To: The Mahomet Aquifer Consortium
From: George Roadcap, PhD, Illinois State Water Survey – University of Illinois

RE: Clinton Landfill Permit

The USEPA DRAFT TSCA Approval permit for Clinton Landfill Incorporated to dispose of PCBs contradicts USEPA's rules for locating PCB landfills by using definitions, statements, and findings that are incorrect and also misleading to the general public. There are crucial inconsistencies between the definitions and applications of key terms within the permit. My comments submitted to USEPA on June 15, 2011 (attached below) address the USEPA definition of "historic high water table" and how its incorrect application allows the permit to comply with the rules. The following three comments amplify my earlier comments and identify new issues. Based on all these comments and issues, I conclude that the disposal of PCBs in the proposed Clinton Landfill does not meet USEPA regulatory requirements set forth in 40 CFR § 761.75(b)(3) and, therefore, represents a risk to the drinking water supplies of east-central Illinois.

1) Why should USEPA adhere to the rule in 40 CFR § 761.75(b)(3) requiring the bottom of a PCB landfill liner to be 50 feet above the historic high water table and why is it important to public safety?

In my response to this question, I will explain why the water table rule is important to a PCB landfill located in central Illinois and why it is important to use the correct definitions for the hydrologic terms in the law. In my earlier comments I present facts that show the landfill will be constructed below the water table, contrary to the rules in 40 CFR § 761.75(b)(3). In short, the elevation of the bottom of the landfill is between 654-659 feet msl and the water levels in the surrounding groundwater are either within 50 feet (617 feet msl for the Mahomet Aquifer) or above it (660-670 feet msl for the Glasford Aquifer and 692 feet msl for the lower Radnor sand).

The elevation of the "historic high water table" and how it is defined are critical to the construction and long-term safety of the PCB landfill. In my previous comments I pointed out the gross inconsistency between the definitions in USEPA's draft permit for of the "water table" and the "historic high water table." The definition of the water table as "The elevation of a free-water surface at which the pressure is equal to and responsive to atmospheric pressure" is consistent with textbooks that cover groundwater. Logically, the historic high water should simply be the highest elevation the free-water surface has ever reached. USEPA's definition of the historic high water table as "The elevation for top-of-sand for the Mahomet Aquifer, top-of-sand elevations in the vicinity of Clinton Landfill #3 are between 483 and 490 feet MSL" is scientifically incorrect because 1) the top-of-sand is a geologic contact and not a free-water surface or potential water surface, and 2) it ignores the water table and potential surfaces that occur in the surficial material and in all of the overlying aquifers including those monitored for the permit application. Therefore, we must examine what could happen to the PCBs in the landfill using the logical definition for the "historic high water table" as the *highest elevation the free-water surface has ever reached.* The highest water levels given in the permit application are over 692 feet MSL and well within 50 feet of the land surface.

The elevation of the water table in any geologic setting is dependent on precipitation, evaporation, permeability, and the elevation of discharge points. Excavations below the water table, such as basements, deep flood retention basins, coal mines, and railroad underpasses, cannot stay dry without sump pumps or long-distance gravity drains. Remove the pumps and drains and inflow from precipitation and groundwater will act to refill the excavation to a level in balance with the original discharge point elevation. In Illinois where mean annual evaporation potential is approximately 75% of the mean precipitation, excavations that humans do not actively dewater, such as a highway barrow pit, fill with water and remain full throughout the year.

A landfill excavated below the water table also will tend to fill with water once a landfill closes and no longer operates and maintains the leachate sumps. The liners above and below the waste material will act to slow the refilling process, but cannot stop it completely, as evidenced by calculations of groundwater inflow with the permit application. The best evidence for the inability of a landfill liner to keep out surrounding groundwater may be from the existing Clinton Landfill #2. Water levels in the permit application for 2004 (figures 812.314-30 and 31) show groundwater flow directly towards the existing landfill at well EX-19 (water level of 642.00 msl or 76.40 feet to water) in the lower Radnor sand and at well EX-12D (water level of 663.52 msl or 41.48 feet to water) in the organic soil layer. Both units have higher water levels in wells (EX-7 and EX-17) to the south towards Salt Creek, the only other possible discharge point beside an unmapped connection with the deeper aquifers. The 15 to 20-foot rise in the water levels of wells EX-7 and EX-19 in November 2005 clearly indicate that the water levels were being impacted by some kind of pumping or dewatering. Water would also enter through the cap on top of the landfill, especially in the post-closure period as differential settling, erosion, burrowing animals, and tree roots compromise the cap.

To be conservative, one must assume that the operator will drop active maintenance of the site at some point in the future if the post-closure funds are depleted. The USEPA permit does not contain any dollar amount or cost analyses of what the post-closure care would require. These costs should be detailed as part of the permit approval and public comment process rather than after approval and "prior to acceptance of PCB waste" as stated on page 30. The permit needs to address whether the coverage of future liabilities is limited only to Clinton Landfill Incorporated, which may have no income after the landfill closes, or includes the larger AREA Disposal or PDC parent companies. Will there be sufficient funds in 50 or 100 years to regrade the site, replace eroded clay cap material, maintain proper vegetation, maintain the perimeter fence, keep out animals, and deal with other contingencies? There is no track record for how the post-closure funds last over time, however, there are plenty of examples of landfill companies going bankrupt, including a 2010 case in Alabama.

After maintenance is dropped the landfill will fill up with water to a level above the original water table (using the standard definition for "water table", not USEPA's incorrect definition of "historic high water table") because the center of the landfill will be 100 feet higher than the original land surface. At the edges of the landfill the leachate will either seep out or rise above the surface and cause a rupture or a slide to relieve the buoyancy pressures. After this occurs, PCB contaminated water and sediments from the landfill would migrate down slope to Salt Creek and contaminate its ecosystem and downstream groundwater and surface water supplies.

The timeframe for this eventuality depends on if and how the site is maintained after closure. With a continuous program for maintaining the integrity of the cap, the landfill may take decades or centuries to fill up with water. Without a maintenance program, the integrity of the cap will be compromised within a few years and the landfill will fill up with water much faster.

In summary, the proposed Clinton PCB landfill is below the actual historic high water table, regardless of how it may be defined by USEPA, and eventually will fill with water; potentially releasing PCBs into the environment and posing a significant risk to water supply and public safety. A more permanent solution for safely storing PCB needs to be found. The water table issue is important to public safety and any waiver of this requirement, such as one obtained by the WDI landfill in Michigan, could compromise the safety of the surrounding drinking water supplies.

2) How valid is USEPA's assertion in the June 2011 press release that "A 150-foot-deep layer of waterproof clay protects underground water supplies (ground water)"?

This statement is misleading to the public in two ways. First, the term "waterproof" should not be applied to geologic materials because every deposit, including glacial clays, has the ability to transmit some water. The models used to support the permit application use a permeability value for the clays that is greater than zero, thus allowing for groundwater flow. Second, the 150 feet separating the bottom of the landfill from the top of the Mahomet Aquifer is not all clay.

The use of the terms waterproof and watertight (page 15 of the permit) are in disagreement with the definitions listed in the permit that make it clear that the clay layers are not waterproof. The definition of clay pan states that the clay formation is "relatively impermeable", not impermeable. Relatively impermeable is not synonymous with "waterproof". The definition of the Mahomet Aquifer also states that the clay layer above is "relatively impermeable," not impermeable. Therefore, by their own definitions USEPA admits that water - and, hence, PCBs - can migrate downward through the clay layer and contaminate the Mahomet Aquifer, albeit slowly. By this reasoning they admit there is a risk of contamination.

There are further inconsistencies in the USEPA definition of the Glasford Formation: "Thick clay making up the upper part of Clay Pan #2 containing thin sands and minor aquifers that does or could supply water to as many as 125 borings and wells cataloged by the State of Illinois in a 3 mile radius of the CWU". USEPA needs to explain how a waterproof clay can contain aquifers. If the clay was truly waterproof, then the pumpage from all of the surrounding wells would have mined water out and substantially lowered water levels or dried up the aquifers. From the static water levels of the drilling logs, there is no evidence of any of the aquifers being depleted.

Geologic records from the landfill site disagree with the statement that there is a 150-foot layer of clay protecting the aquifer. The log for well CSM-1 shows 10 different sand layers including an 11-foot thick Glasford Aquifer sand in the middle of the section. These sand layers are often interconnected and act as conduits to move water both horizontally and vertically through the section to the Mahomet Aquifer. Geologic cross-sections published in Illinois State Geological Survey and Illinois State Water Survey reports (USEPA administrative record documents 115, 171, and 224) show the large variability in the geometry of these sand bodies and how they can be interconnected through the clay.

The movement of water through the glacial sequence ("waterproof clay") in the vicinity of the site is reflected in the potentiometric surface map of the Glasford Aquifer. Anliker and Sanderson 1995 (referenced in the permit and presentations but not in the administrative record; http://www.isws.illinois.edu/pubdoc/CR/ISWSCR-589.pdf) show groundwater flow in the Glasford Aquifer is to the south-southwest towards a discharge point along Salt Creek. The creek has an elevation of approximately 640 feet and the top of the Glasford sand has an elevation of 588 at well CSM-1, therefore, large volumes of groundwater must be moving upwards 52 feet through the glacial sequence.

The USEPA statement also conflicts with other USEPA statements to the public such as the April 2009 press release which states: "The company discovered about half of the community water wells within 15 miles of Clinton Landfill #3 draw their water from the Mahomet Aquifer while the other half pump from another source of underground water." The Glasford Aquifer and the shallow sands are the other source of water for the community wells that are not in the Mahomet Aquifer. How can these wells pump large quantities of water if they are in the middle of a "waterproof clay"?

Further evidence for the movement of water from the surface to the Mahomet Aquifer through the "waterproof clays" is found in the well record databases. Every well record in the central and eastern portions of the Mahomet Aquifer (Mclean, De Witt, Piatt, Champaign, Ford, and Iroquois Counties) show significant thicknesses of clay overlying the aquifer and yet the aquifer is receiving more than the 40 million gallons per day of recharge needed to balance the current pumpage. ISGS boring records show at least 42 feet of clay in the key recharge area along the Sangamon River in Piatt County.

The USEPA presentations and analyses appear to ignore the potential impact of the Decatur wellfield on flow directions and vertical gradients. Decatur operates an emergency wellfield capable of producing 24 million gallons per day (MGD) located in De Witt County eight miles east of the landfill. An analysis by Roadcap and Wilson 2001 (provided to USEPA but not part of the administrative record; http://www.isws.illinois.edu/pubdoc/CR/ISWSCR2001-11.pdf) shows that with the wellfield pumping at 10 MGD, water levels in the Mahomet Aquifer can be drawn down by more than 15 feet at Clinton. This drawdown will cause the flow directions at the landfill to change from going north towards the Clinton wellfield to going east-southeast to the Decatur wellfield, the opposite direction to what USEPA shows in the presentations. The large drawdown also increases the vertical gradients from the upper units down toward the Mahomet Aquifer. When Decatur first operated the wellfield, many local residents claimed that their shallow wells dried up or were otherwise impacted as a result. Decatur fixed many of these wells by lowering the pump setting or drilling a deeper replacement well. These wells would not have been impacted if the shallow wells were hydraulically separated from the Mahomet Aquifer, further illuminating the fact that water is moving through interconnected sands within the overlying clays.

The USEPA administrative record also does not appear to include data from the USGS De Witt County Groundwater Level Network. http://groundwaterwatch.usgs.gov/googlemaps/IL_039_gm.html) The USGS annually measures water levels in up to 11 wells in the county starting in 2005 including four wells that are within four miles of the landfill in different directions (one well was not measured in 2011). The springtime measurements in these wells fluctuated by 4-5 feet, suggesting that the aquifer is responding to changes in climate and possibly the level of Salt Creek. Wells that are away from interconnections with the surface, such as well SWS-2 in Tazewell County (ISWS COOP-19, administrative record #171) will have an annual water level fluctuation of less than 2 feet.

In summary, a hydrologic analysis of the Glasford and Mahomet Aquifers at the site with only 2 boring logs, no monitoring wells and no water level measurements is insufficient to predict how groundwater will behave underneath the landfill. Hydrogeologic evidence from the site and the surrounding area suggests that glacial deposits are not a uniform layer cake of clays, rather they are a complex sequence of erosional and depositional surfaces of clays with interconnecting sand stringers that allow groundwater to move around the clays. More hydrologic information needs to be collected and analyzed at the site before any conclusions can be made concerning the potential impact of any leakage from the landfill on the drinking water supplies in the Glasford and Mahomet Aquifers. The bottom line is that there is a risk of possible leaks of PCBs from the proposed landfill contaminating the Mahomet Aquifer for future generations.

3) How accurate is the USEPA Water Division finding in their January 26, 2011 evaluation of the Clinton Landfill that "The landfill will be protective of underground sources of drinking water"?

One of the arguments the evaluation authors use to support the finding is: "The Mahomet Aquifer is over-pressured, that is, artesian conditions exist: water would flow upward if flow paths existed. The maintenance of this pressure over time demonstrates the integrity of the native clay layer." This argument is incorrect, is not supported by the data, and shows a lack of understanding of basic groundwater hydrology.

The landfill monitoring wells completed in the shallower aquifers have water level elevations (potentiometric head) between 642 and 692 feet and nearby wells completed in the deeper Mahomet Aquifer have water levels between 600 and 620 feet. Therefore, there will always be the potential for leakage from the landfill to reach the Mahomet Aquifer because water always flows from high pressure to low pressure. A well screened only in the Mahomet Aquifer will have a water level above the top of the sand (artesian condition); however, a well screened through every unit will have water flowing down the well from higher units to the Mahomet Aquifer. The existence of artesian conditions does not demonstrate the integrity of the clay, rather it means the potential inflow (including recharge) is greater than the potential of the aquifer to transmit water to a discharge point. To be meaningful, this evaluation needs to include all of the relevant hydrologic information and a description of the flow system.

Comments submitted to USEPA on June 15, 2011:

Dear Rafael

Members of Mahomet Aquifer Consortium asked me to send you the comments concerning the Clinton Landfill application that I prepared for them. I serve as a technical advisor to the consortium. There are some critical inconsistencies in the water table elevation data used by USEPA to state that the PCB landfill will meet the necessary regulations. If the correct data is used, the permit would not be acceptable according to the regulations as stated in the permit.

All underlined items are directly from the USEPA draft permit approving the landfill.

The technical requirements for any landfill accepting PCBs include the following:

> 3. HYDROLOGICAL CONDITIONS: The proposed CWU meets the requirements set out at 40 CFR § 761.75(b)(3):
> A) The bottom of the proposed CWU will be above the historical high water table.
> B) The proposed CWU is not in a flood plain, shore land or groundwater recharge area.
> C) There is no hydraulic connection between the Site and standing or flowing surface water.
> D) The Site will have monitoring wells and leachate collection.
> E) The bottom of the landfill liner system will be at least fifty feet from the historical high water table.

The purpose for keeping the landfill above the water table is not explicitly stated in 40 CFR § 761.75(b)(3); two possible reasons include reducing the potential for contamination of the surrounding groundwater and to prevent the landfill from filling up with groundwater inflow.

USEPA gives the following two definitions for the water table in the permit which are clear and consistent with textbooks on groundwater:

> WATER TABLE: The elevation of a free-water surface at which the pressure is equal to and responsive to atmospheric pressure.
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> GROUNDWATER TABLE: For saturated soil under unconfined conditions, i.e., "water table" conditions, the elevation of the free water surface: for saturated soil under confined conditions i.e., "artesian conditions", the potential elevation of the free water surface.

A major inconsistency with these definitions is USEPA's definition of the historical high water table used to satisfy requirements 3a and 3e above:

> HISTORICAL HIGH WATER TABLE: The elevation for top-of-sand for the Mahomet Aquifer, top-of-sand elevations in the vicinity of Clinton Landfill #3 are between 483 and 490 feet MSL.

This definition is for the historical high water table is incorrect because the "top-of-sand for the Mahomet Aquifer" is a geologic contact, not a "free-water water surface" or the "potential elevation of the free water surface" as in the USEPA definition of a water table. The potential elevation of the free water surface, or potentiometric surface, of the Mahomet Aquifer is around 605 msl as measured by Anliker and Sanderson (1995 - *this report was not made part of the administrative record [AR] even though it referred to many times by USEPA and the applicant used as the basis for flow direction – see AR 207*) and also shown in Wilson et al (1998; AR 171). More recent 2010 measurements made within three miles of the Clinton Landfill by the US Geological Survey show higher water levels of 613 and 617 msl (This *data is also not part of the AR*) (http://groundwaterwatch.usgs.gov/countymaps/IL_039.html).

Why is this important? The bottom of the proposed CWU is at an elevation of 662 msl and the bottom of the 3-foot compact clay layer is at 559 msl, leaving and elevation difference with the water level in the Mahomet Aquifer of as little at 42 feet. This 42-foot difference is less than the required 50 feet of separation required by CFR § 761.75(b)(3e).

In the bigger picture of the hydrology at the site, USEPA's definition is for the historical high water table is also incorrect because it ignores all of the shallower tables in the shallower units. The best evidence for this oversight in the permit is in section 6 on page 12 which describes the monitoring systems:

> A) Background groundwater sampling for water bearing units and drinking water aquifers closest to the proposed CWU has been conducted and PCBs were not detected. Quarterly data for the following units was taken for 2 years and submitted with the Application:
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> i) Roxana Silt (Sangamonian interglacial unit, part of Mason Group),
> ii) lower Radnor Till Sand (upper Glasford Formation),
> iii) Organic soil (correlative with Roby Silt Member of Glasford Formation),
>
> B) The lower Radnor Till Sand and three adjacent water-saturated but unproductive permeable zones of the upper Glasford Formation and Mason Group are heavily monitored as part of the conditions of the RCRA Subtitle D permit and will be monitored as part of this Approval. Groundwater flow in the lower Radnor Till Sand is southward toward Salt Creek Valley where potentiometry suggests it dissipates into valley-fill sediments of Salt Creek.
>
> C) The monitoring plan proposed in the Application is designed to test the closest and best connected drinking water bearing sands, the upper Glasford Formation units. The plan does so. It is a best-possible early warning system based on worst-case and most stringent assumptions.

This section describes the results of water sampling done in the shallow units close to the surface and above the Mahomet Aquifer. Because the applicant has sampled these "drinking water bearing sands", these units must be below the water table. The Roxana Silt has an elevation of approximately 670 msl. Groundwater flow (ie below the water table) is also discussed in the definition of the lower Radnor sand:

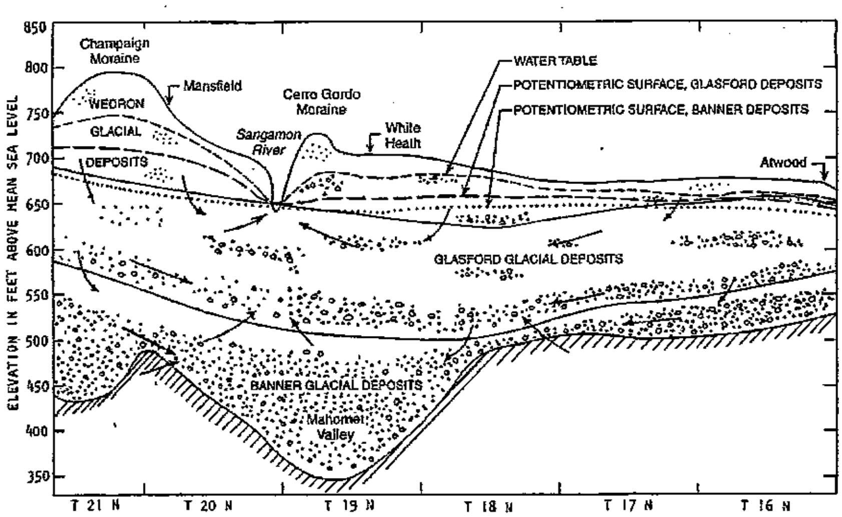
<u>LOWER RADNOR TILL SAND: (M) A 1-2 foot thick water-sand sub-unit of the upper Glasford Formation at the base of the Radnor Till, host to 25-30 drinking water wells within a 5 mile radius of the CWU. The unit is located approximately 18 feet below the base of the CWU's lowest liner and hosts groundwater that is monitored before it disperses into recent valley fill of Salt Creek Valley.</u>

The monitoring plan in section 33 GROUNDWATER MONITORING calls for monitoring wells only in the shallowest units with the deepest of these wells completed at an elevation of approximately 630 msl. If the HISTORICAL HIGH WATER TABLE is truly at 483 and 490 feet MSL, then all of the monitoring wells will be dry and completely ineffective in detecting leakage. It would also be inconsistent in the monitoring plan not to have monitoring wells in the Mahomet Aquifer below the stated high water table.

The permit also completely ignores the 10-foot thick Glasford sand which occurs at an elevation of 580 to 590 in the geologic cross-sections submitted with the permit. This unit is mappable across the county, is a significant source of water to many wells, and has a water level of approximately 660 to 670 msl according to measurements by Anliker and Sanderson (1995). This omission should be addressed be addressed in the permit.

The true water table (the elevation of a free-water surface at which the pressure is equal to and responsive to atmospheric pressure) in across most of Illinois where there are glacial deposits is generally less than 10 feet from the surface. This is why there are extensive networks of drainage tiles in the farm fields and why our cemeteries are on hillsides or in sandy deposits. Information on water table elevations and fluctuations can be found on the ISWS WARM network webpage. (http://www.isws.illinois.edu/warm/sgwdata/wells.aspx).

The requirement that the bottom of a landfill accepting PCB wastes be 50 feet above the historic water table probably eliminates more than 90% of the land in Illinois from having one of these landfills. A representation of the water table typical of Piatt and DeWitt Counties is show in on Figure 9 in Anliker and Sanderson (1995):



In a separate issue, the Permit states on page 17 "Wells in the EPA 3 mile radius database are all topographically above, side-gradient or up-gradient of the proposed CWU." This statement contradicts the report by Greenslate (1996) that shows the capture zone of the City of Clinton wellfield would extend under the landfill area. The Permit should be changed to reflect the fact if the landfill leaked into the Mahomet Aquifer, it could contaminate the Clinton water supply. This would also be another reason to require monitoring wells in the Glasford and Mahomet aquifers.

Similarly, any contamination in the groundwater flow of lower Radnor sand "disperses into recent valley fill of Salt Creek Valley". This statement needs to be explained. The "dispersed" contamination would have to end up in Salt Creek, not only contaminating it, but potentially the downstream water supplies at Mt Pulaski and Lincoln.