NORM Survey Summary [1]

I'd like to update you on the status of surveys we have been conducting to determine levels of Naturally Occurring Radioactive Materials (NORM) at oil and gas sites in Pennsylvania.

Since 1991, the Bureau of Oil and Gas Management and Bureau of Radiation Protection have been conducting surveys and collecting samples at wells sites and related facilities in 26 counties.

Facilities surveyed include over 400 oil and gas well sites, nine pipe yards, and about 500 miles of dirt road that were sprayed with brine for dust suppression.

About sixty percent of the well sites had readings at or below background levels. Thirty four percent had readings within 10 microroentgens per hour (microR/hr) of background, three percent were in the range of 11-20 microR/hr above background, and two percent were 21-54 microR/hr above background. One site was 195 microR/hr above background.

To put this in perspective, several states have adopted regulations which include action levels for contamination. Louisiana has adopted 25 microR/hr and is in the process of changing to 50 microR/hr. Texas, Arkansas and Michigan set levels at 50 microR/hr. Mississippi set its level at 25 microR/hr.

From the more than 400 sites tested, we found two samples, at 54 and 195 microR/hr that would be of concern in states with regulations.

Sludge and soil collected at well sites were generally at or below the level of 5 picocuries per gram (pCi/g). Louisiana, Texas and Mississippi have adopted levels of 30 pCi/g and Arkansas adopted a level of 5 pCi/g.

No significant radiation levels were seen at pipe yards from pipe taken from Pennsylvania wells. One elevated reading was found from pipe from another state.

Several brine treatment facilities surveyed had radiation levels above background, but were not sufficiently elevated to require controls for the protection of the general public.

Road surveys for gamma radiation were generally at or below background levels. All areas with elevated readings are attributed to shale outcroppings.

In summary, our survey results indicate that NORM is not a problem at oil and gas well sites in Pennsylvania. Consequently, development of regulations to address this issue is a low priority.

We will probably continue to elevate brines and sludges to expand our database and for future consideration.

([1] This article was prepared in April 1995 for the *IOGA NEWS*. The attached NORM Survey Summary was prepared September 1, 1992.)

NORM SURVEY SUMMARY

From February to October 1991, The Department conducted a survey to determine the levels of naturally occurring radioactive materials (NORM) associated with oil and gas wells and related facilities. The survey was conducted in three phases. This project was conducted by the Western Area Health Physicist, the Bureau of Radiation Protection, the Oil and Gas Field Operations and the Bureau of Oil and Gas Management. The Bureau of Laboratories conducted the laboratory analysis.

Phase one of the NORM survey began in February and ended in September 1991. The objective of the survey was to obtain samples of brine and brine pit or tank sludge from well sites across the state for laboratory analysis. The samples were tested for radium-226 and radium-228 and are reported in pCi/l for liquids and pCi/kg for solids. In addition, brines and bottom sediments were taken from brine treatment plants and disposal well sites for analysis of combined radium. In this phase, there were 48 sites surveyed.

In Phase II, nine pipeyards were surveyed in seven counties using a low level radiation detection meter. If a pipe showed above background, a sample of scale inside the pipe was taken and sent to the laboratory for analysis. None of the facilities surveyed conducted pipe cleaning operations as described in Louisiana.

From July to October 1991, the Department conducted Phase III by surveying oil and gas well sites using low level detection meters to determine the exposure to low level radioactivity resulting from NORM. Surveys were also conducted at brine treatment plants, municipal treatment plants which accept brine, disposal wells, gas storage fields, and road spreading operations.

OIL AND GAS WELLS

There were 413 oil and gas well sites surveyed. About 374 of the sites were surveyed using the field meters and 39 were surveyed by taking samples of the liquids or solids for laboratory analysis.

At the well sites surveyed with the field meter, readings were taken of background, the well head, pits and tanks, pipes, and other equipment that was present using a low level radiation detection meter. The results were reported in uR/h. At the other well sites, samples of brine or tank sludge was collected for analysis by the DER laboratory. At one site, samples of drill cuttings were collected from one formation that was suspected to be a problem. The samples were analyzed for radium-226, radium-228, specific conductance, total dissolved solids, chloride, sulfates, calcium, strontium and barium. The results for radium-226 and radium-228 are in pCi/l for liquids and

pCi/kg for solids.

Of the 374 sites surveyed with the field meter, 60.5% (226) of the sites had readings at or below background. Another 34.2% (128) of the sites had readings within 10 uR/h of background, and 3.2% (12) of the sites had readings within 20 uR/h. The remaining 2.1% (8) of the sites had readings that ranged from 21 to 54 uR/h above background, with one site at 195 uR/h above background.

Of the 374 wells surveyed, 264 were gas wells and 110 were oil wells. The county distribution is shown below. The sites surveyed were also tracked by target formation. This distribution is also shown below.

COUNTY DISTRIBUTION OF SITES SURVEYED

COUNTY	OIL	GAS	COUNTY	OIL	GAS
Allegheny	1	4	Fayette	0	11
Armstrong	2	15	Forest	12	6
Beaver	5	0	Greene	6	4
Butler	4	4	Indiana	0	24
Cambria	0	5	Jefferson	0	16
Cameron	0	4	McKean	19	14
Centre	0	9	Mercer	3	8
Clarion	4	8	Potter	7	9
Clearfield	0	11	Somerset	0	10
Clinton	0	8	Venango	8	11
Crawford	3	10	Warren	16	15
Elk	7	12	Washington	11	4
Erie	2	27	Westmoreland	0	15

FORMATION DISTRIBUTION OF SITES SURVEYED

FORMATION	OIL	GAS	FORMATION	OIL	GAS
Bald Eagle	0	2	Mississippi	1	4
Bass Island	2	1	Murrysville	0	2
Bois Blanc	0	1	Ohio Shale	0	6
Bradford	53	59	Onondaga	0	4
Bralier	0	3	Oriskany	0	54
Elk	1	10	Oswago	0	1
Helderberg	0	4	Pennsylvania	0	1
Huntersville	0	16	Ridgeley	0	5
Lock Haven	0	12	Salina	0	3
Lockport	0	3	Tuscorora	0	4
Marcellus	0	3	Unknown	21	4
Medina	0	41	Venango	32	21

Samples for laboratory analysis were obtained at 39 sites. Brine samples were obtained at 37 sites (26 gas, 10 oil and 1 combination) and sludge samples were obtained at three oil well sites. In addition, samples of drill cuttings from a formations believed to be a problem

were obtained at one gas well site.

The radium-226 in the brine samples ranged from 3.29 pCi/l to 2,575 pCi/l with one at 4,685 pCi/l. The average was 742 pCi/l. Radium-228 in the brine samples ranged from 7.17 pCi/l to 2,196 pCi/l. The average was 676 pCi/l. Following is a listing of the results by well type.

		Radium 226 (pCi/l)			Radium 228 (pCi/l)		
Well Type	#	Avg.	High	Low	Avg.	High	Low
All	38	742	4,685	8.34	676	2,196	12.06
Deep Gas	9	1,243	4,685	203	1,475	2,110	499
Shallow Gas	17	946	2,575	20	665	2,196	13
Shallow Oil	12	86	275	8.34	94	456	12.06

There were three samples of sludge from the pits at oil wells. Two sites were in Warren County and one was in Venango County. The Radium 226 and Radium 228 results are as follows:

County	Radium-226 (pCi/kg)	Radium-228 (pCi/kg)
Venango Co.	102	165
Warren Co.	153	296
Warren Co.	12.9	7,988

At a gas well being drilled in Venango County, drill cuttings from the well were taken at intervals of 10 feet starting at a depth of 3,959 feet to 3,979 feet. The target formation for these samples was the Tioga-Metabentonite. Shown below are the results of the analysis on those drill cuttings.

Depth (ft)	Radium-226 (pCi/kg)	Radium-228 (pCi/kg)
3959	1.85	1,031
3969	1.48	740.35
3979	1.52	649.97

BRINE TREATMENT FACILITIES

All six of the operating brine treatment facilities and one of the industrial facilities that accepts brine were surveyed. These facilities were surveyed using field meters. Samples of the brine and sludges were collected and sent to the laboratory for analysis. Readings from the facilities varied considerably. Field meter readings ranged from less than 5 uR/h at one facility to 125 uR/h at another facility (activated charcoal filter was 300 uR/h). The brine or effluent from the six facilities had radium-226 of 3.29 to 2,069 pCi/l and radium-228 of 7.17 to 1,555 pCi/l. At four of the facilities, the sludges had radium-226 of 1,274 to 186,333 pCi/kg.

The JJ Bucher facility in Potter County treats brine from oil wells. Readings at the facility were less than 5 uR/h. The laboratory analysis of the brine from the storage tanks showed radium-226 of 14.52 pCi/l and radium-228 of 14.26 pCi/l.

The Minard Run Oil Company's Flood 4,5,E,F,Lewis Run is a discharge from an oil waterflood operation in McKean County. The laboratory analysis of brine discharge showed radium-226 at 3.29 pCi/l and radium-228 at 7.17 pCi/l.

The Petro Tech Treatment Facility in Venango County also treats brine from oil wells. Readings at the facility range from 5 to 10 ur/h (background) at the wet well, to 50 to 80 at the first four holding tanks. Other readings at the site were: other twc holding tanks - 10 to 15 uR/h; 12 settling tanks - 10 to 20 uR/h; and the sludge storage tank - 20 to 25 uR/h. The laboratory analysis of the effluent showed a radium-226 of 1,143 pCi/l and radium-228 of 985 pCi/l. The sludge from the facility had radium-226 of 1,274 pCi/kg and radium-228 of 434 pCi/kg.

The Castle Gas Treatment Facility in Indiana County treats brine from shallow gas and oil wells in Indiana and Westmorleand Counties. Sludge is shipped to Ohio for disposal. Readings at the facility were at background or in the 5 to 15 range. The oil separation chamber had the highest reading of 40 uR/h at the bottom and 20 uR/h on the side. Other readings were: brine receiving tanks - up to 15 uR/h; holding tanks - up to 5 uR/h; other tanks - background; dumpster - background except for hot spot in center at 5 uR/h; treatment tanks - background; polymer feed tank - 5 uR/h; and other tanks and piping - background. The laboratory analysis of the brine from the storage tanks showed radium-226 of 2,069 pCi/l and radium-228 of 1,555 pCi/l.

The Hart Chemical Treatment Facility treats brine from shallow gas wells from Armstrong, Indian, and Jefferson Counties. Sludge is shipped to the B.F.I. landfill in Brockway. Readings at the facility ranged from background to 100 uR/h at the two collection tanks. Readings of samples taken from the large tanks were 10, 6, and 2 uR/h. The sludge in the trough which connects the collection tank and the treatment tank had a reading of 120 uR/h (Note - reported to be left-over AMD sludge). The laboratory analysis of the brine from the storage tanks showed radium-226 of 287 pCi/l and radium-228 of 89 pCi/l.

Readings at the EDC Brine Treatment facility in Warren County were in the 5 to 15 uR/h range with background at 5 uR/h. The reading at the sludge trailer was 10 to 15 uR/h while a previous survey of the facility reported a reading of 40 uR/h around the trailer. The sludge is shipped to the BFI's Greentree Landfill in Kersey, Pa. The laboratory analysis of the effluent from the facility showed radium-226 of 411 pCi/l and radium-228 of 604 pCi/l. An analysis of the sludge showed radium-226 of 13,267 pCi/l and radium-228 of 16,323 pCi/l.

The ConGas Division 5 Brine Treatment Facility is in Jefferson County. Most of the brine comes from shallow wells, while about 5% comes from deep Oriskany wells. The readings at the three impoundments were in the normal 5 to 7 uR/h range. The sludge in the second impoundment had readings up to 125 uR/h. The sand filter had readings of 35 and 15 uR/h while the charcoal filter had readings of 300 and 80 uR/h. The laboratory analysis of the effluent was reported at radium-226 of 1,177 pCi/l and radium-228 of 157 pCi/l. The laboratory results of the sludges for the three impoundments are as follows:

Impoundment	Radium-226 (pCi/kg)	Radium-228 (pCi/kg)
1 - Bottom Sludge	4,128	1,893
2 - Bottom Sludge	11,384	5,837
2 - Top Sludge	186,633	65,815
3 - Bottom Sludge	3,858	1,822

At the Franklin Brine Treatment plant, readings ranged from a background of 5 to 7 uR/h to 90 pCi/l. The readings for the three sludge storage bins were: 20 to 30 uR/h; 20 to 40 uR/h; and 30 to 60 uR/h. Other readings at the facility are: Brine storage tanks - 15 to 20 uR/h and 30 to 60 uR/h; neutralization tank - 90 uR/h; flocculation tank - 40 uR/h; sludge decanters - 20 uR/h and 15 uR/h; two solids accumulation tanks - 20 uR/h; effluent monitoring tank - 20 to 30 uR/h; and the lime storage tank - 5 to 7 uR/h. The laboratory analysis of the effluent was reported as radium-226 of 352 pCi/l and radium-228 of 153 pCi/l. The sludge was reported at radium-226 of 57,527 pCi/kg and radium-228 of 54,365 pCi/kg.

MUNICIPAL TREATMENT PLANTS

Three municipal sewage treatment plants that accept brine or drilling fluids were surveyed. Radiation levels were near, or at background.

The Moshannon Valley Sewage Treatment Plant in Centre County accepts frac water from gas drilling operations. It does not accept brines. The frac water is mixed with the sewage in the wet well and is pumped to the activated sludge unit. Readings were less than 5 to 10 uR/h.

The Clearfield Municipal Authority Treatment Plant treats about 15,000 gal./da. of brine. Readings at the brine storage tanks were around 5 uR/h while the sludge was at background (less than 5 uR/h).

The Bellefonte Wastewater Treatment Plant accepts frac water and no brines. The brine is mixed with the sewage and run through the plant. Readings at the facility did not exceed 5 uR/h.

DISPOSAL WELLS

Four of the seven brine disposal wells in the state were surveyed, one operator did not participate in the survey. The facilities were surveyed using field survey meters. Samples of brine at two of the facilities were collected for laboratory analysis.

At the Dando disposal well in Armstrong County, the two storage tanks had areas with readings at 30 uR/h above background, while the rest of the facility was at background. The brine had a radium-226 level of 1,895 pCi/l and a radium-228 level of 1,157 pCi/l.

The brine and oil tank at the TH Yuckenberg disposal well in Indiana County had a reading of 20 uR/h at the bottom of the tank. The rest of the facility was showed readings at or below background. The brine had a radium-226 level of 1,874 pCi/l and a radium-228 level of 1,420 pCi/l.

The Spencer Land Company's #2 salt water disposal well is in Clearfield County. The readings at the site range from 5 to 15 uR/h with background at 5 ur/h. No brine samples were collected.

The NEA Cross disposal well in Erie County did not have any readings above background.

The Cottonwood Operating Company which operates the West Shanksville disposal well in Somerset County did not want to participate in the survey.

GAS STORAGE FIELDS

Four gas storage facilities were surveyed: the Blackhawk Storage Field in Beaver County, the Leidy Station in Clinton County, the Ellisburg Station in Potter County, and the Sabinsville Station in Tioga County. Although there were some elevated readings, no significant radiation levels were found.

At the Blackhawk Storage Field, readings at the well head, drip pump, and storage tank ranged from less than 5 uR/h to 15 to 20 uR/h.

The Leidy Station consists of wells for gas storage, three dehydrators for drying the gas, and two brine storage tanks. Readings at the equipment ranged from 5 uR/h to 10 to 15 uR/h. There was one hot spot at one end of one of the storage tanks that showed readings of 20 to 22 uR/h.

The brine evaporation pond at the Ellisburg Station Storage Field in Potter County was surveyed. The facility consisted of a covered and roofed pond with several sludge tanks. Readings inside and around the perimeter were around background (200 to 250 cpm). The readings at the

three sludge holding tanks ranged from near background to 10 to 13 uR/h (500, 800, and 800 cpm).

At the brine evaporation pond at the Sabbinsville in Tioga County, only background readings (around 3 uR/h) throughout the facility were noted.

ROADSPREADING OPERATIONS

Routes 03045 and 03169 in Kiskiminetas Township, Armstrong County, where brine has been spread for several years for dust control and road stabilization, were surveyed. The readings at the edge of the road were in the minimum detectable range, while all other areas were indistinguishable from background.

PIPEYARDS

Nine pipeyards were surveyed in seven counties as follows: Indiana (4); Warren (1); Clarion (1); Crawford (1); Forest (1); and McKean (1). The pipe at the pipeyards was surveyed using a low level radiation detection meter. If a pipe showed above background, a sample of scale inside the pipe was taken and sent to the laboratory for analysis.

The pipeyards surveyed included five well pipe suppliers, and four were pipe storage areas for oil or gas production companies. None of the facilities surveyed conducted pipe cleaning operations as described in Louisiana.

At seven of the locations (Pool Well Service, Miller Supply, TW Phillips Gas and Oil Company, McCalls Supply Company, Cabot Oil and Gas Company, Pennzoil, and Meridian Exploration), readings were at background, while in the other two cases, readings were above background.

At the McJunkin pipeyard in Indiana County some six inch casing from a well of unknown type in Kentucky showed readings of 15 uR/h. From the laboratory analysis, the scale from the casing measured 137,091 pCi/kg of radium-226 and 7,656 pCi/kg of radium-228.

At the North Penn Pipe and Supply Yard in Warren County, some two inch production tubing (probably used in a shallow oil well in New York or Pennsylvania) showed levels of 35 uR/h. Radiation levels in the soil were high at the North Penn Pipe and Supply Yard which may have interfered with a good reading. The results of the laboratory analysis for the scale showed radium-226 at 1,361 pCi/kg and radium-228 at 1,055 pCi/kg.

BOGM RADIATION SURVEY SPRING, 1991

COUNTY	MUNICIPALITY	FACILITY	PERMIT	WT	WD	HORIZON	SP COND (UMHOS/CM)	TDS (MG/L)	CL (MG/L)	SO4 (MG/L)	CA (MG/L)	SR (MG/L)	BA (MG/L)	RA226 (pCi/L)	RA228 (pCi/L)
ALLEGHEN	S. FAYETTE	DIKED AREA	003-00826	G	2262		102384	143432	72100	<10	8970		30.4	511.67	202.23
ARMSTRON	COWANSHANNOCK	TANK	005-22232	G	3600									315	165
ARMSTRON	COWANSHANNOCK	TANK	005-20829	G	3530									20	13
CAMBRIA	SUSQUEHANNA	TANK	021-20223	G	3800	CATSKILL/LOCK HAVEN		175296	99800	<10	8790	763	645	1408	904
CAMBRIA	BARR	TANK	021-20605	G	3804	VENANGO		195404	115000	<10	14300	>999	638	1154	1083
CENTRE	CURTIN	TANK	027-20242	G	4975	LOCK HAVEN		222672	118500	110	20400	1270	190	163	126
CENTRE	BURNSIDE	TANK	027-20124	G	4822	CATSKILL/LOCK HAVEN		252980	132000	<10	21700	1160	1080	1489	636
CLEARFIE	JORDAN	TANK	033-22037	G	3850	CATSKILL/LOCK HAVEN		185146	105000	<10	12700		14.1	2015	1749
CLEARFIE	BURNSIDE	TANK	033-21787	G	3701	CATSKILL/LOCK HAVEN		230924	127800	<10	17500			107	77
CLINTON	BEECH CREEK	TANK	035-20378	G	4752	LOCK HAVEN		194902	105000	<10	14233	586	59.8	730.71	490.97
CLINTON	BEECH CREEK	TANK	035-20447	G	4800	LOCK HAVEN		153098	78900	<10	12100	571	12	811.39	530.11
CRAWFORD	BEAVER	TANK	039-21917	G	3685	MEDINA		396012	183000	219	28200	858	1.45	598.98	1682.97
ELK	HIGHLAND	SEP TANK	HIGHLAND	O	N/A	N/A	38796	31502	16500	2256	2830		0.108	15.37	17.68
ELK	HIGHLAND	TANK	047-23007	O	2500	BRADFORD		25159	12600	2264	1790		0.099	22.87	26.15
ERIE	MILLCREEK	TANK	049-24461	G				390928	183000	54	30300	860	1.17	627.78	1478.36
ERIE	CONNEAUT	TANK	049-20162	G	3284	MEDINA		378148	175000	56.4	25100	745	4.1	588.48	1483.47
FAYETTE	SPRINGFIELD	TANK	051-20439	G	8594	HUNTERSVILLE		341918	196900	<10	2000		655	4685	2038
FAYETTE	SPRINGFIELD	TANK	051-20200	G	8150	ORISKANY		354034	145000	<10	19100		498	566	2110
FOREST	HOWE	TANK BATTE	MERIDION	O			105192	130588	69800	131	10200		3.3	42	42
FOREST	KINGSLEY	TANK	BRUNELL	O				86988	44400	29.2	5250		13.3	39.18	55.92
INDIANA	CHERRYHILL	TANK	063-25752	G	3971			186736	113000	<10	13800		922	2019	2196
INDIANA	BURRELL	TANK	063-25556	G	3746			198868	111000	<10	14100	824	704	2575	1868
INDIANA	WHITE	TANK	063-21133	G	3301			121928	58900	<10	7793	215	196	450	313
JEFFERSO	BELL	TANK	065-23083	G	3613									1280	848
MCKEAN	WETMORE	SEP PIT	083-24860	O	2492		38690	36470	16500	1254	2550		0.108	8.34	12.06
MCKEAN	LAFAYETTE	PIT	CURTIS OIL	O										185.28	184.29
SOMERSET	MIDDLECREEK	TANK	111-20049	G	8900	ORISKANY		176876	175000	<10	30000	11900	3470	203	1543
SOMERSET	LINCOLN	TANK	111-20016	G	8560	ORISKANY		182274	175000	<10	22700	7410	1490	1988	499
TIOGA	UNION	DRILL PIT	117-20157	G	DEEP									1137	1457
VENANGO	CORNPLANTER	SEPARATOR	121-23346	O	811		101088	114208	59900	113	7160		5.16	12	30
VENANGO	ALLEGHENY	PIT	BLJ-A-9	O			38016	36282	16050	<10	2420		44.9	54	77
VENANGO	ALLEGHENY	PIT SLUDGE	BLJ-A-9	O										102 pCi/kg	165 pCi/kg
VENANGO	CHERRYTREE	DRILL CUT	121-42962	G	3959	ONONDAGA								1.9 pCi/kg	1031 pCi/kg
VENANGO	CHERRYTREE	DRILL CUT	121-42962	G	3969	ONONDAGA								1.5 pCi/kg	740 pCi/kg
VENANGO	CHERRYTREE	DRILL CUT	121-42962	G	3979	ONONDAGA								1.5 pCi/kg	650 pCi/kg
WARREN	PLEASANT	PIT	DeForest	O			41904	59554	22000	33.2	3640		3.67	34	27
WARREN	PLEASANT	PIT SLUDGE	DeForest	O										153 pCi/kg	296 pCi/kg
WARREN	SOUTHWEST	TANK	123-40354	G	5531	MEDINA		395440	193000	38	47180	1760	3.1	794.64	968.4
WARREN	SOUTHWEST	OILY PIT	CLOSSER	O										13 pCi/kg	7988 pCi/kg
WARREN	WATSON	PIT	PGE DUNN	O			79488	125264	51700	<10	7730		37.4	275	187
WASHINGT	CECIL	SEPARATOR	125-00969	OG	2305		95580	134164	63700	80	8270		3.99	255	456
WESTMORE	WASHINGTON	TANK	129-22382	G	1873			221134	114900	<10	17300		9.97	170	46
WESTMORE	HEMPFIELD	TANK	129-20263	G	1423	VENANGO		402148	156000	<10	23800		177	857	71

BOGM RADIATION SURVEY SPRING, 1991

COUNTY	MUNICIPALITY	FACILITY	PERMIT	WT	WD	HORIZON	SP COND (UMHOS/CM)	TDS (MG/L)	CL (MG/L)	SO4 (MG/L)	CA (MG/L)	SR (MG/L)	BA (MG/L)	RA226 (pCi/L)	RA228 (pCi/L)
DISPOSAL WELLS															
ARMSTRON	KISKIMINETAS	TANKS	DANDO	D	N/A	N/A		232124	113000	<10	16700		597	1895	1157
INDIANA	CHERRYHILL	TANK	YUCKENBURG	D	N/A	N/A		223784	122000	<10	19300		588	1874	1420
BRINE TREATMENT PLANTS															
INDIANA	BURRELL	TANK	PAOO95273	T	N/A	N/A		211588	108000	<10	14400	858	883	2069	1555
INDIANA	WASHINGTON	TANK	PA0095443	T	N/A	N/A								287	89
JEFFERSO	HENDERSON	EFFLUENT	PA0101656	T	N/A	N/A								1177	157
JEFFERSO	HENDERSON	BOT SED #1	PA0101656	T	N/A	N/A								4128 pCi/k	1893 pCi/kg
JEFFERSO	HENDERSON	BOT SED #2	PA0101656	T	N/A	N/A								11384 pCi/	5837 pCi/kg
JEFFERSO	HENDERSON	TOP SED #2	PA0101656	T	N/A	N/A								186633 pCi	65815 pCi/k
JEFFERSO	HENDERSON	BOT SED #3	PA0101656	T	N/A	N/A								3858 pCi/k	1822 pCi/kg
POTTER	SHARON	TANK	PA0112623	T	N/A	N/A	27560	30352	12500	160	1550		1.41	14.52	14.26
VENANGO	FRANKLIN	EFFLUENT	PA0101508	T	N/A	N/A		214660	118000	46	26300	1860	24.3	352	153
VENANGO	FRANKLIN	FILTER CAK	PA0101508	T	N/A	N/A								57527 pCi/	54365 pCi/k
VENANGO	SUGARCREEK	EFFLUENT	PA0105279	T	N/A	N/A		149875	92900	30	13500	616	269	1143	985
VENANGO	SUGARCREEK	TANK SLUDG	PA0105279	T	N/A	N/A								1274 pCi/k	434 pCi/kg
WARREN	WARREN	EFFLUENT	EDC BRINE	T	N/A	N/A	51624	183288	77500	135	23600		4.39	411	604
WARREN	WARREN	FILTER CAK	EDC BRINE	T	N/A	N/A								13267 pCi/	16323 pCi/k
MCKEAN	LAFAYETTE	DISCHARGE	MIN RU 4&5	T	N/A	N/A								3.29	7.17
PIPEYARDS															
INDIANA		PIPE SCALE	POOL		N/A	N/A								2691 pCi/k	1334 pCi/kg
INDIANA		PIPE SCALE	MCJUNKIN		N/A	N/A								137091 pCi	7656 pCi/kg
WARREN		PIPE SCALE	NTH PENN	O	N/A	N/A								1361 pCi/k	1055 pCi/kg