illinois EPA requires the landfill to conduct groundwater assessment monitoring to determine the source of the exceedance, and submit follow-up assessment monitoring reports to the Agency. If the groundwater assessment monitoring shows a release from the landfill, the landfill must propose and carry out a groundwater corrective action plan. The landfill is then required to submit regular corrective action reports.

All wells at Clinton Landfill 3 are currently in detection monitoring<sup>10</sup>, although alternate source demonstrations are currently required for some observed increases and under review for others.

I downloaded the facility's groundwater data from the Illinois EPA's "ACES" data system, itself fed by data submitted electronically by the facility. The system was up to date through fourth quarter 2013 at the time of downloading. I then imported the data into Microsoft Access to screen for results meeting any of the criteria defining an increase. During the review process, I consulted upon occasion with Joyce Day of PDC to elucidate any apparent irregularities in the data and the facility's management thereof. Day reviews Clinton Landfill 3's data and prepares any required notifications or applications for submittal to the Illinois EPA and thus is the person most knowledgeable about the facility's increases, notifications, and groundwater applications. The results of screening for the various increase criteria are given in the following sections.

#### *Eight-quarter consecutive increases*

When the concentration of a constituent over eight quarters increases each time, it is an observed increase under the criterion at Condition VIII.13.a. of the permit. For the increase to be confirmed, the ninth quarter need not be greater than the eighth quarter—it need only be greater than the seventh. In other words, it is the eighth quarter result that is being confirmed by the subsequent sample. For example, if dissolved boron is measured over eight consecutive quarters at 51 µg/L, 52 µg/L, 53 µg/L, 54 µg/L, 55 µg/L, 56 µg/L, 57 µg/L, and 58 µg/L, a confirmation sample result of 57.5 µg/L would still constitute confirmation because it represents an increase over the seventh result, 57 µg/L in this example.

I used Access to produce a table containing all results from 1 July 2009 to present. Waste was first placed in the landfill during that month, so any eight quarter consecutive increases beginning prior to that time could not be attributable to a release of waste from the landfill. The initial data set thus produced was over 52,000 records long.<sup>11</sup> Eliminating records of parameters that were never or seldom<sup>12</sup> detected (e.g., heavy metals, cyanide) still left a record set of about 6000 records. I then sorted

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<sup>10</sup> Detection monitoring is the initial and basic mode at all groundwater monitoring sites. No releases have been identified and the facility carries out a monitoring program designed to identify any such releases.

<sup>11</sup> In the database, a "record" is one result for one chemical in one well from one sampling date.

<sup>12</sup> Here I would define "seldom" as detected so infrequently that there were not eight consecutive quarters of any result greater than the reporting limit.

the resultant data set by parameter, well, and collection date, and screened it visually for eight-quarter trends. From that mass of data, I found exactly one occurrence of an eight-quarter trend.

Well	Parameter	Collected	MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
G08R	Sulfate, diss, mg/L	10/15/2010	156.6	2	Y	Y	N	Y	NA	NA
		1/26/2011		2.6						
		4/14/2011		15						
		7/27/2011		38						
		11/12/2011		40						
		2/1/2012		56						
		4/20/2012		58						
		8/2/2012		71						
		9/26/2012		42						

I included the MAPC in the table, even though it is not used to identify an observed increase by the eight quarter trend method, to show that the values observed were far less than the MAPC. As denoted in the table, the facility correctly identified the trend, reported it, resampled, and reported that it was not confirmed, and therefore no permit application was necessary.

The facility also reported one additional eight quarter trend, magnesium in G20M as of fourth quarter 2013. However, when I looked at the data in the Illinois EPA database, I saw the following.

Well	Parameter	Date Collected	Result
G20M	Magnesium, diss, mg/L	12/3/2011	21
G20M	Magnesium, diss, mg/L	1/17/2012	31
G20M	Magnesium, diss, mg/L	4/10/2012	38
G20M	Magnesium, diss, mg/L	8/3/2012	42
G20M	Magnesium, diss, mg/L	10/23/2012	46
G20M	Magnesium, diss, mg/L	2/15/2013	49
G20M	Magnesium, diss, mg/L	5/14/2013	50
G20M	Magnesium, diss, mg/L	7/22/2013	48
G20M	Magnesium, diss, mg/L	11/7/2013	52

There is an increase of seven quarters, fourth quarter 2011 (21 mg/L) through second quarter 2013 (50 mg/L). In the eighth quarter (7/22/2013), the value decreases to 48 mg/L, and in the final quarter of the year, it rises back to 52 mg/L. I did not consider this as an increasing trend so I emailed Joyce Day about it. She confirmed that the facility had reported it in error and does not actually consider it an eight quarter trend.

*Inorganic and field parameter increases over AGQS/MAPC values*

When the concentration of a constituent in a well in the zone of attenuation exceeds its respective MAPC, it is an observed increase under criterion at Condition VIII.13.b. of the permit. Similarly, when the concentration of a constituent in an upgradient or compliance boundary well exceeds its respective AGQS, it is an observed increase under criterion at Condition VIII.13.d. of the permit. In either case, for the increase to be confirmed, the resample result need only be greater than the respective standard—it does not need to be greater than the observed increase value.

To evaluate whether the facility complied with the permit for results exceeding an AGQS or MAPC and to present that evaluation in this report, I used Access to generate a table of AGQS/MAPC exceedances. In screening the data to prepare the table, I excluded certain data as follows.

- While the permit contains AGQS/MAPC values for organic compounds in addition to inorganic ones, there is considerable overlap between organic AGQS/MAPC exceedances and Condition VIII.13.c. organic increases. It thus makes sense to consider them together, so I excluded organic AGQS/MAPC exceedances from this table and instead included them in an organic evaluation later in the report.
- Waste was first accepted in the MSWU in July 2009. There could have been no release of waste constituents from the landfill prior to that time, so I did not screen data older than July 2009 from any wells for increases. I did screen data from the “S” series wells (Upper Radnor Till Sand) from July 2009 to present.
- New AGQSs/MAPCs were approved for the Lower Radnor Till Sand and Organic Soil units on 15 July 2010. The revised AGQSs/MAPCs were developed through addition of data from extra wells determined to be upgradient, and therefore represent more accurate trigger levels than those previously in place. Therefore I limited Lower Radnor Till Sand and Organic Soil data (“M” and “D” series wells, respectively) to results newer than 15 July 2010 and screened them with the new AGQSs/MAPCs.
- Certain parameters in certain monitoring zones had AGQSs/MAPCs developed later than other parameters for the same monitoring zone, for example, dissolved chromium and dissolved magnesium in the Upper Radnor Till Sand. For purposes of evaluating facility response, I discounted increases captured by Access if sample collection predated approval of the trigger value.
- No AGQSs or MAPCs were approved (or therefore in force) for the Roxana Silt until 11 April 2013, so I screened Roxana Silt well data newer than first quarter 2013.
- I did not screen chemical data from any wells designated by the permit as piezometers, because the permit specifies those to be subject only to water level readings and not chemical analyses (as such, little to no chemical data would be expected from these wells anyway).

With the preceding, I developed an approximation of the universe of sample results and relevant standards the facility would have been dealing with, as a baseline for determining how well the facility has implemented its detection monitoring program. Further considerations are given below.

- Certain wells were extant and sampled before they were formally added to the monitoring well network. For example, Upper Radnor Till Sand upgradient well G07S was installed in 2003 (as G00S) but not added to the network via permit until 28 May 2010. Such wells are technically not subject to the detection and confirmation process of the permit until they are part of the per-

mitted network.<sup>13</sup> Therefore, if the facility did not address increases in these wells in their notifications, I did not consider it an omission.

- I did not separately evaluate exceedances flagged by the Access query that appeared to be stand-alone confirmation sampling results (i.e., not also the routine sample for the next quarter), as they are part of the process for a previous result that I did evaluate. Since the permit and regulations allow up to ninety days after the initial sampling for confirmation samples to be collected, the next quarter's routine sample often serve as the confirmation sample. Exceptions to that include organic parameters, which are routinely sampled semi-annually and therefore require an extra sampling event for resamples, and any other parameter when scheduling precludes the next routine sampling event occurring within ninety days of the original sampling event.

I compared the data set thus developed against the facility-submitted notifications and permit applications. Due to occasional changes in approved AGQs/ MAPCs since the notifications were submitted, I sometimes encountered increases reported in the written submittals that were not ensnared by my Access query—the initially measured concentration no longer constituted an increase compared to current AGQs/MAPCs. Much more rarely, concentrations exceeded a superseded, lower AGQs/MAPC and were therefore not captured by my Access query, yet the confirmation results were found by the query to exceed the current AGQs/MAPC. Such an occurrence would result in an increase that from the perspective of my review was an observed increase, yet was in fact a confirmed increase at the time it occurred. It is for occurrences such as those in this paragraph, plus the general complexity of screening five years' worth of data from an evolving and growing program, that I referred to the data set I developed as an *approximation* of what the facility had to manage.

In addition to showing the dates, wells, and concentrations of exceeding values, the table also indicates whether the facility reported the observed increase and performed confirmation sampling, whether the resample result confirmed the initial observation, whether the facility reported the result of the confirmation procedure, whether a permit application (e.g., alternate source demonstration) was submitted to address any confirmed increases, and whether the application was approved relative to that confirmed increase. Due to the length of the table, I've included the various notations I used in the header at the top of each page.

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<sup>13</sup> Addition to the permitted network is considered to occur when operating authorization is issued for the associated waste disposal cell, though the well table in Condition VIII.9. may not be updated immediately.



Notes:	
Y	Yes
N	No
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(3)	See narrative
(4)	Not confirmed by next routine sampling event
(5)	Confirmed by next routine sampling event
(6)	Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
8/6/2010	G09D	Tot. Diss. Solids, mg/L	787	880	(1)	Y	N	Y	NA	NA
8/30/2010	G05M	Chromium, diss, µg/L	4.6	7.7	Y	Y	N	Y	NA	NA
8/30/2010	G07S	Arsenic, diss, µg/L	125.4	160	Y	Y	Y	Y	NA	NA
10/14/2010	G07S	Arsenic, diss, µg/L	125.4	150	Y	(3)	(3)	(3)	NA	NA
1/26/2011	G01D	Boron, diss, µg/L	530	850	Y	Y	N	Y	NA	NA
1/26/2011	G01D	Nitrate, diss, mg/L	1.5	37	Y	Y	N	Y	NA	NA
1/26/2011	G07S	Arsenic, diss, µg/L	125.4	200	Y	(3)	(3)	(3)	NA	NA
1/26/2011	G08M	Nitrate, diss, mg/L	0.14	7.7	Y	Y	N	Y	NA	NA
3/10/2011	G47D	pH (upper)	8.18	8.69	N	(3)	(3)	(3)	NA	NA
3/22/2011	G49M	pH (upper)	7.97	8.02	N	(3)	(3)	(3)	NA	NA
3/23/2011	G50S	pH (upper)	7.75	7.97	N	(3)	(3)	(3)	NA	NA
3/23/2011	G54S	pH (upper)	7.75	8.07	N	(3)	(3)	(3)	NA	NA
3/25/2011	G39M	pH (upper)	7.97	8.06	N	(3)	(3)	(3)	NA	NA
3/29/2011	G07D	pH (upper)	8.18	9.97	N	(3)	(3)	(3)	NA	NA
4/13/2011	G50S	Lead, diss, µg/L	1	4.3	Y	Y	N	Y	NA	NA
4/13/2011	G50S	pH (upper)	7.75	7.78	Y	Y	N	Y	NA	NA
4/13/2011	G50S	Sp. Cond., µmho/cm	1108.7	1887	Y	Y	N	Y	NA	NA
4/13/2011	G50S	Sulfate, diss, mg/L	8.4	22	Y	Y	Y	Y	Y	Y
4/14/2011	G01D	Sp. Cond., µmho/cm	1383	1488	Y	Y	N	Y	NA	NA
4/14/2011	G01M	Cadmium, diss, µg/L	1	1.3	Y	Y	N	Y	NA	NA
4/14/2011	G01M	Lead, diss, µg/L	1	1.1	Y	Y	N	Y	NA	NA
4/14/2011	G01M	Sp. Cond., µmho/cm	1457	1523	Y	Y	N	Y	NA	NA
4/14/2011	G02D	Sp. Cond., µmho/cm	1383	1545	Y	Y	N	Y	NA	NA
4/14/2011	G03D	Sp. Cond., µmho/cm	1383	1813	Y	Y	N	Y	NA	NA
4/14/2011	G04M	Nitrate, diss, mg/L	0.14	0.34	Y	Y	Y	Y	Y	Y
4/14/2011	G04M	Sp. Cond., µmho/cm	1457	1845	Y	Y	N	Y	NA	NA
4/14/2011	G04M	Zinc, diss, µg/L	22	30	Y	Y	Y	Y	Y	Y
4/14/2011	G18D	Cadmium, diss, µg/L	1	1.8	Y	Y	N	Y	NA	NA
4/14/2011	G18D	Chromium, diss, µg/L	15	65	Y	Y	N	Y	NA	NA
4/14/2011	G18D	Lead, diss, µg/L	2.5	130	Y	Y	N	Y	NA	NA
4/14/2011	G18D	Magnesium, diss, mg/L	72.1	220	Y	Y	N	Y	NA	NA
4/14/2011	G18D	Sp. Cond., µmho/cm	1383	1490	Y	Y	N	Y	NA	NA
4/14/2011	G18D	Zinc, diss, µg/L	16	780	Y	Y	N	Y	NA	NA
4/14/2011	G18M	Chromium, diss, µg/L	4.6	13	Y	Y	N	Y	NA	NA
4/14/2011	G18M	Lead, diss, µg/L	1	6.8	Y	Y	N	Y	NA	NA
4/14/2011	G18M	Sp. Cond., µmho/cm	1457	1540	Y	Y	N	Y	NA	NA
4/14/2011	G18M	Zinc, diss, µg/L	22	23	Y	Y	N	Y	NA	NA
4/14/2011	G19D	Sp. Cond., µmho/cm	1383	1612	Y	Y	N	Y	NA	NA
4/14/2011	G19D	Zinc, diss, µg/L	16	19	Y	Y	(3)	(3)	(3)	(3)
4/14/2011	G19M	Sp. Cond., µmho/cm	1457	1623	Y	Y	N	Y	NA	NA
4/14/2011	G19M	Zinc, diss, µg/L	22	24	Y	Y	N	Y	NA	NA
4/14/2011	G49M	Sulfate, diss, mg/L	65	310	Y	Y	Y	Y	Y	Y
4/14/2011	G49M	Tot. Diss. Solids, mg/L	870	920	Y	Y	Y	Y	Y	Y

Notes:  
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 (6) Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
4/14/2011	G49S	Chloride, diss, mg/L	8.5	20	Y	Y	Y	Y	Y	Y
4/14/2011	G49S	Sp. Cond., $\mu$ mho/cm	1108.7	1667	Y	Y	Y	Y	Y	Y
4/14/2011	G49S	Sulfate, diss, mg/L	8.4	550	Y	Y	Y	Y	Y	Y
4/14/2011	G49S	Tot. Diss. Solids, mg/L	692.7	1400	Y	Y	Y	Y	Y	Y
4/14/2011	G54S	Sulfate, diss, mg/L	8.4	47	Y	Y	Y	Y	Y	Y
4/15/2011	G07D	Sp. Cond., $\mu$ mho/cm	1383	1820	Y	Y	N	Y	NA	NA
4/15/2011	G07S	Arsenic, diss, $\mu$ g/L	125.4	190	Y	Y	N	Y	NA	NA
4/15/2011	G48M	Nitrate, diss, mg/L	0.14	0.36	Y	Y	N	Y	NA	NA
4/15/2011	G48M	Sulfate, diss, mg/L	65	110	Y	Y	Y	Y	Y	Y
4/15/2011	G48M	Zinc, diss, $\mu$ g/L	22	110	Y	Y	Y	Y	Y	Y
4/15/2011	G59D	Nitrate, diss, mg/L	1.5	3.5	Y	Y	N	Y	NA	NA
4/15/2011	G59D	Zinc, diss, $\mu$ g/L	16	27	Y	Y	N	Y	NA	NA
6/2/2011	G17M	Nitrate, diss, mg/L	0.14	0.62	Y	Y	N	Y	NA	NA
6/2/2011	G17M	Tot. Diss. Solids, mg/L	870	890	Y	Y	N	Y	NA	NA
6/2/2011	G17M	Zinc, diss, $\mu$ g/L	22	30	Y	Y	N	Y	NA	NA
7/27/2011	G07D	Zinc, diss, $\mu$ g/L	16	28	Y	Y	N	Y	NA	NA
7/27/2011	G54S	Chromium, diss, $\mu$ g/L	4	5.8	Y	Y	N	Y	NA	NA
7/27/2011	G54S	Lead, diss, $\mu$ g/L	1	3.9	Y	Y	N	Y	NA	NA
7/27/2011	G54S	Sulfate, diss, mg/L	8.4	27	Y	(2)	(5)	NA	Y	Y
7/28/2011	G18M	Sulfate, diss, mg/L	65	67	Y	(2)	(4)	NA	Y	Y
7/28/2011	G19D	Zinc, diss, $\mu$ g/L	16	23	Y	Y	N	Y	NA	NA
7/28/2011	G19M	Chromium, diss, $\mu$ g/L	4.6	6.1	Y	Y	N	Y	NA	NA
7/28/2011	G19M	Nitrate, diss, mg/L	0.14	0.56	Y	Y	N	Y	NA	NA
7/28/2011	G48M	Sulfate, diss, mg/L	65	130	Y	(2)	(5)	NA	Y	Y
7/28/2011	G49M	Nitrate, diss, mg/L	0.14	2.6	Y	Y	Y	Y	Y	Y
7/28/2011	G49M	Sulfate, diss, mg/L	65	280	Y	(2)	(5)	NA	Y	Y
7/28/2011	G49S	Chloride, diss, mg/L	8.5	19	Y	(2)	(5)	NA	Y	Y
7/28/2011	G49S	Magnesium, diss, mg/L	66.4	110	Y	Y	Y	Y	Y	Y
7/28/2011	G49S	Sulfate, diss, mg/L	8.4	530	Y	(2)	(5)	NA	Y	Y
7/28/2011	G49S	Tot. Diss. Solids, mg/L	692.7	1400	Y	(2)	(5)	NA	Y	Y
7/29/2011	G40M	Nitrate, diss, mg/L	0.14	0.58	Y	Y	N	Y	NA	NA
7/29/2011	G50S	Chromium, diss, $\mu$ g/L	4	5.3	Y	Y	Y	Y	Y	Y
7/29/2011	G50S	Sulfate, diss, mg/L	8.4	9.1	Y	(2)	(4)	NA	Y	Y
7/29/2011	G58D	Chloride, diss, mg/L	33	110	Y	Y	Y	Y	Y	Y
7/29/2011	G58D	Sulfate, diss, mg/L	76	300	Y	Y	Y	Y	Y	Y
7/29/2011	G58D	Tot. Diss. Solids, mg/L	787	1100	Y	Y	N	Y	NA	NA
7/29/2011	G58M	Sulfate, diss, mg/L	65	110	Y	(2)	(5)	NA	Y	Y
10/25/2011	G19D	Chloride, diss, mg/L	33	51	Y	Y	Y	Y	Y	Y
10/25/2011	G19D	Sulfate, diss, mg/L	76	210	Y	Y	Y	Y	Y	Y
10/25/2011	G19D	Tot. Diss. Solids, mg/L	787	810	Y	Y	Y	Y	Y	Y
11/3/2011	G07D	pH (upper)	8.18	8.2	N	(3)	(3)	(3)	NA	NA
11/3/2011	G07S	Arsenic, diss, $\mu$ g/L	125.4	150	Y	Y	Y	Y	Y	Y
11/3/2011	G07S	pH (lower)	6.24	5.3	N	(3)	(3)	(3)	NA	NA

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Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
11/9/2011	G16M	Boron, diss, µg/L	622	640	Y	Y	Y	Y	Y	Y
11/9/2011	R17D	Zinc, diss, µg/L	16	25	Y	(3)	(3)	(3)	NA	NA
11/9/2011	R17M	Tot. Diss. Solids, mg/L	870	880	Y	Y	Y	Y	Y	Y
11/9/2011	R17M	Zinc, diss, µg/L	22	34	Y	Y	Y	Y	Y	Y
11/22/2011	G50S	pH (upper)	7.75	7.97	Y	Y	N	Y	NA	NA
11/22/2011	G54S	Sulfate, diss, mg/L	8.4	25	Y	(2)	(5)	Y	Y	Y
12/1/2011	G58D	Sulfate, diss, mg/L	76	88	Y	(2)	(5)	Y	Y	Y
12/1/2011	G58M	Nitrate, diss, mg/L	0.14	0.18	Y	Y	Y	Y	Y	Y
12/1/2011	G58M	Sulfate, diss, mg/L	65	90	Y	(2)	(5)	Y	Y	Y
12/2/2011	G48M	Sulfate, diss, mg/L	65	120	Y	(2)	(5)	Y	Y	Y
12/2/2011	G49S	Chloride, diss, mg/L	8.5	20	Y	(2)	(5)	Y	Y	Y
12/2/2011	G49S	Magnesium, diss, mg/L	66.4	100	Y	(2)	(5)	Y	Y	Y
12/2/2011	G49S	Sulfate, diss, mg/L	8.4	500	Y	(2)	(5)	Y	Y	Y
12/2/2011	G49S	Tot. Diss. Solids, mg/L	692.7	1200	Y	(2)	(5)	Y	Y	Y
12/2/2011	G59D	Zinc, diss, µg/L	16	19	Y	Y	N	Y	NA	NA
12/3/2011	G49M	Sulfate, diss, mg/L	65	400	Y	Y	Y	Y	Y	Y
12/3/2011	G49M	Tot. Diss. Solids, mg/L	870	1000	Y	(2)	(5)	Y	Y	Y
12/8/2011	G09D	Zinc, diss, µg/L	16	19	Y	Y	N	Y	NA	NA
1/10/2012	G07S	Arsenic, diss, µg/L	125.4	150	Y	(2)	(5)	(6)	(6)	(6)
1/11/2012	G49M	Sulfate, diss, mg/L	65	380	Y	Y	Y	Y	Y	Y
1/11/2012	G49M	Tot. Diss. Solids, mg/L	870	1000	Y	Y	Y	Y	Y	Y
1/11/2012	G49S	Chloride, diss, mg/L	8.5	18	Y	(2)	(4)	(6)	(6)	(6)
1/11/2012	G49S	Magnesium, diss, mg/L	66.4	96	Y	(2)	(5)	(6)	(6)	(6)
1/11/2012	G49S	Sp. Cond., µmho/cm	1108.7	1316	Y	(2)	(4)	(6)	(6)	(6)
1/11/2012	G49S	Sulfate, diss, mg/L	8.4	100	Y	(2)	(5)	(6)	(6)	(6)
1/11/2012	G49S	Tot. Diss. Solids, mg/L	692.7	1100	Y	(2)	(5)	(6)	(6)	(6)
1/11/2012	G58M	Nitrate, diss, mg/L	0.14	0.2	Y	Y	N	Y	NA	NA
1/11/2012	G58M	Sulfate, diss, mg/L	65	110	Y	Y	Y	Y	Y	Y
1/12/2012	G54S	Lead, diss, µg/L	1	2	Y	Y	N	Y	NA	NA
1/12/2012	G54S	Sulfate, diss, mg/L	8.4	44	Y	Y	Y	Y	Y	Y
1/17/2012	G19D	Chloride, diss, mg/L	33	45	Y	Y	Y	Y	(6)	(6)
1/17/2012	G19D	Sp. Cond., µmho/cm	1383	1935	Y	Y	N	Y	NA	NA
1/17/2012	G19D	Sulfate, diss, mg/L	76	940	Y	Y	Y	Y	(6)	(6)
1/17/2012	G19D	Tot. Diss. Solids, mg/L	787	1800	Y	Y	Y	Y	(6)	(6)
1/18/2012	G07D	Zinc, diss, µg/L	16	21	Y	Y	N	Y	NA	NA
1/19/2012	G16M	Boron, diss, µg/L	622	640	Y	(6)	(6)	(6)	(6)	(6)
1/19/2012	G39D	Zinc, diss, µg/L	16	24	Y	Y	N	Y	NA	NA
1/19/2012	G39M	Lead, diss, µg/L	1	2	Y	Y	N	Y	NA	NA
1/19/2012	G39M	Nitrate, diss, mg/L	0.14	0.5	Y	Y	N	Y	NA	NA
1/19/2012	G39M	Zinc, diss, µg/L	22	47	Y	Y	N	Y	NA	NA
1/19/2012	R17M	Chromium, diss, µg/L	4.6	6.5	Y	Y	Y	Y	Y	Y
1/19/2012	R17M	Zinc, diss, µg/L	22	25	Y	Y	N	Y	NA	NA
1/20/2012	G48D	Sulfate, diss, mg/L	76	110	Y	Y	Y	Y	Y	Y

Notes:  
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Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
1/20/2012	G48D	Zinc, diss, µg/L	16	35	Y	Y	N	Y	NA	NA
1/20/2012	G48M	Sulfate, diss, mg/L	65	140	Y	Y	Y	Y	Y	Y
2/1/2012	G09D	pH (lower)	5.98	5.73	(3)	(3)	(3)	(3)	NA	NA
2/2/2012	G47D	pH (upper)	8.18	8.71	Y	Y	Y	Y	Y	Y
2/2/2012	G47M	Magnesium, diss, mg/L	82.2	88	Y	Y	N	Y	NA	NA
2/2/2012	G47M	Nitrate, diss, mg/L	0.14	0.76	Y	Y	N	Y	NA	NA
2/2/2012	G47M	Tot. Diss. Solids, mg/L	870	910	Y	Y	Y	Y	Y	Y
4/10/2012	G19M	Sulfate, diss, mg/L	65	74	Y	(2)	(6)	(6)	(6)	(6)
4/10/2012	G49M	Lead, diss, µg/L	1	1.8	Y	Y	N	Y	NA	NA
4/10/2012	G49M	Sulfate, diss, mg/L	65	410	Y	Y	Y	Y	Y	Y
4/10/2012	G49M	Tot. Diss. Solids, mg/L	870	1100	Y	Y	Y	Y	Y	Y
4/10/2012	G54S	Sulfate, diss, mg/L	8.4	43	Y	(2)	(6)	(6)	(6)	(6)
4/10/2012	G58M	Sulfate, diss, mg/L	65	130	Y	(2)	(6)	(6)	(6)	(6)
4/11/2012	G48D	Sulfate, diss, mg/L	76	210	Y	(2)	(6)	(6)	(6)	(6)
4/11/2012	G48D	Tot. Diss. Solids, mg/L	787	930	Y	Y	Y	Y	Y	Y
4/11/2012	G48M	Sulfate, diss, mg/L	65	130	Y	(2)	(4)	(6)	(6)	(6)
4/16/2012	G16M	Boron, diss, µg/L	622	670	Y	(2)	(5)	(6)	(6)	(6)
4/16/2012	G19D	Chloride, diss, mg/L	33	110	Y	(2)	(3)	(6)	(6)	(6)
4/16/2012	G19D	Sulfate, diss, mg/L	76	330	Y	(2)	(3)	(6)	(6)	(6)
4/16/2012	G19D	Tot. Diss. Solids, mg/L	787	1000	Y	(2)	(3)	(6)	(6)	(6)
4/17/2012	G07S	Arsenic, diss, µg/L	125.4	190	Y	(2)	(5)	(6)	(6)	(6)
4/17/2012	G47D	pH (upper)	8.18	8.56	Y	(2)	(5)	(6)	(6)	(6)
4/17/2012	G47M	Boron, diss, µg/L	622	670	Y	Y	Y	Y	Y	Y
4/17/2012	G47M	Chromium, diss, µg/L	4.6	6.3	Y	Y	N	Y	NA	NA
4/17/2012	G47M	Tot. Diss. Solids, mg/L	870	920	Y	(2)	(5)	(6)	(6)	(6)
4/18/2012	G49S	Chloride, diss, mg/L	8.5	17	Y	Y	Y	Y	Y	Y
4/18/2012	G49S	Magnesium, diss, mg/L	66.4	85	Y	Y	Y	Y	Y	Y
4/18/2012	G49S	Sulfate, diss, mg/L	8.4	370	Y	Y	Y	Y	Y	Y
4/18/2012	G49S	Tot. Diss. Solids, mg/L	692.7	980	Y	Y	Y	Y	Y	Y
4/18/2012	G59D	Sulfate, diss, mg/L	76	110	Y	Y	Y	Y	Y	Y
4/19/2012	G40M	Lead, diss, µg/L	1	2	Y	Y	N	Y	NA	NA
4/19/2012	R17M	Chromium, diss, µg/L	4.6	19	Y	(2)	(5)	(6)	(6)	(6)
4/20/2012	G08D	Lead, diss, µg/L	2.5	2.6	Y	Y	N	Y	NA	NA
4/23/2012	G02D	Boron, diss, µg/L	530	540	Y	Y	N	Y	NA	NA
5/1/2012	R19D	Chloride, diss, mg/L	33	37	Y	Y	Y	Y	Y	Y
5/1/2012	R19D	Lead, diss, µg/L	2.5	2.8	Y	Y	N	Y	NA	NA
5/1/2012	R19D	Sulfate, diss, mg/L	76	770	Y	Y	N	Y	NA	NA
5/1/2012	R19D	Zinc, diss, µg/L	16	26	Y	Y	Y	Y	Y	Y
7/24/2012	G49M	Sulfate, diss, mg/L	65	410	Y	(2)	(5)	(6)	(6)	(6)
7/24/2012	G49M	Tot. Diss. Solids, mg/L	870	1100	Y	(2)	(5)	(6)	(6)	(6)
7/24/2012	G49S	Chloride, diss, mg/L	8.5	13	Y	(2)	(5)	(6)	(6)	(6)
7/24/2012	G49S	Magnesium, diss, mg/L	66.4	87	Y	(2)	(5)	(6)	(6)	(6)
7/24/2012	G49S	Sulfate, diss, mg/L	8.4	360	Y	(2)	(5)	(6)	(6)	(6)

Notes:  
 Y Yes  
 N No  
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Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
7/24/2012	G49S	Tot. Diss. Solids, mg/L	692.7	1000	Y	(2)	(5)	(6)	(6)	(6)
7/24/2012	G59D	Sulfate, diss, mg/L	76	96	Y	(2)	(5)	(6)	(6)	(6)
7/25/2012	G48D	Sulfate, diss, mg/L	76	180	Y	(2)	(5)	(6)	(6)	(6)
7/25/2012	G48D	Tot. Diss. Solids, mg/L	787	880	Y	(2)	(5)	(6)	(6)	(6)
7/25/2012	G48M	Nitrate, diss, mg/L	0.14	0.19	Y	Y	N	Y	NA	NA
7/25/2012	G48M	Sulfate, diss, mg/L	65	120	Y	(2)	(5)	(6)	(6)	(6)
7/25/2012	R19D	Zinc, diss, µg/L	16	48	Y	(2)	(2)	(2)	Y	Y
7/26/2012	G47D	pH (upper)	8.18	8.52	Y	(2)	(4)	(6)	(6)	(6)
7/26/2012	G47M	Boron, diss, µg/L	622	630	Y	(2)	(4)	(6)	(6)	(6)
7/26/2012	G47M	Magnesium, diss, mg/L	82.2	83	Y	Y	N	Y	NA	NA
7/26/2012	G47M	Tot. Diss. Solids, mg/L	870	900	Y	(2)	(5)	(6)	(6)	(6)
7/26/2012	G58M	Nitrate, diss, mg/L	0.14	0.3	Y	Y	N	Y	NA	NA
7/26/2012	G58M	Sulfate, diss, mg/L	65	110	Y	(2)	(5)	(6)	(6)	(6)
7/30/2012	G54S	Nitrate, diss, mg/L	0.29	0.52	Y	(3)	(5)	(3)	(3)	(3)
7/30/2012	G54S	Sulfate, diss, mg/L	8.4	54	Y	(2)	(5)	(6)	(6)	(6)
7/31/2012	G07S	Arsenic, diss, µg/L	125.4	130	Y	Y	Y	Y	Y	P
8/1/2012	G16M	Boron, diss, µg/L	622	670	Y	Y	Y	Y	Y	P
8/1/2012	R17M	Chromium, diss, µg/L	4.6	22	Y	(2)	(4)	(6)	(6)	(6)
8/1/2012	R17M	Tot. Diss. Solids, mg/L	870	940	Y	Y	Y	Y	Y	P
8/2/2012	G09D	Sulfate, diss, mg/L	76	77	Y	Y	N	Y	NA	NA
8/2/2012	G09D	Tot. Diss. Solids, mg/L	787	790	Y	Y	N	Y	NA	NA
8/3/2012	G20D	Zinc, diss, µg/L	16	50	Y	Y	N	Y	NA	NA
10/17/2012	G49M	Sp. Cond., µmho/cm	1457	1463	Y	Y	N	Y	NA	NA
10/17/2012	G49M	Sulfate, diss, mg/L	65	390	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49M	Tot. Diss. Solids, mg/L	870	1100	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49S	Chloride, diss, mg/L	8.5	22	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49S	Magnesium, diss, mg/L	66.4	92	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49S	Sp. Cond., µmho/cm	1108.7	1626	Y	Y	N	Y	NA	NA
10/17/2012	G49S	Sulfate, diss, mg/L	8.4	460	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49S	Tot. Diss. Solids, mg/L	692.7	1300	Y	(2)	(5)	(6)	(6)	(6)
10/17/2012	G49S	Zinc, diss, µg/L	36.52	43	(1)	Y	N	Y	NA	NA
10/17/2012	G50S	Magnesium, diss, mg/L	66.4	82	Y	Y	N	Y	NA	NA
10/17/2012	G50S	Sulfate, diss, mg/L	8.4	11	Y	Y	Y	Y	Y	P
10/24/2012	G48M	Sulfate, diss, mg/L	65	92	Y	Y	Y	Y	Y	P
10/25/2012	G48D	Sulfate, diss, mg/L	76	200	Y	Y	Y	Y	Y	P
10/25/2012	G48D	Tot. Diss. Solids, mg/L	787	880	Y	(2)	(4)	(6)	(6)	(6)
10/25/2012	G58M	Sulfate, diss, mg/L	65	170	Y	Y	Y	Y	Y	P
10/25/2012	G59D	Sulfate, diss, mg/L	76	94	Y	(2)	(5)	(6)	(6)	(6)
10/26/2012	G07S	Arsenic, diss, µg/L	125.4	190	Y	(2)	(5)	(6)	(6)	(6)
10/26/2012	G07S	pH (lower)	6.24	5.51	Y	Y	N	Y	NA	NA
10/26/2012	G47M	Magnesium, diss, mg/L	82.2	87	Y	Y	N	Y	NA	NA
10/26/2012	G47M	Sp. Cond., µmho/cm	1457	1620	Y	Y	N	Y	NA	NA
10/26/2012	G47M	Tot. Diss. Solids, mg/L	870	890	Y	Y	N	Y	NA	NA

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11/7/2012	R17M	Sp. Cond., $\mu\text{mho/cm}$	1457	1550	Y	Y	N	Y	NA	NA
11/7/2012	R17M	Tot. Diss. Solids, mg/L	870	910	Y	(2)	(4)	NA	Y	P
11/8/2012	G08M	Nitrate, diss, mg/L	0.14	0.22	Y	Y	N	Y	NA	NA
11/8/2012	G09D	Zinc, diss, $\mu\text{g/L}$	16	87	Y	Y	Y	Y	Y	P
11/8/2012	G16M	Boron, diss, $\mu\text{g/L}$	622	670	Y	(2)	(4)	NA	Y	P
11/8/2012	G16M	Nitrate, diss, mg/L	0.14	0.23	Y	Y	N	Y	NA	NA
12/28/2012	G54S	Nitrate, diss, mg/L	0.29	0.83	(3)	(3)	(5)	(3)	Y	P
12/28/2012	G54S	Sulfate, diss, mg/L	8.4	71	(3)	(3)	(5)	(3)	Y	P
2/6/2013	G49M	Magnesium, diss, mg/L	82.2	93	Y	Y	Y	Y	Y	Y
2/6/2013	G49M	Sulfate, diss, mg/L	65	430	Y	Y	Y	Y	Y	Y
2/6/2013	G49M	Tot. Diss. Solids, mg/L	870	1100	Y	Y	Y	Y	Y	Y
2/6/2013	G49S	Chloride, diss, mg/L	8.5	17	Y	Y	Y	Y	Y	Y
2/6/2013	G49S	Magnesium, diss, mg/L	66.4	93	Y	Y	Y	Y	Y	Y
2/6/2013	G49S	Sp. Cond., $\mu\text{mho/cm}$	1108.7	1238	Y	Y	Y	Y	Y	Y
2/6/2013	G49S	Sulfate, diss, mg/L	8.4	420	Y	Y	Y	Y	Y	Y
2/6/2013	G49S	Tot. Diss. Solids, mg/L	692.7	1100	Y	Y	Y	Y	Y	Y
2/6/2013	G50S	Sp. Cond., $\mu\text{mho/cm}$	1108.7	1146	Y	Y	N	Y	NA	NA
2/6/2013	G50S	Sulfate, diss, mg/L	8.4	150	Y	(2)	(5)	NA	Y	P
2/6/2013	G50S	Tot. Diss. Solids, mg/L	692.7	760	Y	Y	N	Y	NA	NA
2/11/2013	G24D	Chloride, diss, mg/L	33	50	Y	Y	Y	Y	Y	Y
2/11/2013	G24M	Chromium, diss, $\mu\text{g/L}$	4.6	5.5	Y	Y	N	Y	NA	NA
2/11/2013	G31D	Chloride, diss, mg/L	33	36	Y	Y	Y	Y	Y	Y
2/11/2013	G31D	Sp. Cond., $\mu\text{mho/cm}$	1383	1781	Y	Y	N	Y	NA	NA
2/11/2013	G31M	Sulfate, diss, mg/L	65	86	Y	Y	N	Y	NA	NA
2/12/2013	G07S	Arsenic, diss, $\mu\text{g/L}$	125.4	220	Y	(2)	(5)	NA	Y	P
2/12/2013	G07S	pH (lower)	6.24	6.19	Y	Y	Y	Y	Y	Y
2/13/2013	G40M	Nitrate, diss, mg/L	0.14	11	Y	Y	N	Y	NA	NA
2/13/2013	R17M	Nitrate, diss, mg/L	0.14	0.67	Y	Y	Y	Y	Y	Y
2/15/2013	G20M	Nitrate, diss, mg/L	0.14	0.43	Y	Y	N	Y	NA	NA
2/15/2013	G20M	Sulfate, diss, mg/L	65	110	Y	Y	Y	Y	Y	Y
3/4/2013	G03D	Sp. Cond., $\mu\text{mho/cm}$	1383	1500	Y	Y	Y	Y	Y	Y
3/4/2013	G04M	Nitrate, diss, mg/L	0.14	7.9	Y	Y	Y	Y	Y	Y
3/4/2013	G08D	Nitrate, diss, mg/L	1.5	11	Y	Y	Y	Y	Y	Y
3/4/2013	R17D	Magnesium, diss, mg/L	72.1	100	Y	Y	N	Y	NA	NA
3/6/2013	G47M	Nitrate, diss, mg/L	0.14	19	Y	Y	Y	Y	Y	Y
3/6/2013	G47M	Tot. Diss. Solids, mg/L	870	900	Y	Y	N	Y	NA	NA
3/6/2013	G48D	Nitrate, diss, mg/L	1.5	2.1	Y	Y	Y	Y	Y	Y
3/6/2013	G48D	Sp. Cond., $\mu\text{mho/cm}$	1383	1520	Y	Y	N	Y	NA	NA
3/6/2013	G48D	Sulfate, diss, mg/L	76	150	Y	Y	Y	Y	Y	Y
3/6/2013	G58D	Nitrate, diss, mg/L	1.5	2.1	Y	Y	N	Y	NA	NA
3/6/2013	G58D	Sp. Cond., $\mu\text{mho/cm}$	1383	1528	Y	Y	N	Y	NA	NA
3/6/2013	G58M	Lead, diss, $\mu\text{g/L}$	1	1.3	Y	Y	N	Y	NA	NA
3/6/2013	G58M	Nitrate, diss, mg/L	0.14	3.7	Y	Y	Y	Y	Y	Y

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3/6/2013	G58M	Sulfate, diss, mg/L	65	140	Y	(2)	(5)	NA	Y	P
3/6/2013	G59D	Sp. Cond., $\mu$ mho/cm	1383	1800	Y	Y	N	Y	NA	NA
3/6/2013	G59D	Sulfate, diss, mg/L	76	100	Y	Y	Y	Y	Y	P
3/7/2013	G54S	Chloride, diss, mg/L	8.5	9.8	Y	Y	Y	Y	Y	Y
3/7/2013	G54S	Nitrate, diss, mg/L	0.29	0.81	Y	Y	N	Y	NA	NA
3/7/2013	G54S	Sp. Cond., $\mu$ mho/cm	1108.7	1233	Y	Y	Y	Y	Y	Y
3/7/2013	G54S	Sulfate, diss, mg/L	8.4	110	Y	Y	Y	Y	Y	Y
3/8/2013	G01D	Nitrate, diss, mg/L	1.5	19	Y	Y	Y	Y	Y	Y
3/8/2013	G01M	Nitrate, diss, mg/L	0.14	7	Y	Y	Y	Y	Y	Y
3/8/2013	G48M	Nitrate, diss, mg/L	0.14	0.15	Y	Y	Y	Y	Y	Y
3/8/2013	G48M	Sulfate, diss, mg/L	65	120	Y	(2)	(5)	NA	Y	P
4/27/2013	G07S	Arsenic, diss, $\mu$ g/L	125.4	200	Y	(2)	(5)	NA	Y	P
4/27/2013	G07S	pH (lower)	6.24	6.18	Y	(2)	(4)	NA	(6)	(6)
5/3/2013	G54S	Chloride, diss, mg/L	8.5	12	Y	(2)	(5)	NA	(6)	(6)
5/3/2013	G54S	Sp. Cond., $\mu$ mho/cm	1108.7	1210	Y	(2)	(4)	NA	(6)	(6)
5/3/2013	G54S	Sulfate, diss, mg/L	8.4	82	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G24D	Chloride, diss, mg/L	33	38	Y	(2)	(4)	NA	(6)	(6)
5/7/2013	G49M	Magnesium, diss, mg/L	82.2	92	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49M	Sp. Cond., $\mu$ mho/cm	1457	1470	Y	Y	N	Y	NA	NA
5/7/2013	G49M	Sulfate, diss, mg/L	65	370	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49M	Tot. Diss. Solids, mg/L	870	1000	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49R	Arsenic, diss, $\mu$ g/L	11	24	Y	Y	N	Y	NA	NA
5/7/2013	G49R	Sp. Cond., $\mu$ mho/cm	1281	1430	Y	Y	N	Y	NA	NA
5/7/2013	G49R	Sulfate, diss, mg/L	156.6	270	Y	Y	Y	Y	Y	P
5/7/2013	G49R	Tot. Diss. Solids, mg/L	946.5	980	Y	Y	Y	Y	Y	P
5/7/2013	G49S	Chloride, diss, mg/L	8.5	15	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49S	Magnesium, diss, mg/L	66.4	99	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49S	Nitrate, diss, mg/L	0.29	0.68	Y	Y	N	Y	NA	NA
5/7/2013	G49S	Sp. Cond., $\mu$ mho/cm	1108.7	1520	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49S	Sulfate, diss, mg/L	8.4	400	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G49S	Tot. Diss. Solids, mg/L	692.7	1100	Y	(2)	(5)	NA	(6)	(6)
5/7/2013	G50S	Sulfate, diss, mg/L	8.4	87	Y	(2)	(5)	NA	Y	P
5/10/2013	G31D	Chloride, diss, mg/L	33	36	Y	(2)	(4)	NA	(6)	(6)
5/14/2013	G20M	Sulfate, diss, mg/L	65	92	Y	(2)	(5)	NA	(6)	(6)
5/14/2013	R17M	Nitrate, diss, mg/L	0.14	2.5	Y	(2)	(4)	NA	(6)	(6)
5/14/2013	R17M	Sp. Cond., $\mu$ mho/cm	1457	1620	Y	Y	Y	Y	Y	P
5/14/2013	R17M	Tot. Diss. Solids, mg/L	870	900	Y	(2)	(5)	NA	Y	P
5/14/2013	R17R	Nitrate, diss, mg/L	0.06	13	Y	Y	N	Y	NA	NA
5/14/2013	R17R	Sp. Cond., $\mu$ mho/cm	1281	1640	Y	Y	Y	Y	Y	P
5/20/2013	G25R	Nitrate, diss, mg/L	0.06	1.4	Y	Y	Y	Y	Y	P
5/20/2013	G25R	Sulfate, diss, mg/L	156.6	220	Y	Y	Y	Y	Y	P
5/20/2013	G26M	pH (upper)	7.97	8.06	Y	Y	N	Y	NA	NA
5/20/2013	G26R	Nitrate, diss, mg/L	0.06	0.09	Y	Y	Y	Y	Y	P

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5/20/2013	G26R	Sulfate, diss, mg/L	156.6	410	Y	Y	Y	Y	Y	P
5/20/2013	G26R	Tot. Diss. Solids, mg/L	946.5	950	Y	Y	Y	Y	Y	P
5/22/2013	G16D	Nitrate, diss, mg/L	1.5	6.3	Y	Y	N	Y	NA	NA
5/22/2013	G16M	Boron, diss, µg/L	622	720	Y	(2)	(5)	NA	Y	P
5/22/2013	G16M	Nitrate, diss, mg/L	0.14	12	Y	Y	Y	Y	Y	P
5/22/2013	R16R	Nitrate, diss, mg/L	0.06	0.38	Y	Y	N	Y	NA	NA
5/22/2013	R16R	Sp. Cond., µmho/cm	1281	1290	Y	Y	Y	Y	Y	P
5/22/2013	R16R	Tot. Diss. Solids, mg/L	946.5	2100	Y	Y	N	Y	NA	NA
5/23/2013	G08D	Nitrate, diss, mg/L	1.5	7.7	Y	(2)	(4)	NA	Y	P
5/23/2013	G08R	Nitrate, diss, mg/L	0.06	0.29	Y	Y	Y	Y	Y	P
5/23/2013	G09D	Nitrate, diss, mg/L	1.5	2.8	Y	Y	N	Y	NA	NA
5/23/2013	G09D	Sulfate, diss, mg/L	76	150	Y	Y	Y	Y	Y	P
5/23/2013	G09D	Zinc, diss, µg/L	16	36	Y	(2)	(4)	NA	Y	P
5/23/2013	G09R	Nitrate, diss, mg/L	0.06	0.58	Y	Y	Y	Y	Y	P
6/10/2013	G01D	Nitrate, diss, mg/L	1.5	5	Y	(2)	(4)	NA	(6)	(6)
6/10/2013	G01M	Nitrate, diss, mg/L	0.14	6.1	Y	(2)	(4)	NA	(6)	(6)
6/10/2013	G01M	Sulfate, diss, mg/L	65	100	Y	Y	Y	Y	Y	P
6/10/2013	G04M	Nitrate, diss, mg/L	0.14	0.89	Y	(2)	(4)	NA	(6)	(6)
6/10/2013	G08M	Nitrate, diss, mg/L	0.14	0.42	Y	Y	N	Y	NA	NA
6/12/2013	G02R	Sp. Cond., µmho/cm	1281	1350	Y	Y	N	Y	NA	NA
6/13/2013	G39M	Nitrate, diss, mg/L	0.14	14	Y	Y	N	Y	NA	NA
6/13/2013	G47R	Boron, diss, µg/L	565.5	630	Y	Y	N	Y	NA	NA
6/13/2013	G47R	Sp. Cond., µmho/cm	1281	1690	Y	Y	Y	Y	Y	P
6/13/2013	G48R	Nitrate, diss, mg/L	0.06	0.3	Y	Y	Y	Y	Y	P
6/13/2013	G48R	Sulfate, diss, mg/L	156.6	210	Y	Y	Y	Y	Y	P
6/13/2013	G58R	Nitrate, diss, mg/L	0.06	0.12	Y	Y	N	Y	NA	NA
6/13/2013	G58R	Sulfate, diss, mg/L	156.6	170	Y	Y	Y	Y	Y	P
6/14/2013	G03D	Sp. Cond., µmho/cm	1383	1994	Y	Y	N	Y	NA	NA
6/14/2013	G39R	Sp. Cond., µmho/cm	1281	1330	Y	Y	Y	Y	Y	P
6/14/2013	G48D	Nitrate, diss, mg/L	1.5	2.7	Y	(2)	(4)	NA	(6)	(6)
6/14/2013	G48D	Sulfate, diss, mg/L	76	180	Y	(2)	(5)	NA	Y	P
6/14/2013	G48M	Chromium, diss, µg/L	4.6	5.2	Y	Y	N	Y	NA	NA
6/14/2013	G48M	Lead, diss, µg/L	1	2.1	Y	Y	N	Y	NA	NA
6/14/2013	G48M	Nitrate, diss, mg/L	0.14	3	Y	(2)	(5)	NA	(6)	(6)
6/14/2013	G48M	Sulfate, diss, mg/L	65	130	Y	(2)	(4)	NA	Y	P
6/15/2013	G47M	Boron, diss, µg/L	622	630	Y	Y	Y	Y	Y	P
6/15/2013	G47M	Magnesium, diss, mg/L	82.2	89	Y	Y	Y	Y	Y	P
6/15/2013	G47M	Nitrate, diss, mg/L	0.14	20	Y	(2)	(5)	NA	(6)	(6)
6/15/2013	G58M	Nitrate, diss, mg/L	0.14	3.9	Y	(2)	(4)	NA	(6)	(6)
6/15/2013	G58M	Sulfate, diss, mg/L	65	110	Y	(2)	(5)	NA	Y	P
6/18/2013	G59D	Sulfate, diss, mg/L	76	95	Y	(2)	(5)	NA	Y	P
6/18/2013	G59R	Magnesium, diss, mg/L	101.4	120	Y	Y	N	Y	NA	NA
6/18/2013	G59R	Nitrate, diss, mg/L	0.06	0.57	Y	Y	Y	Y	Y	P



Notes:  
 Y Yes  
 N No  
 NA Not applicable  
 P Pending at the time of this writing  
 (1) Omitted from notice of observed increase but confirmation procedure was followed  
 (2) Not specially resampled as previously confirmed  
 (3) See narrative  
 (4) Not confirmed by next routine sampling event  
 (5) Confirmed by next routine sampling event  
 (6) Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
6/18/2013	G59R	Sp. Cond., $\mu\text{mho/cm}$	1281	1610	Y	Y	N	Y	NA	NA
6/18/2013	G59R	Sulfate, diss, mg/L	156.6	550	Y	Y	Y	Y	Y	P
6/18/2013	G59R	Tot. Diss. Solids, mg/L	946.5	1200	Y	Y	Y	Y	Y	P
7/15/2013	G08D	Zinc, diss, $\mu\text{g/L}$	16	20	Y	Y	N	Y	NA	NA
7/15/2013	G08R	Nitrate, diss, mg/L	0.06	1.5	Y	(2)	(4)	NA	Y	P
7/15/2013	G09R	Arsenic, diss, $\mu\text{g/L}$	11	28	Y	Y	N	Y	NA	NA
7/15/2013	G09R	Nitrate, diss, mg/L	0.06	2	Y	(2)	(5)	NA	Y	P
7/15/2013	G16M	Boron, diss, $\mu\text{g/L}$	622	710	Y	(2)	(4)	NA	Y	P
7/16/2013	G39R	Sp. Cond., $\mu\text{mho/cm}$	1281	1294	Y	(2)	(4)	NA	Y	P
7/17/2013	G07S	Arsenic, diss, $\mu\text{g/L}$	125.4	160	Y	(2)	(5)	NA	Y	P
7/17/2013	G31R	Nitrate, diss, mg/L	0.06	1.3	Y	Y	Y	Y	Y	P
7/17/2013	R16R	Sp. Cond., $\mu\text{mho/cm}$	1281	1430	(1)	(2)	(5)	NA	Y	P
7/17/2013	R17R	Sp. Cond., $\mu\text{mho/cm}$	1281	1550	(1)	(2)	(5)	NA	Y	P
7/18/2013	G02R	Nitrate, diss, mg/L	0.06	19	Y	Y	N	Y	NA	NA
7/18/2013	G25R	Nitrate, diss, mg/L	0.06	1.4	Y	(2)	(5)	NA	Y	P
7/18/2013	G25R	Sulfate, diss, mg/L	156.6	360	Y	(2)	(5)	NA	Y	P
7/18/2013	G25R	Tot. Diss. Solids, mg/L	946.5	1000	Y	Y	Y	Y	Y	Y
7/18/2013	G26R	Nitrate, diss, mg/L	0.06	0.25	Y	(2)	(4)	NA	Y	P
7/18/2013	G26R	Sulfate, diss, mg/L	156.6	410	Y	(2)	(5)	NA	Y	P
7/18/2013	G26R	Tot. Diss. Solids, mg/L	946.5	960	Y	(2)	(5)	NA	Y	P
7/18/2013	G58M	Sulfate, diss, mg/L	65	170	Y	(2)	(5)	NA	Y	P
7/18/2013	G58R	Sulfate, diss, mg/L	156.6	180	Y	(2)	(5)	NA	Y	P
7/18/2013	R17M	Sp. Cond., $\mu\text{mho/cm}$	1457	1470	Y	(2)	(4)	NA	Y	P
7/18/2013	R17M	Tot. Diss. Solids, mg/L	870	900	Y	(2)	(4)	NA	Y	P
7/19/2013	G02D	Nitrate, diss, mg/L	1.5	20	Y	Y	N	Y	NA	NA
7/19/2013	G03D	Nitrate, diss, mg/L	1.5	2	Y	Y	N	Y	NA	NA
7/22/2013	G09D	Sulfate, diss, mg/L	76	160	Y	(2)	(5)	NA	Y	P
7/22/2013	G20M	Sp. Cond., $\mu\text{mho/cm}$	1457	1750	Y	Y	N	Y	NA	NA
7/22/2013	G20M	Sulfate, diss, mg/L	65	85	Y	(2)	(5)	NA	Y	P
7/22/2013	G49S	Chloride, diss, mg/L	8.5	15	Y	(2)	(5)	NA	Y	P
7/22/2013	G49S	Magnesium, diss, mg/L	66.4	87	Y	(2)	(5)	NA	Y	P
7/22/2013	G49S	Sp. Cond., $\mu\text{mho/cm}$	1108.7	1450	Y	(2)	(5)	NA	Y	P
7/22/2013	G49S	Sulfate, diss, mg/L	8.4	400	Y	(2)	(5)	NA	Y	P
7/22/2013	G49S	Tot. Diss. Solids, mg/L	692.7	940	Y	(2)	(5)	NA	Y	P
7/22/2013	G59D	Nitrate, diss, mg/L	1.5	2.8	Y	Y	N	Y	NA	NA
7/22/2013	G59D	Sulfate, diss, mg/L	76	89	Y	(2)	(5)	NA	Y	P
7/22/2013	G59R	Nitrate, diss, mg/L	0.06	0.9	Y	(2)	(5)	NA	Y	P
7/22/2013	G59R	Sulfate, diss, mg/L	156.6	510	Y	(2)	(5)	NA	Y	P
7/22/2013	G59R	Tot. Diss. Solids, mg/L	946.5	1100	Y	(2)	(5)	NA	Y	P
7/23/2013	G48D	Sulfate, diss, mg/L	76	170	Y	(2)	(5)	NA	Y	P
7/23/2013	G48M	Nitrate, diss, mg/L	0.14	4.5	Y	(2)	(5)	NA	Y	P
7/23/2013	G48R	Nitrate, diss, mg/L	0.06	0.22	Y	(2)	(4)	NA	Y	P
7/23/2013	G48R	Sulfate, diss, mg/L	156.6	200	Y	(2)	(5)	NA	Y	P

Notes:  
 Y Yes  
 N No  
 NA Not applicable  
 P Pending at the time of this writing  
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 (2) Not specially resampled as previously confirmed  
 (3) See narrative  
 (4) Not confirmed by next routine sampling event  
 (5) Confirmed by next routine sampling event  
 (6) Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Demo	Alt Source	Approved
7/23/2013	G49M	Magnesium, diss, mg/L	82.2	84	Y	(2)	(5)	NA	Y	Y	P
7/23/2013	G49M	Sulfate, diss, mg/L	65	390	Y	(2)	(5)	NA	Y	Y	P
7/23/2013	G49M	Tot. Diss. Solids, mg/L	870	1000	Y	(2)	(5)	NA	Y	Y	P
7/23/2013	G49R	Sulfate, diss, mg/L	156.6	270	Y	(2)	(5)	NA	Y	Y	P
7/23/2013	G49R	Tot. Diss. Solids, mg/L	946.5	1100	Y	(2)	(5)	NA	Y	Y	P
7/24/2013	G50S	Sp. Cond., $\mu$ mho/cm	1108.7	1210	Y	Y	N	Y	NA	NA	NA
7/24/2013	G50S	Sulfate, diss, mg/L	8.4	32	Y	(2)	(5)	NA	Y	Y	P
7/25/2013	G47M	Boron, diss, $\mu$ g/L	622	720	Y	(2)	(4)	NA	Y	Y	P
7/25/2013	G47M	Magnesium, diss, mg/L	82.2	85	Y	(2)	(4)	NA	Y	Y	P
7/25/2013	G47M	Nitrate, diss, mg/L	0.14	7.6	Y	(2)	(4)	NA	Y	Y	P
7/25/2013	G47M	Tot. Diss. Solids, mg/L	870	880	Y	(2)	(4)	NA	Y	Y	P
7/25/2013	G47R	Nitrate, diss, mg/L	0.06	1.5	Y	Y	N	Y	NA	NA	NA
7/25/2013	G47R	Sp. Cond., $\mu$ mho/cm	1281	1420	Y	(2)	(4)	NA	Y	Y	P
7/25/2013	G58D	Nitrate, diss, mg/L	1.5	6.5	Y	(2)	(5)	NA	Y	Y	P
7/29/2013	G40M	Nitrate, diss, mg/L	0.14	11	Y	Y	N	Y	NA	NA	NA
7/29/2013	G54S	Chloride, diss, mg/L	8.5	8.8	Y	(2)	(4)	NA	Y	Y	Y
7/29/2013	G54S	Nitrate, diss, mg/L	0.29	1.3	Y	(2)	(5)	NA	(3)	(3)	(3)
7/29/2013	G54S	Sulfate, diss, mg/L	8.4	120	Y	(2)	(5)	NA	Y	Y	Y
10/24/2013	G05M	Nitrate, diss, mg/L	0.14	0.29	Y	P	P	P	P	P	P
10/25/2013	G07S	Arsenic, diss, $\mu$ g/L	125.4	190	Y	(2)	P	P	P	P	P
10/25/2013	G07S	Nitrate, diss, mg/L	0.29	3.7	Y	P	P	P	P	P	P
10/28/2013	G01D	Nitrate, diss, mg/L	1.5	9.6	Y	P	P	P	P	P	P
10/28/2013	G01M	Sulfate, diss, mg/L	65	190	Y	(2)	P	P	P	P	P
10/28/2013	G02D	Boron, diss, $\mu$ g/L	530	540	Y	P	P	P	P	P	P
10/28/2013	G02D	Nitrate, diss, mg/L	1.5	2.5	Y	P	P	P	P	P	P
10/28/2013	G02R	Cadmium, diss, $\mu$ g/L	1	5.2	Y	P	P	P	P	P	P
10/28/2013	G02R	Lead, diss, $\mu$ g/L	1.1	3.6	Y	P	P	P	P	P	P
10/28/2013	G02R	Nitrate, diss, mg/L	0.06	0.66	Y	P	P	P	P	P	P
11/1/2013	G08M	Nitrate, diss, mg/L	0.14	14	Y	P	P	P	P	P	P
11/2/2013	G09D	Cadmium, diss, $\mu$ g/L	1	1.2	Y	P	P	P	P	P	P
11/2/2013	G09D	Sulfate, diss, mg/L	76	100	Y	(2)	P	P	P	P	P
11/2/2013	G09D	Zinc, diss, $\mu$ g/L	16	33	Y	P	P	P	P	P	P
11/2/2013	G09R	Arsenic, diss, $\mu$ g/L	11	29	Y	P	P	P	P	P	P
11/2/2013	G09R	Nitrate, diss, mg/L	0.06	1.8	Y	(2)	P	P	P	P	P
11/2/2013	G09R	pH (upper)	8.22	9.33	Y	P	P	P	P	P	P
11/5/2013	G16D	Boron, diss, $\mu$ g/L	530	710	Y	P	P	P	P	P	P
11/5/2013	G16M	Nitrate, diss, mg/L	0.14	28	Y	P	P	P	P	P	P
11/5/2013	R16R	Nitrate, diss, mg/L	0.06	22	Y	P	P	P	P	P	P
11/5/2013	R16R	Sp. Cond., $\mu$ mho/cm	1281	1370	Y	(2)	P	P	P	P	P
11/5/2013	R17D	Nitrate, diss, mg/L	1.5	15	Y	P	P	P	P	P	P
11/5/2013	R17D	Sp. Cond., $\mu$ mho/cm	1383	2850	Y	P	P	P	P	P	P
11/5/2013	R17R	Nitrate, diss, mg/L	0.06	19	Y	P	P	P	P	P	P
11/5/2013	R17R	Sp. Cond., $\mu$ mho/cm	1281	1470	Y	(2)	P	P	P	P	P

Notes:  
 Y Yes  
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 NA Not applicable  
 P Pending at the time of this writing  
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 (2) Not specially resampled as previously confirmed  
 (3) See narrative  
 (4) Not confirmed by next routine sampling event  
 (5) Confirmed by next routine sampling event  
 (6) Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
11/7/2013	G20M	Sp. Cond., $\mu$ mho/cm	1457	1590	Y	P	P	P	P	P
11/7/2013	G20M	Sulfate, diss, mg/L	65	70	Y	(2)	P	P	P	P
11/8/2013	G24M	Nitrate, diss, mg/L	0.14	1.1	Y	P	P	P	P	P
11/8/2013	G24R	Boron, diss, $\mu$ g/L	565.5	590	Y	P	P	P	P	P
11/8/2013	G24R	Nitrate, diss, mg/L	0.06	0.11	Y	P	P	P	P	P
11/9/2013	G31D	Nitrate, diss, mg/L	1.5	3.5	Y	P	P	P	P	P
11/9/2013	G31R	Nitrate, diss, mg/L	0.06	4	Y	P	P	P	P	P
11/9/2013	G39M	Nitrate, diss, mg/L	0.14	2.1	Y	P	P	P	P	P
11/9/2013	G39R	Nitrate, diss, mg/L	0.06	0.1	Y	P	P	P	P	P
11/14/2013	G25R	Nitrate, diss, mg/L	0.06	0.23	Y	(2)	P	P	P	P
11/14/2013	G25R	Sulfate, diss, mg/L	156.6	440	Y	(2)	P	P	P	P
11/14/2013	G25R	Tot. Diss. Solids, mg/L	946.5	1300	Y	(2)	P	P	P	P
11/14/2013	G26R	Sulfate, diss, mg/L	156.6	340	Y	(2)	P	P	P	P
11/14/2013	G26R	Tot. Diss. Solids, mg/L	946.5	1000	Y	(2)	P	P	P	P
11/14/2013	G54S	Nitrate, diss, mg/L	0.29	0.52	Y	(2)	P	P	P	P
11/14/2013	G54S	Sulfate, diss, mg/L	8.4	48	Y	(2)	P	P	P	P
11/14/2013	G58R	Magnesium, diss, mg/L	101.4	110	Y	P	P	P	P	P
11/14/2013	G58R	Nitrate, diss, mg/L	0.06	0.09	Y	P	P	P	P	P
11/14/2013	G58R	Sulfate, diss, mg/L	156.6	170	Y	(2)	P	P	P	P
11/19/2013	G50S	Sp. Cond., $\mu$ mho/cm	1108.7	1220	Y	P	P	P	P	P
11/19/2013	G50S	Sulfate, diss, mg/L	8.4	48	Y	(2)	P	P	P	P
11/19/2013	G59D	Sulfate, diss, mg/L	76	86	Y	(2)	P	P	P	P
11/19/2013	G59R	Boron, diss, $\mu$ g/L	565.5	1200	Y	P	P	P	P	P
11/19/2013	G59R	Chromium, diss, $\mu$ g/L	4	6.7	Y	P	P	P	P	P
11/19/2013	G59R	Lead, diss, $\mu$ g/L	1.1	1.2	Y	P	P	P	P	P
11/19/2013	G59R	Magnesium, diss, mg/L	101.4	120	Y	P	P	P	P	P
11/19/2013	G59R	Nitrate, diss, mg/L	0.06	0.89	Y	(2)	P	P	P	P
11/19/2013	G59R	Sulfate, diss, mg/L	156.6	520	Y	P	P	P	P	P
11/19/2013	G59R	Tot. Diss. Solids, mg/L	946.5	1200	Y	(2)	P	P	P	P
11/23/2013	G49M	Magnesium, diss, mg/L	82.2	90	Y	P	P	P	P	P
11/23/2013	G49M	Nitrate, diss, mg/L	0.14	0.86	Y	P	P	P	P	P
11/23/2013	G49M	Sulfate, diss, mg/L	65	370	Y	P	P	P	P	P
11/23/2013	G49M	Tot. Diss. Solids, mg/L	870	1100	Y	P	P	P	P	P
11/23/2013	G49R	Sulfate, diss, mg/L	156.6	260	Y	(2)	P	P	P	P
11/23/2013	G49R	Tot. Diss. Solids, mg/L	946.5	1100	Y	(2)	P	P	P	P
11/23/2013	G49S	Chloride, diss, mg/L	8.5	16	Y	P	P	P	P	P
11/23/2013	G49S	Magnesium, diss, mg/L	66.4	70	Y	P	P	P	P	P
11/23/2013	G49S	Nitrate, diss, mg/L	0.29	0.77	Y	P	P	P	P	P
11/23/2013	G49S	Sp. Cond., $\mu$ mho/cm	1108.7	1260	Y	P	P	P	P	P
11/23/2013	G49S	Sulfate, diss, mg/L	8.4	350	Y	P	P	P	P	P
11/23/2013	G49S	Tot. Diss. Solids, mg/L	692.7	960	Y	P	P	P	P	P
11/25/2013	G47M	Tot. Diss. Solids, mg/L	870	880	Y	P	P	P	P	P
11/25/2013	G47R	Nitrate, diss, mg/L	0.06	4.5	Y	P	P	P	P	P

Notes:  
 Y Yes  
 N No  
 NA Not applicable  
 P Pending at the time of this writing  
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 (3) See narrative  
 (4) Not confirmed by next routine sampling event  
 (5) Confirmed by next routine sampling event  
 (6) Alternate source demonstration previously approved

Collected	Well	Parameter	AGQS/MAPC	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
11/25/2013	G58D	Nitrate, diss, mg/L	1.5	3	Y	P	P	P	P	P
11/25/2013	G58M	Sulfate, diss, mg/L	65	180	Y	(2)	P	P	P	P
11/26/2013	G40R	Zinc, diss, µg/L	11	20	Y	P	P	P	P	P
11/26/2013	G48D	Nitrate, diss, mg/L	1.5	4.5	Y	P	P	P	P	P
11/26/2013	G48D	Sulfate, diss, mg/L	76	190	Y	(2)	P	P	P	P
11/26/2013	G48M	Nitrate, diss, mg/L	0.14	2.4	Y	P	P	P	P	P
11/26/2013	G48M	Sulfate, diss, mg/L	65	130	Y	(2)	P	P	P	P
11/26/2013	G48R	Sulfate, diss, mg/L	156.6	250	Y	(2)	P	P	P	P
11/27/2013	G40D	Nitrate, diss, mg/L	1.5	2.3	Y	P	P	P	P	P
11/27/2013	G40M	Nitrate, diss, mg/L	0.14	3.3	Y	P	P	P	P	P

Due to the number of wells, monitored parameters, and observed increases, occasional AGQS/MAPC changes, the continually evolving nature of the facility and its monitoring program, and my attempts to document these factors, the table became unavoidably complex and lengthy. Given such factors, the most salient part of the table is the last two columns, “Alt Source Demo” and “Approved.” These indicate, respectively, whether a confirmed increase was submitted in an alternate source demonstration for the Permit Section’s review and whether the demonstration was approved.

As the table reflects, alternate source demonstrations have been made by the facility and approved by the Permit Section many times over the operating life of this landfill. It would be beyond the scope of this report to detail the circumstances and rationale of each demonstration; that information is in the alternate source demonstrations themselves, which are already in the public record, and the issued permits reflect whether and to what extent the demonstrations and related actions were approved. However, typical reasons why confirmed increases were determined not to result from a release from the facility include: absence of waste in the adjacent disposal cell (i.e., absence of source), remoteness of upgradient wells from waste, geochemical impact of the excavation itself,<sup>14</sup> lack of corroboration by other parameters in the sample,<sup>15</sup> absence of man-made chemicals (i.e.,

<sup>14</sup> Excavating soil and allowing atmospheric oxygen to penetrate a water-bearing unit changes the oxidation-reduction chemistry of the groundwater, which tends to induce changes in concentration of naturally occurring constituents in the groundwater.

<sup>15</sup> A few exceeding parameters in a well are not likely to indicate a release, if the other measured parameters are within limits and not displaying increasing trends.

most organics), contamination from surface runoff,<sup>16</sup> and natural geospatial variability in groundwater chemistry.

“Natural geospatial variability” means simply that groundwater chemistry (the relative amounts of chemical elements and molecules naturally occurring in groundwater) may be markedly different from one point to another across an area as small as a landfill. This results from the heterogeneity of geologic materials comprising the monitored aquifer and is very common in glacially derived sediments, such as those blanketing most of Illinois.

Once the presence and degree of geospatial variability has been documented at a site, the use of intrawell standards is often implemented. An intrawell standard is simply an AGQS or MAPC derived statistically from data collected in a given well over a number of sampling events, against which subsequent results from that same well are compared. In other words, instead of comparing the results from a downgradient well to a baseline statistically developed in an upgradient well or wells (i.e., an interwell comparison, the default comparison), the results in a particular well are compared to a baseline statistically developed in that same well. This allows for groundwater at the well in question to be chemically different from groundwater at an upgradient well without triggering exceedances, while still detecting any changes in groundwater quality over time that might indicate a release of leachate constituents. At sites that use intrawell comparisons in addition to interwell comparisons, a parameter must exceed both its interwell and intrawell standard to be an observed increase.

The Illinois EPA has not yet approved the use of intrawell comparisons at Clinton Landfill 3. The groundwater chemistry at many of the downgradient wells appears to have changed in response to the excavation of soil during construction of landfill disposal cells. To implement intrawell standards before groundwater chemistry has reached a new equilibrium relative to the effects of excavation could result in standards that are inappropriate later when the groundwater chemistry has stabilized. The current exclusive use of interwell comparisons is a primary reason for the number of confirmed increases at this site; many of the results might not have met the definition of an increase, had they been subject to both interwell and intrawell comparisons.

Regarding confirmed increases for which an alternate source demonstration was approved, it is reasonable to wonder whether or how long an approved alternate source demonstration excuses continuing exceedances or whether a continuing exceedance must go through the formal confirmation and application process each time. Technically, neither 35 Ill. Adm. Code §811.319(a)(4) nor Condition VIII.14. of the permit excuses an observed increase from the confirmation process just because it has been previously confirmed. From a practical standpoint, however, to stuff an alternate source demonstration each quarter with a detailed discussion of continuing observations that were discussed in previously approved alternate source demonstrations would bog down the application review process for little or no enhanced environmental protection. Therefore, it is common practice for sites to exclude redundant evaluations from new applications.

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<sup>16</sup> Well G19D was shown to have been damaged, resulting in a compromise of its surface seal and wellbore integrity, thereby allowing surface runoff to penetrate the well and making the well unsuitable for continued use. This phenomenon has also been reported for other wells at the site (application approval pending). Well damage by heavy equipment is a common occurrence at landfills.

There is no set answer to how long an alternate source demonstration remains in effect for a given parameter and well, because it is a case by case determination. Many factors may come into play: whether waste was in place at the time of the last approved alternate source demonstration, whether trends are present vs. concentrations being consistent, what other constituents in that well are doing, and so forth. In going through the facility's notices, I noted many occasions where they stated that concentrations remained consistent with historical concentrations and that they therefore deemed no additional action was necessary. In many other instances, I noted exceedances that were the subject of previously approved alternate source demonstrations and yet the facility had subjected them to the full confirmation process again, including inclusion in a new alternate source demonstration. Therefore, it appears that the facility is evaluating its increases and not dismissing them out of hand whenever they have already been the subject of a previous alternate source demonstration.

From the table, it is apparent that the vast majority of increases resulted in "NA" (was below applicable standards during the resampling event), "Y" (was included in an alternate source demonstration that was subsequently approved), or "(6)" (was included in a previously approved alternate source demonstration). In a table this long, there are inevitably discrepancies or events whose necessary details cannot be summarized in a line item; these are discussed in the following paragraphs.

#### pH during first quarter 2011

The table shows that the indicator parameter pH exceeded its upper limit (pH has both upper and lower limits unlike other parameters, which have only upper limits) in a handful of wells during the first quarter of 2011. These were not reported as observed increases, but pH was within limits in all wells during the subsequent quarter's sampling event. With the exception of G07D, all wells showing an upper pH increase during first quarter 2011 were newly installed that quarter, meaning the pH excursion may have been an artifact of installation. Beyond the effects of soil disturbance and oxygen introduction, newly installed wells may show elevated pH due to expulsion of high-pH water from well sealing materials as they set and cure.

I emailed Joyce Day about the pH excursions and she responded that these measurements were taken as a benchmark result prior to waste disposal in the unit. Operating authorization for the CWU, to which these wells are adjacent, had not yet been issued and PDC did not consider these wells subject to the reporting process until such time as operating authorization was issued for the unit. My review of the permit in effect at that time confirmed that those wells had not yet been added to the monitoring program. Therefore, the absence of the pH results from the first quarter 2011 observed increase notice is not an omission or oversight.

#### Dissolved arsenic in G07S, 2010–2011

G07S is the upgradient well for the Upper Radnor Till Sand Unit (the permit refers to it as a "temporary" upgradient). The Upper Radnor is of very limited areal extent within the final proposed waste footprint (i.e., maximum final extent of waste) for the overall facility; of the currently constructed disposal cells, it would underlie only the CWU.

Dissolved arsenic was detected at a concentration of 160 µg/L in the G07S sample from third quarter 2010 on 30 August 2010 and was confirmed by a resample result of 170 µg/L. The notice of confirmed increase indicated that it would be included in a permit application, but it was not included in the third quarter 2010 alternate source demonstration submitted (Log 2011-054). Likewise, no alternate source demonstrations were presented for it when it again exceeded its AGQS in the

fourth quarter 2010 through second quarter 2011 sampling events. The facility did report and confirm an arsenic increase in G07S from fourth quarter 2011; an alternate source demonstration (Log 2012-150) for this exceedance was approved by the Permit Section on 16 August 2012.

I emailed Joyce Day about the G07S arsenic increases. PDC had been collecting samples from G07S from second quarter 2010 through first quarter 2011 to develop AGQs for dissolved magnesium and dissolved chromium, and also sampled the rest of the G1 parameters in case it was necessary to update background concentrations prior to the onset of waste disposal in the CWU. The arsenic increase was identified and reported initially in the notification letter. After sending the notification identifying an observed increase in G07S, they remembered that it had not yet been added to the permitted well network and so was not yet subject to the confirmation process.

Condition VIII.10. of the permit states that monitoring points listed in VIII.9., the permitted well list, are to be sampled. G07S was added to Condition VIII.9. by Modification 11 of the permit on 28 May 2010, ostensibly making G07S part of the permitted network prior to the third quarter 2010 sampling event. Day stated in her email that PDC had not requested the addition of the well in their application (Log 2009-529) that resulted in Modification 11. PDC makes their determination of whether a well is part of the program based on the permitted phasing plan, which associates wells with the units they are intended to monitor, and issuance of operating approval for the associated disposal cells. Note b. of Condition VIII.9. also references the phasing plan.

As mentioned previously, of currently developed cells, only the CWU is underlain by the Upper Radnor Till Sand, which G07S monitors. The plan associates G07S with the first phase of the CWU, which was the nearest disposal cell at that time. Disposal in the first phase of the CWU, Phase 1A, was approved on 1 April 2011 by Modification 18 of the permit. PDC considered G07S first subject to monitoring and confirmation at that time. From that point onward, there were no apparent discrepancies in PDC's evaluation of dissolved arsenic increases in G07S.

While G07S was added to the well list in Condition VIII.9. on 28 May 2010, there are mitigating factors that lead me to consider the facility's interpretation of when G07S became subject to detection and confirmation to be correct. First, the unit monitored by G07S does not occur in areas where waste was in place during the third quarter of 2010, i.e., the early phases of the MSWU. Since the unit is not present there, it would not be impacted by a putative release there. Second, as discussed in the section on monitoring wells early in this report, wells are considered "activated" for monitoring and confirmation purposes when the associated disposal cell receives operating authorization (which corresponds to PDC's interpretation), although the list in Condition VIII.9. may occasionally be out of sync. Therefore, the lack of an alternate source demonstration for arsenic in G07S in late 2010 and early 2011 is not an omission or oversight.

#### Dissolved zinc in G19D in 2011

Dissolved zinc was measured at 19 µg/L in a sample from well G19D from 14 April 2011, constituting an observed increase because it exceeded the MAPC of 16 µg/L. The Illinois EPA's groundwater database indicates that G19D was subsequently sampled for zinc on 8 and 28 July 2011 with results of 27 and 23 µg/L, respectively.

In the facility's notice of confirmed increase for second quarter, dated 31 August 2011, the results for the other constituents resampled from G19D match the values for those constituents in the Illinois EPA's database for 8 July, suggesting that the confirmation notice's result of <6 µg/L is also from 8 July. (The notices typically don't state the actual date of collection, but rather which quarter the samples pertain to.) However, the value of <6 µg/L conflicts with the concentration of 27 µg/L reported electronically by the facility.

I emailed Joyce Day about this and she confirmed a mistake on the notification; the proper value should have been 27 µg/L. Thus, this increase was not included in an alternate source demonstration for second quarter 2011.

The third quarter result (23 µg/L) exceeded the MAPC. The notice of confirmed increase for third quarter, dated 24 October 2011, stated that the confirmation sample for zinc in G19D had accidentally been skipped, so the facility would use the fourth quarter routine result for confirmation purposes. Zinc results for G19D were below the reporting limit of 6 µg/L in both the fourth quarter 2011 and first quarter 2012 samples. In the final sample taken from this well (16 April 2012), zinc was measured at 15 µg/L, which was below the MAPC.

While the facility was late in responding to the observed zinc increase, the increase was ephemeral and not suggestive of a release of waste constituents from the landfill. An actual release would be reflected in ongoing exceedances of or trends in multiple parameters.

#### pH in G07S and G07D during fourth quarter 2011

The indicator parameter pH exceeded its upper AGQS of 8.18 with a result of 8.2 in well G07D and its lower AGQS of 6.24 with a result of 5.3 in well G07S, both during fourth quarter 2011. The exceedances were not included in the fourth quarter's notice of observed increase, but the parameter was sampled in both wells as part of the routine first quarter 2012 event, when it was found not to exceed its respective AGQSs. I emailed Joyce Day about these and she responded that these were errors in the fourth quarter 2011 electronic submittal to the Illinois EPA. The correct values should have been 7.05 and 7.19 in G07D (it was sampled twice due to insufficient water volume) and 6.94 in G07S. She will have the PDC laboratory submit corrected electronic data. In going through the facility's data while searching for eight quarter trends, I also encountered a few improbable or clearly erroneous values (e.g., a pH of 1450) that I also passed on to Day, so I would anticipate that PDC's corrected submittals would incorporate these as well. In any event, there were no actual observed increases for pH in G07D and G07S during fourth quarter 2011.

#### Dissolved zinc in R17D during fourth quarter 2011

Zinc exceeded its MAPC of 16 µg/L with a result of 25 µg/L in well R17D during fourth quarter 2011. The notice of observed increase indicated that this was a previously confirmed exceedance and thus would not be specifically resampled. This statement appears to be in error, based on the data in the Illinois EPA database indicating fourth quarter 2011 to be the first time this well was sampled. The first quarter 2012 routine sampling event, which occurred within the requisite ninety days of the fourth quarter 2011 sample to count as a confirmation sample, found zinc in this well to be below the MAPC and therefore neither confirmed nor requiring further action.



#### pH in G09D during first quarter 2012

pH exceeded its lower MAPC of 5.98 in well G09D with a result of 5.73 in the first quarter 2012 sample. It was not included in the notice of observed increases, but when sampled during the routine third quarter event less than ninety days later, it was back within its permitted range. I emailed Joyce Day about this and she replied that there was an error in the electronic submittal. The value on the field sheet and in the Excel report supplied to her by the laboratory was 7.96. Therefore, there was no observed increase in pH in G09D during first quarter 2012.

#### Specific conductance in R16R and R17R during third quarter 2013

Exceedances of the indicator parameter specific conductance (a measure of the electrical conductivity of the water) were encountered in R16R and R17R during the third quarter 2013 sampling event but not reported. I emailed Joyce Day about this and she replied that the exceedances were inadvertently omitted from the third quarter notification letters, though they are noted in her own review and tracking. No confirmation sample was collected because the exceedances were similar to the confirmed exceedance for the same parameter and wells in the second quarter of 2013. These exceedances were included in application Log 2013-524, which has been submitted to the Illinois EPA.

#### Dissolved nitrate in G54S 2012–2013

G54S is the compliance boundary well for the Upper Radnor Till Sand. Nitrate exceeded its AGQS of 0.29 mg/L in that well during the third quarter 2012 sampling event on 30 July 2012. The notice of observed increase stated that it had previously been confirmed and therefore would not be specially resampled this time (though of course it would still be sampled for this parameter during routine quarterly sampling). In my table there is no previous instance of this exceedance. However, the current AGQS of 0.29 mg/L was approved on 30 April 2012 so no previous exceedances less than 0.29 mg/L would have been found by Access using the current AGQS of 0.29 mg/L.

Nitrate also exceeded its new/current AGQS in G54S in fourth quarter 2012 and first quarter 2013 and then dropped below the AGQS during second quarter 2013. The G54S fourth quarter 2012 samples were collected too late for the results to be included in that quarter's observed increase notice<sup>17</sup> but were ultimately included in an alternate source demonstration (for both nitrate and sulfate).

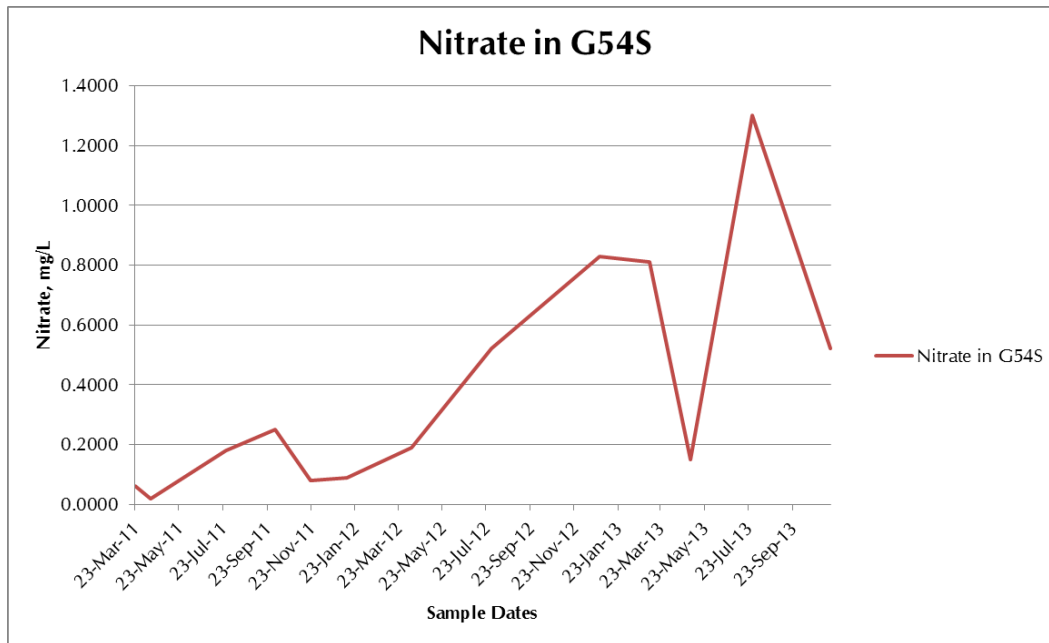
Nitrate exceeded again during the third and fourth quarters of 2013. A table of previously approved alternate source demonstrations included in Application Log 2014-023 (third quarter 2013 alternate source demonstration, currently pending review), states that nitrate was previously discussed in Log 2013-030 (third and fourth quarter 2012 alternate source demonstration). I initially assumed the reference to be erroneous, as I found no reference to nitrate in G54S in 2013-030, whereas it had been addressed in 2012-019.

Log 2012-019 stated that nitrate and other parameters were exceeding then-applicable AGQSs in G54S even before waste was disposed of in the adjacent cell. 2012-019 also addressed sulfate in G54S, and subsequent alternate source demonstrations for chloride, sulfate, and specific conductance have been approved for G54S as recently as November 2013.

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<sup>17</sup> G54S is in a wooded area southeast of the CWU. Access is across an open field and then on a trail through the woods. Having now seen the well, I can well believe that access is difficult during wet weather and that it would be too far to walk carrying heavy equipment. Thus, inclement weather sometimes results in sampling delays.

At the time 2012-019 was approved (30 April 2012), there was no apparent trend in nitrate concentrations in this well. However, nitrate concentrations in G54S show an apparent visual increasing trend in more recent times.



I emailed Joyce Day about the G54S nitrate increases and trend. She provided the following information.

The notice of observed increase for third quarter 2012 was in error in stating that a nitrate increase had previously been confirmed in G54S; however, nitrate was in fact addressed in the third/fourth quarter 2012 alternate source demonstration, Log 2013-030. It was not discussed in the 24 January 2013 initial submittal (hence my failure to find it there) as first quarter 2013 results (which were to be used for confirmation) were not yet available. Consequently, it was addressed in a 26 June 2013 addendum, per discussion with the Permit Section. Thus, while the chain of events led to the submittal being late, the observed nitrate increase in G54S has been included in an alternate source demonstration.

The addendum attributes the confirmed nitrate increase to natural variability, due to remoteness of G54S from emplaced waste, stability of most other parameters, and absence of non-naturally occurring parameters. Log 2013-030, including the addendum, remains under review currently.

#### *Organics exceeding the previous measured concentration or AGQs/MAPCs*

I used Access to screen the data for all organic detections by querying for results with an organic storet (identification) number from the permit, where the "<" field's value was null and the result field value was greater than zero. I excluded any data earlier than July 2009 because no waste had been accepted prior to that time. I also excluded results that were solely a confirmation sample for an observed increase, as the confirmation sample is part of that process.

There are three ways by which an organic result might be an observed increase. The first would be an eight-quarter consecutive release. When I evaluated the data, I found no organic increases by that criterion.

Second, there are AGQs and MAPCs for organics. These are used with the Condition VIII.b./d. criteria of the permit. The confirmation process for these is the same as for inorganic AGQS/ MAPC exceedances—the confirmation sample result must exceed the AGQS/MAPC.

Finally, when the concentration of an organic constituent exceeds its preceding measured concentration in the same well, it is an observed increase under criterion at Condition VIII.13.c. of the permit. For an organic increase observed by this criterion to be confirmed, the concentration in the resample need only be greater than the concentration in the quarter before the observed increase, not greater than the concentration in the quarter of the observed increase itself. For example, if a compound is measured at 2 µg/L in one quarter, is observed to increase to 3 µg/L in the next quarter, and is measured at 2.5 µg/L in the quarter after that, the observed increase it is still confirmed because 2.5 µg/L is greater than 2 µg/L.

The facility has generally not distinguished between organic AGQS/MAPC exceedances and “greater than previous concentration” organic increases in its notifications to the Illinois EPA. The permit and the regulations specify that increases by any of the criteria are reported, confirmed, and included in a permit application, not necessarily by which criterion the increases were identified. Moreover, based on conversations between former Permit Section/Groundwater Unit manager Gwyneth Thompson and PDC, the facility was given to understand simply to treat any organic detection above the PQL as an observed increase whether or not it exceeded the previous concentration. Consequently, my review does not distinguish whether the facility indicated the criterion by which the increase was observed.

Per Condition VIII.13. of the permit and §811.319(a)(4)(A), results less than the PQL do not constitute an observed increase by any of the trigger criteria. Thus, results not exceeding PQLs are not subject to the notification and confirmation process of the permit or Part 811. The permit does not include a table of PQLs but almost all of the organic AGQs and MAPCs appear to be set at the PQL vs. calculated from actual detections.<sup>18</sup>

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<sup>18</sup> AGQs/MAPCs are set at the PQL when organics are not detected during background collection. The vast majority of organic AGQs/MAPCs for the lowermost three zones (S-, M-, and D-series wells) in Volume 5 of the original permit application were indicated to be such and were not revised by the July 2010 revisions to other AGQs/ MAPCs in the M- and D-series wells. While I could not locate the equivalent information for the R-wells from 2013, the vast majority of AGQs/MAPCs in the current permit appear to be PQLs (e.g., compounds that have the same AGQS/MAPC in all four monitoring zones and/or values that are integers vs. decimals). AGQs/MAPCs set at the PQL preclude the possibility of an organic increase over a preceding concentration that is not also an AGQS/MAPC increase. If a constituent was detected during some, but not all, of the sampling events during background collection, the approved statistical method calculates the AGQS/MAPC by substituting a value of one-half the method detection limit for non-detects, performing specified statistical adjustments, or setting the AGQS/MAPC equal to the highest result measured during background collection, depending on the percentage of sample results that were non-detect during background collection and whether the data distribution was statistically “normal” or “not normal.” Obviously, this is a simplified, lay description of how AGQs and MAPCs are derived; anyone desiring more detail is referred to the permit applications.

There were few enough organic detections that I could compare them against the AGQS/ MAPC values in the permits in effect at the time of the detections. In the table, I italicized any result that exceeded an AQGS or MAPC value if such was in effect at that time, or put an asterisk after the parameter name if the detection would have exceeded the AGQS/MAPC that later took effect (i.e., R-series wells on and after 1 April 2013). This shows that the vast majority of the detections exceed the respective AGQS/MAPC in addition to exceeding a previous result of non-detect, demonstrating the overall redundancy of the VIII.13.C. criterion.

Around the beginning of 2011, PDC’s laboratory switched to a new laboratory information system (database system) and an error in how the computer reports phenols concentrations occurred at that time. In environmental monitoring, monitored parameters are typically managed using “storets,” an identification number that also specifies the form of the chemical and the units of concentration. For example, the storet “01000” signifies “arsenic, dissolved, µg/L.” More to the point, “32730” signifies “phenolics, total recoverable, µg/L.” PDC’s new system formatted phenols results as though they were in units of mg/L, yet the storet signified µg/L. For example, the phenols result in well G54S on 23 March 2011 reported in the table below as 7.2 µg/L was actually reported in the electronic submittal as 0.0072 mg/L. PDC correctly reported the results in the paper notices of observed and confirmed increase sent to the Illinois EPA; it was just the electronic submittal that contained the error. PDC will be submitting revised files to correct the Illinois EPA’s database; for the table below, I moved the decimal in phenols results three places to the right to correct the error.

Well	Parameter	Collected	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
G02D	Acetone, µg/L	10/7/2009	11	N	(1)	(2)	N	NA	NA
G07S	Acetone, µg/L	4/7/2010	18	(3)	NA	NA	NA	NA	NA
G05M	Carbon Disulfide, µg/L	10/14/2010	12	Y	Y	N	Y	NA	NA
G12D	4-Methyl-2-pentanone, µg/L	10/14/2010	5.2	Y	Y	N	N	NA	NA
G08D	Carbon Disulfide, µg/L	10/15/2010	34	Y	Y	N	Y	NA	NA
G08M	Carbon Disulfide, µg/L	10/15/2010	13	Y	Y	N	Y	NA	NA
G09D	Carbon Disulfide, µg/L	10/15/2010	25	N	(1)	(2)	N	NA	NA
G40R	Acenaphthene, µg/L*	3/4/2011	5.3	(3)	NA	NA	NA	NA	NA
G48D	Acetone, µg/L	3/14/2011	90	(3)	NA	NA	NA	NA	NA
G54S	Acetone, µg/L	3/23/2011	25	(3)	NA	NA	NA	NA	NA
G54S	Phenols, total, µg/L	3/23/2011	7.2	(3)	NA	NA	NA	NA	NA
G39R	Acetone, µg/L*	3/25/2011	31	(3)	NA	NA	NA	NA	NA
G39R	Phenols, total, µg/L*	3/25/2011	51	(3)	NA	NA	NA	NA	NA
G04M	Chloroform, µg/L	4/14/2011	1.2	Y	Y	Y	Y	Y	Y
G04R	Carbon Disulfide, µg/L	4/14/2011	1.3	Y	Y	Y	Y	Y	Y
G04R	Toluene, µg/L	4/14/2011	1.1	Y	Y	N	Y	NA	NA
G19M	Acetone, µg/L	4/14/2011	5.9	Y	Y	N	Y	NA	NA
G07D	Benzene, µg/L	4/15/2011	1.5	Y	Y	N	Y	NA	NA
G07R	Benzene, µg/L*	4/15/2011	1.5	(3)	NA	NA	NA	NA	NA
G48D	Acetone, µg/L	4/15/2011	49	Y	Y	Y	Y	Y	Y
G59D	Phenols, total, µg/L	4/15/2011	10	Y	Y	N	Y	NA	NA

Well	Parameter	Collected	Result	Reported	Resampled	Confirmed	Reported	Alt Source Demo	Approved
G17D	Acetone, µg/L	4/18/2011	8.3	Y	Y	Y	N	Y	Y
G17D	Carbon Disulfide, µg/L	4/18/2011	1.6	Y	Y	N	Y	NA	NA
G17R	Acetone, µg/L*	4/18/2011	29000	Y	Y	Y	Y	Y	Y
G17R	Carbon Disulfide, µg/L*	4/18/2011	5	Y	Y	Y	Y	Y	Y
G17R	Methyl Ethyl Ketone, µg/L*	4/18/2011	51	Y	Y	Y	Y	Y	Y
G17R	Phenols, total, µg/L*	4/18/2011	22	Y	Y	Y	Y	Y	Y
G17R	Toluene, µg/L*	4/18/2011	3.3	Y	Y	N	Y	NA	NA
G58D	Fluoranthene, µg/L	4/18/2011	0.12	Y	Y	N	Y	NA	NA
G58D	Phenols, total, µg/L	4/18/2011	8.3	Y	Y	N	Y	NA	NA
G58M	Fluoranthene, µg/L	4/18/2011	0.12	Y	Y	N	Y	NA	NA
G39D	Fluoranthene, µg/L	4/19/2011	0.18	Y	Y	N	Y	NA	NA
G39R	Acetone, µg/L*	4/19/2011	19	Y	Y	N	Y	NA	NA
R16R	Chloroform, µg/L*	11/9/2011	1.1	Y	Y	N	Y	NA	NA
R17D	Chloroform, µg/L	11/9/2011	1.2	Y	Y	N	Y	NA	NA
R17R	Chloroform, µg/L*	11/9/2011	5.2	Y	Y	Y	Y	Y	Y
G01D	Phenols, total, µg/L	11/11/2011	5.6	Y	Y	N	Y	NA	NA
G40R	Phenols, total, µg/L*	11/30/2011	9.4	Y	Y	N	Y	NA	NA
G20M	Chloroform, µg/L	12/3/2011	6.4	Y	Y	Y	Y	Y	Y
G48D	Pyrene, µg/L	12/3/2011	0.21	Y	Y	N	Y	NA	NA
G07D	Phenols, total, µg/L	4/11/2012	120	Y	Y	N	Y	NA	NA
G40R	Phenols, total, µg/L*	4/19/2012	26	Y	Y	N	Y	NA	NA
G01D	Phenols, total, µg/L	4/23/2012	29	Y	Y	N	Y	NA	NA
G02R	Phenols, total, µg/L*	4/23/2012	14	Y	Y	N	Y	NA	NA
G39D	Phenols, total, µg/L	4/23/2012	10	Y	Y	N	Y	NA	NA
R19D	Chloroform, µg/L	5/1/2012	4.3	Y	Y	N	Y	NA	NA
G24D	Benzene, µg/L	2/11/2013	2.1	Y	Y	N	Y	NA	NA
G24M	Acetone, µg/L	2/11/2013	12	Y	Y	N	Y	NA	NA
G05M	Methyl Bromide, µg/L	5/3/2013	5.4	Y	Y	N	Y	NA	NA
G05M	Methyl Chloride, µg/L	5/3/2013	2.2	Y	Y	N	Y	NA	NA
G25D	Cis-1,2-Dichloroethylene, µg/L	5/20/2013	3.7	Y	Y	N	Y	NA	NA
G25D	Trichloroethylene, µg/L	5/20/2013	2	Y	Y	N	Y	NA	NA
G25M	Cis-1,2-Dichloroethylene, µg/L	5/20/2013	2.2	Y	Y	N	Y	NA	NA
G25M	Trichloroethylene, µg/L	5/20/2013	1.2	Y	Y	N	Y	NA	NA
G25R	Cis-1,2-Dichloroethylene, µg/L	5/20/2013	1.6	Y	Y	N	Y	NA	NA
G26D	Cis-1,2-Dichloroethylene, µg/L	5/20/2013	1.3	Y	Y	N	Y	NA	NA
R16R	Tetrahydrofuran, µg/L	5/22/2013	21	Y	Y	N	Y	NA	NA
R17M	Methyl Bromide, µg/L	11/2/2013	2.1	Y	P	P	P	P	P
G31M	Methyl Bromide, µg/L	11/9/2013	5.2	Y	P	P	P	P	P
G31M	Methyl Chloride, µg/L	11/9/2013	4.3	Y	P	P	P	P	P
G25D	Toluene, µg/L	11/15/2013	4.4	Y	P	P	P	P	P

Notes:

Italic	Exceeded AGQS/MAPC
*	Would have exceeded AGQS/MAPC on and after 1 April 2013
Y	Yes
N	No
NA	Not applicable
P	Pending at the time of this writing
(1)	Resampled as part of next routine sampling event
(2)	Not confirmed by next routine sampling event
(3)	Well not yet subject to detection monitoring process

Discussion of specific items of interest is provided below.

#### Acetone in G02D during fourth quarter 2009

Acetone, a common laboratory contaminant, was detected at 11 µg/L in the upgradient well G02D sample during the fourth quarter 2009 sampling event. It was not included in the notice of observed increase for fourth quarter. When it was sampled again during the second quarter 2010 monitoring event, it was not detected.

Joyce Day stated that when acetone was initially detected in the G02D sample during the fourth quarter 2009 event, it was also detected at the same concentration (11 µg/L) in the field blank. A field blank is a sample collected in the field using deionized water dispensed into sample bottles as though it were a groundwater sample. Field blanks serve as a check on the cleanliness of the sample bottles and on the possibility of actual samples being impacted by airborne contamination. Since acetone was detected in the field blank, detections of acetone in groundwater samples should have been flagged as suspect, but this did not carry through in the electronic data submittal. In spite of not being flagged, the presence of acetone in the field blank indicates that the detection in groundwater is spurious. Additionally, waste was not accepted in the portion of the landfill adjacent G02D until early 2010, greatly lessening the possibility of migration of a putative release. Given the foregoing and the absence of any acetone detections in this well since then, the detection of acetone in the G02D sample does not indicate a release from the landfill. The detection should still have been subjected to the resampling and reporting procedures; that it was not was likely an oversight.

#### Carbon disulfide in G09D during fourth quarter 2010

Carbon disulfide, a naturally occurring organic compound, was detected at 25 µg/L in the well G09D sample during the fourth quarter 2010 sampling event. It was not included in the notice of observed increase for fourth quarter. When it was sampled again during the second quarter 2010 monitoring event, it was not detected.

Joyce Day stated that the fourth quarter sample had been analyzed outside the method holding time and the result should have been flagged. Regardless of the hold time issue, it should have been identified in the fourth quarter notification letter and resampled, but was missed. G09D was sampled for carbon disulfide again in second quarter 2011 and was then less than the reporting limit (<1 µg/L).

Carbon disulfide was reported from samples from numerous wells at Clinton Landfill 3 and other sites during fourth quarter 2010, with many of the initial detections more than 25 µg/L, but was not confirmed when resampled. Such an occurrence—that it was detected in many wells one quarter but then disappeared—indicates that it was a sampling or laboratory artifact.

#### Acetone in G17D during second quarter 2011

Acetone was detected at 8.3 µg/L in the well G17D sample in the initial second quarter 2011 event and redetected at 5.2 µg/L in the third quarter (which confirmed it because the result was greater than non-detect). The notice of confirmed increase, which also addressed other wells, did not list the acetone detection in G17D. Technically, acetone would not have needed to be reported, since it was less than the PQL and therefore not subject to being evaluated against trigger conditions. However, it was nonetheless included in an alternate source demonstration, Log 2011-448, which the Illinois EPA approved on 30 April 2012.

#### Carbon disulfide in G08M during fourth quarter 2010

Carbon disulfide was detected at 13 µg/L in G08M from the 15 October 2010 sample. In the December resample, it was reported at 1.26 µg/L, suggesting it was a detection above the reporting limit and thereby confirming an increase per the Condition VIII.13.c. criterion. However, it was not reported as confirmed nor was it included in an alternate source demonstration.

Joyce Day stated that the result of 1.26 did not exceed the PQL. PDC's laboratory reporting limit for carbon disulfide during this analysis was 10 µg/L. Reporting limits can fluctuate due to interference from other substances in the sample, dilution of a sample to bring desired constituents within the calibration range of the machine (necessitating a proportional increase in the stated reporting limit), and so forth, and thus are not a fixed number. This is in contrast with a detection limit, which is the theoretical minimum concentration that can be detected under optimum conditions. PDC considers "reporting limit" to be synonymous with "PQL." §811.319(a)(4)(A) defines PQL as "the lowest concentration that can be reliably measured within specified limits of precision and accuracy, under routine laboratory operating conditions," which sounds very much like my understanding of what a reporting limit is, so I would agree with their interpretation.

During this analytical event, PDC had requested that the laboratory report results lower than their current reporting limit of 10 µg/L because the AGQS for carbon disulfide in G08M's hydrogeologic unit is 8 µg/L (which was the reporting limit/PQL achievable by PDC's laboratory at the time background samples were being collected to develop the AGQS)<sup>19</sup>. Condition VIII.13. of the permit and §811.319(a)(4)(A) state the confirmation procedure only applies if the concentrations of the constituents monitored can be measured at or above the PQL. Because the result of 1.26 µg/L was less

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<sup>19</sup> Reporting limits used by PDC Laboratories in the past were generally lower than they are now for many organic parameters because the laboratory was reporting down to the method detection limit (MDL). The MDL is typically the lowest possible value the laboratory can "see" above background noise when spiking known concentrations of analytes in a pure deionized water matrix; however, concentrations at those levels cannot be accurately quantified and reporting down to the MDL often yields increased false positive detections in actual groundwater samples. The practice of reporting down to the MDL apparently resulted from PDC Laboratories' interpretation of older regulatory language. PDC Laboratories is now reporting to the PQL, which I believe to be correct per the current regulations and site permit. PDC considers the term PQL outdated and now uses "MRL" (minimum reporting limit), which is essentially synonymous with the regulatory definition of PQL.

PQLs/MRLs can also fluctuate due to being run on different instruments and in some cases due to available sample volume or sample dilution.

PDC plans to review their current MRLs and may request to adjust AGQSs/MAPCs when those are below levels that can be accurately quantified (i.e., the current AGQS/MAPC is less than PQL/MRL). Per the Permit Section, the facility will have to submit a permit modification application justifying the higher limits in order to modify its AGQSs/MAPCs.

than the laboratory's reporting limit at that time and less than the reporting limit used to establish the AGQS, no increase was confirmed per either Condition VIII.13.c. or Condition VIII.13.d.

The compound has not been redetected since the December 2010 sample and therefore is unlikely to be evidence of a release from the landfill. Because G08M was a new well at the time and the carbon disulfide detections were short-lived, PDC suspects the detections may have been either laboratory/sampling artifacts or were due to water used during well installation. Carbon disulfide also occurs naturally in the environment from the biodegradation of organic material, such as often occurs in glacial sediments.

#### Acetone in G39R and G48D during first quarter 2011

Acetone was detected in samples collected from G39R and G48D in March 2011, just weeks after the installation of those wells. The detections were not reported as observed increases but were again detected during the next routine event (April 2011). As a result of the April detection, acetone at G48D was included in an alternate source demonstration, application Log 2011-448, which was approved. While at G39R was not included in the application, it ceased to be detected after the April event, strongly suggesting that it was an anomaly and not a release from the facility.

I emailed Joyce Day about these and she responded that these results were benchmark samples taken prior to waste disposal in the CWU. Operating authorization for the CWU, to which these wells are adjacent, was first issued on 1 April 2011 and these wells would not have been subject to the reporting process before then. Therefore, I have annotated these detections (and other detections not yet subject to the reporting process for the same reason) with a "(3)" but left them in the table.

As such, the second quarter 2011 results for acetone at wells G39R and G48D were considered to be the initial exceedances. Resample results from second quarter 2011 did not confirm the detection at G39R; therefore, it was not necessary for it to be included in the alternate source demonstration for that quarter. The G48D acetone detection was confirmed by the second quarter 2011 resampling event and was included in an alternate source demonstration (Log 2011-448) that was approved.

#### Phenols in G48D and R17R during first quarter 2012

The Illinois EPA database contains total recoverable phenols results of 22.1 µg/L and 20.2 µg/L in wells G48D and R17R, respectively, for a 13 March 2012 sampling event. This split sampling event was conducted by the Illinois EPA and PDC to investigate an issue that PDC was experiencing with analytes being detected in its quality control blanks (which should have been analyte-free). PDC's results for their portions of the split were <5 µg/L for G48D and 59 µg/L for R17R. Since the split sampling event was conducted for a specific purpose (to be used in conjunction with a then-pending permit application) outside of the normal detection and confirmation process, I did not include the results in the table. The overall results of the split sampling event are discussed in a record review I completed on 15 June 2012.

#### Summary of facility's response to observed increases

The vast majority of the observed and confirmed increases in the facility's data were appropriately managed by PDC. Of the occurrences described in the preceding pages, I would only consider five of them (acetone in G02D in 2009, carbon disulfide in G09D in 2010, zinc in G19D in 2011, zinc in R17D in fourth quarter 2011, and nitrate in G54S in 2012) to be situations where the facility either failed to include a parameter in the quarterly notification or was late in submitting documentation.



Out of more than fifty thousand sample results, five such occurrences is a very low error rate for a program this large and complex. Phrased another way, PDC correctly managed its results more than 99.99% of the time. Indeed, considering the scale of the program, it is probably the best-managed program I have yet evaluated at a Part 811 landfill. Moreover, none of those five increases were indicative of a release from the facility and therefore the oversights did not result in an environmental impact—there was no concealment of or delayed response to an actual release from the facility. As noted previously, review and approval of a number of alternate source demonstrations remain pending at this time: Logs 2013-030, 2013-524, and 2014-023.

### **Annual flow evaluation**

Condition VIII.20. of the permit requires the facility to determine the groundwater flow direction and hydraulic gradients annually and report them by 15 July. The regional file contained annual reports for calendar years 2008 through 2012. The reports indicate southward flow, or flow with a southward component, in all four monitored zones when potentiometric maps could be constructed. The maps seem to be well delineated as to where the calculated potentiometric surface is represented to exist—the Radnor Till Sands do not cover the entire site and the Roxana Silt is completely removed from waste cell footprints during construction. The reports also include the required hydraulic gradient values.

### **Well elevation surveys**

Condition VIII.19. of the permit requires the site to survey and report the elevation of the top of the inner casing (“stick-up”) when wells are installed, every two years thereafter, and whenever there is reason to suspect the elevation may have changed. These measurements were last taken on 25 September 2012 and reported to the Illinois EPA on 5 February 2013, so the facility is up to date on this item. The wells must next be surveyed no later than 25 September of this year.

Well bottoms (a List G parameter that must be measured during second quarter, per Condition VIII.18.) must be measured and reported annually by 15 July for wells without dedicated pumps and every five years (or whenever the pump is removed) for wells with pumps. These values have been included in the annual flow evaluation submitted each 15 July.

### **Annual certifications and reports**

Condition XIII.2. of the permit and §813.504 require the facility to submit by 1 May each year an annual report containing the past year’s monitoring data and discussions thereof; and discussion of the amount of waste expected in the next year, any structures to be built within the next year, any new monitoring stations to be installed within the next year, any modification or significant modification affecting operation of the facility, and the signature of the operator or duly authorized agent as specified in 35 Ill. Adm. Code 815.102. The 2012 annual report, received on 1 May 2013, contains the required information.

## On-site evaluation

### Inspection chronology

I arrived on-site on 1 April at approximately 8:00 A.M. and met initially with Dave Bryant, the facility manager for the site. A short time later, Rob Zinser and James Daily, the samplers, came to the office and escorted me back to well G02D, which they were preparing to sample as it was one of the wells chosen for the split sampling event. We were joined there by Gail Schindler and Lisa Grant from PDC, who were on-site to observe the morning's activities. Joyce Day arrived a bit later.

As we were nearing completion on G02D, Day received a call from Mike Summers and Chris Liebman from Illinois EPA headquarters, who had just arrived at the facility office. She departed to escort them back to us. In the interim, we completed activities at G02D and prepared to move on to the next well.

Because none of the wells at the site have been impacted by releases from the facility and none are in assessment, the order in which the wells are sampled can be flexible. Of the other wells that had been chosen for the split event (G16D, G25D, and G49D), we elected to go next to G25D. This well is located “down in the pit,” the huge excavation wherein the early phases of the MSWU are being constructed and filled. The strong wind that morning, coupled with temperatures in the mid-30s, was making all of us quite miserable. Being below grade afforded us some relief from the wind until such time as the ambient temperature warmed enough to make the remainder of the day more tolerable.

Day, Summers, and Liebman arrived while we were at G25D. Liebman departed after G25D to return to Springfield.

After G25D, we next sampled G16D. After we finished it, it was about 12:30 P.M. and everyone was ready to break for lunch. I was thus gone from the site for about half an hour. After I returned, Zinser and Daily also returned within a very short time, and we proceeded to G49D, the last well for the split sampling event. Shortly after our arrival there, the rest of the entourage arrived.

Upon the completion of G49D, Day, Summers, and I returned to the parking lot in front of the facility office. There I relinquished custody of the samples to Mike Summers, who had agreed to deliver them to the Illinois EPA laboratory upon his return to Springfield. He then departed the site. Day and I met with Bryant in his office, where he showed me that he is retaining copies of the facility's groundwater monitoring documents. Actual physical copies of the various permit applications and construction completion reports had essentially overtaken his storage space, so he is maintaining the groundwater records on CD-ROM.

Day and I then visited the majority of the remaining wells so I could inspect their physical condition. In light of a soggy forecast for the remainder of the week, we prioritized wells and piezometers that would be difficult to access in wet weather. These included the remaining ones along the perimeter of the CWU, ones east and south of the CWU, and ones on the floor of the MSWU excavation. By

the time we finished the G20 cluster in the MSWU excavation, it was about 5:00 P.M. I knew it was unlikely we could finish the remainder of the wells prior to loss of sufficient daylight and I didn't want to detain Day, who had a long drive back to Peoria. We therefore wrapped up for the day, and I informed Bryant that I would return later in the week to finish, weather permitting. I departed the site shortly before 5:30 P.M.

On the morning of 2 April, the forecast and weather radar suggested that I just might have enough time to finish inspecting the remaining wells at the site, so I returned to the facility. Bryant accompanied me and we did in fact complete all the remaining wells. It was just beginning to sprinkle as we completed the final few wells. I told Bryant that I would email him and Day a list of well maintenance needs after I returned to my office, and that he would receive a copy of the full report within a week or so. I then departed the site.

During the inspection, I took a photo of each monitoring well or piezometer and each sample collected. I had not yet updated the camera clock to Daylight Savings Time, so the times attached to the electronic photo files are off by an hour. However, I converted the times to DST when entering them on the photo mounting forms (attached).

More information about specific aspects of the inspection is given in the following sections.

## **Monitor well inspections**

At each monitoring well or piezometer, I inspected its condition using the DLPC/FOS monitoring well inspection form (completed copy attached). The form is a both a guide to and documentation for inspecting the above-ground portion of groundwater monitoring wells and piezometers. Aspects of the inspection include: a) whether the well is locked, b) whether the well is labeled with its monitoring point designation (“name”), c) whether the top of the inner casing has a mark to indicate the point at which the elevation was surveyed and from which depth measurements should be taken, d) verification that standing water is absent from the vicinity of the well, e) whether the inner casing cap has a vent hole, f) whether the outer protective casing has a drain hole near the bottom, g) verification that collision damage is absent, h) verification of surface seal integrity, i) verification of inner casing integrity, j) verification of outer casing integrity, k) any other comments, and l) exposure number and direction of photographs. Because almost all the wells at this site have dedicated pumps, which dictate the point at which water levels can be read, and the non-pump wells appeared to be marked with a survey point, I simply eliminated that column from the inspection form.

As a result of this inspection, it appeared that all of the monitoring wells at the facility were in acceptable condition. There were a number of items requiring attention but none of these rose to the level of constituting a violation—the wells were intact, identifiable, and able to perform properly, insofar as a surficial inspection could confirm.

However, I emailed a list of the issues to Day and Bryant following the inspection on 2 April. Bryant had them tended expeditiously—Bill Grandon from SKS Engineers performed the work on 4 April and took photographs. Day forwarded me documentation and photos on 7 April. I renamed the photo files according to the Bureau of Land Administrative Procedure for digital photo management

and filed them along with my own photos for archiving. I also mounted them in Word documents for inclusion in this report. Since I did not take the photos myself, I did not denote in which direction they were taken. Similarly, the times the photos were taken did not transfer with the digital files, so I indicated no photo times on the photo sheets.

The well issues and their resolutions are discussed in the following paragraphs.

### **Drain holes**

Guidance recommends a small hole in the well's outer protective casing just above the surface seal to allow any water that finds its way between the casings (such as from sampling or weather) to drain back out. Otherwise, water trapped between the casings might infiltrate the well bore (potentially impacting sample integrity) or freeze and crush PVC casings. Almost all of the wells at Clinton Landfill 3 had a drain hole. However, I did not note any on G50S or G54S. G54S appeared to have a small amount of water between its casings. G57S had water between its casings as well, as did G01D, in spite of having drain holes. It's likely that the floor of the annular space between the casings was below the level of the drain holes, a situation that can be remedied by using a tremie pipe to carefully emplace a small amount of cement in the bottom of the annular space.

Grandon drilled quarter-inch drain holes in the outer casings of G50S (photo 060) and G54S (photo 057). G57S (photos 053–054), G01M (photos 062–063), and G01D (photo 064) already had drain holes, as I had noted, so none were added.

Day and Dave Baldwin of SKS Engineers inspected all three of these wells on 9 April and found a small amount of water between the casings in all of them. They added granular bentonite into the inter-casing space of each of the wells to raise the floor of the annular space. Day will forward field documentation once she receives it from Baldwin.

### **Air vents**

Guidance recommends a small hole in the inner casing cap of above-ground-completed (i.e., not flush-mount) monitoring wells. It allows the well to “breathe” with changes in water level or atmospheric pressure. If an airtight cap is tightly seated and has no vent, any changes in water level can cause the air column in the well to become over-pressured or under-pressured (i.e., partial vacuum). This in turn can impede the free fluctuation of the water level within the well, causing erroneous water level readings and possibly impacting potentiometric surface maps. Almost all wells at Clinton 3 would automatically meet this guidance as almost all wells at the facility are equipped with dedicated bladder pumps, whose heads are not air-tight. However, certain piezometers lacked an air vent: G50D, G53D, G57S, G57D, and EX-8D. While these were not vented, their caps were loosely placed, allowing the wells to “breathe” freely.

Grandon drilled air vents in the caps to assure pressure equalization should the caps ever be fitted down tightly after some future monitoring event (photos 051, 052, 055, 056, 058, and 059).

## Outer casing finish

The finish on the outer casing of two of the piezometers, EX-9 and EX-6, was somewhat deteriorated, though the metal itself appeared intact. It may be advisable to refinish the exterior to prevent deterioration of the casing, while being careful, of course, not to contaminate the well with paint. No action was taken on this on the 4<sup>th</sup> but since PDC is aware of the issue, they can continue to keep tabs on it in the future.

## Identification signs

The identification sign of two of the piezometers, EX-5 and EX-9, had faded just about to the point of illegibility; though they were otherwise identified (EX-5 on its inner cap and EX-9 in its cement surface seal). Grandon relabeled them on the 4<sup>th</sup> (photos 061 and 068).

## Waterras

Three wells (G53D, G57D, and EX-5) had Waterras in them. A Waterra is an inertial purging and sampling device consisting of a long tube with a ball valve at the bottom. As one moves the device downward in the well, water displaces the ball and moves up into the tube. When the Waterra is lifted, the water within forces the ball valve closed and it cannot escape. The next downward movement forces more water into the device and as the operator repeats the process, water discharges from the upper end.

In the past I have been unable to find useful information online about Waterras. Most Google hits are commercial sites trying to sell them. USEPA does not appear to have made any blanket statements about whether they are accepted for purging and sampling, although some USEPA regions have suggested in guidance documents that they are suitable for purging.

I have misgivings about Waterras for several reasons. Normal use of the device, moving it up and down in the well, would likely result in stabbing it into or otherwise agitating the sediment at the bottom of the well, thereby allowing sediment to be drawn up the tube to produce an unnaturally turbid sample. Moreover, what references I could find online referred to use as either a disposable device or a device to be removed and decontaminated after each use, whereas the Waterras at this site had been left in the wells. Finally, it would be very easy to use Waterras too fast. Guidance recommends a pumping rate not greater than 0.3 liters per minute, which could easily be exceeded by Waterra. High flow rates may impact not only the quality of the sample being collected but also can result in over-developing the well.

Day removed the two that we found on 1 April (from G53D and G57D) and put them in her truck for disposal. Since these wells are currently only piezometers and are not routinely sampled, the presence of the Waterras was a bit of a puzzle. Day thought they might have been used in a past split-sampling event. Since the only split-sampling events between the facility and the Illinois EPA that I am aware of are ones in which I participated (March 2012 and the current event), she felt that they may have been used in a split sampling event with the USEPA.

When Bryant and I encountered the third Waterra on 2 April, he asked about removing it then but I suggested just having one of his staff remove it later. I didn't really want to take the time then with

rain impending and in all honesty I didn't want to stow a long, wet piece of plastic in my state vehicle, in which we were touring the facility. However, Grandon removed the final Waterra from EX-5 on 4 April (photo 068). Since they are just plastic, they can be disposed of in the landfill.

### **Mystery riser**

There was a mystery broken-off pipe in the ground just east of the G04M/G04R cluster. It was a two-inch diameter PVC pipe such as is used for well casings. Bryant and I felt it was probably just a marker to make the location of the wells easily visible. Several wells or well clusters that were located in agricultural fields or weed patches had a length of PVC stuck into the ground nearby to facilitate finding the wells if tall weeds or corn were otherwise obscuring its location, and the G04 cluster is in the edge of a field. Of course, there was also the possibility that it could have been a piezometer that had not been properly abandoned, so I asked Bryant to have it investigated. On the 4<sup>th</sup>, Grandon confirmed that it was a broken marker, not a well or piezometer, removed it, and sealed the hole (photos 066–067).

### **Padlocks**

All the wells and piezometers at the site were padlocked to restrict access, as required. Padlocks exposed to weather inevitably become difficult to operate, even “weatherproof” ones. During the inspection, G59R's was very difficult to operate, though Day did eventually get it unlocked and relocked. Several other wells had difficult locks as well. At some point the facility should evaluate whether each lock should be replaced, or can be rehabilitated. In the meantime, Grandon lubricated G59R's lock with graphite powder on the 4<sup>th</sup>.

## **Sampling oversight**

A primary goal of the inspection was to observe PDC's samplers to verify that their technique conformed to recommended practices and the site's approved sampling and analysis plan (SAP). Prior to the inspection, I reviewed PDC's SAP and took notes on it. It was my conclusion, based on observation and interview of the samplers, that they are following the approved plan.

## **Groundwater samples collected**

### **Wells sampled**

Samples of groundwater were collected from pre-selected monitoring wells during the sampling event. These wells included G02D, an upgradient well; G16D and G25D, two wells adjacent to active or filled cells of the MSWU; and G49D, a well downgradient of the CWU. The selection rationale was to sample one upgradient well and at least one well downgradient of the MSWU and at least one downgradient of the CWU. The likelihood for a well to provide sufficient water for a split sample, based on its history, was taken into account. Additionally, G25D were selected because it had had detections of organic compounds and was therefore specifically requested via Illinois EPA management by an oversight taskforce to which the Illinois EPA is party. G24D had initially been

tentatively selected for the same reason but it has insufficient recharge to support a split sampling event; therefore, nearby well G16D was substituted.

### **Sampling procedure**

The samples were collected using the dedicated bladder pumps installed in the wells, operated in accordance with the facility's approved Sampling and Analysis Plan. My split procedure was in general accordance with Illinois EPA Bureau of Land sampling standard operating procedures (SOPs). In general, Zinser and I alternated bottles to fill our sample bottle sets, to maximize the comparability of the aliquots for each parameter or parameter group (e.g., metals). Since it was the facility's routine sampling event (i.e., not an EPA-initiated event), Zinser went first on each bottle. For large bottles (e.g., one liter), we would each fill half a bottle, then let the other fill half a bottle, prior to completing our own bottle. Additionally, since I had extra bottles for volatile and semi-volatile matrix spikes and matrix spike duplicates for well G02D and a complete field duplicate for well G25D, I worked those bottles into the alternation to maximize their comparability to my primary sample and Zinser's sample.

For sample aliquots for dissolved parameter analyses (metals, ammonia, nitrate/nitrite, sulfate, and chloride), a 0.45  $\mu$  disposable in-line filter cartridge was attached to the pump discharge tube. Several cycles' worth of water were discharged through the filter to flush and saturate it prior to dissolved aliquot collection.

### **Bottles filled**

For each sample, I filled the following bottles: three 40 mL glass vials with polypropylene caps, Teflon-lined silicone septa, and HCl preservative (for volatile organic compound [VOC] analysis); one one-liter amber glass bottle with polypropylene caps and Teflon liners (for semi-volatile organic compound [SVOC] analysis); one 250 mL polyethylene bottle with polypropylene cap, pulp and Saran cap liner, and HNO<sub>3</sub> preservative (for dissolved metals analysis); one 250 mL polyethylene bottle with polypropylene cap, pulp and Saran cap liner, and H<sub>2</sub>SO<sub>4</sub> preservative (for dissolved ammonia and nitrate/nitrite analysis); one 250 mL polyethylene bottle with polypropylene cap, pulp and Saran cap liner, and NaOH preservative (for total cyanide analysis); one one-liter polyethylene bottle with polypropylene cap, pulp and Saran cap liner (for dissolved sulfate and chloride analysis); and one one-liter polyethylene bottle with polypropylene cap, pulp and Saran cap liner (for total dissolved solids analysis).

In addition to the above bottles, I also filled additional bottles for quality control purposes. For the G02D sample, I filled two additional 40 mL vials and two additional liter amber bottles for matrix spike and matrix spike duplicates for VOCs and semi-volatiles, respectively. At well G25D, I filled one complete additional sample set as a field duplicate sample and blind-labeled it "G90D." Finally, I also kept a pair of laboratory-prepared VOC trip blanks with the VOC sample vials.

### **Sample handling, custody procedures, and final disposition**

Prior to the sampling event, I applied computer-generated self-adhesive labels to each bottle and secured them with transparent packing tape. The labels stated the name of the site, my name, the well, the analytes, and the sampling date. I designated the field duplicate "G90D" to conceal its na-

ture as a field duplicate from the laboratory to avoid any potential bias. I designated the trip blank vials “Trip Blank.”

Because the sampling event had originally been scheduled for 22 January 2014, I had put that date on the label. After it became necessary to reschedule on account of winter weather, I elected not to undertake the tedious task of relabeling the bottles and instead simply struck the date from the bottles and left them undated.<sup>20</sup> The actual date of the sampling event would be reflected on the Chain of Custody Document (COCD) and there should be no confusion in the laboratory with the bottles themselves, as these were to be the only samples from Clinton Landfill 3 collected by me.

For each sample, I placed the VOC vials into bubble pouches. I then placed the bubble pouches and the similarly packaged VOC trip blanks into a food grade plastic bag and kept them together in their own cooler. This was to avoid dispersing the VOC vials among different coolers with the remaining bottles of their respective samples, which would have separated some of them from the trip blank.

For the remaining bottles of each sample, I placed them into a food grade plastic bag, tied the top of the bag in a knot, taped the knot down with packing tape, and sealed it with evidence tape. I wrote my initials, the date, and the time on the evidence tape with a china marker. Thus, the sample from each well was sealed discretely, with the exception of the VOC portion. I photographed each sealed sample near the well from which it had been collected. I placed the sealed samples into coolers containing both bottles of water ice and bagged “blue ice” freeze-packs.

After sampling the final well (G49D), I bagged and sealed the VOC vials from all wells and the trip blank vials together and photographed them. I then placed the sealed VOC samples into a cooler containing bottles of water ice.

I documented the samples and trip blank on the DLPC/FOS Chain of Custody Document (COCD; see attached copy) and obtained Zinser’s signature on the “receipt for samples” section of the form. The “Receipt for Samples” is simply an attestation from a facility representative that the samples came from the referenced facility, and in this case that they were split samples. I then relinquished the samples to Mike Summers, who was to deliver them to the Illinois EPA laboratory when he returned to Springfield. At the laboratory, Summers relinquished the samples to Scott Clark at 4:02 P.M. Clark later emailed me a scan of the COCD with laboratory numbers assigned.

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<sup>20</sup> This proved a prudent decision, as G25D, the most “anticipated” well for this sampling event, had frozen. The G25 well cluster is located on the floor of the main excavation and is thus probably twenty feet or so topographically lower than the surrounding grade at the site. The low elevation of the well, combined with a high potentiometric surface in the Organic Soil unit, led to the static water level in G25D rising into the above-ground portion of the well casing. The brutally cold January weather caused the water to freeze within the above-ground portion. Various options to thaw the well were discussed, but none of them were practical and additionally they could have biased a sample. There seemed to be no option other than waiting for warmer weather to thaw the well naturally, which ultimately did not occur until late March. At that point, it was decided to wait until the beginning of April so that the samples could be part of the facility’s routine second quarter monitoring event instead of an extra sampling event (the facility had already collected all its first quarter samples except for the frozen G25D).



## Parameters requested

Parameters were chosen to approximate the facility's routine second quarter analyte list and included volatile and semi-volatile organic compounds, dissolved inorganic parameters (metals, ammonia, nitrate/nitrite,<sup>21</sup> sulfate, and chloride), pH, specific conductance, total cyanide, and total dissolved solids. For the most part, parameters will be run by SW-846 methods. For some parameters, the Laboratory may use equivalent non-SW-846 methods.

## Preliminary results

On 3 April 2014, Celeste Crowley of the Illinois EPA laboratory emailed me preliminary results for my split sample portions. These results were for volatile organic compounds (VOCs). The attached laboratory report indicates that the results are draft; however, the VOC results are final. The laboratory information system marked the report as draft because other results remain incomplete.

The laboratory ran the VOCs by the USEPA drinking water method, the most sensitive method available to the laboratory. None of the target analytes were detected above the reporting limit. While I will of course review this again in conjunction with the remainder of the results when they become available, it strongly suggests that the previous organic detections in G02D and G25D samples were not the result of a release from the facility, as a release would be expected to be ongoing.

## Comments pertaining to the IEPA Field Technical Checklist

**C.1.e.** I did not evaluate whether the facility maintains a written inventory of all sampling devices and purging equipment in use at the facility, including model number, serial number, and manufacturer's name. This is recommended by certain sources of guidance and was therefore incorporated into the technical checklist that the Illinois EPA uses for both solid wastes facilities (such as Clinton Landfill) and RCRA (hazardous waste) facilities. Such an inventory is not required by either Clinton Landfill's permit or the Part 810-series landfill regulations.

**C.1.f., C.1.h.** Regarding calibration of field instruments and documentation thereof, the recommended procedures for field instrument calibration and verification in the approved SAP specify periodic calibration checks but also allow for alternate procedures based on laboratory SOPs or manufacturer's specifications. PDC Laboratories is in the process of developing its own SOP for the Horiba field parameter meter used at this site.

Until recently, the calibration procedures used for the Horibas were based on the calibration procedures in the Horiba manual, which does not specify periodic calibration checks. The PDC Laboratories SOP review team has decided to defer to the sampling plan at each site with respect to field calibration checks. Thus, periodic field checks during the day are now being implemented. Over time, the laboratory may develop alternate calibration check frequency (e.g., based on evaluation of the results of the periodic checks) and this could also vary between instrument and sensor type, level of confidence needed for the parameter (e.g., pH and specific conductance, which have compliance

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<sup>21</sup> Clinton Landfill's permit actually specifies nitrate, but the Illinois EPA laboratory currently runs nitrate/nitrite. The result is the total amount of nitrate and nitrite.

criteria, as opposed to dissolved oxygen and oxidation-reduction potential, which do not), or other factors.

**C.1.i.–j., C.2.** Clinton Landfill inspects its wells on a quarterly basis. The permit specifies that any well which becomes consistently dry or unserviceable must be replaced. Other equipment is evaluated for function and calibration periodically and repaired or replaced as needed.

**F.2.b.–c.** I did not observe the initial round of water level readings, when the wells would have initially been uncapped for this event. Headspace readings are a safety function, not an environmental measurement. Almost all the wells have bladder pumps, whose tops are open to the atmosphere, and those wells without pumps had their caps only loosely seated. Thus, there would have been at least some potential for any landfill gases to disperse prior to opening, and the wells' air columns would have been in pressure equilibrium with the atmosphere, obviating any need to delay water level measurements.

**F.4.b., F.4.d.** Almost all the wells at the site, and in fact all of the wells that I split samples on, are equipped with dedicated bladder pumps. Low flow purging was employed with minimal water level drawdown, so the questions about volume removed and drawdown are not applicable.

**F.5.** There are very few bailer wells at the facility and as I did not split samples from any of those, I did not observe bailer technique. The facility's approved sampling and analysis plan specifies a method for bailer purging and sampling that conforms to the technical checklist.

**F.6.d.** I marked the question about measurement of field parameters from a split portion instead of an actual sample bottle "not applicable" because the field parameters are measured in a flow cell.

**G.2.** I marked this bailer question "not evaluated" because I did not observe any bailer sampling during this event.

**H.1.b., H.3.b, H.4.c.** These reference a large number of items suggested by various guidance documents for inclusion in sampling documentation. The facility uses forms from its approved sampling and analysis plan that incorporate the most important of these items, and in fact are very similar to the types of documentation used by Illinois EPA samplers during independent (non-split) sampling events. Therefore I consider the documentation used by the facility to be appropriate.

**H.1.c.** I marked the question about wet sample labels legibility not applicable as I did not have opportunity to observe wet sample labels.

## Summary of apparent violations

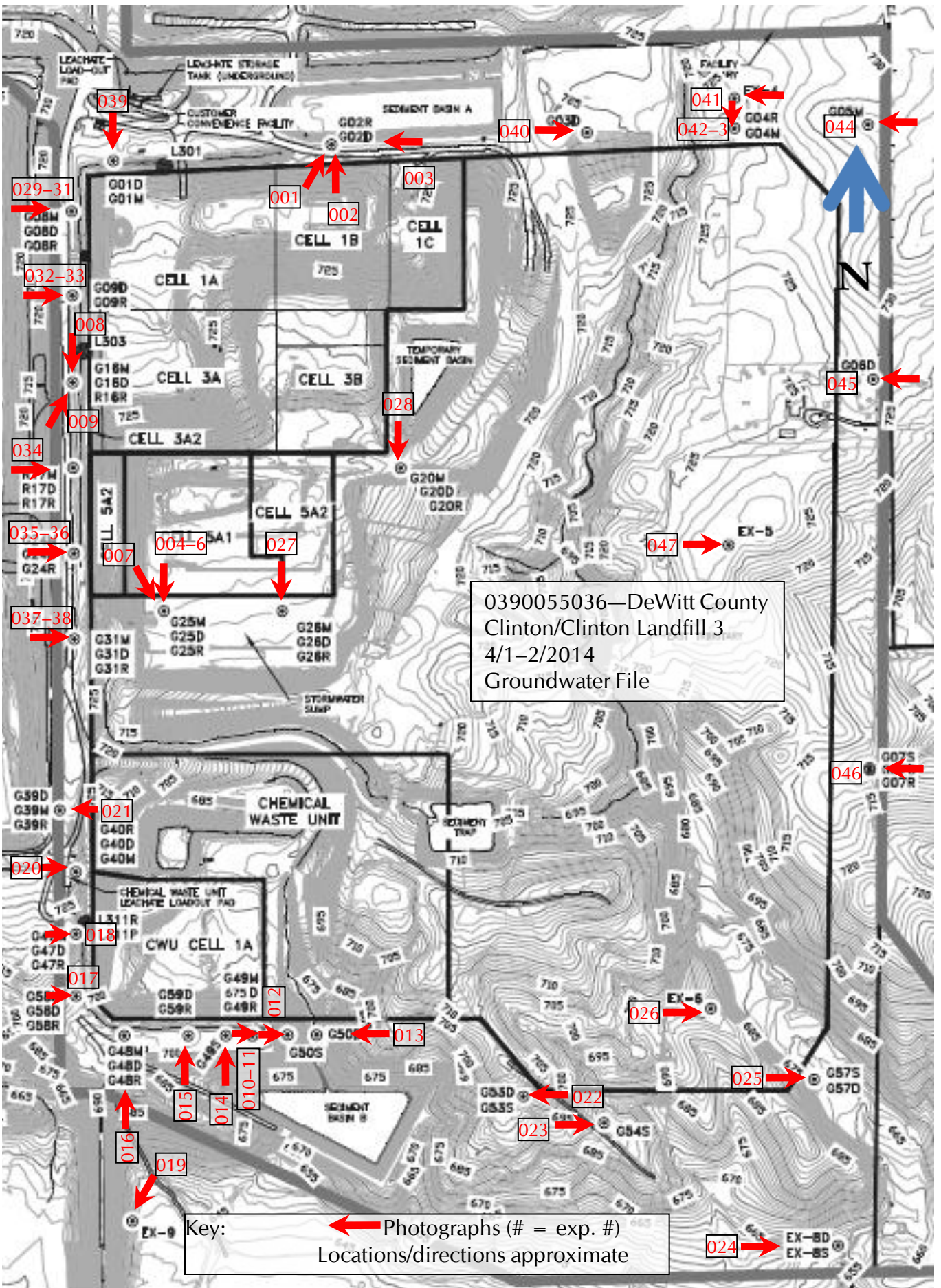
The inspection evaluated Clinton Landfill 3's compliance with Section VIII of its permit, 2005-070-LF, and 35 Ill. Adm. Code requirements applicable to the groundwater monitoring program: §§811.112(e), 811.316, 811.318–811.320, and 813.502–813.504. No apparent violations are cited as a result of this inspection.

## Attachments

1. Facility diagram
2. Inspection photos
3. Photos provided by the facility
4. Well information table
5. Miscellaneous documents provided by the facility
6. Chain of Custody
7. Monitoring well inspection checklist
8. Field technical checklist
9. Sampling and Analysis/Health and Safety Plan
10. Illinois EPA Volatile Organic Compound (VOC) laboratory results

## References

- Hansel, Ardith K. and Johnson, W. Hilton. *Bulletin 104: Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area*. Champaign: Illinois State Geological Survey, 1996.
- Killey, Myrna M. *Illinois' Ice Age Legacy*. Champaign: Illinois State Geological Survey, 2007.



0390055036—DeWitt County  
 Clinton/Clinton Landfill 3  
 4/1-2/2014  
 Groundwater File

Key: Photographs (# = exp.)  
 Locations/directions approximate

024 EX-8D  
 EX-8S



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 8:34 A.M.  
Direction: Northeast  
Photo by: Jeff Turner  
Exposure #: 001  
Comments: G02D



Date: 4/1/2014  
Time: 8:35 A.M.  
Direction: North  
Photo by: Jeff Turner  
Exposure #: 002  
Comments: G02R



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 9:46 A.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 003  
Comments: G02D  
sample



Date: 4/1/2014  
Time: 11:09 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 004  
Comments: G25D  
sample, including  
field duplicate  
"G90D"



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 11:12 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 005  
Comments: G25M



Date: 4/1/2014  
Time: 11:12 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 006  
Comments: G25D



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 11:12 A.M.  
Direction: Southeast  
Photo by: Jeff Turner  
Exposure #: 007  
Comments: G25R



Date: 4/1/2014  
Time: 12:18 P.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 008  
Comments: G16D &  
sample





## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 12:18 P.M.  
Direction: Northeast  
Photo by: Jeff Turner  
Exposure #: 009  
Comments: G16M &  
R16R



Date: 4/1/2014  
Time: 1:39 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 010  
Comments: G49 cluster



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 2:21 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 011  
Comments: G49D &  
sample



Date: 4/1/2014  
Time: 2:57 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 012  
Comments: G50S



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 3:04 P.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 013  
Comments: G50D



Date: 4/1/2014  
Time: 3:08 P.M.  
Direction: North  
Photo by: Jeff Turner  
Exposure #: 014  
Comments: G49S



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 3:10 P.M.  
Direction: North  
Photo by: Jeff Turner  
Exposure #: 015  
Comments: G59 cluster



Date: 4/1/2014  
Time: 3:17 P.M.  
Direction: North  
Photo by: Jeff Turner  
Exposure #: 016  
Comments: G48 cluster



## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 3:19 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 017  
Comments: G58 cluster



Date: 4/1/2014  
Time: 3:22 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 018  
Comments: G47 cluster



## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 3:48 P.M.  
Direction: Southwest  
Photo by: Jeff Turner  
Exposure #: 019  
Comments: EX-9



Date: 4/1/2014  
Time: 3:59 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 020  
Comments: G40 cluster



## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 4:00 P.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 021  
Comments: G39 cluster



Date: 4/1/2014  
Time: 4:16 P.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 022  
Comments: G53 cluster



## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 4:23 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 023  
Comments: G54S



Date: 4/1/2014  
Time: 4:27 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 024  
Comments: EX-8  
cluster





**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



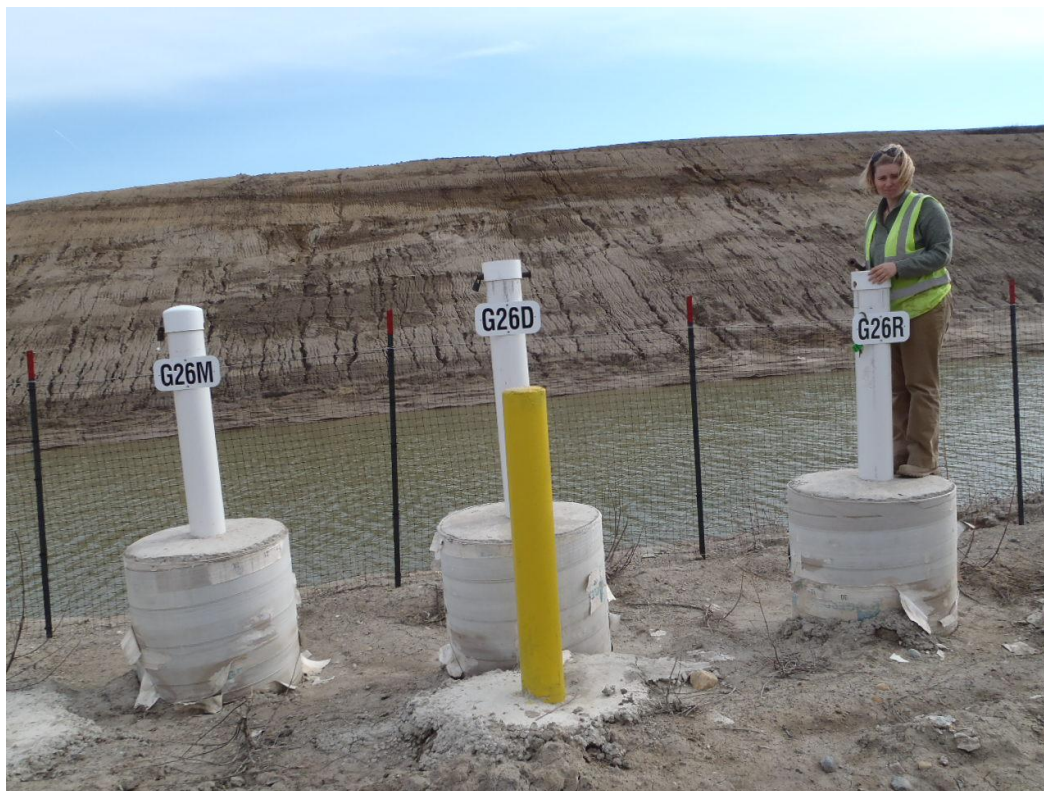
Date: 4/1/2014  
Time: 4:34 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 025  
Comments: G57 cluster



Date: 4/1/2014  
Time: 4:39 P.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 026  
Comments: EX-6



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04012014-[Exp. #].jpg



Date: 4/1/2014  
Time: 4:45 P.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 027  
Comments: G26 cluster



Date: 4/1/2014  
Time: 4:58 P.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 028  
Comments: G20 cluster



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 10:18 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 029  
Comments: G08M



Date: 4/2/2014  
Time: 10:19 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 030  
Comments: G08D



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 10:19 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 031  
Comments: G08R



Date: 4/2/2014  
Time: 10:23 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 032  
Comments: G09R



**DIGITAL PHOTOGRAPHS**

File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 10:23 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 033  
Comments: G09D



Date: 4/2/2014  
Time: 10:27 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 034  
Comments: R17 cluster



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 10:32 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 035  
Comments: G24M &  
G24R



Date: 4/2/2014  
Time: 10:33 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 036  
Comments: G24D



## DIGITAL PHOTOGRAPHS

File Names: 0390055036 ~ 04022014-[Exp. #].jpg



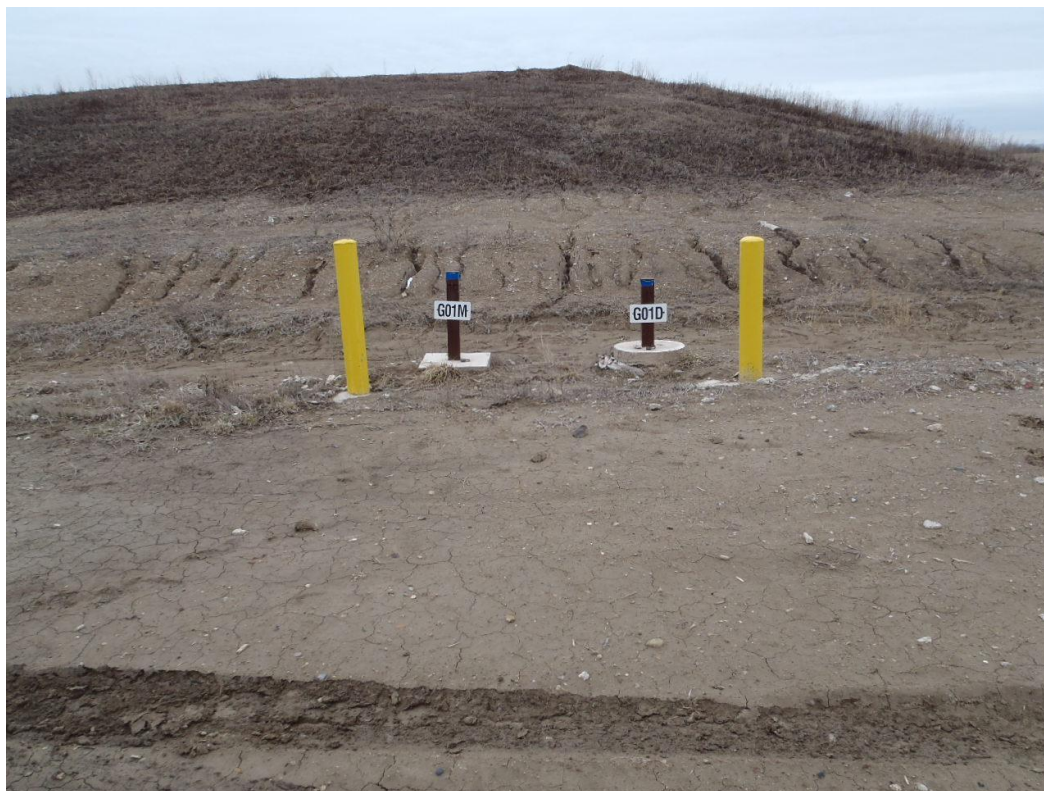
Date: 4/2/2014  
Time: 10:39 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 037  
Comments: G31R



Date: 4/2/2014  
Time: 10:39 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 038  
Comments: G31D &  
G31M



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 10:43 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 039  
Comments: G01 cluster



Date: 4/2/2014  
Time: 10:48 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 040  
Comments: G03D;  
white pipe is  
visibility marker





**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 11:05 A.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 041  
Comments: EX-4; white pipe is visibility marker



Date: 4/2/2014  
Time: 11:06 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 042  
Comments: G04 cluster



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 11:11 A.M.  
Direction: South  
Photo by: Jeff Turner  
Exposure #: 043  
Comments: Broken  
visibility marker just  
east of G04M



Date: 4/2/2014  
Time: 11:15 A.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 044  
Comments: G05M;  
upright white pipe is  
visibility marker



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 11:19 A.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 045  
Comments: G06D



Date: 4/2/2014  
Time: 11:23 A.M.  
Direction: West  
Photo by: Jeff Turner  
Exposure #: 046  
Comments: G07  
cluster; white pipe is  
visibility marker.  
Well behind white  
pipe is G07R.



**DIGITAL PHOTOGRAPHS** File Names: 0390055036 ~ 04022014-[Exp. #].jpg



Date: 4/2/2014  
Time: 11:29 A.M.  
Direction: East  
Photo by: Jeff Turner  
Exposure #: 047  
Comments: EX-5; white  
pipe is visibility  
marker



<b>22.17</b>	<b>Landfill Post-Closure Care</b>	
(a)	Failure to monitor gas, water, settling	<input type="checkbox"/>
(b)	Failure to take remedial action	<input type="checkbox"/>
<b>35 Illinois Administrative Code Requirements Subtitle G</b>		
<b>Part 811 Subpart A</b>	<b>General Standards for All Landfills</b>	
<b>811.112(e)</b>	<b>Recordkeeping Requirements for MSWLF Units—groundwater program records</b>	<input type="checkbox"/>
<b>Part 811 Subpart C</b>	<b>Putrescible and Chemical Waste Landfills</b>	
<b>811.316</b>	<b>Plugging and Sealing of Boreholes</b>	<input type="checkbox"/>
<b>811.318</b>	<b>Design, Construction, and Operation of Groundwater Monitoring Systems</b>	
(a)	Monitor groundwater, maintain wells, and keep records	<input type="checkbox"/>
(b)	Placement of wells	<input type="checkbox"/>
(d)	Monitoring well design, construction, development, and hydraulic testing standards	<input type="checkbox"/>
(e)	Standards for sample collection and analysis	<input type="checkbox"/>
<b>811.319</b>	<b>Groundwater Monitoring Programs</b>	
(a)	Detection Monitoring Program	<input type="checkbox"/>
(b)	Assessment Monitoring	<input type="checkbox"/> NA
(c)	Assessment Report	<input type="checkbox"/> NA
(d)	Remedial Action	<input type="checkbox"/> NA
<b>811.320</b>	<b>Groundwater Quality Standards</b>	
(a)	Applicable Groundwater Quality Standards (AGQSs)	<input type="checkbox"/>
(d)	Establishment of Background Concentrations	<input type="checkbox"/>
(e)	Statistical Analysis of Groundwater Monitoring Data	<input type="checkbox"/>
<b>811.324</b>	<b>Corrective Action Measures for MSWLF Units</b>	<input type="checkbox"/> NA
<b>811.325</b>	<b>Selection of remedy for MSWLF Units</b>	<input type="checkbox"/> NA
<b>811.326</b>	<b>Implementation of the corrective action program at MSWLF Units</b>	<input type="checkbox"/> NA
<b>Part 813 Subpart E</b>	<b>Certification and Reports</b>	
<b>813.502</b>	<b>Groundwater Reports</b>	<input type="checkbox"/>
<b>813.503</b>	<b>Information to be Retained at or near the Waste Disposal Facility</b>	<input type="checkbox"/>
<b>813.504</b>	<b>Annual Report</b>	<input type="checkbox"/>

