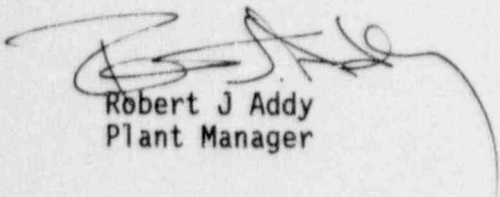


April 17, 1997

Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555

**DOCKET 50-155 - LICENSE DPR-6 - BIG ROCK POINT PLANT - ANNUAL RADIOLOGICAL  
ENVIRONMENTAL MONITORING REPORT - JANUARY THROUGH DECEMBER 1996**

Attached is the Annual Radiological Environmental Monitoring Report for the Big Rock Point Plant. This report covers the period from January 1 through December 31, 1996 and is submitted in accordance with Technical Specification 6.9.2.1.



Robert J Addy  
Plant Manager

CC: Administrator, Region III, USNRC  
NRC Resident Inspector - Big Rock Point

ATTACHMENT

9704250137 961231  
PDR ADOCK 05000155  
R PDR

COO171



**ATTACHMENT**

**CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996**

**Submitted April 17, 1997**



Big Rock Point Annual Radiological  
Environmental Operating Report  
January through December 1996

I. Introduction

The 1996 Big Rock Point Annual Radiological Environmental Operating Report provides a summary and data interpretation of the Big Rock Point Radiological Environmental Monitoring Program as conducted during the 1996 reporting period. Reporting requirements are detailed in Technical Specifications 6.9.2.1, 13.2 and Tables 13.3-1 through 13.3-3.

There are no remaining 1996 laboratory sample analyses pending completion for inclusion into this report. Detailed sample station identification and location information can be found in Attachment 2 of Health Physics Procedure HP 10.9 (Enclosure D). The results of all environmental samples collected were evaluated as follows:

- A. Air iodine and particulate, TLDs (monthly and quarterly), and milk data were statistically evaluated at the 95% confidence level by the methodology detailed in Health Physics Procedure HP 10.2. The data was compared against two criteria: the first criterion is the statistical difference which indicates whether the sample results from near sites are greater than those from control sites, and whether or not the difference is significant. The second criterion is the evaluation level (twice the statistical difference) which is the minimum population mean difference for which the sample mean difference will exceed the statistical difference with 95% confidence. If the evaluation level is exceeded, then correlation of the results with effluent releases is done.
- B. Well water, lake water intake/discharge, sediment, fish and other aquatic biota samples were evaluated using data means comparisons against an appropriate control location (if available) and BRP Technical Specification limits.

II. Discussion and Interpretation of Results

A. Air Samples

Comparison of the airborne particulate sample data between near-site and control locations resulted in no data exceeding the statistical difference level and no data exceeding the statistical evaluation level. In many instances, control location sample values were greater. There was no Iodine-131 activity reported above minimum detectable levels.

A total of 318 air samples were collected during 1996. Three sample results were not included in the statistical evaluation due to low sample volumes. Refer to Enclosure A for all sample collection anomaly evaluations. The deleted samples constitute less than 1% of the total samples. Technical Specification sensitivities were met on all samples other than those already noted.

Comparison of the airborne particulate sample data between near-site and control locations did not exceed the statistical difference. The means of gross beta results for indicator and control locations were 0.016 pCi/m<sup>3</sup> and 0.017 pCi/m<sup>3</sup> respectively. No sample analysis identified I-131 activity above minimum detectable levels.

The air iodine/particulate samples are collected on a weekly basis from six air sampling locations. A seventh station, located on the Big Rock Point Plant site, is used for plant trending purposes only and is not part of the Radiological Environmental Monitoring Program. Air is metered through the sampling units at a continuous one cubic foot per minute flow rate through a Gelman 47mm air filter (air particulate) and a Scott air iodine cartridge. Both filters are in-line with each other and housed within the same filter holder.

The 1996 air sample results are consistent with actual effluent releases and site-specific meteorology.

#### B. TLDs - Gamma Dose

There were a total of 143 monthly, 48 quarterly and 12 annual TLDs collected for the Radiological Environmental Monitoring Program during 1996. Sixty additional on-site TLDs are used for individual reference and are not evaluated as part of the Radiological Environmental Monitoring Program. One monthly TLD was missing from the total (stolen), refer to Enclosure A for all sample anomalies.

The Big Rock Point gamma assessment program consists of eighteen TLD locations: five on-site TLDs (locations 1-ST, 14-G, 15-H, 17-K, 18-L), six inner ring TLDs at the site boundary (locations 9-A, 10-B, 11-C, 12-D, 13-F, 16-J), three outer ring TLDs, 3 to 4.5 miles out, (locations 2-NM, 3-CH, 4-SL), three control TLDs, 10.5 to 50 miles out, (locations 5-PT, 6-BC, 7-TR), and 1 TLD control placed in a lead storage cave used for in-transit dose measurement. For 1996 the average monthly gamma readings were: 3.0 mR for the inner ring (site boundary) TLDs; 3.0 mR for the outer ring (3 to 4.5 miles out) TLDs; and 3.1 mR for the control TLD locations. The average quarterly gamma readings were: 10.1 mR for the inner ring (site boundary) TLDs; 10.6 mR for the outer ring (3 to 4.5 miles out) TLDs; and 10.9 mR for the control TLD locations. The average of the annual gamma readings were: 42.1 mR for the inner ring; 43.3 mR for the outer ring TLD; and 44.7 mR for the control TLD locations. These results are consistent with historical data. The five

on-site TLD locations serve as individual references only and are not included in this evaluation.

The monthly and quarterly statistical TLD data evaluations were accomplished by comparing the inner ring TLDs and the outer ring TLDs against the control TLD locations. The annual TLD data evaluation was done by a direct comparison of data points only.

In comparing the inner ring TLDs to the control TLDs, station 12-E (0.9 mi SSE site boundary) had the greatest monthly mean, quarterly mean, and annual mean. In comparing the outer ring TLDs to the control TLDs, station 4-SL (Susan Lake, 3.5 mi SE) had the greatest monthly, mean, quarterly mean, and annual mean.

Background and in-transit gamma exposure levels were accounted for and subtracted from the TLD data prior to statistical evaluation. No statistical or evaluating levels were exceeded, and in many instances, control location TLD data was greater than indicator TLD data. BRP Technical specification sensitivities were met.

Environmental gamma doses are measured monthly, quarterly and annually by placement of three TLD badges per designated location. Each Teledyne TLD badge contains a 4-zone  $\text{CaSO}_4$  phosphor wafer (the wafer also includes an additional backup/reserve read-out zone). Sensitivity for the multi-zone TLDs are 1.0 millirem with a linear response of 0.1 millirem to 1000 rem.

### C. Milk

A total of 48 individual monthly milk samples were collected from five different dairy farms during 1996. Dairy farms 20-JG, 21-DK and 22-RM or 22-MH serve as indicator locations; and dairy farm 23-BB serves as the control location. In October of 1996, the RmCraney Farm (22-RM) sold his remaining dairy herd. Beginning in November 1996, the Merle Hand Farm (22-MH, 2.8 mi ESE) was selected as the replacement milk sample station. No monthly samples were missed during this transition period.

All analysis results listed in Table 10.2-2 were below LLD. No special or supplemental analysis were required, nor were any Big Rock Technical Specification limits exceeded.

Milk samples are required monthly from each designated collection location (4 total). A two-gallon quantity of raw milk (grab sample) is obtained per collection location in order to meet analytical requirements. Samples are treated with a sodium bisulfite (40 grams per gallon) preservative prior to being sent to Teledyne Brown Engineering for analysis.

#### D. Lake Water

A total of 36 individual monthly lake water composite samples were collected from 3 locations during 1996. Lake water samples from the Lake-in (plant intake) and the Lake-out (plant discharge) are collected daily and composited into monthly samples. Monthly lake water sample composites from Ludington are collected as a control sample.

Evaluation of the monthly lake water analytical results was based on a data means comparison between the samples collected from Lake-in and Lake-out (indicator locations) and the Ludington control location (115 miles SSW of the Plant). The lake water results were also evaluated against BRP Technical Specification reporting limits.

Tritium and gross beta analyses are required for all lake water samples. One of the twenty-four indicator location lake water samples had detectable tritium levels with a result of 236 pCi/L. One control lake water sample had detectable tritium levels with a result of 163 pCi/L. The means for gross beta indicator and control locations were 2.4 pCi/L and 2.7 pCi/L, respectively.

Sr89, Sr90, and gross alpha are required analysis for Lake-out (plant discharge). During 1996 gross alpha was detected in one sample, Sr89 was not detected in any sample, and Sr90 was detected in ten of twelve samples with a mean of 0.7 pCi/L. No BRP Technical Specification reporting limits were exceeded nor were any special/supplemental analyses required during 1996.

Ludington lake-in, BRP lake-in and BRP discharge samples are collected daily for composite into a monthly sample. A one-gallon quantity of sample is sent to Teledyne Brown Engineering for analysis. No treatment of the water samples with a preservative is necessary.

#### E. Well Water

A total of 24 individual monthly well water samples were collected from the BRP site well (indicator) and the Ludington well (control) during 1996. Tritium and gross beta analyses are required for each monthly sample.

Evaluation of the monthly well water analytical results was based on a data means comparison between the BRP site well and the Ludington well samples. No indicator well water samples had any detectable tritium, however, two control samples had detectable tritium, with an average of 167 pCi/L. The gross beta means for the indicator and control location were 1.6 pCi/L and 1.3 pCi/L, respectively. No BRP Technical Specification reporting limits were exceeded nor were any special/supplemental analyses required during 1996.



A one-gallon grab sample is sent to Teledyne Brown Engineering for analysis. No treatment of the water samples with a preservative is necessary.

#### F. Drinking Water

A total of 24 monthly samples were collected from the Charlevoix Municipal Water System (indicator) and the Ludington lake intake (control) during 1996. Tritium and gross beta analyses are required for each monthly sample.

Evaluation of the monthly drinking water analytical results was based on a data means comparison between the Charlevoix Municipal Water System and the Ludington lake samples. Two indicator location tritium results and one control sample tritium result were detectable. The gross beta means for the indicator and control location were 1.7 pCi/L and 2.7 pCi/L, respectively.

No BRP Technical Specification reporting limits were exceeded nor were any special/supplemental analyses required during 1996.

The drinking water samples are collected daily for composite into a monthly sample at Charlevoix and monthly grab samples are obtained from the Ludington well. A one-gallon quantity of sample is sent to Teledyne Brown Engineering for analysis. No treatment of the water samples with a preservative is necessary.

#### G. Crops

The collection of food crops/vegetation samples is not required by the BRP Radiological Environmental Monitoring Program Technical Specifications. There are no regular select locations where food crop samples are collected, however, several crop samples are usually obtained when in season if available. Cabbage leaves, tomato leaves, and beans leaves were collected September 06, 1996 from Kuebler Farms (2.5 mi E).

Evaluation of the crop sample analytical results was direct. All data was combined and reported. No control location was used.

Only gross beta analyses resulted in any detectable activity. All other results were not detectable. The mean gross beta activity was 4.7 pCi/g in 1996, which is comparable to 5.5 pCi/g in 1995 and 6.1 pCi/g in 1994. No BRP Technical Specification reporting limits were exceeded nor were any special/supplemental analyses required during 1996.

Food crop samples are obtained seasonally, usually from the E, SE, ESE or SSE meteorological sectors and when specifically requested. When collected, approximately 1 Kg of sample is placed in a sealable plastic bag for shipment to Teledyne Brown Engineering. No special treatment of the food crop samples with a preservative is necessary.

#### H. Sediment

A total of 13 individual sediment samples were collected from six locations during 1996. Two sediment samples were obtained each from near the BRP discharge channel (1-ST); from Nine Mile Point (2-NM, 3 mi ENE); from the Ludington control station (26-LP, 115 mi SSW); from 1/4 mi south of discharge (24-STS); and from Mt. McSaubia (19-MS, 3 mi W); three sediment samples were collected from 1/4 mi north of discharge (25-STN).

Evaluation of the sediment analytical results was based on data means comparisons between the BRP samples and the Ludington control samples and the BRP Technical Specification reporting limits. Gross beta, Mn-54, Co-60, and Cs-137 analyses resulted in trace amounts of activity present. Gross beta was detected in all indicator and control samples. Gross beta means for indicators and control stations were 8.3 pCi/g and 8.5 pCi/g, respectively. The Cs-137 was the only gamma emitter detected in control samples (in one of the two samples). Cs-137 mean for indicator and control locations was 0.22 pCi/g and 0.026 pCi/g respectively. The Mn-54 mean for the indicator locations was 0.28 pCi/g. The Co-60 mean for the indicator locations was 0.51 pCi/g. These results were consistent with results from 1994 and 1995.

The sediment results from station 25-STN on 10/7/96 showed Co-60 activity at 2.123 pCi/g, which is above the 1.0 pCi/g Action Level. Elevated Mn-54 and Cs-137 activity was also noted in this sample, however, that activity did not exceed the action level. None of the other Big Rock sediment samples collected on this date showed elevated activities. A subsequent sample obtained at this station on 12/18/96 indicated Co-60, Mn-54, and Cs-137 at normal concentrations. There are no NRC reporting levels for sediment samples.

No other BRP Technical Specification reporting levels or action levels were exceeded nor were any other special or supplemental analyses required during 1996.

Sediment samples are collected semi-annually from designated locations. A one liter quantity grab sample is usually obtained a few yards off-shore. No treatment of the samples with a preservative is necessary prior to shipment to Teledyne Brown Engineering.

i. Fish

A total of fourteen individual fish samples were collected from four locations during 1996. Ten samples were obtained from BRP site area: 1-ST discharge, 24-STN 1/4 mile south boundary, and 25-STN 1/4 mile north boundary; and four samples from the Ludington control station (26-LP).

Evaluation of the fish analytical results was based on data means comparisons between the BRP indicator samples and the Ludington control samples and the BRP Technical Specification reporting limits. Only gross beta and Cs-137 measurements resulted in any detectable activity. The gross beta means for the indicator and control locations were 2.5 pCi/g and 2.4 pCi/g, respectively. The Cs-137 means for the indicator and control locations were 0.029 pCi/g and 0.025 pCi/g, respectively. Comparison of results between similar species at the different locations resulted in no significant differences.

Two of the fish samples failed to meet the required LLD for Ba-La-140 analysis due to a combination of the small sample collected, and a delay in the shipment to the Laboratory. No BRP Technical Specification reporting levels were exceeded, nor were any special analyses required during 1996.

Fish samples are collected semi-annually. If possible, at least two different fish species (i.e., forage, sport fish, etc.) are sampled semi-annually at designated sample locations. When caught, a one liter quantity of fish sample is prepared for shipment to Teledyne Brown Engineering. Each sample is treated with 10 ml of a 10% formaldehyde solution for preservation.

J. Crayfish

A total of six crayfish samples were collected from three different locations during 1996 - 1-ST discharge, 24-STN 1/4 mile south boundary, and 25-STN 1/4 mile north boundary. No control samples were taken. Evaluation of the crayfish analytical results was based on a data means comparison with the BRP Technical Specification reporting limits.

Radionuclide analyses results are listed in Table HP 10.2-2 for crayfish. There were trace amounts of activity present in most of the samples. Activity levels were greatest in the samples taken from the discharge area (1-ST) for Co-60, Mn-54 and Cs-137. Activity levels were greatest in the samples taken from the location a quarter mile North of the discharge (24-STN) for gross beta.

One of the crayfish samples failed to meet the required LLD for Ba-La-140 analysis due to a combination of a small sample collected, and a delay in the shipment to the Laboratory. No BRP Technical Specification reporting levels were exceeded nor were any special or supplemental analyses required during 1996.

Crayfish samples are collected semi-annually at designated locations, however, lack of sample media, inclement weather or rough water conditions can either make collecting sufficient sample quantities impossible or wash biota populations out of the immediate sampling vicinity. One liter quantities of crayfish are sent to Teledyne Brown Engineering for analysis. Each sample is treated with 10 ml of a 10% formaldehyde solution for preservation.

#### K. Aquatic Biota

The aquatic biota category consists of algae and periphyton. A total of nine individual samples were collected from three locations during 1996. Sample types and locations are as follows:

Algae: Three indicator location samples were obtained, one from BRP 1-ST discharge, and two from 24-ST 1/4 mile south boundary in 1996. No samples were obtained (not available) from other indicator locations or from the Ludington Control Location (26-LP).

Periphyton: Six indicator samples were obtained, two each from BRP (1-ST discharge, 24-ST 1/4 mile south boundary and 25-STN 1/4 mile north boundary) in 1996.

Evaluation of the biota analytical results was based on a data means comparison with the BRP Technical Specification reporting limits.

Analyses are listed in Table HP 10.2-2 for algae. There were detectable amounts of activity present in all of the samples from indicator locations. Activity levels were greatest in the sample taken at the discharge 1-ST canal for all detectable radionuclides.

Analyses are listed in Table HP 10.2-2 for periphyton. There were detectable amounts of activity present in all samples. Activity levels were greatest in the samples from the discharge canal area for all detected radionuclides, except Cs-137, which was highest at 24-ST, 1/4 mi S.

One of the periphyton samples, and two of the algae samples failed to meet the required LLD for Ba-La-140 analysis due to a combination of a small sample collected, and a delay in the shipment to the Laboratory. No BRP Technical Specification reporting levels were exceeded nor were any special or supplemental analyses required during 1996. The algae samples taken



at the BRP discharge had Mn-54 and Co-60 activities in excess of the BRP action level (1 pCi/g). The results (gamma emitters) of this algae sample taken near the BRP discharge canal are lower than the results of 1995 (with the exception of gross beta) and consistent with the results of analysis from previous years. The gross beta results of the discharge algae sample are higher than the previous two years, and comparable to results seen in 1993. There was only one algae sample obtained from this station in 1996 which contributed to the higher average. There are no NRC reporting levels for algae or periphyton.

Aquatic biota samples (algae and periphyton) are collected semi-annually at designated locations, however, lack of sample media, inclement weather or rough water conditions can either make collecting sufficient sample quantities impossible or wash biota populations out of the immediate sampling vicinity. One liter quantities of biota are sent to Teledyne Brown Engineering for analysis. Each sample is treated with 10 ml of a 10% formaldehyde solution for preservation.

#### K. Broad Leaf Vegetation

No broad leaf vegetation samples were collected from the surrounding BRP environs during 1996. The collection of broad leaf vegetation samples serves as a backup and/or alternative sampling media in case any milk sampling location(s) become(s) unavailable. There were no problems associated with the quantity or quality of milk samples for the 1996 reporting year.

#### L. Gaseous and Liquid Radwaste Effluent Composite Samples

Although not a direct reporting component in the BRP Annual Radiological Environmental Monitoring Report, results of the gaseous and liquid monthly radwaste effluent composite samples are evaluated against overall environmental trending data. This evaluation is the basis for determining isotopic dispersion and deposition patterns within the surrounding environs of BRP. All isotopic values are compared to BRP Technical Specification reporting levels.

Both the gaseous and liquid radwaste effluent composite samples are collected monthly and sent to Teledyne Brown Engineering for analysis. The liquid effluent composite sample is based on a specific volume amount of sample collected per total batch volume released. As noted in Enclosure A, for months in which there were no liquid batch effluent releases no sample is sent to Teledyne Brown Engineering. The gaseous radwaste effluent monthly composite sample results are based on analyzing four or five weekly stack gas filters. No special sample treatment with a preservative is required prior to laboratory analysis.

### III. Assessment of Big Rock Point's Operational Environmental Impact

In reviewing the 1996 Big Rock Point radiological environmental monitoring data and comparing it to previous operational and pre-operational data, all trending parameters continue to indicate that the operation of Big Rock Point has minimal environmental impact. Most radionuclide activity is at environmental "background" levels. Evidence of an overall environmental isotopic build-up (attributable to Plant effluent) remains negligible as well. In most instances, sample analytical results were below previously established environmental background levels. Station ST-1 is the licensed plant radioactive discharge point and as can be expected, this station is normally the indicator location with the highest annual mean when comparing analytical results..

## Enclosures

- A. Sample Collection Anomalies
- B. Big Rock Point 1996 Land Use Census
- C. Health Physics Procedure HP 10.9; Big Rock Point Radiological Environmental Program Sample Collection and Shipment procedure (with sample locations, maps, etc.)
- D. Big Rock Point 1996 (annual) Radiological Environmental Monitoring program Data as provided by Teledyne Isotopes Midwest laboratory, Northbrook, IL.
- E. Teledyne Isotopes Midwest laboratory EPA Interlaboratory Comparison Program Results
- F. Data Graphs
  - 1. Big Rock Point Air particulate (gross beta) 1996 Trending and Big Rock Point Air Particulate (gross beta) 1991-1996 Operational Comparison Graphs
  - 2. Big Rock Point TLD (gamma) 1996 Trending and Big Rock Point TLD (gamma) Monthly, Quarterly and Annual 1991-1996 Operational Comparison Graphs
  - 3. Big Rock Point Well Water (gross beta) 1996 Trending
  - 4. Big Rock Point Lake Water (Charlevoix, Lake-in, and discharge - gross beta); 1960-1962 Pre-operational 1991-1996 Operational Comparison Graphs
  - 5. Big Rock Point Lake Water (Ludington and Charlevoix controls vs. Lake-in gross beta) 1996 Trending
  - 6. Big Rock Point Fish (gross beta) 1991-1996 Trending and Big Rock Point Fish (gross beta) 1991-1996 Operational Comparison Graphs
  - 7. Big Rock Point Sediment (gross beta) 1991-1996 Trending and Big Rock Point (gross beta) 1991-1996 Operational Comparison Graphs
  - 8. Big Rock Point Aquatic Biota (crayfish, algae, periphyton - gross beta) 1991-1996 Trending and Big Rock Point Aquatic Biota; 1960-1962 Pre-operational/1991-1996 Operational Comparison Graphs (including Ludington Control 1991-1996 algae only)

Station	Code	Location	Station	Code	Location
1	ST	Big Rock Point Nuclear	14	G	Information Center Site
2	NM	Nine Mile Point, 3 Miles (4.8 km) E	15	H	Vent Shed (South side) Site
3	CH	Charlevoix, MI, 4-½ Miles (7.2 km) SW	16	J	Susan Creek near Lake Michigan
4	SL	Susan Lake, 3.5 Miles (5.6 km) SE	17	K	Discharge Canal (fisherman)
5	PT	Petoskey, MI, 10-½ Miles (16.8 km) E	18	L	Access Control
6	BC	Boyne City, MI, 12 Miles (19.2 km) SE	19	MS	Mt. McSauba, PE, 3 miles (4.8 km) W
7	TR	Traverse City, MI, 50 Miles (80 km) SSW	20	JG	J Golovich - Maple Grove Road, Charlevoix, MI 4.5 miles (7.2 km) SE
8	D	Control (Lead Cave) Environmental Contractor's Residence	21	DK	D L Kuebler, Upper Bay Shore Road, Charlevoix MI 2.5 miles (4 km) E
9	A	Meteorological Tower Foundation	22	RM	R McCraney, Horton Bay Rd. Petoskey, MI 11.5 miles (18.4 km) E
10	B	West Site Boundary on Lake Michigan	23	BB	B Bochniak, Resort Pike Road, Petoskey, MI 11.5 miles (18.4 km) E
11	C	South Site Boundary, Shanahan's Orchard 0.8 Miles (1.3 km) SW	24	STS	1/4 Mile (0.4 km) South Boundary
12	E	Southeast Boundary 0.9 Miles (1.4 km) SSE, US-31 near the abandoned railway spur	25	STN	1/4 Mile (0.4 km) North Boundary
13	F	First CPCo Pole in Right of Way South of US-31 Information Center Site	26	LP	Ludington Pumped Storage 115 miles SSW (185.1km)

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-1 Sampling and Analysis Summary

<u>Medium</u>	<u>Description</u>	<u>Location</u>	<u>Number of Samples Collected</u>	<u>Type of Analysis</u>	<u>Frequency of Analysis</u>
Air	Continuous at Approx 1 CFM	2-NM thru 7-TR	318	Gross Beta, I-131	Weekly
TLD	Continuous	1-ST thru 7-TR 09-A thru 13-F and 16-J	143 48 12	Gamma	Monthly Quarterly Annual
Milk	2 Gallon Grab	20-JG, 21-DK, 22-RM, 23-BB	48	I-131, Cs-137, Other Gammas	Monthly
Lake Water	1 Gallon Composite	1-ST Intake 1-ST Discharge 26-LP Intake	36	Gross Beta, Tritium	Monthly
Well Water	1 Gallon Grab/Composite	1-ST Well 26-LP Well	24	Gross Beta, Tritium	Monthly
Drinking Water	1 Gallon Composite/Grab	3-CH 26-LP Intake	24(1)	Gross Beta, Tritium	Monthly
Crops	Grab	21-DK	3	Gross Beta, I-131, Cs-137, Other Gamma	As Requested
Sediment	Grab	1-ST, 2-NM, 19-MS, 24-STs, 25-STN, 26-LP	12	Gross Beta, Cs-137, Other Gamma	Semi-Annual
Fish	Grab	1-ST, 24-STs, 25-STN, 26-LP	14	Gross Beta, Cs-137, Other Gamma	Seasonally

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-1 Sampling and Analysis Summary

<u>Medium</u>	<u>Description</u>	<u>Location</u>	<u>Number of Samples Collected</u>	<u>Type of Analysis</u>	<u>Frequency of Analysis</u>
Crayfish	Grab	1-ST, 24-STS, 25-STS	6	Gross Beta, Cs-137 Other Gamma	Seasonally
Aquatic Biota	Grab	1-ST, 24-STS 25-STN	9	Gross beta, Cs-137, Other Gamma	Seasonally
Other Medium Sampled	Grab		None	Gross Beta, Cs-137, Other Gamma	As Required

(1) Same control samples as lake water medium

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-3 High, Low and Mean  
Reporting Results for Greatest Mean Sampling Location

<u>Medium</u>	<u>Type of Analysis</u>	<u>Location</u>	<u>High</u>	<u>Low</u>	<u>Mean</u>
Air (pCi/m <sup>3</sup> )	I-131	LLD	-----	-----	<0.07
	Gross Beta	7-TR 50 mi SSW	0.031	0.008	0.017
TLD (mR) Inner Ring (site boundary)	TLD (Monthly) (1)	12-E 0.9 mi SSE	4.4	3.2	3.8
	TLD (Quarterly) (1)	12-E 0.9 mi SSE	12.8	10.6	11.9
	TLD (Annual)	12-E 0.9 mi SSE	N/A	N/A	49.2
TLD (mR) Outer Ring	TLD (Monthly) (1)	4-SL 3.5 mi SE	4.0	2.7	3.3
	TLD (Quarterly)(1)	4-SL 3.5 mi SE	12.9	10.5	11.6
	TLD (Annual)	4-SL 3.5 mi SE	N/A	N/A	47.3
Milk (pCi/L)	I-131	LLD	-----	-----	<1.0
	Cs-137	LLD	-----	-----	<18.0
	Other Gamma	LLD	-----	-----	<15.0
Lake Water  (pCi/L)	Tritium	1-ST Inlet, BRP Plant Site	236	236	236
	Gross Alpha	1-ST Discharge, BRP Plant Site	0.7	0.7	0.7
	Gross Beta	1-ST Discharge, BRP Plant Site	6.1	1.6	2.8
	Sr-89	LLD	-----	-----	<5.0
	Sr-90	1-ST Discharge, BRP Plant Site	1.1	0.4	0.7
Well Water (pCi/L)	Gross Beta	1-ST BRP Plant Site	2.2	1.2	1.6
	Tritium	26-LP 115 mi SSW	169	164	167



Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-3 High, Low and Mean  
Reporting Results for Greatest Mean Sampling Location

<u>Medium</u>	<u>Type of Analysis</u>	<u>Location</u>	<u>High</u>	<u>Low</u>	<u>Mean</u>
Drinking Water (pCi/L)	Gross Beta	26-LP 115 mi SSW	7.6	1.3	2.7
	Tritium	3-CH 4.5 mi SW	191	166	179
Crops (pCi/g Wet)(2)	Gross Beta	21-DK 2.5 mi E	7.1	3.0	4.7
	Cs-137	LLD	-----	-----	<0.08
	Other Gamma	LLD	-----	-----	<0.05-
					0.10
Sediment (pCi/g Dry)	Gross Beta	19-MS 3 mi W	10.6	10.2	10.4
	Cs-137	1-ST BRP Plant Site	0.87	0.15	0.51
	Mn-54	25-STN 0.25 mi N	0.93	0.02	0.33
	Co-60	25-STN 0.25 mi N	2.12	0.05	0.77
	Other Gamma	LLD	-----	-----	<0.1-
					0.26
Fish (pCi/g Wet)	Gross Beta	24-STS 0.25 mi S	2.6	2.4	2.5
	Cs-137	1-ST BRP Plant Site	0.044	0.009	0.032
	Other Gamma	LLD	-----	-----	<0.10-
					0.26
Crayfish (pCi/g Wet)	Gross Beta	24-STN 0.25 mi N	2.08	1.65	1.87
	Mn-54	1-ST BRP Plant Site	0.130	0.014	0.072
	Co-60	1-ST BRP Plant Site	0.398	0.071	0.234
	Cs-137	1-ST BRP Plant Site	0.144	0.037	0.091
	Other Gamma	LLD	-----	-----	<0.10-
					0.26



Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-3 High, Low and Mean  
Reporting Results for Greatest Mean Sampling Location

<u>Medium</u>	<u>Type of Analysis</u>	<u>Location</u>	<u>High</u>	<u>Low</u>	<u>Mean</u>
Algae (pCi/g Wet)	Gross Beta	1-ST BRP Plant Site	-----	-----	13.66
	Mn-54	1-ST BRP Plant Site	-----	-----	4.649
	Co-60	1-ST BRP Plant Site	-----	-----	6.823
	Cs-137	1-ST BRP Plant Site	-----	-----	0.425
	Other Gamma	LLD	-----	-----	<0.10- 0.26
Periphyton (pCi/g Wet)	Gross Beta	1-ST BRP Plant Site	6.66	3.74	5.20
	Mn-54	1-ST BRP Plant Site	0.435	0.125	0.560
	Co-60	1-ST BRP Plant Site	0.945	0.246	0.596
	Cs-137	24-STS 0.25 mi S	0.220	0.109	0.165
	Other Gamma	LLD	-----	-----	<0.10- 0.26
Broad Leaf Veg (pCi/g Wet)(3)	I-131	No Samples Collected			
	Sr-89				
	Sr-90				
	Other Gamma				
Other analyses performed during year (specify)	N/A	No other analyses performed during 1996			

- (1) Monthly TLD results are normalized for 30 days net;  
Quarterly TLD results are normalized for 91 days net.
- (2) Samples collected in season (on request)
- (3) Supplemental sample when milk is unavailable

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled Unit of Measurement	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a)	All Indicator Locations		Location With Greatest Annual Mean(d)			All Control Locations		Nonroutine Measurements
			LLD	Mean(b) Range(b)		Name Distance and Direction			Mean(b) Range(b)		
Air (pCi/m³)	I-131	315/318	0.07	0/157	LLD	N/A		LLD	0/158	LLD	None
	Gross Beta	315/318	0.01	157/157	0.016 (0.008-0.031)	7-TR 50 mi SSW 52/52	0.017 (0.008-0.031)	158/158	0.017 (0.007-0.032)	None	
TLD (mR) Inner Ring Site Boundary)	TLD (Monthly) (f)	108/108	1.0	71/71	3.0 (1.6-4.4)	12-E 0.9 mi SSE 12/12	3.8 (3.2-4.4)	36/36	3.1 (2.3-4.2)	None	
	TLD(Quarterly) (f)	36/36	1.0	24/24	10.1 (8.3-12.8)	12-E 0.9 mi SSE 4/4	11.9 (10.6-12.8)	12/12	10.9 (9.1-12.4)	None	
	TLD (Annual)	9/9	1.0	6/6	42.1 (34.2-49.2)	12-E 0.9 mi SSE 1/1	49.2	3/3	44.7 (42.7-46.3)	None	
TLD (mR) Outer Ring	TLD (Monthly) (f)	72/72	1.0	36/36	3.0 (2.2-4.0)	4-SL 3.5 mi SE 12/12	3.3 (2.7-4.0)	36/36(1)	3.1 (2.3-4.2)	None	
	TLD (Quarterly) (f)	24/24	1.0	12/12	10.6 (9.4-12.9)	4-SL 3.5 mi SE 4/4	11.6 (10.5-12.9)	12/12(1)	10.9 (9.1-12.4)	None	
	TLD (Annual)	6/6	1.0	3/3	43.3 (41.1-47.3)	4-SL 3.5 mi SE 1/1	47.3	3/3 (1)	44.7 (42.7-46.3)	None	

1) Same control TLDs as Inner Ring.

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled Unit of Measurement	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a) LLD	All Indicator Locations		Location With Greatest Annual Mean(d)		All Control Locations		Nonroutine Measurement
				Mean(b) Range(b)		Name Distance and Direction	Mean(b) Range(b)	Mean(b) Range(b)		
Milk (pCi/L)	I-131	48/48	1.0	0/36	LLD	N/A	LLD	0/12	LLD	None
	Cs-137	48/48	18.0	0/36	LLD	N/A	LLD	0/12	LLD	None
	Other Gamma	48/48	15.0	0/36	LLD	N/A	LLD	0/12	LLD	None
Lake Water (pCi/L)	Tritium	36/36	500.0	1/24	236	1-ST Inlet	1/12 236	1/12	163	None
	Gross Alpha(e)	12/12	1.0	1/12	0.7	1-ST Discharge	1/12 0.7	N/A		None
	Gross Beta	36/36	4.0	24/24	2.4 (1.5-6.1)	1-ST Discharge	12/12 2.8 (1.6-6.1)	12/12	2.7 (1.3-7.6)	None
	Sr-89 (e)	12/12	5.0	0/12	LLD	N/A	LLD	N/A		None
	Sr-90 (e)	12/12	1.0	10/12	0.7 (0.4-1.1)	1-ST Discharge	8/12 0.7 (0.4-1.1)	N/A		None
Well Water (pCi/L)	Gross Beta	24/24	4.0	12/12	1.6 (1.2-2.2)	1-ST BRP Plant Site	12/12 1.6 (1.2-2.2)	5/12	1.3 (0.9-3.1)	None
	Tritium	24/24	500.0	0/12	LLD	26-LP 115 mi SSW	2/12 167 (164-169)	2/12	167 (164-169)	None

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled Type of Measurement	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit Of Detection(a) LLD	All Indicator Locations	Location With Greatest Annual Mean(d)				All Control Locations		Nonroutine Measurements
					Mean(b) Range(b)	Name Distance and Direction	Mean(b) Range(b)		Mean(b) Range(b)		
Drinking Water (1/L)	Gross Beta	24/24	4.0	12/12	1.7 (0.8-2.1)	26-LP 115 mi SSW	12/12 2.7 (1.3-7.6)		12/12(2) 2.7 (1.3-7.6)		None
	Tritium	24/24	500.0	2/12	179 (166-191)	3-CH 4.5 mi SW	2/12 179 (166-191)		1/12(2) 163		None
Fish (1/g Wet)	Gross Beta	3/3	1.0	3/3	4.7 (3.0-7.1)	21-DK 2.5 mi E	3/3 4.7 (3.0-7.1)		N/A		None
	Cs-137	3/3	0.08	0/3	LLD	N/A	LLD		N/A		None
	Other Gamma	3/3	0.05-0.10	0/3	LLD	N/A	LLD		N/A		None
Sediment (1/g Dry)	Gross Beta	13/13	1.0	11/11	8.3 (5.6-12.1)	19-MS 3 mi W	2/2 10.4 (10.2-10.6)		2/2 8.5 (6.8-10.3)		None
	Cs-137	13/13	0.15	11/11	0.22 (0.02-.87)	1-ST BRP Plant Site	2/2 0.51 (0.15-0.87)		1/2 0.026		None
	Mn-54	13/13	0.13	4/11	0.28 (0.02-0.93)	25-STN 0.25 mi N	3/3 0.33 (0.02-0.93)		0/2 LLD		None
	Co-60	13/13	0.13	6/11	0.51 (0.05-2.12)	25-STN 0.25 mi N	3/3 0.77 (0.05-2.12)		0/2 LLD		None
	Other Gamma	13/13	0.1-0.26	0/11	LLD	N/A	LLD		0/2 LLD		None

Same control samples as lake water medium.

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled Type of Measurement	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a) LLD	All Indicator Locations	Location With Greatest Annual Mean(d)		All Control Locations	Nonroutine Measurements
					Name Distance and Direction	Mean(b) Range(b)		
In Air (pCi/g Wet)	Gross Beta	14/14	1.0	10/10	2.5 (1.9-2.8)	24-STN 0.25 mi S 2/2 2.5 (2.4-2.6)	4/4 2.4 (1.7-2.2)	None
	Cs-137	14/14	0.15	8/10	0.029 (0.007-0.044)	1-ST BRP Plant Site 4/5 0.032 (0.009-0.044)	4/4 0.025 (0.013-0.045)	None
	Other Gamma	14/14	0.10-0.26	0/10	LLD	N/A LLD	0/4 LLD	None
In Fish (pCi/g Wet)	Gross Beta	6/6	1.0	6/6	1.41 (0.38-2.08)	25-STN 0.25 mi N 2/2 1.87 (1.65-2.08)	N/A	None
	Mn-54	6/6	0.13	3/6	0.040 (0.011-0.130)	1-ST BRP Plant Site 1/2 0.072 (0.014-0.130)	N/A	None
	Co-60	6/6	0.13	5/6	0.108 (0.014-0.398)	1-ST BRP Plant Site 2/2 0.234 (0.071-0.398)	N/A	None
	Cs-137	6/6	0.15	5/6	0.042 (0.011-0.144)	1-ST BRP Plant Site 2/2 0.091 (0.037-0.144)	N/A	None
	Other Gamma	6/6	0.10-0.26	0/5	LLD	N/A LLD	N/A	None
In Soil (pCi/g Wet)	Gross Beta	3/3	1.0	3/3	5.97 (2.04-13.66)	1-ST BRP Plant Site 1/1 13.66	N/A	None
	Mn-54	3/3	0.13	1/3	1.58 (0.017-4.649)	1-ST BRP Plant Site 1/1 4.649	N/A	None
	Co-60	3/3	0.13	3/3	2.34 (0.036-6.823)	1-ST BRP Plant Site 1/1 6.823	N/A	None
	Cs-137	3/3	0.15	1/3	0.153	1-ST BRP Plant Site 1/1 0.425	N/A	None
	Other Gamma	3/3	0.10-0.26	0/4	LLD	N/A LLD	N/A	None

Big Rock Point Nuclear Power Plant  
Annual Radiological Environmental Operating Report  
January 1 to December 31, 1996  
Table HP 10.2-2 Sample Data Summary

Medium or Pathway Sampled of Measurement	Analyses Evaluated Versus Total Number of Analyses Performed		Lower Limit of Detection(a) LLD	All Indicator Locations	Location With Greatest Annual Mean(d)		All Control Locations Mean(b) Range(b)	Nonroutine Measurements
					Name Distance and Direction	Mean(b) Range(b)		
phyton (/g Wet)	Gross Beta	6/6	1.0	6/6	3.30 (1.95-6.66)	1-ST BRP Plant Site 2/2 5.20 (3.74-6.66)	N/A	None
	Mn-54	6/6	0.13	6/6	0.172 (0.012-0.435)	1-ST BRP Plant Site 2/2 0.560 (0.125-0.435)	N/A	None
	Co-60	6/6	0.13	5/5	0.40 (0.054-0.945)	1-ST BRP Plant Site 2/2 0.596 (0.246-0.945)	N/A	None
	Cs-137	6/6	0.15	5/5	0.160 (0.109-0.220)	24-STS 0.25 mi S 0.165 (0.109-0.220)	N/A	None
	Other Gamma	6/6	0.10-0.26	0/5	LLD	N/A LLD		None
d Leaf Veg (/g Wet) (c)	Gross Beta		1.0	No samples collected				
	I-131		0.06					
	Other Gamma		0.08-0.10					
Analyses performed during year	N/A		N/A	No other analyses performed during 1993				

Nominal Lower Limit of Detection (LLD) as defined in the Big Rock Point Technical Specifications Table 13.3-3 and vendor analytical capabilities.  
Mean and range based upon detectable measurements only. Fraction of detectable measurements at specific locations is indicated next to the mean.  
Supplemental sample when milk is unavailable.  
See reporting results for greatest mean sampling location.  
Not required for 1-ST intake.  
Monthly TLD results are normalized for 30 days net; Quarterly TLD results are normalized for 91 days net.

**ENCLOSURE A**

**CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996**

**SAMPLE COLLECTION ANOMALIES**

**Submitted April 17, 1997**



Enclosure A

Sample Collection Anomalies

<u>Sample Type Affected</u>	<u>Location</u>	<u>Date</u>	<u>Problem</u>	<u>Evaluation</u>
AP - I-131 Beta	2-NM	1/18/96	Low sample volume, results not included In statistical analysis	Sample pump moved away from the service outlet
AP - I-131 Beta	7-TR	7/18/96	Low sample volume, results not included In statistical analysis	Inlet hose shortened to prevent recurrence, all other station inlet hoses in satisfactory condition
AP - I-131 Beta	4-SL	12/26/96	Low sample volume, results not included In statistical analysis	Sample pump failure
TLD	9-A	May	Monthly TLD lost	TLD stolen, no data available
Fish	1-St & 26-LP	June 96	LLD for Ba-La 140 not met	Delay in shipment, and sample size too small to meet analysis (1)
Crayfish	24-STs	June 96	LLD for Ba-La 140 not met	Delay in shipment, and sample size too small to meet analysis (1)
Periphyton & Algae	1-ST 24-STs	June 96	LLD for Ba-La 140 not met	Delay in shipment, and sample size too small to meet analysis (1)
Liquid	BRP	July, Sept Nov Dec	No sample collected	There were no liquid batch effluent releases during these time periods. Consequently no sample is collected and sent to Teledyne.



- (1) The Ba-La 140 LLD for several aquatic Biota (fish, crayfish, periphyton, and algae) samples were not met in 1996. This LLD was not met for two reasons, one being the small sample size sent to the Laboratory for analysis, and the other was a delay in shipment of the samples to the Laboratory for analysis. Obviously the sample size is dependent upon the number of a particular species collected in the nets, or the amount of periphyton, algae, or crayfish present in the sample location, and is not subject to any corrective actions. In some instances the sample may consist of only a half-liter, which is enough to meet all LLD's with the exception of Ba-La-140. However, in the future all fish and Biota samples will be shipped to the Laboratory within 7 days to ensure sample delay is not the cause for missing Ba-La-140 LLD's.

To Big Rock REMP File  
From MLGrogan  
Date January 24, 1996  
Subject BIG ROCK POINT NUCLEAR PLANT -  
MISSED SAMPLE

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

cc TPNeal, Palisades  
TFPopa, Big Rock Point  
Allan Green, Teledyne  
DCC: 950/24\*03\*10LP

MLG96\*006

---

A sample volume of only 100 Ft3 was collected at station 2 NM during the week ending 1/18/96. The sample pump was found lodged against the outlet plug and apparently the pump vibration loosened the plug enough to shut down the motor.

The sample pump was moved away from the service outlet and the unit was returned to service.

To Big Rock REMP File

From MLGrogan

Date June 19, 1996

Subject BIG ROCK POINT NUCLEAR PLANT -  
MISSED SAMPLE

CC Thad Popa  
Tom Neal  
Alan Green

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

MLG96\*019

---

During the May TLD collection at Big Rock Point, the monthly, quarterly and annual TLD's were missing from Station #9 (on site - Meteorological tower). A thorough search of the area was conducted, however, missing TLD's were not located and vandalism is suspected. The second quarter and annual TLD's (BRSP -1 2nd quarter, and BRSP-1 annual) were replaced at this station on June 7, 1996 at 15:30.

Thad Popa will evaluate relocating the TLD holder to a less conspicuous area at or near the meteorological tower in order to prevent recurrence.

To Big Rock REMP File

From MLGrogan

Date July 26, 1996

Subject BIG ROCK POINT NUCLEAR PLANT -  
LOW VOLUME AIR SAMPLE

cc TPNeal, Palisades  
TFPopa, Big Rock Point  
Allan Green, Teledyne  
DCC: 950/24\*03\*10LP

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

MLG96\*024

---

A sample volume of only 4100 Ft<sup>3</sup> (116.1M<sup>3</sup>) was collected at station 7 TR during the week ending July 18, 1996. Over the duration of this week's sampling, the sample pump vibrated over and crimped the inlet hose restricting flow. The minimum sample volume to meet I-131 LLDs (141 M<sup>3</sup>) was not met, and sample results will not be included in statistical analysis for the Big Rock annual radiological environmental operating report .

The inlet hose was shortened to prevent recurrence.

8-8-96

Subj: Environmental Sampling -

On 7-18-96 the Traverse City station had a low flow due to a crimp in the inlet hose to the air pump. The hose was long enough to allow a loop in the upper part of the sampling box behind the instrument panel. This caused the crimp. The hose was shortened.

Checked all other stations they do not have this problem.

Robert S

REVIEWED

V POPA END

8/8/96

To File  
From TFPopa  
Date Aug. 26, 1996  
Subject ELEVATED TLD DOSE TO STATION  
BRP#1 AND BRP#15 (Onsite)

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

TFP 96-24

CC DCC/NA MLGrogan KEPallagi

A review of our monthly TLD Report from Teledyne Isotopes, indicated our onsite TLD readings for stations BRP-#1 (Plant Substation) and BRP-#15 (Vent Shed Area), had increased generally by a factor of two. This increase in dose can be accounted for by the resin work being performed on site for this time period.

TLD station BRP-#15 is within 100 ft. of the transfer location for our Spent Resin Tanks. The increase in general area dose rates for this area caused by the transfer of resin, equipment, and the resin transfer cask itself, correlates with the increase in TLD dose for the work period. Station BRP-#1, located at the South East corner of our plant Substation, also showed an increase for the same period. This location received the shine from the Transfer Casks that were moved and stored at the North side of the Radwaste Building in preparation for shipment.

These dose rates should return to normal at the completion of the project in late September or early October. It should be noted however, that Big Rock maybe unable to ship all the spent resin currently removed. This may effect station BRP-#1 at the Substation for a longer period. The long term storage for the two to three resin casks that may not be shipped is behind the Radwaste Building. Although this is not in direct line with station BRP-#1, a slight increase in background may be visible on this station TLD.

From *MLG* MLGroganCONSUMERS  
POWER  
COMPANY

Date November 23, 1996

Subject Big Rock -  
Radiological Environmental Monitoring Program  
Replacement Milk Sample LocationInternal  
CorrespondenceCC TPNeal, Palisades  
TFPopa, Big Rock  
Allan Green, Teledyne  
1996 Big Rock Annual Radiological Environmental Operating Report  
MLG96\*034

---

During October, RMcCraney Farm (Station 22 RM, 6.5 mi SSE) sold his remaining dairy herd and is no longer available to Big Rock as a monthly milk sample station. A new milk sample location has been identified. Starting in November milk samples will be obtained from the Merle Hand Farm which is in the ESE sector approximately 2.8 miles from the Plant.

This new sample location will be designated Station # 22 (replacing R. McCraney) and the new identification code (on the sample collection forms) will be MH. This sample location will be added to Attachment 2 (Sample Locations) of Health Physics Procedure 10.9, "Big Rock Radiological Environmental Program Sample Collection and Shipment." R. McCraney (RM) will be removed from this Attachment.



To Big Rock REMP File

From <sup>MLG</sup> MLGrogan

Date December 12, 1996

Subject BIG ROCK POINT NUCLEAR PLANT -  
SEDIMENT ACTION LEVEL EXCEEDED

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

CC Thad Popa  
Tom Neal  
Allan Green

MLG96\*036

---

The bottom sediment results for the sample collected at 1/4 mile North station on October 7, 1996 shows Co-60 activity at 2.123 pCi/g, which is above the 1.0 pCi/g Action Level. Elevated Mn-54 and Cs-137 activity is also noted at this location, however, the activity is not at or above the action level. Other sediment samples taken on this date in this sample station vicinity do not show elevated Co-60, Mn-54, or Cs-137 activities. There is no NRC Reporting Level limit established for Sediments in Big Rock Technical Specifications, and other than notifications, no other action is necessary.

I have requested, however, that Teledyne re-analyze the sediment sample collected at Big Rock station 1/4 mile North.



ENCLOSURE B

CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996

BIG ROCK POINT 1996 LAND USE CENSUS

April 17, 1997

8 Pages

To KEPallagi, Big Rock Point

From <sup>MLG</sup> MLGrogan, Palisades

Date July 22, 1996

Subject BIG ROCK POINT -  
1996 LAND USE CENSUS

CONSUMERS  
POWER  
COMPANY

Internal  
Correspondence

CC TPNeal, Palisades  
TFPopa, Big Rock Point  
DCC:740/72\*10\*03/LP

MLG96\*023

The attached tables and map are the results of the Big Rock Point Land Use Census conducted by MLGrogan and TRSchlueter on June 28, 1996. Table 10.11-1 references the distance from Big Rock Point to the nearest residence, garden, beef/dairy cattle and goat per meteorological sector within a (5) five mile radius of the plant. Table 10.11-2 identifies the locations of the nearest residence, of all gardens (greater than 500 square feet) within a three (3) mile radius of the plant, and all beef/dairy animals within a five (5) mile radius of the plant. Table 10.11-3 lists the critical receptor locations used in calculation of offsite doses by the GASPAR computer program. The only changer from the 1995 Land Use Census are SE sector Garden now 1.8 mi (was > 5 mi), and E sector Beef Cattle now 2.7 mi (was 3.0 mi). There were no changes to any Critical Receptor Location.

This land use census is more detailed than required. Big Rock Point Technical Specification 13.2.3 requires the identification within a distance of (5) five miles the location in each of the (9) nine overland meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden greater than 500 square feet producing broad leaf vegetation. The land use census shall also identify within a distance of 3 miles the locations in each of the overland sectors of all milk animals and all gardens of greater than 500 square feet producing broad leaf vegetation.

Prior to conducting the Big Rock Point 1996 Land Use Census the Charlevoix County Agricultural Extension Office was contacted as required by Procedure HP 10.11. Tables 10.11-1 and 10.11-3 are required to be updated in the ODCM as Tables 1.4 and 1.4a respectively. Attached to this report are the new revisions of Tables 1.4 and 1.4a.

If you have any questions, please contact me.

Reviewed by

TPNeal  
TPNeal, HP Environmental Supervisor

7-25-96  
Date

1996 BIG ROCK LAND USE CENSUS REPORT

TABLE 10.11-1

Distance to the nearest residence, garden, milk cow, beef cow and goat in each sector.

<u>SECTOR</u>	<u>RESIDENCE</u>	<u>GARDEN</u>	<u>DAIRY COW</u>	<u>BEEF CATTLE</u>	<u>GOAT</u>
WSW	2.5 mi	>5 mi	>5 mi	>5 mi	>5 mi
SW	1.1 mi	2.7 mi	>5 mi	>5 mi	>5 mi
SSW	1.3 mi	>5 mi	>5 mi	>5 mi	>5 mi
S	1.9 mi	2.1 mi	>5 mi	>5 mi	>5 mi
SSE	1.7 mi	1.7 mi	>5 mi	1.7 mi	>5 mi
SE	1.6 mi	1.8 mi	4.5 mi	1.8 mi	>5 mi
ESE	1.5 mi	1.8 mi	*2.8 mi	3.2 mi	>5 mi
E	1.4 mi	2.4 mi	3.5 mi	2.7 mi	>5 mi
ENE	2.3 mi	>5 mi	>5 mi	>5 mi	>5 mi

\*NOTE: Farm bisected by E/ESE boundary line.

1996 BIG ROCK POINT LAND USE CENSUS REPORT

TABLE 10.11-2

Verification of Items

Locations of nearest residence; of all gardens greater than 500 square feet within a three mile radius of plant; and all beef/dairy cattle within a five mile radius of plant.

<u>Sector and Road</u>	<u>Location Description</u>	<u>Item</u>	<u>Number/Comment</u>
WSW Mt. McSauba Rd	Birchwood Ranch Shores North Point	Residence	1
SW Private Rd	Bergeon residence (Private Road) dirt trail off Martin Rd	Residence	1
SW Waller Rd	Meggison 13050 Waller	Garden	1
SSW Private Drive	Edward K. Shanahan, Private Drive North US-31	Residence	1
S See Rd	JmcClainathan 08621 See Rd	Garden	1
S North (dead) end of See Rd	G. Skeel North of Boyne City Rd	Residence	1
SSE Private Drive	SA Bascom West of Old US-31, adj. Susan Lake	Residence Garden	1 1
SSE Old U.S. 31	Old U.S. 31 Across street 10265 Old U.S. 31	Garden	1
SSE Old U.S. 31	10401 Old U.S. 31	Garden	1
SSE	10527 Old U.S. 31	Garden	1
SSE	10129 Old U.S. 31 North side of Rd, just West of Shrigley	Cattle	5-Beef

Table 10.11-2 (Cont'd)

<u>Sector and Road</u>	<u>Location Description</u>	<u>Item</u>	<u>Number/Comment</u>
SSE Intersection of Boyne City and Quarterline Roads	Lester Ular Farms Southwest corner of intersection	Cattle	30-Beef
SSE Intersection of Boyne City and Quarterline Roads	Jerry & Hazel Haggerty Farms, Southeast corner of intersection	Cattle	8-Beef
SE 1/4 mile west of Smith Rd.	Daniel & Rebecca Berg 09888 Old U.S. 31,	Resid Garden.	2-Beef
SE Intersection of Maple Grove and Dalton Road	Lee Sneathen, Jr. Farms West side of intersection	Cattle	20-Beef 4-Dairy
SE Maple Grove Between Quarterline & Dalton Road Intersections	*John & Shirley Golovich East side of Maple Grove Road	Cattle	40-Dairy 5-Beef
ESE Burgess Road	Ken Hickman 10371 Burgess Road, 1 mile South of US-31	Residence	1
ESE Upper Bay Shore Rd	8838 Upper Bay Shore Rd 1 mile East of Upper Bay Shore & Burgess Road intersection of (South side of road)	Garden	1
ESE Upper Bay Shore Rd	8513 Upper Bay Shore Rd	Garden	1
ESE Burgess Rd	09770 Burgess Rd.	Garden	1
ESE Old U.S. 31	Berg residence 00866 Old U.S. 31 just North of Smith Rd	Garden	1
ESE Upper Bay Shore	8722 Upper Bay Shore Rd	Garden	1

Table 10.11-2 (Cont'd)

<u>Sector and Road</u>	<u>Location Description</u>	<u>Item</u>	<u>Number/Comment</u>
ESE Burgess Rd	09501 Burgess Rd.	Garden	1
ESE Stolt Rd	Thomas Hamlin, Northeast corner intersection of Stolt and Murry Roads	Cattle	40-Beef
ESE Burnett Rd	Mike Baker, 0917 Burnett Rd, East side	Cattle	5-Beef
ESE Townline & Stolt	Rostar, Townline & Stolt intersection, NW section	Cattle	20-Beef
ESE/E Upper Bay Shore Road (bisected by ESE/E sector boundary line)	Merle Hand Upper Bay Shore Rd 3/10 mi West of Maple Grove Rd (South side of road)	Cattle	76-Dairy
E Upper Bay Shore Road	*Kuebler Farms, Upper Bay Shore Road, 2/10 mile East of Burnett (North side of Road)	Cattle Garden	130-Dairy 1
E Upper Bay Shore Road	Nathan Himebauch, 1/2 mi East of Maple Grove Road, North side of Road	Cattle	4-Beef
E East side of Burnett Road	Gary Ruehle, 10367 Burnett Road	Cattle	4-Beef
E Burgess Road	Ralph J. Purvis, 1/2 mi South of intersection of 10631 Burgess and US-31	Residence	1
E Old U.S. 31	Stewart residence 8864 Old U.S. 31	Garden	1
E	10137 Maple Grove, 1/4 mi N of Upper Bay Shore, West side of road	Cattle	2-Beef
ENE US-31	08988 U.S. 31 Werner Cunningham, South side of US-31, 2.3 miles East of BRP Plant	Residence	1

\*NOTE: Current milk sampling locations.



1996 BIG ROCK LAND USE CENSUS REPORT

Table 10.11-3

Critical Receptor Identification

<u>Sector</u>	<u>(miles)</u>	<u>Location/Description</u>	<u>Item</u>	<u>***X/Q(Sec/m<sup>3</sup>)</u>
E	0.6	**Lexalite Plastics Corp	Factory	5.09E-08
E	1.4	Ralph J. Purvis, 1/2 mi. South of intersection of Burgess and US-31	Residence/Garden	5.20E-08
E	0.57	Site Boundary	N/A	4.91E-08
SSE	1.7	10129 Old U.S. 31 North side of Road, just West of Shrigley Road	Beef Cattle	3.57E-08
*E/ESE	2.8	Merle Hand Upper Bay Shore Road, West of Maple Grove	Dairy Cows	3.43E-08

\*Note: Farms bisected by E/ESE sector boundary line. E sector X/Q is listed since it is the most conservative.

\*\*Note: Not used as critical receptor location in BRP GASPAR program, however factory is adjacent to site boundary and staffed 24-hours per day.

\*\*\*Note: Based on BRP 5-year composite meteorological data, 1989-93.

TABLE 1.4

1996 BIG ROCK POINT LAND USE CENSUS REPORT

Distance to the nearest residence, garden, milk cow, beef cow and goat in each sector.

<u>Sector</u>	<u>Residence</u>	<u>Garden</u>	<u>Dairy Cow</u>	<u>Beef Cattle</u>	<u>Goat</u>
WSW	2.5 mi	>5 mi	>5 mi	>5 mi	>5 mi
SW	1.1 mi	2.7 mi	>5 mi	>5 mi	>5 mi
SSW	1.3 mi	>5 mi	>5 mi	>5 mi	>5 mi
S	1.9 mi	2.1 mi	>5 mi	>5 mi	>5 mi
SSE	1.7 mi	1.7 mi	>5 mi	1.7 mi	>5 mi
SE	1.8 mi	1.8 mi	4.5 mi	1.8 mi	>5 mi
ESE	1.5 mi	1.8 mi	*2.8 mi	3.2 mi	>5 mi
E	1.4 mi	2.4 mi	3.5 mi	2.7 mi	>5 mi
ENE	2.3 mi	>5 mi	.5 mi	>5 mi	>5 mi

\*NOTE: Farm bisected by E/ESE boundary line.

TABLE 1.4a

1997 BIG ROCK POINT GASPAR INPUT PARAMETERSCritical Receptors

<u>Location</u>	<u>Sector</u>	<u>Distance (miles)</u>	<u>X/Q (sec/m<sup>3</sup>)</u>	<u>X/Q Decay (sec/m<sup>3</sup>)</u>	<u>X/Q Decay and Dep (sec/m<sup>3</sup>)</u>	<u>D/Q (1/m<sup>2</sup>)</u>
Residence/Garden	E	1.40	5.20E-08	5.18E-08	5.07E-08	6.23E-10
Site Boundary	E	0.57	4.91E-08	4.90E-08	4.85E-08	1.25E-09
Beef Cattle	SSE	1.70	3.57E-08	3.56E-08	3.50E-08	2.30E-10
Dairy Cow	E	2.80	3.43E-08	3.41E-08	3.29E-08	2.75E-10

ENCLOSURE C

CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155

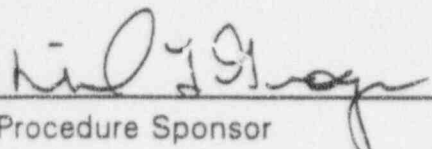
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996

HEALTH PHYSICS PROCEDURE HP 10.9

Submitted April 17, 1997

PALISADES NUCLEAR PLANT  
HEALTH PHYSICS PROCEDURE

TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT

 11/27/96  
\_\_\_\_\_  
Procedure Sponsor Date

\_\_\_\_\_  
Technical Reviewer Date

\_\_\_\_\_  
User Reviewer Date

Big Rock Point  
Annual Radiological Environmental Operation Report  
January through December 1996

Enclosure C: Health Physics Procedure HP 10.9



**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

Table of Contents

1.0	<u>PURPOSE</u> .....	1
2.0	<u>REFERENCES</u> .....	1
2.1	SOURCE DOCUMENTS .....	1
2.2	REFERENCE DOCUMENTS .....	1
3.0	<u>PREREQUISITES</u> .....	1
4.0	<u>PRECAUTIONS AND LIMITATIONS</u> .....	2
5.0	<u>PROCEDURE</u> .....	3
5.1	AIR SAMPLE COLLECTION .....	3
5.1.1	<u>Precautions</u> .....	3
5.1.2	<u>Prerequisites</u> .....	4
5.2	CITY OF CHARLEVOIX, LAKE (DRINKING) WATER SAMPLE COLLECTION .....	5
5.2.1	<u>Prerequisites</u> .....	5
5.3	MILK SAMPLE COLLECTION .....	6
5.3.1	<u>Precautions</u> .....	6
5.3.2	<u>Prerequisites</u> .....	7
5.4	AQUATIC BIOTA COLLECTION .....	7
5.4.1	<u>Precautions</u> .....	7
5.4.2	<u>Prerequisites</u> .....	8
5.5	SEDIMENT SAMPLE COLLECTION .....	10
5.5.1	<u>Prerequisites</u> .....	10

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

Table of Contents

5.6	ENVIRONMENTAL TLD COLLECTION .....	10
5.6.1	<u>Precautions</u> .....	10
5.6.2	<u>Prerequisites</u> .....	11
6.0	<u>ACCEPTANCE CRITERIA</u> .....	12
7.0	<u>ATTACHMENTS AND RECORDS</u> .....	12
7.1	ATTACHMENTS .....	12
7.2	RECORDS .....	13

**ATTACHMENTS**

- Attachment 1, "Environmental Sample Collection Schedule Big Rock Point"
- Attachment 2, "Sampling Locations Big Rock Point Plant"
- Attachment 3, "Sample Identification"
- Attachment 4, "Sample Packaging and Shipment"
- Attachment 5, "Big Rock Point Sample Collection Forms and Records"

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

**USER ALERT**  
**INFORMATION USE PROCEDURE**

The activities covered by this procedure  
may be performed from memory.

**1.0 PURPOSE**

- 1.1 To provide methodology for collection, identification, and shipment of environmental samples in support of the Big Rock Point (BRP) Radiological Environmental Monitoring Program (REMP).

**2.0 REFERENCES**

**2.1 SOURCE DOCUMENTS**

- 2.1.1 Big Rock Point Technical Specifications 13.2; Table 13.3-1
- 2.1.2 Regulatory Guide 4.15(7)
- 2.1.3 10CFR50, Appendix I
- 2.1.4 Palisades Administrative Procedure 7.08, "Big Rock Point and Palisades Radiological Environmental Monitoring Program (REMP)"
- 2.1.5 REMP Sample Shipping Manual, Teledyne Isotopes Midwest Laboratory

**2.2 REFERENCE DOCUMENTS**

None

**3.0 PREREQUISITES**

As indicated in procedure.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

**4.0      PRECAUTIONS AND LIMITATIONS**

- 4.1      This procedure shall be applicable to Big Rock Point CHP, Radiological department, Environmental department, and any contractual personnel assigned to collect or evaluate REMP samples.
- 4.2      Any revisions to this procedure shall be reviewed against Big Rock Point Technical Specifications to verify compliance.
- 4.3      Deviations from the required sampling schedule shall be documented in the Annual Radiological Environmental Operating Report.
- 4.4      Every effort shall be made to complete corrective action on malfunctioning sampling equipment prior to the start of the next sampling cycle.
- 4.5      If the required samples cannot be obtained, then suitable alternative media and new sample locations shall be located within 30 days.
- 4.6      Environmental monitoring stations and equipment shall be maintained and calibrated as required.
- 4.7      Samples shall be collected, prepared, and shipped for analysis in a timely manner to preserve integrity.
- 4.8      Collect all samples using the following methodology in accordance with schedule and location data described in Attachments 1 and 2.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.0 PROCEDURE

**USER ALERT**  
**INFORMATION USE PROCEDURE**

The activities covered by this procedure  
may be performed from memory.

5.1 **AIR SAMPLE COLLECTION**

5.1.1 Precautions

- a. New filters and cartridges should be transported and handled such that potential contamination of them is minimized (ie, placed in clean plastic bags, etc).
- b. If an air sampling unit is discovered not operating, attempt to find the cause and repair. Document on the air sample collection data form.
- c. Air flow meters shall be calibrated annually by General Meter. All in-service air meters will have affixed a valid calibration sticker stating date of calibration, and calibration due date.
- d. Airflow meters should be changed out prior to the expiration of calibration dates. Replacement air meters are available from the BRP Radiological Environmental contact. If an airflow meter is not changed out prior to the calibration expiration date, document the incident on the air sample collection data form.
- e. Air station leakage shall be  $< 1/8$  cfm. If the replacement of air station components is required due to excessive air leakage, document on the air sample collection data sketch.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.1.2 Prerequisites

- a. Fiber air filters.
- b. Absorbent charcoal (carbon) cartridges for iodine sampling.
- c. Glassine envelopes or plastic envelopes.
- d. Air Sample Data Collection Form (containing installation data).
- e. Replacement air sample meters (as required).

5.1.3 Perform the following weekly for each sample location:

- a. Open protective cover on air sampler and record the vacuum reading and the integrated gas meter readings onto a sample collection sheet.
- b. If airflow meter must be replaced, record the meter number, date, and meter reading for the new replacement airflow meter in the "Remarks" column.
- c. Disconnect the air filter holder. Install new holder. Block the inlet to the new filter holder, and observe if vacuum gauge reading exceeds 15 inches of mercury. If vacuum does not exceed 15 inches, then inspect unit for air leakage and perform appropriate maintenance. Document the actions taken in the remarks column on the air sample collection data sheet.
- d. When maximum stable vacuum is reached, shut off the air pump. Record the vacuum obtained and at that time observe the flow indicator on the air flow meter and record the cfm air leakage. Air leakage shall be  $< 1/8$  cfm, if leakage exceeds  $(1/8$  cfm appropriate maintenance and retest.
- e. Return air pump to service.
- f. Remove obstruction from inlet of filter holder. Vacuum should return to normal. If the normal vacuum is  $< 1$ , record it as 1.
- g. Take filter holder to enclosed vehicle.



**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.2.2 Daily perform the following:

- a. Turn on water tap and allow water to run for approximately one minute to purge the line.
- b. Collect approximately 125 ml of water and pour into plastic container.
- c. Repeat Steps 5.2.2a and 5.2.2b daily for entire month. Note any day's sample not taken in "Remarks" column of Sample Data Form.
- d. Seal the container(s) at end of month.
- e. Label containers as per Attachment 3.
- f. Package and ship samples per Attachment 4.
- g. Record on Sample Data Form the location/type, dates, and amount of samples. Under "Remarks," note any other pertinent information (ie, composite sample, start and finish dates, etc if necessary). Sign form in space provided.

5.3 **MILK SAMPLE COLLECTION**

5.3.1 Precautions

- a. Milk samples shall be sent to the laboratory as soon as possible because of the short decay time of I-131. Any undue delay may cause Technical Specifications analytical sensitivity requirements to be elevated.
- b. Obtain the best available replacement sample for any missing milk sample(s). Identify new sample location(s) and notify the Chem/HP Supervisor or designate within 24 hours.
- c. If milk samples are unavailable, then samples of three different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q and one sample of each of the similar broad leaf vegetation grown 10-20 mi distant in the least prevalent wind direction may be used as replacement samples.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

- h. Remove particulate filter carefully from the holder. Place the filter in a glassine or plastic envelope and identify as outlined in Attachment 3.
- i. Remove the charcoal filter cartridge from the holder. Identify as outlined in Attachment 3.
- j. Clean out any residue or moisture build-up in filter holder before new replacement filters are installed.
- k. Ensure that the new air particulate and charcoal filters are properly centered in filter holder to prevent air leakage. Hold filter holder in the upright position when tightening particulate filter in place. This will help minimize filter slippage. Sample airstream flow must first pass through the particulate filter and then through the charcoal cartridge. Filter is now ready to be installed.
- l. If a filter operating vacuum cannot be maintained, replacement of the airflow meter/pump with another unit may be necessary.

**NOTE:** If a field copy was used to collect data, ensure all information has been transferred, dated, and signed.

- m. Ensure all pertinent data has been recorded.

**NOTE:** It may be necessary to leave cover slightly open during summer months to help cool pump.

- n. Close cover and proceed to the next station(s).

**5.2 CITY OF CHARLEVOIX, LAKE (DRINKING) WATER SAMPLE COLLECTION**

**5.2.1 Prerequisites**

- a. Clean one-gallon plastic container(s) (labeled as per Attachment 3).
- b. Miscellaneous Sample Data Form.
- c. The water sample (shall be serviced by the Charlevoix Municipal Water System). The water sample can be collected from any Charlevoix Municipal water supply such as a residence or a gas station etc.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.3.2 Prerequisites

- a. Sodium bisulfite preservative (approximately 40 gm per gallon of milk required)
- b. Miscellaneous Sample Data Form

5.3.3 Monthly, at each specified sample collection location, perform the following:

- a. Obtain two one-gallon grab samples of raw milk and pay milk supplier.
- b. Two clean, empty plastic one-gallon containers may be left with milk supplier for the next month's samples when picking up the current month's samples. If problems are encountered in obtaining a sufficient quantity of milk sample, notify either the BRP or RSD Radiological Environmental contact.
- c. Add approximately 40gm of sodium bisulfite to each one-gallon container of milk and thoroughly mix. The sodium bisulfite can either be in preprepared packets or "scooped" with a volumetric measure from its container.
- d. Label containers as per Attachment 3.
- e. Package and ship samples as per Attachment 4.
- f. Record on Sample Data Form the location/type, date, and amount of samples. Under "Remarks," note any other pertinent information. Sign form in space provided.

5.4 **AQUATIC BIOTA COLLECTION**

5.4.1 Precautions

- a. Aquatic biota sample collection shall be coordinated between the Radiological Services Department Environment Section and the CPCo Environmental Department.
- b. At least one individual in the sample collection party is required to possess a valid MDNR Cultural & Scientific Fish Collectors Permit.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.4.2 Prerequisites

- a. Crayfish spears (with replacement spearheads as required).
- b. Plexiglas bottom buckets (or boxes).
- c. Wire or stiff nylon brushes.
- d. Black felt markers for writing sample identification on containers.
- e. Boat with required safety equipment, or waders.
- f. Gill nets, weights, and floats.
- g. Clean plastic one-liter wide-mouth bottles and tape.
- h. Miscellaneous Sample Data Forms.
- i. 10% formaldehyde solution.
- j. Fillet knives.
- k. Scrapers (putty knives).
- l. Masking or duct tape (for sealing one-liter sample containers).
- m. Notify local MDNR Conservation Officer prior to sample collection.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

- 5.4.3 Collect samples twice during the season of greatest abundance (typically May through October) as follows:
- a. Gill nets are placed at the locations specified in Attachment 1 to collect at least two species of commercially and/or recreationally important fish in the vicinity of the Plant discharge area and the same species in an area not influenced by the Plant discharge (Ludington). One liter of flesh should be collected for each species caught for analysis accuracy. Fish samples from the same area may be combined, if necessary, to make a one-liter composite sample.
  - b. Filamentous algae samples are not required but may be collected from driftwood or shoreline protection structures at vicinity of discharge if available.
  - c. Periphyton sample are not required but may be collected if available. Scrape periphyton from rocks into a pail. When sufficient sample is collected, excess water is gently poured off. The partially solidified periphyton is then transferred to a liter sample bottle.
  - d. Crayfish (invertebrates) are typically available at Big Rock Point and shall be collected if available. Collect crayfish by hand picking or spearing.
  - e. Label all containers as per Attachment 3.
  - f. Package and ship samples per Attachment 4.
  - g. Record on data sheet location, type, date, amount, and under "Remarks" indicate any pertinent information. Sign form in space provided.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

**5.5 SEDIMENT SAMPLE COLLECTION**

**5.5.1 Prerequisites**

- a. Clean one-liter wide-mouth plastic sample bottles.
- b. Dredge or hand scoop (as required).
- c. Miscellaneous Sample Data Forms.

5.5.2 Collect semiannually at locations specified in Attachment 1. Palisades RSD, Big Rock C&HP, and/or Environmental Department personnel will collect these samples.

- a. Label containers per Attachment 3.
- b. Package and ship samples per Attachment 4.
- c. Record on Sample Data Form, the location/type, date, and quantity of sample. Under "Remarks," note any other pertinent information. Sign form in space provided.

**5.6 ENVIRONMENTAL TLD COLLECTION**

**5.6.1 Precautions**

- a. Under no condition shall TLDs be routinely taken into the Plant. Site TLDs for Big Rock Point shall be placed in the lead cave located in the security building and the BRP Radiological Environmental Contact or the Chem/HP Supervisor notified immediately.
- b. Three TLD badges are present at each location. The badges are labeled location specific and either indicated as MONTHLY, QUARTERLY, or ANNUAL to ensure correct replacement. MONTHLY TLDs are to be replaced each month; QUARTERLY TLDs during January, April, July, and October and ANNUAL TLDs during January.



**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

5.6.2 Prerequisites

- a. Environmental TLDs.
- b. Environmental TLD Collection Form.

5.6.3 Monthly, quarterly, or annually at each specified TLD location, perform the following as required:

- a. Upon receipt of TLDs from the laboratory contractor, all TLDs shall be inventoried and immediately placed in the lead cave (at offsite sample collector's residence). Note date of receipt on TLD Data Form.
- b. BRP site and area environmental TLDs shall only be removed from the lead cave for delivery to their proper locations. All control TLDs remain in the lead cave throughout the entire exposure period.
- c. Remove and replace TLDs at each location.
- d. For any missing TLDs, perform the following:
  - 1. Search immediate area.
  - 2. If lost TLD is found, collect it and perform standard change-out procedure.
  - 3. If lost TLD is not found, post the new TLD in proper location.
  - 4. Record in "Remarks" column of TLD Data Form, any of the above circumstances.
- e. Store collected BRP site and area environmental TLDs in lead cave along with control TLDs until ready for mailing to Laboratory contractor. Mark "Do not x-ray" on TLD package.

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

- f. Transportation control TLDs are to be stored in the special lead shield provided by laboratory contractor only after area TLDs are posted. Make sure that the properly matching control TLDs are returned with their designated batch field TLDs. Also, ensure that laboratory contractor's own TLD Data Sheet is completed and enclosed with shipment. Note the date shipped on the TLD Data Form.
  - g. Record on TLD Data Form location/type, date, and time. Under the "Remarks," note any other pertinent information. Sign form in space provided.
- 5.7 Obtain best available replacement(s) for any missing sample(s) if required. Notify the BRP or RSD Radiological Environmental Contact with description and location of the replacement sample(s).
- 5.8 Document any missing samples or malfunctioning equipment on the Sample Data Collection Form(s).
- 6.0 **ACCEPTANCE CRITERIA**
  - Proper completion of procedure
- 7.0 **ATTACHMENTS AND RECORDS**
- 7.1 **ATTACHMENTS**
  - 7.1.1 Attachment 1, "Environmental Sample Collection Schedule Big Rock Point"
  - 7.1.2 Attachment 2, "Sampling Locations Big Rock Point Plant"
  - 7.1.3 Attachment 3, "Sample Identification"
  - 7.1.4 Attachment 4, "Sample Packaging and Shipment"
  - 7.1.5 Attachment 5, "Big Rock Point Sample Collection Forms and Records"

**TITLE: BIG ROCK POINT RADIOLOGICAL ENVIRONMENTAL PROGRAM  
SAMPLE COLLECTION AND SHIPMENT**

---

**7.2 RECORDS**

7.2.1 Distribution of the Sample Collection Data Sheets as per Attachment 4.

7.2.2 Sample Data Collection records shall be maintained with all other Radiological Environmental Monitoring Program Surveillance Records and Documentation. All records are considered complete when the Annual Radiological Environmental Operating Report is submitted to the NRC. Records shall be retained in the Uniform File Index (UFI) under: BRP 740/24\*03\*10/LP.

ENVIRONMENTAL SAMPLE COLLECTION SCHEDULE  
BIG ROCK POINT

<u>Exposure Pathway and/or Sample</u>	<u>Number of Samples and Locations*</u>	<u>Sample Type</u>	<u>Collection Frequency</u>
Airborne:	1-Onsite	Continuous at approximately 1 cfm	Weekly
Particulates	3-Within 5 miles (8 km) of the site boundary	(may be less due to dust loading)	
	2-Vicinity of communities having the highest calculated annual average ground level D/Q		
	1-Control		
Iodines	Same as particulates	Same as particulates	Weekly
Waterborne:	1-Intake	Daily composite	Monthly
Lake Water	1-Discharge	To obtain a one-gallon sample	
Well Water	1-Charlevoix Municipal Water System	Daily composite	Monthly
	1-Site	One-gallon grab sample	Monthly
Ingestion:	3-Within a 2-7 mile (3.2-11.2 km) radius	Two-gallon grab sample	Monthly
Milk	1-Control within 10-20 miles (16-32 km)		
<b>NOTE:</b> If milk samples are not available, refer to Step 5.3.1.			
Fish	2-Location in vicinity of Plant discharge 1-Ludington control	One-liter fish flesh from each available species, two species required. Attempted to obtain the same species from the control location	Twice in season

\*If samples are unavailable at the specified location, an attempt should be made to sample at an alternate location (refer to 4.5.)

**ENVIRONMENTAL SAMPLE COLLECTION SCHEDULE**  
**BIG ROCK POINT**

Proc No HP 10.9  
Attachment 1  
Revision 1  
Page 2 of 2

<u>Exposure Pathway and/or Sample</u>	<u>Number of Samples and Locations*</u>	<u>Sample Type</u>	<u>Collection Frequency</u>
Aquatic Biota:			
(Crayfish, filamentous, algae, periphyton)	1-Discharge	One-liter grab sample	Twice in season
	1-1/4 mile north		
	1-1/4 mile south		
	1-Ludington control (as available)		
Direct:			
TLD	4-Onsite	Continuous	Monthly, quarterly, and annual
	6-Site Boundary		
	3-Within a 3- to 5-mile (4.8-8 km) radius		
	3-10 to 50 miles (16-80 km) distant		
Sediment	1-1 to 3 miles east (1.6-4.8 km) of site Nine Mile Pointe	One-liter grab sample	Semiannually
	1-Discharge		
	1-Mt McSauba		
	1-1/4 mile south		
	1-1/4 mile north		
	1-Ludington (control) (2 samples recommended)		

\*If samples are unavailable at the specified location, an attempt should be made to sample at an alternate location (refer to 4.5.)

Proc No HP 10.9  
Attachment 2  
Revision 1  
Page 1 of 5

[illegible]

SAMPLING LOCATIONS  
BIG ROCK POINT PLANT

Proc No HP 10.9  
Attachment 2  
Revision 1  
Page 2 of 5

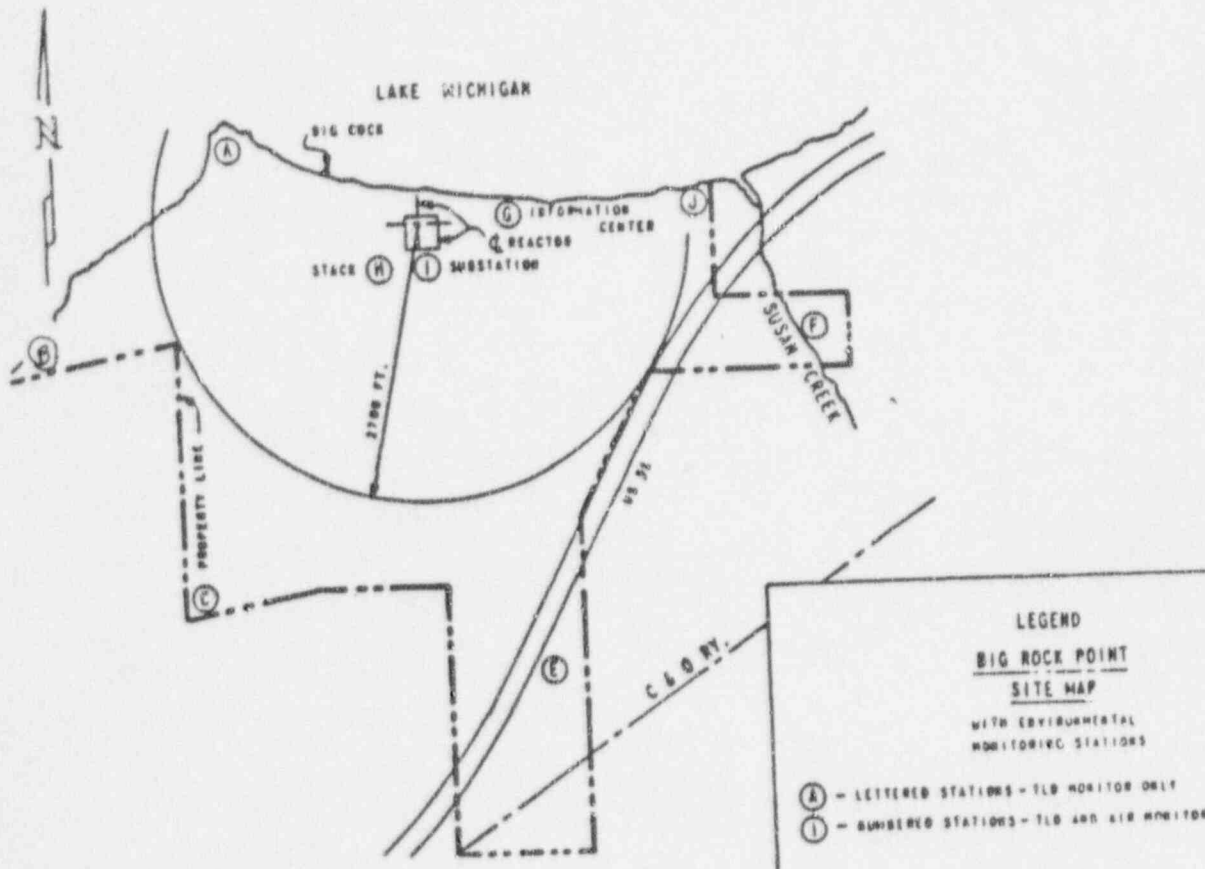
Station	Code	Location	S E D I M E N T	A I R  P A R T I C U L A T E S	A I R  I O D I N E	L A K E  W A T E R	W E L L  W A T E R	M I L K	B I O T A	T L D	F I S H
16	J	Susan Creek Near Lake Michigan								X	
17	K	Discharge Canal (Fisherman)								X	
18	L	Access Control								X	
19	MS	Mt McSauba, PE, 3 Miles (4.8 km) W	X								
20	JG	J Golovich, Maple Grove Road Charlevoix, Michigan 4.5 Miles (7.2 km) SE						X			
21	DK	D L Kuebler, Upper Bay Shore Road, Charlevoix Michigan 2.5 Miles (4 km) E						X			
22	MH	M Hand, Upper Bay Shore Road, Charlevoix, Michigan 2.8 Miles (4.5 km) ESE						X			
23	BB	B Bochniak, Resort Pike Road, Petoskey, Michigan 11.5 Miles (18.4 km) E						X			
24	STS	1/4 Mile (0.4 km) South Boundary	X						X		
25	STN	1/4 Mile (0.4 km) North Boundary	X						X		
26	LP	Ludington Pump Storage	X						X		X

e



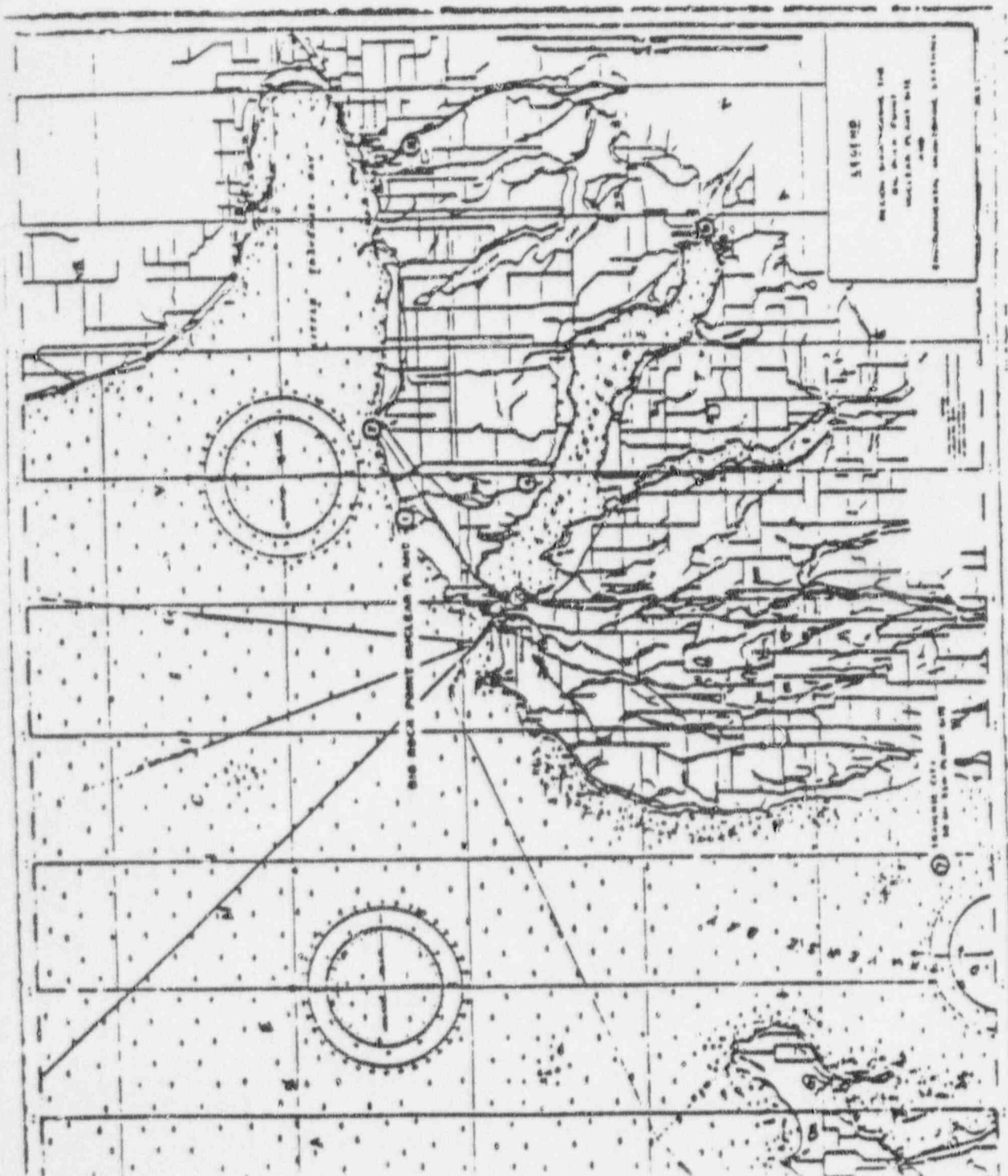
SAMPLING LOCATIONS  
BIG ROCK POINT PLANT

Proc No HP 10.9  
Attachment 2  
Revision 1  
Page 3 of 5



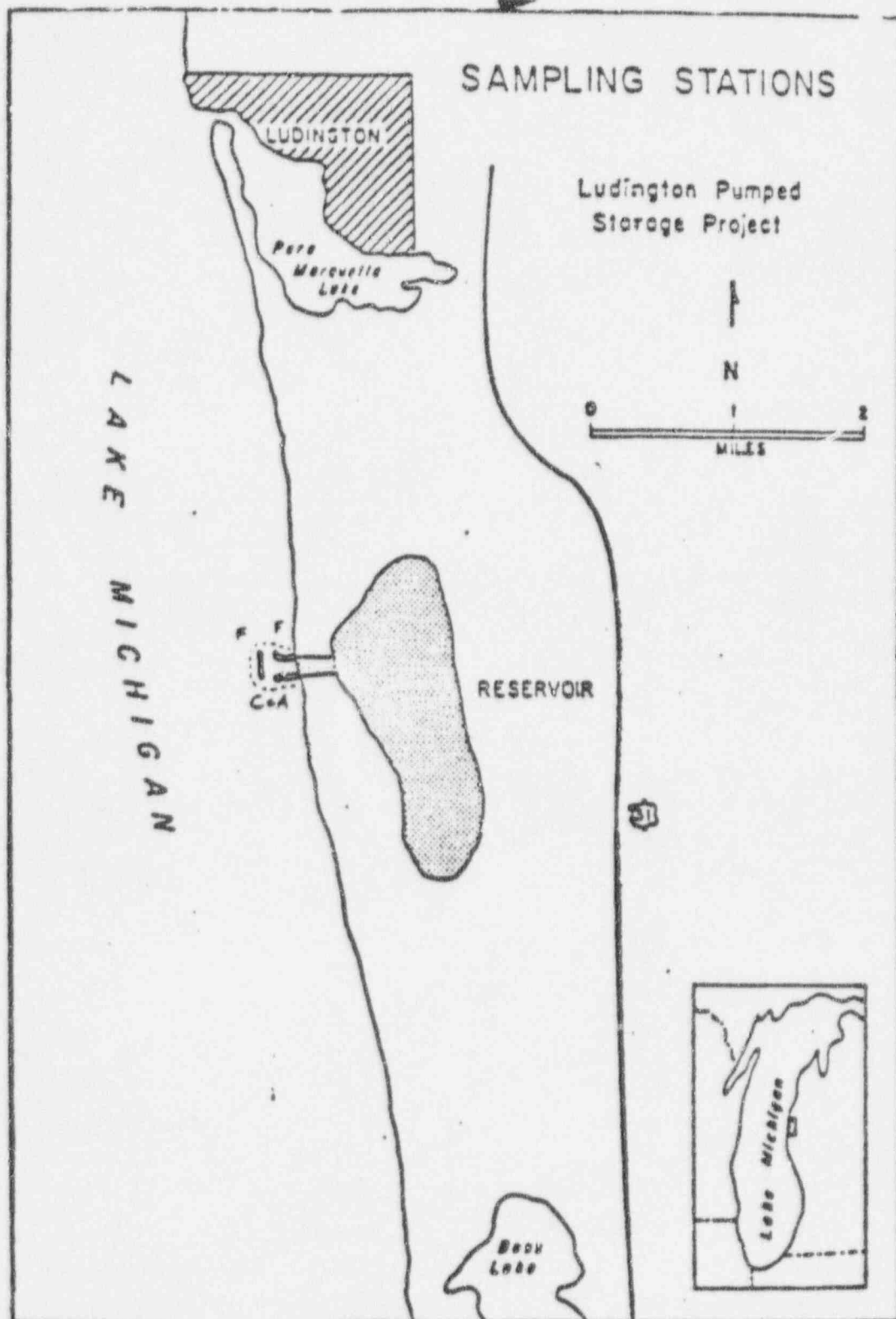
SAMPLING LOCATIONS  
BIG ROCK POINT PLANT

Proc No HP 10.9  
Attachment 2  
Revision 1  
Page 4 of 5



SAMPLING LOCATIONS  
BIG ROCK POINT PLANT

Proc No HP 10.9  
Attachment 2  
Revision 1  
Page 5 of 5



### SAMPLE IDENTIFICATION

**NOTE:** Use waterproof pen. Do not place paper labels inside containers.

1. Collected samples shall be clearly identified.
2. The Plant identification shall be written on each sample container as follows:

Big Rock Point                      BRP

3. The sample media type can either be written out or abbreviated on container using the below-listed sample identification codes:

a. Routine Samples:

Air Particulates	AP
Air Iodine	AI
Well Water	WW
Lake Water	LW
Milk	MK
Drinking Water - Raw	DW-RAW
Drinking Water - Treated	DW-TREATED

b. Special Samples:

Vegetation	VE
Fish	FI
Sediment	SD
Periphyton	PE
Crayfish	CF
Algae	AL

4. The sample location (where collected), sample media type, and date of collection shall be indicated on the sample container(s) and shall agree with the data description given on the Sample Data Collection Form(s).

SAMPLE PACKAGING AND SHIPMENT

1. Samples shall be clearly labeled per Attachment 3.
2. Seal all liquid, biota, fish, and sediment sample containers with tape to prevent leakage.
3. Ship liquid samples separately from air particulate and air iodine samples and TLDs.
4. Use sufficient packing material (ie, crumpled newspaper) to avoid possible sample container damage during shipment.
5. Package air filters in glassine or plastic envelopes.
6. For TLD shipments, make sure that Laboratory contractor's own TLD data sheet is enclosed with package.
7. Ship milk samples as soon as possible. Be sure to add a sufficient amount (40 grams) of sodium bisulfite as preservative to each sample.
8. Ship food products as soon as possible. No preservative is necessary.
9. Ship fish and biota samples with 10% formaldehyde (preservative) solution added. Only 10 milliliters per sample is required.
10. Distribute copies of the Sample Collection Data Sheet(s) to:  
  
Analytical Laboratory  
BRP Radiological Environmental Contact  
Radiological Services Department Environmental Contact  
(Palisades)  
Sample Collector
11. Send samples to the following address:  
  
Teledyne Isotopes Midwest Laboratory  
Att: Laboratory Manager  
700 Landwehr Road  
Northbrook, IL 60062
12. Ship all samples to the Laboratory contractor with minimal delay after collection so as to avoid elevated analytical levels of detection.

## PLANT

Date: \_\_\_\_\_  
Collector: \_\_\_\_\_

[illegible]



Date Received: \_\_\_\_\_  
Date Shipped: \_\_\_\_\_  
Collector: \_\_\_\_\_

[illegible]



Collector:

[illegible]

ENCLOSURE D

CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996

BIG ROCK POINT 1996 FINAL MONTHLY PROGRESS REPORT

Submitted April 17, 1997



TELEDYNE

Brown Engineering  
Environmental Services  
MIDWEST LABORATORY

700 LANDWEHR ROAD  
NORTHBROOK, ILLINOIS 60062-2310  
(847) 564-0700 FAX (847) 564-4517

FINAL  
MONTHLY PROGRESS REPORT  
TO  
CONSUMERS POWER COMPANY  
JACKSON, MICHIGAN

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM (REMP)  
FOR  
BIG ROCK NUCLEAR GENERATING PLANT

PREPARED AND SUBMITTED  
BY  
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES  
MIDWEST LABORATORY

Project Number: 8022

Reporting Period: January - December, 1996

Reviewed and  
Approved by



B. Grob  
Technical Lead

Date 02-07-97

Distribution: T.F. Popa (1 copy)  
M. Grogan (1 copy)

BIG ROCK  
TABLE OF CONTENTS

Section

	List of Tables .....	iii
1	INTRODUCTION.....	iv
2	LISTING OF MISSED SAMPLES .....	v

Appendices

A	Interlaboratory Comparison Program Results .....	A-1
B	Data Reporting Conventions.....	B-1

BIG ROCK  
LIST OF TABLES

No.	Title	Page
1.	Airborne Particulates and Iodine-131	
	Location ST, Big Rock Point .....	1-1
	Location NM, Nine Mile Point .....	1-2
	Location CH, Charlevoix .....	1-3
	Location SL, South of Susan Lake .....	1-4
	Location PT, Petosky .....	1-5
	Location BC, Boyne City .....	1-6
	Location TR, Traverse City .....	1-7
2.	Gamma Radiation, as measured by TLDs, Monthly Exposure .....	2-1
3.	Gamma Radiation, as measured by TLDs, Quarterly Exposure .....	3-1
4.	Gamma Radiation, as measured by TLDs, Annual Exposure .....	4-1
5.	Lake Water, Inlet and Discharge .....	5-1
6.	Water, Ludington Controls .....	6-1
7.	Charlevoix Drinking Water (Lake Water) .....	7-1
8.	Site Well Water .....	8-1
9.	Milk	
	B. Bochik Farm .....	9-1
	D. Kubler Farm .....	9-2
	J. Golovich Farm .....	9-3
	R. McCraney Farm .....	9-4
10.	Fruits and Vegetables .....	10-1
11.	Fish .....	11-1
12.	Crayfish .....	12-1
13.	Periphyton .....	13-1
14.	Algae .....	14-1
15.	Bottom Sediments .....	15-1

BIG ROCK  
LIST OF TABLES (continued)

<u>No.</u>		<u>Page</u>
	Reactor Effluent Samples	
16.1.	Liquid Radwaste .....	16.1-1
16.2.	Stack Filters .....	16.2-1
	Special Samples	
17.1.	NRC Split Samples .....	17.1-1
17.2.	Well water samples .....	17.2-1

## BIG ROCK

### 1.0 INTRODUCTION

The following constitutes the current, 1996 Monthly Progress Report for the Radiological Environmental Monitoring Program conducted at the Consumers Power Company, Big Rock Nuclear Generating Plant. Results of completed analyses are presented in the attached tables. Missing entries indicate analyses that are not yet completed.

Missing tables indicate that those tables are not yet used in the monthly report.

All concentrations, except gross alpha and gross beta, are decay corrected to the time of collection.

All samples were collected within the scheduled period unless noted otherwise in the Listing of Missed Samples.



BIG ROCK

## 2.0 LISTING OF MISSED SAMPLES

Sample Type	Location	Expected Collection Date	Reason
TLD	BRP-09 (ONSITE)	06-06-96	TLD lost in the field.
RW	BIG ROCK	07-30-96	Sample Not Received.
RW	BIG ROCK	09-30-96	Sample Not Received.
RW	BIG ROCK	11-30-96	Sample Not Received.
RW	BIG ROCK	12-31-96	Sample Not Received.

# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: ST - Big Rock Point (1)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
<u>Required LLD</u>		<u>0.01</u>	<u>0.070</u>			<u>0.01</u>	<u>0.070</u>
01-04-96	221	0.033 ± 0.004	< 0.016	07-11-96	252	0.012 ± 0.003	< 0.017
01-11-96	232	0.025 ± 0.004	< 0.015	07-18-96	221	0.018 ± 0.004	< 0.025
01-18-96	229	0.024 ± 0.003	< 0.014	07-25-96	218	0.011 ± 0.003	< 0.016
01-25-96	227	0.022 ± 0.004	< 0.010	08-01-96	212	0.009 ± 0.003	< 0.019
02-01-96	227	0.014 ± 0.004	< 0.019	08-08-96	218	0.017 ± 0.004	< 0.021
02-08-96	235	0.028 ± 0.004	< 0.023	08-15-96	218	0.013 ± 0.003	< 0.014
02-15-96	229	0.011 ± 0.003	< 0.013	08-22-96	218	0.015 ± 0.004	< 0.024
02-22-96	227	0.016 ± 0.003	< 0.022	08-29-96	218	0.011 ± 0.003	< 0.015
02-29-96	229	0.014 ± 0.003	< 0.024	09-05-96	212	0.029 ± 0.004	< 0.023
03-07-96	224	0.024 ± 0.004	< 0.020	09-12-96	221	0.032 ± 0.004	< 0.024
03-14-96	232	0.027 ± 0.004	< 0.020	09-19-96	224	0.008 ± 0.003	< 0.022
03-21-96	227	0.016 ± 0.004	< 0.021	09-26-96	215	0.021 ± 0.004	< 0.027
03-28-96	227	0.019 ± 0.003	< 0.021	10-03-96	218	0.016 ± 0.003	< 0.023
1st Quarter Means±s.d.		0.021 ± 0.007	< 0.024	3rd Quarter Means±s.d.		0.016 ± 0.007	< 0.027
04-04-96	224	0.019 ± 0.004	< 0.019	10-10-96	224	0.017 ± 0.003	< 0.016
04-11-96	229	0.019 ± 0.003	< 0.008	10-17-96	218	0.013 ± 0.004	< 0.025
04-18-96	227	0.017 ± 0.003	< 0.016	10-24-96	224	0.008 ± 0.003	< 0.011
04-25-96	221	0.009 ± 0.003	< 0.025	10-31-96	224	0.020 ± 0.003	< 0.018
05-02-96	221	0.007 ± 0.003	< 0.011	11-07-96	221	0.021 ± 0.004	< 0.025
05-09-96	227	0.013 ± 0.003	< 0.022	11-14-96	229	0.009 ± 0.003	< 0.015
05-16-96	224	0.017 ± 0.003	< 0.027	11-21-96	224	0.015 ± 0.003	< 0.017
05-23-96	215	0.014 ± 0.004	< 0.013	11-27-96	195	0.016 ± 0.004	< 0.011
05-30-96	221	0.010 ± 0.003	< 0.026	12-05-96	252	0.020 ± 0.003	< 0.026
06-06-96	215	0.008 ± 0.003	< 0.016	12-12-96	229	0.012 ± 0.003	< 0.042
06-13-96	224	0.009 ± 0.003	< 0.017	12-19-96	227	0.021 ± 0.004	< 0.020
06-20-96	218	0.016 ± 0.003	< 0.017	12-26-96	227	0.020 ± 0.004	< 0.008
06-27-96	221	0.007 ± 0.003	< 0.024	01-02-97	224	0.020 ± 0.004	< 0.021
07-03-96	181	0.020 ± 0.004	< 0.021	4th Quarter Means±s.d.		0.016 ± 0.005	< 0.042
2nd Quarter Means±s.d.		0.013 ± 0.005	< 0.027				
Cumulative Average:						0.017	
Previous Annual Average:						0.016	

# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: NM - Nine Mile Point (2)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
<u>Required LLD</u>		<u>0.01</u>	<u>0.070</u>			<u>0.01</u>	<u>0.070</u>
01-04-96	232	0.031 ± 0.004	< 0.017	07-11-96	258	0.012 ± 0.003	< 0.017
01-11-96	241	0.031 ± 0.004	< 0.015	07-18-96	227	0.019 ± 0.004	< 0.026
01-18-96	3*	< 0.266*	< 0.959*	07-25-96	221	0.012 ± 0.003	< 0.016
01-25-96	238	0.018 ± 0.003	< 0.010	08-01-96	224	0.009 ± 0.003	< 0.020
02-01-96	235	0.011 ± 0.003	< 0.020	08-08-96	224	0.017 ± 0.003	< 0.021
02-08-96	244	0.027 ± 0.004	< 0.023	08-15-96	218	0.015 ± 0.003	< 0.014
02-15-96	238	0.015 ± 0.003	< 0.013	08-22-96	227	0.013 ± 0.003	< 0.025
02-22-96	232	0.016 ± 0.003	< 0.022	08-29-96	221	0.015 ± 0.003	< 0.015
02-29-96	235	0.015 ± 0.003	< 0.025	09-05-96	215	0.028 ± 0.004	< 0.023
03-07-96	235	0.020 ± 0.003	< 0.021	09-12-96	221	0.026 ± 0.004	< 0.024
03-14-96	238	0.023 ± 0.003	< 0.020	09-19-96	224	0.009 ± 0.003	< 0.022
03-21-96	235	0.014 ± 0.003	< 0.022	09-26-96	215	0.014 ± 0.003	< 0.027
03-28-96	232	0.018 ± 0.003	< 0.022	10-03-96	221	0.015 ± 0.003	< 0.023
1st Quarter Mean±s.d.		0.020 ± 0.006	< 0.025	3rd Quarter Mean±s.d.		0.016 ± 0.006	< 0.027
04-04-96	229	0.019 ± 0.004	< 0.019	10-10-96	224	0.016 ± 0.003	< 0.016
04-11-96	232	0.018 ± 0.003	< 0.008	10-17-96	221	0.016 ± 0.004	< 0.025
04-18-96	232	0.013 ± 0.003	< 0.016	10-24-96	218	0.011 ± 0.003	< 0.011
04-25-96	229	0.008 ± 0.003	< 0.026	10-31-96	218	0.020 ± 0.004	< 0.018
05-02-96	227	0.010 ± 0.003	< 0.012	11-07-96	218	0.020 ± 0.003	< 0.025
05-09-96	229	0.011 ± 0.003	< 0.023	11-14-96	227	0.011 ± 0.003	< 0.015
05-16-96	227	0.013 ± 0.003	< 0.027	11-21-96	221	0.011 ± 0.003	< 0.017
05-23-96	221	0.011 ± 0.003	< 0.013	11-27-96	195	0.014 ± 0.004	< 0.011
05-30-96	227	0.010 ± 0.003	< 0.027	12-05-96	238	0.019 ± 0.003	< 0.024
06-06-96	224	0.008 ± 0.003	< 0.017	12-12-96	147	0.016 ± 0.005	< 0.027
06-13-96	227	0.011 ± 0.003	< 0.017	12-19-96	210	0.025 ± 0.004	< 0.019
06-20-96	224	0.015 ± 0.003	< 0.017	12-26-96	232	0.012 ± 0.003	< 0.009
06-27-96	224	0.010 ± 0.003	< 0.025	01-02-97	229	0.017 ± 0.004	< 0.021
07-03-96	187	0.016 ± 0.004	< 0.022	4th Quarter Mean±s.d.		0.016 ± 0.004	< 0.027
2nd Quarter Mean±s.d.		0.012 ± 0.003	< 0.027				
Cumulative Average:						0.016	
Previous Annual Average:						0.016	

\* Motor vibration caused plug to become dislodged; motor moved to prevent recurrence; required LLDs not met due to low volume.

# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: CH - Charlevoix (3)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
		0.01	0.070			0.01	0.070
<u>Required LLD</u>							
01-04-96	229	0.029 ± 0.003	< 0.017	07-11-96	261	0.013 ± 0.003	< 0.017
01-11-96	235	0.030 ± 0.004	< 0.015	07-18-96	221	0.017 ± 0.004	< 0.025
01-18-96	235	0.027 ± 0.004	< 0.014	07-25-96	224	0.014 ± 0.003	< 0.016
01-25-96	235	0.019 ± 0.003	< 0.010	08-01-96	218	0.010 ± 0.003	< 0.020
02-01-96	232	0.014 ± 0.004	< 0.020	08-08-96	218	0.015 ± 0.003	< 0.021
02-08-96	238	0.027 ± 0.004	< 0.023	08-15-96	227	0.013 ± 0.003	< 0.015
02-15-96	238	0.017 ± 0.003	< 0.013	08-22-96	221	0.013 ± 0.003	< 0.024
02-22-96	232	0.018 ± 0.003	< 0.022	08-29-96	224	0.013 ± 0.003	< 0.015
02-29-96	235	< ± 0.003	< 0.025	09-05-96	218	0.028 ± 0.004	< 0.024
03-07-96	227	0.022 ± 0.003	< 0.020	09-12-96	221	0.027 ± 0.004	< 0.024
03-14-96	232	0.025 ± 0.004	< 0.020	09-19-96	232	0.009 ± 0.003	< 0.023
03-21-96	235	0.010 ± 0.003	< 0.022	09-26-96	221	0.021 ± 0.004	< 0.027
03-28-96	235	0.018 ± 0.003	< 0.022	10-03-96	224	0.014 ± 0.003	< 0.023
1st Quarter Meants.d.		0.021 ± 0.006	< 0.025	3rd Quarter Meants.d.		0.016 ± 0.006	< 0.027
04-04-96	224	0.019 ± 0.004	< 0.019	10-10-96	227	0.012 ± 0.003	< 0.016
04-11-96	227	0.016 ± 0.003	< 0.008	10-17-96	229	0.016 ± 0.004	< 0.026
04-18-96	235	0.013 ± 0.003	< 0.016	10-24-96	227	0.010 ± 0.003	< 0.012
04-25-96	224	0.012 ± 0.003	< 0.026	10-31-96	229	0.021 ± 0.003	< 0.019
05-02-96	224	0.009 ± 0.003	< 0.012	11-07-96	227	0.019 ± 0.003	< 0.026
05-09-96	227	0.013 ± 0.003	< 0.022	11-14-96	235	0.010 ± 0.003	< 0.016
05-16-96	229	0.017 ± 0.003	< 0.028	11-21-96	238	0.011 ± 0.003	< 0.018
05-23-96	221	0.015 ± 0.003	< 0.013	11-27-96	201	0.015 ± 0.004	< 0.011
05-30-96	224	0.014 ± 0.003	< 0.026	12-05-96	255	0.025 ± 0.004	< 0.026
06-06-96	218	0.008 ± 0.003	< 0.016	12-12-96	232	0.013 ± 0.003	< 0.043
06-13-96	224	0.011 ± 0.003	< 0.017	12-19-96	235	0.019 ± 0.003	< 0.021
06-20-96	229	0.018 ± 0.003	< 0.017	12-26-96	235	0.017 ± 0.003	< 0.009
06-27-96	224	0.009 ± 0.003	< 0.025	01-02-97	229	0.019 ± 0.004	< 0.021
07-03-96	181	0.019 ± 0.004	< 0.021	4th Quarter Meants.d.		0.016 ± 0.005	< 0.043
2nd Quarter Meants.d.		0.014 ± 0.004	< 0.028				
Cumulative Average:						0.017	
Previous Annual Average:						0.016	

# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: SL -South of Susan Lakes (4)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
<u>Required LLD</u>		<u>0.01</u>	<u>0.070</u>			<u>0.01</u>	<u>0.070</u>
01-04-96	229	0.029 ± 0.004	< 0.017	07-11-96	249	0.013 ± 0.003	< 0.017
01-11-96	229	0.028 ± 0.004	< 0.015	07-18-96	221	0.018 ± 0.004	< 0.025
01-18-96	235	0.020 ± 0.003	< 0.014	07-25-96	218	0.011 ± 0.003	< 0.016
01-25-96	238	0.018 ± 0.003	< 0.010	08-01-96	212	0.008 ± 0.003	< 0.019
02-01-96	232	0.015 ± 0.004	< 0.020	08-08-96	215	0.018 ± 0.004	< 0.020
02-08-96	238	0.026 ± 0.004	< 0.023	08-15-96	218	0.014 ± 0.003	< 0.014
02-15-96	238	0.017 ± 0.003	< 0.013	08-22-96	218	0.014 ± 0.003	< 0.024
02-22-96	232	0.017 ± 0.003	< 0.022	08-29-96	215	0.013 ± 0.003	< 0.015
02-29-96	229	0.016 ± 0.003	< 0.024	09-05-96	212	0.027 ± 0.004	< 0.023
03-07-96	232	0.023 ± 0.003	< 0.020	09-12-96	215	0.030 ± 0.004	< 0.024
03-14-96	232	0.025 ± 0.004	< 0.020	09-19-96	227	0.009 ± 0.003	< 0.023
03-21-96	235	0.015 ± 0.003	< 0.022	09-26-96	215	0.018 ± 0.004	< 0.027
03-28-96	229	0.020 ± 0.003	< 0.021	10-03-96	221	0.015 ± 0.003	< 0.023
1st Quarter Meant±s.d.		0.021 ± 0.005	< 0.024	3rd Quarter Meant±s.d.		0.016 ± 0.006	< 0.027
04-04-96	227	0.020 ± 0.004	< 0.019	10-10-96	224	0.012 ± 0.003	< 0.016
04-11-96	224	0.017 ± 0.003	< 0.008	10-17-96	221	0.013 ± 0.003	< 0.025
04-18-96	232	0.014 ± 0.003	< 0.016	10-24-96	221	0.011 ± 0.003	< 0.011
04-25-96	224	0.011 ± 0.003	< 0.026	10-31-96	224	0.021 ± 0.004	< 0.018
05-02-96	218	0.009 ± 0.003	< 0.011	11-07-96	224	0.020 ± 0.003	< 0.025
05-09-96	221	0.012 ± 0.003	< 0.022	11-14-96	227	0.009 ± 0.003	< 0.015
05-16-96	227	0.014 ± 0.003	< 0.027	11-21-96	229	0.015 ± 0.003	< 0.018
05-23-96	218	0.012 ± 0.003	< 0.013	11-27-96	190	0.015 ± 0.004	< 0.010
05-30-96	221	0.014 ± 0.003	< 0.026	12-05-96	258	0.020 ± 0.003	< 0.026
06-06-96	218	0.010 ± 0.003	< 0.016	12-12-96	227	0.014 ± 0.003	< 0.042
06-13-96	218	0.010 ± 0.003	< 0.016	12-19-96	232	0.020 ± 0.003	< 0.021
06-20-96	221	0.016 ± 0.003	< 0.017	12-26-96	71	0.039 ± 0.010	< 0.027
06-27-96	215	0.010 ± 0.003	< 0.024	01-02-97	187	0.022 ± 0.004	< 0.017
07-03-96	184	0.017 ± 0.004	< 0.021	4th Quarter Meant±s.d.		0.018 ± 0.008	< 0.042
2nd Quarter Meant±s.d.		0.013 ± 0.003	< 0.027				
						Cumulative Average:	0.017
						Previous Annual Average:	0.016



# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: PT - Petosky (5)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
		0.01	0.070			0.01	0.070
Required LLD							
01-04-96	221	0.027 ± 0.004	< 0.016	07-11-96	249	0.011 ± 0.003	< 0.017
01-11-96	232	0.028 ± 0.004	< 0.015	07-18-96	215	0.020 ± 0.004	< 0.024
01-18-96	218	0.021 ± 0.003	< 0.013	07-25-96	210	0.011 ± 0.003	< 0.015
01-25-96	235	0.021 ± 0.004	< 0.010	08-01-96	221	0.008 ± 0.003	< 0.020
02-01-96	227	0.014 ± 0.004	< 0.019	08-08-96	215	0.018 ± 0.004	< 0.020
02-08-96	232	0.027 ± 0.004	< 0.022	08-15-96	210	0.012 ± 0.003	< 0.014
02-15-96	229	0.013 ± 0.003	< 0.013	08-22-96	221	0.014 ± 0.003	< 0.024
02-22-96	218	0.017 ± 0.004	< 0.021	08-29-96	212	0.014 ± 0.004	< 0.015
02-29-96	227	0.015 ± 0.003	< 0.024	09-05-96	218	0.026 ± 0.004	< 0.024
03-07-96	229	0.021 ± 0.003	< 0.020	09-12-96	215	0.031 ± 0.004	< 0.024
03-14-96	227	0.021 ± 0.003	< 0.019	09-19-96	224	0.009 ± 0.003	< 0.022
03-21-96	224	0.014 ± 0.003	< 0.020	09-26-96	212	0.022 ± 0.004	< 0.026
03-28-96	221	0.017 ± 0.003	< 0.021	10-03-96	221	0.016 ± 0.003	< 0.023
1st Quarter Meants.d.		0.020 ± 0.005	< 0.024	3rd Quarter Meants.d.		0.016 ± 0.007	< 0.026
04-04-96	224	0.017 ± 0.004	< 0.019	10-10-96	224	0.014 ± 0.003	< 0.016
04-11-96	224	0.016 ± 0.003	< 0.008	10-17-96	221	0.018 ± 0.004	< 0.025
04-18-96	227	0.016 ± 0.003	< 0.016	10-24-96	221	0.010 ± 0.003	< 0.011
04-25-96	218	0.010 ± 0.003	< 0.025	10-31-96	218	0.021 ± 0.004	< 0.018
05-02-96	221	0.010 ± 0.003	< 0.011	11-07-96	229	0.022 ± 0.003	< 0.026
05-09-96	218	0.014 ± 0.003	< 0.022	11-14-96	232	0.007 ± 0.003	< 0.016
05-16-96	215	0.018 ± 0.004	< 0.026	11-21-96	221	0.014 ± 0.003	< 0.017
05-23-96	212	0.013 ± 0.003	< 0.013	11-27-96	204	0.015 ± 0.004	< 0.011
05-30-96	215	0.014 ± 0.003	< 0.025	12-05-96	252	0.020 ± 0.003	< 0.026
06-06-96	215	0.008 ± 0.003	< 0.016	12-12-96	229	0.012 ± 0.003	< 0.042
06-13-96	218	0.013 ± 0.003	< 0.016	12-19-96	221	0.021 ± 0.004	< 0.020
06-20-96	215	0.017 ± 0.003	< 0.016	12-26-96	229	0.018 ± 0.003	< 0.009
06-27-96	212	0.007 ± 0.003	< 0.023	01-02-97	232	0.020 ± 0.004	< 0.021
07-03-96	184	0.017 ± 0.004	< 0.021	4th Quarter Meants.d.		0.016 ± 0.005	< 0.042
2nd Quarter Meants.d.		0.014 ± 0.004	< 0.026				
Cumulative Average:						0.016	
Previous Annual Average:						0.016	

# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
 Location: BC - Boyne City (6)  
 Units: pCi/m<sup>3</sup>  
 Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
Required LLD		0.01	0.020			0.01	0.020
01-04-96	227	0.032 ± 0.004	< 0.016	07-11-96	249	0.012 ± 0.003	< 0.017
01-11-96	232	0.029 ± 0.004	< 0.015	07-18-96	218	0.017 ± 0.004	< 0.025
01-18-96	221	0.024 ± 0.004	< 0.013	07-25-96	210	0.010 ± 0.003	< 0.015
01-25-96	238	0.020 ± 0.003	< 0.010	08-01-96	224	0.010 ± 0.003	< 0.020
02-01-96	229	0.016 ± 0.004	< 0.019	08-08-96	215	0.014 ± 0.003	< 0.020
02-08-96	235	0.029 ± 0.004	< 0.023	08-15-96	210	0.014 ± 0.003	< 0.014
02-15-96	232	0.014 ± 0.003	< 0.013	08-22-96	224	0.014 ± 0.003	< 0.024
02-22-96	218	0.015 ± 0.004	< 0.021	08-29-96	212	0.013 ± 0.003	< 0.015
02-29-96	229	0.013 ± 0.003	< 0.024	09-05-96	221	0.029 ± 0.004	< 0.024
03-07-96	235	0.023 ± 0.003	< 0.021	09-12-96	218	0.026 ± 0.004	< 0.024
03-14-96	229	0.023 ± 0.004	< 0.020	09-19-96	224	0.008 ± 0.003	< 0.022
03-21-96	227	0.013 ± 0.003	< 0.021	09-26-96	210	0.022 ± 0.004	< 0.026
03-28-96	221	0.017 ± 0.003	< 0.021	10-03-96	227	0.016 ± 0.003	< 0.024
1st Quarter Means±d.		0.021 ± 0.007	< 0.024	3rd Quarter Means±d.		0.016 ± 0.006	< 0.026
04-04-96	229	0.021 ± 0.004	< 0.019	10-10-96	224	0.016 ± 0.003	< 0.016
04-11-96	227	0.018 ± 0.003	< 0.008	10-17-96	221	0.020 ± 0.004	< 0.025
04-18-96	229	0.018 ± 0.003	< 0.016	10-24-96	218	0.009 ± 0.003	< 0.011
04-25-96	221	0.009 ± 0.003	< 0.025	10-31-96	215	0.020 ± 0.004	< 0.017
05-02-96	224	0.008 ± 0.003	< 0.012	11-07-96	229	0.023 ± 0.004	< 0.026
05-09-96	224	0.012 ± 0.003	< 0.022	11-14-96	232	0.009 ± 0.003	< 0.016
05-16-96	215	0.016 ± 0.004	< 0.026	11-21-96	218	0.017 ± 0.004	< 0.017
05-23-96	215	0.014 ± 0.003	< 0.013	11-27-96	204	0.015 ± 0.004	< 0.011
05-30-96	218	0.016 ± 0.004	< 0.026	12-05-96	255	0.021 ± 0.003	< 0.026
06-06-96	221	0.008 ± 0.003	< 0.017	12-12-96	229	0.015 ± 0.003	< 0.042
06-13-96	221	0.013 ± 0.003	< 0.016	12-19-96	221	0.016 ± 0.003	< 0.020
06-20-96	218	0.017 ± 0.003	< 0.017	12-26-96	232	0.018 ± 0.003	< 0.009
06-27-96	212	0.008 ± 0.003	< 0.023	01-02-97	232	0.022 ± 0.004	< 0.021
07-03-96	190	0.018 ± 0.004	< 0.022	4th Quarter Means±d.		0.017 ± 0.004	< 0.042
2nd Quarter Means±d.		0.011 ± 0.004	< 0.026				
						Cumulative Average:	0.017
						Previous Annual Average:	0.016



# BIG ROCK

Table 1. Airborne particulates and charcoal canisters, analyses for gross beta and iodine-131.  
Location: TR - Traverse City (7)  
Units: pCi/m<sup>3</sup>  
Collection: Continuous, weekly exchange.

Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131	Date Collected	Volume (m <sup>3</sup> )	Gross Beta	Iodine-131
Required LLD		0.01	0.070			0.01	0.070
01-04-96	238	0.027 ± 0.004	< 0.019	07-11-96	255	0.014 ± 0.003	< 0.009
01-11-96	238	0.026 ± 0.004	< 0.015	07-18-96	116 <sup>a</sup>	< 0.008	< 0.027
01-18-96	232	0.025 ± 0.003	< 0.011	07-25-96	229	0.014 ± 0.003	< 0.014
01-25-96	229	0.017 ± 0.003	< 0.010	08-01-96	221	0.011 ± 0.003	< 0.013
02-01-96	246	0.018 ± 0.004	< 0.006	08-08-96	221	0.016 ± 0.003	< 0.008
02-08-96	241	0.030 ± 0.004	< 0.013	08-15-96	218	0.017 ± 0.003	< 0.026
02-15-96	229	0.017 ± 0.004	< 0.014	08-22-96	215	0.016 ± 0.004	< 0.009
02-22-96	235	0.016 ± 0.003	< 0.010	08-29-96	227	0.015 ± 0.003	< 0.017
02-29-96	235	0.014 ± 0.003	< 0.010	09-05-96	221	0.031 ± 0.004	< 0.008
03-07-96	235	0.023 ± 0.003	< 0.039	09-12-96	221	0.029 ± 0.004	< 0.015
03-14-96	235	0.027 ± 0.004	< 0.021	09-19-96	221	0.010 ± 0.003	< 0.018
03-21-96	224	0.016 ± 0.003	< 0.009	09-26-96	232	0.025 ± 0.004	< 0.026
03-28-96	241	0.020 ± 0.003	< 0.013	10-03-96	224	0.015 ± 0.003	< 0.020
1st Quarter Mean±s.d.		0.021 ± 0.005	< 0.039	3rd Quarter Mean±s.d.		0.018 ± 0.007	< 0.027
04-04-96	229	0.018 ± 0.004	< 0.018	10-10-96	229	0.015 ± 0.003	< 0.014
04-11-96	229	0.016 ± 0.003	< 0.013	10-17-96	215	0.017 ± 0.004	< 0.014
04-18-96	221	0.016 ± 0.003	< 0.011	10-24-96	229	0.011 ± 0.003	< 0.012
04-25-96	227	0.012 ± 0.003	< 0.014	10-31-96	238	0.022 ± 0.003	< 0.018
05-02-96	238	0.009 ± 0.003	< 0.026	11-07-96	229	0.017 ± 0.003	< 0.012
05-09-96	224	0.013 ± 0.003	< 0.016	11-14-96	235	0.009 ± 0.003	< 0.009
05-16-96	227	0.020 ± 0.004	< 0.015	11-21-96	232	0.014 ± 0.003	< 0.017
05-23-96	221	0.012 ± 0.003	< 0.014	11-27-96	195	0.014 ± 0.004	< 0.013
05-30-96	224	0.012 ± 0.003	< 0.011	12-05-96	272	0.022 ± 0.003	< 0.020
06-06-96	224	0.008 ± 0.003	< 0.037	12-12-96	235	0.015 ± 0.003	< 0.015
06-13-96	221	0.010 ± 0.003	< 0.014	12-19-96	229	0.021 ± 0.004	< 0.021
06-20-96	215	0.018 ± 0.003	< 0.012	12-26-96	235	0.019 ± 0.003	< 0.025
06-27-96	227	0.008 ± 0.003	< 0.011	01-02-97	235	0.020 ± 0.004	< 0.010
07-03-96	190	0.021 ± 0.004	< 0.014	4th Quarter Mean±s.d.		0.017 ± 0.004	< 0.025
2nd Quarter Mean±s.d.		0.014 ± 0.004	< 0.037				
						Cumulative Average:	0.017
						Previous Annual Average:	0.017

<sup>a</sup> Low volume due to crimping of inlet hose as a result of pump movement caused by vibration. Inlet hose shortened to prevent recurrence.

# BIG ROCK

Table 2. Gamma Radiation, as measured by TLDs, monthly exposure.  
Units: mR/30 days net\*

	January	February	March
Date Placed	1/4/96	2/1/96	3/7/96
Date Removed	2/1/96	3/7/96	4/4/96
Intransit (mR)	4.6 ± 0.2	5.2 ± 0.2	4.8 ± 0.2
BRP-01 (ST)	20.0 ± 0.4	19.6 ± 0.2	19.8 ± 0.5
BRP-02 (NM)	2.9 ± 0.3	2.3 ± 0.2	2.9 ± 0.3
BRP-03 (CH)	3.3 ± 0.2	3.0 ± 0.2	3.0 ± 0.3
BRP-04 (SL)	3.0 ± 0.3	2.8 ± 0.2	2.7 ± 0.3
BRP-05 (PT)	3.4 ± 0.2	2.3 ± 0.2	3.4 ± 0.2
BRP-06 (BC)	3.3 ± 0.2	2.9 ± 0.2	3.2 ± 0.3
BRP-07 (TR)	3.1 ± 0.3	2.9 ± 0.2	3.2 ± 0.2
Mean ± s.d.	5.6 ± 6.4	5.1 ± 6.4	5.5 ± 6.3
BRP-08	2.4 ± 0.3	1.9 ± 0.2	2.7 ± 0.2
BRP-09 (Onsite)	2.5 ± 0.2	2.7 ± 0.2	1.9 ± 0.3
BRP-10 (Onsite)	2.2 ± 0.3	2.5 ± 0.2	1.6 ± 0.2
BRP-11 (Onsite)	2.7 ± 0.3	3.0 ± 0.2	2.3 ± 0.2
BRP-12 (Onsite)	3.4 ± 0.3	3.3 ± 0.2	3.2 ± 0.3
BRP-13 (Onsite)	3.3 ± 0.3	3.2 ± 0.2	2.8 ± 0.2
BRP-14 (Onsite)	31.9 ± 0.4	34.4 ± 0.3	24.5 ± 0.3
BRP-15 (Onsite)	74.3 ± 0.5	79.5 ± 0.3	58.5 ± 0.3
BRP-16 (Onsite)	2.8 ± 0.3	2.9 ± 0.2	2.4 ± 0.2
BRP-17 (Onsite)	6.0 ± 0.3	8.4 ± 0.2	6.2 ± 0.2
BRP-18 (Onsite)	7.7 ± 0.2	8.4 ± 0.3	5.5 ± 0.2
Control 1 (Shield)	2.0 ± 0.3	1.6 ± 0.2	1.5 ± 0.2
Control 2 (Shield)	1.7 ± 0.3	1.6 ± 0.2	1.6 ± 0.2

\* Intransit exposure has been subtracted from total exposure.

# BIG ROCK

Table 2. Gamma Radiation, as measured by TLDs, monthly exposure.  
Units: mR/30 days net<sup>a</sup>

	April	May	June
Date Placed	4/4/96	5/2/96	6/6/96
Date Removed	5/2/96	6/6/96	7/3/96
Intransit (mR)	2.9 ± 0.2	3.3 ± 0.2	4.1 ± 0.2
BRP-01 (ST)	20.8 ± 0.3	35.2 ± 0.6	40.9 ± 0.4
BRP-02 (NM)	2.9 ± 0.2	2.9 ± 0.2	2.4 ± 0.2
BRP-03 (CH)	3.0 ± 0.2	3.6 ± 0.2	3.0 ± 0.3
BRP-04 (SL)	3.6 ± 0.2	3.5 ± 0.2	3.7 ± 0.2
BRP-05 (PT)	2.8 ± 0.2	3.9 ± 0.2	2.4 ± 0.2
BRP-06 (BC)	3.1 ± 0.2	2.8 ± 0.2	3.1 ± 0.2
BRP-07 (TR)	2.8 ± 0.2	3.5 ± 0.2	3.1 ± 0.3
Mean ± s.d.	5.6 ± 6.7	7.9 ± 12.1	8.4 ± 14.3
BRP-08	2.0 ± 0.2	2.3 ± 0.2	1.1 ± 0.3
BRP-09 (Onsite)	2.8 ± 0.2	ND <sup>b</sup>	3.2 ± 0.2
BRP-10 (Onsite)	2.1 ± 0.2	2.5 ± 0.2	2.0 ± 0.2
BRP-11 (Onsite)	3.2 ± 0.2	3.2 ± 0.2	3.6 ± 0.3
BRP-12 (Onsite)	3.3 ± 0.3	3.9 ± 0.2	4.1 ± 0.4
BRP-13 (Onsite)	3.1 ± 0.2	3.6 ± 0.3	3.6 ± 0.2
BRP-14 (Onsite)	34.4 ± 0.2	41.2 ± 0.3	42.4 ± 0.7
BRP-15 (Onsite)	111.7 ± 0.3	314.0 ± 0.6	259.7 ± 0.5
BRP-16 (Onsite)	2.5 ± 0.3	2.9 ± 0.3	2.7 ± 0.3
BRP-17 (Onsite)	6.5 ± 0.2	8.3 ± 0.2	8.7 ± 0.2
BRP-18 (Onsite)	7.7 ± 0.2	7.2 ± 0.3	9.2 ± 0.3
Control 1 (Shield)	1.7 ± 0.2	1.8 ± 0.2	1.3 ± 0.3
Control 2 (Shield)	1.7 ± 0.2	1.8 ± 0.2	1.2 ± 0.2

<sup>a</sup> Intransit exposure has been subtracted from total exposure.

<sup>b</sup> ND = No data; TLD lost in the field.

# BIG ROCK

Table 2. Gamma Radiation, as measured by TLDs, monthly exposure.  
Units: mR/30 days net<sup>a</sup>

	July	August	September
Date Placed	7/3/96	8/1/96	9/5/96
Date Removed	8/1/96	9/5/96	10/3/96
Intransit (mR)	3.9 ± 0.2	3.2 ± 0.2	3.6 ± 0.2
BRP-01 (ST)	26.5 ± 0.3	19.6 ± 0.3	15.2 ± 0.3
BRP-02 (NM)	2.3 ± 0.3	2.6 ± 0.2	2.7 ± 0.2
BRP-03 (CH)	2.7 ± 0.3	3.1 ± 0.3	3.1 ± 0.2
BRP-04 (SL)	3.1 ± 0.3	3.6 ± 0.2	3.0 ± 0.2
BRP-05 (PT)	3.6 ± 0.3	2.6 ± 0.2	4.0 ± 0.2
BRP-06 (BC)	2.4 ± 0.2	3.1 ± 0.2	3.1 ± 0.3
BRP-07 (TR)	2.7 ± 0.3	3.2 ± 0.2	3.1 ± 0.2
Mean ± s.d.	6.2 ± 9.0	5.4 ± 6.3	4.9 ± 4.6
BRP-08	1.7 ± 0.2	1.7 ± 0.2	2.3 ± 0.3
BRP-09 (Onsite)	2.8 ± 0.2	3.0 ± 0.2	3.2 ± 0.2
BRP-10 (Onsite)	2.4 ± 0.2	2.3 ± 0.2	1.9 ± 0.2
BRP-11 (Onsite)	3.5 ± 0.3	3.7 ± 0.2	3.8 ± 0.3
BRP-12 (Onsite)	3.9 ± 0.3	4.0 ± 0.2	3.8 ± 0.3
BRP-13 (Onsite)	3.2 ± 0.3	3.5 ± 0.2	3.3 ± 0.2
BRP-14 (Onsite)	35.4 ± 0.3	33.6 ± 0.3	31.7 ± 0.2
BRP-15 (Onsite)	244.5 ± 0.4	207.2 ± 0.3	127.5 ± 0.3
BRP-16 (Onsite)	2.7 ± 0.3	2.9 ± 0.2	2.3 ± 0.2
BRP-17 (Onsite)	7.1 ± 0.3	6.0 ± 0.2	5.7 ± 0.2
BRP-18 (Onsite)	8.9 ± 0.2	8.6 ± 0.2	7.0 ± 0.3
Control 1 (Shield)	1.9 ± 0.2	1.7 ± 0.2	1.8 ± 0.2
Control 2 (Shield)	1.8 ± 0.2	1.6 ± 0.2	1.7 ± 0.3

<sup>a</sup> Intransit exposure has been subtracted from total exposure.

# BIG ROCK

Table 2. Gamma Radiation, as measured by TLDs, monthly exposure.  
Units: mR/30 days net<sup>a</sup>

	<u>October</u>	<u>November</u>	<u>December</u>
Date Placed	10/3/96	11/7/96	12/5/96
Date Removed	11/7/96	12/5/96	1/2/97
Intransit (mR)	3.1 ± 0.2	4.2 ± 0.2	5.3 ± 0.2
BRP-01 (ST)	14.3 ± 0.2	17.8 ± 0.3	10.9 ± 0.3
BRP-02 (NM)	2.8 ± 0.2	3.2 ± 0.3	2.2 ± 0.2
BRP-03 (CH)	3.4 ± 0.2	3.5 ± 0.3	2.7 ± 0.3
BRP-04 (SL)	3.7 ± 0.2	4.0 ± 0.3	3.2 ± 0.2
BRP-05 (PT)	2.8 ± 0.2	4.2 ± 0.2	2.3 ± 0.2
BRP-06 (BC)	3.6 ± 0.2	3.4 ± 0.3	2.8 ± 0.2
BRP-07 (TR)	3.4 ± 0.2	3.9 ± 0.3	3.2 ± 0.3
Mean ± s.d.	4.5 ± 4.2	5.7 ± 5.3	3.9 ± 3.1
BRP-08	1.4 ± 0.2	2.4 ± 0.2	0.9 ± 0.2
BRP-09 (Onsite)	3.3 ± 0.2	3.7 ± 0.2	2.7 ± 0.2
BRP-10 (Onsite)	2.5 ± 0.2	2.5 ± 0.2	2.2 ± 0.3
BRP-11 (Onsite)	3.7 ± 0.2	3.4 ± 0.2	3.3 ± 0.3
BRP-12 (Onsite)	4.4 ± 0.2	4.1 ± 0.3	3.8 ± 0.2
BRP-13 (Onsite)	3.7 ± 0.2	3.5 ± 0.3	2.8 ± 0.2
BRP-14 (Onsite)	35.1 ± 0.3	39.3 ± 0.3	24.9 ± 0.2
BRP-15 (Onsite)	99.8 ± 0.2	126.5 ± 0.3	57.6 ± 0.3
BRP-16 (Onsite)	2.9 ± 0.2	3.0 ± 0.3	2.3 ± 0.2
BRP-17 (Onsite)	6.3 ± 0.2	6.8 ± 0.3	5.5 ± 0.2
BRP-18 (Onsite)	7.4 ± 0.2	7.3 ± 0.5	5.9 ± 0.2
Control 1 (Shield)	1.6 ± 0.2	1.5 ± 0.2	1.3 ± 0.3
Control 2 (Shield)	1.6 ± 0.2	1.5 ± 0.2	1.2 ± 0.3

<sup>a</sup> Intransit exposure has been subtracted from total exposure.

# BIG ROCK

Table 3. Gamma Radiation, as measured by TLDs, quarterly exposure.  
Units: mR/91 days net<sup>a</sup>

	<u>1st Quarter</u>	<u>2nd Quarter</u>	<u>3rd Quarter</u>	<u>4th Quarter</u>
Date Placed	1/4/96	4/4/96	7/3/96	10/3/96
Date Removed	4/4/96	7/3/96	10/3/96	1/2/97
Intransit (mR)	4.0 ± 0.6	4.1 ± 0.6	2.2 ± 0.6	4.4 ± 0.6
BRP-01 (ST)	54.6 ± 0.7	98.4 ± 0.8	58.6 ± 0.7	46.7 ± 0.6
BRP-02 (NM)	9.4 ± 0.6	10.0 ± 0.6	9.5 ± 0.7	9.6 ± 0.6
BRP-03 (CH)	10.4 ± 0.7	10.7 ± 0.6	10.9 ± 0.6	10.4 ± 0.6
BRP-04 (SL)	10.5 ± 0.6	12.9 ± 0.7	11.1 ± 0.6	11.7 ± 1.1
BRP-05 (PT)	9.8 ± 0.6	11.3 ± 0.6	11.1 ± 0.6	11.3 ± 0.6
BRP-06 (BC)	10.2 ± 0.7	12.1 ± 0.6	11.1 ± 0.6	12.4 ± 0.7
BRP-07 (TR)	10.4 ± 0.7	10.8 ± 0.6	9.1 ± 0.6	10.9 ± 0.6
Mean ± s.d.	16.5 ± 16.8	23.7 ± 32.9	17.3 ± 18.2	16.1 ± 13.5
BRP-08	7.9 ± 0.6	7.0 ± 0.6	6.4 ± 0.6	6.6 ± 0.6
BRP-09 (Onsite)	8.5 ± 0.6	10.8 ± 0.6 <sup>b</sup>	9.0 ± 0.6	9.2 ± 0.6
BRP-10 (Onsite)	9.2 ± 0.6	9.3 ± 0.6	9.1 ± 0.6	8.3 ± 0.6
BRP-11 (Onsite)	10.4 ± 0.7	10.4 ± 0.6	11.3 ± 0.6	10.4 ± 0.6
BRP-12 (Onsite)	10.6 ± 0.6	12.5 ± 0.7	11.6 ± 0.6	12.8 ± 0.6
BRP-13 (Onsite)	9.6 ± 0.6	10.1 ± 0.6	11.0 ± 0.6	11.2 ± 0.6
BRP-14 (Onsite)	95.1 ± 0.7	137.1 ± 0.6	102.9 ± 1.2	102.3 ± 0.7
BRP-15 (Onsite)	208.4 ± 0.9	775.8 ± 7.4	592.2 ± 0.8	290.1 ± 0.7
BRP-16 (Onsite)	10.0 ± 0.7	9.2 ± 0.6	9.0 ± 0.6	9.3 ± 0.6
BRP-17 (Onsite)	21.6 ± 0.6	24.4 ± 0.6	16.8 ± 0.6	18.1 ± 0.6
BRP-18 (Onsite)	24.3 ± 0.6	25.3 ± 0.6	25.7 ± 0.6	19.8 ± 0.6
Control 1 (Shield)	5.7 ± 0.6	5.3 ± 0.6	5.8 ± 0.6	5.4 ± 0.6
Control 2 (Shield)	5.7 ± 0.6	5.4 ± 0.6	5.8 ± 0.6	5.3 ± 0.6

<sup>a</sup> Intransit exposure has been subtracted from total exposure.

<sup>b</sup> TLD was lost in the field, result is for spare #1 which was installed on 06-07-96.

## BIG ROCK

Table 4. Gamma Radiation, as measured by TLDs, annual exposure.  
Units: mR/365 days net\*

	1996
Date Placed	1/4/96
Date Removed	1/2/97
Intransit (mR)	4.0 ± 2.4
BRP-01 (ST)	238.2 ± 2.4
BRP-02 (NM)	41.5 ± 2.4
BRP-03 (CH)	41.1 ± 2.4
BRP-04 (SL)	47.3 ± 2.5
BRP-05 (PT)	45.0 ± 2.4
BRP-06 (BC)	46.3 ± 2.4
BRP-07 (TR)	42.7 ± 2.4
Meants.d.	71.7 ± 73.4
BRP-08	30.8 ± 2.4
BRP-09 (Onsite)	45.6 ± 2.8 <sup>b</sup>
BRP-10 (Onsite)	34.2 ± 2.4
BRP-11 (Onsite)	47.2 ± 2.4
BRP-12 (Onsite)	49.2 ± 2.4
BRP-13 (Onsite)	41.7 ± 2.4
BRP-14 (Onsite)	417.5 ± 2.4
BRP-15 (Onsite)	1832.3 ± 3.5
BRP-16 (Onsite)	38.4 ± 2.4
BRP-17 (Onsite)	79.3 ± 2.4
BRP-18 (Onsite)	95.9 ± 2.4
Control 1 (Shield)	22.7 ± 2.4
Control 2 (Shield)	22.7 ± 2.4

\* Intransit exposure has been subtracted from total exposure.

<sup>b</sup> TLD was lost in the field, result is for spare #1 which was installed on 06-07 96.



# BIG ROCK

Table 5. Lake water, Inlet and Discharge.

Collection: Monthly composites

Units: pCi/L

Location: ST - Big Rock Point NGP - Discharge

---

Lab Code	Required LLDs	BRLW-566	BRLW-1036	BRLW-1811
Date Collected	-	1/31/96	2/29/96	4/1/96
Date Received	-	2/5/96	3/5/96	4/4/96
Gross Alpha	1.0	<0.6	0.7 ± 0.4	<0.7
Gross Beta	4.0	3.0 ± 0.5	6.1 ± 0.5	5.0 ± 0.6
H-3	500	<197	<188	<145
Sr-89	5.0	<0.8	<0.7	<0.9
Sr-90	1.0	1.1 ± 0.3	0.6 ± 0.3	<0.4

Lab Code	Required LLDs	BRLW-2695	BRLW-3566	BRLW-4308
Date Collected	-	4/30/96	5/31/96	7/1/96
Date Received	-	5/3/96	6/5/96	7/3/96
Gross Alpha	1.0	<1.0	<0.5	<0.6
Gross Beta	4.0	2.5 ± 0.6	2.2 ± 0.5	2.7 ± 0.4
H-3	500	<155	<164	<157
Sr-89	5.0	<0.8	<0.9	<1.1
Sr-90	1.0	0.6 ± 0.3	0.9 ± 0.4	0.9 ± 0.4

Lab Code	Required LLDs	BRLW-5260	BRLW-6055	BRLW-6898
Date Collected	-	8/1/96	8/31/96	10/1/96
Date Received	-	8/5/96	9/5/96	10/8/96
Gross Alpha	1.0	<1.0	<0.6	<0.6
Gross Beta	4.0	1.8 ± 0.7	2.5 ± 0.5	2.4 ± 0.5
H-3	500	<151	<160	<157
Sr-89	5.0	<1.3	<0.8	<0.8
Sr-90	1.0	0.8 ± 0.3	0.6 ± 0.3	0.6 ± 0.3

Lab Code	Required LLDs	BRLW-7996, 7	BRLW-8664	BRLW-9566
Date Collected	-	10/31/96	12/2/96	12/31/96
Date Received	-	11/7/96	12/4/96	1/7/97
Gross Alpha	1.0	<1.0	<1.2	<0.6
Gross Beta	4.0	1.9 ± 0.5	1.6 ± 0.7	2.2 ± 0.5
H-3	500	<159	<159	<158
Sr-89	5.0	<1.1	<0.7	<0.6
Sr-90	1.0	0.6 ± 0.2	<0.4	0.7 ± 0.3

---

# BIG ROCK

Table 5. Lake water, Inlet and Discharge.

Collection: Monthly composites  
Units: pCi/L  
Location: ST - Big Rock Point NGP - Inlet

---

Lab Code	Required LLDs	BRLW-567	BRLW-1037, 8	BRLW-1812
Date Collected	-	1/31/96	2/29/96	4/1/96
Date Received	-	2/5/96	3/5/96	4/4/96
Gross Beta	4.0	2.4 ± 0.5	2.9 ± 0.4	2.1 ± 0.5
H-3	500	< 197	< 188	< 145

Lab Code	Required LLDs	BRLW-2696	BRLW-3567	BRLW-4309
Date Collected	-	4/30/96	5/31/96	7/1/96
Date Received	-	5/3/96	6/5/96	7/3/96
Gross Beta	4.0	1.5 ± 0.4	1.8 ± 0.5	1.5 ± 0.5
H-3	500	< 155	< 164	< 157

Lab Code	Required LLDs	BRLW-5261	BRLW-6056	BRLW-6899
Date Collected	-	8/1/96	8/31/96	10/1/96
Date Received	-	8/5/96	9/5/96	10/8/96
Gross Beta	4.0	1.6 ± 0.7	1.9 ± 0.5	2.4 ± 0.5
H-3	500	< 151	236 ± 89	< 157

Lab Code	Required LLDs	BRLW-7998	BRLW-8663	BRLW-9567
Date Collected	-	10/31/96	12/2/96	12/31/96
Date Received	-	11/7/96	12/4/96	1/7/97
Gross Beta	4.0	1.9 ± 0.5	2.2 ± 0.6	1.9 ± 0.6
H-3	500	< 159	< 159	< 158

---

# BIG ROCK

Table 6. Water, Ludington Controls.

Collection: Monthly composites of daily collections  
Units: pCi/L  
Location: Ludington (Lake In)

---

Lab Code	Required LLDs	PALW-712	PALW-1213, 4	PALW-2054
Date Collected	-	2/5/96	3/5/96	4/2/96
Date Received	-	2/14/96	3/11/96	4/12/96
Gross Beta	4.0	1.8 ± 0.8	2.5 ± 0.4	1.3 ± 0.6
H-3	500	< 147	< 188	< 152

Lab Code	Required LLDs	PALW-3031	PALW-3688	PALW-4580
Date Collected	-	5/8/96	6/3/96	7/2/96
Date Received	-	5/14/96	6/11/96	7/12/96
Gross Beta	4.0	7.6 ± 1.1	2.0 ± 0.6	2.4 ± 0.7
H-3	500	< 166	< 163	< 157

Lab Code	Required LLDs	PALW-5730	PALW-6179	PALW-7123
Date Collected	-	7/31/96	9/3/96	10/3/96
Date Received	-	8/23/96	9/10/96	10/11/96
Gross Beta	4.0	2.0 ± 0.6	2.4 ± 0.6	2.2 ± 0.4
H-3	500	163 ± 81	< 163	< 156

Lab Code	Required LLDs	PALW-8084	PALW-8930	PALW-9640
Date Collected	-	11/4/96	12/3/96	12/31/96
Date Received	-	11/11/96	12/11/96	1/10/97
Gross Beta	4.0	3.0 ± 0.6	2.4 ± 0.7	2.2 ± 0.6
H-3	500	< 152	< 158	< 181

---

# BIG ROCK

Table 6. Water, Ludington Controls.

Collection: Monthly composites of daily collections  
 Units: pCi/L  
 Location: Ludington (Well)

---

Lab Code	Required LLDs	PAWW-713	PAWW 1212	PAWW 2055
Date Collected	-	2/5/96	3/5/96	4/2/96
Date Received	-	2/14/96	3/11/96	4/12/96
Gross Beta	4.0	< 0.9	< 0.9	< 0.9
H-3	500	< 147	< 188	< 189

Lab Code	Required LLDs	PAWW-3032, 3	PAWW-3689	PAWW-4537
Date Collected	-	5/8/96	6/3/96	7/2/96
Date Received	-	5/14/96	6/11/96	7/11/96
Gross Beta	4.0	3.1 ± 0.5	< 1.1	1.3 ± 0.6
H-3	500	< 166	< 163	< 158

Lab Code	Required LLDs	PAWW-5731	PAWW 6178	PAWW-7124
Date Collected	-	7/31/96	9/3/96	10/3/96
Date Received	-	8/23/96	9/10/96	10/11/96
Gross Beta	4.0	< 1.0	1.0 ± 0.5	< 0.5
H-3	500	169 ± 81	< 166	< 157

Lab Code	Required LLDs	PAWW-8079	PAWW 8829	PAWW-9641
Date Collected	-	11/4/96	11/30/96	12/31/96
Date Received	-	11/11/96	12/10/96	1/10/97
Gross Beta	4.0	0.9 ± 0.4	< 1.2	1.4 ± 0.6
H-3	500	164 ± 83	< 158	< 181

---

# BIG ROCK

Table 7. Drinking water (Lake Water).  
Collection: Monthly composites  
Units: pCi/L  
Location: Charlevoix

---

Lab Code	Required LLDs	BRDW-569	BRDW-1040	BRDW-1814
Date Collected	-	1/31/96	2/29/96	4/1/96
Date Received	-	2/5/96	3/5/96	4/4/96
Gross Beta	4.0	1.6 ± 0.5	1.6 ± 0.5	1.7 ± 0.5
H-3	500	< 197	< 188	166 ± 79

Lab Code	Required LLDs	BRDW-2698	BRDW-3569	BRDW-4311
Date Collected	-	4/30/96	5/31/96	7/1/96
Date Received	-	5/3/96	6/5/96	7/3/96
Gross Beta	4.0	0.8 ± 0.3	1.7 ± 0.5	1.4 ± 0.4
H-3	500	< 153	191 ± 89	< 158

Lab Code	Required LLDs	BRDW-5263	BRDW-6054	BRDW-6897
Date Collected	-	7/31/96	8/31/96	10/1/96
Date Received	-	8/5/96	9/5/96	10/8/96
Gross Beta	4.0	1.8 ± 0.3	1.9 ± 0.5	2.0 ± 0.5
H-3	500	< 151	< 160	< 157

Lab Code	Required LLDs	BRDW-7994, 5	BRDW-8660, 1	BRDW-9564, 5
Date Collected	-	10/31/96	12/2/96	12/31/96
Date Received	-	11/7/96	12/4/96	1/7/97
Gross Beta	4.0	1.7 ± 0.3	2.0 ± 0.4	2.1 ± 0.4
H-3	500	< 159	< 159	< 158

---

BIG ROCK

Table 8. Well water.  
Collection: Monthly  
Units: pCi/L  
Location: Site well

---

Lab Code	Required LLDs	BRWW-568	BRWW-1039	BRWW-1813
Date Collected	-	1/31/96	2/29/96	4/1/96
Date Received	-	2/5/96	3/5/96	4/4/96
Gross Beta	4.0	1.5 ± 0.5	1.5 ± 0.3	1.9 ± 0.6
H-3	500	< 197	< 188	< 145

Lab Code	Required LLDs	BRWW-2697	BRWW-3568	BRWW-4310
Date Collected	-	4/30/96	5/31/96	7/1/96
Date Received	-	5/3/96	6/5/96	7/3/96
Gross Beta	4.0	1.4 ± 0.4	1.7 ± 0.5	1.4 ± 0.5
H-3	500	< 153	< 164	< 158

Lab Code	Required LLDs	BRWW-5262	BRWW-6057	BRWW-6900
Date Collected	-	8/1/96	8/31/96	10/1/96
Date Received	-	8/5/96	9/5/96	10/8/96
Gross Beta	4.0	1.7 ± 0.3	1.2 ± 0.5	1.4 ± 0.4
H-3	500	< 151	< 160	< 154

Lab Code	Required LLDs	BRWW-7999	BRWW-8662	BRWW-9568
Date Collected	-	10/31/96	12/2/96	12/31/96
Date Received	-	11/7/96	12/4/96	1/7/97
Gross Beta	4.0	1.8 ± 0.8	1.5 ± 0.6	2.2 ± 0.6
H-3	500	< 159	< 159	< 158

# BIG ROCK

Table 9. Milk.  
Collection: Monthly  
Units: pCi/L  
Location: B. Bochniak Farm

Lab Code	Required LLDs	BRMI-208	BRMI-674, 5	BRMI-1325	BRMI-2089, 90
Date Collected	-	1/11/96	2/8/96	3/14/96	4/11/96
Date Received	-	1/15/96	2/12/96	3/15/96	4/15/96
I-131	1.0	<0.4	<0.4	<0.4	<0.4
K-40	-	1430 ± 110	1440 ± 120	1410 ± 170	1400 ± 120
Cs-134	15.0	<3.2	<4.7	<6.0	<6.2
Cs-137	18.0	<4.7	<5.6	<5.9	<5.9
Ba-La-140	15.0	<3.5	<3.3	<3.6	<2.3
Lab Code	Required LLDs	BRMI-2966	BRMI-3834	BRMI-4670	BRMI-5431
Date Collected	-	5/9/96	6/13/96	7/11/96	8/8/96
Date Received	-	5/13/96	6/18/96	7/15/96	8/12/96
I-131	1.0	<0.3	<0.5	<0.4	<0.3
K-40	-	1470 ± 120	1330 ± 150	1490 ± 120	1450 ± 180
Cs-134	15.0	<9.0	<6.6	<4.6	<6.0
Cs-137	18.0	<4.0	<5.3	<3.5	<7.3
Ba-La-140	15.0	<3.1	<2.5	<1.8	<3.7
Lab Code	Required LLDs	BRMI-6266	BRMI-7187	BRMI-8337, 8	BRMI-9089
Date Collected	-	9/12/96	10/10/96	11/14/96	12/12/96
Date Received	-	9/16/96	10/14/96	11/19/96	12/16/96
I-131	1.0	<0.4	<0.4	<0.4	<0.5
K-40	-	1490 ± 60	1420 ± 110	1410 ± 110	1170 ± 130
Cs-134	15.0	<1.5	<4.7	<3.9	<5.9
Cs-137	18.0	<2.4	<4.9	<4.1	<5.3
Ba-La-140	15.0	<3.3	<3.4	<2.3	<2.9



# BIG ROCK

Table 9. Milk.  
Collection: Monthly  
Units: pCi/L  
Location: D. Kubler Farm

Lab Code	Required LLDs	BRMI-206	BRMI-672	BRMI-1323	BRMI-2087
Date Collected	-	1/11/96	2/8/96	3/14/96	4/11/96
Date Received	-	1/15/96	2/12/96	3/15/96	4/15/96
I-131	1.0	<0.5	<0.4	<0.4	<0.3
K-40	-	1380 ± 160	1480 ± 160	1500 ± 120	1470 ± 120
Cs-134	15.0	<3.4	<5.7	<6.3	<2.8
Cs-137	18.0	<4.2	<6.0	<4.4	<5.2
Ba-La-140	15.0	<4.3	<3.1	<3.2	<3.6
Lab Code	Required LLDs	BRMI-2964	BRMI-3832	BRMI-4668	BRMI-5429
Date Collected	-	5/9/96	6/13/96	7/11/96	8/8/96
Date Received	-	5/13/96	6/18/96	7/15/96	8/12/96
I-131	1.0	<0.3	<0.4	<0.4	<0.2
K-40	-	1490 ± 170	1510 ± 140	1360 ± 160	1510 ± 120
Cs-134	15.0	<3.8	<5.1	<5.4	<3.4
Cs-137	18.0	<9.2	<5.4	<8.0	<3.5
Ba-La-140	15.0	<3.1	<2.1	<5.8	<2.1
Lab Code	Required LLDs	BRMI-6267	BRMI-7188	BRMI-8335	BRMI-9090
Date Collected	-	9/12/96	10/10/96	11/14/96	12/12/96
Date Received	-	9/16/96	10/14/96	11/19/96	12/16/96
I-131	1.0	<0.3	<0.3	<0.5	<0.4
K-40	-	1280 ± 110	1490 ± 180	1480 ± 150	1420 ± 140
Cs-134	15.0	<2.2	<5.6	<5.7	<5.8
Cs-137	18.0	<3.8	<6.8	<5.2	<5.8
Ba-La-140	15.0	<2.3	<7.3	<13.9	<3.0

BIG ROCK

Table 9. Milk.  
Collection: Monthly  
Units: pCi/L  
Location: J. Golovich Farm

---

Lab Code	Required LLDs	BRMI-205	BRMI-671	BRMI-1322	BRMI-2086
Date Collected	-	1/11/96	2/8/96	3/14/96	4/11/96
Date Received	-	1/15/96	2/12/96	3/15/96	4/15/96
I-131	1.0	<0.5	<0.4	<0.4	<0.5
K-40	-	1490 ± 160	860 ± 80	1640 ± 130	1550 ± 170
Cs-134	15.0	<3.7	<3.8	<2.7	<3.2
Cs-137	18.0	<5.5	<3.6	<5.7	<6.0
Ba-La-140	15.0	<7.4	<1.9	<2.5	<2.8
Lab Code	Required LLDs	BRMI-2963	BRMI-3830, 1	BRMI-4667	BRMI-5428
Date Collected	-	5/9/96	6/13/96	7/11/96	8/8/96
Date Received	-	5/13/96	6/18/96	7/15/96	8/12/96
I-131	1.0	<0.4	<0.3	<0.3	<0.2
K-40	-	1510 ± 160	1500 ± 100	1420 ± 110	1480 ± 130
Cs-134	15.0	<4.9	<1.8	<2.6	<2.2
Cs-137	18.0	<6.7	<4.8	<4.5	<4.8
Ba-La-140	15.0	<2.3	<2.7	<1.5	<2.1
Lab Code	Required LLDs	BRMI-6268	BRMI-7189	BRMI-8334	BRMI-9088
Date Collected	-	9/12/96	10/10/96	11/14/96	12/12/96
Date Received	-	9/16/96	10/14/96	11/19/96	12/16/96
I-131	1.0	<0.3	<0.3	<0.4	<0.4
K-40	-	1350 ± 80	1480 ± 100	1370 ± 80	1360 ± 130
Cs-134	15.0	<2.9	<3.9	<3.8	<3.8
Cs-137	18.0	<4.6	<3.7	<3.6	<7.1
Ba-La-140	15.0	<5.0	<4.0	<3.4	<3.3

BIG ROCK

Table 9. Milk.  
Collection: Monthly  
Units: pCi/L  
Location: Merle Hand Farm

---

Lab Code	Required LLDs	BRMI-8336 <sup>a</sup>	BRMI-9091
Date Collected	-	11/14/96	12/12/96
Date Received	-	11/19/96	12/16/96
I-131	1.0	<0.5	<0.4
K-40	-	1510 ± 190	1350 ± 180
Cs-134	15.0	<4.9	<5.6
Cs-137	18.0	<8.4	<5.8
Ba-La-140	15.0	<8.1	<4.5

# BIG ROCK

Table 9. Milk.  
Collection: Monthly  
Units: pCi/L  
Location: R. McCraney Farm

Lab Code	Required LLDs	BRMI-207	BRMI-673	BRMI-1324	BRMI-2088
Date Collected	-	1/11/96	2/8/96	3/14/96	4/11/96
Date Received	-	1/15/96	2/12/96	3/15/96	4/15/96
I-131	1.0	<0.5	<0.4	<0.4	<0.3
K-40	-	970 ± 120	1460 ± 120	1460 ± 100	1280 ± 160
Cs-134	15.0	<5.7	<4.6	<4.6	<3.6
Cs-137	18.0	<5.8	<6.1	<3.7	<8.1
Ba-La-140	15.0	<3.4	<2.9	<2.3	<2.7
Lab Code	Required LLDs	BRMI-2965	BRMI-3833	BRMI-4669	BRMI-5430
Date Collected	-	5/9/96	6/13/96	7/11/96	8/8/96
Date Received	-	5/13/96	6/18/96	7/15/96	8/12/96
I-131	1.0	<0.5	<0.4	<0.4	<0.2
K-40	-	1470 ± 90	1370 ± 110	1370 ± 150	1420 ± 160
Cs-134	15.0	<3.4	<4.4	<6.3	<4.2
Cs-137	18.0	<3.3	<4.4	<7.8	<5.7
Ba-La-140	15.0	<3.9	<2.3	<4.8	<3.2
Lab Code	Required LLDs	BRMI-6269	BRMI-7186	NS <sup>b</sup>	
Date Collected	-	9/12/96	10/10/96	11/14/96	
Date Received	-	9/16/96	10/14/96	-	
I-131	1.0	<0.4	<0.4	-	
K-40	-	1320 ± 60	1260 ± 80	-	
Cs-134	15.0	<2.4	<2.7	-	
Cs-137	18.0	<2.4	<3.6	-	
Ba-La-140	15.0	<3.2	<1.5	-	

<sup>a</sup> This location added 11-14-96.

<sup>b</sup> NS = No sample; location dropped from the program.

BIG ROCK

Table 10. Fruits and vegetables.

Collection: Monthly, during harvest season  
Units: pCi/g wet  
Location: Kuebler Farm

---

Lab Code	Required LLDs	BRVE-6105	BRVE-6106	BRVE-6107
Date Collected	-	9/5/96	9/5/96	9/5/96
Date Received	-	9/9/96	9/9/96	9/9/96
Sample Type	-	Cabbage Leaves	Tomato Leaves	Bean Leaves
Gross Beta	1.00	$3.02 \pm 0.15$	$4.05 \pm 0.13$	$7.07 \pm 0.24$
Mn-54	0.080	<0.006	<0.008	<0.010
Fe-59	0.10	<0.016	<0.014	<0.021
Co-58	0.080	<0.001	<0.005	<0.005
Co-60	0.050	<0.006	<0.010	<0.012
Zn-65	0.10	<0.009	<0.014	<0.018
Zr-Nb-95	0.10	<0.005	<0.005	<0.005
Cs-134	0.080	<0.002	<0.008	<0.010
Cs-137	0.080	<0.006	<0.007	<0.004
Ba-La-140	0.10	<0.002	<0.002	<0.008

# BIG ROCK

Table 11. Fish.  
Collection: Semiannually  
Units: pCi/g wet

Location		1/4 Mile North		
Lab Code	Required LLDs	BRF-4436	BRF-4437	BRF-4438
Date Collected	-	6/29/96	6/29/96	6/29/96
Date Received	-	7/8/96	7/8/96	7/8/96
Sample Type	-	Carp	White Sucker	Longnose Sucker
Gross Beta	1.00	2.35 ± 0.07	2.40 ± 0.10	2.59 ± 0.09
Mn-54	0.13	< 0.003	< 0.005	< 0.006
Fe-59	0.26	< 0.012	< 0.014	< 0.034
Co-58	0.13	< 0.006	< 0.008	< 0.010
Co-60	0.13	< 0.005	< 0.004	< 0.006
Zn-65	0.26	< 0.008	< 0.018	< 0.017
Zr-Nb-95	0.10	< 0.008	< 0.013	< 0.019
Cs-134	0.13	< 0.007	< 0.004	< 0.009
Cs-137	0.15	0.010 ± 0.004	0.044 ± 0.007	0.028 ± 0.007
Ba-La-140	0.10	< 0.096	< 0.092	< 0.061
Location		1/4 Mile South		
Lab Code	Required LLDs	BRF-7752	BRF-7753	
Date Collected	-	10/6/96	10/6/96	
Date Received	-	11/1/96	11/1/96	
Sample Type	-	Salmon	Carp	
Gross Beta	1.00	2.62 ± 0.09	2.43 ± 0.08	
Mn-54	0.13	< 0.006	< 0.006	
Fe-59	0.26	< 0.021	< 0.014	
Co-58	0.13	< 0.006	< 0.008	
Co-60	0.13	< 0.007	< 0.006	
Zn-65	0.26	< 0.021	< 0.021	
Zr-Nb-95	0.10	< 0.009	< 0.014	
Cs-134	0.13	< 0.003	< 0.007	
Cs-137	0.15	0.046 ± 0.007	< 0.007	
Ba-La-140	0.10	< 0.038	< 0.064	

# BIG ROCK

Table 11. Fish.  
Collection: Semiannually  
Units: pCi/g wet

Location	Discharge				
	Required LLDs	BRF-4434	BRF-4435	BRF-7751	BRF-7816
Lab Code	-	6/30/96	6/30/96	10/6/96	10/6/96
Date Collected	-	7/8/96	7/8/96	11/1/96	11/5/96
Date Received	-				
Sample Type	-	Carp	Longnose Sucker	Carp	Salmon
Gross Beta	1.00	2.42 ± 0.08	2.49 ± 0.09	2.58 ± 0.08	2.79 ± 0.09
Mn-54	0.13	< 0.006	< 0.007	< 0.007	< 0.009
Fe-59	0.26	< 0.021	< 0.017	< 0.031	< 0.038
Co-58	0.13	< 0.010	< 0.007	< 0.009	< 0.012
Co-60	0.13	< 0.006	< 0.010	< 0.007	< 0.009
Zn-65	0.26	< 0.014	< 0.018	< 0.014	< 0.013
Zr-Nb-95	0.10	< 0.017	< 0.017	< 0.017	< 0.023
Cs-134	0.13	< 0.006	< 0.009	< 0.006	< 0.008
Cs-137	0.15	0.025 ± 0.006	0.038 ± 0.011	< 0.009	0.042 ± 0.009
Ba-La-140	0.10	< 0.079	< 0.13 <sup>a</sup>	< 0.051	< 0.075
Lab Code	Required LLDs	BRF-7817			
Date Collected	-	10/6/96			
Date Received	-	11/5/96			
Sample Type	-	Lake Trout			
Gross Beta	1.00	1.93 ± 0.06			
Mn-54	0.13	< 0.006			
Fe-59	0.26	< 0.029			
Co-58	0.13	< 0.007			
Co-60	0.13	< 0.009			
Zn-65	0.26	< 0.007			
Zr-Nb-95	0.10	< 0.019			
Cs-134	0.13	< 0.009			
Cs-137	0.15	0.044 ± 0.009			
Ba-La-140	0.10	< 0.064			



# BIG ROCK

Table 11. Fish.  
Collection: Semiannually  
Units: pCi/g wet

Location		Ludington Pumped Storage Plant (Control)			
Lab Code	Required LLDs	PAF-4452, 3	PAF-4454	PAF-7754	PAF-7819
Date Collected	.	6/12/96	6/12/96	10/8/96	10/8/96
Date Received	.	7/8/96	7/8/96	11/1/96	11/5/96
Sample Type	.	White Sucker	Brown Trout	Lake Trout	Sucker
Gross Beta	1.00	2.13 ± 0.08	1.67 ± 0.06	2.16 ± 0.07	2.11 ± 0.08
Mn-54	0.13	< 0.005	< 0.005	< 0.007	< 0.010
Fe-59	0.26	< 0.013	< 0.033	< 0.027	< 0.041
Co-58	0.13	< 0.004	< 0.006	< 0.017	< 0.007
Co-60	0.13	< 0.003	< 0.007	< 0.006	< 0.009
Zn-65	0.26	< 0.006	< 0.015	< 0.020	< 0.014
Zr-Nb-95	0.10	< 0.011	< 0.013	< 0.020	< 0.021
Cs-134	0.13	< 0.005	< 0.007	< 0.010	< 0.005
Cs-137	0.15	0.013 ± 0.004	0.025 ± 0.010	0.045 ± 0.011	0.015 ± 0.009
Ba-La-140	0.10	< 0.093	< 0.23*	< 0.057	< 0.007

\* Required LLD not met due to delay in analyses and small sample size.

# BIG ROCK

Table 12. Crayfish.  
Collection: Semiannually  
Units: pCi/g wet

Location		1/4 Mile North	
Lab Code	Required LLDs	BRBO-4445	BRBO-7746
Date Collected	-	6/29/96	10/8/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	2.08 ± 0.31	1.65 ± 0.31
Mn-54	0.13	0.045 ± 0.008	< 0.011
Fe-59	0.26	< 0.021	< 0.027
Co-58	0.13	< 0.011	< 0.015
Co-60	0.13	0.100 ± 0.007	0.036 ± 0.015
Zn-65	0.26	< 0.014	< 0.021
Zr-Nb-95	0.10	< 0.015	< 0.016
Cs-134	0.13	< 0.008	< 0.008
Cs-137	0.15	0.023 ± 0.005	0.023 ± 0.008
Ba-La-140	0.10	< 0.082	< 0.027
Location		1/4 Mile South	
Lab Code	Required LLDs	BRBO-4446	BRBO-7747, 8
Date Collected	-	6/28/96	10/6/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	1.17 ± 0.23	1.57 ± 0.22
Mn-54	0.13	0.030 ± 0.011	< 0.011
Fe-59	0.26	< 0.035	< 0.017
Co-58	0.13	< 0.016	< 0.007
Co-60	0.13	0.026 ± 0.010	< 0.014
Zn-65	0.26	< 0.000	< 0.018
Zr-Nb-95	0.10	< 0.021	< 0.018
Cs-134	0.13	< 0.015	< 0.011
Cs-137	0.15	0.016 ± 0.008	< 0.011
Ba-La-140	0.10	< 0.12 <sup>a</sup>	< 0.051

# BIG ROCK

Table 12. Crayfish.  
Collection: Semiannually  
Units: pCi/g wet

Location	Big Rock Point
Lab Code	Required LLDs
Date Collected	-
Date Received	-
Gross Beta	1.00
Mn-54	0.13
Fe-59	0.26
Co-58	0.13
Co-60	0.13
Zn-65	0.26
Zr-Nb-95	0.10
Cs-134	0.13
Cs-137	0.15
Ba-La-140	0.10

Location	Discharge
Lab Code	Required LLDs BRBO-4444 BRBO-7815
Date Collected	- 6/30/96 10/6/96
Date Received	- 7/8/96 11/5/96
Gross Beta	1.00 1.63 ± 0.22 0.38 ± 0.08
Mn-54	0.13 0.130 ± 0.012 < 0.014
Fe-59	0.26 < 0.033 < 0.032
Co-58	0.13 < 0.013 < 0.025
Co-60	0.13 0.398 ± 0.012 0.071 ± 0.014
Zn-65	0.26 < 0.019 < 0.023
Zr-Nb-95	0.10 < 0.022 < 0.019
Cs-134	0.13 < 0.010 < 0.015
Cs-137	0.15 0.144 ± 0.010 0.037 ± 0.011
Ba-La-140	0.10 < 0.055 < 0.063

\* Required LLD not met due to delay in analyses and small sample size.

# BIG ROCK

Table 13. Periphyton.  
Collection: Semiannually  
Units: pCi/g wet

Location		1/4 Mile North	
Lab Code	Required LLDs	BRSL-4440	BRSL-7749
Date Collected	-	6/29/96	10/7/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	2.32 ± 0.56	2.56 ± 0.65
Mn-54	0.13	0.012 ± 0.005	0.182 ± 0.031
Fe-59	0.26	< 0.020	< 0.051
Co-58	0.13	< 0.007	< 0.032
Co-60	0.13	0.054 ± 0.006	0.499 ± 0.030
Zn-65	0.26	< 0.023	< 0.046
Zr-Nb-95	0.10	< 0.015	< 0.018
Cs-134	0.13	< 0.007	< 0.012
Cs-137	0.15	0.149 ± 0.010	0.191 ± 0.028
Ba-La-140	0.10	< 0.048	< 0.078

Location		1/4 Mile South	
Lab Code	Required LLDs	BRSL-4441	BRSL-7845
Date Collected	-	6/28/96	10/5/96
Date Received	-	7/8/96	11/5/96
Gross Beta	1.00	1.95 ± 0.47	2.55 ± 0.62
Mn-54	0.13	0.125 ± 0.013	0.154 ± 0.012
Fe-59	0.26	< 0.036	< 0.035
Co-58	0.13	< 0.013	< 0.013
Co-60	-	0.246 ± 0.011	0.417 ± 0.012
Zn-65	0.26	< 0.026	< 0.016
Zr-Nb-95	0.10	< 0.021	< 0.020
Cs-134	0.13	< 0.009	< 0.010
Cs-137	0.15	0.109 ± 0.013	0.220 ± 0.013
Ba-La-140	0.10	< 0.060	< 0.073

BIG ROCK

Table 13. Periphyton.  
 Collection: Semiannually  
 Units: pCi/g wet

Location		Discharge	
Lab Code	Required LLDs	BRSL-4439	BRSL-7814
Date Collected	-	6/30/96	10/5/96
Date Received	-	7/8/96	11/5/96
Gross Beta	1.00	6.66 ± 0.84	3.74 ± 0.75
Mn-54	0.13	0.125 ± 0.013	0.435 ± 0.057
Fe-59	0.26	< 0.036	< 0.086
Co-58	0.13	< 0.013	< 0.046
Co-60	-	0.246 ± 0.011	0.945 ± 0.050
Zn-65	0.26	< 0.026	< 0.040
Zr-Nb-95	0.10	< 0.021	< 0.040
Cs-134	0.13	< 0.009	< 0.040
Cs-137	0.15	0.109 ± 0.013	0.183 ± 0.043
Ba-La-140	0.10	< 0.158*	< 0.086

\* Required LLD not met due to delay in analyses and small sample size.

# BIG ROCK

Table 14. Algae.  
Collection: Semiannually  
Units: pCi/g wet

Location	1/4 Mile North
Lab Code	Required LLDs
Date Collected	-
Date Received	-
Gross Beta	1.00
Mn-54	0.13
Fe-59	0.26
Co-58	0.13
Co-60	0.13
Zn-65	0.26
Zr-Nb-95	0.10
Cs-134	0.13
Cs-137	0.15
Ba-La-140	0.10

Location	1/4 Mile South		
Lab Code	Required LLDs	BRSL-4443	BRSL-7750
Date Collected	-	6/28/96	10/7/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	2.04 ± 0.20	2.20 ± 0.26
Mn-54	0.13	< 0.088	< 0.017
Fe-59	0.26	< 0.078	< 0.018
Co-58	0.13	< 0.025	< 0.017
Co-60	-	0.158 ± 0.015	0.036 ± 0.015
Zn-65	0.26	< 0.055	< 0.038
Zr-Nb-95	0.10	< 0.054	< 0.031
Cs-134	0.13	< 0.016	< 0.015
Cs-137	0.15	< 0.016	< 0.017
Ba-La-140	0.10	< 0.25*	< 0.074

BIG ROCK

Table 14. Algae.  
 Collection: Semiannually  
 Units: pCi/g wet

Location	Discharge	
Lab Code	Required LLDs	BRSL-4442
Date Collected	-	6/30/96
Date Received	-	7/8/96
Gross Beta	1.00	13.66 ± 1.42
Mn-54	0.13	4.649 ± 0.078
Fe-59	0.26	< 0.143
Co-58	0.13	< 0.067
Co-60	-	6.823 ± 0.066
Zn-65	0.26	< 0.090
Zr-Nb-95	0.10	< 0.071
Cs-134	0.13	< 0.043
Cs-137	0.15	0.425 ± 0.034
Ba-La-140	0.10	< 0.12*

\* Required LLD not met due to delay in analyses and small sample size.



# BIG ROCK

Table 15. Bottom Sediments.

Collection: Semiannually

Units: pCi/g dry

Location		1/4 Mile North		
Lab Code	Required LLDs	BRBS-4448	BRBS-7743	BRBS-9718
Date Collected	-	6/27/96	10/7/96	12/18/96
Date Received	-	7/8/96	11/1/96	1/14/97
Gross Beta	1.00	8.08 ± 1.49	12.08 ± 1.58	9.39 ± 1.55
Mn-54	0.13	0.020 ± 0.011	0.933 ± 0.044	0.042 ± 0.019
Fe-59	0.26	< 0.013	< 0.077	< 0.049
Co-58	0.13	< 0.009	< 0.046	< 0.026
Co-60	0.13	0.046 ± 0.013	2.123 ± 0.042	0.135 ± 0.017
Zn-65	0.26	< 0.050	< 0.086	< 0.064
Zr-Nb-95	0.10	< 0.007	< 0.020	< 0.032
Cs-134	0.13	< 0.014	< 0.028	< 0.019
Cs-137	0.15	0.123 ± 0.017	0.543 ± 0.036	0.188 ± 0.023
Ba-La-140	0.10	< 0.015	< 0.034	< 0.055

Location		1/4 Mile South	
Lab Code	Required LLDs	BRBS-4449	BRBS-7744
Date Collected	-	6/27/96	10/7/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	7.29 ± 1.46	7.35 ± 1.44
Mn-54	0.13	< 0.013	< 0.013
Fe-59	0.26	< 0.032	< 0.029
Co-58	0.13	< 0.017	< 0.024
Co-60	0.13	< 0.016	0.060 ± 0.012
Zn-65	0.26	< 0.053	< 0.047
Zr-Nb-95	0.10	< 0.021	< 0.018
Cs-134	0.13	< 0.018	< 0.013
Cs-137	0.15	0.138 ± 0.021	0.207 ± 0.017
Ba-La-140	0.10	< 0.028	< 0.019

# BIG ROCK

Table 15. Bottom Sediments.  
Collection: Semiannually  
Units: pCi/g dry

Location		9 Mile Point	
Lab Code	Required LLDs	BRBS-4451	BRBS-7820
Date Collected	-	6/27/96	10/7/96
Date Received	-	7/8/96	11/5/96
Gross Beta	1.00	6.02 ± 1.32	6.05 ± 1.39
Mn-54	0.13	< 0.008	< 0.018
Fe-59	0.26	< 0.014	< 0.024
Co-58	0.13	< 0.009	< 0.008
Co-60	0.13	< 0.006	< 0.013
Zn-65	0.26	< 0.041	< 0.056
Zr-Nb-95	0.10	< 0.008	< 0.021
Cs-134	0.13	< 0.010	< 0.017
Cs-137	0.15	0.048 ± 0.013	0.048 ± 0.017
Ba-La-140	0.10	< 0.009	< 0.030

Location		Discharge	
Lab Code	Required LLDs	BRBS-4447	BRBS-7742
Date Collected	-	6/27/96	10/7/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	9.16 ± 1.54	5.63 ± 1.42
Mn-54	0.13	0.114 ± 0.021	< 0.026
Fe-59	0.26	< 0.014	< 0.038
Co-58	0.13	< 0.015	< 0.016
Co-60	0.13	0.652 ± 0.026	0.058 ± 0.011
Zn-65	0.26	< 0.059	< 0.055
Zr-Nb-95	0.10	< 0.011	< 0.030
Cs-134	0.13	< 0.026	< 0.017
Cs-137	0.15	0.866 ± 0.034	0.148 ± 0.016
Ba-La-140	0.10	< 0.012	< 0.031

# BIG ROCK

Table 15. Bottom Sediments, analyses for gross beta and gamma-emitting isotopes.

Collection: Semiannually

Units: pCi/g dry

Location		Ludington (Control)	
Lab Code	Required LLDs	PABS-4455	PABS-7818
Date Collected	-	5/28/96	10/7/96
Date Received	-	7/8/96	11/5/96
Gross Beta	1.00	6.75 ± 1.35	10.32 ± 1.53
Mn-54	0.080	< 0.024	< 0.018
Fe-59	0.10	< 0.055	< 0.039
Co-58	0.080	< 0.011	< 0.008
Co-60	0.050	< 0.016	< 0.010
Zn-65	0.10	< 0.060	< 0.050
Zr-Nb-95	0.10	< 0.040	< 0.013
Cs-134	0.15	< 0.019	< 0.017
Cs-137	0.18	< 0.017	0.026 ± 0.013
Ba-La-140	0.10	< 0.081	< 0.067
Location		Mt. McSaub	
Lab Code	Required LLDs	BRBS-4450	BRBS-7745
Date Collected	-	6/27/96	10/7/96
Date Received	-	7/8/96	11/1/96
Gross Beta	1.00	10.57 ± 1.54	10.19 ± 1.50
Mn-54	0.13	< 0.011	< 0.008
Fe-59	0.26	< 0.024	< 0.014
Co-58	0.13	< 0.018	< 0.018
Co-60	0.13	< 0.011	< 0.010
Zn-65	0.26	< 0.048	< 0.042
Zr-Nb-95	0.10	< 0.011	< 0.013
Cs-134	0.13	< 0.011	< 0.011
Cs-137	0.15	0.024 ± 0.012	0.047 ± 0.014
Ba-La-140	0.10	< 0.007	< 0.017

# BIG ROCK

Table 16.1. Liquid Radwaste.

Collection: Monthly composite  
Units: uCi/mL

Location	Big Rock			
	Required LLDs	BRRW-715	BRRW-1307	BRRW-1950
Date Collected	-	1/31/96	2/29/96	3/31/96
Date Received	-	2/14/96	3/14/96	4/8/96
Gross Alpha	1.0 E-07	2.1E-8 ± 3.5E-9	2.7E-8 ± 6.3E-9	1.2E-8 ± 4.1E-9
H-3	1.0 E-05	1.1E-3 ± 7.0E-6	5.6E-4 ± 5.0E-6	1.4E-3 ± 7.7E-6
Sr-89	5.0 E-08	< 1.8E-9	< 2.0E-9	< 1.1E-9
Sr-90	5.0 E-08	6.7E-7 ± 1.1E-8	1.4E-6 ± 1.6E-8	1.0E-6 ± 1.4E-8
Pu-239	5.0 E-08	< 2.9E-10	2.0E-9 ± 4.1E-10	2.2E-9 ± 3.8E-10
Cr-51	5.0 E-07	3.1E-6 ± 1.1E-6	3.9E-6 ± 1.2E-6	< 8.7 E-7
Mn-54	5.0 E-07	2.3E-4 ± 3.1E-7	2.9E-4 ± 3.8E-7	1.6E-4 ± 2.5E-7
Fe-59	5.0 E-07	1.2E-5 ± 2.8E-7	3.7E-5 ± 3.4E-7	7.6E-6 ± 1.8E-7
Co-58	5.0 E-07	2.6E-6 ± 1.7E-7	5.4E-6 ± 2.1E-7	4.5E-6 ± 1.3E-7
Co-60	5.0 E-07	3.8E-4 ± 2.5E-7	4.8E-4 ± 3.1E-7	2.6E-4 ± 2.1E-7
Zn-65	5.0 E-07	1.1E-5 ± 2.9E-7	9.7E-6 ± 3.4E-7	10E-6 ± 2.4E-7
Zr-95	5.0 E-07	< 4.2E-7	8.7E-7 ± 2.3E-7	< 2.0E-7
Nb-95	5.0 E-07	< 1.9E-7	3.0E-6 ± 2.7E-7	3.2E-7 ± 1.2E-7
Ag-110m	5.0 E-07	5.8E-6 ± 2.3E-7	2.9E-6 ± 2.2E-7	6.2E-7 ± 1.5E-7
Sb-124	5.0 E-07	6.8E-7 ± 1.5E-7	3.4E-6 ± 1.9E-7	0.0E-1 ± 1.8E-7
Cs-134	5.0 E-07	8.0E-6 ± 8.8E-8	1.5E-5 ± 1.1E-7	5.0E-6 ± 7.4E-8
Cs-137	5.0 E-07	2.7E-4 ± 2.5E-7	4.5E-4 ± 3.4E-7	1.5E-4 ± 1.9E-7
Ba-140	5.0 E-07	< 1.4E-6*	< 1.9E-6*	< 6.3E-7*
La-140	5.0 E-07	< 2.3E-7	< 2.2E-7	< 7.1E-8
Ce-141	5.0 E-07	< 2.2E-7	6.5E-7 ± 2.7E-7	< 2.1E-7
Ce-144	5.0 E-07	1.5E-6 ± 6.8E-7	4.0E-6 ± 1.1E-6	< 1.0E-6*

# BIG ROCK

Table 16.1. Liquid Radwaste.

Collection: Monthly composite

Units:  $\mu\text{Ci/mL}$

Lab Code	Required LLDs	BRRW-3092	BRRW-4016	BRRW-4741
Date Collected	-	4/30/96	5/31/96	6/30/96
Date Received	-	5/17/96	6/24/96	7/16/96
Gross Alpha	1.0 E-07	1.3E-8 $\pm$ 2.8E-9	1.8E-8 $\pm$ 5.1E-9	<2.5E-9
H-3	1.0 E-05	1.5E-4 $\pm$ 2.6E-6	5.0E-4 $\pm$ 5.1E-6	3.4E-4 $\pm$ 4.2E-6
Sr-89	5.0 E-08	<3.3E-9	<1.8E-9	<4.3E-9
Sr-90	5.0 E-08	8.2E-7 $\pm$ 1.4E-8	7.7E-7 $\pm$ 1.4E-8	5.7E-7 $\pm$ 1.4E-8
Pu-239	5.0 E-08	<3.3E-10	6.4E-10 $\pm$ 1.8E-10	8.6E-11 $\pm$ 8.5E-11
Cr-51	5.0 E-07	5.4E-6 $\pm$ 1.4E-6	<1.4E-6 <sup>a</sup>	<1.6E-7 <sup>a</sup>
Mn-54	5.0 E-07	6.3E-4 $\pm$ 5.0E-7	2.1E-4 $\pm$ 3.0E-7	5.1E-5 $\pm$ 1.9E-7
Fe-59	5.0 E-07	3.1E-5 $\pm$ 4.4E-7	6.5E-6 $\pm$ 5.3E-7	3.8E-7 $\pm$ 1.4E-7
Co-58	5.0 E-07	5.9E-6 $\pm$ 2.8E-7	2.5E-6 $\pm$ 1.7E-7	1.2E-6 $\pm$ 1.2E-7
Co-60	5.0 E-07	8.3E-4 $\pm$ 4.2E-7	3.1E-4 $\pm$ 2.4E-7	2.0E-4 $\pm$ 1.8E-7
Zn-65	5.0 E-07	1.4E-5 $\pm$ 4.7E-7	4.6E-6 $\pm$ 2.6E-7	5.5E-6 $\pm$ 2.0E-7
Zr-95	5.0 E-07	<7.1E-7 <sup>a</sup>	<4.4E-7	<2.8E-7
Nb-95	5.0 E-07	4.3E-7 $\pm$ 2.0E-7	<2.1E-7	<1.2E-7
Ag-110m	5.0 E-07	7.3E-6 $\pm$ 3.3E-7	1.3E-6 $\pm$ 2.0E-7	3.2E-7 $\pm$ 1.3E-7
Sb-124	5.0 E-07	1.8E-6 $\pm$ 2.4E-7	6.9E-7 $\pm$ 1.5E-7	0.0E-1 $\pm$ 1.7E-7
Cs-134	5.0 E-07	4.4E-6 $\pm$ 1.4E-7	2.7E-6 $\pm$ 7.8E-8	6.7E-6 $\pm$ 6.5E-8
Cs-137	5.0 E-07	2.2E-4 $\pm$ 2.7E-7	9.5E-5 $\pm$ 1.7E-7	2.3E-4 $\pm$ 2.2E-7
Ba-140	5.0 E-07	<1.6E-6 <sup>a</sup>	<2.5E-6 <sup>a</sup>	9.6E-7 $\pm$ 5.3E-7
La-140	5.0 E-07	<4.7E-7	<2.5E-7	<8.8E-8
Ce-141	5.0 E-07	<6.8E-7 <sup>a</sup>	<3.4E-7	<1.6E-7
Ce-144	5.0 E-07	<2.4E-6 <sup>a</sup>	<1.1E-6 <sup>a</sup>	1.3E-6 $\pm$ 5.2E-7

# BIG ROCK

Table 16.1. Liquid Radwaste.

Collection: Monthly composite  
Units: uCi/mL

Lab Code	Required LLDs	NS <sup>b</sup>	BRRW-6245	NS <sup>b</sup>
Date Collected	-	7/30/96	8/31/96	9/30/96
Date Received	-	-	9/13/96	-
Gross Alpha	1.0 E-07	-	<6.8E-9	-
H-3	1.0 E-05	-	1.3E-4 ± 2.4E-6	-
Sr-89	5.0 E-08	-	<2.6E-9	-
Sr-90	5.0 E-08	-	3.8E-7 ± 7.8E-9	-
Pu-239	5.0 E-08	-	1.8E-9 ± 2.6E-10	-
Cr-51	5.0 E-07	-	<6.8E-7 <sup>a</sup>	-
Mn-54	5.0 E-07	-	5.6E-5 ± 1.6E-7	-
Fe-59	5.0 E-07	-	3.2E-7 ± 1.1E-7	-
Co-58	5.0 E-07	-	1.9E-7 ± 9.1E-8	-
Co-60	5.0 E-07	-	1.2E-4 ± 1.4E-7	-
Zn-65	5.0 E-07	-	1.6E-6 ± 1.5E-7	-
Zr-95	5.0 E-07	-	<2.1E-7	-
Nb-95	5.0 E-07	-	<9.5E-8	-
Ag-110m	5.0 E-07	-	6.1E-7 ± 1.2E-7	-
Sb-124	5.0 E-07	-	0.0E-1 ± 1.3E-7	-
Cs-134	5.0 E-07	-	2.2E-6 ± 4.8E-8	-
Cs-137	5.0 E-07	-	7.7E-5 ± 1.3E-7	-
Ba-140	5.0 E-07	-	<7.4E-7 <sup>a</sup>	-
La-140	5.0 E-07	-	<7.5E-8	-
Ce-141	5.0 E-07	-	<1.5E-7	-
Ce-144	5.0 E-07	-	<6.5E-7 <sup>a</sup>	-

# BIG ROCK

Table 16.1. Liquid Radwaste.

Collection: Monthly composite  
Units: uCi/mL

Lab Code	Required LLDs	BRRW-8294	NS <sup>b</sup>	NS <sup>b</sup>
Date Collected	-	10/31/96	11/30/96	12/31/96
Date Received	-	11/15/96	-	-
Gross Alpha	1.0 E-07	6.7E-9 ± 4.7E-9	-	-
H-3	1.0 E-05	2.3E-1 ± 9.9E-5	-	-
Sr-89	5.0 E-08	< 3.2E-9	-	-
Sr-90	5.0 E-08	6.7E-7 ± 1.0E-8	-	-
Pu-239	5.0 E-08	1.2E-10 ± 1.0E-10	-	-
Cr-51	5.0 E-07	< 1.6E-6	-	-
Mn-54	5.0 E-07	4.6E-5 ± 2.0E-7	-	-
Fe-59	5.0 E-07	< 2.6E-7	-	-
Co-58	5.0 E-07	2.9E-7 ± 1.5E-7	-	-
Co-60	5.0 E-07	1.3E-4 ± 2.0E-7	-	-
Zn-65	5.0 E-07	2.2E-6 ± 2.3E-7	-	-
Zr-95	5.0 E-07	< 2.2E-7	-	-
Nb-95	5.0 E-07	< 2.1E-7	-	-
Ag-110m	5.0 E-07	< 2.0E-7	-	-
Sb-124	5.0 E-07	0.0E-1 ± 2.2E-7	-	-
Cs-134	5.0 E-07	2.5E-6 ± 6.9E-8	-	-
Cs-137	5.0 E-07	1.3E-4 ± 2.1E-7	-	-
Ba-140	5.0 E-07	< 2.5E-6	-	-
La-140	5.0 E-07	< 1.7E-7	-	-
Ce-141	5.0 E-07	< 2.1E-7	-	-
Ce-144	5.0 E-07	1.7E-6 ± 5.2E-7	-	-

<sup>a</sup> Required LLD not met due to high activity of sample causing abnormal background levels; sample counted overnight.

<sup>b</sup> NS = No sample; sample not received.



# BIG ROCK

Table 16.2. Stack filters.

Collection: Continuous, monthly exchange  
Units: pCi/filter

Location		Big Rock		
Lab Code	Required LLDs	BRSP-716	BRSP-1308	BRSP-1951
Date Collected	-	1/30/96	2/29/96	3/27/96
Date Received	-	2/14/96	3/14/96	4/8/96
Gross Alpha	10	14.3 ± 1.2 <sup>a</sup>	8.9 ± 1.6 <sup>a</sup>	< 1.6 <sup>a</sup>
Sr-89	10	1,283.5 ± 25.9	< 3.7	< 3.0 <sup>a</sup>
Sr-90	10	4.8 ± 1.3	3.2 ± 1.3	< 2.2 <sup>a</sup>
Pu-239	10	< 0.3	< 0.3	0.2 ± 0.1
Lab Code	Required LLDs	BRSP-3091	BRSP-4017	BRSP-4742
Date Collected	-	4/30/96	5/28/96	6/25/96
Date Received	-	5/17/96	6/24/96	7/16/96
Gross Alpha	10	7.5 ± 1.2 <sup>a</sup>	18.7 ± 2.2 <sup>a</sup>	12.1 ± 1.2 <sup>a</sup>
Sr-89	10	34.7 ± 0.4	9,231.6 ± 94.6	8,240.4 ± 80.0
Sr-90	10	0.1 ± 0.0	19.3 ± 3.7	28.6 ± 3.3
Pu-239	10	< 0.2	< 0.0	0.8 ± 0.4
Lab Code	Required LLDs	BRSP-5558	BRSP-6246	BRSP-7134
Date Collected	-	7/30/96	8/27/96	9/24/96
Date Received	-	8/15/96	9/13/96	10/11/96
Gross Alpha	10	10.0 ± 1.6 <sup>a</sup>	5.2 ± 1.7 <sup>a</sup>	8.0 ± 1.2
Sr-89	10	10,959.9 ± 61.3	13,523.7 ± 73.6	12,740.0 ± 76.7
Sr-90	10	51.3 ± 3.1	193.7 ± 6.0	34.1 ± 3.5
Pu-239	10	< 0.4	< 0.3	< 0.3
Lab Code	Required LLDs	BRSP-8293	BRSP-9224	BRSP-9771
Date Collected	-	10/31/96	11/30/96	12/31/96
Date Received	-	11/15/96	12/20/96	1/16/97
Gross Alpha	10	23.7 ± 2.1	8.8 ± 1.1	2.4 ± 0.6
Sr-89	10	8,499.7 ± 79.3	24,998.2 ± 124.6	9,489.0 ± 65.7
Sr-90	10	126.9 ± 6.1	212.9 ± 8.5	224.7 ± 9.2
Pu-239	10	< 0.6	< 0.8	< 0.4

<sup>a</sup> Corrected Data.

BIG ROCKTable 17.2. Well water.  
Units: uCi/ml

Location	Lab Code	Collection Date	H-3
	Required LLDs	-	5.0 E-07
#1-Annex	BRWW-6329	9/12/96	< 1.7E-7
#5 - Screen House	BRWW-6330	9/12/96	2.4E-5 ± 1.1E-6
#6	BRWW-6331, 2	9/12/96	1.7E-5 ± 7.1E-7
#7 - North Fence	BRWW-6333	9/12/96	< 1.7E-7
#8 - Maintenance Bldg.	BRWW-6334	9/12/96	< 1.7E-7
#9 - Stack	BRWW-6335	9/12/96	8.2E-7 ± 1.1E-7

ENCLOSURE E

CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996

EPA INTERLABORATORY COMPARISON PROGRAM RESULTS

Submitted April 17, 1997

APPENDIX A  
INTERLABORATORY COMPARISON PROGRAM RESULTS

NOTE: Teledyne's Midwest Laboratory participates in intercomparison studies administered by U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada. The results are reported in Appendix A. Also reported are results of International Intercomparison and Teledyne testing of TLD's, as well as, in-house spikes, blanks, duplicates and mixed analyte performance evaluation program. Appendix A is updated four times a year; the complete Appendix is included in March, June, September and December monthly progress reports only. Please refer to March, June, September and December progress reports for information.

January, 1996 through December, 1996

## Appendix A

### Interlaboratory Comparison Program Results

Teledyne's Midwest Laboratory (formerly Hazleton Environmental Sciences) has participated in interlaboratory comparison (crosscheck) programs since the formulation of its quality control program in December 1971. These programs are operated by agencies which supply environmental type samples (e.g., milk or water) containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on the laboratory's analytical procedures and to alert it to any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

The results in Table A-1 were obtained through participation in the environmental sample crosscheck program for milk, water and air filters during the past twelve months. Data for previous years is available upon request.

This program is conducted by the U.S. Environmental Protection Agency Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, Las Vegas, Nevada.

The results in Table A-2 were obtained for Thermoluminescent Dosimeters (TLDs), since 1976 via various International Intercomparisons of Environmental Dosimeters under the sponsorships listed in Table A-2. Also Teledyne testing results are listed.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-5 list results of the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Data for previous years available upon request.

The results in Table A-6 were obtained through participation in the mixed analyte performance evaluation program.

The results in Table A-7 were obtained through participation in the Environmental Measurement Laboratory Quality Assessment Program.

Attachment A lists acceptance criteria for "spiked" samples.

Out-of-limit results are explained directly below the result.

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L <sup>b</sup>		
				Teledyne Results $\pm 2$ Sigma <sup>c</sup>	EPA Result <sup>d</sup> 1s, N=1	Control Limits
STW-752	WATER	Jan, 1996	Gr. Alpha	19.5 $\pm$ 1.5	12.1 $\pm$ 5.0	3.4 - 20.8
STW-752	WATER	Jan, 1996	Gr. Beta	7.9 $\pm$ 0.7	7.0 $\pm$ 5.0	0.0 - 15.7
STW-753	WATER	Feb, 1996	I-131	70.7 $\pm$ 1.5	67.0 $\pm$ 7.0	54.9 - 79.1
STW-761	WATER	Mar, 1996	H-3	22,776.7 $\pm$ 185.0	22,002.0 $\pm$ 2,200.0	18,185.1 - 25,818.9
Results where inadvertently not reported due to administrative error in laboratory.						
STW-762	WATER	Apr, 1996	Gr. Alpha	63.8 $\pm$ 2.4	74.8 $\pm$ 18.7	42.4 - 107.2
STW-762	WATER	Apr, 1996	Ra-226	2.9 $\pm$ 0.1	3.0 $\pm$ 0.5	2.1 - 3.9
STW-762	WATER	Apr, 1996	Ra-228	4.6 $\pm$ 0.2	5.0 $\pm$ 1.3	2.7 - 7.3
STW-762	WATER	Apr, 1996	Uranium	57.9 $\pm$ 0.5	58.4 $\pm$ 5.8	48.3 - 68.5
STW-763	WATER	Apr, 1996	Co-60	32.7 $\pm$ 0.6	31.0 $\pm$ 5.0	22.3 - 39.7
STW-763	WATER	Apr, 1996	Cs-134	43.0 $\pm$ 1.0	46.0 $\pm$ 5.0	37.3 - 54.7
STW-763	WATER	Apr, 1996	Cs-137	52.3 $\pm$ 2.1	50.0 $\pm$ 5.0	41.3 - 58.7
STW-763	WATER	Apr, 1996	Gr. Beta	154.9 $\pm$ 6.8	166.9 $\pm$ 25.0	123.5 - 210.3
STW-763	WATER	Apr, 1996	Sr-89	42.0 $\pm$ 3.6	43.0 $\pm$ 5.0	34.3 - 51.7
STW-763	WATER	Apr, 1996	Sr-90	15.3 $\pm$ 2.9	16.0 $\pm$ 5.0	7.3 - 24.7
STW-764	WATER	Jun, 1996	Ba-133	745.0 $\pm$ 19.5	745.0 $\pm$ 75.0	614.9 - 875.1
STW-764	WATER	Jun, 1996	Co-60	97.0 $\pm$ 3.6	99.0 $\pm$ 5.0	90.3 - 107.7
STW-764	WATER	Jun, 1996	Cs-134	72.3 $\pm$ 1.2	79.0 $\pm$ 5.0	70.3 - 87.7
STW-764	WATER	Jun, 1996	Cs-137	201.3 $\pm$ 2.3	197.0 $\pm$ 10.0	179.7 - 214.3
STW-764	WATER	Jun, 1996	Zn-65	298.0 $\pm$ 6.2	300.0 $\pm$ 30.0	248.0 - 352.0
STW-765	WATER	Jun, 1996	Ra-226	4.8 $\pm$ 0.1	4.9 $\pm$ 0.7	3.7 - 6.1
STW-765	WATER	Jun, 1996	Ra-228	8.7 $\pm$ 0.5	9.0 $\pm$ 2.3	5.0 - 13.0
STW-765	WATER	Jun, 1996	Uranium	20.4 $\pm$ 0.8	20.2 $\pm$ 3.0	15.0 - 25.4
STW-767	WATER	Jul, 1996	Sr-89	24.0 $\pm$ 2.0	25.0 $\pm$ 5.0	16.3 - 33.7
STW-767	WATER	Jul, 1996	Sr-90	11.3 $\pm$ 1.2	12.0 $\pm$ 5.0	3.3 - 20.7
STW-768	WATER	Jul, 1996	Gr. Alpha	20.1 $\pm$ 2.0	24.4 $\pm$ 6.1	13.8 - 35.0
STW-768	WATER	Jul, 1996	Gr. Beta	40.4 $\pm$ 3.2	44.8 $\pm$ 5.0	36.1 - 53.5
STW-774	WATER	Sep, 1996	Ra-226	13.6 $\pm$ 0.4	14.0 $\pm$ 2.1	10.4 - 17.6
STW-774	WATER	Sep, 1996	Ra-228	5.4 $\pm$ 0.4	4.7 $\pm$ 1.2	2.6 - 6.8
STW-774	WATER	Sep, 1996	Uranium	10.0 $\pm$ 0.2	10.1 $\pm$ 3.0	4.9 - 15.3
STW-775	WATER	Oct, 1996	I-131	26.7 $\pm$ 2.3	27.0 $\pm$ 6.0	16.6 - 37.4
STW-778	WATER	Oct, 1996	Gr. Alpha	10.2 $\pm$ 2.1	10.3 $\pm$ 5.0	1.6 - 19.0
STW-778	WATER	Oct, 1996	Gr. Beta	32.0 $\pm$ 1.6	34.6 $\pm$ 5.0	25.9 - 43.3

Table A-1. U.S. Environmental Protection Agency's crosscheck program, comparison of EPA and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L <sup>b</sup>		
				Teledyne Results $\pm 2$ Sigma <sup>c</sup>	EPA Result <sup>d</sup> 1s, N=1	Control Limits

- <sup>a</sup> Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the environmental sample crosscheck program operated by the Intercomparison and Calibration Section, Quality Assurance Branch, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency (EPA), Las Vegas, Nevada.
- <sup>b</sup> All results are in pCi/L, except for elemental potassium (K) data in milk, which are in mg/L; air filter samples, which are in pCi/Filter.
- <sup>c</sup> Unless otherwise indicated, the TBESML results are given as the mean  $\pm 2$  standard deviations for three determinations.
- <sup>d</sup> USEPA results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by the EPA.



12-31-96

ATTACHMENT A

## ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES\*

Analysis	Level	One Standard Deviation for single determinations
Gamma Emitters	5 to 100 pCi/liter or kg >100 pCi/liter or kg	5.0 pCi/liter 5% of known value
Strontium-89 <sup>b</sup>	5 to 50 pCi/liter or kg >50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90 <sup>b</sup>	2 to 30 pCi/liter or kg >30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium	>0.1 g/liter or kg	5% of known value
Gross alpha	≤20 pCi/liter >20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤100 pCi/liter >100 pCi/liter	5.0 pCi/liter 5% of known value
Tritium	≤4,000 pCi/liter >4,000 pCi/liter	1s = (pCi/liter) = 169.85 x (known) <sup>0.0933</sup> 10% of known value
Radium-226,-228	<0.1 pCi/liter	15% of known value
Plutonium	0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129 <sup>b</sup>	≤55 pCi/liter >55 pCi/liter	6.0 pCi/liter 10% of known value
Uranium-238, Nickel-64 <sup>b</sup> Technetium-99 <sup>b</sup>	≤35 pCi/liter >35 pCi/liter	6.0 pCi/liter 15% of known value
Iron-55 <sup>b</sup>	50 to 100 pCi/liter >100 pCi/liter	10 pCi/liter 10% of known value
Others <sup>b</sup>	—	20% of known value

\* From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program, Fiscal Year, 1981-1982, EPA-600/4-81-004.

<sup>b</sup> Teledyne limit.

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR		
				Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
<u>2nd International Intercomparison</u>						
115-2	CaF <sub>2</sub> : Mn Bulb	Apr, 1976	Field	17.0 ± 1.9	17.1	16.4 ± 7.7
115-2	CaF <sub>2</sub> : Mn Bulb	Apr, 1976	Lab	20.8 ± 4.1	21.3	18.8 ± 7.6
Second International Intercomparison of Environmental Dosimeters conducted in April of 1976 by the Health and Safety Laboratory (HASL), New York, New York, and the School of Public Health of the University of Texas, Houston, Texas.						
<u>3rd International Intercomparison</u>						
115-3	CaF <sub>2</sub> : Mn Bulb	Jun, 1977	Field	30.7 ± 3.2	34.9 ± 4.8	31.5 ± 3.0
115-3	CaF <sub>2</sub> : Mn Bulb	Jun, 1977	Lab	89.6 ± 6.4	91.7 ± 14.6	86.2 ± 24.0
Third International Intercomparison of Environmental Dosimeters conducted in the summer of 1977 by Oak Ridge National Laboratory and the School of Public Health of the University of Texas, Houston, Texas.						
<u>4th International Intercomparison</u>						
115-4	CaF <sub>2</sub> : Mn Bulb	Jun, 1979	Field	14.1 ± 1.1	14.1 ± 1.4	16.0 ± 9.0
115-4	CaF <sub>2</sub> : Mn Bulb	Jun, 1979	Lab, High	40.4 ± 1.4	45.8 ± 9.2	43.9 ± 13.2
115-4	CaF <sub>2</sub> : Mn Bulb	Jun, 1979	Lab, Low	9.8 ± 1.3	12.2 ± 2.4	12.0 ± 7.4
Fourth International Intercomparison of Environmental Dosimeters conducted in the summer of 1979 by the School of Public Health of the University of Texas, Houston, Texas.						
<u>5th International Intercomparison</u>						
115-5A	CaF <sub>2</sub> : Mn Bulb	Oct, 1980	Field	31.4 ± 1.8	30.0 ± 6.0	30.2 ± 14.6
115-5A	CaF <sub>2</sub> : Mn Bulb	Oct, 1980	Lab, End	96.6 ± 5.8	88.4 ± 8.8	90.7 ± 31.2
115-5A	CaF <sub>2</sub> : Mn Bulb	Oct, 1980	Lab, Start	77.4 ± 5.8	75.2 ± 7.6	75.8 ± 40.4
Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and the Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.						
<u>5th International Intercomparison</u>						
115-5B	LiF-100 Chips	Oct, 1980	Field	30.3 ± 4.8	30.0 ± 6.0	30.2 ± 14.6
115-5B	LiF-100 Chips	Oct, 1980	Lab, End	85.4 ± 11.7	88.4 ± 8.8	90.7 ± 31.2
115-5B	LiF-100 Chips	Oct, 1980	Lab, Start	81.1 ± 7.4	75.2 ± 7.6	75.8 ± 40.4
Fifth International Intercomparison of Environmental Dosimeters conducted in the fall of 1980 at Idaho Falls, Idaho and sponsored by the School of Public Health of the University of Texas, Houston, Texas and the Environmental Measurements Laboratory, New York, New York, U.S. Department of Energy.						
<u>6th International Intercomparison</u>						
115-6	Teledyne did not participate in the Sixth International Intercomparison of Environmental Dosimeters.					
<u>7th International Intercomparison</u>						
115-7A	LiF-100 Chips	Jun, 1984	Field	75.4 ± 2.6	75.8 ± 6.0	75.1 ± 29.8
115-7A	LiF-100 Chips	Jun, 1984	Lab, Co-60	80.0 ± 3.5	79.9 ± 4.0	77.9 ± 27.6
115-7A	LiF-100 Chips	Jun, 1984	Lab, Cs-137	66.6 ± 2.5	75.0 ± 3.8	73.0 ± 22.2

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
<u>7th International Intercomparison</u>						
115-7B	LiF-100 Chips	Jun, 1984	Field	71.5 ± 2.6	75.8 ± 6.0	75.1 ± 29.8
115-7B	LiF-100 Chips	Jun, 1984	Lab, Co-60	84.8 ± 6.4	79.9 ± 4.0	77.9 ± 27.6
115-7B	LiF-100 Chips	Jun, 1984	Lab, Cs-137	78.8 ± 1.6	75.0 ± 3.8	73.0 ± 22.2
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
<u>7th International Intercomparison</u>						
115-7C	CaSO <sub>4</sub> : Dy Cards	Jun, 1984	Field	76.8 ± 2.7	75.8 ± 6.0	75.1 ± 29.8
115-7C	CaSO <sub>4</sub> : Dy Cards	Jun, 1984	Lab, Co-60	82.5 ± 3.7	79.9 ± 4.0	77.9 ± 27.6
115-7C	CaSO <sub>4</sub> : Dy Cards	Jun, 1984	Lab, Cs-137	79.0 ± 3.2	75.0 ± 3.8	73.0 ± 22.2
Seventh International Intercomparison of Environmental Dosimeters conducted in the spring and summer of 1984 at Las Vegas, Nevada, and sponsored by the U.S. Department of Energy, The Nuclear Regulatory Commission, and the U.S. Environmental Protection Agency.						
<u>8th International Intercomparison</u>						
115-8A	LiF-100 Chips	Jan, 1986	Field, Site 1	29.5 ± 1.4	29.7 ± 1.5	28.9 ± 12.4
115-8A	LiF-100 Chips	Jan, 1986	Field, Site 2	11.3 ± 0.8	10.4 ± 0.5	10.1 ± 9.1
115-8A	LiF-100 Chips	Jan, 1986	Lab, Cs-137	13.7 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.						
<u>8th International Intercomparison</u>						
115-8B	LiF-100 Chips	Jan, 1986	Field, Site 1	32.3 ± 1.2	29.7 ± 1.5	28.9 ± 12.4
115-8B	LiF-100 Chips	Jan, 1986	Field, Site 2	9.0 ± 1.0	10.4 ± 0.5	10.1 ± 9.0
115-8B	LiF-100 Chips	Jan, 1986	Lab, Cs-137	15.8 ± 0.9	17.2 ± 0.9	16.2 ± 6.8
Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.						
<u>8th International Intercomparison</u>						
115-8C	CaSO <sub>4</sub> : Dy Cards	Jan, 1986	Field, Site 1	32.2 ± 0.7	29.7 ± 1.5	28.9 ± 12.4
115-8C	CaSO <sub>4</sub> : Dy Cards	Jan, 1986	Field, Site 2	10.6 ± 0.6	10.4 ± 0.5	10.1 ± 9.0
115-8C	CaSO <sub>4</sub> : Dy Cards	Jan, 1986	Lab, Cs-137	18.1 ± 0.8	17.2 ± 0.9	16.2 ± 6.8

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

				mR		
Lab Code	TLD Type	Date	Measurement	Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
Eighth International Intercomparison of Environmental Dosimeters conducted in the fall and winter of 1985-1986 at New York, New York, and sponsored by the U.S. Department of Energy.						
<u>9th International Intercomparison</u>						
115-9						
The Ninth International Intercomparison of Environmental Dosimeters was not available to Teledyne's Midwest Laboratory.						
<u>10th International Intercomparison</u>						
115-10A	LiF-100 Chips	Aug, 1993	Field	25.7 ± 1.4	27.0 ± 1.6	26.4 ± 10.2
115-10A	LiF-100 Chips	Aug, 1993	Lab, 1	22.7 ± 1.6	25.9 ± 1.3	25.0 ± 9.4
115-10A	LiF-100 Chips	Aug, 1993	Lab, 2	62.7 ± 2.6	72.7 ± 1.9	69.8 ± 20.3
The Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho State University and sponsored by the U.S. Department of Energy and the Idaho State University.						
<u>10th International Intercomparison</u>						
115-10B	CaSO <sub>4</sub> : Dy Cards	Aug, 1993	Field	26.0 ± 2.3	27.0 ± 1.6	26.4 ± 10.2
115-10B	CaSO <sub>4</sub> : Dy Cards	Aug, 1993	Lab, 1	24.1 ± 1.7	25.9 ± 1.3	25.0 ± 9.4
115-10B	CaSO <sub>4</sub> : Dy Cards	Aug, 1993	Lab, 2	69.2 ± 3.0	72.7 ± 1.9	69.8 ± 20.3
The Tenth International Intercomparison of Environmental Dosimeters conducted in 1993 at Idaho Stat University and sponsored by the U.S. Department of Energy and the Idaho Stat University.						
<u>Teledyne Testing</u>						
89-1	LiF-100 Chips	Sep, 1989	Lab	21.0 ± 0.4	22.4	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in September, 1989.						
<u>Teledyne Testing</u>						
89-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1989	Lab	20.9 ± 1.0	20.3	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in June, 1990.						
<u>Teledyne Testing</u>						
90-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Jun, 1990	Lab	20.6 ± 1.4	19.6	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in June, 1990.						

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR		
				Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
<u>Teledyne Testing</u>						
90-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Jun, 1990	Lab	100.8 ± 4.3	100.0	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Dosimetry Associates, Inc., Northville, MI, in October, 1990.						
<u>Teledyne Testing</u>						
91-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Oct, 1990	Lab, 1	33.4 ± 2.0	32.0	ND
91-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Oct, 1990	Lab, 2	55.2 ± 4.7	58.8	ND
91-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Oct, 1990	Lab, 3	87.8 ± 6.2	85.5	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in October, 1991.						
<u>Teledyne Testing</u>						
92-1	LiF-100 Chips	Feb, 1992	Lab, 1	11.1 ± 0.2	10.7	ND
92-1	LiF-100 Chips	Feb, 1992	Lab, 2	25.6 ± 0.5	25.4	ND
92-1	LiF-100 Chips	Feb, 1992	Lab, 3	46.4 ± 0.5	46.3	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in February, 1992.						
<u>Teledyne Testing</u>						
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 1, #1	20.1 ± 0.1	20.1	ND
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 1, #2	40.6 ± 0.1	40.0	ND
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 1, #3	60.0 ± 1.3	60.3	ND
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 2, #1	20.3 ± 0.3	20.1	ND
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 2, #2	39.2 ± 0.3	40.0	ND



Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR		
				Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
92-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Apr, 1992	Reader 2, #3	60.7 ± 0.4	60.3	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.

Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in April, 1992.

#### Teledyne Testing

93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 1	10.0 ± 1.0	10.2	ND
93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 2	25.2 ± 2.2	25.5	ND
93-1	Teledyne LiF-100 Chips	Mar, 1993	Lab, 3	42.7 ± 5.7	45.9	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.

Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1993. Due to a potential error of 10-12% when cards were irradiated, results of the testing on the cards will not be published. Data is available upon request.

#### Teledyne Testing

94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 1	15.6 ± 0.4	14.9	ND
94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 2	30.2 ± 0.4	29.8	ND
94-1	Teledyne LiF-100 Chips	Nov, 1994	Lab, 3	59.2 ± 0.3	59.7	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 1, #1	14.9 ± 0.1	14.9	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 1, #2	30.8 ± 0.1	29.8	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 1, #3	58.9 ± 0.3	59.7	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 2, #1	15.4 ± 0.2	14.9	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 2, #2	31.4 ± 0.2	29.8	ND
94-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Nov, 1994	Reader 2, #3	60.1 ± 0.3	59.7	ND

Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR		
				Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
ND = No Data; Teledyne Testing was only performed by Teledyne.						
Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in November, 1994.						
<u>Teledyne Testing</u>						
95-1	LiF-100 Chips	Mar, 1995	Lab, 1	16.1 ± 0.2	15.7	
95-1	LiF-100 Chips	Mar, 1995	Lab, 2	31.7 ± 0.1	32.3	
95-1	LiF-100 Chips	Mar, 1995	Lab, 3	59.7 ± 0.6	60.8	
95-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 1, #1	16.4 ± 0.1	15.7	ND
95-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 1, #2	34.9 ± 0.1	32.3	ND
95-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 1, #3	64.4 ± 1.5	60.8	ND
ND = No Data; Teledyne Testing was only performed by Teledyne.						
Cards and Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1995.						
<u>Teledyne Testing</u>						
95-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 2, #1	16.4 ± 0.2	15.7	ND
95-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 2, #2	33.9 ± 0.4	32.3	ND
95-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1995	Reader 2, #3	60.5 ± 0.3	60.8	ND
ND = No Data; Teledyne Testing was only performed by Teledyne.						
Cards and Chips were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1995.						
<u>Teledyne Testing</u>						
96-1	LiF-100 Chips	Mar, 1996	Lab, 1	15.9 ± 0.3	15.4	
96-1	LiF-100 Chips	Mar, 1996	Lab, 2	29.4 ± 0.3	30.8	
96-1	LiF-100 Chips	Mar, 1996	Lab, 3	62.5 ± 1.3	62.5	
96-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 1, #1	14.4 ± 0.1	15.4	ND
96-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 1, #2	31.8 ± 0.1	30.8	ND



Table A-2. Crosscheck program results; Thermoluminescent Dosimeters. (TLDs).

Lab Code	TLD Type	Date	Measurement	mR		
				Teledyne Results ± 2 Sigma	Known Value ± 2 Sigma	Average ± 2 Sigma (All Participants)
96-1	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 1, #3	64.7 ± 0.4	62.5	ND
ND = No Data; Teledyne Testing was only performed by Teledyne. Chips and Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1996.						
<u>Teledyne Testing</u>						
96-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 2, #1	14.3 ± 0.4	15.4	ND
96-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 2, #2	31.8 ± 0.1	30.8	ND
96-2	Teledyne CaSO <sub>4</sub> : Dy Cards	Mar, 1996	Reader 2, #3	68.6 ± 0.1	62.5	ND

ND = No Data; Teledyne Testing was only performed by Teledyne.  
 Chips and Cards were irradiated by Teledyne Isotopes, Inc., Westwood, New Jersey, in March, 1996.

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L <sup>a</sup>		
				Teledyne Results 2s, n=1 <sup>b</sup>	Known Activity	Control <sup>c</sup> Limits
SPCH-607	CHARCOAL CANISTER	Feb, 1996	I-131(g)	0.3 ± 0.0	0.3	0.2 - 0.4
SPAP-609	AIR FILTER	Feb, 1996	Cs-137	2.2 ± 0.0	1.9	1.1 - 2.7
SPAP-611	AIR FILTER	Feb, 1996	Gr. Beta	6.8 ± 0.0	8.0	0.0 - 18.0
SPW-621	WATER	Feb, 1996	I-131	86.2 ± 0.7	95.9	76.7 - 115.1
SPW-621	WATER	Feb, 1996	I-131(g)	96.2 ± 4.7	95.9	57.5 - 105.9
SPW-622	WATER	Feb, 1996	Gr. Alpha	96.4 ± 6.6	82.8	41.4 - 124.2
SPW-622	WATER	Feb, 1996	Gr. Beta	83.7 ± 3.3	85.7	75.7 - 95.7
SPW-623	WATER	Feb, 1996	H-3	18228.7 ± 391.3	17833.0	14266.4 - 21399.6
SPW-624	WATER	Feb, 1996	Co-60	231.0 ± 14.5	239.3	215.4 - 263.2
SPW-624	WATER	Feb, 1996	Cs-137	428.3 ± 24.1	428.3	385.5 - 471.1
SPMI-625	MILK	Feb, 1996	Cs-137	63.1 ± 3.2	53.5	43.5 - 63.5
SPMI-625	MILK	Feb, 1996	I-131	47.8 ± 0.7	48.0	36.0 - 60.0
SPMI-625	MILK	Feb, 1996	I-131(g)	48.0 ± 2.9	48.0	28.8 - 58.0
SPVE-1068	VEGETATION	Feb, 1996	I-131(g)	0.8 ± 0.0	0.8	0.5 - 1.1
SPMI-2217	MILK	Apr, 1996	Cs-134	35.4 ± 2.5	37.1	27.1 - 47.1
SPMI-2217	MILK	Apr, 1996	Cs-137	117.2 ± 5.4	106.6	95.9 - 117.3
SPW-2219	WATER	Apr, 1996	Co-60	26.0 ± 3.4	23.4	13.4 - 33.4
SPW-2219	WATER	Apr, 1996	Cs-134	36.1 ± 2.9	37.1	27.1 - 47.1
SPW-2219	WATER	Apr, 1996	Cs-137	117.1 ± 6.4	106.6	95.9 - 117.3
SPW-2221	WATER	Apr, 1996	Gr. Alpha	76.9 ± 6.1	82.8	41.4 - 124.2
SPW-2221	WATER	Apr, 1996	Gr. Beta	132.3 ± 5.0	136.8	123.1 - 150.5
SPW-2223	WATER	Apr, 1996	H-3	17538.9 ± 354.1	17937.0	14349.6 - 21524.4
SPW-2283	WATER	Apr, 1996	I-129	15.7 ± 1.4	14.9	2.9 - 26.9
SPW-2285	WATER	Apr, 1996	Fe-55	1.2 ± 0.5	1.1	0.0 - 21.1
SPW-2287	WATER	Apr, 1996	Tc-99	70.5 ± 7.9	66.0	46.2 - 85.8
SPW-2289	WATER	Apr, 1996	Am-241	77.4 ± 0.4	82.8	49.7 - 115.9
SPW-2289	WATER	Apr, 1996	Cm-244	37.9 ± 1.7	36.4	21.8 - 51.0
SPW-2291	WATER	Apr, 1996	Th-230	41.6 ± 1.9	45.0	27.0 - 63.0
SPW-2292	WATER	Apr, 1996	U-238	46.2 ± 2.0	45.4	31.8 - 59.0
SPF-3420	FISH	May, 1996	Cs-137	0.1 ± 0.0	0.1	0.1 - 0.1
SPW-3439	WATER	May, 1996	I-131	23.9 ± 0.8	25.3	13.3 - 37.3
SPMI-3441	MILK	May, 1996	I-131	23.5 ± 0.5	25.3	13.3 - 37.3
SPMI - 4054	MILK	Jun, 1996	Cs-134	28.1 ± 2.6	31.3	21.3 - 41.3
SPMI - 4054	MILK	Jun, 1996	Cs-137	47.0 ± 3.7	42.5	32.5 - 52.5
SPMI - 4054	MILK	Jun, 1996	I-131(g)	39.4 ± 3.6	40.4	24.2 - 50.4

Table A 3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L <sup>a</sup>		
				Teledyne Results 2s, n=1 <sup>b</sup>	Known Activity	Control <sup>c</sup> Limits
SPMI-4054	MILK	Jun, 1996	Cs-134	28.1 ± 2.6	31.3	21.3 - 41.3
SPMI-4054	MILK	Jun, 1996	Cs-137	47.0 ± 3.7	42.5	32.5 - 52.5
SPMI-4054	MILK	Jun, 1996	I-131	35.7 ± 0.6	40.3	28.3 - 52.3
SPMI-4054	MILK	Jun, 1996	I-131(g)	39.4 ± 3.6	40.4	24.2 - 50.4
SPW-4246	WATER	Jun, 1996	Gr. Alpha	70.0 ± 3.6	82.7	41.4 - 124.1
SPW-4246	WATER	Jun, 1996	Gr. Beta	140.5 ± 3.2	136.1	122.5 - 149.7
SPAP-4750	AIR FILTER	Jul, 1996	Cs-137	2.2 ± 0.0	1.9	1.1 - 2.7
SPW-4936	WATER	Jul, 1996	Co-60	105.7 ± 15.4	112.6	101.3 - 123.9
SPW-4936	WATER	Jul, 1996	Cs-134	127.1 ± 10.9	135.2	121.7 - 148.7
SPW-4936	WATER	Jul, 1996	Cs-137	220.2 ± 20.2	211.9	190.7 - 233.1
SPMI-4938	MILK	Jul, 1996	Cs-134	130.4 ± 11.4	135.2	121.7 - 148.7
SPMI-4938	MILK	Jul, 1996	Cs-137	229.2 ± 21.6	211.9	190.7 - 233.1
SPW-4942	WATER	Jul, 1996	Fe-55	2.0 ± 0.5	1.8	0.0 - 21.8
SPF-4996	FISH	Jul, 1996	Cs-137	0.1 ± 0.0	0.1	0.0 - 0.1
SPAP-5669	AIR FILTER	Jul, 1996	Gr. Beta	7.0 ± 0.0	7.8	0.0 - 17.8
SPW-5700	WATER	Aug, 1996	H-3	49589.0 ± 589.5	51058.0	40846.4 - 61269.6
SPMI-7384	MILK	Oct, 1996	I-131	35.0 ± 0.9	39.9	27.9 - 51.9
SPMI-7385	MILK	Oct, 1996	Cs-134	19.5 ± 2.4	21.4	11.4 - 31.4
SPMI-7385	MILK	Oct, 1996	Cs-137	26.0 ± 3.9	24.1	14.1 - 34.1
SPMI-7385	MILK	Oct, 1996	I-131(g)	117.3 ± 6.4	114.1	68.5 - 125.5
SPMI-7444	MILK	Oct, 1996	I-131	64.5 ± 14.4	79.9	63.9 - 95.8
SPW-7444	WATER	Oct, 1996	I-131(g)	82.2 ± 16.2	79.9	47.9 - 89.9
SPMI-7445	MILK	Oct, 1996	I-131	235.5 ± 2.8	199.7	159.8 - 239.6
SPW-7445	WATER	Oct, 1996	I-131(g)	190.9 ± 14.1	199.7	119.8 - 219.7
SPMI-7685	MILK	Oct, 1996	I-131	103.6 ± 1.5	114.1	91.3 - 136.9
SPAP-2	AIR FILTER	Oct, 1996	Gr. Beta	6.0 ± 0.0	6.0	0.0 - 16.0
SPSO-2478	SOIL	Oct, 1996	Cs-134	0.2 ± 0.0	0.2	0.1 - 0.2
SPSO-2478	SOIL	Oct, 1996	Cs-137	0.5 ± 0.0	0.4	0.3 - 0.6
SPCH-7473	CHARCOAL CANISTER	Oct, 1996	I-131(g)	0.4 ± 0.0	0.4	0.2 - 0.5
SPCH-7474	CHARCOAL CANISTER	Oct, 1996	I-131(g)	0.5 ± 0.0	0.5	0.3 - 0.7
SPAP-7476	AIR FILTER	Oct, 1996	Cs-137	2.1 ± 0.0	1.9	1.1 - 2.7
SPW-8734	WATER	Nov, 1996	Co-60	42.4 ± 7.2	43.0	33.0 - 53.0
SPW-8734	WATER	Nov, 1996	Cs-134	29.0 ± 6.6	30.1	20.1 - 40.1
SPW-8734	WATER	Nov, 1996	Cs-137	35.1 ± 9.5	31.5	21.5 - 41.5
SPW-8740	WATER	Nov, 1996	H-3	25383.5 ± 433.5	25075.0	20060.0 - 30090.0

Table A-3. In-house "spike" samples.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in pCi/L <sup>a</sup>		
				Teledyne Results 2s, n=1 <sup>b</sup>	Known Activity	Control <sup>c</sup> Limits

<sup>a</sup> All results are in pCi/L, except for elemental potassium (K) in milk, which are in mg/L.; air filter samples, which are in pCi/Filter; and food products, which are in mg/kg.

<sup>b</sup> All samples are the results of single determinations.

<sup>c</sup> Control limits are based on Attachment A, page A2 of this report.

NOTE: For fish, Jello is used for the spike matrix. For vegetation, Sawdust is used for the spike matrix.

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L <sup>a</sup>		
				Teledyne Results (4.66 Sigma)		Acceptance Criteria (4.66 Sigma)
				LLD	Activity <sup>b</sup>	
SPW-7	WATER	Jan 1996	Ra-226	<0.02	0.02 ± 0.13	<1.0
SPW-2	WATER	Feb 1996	Ra-226	<0.02	0.01 ± 0.02	<1.0
SPCH-608	CHARCOAL CANISTER	Feb 1996	I-131(g)	<2.7	-0.10 ± 1.63	<9.6
SPAP-610	AIR FILTER	Feb 1996	Co-60	<4.1	3.46 ± 3.39	<10.0
SPAP-610	AIR FILTER	Feb 1996	Cs-134	<3.6	-0.25 ± 2.94	<10.0
SPAP-610	AIR FILTER	Feb 1996	Cs-137	<2.4	-0.31 ± 2.53	<10.0
SPAP-612	AIR FILTER	Feb 1996	Gr. Beta	<0.4	0.32 ± 0.29	<3.2
SPW-627	WATER	Feb 1996	Co-60	<3.0	1.70 ± 1.60	<10.0
SPW-627	WATER	Feb 1996	Cs-134	<2.5	-0.36 ± 1.66	<10.0
SPW-627	WATER	Feb 1996	Cs-137	<3.2	0.33 ± 1.60	<10.0
SPW-627	WATER	Feb 1996	Gr. Alpha	<1.0	0.20 ± 0.93	<1.0
SPW-627	WATER	Feb 1996	Gr. Beta	<3.2	2.26 ± 1.76	<3.2
SPW-627	WATER	Feb 1996	I-131	<0.4	-0.21 ± 0.32	<0.5
SPW-628	WATER	Feb 1996	Co-60	<2.6	-1.38 ± 2.18	<10.0
SPW-628	WATER	Feb 1996	Cs-134	<3.1	0.95 ± 2.11	<10.0
SPW-628	WATER	Feb 1996	Cs-137	<3.8	0.55 ± 2.31	<10.0
SPW-628	WATER	Feb 1996	I-131	<0.5	-0.18 ± 0.35	<0.5
SPW-629	WATER	Feb 1996	H-3	<197	-12.47 ± 97.17	<200.0
SPMI-630	MILK	Feb 1996	Co-60	<3.5	1.26 ± 1.79	<10.0
SPMI-630	MILK	Feb 1996	Cs-134	<2.5	-0.12 ± 1.53	<10.0
SPMI-630	MILK	Feb 1996	Cs-137	<2.6	0.22 ± 1.44	<10.0
SPMI-630	MILK	Feb 1996	I-131	<0.3	-0.07 ± 0.24	<0.5
SPMI-630	MILK	Feb 1996	Sr-89	<0.9	-0.20 ± 1.27	<5.0
SPMI-630	MILK	Feb 1996	Sr-90	N/A	1.48 ± 0.40	<1.0
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPVE-1069	VEGETATION	Feb 1996	I-131(g)	<0.012	0.00 ± 0.01	<20.0
SPW-3	WATER	Mar 1996	Ra-226	<0.08	-0.00 ± 0.04	<1.0
SPW-3	WATER	Mar 1996	Ra-228	<0.9	0.47 ± 0.75	<1.0
SPW-4	WATER	Apr 1996	Ra-226	<0.06	0.09 ± 0.04	<1.0
SPMI-2218	MILK	Apr 1996	Cs-134	<4.8	2.52 ± 2.62	<10.0
SPMI-2218	MILK	Apr 1996	Cs-137	<5.4	4.42 ± 3.00	<10.0
SPW-2220	WATER	Apr 1996	Co-60	<2.9	0.95 ± 1.58	<10.0
SPW-2220	WATER	Apr 1996	Cs-134	<2.7	1.47 ± 1.64	<10.0
SPW-2220	WATER	Apr 1996	Cs-137	<1.9	-1.28 ± 1.72	<10.0
SPW-2222	WATER	Apr 1996	Gr. Alpha	<0.2	-0.21 ± 0.97	<1.0

Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L <sup>a</sup> .		
				Teledyne Results (4.66 Sigma)		Acceptance Criteria (4.66 Sigma)
				LLD	Activity <sup>b</sup>	
SPW-2222	WATER	Apr 1996	Gr. Beta	<2.8	2.26 ± 1.57	<3.2
SFW-2224	WATER	Apr 1996	H-3	<151	-101.30 ± 70.18	<200.0
SPW-2284	WATER	Apr 1996	I-129	<1.4	0.22 ± 0.84	<1.5
SPW-2286	WATER	Apr 1996	Fe-55	<0.7	-0.07 ± 0.43	<1000.0
SPW-2288	WATER	Apr 1996	Tc-99	<4.2	0.55 ± 2.29	<10.0
SPF-3421	FISH	May 1996	Co-60	<0.010	0.00 ± 0.01	<10.0
SPF-3421	FISH	May 1996	Cs-134	<0.014	-0.00 ± 0.01	<10.0
SPF-3421	FISH	May 1996	Cs-137	<0.015	0.01 ± 0.01	<10.0
SPW-3440	WATER	May 1996	I-131	<0.1	0.04 ± 0.20	<0.5
SPMI-3442	MILK	May 1996	I-131	<0.1	-0.07 ± 0.20	<0.5
SPW-6	WATER	Jun 1996	Ra-228	<1.0	0.73 ± 1.05	<1.0
SPMI-4055	MILK	Jun 1996	Co-60	<8.7	2.51 ± 4.51	<10.0
SPMI-4055	MILK	Jun 1996	Cs-134	<6.1	1.87 ± 3.37	<10.0
SPMI-4055	MILK	Jun 1996	Cs-137	<5.3	1.82 ± 11.80	<10.0
SPMI-4055	MILK	Jun 1996	I-131	<0.3	0.21 ± 0.24	<0.5
SPMI-4055	MILK	Jun 1996	Sr-89	<0.8	0.57 ± 1.83	<5.0
SPMI-4055	MILK	Jun 1996	Sr-90	N/A	1.49 ± 0.44	<1.0
Low level of Sr-90 concentration in milk (1-5 pCi/L) is not unusual.						
SPW-7	WATER	Jul 1996	Ra-228	<0.8	-0.05 ± 0.70	<1.0
SPA <sup>n</sup> -4751	AIR FILTER	Jul 1996	Co-60	<2.7	1.26 ± 1.44	<10.0
SPAP-4751	AIR FILTER	Jul 1996	Cs-134	<4.8	1.50 ± 1.80	<10.0
SPAP-4751	AIR FILTER	Jul 1996	Cs-137	<2.4	0.63 ± 1.49	<10.0
SPW-4937	WATER	Jul 1996	Co-60	<4.5	-0.25 ± 3.27	<10.0
SPW-4937	WATER	Jul 1996	Cs-134	<5.5	0.34 ± 3.39	<10.0
SPW-4937	WATER	Jul 1996	Cs-137	<5.7	-0.35 ± 3.43	<10.0
SPMI-4939	MILK	Jul 1996	Co-60	<8.0	1.13 ± 4.73	<10.0
SPMI-4939	MILK	Jul 1996	Cs-134	<7.2	1.80 ± 5.18	<10.0
SPMI-4939	MILK	Jul 1996	Cs-137	<5.8	1.04 ± 3.77	<10.0
SPW-4943	WATER	Jul 1996	Fe-55	<0.6	0.18 ± 0.35	<1000.0
SPF-4997	FISH	Jul 1996	Co-60	<0.006	0.00 ± 0.00	<10.0
SPF-4997	FISH	Jul 1996	Cs-134	<0.006	-0.00 ± 0.01	<10.0
SPF-4997	FISH	Jul 1996	Cs-137	<0.009	0.01 ± 0.01	<10.0
SPAP-5670	AIR FILTER	Jul 1996	Gr. Beta	<0.4	0.80 ± 0.32	<3.2
SPW-8	WATER	Aug 1996	Ra-226	<0.04	0.16 ± 0.03	<1.0
SPW-8	WATER	Aug 1996	Ra-228	<1.0	0.44 ± 0.79	<1.0
SPW-9	WATER	Sep 1996	Ra-226	<0.05	0.01 ± 0.03	<1.0



Table A-4. In-house "blank" samples.

Lab Code	Sample Type	Sample Date	Analysis	Concentration pCi/L <sup>a</sup> .		
				Teledyne Results (4.66 Sigma)		Acceptance Criteria (4.66 Sigma)
				LLD	Activity <sup>b</sup>	
SPW-7013	WATER	Sep 1996	Sr-89	<1.8	-0.73 ± 1.10	<5.0
SPW-7013	WATER	Sep 1996	Sr-90	<0.5	-0.05 ± 0.21	<1.0
SPW-10	WATER	Oct 1996	Ra-228	<1.0	0.80 ± 0.57	<1.0
SPMI-7382	MILK	Oct 1996	Cs-134	<3.1	-0.25 ± 2.62	<10.0
SPMI-7382	MILK	Oct 1996	Cs-137	<4.8	0.15 ± 2.68	<10.0
SPMI-7382	MILK	Oct 1996	I-131(g)	<3.7	-1.61 ± 3.28	<20.0
SPMI-7383	MILK	Oct 1996	Cs-134	<5.7	0.28 ± 3.68	<10.0
SPMI-7383	MILK	Oct 1996	Cs-137	<4.1	-1.83 ± 3.63	<10.0
SPMI-7383	MILK	Oct 1996	I-131	<0.4	0.18 ± 0.23	<0.5
SPMI-7383	MILK	Oct 1996	I-131(g)	<6.8	1.19 ± 4.08	<20.0
SPMI-7443	MILK	Oct 1996	I-131	<0.4	-0.08 ± 0.17	<0.5
SPCH-7475	CHARCOAL CANISTER	Oct 1996	I-131(g)	<2.8	-1.58 ± 12.74	<9.6
SPAP-7477	AIR FILTER	Oct 1996	Cs-137	<2.2	0.00 ± 0.00	<10.0
SPSO-7479	SOIL	Oct 1996	Cs-134	<0.011	0.00 ± 0.00	<10.0
SPSO-7479	SOIL	Oct 1996	Cs-137	<0.007	0.00 ± 0.00	<10.0
SPAP-7527	AIR FILTER	Oct 1996	Gr. Beta	<0.7	0.10 ± 0.45	<3.2
SPF-7505	FISH	Oct 1996	Co-60	<0.016	-0.00 ± 0.01	<10.0
SPF-7505	FISH	Oct 1996	Cs-134	<0.017	-0.01 ± 0.04	<10.0
SPF-7505	FISH	Oct 1996	Cs-137	<0.016	-0.00 ± 0.01	<10.0
SPW-8735	WATER	Nov 1996	Co-60	<6.0	-0.14 ± 0.10	<10.0
SPW-8735	WATER	Nov 1996	Cs-134	<4.7	-0.53 ± 7.69	<10.0
SPW-8735	WATER	Nov 1996	Cs-137	<8.2	2.09 ± 4.63	<10.0
SPW-8735	WATER	Nov 1996	Gr. Alpha	<0.3	0.15 ± 0.21	<1.0
SPW-8735	WATER	Nov 1996	Gr. Beta	<0.8	-0.41 ± 0.52	<3.2
SPW-8739	WATER	Nov 1996	H-3	<158	104.99 ± 82.93	<200.0

<sup>a</sup> Liquid sample results are reported in pCi/Liter, air filter sample results are in pCi/filter, charcoal sample results are in pCi/charcoal, and solid sample results are in pCi/kilogram.

<sup>b</sup> The activity reported is the net activity result.



Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
CF - 20, 21	Jan, 1996	Gr. Beta	7.1423 ± 0.2477	6.8880 ± 0.1339	7.0152 ± 0.1408
CF - 20, 21	Jan, 1996	K-40	3.6750 ± 0.3620	3.6536 ± 0.1270	3.6643 ± 0.1946
CF - 20, 21	Jan, 1996	Sr-89	-0.0115 ± 0.0138	0.0042 ± 0.0097	-0.0037 ± 0.0085
CF - 20, 21	Jan, 1996	Sr-90	0.0057 ± 0.0034	0.0045 ± 0.0021	0.0051 ± 0.0020
MI - 47, 48	Jan, 1996	Cs-137	-1.6700 ± 4.1200	2.7900 ± 3.3500	0.5600 ± 2.6550
MI - 47, 48	Jan, 1996	I-131	0.0511 ± 0.2159	0.0763 ± 0.2005	0.0637 ± 0.1473
LW - 103, 104	Jan, 1996	Co-60	0.2690 ± 1.6500	1.0900 ± 2.2400	0.6795 ± 1.3911
LW - 103, 104	Jan, 1996	Cs-134	0.4450 ± 1.5400	1.0400 ± 2.3800	0.7425 ± 1.4174
LW - 103, 104	Jan, 1996	Cs-137	0.6930 ± 1.5800	0.2970 ± 2.2200	0.4950 ± 1.3624
LW - 103, 104	Jan, 1996	Gr. Beta	2.2440 ± 0.5110	2.2050 ± 0.5678	2.2245 ± 0.3819
LW - 103, 104	Jan, 1996	I-131	0.0550 ± 0.2332	0.0721 ± 0.2983	0.0635 ± 0.1893
LW - 103, 104	Jan, 1996	I-131(g)	-3.9100 ± 6.2600	1.3800 ± 12.0000	-1.2650 ± 6.7673
LW - 103, 104	Jan, 1996	K-40	78.6450 ± 35.3000	99.3760 ± 48.5000	89.0105 ± 29.9931
CW - 132, 133	Jan, 1996	Gr. Beta	1.7043 ± 1.2727	-0.2699 ± 1.1417	0.7172 ± 0.8549
CW - 132, 133	Jan, 1996	Gr. Beta	5.5009 ± 1.6811	3.8880 ± 1.5639	4.6944 ± 1.1480
MI - 70, 71	Jan, 1996	Co-60	1.2400 ± 4.2600	1.6800 ± 4.0900	1.4600 ± 2.9528
MI - 70, 71	Jan, 1996	Cs-137	0.3210 ± 3.2700	2.3700 ± 3.4200	1.3455 ± 2.3659
MI - 154, 155	Jan, 1996	Co-60	1.5700 ± 2.5500	-0.4590 ± 3.2500	0.5555 ± 2.0655
MI - 154, 155	Jan, 1996	Cs-134	0.1120 ± 2.1800	-2.3100 ± 2.5900	-1.0990 ± 1.6927
MI - 154, 155	Jan, 1996	Cs-137	-0.7350 ± 2.0100	0.6920 ± 2.8500	-0.0215 ± 1.7437
MI - 154, 155	Jan, 1996	I-131	0.0429 ± 0.2521	0.0326 ± 0.2410	0.0377 ± 0.1744
MI - 154, 155	Jan, 1996	I-131(g)	1.2400 ± 3.4000	0.0793 ± 3.8500	0.6597 ± 2.5682
MI - 154, 155	Jan, 1996	K-40	1,521.1000 ± 89.3000	1,628.4000 ± 122.0000	1,574.7500 ± 75.5951
MI - 154, 155	Jan, 1996	Sr-89	-0.5282 ± 0.8162	-0.6568 ± 0.8029	-0.5925 ± 0.5724
MI - 154, 155	Jan, 1996	Sr-90	0.8201 ± 0.3348	0.9595 ± 0.3294	0.8898 ± 0.2348
WW - 180, 181	Jan, 1996	I-131	0.0000 ± 0.1940	-0.0631 ± 0.2130	-0.0315 ± 0.1440
MI - 298, 299	Jan, 1996	I-131	0.1096 ± 0.2108	0.2322 ± 0.2760	0.1709 ± 0.1737
MI - 298, 299	Jan, 1996	K-40	1,579.0000 ± 177.0000	1,551.7000 ± 168.0000	1,565.3500 ± 122.0174
CW - 355, 356	Jan, 1996	Gr. Beta	0.0868 ± 0.9590	-0.3493 ± 0.9041	-0.1312 ± 0.6590
CW - 355, 356	Jan, 1996	Gr. Beta	2.3816 ± 1.2727	2.0620 ± 1.2550	2.2218 ± 0.8937
SW - 436, 437	Jan, 1996	Co-60	0.1360 ± 1.0900	0.6880 ± 1.8700	0.4120 ± 1.0822
SW - 436, 437	Jan, 1996	Cs-137	0.0782 ± 1.2000	1.6100 ± 1.8700	0.8441 ± 1.1110
WW - 500, 501	Jan, 1996	H-3	21,035.5732 ± 418.5372	20,597.1409 ± 414.3977	20,816.3571 ± 294.4906
SWT - 554, 555	Jan, 1996	Gr. Beta	2.8534 ± 0.5402	3.1179 ± 0.5254	2.9857 ± 0.3768
SW - 841, 842	Jan, 1996	K-40	65.0260 ± 28.3000	118.9000 ± 57.7000	91.9630 ± 32.1332
SW - 479, 480	Feb, 1996	Gr. Beta	6.7187 ± 1.0111	7.8142 ± 1.3095	7.2665 ± 0.8272
MI - 521, 522	Feb, 1996	Co-60	-1.0500 ± 2.9400	0.0602 ± 5.0000	-0.4949 ± 2.9002

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
MI - 521, 522	Feb, 1996	Cs-137	-0.7930 ± 2.8100	-0.3920 ± 3.4400	-0.5925 ± 2.2209
MI - 521, 522	Feb, 1996	I-131	0.1131 ± 0.3229	0.2232 ± 0.2998	0.1682 ± 0.2203
MI - 580, 581	Feb, 1996	Co-60	-0.7660 ± 2.7300	1.7200 ± 1.4800	0.4770 ± 1.5527
MI - 580, 581	Feb, 1996	Cs-137	0.5780 ± 2.2900	0.4440 ± 1.2600	0.5110 ± 1.3069
LW - 709, 710	Feb, 1996	Gr. Alpha	0.0692 ± 0.3694	0.4866 ± 0.3667	0.2779 ± 0.2603
LW - 709, 710	Feb, 1996	Gr. Beta	1.6911 ± 0.4163	1.9519 ± 0.4187	1.8215 ± 0.2952
LW - 709, 710	Feb, 1996	H-3	37.4444 ± 74.3195	84.3897 ± 76.4083	60.9171 ± 53.2954
MI - 603, 604	Feb, 1996	I-131	-0.8566 ± 0.4141	-0.2433 ± 0.2580	-0.5499 ± 0.2440
MI - 603, 604	Feb, 1996	K-40	1,382.9000 ± 115.0000	1,335.3000 ± 175.0000	1,359.1000 ± 104.7020
WW - 648, 649	Feb, 1996	I-131	-0.0626 ± 0.2685	-0.0926 ± 0.2831	-0.0776 ± 0.1951
MI - 674, 675	Feb, 1996	I-131	-0.8334 ± 0.4012	-0.1217 ± 0.3926	-0.4776 ± 0.2807
MI - 674, 675	Feb, 1996	K-40	1,390.4000 ± 174.0000	1,493.6000 ± 166.0000	1,442.0000 ± 120.2414
WW - 865, 866	Feb, 1996	I-131	0.1291 ± 0.2170	0.0820 ± 0.2136	0.1056 ± 0.1522
PW - 932, 933	Feb, 1996	Co-60	0.5120 ± 1.4900	0.3780 ± 2.3900	0.4450 ± 1.4082
PW - 932, 933	Feb, 1996	Cs-137	0.0738 ± 1.6600	0.7260 ± 3.0400	0.3999 ± 1.7318
SW - 911, 912	Feb, 1996	Co-60	-1.7600 ± 3.3100	1.0300 ± 1.5400	-0.3650 ± 1.8254
SW - 911, 912	Feb, 1996	Cs-137	-0.2630 ± 3.6000	-0.8940 ± 1.7500	-0.5785 ± 2.0014
SWT - 953, 954	Feb, 1996	Gr. Beta	2.5439 ± 0.5217	2.2467 ± 0.5131	2.3953 ± 0.3659
LW - 1037, 1038	Feb, 1996	Gr. Beta	2.7972 ± 0.5293	3.0691 ± 0.5242	2.9331 ± 0.3725
LW - 1037, 1038	Feb, 1996	H-3	36.5277 ± 94.7223	116.7583 ± 97.9812	76.6430 ± 68.1407
CW - 977, 978	Mar, 1996	Gr. Beta	0.7188 ± 1.1771	-0.1223 ± 1.0275	0.2983 ± 0.7812
CW - 977, 978	Mar, 1996	Gr. Beta	3.9324 ± 1.5560	3.1466 ± 1.5001	3.5395 ± 1.0807
SW - 1467, 1468	Mar, 1996	H-3	130.3215 ± 81.1431	130.3215 ± 81.1431	130.3215 ± 57.3768
SW - 1467, 1468	Mar, 1996	Sr-89	-0.0970 ± 1.9887	-1.0924 ± 1.9042	-0.5947 ± 1.3767
SW - 1467, 1468	Mar, 1996	Sr-90	0.5674 ± 0.3439	0.8920 ± 0.3422	0.7297 ± 0.2426
MI - 1058, 1059	Mar, 1996	I-131	-0.3095 ± 0.4284	-0.0360 ± 0.4053	-0.1728 ± 0.2949
MI - 1058, 1059	Mar, 1996	K-40	1,500.0000 ± 157.0000	1,549.0000 ± 156.0000	1,524.5000 ± 110.6628
MI - 1058, 1059	Mar, 1996	Sr-89	0.5701 ± 0.9417	-1.5144 ± 1.2855	-0.4721 ± 0.7967
MI - 1058, 1059	Mar, 1996	Sr-90	1.5357 ± 0.3610	2.3692 ± 0.5498	1.9525 ± 0.3288
MI - 1152, 1153	Mar, 1996	I-131	0.4478 ± 0.6285	0.1991 ± 0.5613	0.3235 ± 0.4213
MI - 1152, 1153	Mar, 1996	K-40	1,524.3000 ± 157.0000	1,358.8000 ± 172.0000	1,441.5500 ± 116.4399
P - 1175, 1176	Mar, 1996	H-3	160.7848 ± 82.4671	151.8191 ± 82.0762	156.3020 ± 58.1750
LW - 1213, 1214	Mar, 1996	Gr. Beta	2.2980 ± 0.5989	2.6667 ± 0.6178	2.4823 ± 0.4302
LW - 1213, 1214	Mar, 1996	H-3	92.3600 ± 97.1490	29.4770 ± 94.5700	60.9185 ± 67.7890
SW - 1282, 1283	Mar, 1996	H-3	82.3522 ± 96.2415	36.8938 ± 94.3559	59.6230 ± 67.3896
LW - 1309, 1310	Mar, 1996	Co-60	2.9800 ± 4.7000	4.1400 ± 2.4800	3.5600 ± 2.6571
LW - 1309, 1310	Mar, 1996	Cs-134	-0.1740 ± 3.5700	2.2000 ± 4.4100	1.0130 ± 2.8369

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
LW - 1309, 1310	Mar, 1996	Cs-137	-4.7600 ± 3.9000	-1.0800 ± 4.2200	-2.9200 ± 2.8731
LW - 1309, 1310	Mar, 1996	Gr. Beta	2.5861 ± 0.5296	2.8938 ± 0.5364	2.7400 ± 0.3769
LW - 1309, 1310	Mar, 1996	I-131	0.4437 ± 0.5347	0.1485 ± 0.5179	0.2961 ± 0.3722
LW - 1309, 1310	Mar, 1996	I-131(g)	0.9870 ± 5.4900	-0.6760 ± 5.3400	0.1555 ± 3.8294
LW - 1309, 1310	Mar, 1996	K-40	104.7400 ± 51.7000	85.6000 ± 56.5000	95.1700 ± 38.2921
LW - 1362, 1363	Mar, 1996	H-3	162.9285 ± 99.8622	107.9647 ± 97.6775	135.4466 ± 69.8451
LW - 1362, 1363	Mar, 1996	Sr-89	-1.0161 ± 0.8768	0.2819 ± 1.3918	-0.3671 ± 0.8225
LW - 1362, 1363	Mar, 1996	Sr-90	0.7296 ± 0.3269	0.0477 ± 0.5074	0.3886 ± 0.3018
F - 1446, 1447	Mar, 1996	Co-60	0.0011 ± 0.0096	-0.0021 ± 0.0136	-0.0005 ± 0.0083
F - 1446, 1447	Mar, 1996	Cs-134	0.0003 ± 0.0080	0.0026 ± 0.0132	0.0015 ± 0.0077
F - 1446, 1447	Mar, 1996	Cs-137	0.0193 ± 0.0100	0.0114 ± 0.0119	0.0154 ± 0.0078
F - 1446, 1447	Mar, 1996	Gr. Beta	1.9680 ± 0.0709	1.8487 ± 0.0640	1.9084 ± 0.0478
F - 1446, 1447	Mar, 1996	I-131(g)	-0.0619 ± 0.3550	-0.6810 ± 0.5450	-0.3715 ± 0.3252
F - 1446, 1447	Mar, 1996	K-40	1.9652 ± 0.3080	2.0371 ± 0.3800	2.0012 ± 0.2446
SW - 1537, 1538	Mar, 1996	H-3	141.6453 ± 96.7270	175.2449 ± 98.0905	158.4451 ± 68.8801
LW - 1612, 1613	Mar, 1996	Co-60	3.5000 ± 3.0800	0.6920 ± 1.6200	2.0960 ± 1.7400
LW - 1612, 1613	Mar, 1996	Cs-134	1.4000 ± 2.6700	1.5800 ± 1.9600	1.4900 ± 1.6561
LW - 1612, 1613	Mar, 1996	Cs-137	4.7100 ± 3.0200	1.3100 ± 2.4100	3.0100 ± 1.9319
LW - 1612, 1613	Mar, 1996	Gr. Beta	2.6122 ± 0.5460	3.0068 ± 0.5285	2.8095 ± 0.3799
LW - 1612, 1613	Mar, 1996	I-131	0.2556 ± 0.1548	0.0982 ± 0.1470	0.1769 ± 0.1067
LW - 1612, 1613	Mar, 1996	I-131(g)	0.2750 ± 3.7100	0.7110 ± 2.8600	0.4930 ± 2.3422
LW - 1612, 1613	Mar, 1996	K-40	61.2000 ± 33.1000	98.3000 ± 31.4000	79.7500 ± 22.8121
CW - 1709, 1710	Mar, 1996	Gr. Beta	4.4929 ± 1.6917	3.5791 ± 1.6536	4.0360 ± 1.1828
CW - 1709, 1710	Mar, 1996	Gr. Beta	0.4362 ± 1.4668	0.2828 ± 1.4589	0.3595 ± 1.0344
AP - 2140, 2141	Mar, 1996	Sr-89	0.0001 ± 0.0007	-0.0002 ± 0.0007	-0.0001 ± 0.0005
AP - 2140, 2141	Mar, 1996	Sr-90	0.0000 ± 0.0002	0.0001 ± 0.0002	0.0001 ± 0.0001
WW - 1659, 1660	Mar, 1996	Co-60	0.1960 ± 3.2100	2.2100 ± 2.5200	1.2030 ± 2.0405
WW - 1659, 1660	Mar, 1996	Cs-137	-1.8700 ± 3.2800	2.2600 ± 2.4400	0.1950 ± 2.0440
WW - 1659, 1660	Mar, 1996	H-3	995.7658 ± 117.5351	1,115.3290 ± 121.1114	1,055.5474 ± 84.3838
PW - 1757, 1758	Mar, 1996	H-3	88.5534 ± 119.6998	68.8749 ± 119.0511	78.7141 ± 84.4115
AP - 2547, 2548	Mar, 1996	Co-60	0.0004 ± 0.0006	-0.0002 ± 0.0006	0.0001 ± 0.0004
AP - 2547, 2548	Mar, 1996	Cs-137	-0.0001 ± 0.0006	0.0000 ± 0.0006	-0.0000 ± 0.0004
AP - 2568, 2569	Mar, 1996	Co-60	0.0005 ± 0.0005	0.0000 ± 0.0004	0.0003 ± 0.0003
AP - 2568, 2569	Mar, 1996	Cs-137	-0.0004 ± 0.0005	-0.0002 ± 0.0004	-0.0003 ± 0.0003
MI - 1778, 1779	Apr, 1996	I-131	0.1746 ± 0.2116	0.0752 ± 0.1924	0.1249 ± 0.1430
MI - 1778, 1779	Apr, 1996	K-40	1,390.4000 ± 98.1000	1,426.0000 ± 144.0000	1,408.2000 ± 87.1200
MI - 1778, 1779	Apr, 1996	Sr-89	-3.0921 ± 2.1421	-1.3987 ± 1.9624	-2.2454 ± 1.4526

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
MI - 1778, 1779	Apr, 1996	Sr-90	2.2153 ± 0.5049	1.9830 ± 0.4425	2.0991 ± 0.3357
MI - 1799, 1800	Apr, 1996	Co-60	0.1740 ± 2.6900	1.8900 ± 4.5800	1.0320 ± 2.6558
MI - 1799, 1800	Apr, 1996	Cs-137	2.0500 ± 2.4200	1.7500 ± 3.1500	1.9000 ± 1.9861
MI - 1799, 1800	Apr, 1996	I-131	0.1298 ± 0.2421	0.1053 ± 0.2114	0.1176 ± 0.1607
MI - 1843, 1844	Apr, 1996	I-131	0.0149 ± 0.2136	0.0570 ± 0.2205	0.0359 ± 0.1535
MI - 1843, 1844	Apr, 1996	K-40	1,429.1000 ± 93.2000	1,630.3000 ± 143.0000	1,529.7000 ± 85.3452
LW - 1913, 1914	Apr, 1996	Co-60	2.2100 ± 0.7960	1.1500 ± 3.2300	1.6800 ± 1.6633
LW - 1913, 1914	Apr, 1996	Cs-134	0.4140 ± 0.8110	-0.7650 ± 3.0700	-0.1755 ± 1.5877
LW - 1913, 1914	Apr, 1996	Cs-137	0.5290 ± 0.8890	0.5070 ± 3.0900	0.5180 ± 1.6077
LW - 1913, 1914	Apr, 1996	Gr. Beta	3.0335 ± 0.5464	2.6622 ± 0.5491	2.8478 ± 0.3873
LW - 1913, 1914	Apr, 1996	I-131	0.0606 ± 0.2364	0.0603 ± 0.2573	0.0605 ± 0.1747
LW - 1913, 1914	Apr, 1996	I-131(g)	-0.2280 ± 1.7100	-1.6800 ± 5.3900	-0.9540 ± 2.8274
LW - 1913, 1914	Apr, 1996	K-40	39.4200 ± 17.4000	86.9000 ± 43.4000	63.1600 ± 23.3791
SO - 1946, 1947	Apr, 1996	Cs-137	0.1859 ± 0.0270	0.1768 ± 0.0201	0.1813 ± 0.0168
SO - 1946, 1947	Apr, 1996	K-40	10.4690 ± 0.4820	10.4630 ± 0.3570	10.4660 ± 0.2999
CW - 1991, 1992	Apr, 1996	Gr. Beta	3.8508 ± 1.6711	4.6034 ± 1.7163	4.2271 ± 1.1977
CW - 1991, 1992	Apr, 1996	Gr. Beta	-0.2825 ± 1.4171	0.2820 ± 1.4546	-0.0003 ± 1.0154
WW - 1890, 1891	Apr, 1996	Co-60	1.6200 ± 1.7500	0.1810 ± 2.2000	0.9005 ± 1.4056
WW - 1890, 1891	Apr, 1996	Cs-137	-0.5890 ± 1.6900	0.1370 ± 2.5100	-0.2260 ± 1.5130
WW - 1890, 1891	Apr, 1996	H-3	538.1625 ± 97.1244	601.3381 ± 99.3811	569.7503 ± 69.4798
WW - 2063, 2064	Apr, 1996	Gr. Beta	6.3139 ± 0.7737	6.2909 ± 0.8290	6.3024 ± 0.5670
WW - 2063, 2064	Apr, 1996	H-3	69.4957 ± 78.1213	26.7729 ± 76.2293	48.1343 ± 54.5753
MI - 2089, 2090	Apr, 1996	I-131	0.1583 ± 0.2546	0.1536 ± 0.2311	0.1559 ± 0.1719
MI - 2089, 2090	Apr, 1996	K-40	1,338.3000 ± 180.0000	1,456.5000 ± 160.0000	1,397.4000 ± 120.4159
LW - 2303, 2304	Apr, 1996	Co-60	1.9400 ± 2.9500	1.4800 ± 3.0400	1.7100 ± 2.1180
LW - 2303, 2304	Apr, 1996	Cs-137	0.8050 ± 2.7200	0.9610 ± 3.0000	0.8830 ± 2.0247
LW - 2303, 2304	Apr, 1996	Gr. Beta	3.7252 ± 1.2629	4.0921 ± 1.3004	3.9087 ± 0.9063
MI - 2418, 2419	Apr, 1996	I-131	0.1925 ± 0.4050	0.2006 ± 0.2588	0.1966 ± 0.2403
MI - 2418, 2419	Apr, 1996	K-40	1,418.9000 ± 120.0000	1,477.3000 ± 182.0000	1,448.1000 ± 109.0000
SS - 2442, 2443	Apr, 1996	Gr. Alpha	3.5711 ± 3.9146	0.3459 ± 2.7237	1.9585 ± 2.3845
SS - 2442, 2443	Apr, 1996	Gr. Beta	5.5419 ± 3.0734	8.6149 ± 3.2661	7.0784 ± 2.2424
SS - 2442, 2443	Apr, 1996	K-40	7.5398 ± 0.2470	7.8097 ± 0.2680	7.6748 ± 0.1822
SS - 2442, 2443	Apr, 1996	Sr-90	0.0110 ± 0.0097	0.0030 ± 0.0042	0.0070 ± 0.0053
SL - 2589, 2590	Apr, 1996	Cs-137	0.0527 ± 0.0297	0.0626 ± 0.0358	0.0577 ± 0.0233
SL - 2589, 2590	Apr, 1996	K-40	4.1139 ± 0.4900	3.2858 ± 0.5080	3.6999 ± 0.3529
WW - 2700, 2701	Apr, 1996	H-3	-13.8536 ± 73.4156	-31.1707 ± 72.5940	-22.5122 ± 51.6230
SW - 2675, 2676	Apr, 1996	Co-60	-1.9100 ± 1.9100	-1.1500 ± 2.8600	-1.5300 ± 1.7196



Table A-5. In-house "duplicate" samples.

Lab Codes <sup>a</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
SW - 2675, 2676	Apr, 1996	Cs-137	-1.0100 ± 2.2000	3.0100 ± 2.5900	1.0000 ± 1.6991
SW - 2503, 2504	Apr, 1996	K-40	95.8880 ± 47.8000	71.0460 ± 36.8000	83.4670 ± 30.1624
LW - 2777, 2778	Apr, 1996	Co-60	3.1300 ± 3.7000	1.8900 ± 2.7700	2.5100 ± 2.3110
LW - 2777, 2778	Apr, 1996	Cs-134	-1.0500 ± 2.5100	-1.4600 ± 2.5400	-1.2550 ± 1.7855
LW - 2777, 2778	Apr, 1996	Cs-137	0.3840 ± 3.2600	2.4900 ± 3.1300	1.4370 ± 2.2597
LW - 2777, 2778	Apr, 1996	Gr. Beta	2.7205 ± 0.6414	2.2112 ± 0.6169	2.4658 ± 0.4449
LW - 2777, 2778	Apr, 1996	I-131	0.1973 ± 0.2628	-0.1244 ± 0.4231	0.0365 ± 0.2490
LW - 2777, 2778	Apr, 1996	I-131(g)	2.0800 ± 10.3000	-1.7600 ± 11.5000	0.1600 ± 7.7191
LW - 2777, 2778	Apr, 1996	K-40	91.0650 ± 43.2000	59.7000 ± 37.0000	75.3825 ± 28.4396
F - 2612, 2613	May, 1996	Co-60	0.0020 ± 0.0070	0.0031 ± 0.0137	0.0026 ± 0.0077
F - 2612, 2613	May, 1996	Cs-137	0.0004 ± 0.0059	0.0082 ± 0.0128	0.0043 ± 0.0071
BS - 2654, 2655	May, 1996	Gr. Beta	4.6997 ± 1.7758	5.9663 ± 1.8980	5.3330 ± 1.2996
BS - 2654, 2655	May, 1996	K-40	6.4406 ± 0.4180	6.6513 ± 0.3510	6.5460 ± 0.2729
BS - 2654, 2655	May, 1996	Sr-89	0.0115 ± 0.0275	0.0076 ± 0.0247	0.0096 ± 0.0185
BS - 2654, 2655	May, 1996	Sr-90	0.0021 ± 0.0058	0.0010 ± 0.0053	0.0015 ± 0.0039
F - 2633, 2634	May, 1996	Co-60	0.0077 ± 0.0135	0.0041 ± 0.0063	0.0059 ± 0.0076
F - 2633, 2634	May, 1996	Cs-137	0.0075 ± 0.0079	0.0025 ± 0.0064	0.0050 ± 0.0051
MI - 2742, 2743	May, 1996	Co-60	-1.6100 ± 3.2100	0.2250 ± 2.7200	-0.6925 ± 2.1037
MI - 2742, 2743	May, 1996	Cs-137	0.6880 ± 2.6100	-0.5110 ± 2.3400	0.0885 ± 1.7527
MI - 2742, 2743	May, 1996	I-131	-0.0263 ± 0.2140	0.2399 ± 0.2578	0.1068 ± 0.1675
MI - 2841, 2842	May, 1996	Co-60	2.0600 ± 3.3400	0.4630 ± 3.6400	1.2615 ± 2.4701
MI - 2841, 2842	May, 1996	Cs-137	0.4460 ± 2.7600	3.3300 ± 3.4000	1.8880 ± 2.1896
MI - 2841, 2842	May, 1996	I-131	0.3926 ± 0.2720	-0.0419 ± 0.2320	0.1754 ± 0.1788
WW - 2866, 2867	May, 1996	Gr. Beta	6.8885 ± 1.3446	6.9243 ± 1.3471	6.9064 ± 0.9517
WW - 2866, 2867	May, 1996	H-3	178.3372 ± 87.5017	133.7529 ± 85.5877	156.0450 ± 61.2001
LW - 2981, 2982	May, 1996	Co-60	1.9400 ± 2.4500	0.7540 ± 1.9900	1.3470 ± 1.5782
LW - 2981, 2982	May, 1996	Cs-134	0.8040 ± 2.3500	0.1660 ± 1.9900	0.4850 ± 1.5397
LW - 2981, 2982	May, 1996	Cs-137	2.2400 ± 2.6900	-0.7880 ± 2.1600	0.7260 ± 1.7249
LW - 2981, 2982	May, 1996	Gr. Beta	3.7095 ± 0.6063	2.5867 ± 0.5678	3.1481 ± 0.4153
LW - 2981, 2982	May, 1996	I-131	-0.0178 ± 0.2116	0.0518 ± 0.2280	0.0170 ± 0.1555
LW - 2981, 2982	May, 1996	I-131(g)	1.9100 ± 8.8900	-2.9600 ± 7.2900	-0.5250 ± 5.7484
LW - 2981, 2982	May, 1996	K-40	121.0000 ± 38.6000	150.7000 ± 23.3000	135.8500 ± 22.5436
F - 2887, 2888	May, 1996	Co-60	0.0025 ± 0.0074	-0.0067 ± 0.0107	-0.0021 ± 0.0065
F - 2887, 2888	May, 1996	Cs-137	-0.0003 ± 0.0054	0.0092 ± 0.0083	0.0045 ± 0.0050
WW - 3032, 3033	May, 1996	Gr. Beta	3.5731 ± 0.8840	2.5437 ± 0.5356	3.0584 ± 0.5168
WW - 3032, 3033	May, 1996	H-3	32.0189 ± 83.8864	133.6172 ± 88.2476	82.8181 ± 60.8781
SS - 2931, 2932	May, 1996	Cs-137	0.2016 ± 0.0948	0.1473 ± 0.0352	0.1745 ± 0.0506

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
SS - 2931, 2932	May, 1996	K-40	21.4470 ± 1.7600	18.8680 ± 0.9850	20.1575 ± 1.0084
CW - 2955, 2956	May, 1996	Gr. Beta	2.6457 ± 1.5687	3.6434 ± 1.6186	3.1445 ± 1.1270
CW - 2955, 2956	May, 1996	Gr. Beta	-0.3404 ± 1.1161	-0.4374 ± 1.1068	-0.3889 ± 0.7859
MI - 3053, 3054	May, 1996	Sr-89	0.5734 ± 1.5144	-0.5940 ± 1.9757	-0.0103 ± 1.2447
MI - 3053, 3054	May, 1996	Sr-90	1.3596 ± 0.4076	1.9168 ± 0.5433	1.6382 ± 0.3396
MI - 3099, 3100	May, 1996	Co-60	0.3260 ± 2.6800	0.3250 ± 4.3100	0.3255 ± 2.5376
MI - 3099, 3100	May, 1996	Cs-137	-0.5550 ± 2.5400	-0.8250 ± 3.6300	-0.6900 ± 2.2152
MI - 3099, 3100	May, 1996	I-131	0.0000 ± 0.2849	0.1521 ± 0.2367	0.0761 ± 0.1852
F - 3251, 3252	May, 1996	K-40	2.6265 ± 0.3740	2.7477 ± 0.2620	2.6871 ± 0.2283
BS - 3230, 3231	May, 1996	Cs-137	0.5908 ± 0.0415	0.6314 ± 0.0479	0.6111 ± 0.0317
BS - 3230, 3231	May, 1996	K-40	22.4440 ± 0.8280	21.8090 ± 0.8310	22.1265 ± 0.5865
MI - 3344, 3345	May, 1996	I-131	0.1825 ± 0.2236	0.1735 ± 0.2762	0.1780 ± 0.1777
MI - 3344, 3345	May, 1996	K-40	1,611.2000 ± 190.0000	1,409.5000 ± 157.0000	1,510.3500 ± 123.2366
VE - 3381, 3382	May, 1996	Gr. Alpha	0.4453 ± 0.1729	0.4370 ± 0.1764	0.4411 ± 0.1235
VE - 3381, 3382	May, 1996	Gr. Beta	4.2583 ± 0.2415	4.0142 ± 0.2465	4.1363 ± 0.1725
VE - 3381, 3382	May, 1996	K-40	4.5676 ± 0.2820	4.1093 ± 0.3490	4.3385 ± 0.2243
SWU - 3404, 3405	May, 1996	Gr. Beta	2.5210 ± 0.5256	3.1121 ± 0.5527	2.8165 ± 0.3811
SWU - 3404, 3405	May, 1996	H-3	197.5959 ± 88.4614	188.3624 ± 88.0751	192.9792 ± 62.4152
SW - 3677, 3678	May, 1996	Co-60	0.4910 ± 2.4000	0.1600 ± 1.7800	0.3255 ± 1.4940
SW - 3677, 3678	May, 1996	Cs-137	1.1600 ± 3.4000	-0.6680 ± 2.1900	0.2460 ± 2.0221
SW - 3677, 3678	May, 1996	Gr. Beta	5.3891 ± 1.3033	6.0224 ± 1.2717	5.7057 ± 0.9105
DW - 3551, 3552	May, 1996	Gr. Beta	2.7774 ± 0.5358	1.8916 ± 0.4948	2.3345 ± 0.3647
DW - 3551, 3552	May, 1996	I-131	0.3093 ± 0.3725	0.0000 ± 0.3989	0.1547 ± 0.2729
DW - 3551, 3552	May, 1996	K-40	113.1400 ± 47.8000	131.5000 ± 74.9000	122.3200 ± 44.4265
WW - 3506, 3507	May, 1996	H-3	3.0953 ± 81.2184	-32.1916 ± 79.5882	-14.5481 ± 56.8566
PW - 3700, 3701	May, 1996	Co-60	0.8910 ± 2.2100	-0.4110 ± 3.0700	0.2400 ± 1.8914
PW - 3700, 3701	May, 1996	Cs-137	-1.6500 ± 2.5300	0.2960 ± 3.1700	-0.6770 ± 2.0279
MI - 3447, 3448	Jun, 1996	Co-60	-0.5800 ± 4.8900	-1.2600 ± 4.7500	-0.9200 ± 3.4086
MI - 3447, 3448	Jun, 1996	Cs-137	0.7550 ± 3.5900	2.6200 ± 3.9300	1.6875 ± 2.6614
MI - 3447, 3448	Jun, 1996	I-131	-0.0354 ± 0.1423	-0.0708 ± 0.2845	-0.0531 ± 0.1590
G - 3530, 3531	Jun, 1996	Gr. Beta	4.7514 ± 0.0978	4.9200 ± 0.0996	4.8357 ± 0.0698
G - 3530, 3531	Jun, 1996	K-40	4.9488 ± 0.5170	4.5401 ± 0.4480	4.7445 ± 0.3421
G - 3530, 3531	Jun, 1996	Sr-89	0.0041 ± 0.0056	-0.0006 ± 0.0057	0.0017 ± 0.0040
G - 3530, 3531	Jun, 1996	Sr-90	0.0000 ± 0.0013	0.0009 ± 0.0014	0.0005 ± 0.0009
WW - 3597, 3598	Jun, 1996	Gr. Beta	2.6521 ± 0.7188	1.6547 ± 0.6666	2.1534 ± 0.4902
WW - 3597, 3598	Jun, 1996	H-3	114.9457 ± 80.8320	107.8722 ± 80.5219	111.4089 ± 57.04
G - 3621, 3622	Jun, 1996	K-40	5.5191 ± 0.1840	5.6649 ± 0.2200	5.5920 ± 0.1434

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
MI - 3642, 3643	Jun, 1996	I-131	-0.2191 ± 0.3434	0.2403 ± 0.3137	0.0106 ± 0.2326
F - 4452, 4453	Jun, 1996	Cs-137	0.0147 ± 0.0058	0.0120 ± 0.0047	0.0133 ± 0.0037
F - 4452, 4453	Jun, 1996	Cs-137	0.0147 ± 0.0058	0.0120 ± 0.0047	0.0133 ± 0.0037
F - 4452, 4453	Jun, 1996	Gr. Beta	2.1435 ± 0.1120	2.1090 ± 0.1050	2.1262 ± 0.0767
F - 4452, 4453	Jun, 1996	Gr. Beta	2.1435 ± 0.1120	2.1090 ± 0.1050	2.1262 ± 0.0767
F - 4452, 4453	Jun, 1996	K-40	1.9188 ± 0.1070	2.0107 ± 0.1060	1.9648 ± 0.0753
F - 4452, 4453	Jun, 1996	K-40	1.9188 ± 0.1070	2.0107 ± 0.1060	1.9648 ± 0.0753
MI - 3830, 3831	Jun, 1996	I-131	0.0373 ± 0.4959	0.1570 ± 0.4625	0.0972 ± 0.3391
MI - 3830, 3831	Jun, 1996	K-40	1,544.7000 ± 111.0000	1,447.1000 ± 159.0000	1,495.9000 ± 96.9562
MI - 3773, 3774	Jun, 1996	Co-60	1.3400 ± 2.9800	2.5300 ± 3.1800	1.9350 ± 2.1790
MI - 3773, 3774	Jun, 1996	Cs-137	3.7800 ± 2.6400	-0.3320 ± 2.6000	1.7240 ± 1.8527
MI - 3773, 3774	Jun, 1996	I-131	0.1664 ± 0.3100	-0.1240 ± 0.4621	0.0212 ± 0.2782
MI - 3874, 3875	Jun, 1996	Sr-89	-2.1430 ± 1.8964	-1.3467 ± 1.9330	-1.7448 ± 1.3540
MI - 3874, 3875	Jun, 1996	Sr-90	2.3113 ± 0.5587	2.3694 ± 0.5928	2.3403 ± 0.4073
G - 3918, 3919	Jun, 1996	K-40	6.6922 ± 0.2270	7.1444 ± 0.2770	6.9183 ± 0.1791
G - 4045, 4046	Jun, 1996	K-40	4.7112 ± 0.5300	5.1352 ± 0.3330	4.9232 ± 0.3130
SWU - 4092, 4093	Jun, 1996	Gr. Beta	2.3788 ± 0.6583	1.9279 ± 0.6369	2.1533 ± 0.4580
SWU - 4092, 4093	Jun, 1996	H-3	208.0150 ± 84.7681	223.9706 ± 85.4329	215.9928 ± 60.1756
MI - 4071, 4072	Jun, 1996	I-131	-0.1101 ± 0.5660	-0.1326 ± 0.5298	-0.1214 ± 0.3876
MI - 4071, 4072	Jun, 1996	K-40	1,229.3000 ± 142.0000	1,512.1000 ± 143.0000	1,370.7000 ± 100.7633
MI - 4071, 4072	Jun, 1996	Sr-89	0.2841 ± 1.0223	-0.4201 ± 1.2371	-0.0680 ± 0.8024
MI - 4071, 4072	Jun, 1996	Sr-90	0.9516 ± 0.3157	1.2585 ± 0.3851	1.1050 ± 0.2490
WW - 4113, 4114	Jun, 1996	I-131	0.0777 ± 0.5375	0.2762 ± 0.5142	0.1770 ± 0.3719
SW - 4162, 4163	Jun, 1996	H-3	13.3915 ± 75.3848	6.2494 ± 75.0457	9.8205 ± 53.1853
PW - 4215, 4216	Jun, 1996	H-3	58.4305 ± 80.8304	104.2785 ± 79.1202	81.3545 ± 56.5543
LW - 4259, 4260	Jun, 1996	H-3	195.8174 ± 86.1367	215.2812 ± 86.9327	205.5493 ± 61.1899
PW - 4549, 4550	Jun, 1996	Co-60	-0.4630 ± 1.4000	-0.3690 ± 1.5300	-0.4160 ± 1.0369
PW - 4549, 4550	Jun, 1996	Cs-137	-1.1200 ± 1.7200	-0.6960 ± 1.9900	-0.9080 ± 1.3152
SW - 4406, 4407	Jun, 1996	Co-60	-0.9280 ± 1.9500	-0.2850 ± 2.6100	-0.6065 ± 1.6290
SW - 4406, 4407	Jun, 1996	Cs-137	-0.3900 ± 2.4300	2.5700 ± 2.9300	1.0900 ± 1.9033
E - 4284, 4285	Jul, 1996	Gr. Beta	1.0430 ± 0.0595	1.1245 ± 0.0648	1.0837 ± 0.0440
E - 4284, 4285	Jul, 1996	K-40	1.1372 ± 0.1830	1.1588 ± 0.1160	1.1480 ± 0.1083
E - 4284, 4285	Jul, 1996	Sr-89	0.0019 ± 0.0044	0.0016 ± 0.0045	0.0017 ± 0.0032
E - 4284, 4285	Jul, 1996	Sr-90	-0.0001 ± 0.0011	0.0003 ± 0.0010	0.0001 ± 0.0007
WW - 4305, 4306	Jul, 1996	Gr. Beta	1.1828 ± 0.3499	1.2369 ± 0.3447	1.2098 ± 0.2456
MI - 4326, 4327	Jul, 1996	Co-60	-0.1700 ± 2.9800	-1.0600 ± 3.4400	-0.6150 ± 2.2756
MI - 4326, 4327	Jul, 1996	Cs-137	-0.0644 ± 2.6300	2.0100 ± 2.9700	0.9728 ± 1.9835



Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
P - 4431, 4432	Jul, 1996	H-3	24.8404 ± 71.8799	110.9537 ± 75.7439	67.8970 ± 52.2108
AP - 4595, 4596	Jul, 1996	Sr-89	0.0015 ± 0.0029	-0.0022 ± 0.0030	-0.0004 ± 0.0021
AP - 4595, 4596	Jul, 1996	Sr-90	0.0008 ± 0.0006	0.0002 ± 0.0007	0.0005 ± 0.0004
WW - 4375, 4376	Jul, 1996	Co-60	1.3000 ± 2.1300	1.1800 ± 2.4300	1.2400 ± 1.6157
WW - 4375, 4376	Jul, 1996	Cs-137	1.1100 ± 2.2700	1.0200 ± 2.8700	1.0650 ± 1.8296
WW - 4375, 4376	Jul, 1996	H-3	-30.7552 ± 76.9153	-25.4322 ± 77.1605	-28.0937 ± 54.4741
MI - 4503, 4504	Jul, 1996	I-131	-0.0390 ± 0.2814	0.1693 ± 0.2869	0.0652 ± 0.2009
MI - 4503, 4504	Jul, 1996	K-40	1,287.1000 ± 161.0000	1,188.3000 ± 136.0000	1,237.7000 ± 105.3767
MI - 4503, 4504	Jul, 1996	Sr-89	-1.4974 ± 0.9605	-1.7702 ± 1.2061	-1.6338 ± 0.7709
MI - 4503, 4504	Jul, 1996	Sr-90	1.5658 ± 0.5270	2.4509 ± 0.5124	2.0084 ± 0.3675
MI - 4527, 4528	Jul, 1996	Co-60	2.3600 ± 2.5400	-1.2100 ± 2.6300	0.5750 ± 1.8281
MI - 4527, 4528	Jul, 1996	Cs-134	0.7910 ± 1.9100	1.9000 ± 2.5500	1.3455 ± 1.5930
MI - 4527, 4528	Jul, 1996	Cs-137	-0.6890 ± 2.0300	0.0613 ± 2.2900	-0.3139 ± 1.5301
MI - 4527, 4528	Jul, 1996	I-131	0.1910 ± 0.4532	0.0901 ± 0.4519	0.1406 ± 0.3200
MI - 4527, 4528	Jul, 1996	I-131(g)	-0.0570 ± 2.8300	0.1290 ± 3.5800	0.0360 ± 2.2817
MI - 4527, 4528	Jul, 1996	K-40	1,419.1000 ± 91.3000	1,408.6000 ± 107.0000	1,413.8500 ± 70.3290
MI - 4527, 4528	Jul, 1996	Sr-89	-0.3720 ± 1.0231	-1.4605 ± 1.1500	-0.9162 ± 0.7697
MI - 4527, 4528	Jul, 1996	Sr-90	1.0524 ± 0.2303	1.3388 ± 0.2716	1.1956 ± 0.1780
WW - 4684, 4685	Jul, 1996	H-3	-30.7174 ± 76.8208	-12.9958 ± 77.6342	-21.8566 ± 54.6088
WW - 4808, 4809	Jul, 1996	Gr. Beta	0.9983 ± 1.2558	0.8849 ± 1.2477	0.9416 ± 0.8852
WW - 4808, 4809	Jul, 1996	H-3	-15.0491 ± 82.3946	-30.4456 ± 72.7801	-22.7473 ± 54.9677
G - 4762, 4763	Jul, 1996	K-40	6.9707 ± 0.3420	7.2772 ± 0.2280	7.1240 ± 0.2055
LW - 4832, 4833	Jul, 1996	Co-60	-1.1600 ± 1.6700	1.1600 ± 1.8600	0.0000 ± 1.2498
LW - 4832, 4833	Jul, 1996	Cs-137	1.0200 ± 1.6300	1.6900 ± 2.2400	1.3550 ± 1.3851
LW - 4832, 4833	Jul, 1996	Gr. Beta	3.4602 ± 0.7027	3.3545 ± 0.6948	3.4074 ± 0.4941
LW - 4832, 4833	Jul, 1996	Gr. Beta	3.4602 ± 0.7027	3.3545 ± 0.6948	3.4074 ± 0.4941
LW - 5014, 5015	Jul, 1996	Gr. Beta	2.0107 ± 0.6109	2.0288 ± 0.6093	2.0197 ± 0.4314
F - 5515, 5516	Jul, 1996	Cs-137	0.0534 ± 0.0171	0.0522 ± 0.0182	0.0528 ± 0.0125
F - 5515, 5516	Jul, 1996	Gr. Beta	2.5113 ± 0.0911	2.4617 ± 0.0908	2.4865 ± 0.0643
F - 5515, 5516	Jul, 1996	K-40	2.4049 ± 0.2870	2.6688 ± 0.3560	2.5369 ± 0.2286
CW - 4956, 4957	Jul, 1996	Gr. Beta	2.1830 ± 1.4513	3.9669 ± 1.5535	3.0749 ± 1.0630
CW - 4956, 4957	Jul, 1996	Gr. Beta	0.5827 ± 1.2131	0.2749 ± 0.8554	0.4288 ± 0.7422
SW - 5248, 5249	Jul, 1996	Co-60	-1.0000 ± 1.9100	0.1870 ± 1.8700	-0.4065 ± 1.3365
SW - 5248, 5249	Jul, 1996	Cs-137	0.7590 ± 2.2800	-0.5680 ± 2.4400	0.0955 ± 1.6697
WW - 5215, 5216	Jul, 1996	H-3	183.4121 ± 90.9893	317.9144 ± 96.0148	250.6632 ± 66.1398
MI - 5081, 5082	Jul, 1996	Co-60	1.1900 ± 3.0700	-1.7100 ± 4.1800	-0.2600 ± 2.5931
MI - 5081, 5082	Jul, 1996	Cs-137	0.4920 ± 2.6000	-2.8800 ± 3.3400	-1.1940 ± 2.1160

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
MI - 5081, 5082	Jul, 1996	I-131	0.1808 ± 0.5572	0.5417 ± 0.6704	0.3613 ± 0.4359
MI - 5081, 5082	Jul, 1996	I-131	0.1808 ± 0.5572	0.3699 ± 0.6986	0.2754 ± 0.4468
SWU - 5125, 5126	Jul, 1996	Gr. Beta	4.1217 ± 2.0543	5.5300 ± 2.3022	4.8258 ± 1.5427
SWU - 5125, 5126	Jul, 1996	H-3	176.3979 ± 90.7067	125.7490 ± 88.7348	151.0734 ± 63.4460
VE - 5146, 5147	Jul, 1996	Gr. Beta	3.1394 ± 0.1026	3.0940 ± 0.0683	3.1167 ± 0.0616
VE - 5146, 5147	Jul, 1996	K-40	3.3818 ± 0.1400	3.4692 ± 0.1430	3.4255 ± 0.1001
DW - 5269, 5. 70	Jul, 1996	Gr. Beta	6.4711 ± 1.3831	5.9871 ± 1.2673	6.2291 ± 0.9379
DW - 5269, 5270	Jul, 1996	I-131	0.2126 ± 0.3519	0.0404 ± 0.3202	0.1265 ± 0.2379
MI - 5168, 5169	Aug, 1996	I-131	-0.0474 ± 0.4432	-0.6129 ± 0.5327	-0.3302 ± 0.3465
MI - 5168, 5169	Aug, 1996	K-40	1,585.8000 ± 123.0000	1,534.4000 ± 162.0000	1,560.1000 ± 101.7018
MI - 5289, 5290	Aug, 1996	I-131	-0.0550 ± 0.5085	-0.3445 ± 0.5937	-0.1998 ± 0.3909
MI - 5190, 5191	Aug, 1996	Co-60	-1.6400 ± 2.7500	-0.1890 ± 4.0300	-0.9145 ± 2.4394
MI - 5190, 5191	Aug, 1996	Cs-137	0.1550 ± 3.1400	0.6150 ± 3.3900	0.3850 ± 2.3104
MI - 5190, 5191	Aug, 1996	I-131	0.2155 ± 0.4940	0.4414 ± 0.4691	0.3285 ± 0.3406
SL - 5424, 5425	Aug, 1996	Co-60	0.0012 ± 0.0107	0.0083 ± 0.0085	0.0047 ± 0.0068
SL - 5424, 5425	Aug, 1996	Cs-134	0.0089 ± 0.0094	0.0054 ± 0.0084	0.0071 ± 0.0063
SL - 5424, 5425	Aug, 1996	Cs-137	0.0328 ± 0.0171	0.0365 ± 0.0149	0.0347 ± 0.0113
SL - 5424, 5425	Aug, 1996	I-131(g)	0.0005 ± 0.0304	-0.0166 ± 0.0275	-0.0081 ± 0.0205
SL - 5424, 5425	Aug, 1996	K-40	1.5677 ± 0.2530	1.6391 ± 0.2110	1.6034 ± 0.1647
MI - 5386, 5387	Aug, 1996	Co-60	0.7970 ± 3.1900	-3.4000 ± 4.8300	-1.3015 ± 2.8942
MI - 5386, 5387	Aug, 1996	Cs-137	1.1400 ± 2.6400	1.7500 ± 3.4900	1.4450 ± 2.1880
MI - 5386, 5387	Aug, 1996	I-131	0.0065 ± 0.1987	-0.0211 ± 0.2171	-0.0073 ± 0.1472
MI - 5386, 5387	Aug, 1996	I-131	0.0065 ± 0.1987	-0.0271 ± 0.2797	-0.0103 ± 0.1716
SWU - 5905, 5906	Aug, 1996	Gr. Beta	1.4815 ± 0.6624	2.4356 ± 0.5278	1.9586 ± 0.4235
SWU - 5905, 5906	Aug, 1996	H-3	257.1759 ± 84.2902	306.5672 ± 86.2631	281.8715 ± 60.3037
MI - 5582, 5583	Aug, 1996	I-131	0.2361 ± 0.5705	-0.0245 ± 0.5563	0.1058 ± 0.3984
MI - 5582, 5583	Aug, 1996	K-40	1,473.6000 ± 180.0000	1,459.0000 ± 152.0000	1,466.3000 ± 117.7964
LW - 5606, 5607	Aug, 1996	Co-60	0.7330 ± 1.8200	-0.8030 ± 1.5400	-0.0350 ± 1.1921
LW - 5606, 5607	Aug, 1996	Cs-137	0.4970 ± 1.8900	-0.8750 ± 2.5900	-0.1890 ± 1.6031
LW - 5606, 5607	Aug, 1996	Gr. Beta	5.4236 ± 1.2712	5.3355 ± 1.2524	5.3795 ± 0.8923
SL - 5667, 5668	Aug, 1996	Cs-137	0.0316 ± 0.0139	0.0289 ± 0.0152	0.0303 ± 0.0103
SL - 5667, 5668	Aug, 1996	K-40	2.4446 ± 0.2910	2.6982 ± 0.2670	2.5714 ± 0.1975
CW - 5759, 5760	Aug, 1996	Gr. Beta	3.7309 ± 1.4739	4.5529 ± 1.5367	4.1419 ± 1.0646
CW - 5759, 5760	Aug, 1996	Gr. Beta	0.6563 ± 1.1139	0.6561 ± 1.1136	0.6562 ± 0.7876
MI - 5817, 5818	Aug, 1996	Co-60	-4.3400 ± 4.6000	3.7100 ± 4.8200	-0.3150 ± 3.3314
MI - 5817, 5818	Aug, 1996	Cs-137	-0.6750 ± 4.2000	1.3900 ± 3.5700	0.3575 ± 2.7561
MI - 5817, 5818	Aug, 1996	I-131	0.0287 ± 0.0732	0.0522 ± 0.0769	0.0405 ± 0.0531

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
SWT - 5884, 5885	Aug, 1996	Gr. Beta	2.7135 ± 0.7709	2.8640 ± 0.7248	2.7888 ± 0.5290
SW - 5925, 5926	Aug, 1996	Gr. Beta	3.5571 ± 0.6476	3.7970 ± 0.9008	3.6770 ± 0.5547
MI - 5978, 5979	Aug, 1996	I-131	-0.1138 ± 0.5079	0.3728 ± 0.4119	0.1295 ± 0.3270
MI - 5978, 5979	Aug, 1996	K-40	1,468.4000 ± 179.0000	1,560.8000 ± 173.0000	1,514.6000 ± 124.4689
VE - 5950, 5951	Aug, 1996	Co-60	0.0006 ± 0.0062	0.0028 ± 0.0058	0.0017 ± 0.0043
VE - 5950, 5951	Aug, 1996	Cs-137	-0.0006 ± 0.0048	0.0003 ± 0.0047	-0.0002 ± 0.0034
VE - 6031, 6032	Sep, 1996	Gr. Beta	2.9014 ± 0.0919	2.7239 ± 0.1833	2.8126 ± 0.1025
VE - 6031, 6032	Sep, 1996	K-40	3.2199 ± 0.1950	3.3724 ± 0.3060	3.2962 ± 0.1814
VE - 6031, 6032	Sep, 1996	Sr-89	0.0018 ± 0.0024	-0.0004 ± 0.0021	0.0007 ± 0.0016
VE - 6031, 6032	Sep, 1996	Sr-90	0.0002 ± 0.0007	0.0009 ± 0.0005	0.0006 ± 0.0005
LW - 6052, 6053	Sep, 1996	Co-60	0.9250 ± 1.0500	-0.5060 ± 1.5400	0.2095 ± 0.9319
LW - 6052, 6053	Sep, 1996	Cs-134	0.3430 ± 1.3200	0.8910 ± 2.3000	0.6170 ± 1.3259
LW - 6052, 6053	Sep, 1996	Cs-137	0.0211 ± 1.2900	-0.1280 ± 1.8600	-0.0535 ± 1.1318
LW - 6052, 6053	Sep, 1996	Gr. Beta	2.1334 ± 0.7031	3.0766 ± 0.5583	2.6050 ± 0.4489
LW - 6052, 6053	Sep, 1996	I-131	-0.4089 ± 0.3821	0.0180 ± 0.3249	-0.1955 ± 0.2506
LW - 6052, 6053	Sep, 1996	I-131(g)	1.2200 ± 6.0300	1.7000 ± 10.1000	1.4600 ± 5.8816
LW - 6052, 6053	Sep, 1996	K-40	66.8250 ± 30.1000	43.6000 ± 27.1000	55.2125 ± 20.2517
WW - 6181, 6182	Sep, 1996	Gr. Beta	1.6248 ± 0.6211	1.0281 ± 0.6056	1.3264 ± 0.4337
WW - 6181, 6182	Sep, 1996	H-3	5.3932 ± 82.7475	62.9204 ± 85.2105	34.1568 ± 59.3885
MI - 6006, 6007	Sep, 1996	I-131	0.0780 ± 0.3076	0.0130 ± 0.3110	0.0455 ± 0.2187
MI - 6006, 6007	Sep, 1996	K-40	1,472.0000 ± 166.0000	1,502.9000 ± 110.0000	1,487.4500 ± 99.5691
CW - 6128, 6129	Sep, 1996	Gr. Beta	4.6340 ± 1.6130	4.5894 ± 1.6139	4.6117 ± 1.1409
CW - 6128, 6129	Sep, 1996	Gr. Beta	4.6340 ± 1.6130	4.5894 ± 1.6139	4.6117 ± 1.1409
CW - 6128, 6129	Sep, 1996	Gr. Beta	0.2285 ± 1.1265	0.3197 ± 1.1117	0.2741 ± 0.7913
SW - 6204, 6205	Sep, 1996	H-3	113.2802 ± 85.3728	61.4098 ± 83.1710	87.3450 ± 59.5943
MI - 6225, 6226	Sep, 1996	Co-60	1.9300 ± 2.8500	-0.5880 ± 2.5900	0.6710 ± 1.9255
MI - 6225, 6226	Sep, 1996	Cs-137	2.7700 ± 2.7200	-0.2550 ± 2.4700	1.2575 ± 1.8371
MI - 6225, 6226	Sep, 1996	I-131	-0.2584 ± 0.4450	0.2718 ± 0.3680	0.0067 ± 0.2887
VE - 6270, 6271	Sep, 1996	K-40	2.2202 ± 0.2730	2.0725 ± 0.2780	2.1464 ± 0.1948
WW - 6331, 6332	Sep, 1996	H-3	16,801.2285 ± 999.6339	17,111.8829 ± 1,006.0494	16,956.5557 ± 709.1198
CW - 6294, 6295	Sep, 1996	Gr. Beta	4.7742 ± 1.1613	3.9486 ± 1.6377	4.3614 ± 1.0038
CW - 6294, 6295	Sep, 1996	Gr. Beta	1.0482 ± 1.2275	-0.3383 ± 1.0818	0.3550 ± 0.8181
VE - 6379, 6380	Sep, 1996	K-40	1.7000 ± 0.2860	1.8440 ± 0.1800	1.7720 ± 0.1690
VE - 6379, 6380	Sep, 1996	Sr-89	-0.0018 ± 0.0018	-0.0009 ± 0.0014	-0.0013 ± 0.0012
VE - 6379, 6380	Sep, 1996	Sr-90	0.0012 ± 0.0006	0.0005 ± 0.0005	0.0008 ± 0.0004
CW - 6432, 6433	Sep, 1996	Gr. Beta	3.1975 ± 1.5496	3.2345 ± 1.4740	3.2160 ± 1.0694
VE - 6481, 6482	Sep, 1996	Gr. Beta	2.8412 ± 0.0780	2.8390 ± 0.0736	2.8401 ± 0.0536

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
VE - 6481, 6482	Sep, 1996	K-40	3.3857 ± 0.2370	3.5694 ± 0.1540	3.4776 ± 0.1413
SW - 6524, 6525	Sep, 1996	H-3	223.5203 ± 90.7888	151.2226 ± 87.8631	187.3714 ± 63.1715
SWT - 6545, 6546	Sep, 1996	Gr. Beta	2.7317 ± 0.5235	2.1160 ± 0.4971	2.4238 ± 0.3610
AP - 7220, 7221	Sep, 1996	Co-60	0.0006 ± 0.0007	0.0001 ± 0.0011	0.0003 ± 0.0006
AP - 7220, 7221	Sep, 1996	Cs-134	-0.0001 ± 0.0006	0.0001 ± 0.0007	-0.0000 ± 0.0004
AP - 7220, 7221	Sep, 1996	Cs-137	-0.0002 ± 0.0006	0.0009 ± 0.0008	0.0004 ± 0.0005
AP - 7220, 7221	Sep, 1996	I-131(g)	0.0013 ± 0.0041	0.0004 ± 0.0063	0.0008 ± 0.0038
AP - 7220, 7221	Sep, 1996	K-40	0.0193 ± 0.0100	0.0297 ± 0.0160	0.0245 ± 0.0094
DW - 6572, 6573	Sep, 1996	Gr. Alpha	1.0283 ± 0.6412	0.2799 ± 0.3100	0.6541 ± 0.3561
DW - 6572, 6573	Sep, 1996	Gr. Beta	2.8779 ± 0.8307	2.4510 ± 0.2702	2.6645 ± 0.4368
SW - 6593, 6594	Sep, 1996	H-3	58.2259 ± 80.0303	89.9855 ± 81.4187	74.1057 ± 57.0830
CW - 6616, 6617	Sep, 1996	Gr. Beta	3.1242 ± 1.6295	4.9871 ± 1.7193	4.0556 ± 1.1844
CW - 6616, 6617	Sep, 1996	Gr. Beta	0.2660 ± 1.0617	-0.2956 ± 1.0299	-0.0148 ± 0.7396
PW - 6675, 6676	Sep, 1996	H-3	21.6674 ± 80.1010	88.4752 ± 83.0584	55.0713 ± 57.6950
AP - 7537, 7538	Sep, 1996	Co-60	0.0003 ± 0.0005	-0.0000 ± 0.0007	0.0001 ± 0.0005
AP - 7537, 7538	Sep, 1996	Cs-137	0.0002 ± 0.0004	0.0002 ± 0.0007	0.0002 ± 0.0004
VE - 6654, 6655	Sep, 1996	Co-60	-0.0057 ± 0.0156	0.0022 ± 0.0147	-0.0018 ± 0.0107
VE - 6654, 6655	Sep, 1996	Cs-137	0.0128 ± 0.0133	0.0131 ± 0.0110	0.0130 ± 0.0086
CW - 6719, 6720	Sep, 1996	Gr. Beta	2.9910 ± 1.4044	2.1008 ± 1.5104	2.5459 ± 1.0312
CW - 6719, 6720	Sep, 1996	Gr. Beta	-0.3107 ± 1.0842	1.1119 ± 1.1700	0.4006 ± 0.7976
AP - 7558, 7559	Sep, 1996	Co-60	0.0003 ± 0.0004	0.0008 ± 0.0007	0.0006 ± 0.0004
AP - 7558, 7559	Sep, 1996	Co-60	0.0003 ± 0.0004	0.0008 ± 0.0007	0.0006 ± 0.0004
AP - 7558, 7559	Sep, 1996	Cs-137	-0.0001 ± 0.0004	0.0002 ± 0.0007	0.0001 ± 0.0004
AP - 7558, 7559	Sep, 1996	Cs-137	-0.0001 ± 0.0004	0.0002 ± 0.0007	0.0001 ± 0.0004
WW - 6696, 6697	Sep, 1996	H-3	313.7207 ± 98.9677	302.7129 ± 98.5588	308.2168 ± 69.8363
LW - 7118, 7119	Sep, 1996	Gr. Alpha	0.0448 ± 0.4053	-0.1825 ± 0.3885	-0.0688 ± 0.2807
LW - 7118, 7119	Sep, 1996	Gr. Beta	2.0623 ± 0.4378	1.5831 ± 0.5835	1.8227 ± 0.3647
LW - 7118, 7119	Sep, 1996	H-3	89.2546 ± 81.1237	92.8011 ± 81.2786	91.0279 ± 57.4179
E - 6783, 6784	Oct, 1996	Gr. Beta	0.9337 ± 0.0331	0.9578 ± 0.0317	0.9457 ± 0.0229
E - 6783, 6784	Oct, 1996	K-40	0.8969 ± 0.1320	1.1090 ± 0.1530	1.0029 ± 0.1010
E - 6783, 6784	Oct, 1996	Sr-89	-0.0002 ± 0.0032	-0.0009 ± 0.0029	-0.0006 ± 0.0022
E - 6783, 6784	Oct, 1996	Sr-90	0.0005 ± 0.0013	0.0005 ± 0.0012	0.0005 ± 0.0009
SW - 6877, 6878	Oct, 1996	H-3	1,223.4684 ± 119.5914	1,320.2432 ± 122.4059	1,271.8558 ± 85.5647
AP - 7199, 7200	Oct, 1996	Sr-89	-0.0006 ± 0.0015	0.0005 ± 0.0020	-0.0001 ± 0.0013
AP - 7199, 7200	Oct, 1996	Sr-90	0.0004 ± 0.0006	0.0006 ± 0.0008	0.0005 ± 0.0005
MI - 6746, 6747	Oct, 1996	I-131	-0.0925 ± 0.2640	0.1078 ± 0.2514	0.0077 ± 0.1823
MI - 6746, 6747	Oct, 1996	K-40	1,427.9000 ± 180.0000	1,425.3000 ± 208.0000	1,426.6000 ± 137.5354



Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
F - 6824, 6825	Oct, 1996	Co-60	0.0164 ± 0.0108	0.0030 ± 0.0057	0.0097 ± 0.0061
F - 6824, 6825	Oct, 1996	Cs-137	0.0087 ± 0.0073	0.0039 ± 0.0051	0.0063 ± 0.0044
WW - 6926, 6927	Oct, 1996	Co-60	0.8880 ± 1.3900	-0.4140 ± 2.7800	0.2370 ± 1.5541
WW - 6926, 6927	Oct, 1996	Cs-137	1.2900 ± 1.5000	1.8300 ± 3.2300	1.5600 ± 1.7807
WW - 6926, 6927	Oct, 1996	H-3	7.0861 ± 78.2685	-3.5430 ± 77.7859	1.7715 ± 55.1738
G - 7001, 7002	Oct, 1996	Co-60	0.0072 ± 0.0247	0.0046 ± 0.0099	0.0059 ± 0.0133
G - 7001, 7002	Oct, 1996	Cs-134	0.0101 ± 0.0188	0.0043 ± 0.0099	0.0072 ± 0.0106
G - 7001, 7002	Oct, 1996	Cs-137	-0.0068 ± 0.0204	-0.0042 ± 0.0093	-0.0055 ± 0.0112
G - 7001, 7002	Oct, 1996	Gr. Beta	5.2080 ± 0.2600	5.1980 ± 0.2600	5.2030 ± 0.1838
G - 7001, 7002	Oct, 1996	I-131(g)	-0.0137 ± 0.0372	0.0141 ± 0.0183	0.0002 ± 0.0207
G - 7001, 7002	Oct, 1996	K-40	6.1948 ± 0.7170	5.5229 ± 0.4170	5.8589 ± 0.4147
SS - 7024, 7025	Oct, 1996	Cs-137	0.0141 ± 0.0132	0.0248 ± 0.0125	0.0195 ± 0.0091
SS - 7024, 7025	Oct, 1996	Gr. Beta	7.6523 ± 2.0292	6.4672 ± 1.8437	7.0597 ± 1.3708
SS - 7024, 7025	Oct, 1996	K-40	7.1780 ± 0.5510	6.9053 ± 0.4040	7.0417 ± 0.3416
LW - 7045, 7046	Oct, 1996	Co-60	1.6200 ± 3.1100	-0.7530 ± 2.9100	0.4335 ± 2.1296
LW - 7045, 7046	Oct, 1996	Cs-134	-0.0246 ± 3.0400	-1.9300 ± 3.0500	-0.9773 ± 2.1531
LW - 7045, 7046	Oct, 1996	Cs-137	-0.9830 ± 2.8500	1.9300 ± 2.9700	0.4735 ± 2.0581
LW - 7045, 7046	Oct, 1996	Gr. Beta	2.8219 ± 0.7438	2.8922 ± 0.5347	2.8571 ± 0.4580
LW - 7045, 7046	Oct, 1996	I-131	0.2410 ± 0.3690	-0.2043 ± 0.4541	0.0184 ± 0.2926
LW - 7045, 7046	Oct, 1996	I-131(g)	-5.1500 ± 29.9000	5.8000 ± 27.7000	0.3250 ± 20.3795
LW - 7045, 7046	Oct, 1996	K-40	51.3000 ± 37.9000	34.5000 ± 33.8000	42.9000 ± 25.3912
F - 6952, 6953	Oct, 1996	K-40	2.7927 ± 0.1670	2.7243 ± 0.1020	2.7585 ± 0.0978
MI - 6853, 6854	Oct, 1996	Co-60	-0.7610 ± 4.7900	1.8000 ± 2.8100	0.5195 ± 2.7767
MI - 6853, 6854	Oct, 1996	Cs-137	1.5500 ± 3.5900	-0.8890 ± 2.4000	0.3305 ± 2.1592
MI - 6853, 6854	Oct, 1996	I-131	-0.1047 ± 0.2745	0.2027 ± 0.2586	0.0490 ± 0.1886
MI - 6854, 6855	Oct, 1996	Co-60	1.8000 ± 2.8100	0.4510 ± 4.9000	1.1255 ± 2.8243
MI - 6854, 6855	Oct, 1996	Co-60	1.8000 ± 2.8100	0.4510 ± 4.9000	1.1255 ± 2.8243
MI - 6854, 6855	Oct, 1996	Cs-137	-0.8890 ± 2.4000	1.5900 ± 3.2700	0.3505 ± 2.0281
MI - 6854, 6855	Oct, 1996	Cs-137	-0.8890 ± 2.4000	1.5900 ± 3.2700	0.3505 ± 2.0281
MI - 6854, 6855	Oct, 1996	I-131	0.0490 ± 0.1886	-0.1840 ± 0.2910	-0.0675 ± 0.1734
MI - 6854, 6855	Oct, 1996	I-131	0.2000 ± 0.2600	-0.1837 ± 0.2904	0.0082 ± 0.1949
MI - 6854, 6855	Oct, 1996	I-131	0.2027 ± 0.2586	-0.1840 ± 0.2910	0.0094 ± 0.1946
BS - 7138, 7139	Oct, 1996	Gr. Beta	9.5648 ± 2.4583	7.9345 ± 2.3466	8.7497 ± 1.6993
BS - 7138, 7139	Oct, 1996	K-40	7.2366 ± 0.4030	7.1729 ± 0.5230	7.2048 ± 0.3301
SO - 7306, 7307	Oct, 1996	Cs-137	0.2375 ± 0.0250	0.2243 ± 0.0437	0.2309 ± 0.0252
SO - 7306, 7307	Oct, 1996	K-40	9.4591 ± 0.4680	9.4848 ± 0.7300	9.4720 ± 0.4337
BO - 7747, 7748	Oct, 1996	Gr. Beta	1.6819 ± 0.3193	1.4542 ± 0.3070	1.5681 ± 0.2215

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
BO - 7747, 7748	Oct, 1996	K-40	0.7271 ± 0.1770	0.5964 ± 0.1430	0.6617 ± 0.1138
F - 7328, 7329	Oct, 1996	K-40	2.0975 ± 0.4500	1.7161 ± 0.3850	1.9068 ± 0.2961
MI - 7285, 7286	Oct, 1996	I-131	-0.1241 ± 0.2405	-0.0565 ± 0.2463	-0.0903 ± 0.1721
CW - 7176, 7177	Oct, 1996	Gr. Beta	3.1350 ± 1.0492	2.2278 ± 0.9950	2.6814 ± 0.7230
MI - 7351, 7352	Oct, 1996	Sr-89	-0.4959 ± 1.3277	-2.6954 ± 1.1984	-1.5956 ± 0.8943
MI - 7351, 7352	Oct, 1996	Sr-90	1.6216 ± 0.4003	1.5659 ± 0.3840	1.5938 ± 0.2774
VE - 7425, 7426	Oct, 1996	K-40	1.9203 ± 0.2360	1.7284 ± 0.2700	1.8244 ± 0.1793
MI - 7514, 7515	Oct, 1996	Co-60	2.1800 ± 5.1000	5.8600 ± 5.3900	4.0200 ± 3.7102
MI - 7514, 7515	Oct, 1996	Co-60	2.1800 ± 5.1000	5.8600 ± 5.3900	4.0200 ± 3.7102
MI - 7514, 7515	Oct, 1996	Cs-137	0.2630 ± 3.4000	1.3400 ± 4.3000	0.8015 ± 2.7409
MI - 7514, 7515	Oct, 1996	Cs-137	0.2630 ± 3.4000	1.3400 ± 4.3000	0.8015 ± 2.7409
MI - 7514, 7515	Oct, 1996	I-131	-0.0367 ± 0.2747	0.0170 ± 0.2780	-0.0098 ± 0.1954
F - 7584, 7585	Oct, 1996	Co-60	0.0051 ± 0.0115	0.0050 ± 0.0119	0.0051 ± 0.0083
F - 7584, 7585	Oct, 1996	Cs-137	0.0048 ± 0.0087	0.0006 ± 0.0094	0.0027 ± 0.0064
WW - 7653, 7654	Oct, 1996	Co-60	0.5440 ± 1.7200	-3.0500 ± 2.8000	-1.2530 ± 1.6430
WW - 7653, 7654	Oct, 1996	Co-60	0.5440 ± 1.7200	-3.0500 ± 2.8000	-1.2530 ± 1.6430
WW - 7653, 7654	Oct, 1996	Cs-137	-0.3090 ± 1.9800	-1.3700 ± 3.5700	-0.8395 ± 2.0412
WW - 7653, 7654	Oct, 1996	Cs-137	-0.3090 ± 1.9800	-1.3700 ± 3.5700	-0.8395 ± 2.0412
WW - 7653, 7654	Oct, 1996	H-3	-20.6120 ± 75.8854	27.0900 ± 78.0749	3.2390 ± 54.4387
SS - 8040, 8041	Oct, 1996	K-40	22.2090 ± 0.8210	23.4780 ± 0.8550	22.8435 ± 0.5927
SWT - 7972, 7973	Oct, 1996	Gr. Beta	2.7320 ± 0.5059	2.1353 ± 0.5134	2.4337 ± 0.3604
CW - 7794, 7795	Oct, 1996	Gr. Beta	1.2200 ± 1.7000	2.3526 ± 1.7822	1.7863 ± 1.2315
DW - 7994, 7995	Oct, 1996	Gr. Beta	1.6467 ± 0.4826	1.8357 ± 0.4589	1.7412 ± 0.3330
DW - 7994, 7995	Oct, 1996	H-3	64.0848 ± 81.6689	29.6241 ± 80.1237	46.8545 ± 57.2049
WW - 8121, 8122	Nov, 1996	Gr. Beta	5.2418 ± 0.7885	4.8908 ± 0.7351	5.0663 ± 0.5390
WW - 8121, 8122	Nov, 1996	H-3	49.1914 ± 78.3272	25.7955 ± 77.2446	37.4935 ± 55.0042
CW - 8089, 8090	Nov, 1996	Gr. Beta	2.0590 ± 1.7640	-0.0624 ± 1.6065	0.9983 ± 1.1930
CW - 8089, 8090	Nov, 1996	Gr. Beta	-0.3253 ± 1.5458	0.0296 ± 1.5731	-0.1479 ± 1.1027
SWU - 8213, 8214	Nov, 1996	Gr. Beta	2.5755 ± 0.5930	1.9537 ± 0.5962	2.2646 ± 0.4204
SWU - 8213, 8214	Nov, 1996	H-3	257.8646 ± 86.6697	234.9041 ± 85.7288	246.3843 ± 60.9530
SWU - 8213, 8214	Nov, 1996	K-40	109.2500 ± 41.2000	97.1440 ± 52.0000	103.1970 ± 33.1717
CW - 8302, 8303	Nov, 1996	Gr. Beta	0.9444 ± 1.4135	2.1017 ± 1.4184	1.5230 ± 1.0012
MI - 8337, 8338	Nov, 1996	I-131	-0.0286 ± 0.2146	0.0724 ± 0.2406	0.0219 ± 0.1612
MI - 8337, 8338	Nov, 1996	K-40	1,454.6000 ± 91.6000	1,365.5000 ± 193.0000	1,410.0500 ± 106.8171
WW - 8561, 8562	Nov, 1996	H-3	4,719.0000 ± 197.0000	4,718.8773 ± 197.2068	4,718.9387 ± 139.3732
SW - 8581, 8582	Nov, 1996	Gr. Beta	3.1780 ± 0.6522	2.4547 ± 0.6458	2.8164 ± 0.4589
WW - 8681, 8682	Nov, 1996	Gr. Alpha	0.1083 ± 1.7623	-1.6686 ± 1.5384	-0.7802 ± 1.1697

Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
WW - 8681, 8682	Nov, 1996	Gr. Beta	2.7636 ± 1.6718	1.2914 ± 1.6711	2.0275 ± 1.1819
CW - 8612, 8613	Nov, 1996	Gr. Beta	2.5959 ± 1.4986	1.9085 ± 1.4277	2.2522 ± 1.0349
CW - 8612, 8613	Nov, 1996	Gr. Beta	0.0730 ± 1.0631	-0.7679 ± 1.0588	-0.3474 ± 0.7502
CW - 9219, 9220	Nov, 1996	Co-60	0.4990 ± 1.9100	-0.2780 ± 1.6600	0.1105 ± 1.2653
CW - 9219, 9220	Nov, 1996	Cs-137	1.3800 ± 2.0100	0.1520 ± 1.6300	0.7660 ± 1.2939
CW - 9219, 9220	Nov, 1996	H-3	2,091.6585 ± 147.0922	2,206.2783 ± 149.9008	2,148.9684 ± 105.0076
CW - 8830, 8831	Nov, 1996	Gr. Alpha	0.1864 ± 0.3044	0.4130 ± 0.3037	0.2997 ± 0.2150
CW - 8830, 8831	Nov, 1996	Gr. Beta	11.0773 ± 0.6482	10.2141 ± 0.5784	10.6457 ± 0.4344
CW - 8830, 8831	Nov, 1996	H-3	2,053.4722 ± 144.0356	2,112.1937 ± 145.4793	2,082.8329 ± 102.3603
CW - 8830, 8831	Nov, 1996	Sr-89	-0.2648 ± 0.5335	-0.2665 ± 0.6325	-0.2656 ± 0.4137
CW - 8830, 8831	Nov, 1996	Sr-90	0.2880 ± 0.3295	0.2980 ± 0.3905	0.2930 ± 0.2555
SW - 8635, 8636	Dec, 1996	Gr. Beta	2.4968 ± 0.8037	3.0769 ± 0.7797	2.7869 ± 0.5599
SW - 8635, 8636	Dec, 1996	K-40	90.1230 ± 52.8000	90.4480 ± 51.9000	90.2855 ± 37.0184
DW - 8660, 8661	Dec, 1996	Gr. Beta	2.1325 ± 0.5706	1.8680 ± 0.5881	2.0003 ± 0.4097
DW - 8660, 8661	Dec, 1996	H-3	110.0746 ± 83.6820	117.3323 ± 83.9962	113.7035 ± 52.2833
MI - 8704, 8705	Dec, 1996	I-131	-0.2720 ± 0.2656	-0.2978 ± 0.2604	-0.2849 ± 0.1860
MI - 8704, 8705	Dec, 1996	K-40	1,301.2000 ± 141.0000	1,342.9000 ± 150.0000	1,322.0500 ± 102.93
MI - 8725, 8726	Dec, 1996	Co-60	0.4980 ± 2.7500	0.4080 ± 4.4400	0.4530 ± 2.6113
MI - 8725, 8726	Dec, 1996	Cs-134	1.2300 ± 2.3300	-0.6450 ± 3.8000	0.2925 ± 2.2287
MI - 8725, 8726	Dec, 1996	Cs-137	1.7600 ± 2.5400	1.1100 ± 3.3900	1.4350 ± 2.1180
MI - 8725, 8726	Dec, 1996	I-131	-0.1756 ± 0.1896	-0.1739 ± 0.2108	-0.1747 ± 0.1418
MI - 8725, 8726	Dec, 1996	I-131(g)	-0.9720 ± 3.4000	4.5100 ± 4.8700	1.7690 ± 2.9697
MI - 8725, 8726	Dec, 1996	K-40	1,402.2000 ± 111.0000	1,297.5000 ± 150.0000	1,349.8500 ± 93.3019
MI - 8725, 8726	Dec, 1996	Sr-89	-1.0624 ± 1.0291	-1.0463 ± 1.0044	-1.0543 ± 0.7190
MI - 8725, 8726	Dec, 1996	Sr-90	1.3308 ± 0.3709	1.1232 ± 0.3625	1.2270 ± 0.2593
SO - 8802, 8803	Dec, 1996	Cs-137	0.4670 ± 0.0419	0.4514 ± 0.0374	0.4592 ± 0.0281
SO - 8802, 8803	Dec, 1996	Gr. Alpha	14.0253 ± 4.2670	13.8640 ± 4.0228	13.9447 ± 2.9322
SO - 8802, 8803	Dec, 1996	Gr. Beta	21.4173 ± 3.1354	21.4610 ± 2.8794	21.4391 ± 2.1285
SO - 8802, 8803	Dec, 1996	K-40	11.0890 ± 0.6640	10.8030 ± 0.6130	10.9460 ± 0.4518
SWU - 9540, 9541	Dec, 1996	Gr. Beta	7.5204 ± 0.8776	5.9562 ± 0.8260	6.7383 ± 0.6026
SWU - 9540, 9541	Dec, 1996	H-3	90.1991 ± 86.7053	86.5424 ± 86.5510	88.3707 ± 61.2554
F - 9040, 9041	Dec, 1996	Co-60	-0.0006 ± 0.0144	-0.0002 ± 0.0150	-0.0004 ± 0.0104
F - 9040, 9041	Dec, 1996	Cs-134	-0.0015 ± 0.0103	0.0005 ± 0.0120	-0.0005 ± 0.0079
F - 9040, 9041	Dec, 1996	Cs-137	0.0371 ± 0.0163	0.0428 ± 0.0186	0.0400 ± 0.0124
F - 9040, 9041	Dec, 1996	Gr. Beta	3.5649 ± 0.0939	3.5230 ± 0.0939	3.5440 ± 0.0664
F - 9040, 9041	Dec, 1996	I-131(g)	0.0008 ± 0.0151	-0.0004 ± 0.0153	0.0002 ± 0.0107
F - 9040, 9041	Dec, 1996	K-40	3.2987 ± 0.4720	3.0073 ± 0.4330	3.1530 ± 0.3203



Table A-5. In-house "duplicate" samples.

Lab Codes <sup>b</sup>	Sample Date	Analysis	Concentration in pCi/L <sup>a</sup>		
			First Result	Second Result	Averaged Result
CW - 9109, 9110	Dec, 1996	Gr. Beta	4.1495 ± 1.2265	1.9601 ± 1.5457	3.0548 ± 0.9866
CW - 9109, 9110	Dec, 1996	Gr. Beta	-0.8681 ± 1.3230	-1.1056 ± 1.3024	-0.9869 ± 0.9282
MI - 9197, 9198	Dec, 1996	I-131	0.0738 ± 0.3589	-0.1464 ± 0.3804	-0.0363 ± 0.2615
MI - 9197, 9198	Dec, 1996	K-40	1,462.6000 ± 143.0000	1,381.2000 ± 149.0000	1,421.9000 ± 103.2594
WW - 9269, 9270	Dec, 1996	Co-60	-1.1100 ± 2.3300	-0.2890 ± 2.6000	-0.6995 ± 1.7456
WW - 9269, 9270	Dec, 1996	Cs-137	-1.2100 ± 2.2100	0.2210 ± 2.5500	-0.4945 ± 1.6872
WW - 9269, 9270	Dec, 1996	H-3	1,051.0538 ± 116.7594	1,126.1290 ± 119.0359	1,088.5914 ± 83.3701
LW - 9291, 9292	Dec, 1996	Co-60	-0.2250 ± 2.0000	1.2400 ± 2.3400	0.5075 ± 1.5391
LW - 9291, 9292	Dec, 1996	Cs-137	4.0400 ± 2.1800	0.1930 ± 2.8300	2.1165 ± 1.7861
LW - 9291, 9292	Dec, 1996	Gr. Beta	4.8680 ± 1.3409	7.3432 ± 1.4448	6.1056 ± 0.9856
SW - 9743, 9744	Dec, 1996	H-3	1.2426 ± 89.7614	51.5686 ± 91.8276	26.4056 ± 64.2056
SW - 9414, 9415	Dec, 1996	Gr. Beta	3.9527 ± 0.6945	4.6396 ± 0.7606	4.2961 ± 0.5150
DW - 9520, 9521	Dec, 1996	Gr. Beta	6.1588 ± 1.3500	5.6935 ± 1.2445	5.9261 ± 0.9180
DW - 9520, 9521	Dec, 1996	I-131	0.3473 ± 0.4182	0.2339 ± 0.4184	0.2905 ± 0.2958
CW - 9383, 9384	Dec, 1996	Gr. Beta	4.7813 ± 1.7392	4.5942 ± 1.5609	4.6877 ± 1.1685
CW - 9383, 9384	Dec, 1996	Gr. Beta	0.6113 ± 1.4866	0.4335 ± 1.4715	0.5224 ± 1.0459
SW - 9433, 9434	Dec, 1996	H-3	309.2956 ± 91.1018	247.0810 ± 88.6407	278.1883 ± 63.5545
SW - 9497, 9498	Dec, 1996	H-3	241.0070 ± 91.8990	126.5590 ± 87.2570	183.7830 ± 63.3625
DW - 9564, 9565	Dec, 1996	Gr. Beta	2.0290 ± 0.5925	2.1508 ± 0.5749	2.0899 ± 0.4128
DW - 9564, 9565	Dec, 1996	H-3	120.7999 ± 83.3742	94.1528 ± 82.2309	107.4763 ± 58.5516

<sup>a</sup> All concentrations are reported in pCi/liter, except solid samples, which are reported in pCi/gram.

<sup>b</sup> Lab codes are comprised of the sample media and the sample numbers. Client codes have been eliminated to protect client anonymity.

Table A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP), comparison of MAPEP and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in Bq/kg <sup>b</sup>		
				Teledyne Results ±Standard Deviation <sup>c</sup>	MAPEP Result <sup>d</sup> 1s, N=1	Control Limits
STSO-776	SOIL	Sep, 1996	Am-241	27.0	28.7 ± 2.8	20.9 - 37.3
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	Co-60	879.0	812.0 ± 83.5	568.4 - 1,055.6
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	Cs-137	1,716.0	1,531.0 ± 193.4	1,071.7 - 1,990.3
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	Pu-238	13.0	15.9 ± 1.8	11.1 - 20.7
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	Pu-239/240	18.0	19.7 ± 2.0	13.8 - 25.6
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	Sr-90	441.0	536.0 ± 57.1	375.2 - 696.8
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	U-234/233	59.0	63.9 ± 7.3	44.7 - 83.1
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						
STSO-776	SOIL	Sep, 1996	U-238	60.0	64.0 ± 6.4	44.8 - 83.2
Standard deviation for three determinations not reported in Mixed Analyte Performance Evaluation Program Summary Report.						

<sup>a</sup> Results obtained by Teledyne Brown Engineering Environmental Services Midwest Laboratory as a participant in the Department of Energy's Mixed Analyte Performance Evaluation Program, Idaho Operations office, Idaho Falls, Idaho.

<sup>b</sup> All results are in Becquerels per kilogram as requested by the Department of Energy.

<sup>c</sup> Unless otherwise indicated, the TBEESML results are given as the mean ± 1 standard deviations for three determinations.

<sup>d</sup> MAPEP results are presented as the known values and expected laboratory precision (1s, 1 determination) and control limits as defined by the MAPEP.

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in Bq/L <sup>1b</sup>		Control Limits <sup>a</sup>
				Teledyne Result <sup>c</sup>	EML Result <sup>d</sup>	
STW-755	WATER	Mar, 1996	Am-241	0.8 ± 0.1	0.8 ± 0.0	0.7 - 1.6
STW-755	WATER	Mar, 1996	Co-60	33.6 ± 1.0	32.8 ± 0.6	0.9 - 1.2
STW-755	WATER	Mar, 1996	Cs-137	42.8 ± 1.3	38.3 ± 0.9	0.9 - 1.3
STW-755	WATER	Mar, 1996	Fe-55	109.0 ± 21.7	83.0 ± 3.4	0.3 - 1.6
STW-755	WATER	Mar, 1996	H-3	434.0 ± 34.1	251.0 ± 11.4	0.7 - 1.9
STW-755	WATER	Mar, 1996	Mn-54	41.9 ± 1.4	38.4 ± 1.2	0.9 - 1.2
STW-755	WATER	Mar, 1996	Pu-238	0.9 ± 0.1	1.0 ± 0.1	0.7 - 1.3
STW-755	WATER	Mar, 1996	Pu-239	0.7 ± 0.1	0.8 ± 0.1	0.6 - 1.4
STW-755	WATER	Mar, 1996	Sr-90	2.2 ± 0.7	1.5 ± 0.0	0.7 - 1.7
STW-756	WATER	Mar, 1996	Gr. Alpha	2,180.0 ± 53.5	1,850.0 ± 185.0	0.6 - 1.3
STW-756	WATER	Mar, 1996	Gr. Beta	872.0 ± 27.0	744.0 ± 74.0	0.8 - 1.7
STSO-757	SOIL	Mar, 1996	Am-241	6.2 ± 2.9	3.7 ± 0.5	0.5 - 2.4
STSO-757	SOIL	Mar, 1996	Cs-137	404.0 ± 0.2	359.0 ± 10.0	0.7 - 1.4
STSO-757	SOIL	Mar, 1996	K-40	525.0 ± 23.3	465.0 ± 30.0	0.7 - 1.6
STSO-757	SOIL	Mar, 1996	Pu-238	42.3 ± 1.6	43.0 ± 2.4	0.2 - 2.0
STSO-757	SOIL	Mar, 1996	Pu-239	9.0 ± 0.7	9.2 ± 0.3	0.6 - 2.0
STSO-757	SOIL	Mar, 1996	Sr-90	1,200.0 ± 32.3	1,340.0 ± 113.0	0.6 - 3.0
STSO-757	SOIL	Mar, 1996	Uranium	68.2 ± 2.4	71.7 ± 4.2	0.3 - 1.5
STVE-758	VEGETATION	Mar, 1996	Am-241	6.1 ± 1.3	5.6 ± 0.2	0.6 - 2.9
STVE-758	VEGETATION	Mar, 1996	Cm-244	6.0 ± 1.2	4.4 ± 0.2	0.4 - 1.9
STVE-758	VEGETATION	Mar, 1996	Co-60	65.6 ± 4.0	59.7 ± 1.0	0.6 - 1.5
STVE-758	VEGETATION	Mar, 1996	Cs-137	1,100.0 ± 12.6	944.0 ± 16.2	0.8 - 1.5
STVE-758	VEGETATION	Mar, 1996	K-40	1,190.0 ± 61.6	1,030.0 ± 33.0	0.5 - 1.5
STVE-758	VEGETATION	Mar, 1996	Pu-239	9.2 ± 1.3	9.8 ± 1.2	0.6 - 2.0
STVE-758	VEGETATION	Mar, 1996	Sr-90	1,210.0 ± 32.2	1,300.0 ± 52.4	0.5 - 1.4
STAF-759	AIR FILTER	Mar, 1996	Am-241	0.3 ± 0.0	0.2 ± 0.0	0.6 - 1.9
STAF-759	AIR FILTER	Mar, 1996	Ce-144	23.2 ± 1.0	33.3 ± 3.3	0.6 - 1.3
STAF-759	AIR FILTER	Mar, 1996	Co-57	6.1 ± 0.1	8.9 ± 0.9	0.6 - 1.3
STAF-759	AIR FILTER	Mar, 1996	Co-60	26.5 ± 0.4	29.5 ± 2.9	0.7 - 1.3
STAF-759	AIR FILTER	Mar, 1996	Cs-134	12.9 ± 0.3	14.7 ± 1.5	0.7 - 1.2
STAF-759	AIR FILTER	Mar, 1996	Cs-137	6.2 ± 0.9	6.6 ± 0.7	0.7 - 1.3
STAF-759	AIR FILTER	Mar, 1996	Mn-54	3.3 ± 0.4	3.4 ± 0.4	0.8 - 1.3
STAF-759	AIR FILTER	Mar, 1996	Pu-238	0.1 ± 0.0	0.1 ± 0.0	0.6 - 1.6
STAF-759	AIR FILTER	Mar, 1996	Pu-239	0.1 ± 0.0	0.1 ± 0.0	0.7 - 1.6
STAF-759	AIR FILTER	Mar, 1996	Ru-106	10.2 ± 1.9	11.6 ± 1.4	0.5 - 1.6
STAF-759	AIR FILTER	Mar, 1996	Sb-125	10.1 ± 0.8	9.8 ± 1.0	0.4 - 1.4
STAF-759	AIR FILTER	Mar, 1996	Sr-90	1.1 ± 0.2	1.1 ± 0.0	0.6 - 2.3
STAF-759	AIR FILTER	Mar, 1996	Uranium	0.1 ± 0.0	0.1 ± 0.0	0.8 - 2.9

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in Bq/L <sup>1b</sup>		Control Limits <sup>a</sup>
				Teledyne Result <sup>c</sup>	EML Result <sup>d</sup>	
STAF-760	AIR FILTER	Mar, 1996	Gr. Alpha	2.2±0.1	1.6±0.2	0.8 - 1.6
STAF-760	AIR FILTER	Mar, 1996	Gr. Beta	2.0±0.0	1.8±0.2	0.8 - 1.9
STW-770	WATER	Sep, 1996	Am-241	1.3±0.2	1.1±0.0	0.6 - 1.7
STW-770	WATER	Sep, 1996	Co-60	65.0±2.2	61.1±0.7	0.9 - 1.2
STW-770	WATER	Sep, 1996	Cs-137	96.1±3.0	89.5±1.4	0.9 - 1.3
STW-770	WATER	Sep, 1996	Gr. Alpha	993.0±12.2	1,210.0±121.0	0.5 - 1.3
STW-770	WATER	Sep, 1996	Gr. Beta	579.0±8.1	540.0±54.0	0.6 - 1.6
STW-770	WATER	Sep, 1996	H-3	488.0±34.6	587.0±58.0	0.7 - 1.9
STW-770	WATER	Sep, 1996	Mn-54	65.0±3.0	60.5±0.6	0.9 - 1.2
STW-770	WATER	Sep, 1996	Pu-238	1.3±0.3	1.9±0.1	0.7 - 1.3
An investigation was conducted. No errors in calculations or transcription were noted. The analysis was repeated in duplicate under the observation of the Technical Lead. No discrepancies were noted in the performance of the procedure. The result of the reanalysis was 2.14±0.11 Bq/L. No further action is planned.						
STW-770	WATER	Sep, 1996	Pu-239	0.7±0.2	0.8±0.0	0.8 - 1.4
STW-770	WATER	Sep, 1996	Sr-90	3.6±0.7	2.7±0.2	0.7 - 1.7
STW-770	WATER	Sep, 1996	U-234	0.5±0.2	0.5±0.0	0.8 - 1.5
STW-770	WATER	Sep, 1996	U-238	0.4±0.1	0.5±0.4	0.8 - 1.4
STSO-771	SOIL	Sep, 1996	Am-241	15.6±3.8	13.5±0.5	0.5 - 2.7
STSO-771	SOIL	Sep, 1996	Co-60	4.0±2.5	2.9±0.2	0.5 - 1.5
STSO-771	SOIL	Sep, 1996	Cs-137	1,750.0±24.4	1,550.0±22.2	0.8 - 1.3
STSO-771	SOIL	Sep, 1996	K-40	369.0±59.5	300.0±25.0	0.7 - 1.7
STSO-771	SOIL	Sep, 1996	Pu-238	0.8±0.4	1.1±0.2	0.4 - 1.9
STSO-771	SOIL	Sep, 1996	Pu-239	24.0±1.9	21.8±1.1	0.7 - 1.9
STSO-771	SOIL	Sep, 1996	Sr-90	63.6±4.0	69.9±5.1	0.5 - 2.8
STSO-771	SOIL	Sep, 1996	U-234	37.2±3.8	39.2±2.4	0.4 - 1.3
STSO-771	SOIL	Sep, 1996	U-238	40.8±4.0	41.6±0.6	0.4 - 1.6
STVE-772	VEGETATION	Sep, 1996	Am-241	1.5±0.9	1.2±0.4	0.7 - 2.8
STVE-772	VEGETATION	Sep, 1996	Cm-244	0.6±0.5	0.8±0.1	0.5 - 1.7
STVE-772	VEGETATION	Sep, 1996	Co-60	14.0±4.4	10.9±0.7	0.6 - 1.4
STVE-772	VEGETATION	Sep, 1996	Cs-137	219.0±10.1	190.0±6.7	0.8 - 1.5
STVE-772	VEGETATION	Sep, 1996	K-40	1,160.0±99.4	992.0±29.0	0.8 - 1.5
STVE-772	VEGETATION	Sep, 1996	Sr-90	1,420.0±35.1	1,390.0±12.0	0.5 - 1.3
STAP-773	AIR FILTER	Sep, 1996	Co-57	11.8±0.3	14.8±0.8	0.6 - 1.2
STAP-773	AIR FILTER	Sep, 1996	Co-60	9.2±0.4	8.6±0.4	0.7 - 1.2
STAP-773	AIR FILTER	Sep, 1996	Cs-134	9.6±0.4	10.8±0.4	0.7 - 1.2
STAP-773	AIR FILTER	Sep, 1996	Cs-137	8.7±0.4	8.5±0.4	0.7 - 1.3
STAP-773	AIR FILTER	Sep, 1996	Gr. Alpha	0.7±0.0	1.2±0.1	0.8 - 1.6

An investigation was conducted and a transcription error while calculating the result was discovered. The recalculated value is 1.15±0.01Bq/filter. No further action is planned.

Table A-7. Environmental Measurements Laboratory Quality Assessment Program (EML), comparison of EML and Teledyne's Midwest Laboratory results for various sample media<sup>a</sup>.

Lab Code	Sample Type	Date Collected	Analysis	Concentration in Bq/L <sup>-1b</sup>		Control Limits <sup>c</sup>
				Teledyne Result <sup>c</sup>	EML Result <sup>d</sup>	
STAP-773	AIR FILTER	Sep, 1996	Gr. Beta	0.5 ± 0.0	0.5 ± 0.1	0.7 - 1.8
STAP-773	AIR FILTER	Sep, 1996	Mn-54	7.1 ± 0.5	6.4 ± 0.3	0.8 - 1.3
STAP-773	AIR FILTER	Sep, 1996	Ru-106	11.5 ± 3.2	10.8 ± 1.1	0.6 - 1.3
STAP-773	AIR FILTER	Sep, 1996	Sb-125	12.4 ± 1.0	10.8 ± 0.5	0.6 - 1.4

<sup>a</sup> The Environmental Measurements Laboratory provides the following nuclear species : Air Filters, Soil, Tissue, Vegetation and Water. Teledyne does not participate in the Tissue program.

<sup>b</sup> Results are reported in Bq/L<sup>-1</sup> with the following exceptions: Air Filter results are reported in Bq/Filter<sup>-1</sup>, Soil results are reported in Bq/Kg<sup>-1</sup>, Vegetation results are reported in Bq/Kg<sup>-1</sup>. The results of elemental Uranium are reported in ug/filter<sup>-1</sup>, g, or ml.

<sup>c</sup> Teledyne results are reported as the mean of three determinations ± standard deviation.

<sup>d</sup> The EML result listed is the mean of replicate determinations for each nuclide ± the standard error of the mean.

<sup>e</sup> The control limits are reported by EML and are established from percentiles of historic data distributions (1982-1992). The evaluation of this historic data and the development of the control limits is presented in DOE report EML-564.



## Data Reporting Conventions

- 1.0 All activities except gross alpha and gross beta are decay corrected to collection time or the end of the collection period.

### 2.0 Single Measurements

Each single measurement is reported as follows:

$$x \pm s$$

where  $x$  = value of the measurement;

$s = 2\sigma$  counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is found to be below the lower limit of detection  $L$  it is reported as

$$<L$$

where  $L$  = the lower limit of detection based on  $4.66\sigma$  uncertainty for a background sample.

### 3.0 Duplicate analyses

- 3.1 Individual results:  $x_1 \pm s_1$   
 $x_1 \pm s_2$

Reported result:  $x \pm s$

where  $x = (1/2)(x_1 \pm x_2)$

$$s = (1/2) \sqrt{s_1^2 + s_2^2}$$

- 3.2 Individual results:  $<L_1$   
 $<L_2$

Reported result:  $<L$

where  $L$  = lower of  $L_1$  and  $L_2$

- 3.3 Individual results:  $x \pm s$   
 $<L$
- Reported result:  $x \pm s$  if  $x \geq L$ ;  
 $<L$  otherwise

#### 4.0. Computation of Averages and Standard Deviations

- 4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average  $\bar{x}$  and standard deviation(s) of a set of  $n$  numbers  $x_1, x_2, \dots, x_n$  are defined as follows:

$$\bar{x} = \frac{1}{n} \sum x$$

$$s = \sqrt{\frac{\sum (\bar{x} - x_i)^2}{n-1}}$$

- 4.2 Values below the highest lower limit of detection are not included in the average.
- 4.3 If all of the values in the averaging group are less than the highest LLD, the highest LLD is reported.
- 4.4 If all but one of the values are less than the highest LLD, the single value  $x$  and associated two sigma error is reported.
- 4.5 In rounding off, the following rules are followed:
- 4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.
- 4.5.2. If the figure following those to be retained is greater than or equal to 5, the figure is dropped and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45.



1.

APPENDIX B  
DATA REPORTING CONVENTIONS

ENCLOSURE F

CONSUMERS ENERGY COMPANY  
BIG ROCK POINT PLANT  
DOCKET 50-155

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT  
January through December 1996

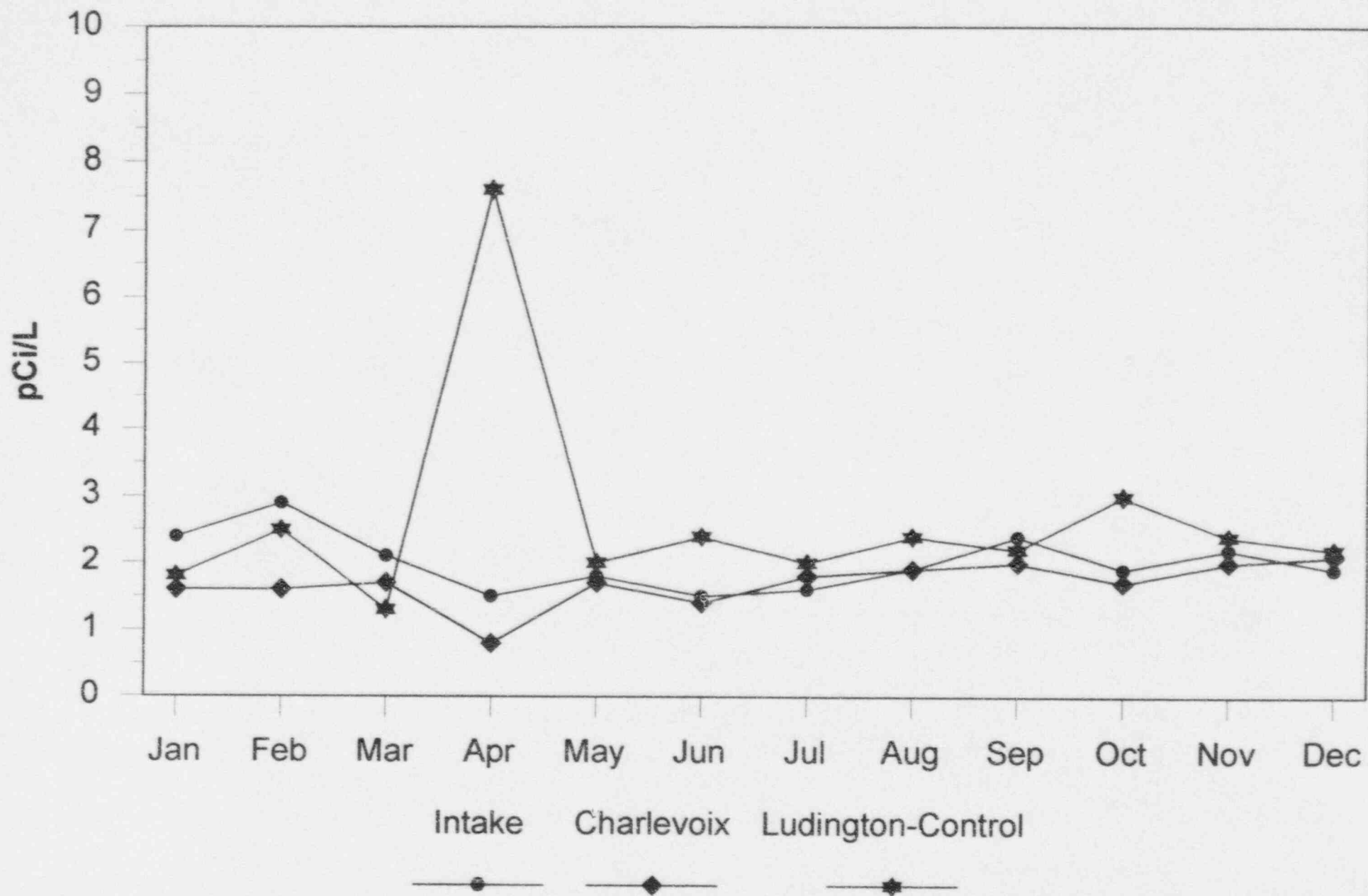
DATA GRAPHS

Submitted April 17, 1997

# 1996 Big Rock Point Lake Water Samples

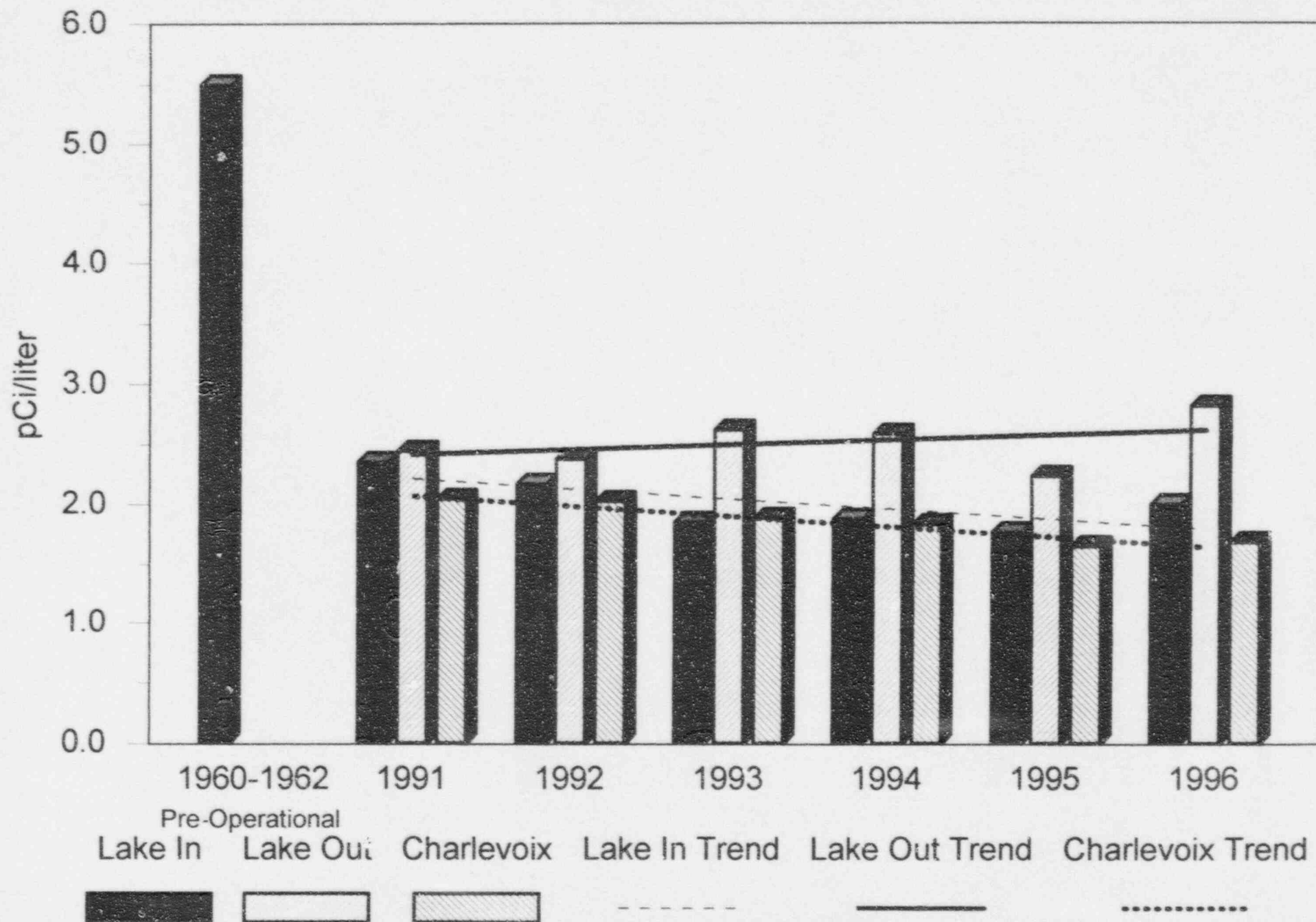
Gross Beta pCi/L

Ludington Control vs Intake & Charlevoix



# Big Rock Point Lake Water Gross Beta

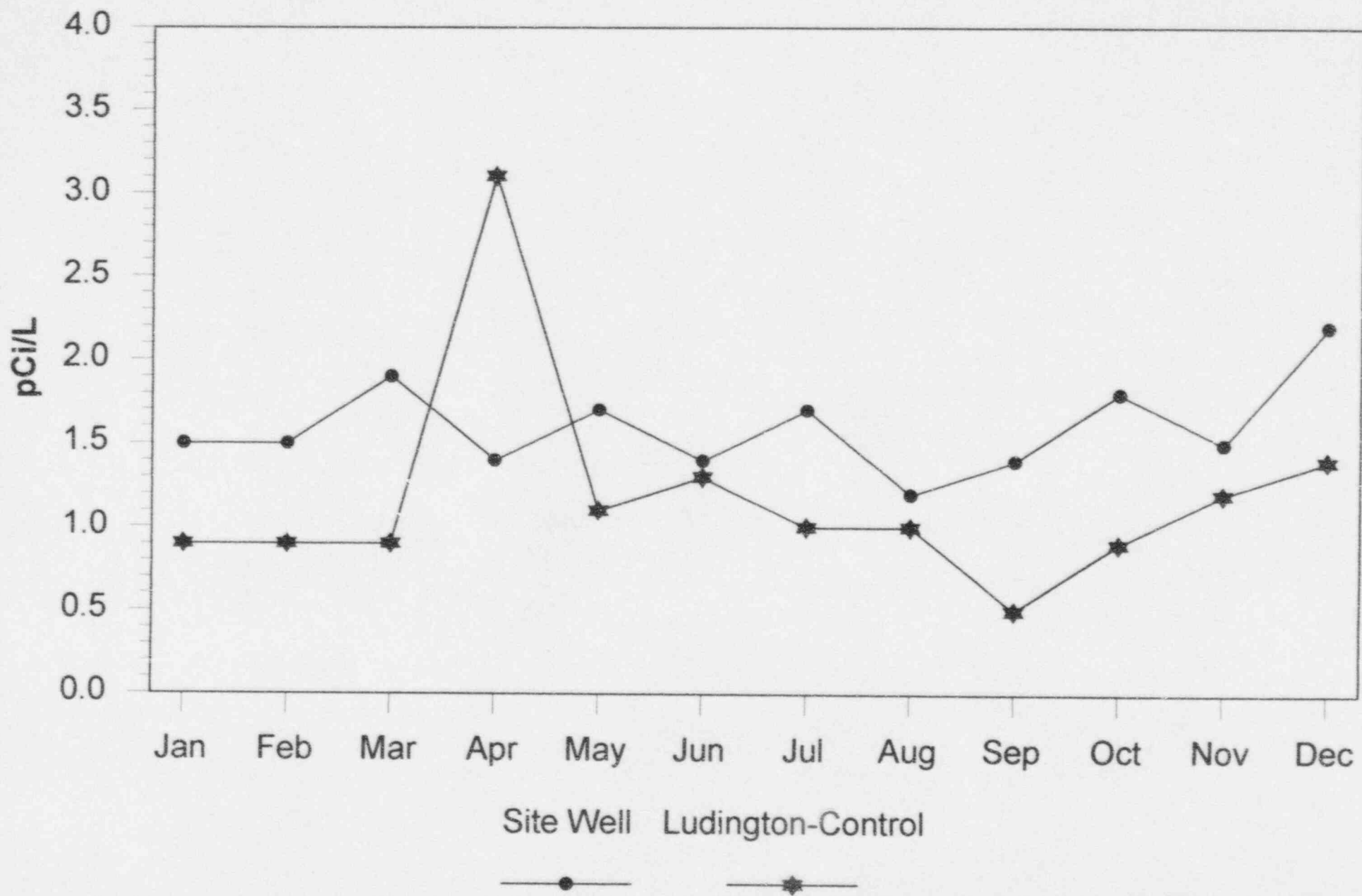
Pre-Operational vs Operational



# 1996 Big Rock Point Well Water Samples

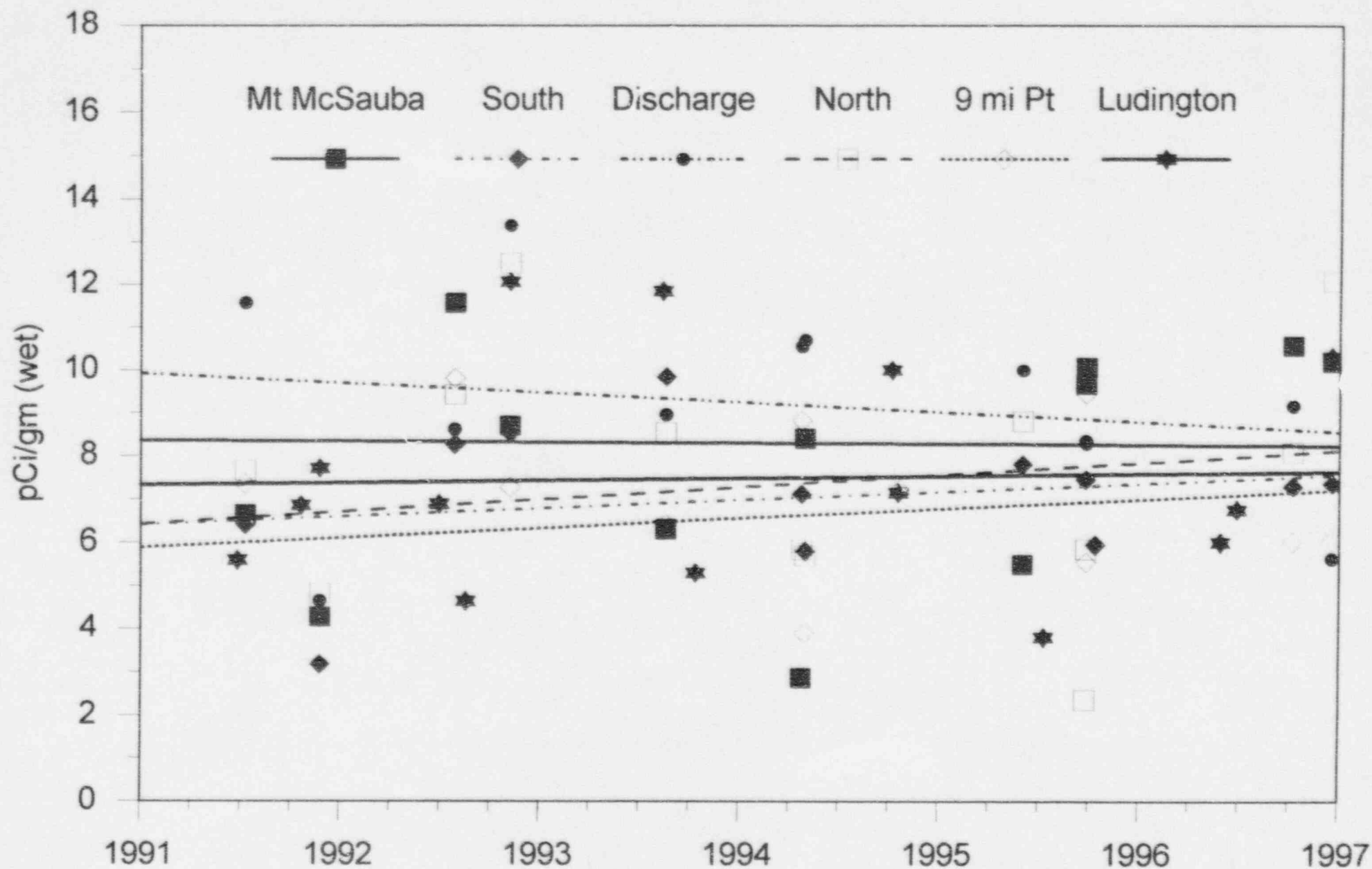
Gross Beta pCi/L

Ludington Control vs Site Well



# Big Rock Point Sediment Gross Beta

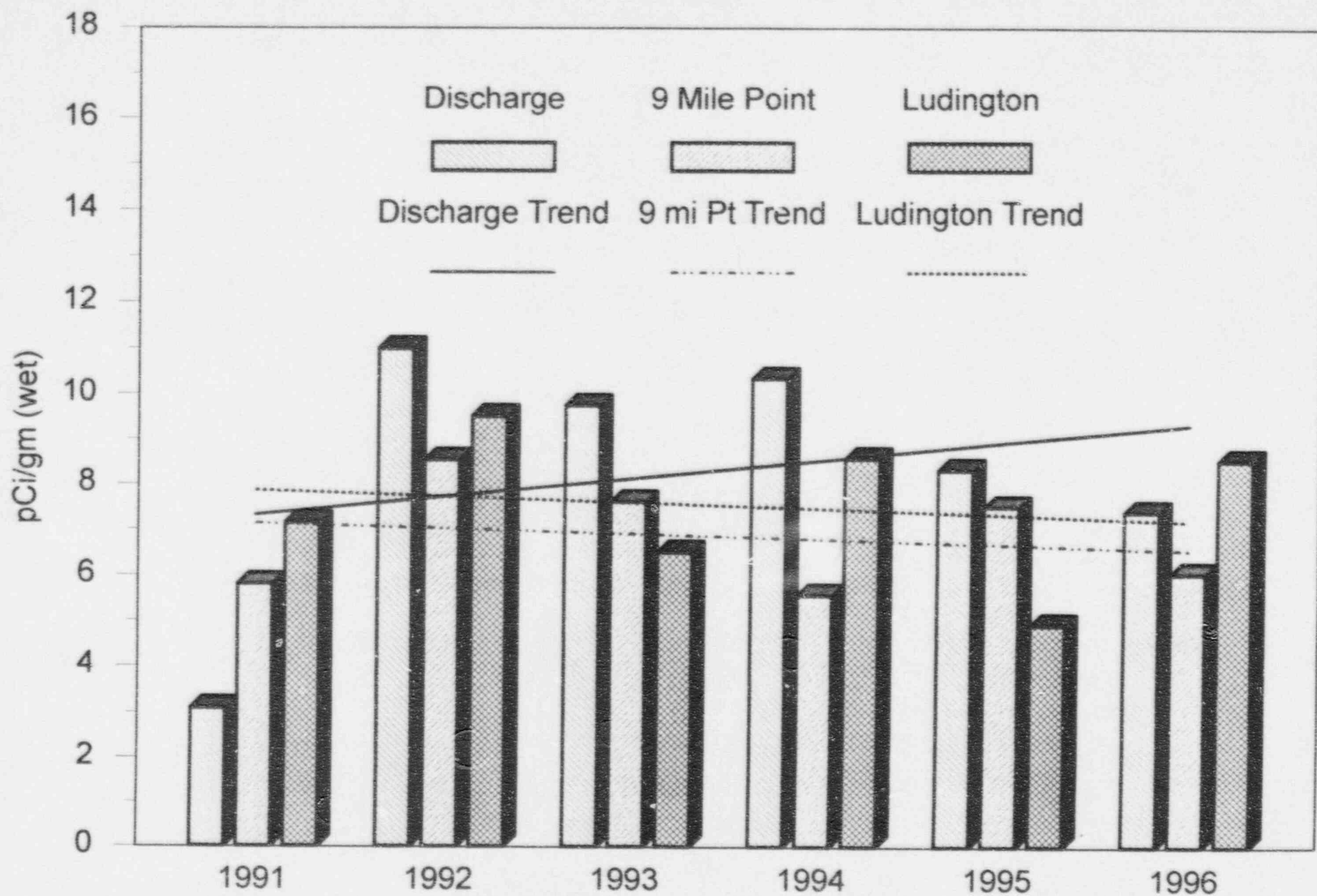
1991 - 1996



Action Level = 30

# Big Rock Point Sediment Gross Beta

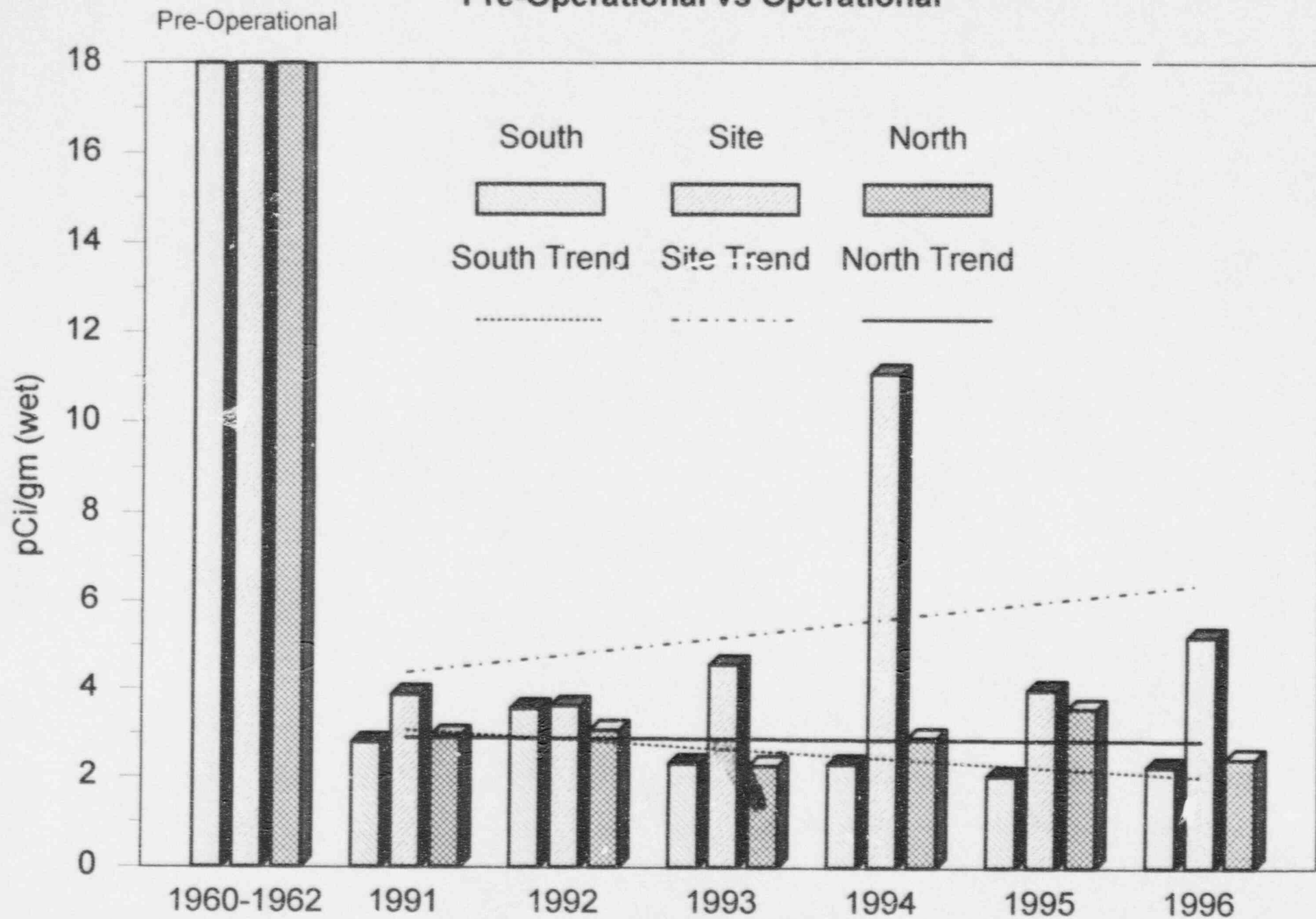
1991 - 1996





# Big Rock Point Periphyton Gross Beta

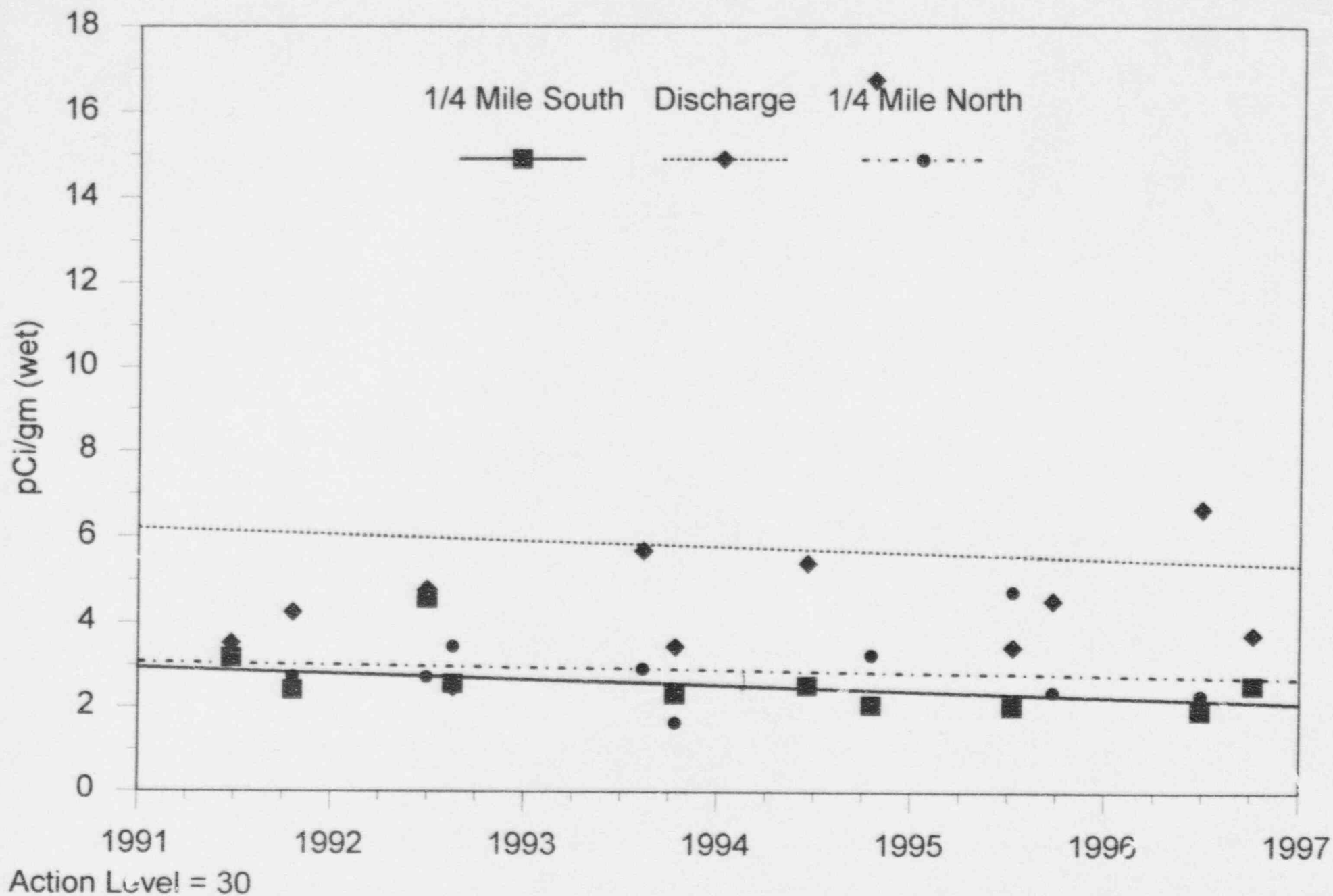
## Pre-Operational vs Operational



Pre-Operational Levels: South(Mt McSauba)=110, Site=79.4, North(9 Mi Pt)=45

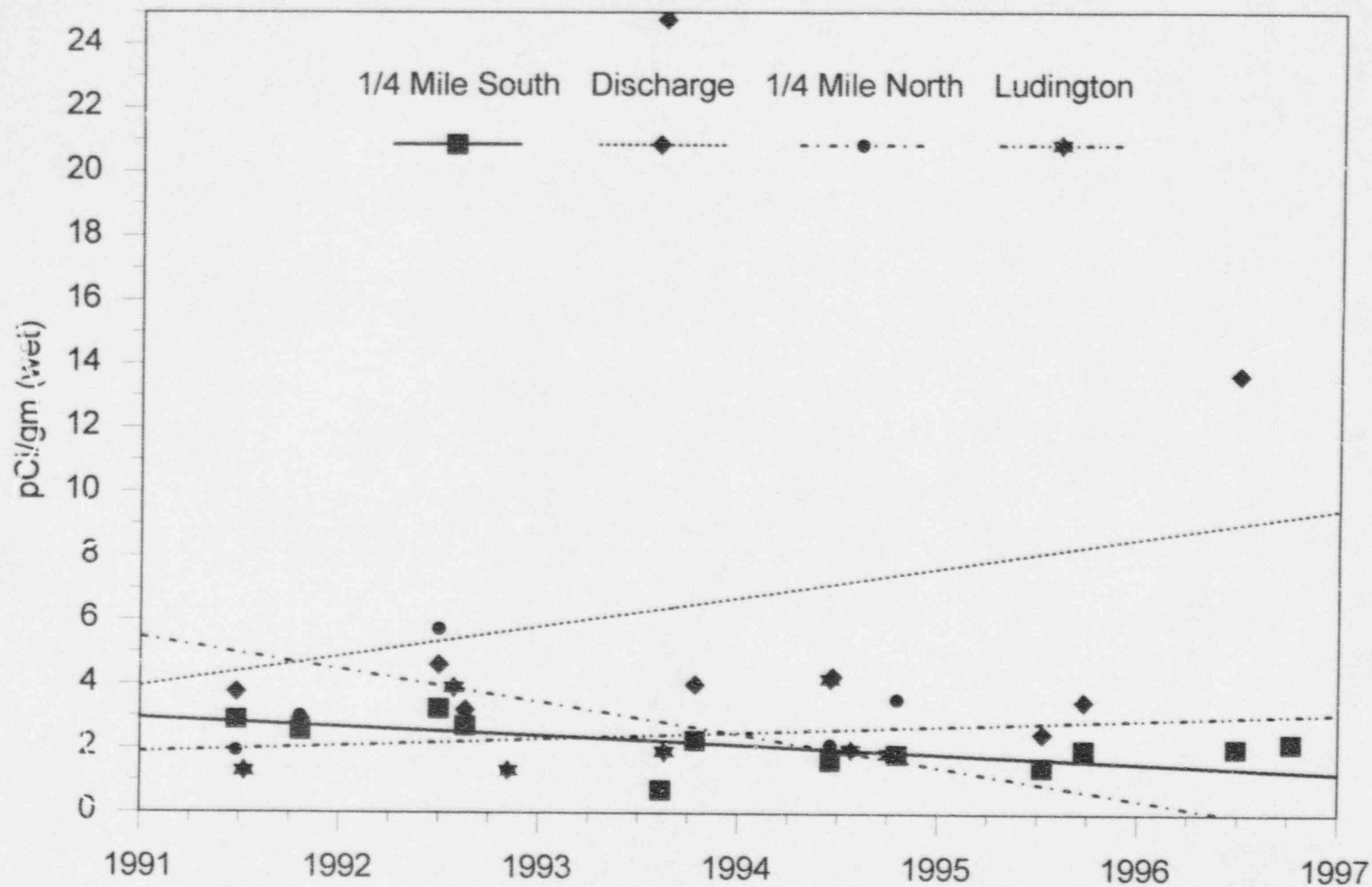
# Big Rock Point Periphyton Gross Beta

1991- 1996



# Big Rock Point Algae Gross Beta

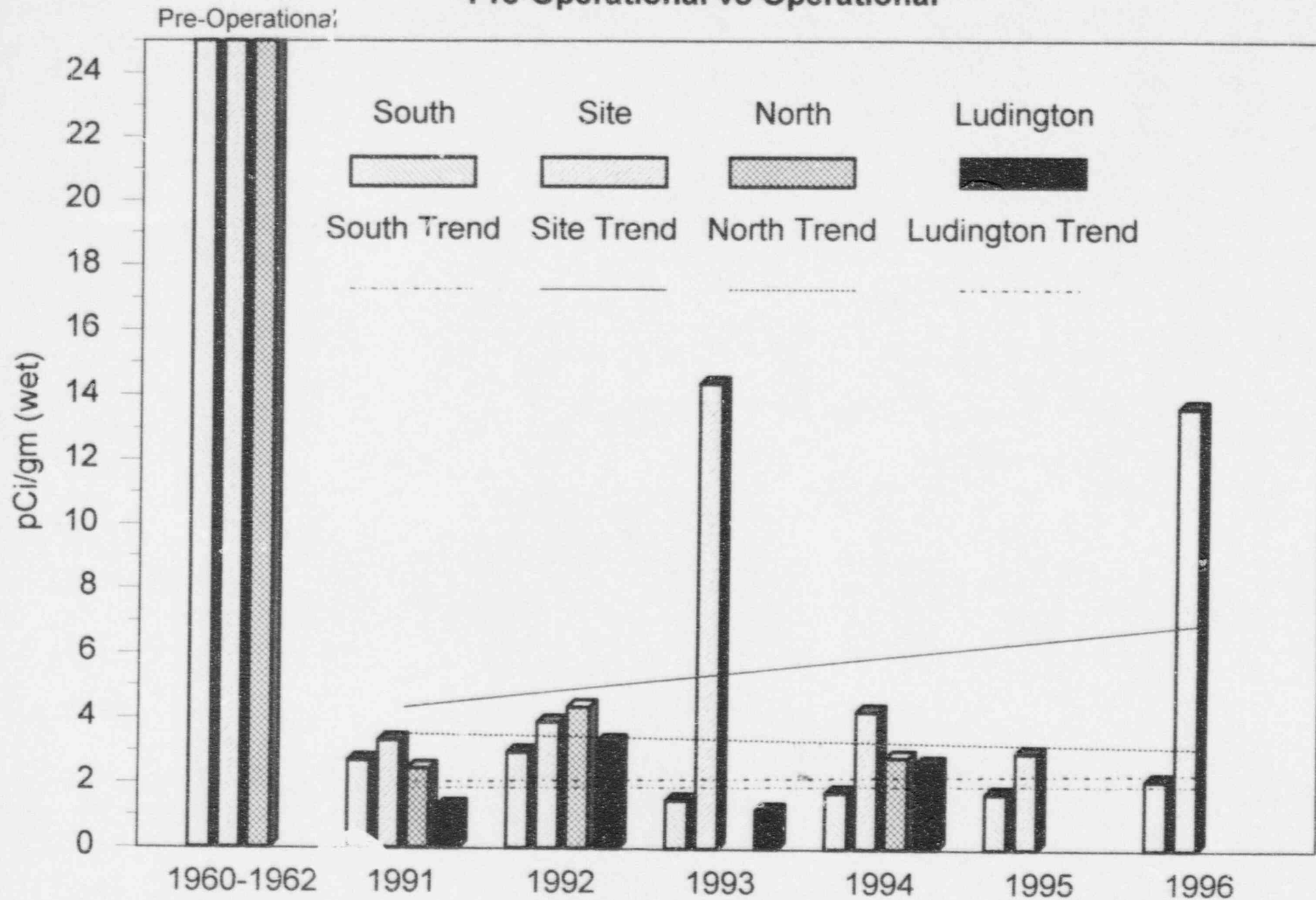
1991 - 1996



Action Level = 30

# Big Rock Point Algae Gross Beta

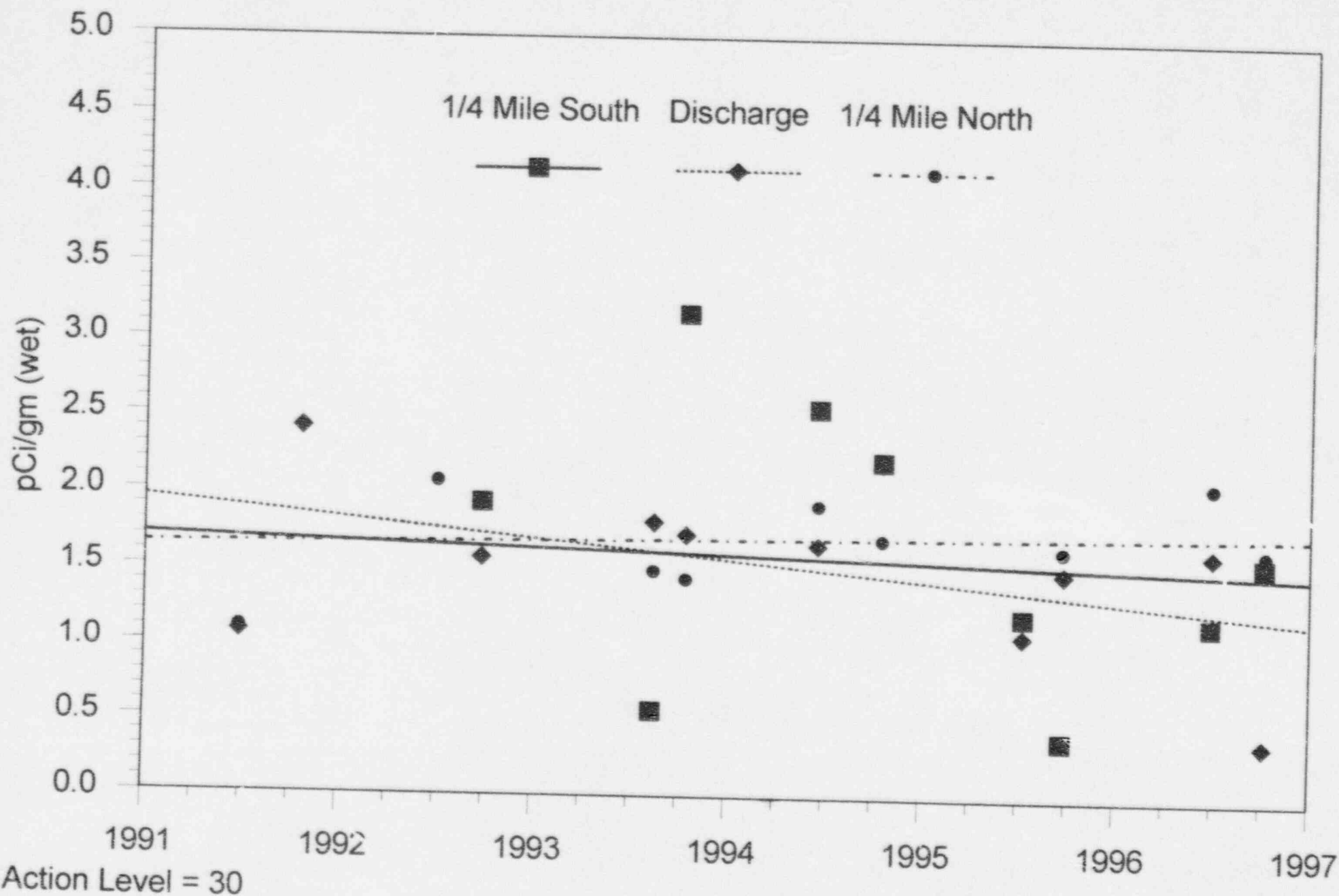
## Pre-Operational vs Operational



Pre-Operational Levels: South(MtMcSauba)=182.4, Site=49.0, North(9 mi Pt)=315.4

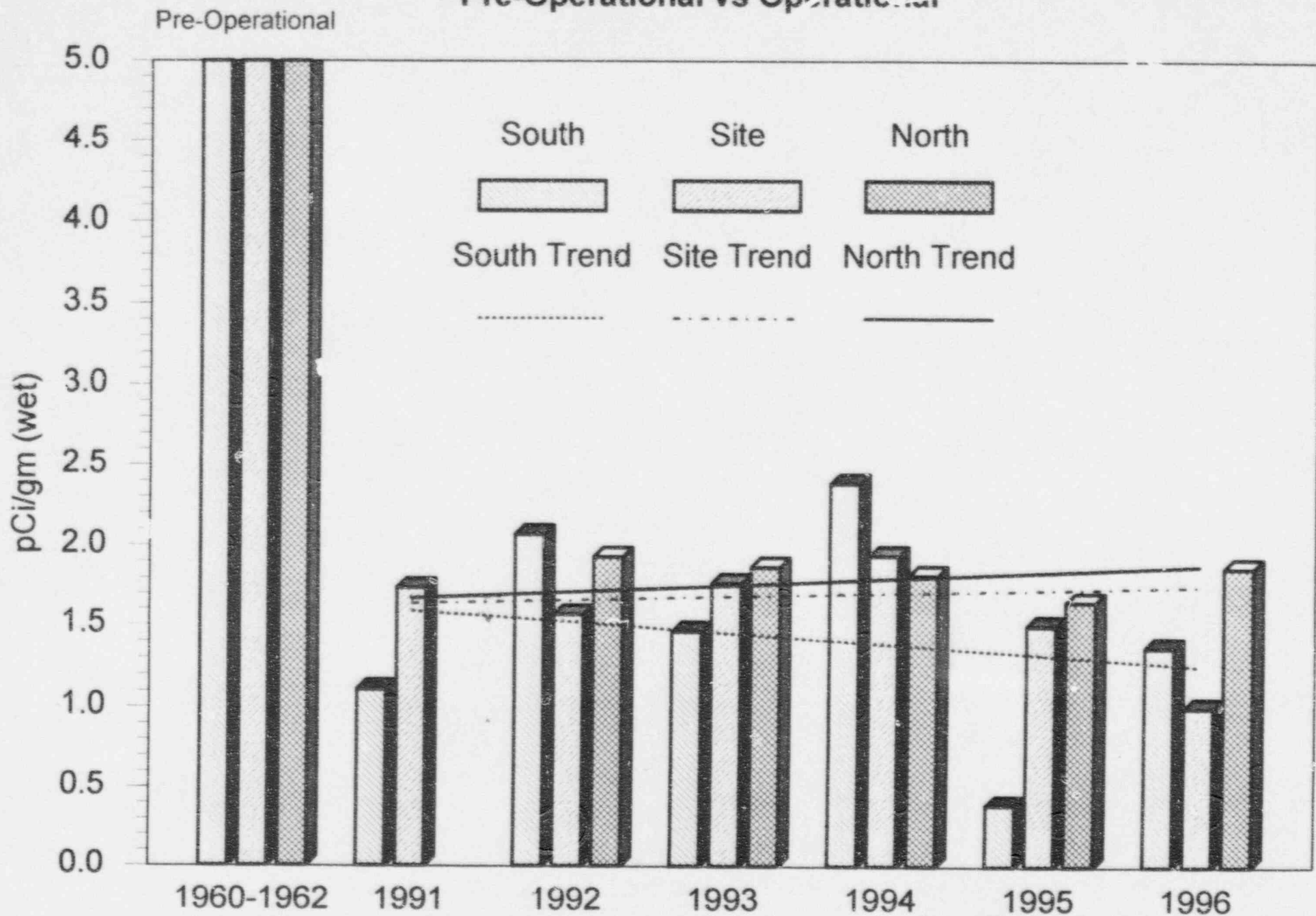
# Big Rock Point Crayfish Gross Beta

1991 - 1996



# Big Rock Point Crayfish Gross Beta

Pre-Operational vs Operational

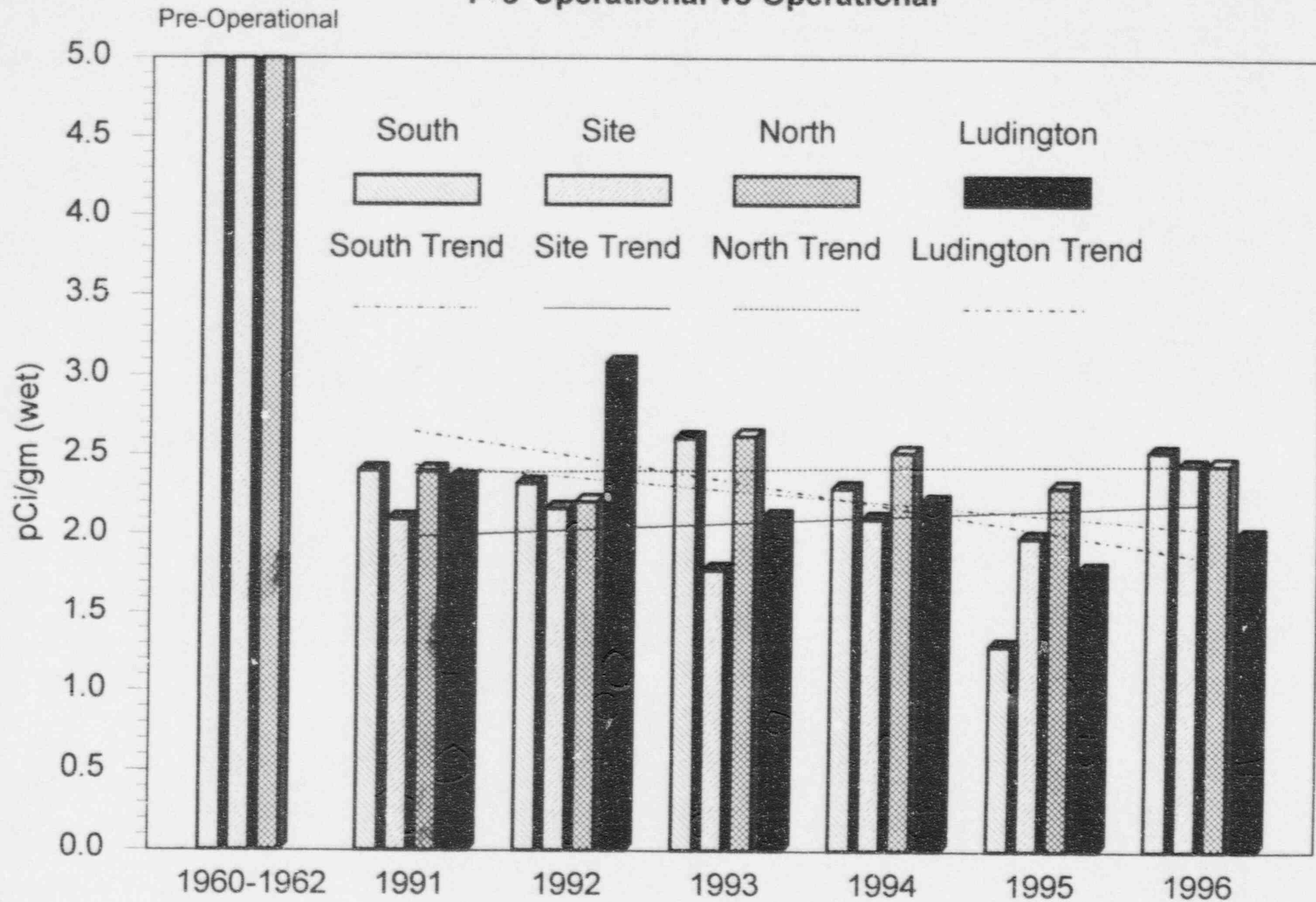


Pre-Operational Levels: South(Mt McSauba)=27.5, Site=24.1, North(9 Mi Pt)=25.8



# Big Rock Point Fish Gross Beta

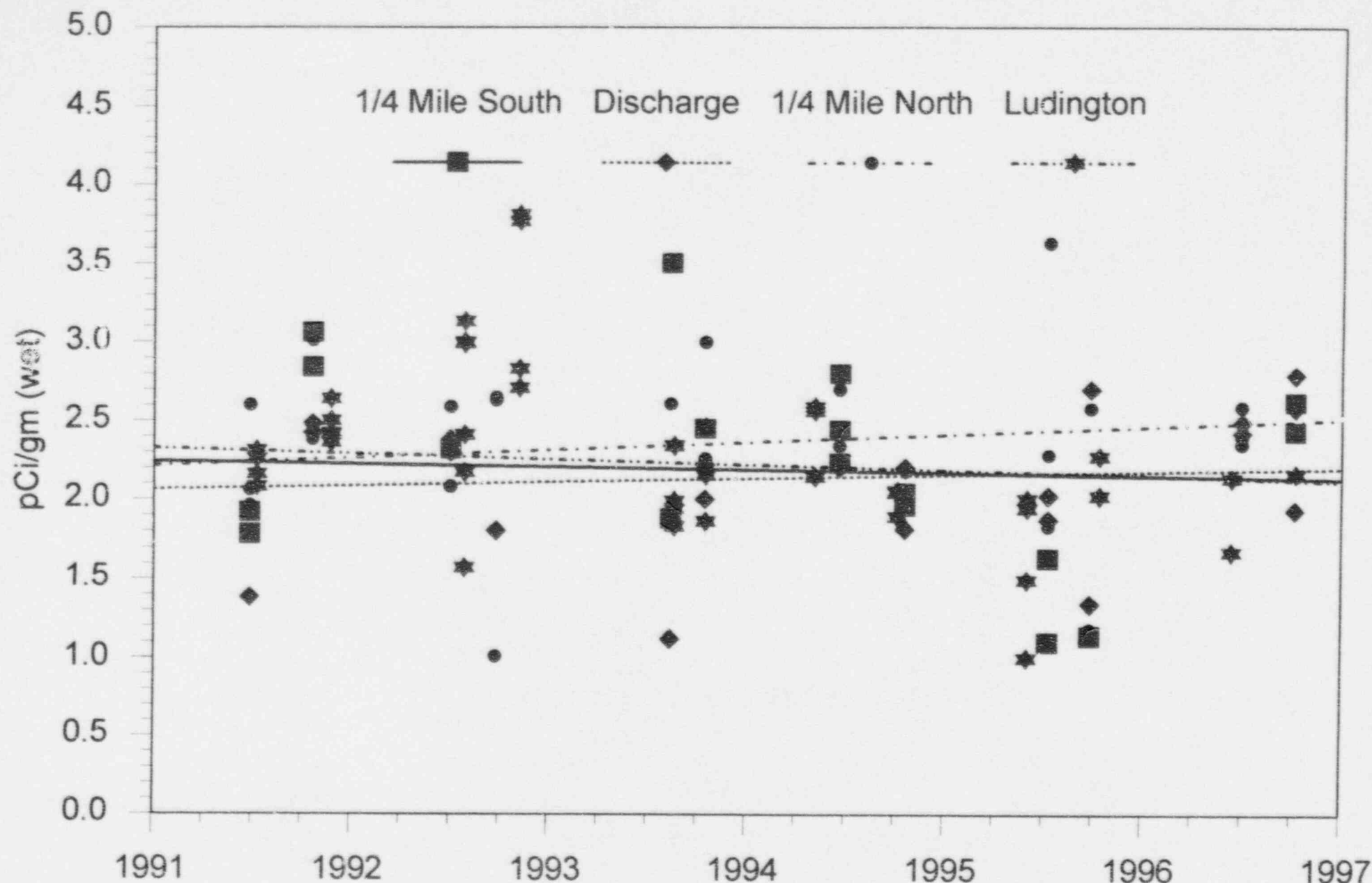
## Pre-Operational vs Operational



Pre-Operational Levels: South=14.3, Site=11.6, North=16.0

# Big Rock Point Fish Gross Beta

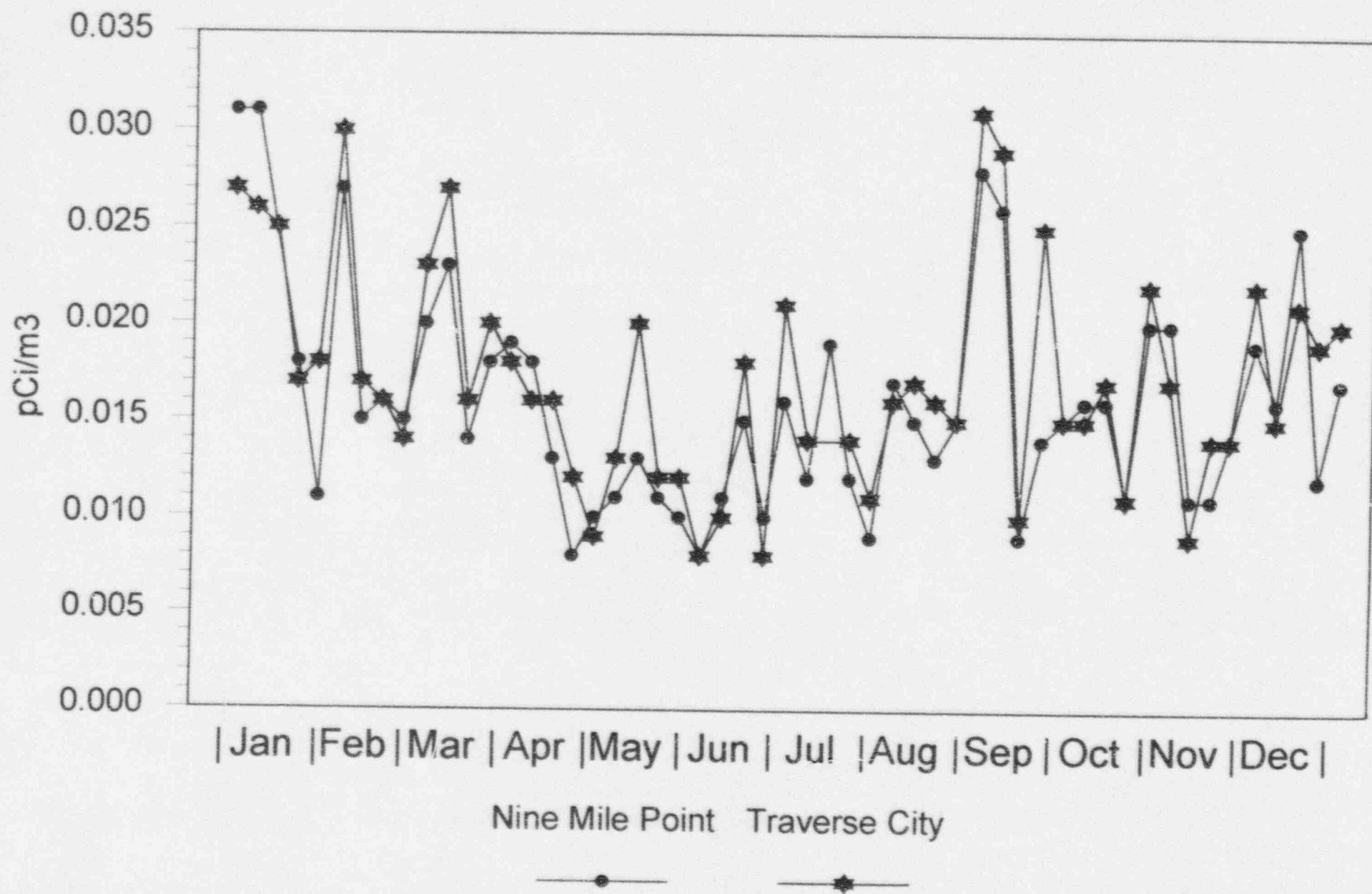
1991 - 1996



Action Level = 30

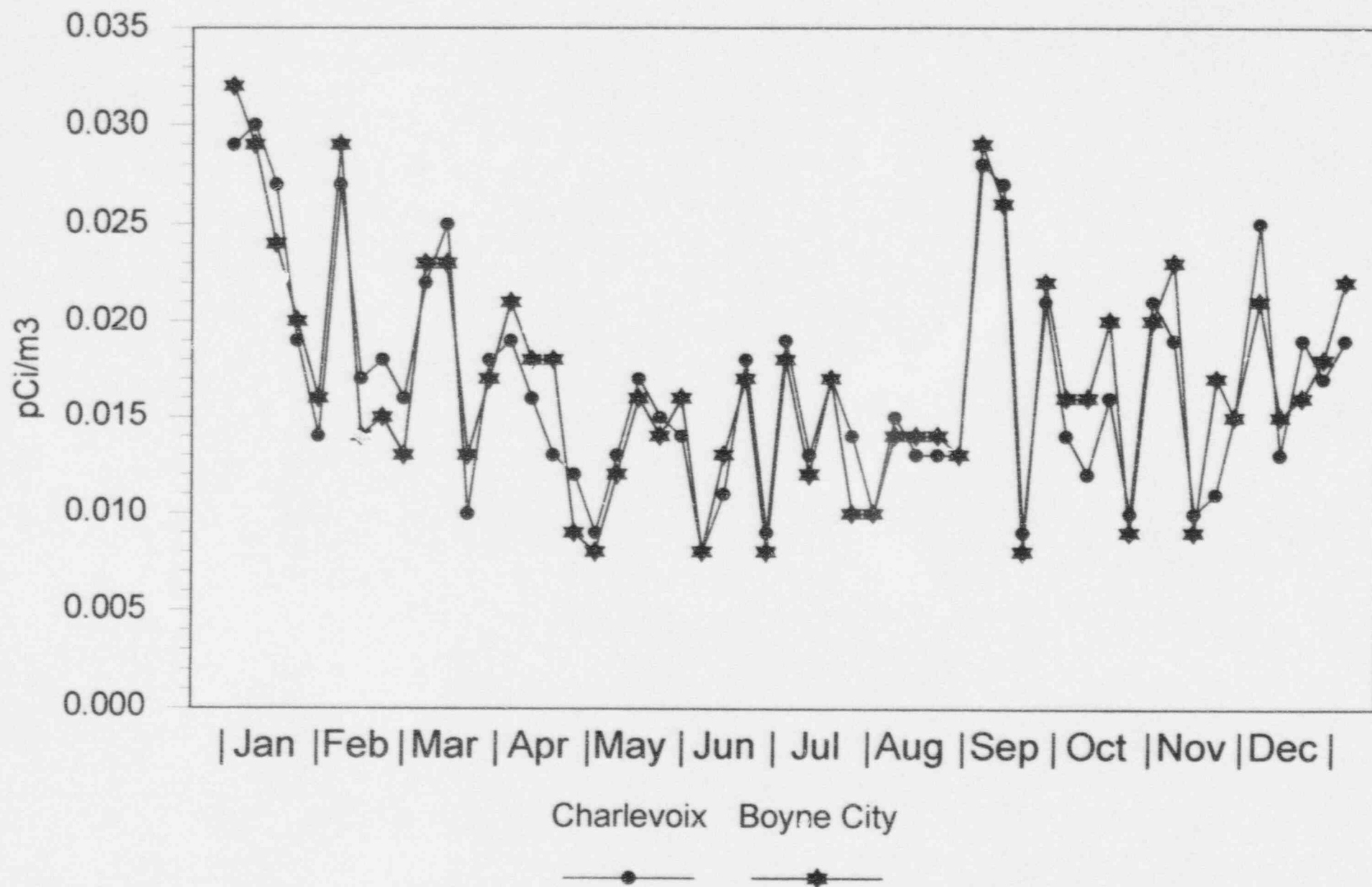
# 1996 Big Rock Air Particulate Weekly Gross Beta

Traverse City - Control vs. Nine Mile Point



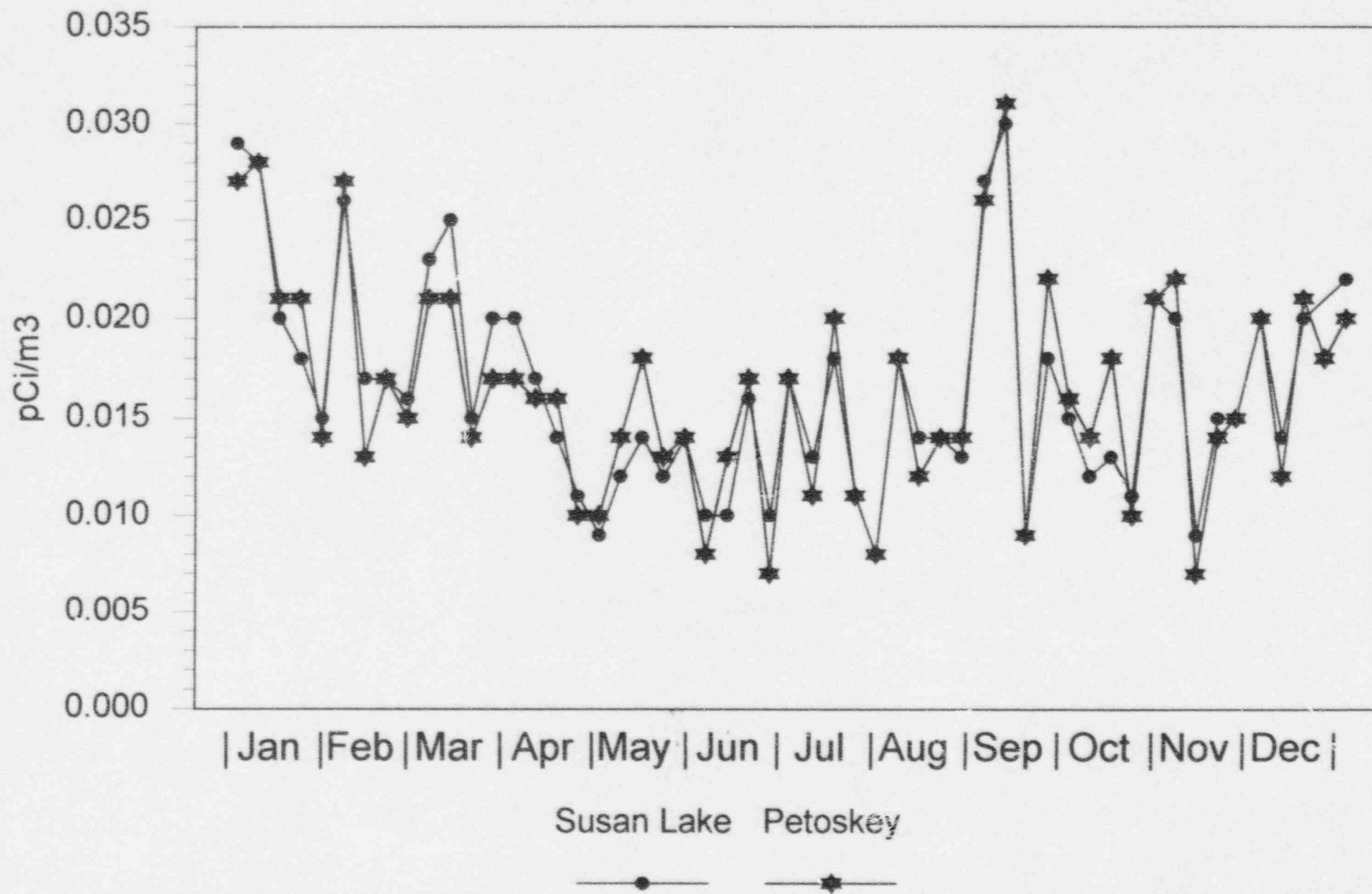
# 1996 Big Rock Air Particulate Weekly Gross Beta

Boyne City Control vs. Charlevoix



# 1996 Big Rock Air Particulate Weekly Gross Beta

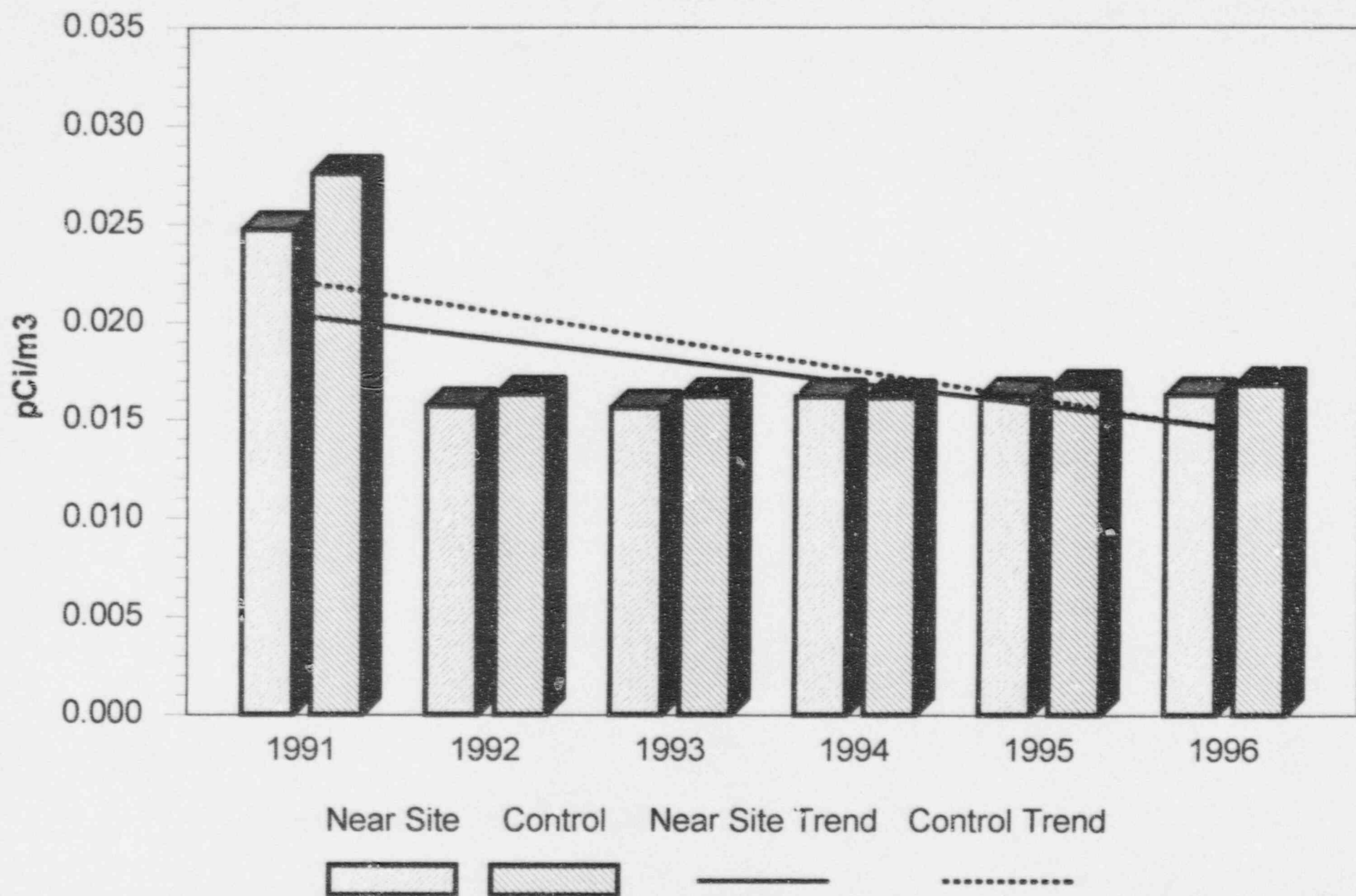
Petoskey - Control vs. Susan Lake



# Big Rock Air Particulate

Gross Beta

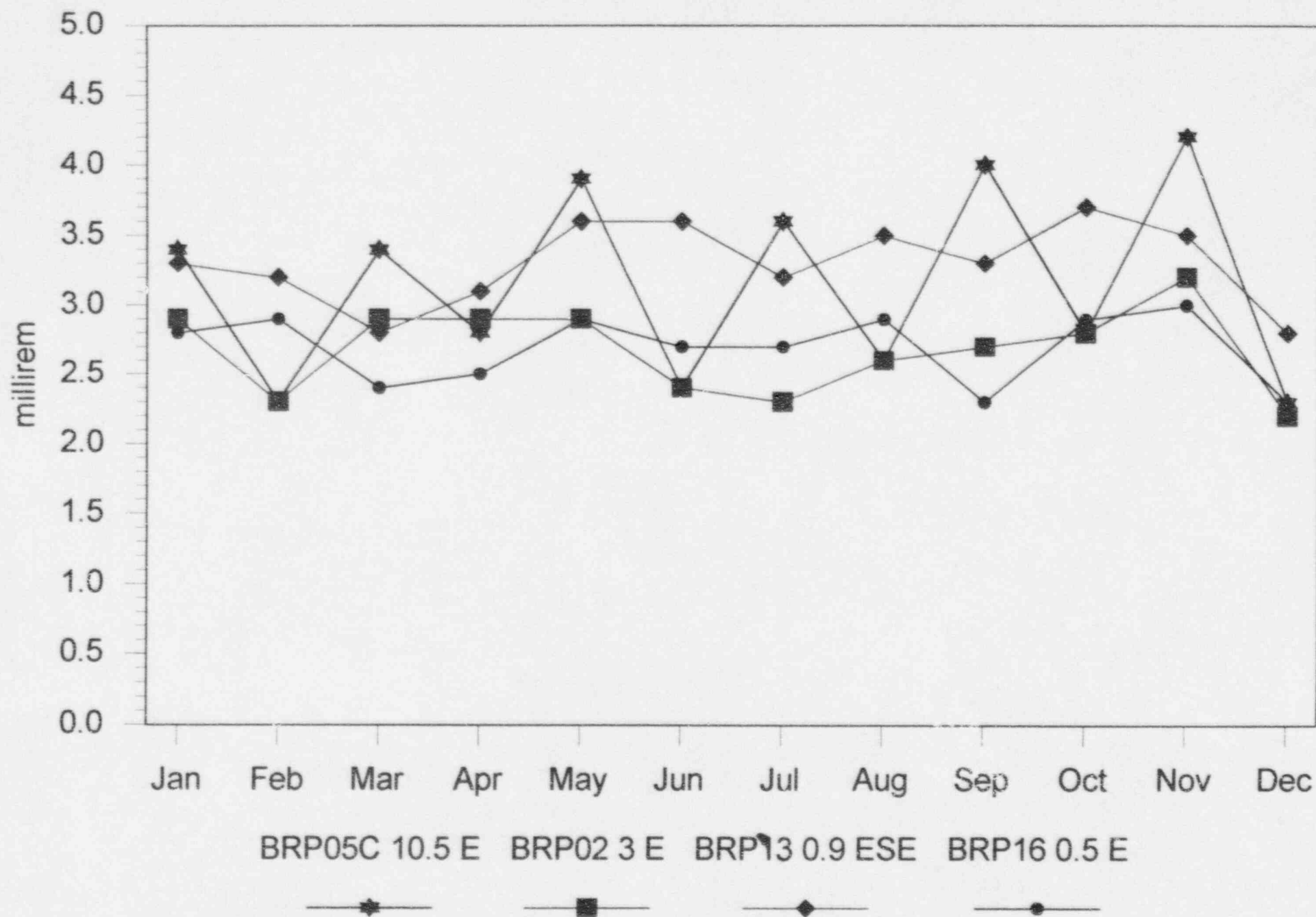
1991 - 1996





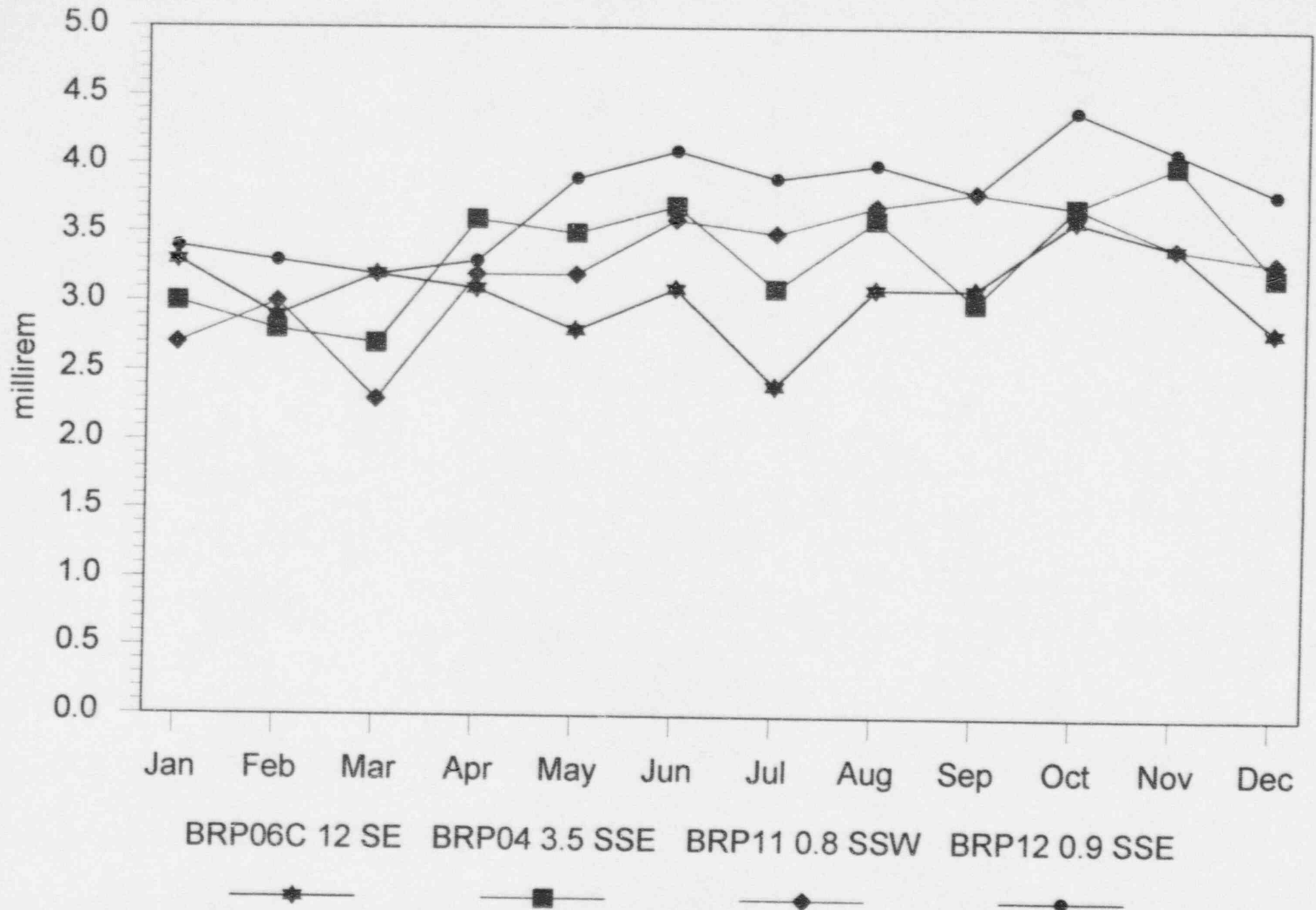
# 1996 Big Rock Point TLDs

BRP05 Control vs BRP02, BRP13 and BRP16



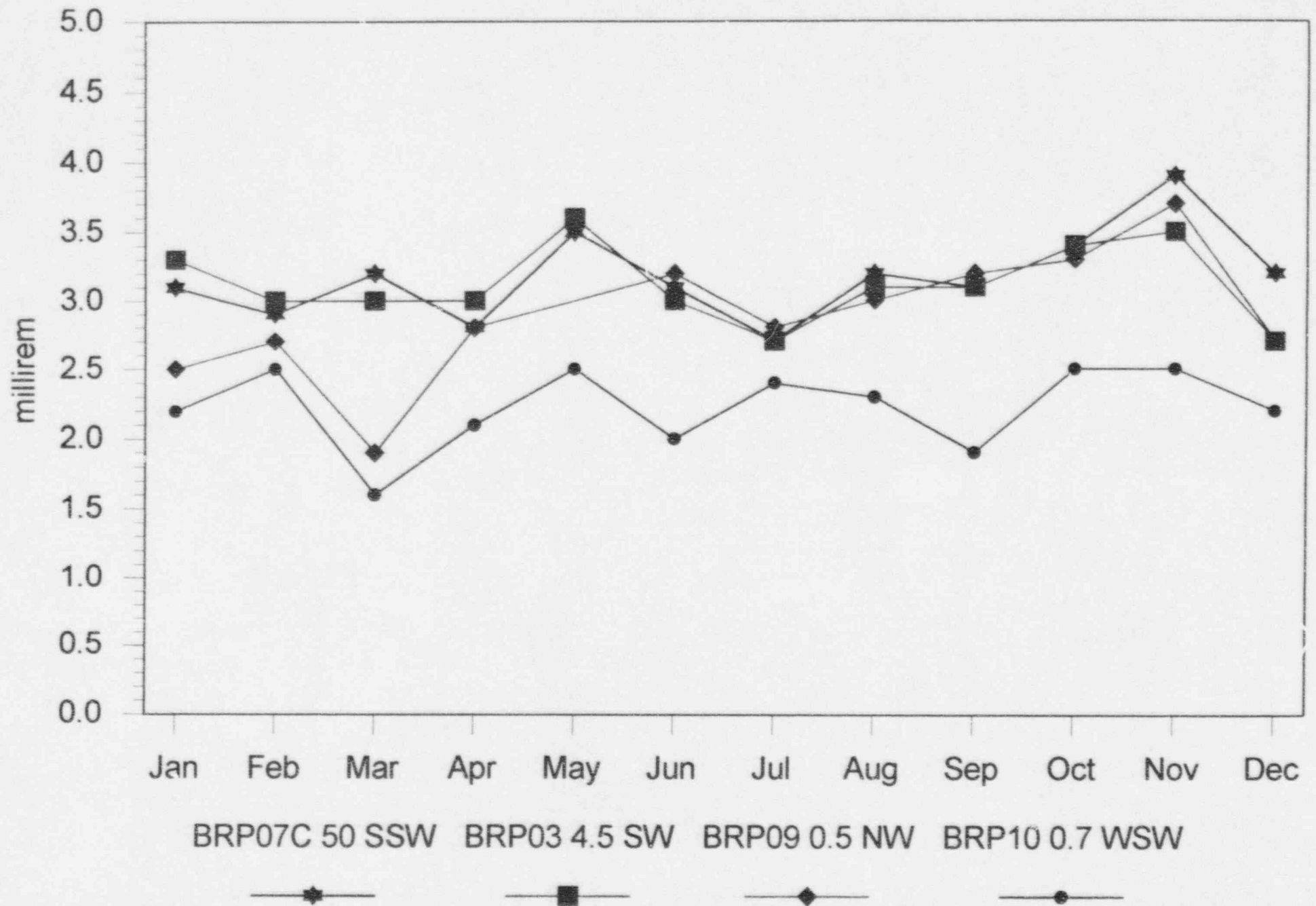
# 1996 Big Rock Point TLDs

BRP06 Control vs BRP04, BRP11 and BRP12



# 1996 Big Rock Point TLDs

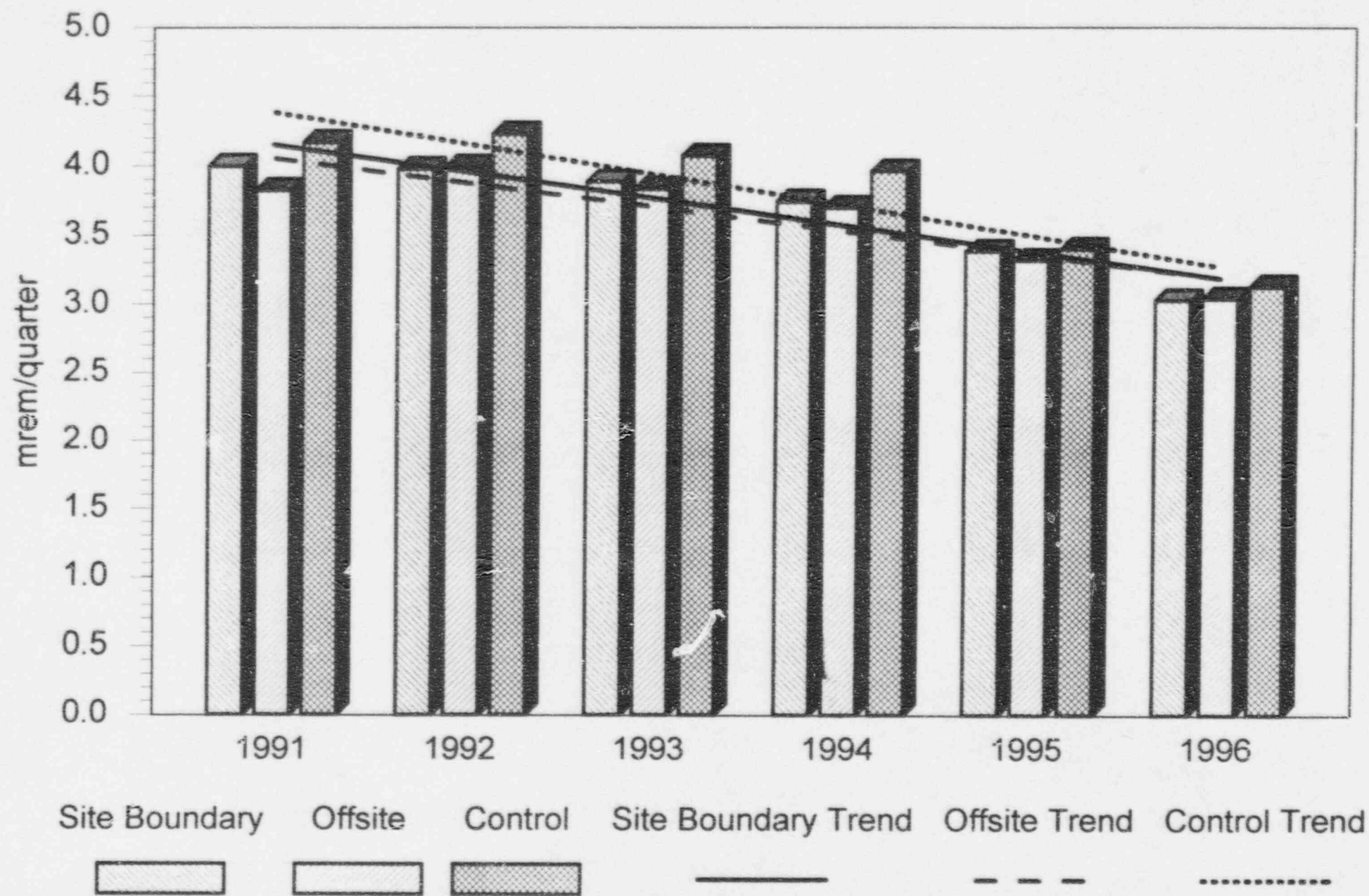
BRP07 Control vs BRP03, BRP09 and BRP10



# Big Rock Point

## Monthly TLDs

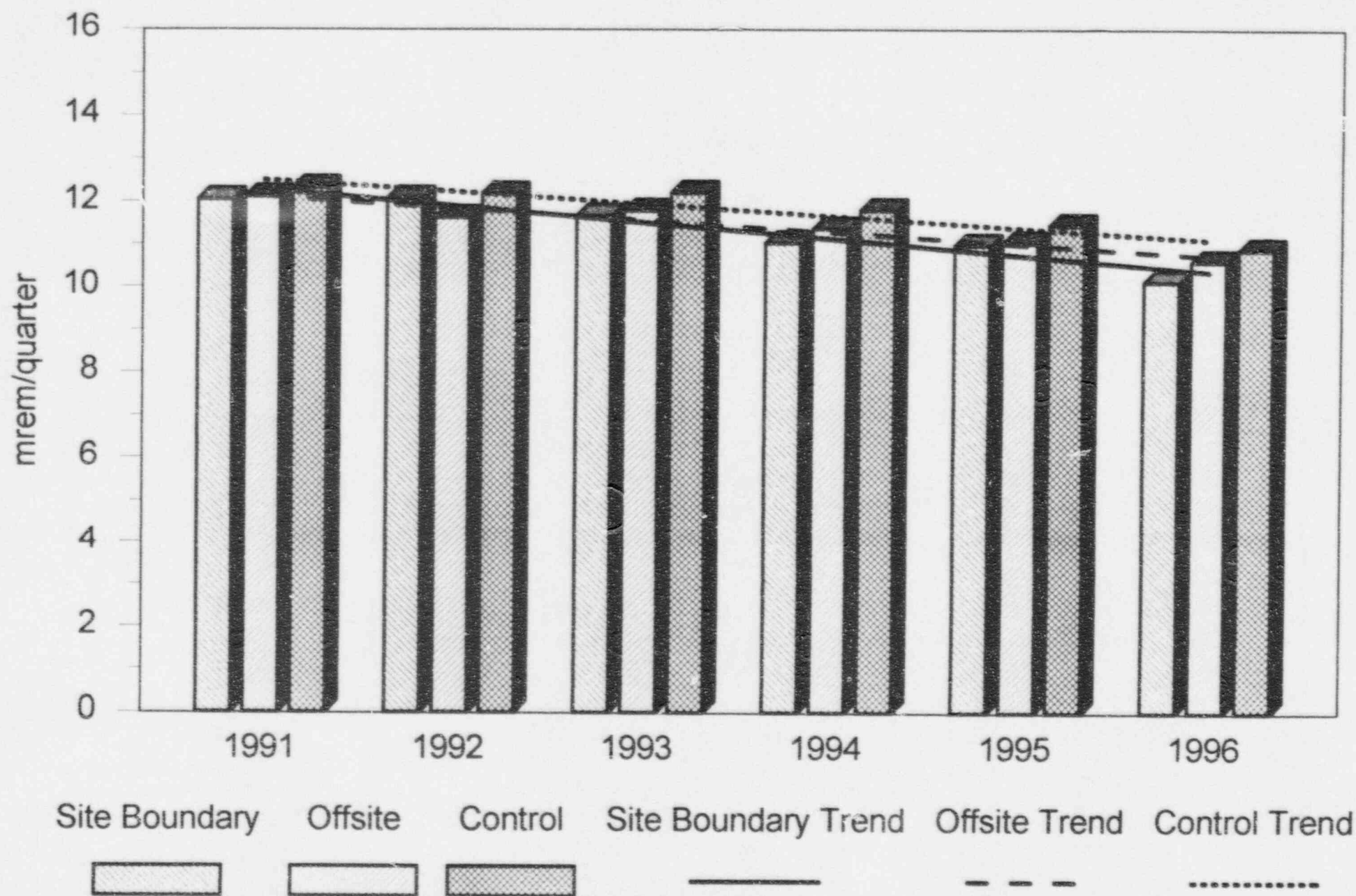
1991 - 1996



# Big Rock Point

## Quarterly TLDs

1991 - 1996





# Big Rock Point

## Annual TLDs

1991 - 1996

