MEMORANDUM
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To: Ms. Brenda Ardrey, CGFM
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From: Todd Thalhamer, P.E. and Timothy Stark, Ph.D., P.E., D.GE

Date: July 22, 2013

RE: Comments on the Draft Bridgeton Landfill North Quarry Contingency Plan – Part 1, Dated June 27, 2013

We have reviewed the Draft Bridgeton Landfill North Quarry Contingency Plan – Part 1 (Plan) submitted by Republic Services (Republic, 2013) for the Bridgeton Landfill near Bridgeton, Missouri. (Note: The First Agreed Order, Section 17 requires submission of work plans including a North Quarry Contingency Plan in 2 Parts to the Department of Natural Resources (DNR) by dates identified in Exhibit B that have been reviewed and signed by a professional engineer. The Draft Bridgeton Landfill North Quarry Contingency Plan – Part 1 does not meet the requirements of Section 17 of the Agreed Order.) This memorandum presents our initial comments and recommendations on the Draft Contingency Plan – Part 1. This review was completed in a short period of time to allow the Department of Natural Resources (DNR) to promptly address concerns and inadequacies in the submitted draft plan with the permitted facility. As a result of our limited review time, all potential issues and/or contingencies in relation to the subsurface smoldering event (SSE) have not have been examined and we reserve the right to modify our opinions and recommendations if new information, additional data, research, transcripts, or publications become available. The accuracy and the validity of the landfill data used in our review are assumed. Additionally, we have outlined why immediate action to correct inadequacies found in the submitted "draft" should be required of Bridgeton Landfill, LLC. Timeliness in completing the Contingency Planning process is essential given the proximity of this facility to residences and businesses within the Bridgeton community.

We understand that DNR is responsible for oversight and as such, must consider various options and comments provided by their staff, consultants and others prior to approving actions by the operator. The DNR has approved Republic Services' use of GIWs at Bridgeton Sanitary Landfill of GIWs in lieu of a physical barrier in the neck. As this GIW system has been implemented, this report references use of that GIW system and provides comments and as requested by DNR, our opinions on enhancements that could be made to that system as part of contingency planning.

The following preliminary opinions and recommendations are those of Stark Consultants, Inc., and Hammer Consulting Services and provided in our capacity as technical experts/advisors to DNR. These preliminary opinions and recommendations are based on our review of the relevant data and the recommendations provided below may or may not be acted upon by DNR. This memorandum to DNR was produced under a contract between the authors and DNR. The statements, recommendations, and conclusions contained in this memo report are not necessarily those of DNR or its employees.

Expectations of the Contingency Plan

In July 2012, DNR first directed Bridgeton Landfill to develop plans to proactively respond to the SSE. On May 13, 2013, the Bridgeton Landfill entered into an Agreed Order with the State of Missouri which states, in part, "If Bridgeton Landfill does not take actions required by this Agreed Order, then violations of environmental laws identified in the Petition are imminent."

Bridgeton Landfill is required to submit to the Department for review and approval a "North Quarry Contingency Plan" in two parts and upon approval, Bridgeton Landfill will be required to implement these plans according to certain triggers. Bridgeton Landfill's Contingency Plans Part I and II are expected to provide for collection of reliable data for use in determining if an agreed upon triggering event has occurred; once triggered, the response plan is adequate to protect the community from adverse health effects or harm to their environment; and the timeline provided for completion is reasonable and designed in a manner to ensure sufficient time for completion.

Given the potential negative outcomes from additional long-term exposure to odors and other landfill gas emissions from expansion of the SSE into the North Quarry or from the effects of the SSE upon the radiological material in West Lake Landfill, Operable Unit 1, Area 1, adequacy of the contingency plan should be evaluated by the impacts to:

1) Human health;
2) Community;
3) Environment; and
4) Facility.

A contingency plan of this magnitude should not only address potential negative impacts to the facility in determining the appropriate actions but the plan should consider community concerns as well. Based on recent Bridgeton community meetings by DNR and US EPA, the contingency plan should take into consideration the following objectives:

1.) Stopping any further movement of the SSE towards the North Quarry; and
2.) Installing an isolation break between the North Quarry and Operable Unit 1, Area 1, in such a manner as not to impact the toe of the North Quarry's slope or infringe into the radiologically contaminated area within Operable Unit 1, Area 1.

This contingency plan does not account for all these objectives. For example, placing a third trigger line half way through the North Quarry Area suggests that Bridgeton Landfill, LLC is willing to allow the SSE to enter into the North Quarry before any action occurs to contain the SSE or isolate the radiological unit from the SSE.

Background Information

Landfill Location:
The West Lake Landfill site is located in Bridgeton, Missouri. The site is listed on the U.S. Environmental Protection Agency's (EPA's), Superfund National Priorities List due to the disposal of radiological wastes at the site. The Bridgton Municipal Solid Waste (MSW) Landfill site sits within the West Lake Landfill site and is inactive and no longer accepting waste for disposal. The West Lake Landfill site has four distinct units:

- Operable Unit 1, Area 1
- Operable Unit 1, Area 2
- Bridgeton MSW Landfill
- Demolition Landfill

The U.S. EPA oversees the first two units. The Bridgeton MSW Landfill, owned by Bridgeton Landfill, LLC, whose parent company is Republic Services, Inc., is overseen by DNR. The Bridgeton MSW Landfill has two distinct areas known as the North and South Quarries which are separated by a narrow area referred to as the "neck". This neck area lies between and joins the two quarries.

Landfill Description:
The landfill site is a former limestone quarry and crushing operations began in 1939 and ended in 1988. The quarrying resulted in two quarries: North and South Quarries, which were excavated to a maximum depth of 240 feet below ground surface (bgs). The North and South quarries cover an area of approximately 52 acres. The waste is located in two distinct areas known as the North and South Quarries. Bridgeton was initially permitted on Nov. 18, 1985 and ceased accepting waste on December 31, 2004. The landfill stopped accepting waste to reduce the potential for birds and other wildlife from interfering with nearby airport operations at Lambert-St. Louis International Airport.

The total waste thickness before the SSE was approximately 320 feet which means about 80 feet of waste is above the ground surface and 240 feet is bgs. The landfill accepted approximately 17,000,000 in-place cubic yards of waste, including commercial, industrial, and municipal solid wastes.

Current Status of SSE:
During the past year the SSE has continued to expand within Bridgeton Landfill's South Quarry and is now at the southern end of the neck area. The Bridgeton Landfill is experiencing a significant smoldering fire that has the potential to cause severe environmental impacts to the community from the release of landfill gases and contaminated ground and surface water and damage to the landfill's infrastructure. The recent June 2013 data package indicates a general overdraw condition and the settlement continues to expand. The May/June data also allows for CO levels and temperature data to be compared and examined for trends. To date, the smoldering event continues to impact the environmental control systems and the community of Bridgeton.

To project the approximate location of both the heat and smoldering fronts, selected temperature and carbon monoxide data from TMPs, GIWs, and gas collection wells were analyzed.

Using temperatures above 165 ºF as the indicator of the heat front, the heat front has passed at least one of the farthest north Temperature Monitoring Probes (TMPs), TMP-1 to TMP-4. TMP data from May to June 2013 indicates the heat front is now at TMP-2 and impacting areas in the "neck" or narrow portion of the landfill. The heat front may also be impacting the North Quarry; however until additional TMPs are installed in the North Quarry and/or additional data is collected over time one can only estimate the location of the heat front.

As to the location of the smoldering front(s) with respect to the "neck" and North and South Quarries, the smoldering event appears to be contained in the South Quarry in between GIW-5 to GIW-6 and GIW-8 and GIW-10. Additional carbon monoxide (CO) data over time is required to determine the most probable location(s). We understand that Republic Services has agreed to provide carbon monoxide data in future months for the wells in the neck and North Quarry in addition to the information presently provided for gas extraction wells in the South Quarry. Figure 1 shows the approximate location of the heat front in the neck using TMP data from May to June 2013, while Figure 2 shows the approximate location of the smoldering event(s) based on the CO results from June 7, 2013. Both digital captures are from SCS Engineers, Well Layout Plan, dated January 10, 2013. To better understand the spatial complexity of these reactions, a cross section of the neck was prepared (Stark 2013). Figure 3 shows the approximate location of both the heat and smoldering fronts as it relates to the GIW and TMP systems as of April 2013.

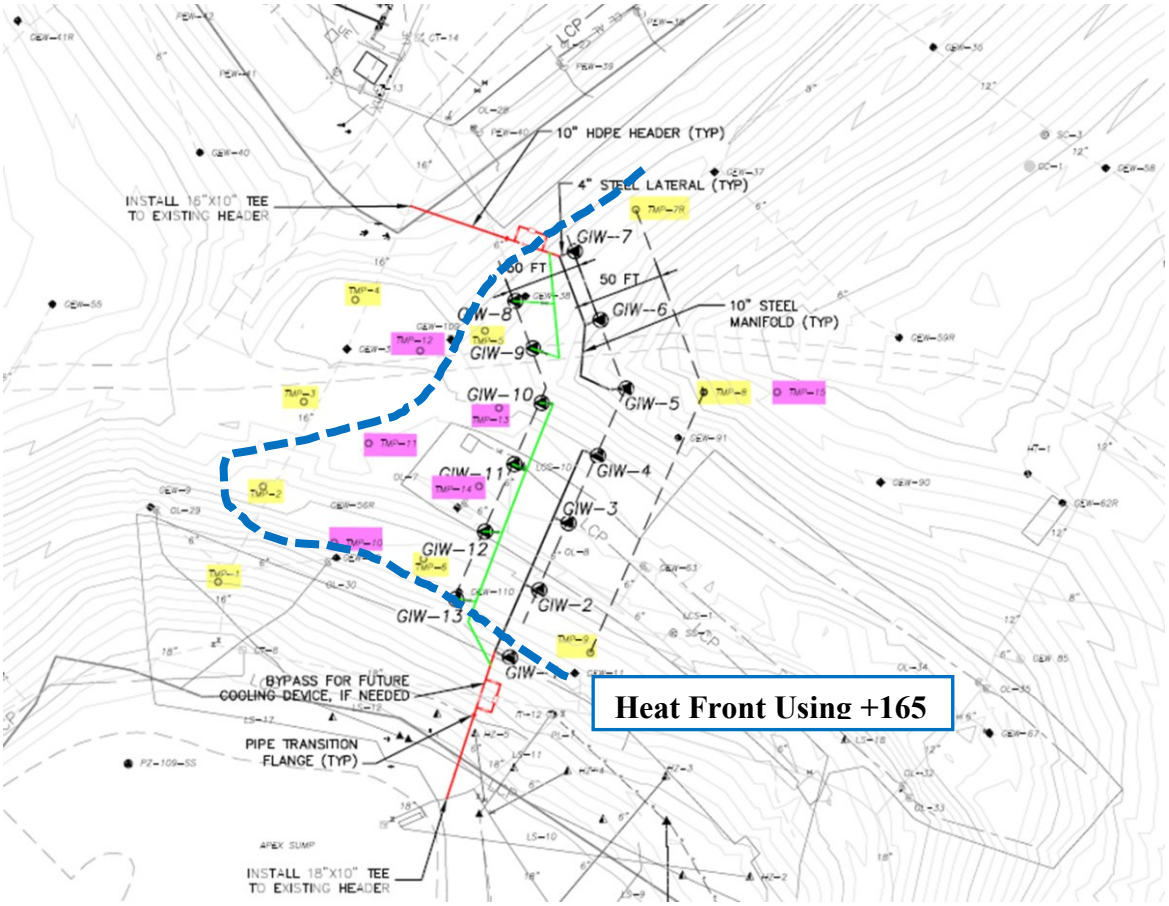

Figure 1. Approximate Location of Heat Front Based 165 ºF at the Bridgeton Landfill, MO (Map Source: SCS Engineers, 2012).

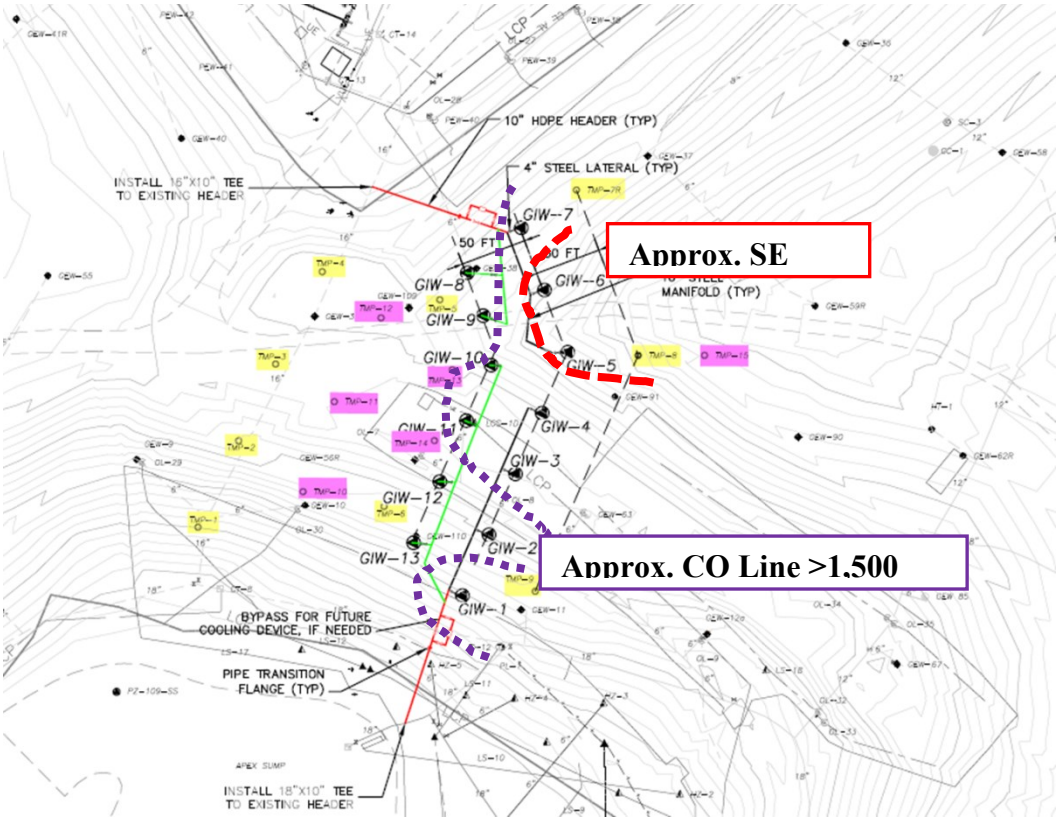

Figure 2. Approximate Area of the Smoldering Event (SE) and CO Line above 1,500 ppm at the Bridgeton Landfill, MO (Map Source: SCS Engineers, 2012).

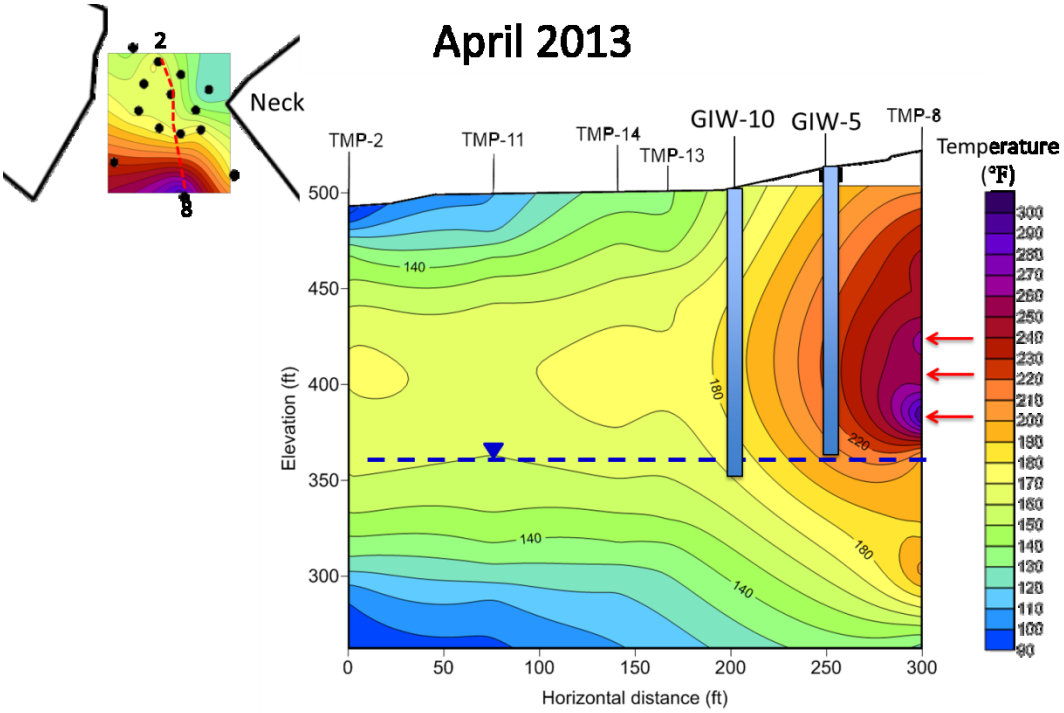

Figure 3. Cross Section of the Estimated Smoldering and Heating Events as of April 2013 at the Bridgeton Landfill, MO (Source: Stark, 2013).

General Discussion of the Contingency Plan:

The draft plan fails to provide options that prevent or mitigate the long-term impacts that would be felt by the community should the SSE pass through the neck and enter into the North Quarry. It is our opinion that all efforts to contain the SSE should be concentrated at or within the "neck" to prevent this event from triggering the construction of the isolation break at the West Lake Operable Unit 1, Area 1. As discussed in the Plan, the "neck" area is approximately 300 feet wide at the top and narrows as it approaches the bottom. Republic (2013) claims the specially designed gas extraction wells, known as Gas Interceptor Wells (GIWs), will stop the movement of heat and pressure and thus subsurface migration of the SSE to the North Quarry. However, we are not aware of any technical literature that shows this system has been used successfully to contain an SSE.

The US EPA aerial photographs from 1968, 1974, 1979, 1982, and 1985 shows rock crushing complexes and access roads located at and on the "neck" area between the North and South Quarries. Thus, the opportunity to isolate and contain this SSE in the South Quarry has its merits. The "neck" area is going to have a significant amount of inert material based on prior operations and this fact should continue to be taken advantage of in designing an isolation and containment plan. In addition, the width of the barrier system will be much smaller at the "neck" than in the North Quarry which will reduce construction time and cost. The operator should use a combination of available processes and the GIWs to ensure to the community that the SSE will not enter the North Quarry.

Second, if the objective is to minimize the odors and impacts to the community, then the Contingency Plan should be designed to contain and isolate the SSE to the South Quarry. If the primary objective is not to minimize the impacts to the community, then other conditions should be required to reduce the impact to the community.

For brevity's sake, the following statements and comments are based on each section.

Section 2.4 Progression of the SSE

The operator uses a rate of 0.58 to 1.35 feet over a one-month period to discuss the rate of migration of the SSE towards the North Quarry. We believe this rate refers to the vertical settlement rate and not horizontal migration rate. In addition, Republic (2013) states this rate is unreliable for a variety of reasons including:

> "Some of these variables are due to ground surface conditions (including events where soil material is added to, or cut away from, a monitored area) barometric pressure and/or pressure conditions in the landfill, etc. So, when determining rate of movement, it can be useful to look at several months of previous data to eliminate the month-to-month variables."

Should the SSE enter into the North Quarry, prior horizontal movement rates of up to 1.0 to 2.0 feet per day should be used as a conservative rate of spread to provide for a factor of safety for construction of the West Lake Landfill, Operable Unit 1, Area 1 isolation break. Prior SSE data has shown this reaction is capable of moving at these rates due to variability in waste, operating conditions, and subsurface configurations. For planning purposes, a scenario rate of 2.0 feet per

day should be used. It is important to note that the rate of SSE progression has slowed in the "neck" area due to the GIWs and/or the amount of inert material used to construct the access roads for the South Quarry, interim soil cover over the previously deposited waste in the North Quarry, and various rock crushing operations.

Section 3.0 Isolate, Contain, and Monitoring Features

Modern waste disposal systems and barriers are designed to "isolate" subsurface contaminants and are engineered to provide safe long-term "containment" of municipal solid waste, other nonhazardous solid and liquid waste (e.g., industrial waste), hazardous and toxic wastes, and low-level radioactive waste. In short, the goal in environmental public health projects is to "isolate and contain" the event so the impact to the environment and public is minimized. This policy was implemented at the Republic Services Waste facility in Ohio where an "isolation break" was installed to prevent the SSE from migrating from the original 88 acres to the lateral expansion to the north. This isolation break involved excavation of a significant amount of waste to create a gap between the 88 acres and the lateral expansion.

A similar situation exists between the North and South Quarries at Bridgeton MSW Landfill. In particular, the South Quarry is analogous to the original 88 acres and the North Quarry is analogous to the lateral expansion. Therefore, the SSE should be isolated to and contained in the South Quarry to protect the environment and public as was done by Republic Services in Ohio in 2009. Republic Services of in Ohio was able to successfully complete an isolation break in record time and thus prevented the SSE/reaction from entering other landfill cells. The isolation wall between the two waste areas and subsequence engineered cover over the entire landfill was credited in significantly reducing the impacts to the community from landfill gasses and odors. Based upon our review, only an injection system at the neck is feasible due to the location of the SSE and required construction timelines. The injection system should be based on a cryogenic gas, firefighting foam, or precooled liquid (Note: Depending on the circumstances all three methods may be used at the same time) and used in combination with the enhancement to the containment system (i.e., enhanced GIW line).

Section 3.1.1 Existing Isolation Features:

Republic Services in accordance with their approved "Gas Interceptor Well Expanded Design (Permit #0118912) at Bridgeton Landfill, Bridgeton, Missouri" plan has installed a system of 13 gas interceptor wells (GIWs) to stop the movement of heat and disrupt the migration of the SSE through the neck. These additional special purpose, GIWs were installed in two rows. The first row of GIWs was installed approximately 50 feet north of the first line of temperature monitoring probes (TMPs 7R, 8, and 9) in the southern area of the neck. The second row of GIWs was installed 50 feet north of the first row of GIWs, and staggered in between the first row of GIWs. In addition to the GIWs, six additional TMPs were installed. The well spacing design was stated to provide a heavy vacuum overlap from well to well. This design was used to create a low pressure zone or "wall" that would act as a vacuum curtain and allow heated and pressurized gas to be collected and safely destroyed in the current gas collection and control system (GCCS).

Should these GIWs fail to isolate the SSE as presented or the SSE does not significantly slow due to the presence of inert material based on prior operations in this area of the landfill, the SSE may advance into the North Quarry unless additional control methods are implemented. At that point, operational objectives must shift from controlling the odors and air emissions to the potential for impacts from the SSE on the radiological material contained in West Lake Landfill, Operable Unit 1, Area 1.

The operator states heat and pressure removal via the GIWs will isolate the SSE to the South Quarry; however, there is no technical literature that supports the referenced GIWs has stopped a SSE or that the GIWs will be successful in disrupting the subsurface migration of an SSE. Only the use of additional soil cover and the injection of inert gas have been documented in professional literature to remove heat from a SSE (Thalhamer, 2013).

Section 3.1.2 Additional Isolation Options

The operator states there are no reported uses of inert gas in landfills other than fires that are shallow and isolated in nature and there is no evidence that such injections could enter the waste mass at the depth of this SSE due to the high density of the waste material and pressure. We disagree with these statements and are currently seeking professional expertise in this industry. A cryogenic plan is currently under development and we will forward the plan to DNR once the plan is completed.

Republic (2013) dismisses inert gas injection because it believes the radius of influence of inert gas is low. This is a paradoxical situation for Republic (2013) because if the radius of influence of injection is small, the radius of the extraction by the GIWs is also small. While the radius of influence of inert gas may be limited due to the specified waste parameters, one could add a factor of safety for the reduced effectiveness by spacing the injection wells closer together and increasing the overall number of injection wells. The operator also states the preferred method for suppression is not injection. This is true, the preferred method for SSE suppression is the addition of soil cover and reduction of air intrusion. While the injection of inert gases for the suppression of a SSE is questionable at best, the injection of inert gases, in this case, would be for containment which has been shown to be successful at the Berry Street Mall Landfill Fire in 1992 and the Kona Landfill Fire in early 2000.

Using the same applied engineering principles as stated by the operator for their experimental GIWs, the system is expected to pull inert gas and heat from the high density waste material as well as pressure. In other words, then the GIWs could be used to accomplish either or both tasks – removal of heat and injection of inert gas.

Physical Barriers:
The operator indicates that a physical barrier at the neck area between the South and North Quarry areas, at depths of 250 feet for a full barrier, is extremely problematic and is not being considered for further development. However, the operator indicates a physical barrier between the North Quarry and West Lake Landfill, Operating Unit, Area 1 where waste may be about 40 feet thick may be feasible. While the constructability of the 40 foot barrier is obviously preferred, the operator fails to examine the possibility of a hybrid physical barrier that could use the high leachate level in the landfill along with removing 25 to 30 feet of waste in the neck to

create an operational bench for a vertical barrier. However, after further examining the location of the SSE in comparison to the vertical barrier and construction timelines, we do not believe this option is viable.

Section 3.3 Monitoring Features and Section 3.4 Contingent Monitoring Features

The current monitoring features described by the operator are operational minimums that would be expected of any facility experiencing an SSE. Mapping of landfill surface settlement is not considered a monitoring feature for tracking or locating the active heat or smoldering front, but rather defines where the event has previously consumed waste.

The following measures should be implemented to enhance the monitoring of the SSE at the neck area:

- At a minimum, the addition of two temperature monitoring probes (i.e., 1 to the east and 1 to the west) in the neck area where a data gap exists and an additional line of sentry temperature monitoring probes at the northern end of the neck area approximately 50 feet from the existing line of TMP-1, TMP-2, TMP-3, and TMP-4;
- At a minimum, monthly CO monitoring of wells in the neck and North Quarry or the addition of new CO monitoring probes in the neck.
- Evaluate the gas collection and control system components in the North Quarry to determine if the system is currently adequate;
- Adjust the gas collection and control system to:
  - Prevent oxygen concentration for all interior gas extraction wells from exceeding 1%;
  - Keep the oxygen concentrations in the waste mass below 1% and optimally below 0.5% for an interior gas extraction well in excess of 180°F;
  - Prevent all wells in the North Quarry from exceeding 1%;
  - Keep "overdraw" conditions to a minimum. While landfill odors can be a driving factor in increasing the vacuum on a gas collection system, the operator should examine the design and operation of the gas collection system first. Excessive oxygen concentrations in the interior waste prisms should be avoided
- North Quarry Monitoring --- Perform daily, visual assessments for settlement, depression and/or soil cracks.

Section 4.0 Evaluation of Potential Trigger Criteria

It appears the operator is not clear on the purpose of the Contingency Plan. Section 4 opens with "The intent of trigger criteria is to identify where the SSE is occurring and the rate at which it is advancing toward a pre-agreed location in order to evaluate the appropriateness and best timing for contingent isolation, containment, and monitoring features. Properly established and utilized, such triggers should allow Bridgeton Landfill to determine when an additional mitigation measure should be completed to prevent adverse impacts (further movement of the SSE, odor, and fugitive emissions) from developing in the North Quarry, and to prevent the SSE from ever being able to affect waste contained in the West Lake OU-1, Area 1." The purpose of the Contingency Plan is to provide an implementation plan(s) so when a triggering event occurs the previously agreed upon actions are immediately implemented by the operator.

Section 4.2 Potential Trigger Parameters

The operator states in the trigger parameters table that carbon monoxide (CO) results should be obtained monthly or quarterly and that results would then take three weeks to obtain after a decision to sample is made. CO is a key trigger parameter for identifying the location of the SSE.

Obtaining laboratory results on an expedited schedule is a direct factor of cost. Preliminary CO results can be obtained on a "rush" basis (i.e., within 24 to 48 hours) after submittal to a certified laboratory. Potential trigger parameters should not be eliminated simply based on additional sampling costs.

Carbon monoxide readings should be obtained from GEWs, GIWs and other monitors in the neck area and North Quarry on at least a monthly basis for tracking movement of the SSE and monitoring of the GIWs. Weekly readings may become necessary depending on temperatures and results of the monthly carbon monoxide sampling. Additionally, carbon monoxide readings should continue being taken in the South Quarry due to health and safety concerns for workers at the site and emergency responders. Table 1 is provided to demonstrate the site safety issues from temperatures and CO that should be available to site personnel.

Table 1. 2013 Evaluated CO and Temperature Data for the Bridgeton Landfill.

Well Name	Date Sampled	Hydrogen	Temp	Carbon Monoxide
		%	° F	(ppm)
GEW-11	5/14/2013	25	180	3,000
GEW-26R	5/14/2013	22	185	3,200
GEW-32R	3/5/2013	33	192	4,100
GEW-57R	5/14/2013	32	192	3,100
GEW-58	3/5/2013	34	184	2,900
GEW-60R	5/14/2013	31	196	3,100
GEW-62R	5/14/2013	28	180	2,300
GEW-63	5/14/2013	26	196	4,800
GEW-64	5/15/2013	29	196	4,500
GEW-66	5/14/2013	30	198	5,400
GEW-71	5/14/2013	27	182	5,200
GEW-72R	1/22/2013	13	-	1,800
GEW-74	3/5/2013	28	-	6,400
GEW-75	1/24/2013	18	-	4,200
GEW-76R	3/5/2013	25	-	6,500
GEW-79R	12/5/2012	23	-	6,700
GEW-82R	5/14/2013	24	180	3,200
GEW-85	5/14/2013	33	188	3,300
GEW-90	5/14/2013	32	196	2,800
GEW-91	5/14/2013	21	194	4,500
LCS-4B	2/13/2013	8.2	-	3,500

Section 4.3 Evaluation of Potential Trigger Parameters

Section 4.3.1 Point Measurements

As noted in Section 3.3 and 3.4 above, at a minimum, two additional temperature monitoring probes (i.e., 1 to the east and 1 to the west) in the neck area should be installed immediately. Currently, there is a gap along the landfill's perimeter and TMP-1 and TMP-4 that could allow the SSE to pass through to the North Quarry without being noticed in a timely matter. Also, an additional line of sentry temperature monitoring probes at the northern end of the neck area should be installed approximately 50 feet from the existing line of TMP-1, TMP-2, TMP-3, and TMP-4.

Section 4.3.2 Non-Point Measurements

The operator states that CO can be less helpful to confirm the location of an SSE. The use of CO has been established by industry and the regulated community for years to confirm the location of an SSE because it indicates combustion. While one set of data may not indicate the exact location or determine if the SSE is advancing or declining, plotting the data over time and establishing trend lines can show the location and indicate direction of the SSE. CO should be used to locate the SSE and determine the migration rate.

Section 4.3.2 Settlement Front Data

Using vertical settlement as a measure of the location of the heat front is like using the blackened area of a wildfire to locate the fire. Settlement data can be accurate but it is a post indicator of the SSE and not all SSEs indicate settlement rates of 0.58 to 1.35 per month vertically as discussed above. Some SSEs do not even show settlement due to the type of waste, compaction, and/or non-combustible materials creating "bridging" effects. In addition, fingers, fissures and other localized smoldering fronts may never show settlement depending on the properties of the waste, the overlying materials, and/or the size of the localized front.

Section 4.4 Selection of Trigger Parameters

The operator uses TMP maximum temperature above 220°F, settlement movement of 1.35 feet per month, and a combination of wellhead temperature greater than 170°F and laboratory CO above 3,000 ppm for trigger parameters. None of these parameters are supported by the published literature on SSEs. It is uncertain as to why the operator selected a temperature of 220°F and CO of 3,000 ppm. These are not conservative values and do not include a factor of safety. In other words, these two values are so high that they are not indicators of the onset of combustion but are confirmation that significant combustion is occurring. Trigger values should be low to indicate possible combustion so potential remedial measures can be implemented especially given the urban location of this facility. The trigger parameters that we recommend for identifying the SSE front, i.e., indication of combustion, are presented below.

Section 4.4 Selection of Trigger Parameters:

The use of the first trigger line (i.e., an arc connecting TMP-6, -14, -13, 5) could be used for the installation of the additional GIWs and inert gas injection wells. This is the only parameter we would use to prevent the SSE from entering the North Quarry. If the operator is confident in the GIWs and the data continues to show the SSE between the first two rows of GIWs then the operator should support the previously proposed triggers (Thalhamer, 2013). The following

Table 2 shows the proposed Sentry Criteria for the construction of an isolation break in the "neck" area of the Bridgeton MSW Landfill, Missouri.

Table 2. Proposed Sentry Criteria [1, 2] **Bridgeton Sanitary Landfill, North Quarry Isolation Break**

Indicator	Volume or/and Temperature	Isolation Break Required	Parameters
Carbon Monoxide (CO)			
CO levels in any gas extraction well or sentry monitoring well in the North Quarry.	>1,500 ppm	YES	CO result shall be repeatable and re-measured within 8 hours of receipt of the data. CO measurements shall be based on laboratory analysis and not field equipment. DNR and the fire authority shall be notified within 48 hours. Should any result exceed 1,500 ppm CO, the isolation break shall be constructed.
CO levels in two or more gas extraction wells and/or sentry monitoring well in the North Quarry.	>1,000 ppm	YES	Re-measure the initial CO result over 1,000 ppm within five days of receipt of the data. CO results greater than 1,000 ppm, but less than 1,500 ppm shall be re-measured 4 times for 4 weeks. DNR and the fire authority shall be notified within 5 days. Should all the retest exceed 1,000 ppm CO, the isolation break shall be constructed.
CO levels in any gas extraction well or sentry monitoring well in the North Quarry.	<1,000 ppm	No	No additional actions required. Continue monitoring per the First Agreed Order (Case No. 13SL-CC01088).
Temperature (°F)			
Any reportable temperature in a ***TMP*** at the sentry line[3] or in the North Quarry.	>200°F	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 200°F in a TMP, the isolation break shall be constructed.
Any reportable temperature in a ***gas well*** located within the North Quarry.	>180°F	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 180°F in a gas well, the isolation break shall be constructed.
Combination of CO + °F			
Any reportable temperature in a ***TMP*** or ***gas well*** at or past the sentry line exceeding 195°F and any gas well in the North Quarry exceeding 1,500 ppm CO.	>195°F + >1,500 ppm	YES	Temperature result shall be repeatable within 8 hours. DNR and the fire authority shall be notified within 48 hours. Should any temperature exceed 195°F in a gas well in the North Quarry and CO is detected above 1,500 ppm at the sentry line or North Quarry, the isolation break shall be constructed.
Any reportable temperature in a ***TMP*** less than 195°F or ***gas well*** located within the North Quarry or sentry line with CO less than 1,000 ppm.	<195°F + <1,500 ppm	No	Temperature(s) shall be collected weekly. Continue monitoring per the First Agreed Order (Case No. 13SL-CC01088).

[1] These criteria are in addition to the First Agreed Order of Preliminary Injunction (Case No. 13SL-CC01088) between the State of Missouri and the Bridgeton Sanitary Landfill, LLC.
[2] The temperature and CO levels for this matrix are for the establishment of a trigger value and not for the confirmation of a smoldering event.
[3] The sentry line for this matrix is currently defined as TMP-1 through TMP-4 on the Well Layout Plan by SCS Engineers, date 1/10/2013.

Section 5.0 Contingent Future Actions Determined by Triggers

Trigger Line 1 – Install Additional GIWs, TMPs, and North Quarry Phase 1 Cap and Enhanced GCCS

- Additional TMPs and GEWs as detailed in Section 3.3 need to be installed immediately.
- An evaluation of the adequacy of the North Quarry's GCCS needs to begin immediately and expansion implemented, if needed, to avoid future overdrawing of the system.
- To ease community concern of the SSE moving through the neck and into the North Quarry, the third line of GIWs and injection wells need to be installed when one of the triggering parameters as set out in Table 2 occurs in the first trigger line (i.e., an arc connecting TMP-6, -14, -13, 5) as detailed in Section 4.4 above.
- The heating event appears to have already passed through the neck to avoid community impacts the North Quarry cap should be installed.

Trigger Line 2 – Install North Quarry Phase 2 Cap and Enhanced GCCS

- The use of the 2nd trigger line for installation of the North Quarry Phase 2 Cap and further GCCS enhancement is not acceptable as it is likely the community would already be impacted by landfill emissions.

Trigger Line 3 – Construct Isolation Barrier

- Lastly, the use of the 3rd trigger line GIWs is not acceptable because it is located in the North Quarry. Being located in the North Quarry, this trigger line does not allow for enough time to construct the isolation barrier if the timelines proposed by Republic (2013) are used.

Section 5.2 Other Trigger Criteria:

The discussion presented in this section of the Contingency Plan is concerning. The operator is suggesting that the North Quarry may experience, has experienced, or is experiencing a SSE independently of the event in the South Quarry. If this is the case, then the isolation of the radiological unit should commence immediately. One should not risk the possibility of an independent reaction from occurring in the North Quarry and impacting the radioactive waste. If the isolation break is not constructed then the trigger criteria should be lowered to 1,000 ppm of CO.

Summary:

This section presents a list of some of our preliminary observations of and concerns with the June 27, 2013, Contingency Plan as proposed by Republic (2013). With our limited review time, the following comments are presented:

1. Community impacts must be accounted for in this Contingency Plan.

2. The SSE should be isolated and contained in the "neck" portion of the Bridgeton Landfill.

3. One cannot assume a SSE reaction in the North Quarry will be similar to the SSE as it progressed through the South Quarry. We are not aware of any analysis indicating the waste streams in the two quarries are similar. Therefore, we fundamentally disagree with

the Contingency Plan using any part of the North Quarry as trigger criteria. The North Quarry should not be allowed to be used as a trigger for the construction of the radiological isolation break due to the compressed construction timelines. In addition, the community expects not to be exposed to a SSE in the North Quarry. It is not rational for the operator to expect the community to accept a trigger line approximately half way through the North Quarry that results in the community being exposed to additional long-term emissions from the landfill.

4. The vertical settlement rate of 0.58 to 1.35 feet per month does not accurately predict the location of the SSE and temperature fronts. The vertical settlement is the last indicator of an SSE and may never manifest itself. As a result, the vertical settlement front is always behind the temperature front and the SSE.

5. The GIWs are experimental and additional safe guards should be in place to ensure the SSE remains in the South Quarry.

6. The use of temperatures above 220°F and CO above 3,000 ppm are not supported in technical literature. These two values are so high that they are not indicators of the onset of combustion but are confirmation of substantial combustion. Trigger values should be lower (See Table 2) to allow the appropriate amount of time to implement remedial measures. The proposed temperature and CO criteria are too high and do not include a factor of safety.

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