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ATTACHMENT 10

ZEBRA MUSSEL MONITORING PROGRAM
At LaSalle Nuclear Station, 2012

Prepared for

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Warrenville, Illinois

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1.0 INTRODUCTION

Exelon Nuclear has sponsored a zebra mussel (*Dreissena. polymorpha*) monitoring program since 1990 (ZEI 2003, LMS 2004-2005, HDR/LMS 2006-2007, HDR Engineering, Inc. 2008-2011). Stations electing to continue monitoring in 2012 include Braidwood Station, Byron Station, and LaSalle Station. Since the monitoring program began in 1990, zebra mussel colonization has occurred at all three of these stations, to varying degrees.

The principal objectives of these monitoring efforts at LaSalle are to:

- Detect the presence and densities of zebra mussels at the intake structures and source water bodies.
- Evaluate year-to-year changes in the zebra mussel populations, including settlement densities.
- Provide a basis for examining possible effects of zebra mussels on Station operations.

2.0 METHODS

2.1 ARTIFICIAL SUBSTRATE SAMPLING

To determine zebra mussel settlement densities, artificial substrates were placed in front of the LaSalle Station river intake in the Illinois River. Three arrays of artificial substrate samplers were placed, which included two Type A substrates and one Type B substrate.

Type A substrates consisted of two pieces of PVC pipe that were 15 cm (6 in.) long and had an inside diameter of 5.08 cm (2 in.) and an outside diameter of 6.08 cm (2.39 in.). Each pipe was cut in half lengthwise and rejoined using hose clamps. The PVC substrates were deployed by cable from the railing above the intake in a central location. Concrete blocks were used to anchor each sampling array to the bottom of the intake. One cumulative substrate sampler and one monthly (periodic) array was deployed at each sampling location. The PVC substrates were attached to the cable approximately 0.5 and 1.5 meters below the surface of the water, respectively. Artificial substrates were installed in front of the intake on 5 April. Retrieval of Type A substrates occurred on a monthly basis and consisted of gently removing the series of PVC pipes from the water and placing each individual sample into a labeled container containing a solution of 40% isopropyl alcohol. New PVC substrates were then placed on the monthly array and returned to their original positions in the water column. Cumulative substrates remained in the water from 5 April to 7 November.

Type B substrate arrays consist of a microscope slide rack (Dura-Sampler) attached in the same manner as the PVC Type A arrays. Retrieval of Type B substrates occurred on a monthly basis and required gently removing the microscope slide samplers from the water and placing eight glass slides from each sampler into an appropriately labeled container containing 40% isopropyl alcohol. New labeled glass slides were then installed into the slide samplers and returned to their original location. PVC and glass were chosen as principle substrates because it has been shown that PVC is a preferred substrate (Walz 1975), while glass slides allow for a standard measurement of settlement densities and examination under a low powered binocular microscope (Marsden 1992).

Two Type A and one Type B sample arrays were placed within the LaSalle Station Cooling Lake on 5 April. Substrates were set at depths of 1.0, 3.0 and 5.0 meters on a cable suspended between a surface float and a concrete anchor. Both cumulative and monthly substrates were set. Monthly

retrieval of Type A and Type B substrates was conducted as described above. Sampling was concluded on 7 November with the removal of all the substrates from the LaSalle Station intake and cooling lake. Monitoring was designed to provide information on accumulated infestation and growth of settled zebra mussels throughout the growing season.

Settlement was determined by scraping the inside and outside of both halves of each PVC pipe sampler. The area of the substrate that was sampled was calculated by first finding the inside and outside circumferences of the PVC pipe.

$$c = \pi d$$

Where:

c = circumference of a circle

$\pi = 3.14$

d = diameter of a circle

The total area of PVC pipe that was sampled was calculated by summing the total area sampled inside of the PVC pipe plus the total area sampled outside of the PVC pipe. The inside and outside area of the PVC pipe was calculated using the following equation:

$$A = c \times l$$

Where:

A = area sampled

c = circumference of a circle

l = length of the PVC pipe

The number of mussels found was then converted from number per square inch to the conventional number per square meter. Shell lengths (measured along the longest axis) were also measured for up to 50 individuals to obtain maximum, minimum, and mean sizes for each substrate. Shells less than 1.0 mm in length were measured to the nearest 25 microns using an ocular micrometer that was calibrated to a stage micrometer. Shells greater than 1.0 mm in length were measured to the nearest half-millimeter using a standard metric ruler.

2.3 WATER QUALITY MEASUREMENTS

Four physicochemical parameters (temperature, dissolved oxygen, pH and conductivity) were measured in conjunction with the sampling program. These data were collected at each location prior to each sampling effort. All physicochemical measurements were made at one meter below the surface of the water. Temperature (°C), dissolved oxygen (ppm), and conductivity (µmhos) were measured using an YSI Model 85 Oxygen, Conductivity, Temperature, and Salinity meter. An Oakton WP pH Tester1 was used to determine pH.

Temperature monitors (Onset OpticStowAway Temp Loggers) were attached at mid-depth to the cumulative and monthly substrates to record hourly changes in temperature throughout the entire sampling period. Periodic temperature data was downloaded on a monthly basis, while cumulative temperature recordings were monitored by a separate logger from 5 April through 7 November.

3.0 RESULTS AND DISCUSSION

3.1 ARTIFICIAL SUBSTRATE SAMPLING

3.1.1 Intake Substrates

One zebra mussel was collected on the monthly substrates from the LaSalle Station river intake in July. The juvenile mussel measured 1.6 mm and represents a settlement density of 18/m^2 (Table 3-1). Analysis of the surface cumulative substrate (0.5 m) revealed heavy filamentous algae and bryozoans colonies covering the outside of the substrate. The inside of the pipe contained numerous caddisfly larvae and byrozoan colonies. The bottom cumulative substrate (1.5 m) was also covered both inside and outside with caddisfly larvae, bryozoans, and other aquatic invertebrates.

3.1.2. Cooling Lake Substrates

No zebra mussels were collected on the monthly substrates from the LaSalle Station Cooling Lake throughout the seven month sampling period (Table 3-2). Cumulative substrates were 90-100% covered with bryozoan colonies. All depths sampled (1.0, 3.0, 5.0 m) were observed to have a similar degree of colonization.

3.2 WATER QUALITY MEASUREMENTS

Physicochemical parameters (temperature, dissolved oxygen, pH and conductivity) were measured in conjunction with the sampling program are presented in Tables 3-1 and 3-2. Water quality measurements were taken during each of the sampling dates at the LaSalle Station intake and cooling water lake.

3.2.1 Intake Water Quality

Temperatures at the LaSalle Station intake ranged from 7.9° C on 7 November to 34.1° C on 7 July (Figure 3-1). Dissolved oxygen (DO) concentrations ranged from 6.30 ppm on 4 October to 9.8 ppm on 7 November (Table 3-1). Recordings for pH ranged from 7.6 to 8.1 and conductivity ranged from 393 to 837 μmhos throughout the sampling season.

Table 3-1. Water Quality Parameters and Mean Zebra Mussel Densities Collected Monthly During the 2012 Sampling Effort at LaSalle Intake.

		Water Quality						Juveniles		Adults	
Date	Days/ Sample	Time	Temp. (°C)	DO (ppm)	pH	Cond. (µmhos)	Sample Depth	Glass	PVC	Glass	PVC
04/05/12		08:25	14.6	9.15	8.0	715	-	-	-	-	-
05/09/12	34	08:00	17.8	7.80	7.6	393	-	na	na	na	na
05/30/12	21	08:00	24.6	7.85	8.0	791	-	-	-	-	-
07/05/12	36	08:05	31.3	7.90	7.8	763	1.5	-	1.6mm	-	-
08/07/12	33	13:05	30.6	7.06	7.7	760	-	-	-	-	-
09/10/12	34	13:40	25.9	8.40	7.8	837	-	-	-	-	-
10/04/12	22	08:15	20.5	6.30	8.0	803	-	-	-	-	-
11/07/12	34	09:10	10.2	9.80	8.1	637	-	-	-	-	-

Table 3-2. Water Quality Parameters and Mean Zebra Mussel Densities Collected Monthly During the 2012 Sampling Effort at LaSalle Cooling Lake.

		Water Quality						Juveniles		Adults	
Date	Days/ Sample	Time	Temp. (°C)	DO (ppm)	pH	Cond. (µmhos)	Sample Depth	Glass	PVC	Glass	PVC
04/05/12	-	09:15	18.8	9.20	8.4	1210	-	-	-	-	-
05/09/12	34	09:20	25.3	7.59	8.2	1368	-	-	-	-	-
05/30/12	21	08:54	27.0	7.16	8.5	1253	-	-	-	-	-
07/05/12	36	09:05	34.8	7.35	8.4	1237	-	-	-	-	-
08/07/12	33	13:39	34.9	8.62	8.4	1277	-	-	-	-	-
09/10/12	34	14:15	30.3	9.53	8.5	1533	-	-	-	-	-
10/04/12	22	08:50	25.5	6.28	8.7	1142	-	-	-	-	-
11/07/12	34	09:50	17.6	9.20	8.8	1241	-	-	-	-	-

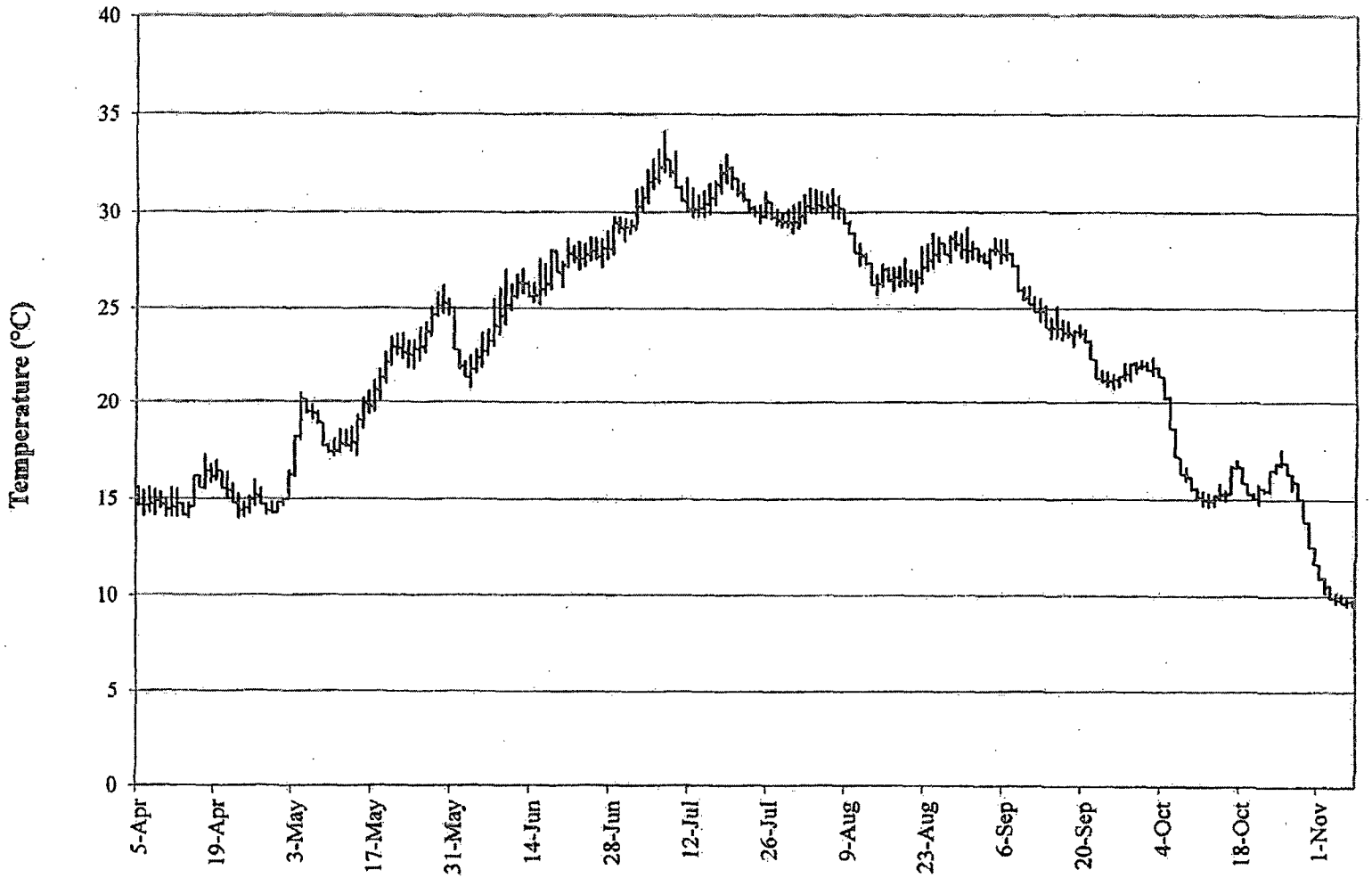

Figure 3-1. Temperature Profile at the LaSalle Station Intake for the Period of 5 April to 7 November, 2012.

3.2.2 Cooling Lake Water Quality

Temperatures from the LaSalle Station cooling lake ranged from 16.2° C on 1 November to 37.2° C on 7 July (Figure 3-2). Dissolved oxygen (DO) concentrations ranged from 6.28 ppm on 4 October to 9.53 ppm on 10 September (Table 3-2). Recordings for pH ranged from 8.2 to 8.8 and conductivity ranged from 1142 to 1533 µmhos throughout the sampling season.

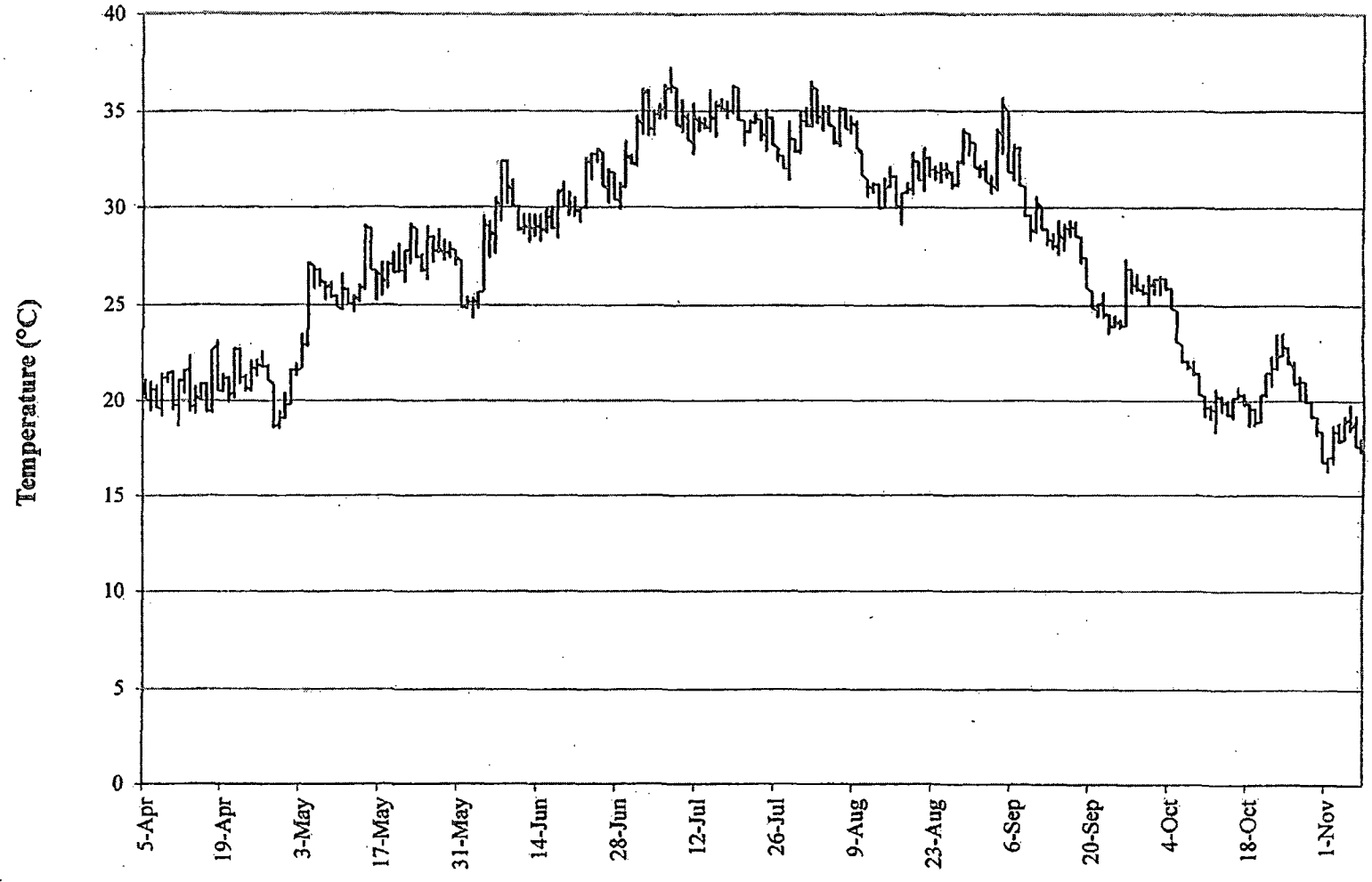

Figure 3-2. Temperature Profile at LaSalle Lake for the Period of 5 April to 7 November, 2012.

4.0 SUMMARY AND RECOMMENDATIONS

In 2012, one zebra mussel was found on the periodic (monthly) substrates from the river intake at LaSalle Station. This juvenile measured 1.5 mm in length and represents a settlement density of 18/m^2. No zebra mussels were detected on the river intake cumulative substrates or any of the LaSalle Lake substrates. The cumulative substrates from both the river intake and LaSalle Lake were 90-100% covered by bryozoan colonization at all sample depths.

Early detection of zebra mussel colonization is essential for uninterrupted Station operation. Because zebra mussels are present in the Illinois River, they are continually reintroduced to the cooling lake through make-up water. Continued monitoring is important to recognize the circumstances associated with zebra mussel infestation and colonization.

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