WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

INTERIM REMEDIAL ACTION REPORT
PHASES 1 & 2
RAMCO ALUMINUM WASTE DISPOSAL SITE
PORT OF KLICKITAT INDUSTRIAL PARK
DALLESPORT, WASHINGTON

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Prepared by:

Robert D. Swackhamer 6/4/08

Robert D. Swackhamer, PE
Toxics Cleanup Program
State of Washington
Department of Ecology

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1.0 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

The purpose of this report is to document construction of the first two phases of an interim remedial action and to express an opinion as to whether the interim remedial action has been constructed in substantial compliance with plans and specifications and related documents.

1.2 SUMMARY OF INTERIM CLEANUP ACTION

James Dean Construction Inc., a contractor hired by the State of Washington Department of Ecology, excavated just over 49,000 tons of aluminum waste and associated material, treated it, and hauled it to Wasco County Landfill for disposal. Treatment prior to hauling consisted of screening or crushing, followed by aeration (storage in piles open to the air) for periods of time ranging from less than one hour to more than seven days. The work was conducted in two phases. Phase 1 hauling occurred February 22, 2007, through April 17, 2007. Phase 2 hauling occurred January 3, 2008, through February 7, 2008. These are the periods when transport to the landfill occurred. Mobilization and demobilization of equipment occurred before and after these dates. About 20,000 tons of aluminum waste and associated soil at the site remains to be transported to the landfill during Phase 3.

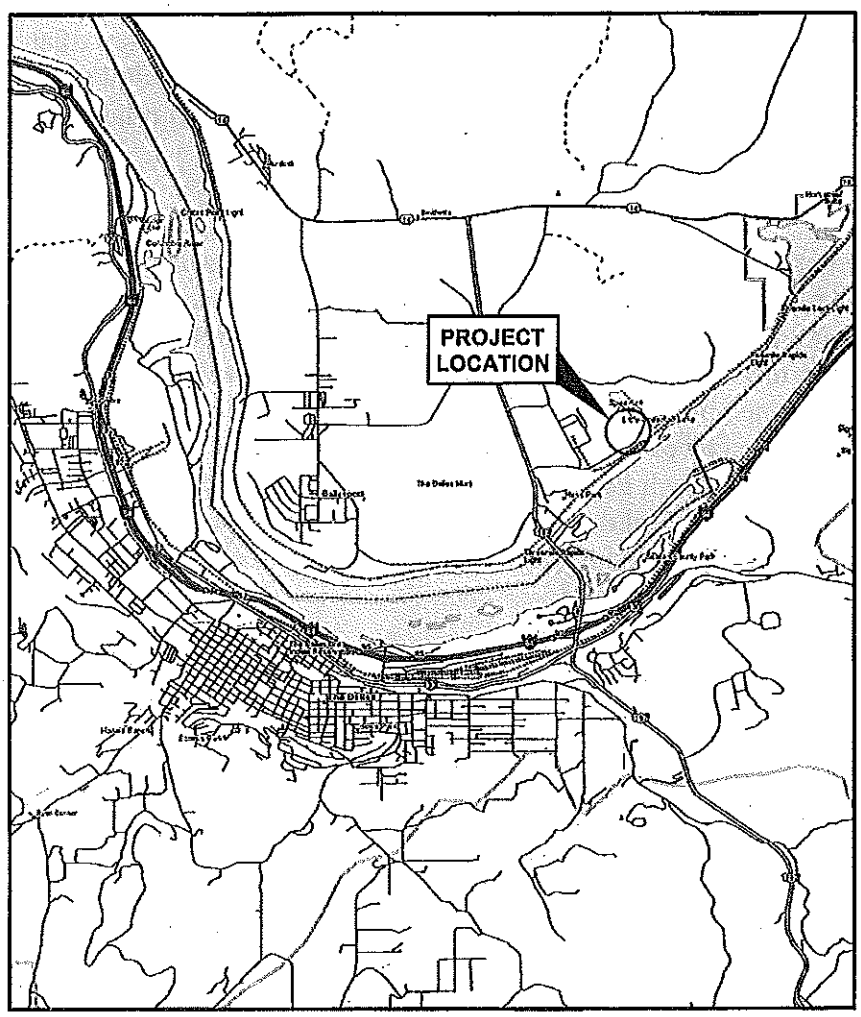
1.3 COMPLIANCE WITH PLANS AND SPECIFICATIONS

The interim remedial action has been conducted in substantial compliance with plans and specifications and related documents, notwithstanding deviations described in this report from such plans, specifications, and documents.

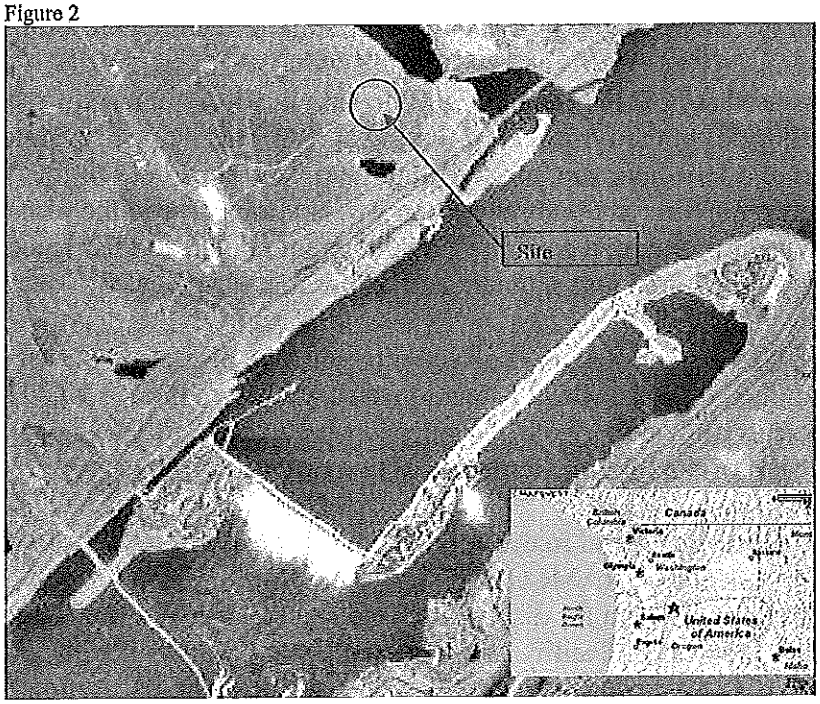
The principal pre-construction documents are "Interim Remedial Action Plan, RAMCO Aluminum Waste Disposal Site, Port of Klickitat Industrial Park, Dallesport, Washington," issued by Ecology October 9, 2006, (hereinafter called the "Plan") and "Specification for Excavation, Transport & Disposal of Aluminum Waste from RAMCO Site Dallesport Industrial Park," issued by Ecology December 18, 2006, and expanded upon by Addendum #1 issued by Ecology January 3, 2007 (together referred to as the "Specification" in this report.)

Deviations of note include the fact that the 49,000 tons transported thus far plus the estimated 20,000 tons remaining exceeds the estimate of 52,000 tons contained in the Specification, the fact that some material sent to the landfill contained pieces larger than described in the Specification, and the fact that the Wasco County Landfill was not one of two landfills mentioned as possible destinations for the waste in the Plan.

2.0 SITE DESCRIPTION



PROJECT LOCATION
Figure 2



Recycled Aluminum Metals Company Site, 45.6256N 121.1309W.

2.1 BACKGROUND

Recycled Aluminum Metals Company[1] (RAMCO or RAMCo) occupied a building located within the Port of Klickitat Industrial Park, where it extracted aluminum from dross it received from primary aluminum smelters in the Pacific Northwest. Dross is a by-product from the primary smelting process. However, it still contains aluminum in recoverable amounts.

The extraction process used at RAMCO consisted of heating the dross in a gas-fired furnace, and adding salt (sodium chloride) to the furnace as a fluxing agent. This helped separate out the aluminum. At the end of a four-hour run, molten aluminum was tapped out of the furnace into ingots. The molten salt remaining in the furnace then was skimmed out of the furnace either into metal molds or onto a bed of sand on a concrete floor, where it cooled and hardened. The salt cake was then a waste that required management and disposal.

From approximately 1982 to 1989, RAMCO placed this salt cake plus a smaller amount of baghouse dust in an unlined disposal site at a location separated from the RAMCO building by about ½ mile, near the eastern boundary of the Dallesport Industrial Park. Excavating this disposal site was the heart of the Interim Remedial Action described in this report.

After RAMCO ceased placing material in the unlined landfill in approximately 1989, there was a period when aluminum waste from RAMCO was sent to the North Wasco County Landfill across the Columbia River in Oregon for disposal. (Note: The North Wasco County Landfill, as it was called at the time, is the same facility as the Wasco County Landfill, which again became the destination for RAMCO waste during the 2007-2008 Interim Remedial Action.) In approximately 1991, RAMCO stopped shipping the waste off-site and began stockpiling it on Port of Klickitat property adjacent to the building leased by RAMCO.

RAMCO ceased operations in the Dallesport Industrial Park, and therefore ceased producing waste, in approximately 1993. This left the Port of Klickitat with a large open stockpile of aluminum waste on one part of its property, as well as the aluminum waste that had been buried in the disposal site on another part of its property.

Ecology and the Port of Klickitat pursued and obtained funding from the financially struggling RAMCO to deal with the open stockpile of waste. By 1995, the approximately 21,433 tons of waste in the open stockpile had been transported to Roosevelt Regional Landfill for disposal. Roosevelt Regional Landfill is located in eastern Klickitat County, Washington, about 60 miles, east of the Dallesport Industrial Park. The waste was allowed to go to Roosevelt Regional Landfill after a petition filed by RAMCO to exempt the waste from the Dangerous Waste regulation was granted by the Department of Ecology.

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[1]Recycled Aluminum Metals Company was a subsidiary of Robert A. Barnes, Inc. In some records, particularly prior to 1988, the company is called "R. A. Barnes."

Erratum: The Plan incorrectly stated that this material went to Roosevelt Regional Landfill after crushing and aeration, a form of "Treatment by Generator" under Dangerous Waste regulations and policy in effect at the time, rendered the material acceptable for disposal at Roosevelt Regional Landfill. While that course of action was proposed and testing was done to support it, the transport of the RAMCO material to Roosevelt Regional Landfill in the early 1990's actually was authorized by an exemption from the rule as stated in the previous paragraph.

The RAMCO pyrometallurgical equipment was sold to Imsamet Acquisition Corporation and removed from the Dallesport Industrial Park. The aluminum waste that had been buried in the unlined disposal site from 1982 to 1989 remained there until removal began with the 2007-2008 Interim Action described by this report.

2.2 SITE CONDITIONS PRIOR TO ACTION

The Dallesport Industrial Park, owned and operated by the Port of Klickitat, is located immediately east of Washington State Highway 197 and approximately two miles east of the small community of Dallesport, Washington. Across the Columbia River from the Dallesport Industrial Park is the city of The Dalles, Oregon, with a population of 12,250 in 2002. Spanning the Columbia River since 1957 between Dallesport Industrial Park and the city of The Dalles is The Dalles Dam, operated by the US Army Corps of Engineers.

The unlined disposal site, the target of the interim remedial action described here, was located about 400 feet southwest of Spearfish Lake, about 500 feet north of a pond known as Joe's Lake, and about 1000 feet north of Lake Celilo, the name of the portion of the Columbia River that is impounded behind The Dalles Dam. On average, the area receives approximately 14 inches of precipitation per year. Groundwater in the area is approximately 60 to 80 feet below ground surface level.

The disposal site covered approximately 1.5 acres, with the waste being approximately 30 feet deep at its deepest point. The disposal site sat in a small bowl, underlain and surrounded on almost three sides by Columbia River Basalt outcrop of The Dalles Formation, Miocene Epoch. See Figure 1 and Figure 2 for the project location. See Appendix A for photographs of the site before and after the interim remedial action.

Fractured basalt underlying and surrounding the site may be present. However, different conclusions have been reached by different parties regarding this point. At the time the disposal site was proposed in 1982, an engineering report concluded from six holes drilled to depths of approximately 23 feet that there was a solid rock basalt layer a minimum of 10 feet thick below the bottom of the proposed waste site and a minimum of 20 feet surrounding the perimeter, with

no detectable fissures, flaws or fractures within the rock[2]. However, Ecology staff drilling logs for several wells drilled adjacent to the disposal site in 2005 report fractured basalt at depths as shallow as 4 feet in one well, 7 feet in a second well, 14 feet in a third well, 32 feet in a fourth well, and 34 feet in a fifth well. Additionally, elevated levels of salts measured in groundwater appeared to support the view that some pathways from the disposal site to groundwater, such as fractures, did exist.

In June and July of 2005, the Washington Department of Ecology oversaw the installation of five groundwater monitoring wells onsite, adjacent to the landfill, to determine the depth to groundwater and the impacts the landfill may be having on the groundwater in the area. Nitrates, sodium, chloride, and total dissolved solids in groundwater have been measured at levels exceeding primary or secondary water quality standards. Because major salt-forming chemical elements (sodium, calcium, potassium) measured during groundwater sampling exceeded levels of these elements found in seawater, there was a strong indication that salts from the landfill were leaching into groundwater.

Leaching tests performed to determine whether the waste is a Dangerous Waste indicate that metals also could leach from the aluminum waste. However, groundwater monitoring thus far has not shown elevated levels of metals attributable to leaching from the disposal site.

In April 2006, Ecology oversaw additional sampling of the aluminum waste in the landfill using a geoprobe. Geoprobe is a brand of hydraulically powered machines using the direct push technique to obtain soil samples. Direct push means pushing tools and samplers into the ground rather than having to drill to remove soil or make a path. Essentially the weight of the geoprobe machine is used as a hammer to drive the steel and sampler into the ground.

A key finding from one geoprobe boring was a zone at the bottom of the aluminum waste (27 to 29 feet below the surface of the landfill cover) with perched water, an elevated temperature, and a strong odor of ammonia gas being evolved. In addition, the geoprobe was not able to penetrate a dense layer approximately eight feet below the surface in the center of the landfill.

The waste in the unlined disposal site contained up to 28 percent aluminum, up to 8 percent sodium, up to 2.8 percent magnesium, up to 2.1 percent calcium, up to 1.5 percent potassium, plus lesser amounts of chromium, manganese, iron, copper, nickel and zinc.

Ecology conducted a Site Hazard Assessment pursuant to MTCA on the unlined disposal site. The site was added to the state Hazardous Sites List and assigned a hazard ranking of 2, where 1 represents the highest relative risk and 5 represents the lowest relative risk. In other words, the RAMCO site ranked among the upper 40 percent of sites according to the risk it presented.

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[2]Engineering Report Supplement: R.A. Barnes Industrial Waste Site Application, Tenneson Engineering Corporation, April 16, 1982.

3.0 INTERIM REMEDIAL ACTION

3.1 PHASE 1

James Dean Construction Inc. brought a leased portable screening plant to the site. Fed primarily by a hydraulic excavator, the screening plant produced fines (material less than 1 ½ inches in diameter) and oversize (material greater than 1 ½ inches in diameter). No material was crushed during Phase 1. The fines were transported to the Wasco County Landfill after appropriate aeration. Oversize was placed in a stockpile and kept onsite to be crushed during Phase 2.

In the center of the RAMCO disposal site about eight feet below the surface, a layer was encountered that was so hard and dense that a Caterpillar D8 bulldozer with a single-tooth ripper could not rip it. The layer was about one foot thick and was removed with difficulty using an excavator with a hydraulic hammer to break pieces off of it. It is unknown whether the consolidation creating this layer was the result of a physical mechanism or a chemical reaction.

Phase 1 operations were terminated April 17, 2007, because hot and dry weather made control of air emissions difficult from operations in the pit.

James Dean Construction transported 28,962 tons to Wasco Landfill during Phase 1 and received approximately $ 771,667 from Ecology. In addition, Ecology spent about $ 3,042 for fencing installation and rental for one year to secure the site.

3.2 PHASE 2

James Dean Construction initially set up a crushing plant consisting of a jaw crusher followed by an impact crusher. It soon became apparent that the aluminum waste contained some inclusions sufficiently high in aluminum content to behave like aluminum metal (i.e. when crushed the inclusions deformed rather than fracturing.) While these inclusions constituted a small fraction of the waste material, some of the inclusions were quite large, more than one foot in diameter. The contractor estimated that the impact crusher sustained about $ 25,000 in damage before the contractor ceased using it.

With the jaw crusher, the issue was downtime to remove the inclusions that jammed the crusher and remained in it rather than passing through. Clearing one of these jams typically took about two hours, but in one case took over two days of work. James Dean Construction requested permission to widen the setting between the jaws of the crusher to 4.5 inches, which produced a product with individual pieces as large as eight inches by six inches. Since this reduced the total surface area of the waste that was exposed to aeration, Ecology allowed this larger material to be transported to the landfill only when other indicators (no visible emissions, no heat, no odor) showed it was not reactive.

A portable screening plant screened out fines prior to the oversize being fed to the jaw crusher. Even though most of the material processed during Phase 2 had already been screened during Phase 1 and classified as oversize, this oversize material still produced a considerable amount of fines when screened again. The weathering that took place over the summer of 2007 contributed to this. The aluminum waste that had been excavated, screened and stockpiled was exposed to aeration, precipitation, and sunlight over the summer. Evidence of weathering included visible cracks that developed in some of the large chunks. Some pieces had weathered to the point that they could be crumbled under moderate pressure applied by hand. These pieces disintegrated into fines on the screen during Phase 2.

James Dean Construction transported 20,053 tons to Wasco County Landfill during Phase 2 and received approximately $ 717,839 from Ecology. The higher per ton cost during Phase 2 as compared to Phase 1 is due to the additional cost for crushing.

Adding together the numbers for both phases, James Dean Construction transported a total of 49,015 tons to Wasco County Landfill during Phases 1 and 2 and received slightly less than $ 1.49 million from Ecology. In addition, to secure the site Ecology spent about $ 3,042 for fencing installation and rental for the 12 months ending March 1, 2008. Fence rental for the 12 months ending March 1, 2009, will cost an estimated $ 1400.

3.3 HANDLING OF WASTE AT WASCO COUNTY LANDFILL

The instructions for handling this special waste imposed by Waste Connections, Inc., operator of Wasco County Landfill, incorporated the procedures spelled out in the Plan for treating the waste at the RAMCO site by the generator prior to transport to Wasco County Landfill. In addition, at Wasco County Landfill the Waste Connections, Inc. instructions required burial of the salt cake in a designated area and covering with soil at the end of the day; prohibited saturation with water or leachate; prohibited mixing with alkaline special wastes such as fly ash, bottom ash, or lime mud; and prohibited the use of water as dust suppression.

Following the completion of Phase 2, Waste Connections, Inc. reported to Ecology that it had no problems with the handling of the waste during Phases 1 and 2.

3.4 DEVIATIONS

3.4.1 CRUSHER PRODUCT SIZE AND DURATION OF AERATION

Crusher Product Size
The Plan (page 11) states that material that passes through a 1.5-inch screen and meets other criteria can be loaded directly into trucks for transport to the landfill. The Plan further states that other excavated material (i.e. material that does not pass the 1.5-inch screen and other criteria) will be set aside and will be treated by crushing and aeration prior to transportation to the

landfill. The Plan does not actually state that the crushing will reduce the material to the point that it will pass through the 1.5-inch screen, although that would be a reasonable inference.

The original Specification (page 73) did explicitly state that all crushed material shall pass through a 1.5-inch screen, followed by aeration for seven days. However, when some prospective bidders objected that they didn't have sufficient information about the crushing and aeration to submit a bid, Ecology issued Addendum #1, which removed the crushing and aeration from the project to be bid on. Addendum #1 also stated the method of treatment would be decided after excavation provided a better understanding of the physical makeup of the material and stated this work would be added to the contract as a change order.

When the change order covering crushing was signed in December, 2007, it specified a price for the crushing ($ 7.50 per ton) but did not specify the size of the crushed product. Wasco County Landfill, partner with James Dean Construction Company, had adopted the measures in the Plan, which implies crushing to 1.5 inches.

However, to solve the problems of crusher plugging and damage, as described above in Section 3.2 of this report, I verbally authorized setting the jaw crusher at 4.5 inches and transporting this material to the landfill if it met certain conditions indicating it was not reactive.

Duration of Aeration
The original specification stated the material that failed the criteria allowing it to be transported to Wasco County Landfill immediately would be aerated for seven days. As described above, an addendum subsequently removed the crushing and aeration from the specification. When crushing and aeration were instituted through a change order, the change order did not specify the duration of aeration.

In carrying out the project, the temperature, odor, and visible emissions criteria took precedence and not all the material that initially failed one of the criteria received seven days of aeration. The duration of aeration following crushing was highly variable, ranging from less an hour for material that was loaded immediately into trucks (this was material that did not fail the criteria and would not have required aeration even under the wording of the original specification) to material that was stored in large piles for more than two weeks.

Some material also received additional aeration before crushing because it was excavated in Phase 1 and stored in an open pile for months before being processed and transported to Wasco County Landfill in Phase 2.

3.4.2 TONNAGE ESTIMATE

The density (1650 pounds per cubic yard) used in preparing the Specification has proved to be too low, which means the tonnage estimate contained in the Specification (52,000 tons) is also too low. The material in place before excavation started likely totaled 69,000 tons (49,000 tons

taken to Wasco County Landfill thus far plus an estimated 20,000 tons yet to be transported) although an exact figure won't be available until excavation is completed in Phase 3.

The density of material excavated probably ranged from 2000 pounds per cubic yard to 2200 pounds per cubic yard. (These also are estimates, not measurements.)

One factor that probably contributed to the low pre-excavation estimate is that the density reported at the time the salt cake was created does not include gains in moisture or compaction occurring while the material was in place. A second contributing factor is that some of the material transported to the landfill was surrounding soil, not salt cake.

3.4.3 WASTE DESTINATION

The Plan on page 1 describes the location of Roosevelt Regional Landfill in Klickitat County, Washington, and the Columbia Ridge Landfill near Arlington, Oregon (both of which are about 60 miles from the RAMCO site) and then states: "It is possible that the contracting process could result in transporting the material to one of these landfills or to a more distant landfill."

In fact, the contracting process resulted in the successful bidder proposing to use Wasco County Landfill, which is about ten miles from the RAMCO site, and thus less distant than the two mentioned by name in the Plan. The Plan (page 11) and Specification (page 72) both required disposal in a RCRA Subtitle D landfill.

About 1989 RAMCO sent aluminum waste to the North Wasco County Landfill, which was then an unlined landfill. Since that time, this landfill (now called Wasco County Landfill) has been upgraded to a regional landfill. During Ecology's evaluation of the bid proposing to use Wasco County Landfill, Ecology concluded that Wasco County Landfill met the applicable requirements.

3.5 CONTRACTOR PERFORMANCE VERIFICATION

At the landfill, trucks were weighed twice on each trip, once coming in loaded and once leaving empty. A weigh ticket with a unique identifier number was produced for each trip and copies of these weigh tickets were submitted to Ecology by James Dean Construction with its invoices. Each truck driver also kept a daily log on which he recorded the time of day he left the RAMCO job site on each trip and these daily driver logs also were submitted to Ecology with the invoices. An example of a weigh ticket is included in this report as Figure 3 and an example of a driver log is included as Figure 4.

Waste Connections, Inc
WASCO COUNTY LANDFILL
The Dalles, OR 97058

000261
JAMES DEAN CONSTRUCTION, INC.
JAMES DEAN CONSTRUCTION, INC.
55 MT. ADAMS HIGHWAY
GLENWOOD WA 98619

Site 40
Ticket 000742
Date In 01/15/08
Time In 07:44
Date Out 01/15/08
Time Out 08:04

Weighmaster Linda
Origin WASH ST

Ref. WHITE
Grid

DESCRIPTION

Scale 1 Gross Wt.	92840 LB	Vehicle D	
Scale 1 Tare Wt.	38600 LB	Roll-Off	
Net Wt.	54240 LB	TON	27.12

INDUSTRIAL -OUT OF C per TON

PO # SID
NOTE
DRIVER

BY SIGNING THIS, I CERTIFY THAT THIS DIPOSAL MATERIAL ORIGINATED IN THE COUNTY/STATE AS STATED ABOVE. I ALSO CERTIFY THAT TO THE BEST OF MY KNOWLEDGE THIS LOAD CONTAINS NO HAZARDOUS OR SPECIAL WASTE.

Signature _____

FIGURE 3
EXAMPLE OF SCALE WEIGH TICKET

JAMES DEAN CONSTRUCTION, INC.
55 Mt. Adams Hwy.
GLENWOOD, WA 98619
(509) 364-3537
Fax (509) 364-3317

CUSTOMER'S ORDER NO. 07002 | PHONE | DATE 1/15/08

NAME Sid 161~172

ADDRESS RamCo, Dallesport TO WASCOE Land-FILL

Start 6:30 STOP 4:30

QTY.	DESCRIPTION	PRICE	AMOUNT
1.	7:15		
2.	8:22		
3.	9:21		
4.	10:17		
5.	11:17		
6.	12:17		
7.	1:16		
8.	2:23		
9.	3:29 10 Hrs.		
		TAX	
RECEIVED BY		TOTAL	

All claims and returned goods MUST be accompanied by this bill.

2307 NEBS To Reorder: 800-225-6380 or nebs.com Thank You

FIGURE 4
EXAMPLE OF TRUCK CAB DRIVER LOG

3.6 ONSITE TREATMENT

The onsite treatment (screening, crushing and aeration) was designed to prevent problems caused by the self-heating and ammonia-generating properties of aluminum waste when it contacts water. The fact that Waste Connections Inc., operator of Wasco County Landfill, reported to Ecology that it had no problem handling the waste is an indication that the onsite treatment succeeded.

Most of the temperature readings taken after processing at the RAMCO site showed the material at what might be expected as ambient temperature (say 50 degrees Fahrenheit). Less frequently, the readings were slightly elevated (say 80 degrees Fahrenheit) but still well below the criterion established for allowing material to be transported to Wasco County Landfill (130 degrees Fahrenheit). There was one day at the end of Phase 1 when the waste exceeded 130 degrees Fahrenheit and had to be further aerated before the temperature came down and it could be transported to Wasco County Landfill. The highest single temperature reading taken during this episode was 180 degrees Fahrenheit. Two of the techniques used to accelerate aeration during this episode were spreading the material into smaller piles to increase air access to it and wetting the material.

Contractor James Dean Construction retained an industrial hygienist to survey for ammonia and implement a plan for worker protection. This resulted in workers on some jobs at some times wearing air purifying respirators.

4.0 WORK REMAINING TO BE DONE

4.1 PHASE 3

Initial plans were to complete the excavation in two phases, but the combination of more tonnage than expected to be excavated and limited Phase 2 funding mean a third phase will be necessary to complete the job. Removing the estimated 20,000 tons remaining in Phase 3 will cost about $ 650,000. The work is tentatively scheduled to take place in January and February of 2009, but this too is dependent on funding and prioritization of this project relative to other projects. Some of the remaining material already has been screened or crushed and can be loaded into trucks and transported to the landfill without further processing. This includes one storage pile containing about 4,000 tons of fines and two much smaller storage piles of crushed material.

The aluminum waste is light grey or white in color. The underlying basalt is brown or dark grey in color. The soil that was placed over and around the aluminum waste is brown. A visual criterion will be used to determine the limits of excavation. All light grey or white material will be excavated. All loose soil covering light grey or white material, commingled with light grey or white material, or forming the dike or blankets surrounding light grey or white material also will be excavated. This will restore the basalt bowl to its approximate condition immediately prior to the start of waste disposal in the early 1980s.

At present it appears that no cover, such as riprap or washed sand, will be applied to cover the basalt after excavation. Ecology has informed the Port of Klickitat that such an improvement will not be solely funded by Ecology, but that the Port could apply for a grant if it were willing to pay a matching portion for this work. The Port has indicated it believes this additional work is not necessary. The silt fence installed along the east boundary of the site should be left in place until it is determined that erosion of material from the site toward Spearfish Lake will not be a problem.

4.2 CONFIRMATION SOIL SAMPLING

As stated above, excavation limits will be determined using visual means. However, one round of soil sampling with laboratory analysis for metals following the completion of excavation could be used to confirm that the visual identification succeeded in removing material with metals content above background levels.

4.3 CONFIRMATION GROUNDWATER SAMPLING

The four remaining monitoring wells need to be sampled and analyzed to document attenuation of the groundwater. The interim action was designed to prevent further leaching into the groundwater, but the interim action did not remove the salts that already have reached groundwater. The frequency of sampling should be adjusted depending on the trend of the initial sampling events. For example, we could start with annual sampling but if results from the first two years didn't show much change, a frequency of once every two or five years might be appropriate. The Port of Klickitat water well located southwest of the disposal site should be included in some of the sampling rounds.

4.4 DECOMMISSIONING MONITORING WELL MW-2

Monitoring well MW-2 was damaged beyond repair when a piece of mobile equipment collided with it. State well construction regulations require that the well be decommissioned by a licensed well driller (or a professional engineer or architect.) The most efficient method would be to fill the PVC casing with bentonite chips, but this method is not appropriate if material has entered the casing and bridged it, thus preventing the bentonite from reaching the bottom of the casing. Preliminary indications (one measurement) are that this might be the case. If the blockage cannot be cleared in some way such as with compressed air, the alternative of over-drilling this relatively deep well will be costly.

4.5 SURVEY AND AS-BUILT DRAWING

Surveying the contours of the ground after excavation is complete and tying the survey into a recognized datum would allow preparation of an as-built drawing. A plan view and at least one cross-section with elevation isopleths at 10-foot intervals would document the as-built final status of the interim action.

Table 1
Tons Transported to Wasco County Landfill by Day

Phase 1

February 22, 2007	169.84	tons
February 23, 2007	472.17	tons
February 26, 2007	549.99	tons
February 27, 2007	746.70	tons
February 28, 2007	875.99	tons
March 1, 2007	580.64	tons
March 2, 2007	393.18	tons
March 5, 2007	815.32	tons
March 6, 2007	803.83	tons
March 7, 2007	866.96	tons
March 8, 2007	784.10	tons
March 9, 2007	914.53	tons
March 12, 2007	1002.92	tons
March 13, 2007	1160.68	tons
March 14, 2007	1128.98	tons
March 15, 2007	1095.94	tons
March 16, 2007	692.11	tons
March 19, 2007	945.26	tons
March 20, 2007	320.38	tons
March 21, 2007	650.14	tons
March 22, 2007	1007.16	tons
March 26, 2007	999.52	tons
March 27, 2007	821.48	tons
March 28, 2007	848.72	tons
March 29, 2007	875.54	tons
April 2, 2007	786.90	tons
April 3, 2007	775.52	tons
April 4, 2007	954.03	tons
April 5, 2007	723.11	tons
April 9, 2007	974.99	tons
April 10, 2007	1013.88	tons
April 11, 2007	868.08	tons
April 12, 2007	1537.35	tons
April 16, 2007	1055.93	tons
April 17, 2007	738.13	tons

Total Phase 1	28862	tons

Table 1 (continued)
Tons Transported to Wasco County Landfill by Day

Phase 2

January 3, 2008	122.28	tons
January 4, 2008	612.87	tons
January 7, 2008	723.02	tons
January 8, 2008	175.17	tons
January 10, 2008	804.18	tons
January 14, 2008	846.94	tons
January 15, 2008	1022.82	tons
January 16, 2008	1081.53	tons
January 17, 2008	1091.82	tons
January 18, 2008	1075.34	tons
January 21, 2008	1125.06	tons
January 22, 2008	784.60	tons
January 23, 2008	1104.65	tons
January 24, 2008	1106.69	tons
January 25, 2008	914.97	tons
January 28, 2008	518.59	tons
January 29, 2008	913.33	tons
January 30, 2008	852.27	tons
January 31, 2008	852.46	tons
February 1, 2008	211.46	tons
February 4, 2008	965.53	tons
February 5, 2008	1081.37	tons
February 6, 2008	957.26	tons
February 7, 2008	1109.18	tons
Total Phase 2	20053.39	tons
Total Phases 1 & 2	49015.39	tons

Photo # 1 Before – West toe of the disposal site occupies the center left and lower left of photo. Basalt outcrop bluff in upper left and center forms the south wall of the bowl in which the unlined disposal site sits. Columbia River, also known as Lake Celilo at this point, is in the background to the south. Orange pipes in center indicate position of monitoring well MW-2. (Photo by Jeff Newschwander)

Photo # 1 After Phase 2– The orange pipe in the center indicates the location of the remnant of monitoring well MW-2. The gray aluminum waste below the rock outcropping shows the height of the waste prior to excavation.

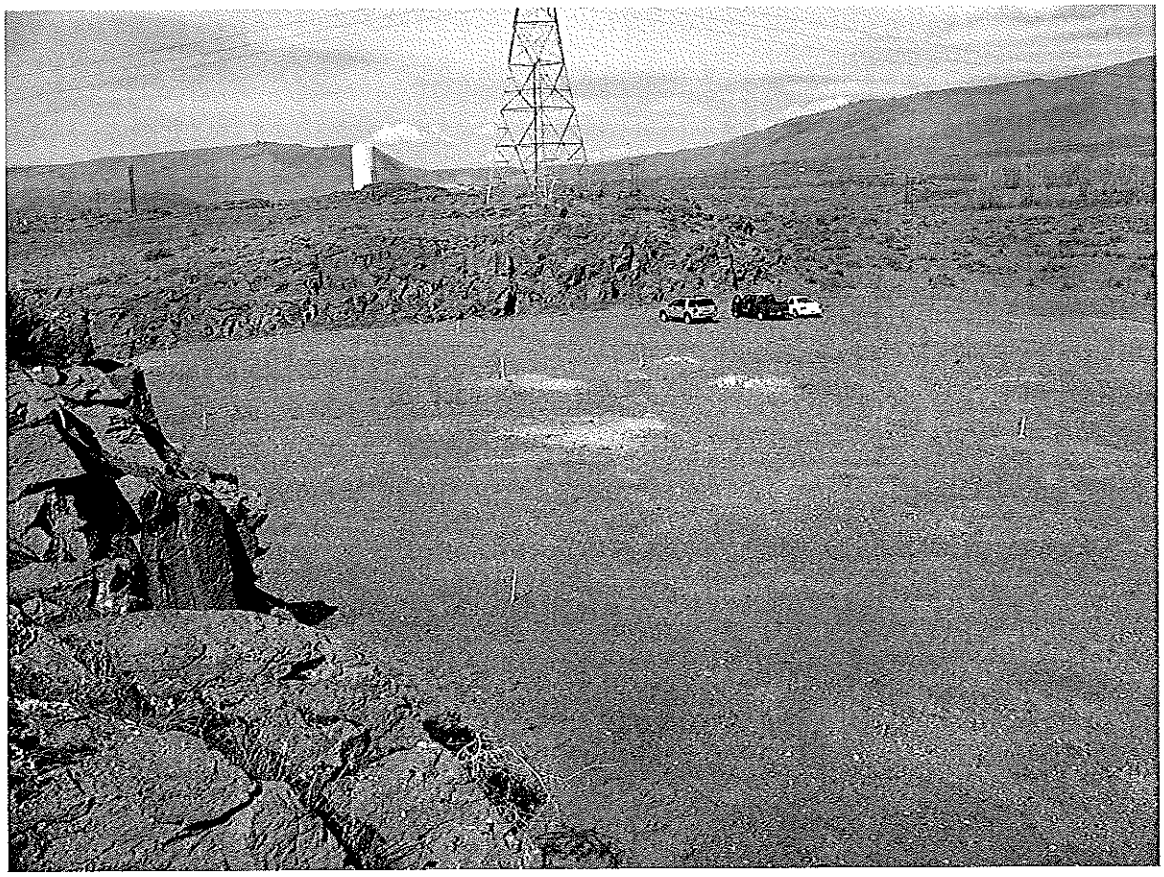

Photo # 2 Before– Looking northwest and down on disposal site cover from atop basalt outcrop bluff that forms southern wall of bowl in which the disposal site sits. The disposal site cover is the relatively flat area that occupies most of the photograph. The vehicles are parked on the disposal site cover. Note Bonneville Power Administration electrical power transmission lines and tower. (Photo by Jeff Newschwander)

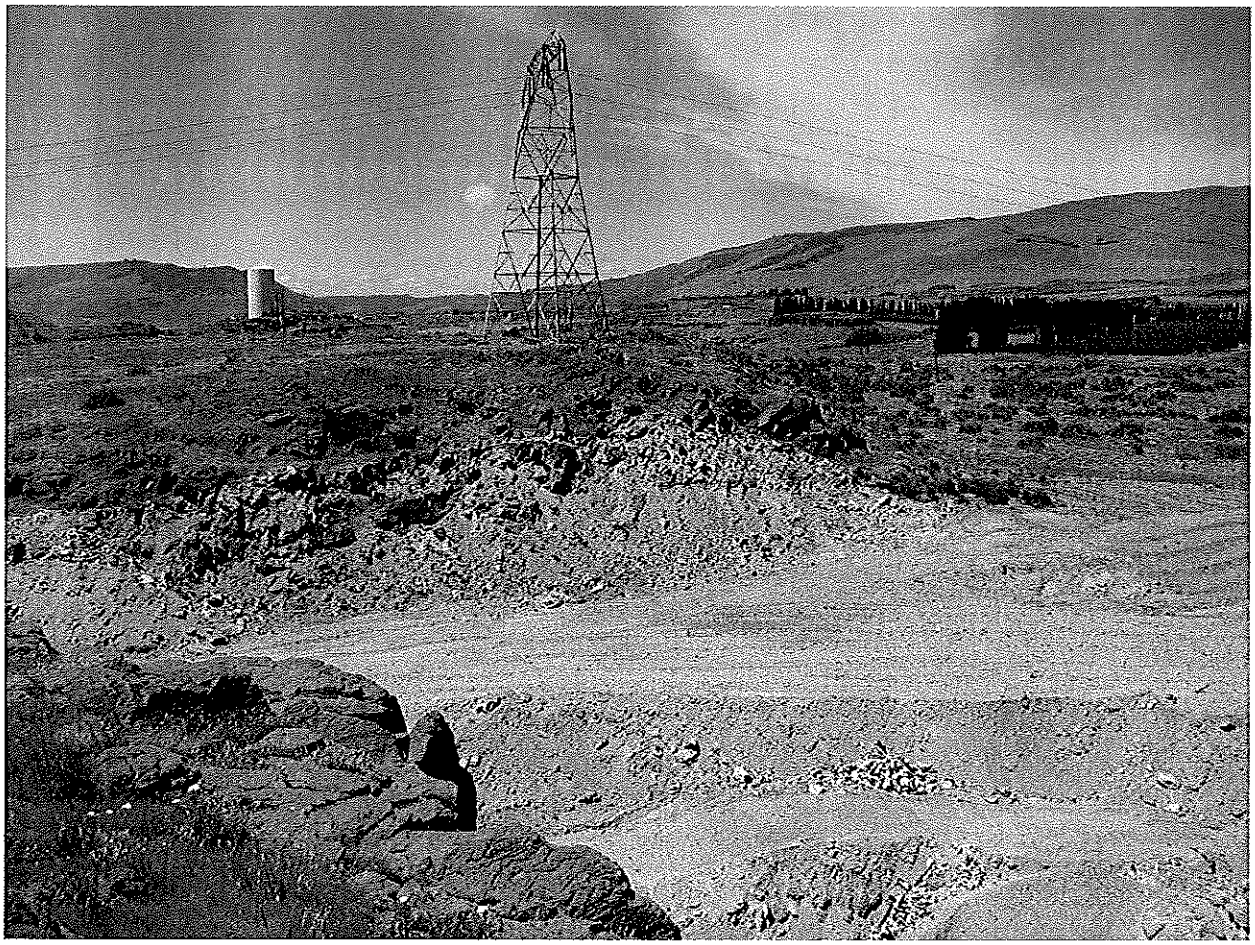

Photo # 2 After – Again, the gray aluminum waste beneath the rocks on the north side indicate both the original height of the waste and the depth of the excavation thus far.

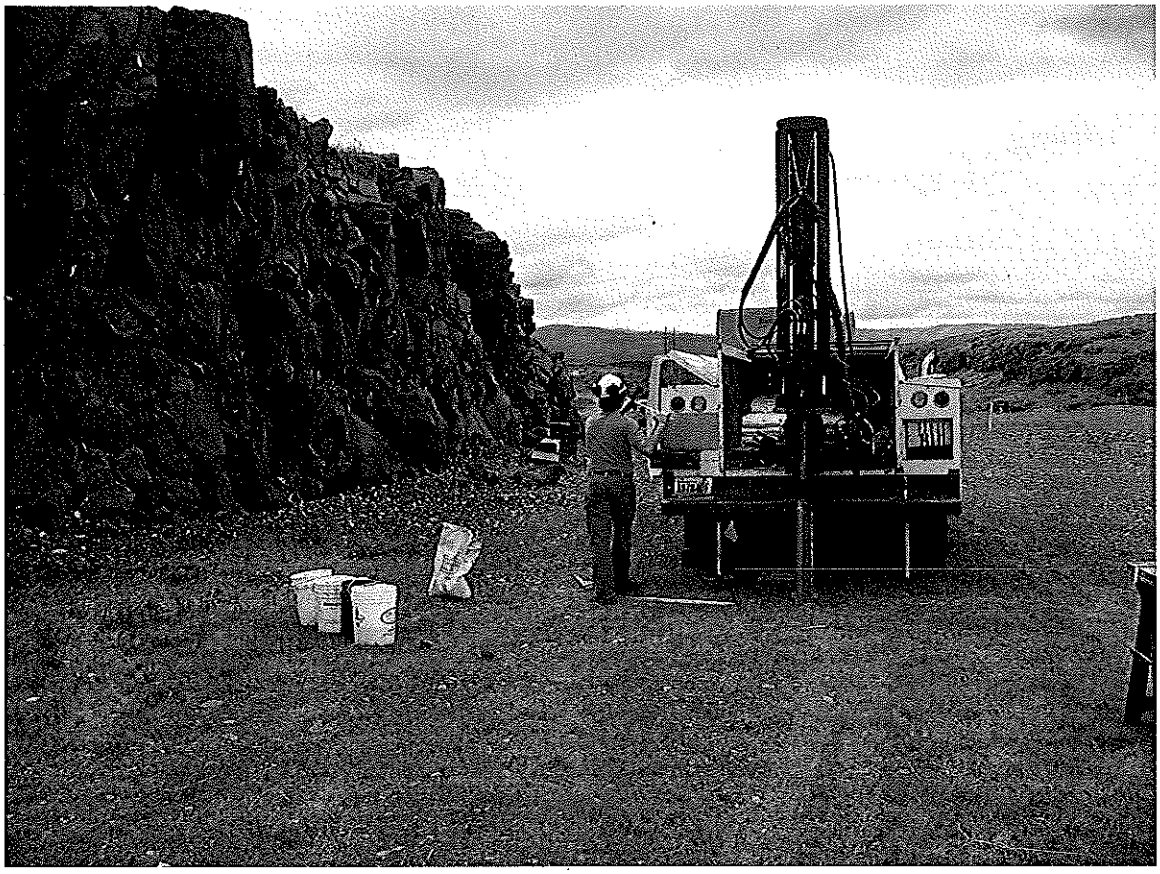

Photo # 3 Before – Geoprobe machine sitting on cover of disposal site and operator indicate scale of basalt outcrop bluff which forms south wall of bowl in which the disposal site sits. (Photo by Jeff Newschwander)

Photo # 3 After – The pickup truck indicates scale after Phase 2 excavation of the basalt outcrop bluff that forms the south wall of bowl in which aluminum waste was disposed.

DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE
MEMORANDUM

June 22, 2007

TO: Files

FROM: Bob Swackhamer

SUBJECT: Tonnage estimates, RAMCO

Based on my observations onsite 6/21/07, I estimate the following material yet to be sent to the landfill:

Oversize Pile

Estimate volume as a triangular prism 250 feet long by 130 feet wide by 70 feet high with a density of 1 ton per cubic yard

(.5)(250 ft)(130 ft)(70 ft)(1 cubic yard/27 cubic feet) = 42,130 cubic yards

Say 42,000 tons

East Berm

Estimate volume as a rectangular solid 300 feet long by 10 feet wide by 8 feet high, with a density of 1 ton per cubic yard.

(300 ft)(10 ft)(8 ft)(1 cubic yard/27 cubic feet) = 889 cubic yards

Say 1,000 tons

DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE
MEMORANDUM

November 28, 2007

TO: Files

FROM: Bob Swackhamer

SUBJECT: Cost estimates, RAMCO Change Order No. 2

Item No. 1: Added amount for Phase 2 Crushing, Excavation, Transport & Disposal

Using the estimate from my memo of 6/22/07 of 43,000 tons remaining at the site; $ 23.00 per ton from the existing contract for excavation, transport and disposal; and the proposed crushing payment rate of $ 7.50 per ton from Change Order No. 2 gives:

(43,000 tons)($ 30.50 per ton) = $ 1,311,500

Item No. 2: Establish Crushing Payment Rate of $ 7.50 per ton

Cost of the crushing has been included under Item No. 1 above.

Item No. 3: Extra Loader Cost Due to Delays Caused by Treatment

Guess: Upper bound of extra time would be four weeks of loader operation.

Using $ 34 per hour for the operator and $ 4150 per month for Caterpillar 966 loader equipment rental gives:

($34 per hour)(160 hours) + $ 4150 = $ 9590 say $ 10,000

Item No. 1	$ 1,311,500
Item No. 2	0
Item No. 3	10,000
Total	$ 1,321,500

August 31, 2006

REPORT

Gas System Operating Review At The Countywide Landfill

Prepared for:

REPUBLIC SERVICES OF OHIO II, LLC

Countywide Landfill

3619 Gracemont St. S.W.

East Sparta, OH 44626

Prepared by:

CORNERSTONE

Environmental Group, LLC

607 Eastern Avenue

Plymouth, WI 53073

"Think Cornerstone *for building and maintaining your solid waste business on a strong foundation."*

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1.0 INTRODUCTION

This report summarizes lab work, field work, and research conducted in an effort to assess and remedy unexpected odor issues and landfill gas (LFG) exhibiting higher than expected temperatures at the Countywide Landfill. The report also discusses potential recommendations intended to manage and monitor the gas and odor issues at the site. Finally, the report includes an LFG well analysis that discusses various well conditions, including a review of pressure and temperature data obtained from the system.

2.0 EXECUTIVE SUMMARY

The Countywide Landfill has experienced an unexpected increase in landfill gas (LFG) production. This increase in LFG production is thought to likely be a result of aluminum waste reacting with liquids in the landfill; producing heat, hydrogen gas, and other gasses. The heat from the aluminum waste reaction also increased the speed of the municipal solid waste (MSW) decomposition and its LFG generation. Countywide's LFG collection and flaring systems were not extensive enough to process all the unexpected LFG, thus odors were noticed on-site and off-site. Countywide Landfill has implemented an expansion of the LFG collection system which has greatly reduced the odors and allowed more LFG capture. However, as of the middle of August 2006, a small number of odor complaints are still occurring and Countywide Landfill continues to expand the LFG collection and flaring system.

3.0 BACKGROUND

The Countywide Landfill is a Subtitle D municipal solid waste landfill located in Stark County, Ohio, that is owned and operated by Republic Services of Ohio II, LLC. Countywide Landfill is permitted and licensed to accept both municipal solid waste and industrial waste. Countywide has been in operation since 1991. In approximately December of 2005, Countywide began to receive additional complaints that odors were traveling beyond the property boundary.

Historically, Countywide's LFG collection system operated as expected. Prior to December 2005, most of the LFG well data collected was typical of expected landfill decomposition and landfill gas production. Beginning in December 2005, Countywide identified additional LFG wells with higher than expected temperatures. More recently, the number of LFG wells with higher than expected gas temperatures have increased and more landfill neighbors than usual have claimed to have experienced odors attributed to the landfill.

Upon review of the odor complaints and a review of LFG system, Countywide began to implement various measures in an effort to respond to the odor issues. Various measures have been taken, including retaining Cornerstone Environmental Group, LLC ("Cornerstone"), as well as other consultants, and industry experts to provide

recommendations to address odor issues at the site. Since December 2005, these consultants and experts have conducted on site reviews of operating conditions, designed, installed, and operated various equipment aimed at reducing odors, and provided additional recommendations intended to further improve gas control and collection at the site – and thereby reduce odors attributable to the site.

4.0 ASSESSMENT OF POTENTIAL ISSUES

4.1 Preliminary Assessment of Odors

Canton City Health Department personnel have indicated that they have received odor complaints that are attributable to landfill operations. Countywide has determined that the complaints warrant a review of site operating conditions in an effort to (1) identify potential sources of odors that maybe leaving the site (2) develop recommendations to control sources of odors, and (3) implement recommendations in an effort to control potential odors.

In accordance with Countywide's Odor Control Contingency Plan, the intensity of odors has been subjectively measured using the following "scale":

0 = A concentration of an odorant which produces no sensation,
1 = A concentration which is just barely detectable,
2 = A distinct and definite odor whose characteristic is clearly detectable,
3 = An odor strong enough to cause a person to attempt to avoid it completely, and
4 = An odor so strong as to be overpowering and intolerable for any length of time.

The current process to assess odor complaints was developed in conjunction with the Stark County Health Department and the Canton City Health Department. In general, complaints are received via e-mail and/or voice mail and complainants are asked to provide information concerning the intensity of the odor, time, location, and basic meteorological conditions at the time the complaint is made. Upon receiving complaints, Countywide may attempt to send personnel to the location of the complaint in an effort to verify the complaint and determine if the odor could be associated with a source (landfill or others). Although a complete survey of odor complaints has not been undertaken, in general, odor complaints originated from Haut St., Dueber Avenue, Downing St.., and Sherman Church Road.

This subjective "scale" relies heavily on each individual's sense of smell; therefore reports have been inconclusive and conflicting in regard to intensity of the odors detected. None-the-less the frequency of odor complaints has increased since December 2005. Accordingly, Countywide Landfill has implemented substantial capital investments and operational changes aimed at reducing sources of potential odors (refer to Section 7.0 of this report). In addition, Countywide has identified and is procuring equipment designed to standardize odor detection in an effort to reduce potential

contradictions and inconsistencies inherent in the current odor investigation procedure. Refer to the section (8.0) of this report for more details.

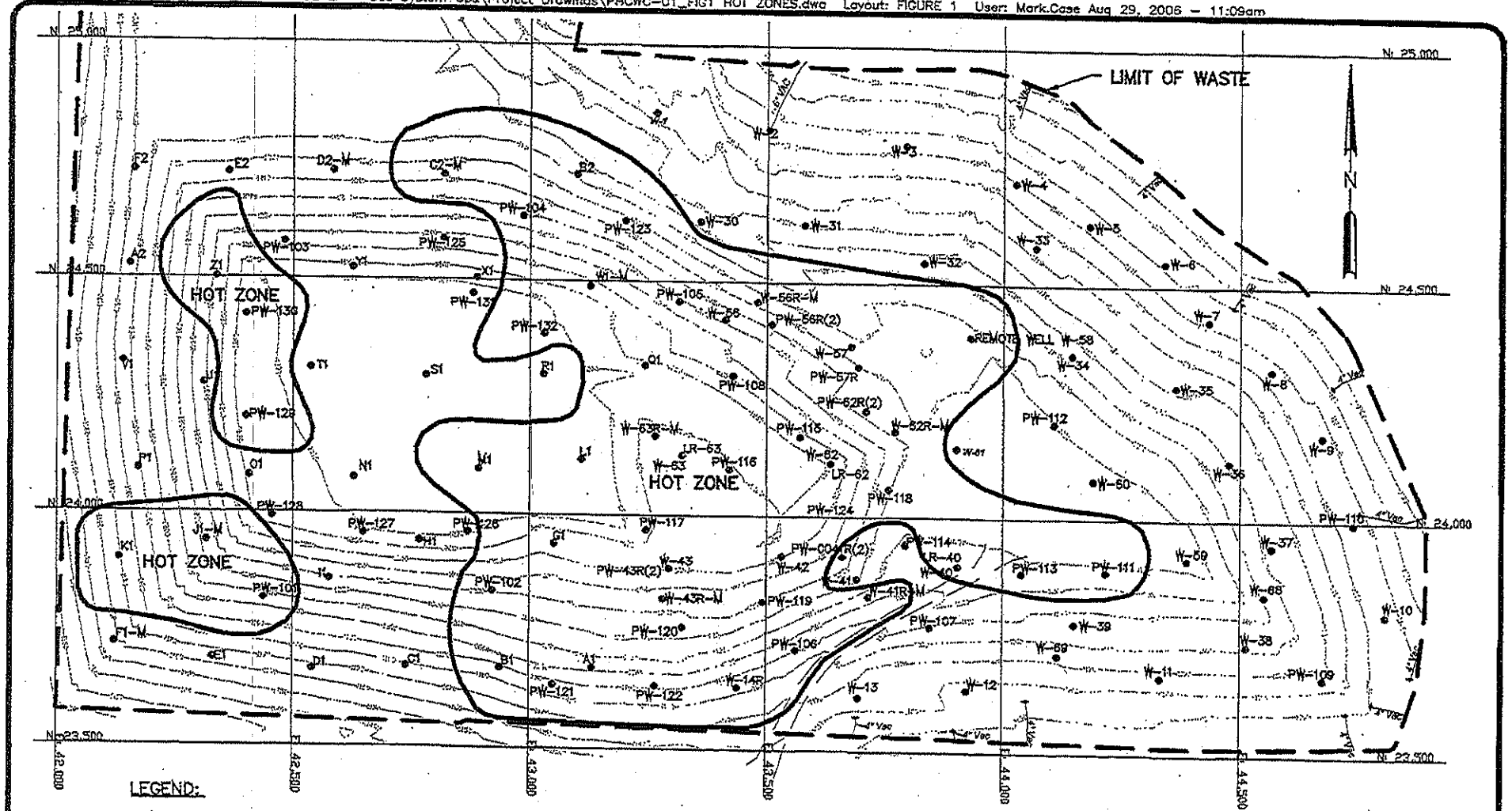
4.2 Preliminary Assessment of LFG Temperatures

One potential source of odor complaints is LFG that could migrate beyond the property boundary. In an effort to assess the possibility of LFG contribution to odor complaints, Cornerstone reviewed data from the LFG collection system to identify possible trends that could contribute to odors. One of the parameters assessed was LFG well temperatures. A review of LFG well temperatures indicates that several wells have exhibited higher than expected temperatures. Trend analyses indicate that LFG gas flow has increased in areas of the landfill where wells have shown higher than expected temperatures. Typical LFG temperatures generally range from 70° F to 131° F. It is not uncommon, however, for gas temperatures to occasionally measure greater than 131° F. Countywide has identified a significant number of LFG collectors with flowing LFG temperatures greater than expected. Figure 1 shows the area of the landfill with greater than 131° F gas temperatures during the first 3 weeks of August 2006.

4.3 Increased Production of Landfill Gas

LFG production is typically estimated using an EPA model (LANDGEM). Using this model and assuming the EPA defaults for methane potential (Lo) and methane generation rate (k) indicates that the Countywide Landfill should be generating 2217 to 3255 scfm of LFG in years 2005 and 2006, respectively. As later described in this report, actual LFG collected from the Countywide Landfill during the first 3 weeks in August, 2006 have been over 5000 scfm. This wide variance between predicted and actual LFG production can be explained via an aluminum waste reaction giving off hydrogen gas and heat. The heat of reaction also caused MSW to decompose faster thus producing more LFG. This increase in hydrogen gas and LFG was unexpected and became the focal point of the investigation conducted by Countywide and its team of experts.

File: C:\CADD Projects\REP - COUNTYWIDE LF - Gas System Ops\Project Drawings\PHCWC-01_FIG1 HOT ZONES.dwg Layout: FIGURE 1 User: Mark.Case Aug 29, 2006 - 11:09am



LEGEND:

—1150— 10' EXISTING GROUND CONTOURS 8-18-06

⊕ EXISTING VERTICAL GAS EXTRACTION WELL

4" Vac SIDE SLOPE RISER VACUUM CONNECTION

HOT ZONE

0 300 600

SCALE IN FEET

TOPOGRAPHY PREPARED BY DIVERSIFIED ENGINEERING, INC. DATED AUGUST 18, 2006

CORNERSTONE Environmental Group, LLC

REPUBLIC SERVICES OF OHIO
COUNTYWIDE LANDFILL
GAS SYSTEM OPERATING REVIEW
AREA OF LANDFILL WITH FLOWING LFG TEMPERATURE >131°F DURING THE FIRST 3 WEEKS OF AUGUST 2006

FIGURE NO. **1**

PROJECT NO. 60043

5.0 POTENTIAL CAUSE OF ODORS & UNEXPECTED GAS TEMPERATURES

Upon identification of potential sources of odors, Cornerstone embarked on an analysis of potential factors that could be contributing to conditions that could lead to increased production of LFG and higher than expected temperatures. Although it is still preliminary, the evidence gathered and reviewed to date points to a series of events that created conditions particularly conducive to the creation of odors at the Landfill. The following events may have contributed to conditions that Countywide is currently experiencing:

1. Non-hazardous industrial waste from aluminum production was disposed at the Countywide Landfill from 1993 to 2006. Based on recent test results, published data, and manufacturer's declarations, aluminum waste (depending on the specific chemical makeup) may react with liquids to form ammonia, hydrogen, and to a lesser extent, other by-products. Due to changes in the aluminum manufacturing process and raw aluminum materials over that time period, exact quantities and chemical makeup of this material is not available. The total amount of all waste disposed in the 88-acre disposal area at Countywide is estimated at just over 13 million tons. Countywide no loner accepts aluminum waste and has not accepted neither salt cake since 2001, nor bag house dust since July 2006, nor shredder delac since July 2006. The reaction described above is generally exothermic and heat is produced as the reaction occurs.

2. Liquids were potentially added to the waste via rain, moist waste, leachate recirculation, and the aluminum waste reaction itself may have created water when hydrogen gas from the reaction combines with oxygen from the air.

3. Air may have entered buried waste containing potentially reactive metal ions (such as the aluminum waste described above which could have caused an exothermic reaction (see Section 6.1)).

4. It is possible that the combination of liquids in the landfill and air, combined with the aluminum waste created an exothermic reaction in certain portions of the landfill (See section 6.1) that is producing heat, hydrogen and additional water. This may explain the presence of LFG at higher than expected temperatures. This theory finds additional support in the fact that LFG data shows a higher than expected concentration of hydrogen gas. Hydrogen gas is rarely seen in LFG in any substantial concentrations and its presence could be due to the aluminum waste reaction described above.

5. Water and higher than expected temperatures resulting from the exothermic reaction potentially involving the aluminum waste may have resulted in conditions that accelerated the rate of decomposition of the municipal solid waste (MSW) which was co-disposed with the aluminum waste. Countywide believes that the higher than expected temperatures and additional liquids in the landfill

may have caused the rate of decomposition of the MSW to increase substantially as compared to expected MSW decomposition.

6. The combination of factors summarized in paragraphs one through five may also have resulted in the underground oxidation of the MSW in the landfill. The presence of carbon monoxide (CO) in the LFG is an indicator that oxidation may be occurring. CO gas is commonly thought to be a byproduct of incomplete combustion and therefore, the possibility of a fire has been considered. However, since no smoke, charred residue, or flames have been observed (even when the waste is excavated and exposed to air) and wellheads have not melted, the team believes a fire is unlikely.

In sum, the factors described above resulted in the rapid decomposition of waste and an unexpected increase in LFG production. This additional LFG production is a potential source of odors. Countywide has modified its LFG gas collection and control system to provide increased gas collection in an effort to reduce sources of odors. Since December 2005, Countywide has nearly tripled its gas collection from approximately 1800 scfm to over 5,000 scfm.

Countywide's consultants and experts recommend that increased gas collection and flaring is the key to further reducing odors from the site. Since December 2005 Countywide has responded to the increase in LFG by installing new wells, piping, and flaring capacity. Countywide intends to install additional wells and flaring capacity throughout the balance of 2006 in an effort to further collect and manage LFG production at the facility.

6.0 DATA GATHERING AND ANALYSIS

Throughout the process of analyzing and reviewing issues at the site, a sufficient amount of data has been generated. A summary of data gathered since January 2006, including field investigations and laboratory analyses are included below. Additional detail is provided in the appendices. The following topics will be discussed:

- Laboratory Testing and Analysis of Aluminum Waste
- Laboratory Testing of Potential Chemicals That Can Reduce Reaction
- Wellhead & Down Hole LFG Temperature Data Review
- LFG Pressure
- LFG Chemistry

6.1 Laboratory Testing and Analysis of Aluminum Waste

In an effort to understand potential reactions that could occur when aluminum waste is exposed to liquids in an anaerobic environment (i.e., a landfill environment), Countywide contracted with American Analytical Laboratory to conduct bench scale testing designed to closely resemble actual conditions within the landfill. Three types of aluminum waste were bench tested, including bag house dust, shredder delac, and aluminum looking waste from a borehole (thought to be the salt cake). A description of the three wastes that were tested is included in Appendix A.

Testing of the aluminum wastes were conducted at varying temperatures ranging from room temperature up to 160 degrees F (71 degrees C). The varying temperatures were utilized to simulate a landfill environment. Testing was conducted by adding water to some aluminum waste samples and adding cell #7 leachate to other aluminum waste samples. Testing also included purging some aluminum waste samples with nitrogen and purging other aluminum waste samples with LFG. It is believed that the aluminum waste that was (1) purged with LFG, (2) subjected to temperatures up to 160 degrees F, and (3) saturated with leachate are the most representative of actual conditions within Countywide Landfill. Accordingly, the remainder of this section focuses on results that meet the criteria above. Information relative to other bench testing is contained within Appendix B.

Lab results for aluminum waste purged with LFG, saturated with leachate, and subjected to higher temperature showed the following:

- A 100 gram (0.221 pounds) sample of each type of aluminum waste was tested over a 53-hour period to determine the amount of gas generated by any reaction. The total amount of gas generated by each reaction was:
    - Fresh Bag house - 392 ml (or 0.0138 cubic feet) of gas,
    - Fresh Shredder delac – 156 ml (or 0.0055 cubic feet) of gas,
    - Bore hole salt cake - 198 ml (or 0.00697 cubic feet) of gas.
- Considering the 53-hour test period, the above results can be expressed in terms of gas flow over time per ton as:
    - Fresh Bag house –2.4 cubic feet per hour (cfh) of gas per ton of waste,
    - Fresh Shredder delac – 0.9 cfh of gas per ton of waste,
    - Aluminum waste from a bore hole – 1.2 cfh of gas per ton of waste.
- Assuming a direct correlation existed between gas produced in the laboratory to gas produced in the landfill as a result of the potential amount of aluminum waste disposed, the amount of additional gas that could be produced as compared to the historical and expected LFG flow of from the Countywide Landfill could be significant

- Gas chemistry from the aluminum waste reaction varied depending on the type of aluminum waste The results are as follows:
    - Fresh bag house – 6.4% methane, 53.0% hydrogen, 33.3% nitrogen, 7% oxygen, and 0.1% carbon dioxide;
    - Fresh shredder delac – 3.8% methane, 1.3% hydrogen, 75.5% nitrogen, 17.8% oxygen, and 1.5% carbon dioxide;
    - Bore hole aluminum waste – 2.6% methane, 5.8% hydrogen, 68.0% nitrogen, 16.9% oxygen, and 6.8% carbon dioxide.
- Carbon monoxide was not identified in the gas from any of the three types of aluminum waste. This is important because the carbon monoxide found in some LFG wells may not be coming from the aluminum waste reaction. It may be more likely that carbon monoxide found in some LFG wells is instead coming from hot MSW that was co-disposed with the aluminum waste.

The test results indicate that fresh bag house dust produces more hydrogen gas and a higher volume of gas than fresh shredder delac or the bore hole aluminum waste. Bore hole aluminum waste produced approximately half the volume of gas and much lower concentrations of hydrogen gas than the fresh bag house dust. It is possible that a fresh sample of aluminum waste would have produced more gas and more hydrogen than aluminum waste sample obtained from a bore hole. Countywide, however, was unable to obtain a representative sample of fresh aluminum waste for testing.

6.2 Laboratory Testing of Potential Chemicals That Can Reduce The Reaction

Based on the testing described above, Countywide embarked on an effort to identify a potential chemical that could be added to the most active reaction (bag house dust) to slow or limit the reaction. Based on a paper search, the laboratory tested the addition of magnesium chloride (otherwise referred to as common road salt) in a liquid solution as a potential limiting agent. Magnesium Chloride was identified as a potential additive because it has been used in some aluminum foundries to reduce emissions. A 25% and 50%, by weight, solution of magnesium chloride was added to a bag house dust sample and subsequently analyzed for gas production as described above. Both solutions were effective in slowing the reaction and reducing gas production by more than 5 times as compared to gas production with no addition of magnesium chloride. Appendix B contains details of magnesium chloride laboratory testing.

6.3 Wellhead & Down Hole LFG Temperature Data Review

In an effort to understand gas wellhead temperatures better, a review of down hole temperature was conducted. Knowing the hottest zone of the landfill (in plan view and at depth) can help in understanding where the reaction maybe occurring. Based on our review of down hole temperature measurements it appears that the heat is greatest in the middle plan view and the mid depth of the landfill. Gas temperature data from the base of the landfill is not available however the leachate extracted from side slope risers is typically 95 to 110 degrees F (indicating expected temperatures at the bottom of the landfill). Appendix C contains historical (prior to December 2005) LFG tuning data as well as more recent tuning from the first 3 weeks of August, 2006.

In November 2005, 4% of the LFG collectors had well head gas temperatures greater than 131 degrees F (3 out of 70). Between November 2005 and August 2006, many more new LFG collectors were installed. During the first 3 weeks of August 2006, 40% of the LFG collectors had well head gas temperatures greater than 131 degrees F (53 out of 134).

During the first 3 weeks of August 2006:

- 134 LFG collectors were monitored,
- 4 LFG collectors had wellhead temperatures of > 200 degrees F,
- 22 LFG collectors had wellhead temperatures between 150 and 199 degrees F,
- 27 LFG collectors had wellhead temperatures between 131 and 149 degrees F, &
- 81 LFG collectors had wellhead temperatures of < 131 degrees F.

Down hole temperatures have been measured twice at the Countywide Landfill (April 20, 2006 and June 28 thru July 10, 2006). Down hole temperatures were taken with a thermocouple at 10 foot depth intervals. Due to high gas pressures and the presence of leachate, some down hole temperatures were not possible to collect and some results of the down hole temperature measurements were taken in the gas stream and some were taken in the perched liquids. Therefore results of the down hole temperature monitoring should only be used as a general guide.

The latest down hole temperatures (June 28 to July 10, 2006) are summarized as follows:

- 90 well locations were profiled, (18 wells could not be profiled because of remote wellheads, gas pressure, obstructions, or heat limitations described above),
- 36 of 90 wells profiled had greater than or equal to 131 degrees F at the 10 foot reading,
- Maximum recorded temperature was at well # PW117 of 353.4 degrees F, found at 50 feet below ground surface,
- Approximately half of the wells have down hole temperatures that are cooling with depth,

- While some wells have increasing temperatures with depth, the hottest area is normally 50 to 60 feet below ground surface (ie: well above the base liner).

Down hole temperatures are detailed in Appendix D

6.4 LFG Chemistry

In order to understand the type of decomposition occurring in areas of the landfill it is important to review the LFG chemistry at specific wells and as a composite gas stream at the blower/flare stations. Waste in the Countywide Landfill normally experiences anaerobic decomposition (without air). Anaerobic decomposition typically produces 50-60% methane, 40 to 50% carbon dioxide and small amounts of oxygen and nitrogen from mild vacuum extraction. Refer to Appendix A for wellfield tuning logs that show LFG chemistry of methane, carbon dioxide, oxygen and balance gases determine with field instruments. Refer to Appendix E for lab results of the LFG including: hydrogen, carbon monoxide, and others

Laboratory gas chemistry has been measured three times at the inlet to flare #1. Results are shown in Appendix E and are summarized Table 1.

Table 1 – Countywide Landfill
Lab Results (saturated) of LFG Taken at the Inlet to Flare #1

Date of Analysis	Methane (%)	Hydrogen (%)	Nitrogen (%)	Oxygen (%)	CO2 (%)	CO (ppm)
4/19/06	37.8	6.2	7.4	1.3	45.0	845
6/1/06	30.4	9.0	7.2	1.4	49.3	1611
8/23/06	16.4	15.7	10.6	2.3	51.7	1965

The rise in hydrogen and carbon monoxide gas collected at flare #1 between 4/19/06 and 8/23/06 is due primarily to the increased gas collection in hot portions of the landfill between those dates. Collecting more LFG from the hot portions of the landfill reduced odors and naturally increased the composite gas concentration of hydrogen and carbon monoxide.

Laboratory gas chemistry has been measured once at the inlet to flare #2 and #3. Results are shown in Appendix E and are summarized Table 2.

Table 2 – Countywide Landfill
Lab Results (saturated) of LFG Taken at the Inlet to Flare #2 & #3

Flare #	Date of Analysis	Methane (%)	Hydrogen (%)	Nitrogen (%)	Oxygen (%)	CO2 (%)	CO (ppm)
2	8/23/06	36.3	5.6	12.2	2.2	41.1	0
3	8/23/06	4.9	16.7	21.4	5.1	48.1	2417

Gas chemistry as been determined at numerous LFG wells. Laboratory results are shown in Appendix E and are summarized in Table 3. Table 3 also shows some field CO measurements so trend over time can be assessed.

Based on the lab results shown in Table 3, hydrogen gas is consistent in 25 LFG wells with hydrogen gas found in the bench scale test (section 6.1 of this report). This leads us to believe the reaction found in the lab is also occurring in portions of the landfill.

Carbon monoxide (CO) has been measured at numerous LFG wells; refer to Appendix E. CO results from the field were done with a Draeger tube after filtering the LFG thru a carbon filter. Field measured CO has correlated reasonably well with CO analysis from the laboratory (ASTM Method D1946). Refer to Appendix E for side by side comparisons. This good correlation between the field and the lab CO should allow field CO sampling to proceed with confidence.

The presence of CO in the LFG wells can be an indication that underground oxidation or fire is occurring in the waste. According to the Federal Emergency Management Agency's May 2002 landfill fire guide, levels between 10 and 100 ppm indicate that combustion is not present. The report suggests that levels of CO between 100 and 1,000 ppm are suspicious and require further monitoring. The report also indicates that levels of CO in excess of 1,000 ppm are considered a positive indication of an active underground landfill fire if it is combined with smoke, flames, soot in the header pipes, and settlement.

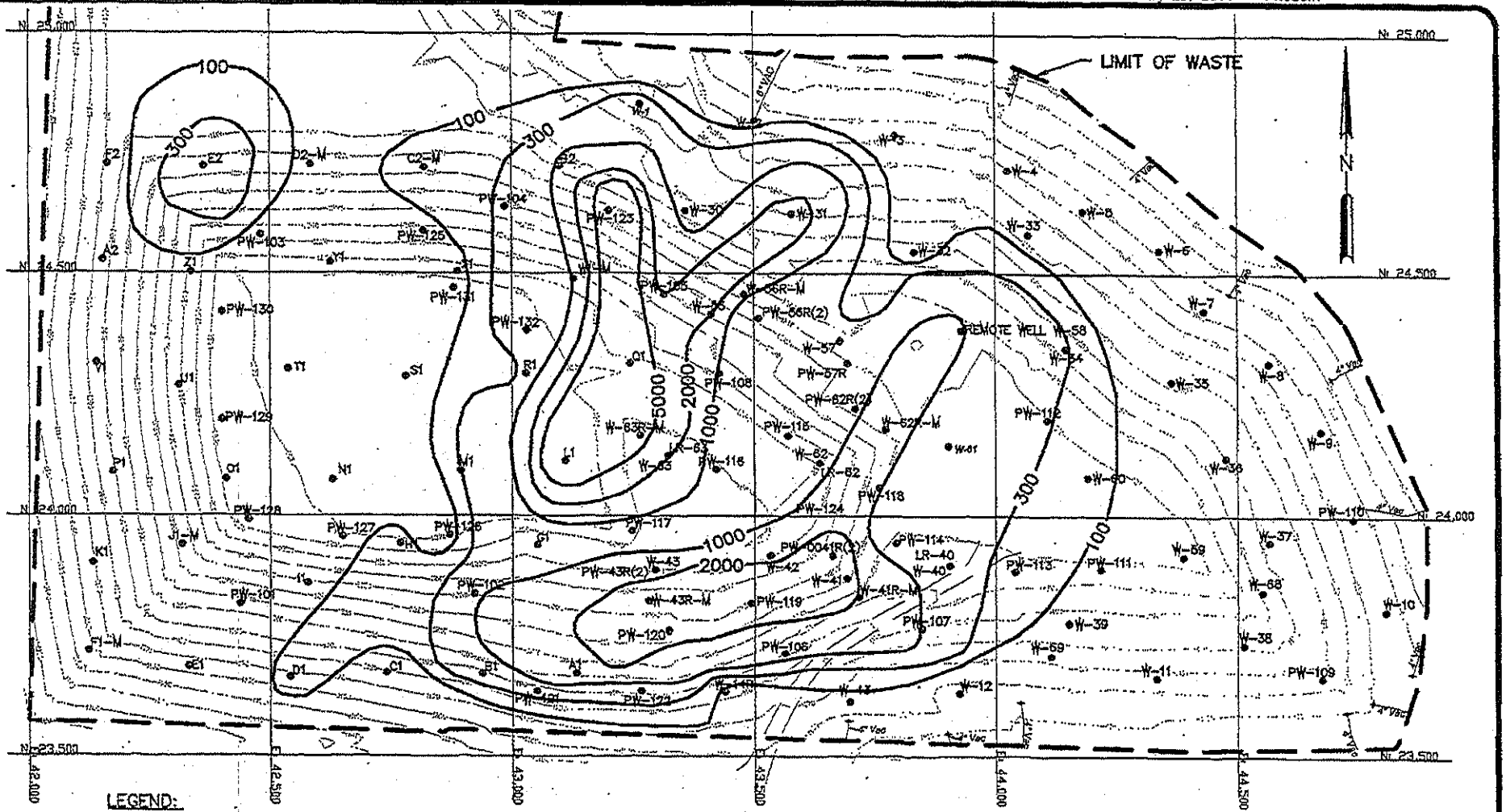
Since we have not seen waste extracted from boreholes ignite when mixed with air, we have not seen smoke venting from positive pressure LFG boreholes during drilling, and we have not seen soot in headers or wells; we do not believe a fire is occurring at the Countywide Landfill. Figure #2 shows CO results at the Countywide Landfill. All LFG wells in the landfill are being tuned and monitored carefully.

Table 3 – Countywide Landfill
Lab Results From LFG Wells

Well #	Date of Analysis	Methane (%)	Hydrogen (%)	Nitrogen (%)	Oxygen (%)	CO2 (%)	CO (ppm)
W8	7/11/06	12.0	0.0	60.8	5.5	19.4	0
W30	8/23/06	10.3	19.9	32.1	7.6	27.8	1857
W31	8/23/06	7.5	48.8	0.5	0.2	39.6	2741
W32	4/19/06	46.5	4.4	1.7	0.46	45.0	0
W38	7/11/06	55.0	0.4	0.9	0.3	41.1	0
W43R	2/1/06	0.7	27.0	0.5	0.1	66.6	8067
W58	7/11/06	30.8	18.6	2.5	0.7	44.8	914
W60	7/11/06	48.1	10.7	1.8	0.5	36.4	0
W62R	4/19/06	5.5	32.7	0.43	0.13	58.6	2997
W62R2	7/11/06	27.0	12.5	1.6	0.5	56.0	1317
PW104	8/23/06	20.1	15.2	0.1	0.1	61.4	1287
PW105	7/11/06	12.0	19.6	1.3	0.4	63.6	1719
PW107	8/23/06	21.3	14.9	1.5	0.1	59.5	1199
PW108	8/23/06	15.7	14.8	3.2	0.3	63.2	1002
PW114	7/11/06	44.5	0.2	5.9	1.5	45.7	0
PW114	8/23/06	44.4	0.0	13.5	3.3	36.4	0
PW115	8/23/06	2.2	24.7	2.8	0.7	65.9	3901
PW117	8/23/06	3.0	31.2	0.6	0.2	61.7	2132
PW119	8/23/06	0.6	35.2	1.8	0.5	57.9	3242
PW120	8/23/06	1.3	33.2	0.8	0.2	60.2	1739
PW123	8/23/06	0.8	42.3	0.1	0.1	53.1	4480
PW124	8/23/06	10.9	17.9	4.3	0.6	63.0	1287
PW126	8/23/06	29.7	5.9	1.1	0.3	60.2	688
PW127	8/23/06	53.8	0.9	0.5	0.2	42.1	0
PW130	7/11/06	47.5	4.1	5.5	1.4	38.9	0
PW130	8/23/06	24.5	11.1	0.2	0.1	61.2	1081
PW132	7/11/06	22.6	9.5	0.8	0.2	64.3	1022
B-2	7/11/06	11.1	25.8	0.7	0.2	59.2	2633
E-2	7/11/06	43.5	9.6	1.5	0.4	42.6	0
K-1	4/19/06	50.3	0.66	5.9	0.29	41.0	0
M-1	8/23/06	5.8	23.2	0.8	0.3	66.1	4323
P-1	7/11/06	51.0	1.2	4.6	1.1	39.5	0
Q-1	4/19/06	0.3	33.0	0.48	0.14	62.5	6249
Q-1	7/11/06	0.4	30.2	1.2	0.3	63.3	5905
R-1	4/19/06	30.3	0.34	7.9	1.9	57.5	0
R-1	7/11/06	24.0	1.7	5.3	1.4	64.6	1199

Notes:
All lab results are reported as saturated gas.

File: C:\CADD Projects\REP – COUNTYWIDE LF – Gas System Ops\Project Drawings\PHCWC-02_FIG2 CO2 CONCENTRATIONS.dwg Layout: FIGURE 2 User: Mark.Case Aug 29, 2006 – 11:08am



LEGEND:

- 10' EXISTING GROUND CONTOURS 8-18-06
- EXISTING VERTICAL GAS EXTRACTION WELL
- SIDE SLOPE RISER VACUUM CONNECTION
- CARBON MONOXIDE CONCENTRATION (ppm)

0 300 600

SCALE IN FEET

TOPOGRAPHY PREPARED BY DIVERSIFIED ENGINEERING, INC. DATED AUGUST 18, 2006

CORNERSTONE Environmental Group, LLC

REPUBLIC SERVICES OF OHIO
COUNTYWIDE LANDFILL
GAS SYSTEM OPERATING REVIEW

JUNE & JULY 2006 CARBON MONOXIDE CONCENTRATIONS IN LFG WELLS

FIGURE NO. 2

PROJECT NO. 60043

6.5 LFG Pressures

In order to understand where the reaction in the waste is occurring a review of pressures was done. Since LFG collectors are designed to be under vacuum, finding pressure in a collector is a signal that actions to repair the collector maybe necessary. Higher than expected gas pressure has been observed in certain areas of the landfill, with higher than expected hydrogen content and temperatures. The highest gas pressure during the first 3 weeks of August 2006 was at well B-1 at 95.4" water column.

This level of pressure is substantially higher than expected at a landfill and indicative of a reaction believed to be associated with the aluminum waste. During the first 3 weeks of August 2006, 42 gas collectors had periodic positive pressure (most of which were back under vacuum within a few days). These pressures are not because the LFG collection system was blocked but instead because the pressure from the reaction was above the available vacuum of this (and most) gas collection systems. Gas pressures are shown in Appendix A.

7.0 ACTIONS TAKEN TO RESPOND TO UNEXPECTED CONDITIONS

Since January 2006, Countywide Landfill has undertaken an aggressive odor management approach. The approach focuses primarily on collecting more landfill gas. Countywide Landfill accelerated the expansion of the LFG collection system beyond that which is required by the regulations and has implemented numerous other actions. All of these actions are beyond the scope and ahead of the timelines required by the federal new source performance standards. Countywide undertook such activities voluntarily and expeditiously in response to the unexpected sources of odors at the landfill. Actions taken thru August 20, 2006 include:

1. Discontinued leachate recirculation to temporarily reduce moisture within the landfill.

2. Hired expert landfill gas and leachate consultants and contractors to review the situation and make recommendations.

3. Installed 38 new LFG wells and rehabilitated numerous other LFG wells. Also connected 27 additional locations to LFG extraction including horizontal collectors, leachate cleanouts, and collectors under the geo cap The 88-acre portion of the Countywide Landfill now has a total of 135 LFG extraction points or an average of 1.53 LFG extraction points per acre. This is above the industry norm of 1 LFG extraction point per acre.

4. Installed over 1700 feet of new 12" dia LFG header, repaired 350 feet of 18" diameter header, and installed hundreds of feet of 4", 6", and 8" diameter laterals to connect all the new LFG extraction points.

5. Implemented a program of adjusting (tuning) the LFG collection system weekly and sometimes daily in an effort to maximize LFG extraction while minimizing air intrusion. This process is a careful balance between extracting the LFG as it is generated but not extracting so hard as to allow excessive air intrusion.

6. Installed a 2.5 acre temporary geomembrane cap (geo cap) on the south slope of the landfill in order to contain leachate seeps and odors escaping from that area. LFG collectors and leachate collectors were also installed under this geo cap.

7. Conducted down hole temperature, liquid levels, carbon monoxide, and hydrogen monitoring at select landfill gas wells in order better understand the dynamics occurring underground.

8. Conducted laboratory testing of aluminum dross waste that was accepted at the landfill to determine what impacts this waste had in speeding MSW decomposition and creating the odors.

9. Conducted gas chemistry testing upwind, downwind, under the temporary geo cap and at the blower / flare station inlet in order to better understand the impact of odors on the neighborhood.

10. Applied additional intermediate cover soil in select areas where settlement had occurred to suppress odors.

11. Repaired 8 landfill gas well casings that were pinched as a result of waste settlement.

12. Installed 3 LFG horizontal collectors / leachate toe collectors near LCR-3D on the south slope.

13. Installed 2 horizontal LFG collectors under a new geo cap located near the shedder fluff pile.

14. Scarified and recompacted the intermediate cover located along the north slope, uphill from the northern haul road, and on portions of the south slope.

15. Connected LFG wells located in the top deck to vacuum extraction after waste filling on the top deck was at an appropriate grade.

16. Installed portable odor neutralizing systems. This includes a 1000 foot extension of the odor neutralizing system along interstate 77 (2000 feet in total is installed now), and installation of 3 portable odor neutralizing sprayers.

17. Installed an auto dialer on the existing LFG flare to dial out if the flare shuts down. This is designed to decrease downtime.

8.0 FUTURE PLANS

Based on the foregoing analysis and our experience and recommendations of industry experts; Countywide is considering implementing the following additional measures to address conditions at the site:

1. Expand the LFG collection system with more LFG wells to collect more LFG.
2. Expand the blower and flares to get more capacity to process LFG. This will be done after CCHD approves our request.
3. Continue tuning the LFG wellfield to maximize LFG extraction while minimizing air intrusion once a week, minimum.
4. Survey the intermediate cover condition then scarify and recompact the intermediate cover as needed.
5. Submit a request to OEPA Scott Winkler to add road salt (MgCl) to two LFG wells as a test to try and slow the rapid decomposition.
6. Repair LFG leaks at risers 5AB and 5CD.
7. Fix any leaking HDPE boots on the geo cap area.
8. Install liquid pumps in up to 6 existing LFG wells located in the south slope.
9. Install a new leachate trench, located along the south toe near the temporary geo cap, to collect more leachate.
10. Conduct a vacuum survey to confirm that vacuum is getting to all headers and laterals. Repair headers and laterals as necessary
11. At flare # 1 (located in the southeast corner of the landfill) conduct maintenance including: install a new flame arrestor, cleanout the knockout pot, and raise the flare stack height.
12. Test MgCl additions in two LFG wells and report our findings to Canton City Health Department and OEPA, via conference call.
13. Potentially develop and implement a community relations plan to communicate data to the public and offer more tours to the public
14. Seal locations found to be venting LFG or allowing air intrusion to occur.
15. Finalize as-builts of the upgraded LFG collection system during the 1st half of 2006.

16. Prepare a LFG collection and control system design for the Landfill Expansion Area.

17. Specify and purchase a backup blower for flare #1.

18. Prepare PTI application for permanent flare capacity increase.

19. Modify the existing odor complaint scale (1 thru 4) to be consistent with the Nasal Ranger scale. Purchase an olfactometer (ie: Nasal Ranger) to allow better quantification of odors coming from the landfill and to quantify neighbor complaints.