SECTION 3 – LAND USE CENSUS

A. **Land Use Census Overview:** A Land Use Census was conducted July 19 through September 16, 2011 to comply with:

- Offsite Dose Calculation Manual procedure 1/2-ODC-3.03, "*Controls for RETS and REMP Programs*", Attachment R, Control 3.12.2, and Surveillance Requirement 4.12.2.1

- BVPS REMP procedure 1/2-ENV-04.02, *"Milch Animal Sampling Location Determination & ODCM Procedure 1/2-ODC-3.03, Control 3.12.2 Action Statements a and b Compliance Determination"*

The Land Use census indicated that no changes were required in the current sampling locations, and no changes were required to the methodology used for determination of offsite dose from plant releases. A numerical summary of the Land Use Census results are provided in Table 3-1. The following information is also provided to clarify the Land Use Census as documented in letter NPD3NRE:0796, dated September 27, 2011:

B. **Nearest Residence:** The location has not changed since the previous census. The location remains at the **Terwilliger Residence**, 211 Ferry Hill Road, Shippingport, PA (0.406 miles, NE).

C. **Nearest Garden >500 sqft**: The location has not changed since the previous census. The location remains at the **Knisley Residence**, 175 Kerona Road, Shippingport, PA (0.7 miles, NE). However, this garden has not joined our sampling program because it does not contain leafy vegetables most appropriate for sampling (i.e. cabbage or lettuce) this year. The previous sampling location at the **Cox Residence**, 238 State Route 168, Hookstown, PA (0.760 miles, in the SSW Sector) was available for sampling cabbage this year and remains the nearest garden meeting all the requirements of NUREG-1301.

D. **Nearest Dairy Cow:** The location has not changed since the previous census. The location remains at the **Searight Dairy**, 948 McCleary Road, RD 1, Hookstown, PA (2.097 miles, SSW).

E. **Nearest Doe Goat:** The location has changed since the previous census. The location is once again the **Collins Farm**, 289 Calhoun Road, Aliquippa, PA (3.547 miles SE). However, goat milk samples were not available from this location, nor from any other location within the 5 mile radius this year (documented in CR #2011-02332).

F. **Projection for 2012 Dairy Cow Sampling Locations:** Using a linear regression analysis of deposition parameters (D/Q), Dairy Cow sampling locations were determined to remain at the same locations used in 2011:

- **Searight Dairy**, 948 McCleary Road, RD1, Hookstown, PA (2.097 miles SSW)

SECTION 3 – LAND USE CENSUS

- **Halstead Dairy**, 104 Tellish Drive, Hookstown, PA (5.079 miles SSW)
- **Brunton Dairy**, 3681 Ridge Road, Aliquippa, PA (6.158 miles SE)
- **Windsheimer Dairy**, RD 1 Burgettstown, PA (10.476 miles SSW)

G. Projection for 2012 Doe Goat Sampling Locations: The linear regression analysis also indicated that there may be a Doe Goat sampling location in 2012. The Doe Goat sampling location for 2012 may be as follows if Goat Milk becomes available from this site:
- **Collins Farm,** 289 Calhoun Road, Aliquippa, PA (3.547 miles SE)

H. D/Q for Milch Animal Locations: None of the 2011 milch animal sampling locations experienced a >20% increase in D/Q. Therefore, a Special Report per ODCM procedure 1/2-ODC-3.03, Attachment R, Control 3.12.2 Action "a" and/or Action "b" was not required.

I. D/Q for Offsite Dose Determination: There was no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, a linear regression analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% more than the offsite dose previously calculated using current ODCM methodology. Therefore, a Special Report per ODCM procedure 1/2-ODC-3.03, Attachment R, Control 3.12.2 Action "a" and/or Action "b" was not required.

J. D/Q Historical Comparison: There was no adverse trend in D/Q when comparing historical data to the ODCM default D/Q values. This validates that there was no adverse effect on the current ODCM methodology used for offsite dose determination from effluent releases. Specifically, the analysis of D/Q did not yield any valid locations where the offsite dose could have increased >20% more than the offsite dose previously calculated using current ODCM methodology. Therefore, a change in ODCM Receptor location and/or a change to meteorology at the current ODCM Receptor location are not required.

Special Note: The Knisley Residence, 175 Kerona Road, Shippingport, PA (0.7 miles, NE) trends approximately 20% higher (119.5%) than the historic ODCM values. However, the calculations utilized for Offsite Dose Determination advises that there is no adverse effect from this receptor location. Furthermore, this receptor does not meet the assumption of NUREG-1301 that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage) in order to provide assurance of significant exposure through Regulatory Guide 1.109 methodology. In conclusion, until the Knisley Garden begins to grow broadleaf vegetation as defined by NUREG-1301, this receptor may continue to be trended but not utilized for ODCM Receptor location changes.

SECTION 3 – LAND USE CENSUS

K. Discrepancies or Conditions of Note:

Condition Report # 2011-02332 documented that the Doe Goat location identified at the Collins Farm at 289 Calhoun Road, Aliquippa, PA (3.547 miles SE) has not been able to provide enough milk to participate in the Radiological Environmental Monitoring Program (REMP) sampling program for 2011. It is unknown as to whether or not it will be able to in the future.

In 2010, the same occurrence happened at the Ferry Farm, 227 Calhoun Road, Aliquippa, PA (3.320 miles SE) and was documented in CR #10-82742.

These two sample locations may need to be dropped from the REMP. However, 1/2-ODC-2.03 Step 8.4.1.3 requires that the NRC be notified in writing when samples are no longer obtainable from a milk sample location before they are dropped from the REMP surveillance program. Therefore, the BVPS REMP continued to monitor these two goat locations throughout the season, but may discontinue monitoring once this 2011 annual report has been submitted to the NRC.

The unavailability of goat milk at these two locations were causing the REMP to not meet the ODCM sample requirements in 1/2-ODC-2.03 and in 1/2-ODC-3.03, Attachment Q Table 3.12-1 stating that a minimum of four (4) milk locations shall be sampled. There are no other milk animal locations available to add to the REMP, as all milk animal sites located within the 5 mile radius of BVPS are currently participating in the sampling program.

While efforts will continue each season to search for new dairy locations, BVPS found it more prudent to change the ODCM requirements to allow for an increase in vegetation sampling as an alternative to the condition of declining milk sample locations.

SECTION 3 – LAND USE CENSUS

Table 3-1

Location of Nearest Residences, Gardens, Dairy Cows and Doe Goats

SECTOR	RESIDENCES 0 to 5 miles (miles)	GARDENS 0 to 5 miles (miles)	DAIRY COWS 0 to 5 miles (miles)	DOE GOATS 0 to 5 miles (miles)
N	1.584	1.584	None	None
NNE	1.661	3.1	None	None
NE	**0.406** [b]	**0.7** [b]	None	None
ENE	0.603	1.047	None	None
E	0.429	2.0	None	3.402
ESE	0.850	1.713	None	None
SE	1.583	1.5	None [a]	**3.547** [b]
SSE	1.102	3.1	None	None
S	1.399	2.354	3.851	None
SSW	0.760	0.760	**2.097** [b]	None
SW	1.453	1.453	None	None
WSW	1.394	2.5	None	None
W	2.204	None	None	None
WNW	2.742	2.8	None	None
NW	0.885	1.033	None	None
NNW	0.902	2.4	2.442	None

[a] Although there are no Dairy Cows within 5 miles in this sector, a large local dairy located at 6.158 miles is included in the milk sampling program.

[b] **Distances shown in Bold print are the nearest location for that receptor.**

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

A. **Split Sample Program (Inter-Laboratory Comparison, Part 1 of 2):** BVPS participates in a split sample program with the Pennsylvania Department of Environmental Protection (PADEP) in support of their nuclear power plant monitoring program.

- BVPS provided split samples to PADEP throughout the report period. The shared media and number of locations were typically comprised of; milk (1), surface water (3), sediment (1), fish (1), and food crops (2).
- PADEP has co-located continuous air particulate & air iodine sample stations with four (4) of the BVPS locations.
- PADEP has co-located TLDs with twenty-four (24) of the BVPS TLDs.

B. **Spike Sample Program (Inter-Laboratory Comparison, Part 2 of 2):** BVPS participates in a spike sample program with an Independent Laboratory. This program is used to independently verify sample analyses performed by the BVPS Contractor Laboratory.

- **Acceptance Criteria:** The NRC criteria listed in NRC Inspection Procedure 84750, 03/15/94, Inspection Guidance 84750-03 is used as acceptance criteria for comparisons of results of spiked samples between the Contractor Lab and the Independent Lab. These comparisons are performed by dividing the comparison standard (Independent Lab result) by its associated uncertainty to obtain the resolution. The comparison standard value is multiplied by the ratio values obtained from the following table to find the acceptance band for the result to be compared. However, in such cases where the counting precision of the standard yields a resolution of less than 4, a valid comparison is not practical, and therefore, not performed.

NRC Criteria	
Resolution	**Ratio**
< 4	--
4 - 7	0.50 - 2.00
8 - 15	0.60 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
> 200	0.85 - 1.18

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Participation in an Inter-Laboratory Comparison Program is required by BVPS Unit 1 and 2 Offsite Dose Calculation Manual procedure 1/2-ODC-3.03 Attachment S Control 3.12.3. For the report period, the requirement was met by the Contractor Lab analyzing NIST traceable spiked samples supplied by an Independent Lab.

During the report period, BVPS used (Environmental, Inc., Midwest Laboratory – Northbrook, IL) as the Contractor Laboratory, and (Analytics – Atlanta, GA) as the Independent Laboratory.

The spiked samples included air particulate filter papers, charcoal cartridges, water samples, and milk samples. The samples were submitted by the Independent Laboratory to the Contractor Laboratory for analysis. The "spiked to" values were used for calculating comparison Acceptance Criteria.

- **Spiked Milk & Water Samples:** The spiked sample results (i.e.; the BVPS criteria) for each calendar quarter are reported in Table 4-1 through Table 4-4, respectively. The following summary is provided:
  - A total of forty-six (46) gamma spectrometry radionuclide analyses were performed by the Contractor Laboratory on four (4) milk samples.
  - A total of forty-six (46) gamma spectrometry radionuclide analyses were performed by the Contractor Laboratory on four (4) water samples.
  - A total of four (4) chemical analyses for I-131 were performed by the Contractor Laboratory on four (4) milk samples.
  - A total of four (4) chemical analyses for I-131 analyses were performed by the Contractor Laboratory on four (4) water samples.
  - A total of four (4) tritium analyses were performed by the Contractor Laboratory on four (4) water samples.
  - Comparison of results of the spiked milk and water samples showed acceptable agreement with the NRC acceptance criteria. All one-hundred-four (104) analyses met the NRC acceptance criteria.

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

- **Spiked Filter Paper and Charcoal Cartridge Samples:** The spiked sample results for each calendar quarter are also reported in Table 4-1 through Table 4-4, respectively. The following summary is provided:

  - Gross Beta (Cesium-137) analyses were performed by the Contractor Laboratory on two (2) filter paper samples.

  - Iodine-131 analyses were performed by the Contractor Laboratory on two (2) charcoal cartridge samples.

  - Comparison of results of the spiked filter paper and charcoal cartridge samples showed acceptable agreement with the NRC acceptance criteria. All four (4) analyses performed by the Contractor Laboratory met the NRC acceptance criteria.

C. Conclusions

- **Results of Split Sample Program:**

  The split sample program is coordinated by the state, and the results are not provided with this report.

- **Results of Spike Sample Program:**

  Based on the Inter-Laboratory comparison data, BVPS considers all analyses provided throughout the report period by the Contractor Laboratory to be acceptable with respect to both accuracy and measurement. A comparison of the data is provided in the following tables. All analyses for the 2011 report period were within the NRC Acceptance Criteria.

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-1

Inter-Laboratory Comparison Program Spiked Samples – 1st Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
03/17/11 Water Ind Lab: E7472-93 Con. Lab: SPW-1134	Sr-89	60	0.80 - 1.25	0.98	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.82	AGREEMENT
	I-131	60	0.80 - 1.25	0.96	AGREEMENT
	I-131	60	0.80 - 1.25	0.98	AGREEMENT
	Ce-141	60	0.80 - 1.25	not present	n/a
	Cr-51	60	0.80 - 1.25	1.03	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.95	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.07	AGREEMENT
	Co-58	60	0.80 - 1.25	1.01	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.05	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.08	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	1.02	AGREEMENT
03/17/11 Water Ind. Lab: E7471-93 Con. Lab: SPW-1133	H-3	60	0.80 - 1.25	1.06	AGREEMENT
03/17/11 Milk Ind. Lab: E7473-93 Con. Lab: SPMI-1135	Sr-89	60	0.80 - 1.25	0.93	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	0.90	AGREEMENT
	I-131	60	0.80 - 1.25	0.95	AGREEMENT
	Ce-141	60	0.80 - 1.25	not present	n/a
	Cr-51	60	0.80 - 1.25	1.04	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.91	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.01	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.02	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.07	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	1.00	AGREEMENT
03/17/11 Filter Paper Ind. Lab: E7474-93 Con. Lab: SPAP-1136	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.17	AGREEMENT
03/17/11 Charcoal Cartridge Ind. Lab: E7475-93 Con. Lab: SPCH-1137	I-131	60	0.80 - 1.25	0.93	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-2

Inter-Laboratory Comparison Program Spiked Samples – 2nd Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
06/16/11 Water Ind Lab: E7857-93 Con. Lab: SPW-3817	Sr-89	60	0.80 - 1.25	0.93	AGREEMENT
	Sr-90	60	0.80 - 1.25	1.02	AGREEMENT
	I-131	60	0.80 - 1.25	0.91	AGREEMENT
	I-131	60	0.80 - 1.25	0.94	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.98	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.05	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.03	AGREEMENT
	Co-58	60	0.80 - 1.25	1.02	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.01	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.08	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.03	AGREEMENT
	Co-60	60	0.80 - 1.25	1.02	AGREEMENT
06/16/11 Water Ind. Lab: E7856-93 Con. Lab: SPW-3816	H-3	60	0.80 - 1.25	0.99	AGREEMENT
06/16/11 Milk Ind. Lab: E7858-93 Con. Lab: SPMI-3818	Sr-89	60	0.80 - 1.25	0.90	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.85	AGREEMENT
	I-131	60	0.80 - 1.25	0.93	AGREEMENT
	I-131	60	0.80 - 1.25	1.03	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.01	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.06	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.93	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.07	AGREEMENT
	Co-58	60	0.80 - 1.25	1.03	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.02	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.08	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	1.01	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-3

Inter-Laboratory Comparison Program Spiked Samples – 3rd Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
09/15/11 **Water** Ind Lab: E8114-93 Con. Lab: SPW-6247	Sr-89	60	0.80 - 1.25	0.99	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.83	AGREEMENT
	I-131	60	0.80 - 1.25	0.87	AGREEMENT
	I-131	60	0.80 - 1.25	0.96	AGREEMENT
	Ce-141	60	0.80 - 1.25	1.02	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.01	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.04	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.05	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.10	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.05	AGREEMENT
	Co-60	60	0.80 - 1.25	0.99	AGREEMENT
09/15/11 **Water** Ind. Lab: E8113-93 Con. Lab: SPW-6246	H-3	60	0.80 - 1.25	0.97	AGREEMENT
09/15/11 **Milk** Ind. Lab: E8115-93 Con. Lab: SPMI-6248	Sr-89	60	0.80 - 1.25	0.82	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.86	AGREEMENT
	I-131	60	0.80 - 1.25	0.92	AGREEMENT
	I-131	60	0.80 - 1.25	0.97	AGREEMENT
	Ce-141	60	0.80 - 1.25	0.97	AGREEMENT
	Cr-51	60	0.80 - 1.25	1.02	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.90	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.03	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.03	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.14	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.04	AGREEMENT
	Co-60	60	0.80 - 1.25	0.97	AGREEMENT
09/15/11 **Filter Paper** Ind. Lab: E8116-93 Con. Lab: SPAP-6249	Cs-137 (Gross Beta)	60	0.80 - 1.25	1.15	AGREEMENT
09/15/11 **Charcoal Cartridge** Ind. Lab: E8117-93 Con. Lab: SPCH-6250	I-131	60	0.80 - 1.25	0.95	AGREEMENT

SECTION 4 - SPLIT SAMPLE PROGRAM and SPIKE SAMPLE INTER-LABORATORY COMPARISON PROGRAM

Table 4-4

Inter-Laboratory Comparison Program Spiked Samples – 4th Quarter

Sample Date, Type and Identification No.	Resolution	Resolution	Required Ratio Band	Ratio Env Inc: Analytics	Comparison
12/08/11 Water Ind Lab: E8190-93 Con. Lab: SPW-8541	Sr-89	60	0.80 - 1.25	0.92	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.84	AGREEMENT
	I-131	60	0.80 - 1.25	0.95	AGREEMENT
	I-131	60	0.80 - 1.25	1.00	AGREEMENT
	Ce-141	60	0.80 - 1.25	not present	n/a
	Cr-51	60	0.80 - 1.25	0.97	AGREEMENT
	Cs-134	60	0.80 - 1.25	1.01	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.04	AGREEMENT
	Co-58	60	0.80 - 1.25	1.00	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.06	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.07	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.06	AGREEMENT
	Co-60	60	0.80 - 1.25	1.04	AGREEMENT
12/08/11 Water Ind. Lab: E8189-93 Con. Lab: SPW-8540	H-3	60	0.80 - 1.25	1.01	AGREEMENT
12/08/11 Milk Ind. Lab: E8191-93 Con. Lab: SPMI-8542	Sr-89	60	0.80 - 1.25	0.81	AGREEMENT
	Sr-90	60	0.80 - 1.25	0.83	AGREEMENT
	I-131	60	0.80 - 1.25	0.99	AGREEMENT
	I-131	60	0.80 - 1.25	1.03	AGREEMENT
	Ce-141	60	0.80 - 1.25	not present	n/a
	Cr-51	60	0.80 - 1.25	1.00	AGREEMENT
	Cs-134	60	0.80 - 1.25	0.94	AGREEMENT
	Cs-137	60	0.80 - 1.25	1.05	AGREEMENT
	Co-58	60	0.80 - 1.25	0.99	AGREEMENT
	Mn-54	60	0.80 - 1.25	1.06	AGREEMENT
	Fe-59	60	0.80 - 1.25	1.06	AGREEMENT
	Zn-65	60	0.80 - 1.25	1.08	AGREEMENT
	Co-60	60	0.80 - 1.25	1.03	AGREEMENT

SECTION 5 – CORRECTIONS TO PREVIOUS RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT(S)

Corrections to Previous Radiological Environmental Operating Report(s): There are no corrections to previous reports at this time.

Enclosure B
L-12-085

2011 Annual Environmental Operating Report (Non-Radiological)
(Report follows)

RTL# A9.630F

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION

2011 ANNUAL ENVIRONMENTAL OPERATING REPORT

NON-RADIOLOGICAL

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

BEAVER VALLEY POWER STATION
ENVIRONMENTAL & CHEMISTRY SECTION

Technical Report Approval

2011 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

(Non-Radiological)

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

Prepared by: Cameron L. Lange *(Via E-mail)* **Date:** 01/30/2012

Prepared by: Jason A. Ludwig **Date:** 03/06/2012

Reviewed by: Jonathan T. Earle **Date:** 3-12-12

Approved by: Donald J. Salera **Date:** 3-6-12

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report is submitted in accordance with Section 5.4.1 of Appendix B: To Facility Operating License No. NPF-73, Beaver Valley Power Station Unit 2, Environmental Protection Plan (Non-Radiological). Beaver Valley Power Station (BVPS) is operated by FirstEnergy Nuclear Operating Company (FENOC). The Objectives of the Environmental Protection Plan (EPP) are:

- Verify that the facility is operated in an environmentally acceptable manner, as established by the Final Environmental Statement-Operating License Stage (FES-OL) and other NRC environmental impact assessments.

- Coordinate NRC requirements and maintain consistency with other Federal, State, and local requirements for environmental protection.

- Keep NRC informed of the environmental effects of facility construction and operation and of actions taken to control those effects.

To achieve the objectives of the EPP, FENOC and BVPS have written programs and procedures to comply with the EPP, protect the environment, and comply with governmental requirements primarily including the US Environmental Protection Agency (EPA) and the Pennsylvania Department of Environmental Protection (PA DEP) requirements. Water quality matters identified in the Final Environmental Statements-Operating License Stage (FES-OL) are regulated under the National Pollutants Discharge Elimination System (NPDES) Permit No. PA0025615. Waste is regulated under EPA Identification No. PAR000040485. Attachment 10.1 contains a listing of permits and certificates for environmental compliance.

The BVPS programs and procedures include pre-work and pre-project environmental evaluations, operating procedures, pollution prevention and response programs procedures and plans, process improvement and corrective action programs, and human performance programs. Technical and managerial monitoring of tasks, operations, and other activities are performed. Any identified challenges, concerns, or questions are captured in the FENOC Problem Identification and Resolution Program with a Condition Report. Condition Reports include investigations, cause determinations, and corrective actions.

During 2011 BVPS continued an Aquatic Monitoring Program to evaluate its potential impact on the New Cumberland Pool of the Ohio River, and to provide information on potential impacts to BVPS operation from macrofoulers such as Asian clams and zebra mussels.

1.2 SUMMARY AND CONCLUSIONS

There were no significant environmental events during 2011. During 2011, no significant changes to operations that could affect the environment were made at Beaver Valley Power Station. ***As in previous years, results of the BVPS environmental programs did not indicate any adverse environmental impacts from station operation.***

1.3 ANALYSIS OF SIGNIFICANT ENVIRONMENTAL CHANGE

During 2011, no significant changes were made at BVPS to cause significant negative affect on the environment.

1.4 AQUATIC MONITORING PROGRAM EXECUTIVE SUMMARY

The 2011 Beaver Valley Power Station (BVPS) Units 1 and 2 Non-Radiological Monitoring Program consisted of an Aquatic Program that included surveillance and field sampling of the Ohio River's aquatic life in the vicinity of the station. The Aquatic Program is an annual program conducted to provide baseline aquatic resources data, to assess the impact of the operation of BVPS on the aquatic ecosystem of the Ohio River, and to monitor for potential impacts of biofouling organisms (*Corbicula* and zebra mussels) on BVPS operations. This is the 35th year of operational environmental monitoring for Unit 1 and the 24th year for Unit 2. As in previous years, the results of the program did not indicate any adverse environmental impact to the aquatic life in the Ohio River associated with the operation of BVPS.

The results of the 2011 benthic macroinvertebrate survey conducted in June and September indicated a normal community structure exists in the Ohio River both upstream and downstream of the BVPS. These benthic surveys are a continuation of a Fate and Effects Study conducted from 1990 through 1992 for the Pennsylvania Department of Environmental Protection (PADEP) to assess the ecosystem impacts of the molluscicides Nalco products H150M and Sodium Hypochlorite that are used to control biofouling organisms at BVPS. To date the results of the benthic studies have not indicated any impacts of operation at the BVPS including the use these biocides on the benthic community below the BVPS discharge.

Substrate was probably the most important factor influencing the distribution and abundance of the benthic macroinvertebrates in the Ohio River near BVPS. The generally soft muck-type substrate along the shoreline found in 2011 and previous years was conducive to segmented worm (oligochaete) and midge fly larvae (chironomid) proliferation. Fifty-four (54) macroinvertebrate taxa were identified during the 2011 monitoring program. In 2011 two new taxa were added to the cumulative list of macroinvertebrates collected near BVPS (Table 5.2). One taxon was *Pseudochironomis* sp, which is a chironomid (midge fly). The other new taxon was *Bithynia* sp., which is a non-indigenous snail that was introduced to the freshwaters of the northeastern United States in the 1870s and has become established in many slow moving rivers and freshwater water lakes. No state or Federal threatened or endangered macroinvertebrate species were collected during 2011.

In May oligochaetes were the most frequently collected group of macroinvertebrate, while in

September chironomids were the most frequently collected group. ***There were no major differences in the community structure between control and non-control stations that could be attributed to operation of BVPS. The overall community structure has changed little since pre-operational years, and program results did not indicate that BVPS operations were affecting the benthic community of the Ohio River.***

The fish community of the Ohio River near the BVPS was sampled in June (spring), July (summer), September (fall) and November (winter) of 2011 with nighttime electrofishing and daytime seining. Since monitoring began in the early 1970's, the number of identified fish taxa has increased from 43 to 78 for the New Cumberland Pool.

Benthivores (bottom feeders including suckers and buffalo) and forage species (e.g. gizzard shad and emerald shiners) were generally collected in the highest numbers in 2011. The total number of forage species collected in 2011 was less than in 2010. Variations in annual catch were probably attributable to normal fluctuations in the population size of the forage species and the predator populations that rely on them. Forage species, such as gizzard shad and emerald shiner with high reproductive potentials, frequently respond to changes in natural environmental factors (competition, food availability, cover, and water quality) with large fluctuations in population size. This, in turn, influences their appearance in the sample populations during annual surveys. Spawning/rearing success due to abiotic factors is usually the determining factor of the size and composition of a fish community.

In 2011, the annual catch rate was 0.93 fish per minute. The greatest catch rate in 2011 occurred in fall (September) when the catch rate was 1.42 fish per minute. Shorthead redhorse sucker and smallmouth bass contributed to the majority of this total. The lowest catch rate occurred in summer (July) with a rate of 0.47 fish per electrofishing minute. The annual catch rates were consistent over the four years ranging from a high of 1.98 fish per minute in 2008 to 0.93 in 2011.

Little difference in the species composition of the catch was observed between the control (Station 1) and non-control (Stations 2A, 2B and 3) stations. Habitat preference and availability were probably the most important factors affecting where and when fish were collected. ***Results from the 2011 fish surveys indicated that a normal community structure for the Ohio River exists near BVPS based on species composition and relative abundance. In 2011, there was no indication of negative impact to the fish community in the Ohio River from the operation of BVPS.***

The monthly reservoir ponar samples collected in Units 1 and 2 cooling towers and the four samples collected at the intake during 2011 indicated that *Corbicula* were present in the Ohio River and entering the station. Although no settled Corbicula were collected in cooling tower ponar sampling in 2011, their presence in the river and in the cooling tower reservoirs as juveniles, indicates that they are still available for settlement. ***Overall, the numbers of Corbicula collected in the samples were comparatively low, which continued the trend over the past few years of fewer Corbicula and reflected a water-body-wide trend observed in the Ohio River.***

In 1995, live zebra mussels were collected for the first time by divers in the BVPS main intake and auxiliary intake structures during scheduled cleanings. Overall, both the number of observations and densities of settled mussels were similar in 2003-present although somewhat higher in 2008 and 2010. In 2011, settlement was noted at the intake and at the barge slip. Overall, veliger densities in 2011 were lower than 2010, but comparable to 2009. This is likely due to annual variability in numbers of veligers in the Ohio River. ***Although densities of settled mussels in the vicinity of BVPS are low compared to other populations such as in the Lower Great Lakes, densities comparable to those in the Ohio River are sufficient to cause problems in the operation of untreated cooling water intake systems.***

2.0 ENVIRONMENTAL PROTECTION PLAN NON-COMPLIANCES

There were no Environmental Protection Plan non-compliances identified in 2011.

3.0 CHANGES INVOLVING UNREVIEWED ENVIRONMENTAL QUESTIONS

No Unreviewed Environmental Questions were identified in 2011. Therefore, there were no changes involving an Unreviewed Environmental Question.

4.0 NON-ROUTINE ENVIRONMENTAL REPORT

There were no non-routine environmental reports in 2011.

5.0 AQUATIC MONITORING PROGRAM

This section of the report summarizes the Non-Radiological Environmental Program conducted for the BVPS, Units 1 and 2; Operating License Numbers DPR-66 and NPF-73. This is a non-mandatory program, because on February 26, 1980, the Nuclear Regulatory Commission (NRC) granted BVPS's request to delete all of the Aquatic Monitoring Program, with the exception of the fish impingement program (Amendment No. 25), from the Environmental Technical Specifications (ETS). In 1983, BVPS was permitted to also delete the fish impingement studies from the ETS program of required sampling along with non-radiological water quality requirements. However, in the interest of providing an uninterrupted database, BVPS has continued the Aquatic Monitoring Program.

The objectives of the 2011 environmental program were:

- To monitor for any possible environmental impact of BVPS operation on the benthic macroinvertebrate and fish communities in the Ohio River;
- To provide a low level sampling program to continue an uninterrupted environmental database for the Ohio River near BVPS, pre-operational to present; and
- To evaluate the presence, growth, and reproduction of macrofouling *Corbicula* (Asiatic clam) and zebra mussels (*Dreissena* spp.) at BVPS.

5.1 SITE DESCRIPTION

BVPS is located on an approximately 453-acre tract of land on the south bank of the Ohio River in the Borough of Shippingport, Beaver County, Pennsylvania. The Shippingport Atomic Power Station once shared the site with BVPS before being decommissioned. Figure 5.1 is a plan view of BVPS. The site is approximately 1 mile (1.6 km) from Midland, Pennsylvania; 5 miles (8 km) from East Liverpool, Ohio; and 25 miles (40 km) from Pittsburgh, Pennsylvania. The population within a 5-mile (8 km) radius of the plant is approximately 18,000. The Borough of Midland, Pennsylvania has a population of approximately 3,500.

The station is situated at Ohio River Mile 34.8 (Latitude: 40° 36' 18"; Longitude: 80° 26' 02") at a location on the New Cumberland Pool that is 3.1 river miles (5.3 km) downstream from Montgomery Lock and Dam and 19.6 miles (31.2 km) upstream from New Cumberland Lock and Dam. The Pennsylvania-Ohio-West Virginia border is 5.2 river miles (8.4 km) downstream from the site. The river flow is regulated by a series of dams and reservoirs on the Beaver, Allegheny, Monongahela, and Ohio Rivers and their tributaries.

The study site lies along the Ohio River in a valley, which has a gradual slope that extends from the river at an elevation of 665 ft (203 m) above mean sea level; to an elevation of 1,160 ft (354 m) along a ridge south of BVPS. The plant entrance elevation at the station is approximately 735 ft (224 m) above mean sea level.

BVPS Units 1 and 2 have a thermal rating of 2,900 megawatts (MW). Units 1 & 2 have a design electrical rating of 974 MW and 969 MW, respectively. The circulating water systems for each unit are considered a closed cycle system with continuous overflow, using a cooling tower to minimize heat released to the Ohio River. Commercial operation of BVPS Unit 1 began in 1976 and Unit 2 began operation in 1987.

5.2 STUDY AREA

The environmental study area was established to assess potential impacts and consists of four sampling stations, each having a north and south shore (Figure 5.1). Station 1 is located at River Mile (RM) 34.5, approximately 0.3 miles (0.5 km) upstream of BVPS and is the control station. Station 2A is located approximately 0.5 miles (0.8 km) downstream of the BVPS discharge structure in the main channel. Station 2B is located in the back channel of Phillis Island, also 0.5 miles downstream of the BVPS discharge structure. Station 2B is the principal non-control station because the majority of discharges from BVPS Units 1 and 2 are released to this back channel. Station 3 is located approximately two miles (3.2 km) downstream of BVPS and only rarely is influenced by the BVPS discharge.

5.3 METHODS

Shaw Environmental, Inc. (Shaw) was contracted to perform the 2011 Aquatic Monitoring Program as specified in BVBP-ENV-001-Aquatic Monitoring (procedural guide). This procedural guide references and describes in detail the field and laboratory procedures used in the various monitoring programs, as well as the data analysis and reporting requirements. These procedures are summarized according to task in the following subsections. Sampling was conducted according to the schedule presented in Table 5.1.

5.3.1 Benthic Macroinvertebrate Monitoring

The benthic macroinvertebrate monitoring program consisted of river bottom sampling using a Ponar grab sampler at four stations on the Ohio River. Prior to 1996, duplicate sampling occurred at Stations 1, 2A, and 3, while triplicate sampling occurred at Station 2B (i.e., one sample at each shoreline and mid-channel) (Figures 5.1 and 5.2). In 1996, a review of the sampling design indicated that sampling should be performed in triplicate at each station to conform to standardized U.S. Environmental Protection Agency (USEPA) procedures. Therefore, starting in 1996, triplicate samples were taken at Stations 1, 2A, and 3, as in 1995, with triplicate samples also collected at each shore and mid-channel location at Station 2B. A petite Ponar dredge was used to collect these samples, replacing the standard Ponar dredge used in prior studies.

Benthic macroinvertebrate sampling was scheduled to be conducted in May and September 2011. In spring, sampling was delayed until June due to extremely high river flows in May that made

sampling from a boat on the Ohio River unsafe. For each 2011 field effort, 18 benthic samples were collected and processed in the laboratory. All field procedures and data analyses were conducted in accordance with the procedural guide. The contents of each Ponar grab sample were gently washed through a U.S. Standard No. 30 sieve and the retained contents were placed in a labeled bottle and preserved in ethanol. In the laboratory, rose bengal stain was added to aid in sorting and identifying the benthic organisms. Macroinvertebrates were sorted from each sample, identified to the lowest taxon practical and counted. Mean density (number/m^2) for each taxon was calculated for each replicate. Four indices used to describe the benthic community were calculated: Shannon-Weiner diversity index, evenness (Pielou, 1969), species richness, and the number of taxa. These estimates provide an indication of the relative quality of the macroinvertebrate community.

5.3.2 Fish Monitoring

Fish sampling was conducted in 2011 to provide a continuous baseline of data and to detect possible changes that may have occurred in the fish populations in the Ohio River near BVPS. Fish population surveys have been conducted in the Ohio River near BVPS annually from 1970 through 2011. These surveys have resulted in the collection of 73 fish species and five different hybrids.

Adult fish surveys were scheduled to be performed in May, July, September, and November 2011. In spring, sampling was delayed until June due to extremely high river flows in May that made sampling from a boat on the Ohio River unsafe. During each survey, fish were scheduled to be sampled by standardized electrofishing techniques at four stations (Stations 1, 2A, 2B and 3) (Figure 5.3). Seining was scheduled to be performed at Station 1 (north shore) and Station 2B (south shore of Phillis Island) to sample species that are generally under-represented in electrofishing catches (e.g., young-of-the-year fish and small cyprinids).

Night electrofishing was conducted using a boat-mounted electroshocker with floodlights attached to the bow. A Smith-Root Type VI A variable voltage, pulsed-DC electrofishing unit powered by a 5-kW generator was used. The voltage selected depended on water conductivity and was adjusted to provide constant amperage (4-6 amps) of the current through the water. The north and south shoreline areas at each station were shocked for at least 10 minutes of unit "on" time (approximately five minutes along each shore) during each survey.

When large schools of fish of a single non-game species such as gizzard shad and shiners were encountered during electrofishing efforts, all of the stunned fish were not netted and retrieved onboard the boat. A few fish were netted for verification of identity, and the number of observed stunned fish remaining in the water was estimated. The size range of the individual fish in the school was also estimated and recorded. This was done in an effort to expedite sample processing and cover a larger area during the timed electrofishing run. Regardless of the number of individuals, all game fish were boated when observed.

Fish seining was performed at Station 1 (control) and Station 2B (non-control) during each of the four 2011 BVPS fishery surveys. A 30-ft long bag seine made of 1/4-inch nylon mesh netting was used to collect fish located close to shore in 1 to 4 ft of water. Three seine hauls were performed at both Station 1 (north shore) and Station 2B (south shore of Phillis Island) during each survey.

Fish collected during electrofishing and seining efforts were processed according to standardized procedures. All captured game fishes were identified to species, counted, measured for total length (nearest 1 mm), and weighed (nearest 1 g for fish less than or equal to 1000 g and the nearest 5 g for all other fish). Non-game fishes were counted, and a random subsample of lengths was taken. Live fish were returned to the river immediately after processing was completed. All fish that were unidentifiable or of questionable identification and were obviously not on the endangered or threatened species list were placed in plastic sample bottles, preserved, labeled and returned to the laboratory for identification. Any species of fish that had not previously been collected at BVPS was retained for the voucher collection. Any threatened or endangered species (if collected) would be photographed and released.

5.3.3 *Corbicula* Density Determinations for Cooling Tower Reservoirs

The *Corbicula* Monitoring Program at BVPS includes sampling the circulating river water and the service water systems of the BVPS (intake structure and cooling towers). The objectives of the ongoing Monitoring Program are to evaluate the presence of *Corbicula* at BVPS, and to evaluate the potential for and timing of infestation of the BVPS. This program is conducted in conjunction with a program to monitor for the presence of macrofouling zebra mussels (see Section 5.3.5).

Corbicula enter the BVPS from the Ohio River by passing through the water intakes, and eventually settle in low flow areas including the lower reservoirs of the Units 1 and 2 cooling towers. The density and growth of these *Corbicula* were monitored by collecting monthly samples from the lower reservoir sidewalls and sediments. The sampler used on the sidewalls consisted of a D-frame net attached behind a 24-inch long metal scraping edge. This device was connected to a pole long enough to allow the sampler to extend down into the reservoir area from the outside wall of the cooling tower. Sediments were sampled with a petite Ponar dredge.

Cooling tower reservoir sampling was historically conducted once per month. Beginning in December 1997, it was decided to forego sampling in cold water months since buildup of *Corbicula* does not occur then. Monthly sampling has been maintained throughout the warmer water months of the year. In 2011 sampling began in April and ended in early November.

In 2011, once each month (April through November), a single petite Ponar grab sample was taken in the reservoir of each cooling tower to obtain density and growth information on *Corbicula* present in the bottom sediment. The samples collected from each cooling tower were returned to the laboratory and processed. Samples were individually washed, and any *Corbicula*

removed and rinsed through a series of stacked U.S. Standard sieves that ranged in mesh size from 1.00 mm to 9.49 mm. Live and dead clams retained in each sieve were counted and the numbers were recorded. The size distribution data obtained using the sieves reflected clam width, rather than length. Samples containing a small number of *Corbicula* were not sieved; individuals were measured and placed in their respective size categories. A scraping sample of about 12 square feet was also collected at each cooling tower during each monthly sampling effort. This sample was processed in a manner consistent with the petit Ponar samples.

Population surveys of both BVPS cooling tower reservoirs have been conducted during scheduled outages (1986 to present) to estimate the number of *Corbicula* present in these structures. During the scheduled shutdown period for each unit, each cooling tower reservoir bottom is sampled by petite Ponar at standardized locations within the reservoir. Counts of live and dead clams and determination of density were made. There were no scheduled outages during 2011 when samples were collected.

5.3.4 *Corbicula* Juvenile Monitoring

The *Corbicula* juvenile study was designed to collect data on *Corbicula* spawning activities and growth of individuals entering the intake from the Ohio River. From 1988 through 1998, clam cages were deployed in the intake forebay to monitor for *Corbicula* that entered the BVPS.

Observational-based concerns that the clam cages would quickly clog with sediment during high sediment periods and, as a result, would not effectively sample for *Corbicula*, led to an evaluation of an alternate sampling technique. From April through June 1997, a study was conducted to compare the results of the clam cage samplers to a petite Ponar dredge technique to determine *Corbicula* presence and density in the BVPS intake bays. It was hypothesized that using a Ponar sampler to collect bottom sediments and analysis of those sediments would provide a more representative sample of *Corbicula* settlement and growth rates, and had the added benefit of not requiring confined space entry to conduct the sampling. Results of the study confirmed this hypothesis.

During the 1998 sampling season, at the request of BVPS personnel, all clam cages were removed after the May collection. Monthly petite Ponar grabs from the forebay in the intake building continued thereafter. Samples were processed in the same manner as Cooling Tower Samples (Section 5.3.3).

From 2002 to present, because of site access restrictions, sampling with the petite Ponar has been moved to the Ohio River directly in front of the Intake Structure Building. Collections are presently scheduled to be made in conjunction with the fisheries sampling (May, July, September, and November). In 2011, due to high flow and unsafe conditions in May, spring intake monitoring was delayed until June. During each sampling month two Ponar grabs are taken approximately 20 feet off shore of the intake building. These grab samples are processed in the same manner as when they were collected from within the Intake Structure Building.

5.3.5 Zebra Mussel Monitoring

The Zebra Mussel Monitoring Program includes sampling the Ohio River and the circulating river water system of the BVPS.

The objectives of the Monitoring Program were:

(1) To identify if zebra mussels were in the Ohio River adjacent to BVPS and provide early warning to operations personnel as to their possible infestation;

(2) To provide data as to when the larvae were mobile in the Ohio River and insights as to their vulnerability to potential treatments; and

(3) To provide data on their overall density and growth rates under different water temperatures and provide estimates on the time it requires these mussels to reach the size and density that could impact the plant.

The zebra mussel sampling for settled adults was historically conducted once per month, yearlong. Beginning in December 1997, it was decided to forego sampling in the colder water months of each year, since buildup of zebra mussels, does not occur then. Monthly sampling has been maintained throughout the balance of the year. In 2011 sampling occurred from April through November.

A pump sample for zebra mussel veligers was collected at the barge slip location monthly from April through October in 1996 and 1997. The scope of the sampling was expanded in 1998 to also include the intake structure. In June 1998, the Emergency Outfall and Emergency Outfall Impact Basin locations were also added. Additional pump samples were collected from the cooling towers of Unit 1 and Unit 2 in October 1998. In 2011 veliger sampling began in April and was conducted monthly through October.

At the Intake Structure and Barge Slip the following surveillance techniques were used:

- Wall scraper sample collections on a monthly basis (April through November) from the barge slip and the riprap near the intake structure to detect attached adults; and

- Pump sample collections from the barge slip and outside the intake structure, to detect the planktonic early life forms (April through October).

At each of the cooling towers the following techniques were used:

- Monthly reservoir scraper sample collections in each cooling tower (April through November); and

- Pump samples in April through October to detect planktonic life forms.

At the Emergency Outfall and the Splash Pool the following techniques were used:

- Monthly scraper sample collections in each (April through November); and
- Pump samples in each from April through October to detect planktonic life forms.

5.3.6 Reports

Each month, activity reports that summarized the activities that took place the previous month were prepared and submitted. These reports included the results of the monthly *Corbicula*/zebra mussel monitoring including any trends observed and any preliminary results available from the benthic and fisheries programs. The reports addressed progress made on each task, and reported any observed biological activity of interest.

5.4 AQUATIC MONITORING PROGRAM AND RESULTS

The following sections summarize the findings for each of the program elements. Sampling dates for each of the program elements are presented in Table 5.1.

5.4.1 Benthic Macroinvertebrate Monitoring Program

Benthic surveys were performed in June and in September 2011. Benthic samples were successfully collected using a petite Ponar grab sampler at Stations 1, 2A, 2B, and 3 (Figure 5.2). Triplicate samples were taken off the south shore at Stations 1, 2A, and 3. Sampling at Station 2B, in the back channel of Phillis Island, consisted of triplicate petite Ponar grabs at the south side, middle, and north side of the channel (i.e., Sample Stations 2B1, 2B2, and 2B3, respectively).

Substrate type is an important factor in determining the composition of the benthic community. The habitats in the vicinity of BVPS are the result of damming, channelization, and river traffic. Shoreline habitats at the majority of sampling locations were generally in depositional areas that consisted of soft muck substrates composed of mixes of sand, silt, and detritus. One exception was along the north shoreline of Phillis Island at Station 2A where hard-pan clay overlain with a thin layer of fine sand dominated. The other distinct habitat, hard substrate (gravel and cobble), was located in mid-channel of the back channel of Phillis Island. The hard substrate was probably the result of channelization and ongoing scouring by river currents. In general, the substrates found at each sampling location have been consistent from year to year.

Fifty-four (54) macroinvertebrate taxa were identified during the 2011 monitoring program (Tables 5.2 and 5.3), which was four more than in 2010. A mean density of 1,610 macroinvertebrates/m^2 was collected in May and 1,228/m^2 in September (Table 5.4). As in previous years, the macroinvertebrate assemblage during 2011 was dominated by burrowing organisms typical of soft unconsolidated substrates. Oligochaetes (segmented worms), mollusks (clams and snails) and chironomid (midge fly) larvae were abundant (Table 5.4). Sixteen (16) taxa of chironomids and 14 taxa of oligochaetes were collected. As in 2010, the total mean density of organism was higher in May than in September.

Thirty-two (32) taxa were present in the May 2011 samples. Forty-seven (47) taxa were present in the September samples (Table 5.3.1 and 5.3.2). Twenty-five (25) of the 50 taxa were present in both May and September. As in 2008-2010, immature tubificid worms were numerically the most abundant organism in May; however, the chironomid *Polypedilium* sp. was the most abundant taxa in September.

The Asiatic clam (*Corbicula*) has been observed in the Ohio River near BVPS from 1974 to present. Zebra mussels were first collected in the BVPS benthic samples in 1998. Adult zebra mussels, however, were detected in 1995 and 1996 by divers in the BVPS main and auxiliary intake structures during scheduled cleaning operations. Zebra mussel veligers, adults and juveniles were collected during the 1997-2011 sampling programs (see Sections 5.4.5 Zebra Mussel Monitoring Program). Both live adult *Corbicula* and adult zebra mussels were collected in benthic macroinvertebrate samples in 2011.

In 2011 two new taxa were added to the cumulative list of macroinvertebrates collected near BVPS (Table 5.2). One taxon was *Pseudochironomis* sp, which is a chironomid (midge fly). The other new taxon was *Bithynia* sp., which is a non-indigenous snail that was introduced to the freshwaters of the northeastern United States in the 1870s and has become established in many slow moving rivers and freshwater water lakes. No state or Federal threatened or endangered macroinvertebrate species were collected during 2011.

In the May 2011 samples, oligochaetes accounted for the highest mean density of macroinvertebrates and chironomids had the second highest (979/m^2 or 61 percent of the total density and 535/m^2 or 33 percent, respectively) (Table 5.4). Mollusks and had a mean density of only 24/m^2. Mollusks were present at a density of 55/m^2. Organisms other then oligochaetes, chironomids and mollusks were present at a density of 41/m^2 in May.

In September 2011 samples, chironomids accounted for the highest mean density of macroinvertebrates and oligochaetes had the second highest (351/m^2 or 29 percent of the total density and 538/m^2 or 44 percent, respectively) (Table 5.4). Mollusks had the third highest mean density in September 2011 (253/m^2 or 21 percent) while the "others" category had the fourth highest mean density (86/m^2 or seven percent).

In May 2011, the highest density of macroinvertebrates (3,186/m^2) occurred at Station 2B3. In September, the highest density of macroinvertebrates also occurred at Station 3 (2,121/m^2). In

May the lowest mean density of organisms occurred at Station 1 (115/m^2). In September, the lowest mean density of organisms also occurred at Station 2A (674/m^2).

For a comparison of the control to non-control stations, Station 1 was designated the control station, because it is always out of the influence of the BVPS discharge and Station 2B (mean density of Station 2B1, 2B2, and 2B3) was designated as the non-control station, since it is the station most regularly subjected to BVPS's discharge. Stations 3 and 2A may be under the influence of the plume under certain conditions, but it is unlikely that they are regularly influenced by BVPS.

The mean density of macroinvertebrates in the non-control station was almost 15 times higher (1,700/m^2) than that of the control station (1115/m^2) in May (Table 5.5). The high density of oligochaetes (1,018/m^2) and chironomids (530/m^2) in the non-control samples accounted for the majority of this difference. Only oligochaetes were collected at the control station. A similar difference in density occurred in 2008, 2009 and 2010. Overall the differences probably reflect the natural differences in substrate and natural heterogeneous distributions of these organisms between the stations rather than project-related impacts.

In September, the density of macroinvertebrates present at the non-control stations (1,233/m^2) was about 1.4 times greater than at the control station (874/m^2). This was the reverse of the previous year, when the density of macroinvertebrates was 1.4 times greater at the control station. Differences were within the expected range of variation for natural populations of macroinvertebrates.

Indices that describe the relative diversity, evenness, and richness of the macroinvertebrate population structure among stations and between control and non-control sites were calculated. A higher Shannon-Weiner diversity index indicates a relatively better structured assemblage of organisms, while a lower index generally indicates a low quality or stressed community. Evenness is an index that estimates the relative contribution of each taxon to the community assemblage, the closer to 1.00, the healthier the community. The community richness is another estimate of the quality of the macroinvertebrate community with a higher richness number indicating a healthier community.

The Shannon-Weiner diversity indices in May 2011 collections ranged from 0.18 at Station 3 to 1.00 at Station 2A (Table 5.6). In May evenness ranged from 0.24 at Station 3 to 0.86 at Station 1. Richness was greatest at Stations 2B2 (4.67) and lowest at Station 3 (0.98). The overall low indices at Station 1 and 3 are attributed to the relatively few species (5 and 6, respectively) collected. This low number of organisms likely is due to natural variation in the Ohio River rather than due to BVPS operations, since Station 1 is a control station and Station 3 is seldom under the influence of the BVPS discharge. The Shannon-Weiner diversity of the macroinvertebrate community (0.65-1.14) evenness (0.65-0.89) and richness (2.34-5.40) in September 2011 were higher than in May. There was also generally an increase in the number of taxa present in September compared to May. Relatively high numbers of taxa are frequently present in early fall due to the increased numbers of aquatic stages of insects, especially chironomids, as well as the ability to identify to lower taxonomic levels many of the tubificids

that are lumped together when immature. A comparable increase in indices values in September compared to May was observed in 2010.

In May 2011, the number of taxa was appreciably lower in the control station (Station 1) than in the non-control stations (2B1, 2B2, 2B3) while the diversity, evenness and richness indices were comparable (Table 5.6). In September 2011 the indices between the control and non-control stations were, in general, comparable. Similar trends were apparent in the previous three study years and were likely due to natural variations in the local populations at these locations. No impacts of the BVPS on the benthic community, as measured by differences between control and non-control zones, were evident in either May or September.

Substrate was probably the most important factor controlling the distribution and abundance of the benthic macroinvertebrates in the Ohio River near BVPS. Soft, mucky substrates that generally existed along the shoreline are conducive to oligochaete, chironomid, and mollusk habitation and limit species of macroinvertebrates that require a more stable bottom.

The density of macroinvertebrates in May and September 2011 fell within the range of densities of macroinvertebrates collected at BVPS in previous years (Table 5.7). ***The community structure has changed little since pre-operational years, and the available evidence does not indicate that BVPS operations have affected the benthic community of the Ohio River.***

5.4.2 Fish Sampling Program

In 2011, 191 fish representing 27 taxa were collected (i.e., handled) during BVPS surveys by electrofishing and seining (Table 5.8). All taxa collected in 2011 were previously encountered at BVPS. The most common species in the 2011 BVPS surveys that were collected by electrofishing and seining combined were shorthead redhorse sucker (17.8% of the total catch), smallmouth bass (12.6%), gizzard shad (10.5%), sauger (8.4%), spotfin shiner (6.3%), spotted bass (5.2%) and white bass (5.2%). None of the remaining 20 species contributed to more than 5 percent of the total handled catch. The most frequently observed but not handled fish in 2011 were unidentified suckers (Table 5.15). Game fish collected in 2011 included black crappie, channel catfish, bluegill, flathead catfish, largemouth bass, white bass, smallmouth bass, sauger, walleye, pumpkinseed, yellow perch, rock bass and spotted bass. Game fish represented 41.4% of the total handled catch.

A total of 151 fish, representing 22 taxa, was collected by electrofishing in 2011 (Table 5.9) compared to 176 fish representing 18 species in 2010. Shorthead redhorse suckers, smallmouth bass and sauger accounted for the greatest portion of the 2011 electrofishing catch (22.5%, 14.6% and 10.6%, respectively) followed by spotted bass (6.6%), gizzard shad (5.3%), quillback (5.3%) and golden redhorse sucker (5.3%). No other species collected contributed to greater than five percent of the total catch. Fish observed and not collected in the 2011 electrofishing study are presented in Table 5.15.

A total of 40 fish representing nine (9) taxa was collected in 2011 (Table 5.10) compared to 287

fish representing 16 in 2010. The large numbers of juvenile bluegills (109 individuals) and emerald shiners (91 individuals) in one month in contributed to much of this difference. The most abundant taxa collected in 2011 were spotfin shiner and gizzard shad (each representing 30.0% of the total catch) followed by emerald shiner (12.5%), and juvenile white bass (10.0%). No other species collected contributed to greater than five percent of the total catch. Game species were only collected as juveniles.

A total of 40 fish representing 11 species was captured during the June (spring) 2011 sampling event (Table 5.11). Thirty-one (31) fish representing nine (9) species were collected during electrofishing. Shorthead redhorse sucker (38.7% of the total catch), smallmouth bass (16.1%) and quillback (16.1%) were the most common species boated during the electrofishing effort. No other species contributed to more than seven percent of the June electrofishing catch. Channel catfish, smallmouth bass, and white bass were the game species collected in June. Nine fish; six spotfin shiner, two emerald shiner, and one juvenile smallmouth bass were collected by seine netting in June.

A total of 23 fish representing 11 species was captured during the July (summer) 2011 sampling event (Table 5.12). A total of 19 fish representing nine (9) species was collected during electrofishing efforts. Spotted bass, quillback, shorthead redhorse sucker, and gizzard shad were the most abundant species and each represented 15.8% of the total electrofishing catch. Bluegill, smallmouth bass and spotted bass were the game species collected during the July electrofishing study (Table 5.12). Two spotfin shiners and one emerald shiner were the only fish collected during seining efforts in July.

During the September (fall) 2011 sampling event, 82 fish representing 23 taxa were collected (Table 5.13). A total of 57 fish representing 18 species was collected during electrofishing efforts. Shorthead redhorse sucker and smallmouth bass were the most abundant species, contributing to 17.5% and 14.0% of the fish collected during electrofishing. Golden redhorse sucker, sauger, and spotted bass (each representing 8.8% of the catch) were the only other species that contributed to greater than seven percent of the total electrofishing catch. A total of 25 fish was collected during seining efforts. Juvenile gizzard shad (48.0% of the total catch) were the most abundant species in the seine catch. Black crappie, bluegill, channel catfish, flathead catfish, sauger, smallmouth bass, spotted bass, rock bass, walleye and white bass were the game fish collected in September.

During the November (winter) 2011 sampling event, 47 fish representing 15 taxa were captured (Table 5.14). A total of 44 fish representing 13 species were collected during electrofishing. Sauger was the most abundant species collected by electrofishing and contributed to 25.0% of the total. Other relatively abundant species were shorthead redhorse sucker (20.5%), smallmouth bass (15.9%), smallmouth buffalo (9.1%), and bluegill (6.8%). No other species contributed to greater than five percent of the total catch. An additional 11 fish that included carp, sauger and unidentified suckers were also observed, but not boated during electrofishing efforts (Table 5.15). A bluegill juvenile, a bluntnose minnow and an emerald shiner were the only fish collected during seine netting in 2011. This is many fewer than the 209 fish collected in seine nets during the November 2010 effort. Game species collected in November included bluegill,

largemouth bass, pumpkinseed, sauger, smallmouth bass, spotted bass, white bass, and yellow perch.

Electrofishing catch rates are presented in Tables 5.16, 5.17, 5.18, and 5.19 for fish that were boated and handled during the 2008 through 2011 surveys by season (FENOC 2009, 2010 and 2011. In 2011, the annual catch rate was 0.93 fish per minute. The greatest catch rate in 2011 occurred in fall (September) when the catch rate was 1.42 fish per minute. Shorthead redhorse sucker and smallmouth bass contributed to the majority of this total. The lowest catch rate occurred in summer (July) with a rate of 0.47 fish per electrofishing minute. The annual catch rates were consistent over the four years ranging from a high of 1.98 fish per minute in 2008 to 0.98 in 2011. Over the four years, the highest seasonal catch rates occurred in May 2008 (4.54 fish per minute) and in May 2010 (2.20 fish per minute). The lowest seasonal catch rates occurred in July 2011 (0.47 fish per minute) and July 2010 (0.32 fish per minute).

The results of the electrofishing sampling effort (Table 5.9) did not indicate any major differences in species composition between the control station (1) and the non-control Stations 2A, 2B, and 3. A greater number of fish representing more species was captured at non-control stations than control stations. This was most likely due to the extra effort expended at non-control stations versus control stations (i.e., there are three non-control stations and only one control station). In 2011, a comparable number of individual, but fewer species were collected by seines at the control station compared to the non-control station (Table 5.10).

In 2011, species composition remained comparable among stations. Common taxa collected in the 2011 surveys by all methods included redhorse sucker species, sauger, smallmouth bass, and gizzard shad. Little difference in the species composition of the catch and relative composition was observed between the control (1) and non-control stations (2A, 2B and 3). Habitat preference and availability were probably the most important factors affecting where and when different species of fish are collected.

The results of the 2011 fish surveys indicated that there is a normal community structure in the Ohio River in the vicinity of BVPS based on species composition and relative abundance of fish observed during the surveys. Benthivores (bottom feeders including suckers and buffalo) and forage species (e.g. gizzard shad, emerald shiners) were generally collected in the highest numbers. The large numbers of juvenile bluegill and emerald shiner, which serve as forage, were not present in 2011. The numbers of forage species were less than in 2010 and some other past years. Variations in annual catch were probably attributable to normal fluctuations in the population size of the forage species and the predator populations that rely on them. Forage species, such as gizzard shad and emerald shiner with high reproductive potentials, frequently respond to changes in natural environmental factors (competition, food availability, cover, and water quality) with large fluctuations in population size. This, in turn, influences their appearance in the sample populations during annual surveys. Spawning/rearing success due to abiotic factors is usually the determining factor of the size and composition of a fish community. In addition, differences in electrofishing catch rate can be attributed to environmental conditions that prevail during sampling efforts. High water, increased turbidity, and swift currents that occur during electrofishing efforts in some years can affect the collection efficiency in any given year.

5.4.3 Corbicula Monitoring Program

In 2011, no settled *Corbicula* were collected from the Unit 1 cooling tower basin during monthly reservoir sampling (Table 5.20 and Figure 5.5). No *Corbicula* were collected in the scraping samples. *Corbicula* juveniles; however, were collected in monthly pump samples collected in the Unit 1 cooling tower reservoir from June through October. The highest density of juvenile Corbicula occurred in July when a density of 372 *Corbicula*/m^3 was present.

In 2011, no settled *Corbicula* were collected from the Unit 2 cooling tower reservoir during monthly sampling (Table 5.21 and Figure 5.6). No *Corbicula* were collected in the scraping samples. *Corbicula* juveniles; however, were collected in monthly pump samples collected in the Unit 2 cooling tower reservoir in April and from June through October. The highest density of juvenile Corbicula occurred in August when a density of 157 *Corbicula*/m^3 was present.

In 2011, BVPS continued its *Corbicula* control program (Year 17), which included the use of a molluscicide (CT-1) to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-1 to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications (CT-1) focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 and 1995, the CT-1 applications targeted the internal water systems; therefore, the CT-1 concentrations in the cooling towers were reduced during CT-1 applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the CT-1 applications. Reservoir sediment samples taken after CT-1 applications represent mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

The monthly reservoir sediment samples and pump samples collected in Units 1 and 2 Cooling Towers in recent years demonstrated that *Corbicula* were entering and colonizing the reservoirs. No settled *Corbicula* were collected in the cooling towers in 2011; however, their presence in the cooling tower pump samples indicates that they still are available for establishment in the cooling towers. The recent decrease of *Corbicula* at the BVPS returns densities to levels more consistent with densities in the Ohio River in the mid-1990's, but well below those present during the 1980's. Whether the decrease in density of *Corbicula* in 2011 is indicative of decreasing levels in the environment or due to sampling variability is uncertain, however, continued monitoring of *Corbicula* densities is recommended.

5.4.4 *Corbicula* Juvenile Monitoring Program

Figure 5.7 presents the abundance and size distribution data for samples collected in the Ohio River near the intake structure by petite ponar dredge in 2011. Three live individuals were collected in each month sampled (June, July, September, and November) for a total of 12 individuals. They ranged in size from the 1.00-1.99 mm size range that were spawned in 2011 to greater than 9.50 mm that were spawned in prior years. The number of individuals collected in

2011 was somewhat less than in the prior three years; 27 individuals in 2010, 42 in 2009, and 23 in 2008. A spring/early-summer spawning period typically occurs in the Ohio River near BVPS each year when preferred spawning temperatures (60-65° F) are reached (Figure 5.8). The offspring from this spawning event generally begin appearing in the sample collections in June. The settled clams generally increase in size throughout the year. ***The overall low numbers of live Corbicula collected in the sample collected outside the intake and cooling towers in 2011, compared to levels in the 1980's, likely reflects a natural decrease in the density of Corbicula in the Ohio River near BVPS, although an increased density of live individuals in the cooling towers may indicate that the population is beginning to increase again. Continued monitoring of Corbicula densities is recommended.***

5.4.5 Zebra Mussel Monitoring Program

Zebra mussels (*Dreissena polymorpha*) are exotic freshwater mollusks that have ventrally flattened shells generally marked with alternating dark and lighter bands. They are believed to have been introduced into North America through the ballast water of ocean-going cargo vessels probably from Eastern Europe. They were first identified in Lake St. Clair in 1988 and rapidly spread to other Great Lakes and the Mississippi River drainage system, and have become increasingly abundant in the lower, middle, and upper Ohio River. They use strong adhesive byssal threads, collectively referred to as their byssus, to attach themselves to any hard surfaces (e.g., intake pipes, cooling water intake systems, and other mussels). Responding to NRC Notice No. 89-76 (Biofouling Agent-Zebra Mussel, November 21, 1989), BVPS instituted a Zebra Mussel Monitoring Program in January 1990. Studies have been conducted each year since then.

Zebra mussels were detected in both pump samples (Figures 5.9 and 5.10) and substrate samples (Figure 5.11 and 5.12) in 2011. Zebra mussel veliger pump samples were collected from April through October 2011 (Figures 5.9 and 5.10). Veligers were collected at all of the six sites that were sampled in 2011. At most sample sites, densities of veligers generally increased through the year, peaked in June or July and then were less abundant for the balance of the sampling year. This seasonal pattern is typical for zebra mussels in the northeastern United States. Spawning begins as water temperature reach approximately 14^{O} C and peaks at water temperatures of 21^{O} C. Veligers densities usually peak about two weeks after the optimum water temperature for spawning is reached. Veliger densities then fall off as veligers mature and settle. The greatest density of veligers was present in the sample collected from the Emergency Outfall Basin in June (33,160/m^3). This was an order of magnitude less than the peak density of veligers collected in 2010 (256,800/m^3). In April, veligers were collected only at the thermally enhanced Unit 1 and Unit 2 Cooling Tower reservoirs. Veligers were not collected at any sites in May. From June through October veligers were present in every sample collected at all locations. Overall, veliger densities in 2011 were lower than in 2010, but comparable to the densities present in 2009. This is likely due to annual variability in numbers of veligers in the Ohio River.

In 2011, settled zebra mussels were collected only in scrape samples at the barge slip and the intake structure (Figures 5.11 and 5.12). The highest density of settled mussels in any sample

collected was at the barge slip (12 mussels/m^2) in June. The mussels collected at each of the sites included individuals that were capable of reproducing. The density of collected adult zebra mussels in 2011 was comparable to densities that occurred in 2010, 2009 and 2008.

Overall, both the number of observations and densities of settled mussels in 2011 were similar to those recorded in 2008-2010, which was somewhat higher than the preceding five years. Although densities of settled mussels are low compared to other populations such as the Lower Great Lakes, densities comparable to those in the Ohio River are sufficient to cause problems in the operation of untreated cooling water intake systems. ***Whether the population of zebra mussels in this reach of the Ohio River is resurging or only yearly fluctuations are present cannot be determined. In any case, the densities of mussels that presently exist are more than sufficient to impact the BVPS, if continued prudent monitoring and control activities are not conducted.***

6.0 ZEBRA MUSSEL AND *CORBICULA* CONTROL ACTIVITIES

In 2011, BVPS continued its *Corbicula* and zebra mussel control program (18th year), which included the use of a molluscicide (CT-1) to prevent the proliferation of *Corbicula* within BVPS. BVPS was granted permission by the Pennsylvania Department of Environmental Protection to use CT-1 to target the Unit 1 river water system and the Unit 2 service water system.

In 1990 through 1993, the molluscicide applications (CT-1) focused on reducing the *Corbicula* population throughout the entire river water system of each BVPS plant (Units 1 and 2). In 1994 through 20010, the CT-1 or 2 applications targeted zebra mussels and *Corbicula* in the internal water systems; therefore the molluscicide concentrations in the cooling towers were reduced during CT-1 or 2 applications. Consequently, adult and juvenile *Corbicula* in the cooling towers often survived the applications. Reservoir sediment samples taken after CT-1 or 2 applications represented mortality of *Corbicula* in the cooling tower only and do not reflect mortality in BVPS internal water systems.

In addition to clamicide treatments, preventive measures were taken that included quarterly cleaning of the Intake Bays. The bay cleanings are intended to minimize the accumulation and growth of mussels within the bays. This practice prevents creating an uncontrolled internal colonization habitat.

7.0 REFERENCES

Commonwealth of Pennsylvania, 1994. Pennsylvania's Endangered Fishes, Reptiles and Amphibians. Published by the Pennsylvania Fish Commission.

Counts, C. C. III, 1985. Distribution of *Corbicula fluminea* at Nuclear Facilities. Division of Engineering, U.S. Nuclear Regulatory Commission. NUREGLCR. 4233. 79 pp.

Dahlberg, M. D. and E. P. Odum, 1970. Annual cycles of species occurrence, abundance and diversity in Georgia estuarine fish populations. Am. Midl. Nat. 83:382-392.

FENOC, 2003. Annual Environmental Operating Report, Non-radiological. First Energy Nuclear Operating Company, Beaver Valley Power Station, Unit No. 1 & 2. 113 pp.

FENOC, 2004. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2005. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2006. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2007. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2008. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2009. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2010. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp.

FENOC, 2011. Annual Environmental Operating Report, Non-radiological. First Energy Operating Company, Beaver Valley Power Station, Unit No. 1&2. 82 pp

Hutchinson, G. E., 1967. A treatise on limnology. Vol. 2, Introduction to lake biology and the limnoplankton. John Wiley and Sons, Inc., New York. 1115 pp.

Hynes, H. B. N., 1970. The ecology of running waters. Univ. Toronto Press, Toronto.

NRC, IE Bulletin 81-03: Flow Blockage of Cooling Tower to Safety System Components by *Corbicula sp.* (Asiatic Clam) and *Mytilus sp.* (Mussel).

Pielou, E. C., 1969. An introduction to mathematical ecology. Wiley Interscience, Wiley & Sons, New York, NY.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott, 1991. Common and Scientific Names of Fishes from the United States and Canada (fifth edition). American Fisheries Society Special Publication No. 20:1-183.

Shiffer, C., 1990. Identification Guide to Pennsylvania Fishes. Pennsylvania Fish Commission, Bureau of Education and Information. 51 pp.

Winner, J. M., 1975. Zooplankton. In: B. A. Whitton, ed. River ecology. Univ. Calif. Press, Berkeley and Los Angeles. 155-169 pp.

8.0

TABLES

TABLE 5.1
BEAVER VALLEY POWER STATION (BVPS)
SAMPLING DATES FOR 2011

Study	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Macroinvertebrate						28			9			
Fish						28	28		9		8	
Corbicula and Zebra Mussel				20	26	28	28	24	9	18	8	
Corbicula CT Density												
Zebra Mussel Veliger				20	26	28	28	24	9	18		

Table 5.2

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family / Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Porifera						
			Spongilla fragilis	X		
Cnidaria						
	Hydrozoa					
		Clavidae				
			Cordylophora lacustris	X		
		Hydridae				
			Craspedacusta sowerbii	X		
			Hydra sp.	X		
Platyhelminthes						
	Tricladida			X		
	Rhabdocoela			X		
Nemertea				X		
Nematoda				X		
Entoprocta						
			Urnatella gracilis	X		
Ectoprocta						
			Fredericella sp.	X		
			Paludicella articulata	X		
			Pectinatella sp.	X		
			Plumatella sp.	X		
Annelida						
	Oligochaeta			X	X	
		Aeolosomatidae		X		
		Enchytraeidae		X		
		Naididae		X		
			Allonais pectinata	X		
			Amphichaeta leydigi	X		
			Amphichaeta sp.	X		
			Arcteonais lomondi	X		
			Aulophorus sp.	X		
			Chaetogaster diaphanus	X		
			C. diastrophus	X		
			Dero digitata	X		
			Dero flabelliger	X		
			D. nivea	X		
			Dero sp.	X		
			Nais barbata	X		
			N. behningi	X		
			N. bretscheri	X		
			N. communis	X		
			N. elinguis	X		
			N. pardalis	X		
			N. pseudobtusa	X		
			N. simplex	X		
			N. variabilis	X	X	
			Nais sp.	X		
			Ophidonais serpentina	X		
			Paranais frici	X		
			Paranais litoralis	X		
			Paranais sp.	X		
			Piguetiella michiganensis	X		
			Pristina idrensis	X		
			Pristina longisoma	X		
			Pristina longiseta	X		
			P. osborni	X		
			P. sima	X		
			Pristina sp.	X		
			Pristinella sp.	X		

Table 5.2 (continued)

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Annelida	**Oligochaeta**	Naididae	*Pristinella jenkinae*	X	X	
			Pristinella idrensis	X		
			Pristina osborni	X		
			Ripistes parasita	X		
			Slavina appendiculata	X		
			Specaria josinae	X		
			Stephensoniana trivandrana	X		
			Stylaria fossularis	X		
			S. lacustris	X	X	
			Uncinais uncinata	X		
			Vejdovskyella comata	X		
			Vejdovskyella intermedia	X		
			Vejdovskyella sp.	X		
	Tubificida			X		
		Tubificidae		X	X	
			Aulodrilus limnobius	X		
			A. pigueti	X		
			A. pluriseta	X		
			Aulodrilus sp.	X	X	
			Bothrioneurum vejdovskyanum	X	X	
			Branchiura sowerbyi	X	X	
			Ilyodrilus templetoni	X		
			Limnodrilus cervix	X		
			L. cervix (variant)	X		
			L. claparedianus	X	X	
			L. hoffmeisteri	X	X	
			L. maumeensis	X	X	
			L. profundicla	X	X	
			L. spiralis	X	X	
			L. udekemianus	X		
			Limnodrilus sp.	X		
			Peloscolex multisetosus longidentus	X		
			P. m. multisetosus	X		
			Potamothrix moldaviensis	X		
			Potamothrix sp.	X		
			P. vejdovskyi	X		
			Psammoryctides curvisetosus	X		
			Tubifex tubifex	X		
			Unidentified immature forms:			
			with hair chaetae	X		
			without hair chaetae	X	X	
		Lumbriculidae		X	X	
		Hirudinae		X		
		Glossiphoniidae		X		
			Helobdella elongata	X		
			H. stagnalis	X		
			Helobdella sp.	X		
		Erpobdellidae				
			Erpobdella sp.	X		
			Mooreobdella microstoma	X		
		Haplotaxidae				
			Stylodrilus sp.	X		
	Lumbricina			X		
		Lumbricidae		X		

Table 5.2 (continued)

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family / Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Arthropoda						
	Acarina			X		
			Oxus sp.			
	Ostracoda			X		
	Isopoda					
			Asellus sp.	X		
Arthropoda						
	Amphipoda					
		Talitridae				
			Hyalella azteca	X		
		Gammaridae				
			Crangonyx pseudogracilis	X		
			Crangonyx sp.	X		
			Gammarus fasciatus	X		
			Gammarus sp.	X	X	
		Pontoporeiidae				
			Monoporeia affinis	X		
		Corophididae		X		
Decapoda				X		
Collembola				X		
Ephemeroptera				X		
		Heptageniidae		X		
			Stenacron sp.	X		
			Stenonema sp.	X		
		Ephemeridae				
			Ephemera sp.	X		
			Hexagenia sp.	X	X	
			Ephron sp.	X		
		Baetidae				
			Baetis sp.	X		
		Caenidae				
			Caenis sp.	X	X	
			Serattella sp.	X		
		Tricorythidae				
			Tricorythodes sp.	X		
Megaloptera						
			Sialis sp.	X		
Odonata						
		Gomphidae				
			Argia sp.	X		
			Dromogomphus spoliatus	X		
			Dromogomphus sp.	X	X	
			Gomphus sp.	X		
		Lestidae				
			Lestes sp.		X	X
		Libellulidae				
			Libellula sp.	X		
Plecoptera				X		
Trichoptera				X		
		Hydropsychidae				
			Cheumatopsyche sp.	X		
			Hydropsyche sp.	X		
			Parapsyche sp.	X		
		Hydroptilidae				
			Hydroptila sp.	X	X	
			Orthotrichia sp.	X		
			Oxyethira sp.	X	X	
		Leptoceridae				
			Ceraclea sp.	X		
			Oecetis sp.	X		
		Polycentropodidae				
			Cyrnellus sp	X		
		Polycentropodidae	*Polycentropus* sp.	X		

Table 5.2 (continued)

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Coleoptera						
		Hydrophilidae		X		
Coleoptera		Elmidae	*Ancyronyx variegatus*	X		
			Dubiraphia sp.	X		
			Helichus sp.	X		
			Optioserus sp.	X		
			Stenelmis sp.	X		
		Psephenidae		X		
Diptera						
			Unidentified Diptera	X		
		Psychodidae		X		
			Pericoma sp.	X		
			Psychoda sp.	X		
			Telmatoscopus sp.	X		
			Unidentified Psychodidae pupae	X		
		Chaoboridae				
			Chaoborus sp.	X		
		Simuliidae				
			Similium sp.	X		
		Chironomidae		X	X	
		Chironominae		X		
			Tanytarsini pupa	X		
			Chironominae pupa	X	X	
			Axarus sp.	X	X	
			Chironomus sp.	X	X	
			Cladopelma sp.	X		
			Cladotanytarsus sp.	X	X	
			Cryptochironomus sp.	X	X	
			Dicrotendipes nervosus	X		
			Dicrotendipes sp.	X	X	
			Glyptotendipes sp.	X		
			Harnischia sp.	X		
			Microchironomus sp.	X		
			Micropsectra sp.	X		
			Microtendipes sp.	X		
			Parachironomus sp.	X		
			Paracladopelma sp.	X		
			Paratanytarsus sp.	X		
			Paratendipes sp.	X		
			Phaenopsectra sp.	X		
			Polypedilum (s.s.) convictum type	X		
			P. (s.s.) simulans type	X		
			Polypedilum sp.	X	X	
			Pseudochironomis sp.		X	X
			Rheotanytarsus sp.	X		
			Stempellina sp.	X		
			Stenochironomus sp.	X		
			Stictochironomus sp.	X		
			Tanytarsus coffmani	X		
			Tanytarsus sp.	X	X	
			Tribelos sp.	X		
			Xenochironomus sp.	X		
		Tanypodinae		X		
			***Tanypodinae* pupae**	X		
			Ablabesmyia sp.	X	X	
			Clinotanypus sp.	X	X	
			Coelotanypus scapularis	X		
			Coelotanypus sp.	X	X	
			Djalmabatista pulcher	X		
			Djalmabatista sp.	X		
			Procladius sp.	X	X	
			Tanypus sp.	X		

Table 5.2 (continued)

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family / Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Diptera		Tanypodinae	*Thienemannimyia* group	X		
			Zavrelimyia sp.	X		
		Orthocladiinae		X		
			***Orthocladiinae* pupae**	X		
			Cricotopus bicinctus	X		
			C. (s.s.) trifascia	X		
			Cricotopus (Isocladius)-sylvestris Group	X		
			C. (Isocladius) sp.	X		
			Cricotopus (s.s.) sp.	X	X	
			Eukiefferiella sp.	X		
			Hydrobaenus sp.	X		
			Limnophyes sp.	X		
			Nanocladius (s.s.) distinctus	X		
			Nanocladius sp.	X		
			Orthocladius sp.	X	X	
			Parametriocnemus sp.	X		
			Paraphaenocladius sp.	X		
			Psectrocladius sp.	X		
			Pseudorthocladius sp.	X		
			Pseudosmittia sp.	X		
			Smittia sp.	X		
			Theinemannimyia sp.	X		
		Diamesinae				
			Diamesa sp.	X		
			Potthastia sp.	X		
		Ceratopogonidae		X	X	
			Probezzia sp.	X		
			Bezzia sp.	X	X	
			Culicoides sp.	X		
		Dolichopodidae		X		
		Empididae		X		
			Clinocera sp.	X		
			Wiedemannia sp.	X		
		Ephydridae		X		
		Muscidae		X		
		Rhagionidae		X		
		Tipulidae		X		
		Stratiomyidae		X		
		Syrphidae		X		
Lepidoptera				X		
Hydracarinidia				X		
			Oxus sp.	X	X	
Mollusca						
	Gastropoda			X		
		Hydrobiidae		X		
		Amnicolinae				
			Amnicola sp.	X		
			Aminicola binneyana	X	X	
			Amnicola limosa	X	X	
			Stagnicola elodes	X		
		Bithynidae				
			Bithynia sp.		X	X
	Physacea			X		
		Pleuroceridae				
			Pleurocera acuta	X	X	
			Goniobasis sp.	X	X	
		Physidae		X		
			Physa sp.	X	X	
			Physa ancillaria	X		
			Physa integm	X	X	

Table 5.2 (continued)

Systematic List of Macroinvertebrates Collected From 1973 Through 2011 in The Ohio River Near BVPS

Phylum	Class	Family / Sub-Family	Genus and Species	Previous Collections	Collected in 2011	New in 2011
Mollusca	**Physacea**	Ancylidae		X	X	
			Ferrissia sp.	X		
		Planorbidae				
			Gillia atilis	X	X	
		Valvatidae		X		
			Valvata perdepressa	X		
			Valvata piscinalis	X		
			Valvata sincera	X	X	
			Valvata sp.	X		
Pelecypoda				X		
	Sphaeriacea			X		
		Corbiculidae				
			Corbicula fluminea	X	X	
			Corbicula sp.	X		
		Sphaeriidae		X		
			Pisidium ventricosum	X		
			Pisidium sp.	X	X	
			Sphaerium sp.	X		
			Unidentified immature Sphaeriidae	X		
		Dreissenidae				
			Dreissena polymorpha	X	X	
		Unionidae		X		
			Anodonta grandis	X		
			Anodonta (immature)	X		
			Elliptio sp.	X		
			Quadrula pustulosa	X		
			Unidentified immature Unionidae	X		

TABLE 5.3

BENTHIC MACROINVERTEBRATE COUNTS FOR TRIPLICATE SAMPLES
TAKEN AT EACH SAMPLE STATION FOR MAY AND SEPTEMBER 2011

Scientific name	May							Sept							
	Location						May	Location						Sept	2011
	1	2A	2B1	2B2	2B3	3	Total	1	2A	2B1	2B2	2B3	3	Total	Total
Ablabesmyia sp.	0	1	0	0	2	0	3	0	0	1	0	0	0	1	4
Amnicola binneyana	0	0	0	0	0	0	0	5	0	3	13	0	0	21	21
Amnicola limosa	0	0	7	0	0	0	7	0	3	0	2	1	1	7	14
Ancylidae	0	0	0	0	0	0	0	0	0	2	1	0	10	13	13
Aulodrilus sp	0	0	0	0	0	0	0	1	0	0	0	0	2	3	3
Axarus sp.	0	24	0	0	0	0	24	0	0	0	0	0	0	0	24
Bothrioneurum vejdovskyanum	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Bezzia sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
Branchiura sowerbyi	1	0	0	0	2	1	4	0	0	0	0	1	4	5	9
Bithnya sp	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4
Caenis sp.	0	2	0	0	0	0	2	0	0	0	6	0	3	9	11
Ceratopogonidae	0	1	0	0	3	0	4	0	0	0	0	0	1	1	5
Chironomid pupae	0	4	3	0	0	0	7	0	0	3	1	0	0	4	11
Chironomidae	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Chironomus sp.	0	21	9	1	26	0	57	1	1	0	1	2	0	5	62
Cladotanytarsus sp	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Clinotanypus sp.	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Coelotanypus sp.	0	0	0	0	0	0	0	1	1	0	5	0	2	9	9
Corbicula fluminea	0	0	0	0	0	0	0	1	0	3	2	0	3	9	9
Cricotopus (s.s.) sp.	0	0	4	0	0	0	4	0	0	0	1	0	0	1	5
Cryptochironomus sp.	0	9	0	0	0	0	9	2	12	8	11	0	12	45	54
Dicrotentipides sp	0	1	1	0	0	0	2	0	0	6	6	0	1	13	15
Dreissena polymorpha	0	0	0	12	0	0	12	0	0	8	2	0	10	20	32
Dromogomphus sp	0	0	0	0	1	0	1	0	0	0	1	0	0	1	2
Gammarus sp.	0	0	2	1	2	1	6	0	0	0	1	0	4	5	11
Gillia atilis	0	0	0	0	0	0	0	0	0	0	0	1	2	3	3
Goniobasis sp.	0	0	0	0	0	0	0	0	0	1	2	0	0	3	3
Hexagenia sp.	0	1	0	0	2	0	3	0	0	0	0	1	0	1	4
Hydroptila sp	0	0	0	0	0	0	0	0	0	0	3	0	19	22	22
Immature tubificid without	1	22	18	1	115	152	309	22	0	14	23	23	1	83	392
Lestes sp.	0	0	1	0	0	0	1	0	1	1	1	0	2	5	6
Limnodrilus claparedianus	1	0	0	0	1	2	4	0	0	0	0	0	0	0	4
Limnodrilus hoffmeisteri	4	3	6	0	60	7	80	3	2	7	12	3	2	29	109
Limnodrilus maumeensis	1	0	0	0	0	0	1	0	0	0	0	3	4	7	8
Limnodrilus profundicola	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
Limnodrilus udemekianus	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1
Lumbriculidae	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1
Nais variabilis	0	2	4	0	0	0	6	0	0	1	0	0	0	1	7
Oligochaeta	0	0	0	4	0	0	4	0	0	1	0	0	0	1	5
Orthocladius sp.	0	0	0	0	4	0	4	0	0	0	1	0	0	1	5
Oxus sp (Hydracarina)	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Oxyethira sp (Tricoptera)	0	0	0	0	0	0	0	0	0	0	1	0	2	3	3
Physa sp	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2
Physa integm	0	0	0	0	0	0	0	0	1	1	0	0	1	3	3
Pisidium sp.	0	0	0	0	1	0	1	13	1	2	1	0	3	20	21
Pleurocera acuta	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Polypedilum sp.	0	28	58	0	2	4	92	10	24	7	30	14	44	129	221
Pristinella jenkinae	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Procladius sp.	0	6	0	0	0	0	6	0	0	0	2	1	8	11	17
Pseudochironomis sp.	0	3	0	0	0	0	3	0	0	0	0	0	0	0	3

TABLE 5.4

MEAN NUMBER OF MACROINVERTEBRATES (NUMBER/M^2) AND PERCENT COMPOSITION OF OLIGOCHAETES, CHIRONOMIDS, MOLLUSKS, AND OTHER ORGANISMS, 2011 BVPS

May	Station													
	1 (Control)		2A		2B1 (Non-control)		2B2 (Non-control)		2B3 (Non-control)		3		Total Mean	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
Oligochaetes	115	100	387	19	401	25	86	30	2566	81	2322	97	979	61
Chironomids	0	0	1562	76	1089	67	14	5	487	15	57	2	535	33
Mollusks	0	0	43	2	100	6	172	60	14	0	0	0	55	3
Others	0	0	57	3	43	3	14	5	115	4	14	1	41	3
Total	115	100	2049	100	1633	100	286	100	3182	100	2393	100	1610	100

September	Station													
	1 (Control)		2A		2B1 (Non-control)		2B2 (Non-control)		2B3 (Non-control)		3		Total Mean	
	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%	#/m^2	%
Oligochaetes	387	44	43	6	358	33	502	27	430	59	387	18	351	29
Chironomids	215	25	545	81	358	33	831	44	244	33	1032	49	538	44
Mollusks	272	31	72	11	344	32	358	19	29	4	444	21	253	21
Others	0	0	14	2	14	1	201	11	29	4	258	12	86	7
Total	874	100	674	100	1074	100	1892	100	732	100	2121	100	1228	100

TABLE 5.5

MEAN NUMBER OF MACROINVERTEBRATES (NUMBER/M^2) AND PERCENT COMPOSITION OF OLIGOCHAETA, CHIRONOMIDAE, MOLLUSCA, AND OTHER ORGANISMS FOR THE CONTROL STATION (1) AND THE AVERAGE FOR NON-CONTROL STATIONS (2B1, 2B2, AND 2B3), 2011 BVPS

May	Control Station (Mean)		Non-Control Station (Mean)	
	#/m^2	%	#/m^2	%
Oligochaeta	115	100	1018	60
Chironomidae	0	0	530	31
Mollusca	0	0	95	6
Others	0	0	57	3
TOTAL	115	100	1700	100

September	Control Station (Mean)		Non-Control Station (Mean)	
	#/m^2	%	#/m^2	%
Oligochaeta	387	44	430	35
Chironomidae	215	25	478	39
Mollusca	272	31	244	20
Others	0	0	81	7
TOTAL	874	100	1233	100

TABLE 5.6

SHANNON-WEINER DIVERSITY, EVENNESS AND RICHNESS INDICES
FOR BENTHIC MACROINVERTEBRATES COLLECTED IN THE OHIO RIVER, 2011

	Station					
May	1	2A	2B1	2B2	2B3	3
No. of Taxa	5	17	12	15	14	6
Shannon-Weiner Index	0.60	1.00	0.73	0.53	0.60	0.18
Evenness	0.86	0.81	0.68	0.45	0.53	0.24
Richness	1.92	3.22	2.32	4.67	2.41	0.98

	Station					
September	1	2A	2B1	2B2	2B3	3
No. of Taxa	12	10	19	26	11	28
Shannon-Weiner Index	0.81	0.65	1.14	1.12	0.71	1.13
Evenness	0.75	0.65	0.89	0.79	0.68	0.78
Richness	2.68	2.34	4.17	5.12	2.54	5.40

Table 5.7. Benthic Macroinvertebrate Densities for Stations 1 (Control) and 2B (Noncontrol), BVPS, 1973-2011.

	Preoperational					
	1973		1974		1975	
	1	2B	1	2B	1	2B
May	248	508	1116	2197		
August	99	244	143	541	1017	1124
Mean	**173**	**376**	**630**	**1369**	**1017**	**1124**

	Operational					
	1976		1977		1978	
	1	2B	1	2B	1	2B
May	927	3660	674	848	351	126
August	851	785	591	3474	601	1896
Mean	**889**	**2223**	**633**	**2161**	**476**	**1011**

	Operational					
	1979		1980		1981	
	1	2B	1	2B	1	2B
May	1004	840	1041	747	209	456
Aug/Sept	1185	588	1523	448	2185	912
Mean	**1095**	**714**	**1282**	**598**	**1197**	**684**

	Operational					
	1982		1983		1984	
	1	2B	1	2B	1	2B
May	3490	3026	3590	1314	2741	621
September	2958	3364	4172	4213	1341	828
Mean	**3223**	**3195**	**3881**	**2764**	**2041**	**725**

	Operational					
	1985		1986		1987	
	1	2B	1	2B	1	2B
May	2256	867	601	969	1971	2649
September	1024	913	849	943	2910	2780
Mean	**1640**	**890**	**725**	**956**	**2440**	**2714**

Table 5.7. Benthic Macroinvertebrate Densities for Stations 1 (Control) and 2B (Noncontrol), BVPS, 1973-2011 (Continued).

	Operational					
	1988		1989		1990	
	1	2B	1	2B	1	2B
May	1804	1775	3459	2335	15135	5796
September	1420	1514	1560	4707	5550	1118
Mean	**1612**	**1645**	**2510**	**3274**	**10343**	**3457**

	Operational					
	1991		1992		1993	
	1	2B	1	2B	1	2B
May	7760	6355	7314	10560	8435	2152
September	3588	2605	2723	4707	4693	2143
Mean	**5808**	**4480**	**5019**	**7634**	**6564**	**2148**

	Operational					
	1994		1995		1996	
	1	2B	1	2B	1	2B
May	6980	2349	8083	9283	1987	1333
September	1371	2930	1669	3873	1649	2413
Mean	**4176**	**2640**	**4876**	**6578**	**1814**	**1873**

	Operational					
	1997		1998		1999	
	1	2B	1	2B	1	2B
May	1411	2520	6980	2349	879	1002
September	1944	2774	1371	2930	302	402
Mean	**1678**	**2647**	**4176**	**2640**	**591**	**702**

	Operational					
	2000		2001		2002	
	1	2B	1	2B	1	2B
May	2987	2881	3139	5232	1548	2795
September	3092	2742			8632	14663
Mean	**3040**	**2812**	**3139**	**5232**	**5090**	**8729**

Table 5.7. Benthic Macroinvertebrate Densities for Stations 1 (Control) and 2B (Noncontrol), BVPS, 1973-2011 (Continued).

	Operational					
	2003		**2004**		**2005**	
	1	**2B**	**1**	**2B**	**1**	**2B**
May	7095	10750	2752	4558	516	1146
September	2193	6464	10062	7604	4773	6435
Mean	**4644**	**8607**	**6407**	**6181**	**2645**	**3791**

	Operational					
	2006		**2007**		**2008**	
	1	**2B**	**1**	**2B**	**1**	**2B**
May	143	1242	559	912	158	1252
September	229	2199	560	3794	1161	2150
Mean	**186**	**1721**	**560**	**2353**	**660**	**1701**

	Operational					
	2009		**2010**		2011	
	1	**2B**	**1**	**2B**	1	2B
May	71	1462	1763	2527	115	1700
September	903	1902	1720	1256	874	1233
Mean	**487**	**1682**	**1742**	**1892**	**495**	**1467**

TABLE 5.8

TOTAL FISH CATCH; ELECTROFISHING AND SEINE NET COMBINED DURING THE BVPS 2011 FISHERIES SURVEY

Common Name	Scientific Name	Number	Percent
Smallmouth buffalo	*Ictiobus bubalus*	7	3.66
Black crappie	*Pomoxis nigromaculatus*	1	0.52
Bluegill	*Lepomis macrochirus*	7	3.66
Bluntnose minnow	*Pimephales notatus*	2	1.05
Channel catfish	*Ictalurus punctatus*	2	1.05
Common carp	*Cyprinus carpio*	2	1.05
Emerald shiner	*Notropis atherinoides*	5	2.62
Flathead catfish	*Pylodictis olivaris*	2	1.05
Freshwater drum	*Aplodinotus grunniens*	4	2.09
Gizzard shad	*Dorosoma cepedianum*	20	10.47
Golden redhorse sucker	*Moxostoma erythrurum*	8	4.19
Largemouth bass	*Micropterus salmoides*	1	0.52
Longnose gar	*Lepisosteus osseus*	5	2.62
Log perch	*Percina caprodes*	1	0.52
Mooneye	*Hiodon tergisus*	2	1.05
Pumpkinseed	*Lepomis gibbosus*	1	0.52
Quillback	*Carpiodes cyprinus*	8	4.19
Rock bass	*Ambloplites rupestris*	1	0.52
Sauger	*Sander canadense*	16	8.38
Shorthead redhorse sucker	*Moxostoma macrolepidotum*	34	17.80
Silver redhorse	*Moxostoma anisurum*	2	1.05
Smallmouth bass	*Micropterus dolomieu*	24	12.57
Spotfin shiner	*Notropis spilopterus*	12	6.28
Spotted bass	*Micropterus punctulatus*	10	5.24
Walleye	*Sander vitreum*	3	1.57
White bass	*Morone chrysops*	10	5.24
Yellow perch	*Perca flavescens*	1	0.52
Total Fish Collected in 2011		**191**	**100.00**

TABLE 5.9

COMPARISON OF CONTROL VS. NON-CONTROL ELECTROFISHING CATCHES DURING THE BVPS 2011 FISHERIES SURVEY

Common Name	Control	%	Non-control	%	Total fish	%
Smallmouth buffalo	2	4.44	5	4.7	7	4.64
Black crappie			1	0.9	1	0.66
Bluegill			6	5.7	6	3.97
Channel catfish			2	1.9	2	1.32
Common carp	1	2.22	1	0.9	2	1.32
Flathead catfish	2	4.44			2	1.32
Freshwater drum	1	2.22	3	2.8	4	2.65
Gizzard shad			8	7.5	8	5.30
Golden redhorse sucker	5	11.11	3	2.8	8	5.30
Largemouth bass			1	0.9	1	0.66
Longnose gar	2	4.44	3	2.8	5	3.31
Mooneye	1	2.22	1	0.9	2	1.32
Pumpkinseed			1	0.9	1	0.66
Quillback	4	8.89	4	3.8	8	5.30
Sauger	3	6.67	13	12.3	16	10.60
Shorthead redhorse sucker	14	31.11	20	18.9	34	22.52
Silver redhorse			2	1.9	2	1.32
Smallmouth bass	5	11.11	17	16.0	22	14.57
Spotted bass	3	6.67	7	6.6	10	6.62
Walleye	2	4.44	1	0.9	3	1.99
White bass			6	5.7	6	3.97
Yellow perch			1	0.9	1	0.66
Total	**45**	**100.00**	**106**	**100.0**	**151**	**100.00**

TABLE 5.10

COMPARISON OF CONTROL VS. NON-CONTROL SEINE CATCHES DURING THE BVPS 2011 FISHERIES SURVEY

Common Name	Control	%	Non-control	%	Total fish	%
Bluegill	0	0.00	1	4.76	1	2.50
Bluntnose minnow	1	5.26	1	4.76	2	5.00
Emerald shiner	2	10.53	3	14.29	5	12.50
Gizzard shad	8	42.11	4	19.05	12	30.00
Log perch	0	0.00	1	4.76	1	2.50
Rock bass	0	0.00	1	4.76	1	2.50
Smallmouth bass	0	0.00	2	9.52	2	5.00
Spotfin shiner	8	42.11	4	19.05	12	30.00
White bass	0	0.00	4	19.05	4	10.00
Total	**19**	**100.00**	**21**	**100.00**	**40**	**100.00**

TABLE 5.11

FISH SPECIES COLLECTED DURING THE JUNE 2011 (SPRING) SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

	Sample locations *						Seine		Electrofishing	
Common Name	S-1	S-2	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Smallmouth buffalo			1		1		0	0.00	2	6.45
Black crappie							0	0.00	0	0.00
Bluegill							0	0.00	0	0.00
Bluntnose minnow							0	0.00	0	0.00
Channel catfish						1	0	0.00	1	3.23
Common carp							0	0.00	0	0.00
Emerald shiner		2					2	22.22	0	0.00
Flathead catfish							0	0.00	0	0.00
Freshwater drum							0	0.00	0	0.00
Gizzard shad						1	0	0.00	1	3.23
Golden redhorse sucker			1		1		0	0.00	2	6.45
Largemouth bass							0	0.00	0	0.00
Longnose gar					1		0	0.00	1	3.23
Log perch							0	0.00	0	0.00
Mooneye							0	0.00	0	0.00
Pumpkinseed							0	0.00	0	0.00
Quillback			3	1	1		0	0.00	5	16.13
Rock bass							0	0.00	0	0.00
Sauger							0	0.00	0	0.00
Shorthead redhorse sucker			4	6	1	1	0	0.00	12	38.71
Silver redhorse							0	0.00	0	0.00
Smallmouth bass		1	2	1	2		1	11.11	5	16.13
Spotfin shiner	6						6	66.67	0	0.00
Spotted bass							0	0.00	0	0.00
Walleye							0	0.00	0	0.00
White bass					2		0	0.00	2	6.45
Yellow perch							0	0.00	0	0.00
Total	6	3	11	8	9	3	9	100.00	31	100.00

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.12

FISH SPECIES COLLECTED DURING THE JULY 2011 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

	Sample locations *						Seine		Electrofishing	
Common Name	**S-1**	**S-2**	**E-1**	**E-2A**	**E-2B**	**E-3**	**Total**	**%**	**Total**	**%**
Smallmouth buffalo							0	0.00	0	0.00
Black crappie							0	0.00	0	0.00
Bluegill				1		1	0	0.00	2	10.53
Bluntnose minnow							0	0.00	0	0.00
Channel catfish							0	0.00	0	0.00
Common carp							0	0.00	0	0.00
Emerald shiner	1						1	33.33	0	0.00
Flathead catfish							0	0.00	0	0.00
Freshwater drum				1			0	0.00	1	5.26
Gizzard shad				2		1	0	0.00	3	15.79
Golden redhorse sucker			1				0	0.00	1	5.26
Largemouth bass							0	0.00	0	0.00
Longnose gar					1		0	0.00	1	5.26
Log perch							0	0.00	0	0.00
Mooneye							0	0.00	0	0.00
Pumpkinseed							0	0.00	0	0.00
Quillback			1	2			0	0.00	3	15.79
Rock Bass							0	0.00	0	0.00
Sauger							0	0.00	0	0.00
Shorthead redhorse sucker			2	1			0	0.00	3	15.79
Silver redhorse							0	0.00	0	0.00
Smallmouth bass				1	1		0	0.00	2	10.53
Spotfin shiner	2						2	66.67	0	0.00
Spotted bass				1	2		0	0.00	3	15.79
Walleye							0	0.00	0	0.00
White bass							0	0.00	0	0.00
Yellow perch							0	0.00	0	0.00
Total	**3**	**0**	**4**	**9**	**4**	**2**	**3**	**100.00**	**19**	**100.00**

TABLE 5.13

FISH SPECIES COLLECTED DURING THE SEPTEMBER 2011 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

	Sample locations *						Seine		Electrofishing	
Common Name	**S-1**	**S-2**	**E-1**	**E-2A**	**E-2B**	**E-3**	**Total**	**%**	**Total**	**%**
Smallmouth buffalo					1		0	0.00	1	1.75
Black crappie						1	0	0.00	1	1.75
Bluegill				1			0	0.00	1	1.75
Bluntnose minnow		1					1	4.00	0	0.00
Channel catfish						1	0	0.00	1	1.75
Common carp					1		0	0.00	1	1.75
Emerald shiner	1						1	4.00	0	0.00
Flathead catfish			2				0	0.00	2	3.51
Freshwater drum					1		0	0.00	1	1.75
Gizzard shad	8	4		3			12	48.00	3	5.26
Golden redhorse sucker			3	1	1		0	0.00	5	8.77
Largemouth bass							0	0.00	0	0.00
Longnose gar			2			1	0	0.00	3	5.26
Log perch		1					1	4.00	0	0.00
Mooneye			1		1		0	0.00	2	3.51
Pumpkinseed							0	0.00	0	0.00
Quillback							0	0.00	0	0.00
Rock bass		1					1	4.00	0	0.00
Sauger			1	2	1	1	0	0.00	5	8.77
Shorthead redhorse sucker			1	7	1	1	0	0.00	10	17.54
Silver redhorse				1	1		0	0.00	2	3.51
Smallmouth bass		1	2	4	2		1	4.00	8	14.04
Spotfin shiner		4					4	16.00	0	0.00
Spotted bass			2	1	2		0	0.00	5	8.77
Walleye			2			1	0	0.00	3	5.26
White bass		4			2	1	4	16.00	3	5.26
Yellow perch							0	0.00	0	0.00
Total	**9**	**16**	**16**	**20**	**14**	**7**	**25**	**100.00**	**57**	**100.00**

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.14

FISH SPECIES COLLECTED DURING THE NOVEMBER 2011 SAMPLING OF THE OHIO RIVER IN THE VICINITY OF BVPS

	Sample locations *						Seine		Electrofishing	
Common Name	S-1	S-2	E-1	E-2A	E-2B	E-3	Total	%	Total	%
Smallmouth buffalo			1		1	2	0	0.00	4	9.09
Black crappie							0	0.00	0	0.00
Bluegill		1			2	1	1	33.33	3	6.82
Bluntnose minnow	1						1	33.33	0	0.00
Channel catfish							0	0.00	0	0.00
Common carp			1				0	0.00	1	2.27
Emerald shiner		1					1	33.33	0	0.00
Flathead catfish							0	0.00	0	0.00
Freshwater drum			1		1		0	0.00	2	4.55
Gizzard shad				1			0	0.00	1	2.27
Golden redhorse sucker							0	0.00	0	0.00
Largemouth bass				1			0	0.00	1	2.27
Longnose gar							0	0.00	0	0.00
Log perch							0	0.00	0	0.00
Mooneye							0	0.00	0	0.00
Pumpkinseed						1	0	0.00	1	2.27
Quillback							0	0.00	0	0.00
Rock bass							0	0.00	0	0.00
Sauger			2	1	6	2	0	0.00	11	25.00
Shorthead redhorse sucker			7	2			0	0.00	9	20.45
Silver redhorse							0	0.00	0	0.00
Smallmouth bass			1	3	3		0	0.00	7	15.91
Spotfin shiner							0	0.00	0	0.00
Spotted bass			1	1			0	0.00	2	4.55
Walleye							0	0.00	0	0.00
White bass				1			0	0.00	1	2.27
Yellow perch					1		0	0.00	1	2.27
Total	**1**	**2**	**14**	**10**	**14**	**6**	**3**	**100.00**	**44**	**97.73**

* Gear = (E) Fish captured by electrofishing; (S) captured by seining

TABLE 5.15

ESTIMATED NUMBER OF FISH OBSERVED * DURING ELECTROFISHING OPERATIONS, 2011

Common Name	June	July	Sept	Nov	Total
Unidentified redhorse suckers	5	-	-	-	**5**
Carp	-	-	-	1	**1**
Longnose gar	4	-	-	-	**4**
Unidentified suckers	3	-	-	6	**9**
Sauger	-	-	-	4	**4**
Gizzard shad	2	-	-	-	**2**
Total	**14**	**0**	**0**	**11**	**25**

* = Not boated or handled

Table 5.16

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2008 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	40.5	Smallmouth buffalo	6	0.1481
		Bluegill	1	0.0247
		Carp	1	0.0247
		Channel catfish	10	0.2469
		Freshwater drum	2	0.0494
		Golden redhorse sucker	18	0.4444
		Quillback	9	0.2222
		Rock bass	1	0.0247
		Sauger	51	1.2593
		Shorthead redhorse sucker	40	0.9877
		Silver redhorse	11	0.2716
		Smallmouth bass	18	0.4444
		Spotted bass	4	0.0988
		Walleye	12	0.2963
		Season Total	**184**	**4.5432**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Summer	41.0	Smallmouth buffalo	5	0.1220
		Bluegill	1	0.0244
		Flathead catfish	1	0.0244
		Freshwater drum	4	0.0976
		Gizzard shad	4	0.0976
		Longnose gar	3	0.0732
		Quillback	1	0.0244
		Sauger	2	0.0488
		Shorthead redhorse sucker	2	0.0488
		Smallmouth bass	4	0.0976
		Spotted bass	1	0.0244
		Season Total	**28**	**0.6829**

Table 5.16 (continued)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2008 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Fall	41.0	Smallmouth buffalo	2	0.0488
		Carp	1	0.0244
		Channel catfish	2	0.0488
		Freshwater drum	1	0.0244
		Gizzard shad	17	0.4146
		Golden redhorse sucker	3	0.0732
		Mooneye	1	0.0244
		Northern hog sucker	0	0.0000
		Quillback	4	0.0976
		Sauger	2	0.0488
		Shorthead redhorse sucker	7	0.1707
		Silver redhorse	1	0.0244
		Smallmouth bass	9	0.2195
		Spotted bass	1	0.0244
		White bass	1	0.0244
		Season Total	**52**	**1.2683**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Winter	40.4	Smallmouth buffalo	3	0.0743
		Bluegill	2	0.0495
		Carp	0	0.0000
		Gizzard shad	3	0.0743
		Golden redhorse sucker	9	0.2228
		Largemouth bass	1	0.0248
		Longnose gar	2	0.0495
		Quillback	2	0.0495
		River carpsucker	1	0.0248
		Sauger	10	0.2475
		Shorthead redhorse sucker	15	0.3713
		Silver redhorse	1	0.0248
		Smallmouth bass	4	0.0990
		Spotted bass	4	0.0990
		White bass	1	0.0248
		Season Total	**58**	**1.4356**
2008	**162.9**		**322**	**1.9767**

Table 5.17

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2009 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	40.3	Smallmouth buffalo	7	0.1737
		Flathead catfish	1	0.0248
		Freshwater drum	1	0.0248
		Gizzard shad	2	0.0496
		Golden redhorse sucker	8	0.1985
		Longnose gar	4	0.0993
		Quillback	5	0.1241
		River carpsucker	2	0.0496
		Shorthead redhorse sucker	15	0.3722
		Silver redhorse	1	0.0248
		Smallmouth bass	9	0.2233
		Spotted bass	1	0.0248
		Walleye	1	0.0248
		White bass	1	0.0248
		Season Total	**58**	**1.4392**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Summer	40.0	Smallmouth buffalo	4	0.1000
		Carp	3	0.0750
		Channel catfish	1	0.0250
		Gizzard shad	2	0.0500
		Golden redhorse sucker	1	0.0250
		Mooneye	2	0.0500
		Quillback	3	0.0750
		Sauger	6	0.1500
		Shorthead redhorse sucker	13	0.3250
		Smallmouth bass	2	0.0500
		Spotted bass	2	0.0500
		Season Total	**39**	**0.9750**

Table 5.17 (continued)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2009 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Fall	40.5	Smallmouth buffalo	1	0.0247
		Black crappie	1	0.0247
		Bluegill	3	0.0741
		Carp	3	0.0741
		Gizzard shad	1	0.0247
		Golden redhorse sucker	6	0.1481
		Quillback	1	0.0247
		Sauger	13	0.3210
		Shorthead redhorse sucker	4	0.0988
		Silver redhorse	1	0.0247
		Smallmouth bass	3	0.0741
		Spotted bass	4	0.0988
		White bass	8	0.1975
		Season Total	**49**	**1.2099**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Winter	40.0	Smallmouth buffalo	5	0.1250
		Carp	4	0.1000
		Channel catfish	1	0.0250
		Flathead catfish	1	0.0250
		Golden redhorse sucker	4	0.1000
		Longnose gar	3	0.0750
		Mooneye	1	0.0250
		Quillback	3	0.0750
		Sauger	11	0.2750
		Shorthead redhorse sucker	12	0.3000
		Smallmouth bass	6	0.1500
		Spotted bass	1	0.0250
		Walleye	3	0.0750
		White bass	3	0.0750
		Season Total	**58**	**1.4500**
2009	**160.8**		**204**	**1.2687**

Table 5.18

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2010 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	41.0	Smallmouth buffalo	4	0.0976
		Channel catfish	3	0.0732
		Freshwater drum	1	0.0244
		Gizzard shad	3	0.0732
		Golden redhorse sucker	11	0.2683
		Longnose gar	4	0.0976
		Mooneye	2	0.0488
		Sauger	16	0.3902
		Shorthead redhorse sucker	22	0.5366
		Silver redhorse	4	0.0976
		Smallmouth bass	13	0.3171
		Spotted bass	2	0.0488
		Walleye	3	0.0732
		White bass	2	0.0488
		Season Total	**90**	**2.1951**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Summer	40.4	Smallmouth buffalo	4	0.0990
		Channel catfish	1	0.0248
		Flathead catfish	1	0.0248
		Golden shiner	1	0.0248
		Mooneye	1	0.0248
		Quillback	2	0.0495
		Shorthead redhorse sucker	2	0.0495
		Silver redhorse	1	0.0248
		Season Total	**13**	**0.3218**

Table 5.19

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2011 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Spring	40.5	Smallmouth buffalo	2	0.0494
		Channel catfish	1	0.0247
		Gizzard shad	1	0.0247
		Golden redhorse sucker	2	0.0494
		Longnose gar	1	0.0247
		Quillback	5	0.1235
		Shorthead redhorse sucker	12	0.2963
		Smallmouth bass	5	0.1235
		White bass	2	0.0494
		Season Total	**31**	**0.7654**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Summer	40.3	Bluegill	2	0.0496
		Freshwater drum	1	0.0248
		Gizzard shad	3	0.0744
		Golden redhorse sucker	1	0.0248
		Longnose gar	1	0.0248
		Quillback	3	0.0744
		Shorthead redhorse sucker	3	0.0744
		Smallmouth bass	2	0.0496
		Spotted bass	3	0.0744
		Season Total	**19**	**0.4715**

Table 5.18 (continued)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2010 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Fall	40.2	Smallmouth buffalo	1	0.0249
		Gizzard shad	6	0.1493
		Golden redhorse sucker	2	0.0498
		Sauger	1	0.0249
		Shorthead redhorse sucker	2	0.0498
		Silver redhorse	1	0.0249
		Smallmouth bass	3	0.0746
		Spotted bass	4	0.0995
		White bass	6	0.1493
		Season Total	**26**	**0.6468**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Winter	40.4	Smallmouth buffalo	1	0.0248
		Freshwater drum	3	0.0743
		Gizzard shad	4	0.0990
		Golden redhorse sucker	2	0.0495
		Mooneye	1	0.0248
		Pumpkinseed	0	0.0000
		Quillback	2	0.0495
		River carpsucker	1	0.0248
		Sauger	3	0.0743
		Shorthead redhorse sucker	7	0.1733
		Silver redhorse	5	0.1238
		Smallmouth bass	3	0.0743
		Spotted bass	2	0.0495
		White bass	13	0.3218
		Season Total	**47**	**1.1634**
2010	**162.0**		**176**	**1.08642**

Table 5.19 (continued)

CATCH PER UNIT EFFORT (CPUE AS FISH/ELECTROFISHING MINUTE) BY SEASON DURING THE BVPS 2011 FISHERIES SURVEY

Season	Effort (min)	Common Name	Number Collected	CPUE (fish/min)
Fall	40.2	Smallmouth buffalo	1	0.0249
		Black crappie	1	0.0249
		Bluegill	1	0.0249
		Channel catfish	1	0.0249
		Common carp	1	0.0249
		Flathead catfish	2	0.0498
		Freshwater drum	1	0.0249
		Gizzard shad	3	0.0746
		Golden redhorse sucker	5	0.1244
		Longnose gar	3	0.0746
		Mooneye	2	0.0498
		Sauger	5	0.1244
		Shorthead redhorse sucker	10	0.2488
		Silver redhorse	2	0.0498
		Smallmouth bass	8	0.1990
		Spotted bass	5	0.1244
		Walleye	3	0.0746
		White bass	3	0.0746
		Season Total	**57**	**1.4179**
Season	**Effort (min)**	**Common Name**	**Number Collected**	**CPUE (fish/min)**
Winter	40.5	Smallmouth buffalo	4	0.0988
		Bluegill	3	0.0741
		Common carp	1	0.0247
		Freshwater drum	2	0.0494
		Gizzard shad	1	0.0247
		Largemouth bass	1	0.0247
		Pumpkinseed	1	0.0247
		Sauger	11	0.2716
		Shorthead redhorse sucker	9	0.2222
		Smallmouth bass	7	0.1728
		Spotted bass	2	0.0494
		White bass	1	0.0247
		Yellow perch	1	0.0247
		Season Total	**44**	**1.0864**
2011	**161.5**		**151**	**0.93498**

TABLE 5.20

UNIT 1 COOLING RESERVOIR MONTHLY SAMPLING
CORBICULA DENSITY DATA FOR
2011 FROM BVPS

Collection Date	Area Sampled (sq ft)	Live or Dead	Count	Maximum Length Range (mm)	Minimum Length Range(mm)	Estimated Number (per sq m)
4/20/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
5/26/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
6/28/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
7/28/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
8/24/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
9/9/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
10/18/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
11/8/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
Unit summary		Dead	0	---	---	0
		Live	0	---	---	0

TABLE 5.21

UNIT 2 COOLING RESERVOIR MONTHLY SAMPLING <u>CORBICULA</u> DENSITY DATA FOR 2011 FROM BVPS

Collection Date	Area Sampled (sq ft)	Live or Dead	Count	Maximum Length Range (mm)	Minimum Length Range(mm)	Estimated Number (per sq m)
4/20/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
5/26/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
6/28/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
7/28/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
8/24/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
9/9/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
10/18/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
11/8/2011	0.25	Dead	0	---	---	0
		Live	0	---	---	0
Unit summary		Dead	0	---	---	0
		Live	0	---	---	0

9.0

FIGURES

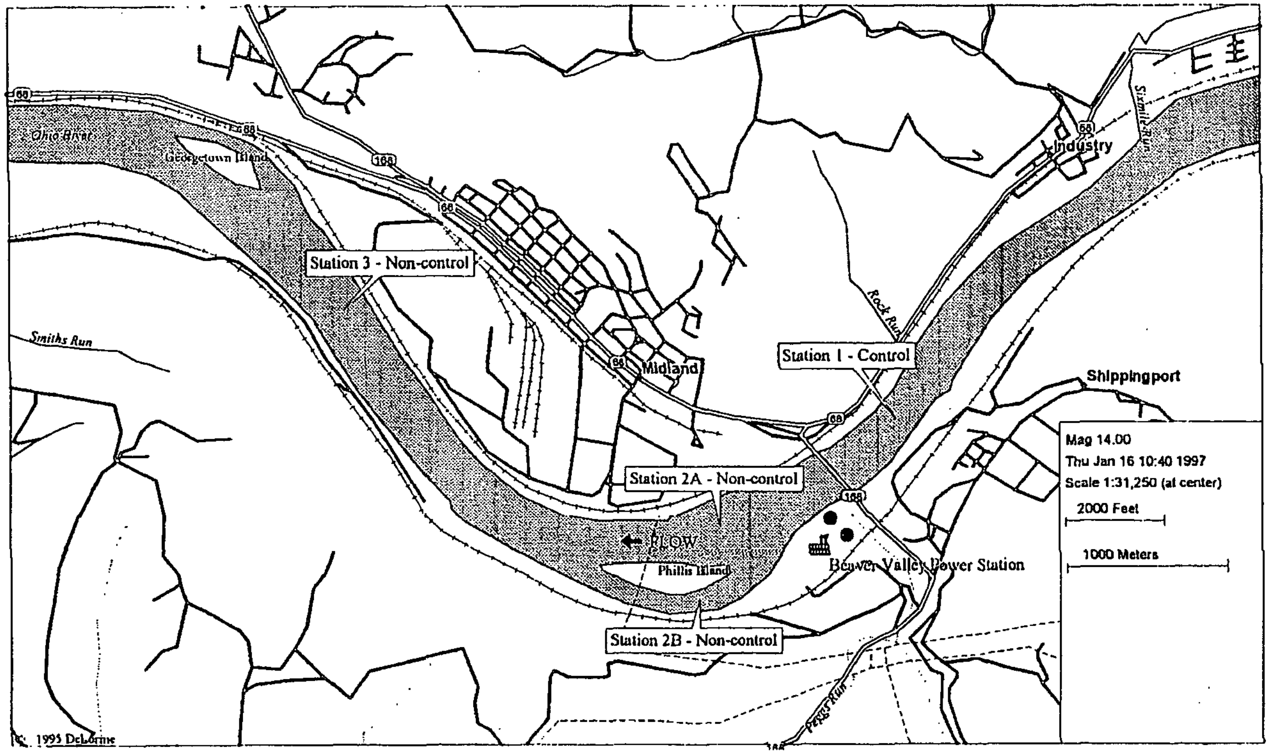


Figure 5.1 2011 Beaver Valley Power Station Aquatic Monitoring Program Sampling Control and Non-Control Sampling Stations

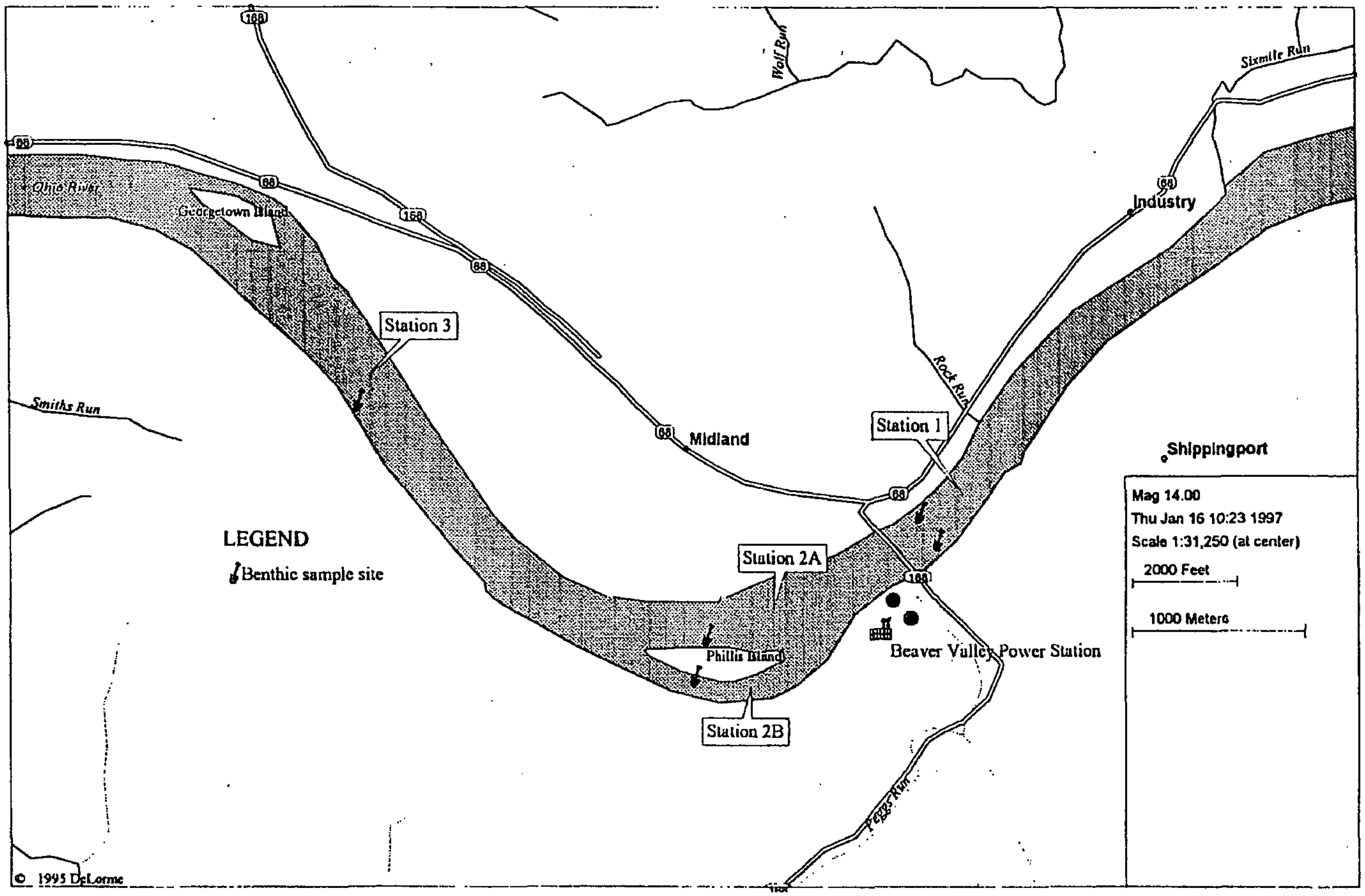


Figure 5.2 Location Map for Beaver Valley Power Station Benthic Organism Survey Sampling Sites for the 2011 Study

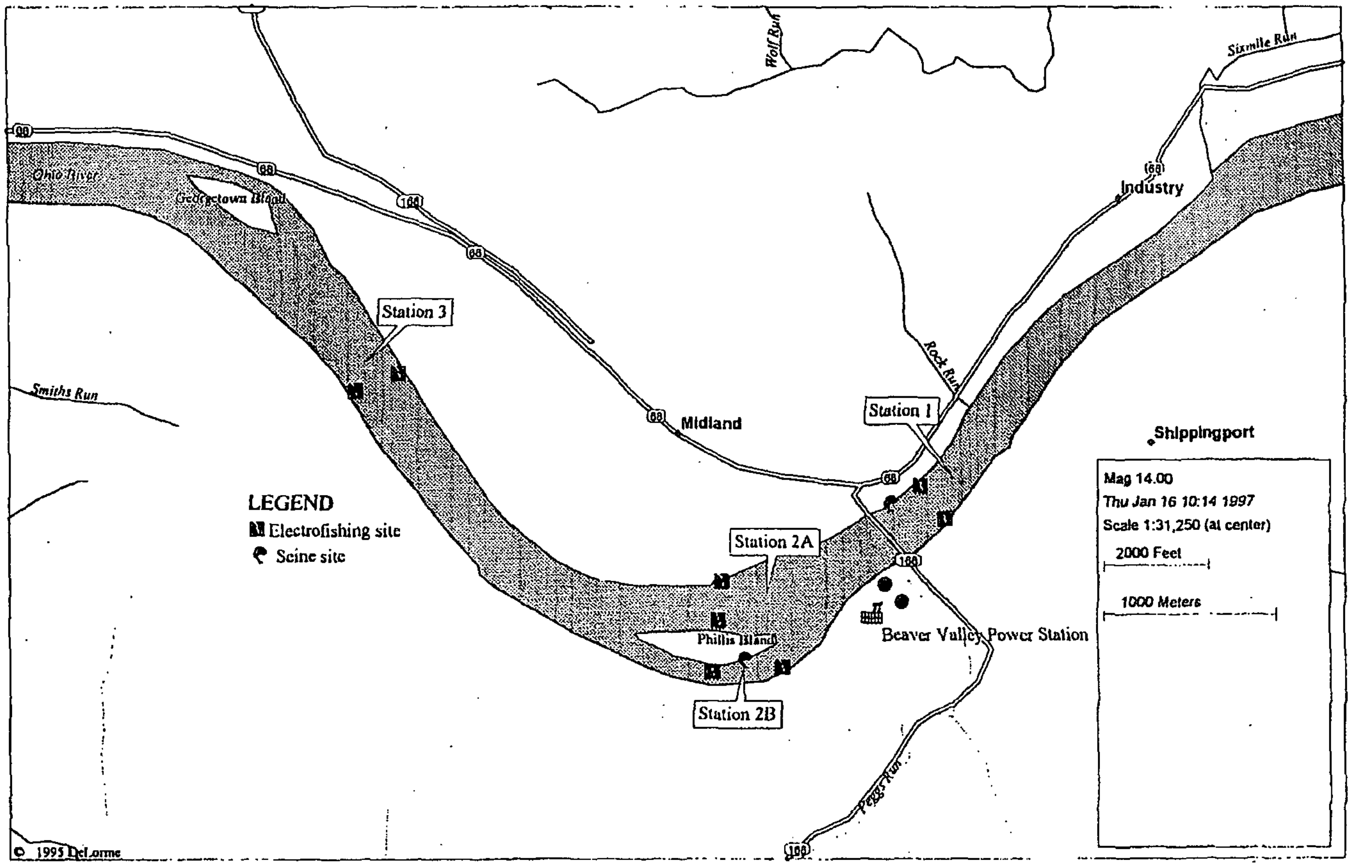


Figure 5.3 Location Map for Beaver Valley Power Station Fish Population Survey Fish Sampling Sites for the 2011 Study

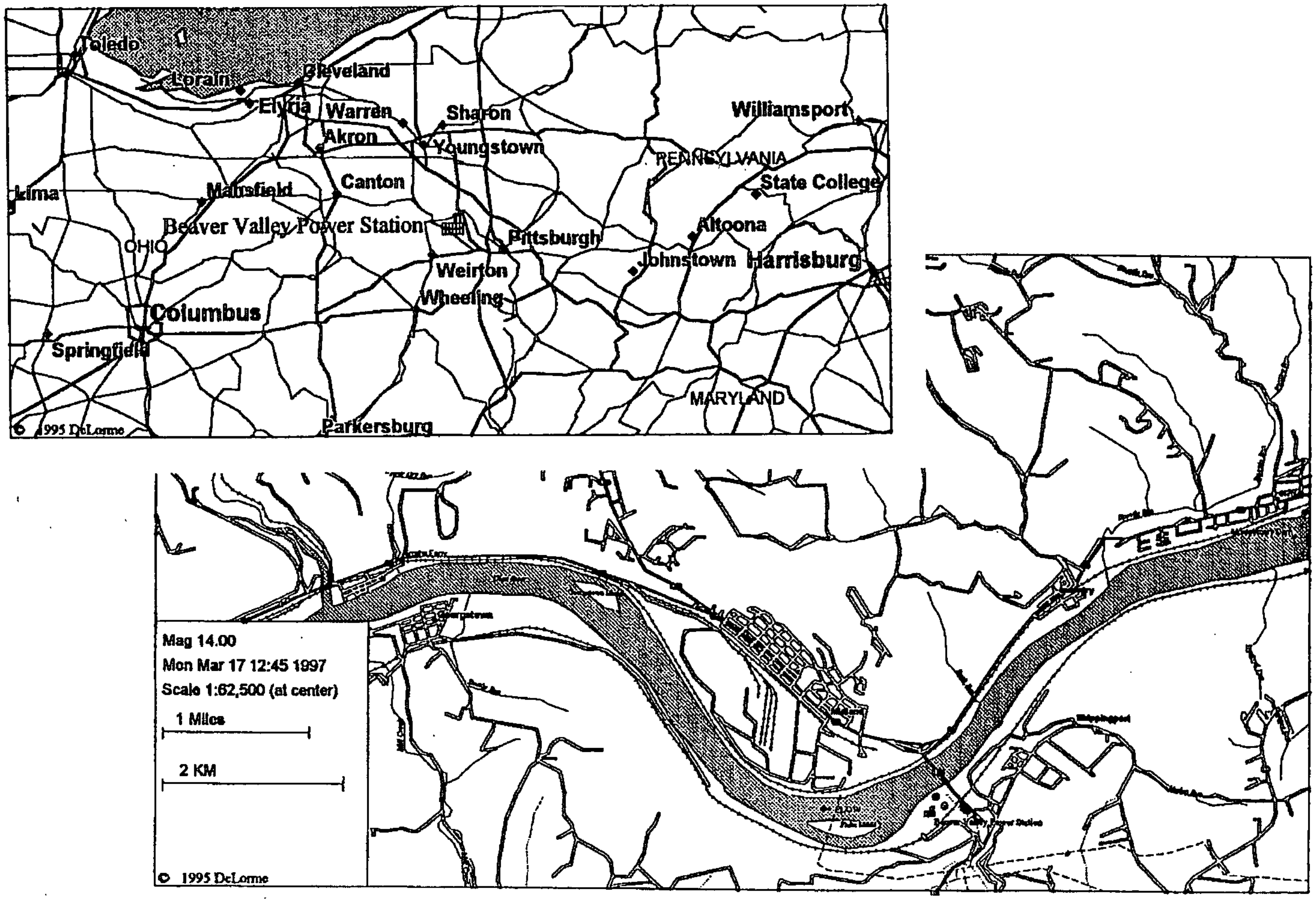
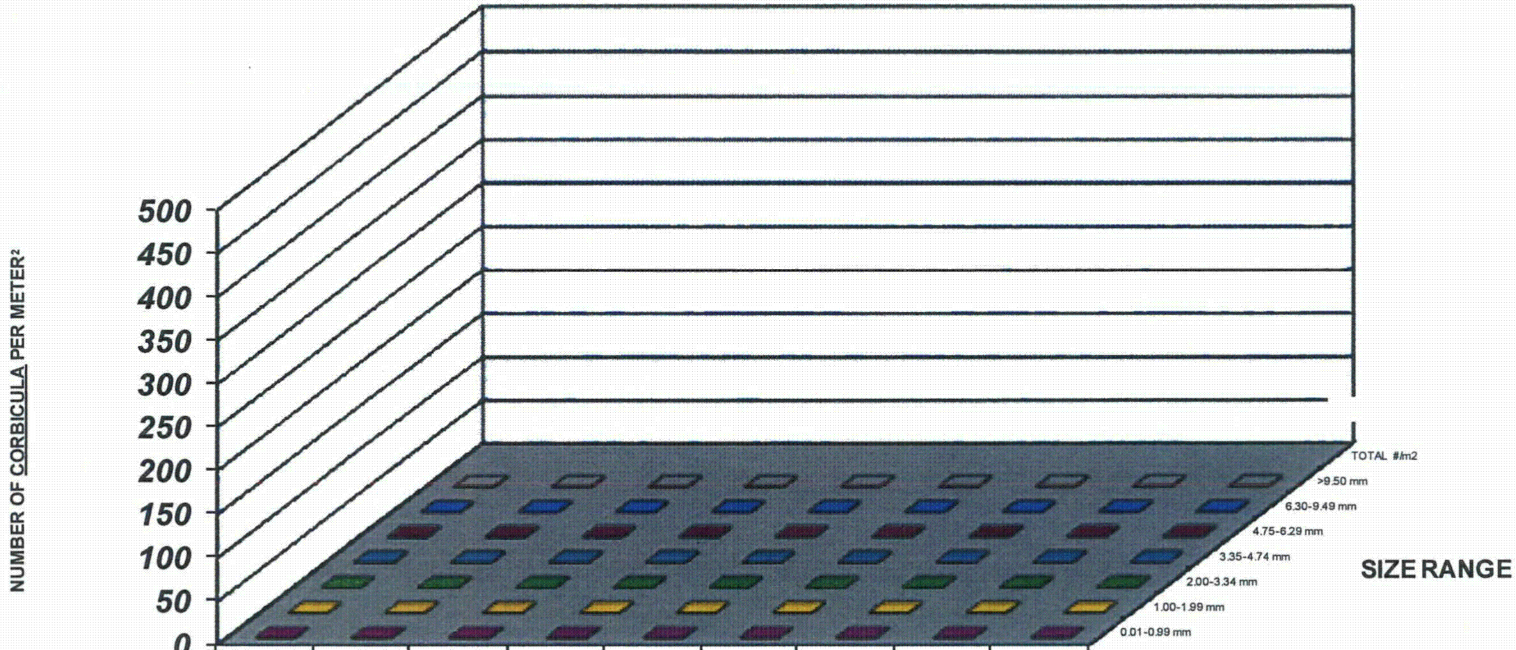


Figure 5.4 Location of Study Area, Beaver Valley Power Station Shippingport, Pennsylvania BVPS

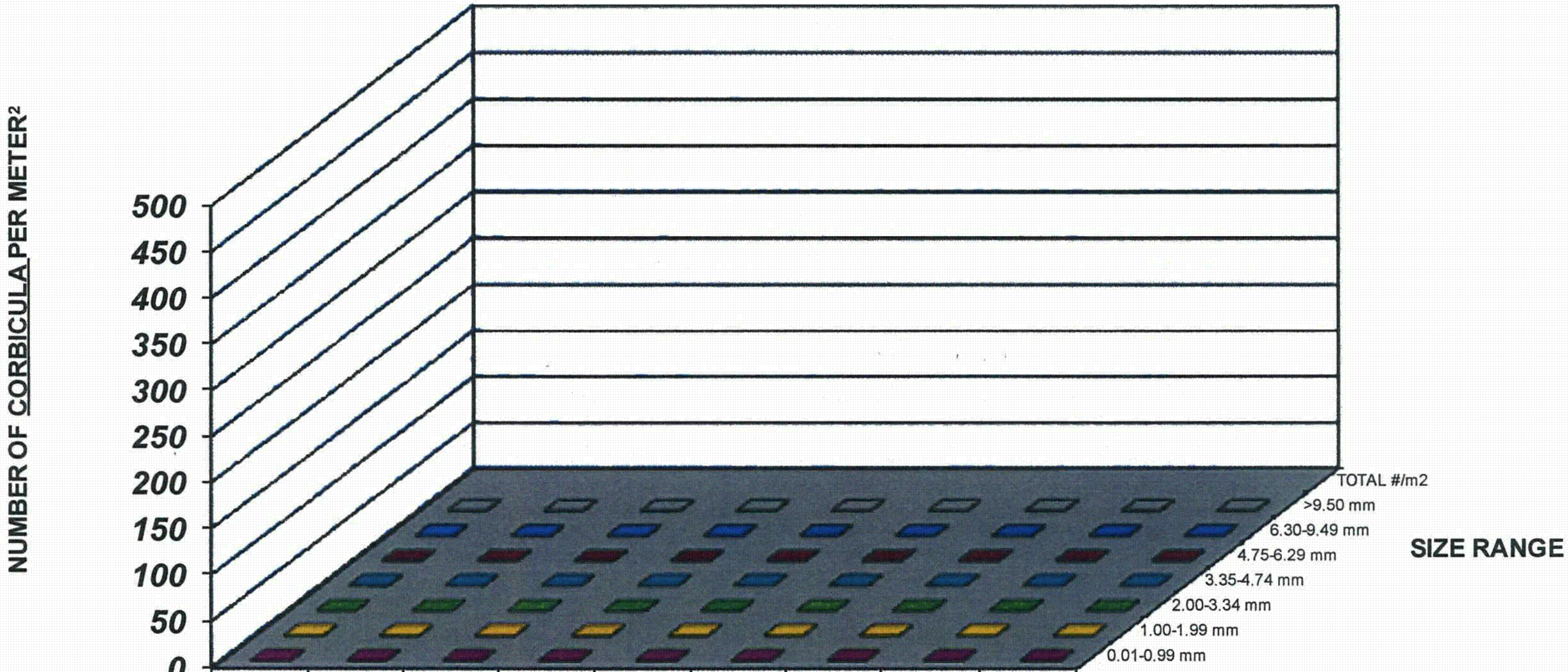
Comparison of live Corbicula clam density estimates among 2011 BVPS Unit 1 cooling tower reservoir events, for various clam shell groups.



		4/20	5/26	6/28	7/28	8/24	9/9	10/18	11/8
0.01-0.99 mm	0	0	0	0	0	0	0	0	0
1.00-1.99 mm	0	0	0	0	0	0	0	0	0
2.00-3.34 mm	0	0	0	0	0	0	0	0	0
3.35-4.74 mm	0	0	0	0	0	0	0	0	0
4.75-6.29 mm	0	0	0	0	0	0	0	0	0
6.30-9.49 mm	0	0	0	0	0	0	0	0	0
>9.50 mm	0	0	0	0	0	0	0	0	0
TOTAL #/m2	0	0	0	0	0	0	0	0	0

Figure 5.5

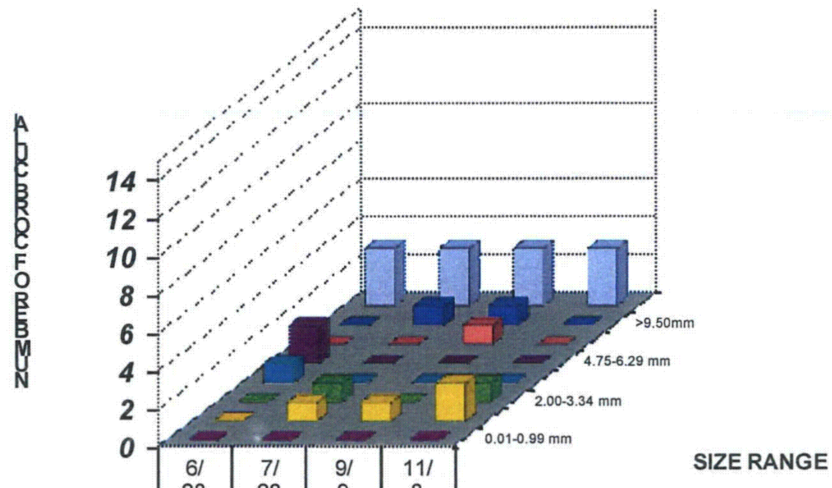
Comparison of live Corbicula clam density estimates among 2011 BVPS Unit 2 cooling tower reservoir events, for various clam shell groups.



		4/20	5/26	6/28	7/28	8/24	9/9	10/18	11/8
0.01-0.99 mm	0	0	0	0	0	0	0	0	0
1.00-1.99 mm	0	0	0	0	0	0	0	0	0
2.00-3.34 mm	0	0	0	0	0	0	0	0	0
3.35-4.74 mm	0	0	0	0	0	0	0	0	0
4.75-6.29 mm	0	0	0	0	0	0	0	0	0
6.30-9.49 mm	0	0	0	0	0	0	0	0	0
>9.50 mm	0	0	0	0	0	0	0	0	0
TOTAL #/m2	0	0	0	0	0	0	0	0	0

Figure 5.6

Comparison of live <u>Corbicula</u> clam density estimates among 2011 BVPS Intake Structure sample events, for various clam shell groups.



	6/28	7/28	9/9	11/8
0.01-0.99 mm	0	0	0	0
1.00-1.99 mm	0	1	1	2
2.00-3.34 mm	0	1	0	1
3.35-4.74 mm	1	0	0	0
4.75-6.29 mm	2	0	0	0
6.30-9.49 mm	0	0	1	0
>9.50mm	0	1	1	0
TOTAL	3	3	3	3

Intake structure bottom samples are collected from the Ohio River at the Intake Building.

Figure 5.7

Water Temperature and River Elevation Recorded at the Ohio River at BVPS Intake Structure During 2011 on Monthly Sample Dates.

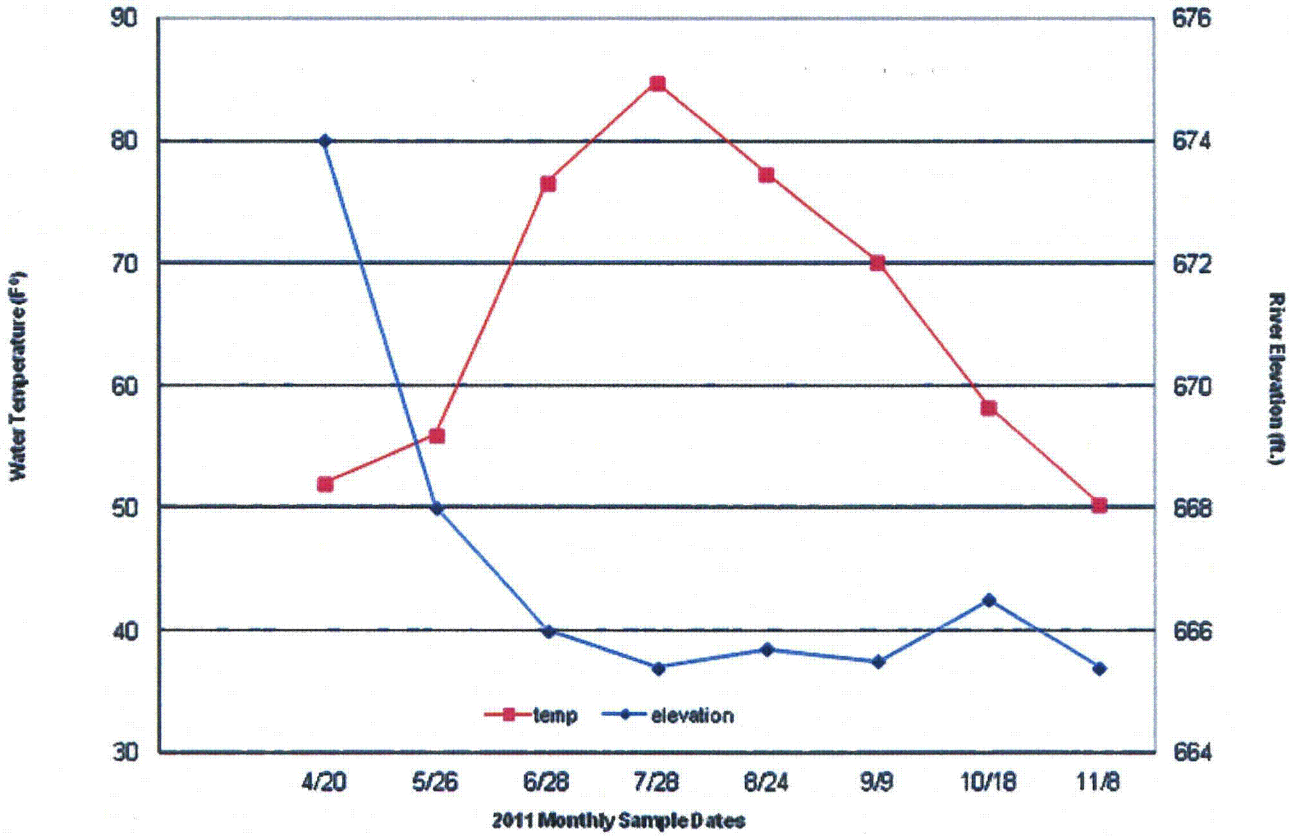
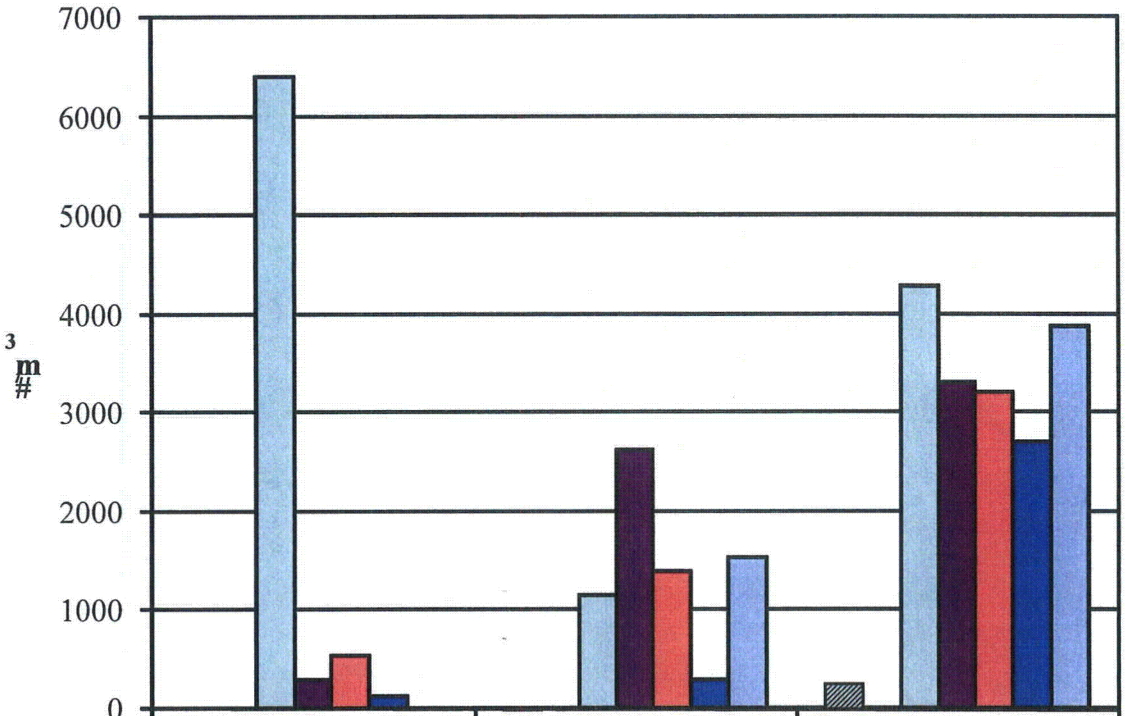
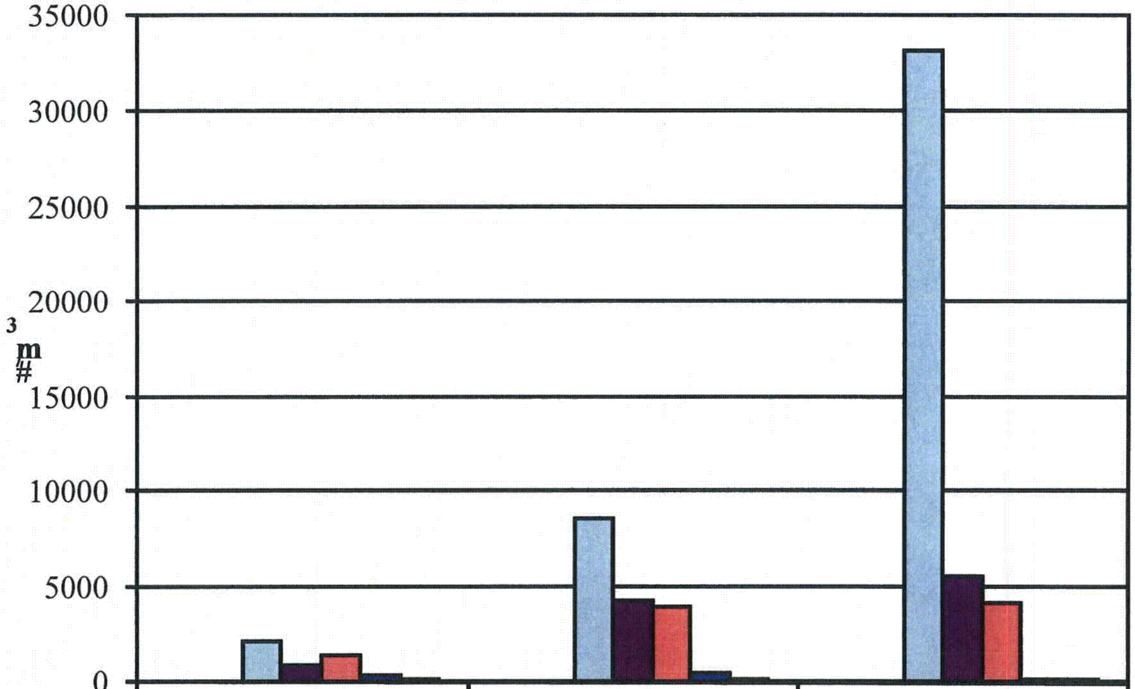


Figure 5.8



	Intake Structure/Open Water	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
4/20	0	10	250
5/26	0	0	0
6/28	6400	1137	4280
7/28	290	2629	3313
8/24	530	1390	3205
9/9	140	300	2693
10/18	0	1520	3870

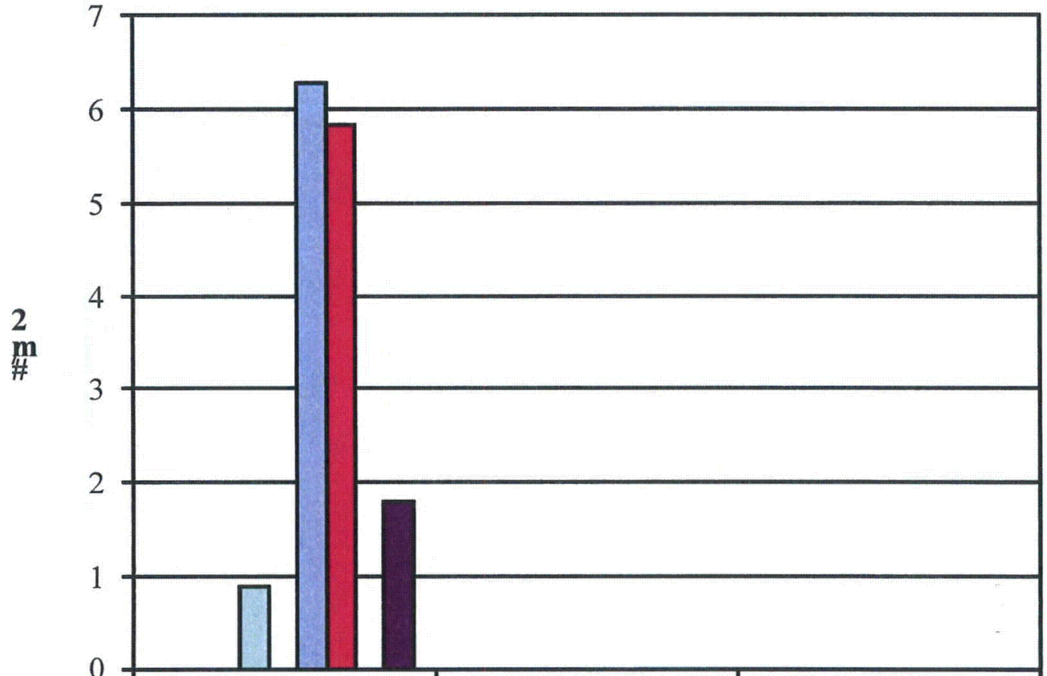
Figure 5.9. Density of zebra mussel veligers collected at Beaver Valley Power Station, 2011.



	Barge Slip	Splash Pool	Emergency Outfall Facility
4/20	0	0	0
5/26	0	0	0
6/28	2200	8550	33160
7/28	900	4215	5500
8/24	1390	3990	4200
9/9	380	480	30
10/18	160	20	40

Sample location

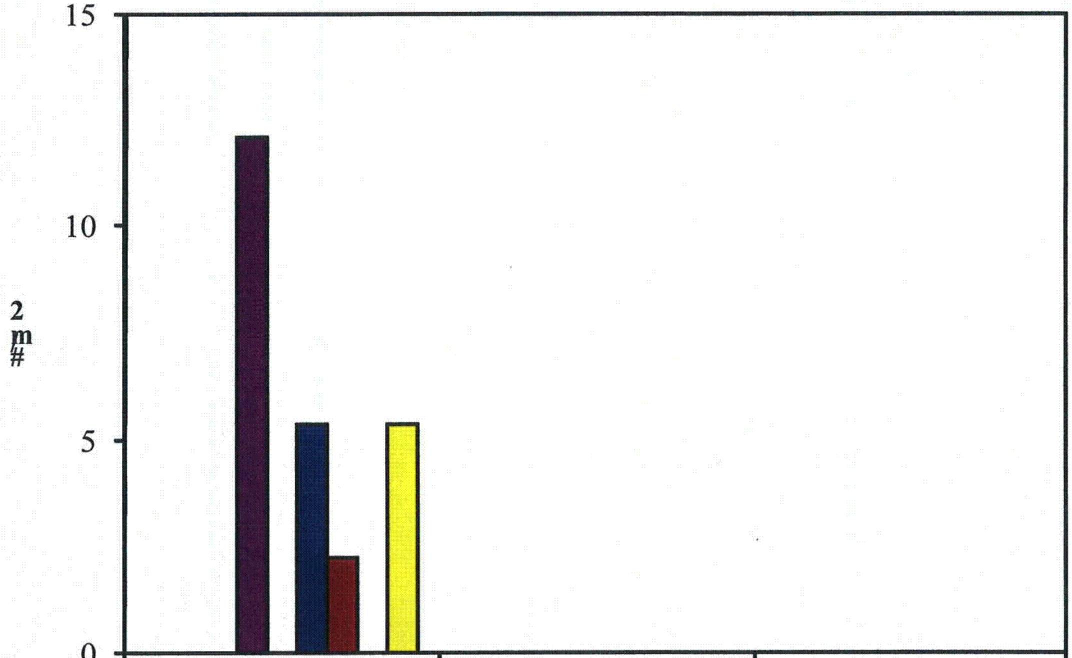
Figure 5.10. Density of zebra mussel veligers collected at Beaver Valley Power Station, 2011.



	Intake Structure/Open Water*	Unit 1 Cooling Tower Reservoir	Unit 2 Cooling Tower Reservoir
	0	0	0
4/20	0	0	0
5/26	0	0	0
6/28	1	0	0
7/28	0	0	0
8/24	6	0	0
9/9	6	0	0
10/18	0	0	0
11/8	2	0	0

Figure 5.11. Density of settled zebra mussels at Beaver Valley Power Station, 2011.

* River Elevation Too High to Safely Sample in April and May.



	Barge Slip*	Splash Pool	Emergency Outfall Facility
▨	0	0	0
4/20	0	0	0
5/26	0	0	0
6/28	12	0	0
7/28	0	0	0
8/24	5	0	0
9/9	2	0	0
10/18	0	0	0
11/8	5	0	0

Figure 5.12. Density of settled zebra mussels at Beaver Valley Power Station, 2011.
* River Elevation Too High to Safely Sample in April and May.

10.0

PERMITS

Attachment 10.1: PERMITS & CERTIFICATES FOR ENVIRONMENTAL COMPLIANCE

Registration Number	Regulator/Description	Expiration
PAR000040485	BVPS EPA generator identification Resource Conservation & Recovery Act (RCRA) Identification number for regulated waste activity. Also used by PA DEP to monitor regulated waste activity under the Pennsylvania Solid Waste Management Act (SWMA).	Indefinite
04-02474	BVPS EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for SARA Tier II reporting and emergency planning.	Indefinite
04-02475	FE Long Term Distribution Center/Warehouse (22) EPA Facility Identification Number for CERCLA/EPCRA/SARA. Used for SARA Tier II reporting and emergency planning.	Indefinite
PA0025615	BVPS NPDES Permit number under US EPA and PA DEP.	12/27/2006 *Continued pending approval of renewal application.*
04-13281	BVPS Unit 1 PA DEP Facility Identification & certificate number for regulated storage tanks.	Indefinite
04-13361	BVPS Unit 2 PA DEP Facility Identification & certificate number for regulated storage tanks.	Indefinite
OP-04-00086	PA DEP State Only Synthetic Minor Permit for emergency auxiliary boilers, emergency diesel generators, paint shop and other miscellaneous sources..	10/12/2012
N/A	PA DEP Open Burning Permit for operation of the BVPS Fire School- annual application and renewal	01/13/2012
042009 450 002RT	US Department of Transportation Hazardous Materials Registration	06/30/2012
200100242	US Army Permit for maintenance dredging (With Encroachment/Submerged Lands Agreement #0477705, this allows maintenance dredging.).	12/31/2021
0477705	Encroachment Permit/Submerged Lands Agreement for construction and maintenance of current barge slip. (With US Army Permit #200100242, this allows maintenance dredging.)	Indefinite
06786A	Encroachment Permit/Submerged Lands Agreement for transmission line over Ohio River @ Mile 34.5	Indefinite
18737	Encroachment Permit/Submerged Lands Agreement for Unit 1 intake and discharge (main combined intake and outfall structures)	Indefinite
0475711	Encroachment Permit/Submerged Lands Agreement for construction and maintenance of Unit 2 auxiliary intake	Indefinite
GP020409201	For construction and maintenance of boat ramp near barge slip.	Indefinite
	- End Table -	

APPENDIX A

SCIENTIFIC AND COMMON NAME[1] OF FISH COLLECTED IN THE NEW CUMBERLAND POOL OF THE OHIO RIVER, 1970 THROUGH 2011 BVPS

[1]Nomenclature follows Robins, et al. (1991)

Appendix A

Family and Scientific Name	**Common Name**
Lepisosteidae (gars)	
Lepisosteus osseus	Longnose gar
Hiodontidae (mooneyes)	
Hiodon alosoides	Goldeye
H. tergisus	Mooneye
Clupeidae (herrings)	
Alosa chrysochloris	Skipjack herring
A. pseudoharengus	Alewife
Dorosoma cepedianum	Gizzard shad
Cyprinidae (carps and minnows)	
Campostoma anomalum	Central stoneroller
Carassius auratus	Goldfish
Ctenopharyngodon idella	Grass carp
Notropis spilopterus	Spotfin shiner
Cyprinus carpio	Common carp
C. carpio x C. auratus	Carp-goldfish hybrid
Luxilus chrysocephalus	Striped shiner
Macrhybopsis storeriana	Silver chub
Nocomis micropogon	River chub
Notemigonus crysoleucas	Golden shiner
Notropis atherinoides	Emerald shiner
N. buccatus	Silverjaw minnow
N. hudsonius	Spottail shiner
N. rubellus	Rosyface shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Pimephales notatus	Bluntnose minnow
P. promelas	Fathead minnow
Rhinichthys atratulus	Blacknose dace
Semotilus atromaculatus	Creek chub
Catostomidae (suckers)	
Carpiodes carpio	River carpsucker
C. cyprinus	Quillback
C. velifer	Highfin carpsucker
Catostomus commersonii	White sucker
Hypentelium nigricans	Northern hogsucker
Ictiobus bubalus	Smallmouth buffalo
I. niger	Black buffalo
Minytrema melanops	Spotted sucker

Appendix A
(Continued)

Family and Scientific Name	Common Name
Moxostoma anisurum	Silver redhorse
M. carinatum	River redhorse
M. duquesnei	Black redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
Ictaluridae (bullhead catfishes)	
Ameiurus catus	White catfish
A. furcatus	Blue catfish
A. melas	Black bullhead
A. natalis	Yellow bullhead
A. nebulosus	Brown bullhead
Ictalurus punctatus	Channel catfish
Noturus flavus	Stonecat
Pylodictis olivaris	Flathead catfish
Esocidae (pikes)	
Esox lucius	Northern pike
E. masquinongy	Muskellunge
E. lucius x *E. masquinongy*	Tiger muskellunge
Salmonidae (trouts)	
Oncorhynchus mykiss	Rainbow trout
Percopsidae (trout-perches)	
Percopsis omiscomaycus	Trout-perch
Cyprinodontidae (killifishes)	
Fundulus diaphanus	Banded killifish
Atherinidae (silversides)	
Labidesthes sicculus	Brook silverside
Percichthyidae (temperate basses)	
Morone chrysops	White bass
M. saxatilis	Striped bass
M. saxatilis x *M. chrysops*	Striped bass hybrid
Centrarchidae (sunfishes)	
Ambloplites rupestris	Rock bass
Lepomis cyanellus	Green sunfish
L. gibbosus	Pumpkinseed
L. macrochirus	Bluegill
L. microlophus	Redear sunfish
L. gibbosus x *L. microlophus*	Pumpkinseed-redear sunfish hybrid
Micropterus dolomieu	Smallmouth bass
M. punctulatus	Spotted bass
M. salmoides	Largemouth bass
Pomoxis annularis	White crappie
P. nigromaculatus	Black crappie

Appendix A
(Continued)

Family and Scientific Name	Common Name
Percidae (perches)	
Etheostoma blennioides	Greenside darter
E. nigrum	Johnny darter
E. zonale	Banded darter
Perca flavescens	Yellow perch
Percina caprodes	Logperch
P. copelandi	Channel darter
Sander canadense	Sauger
S. vitreum	Walleye
S. canadense x S. vitreum	Saugeye
Sciaenidae (drums)	
Aplodinotus grunniens	Freshwater drum