Radioactive Waste Management Associates

Memo

To: G Abraham, Esq

From: M Resnikoff

CC: J Travers

Date: 6/30/2010

Re: June 9 NEWSNY filing

During the development phase of drilling it can be expected that mostly background cuttings, together with extant and introduced drilling fluids will be brought up to the surface. However, as we have previously shown, gamma logs (GAPI), USGS testing and DEC testing establishes that the radioactivity of Marcellus shale rock cuttings by themselves is approximately 25 times higher than surface background. When drilling horizontal boreholes within the Marcellus shale formation, one expects to see much higher radioactivity in solid waste, but the CoPhysics and Billman reports claim otherwise.

Billman report. Billman states he washed the rock cuttings (what Billman calls "rock dust") and examined them under a microscope. Based on the black color, he concluded these were Marcellus shale. There is no indication in the report that Billman examined the drilling logs.

West p. 1, para. 2,3: West argues that our critique of the samples, that they may not be of the horizontal boring in the Marcellus shale, has been answered by Billman. As far as we are aware, Billman did not examine the drilling logs. An explanation for the disparity between the overwhelming independent evidence that Marcellus shale cuttings are highly radioactive and Billman's and CoPhysics' contrary conclusion is that the Ra-226 was washed out of the cuttings prior to analysis. This can only be discovered by cross-examining NEWSNY's researchers.

West, p. 2, para. 3: West argues that our numbers are off by a factor of 1000. We agree. Our calculations were correct as far as they went – we calculated the detectable dose rate at a point and did not integrate over the face of the detector, which would increase the sensitivity of the detector. West goes on to argue that the detectors are sensitive down to 1 pCi/g radium-226. We disagree on this point. NEWSNY lists background radiation as 8 microR/hr. Unfortunately, to convert radionuclide concentrations in Marcellus shale drilling wastes (pCi/g) into dose rates (microR/hr), NEWSNY uses a concentration to exposure rate conversion factor for radium in soil of 2.7 microR/hr per pCi/g based on a mix of radionuclides that would be present at a uranium mill[1]. Uranium mill waste may not be the same as Marcellus shale.

[1] New England Waste Services of New York (NEWSNY), "Calculation of Radiation Monitor Alarm Setpoint and Procedure to Reject or Accept NORM," (2010).

In order to determine whether NEWSNY's radiation detectors are actually sensitive down to 1 pCi/g Ra-226 and its progeny, we use the dose conversion factors presented in the US EPA's Federal Guidance Report No. 12[2] (FGR 12). These dose conversion factors apply to exposure to soil contaminated with radionuclides. Most Marcellus shale drill cuttings are roughly the size of coarse sand. We believe these dose conversion factors better represent Marcellus shale drilling wastes than uranium mill tailings because uranium mill waste contains a large amount of uranium and all of its decay products whereas Marcellus shale drill cuttings contain little uranium and mostly Ra-226 and its decay products. 1 pCi/g of Radium-226 and its progeny thus produces a dose rate of 1.28 microR/hr. Taking into account attenuation due to truck metal, a factor of 0.79 (see below), the dose rate is 1.01 microR/hr, approximately 10% of background. It is therefore likely that 1 pCi/g Ra-226 would be lost in background noise.

Radiation monitor set point. We have concerns about the calculation of the radiation monitor set point and the procedures to accept or reject NORM. These were briefly laid out in an email and are discussed here in more detail, together with the June 9th NEWSNY filing.

1) NEWSNY states that the alarm should be set at 15 pCi/g for Ra-226. We disagree. The alarm level should be set at 5 pCi/g, for total Ra (Ra-226 + Ra-228), because 5 pCi/g is the RCRA cleanup standard for surface soil at contaminated sites. For Ra-226, background for surface soil in NYS is less than 1 pCi/g; this is also the background in the drill hole down to the Marcellus shale formation.

2) Using MicroShield, the attenuation factor for 1/8" steel is not 0.84 as claimed by NEWSNY, but 0.68 for Ra-226 alone. However, NEWSNY does not make clear for which radionuclides it is calculating the attenuation factor: Ra-226 alone (0.68), Ra-226 and its decay products (0.79) or U-238 and its decay products (0.78). None of these factors is the same as NEWSNY's 0.84.

3) According to NEWSNY, the dose rate due to Ra-226 and its family of radionuclides at 15 pCi/g is 40.5 microR/hr (15 pCi/g Ra-226 * 2.7 microR/hr per pCi/g), or 13.5 microR/hr for Ra-226 at 5 pCi/g. We agree with NEWSNY if the material is U-238 and its decay products, not Ra-226 and its decay products. If we assume only Ra-226 and all its decay products are in secular equilibrium at 5 pCi/g, then using the dose conversion factors from EPA's FGR12[3], the unshielded dose rate is 6.4 microR/hr (Table 1). Taking NEWSNY's assumption, and 2) above, the dose rate through the truck wall is approximately 5.1 microR/hr, which is then added to background. That is, the detector would have to see background plus approximately 60%. To achieve this, the alarm set point must be set at 5 pCi/g for total Ra (Ra-226 + Ra-228).

4) NEWSNY wishes the set point to be at 15 pCi/g as an investigation level, and at 50 pCi/g for a rejection level. We disagree. We would set the rejection point at 5 pCi/g, the RCRA cleanup concentration for surface soil. Above this point, the truck should either be returned to the drilling site, or to a site that disposes of similar radioactive material, such as Energy Solutions in Clive, Utah. Energy Solutions accepts NORM and uranium mill tailing and processing waste materials[4] and the facility has accepted uranium wastes from places such as Wayne, Maywood, and Montclair, New Jersey that processed uranium during the Manhattan Project. For example, the CWM Chemical Services' commercial hazardous waste facility is not permitted to accept any materials that contain more than trace amounts of radioactivity. The trace amount limitation for radium is defined as 5 pCi/g[5]. See Attachment.

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[2] US EPA, "External Exposure to Radionuclides in Air, Water and Soil," Federal Guidance Report No. 12, EPA 402-R-93-081 (1993).
[3] *Ibid*
[4] Energy Solutions, "Energy Solutions – Clive," Website URL: http://www.energysolutions.com/?id=OTkw (undated). Accessed 30 June 2010.
[5] Merges, P., NYS Department of Environmental Conservation, letter to J. Knickerbocker, CWM Chemical Services (1999).

5) **West, p. 2 para. 4,5**: West argues that EPA 901.1, written for gamma emitting radioactivity in water, is adequate to measure radium-226. We disagree. If Ra-226 is in secular equilibrium with Bi-214, a strong gamma emitter, then a gamma spec measurement under EPA 901.1 would be sufficient. This is an assumption by CoPhysics. But it is likely not the case that Bi-214 is in secular equilibrium with Ra-226, because the drilling process increases the concentration of Ra-226 relative to Bi-214. This is seen in the radioactive concentrations in brine, as shown in DEC data. The Superfund sites that West mentions in his letter (page 2) are not identified as drilling sites.

Ra-226 is likely not in equilibrium with Bi-214. As seen in brine measurements taken by DEC[6] (Table 2), Ra-226 is not in equilibrium with U-238. Ra-226 concentrations are enhanced compared to U-238. Almost the entire gross alpha measurement is due to Ra-226. While Bi-214 is not directly measured in DEC's brine measurements, little can be due to the parent radionuclides of Bi-214 because unlike Ra-226, Bi-214 is not soluble in water. Therefore it is important that Ra-226 be measured separately and that Bi-214 not be used as a surrogate. However, CoPhysics cannot separately measure Ra-226 because it is not ELAP-certified by the State of New York.

CoPhysics is not ELAP-certified. Since CoPhysics is not certified to analyze radiochemistry in the State of New York under Department of Health regulations[7], its analytical results are questionable. Because it is not a licensed environmental laboratory, CoPhysics is unable to measure Ra-226 and Ra-228 and must instead measure chemical surrogates, Ac-228 and Bi-214, respectively. Direct measurement of concentrations of Ra-226 and Ra-228 in a sample requires a lab to chemically separate radium while maintaining an environmentally closed system, and then measure the emanation of radon gas once radium and radon within the system achieve equilibrium, as in EPA 903.1[8]. When Ra-226 is leached from the shale and Bi-214 is not (because the former but not the latter is water soluble), it can be expected that shale cuttings will contain substantially more Ra-226 than Bi-214. Measuring Bi-214 in a waste sample, while it may be a simpler and less costly approach, is therefore an improper method for determining the expected concentration of Ra-226 in the waste.

What will be disposed of at the Chemung County landfill? To determine what is coming to the Chemung County landfill, we need to have the rock flour exactly as it would be disposed of. The liquid that is contained in the rock flour is likely enhanced in Ra-226 because extant brine in the shale formation is the same as "production brine" and will be brought to the surface with other drilling wastes. Some of this liquid brine will be contained in the solid waste even after dewatering. This liquid is much more radioactive than cuttings alone. See Table 2. The sampling, preparation and analytical steps taken by CoPhysics and Billman can only be discovered by cross-examining witnesses.

Environmental Impacts of Shale Disposal

The June 9 submissions by NEWSNY fail to address the bioaccumulative effects of environmental exposure to Ra-226 in the landfill's leachate, should substantial volumes of Marcellus shale drilling wastes be disposed of in the landfill. We previously raised this issue in our initial submission on April 6, 2010 when we discussed the possibility of radiologically contaminated leachate treated at the City of Elmira waste water treatment plant and disposed of at the landfill entering the Chemung River[9].

Radium-226 contaminated leachate that leaks from the Chemung County landfill will bioaccumulate in food organisms. This means that food organisms take up radium at a faster rate than it is lost from

[6] NYSDEC, "Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program, Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs," Appendix 13, pp. cxxiii-cxxvii (2009).
[7] NYSDOH, "ELAP Labs Certified for Radiochemistry," Website URL: http://www.wadsworth.org/labcert/elap/radiochem.html (Accessed 28 June 2010). (According to NYSDOH, CoPhysics is not listed as an ELAP certified laboratory. Furthermore, there are no ELAP certified laboratories in Monroe County, NY where the CoPhysics laboratory is located.)
[8] US EPA, "Radon Emanation Technique for Radium-226 in Drinking Water: Method 903.1," Website URL: http://www.epa.gov/waterscience/methods/method/files/903_1.pdf (2007). Accessed 29 June 2010.
[9] Resnikoff, M., "Radioactive in Marcellus Shale," memorandum to Gary Abraham, Esq. (2010).

their bodies. Since the chemical properties of radium are similar to those of calcium, high levels of radium can concentrate in tissue, bone, shell, and exoskeletons of these organisms. If aquatic organisms such as fish and shellfish accumulate radium in their bodies, humans that eat fish and shellfish will be exposed to elevated levels of radium. The Chemung County Landfill is located approximately one half mile from the Chemung River which is home for several freshwater fish species such as the smallmouth and largemouth bass, trout, sunfish, bluegill, and carp. The Chemung River is known to be a popular site for recreational fishing.

Several studies have been performed to observe the uptake of radium in aquatic organisms. One study carried out by Jeffree and Simpson found that oysters can accumulate radium-226 in a linear manner from produced water containing radium at levels which were much lower than those measured in the coastal waters of Louisiana[10]. The same study which also looked at the effects of uranium mill tailings on freshwater mussels found that mussels accumulated a dry weight tissue mean concentration of 679 pCi/g radium-226 when exposed to a water concentration of 50 pCi/L of radium-226 for 56 days. In addition, it was observed that the freshwater mussels retained radium-226 for 286 days after being placed in radium free water[11]. Similarly, a study performed at two offshore production platforms in the northern Gulf of Mexico detected measurable levels of radium-228 in the skin, fillet, and bone of red snapper and the skin of blue fish in the vicinity of the platforms[12].

Water lilies, mussels, and snapping turtles in freshwater streams receiving drainage from uranium mines in the Northern Territory of Australia have also been found to accumulate radium from the water. Water lilies exposed to 11.7 pCi/L radium-226 for 35 days accumulated radium to a dry weight concentration of more than 54 pCi/g[13]. In addition, edible tissues of trout in surface ponds near an open pit uranium mine were found to contain dry weight concentrations up to 0.15 pCi/g Ra-226 when exposed to pond water that contained 12 to 33 pCi/L[14].

[10] Jeffree, R.A. and R.D. Simpson, 1986. "An Experimental Study of the Uptakes and Loss of Ra-226 by the Tissue of the Tropical Freshwater Mussel Velesunio angasi (Sowerby) Under Varying Ca and Mg Water Concentrations," Hydrobiologia, 139:59-80.
[11] *Ibid*
[12] Continental Shelf Associates, Inc. 1992. "Measurements of Nationally Occurring Radioactive Materials at Two Offshore Production Platforms in the Northern Gulf of Mexico, Preliminary Data Report," Prepared for the American Petroleum Institute.
[13] Twining, J.R., 1988. "Radium Accumulation from Water by Foliage of the Water Lily, Nymphaea violacea," International Association of Theoretical and Applied Limnology/Travaux.
[14] Rope, S.K. and F.W. Whicker, 1985. "A Field Study of Ra Accumulation in Trout with Assessment of Radiation Dose to Man," Health Physics, 49: 247-257.

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Twining, J.R., 1988. "Radium Accumulation from Water by Foliage of the Water Lily, Nymphaea violacea," International Association of Theoretical and Applied Limnology/Travaux.

United States Environmental Protection Agency (US EPA), "Radon Emanation Technique for Radium-226 in Drinking Water: Method 903.1," Website URL: http://www.epa.gov/waterscience/methods/method/files/903_1.pdf (2007). Accessed 29 June 2010.

US EPA, "External Exposure to Radionuclides in Air, Water and Soil," Federal Guidance Report No. 12, EPA 402-R-93-081 (1993).

Tables

Table 1. Unshielded Dose Rate from Radium-226 and Progeny Using External Radiation Dose Conversion Factors from FGR 12

Radionuclide	Scale Concentration pCi/g	DCF - Soil Contaminated to an Infinite Depth ($Sv-m^3/Bq-s$) Effective	DCF - Soil Contaminated to an Infinite Depth (mrem-g/uCi-y) Effective	DCF - Soil Contaminated to an Infinite Depth (mrem-g/pCi-y) Effective	DCF - Soil Contaminated to an Infinite Depth (mrem-g/pCi-hr) Effective	DCF - Soil Contaminated to an Infinite Depth (urem-g/pCi-hr) Effective	Dose Rate (urem/hr) Effective
Ra-226	5	1.70E-19	3.18E+04	3.18E-02	3.63E-06	3.63E-03	1.81E-02
Rn-222	5	1.26E-20	2.35E+03	2.35E-03	2.69E-07	2.69E-04	1.34E-03
Po-218	5	3.02E-22	5.64E+01	5.64E-05	6.44E-09	6.44E-06	3.22E-05
Pb-214	5	7.18E-18	1.34E+06	1.34E+00	1.53E-04	1.53E-01	7.66E-01
Bi-214	5	5.25E-17	9.81E+06	9.81E+00	1.12E-03	1.12E+00	5.60E+00
Po-214	5	2.75E-21	5.14E+02	5.14E-04	5.86E-08	5.86E-05	2.93E-04
Pb-210	5	1.31E-20	2.45E+03	2.45E-03	2.79E-07	2.79E-04	1.40E-03
Bi-210	5	1.93E-20	3.61E+03	3.61E-03	4.12E-07	4.12E-04	2.06E-03
Po-210	5	2.80E-22	5.23E+01	5.23E-05	5.97E-09	5.97E-06	2.99E-05
						Total (urem/hr):	**6.39E+00**

Table 2. NYS Marcellus Radiological Data from Production Brine

Well	API #	Date Collected	Town (County)	Parameter	Result +/- Uncertainty
Maxwell 1C	31-101-22963-03-01	10/7/2008	Caton (Steuben)	Gross Alpha	17,940 +/- 8,634 pCi/L
				Gross Beta	4,765 +/- 3,829 pCi/L
				Cesium-137	-2.26 +/- 5.09 pCi/L
				Cobalt-60	-0.748 +/- 4.46 pCi/L
				Ruthenium-106	9.27 +/- 46.8 pCi/L
				Zirconium-95	37.8 +/- 21.4 pCi/L
				Radium-226	2,472 +/- 484 pCi/L
				Radium-228	874 +/- 174 pCi/L
				Thorium-228	53.778 +/- 8.084 pCi/L
				Thorium-230	0.359 +/- 0.221 pCi/L
				Thorium-232	0.065 +/- 0.103 pCi/L
				Uranium-234	0.383 +/- 0.349 pCi/L
				Uranium-235	0.077 +/- 0.168 pCi/L
				Uranium-238	0.077 +/- 0.151 pCi/L
Frost 2	31-097-23856-00-00	10/8/2008	Orange (Schuyler)	Gross Alpha	14,530 +/-3,792 pCi/L
				Gross Beta	4,561 +/- 1,634 pCi/L
				Cesium-137	2.54 +/- 4.64 pCi/L
				Cobalt-60	-1.36 +/- 3.59 pCi/L
				Ruthenium-106	-9.03 +/- 36.3 pCi/L
				Zirconium-95	31.6 +/- 14.6 pCi/L
				Radium-226	2,647 +/- 494 pCi/L
				Radium-228	782 +/- 157 pCi/L
				Thorium-228	47.855 +/- 9.140 pCi/L
				Thorium-230	0.859 +/- 0.587 pCi/L
				Thorium-232	0.286 +/- 0.328 pCi/L
				Uranium-234	0.770 +/- 0.600 pCi/L
				Uranium-235	0.113 +/- 0.222 pCi/L
				Uranium-238	0.431 +/- 0.449 pCi/L
Webster T1	31-097-23831-00-00	10/8/2008	Orange (Schuyler)	Gross Alpha	123,000 +/- 23,480 pCi/L
				Gross Beta	12,000 +/- 2,903 pCi/L
				Cesium-137	1.32 +/- 5.76 pCi/L
				Cobalt-60	-2.42 +/- 4.76 pCi/L
				Ruthenium-106	-18.3 +/- 44.6 pCi/L
				Zirconium-95	34.5 +/- 15.6 pCi/L
				Radium-226	16,030 +/- 2,995 pCi/L
				Radium-228	912 +/- 177 pCi/L
				Thorium-228	63.603 +/- 9.415 pCi/L
				Thorium-230	0.783 +/- 0.286 pCi/L
				Thorium-232	0.444 +/- 0.213 pCi/L
				Uranium-234	0.232 +/- 0.301 pCi/L
				Uranium-235	0.160 +/- 0.245 pCi/L
				Uranium-238	-0.016 +/- 0.015 pCi/L

Well	API #	Date Collected	Town (County)	Parameter	Result +/- Uncertainty
Calabro T1	31-097-23836-00-00	3/26/2009	Orange (Schuyler)	Gross Alpha	18,330 +/- 3,694 pCi/L
				Gross Beta	-324.533 +/- 654 pCi/L
				Cesium-137	3.14 +/- 7.19 pCi/L
				Cobalt-60	0.016 +/- 5.87 pCi/L
				Ruthenium-106	17.0 +/- 51.9 pCi/L
				Zirconium-95	24.2 +/- 13.6 pCi/L
				Radium-226	13,510 +/- 2,655 pCi/L
				Radium-228	929 +/- 179 pCi/L
				Thorium-228	45.0 +/- 8.41 pCi/L
				Thorium-230	2.80 +/- 1.44 pCi/L
				Thorium-232	-0.147 +/- 0.645 pCi/L
				Uranium-234	1.91 +/- 1.82 pCi/L
				Uranium-235	0.337 +/- 0.962 pCi/L
				Uranium-238	0.765 +/- 1.07 pCi/L
Maxwell 1C	31-101-22963-03-01	4/1/2009	Caton (Steuben)	Gross Alpha	3,968 +/- 1,102 pCi/L
				Gross Beta	618 +/- 599 pCi/L
				Cesium-137	-0.443 +/- 3.61 pCi/L
				Cobalt-60	-1.840 +/- 2.81 pCi/L
				Ruthenium-106	17.1 +/- 29.4 pCi/L
				Zirconium-95	26.4 +/- 8.38 pCi/L
				Radium-226	7,885 +/- 1,568 pCi/L
				Radium-228	234 +/- 50.5 pCi/L
				Thorium-228	147 +/- 23.2 pCi/L
				Thorium-230	1.37 +/- 0.918 pCi/L
				Thorium-232	0.305 +/- 0.425 pCi/L
				Uranium-234	1.40 +/- 1.25 pCi/L
				Uranium-235	0.254 +/- 0.499 pCi/L
				Uranium-238	0.508 +/- 0.708 pCi/L
Haines 1	31-101-14872-00-00	4/1/2009	Avoca (Steuben)	Gross Alpha	54.6 +/- 37.4 pCi/L
				Gross Beta	59.3 +/- 58.4 pCi/L
				Cesium-137	0.476 +/- 2.19 pCi/L
				Cobalt-60	-0.166 +/- 2.28 pCi/L
				Ruthenium-106	7.15 +/- 19.8 pCi/L
				Zirconium-95	0.982 +/- 4.32 pCi/L
				Radium-226	0.195 +/- 0.162 pCi/L
				Radium-228	0.428 +/- 0.335 pCi/L
				Thorium-228	0.051 +/- 0.036 pCi/L
				Thorium-230	0.028 +/- 0.019 pCi/L
				Thorium-232	0.000 +/- 0.007 pCi/L
				Uranium-234	0.000 +/- 0.014 pCi/L
				Uranium-235	0.000 +/- 0.005 pCi/L
				Uranium-238	-0.007 +/- 0.006 pCi/L

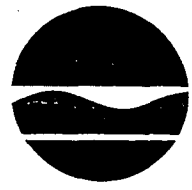
Well	API #	Date Collected	Town (County)	Parameter	Result +/- Uncertainty
Haines 2	31-101-16167-00-00	4/1/2009	Avoca (Steuben)	Gross Alpha	70.0 +/- 47.8 pCi/L
				Gross Beta	6.79 +/- 54.4 pCi/L
				Cesium-137	2.21 +/- 1.64 pCi/L
				Cobalt-60	1.42 +/- 2.83 pCi/L
				Ruthenium-106	5.77 +/- 15.2 pCi/L
				Zirconium-95	2.43 +/- 3.25 pCi/L
				Radium-226	0.163 +/- 0.198 pCi/L
				Radium-228	0.0286 +/- 0.220 pCi/L
				Thorium-228	0.048 +/- 0.038 pCi/L
				Thorium-230	0.040 +/- 0.022 pCi/L
				Thorium-232	-0.006 +/- 0.011 pCi/L
				Uranium-234	0.006 +/- 0.019 pCi/L
				Uranium-235	0.006 +/- 0.013 pCi/L
				Uranium-238	-0.013 +/- 0.009 pCi/L
Carpenter 1	31-101-26014-00-00	4/1/2009	Troupsburg (Steuben)	Gross Alpha	7,974 +/- 1,800 pCi/L
				Gross Beta	1,627 +/- 736 pCi/L
				Cesium-137	2.26 +/- 4.97 pCi/L
				Cobalt-60	-0.500 +/- 3.84 pCi/L
				Ruthenium-106	49.3 +/- 38.1 pCi/L
				Zirconium-95	30.4 +/- 11.0 pCi/L
				Radium-226	5,352 +/- 1,051 pCi/L
				Radium-228	138 +/- 37.3 pCi/L
				Thorium-228	94.1 +/- 14.9 pCi/L
				Thorium-230	1.80 +/- 0.946 pCi/L
				Thorium-232	0.240 +/- 0.472 pCi/L
				Uranium-234	0.000 +/- 0.005 pCi/L
				Uranium-235	0.000 +/- 0.005 pCi/L
				Uranium-238	-0.184 +/- 0.257 pCi/L
Zinck 1	31-101-26015-00-00	4/1/2009	Woodhull (Steuben)	Gross Alpha	9,426 +/- 2,065 pCi/L
				Gross Beta	2,780 +/- 879 pCi/L
				Cesium-137	5.47 +/- 5.66 pCi/L
				Cobalt-60	0.547 +/- 4.40 pCi/L
				Ruthenium-106	-16.600 +/- 42.8 pCi/L
				Zirconium-95	48.0 +/- 15.1 pCi/L
				Radium-226	4,049 +/- 807 pCi/L
				Radium-228	826 +/- 160 pCi/L
				Thorium-228	89.1 +/- 14.7 pCi/L
				Thorium-230	0.880 +/- 1.23 pCi/L
				Thorium-232	0.000 +/- 0.705 pCi/L
				Uranium-234	-0.813 +/- 0.881 pCi/L
				Uranium-235	-0.325 +/- 0.323 pCi/L
				Uranium-238	-0.488 +/- 0.816 pCi/L

Well	API #	Date Collected	Town (County)	Parameter	Result +/- Uncertainty
Schiavone 2	31-097-23226-00-01	4/6/2009	Reading (Schuyler)	Gross Alpha	16,550 +/- 3,355 pCi/L
				Gross Beta	1,323 +/- 711 pCi/L
				Cesium-137	1.46 +/- 5.67 pCi/L
				Cobalt-60	-2.550 +/- 5.11 pCi/L
				Ruthenium-106	20.6 +/- 42.7 pCi/L
				Zirconium-95	30.6 +/- 12.1 pCi/L
				Radium-226	15,140 +/- 2,989 pCi/L
				Radium-228	957 +/- 181 pCi/L
				Thorium-228	38.7 +/- 7.45 pCi/L
				Thorium-230	1.68 +/- 1.19 pCi/L
				Thorium-232	0.153 +/- 0.301 pCi/L
				Uranium-234	3.82 +/- 2.48 pCi/L
				Uranium-235	0.354 +/- 0.779 pCi/L
				Uranium-238	0.354 +/- 0.923 pCi/L
Parker 1	31-017-26117-00-00	4/2/2009	Oxford (Chenango)	Gross Alpha	3,914 +/- 813 pCi/L
				Gross Beta	715 +/- 202 pCi/L
				Cesium-137	4.12 +/- 3.29 pCi/L
				Cobalt-60	-1.320 +/- 2.80 pCi/L
				Ruthenium-106	-9.520 +/- 24.5 pCi/L
				Zirconium-95	1.39 +/- 6.35 pCi/L
				Radium-226	1,779 +/- 343 pCi/L
				Radium-228	201 +/- 38.9 pCi/L
				Thorium-228	15.4 +/- 3.75 pCi/L
				Thorium-230	1.25 +/- 0.835 pCi/L
				Thorium-232	0.000 +/- 0.385 pCi/L
				Uranium-234	1.82 +/- 1.58 pCi/L
				Uranium-235	0.304 +/- 0.732 pCi/L
				Uranium-238	0.304 +/- 0.732 pCi/L
WGI 10	31-097-23930-00-00	4/6/2009	Dix (Schuyler)	Gross Alpha	10,970 +/- 2,363 pCi/L
				Gross Beta	1,170 +/- 701 pCi/L
				Cesium-137	1.27 +/- 5.17 pCi/L
				Cobalt-60	0.960 +/- 4.49 pCi/L
				Ruthenium-106	14.5 +/- 37.5 pCi/L
				Zirconium-95	15.2 +/- 8.66 pCi/L
				Radium-226	6,125 +/- 1,225 pCi/L
				Radium-228	516 +/- 99.1 pCi/L
				Thorium-228	130 +/- 20.4 pCi/L
				Thorium-230	2.63 +/- 1.39 pCi/L
				Thorium-232	0.444 +/- 0.213 pCi/L
				Uranium-234	0.000 +/- 0.702 pCi/L
				Uranium-235	1.17 +/- 1.39 pCi/L
				Uranium-238	0.389 +/- 1.01 pCi/L

Well	API #	Date Collected	Town (County)	Parameter	Result +/- Uncertainty
WGI 11	31-097-23949-00-00	4/6/2009	Dix (Schuyler)	Gross Alpha	20,750 +/- 4,117 pCi/L
				Gross Beta	2,389 +/- 861 pCi/L
				Cesium-137	4.78 +/- 6.95 pCi/L
				Cobalt-60	-0.919 +/- 5.79 pCi/L
				Ruthenium-106	-19.700 +/- 49.8 pCi/L
				Zirconium-95	9.53 +/- 11.8 pCi/L
				Radium-226	10,160 +/- 2,026 pCi/L
				Radium-228	1,252 +/- 237 pCi/L
				Thorium-228	47.5 +/- 8.64 pCi/L
				Thorium-230	1.55 +/- 1.16 pCi/L
				Thorium-232	-0.141 +/- 0.278 pCi/L
				Uranium-234	0.493 +/- 0.874 pCi/L
				Uranium-235	0.000 +/- 0.540 pCi/L
				Uranium-238	-0.123 +/- 0.172 pCi/L

Attachment

New York State Department of Environmental Conservation
Division of Solid & Hazardous Materials
Bureau of Radiation & Hazardous Site Management
50 Wolf Road, Albany, New York 12233-7255
518-457-9253 FAX 518-457-9240



John P. Cahill
Commissioner

November 10, 1999

Ms. Jill Knickerbocker
Technical Manager
CWM Chemical Services, L.L.C.
1550 Balmer Rd.
P.O. Box 200
Model City, New York 14107

Dear Ms. Knickerbocker:

This responds to your September 24, 1999 e-mail request to Barbara Youngberg, of this Bureau, regarding the disposal at CWM of wastes that contain trace concentrations of radioactive material. In your e-mail message, you stated that CWM would like to be able to screen out the material that is clearly more than "slightly above background." We agree that some guidance on this would save time for both CWM and DEC.

As you know, the CWM site permit issued under 6 NYCRR Part 373 states in Item 6 of Attachment A, *Waste Analysis Plan*,

> Any waste containing trace levels of radioactive material that reads slightly above background may not be land disposed without NYSDEC approval. Wastes with higher levels of radioactivity are prohibited from land disposal.

The test, therefore, is only whether or not the radionuclides are present in trace concentrations reading slightly above background. This recognizes that all matter contains radioactive material and that background levels of radioactive material are not excluded from acceptance at CWM. This criterion allows for wastes containing slightly more than background concentrations to be accepted, on a case-by-case basis. If the concentration of the radioactive materials is not in that range, the waste is not acceptable, regardless of how safely the waste could be managed at CWM.

The following list describes types and concentrations of radioactive material that are clearly more than "slightly above background." **This list is provided for the purpose of screening out those wastes which should not be submitted for approval to DEC, because they clearly do not meet the criteria of Item 6. Wastes with radionuclide concentrations less than those listed here are not necessarily acceptable for disposal at CWM. Each waste must be reviewed and approved on a case-by-case basis by this office.**

In soils, the following concentrations of radionuclides are clearly not trace concentrations reading "slightly above background:"

- natural uranium, with decay products present, greater than 10 pCi/g
- natural thorium, with decay products present, greater than 10 pCi/g
- radium-226 or radium-228 greater than 5 pCi/g
- cesium-137 greater than 2 pCi/g

In addition to the prohibition in Item 6 of CWM's *Waste Analysis Plan*, other categories of radioactive material are not acceptable for disposal at CWM. They are

- source, special nuclear, or by-product material subject to licensing by the US Nuclear Regulatory Commission or an Agreement State (New York State is an Agreement State)
- naturally occurring and accelerator produced radioactive material subject to radioactive material licensing under any State's laws or regulations
- unlicensed source, special nuclear, or by-product material from remediation of sites where the radioactive contamination resulted from the use or possession of radioactive material under a radioactive materials license issued by the US Nuclear Regulatory Commission or an Agreement State (New York State is an Agreement State)
- unlicensed naturally occurring and accelerator produced radioactive material from remediation of sites where the radioactive contamination resulted from the use or possession of radioactive material under a radioactive materials license issued by any state

For CWM to accept wastes containing such radioactive materials, or for CWM to accept any wastes containing radioactive material at greater than trace concentrations, would require an amendment to the current permit issued under Part 373 and approval under 6 NYCRR Parts 382 and 383, this Department's regulations for radioactive waste disposal facilities. Preparation of a State Environmental Quality Review Act environmental impact statement would be required.

Please call me if you have any questions.

Sincerely,

Paul J. Merges

Paul J. Merges, Ph.D.
Director
Bureau of Radiation & Hazardous Site Management