

Missouri Attorney General CHRIS KOSTER

Bridgeton Landfill Agreement Highlights

- Republic commits to concrete pipe removal and to permanently cap the smoldering landfill, including:
 - Permanent odor capture and control.
 - Oxygen starvation to assist in extinguishing smolder.
- Republic provides temporary housing assistance to residents near the landfill for the duration of work set to begin May 20 resulting in increased odor.
- Republic tests leachate daily for hazardous characteristics and properly disposes in compliance with the Missouri Hazardous Waste Management Law.
- Republic commits to containment measures to prevent migration beyond the neck into the West Lake Landfill.
- Republic pays state costs for comprehensive air monitoring and sampling, to occur
 daily, weekly, and as needed to ensure protection of public health and environment.



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Timeline

	March 27	Attorney General files suit against Republic.
To the second	April 24	Court dates set for May to address unresolved issues.
	May 3	Preliminary agreement reached.
	May 7	First round of lodging-program notices disseminated to affected residents.
	May 13	Agreed order signed and filed.
	May 14	Second round of lodging-program notices.
	May 17	Third round of lodging-program notices.
	May 19	Lodging Program begins.
The second secon	May 20	Anticipated start date for Reinforced Concrete Pipe Remedy.



West Lake Landfill Bridgeton, Missouri

Operable Unit 1, Area 1
Bridgeton Sanitary Landfill &
Subsurface Smoldering Event



andfill Areas

OU1 Area 1 (Radiological Area)

Approximate Subsurface Smoldering Event

Bridgeton SLF Outline

Conceptual Proposed Intercepter Probes

Existing Intercepter Probe Rows
Existing Intercepter Probe Rows

Missouri Department of Natural Resources

Division of Environmental Quality
Solid Waste Management Program
Created by: Dave Drilling on May 7, 2013



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Remedy Evaluation for Abandonment of Reinforced Concrete Pipes (RCPs)



Prepared by: Missouri Department of Natural Resources with assistance from Missouri Department of Health and Senior Services

Introduction

This remedy evaluation provides information about the options considered for the abandonment of reinforced concrete pipes (RCPs) which were a part of the replaced leachate collection system or landfill gas collection system at the Bridgeton Sanitary Landfill, hereafter Bridgeton.

Facility Location

Bridgeton is located at 13570 St. Charles Rock Road in Bridgeton Missouri and is owned by Bridgeton Landfill, LLC which is a subsidiary of Republic Services. The site has a permitted boundary of 212 acres of which the landfill of concern is approximately 52 acres. The maximum total waste thickness is 320 feet and is located in two contiguous quarries known as the North and South Quarries. The landfill is inactive having ceased accepting waste on December 31, 2004.

Summary of Issue

In December 2010, Bridgeton first reported to the Solid Waste Management Program, hereafter SWMP, that the landfill was experiencing elevated levels of carbon dioxide and low levels of methane on some gas extraction wells in the South Quarry. The facility began testing landfill gas from the gas extraction system and found elevated hydrogen and carbon monoxide and reduced methane concentrations, which is indicative of a subsurface smoldering event, hereafter SSE. As a result of the SSE, the landfill is experiencing excess leachate generation, excess non-uniform settlement, elevated extraction well temperatures, increased non-methane gas production, increased pressure in the landfill and at times, significant odors. These gases with strong odor are migrating off site to the surrounding community. The malodorous compounds have chemical properties that make them difficult to control using normal strategies (e.g., their high rates of diffusion through landfill cover materials) and are detectable to the human nose at very low concentrations.

In an attempt to control fugitive gas emissions and odors, Bridgeton plans to install an enhanced interim cover system over the entire south quarry. This cover system will consist of a green 60 mil High Density Polyethylene (HDPE) -Ethylene Vinyl Alcohol (EVOH) textured flexible membrane liner (FML). EVOH is a semi-crystalline thermoplastic resin which is reported to capture the small non-polar (odor causing) molecules. This FML material is manufactured with a thin layer of EVOH "sandwiched" between two layers of HDPE. Prior to installation of the FML cap, the landfill must complete some repair/maintenance work as continued settlement could impact the integrity of the synthetic cap and its ability to reduce the amount of gas escaping the landfill.

RCP History

There are 11 four foot inside diameter vertical reinforced concrete pipe (RCP) structures, approximately 200 to 300 feet deep located in the South Quarry. The original purpose of the RCPs was to allow for either leachate collection or to collect gas or gas condensate from the landfill. After the RCPs no longer functioned as originally designed, attempts were made to abandon them, initially between 2003 and 2005 and most recently in 2011. Prior to the SSE, these RCPs were abandoned by either digging them up or attempting to fill them with dirt/rock. Since the SSE, the overall settlement rate and landfill gas pressure has increased resulting in some of the RCPs dislodging the dirt/rock used to plug them and now appear to be a conduit, i.e., preferential pathway, for odors caused by the SSE deeper in the landfill to escape. Based on the most recent abandonment plan provided by the facility owner, six of the RCPs have been identified as potential risks. The other five RCPs are not considered risks as they remain plugged and do not present problems for installation of the EVOH interim cap on the south quarry. See the attached Sheet Number 1 for RCP locations to be abandoned.

Summary of Risks

The largest identified risk to the public from the RCPs is from gas emissions migrating into the ambient air, i.e., odor generating compounds. The following monitoring/sampling has been completed at and in the area surrounding the landfill. The Department of Natural Resources, hereafter DNR, has requested the Department of Health and Senior Services, hereafter DHSS, to assist by evaluating data from air monitoring and sampling events and providing trigger criteria for issuing immediate public health recommendations/alerts.

Timeline: Construction Activity and Air Monitoring and Sampling Results

August 16 and 17, 2012 – Bridgeton completes a comprehensive air sampling with SWMP staff overseeing and evaluating the sampling process. An air sampling report was submitted on Oct. 21, 2012 for Bridgeton by their contractor.

January 14, 2013 – Bridgeton reported a leachate line broke resulting in an immediate increase in odors and associated complaints. Parts to repair the broken section of line took nearly a week and a half to obtain and for the complete repair to occur.

Beginning the week of January 21 and continuing through the week of March 8, 2013 — Installation of thirteen enhanced interceptor gas wells to minimize movement of subsurface heat and further address odor concerns. The interceptor plan results in a low pressure area vacuum curtain or "wall" that will allow landfill gas to be collected and then safely destructed in the current landfill gas collection and control system and reduces heat from the SSE.

February 2, 2013 – Continuous air monitoring begins for carbon monoxide, hydrogen sulfide, sulfur dioxide, total VOCs, and gamma radiation using DNR's AreaRAE® system. DNR begins use of continuous air monitoring equipment at 6 locations around Bridgeton to assess the air quality. The multisensor system is equipped for photoionization detection of volatile organic compounds (VOCs), hydrogen sulfide, carbon monoxide and gamma radiation. At the beginning of the sampling, DNR staff discovered a leachate release from a pipe becoming disconnected from the landfill's leachate collection system. Leachate samples were collected by DNR staff and by Republic's contractor for analysis to determine if further action is necessary.

DHSS reviewed the air quality screening data and found that gas concentrations did not exceed a level of concern for public health. DHSS also reviewed the gamma radiation readings detected by the DNR and collected samples from the air to provide additional details. The real time radiation sampling by DNR did not detect gamma radiation rates outside of normal levels. Laboratory analysis of the DHSS samples by two different laboratories confirmed no radioactivity was detected above normal background levels.

February 4 and 5, 2013 — DNR performed air sampling using SUMMA® canisters to identify odor constituents and levels of VOCs. Cartridges with sampling pumps were used to collect samples that were analyzed for aldehydes. Air samples downwind of the landfill were collected from 6 locations, including locations in a residential area.

DHSS reviewed the air sample data and the analysis found the analyzed gas concentrations did not exceed a level of concern for public health. Samples collected in a nearby residential area also showed no chemicals detected above a level of public health concern. One sample collected along the landfill property line did identify a short-term benzene concentration that was slightly above a conservative health-protective screening level for long-term (>1 year) residential exposure. This momentary sample result was two to three times less than health-protective screening levels for shorter term exposures. A significant decrease in landfill gas chemical concentrations was observed from the property line to the residential neighborhood, apparently due to dispersion of the landfill gases in ambient air.

February 15, 2013 – Republic Services notified the department that during installation of a gas extraction well, significant odors were created. DNR began receiving odor concerns from the public. DNR performed air sampling using SUMMA® canisters in response to heightened odors associated with the drilling of a new gas extraction well. The air samples collected included 2 downwind locations, one of which was near a residential area approximately 1,500 feet from the landfill. The third sample was collected from an upwind location.

DHSS reviewed the air sample data and concentrations of volatile organic compounds (VOCs) in the ambient air samples and found that the analyzed gas concentrations did not exceed a level of concern for public health. Only benzene in the sample collected near the landfill property line exceeded a health-based screening level for chronic (>1 year) exposure. A lower benzene concentration was detected at the sampling location near the residential area, but did not exceed the screening levels for chronic exposure. None of the detected VOCs exceeded health-based screening levels for acute (<14 days) or intermediate (2 weeks – 1 year) exposure.

Month of February 2013 – DNR collects continuous screening data. More than 5.5 million data records were collected.

March 11, 2013 – During the drilling of gas extraction well, or GEW 58, elevated odors resulted when a pocket of landfill gas and steam was encountered during the drilling operation. The department's AreaRas® air monitoring equipment continues collecting data related to odors.

March 13, 2013 – DNR collects SUMMA® canister air samples in the vicinity of Bridgeton Sanitary Landfill as elevated odors were generated during gas extraction well drilling activities.

DHSS specifically reviewed the concentrations of volatile organic compounds (VOCs) in this data. DHSS did not identify VOC concentrations of public health concern in the data from this sampling event. DHSS recommended continued air monitoring and sampling to identify any potential health risks of public exposure to landfill gases.

March 15, 2013 – During drilling of GEW 71B, elevated odors occur as a pocket of landfill gas and steam is encountered during the drilling operation. DNR's AreaRae equipment continues to collect data related to odors.

March 21, 2013 — During the drilling of GEW88, elevated odors result as a pocket of landfill gas and steam is encountered. DNR's AreaRae equipment continues to collect data related to odors.

March 23, 2013 — Odors elevate while Republic Services drill, GEW64A.

April 8-9, 2013 – Republic Services anticipates some increase in odors as they abandon the site planned for temperature monitoring probe #15. Republic Services was unable to complete installation of this temperature monitoring probe as the thermocouples could not be set due to pressure in this area of the waste mass.

April 9, 2013 – Republic Services reported that the five additional temperature monitoring probes are completed and will be monitoring temperatures within the waste mass within the neck between the south and north quarries. As noted above, temperature monitoring probe #15 was not installed.

Enhanced Air Sampling and Monitoring to Address Construction Odors

As a result of continued and increased levels of odors at and surrounding the facility, DNR determined a need to enhance the air monitoring and sampling being conducted at and near Bridgeton during the remaining construction activities to reduce odors and contain the SSE.

April 16, 2013 — A Comprehensive Sampling Event began on this date and completion has been postponed due to weather and construction delays. DNR's contractor conducts sampling and the laboratory analyzes 183 compounds from upwind, downwind, source gas and on-site locations. Two of the sampling locations will be close to the perimeter of the landfill, in order to evaluate emissions immediately upwind and downwind of the landfill. Additionally, DNR's contractor collects 8 samples for odor analysis by the St. Croix olfactory method (ASTM-E679). (Note: At least 1 more Comprehensive Sampling Event is planned during the next 3 months.)

April 19, 2013 — Daily Monitoring Events begin and will continue through completion of the interim cap on the south quarry. The DNR's contractor conducts air monitoring at a minimum of 12 locations using a hand-held hydrogen-sulfide detector, benzene detector and an odor detector. Sampling occurs around the perimeter of Bridgeton Sanitary Landfill at least 2 times per day and as needed, based upon community complaints received between the 2 daily cycles.

April 22, 2013 – Weekly Sampling Events begin and will continue through completion of the interim cap on the south quarry. Once per week, DNR's contractor conducts a 4 hour sampling of 2 upwind and 2 downwind locations outside the permitted boundary of the landfill. The event includes VOCs, reduced sulfur compounds and aldehydes.

Immediate Sampling Events — Exact locations determined by a triggering event and local weather conditions. Similar to weekly sampling events, DNR's contractor conducts a 4 hour sampling of 2 upwind and 2 downwind locations. The immediate sampling event provides data to evaluate differences in concentrations that occur due to an unexpected event at the permitted facility. These sampling events will include the same compounds as the weekly sampling events.

Summary of Options to Address RCPs (Assuming an Interim EVOH Cap will be installed)

Objectives of properly abandoning the RCPs are to reduce emissions, allow for installation of the EVOH interim cap and then maintaining the cap's integrity. The following options were considered in the review process and considered when making the final determination for the abandonment action.

Option 1	Take No Immediate Action to Properly Abandon the RCPs
Option 2	Install additional wells to capture odors near the RCPs (Repair the RCPs as they protrude
•	through the new interim cap).
Option 3	Remove rings one at a time on either a schedule or an as needed basis.
Option 4	Place soil on the area around and on top of the RCP.
Option 5	Excavate and grout-fill each RCP.
Option 6	Excavate and remove the top 4 rings of each RCP and install a collection system during
'	backfill.

Option 1 – Take no immediate action. Do nothing now to abandon the RCPs, place the new EVOH interim cap over the RCPs, as is, i.e., cover with flexible membrane liner. This option involves no construction resulting in displacement of decomposing waste. However, as settlement continues the RCPs will compromise the integrity of the EVOH cap by stretching the cap material around the RCP until it fails. The timing of a cap failure is unpredictable and will result in uncontrolled odor emissions of unknown quantity until resources can be mobilized for repairs. As currently planned, the EVOH interim cap design allows only for light duty vehicles, i.e., ATV sized vehicles, to travel on the access roads. Any attempt to abandon RCP's after cap installation is expected to result in damage to surrounding areas of the cap where heavy equipment is moved thereby allowing for increased odor emissions.

Option 2 – Add gas extraction wells near the RCPs to reduce odor emissions. This plan was originally attempted by the facility. When drilling gas extraction wells near the RCPs to capture odor and pressure emissions from the SSE, the drilling impacted both the integrity of the RCP structure and proved ineffective in reducing odor emissions. As stated in Option 1 above, the EVOH interim cap design allows

only for light duty vehicles to travel on the access roads and any later attempt to abandon RCP's is expected to result in damage to surrounding areas of the cap thereby allowing for increased odor emissions.

Option 3 - Partial abandonment by removing one 5' section of the RCP. By removing individual 5' sections as needed minimal construction activity occurs at one time. However, due to continued settlement of the landfill this activity will recur periodically as the RCPs resurface. This option has the same challenge as Option 1 as periodically the cap integrity will be impacted by the need to remove additional 5' sections of the RCPs. As in Option 1, the timing of a cap failure is unpredictable and will result in uncontrolled odor emissions of unknown quantity until resources can be mobilized for repairs. Furthermore, removing the rings 1 at a time will require multiple excavations and odor events prolonging the impact on the surrounding community. Once the EVOH interim cap is installed, any attempt to remove sections of the RCPs is expected to result in damage to the cap allowing for increased odor emissions.

Option 4 — Use additional soil to bury the RCPs in place. This option would not have some of the anticipated odors associated with other options. The areas of the landfill containing the RCPs would be continuously built up as the balance of the landfill settles causing the RCP areas to tower over the surrounding terrain, making future remediation more difficult and creating slope stability concerns. This option has the same challenge as Option 1, as the cap integrity will be impacted by surrounding settlement and in this case due to structural integrity concerns landfill personnel may hesitate to drive heavy equipment on top of the RCPs. Again, as in Option 1, the timing of a cap failure is unpredictable and will result in uncontrolled odor emissions of unknown quantity until resources can be mobilized for repairs.

Option 5 – Partial excavation to locate the top of the RCP, attempt to remove remaining plug and replace with grout material. This option involves some construction and displacement of an amount of decomposing waste. The possibility exists for increased odors during the excavation and leaving the RCPs in place will allow for damage or failure of the EVOH interim cap due to future settlement. Potentially all void areas within the RCP may not be sealed and continued odor emissions may result.

Option 6 – Partial excavation by removing up to 4 sections of the RCPs. This option involves some construction activity with displacement of decomposing waste which potentially may increase short-term odor emissions. The plan presented by the facility does expedite removal and disposal of any excavated waste similar to the method previously used for gas extraction well drilling. Future landfill settlement is accommodated by removal of multiple RCP sections, does not create a slope stability concern and allows for the integrity of the EVOH interim cap to be maintained. As part of the facility's plan, modified gas and leachate extraction pipes will be installed to allow for collection of odors and other emissions.

Proposed Final Remedy - Approved Plan

The approved plan is to excavate six of the RCPS. Each excavation of the RCPs is to a minimum diameter of 24 feet and a depth of up to 25 feet (depth necessary to remove up to four RCP rings). This will be completed with a track-hoe and the top sections of the RCP will be removed. Any excavated waste will be transferred offsite for proper disposal. The resulting hole will then be filled with varying grades of aggregate to allow gas collection and soils will be placed on top to seal the excavation. Modified gas and leachate extraction pipes will be installed on two sides of the RCP to manage the gases and liquids that may collect in the RCP. See attached Detail Number 1.

Republic anticipates it will take two weeks to complete the excavation of all the RCPs weather dependent. Each RCP is targeted for completion in one long work day. All excavated waste will be immediately placed in covered containers and taken to the on-site transfer station for proper disposal at an active landfill. If conditions require more than 12-hours for completion, the hole will be filled with clean soil overnight and work will resume the following day.

The goals listed by Republic for the abandonment program are:

- 1. Create a safe area in the vicinity of the abandoned vertical sumps (RCP's);
- 2. Reduce the likelihood of damaging differential settlement or protrusion of the RCP structure through the enhanced cap.
- 3. Reduce the ability of the RCPs to deliver gases and odors directly to the cover system at a level where collection would prove difficult.
- 4. Minimize odor releases during the abandonment process(es).
- 5. Provide an abandonment approach(es) that maintains worker safety.

Republic proposed Option 6 to remove the top rings from the 6 RCPs. The primary objective of the plan is to limit odor emissions and prevent damage to the EVOH interim cap for as long as possible. DNR reviewed, provided comments and approved the RCP Abandonment Plan as the best of the 6 options considered.

Prepared by:

Chris Nagel, Director

Solid Waste Management Program

Missouri Department of Natural Resources

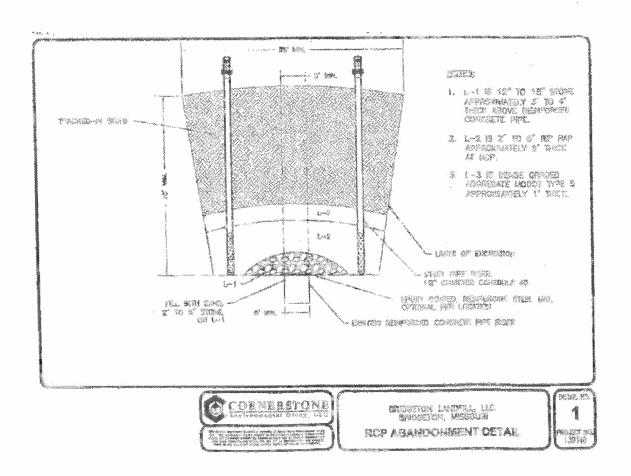
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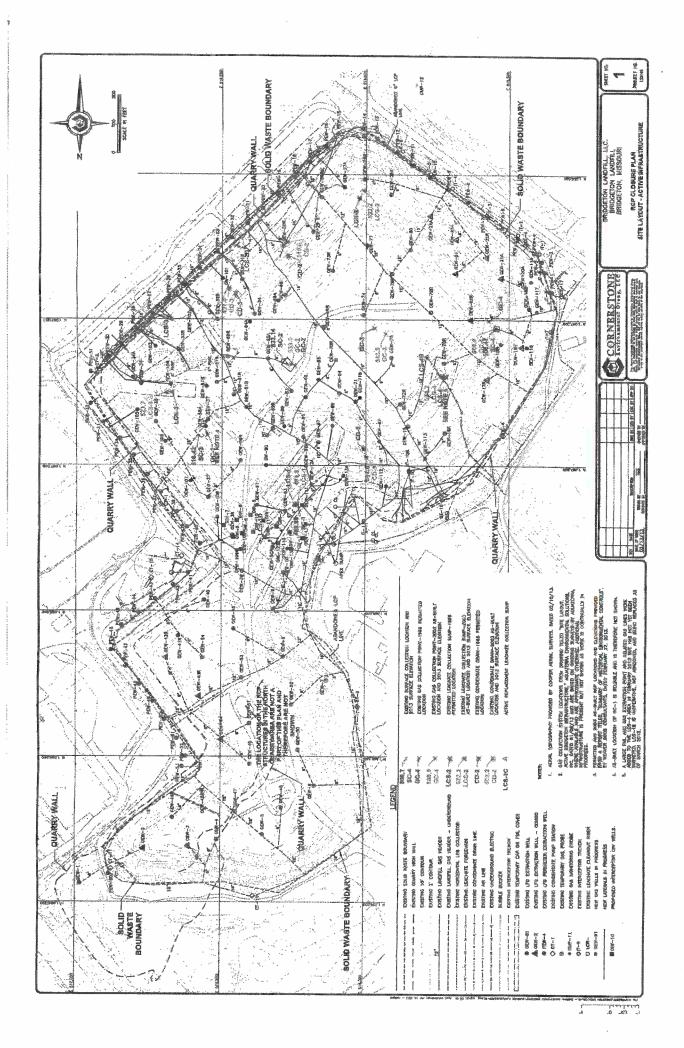
Jonathan D. Garoutte, Chief

Bureau of Environmental Epidemiology

Missouri Department of Health and Senior Services

Detail Number 1







Jeremiah W. (Jay) Nixon Governor

DATE:

May 10, 2013

TO:

Chris Nagel, Director

Solid Waste Management Program

Missouri Department of Natural Resources

FROM:

Jonathan Garoutte, Chief

Bureau of Environmental Epidemiology

Missouri Department of Health and Senior Services

SUBJECT:

Review of Remedy Evaluation for Abandonment of Reinforced Concrete

Pipes (RCPs).

The Missouri Department of Health and Senior Services (DHSS) has reviewed the Remedy Evaluation for Abandonment of Reinforced Concrete Pipes for Bridgeton Sanitary Landfill prepared by the Missouri Department of Natural Resources (DNR). Based on the options outlined and impacts presented by DNR, we concur that option 6 is the best option for protection of public health. Option 6 minimizes the potential for ongoing future releases by taking care of the RCPs now and not taking the risk that they will resurface later and need additional maintenance that would again release more landfill gasses. It also minimizes the potential for large events, such as a slope failure, that could release more significant amounts of landfill gases. Also, we have not seen chemical concentrations of public health concern for short term exposures during the significant well drilling work so far, and our understanding is that this RCP work may produce landfill gas emissions within a comparable range. Lastly, based on conversations with you and other DNR staff, option 6 may maximize the chance for the interim cap to actually bring the subsurface smoldering event to an end. So, the added time it will take for option 6 versus the other options seems outweighed by the benefits of reducing risk of future emissions and ongoing public exposure potential. For these reasons, again, I believe we concur with the choice of option 6.

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