State Form 4336

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
INDIANAPOLIS

OFFICE MEMORANDUM

***Not for Public Release**

Date: December 18, 2014

To: Andrea Robertson
Brownfields

From: Jim Risch
Chemistry Services Section

Subject: Radiochemistry Results for Reid Hospital
Richmond, Wayne County, Indiana
Site # 4131015
Sampled: July 29-30, 2014
Sample Numbers: SB-5 to SB-13
Pace Analytical Services – Greensburg, Pennsylvania

I reviewed the groundwater radiochemistry results for the samples identified above, as well as the Cardno ATC Sampling and Analysis Plan and Quality Assurance Project Plan (SAP and QAPP, both dated June 13, 2014) and Phase II Investigation Report (dated August 29, 2014). I also spoke with Jane Smith with ISDH, regarding her comments on the results. Pace Laboratory has not responded to the e-mail questions I had after my discussion with Jane, and I have not seen the Pace Laboratory SOP (Appendix C to the QAPP). However, based on my current understanding of the results, I have the following comments:

Reading the results

Radiochemistry results submitted to Chemistry for review are typically presented in the form of a concentration in picocuries per liter (pCi/L) and reporting limit (RL), also in pCi/L. This format allows for simple comparison with a screening level. However, for the Reid Hospital results, Pace Laboratory used the format:

Act ± Unc (MDC) Carr Trac

Act = Activity in pCi/L, which is the same as concentration above. Unc = Uncertainty, which appears to give a 95% confidence interval for the activity result. MDC = Minimum Detectable Concentration, which is comparable to the RL above. Carr = Carrier Recovery and Trac = Tracer Recovery, which appear to be "not applicable" for the Reid Hospital data, so no explanation needed.

Therefore, as an example, the gross alpha activity result for sample SB-8 [112 ±25.7 (11.6)] means the result is between 86.3 to 137.7 pCi/L with 95% confidence, and RL of

11.6 pCi/L.

Analytical methods

The listed methods were EPA 900.0 for gross alpha & beta and EPA 901.1 for gamma emitting radionuclides. Jane Smith expressed concerns that Pace did not follow the listed methods. I investigated and have the following comments:

- **Reporting limit (RL)**: Table 3a of the Reid Hospital QAPP lists reporting limits for gross alpha (3 pCi/L), gross beta (4 pCi/L) and gamma emitters (1 pCi/L) that correspond to the method specifications. The footnote on Table 3a states the RLs are "subject to change." The MDCs listed in the Pace lab data did not meet RLs listed in the QAPP, and in many cases were much higher. Section 3.7.1 of the Reid Hospital SAP states: "the laboratory will be notified that the detection limits for analytical samples should be low enough to compare against the respective RCG Screening Levels." There are currently no RCG Screening Levels for radionuclides, although the gross alpha MCL (15 pCi/L) is often used. Therefore, it appears that Pace did not provide RLs that meet the requirements of the methods. However, since no clear screening levels were set in the QAPP and SAP or communicated to the lab, Pace was not required to adjust the analyses to achieve lower RLs.
- **Sample size**: For both methods EPA 900.0 and EPA 901.1, the reporting limit depends partly on the sample size chosen for analysis. Sample size may also be chosen based on the instrument and instrument settings used and the characteristics of the sample analyzed (esp. solids density for EPA method 900.0). The Pace lab sample preparation sheets show an approximate 9 g sample size for EPA 900.0 and 2.0 L sample size for EPA 901.1. I could not determine how sample size was set, or if the size was adjusted during the analyses. These procedures may be listed in the Pace lab SOP, and therefore clearly acceptable for this project.
- **Count time**: For both methods EPA 900.0 and EPA 901.1, the reporting limit also depends partly on the count time chosen for analysis. Technical Notes for EPA Method 900.0 states that "the maximum recommended count time is 1,000 minutes. If the RL cannot be achieved in that time period a different instrument (i.e., higher efficiency), a larger sample or a different method should be used." Method EPA 901.1 states "Sample aliquots are counted long enough to meet the required sensitivity of measurement." The Pace lab data showed count times of 600 min for EPA 900.0 and 60 min for EPA 901.1. I could not determine how these times were set or if they were adjusted for the analyses. These procedures may also be listed in the Pace lab SOP, and therefore acceptable for the project.
- **Interference**: Method EPA 901.1 notes that significant interference may occur when the sample radionuclides emit gamma photons of nearly identical energies.

Jane noted peak overlap in the results spectra and questioned the quantification of several isotopes, esp. radium-226 and radium-228 by this method. However, there is significant uncertainty for the results of the 10 isotopes listed for each sample in the Pace lab data. I could not determine whether this uncertainty was properly evaluated, but it appears that the results are qualified by the uncertainty to account for interference.

Significant results

The Cardno ATC Phase II report stated: *One or more radionuclides were detected in all of the groundwater samples tested (SB-5 through SB-14). Although the IDEM has not published screening levels for radionuclides, the concentration of gross alpha particles detected in the groundwater samples collected from SB-6 through SB-14 exceeded the U.S. EPA drinking water standard of 15 picocuries per liter (pCi/L).* Since no screening levels were established for this project prior to collecting samples, I could not easily determine which results showed significant radionuclide impact.

As a conservative estimate, I considered a result significant if: **Act – Unc > MDC**. The following results were significant by this definition:

- SB-5: gross beta, Lead-214
- SB-6: gross alpha, gross beta, Bismuth-214, Lead-212, Lead-214, Potassium-40, Thallium-208
- SB-7: gross alpha, gross beta, Bismuth-214, Lead-212, Lead-214, Potassium-40, Radium-228, Thallium-208
- SB-9: gross alpha, gross beta
- SB-8: gross alpha, gross beta, Bismuth-214, Lead-214
- SB-10: gross alpha, gross beta
- SB-11: gross alpha, gross beta, Bismuth-214, Potassium-40
- SB-12: gross alpha, gross beta, Bismuth-214
- SB-13: gross alpha, gross beta
- SB-14: gross alpha, gross beta

Conclusion

Groundwater samples SB-6 to SB-14 showed significant impact from radionuclides. Although Pace labs did not reply to my e-mail regarding Jane Smith's comments, and I did not have a copy of the Pace labs SOP for review, it appears from the lab data that Pace followed their standard procedures for the EPA 900.0 and EPA 901.1 analyses and was not required to adjust the tests to achieve lower reporting limits. The July 2014 groundwater results are usable for planning additional sampling at the Reid Hospital site. If set screening levels are needed for future groundwater sampling, then these levels must be communicated to the lab so that appropriate adjustments may be made to the analyses.