BENNETT & WILLIAMS
ENVIRONMENTAL CONSULTANTS, INC.
2700 EAST DUBLIN-GRANVILLE ROAD • SUITE 400 • COLUMBUS, OHIO 43231-4054
TELEPHONE: (614) 882-9122 • FAX: (614) 882-4260 • 1-800-635-3810

MEMORANDUM

TO: Mark Bohne, PBOW RAB Co-Chair and RAB members

FROM: Julie Weatherington-Rice

RE: Public Educational Review for the RAB of the "Draft Final Engineering Evaluation / Cost Analysis Report at Reservoir No. 2 Burning Ground, Former Plum Brook Ordnance Works Sandusky, Ohio"

DATE: July 26, 2006

Per our current contractual arrangement with USACE which requires both a technical memorandum for each report and an educational explanation to the RAB, this memorandum constitutes our public education review of the Jacobs Engineering June 2006 Draft document "Draft Final Engineering Evaluation / Cost Analysis Report at Reservoir No. 2 Burning Ground, Former Plum Brook Ordnance Works Sandusky, Ohio". Please forward these comments to the other RAB members.

We will also be submitting a more "technical" memorandum to the USACE as well to help explain the information presented in this educational report. We will supply you with a copy of that memorandum as well, for your files.

As stated in the TNT-B report review earlier this month, for the record, one of the ultimate disposal points for the non-hazardous soils from this clean-up effort is probably the Erie County Landfill unless the soils are contaminated beyond the ability of the landfill to accept the materials. If the soils are determined to be of a low enough level of contamination, they can be used as daily cover at the landfill site. As was discussed in the last public meeting, the Erie County Landfill has a history of violations. A preliminary review of the ground water chemistry for the landfill in the 1990s by Bennett & Williams indicated potential off-site migration of contaminants from the landfill. Under the Ohio and Federal laws that govern solid waste management and disposal in

Ohio, if, at a later date, the Erie County Landfill is found to be in substantial non-compliance and is forced into corrective actions, such as a "Superfund" status, all identifiable entities who have disposed of materials at the site will be listed as Potential Responsible Parties (PRPs). An evaluation will be made at that time by US EPA as to the economic viability of each PRP to contribute to fund the clean-up of the facility.

This Draft document presents, in much more detail, the five options for final remediation of the Reservoir No. 2 Burning Grounds that were presented at the last RAB meeting at Firelands College. These options are simply described as: 1) do nothing; 2) dig everything up and move it off site; 3) remove contaminated materials from the No. 2 Burring Ground area, treat on site what can be treated, stabilize the lead in the soil, and haul off what can't be put back in the ground; 4) treat in position at the No. 2 Burning Ground what can be treated there, remove from the site the lead contaminated soils, stabilize them at Plum Brook, and haul off what can't be put back in the ground; and 5) treat in position at the No. 2 Burning Grounds what can be treated there, remove from the site the lead contaminated soils and compost them at Plum Brook with a suitable carbon-based source like chicken manure, cow manure and/or straw, and haul off what can't be put back into the ground. The Draft Report indicates that Alternatives 2, 3, 4, and 5 will probably meet US and Ohio EPA requirements. It also indicates that Alternatives 3, 4, and 5 will result in a more limited truck traffic impact on the local community. They then prepare cost analyses to determine which alternatives are the most cost effective and which still get the job done.

For the most part, the document is complete. There was, however, one important oversight that could, if not corrected before the site restoration is completed, make it difficult, if not impossible to grow grass on the site after the site restoration is completed. The issue is the retention of the high pH (11.0 or higher) materials on site for backfill and/or regarding materials at the No. 2 Burning Ground site. If the pH of the top three feet of the restored site is too high (above 9.0 or lower depending on the "grass" being grown), it may not be possible to get grass to easily grow there again. Anyone who has seen the barren expanses of lime and alum coagulation slurry pits of a public water treatment plant has witnessed the effect of a high pH landscape. High pH conditions can create an alkali "desert" in the midst of a green-grassed area in Ohio. It is this issue that we chose to address in some detail since it could have a long-term detrimental impact on the site restoration process. The rest of this review addresses this issue.

Engineering Review – Identified pH Vegetation Growth Upper Limit Issue

Since this is an "engineering evaluation" the draft report was reviewed first by Michael D. Robison, PE, of our firm, for engineering considerations to assure adherence to standardized engineering protocol for this type of a document and then by myself for continuity on the Plum Brook project. In his review, Mr. Robison found no deviations from standard engineering format in this draft report. He did, however raise a concern about the residual pH values and phosphate loadings as they relate to seed germination and vegetative growth of the "grass" cover for the either replaced and/or treated in place re-graded lime slurry application areas for Alternatives 3, 4, and 5.

He raised this issue because of a pervious demonstration project with Ohio Department of Natural Resources that Bennett & Williams had participated in a number of years ago. As part of a pilot project supported by American Electric Power, high pH lime scrubber slurry from the coal-fired Conesville, Ohio electrical generating plant was used as a soil substitute for abandoned mine-land reclamation projects in eastern Ohio. While the high pH lime materials did an excellent job of neutralizing the acid strip mine materials, the resulting "soil" had a pH reading so high that grass seeds either failed to germinate and/or the resulting grass failed to thrive. Revegetation of the sites proved to be a difficult undertaking that required several years to resolve. Therefore, Mr. Robison asked me to research this issue as part of my review so that this same unfortunate situation would not be repeated at Plum Brook.

Vegetation Limiting Phosphorus and pH Issues Researched

Since this draft report does not specify which "grass" is to be planted at the re-graded Reservoir No. 2 Burning Grounds after treatment and restoration are completed, I am assuming that the grass seeding of choice will be a typical fescue(s) and/or a fescue/bluegrass/rye mixture. While we recognize that the phosphate augmentation to stabilize the lead in the soil is planned for "disposed of" materials, I am adding the phosphorous information as well for basic information.

As a general rule of thumb, available phosphorous values should not exceed 400 pounds per acre. Levels higher than that can result in impacts to seed germination and the stunting of vegetative growth. There is also the potential for release of bound phosphates to surface water if the field capacity is above that reading. This would be especially problematical at Plum Brook since Lake Erie has just recently experienced a renewed upswing it its phosphorus loading levels after many years of declining levels. Plum Brook drains directly to Lake Erie, thereby potentially increasing the loading levels to the lake at a time when other researchers are trying to quantify the source(s) for the upswing and reduce the loading rates again.

The final grass seed selection will dictate the final pH limitations of the re-graded site. In addition, since fescues can have root masses that extend three feet (or more) in depth below the surface of the ground while Kentucky bluegrasses have roots only about six inches in depth, the specific seeding choices also impact how deep the final pH readings must be monitored for successful revegetation. Most of the available on-line extension bulletins addressing pH limitations for seed germination and/or plant growth from the various land-grant universities seem to be addressing low pH limitations and/or optimum pH conditions. The condition at Plum Brook will be a high pH limitation. I did find a useful reference on tall fescue management from West Virginia University Extension Service that recommended a pH in the range of 5.8 to 6.5 for highest productivity. Since the lime stabilization process calls for raising the pH to 11, these optimum values are significantly below the resulting materials that will be used for fill and/or left in place after treatment. Additional publications from other universities indicated the same general range of ideal growing conditions.

There is, however, another way to address this issue. I was able to locate an excellent reference from Ernst Conservation Seeds. Their catalogue lists each grass and forbs by individual pH requirements and allows the customer to purchase either straight seed or a blended seed. A quick review of their information indicates that tall fescue *(festuca arundinacea) (F. elatior)* can be grown in settings that include *"Low fertility, acid, clay, loamy and sandy soils, pH 5.0 to 9.0. Partial shade tolerant. Drought tolerant."* Most of the other fescues, ryes and bluegrasses have lower upper pH thresholds. For instance, Perennial Ryegrass *(Lolium perenne)* has an upper pH limitation of 7.5 and Kentucky Bluegrass *(Poa pratensis)* has an upper pH limitation of 8.4. Therefore, if it is possible to mix the ex-situ or in-situ lime slurry treated materials with other materials on the site to insure a pH reading of no higher than 7.5 or so to a depth of three feet, revegetation of the site should be much less of a problem.

Incorporating this Issue into the Project Steps and Costs

Such an effort is not identified and included in the "Draft Final Engineering Evaluation / Cost Analysis Report at Reservoir No. 2 Burning Ground, Former Plum Brook Ordnance Works Sandusky, Ohio". To incorporate this work effort, it would be necessary to incorporate a work item after the 24-hour hydrated lime treatment that would require that the resulting materials be blended with either on-site or off-site materials to reduce the resulting "fill" materials to a pH of below 7.5, if possible. The mechanisms for this process will be different for the Alternative 3 "Ex Situ Treatment" than it will be for the Alternatives 4 and 5 "In Situ Treatment" of the TNT, DNT, and benzo(a)pyrene portions of the site.

The depth of the neutralization mixing zone will be determined, in part, by the type of "grass" vegetation specified. It may well be necessary to take on-site pH readings of the regarded soils to insure that the resulting final pH levels are low enough so that seed germination and plant growth are possible. That on-site testing may be possible with field equipment, thereby reducing the need for additional samples to be sent to the lab. **It should be noted that this issue in no way reflects on the technical processes being considered for site remediation in this Draft report. This issue is only important in terms of trying to revegetate the site after the remediation and regarding has been completed.**

Specific Comments

4.1.2 Hydrated Lime Treatment

This section might be a suitable location to address the issue of final pH values of these materials when used for site restoration.

4.1.4 In Situ Soil Tilling

This section might also benefit from a discussion of the final pH levels needed for site revegetation. It is also important to note that the uniformity of pH values with this technique may not be as continuous as those values achieved in the ex situ mixing situation. Therefore, while there may be areas with pHs lower than the planned for pH of 11, there is also the very real possibility of areas with pH values above 11. The potentially greater variable range of pH values using this technique may require different remediation processes to lower the final pH reading or the materials as used in the final restoration.

4.2.3 Alternative 3: Ex Situ Treatment

This section needs a discussion about how the *"Treated soil that meets the PRG concentrations levels for DNT, TNT, PCBs, PAHs and lead would be used as on-site backfill material"* would be subsequently remediated to lower the resultant pH level of 11 if some and/or all of that material has also undergone the ex situ lime slurry treatment phase.

If ex situ lime slurry treatment materials are ultimately used as backfill and restoration materials, then at least a portion of this description will be different than that described for Alternative 2 if the site closure plans call for revegetation of the site (see last paragraph middle of page 16). A more specific seeding requirement would be useful here to determine the depth needed for reneutralized high pH materials.

4.2.4 Alternative 4: In Situ Treatment

The issues regarding the final pH values for the remaining in situ lime treatment materials might be addressed in the second paragraph. A more specific seeding requirement would be useful here to determine the depth needed for the reneutralized high pH materials.

4.2.5 Alternative 5: Composting

The concern here is identical to that identified in 4.2.4.

5.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This section may benefit from a very short discussion that identifies the resulting hydrated lime slurry mixture as having a pH too high to support most types of plant growth. The second step, post treatment may increase the cost of this alternative.

5.5.2 Compliance with ARARs

This section may also benefit from a very short discussion that identified the resulting in situ hydrated lime tilled materials as having a pH too high to support most types of plant growth. The second step, post treatment may increase the cost of this alternative.

5.6.2 Compliance with ARARs

Same comment here as in 5.5.2.

6.6 Technical Feasibility

This section may also need to be revised to discuss the second step, post treatment processes needed to restore the site pHs to levels that will support typical Ohio vegetation such as grasses

6.11 Cost

These costs may have to be modified depending how the second step, post treatment pH issue is addressed. It would also be helpful to specify at least which family(ies) of grasses are being considered for revegetation.

The resulting issues of second step, post treatment pH remediation will carry though the report to each section and cost table, depending on whether the resulting solution(s) will create enough change in process(s) to require an additional step(s) or whether, now identified at this Draft stage, the reblending of the on-site soils can be specified in such a way that little or no additional costs would be required.

This concludes our educational comments on this Draft Report.

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