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MISSOURI DEPARTMENT OF
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June 16, 2000

Ms. Julieann Warren, Chief
Site Evaluation Unit
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

30280430
Superfund

Re: Chicago Heights Blvd.
VOC Plume PA/SI Report

Dear Ms. Warren:

Thank you for forwarding to my attention a copy of the Report referenced above, under cover of your letter dated May 10th. While we agree with the constructive approach the Department has taken in addressing remedial concerns at the Missouri Metals Site on Page Boulevard, we believe it is appropriate to bring to your attention several statements contained in the Report which we disagree with and which we believe are not fully supported by the information available to us. Two of the more material issues, the preferential subsurface pathway and the identification of alternative sources of contamination, are addressed in turn below.

The Report indicates, at Section 3.3 and elsewhere, that a preferential subsurface pathway exists which is strongly influencing groundwater and contaminant migration, and that this pathway is the reason the plume has not dispersed over a wider area. As previously indicated to the Department in a letter from Burns & McDonnell dated April 5, 2000 (a copy of which is enclosed for your convenience), no significant subsurface pathways are readily discernable in the area based on a review of historical topographic maps obtained from Department files of nearby properties. While preferential pathways, if existing, can influence migration of subsurface contaminants, other factors described in the Burns & McDonnell letter can override such pathways in determining contaminant migration. The Burns & McDonnell letter also indicates that in their experience VOC groundwater plumes "often appear as narrow lenticular plumes as opposed to plumes that have 'fanned out' from the source area."

While Section 3.3 of the Report seems to raise the preferential pathway concept as a possible explanation for the sampling results, in Section 3.4 of the Report this possibly is stated as a conclusion ("A significant preferential subsurface pathway exists that is influencing that migration.") We disagree. The facts known to date simply do not support the conclusion that a preferential subsurface pathway exists. We believe, therefore, the conclusion reached in the Report to be in error.

Regarding the alternative source issue, the Report indicates (Section 3.3/3.4) that it is "highly unlikely" that another source could be contributing to the contamination that has been detected. That view appears to be based, at least in part, on conclusions reached by Environmental Solutions, Inc., consultants working for an unknown party or parties on the All American Life Insurance Company site located on Dielman Rock Island Drive. Section 2.3.1 of the Report indicates that in a letter dated April 11, 1997, the Department "agreed with Environmental Solutions conclusion that groundwater and soil data showed that the PCE, TCE, and cis-1,2-dichloroethylene (cis-1,2-PCE) contaminants in the groundwater were originating off-site at an up gradient source." Those conclusions, however, would appear to contradict the findings of Mr. Timothy Chibnall, an environmental specialist with the Voluntary Cleanup Section of the Department, in a letter dated April 3, 1997 (a copy of which is also enclosed for your convenience). Mr. Chibnall's letter states, in pertinent part, that "Based on my interpretation of the ground water flow data and the contaminants detected in ground water at the [All American Life Insurance Company] site, I am not sure that the contaminations detected originated at EG&G (or that all of the contamination originated off-site)", and "Because degradation products were not detected, I'm lead to believe that, if the source of the chlorinated compounds in ground water is off-site, it may very well be a site other than EG&G."

For the reasons stated above and in the Burns & McDonnell letter, we disagree with the position taken in the Report, which is to heavily discount the possibility of alternative sources for the contaminants detected. We also disagree with the conclusion reached in Section 3.4 that VOC contamination in groundwater at the All American Life Insurance Company site was determined to be migrating to that site from an upgradient source, as the Department clearly took a different view in Mr. Chibnall's letter, written only eight days prior to the April 11, 1997 letter cited above.

The Report also gives only a brief mention to the reported abandoned dump site south of Meeks Boulevard in the vicinity of the southern end of Elmridge Place. As indicated in the Burns & McDonnell letter, photographs taken from the southern end of the Missouri Metals site in the late 1950's show large piles of dirt and refuse strewn over the residential property south of Meeks

Boulevard. Area residents have indicated that the residential area south of Meeks Boulevard and north of Chicago Heights Boulevard was a former landfill or dump site. This information concerning historical contamination in the plume area, combined with the other potential sources of contamination in the area (All American Life Insurance, County Cab Company, etc.) and the previously reported oil spill east of the Missouri Metals site on Meeks Boulevard in the early spring of 1999 simply does not support the Department's conclusion that an alternative source is "highly unlikely". We believe that the existing information readily supports the existence of an alternative source.

We would request that all available information regarding alternative contaminant sources be included in any on-going or future review of the area. As previously indicated, we are prepared to meet with you to further discuss these issues, or any related issues, at your convenience.

We look forward to working with you in the future, and thank you for your assistance with this matter.

Sincerely,

John L. Healy
Senior Attorney

Encls.

cc: B. Stone
D. Ballard

Final Draft UL
4/14/10

Summary of Site Characterization for PerkinElmer Missouri Metals Site, Overland, Missouri

This document summarizes the conceptual site model, evaluates the site characterization to date, and identifies additional data collection or characterization activities in order to adequately characterize the fate and extent of the contaminant plume.

Conceptual Site Model

The PerkinElmer Site is a metal fabrication facility located at 9970 Page Boulevard in Overland, Missouri. The facility has been in operation since 1957 under various ownership, manufacturing aircraft component parts. The site is approximately 3.5 acres in size. A residential neighborhood and apartment buildings are located southeast of the site.

Metals and volatile organic compounds (VOCs) were identified in the soil and VOCs were identified in the groundwater in 1988. Based on previous site investigations, there are two known source areas of contamination on-site, identified as the former degreasing pit area and the former drum storage area. Primary contaminants of concern (COCs) in the groundwater include tetrachloroethene (PCE), trichloroethylene (TCE), dichloroethene (DCE), and vinyl chloride.

Shallow Zone - Unconsolidated Soil

The shallow zone consists of fill and silty-clay to clayey-silt. The fill ranges from one to seven feet in thickness. The areas where fill is greater than three feet appear to be reworked native soils and consist of silty clay with remnants of concrete, glass, and brick. The silty-clay to clay-silt soil is approximately twelve to twenty feet thick and is approximately fifteen to twenty-five feet below ground surface. Published hydraulic conductivity for this type of soil ranges from 10^{-3} to 10^{-7} cm/s with an average of 10^{-5} cm/s (Freeze and Cherry, 1979). Effective porosity for a silty clay loam, taken from *USEPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance*, dated April 1989, is 10%. Effective porosity may be considerably lower as clay content increases. A decrease in effective porosity would result in an increased horizontal flow velocity. The calculated horizontal hydraulic gradient for the shallow zone is 0.04 ft/ft, based on March 2001 piezometric surface elevation data. This yields a horizontal flow velocity range for the shallow zone of 0.04 to 413 feet per year, with an average of 4.14 feet per year. These calculations do not take into consideration secondary porosity features such as root casts or burrows. The calculated vertical hydraulic gradient between the shallow zone and the deep zone, based on March 2001 piezometric surface elevation data, is 0.06 ft/ft downward at the former degreasing pit area and 0.02 ft/ft downward at the former drum storage area.

COCs in the shallow zone likely migrated horizontally and vertically through both primary and secondary porosity features. Horizontally, COCs would follow the groundwater flow pathway through the unconsolidated soil to the southeast. Vertically, COCs would migrate from the source areas downward into the bedrock zone.

Deep Zone – Siltstone and Shale Bedrock

The deep zone or bedrock zone consists of alternating layers of siltstone and shale with occasional clay and sandstone lenses. This wide variation in lithology suggests a highly dynamitic depositional environment. Boring logs of on-site wells indicate the first bedrock unit is a 4 to 12 foot thick highly weathered siltstone with some fine sand. Sandstone lenses appear within the siltstone on-site. However, there are not enough deep-zone monitoring wells to adequately interpret the on-site lithology of the deep zone. Off-site, approximately 100 feet from the property boundary, a 1 to 5 foot thick moderately weathered shale overlays the siltstone. This shale appears to be absent on-site. A one to two foot thick moderately weathered shale under lays the siltstone, both on-site and off-site. This shale layer is underlain by a 1 to 6 foot thick moderately to highly weathered siltstone with sand. This siltstone layer pinches out between 300 and 400 feet downgradient of the southeastern property boundary. Boring logs show a clay lens is present beneath this siltstone at monitoring wells GMW-19 and GMW-16. However, due to the lack of deep monitoring wells on-site and the distance between GMW-19 and the next downgradient monitoring well (approximately 300 feet) the extent of this clay lens is unknown. There are also sandstone lenses present on-site within the siltstone in the vicinity of injection wells GMW-40, GMW-38-and GMW-39; and below the siltstone in the vicinity of GMW-17. However, due to the lack of deep wells on-site the extent of these sand lenses is unknown. Finally, the siltstone is underlain by a weathered shale layer.

Based on the above interpretation of boring logs, the lithology at the PerkinElmer site is much more complex than interpreted in the Remedial Investigation and subsequent reports. Burns & McDonnell states that monitoring wells GMW-19 through GMW-24 are all completed 'strictly' within the siltstone bedrock. This statement is not supported by boring logs. GMW-22 and GMW-23 are both screened in the siltstone. However, the boring log for GMW-20 states that the drill cuttings were too wet and too pulverized to determine the lithology and were therefore not logged. Hence, there is insufficient data to determine if this well is screened entirely in siltstone. In GMW-21 a 1 foot shale layer intersects the well screen and in GMW-24 the upper 2 feet is screened in shale while the lower 2 feet is screened in sandstone. In GMW-19 the upper 1 foot of the screen is in siltstone and the remaining 4 feet is screened in clay.

Published hydraulic conductivity for shale is 10^{-7} to 10^{-11} cm/s, and fractured siltstone is likely to be within the range of 10^{-7} to 10^{-3} cm/s (Freeze and Cherry, 1979). Effective porosity for the siltstone and shale, taken from *USEPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance*, dated April 1989, is likely between 5 to 10%, but could be considerably lower. The calculated horizontal hydraulic gradient for the shallow zone is 0.025, based on March 2001 piezometric surface elevation data. Using a hydraulic conductivity range of 10^{-7} to 10^{-3} with an average of 10^{-5} and an effective porosity of 10% yields a horizontal flow velocity range for the deep zone of 0.03 to 258.7 feet per year, with an average of 2.6 feet per year. Using an effective porosity of 5% would result in an increase of horizontal flow velocity range to 0.05 to 517.3 feet per year, with an average of 5.2 feet per year. These calculations do not take into consideration secondary porosity features such as fractures due to weathering and variations in lithology such as sandstone and clay lenses which could significantly impact the rate of contaminant migration.

VOCs in moderately to highly weathered siltstone bedrock will find the path of least resistance and migrate primarily through fractures and other secondary porosity features. Horizontally, COCs would likely travel downgradient through the siltstone and along the top of the underlying shale. Vertical gradient at both source areas between the shallow, intermediate and deep zone wells are downward. DNAPL is likely to migrate through secondary porosity features in the weathered shale layer to the underlying siltstone, sandstone, and clay.

Characterization of Horizontal and Vertical Extent of Contamination

Shallow Zone – Unconsolidated Soil

The horizontal extent of contamination in the unconsolidated shallow zone has not been determined. The number and locations of shallow zone monitoring wells are not sufficient to define the extent of the shallow zone contaminant plume. Shallow zone wells GMW-3 and GMW-8 are located along the south and east property boundaries, respectively. Both of these wells exhibit high levels of COCs. Shallow zone wells should be installed off-site to the south, east, and southeast to determine the extent of the contaminant plume. Additional wells may be necessary depending on the extent of the plume. Determining the extent of the shallow zone groundwater plume is necessary to assess the source of VOCs to indoor air off-site. Isoconcentration maps should be constructed for the shallow zone for each of the four COCs: PCE, TCE, DCE, and vinyl chloride.

Deep Zone – Siltstone and Shale Bedrock

The horizontal and vertical extent of contamination in the bedrock zone has not been determined. The number of bedrock zone monitoring wells on-site is insufficient to determine the horizontal extent of the contaminant plume. There are three intermediate zone wells, screened within both the soil and bedrock zones, and two deep zone wells screened within the bedrock. Additional bedrock wells are necessary on-site to define the horizontal extent of contamination and characterize the bedrock lithology within and surrounding the source areas. Additional off-site bedrock wells are necessary to define the off-site extent of the bedrock plume. Based on available boring logs a weathered shale layer is present below the alternating layers of siltstone, shale, clay, and sandstone. On-site monitoring wells in the vicinity of the source areas should be installed within this shale layer to determine the vertical extent of contamination. Isoconcentration maps should be constructed for each distinct bedrock zone (one for the interbedded siltstone and shale zone and one for the underlying shale) for each of the four COCs: PCE, TCE, DCE, and vinyl chloride.

Validity of Hydraulic Conductivity Data

Shallow Zone – Unconsolidated Soil

The hydraulic conductivity for native soil in the shallow zone was derived from tri-axial testing conducted in 1992. While hydraulic conductivity can be estimated by back calculation using tri-axial tests, tri-axial tests are designed to determine the strength and stress-strain properties of the soil. The sample was more likely compressed or reformed prior to testing. This would result in measuring the primary porosity, however, secondary porosity features found in-situ would not be measured in the lab. This would cause the estimated hydraulic conductivity to be biased low, especially in fine grained soils.

Deep Zone – Siltstone and Shale Bedrock

Pump test results conducted during the 1992 remedial investigation yielded a range of hydraulic conductivities of 3.9×10^{-4} to 6.9×10^{-3} cm/s for the siltstone. However, none of the well pairs used were screened in the same lithology nor were any of the wells screened entirely within the siltstone. Pump tests were conducted at four well pairs: GMW-14 and OW-2; GMW-14 and

OW-1; GMW-16 and GMW-14; and GMW-18 and GMW-5.

The pumping well and observation wells in each of these well pairs are partially or entirely screened in different zones. OW-1 and OW-2 are both 10 foot screens screened in the silty-clay soil; GMW-14 is a 5 foot screen, with the upper three feet in the silty-clay soil and the lower 2 feet in siltstone. GMW-16 is a 5 foot screen with the upper 2.5 feet in siltstone and the lower 2.5 feet in clay. There is a shale layer between the screened intervals of GMW-14 and GMW-16. GMW-5 is a 15 foot screen in the silty-clay soil and GM-18 is a 20 foot screen in the silty-clay soil and siltstone. Pumping tests using wells screened partially or completely in different zones will yield results representative of both zones. Therefore the hydraulic conductivity values obtained via the pump test may not be entirely representative of the siltstone, but will exhibit characteristics of all the zones in which the wells are screened.

Estimated Contaminant Flow Rate Calculations

Use of Darcy's Law

Burns & McDonnell calculated the flow rate for the siltstone groundwater plume using Darcy's Law. Darcy's Law applies to homogenous isotropic conditions and does not take into consideration issues such as secondary porosity. Bedrock beneath the PerkinElmer site and in the off-site residential area consists of moderately to severely weathered siltstone and shale with clay, clayey-gravel, and sandstone lenses. According to boring logs, portions of the siltstone are highly fractured. Dense non-aqueous phase liquid (DNAPL) is going to find the path of least resistance and travel downgradient through secondary porosity features. Therefore, especially in weathered rock, groundwater flow calculations are an estimate at best.

In addition, Burns & McDonnell uses an effective porosity of 30%. Based on the lithology at the site this value is high. Burns & McDonnell must provide documentation supporting the estimated effective porosity used in their calculations. Based on the lithology an effective porosity for siltstone and shale is more likely between 5 to 10%, but could be considerably lower. This value was taken from *USEPA Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance*, dated April 1989.

Travel Time Calculations

Burns & McDonnell conducted travel time calculations to determine the approximate probable distance that the groundwater plume from the site could have traveled between March 2001 and December 2004. Due to distance between GWM-19 and GMW-21 and the high concentrations in GMW-19 it is likely high concentrations exist somewhere between these two wells. Therefore, calculating the travel time from GWM-19 to GMW-21 is misleading. It would be more appropriate to calculate the approximate distance VOCs traveled from the source area since the time they were first detected at the site. VOCs were first detected on-site in 1988, thus travel time from 1988 to 2004 is 16 years. Using the same input parameters as Burns & McDonnell ($k = 1$ ft/day, $i = 0.04$, $n_e = 30\%$) and a travel time of 16 years the estimated travel distance from the source area is 780 feet. Using an effective porosity value range of 5 to 10% and keeping all other values the same increases the travel distance to between 1,460 and 2,920 feet. The distance from source area well GMW-6 to the nearest off-site well, GMW-19, is 330 feet. The distance between the former degreasing pit area (GMW-6 and GMW-15) and the farthest off-site well, GMW-23, is 850 feet. The distance between the former drum storage area (GMW-6, GMW14, and GMW-16) and the farthest off-site well, GMW-23, is 600 feet. Based on these calculations, there was more than enough time for contaminants to migrate from the source areas to the farthest off-site wells. While these calculations do not take into consideration degradation and retardation they also do not consider secondary porosity due to weathering and fractures or the varying bedrock lithology.

Source of Off-site Contamination

Shallow Zone – Unconsolidated Soil

Burns & McDonnell provided aerial photos showing the historical use of the off-site areas in the 1960's. These aerial photos indicate this area was a sporadic mix of industrial and residential development in 1960 and in 1967 all of the residences had been removed. By 1971, the off-site area returned to primarily residential with some industrial property to the northwest. If Burns & McDonnell suspects that these historical industrial facilities are a potential source to off-site groundwater contamination then soil investigation activities should be conducted within suspected source areas. Aerial photos alone do not provide sufficient evidence to back up these claims.

Burns & McDonnell states that potential anthropogenic flow pathways were evaluated as part of previous investigations but did not provide reference to the documents where these flow pathways were evaluated. Discussion of the 1960 aerial photos does not adequately address the issue of anthropogenic flow pathways. Anthropogenic flow pathways may include building sumps, drainage pits, subsurface utility conduits or possible buried drainage areas that can serve as conduits for groundwater or soil gas to enter or come into contact with buildings. These structures can provide preferential migratory routes resulting in accelerated conveyance of contaminants from one location to another. The routes may explain the occurrence of contaminants detected within the Chicago Heights Boulevard VOC Plume site residential area. These potential pathways must be investigated as a potential source for off-site contamination.

Deep Zone – Siltstone and Shale Bedrock

The department does not agree with Burns & McDonnell that detection of PCE and TCE in GMW-21 through GMW-24 are from other unknown or off-site sources. Burns & McDonnell asserts that a limited presence of daughter products (DCE and vinyl chloride) in downgradient off-site wells indicates that contamination in these wells are from other off-site sources and not associated with the groundwater plume from the PerkinElmer site. There are varying factors that could attribute to lack of daughter products in these wells. Due to the complex lithology and the distance of these wells from the source area aquifer conditions that contribute to natural attenuation may not be consistent throughout the plume. Evaluation of the groundwater data indicates that vinyl chloride is present in the shallow zone wells and intermediate zone wells near the source area. As you move away from the source area within the shallow zone, detections of vinyl chloride decrease significantly. Vinyl chloride has also not been detected or had limited detections in on-site or near off-site deep zone monitoring wells. Therefore, wells GMW-21 through GMW-24 are not the only wells with limited detections of daughter products. This could indicate that aquifer conditions are not favorable to degrade the DCE to vinyl chloride or the vinyl chloride is quickly being degraded to ethene and ethane. Monitored natural attenuation parameters including: oxidation-reduction potential, dissolved oxygen, pH, methane, ethene, and ethane should be collected in both the shallow zone and deep zone wells to determine what natural attenuation processes are occurring at the site. For further guidance on evaluating natural attenuation and remedy effectiveness please refer to the USEPA guidance document *Performance Monitoring for MNA Remedies for VOCs in Groundwater*, dated April 2004.

Burns & McDonnell also states "The pattern of detections in GMW-21 thorough GMW-24 is not consistent with only a source emanating from the PerkinElmer Site." First, two sampling events spaced three years apart is not enough data to establish a trend. Second, GMW-22 and GMW-23 are both screened entirely within the siltstone, while GMW-21 and GMW-24 are partially screened within the siltstone and partially screened within shale. Therefore, GMW-21 and GMW-24 may be monitoring different zones than GMW-22 and GMW-23 and with one another. This could result in lower concentrations in GMW-21 than the farther downgradient well, GMW-22.

Evaluation of Remedy Effectiveness

It is premature to conclude that the remediation goals of preventing additional off-site migration of contaminants and source treatment have been accomplished. There has not been any groundwater data collected since 2004 to determine if the permanganate injection is adequately treating the source area or determine if additional off-site migration has been prevented. Additional sampling of new and existing monitoring wells would be necessary to: 1) determine if injection of potassium permanganate is adequately remediating site wide groundwater; and 2) determine if the plume is stable, increasing or decreasing, especially since permanganate was found in several wells during the last several sampling events. Following collection of groundwater data, isoconcentration maps should be constructed and statistical and or plume stability analyses should be performed to evaluate remedy effectiveness.

The current groundwater monitoring well network is not sufficient to determine the horizontal or vertical extent of contamination. There are not sufficient off-site shallow wells to determine the extent of the shallow groundwater plume. Shallow zone wells should be installed off-site to the south, east, and southeast to determine the extent of the contaminant plume. Additional wells may be necessary depending on the extent of the plume. Determining the extent of the shallow zone groundwater plume is necessary to assess the source of VOCs to indoor air off-site.

There is an insufficient number of deep groundwater wells to adequately assess the horizontal and vertical extent of groundwater contamination in the source area. Additional bedrock wells are necessary on-site to define the horizontal extent of contamination and characterize the bedrock lithology within and surrounding the source areas. Additional off-site bedrock wells are necessary to define the off-site extent of the bedrock plume. On-site monitoring wells in the vicinity of the source areas should be installed within the lowermost shale layer to determine the vertical extent of contamination. Depending on vertical depth of contamination, the permanganate treatment may not have treated contaminants at depth.