MMM GROUP

TECHNICAL MEMORANDUM NH#1 - REACH 14W-14A AQUATIC HABITAT

Job No.: 14.09222.001

Date: March 28, 2012

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1 Introduction

As you are aware MMM Group has been retained by Bentall Kennedy (Canada) LP - Lazy Pat Farms (hereinafter referred to as Lazy Pat lands) to undertake an assessment of the natural environmental features in support of the proposed commercial land development. The results of field investigations and monitoring were documented in the Environmental Impact Report/Functional Servicing Study (March 2011) and submitted to the Town of Oakville (Town) and Conservation Halton (CH) for review. The Town and CH provided comments in an August 5, 2011 e-mail and a subsequent September 6, 2011 correspondence. The majority of the comments are addressed in a response table that has been prepared and submitted under a separate cover. Due to the nature of data collected and the corresponding analysis, the response table format was not considered a suitable format to present detailed information and as a result (this) Memorandum NH#1 – Reach 14W-14A Aquatic Habitat has been prepared and referred to in the response table. This memorandum focuses principally upon information requests associated with Reach 14W-14A also referred to as the “farm pond” and should also be considered an addendum to the EIR/FSS submitted to CH and the Town.

This memorandum details the additional fieldwork undertaken to address undertaken between June and October 2011 and the analysis of the data. Specifically the following information is addressed:

1.1 Fish Community Survey

CH has recommended that at least 2 or 3 gear types be used to sample fish species in the pond based on the rationale that different fish species will utilize different habitats in the pond (i.e. shallow water vs. deep water, shaded water versus open water and the availability of cover).

1.2 Fish Community Classification

CH has indicated that they consider the pond to have a self-sustaining coolwater fish population.

1.3 Supplemental Fish Habitat Documentation

CH has requested supplemental fish habitat surveys to identify habitat features supporting critical life stages, bathymetric surveys and aquatic vegetation surveys.

1.4 Water Temperature Data

CH requested the installation three continuously recording temperature data loggers in the deepest area of the pond at depths of 33%, 66% and near the bottom. In addition to temperature monitoring, sampling for dissolved oxygen and water clarity measurements at these depths should be undertaken.

1.5 Thermal Impacts of Proposed Conversion of Farm Pond to a SWMP

CH has suggested that the conversion of the farm pond to a SWMP will result in an increase to the thermal warming impacts and will cause a less stable thermal regime.

1.6 Phytoplankton/Zooplankton Production

HC has indicated that the pond contributes self-sustaining phytoplankton and zooplankton to downstream watercourses during periods of high flow.

1.7 Sediment Source

HC has indicated that the pond provides a source of sediment to downstream watercourses as a provision for bedload, an important resource to maintain erosion in a state of dynamic equilibrium.

1.8 Organic Material Source

HC has indicated that the pond is a source of organic material in the form of leaves, twigs, etc. to downstream watercourse for downstream watercourses that helps provide a base of the food chain.

1.9 Headwater Wetland Function

HC indicated that the pond can be considered a headwater wetland that provides many functions which are beneficial from a fish community, water quality, water quantity, wildlife habitat and flood regulation standpoint.

1.10 Pond providing Pelagic and Littoral Habitat

CH has indicated that the pond provides pelagic and littoral zone habitat that is adjacent to open water areas; both of which are limited to in the North Oakville area.

2 Existing Conditions

As described in Section 5.3.4.4 (p. 5-26) of the EIR, the farm pond was constructed between 1954 and 1960 as a component of the agricultural operation (likely irrigation) and functions as a by-pass pond with a single inlet/outlet and has an intermittent connection to the receiving watercourse (Reach 14W-12). The source of water for the pond consists of surface water contributions, specifically flow from Reaches 14W-14, 14W-13 and perhaps backflow from 14W-12. Water is stored in the farm pond stores the water until such time as the water level reaches a certain elevation then the pond discharges into Reach 14W-12. Thus the farm pond's connection to Reach 14W-12 is related to the surface water level.

An examination of the groundwater conditions potentially influencing the farm pond were also examined and based on hydrogeological investigations undertaken in support of the development plan, the farm pond is losing water into the ground. As a result the farm pond does not appear to be receiving sufficient groundwater inputs that would moderate thermal impacts and provide a stable thermal regime or maintain a consistent water depth. This assessment is supported by the water temperature data presented in the following sections.

Due to the inlet/outlet feature as well as the minimal groundwater interactions, water discharging from the farm pond will consist of the surface water that during the summer is at its warmest. This water is then discharged into Reach 14W-12 supporting coolwater Redside Dace habitat.

3 Results and Assessment of Additional Data

The following sections respond to the HC comments related to the farm pond (Reach 14W-14A), specifically the request for additional information and their suspected functions of this feature that were outlined in the August 3, 2011 email as well as the September 6, 2011 correspondence. .

3.1 Fish Community Survey

As was identified in the EIR, fish community sampling had been undertaken in 2002 by MMM Group (formerly Marshal Macklin Monaghan Ltd) using minnow traps to obtain baseline fish community data. Fish community sampling was also undertaken in 2002 by Natural Resource Solutions Incorporated (NRSI), a member of the consulting team preparing the NOCSS, using a backpack electroshocking unit. MMM Group replicated these sampling methods in the pond in 2009 to document up to date data in support of the preparation of the EIR. Both of these sampling events used two sampling methods thus meeting the recommended 2-3 methods identified in the HC August 3, 2011 email.

The EIR summarized the fish community data collected in 2002 and 2009 that indicated a fish community made up largely of tolerant fish species. The one exception was the presence of Largemouth Bass that we presume is stocked considering the absence of naturally occurring suitable habitat in the area as well as the artificial nature of the pond that are often stocked by landowners. This data is summarized in Table 1.

Table 1: Summary of Fish Community Sampling (14W-14A, MESP 2003, MMM, 2003 & MMM, 2009)

Common Name	Scientific Name	Number of Individuals
Brook Stickleback	*Culaea inconstans*	2
Brown Bullhead	*Ictalurus nebulosus*	1
Creek Chub	*Semotilus atromaculatus*	37
Largemouth Bass	*Micropterus salmoides*	3
White Sucker	*Catostomus commersoni*	7

In response to the August 3, 2011 CH email, an additional round of sampling was undertaken in 2011. A Licence to Collect for Scientific Purposes (Licence no 1064904) was obtained from the MNR on (September 26, 2011) to undertake the 2011 fish community sampling. Fish community sampling efforts in 2011 involved the use of minnow traps and pot traps set throughout the pond at various locations and water depths to collect fish that are anticipated to use the different habitats within the pond. The nine (9) traps were set between 0915 and1206 hrs on October 6, 2011, for a period of 24 hours (Table 2). It has been our experience (throughout the province) that the use of pot traps in combination with minnow traps have resulted in the capture of a wide range of species including Centrarchidae, Cyprinidae, Gadidae, Percidae, Esocidae and Umbridae various age classes (young-of-the-year, juvenile and adult).

Table 2: Summary 2011 Sampling Methodology/Gear Types

Equipment Type	UTM Coordinate
Pot Trap	17 T 598200 4809169
Minnow Trap	17 T 598203 4809161
Pot Trap	17 T 598195 4809148
Minnow Trap	17 T 598148 4809160
Pot Trap	17 T 598155 4809155
Minnow Trap	17 T 598168 4809209
Minnow Trap	17 T 598076 4809221
Minnow Trap	17 T 598033 4809233
Minnow Trap	17 T 598031 4809218
Minnow Trap	17 T 598067 4809189

The fish community captured in 2011 is similar to the fish captured in previous sampling events and did not revise the previous understanding of the pond as supporting a warmwater community with coolwater tolerant species. Due to the habitat present in the pond, poor connectivity to downstream habitat as well as the thermal regime a more diverse community is unlikely to be supported by the pond. Table 3 summarizes the results of fish community sampling in 2011. These species are consistent with previous sampling efforts in the pond for species composition with the addition of another warmwater species, Pumpkinseed.

Table 3: Summary of Fish Community Sampling (14W-14A, 2011)

Common Name	Scientific Name	Number of Individuals
Brown Bullhead	*Ameiurus nebulosus*	7
Creek Chub	*Semotilus atromaculatus*	7
Largemouth Bass	*Micropterus salmoides*	1
Pumpkinseed (adult & YoY)	*Lepomis gibbosus*	81

As a result the fish community of the farm pond has been surveyed on the following occasions and the approximate locations identified on Figure 1:

- 2002 MMM Group – Minnow Trap (approx. 24 hr set) to obtain background data for site;
- 2002 NRSI – Backpack Electroshocking along the shoreline in support of NOCSS;
- 2009 MMM Group – Minnow Trap (approx. 24 hr set) in support of the EIR;
- 2009 MMM Group – Backpack Electroshocking along the shoreline in support of the EIR
- 2011 MMM Group – Minnow Trap to supplement existing data at request of HC
- 2011 MMM Group – Pot Trap to supplement existing data at request of HC

It is our opinion that the use of 3 sampling gear types as well as two sampling events in each year (2002, 2009 and 2011) at times by two separate parties should be sufficient to characterize the fish community present in this farm pond. Given the effort, cost and the type of habitat present the use of alternative sampling methods suggested by HC including a boat electroshocker are not warranted as it is unlikely that the fish community would differ from that observed during previous sampling of this farm pond.

As requested by CH we have also calculated the catch per unit effort (CPUE) for the sampling events, excluding NRSI data as it is unavailable.

Minnow/Pot Trap

Average fishing time (unit of effort) for the 10 minnow and pot traps set in 2011 is 26 hours for an approximate total fishing time of (10 traps x 26 hrs) 260 total trap hours. The total number of fish captured is 103. Resulting in a catch per unit of effort (CPUE):

CPUE = [# fish / # Total Trap Hours]

= [103 Fish / 260 Total Trap Hours]

= 0.396 Fish / Total Trap Hours

Electrofishing

For the electroshocking we captured 6 fish during 368 shocking seconds within an area sample of approximate 320 m^2.

CPUE = [# fish / Sampling Effort]

= [6 Fish / (320 m^2/ 368 second)]

= [6 Fish / 0.87 m^2/s]

= 6.89 Fish / (m^2/s)

3.2 Fish Community Classification

The species captured as well as their thermal classification (based on thermal preference) is identified in Table 4. The three coolwater species identified in the table have a preference within the coolwater thermal regime; however, they also have a tolerance for warmwater habitat and are commonly found within warmwater habitats. These three species including White Sucker, Creek Chub and Brook Stickleback have a thermal range of 0ºC to 31.2ºC, 1.7ºC to 32.5ºC and 0ºC – 30.6ºC respectively. When examining the warmwater species thermal preferences and ranges of tolerance it would appear that the habitat present is well suited to their thermal requirements.

As a result of the thermal tolerances of the coolwater species and the water temperature data presented in the following sections, it would appear that the classification of this community as a warmwater is more appropriate. This is supported by NOCSS Characterization Report (p.4W-118) that states *"There is a manmade online pond (14W-14A) located in the vicinity of Dundas Street. Shoreline habitat of this pond consists of cattails, stumps and woody debris. Underwater habitat throughout the pond is unknown. Substrate consists of silt and muck. This pond supports a* ***warmwater baitfish and sportfish community*** *(LGL 1999, NRSI 2005). The presence of sportfish indicates that the pond is productive as largemouth bass are the top level predator species requiring a substantive forage base."*

Table 4: THERMAL AND VELOCITY TOLERANCES FOR FISH SPECIES KNOWN TO OCCUR WITHIN THE ZONE OF INFLUENCE*

FISH SPECIES		LIVE STAGE							
COMMON NAME	SCIENTIFIC NAME	SPAWNING	EGG/EMBRYO	LARVAE/FRY	JUVENILE	ADULT	MORTALITY (ADULT) Acclimation Temperature	MORTALITY (ADULT) Upper Incipient Lethal Temperature	PREFERRED TEMPERATURE (TABLE 3, CHU ET. AL., 2009)
Brook Stickleback	*Culea inconstans*	May – June at 8ºC - 19ºC	Hatch: 8 – 10 days at 16ºC - 17ºC 9 – 11 days at 17ºC - 18ºC Optimum hatching temp.: 18.3ºC max for embryo survival: 21ºC			Thermal range: 0ºC – 30.6ºC	25ºC - 26ºC	30.6ºC	21.3 ºC
Creek Chub	*Semotilus atromaculatus*	April – July Spawning triggered at: 12.8ºC Range: 12.8ºC – 26.7ºC	Hatch in 10 days at 13ºC Temperature range for hatching: 15ºC - 20ºC Optimal temperature range for embryo: 14ºC - 20ºC in spring		Optimal growth range: 12ºC - 24ºC, preferred for growth: 21ºC	Thermal range: 1.7ºC – 32.5ºC	5ºC	24.7ºC	20.8 ºC
							10ºC	27.3ºC	
							15ºC	29.3ºC (lower 0.7ºC)	
							25ºC	30.3ºC (lower 4.5ºC)	
Largemouth Bass	*Micropterus salmoides*	May – June Spawning occurs at: 17ºC - 22ºC	Hatch: 13ºC - 26ºC, optimal: 20ºC - 21ºC low survival >30ºC and <10ºC Upper lethal limits: Acclimated to 20ºC is 36.7ºC Acclimated to 28ºC is 40.1ºC	Larvae: Thermal range: 20ºC - 30ºC Preferred: 27ºC Fry: Thermal range: 17.5ºC – 27.5ºC Preferred: 27ºC Critical limit: >36ºC	Thermal range: 23ºC - 31ºC Preferred: 30ºC Optimal growth: 24ºC - 30ºC Little growth <15ºC	Thermal range: 10ºC - 38ºC Preferred temp.: 30.3ºC	20ºC	32.5ºC (lower 5.5ºC)	30.2 ºC
							25ºC	34.5ºC (lower 7ºC)	
							30ºC	36.4ºC (lower 11.8ºC)	
Pumpkinseed	*Lepomis gibbosus*	May – August Spawning occurs at: 20ºC - 28ºC At 11ºC - 13ºC spawning ceases	Hatch: 19ºC - 28ºC, optimum temperature: 28ºC		Thermal range: 24.2ºC - 32ºC Preferred: 30ºC Lower lethal temp.: 2.1ºC when acclimated to 12ºC in summer.	Thermal range: 4.5ºC - 38ºC Preferred: 26ºC Signs of stress begin at 31ºC - 38ºC and < 4.5ºC	5ºC	(lower 1.1ºC)	26 ºC
							10ºC	(lower 1.2ºC)	
							12ºC	28.5ºC (lower 3.6ºC)	
							20ºC	31.6ºC (lower 6.4ºC)	
							28ºC	31.9ºC (11.3ºC)	
							30ºC	34.8ºC (lower 13.4ºC)	
							32ºC	33.5ºC	
							34ºC	37ºC (lower 16.1ºC)	
White Sucker	*Catostomus commersonii*	April – June Spawning migration triggered: 10ºC - 18ºC Spawning occurs: 7ºC - 10ºC	Hatch: 13.9ºC - 20ºC, prefer 11ºC - 16ºC upper lethal temp.: 24ºC lower lethal temp.: 6ºC	Thermal range: 13ºC - 25ºC, preferred 27ºC Upper lethal: 32ºC	Upper lethal temp. 26ºC - 31ºC, lower lethal temp. 21ºC - 6ºC	Thermal range: 0ºC – 31.2ºC Preferred temp.: 22.4ºC	5ºC	26.3ºC	22.4 ºC
							10ºC	27.7ºC	
							15ºC	29.3ºC	
							20ºC	29.3ºC (lower 2.5ºC)	
							25ºC	28.3ºC (lower 6.6ºC)	
Brown Bullhead	*Ameiurus nebulosus*	May – June Temperature reaches 21.1 ºC	Hatch: 20.6 ºC to 23.3 ºC			Upper Tolerance Temperature: 36.1 ºC	6 ºC	28.6 ºC	
							36 ºC	37.5 ºC	26 ºC

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3.3 Supplemental Fish Habitat Documentation

The pond to date has not been actively managed by the landowner as anything but a farm pond and in that time the absence of management for its intended function as agricultural function has allowed it to naturalize. HC has requested additional information including the preparation of a bathymetric survey, critical habitat assessment in addition to this request sediment sampling and an attempt to visually assess habitat in the deeper portions of the pond was undertaken. Aquatic habitat was visually assessed from the shoreline and wadeable depths to document near shore habitat as well as aquatic vegetation. Deeper water areas were assessed during field investigations in 2011 from a canoe including the attempted use of an underwater camera. This vantage point allowed staff to view submerged vegetation in the shallow, non-wadeable areas of the pond and to easily document the riparian community along the waterline.

Bathymetric Survey

The bathymetry of the pond is illustrated in Figure 1. The pond is generally shallowest at the northwest end of the pond, with depth increasing fairly uniformly toward the southeast end of the pond. The slope of the pond bottom varies, with some areas having a greater slope than other areas. The most prominent slope occurs along the southeastern end of the pond, parallel to the laneway.

Aquatic Vegetation

The aquatic vegetation associated with the farm pond consists of emergent vegetation, submerged and floating vegetation. Algal growth occurs throughout the pond primarily at the northwest end and along the perimeter of the pond, which consists of dense mats of algae. Similar algae mats were observed in Stream Reaches 14W-16 and 14W-12 over the course of 2009 and 2011 field investigations on the Lazy Pat lands. A detailed species list associated with the pond is presented in the EIR. In addition to the vegetation identified in the EIR, supplemental vegetation investigations were undertaken in 2011 and resulted in the identification of two additional species including:

- Stalk-grain Sedge (Carex stipata)
- Common Hornwort (Ceratophyllum demersum)

Fish Habitat Structure and Function

As previously mentioned the aquatic habitat in the shallower areas of the pond was assessed from the shore as well as wadeable water depths with deeper areas examined from a canoe examining the surface as well as attempting to examine the deeper water areas with an underwater camera. Generally the dense aquatic vegetation appears to provide the greatest amount of cover and habitat for the fish present. Woody debris is scattered along the shoreline in limited quantities owing to the absence of woody vegetation surrounding the pond. Observations of the deeper water area with the underwater camera were unclear owning to the limited clarity in the pond however, there were scattered areas of submerged vegetation stems observed during the examination. It is anticipated that the cover/structure habitat within the deeper water area is limited due to the constructed nature of this feature, its function as a farm pond (fish habitat structured unlikely to have been installed) and the absence of woody debris and/or coarse substrate that would improve habitat complexity. As a result it appears that the main cover habitat within the pond consists of the aquatic vegetation along the fringe of the pond.

The substrate of the pond was also observed using a combination of visual assessments during field investigations as well as using an Ekman Dredge from the canoe. Generally with the exception of the boulders and concrete debris along the laneway, the substrate throughout the pond is dominated by silt and muck which is consistent with observations made in NOCSS.

Fish Habitat Structure and Function

The pond presumably provides suitable specialized habitat for the species present (i.e. spawning habitat, nursery habitat, etc.) however, considering the generalized nature of the species present their requirements are often limited to spawning habitat.

Specialized spawning habitat associated with the Largemouth Bass and Pumpkinseed is likely located in the shallower habitat in the vicinity of the inlet/outlet as well as the gently sloping pond bed in this northern portion of the pond. As the depths increase towards the laneway, the habitat in this area is less likely to provide this type of suitable specialized habitat. The combination of dense aquatic vegetation surrounding the pond shores (for Largemouth Bass) as well as adjacent open water habitat (for Pumpkinseed) would be suitable to fulfill the majority of the habitat needs for these species as it provides cover and forage habitat. It is anticipated that the deeper area within the pond at the south end provides overwintering habitat for this and the other species present.

Extensive spawning habitat is available for Brown Bullhead that requires muddy substrates in close proximity to woody debris/aquatic vegetation and flooded vegetation. The pond provides suitable habitat for this species that is typically found near /on the bottom in shallow, warmwater habitats, in slow moving water (i.e. ponds, small lakes, etc) in association with dense aquatic vegetation, and sand to mud bottoms.

Brook Stickleback spawns on the stems of aquatic or flooded vegetation that are abundant in the area and the habitat in the pond provides suitable habitat for the species as they are often found in wetlands, beaver ponds and pond habitats with aquatic vegetation and are able to withstand periods of low dissolved oxygen. Given the habitat present they are well suited to the pond owing to the dense aquatic vegetation and seasonally flooded shoreline (flooded vegetation).

It would appear that the pond does not provide spawning habitat for Creek Chub as they typically will spawn in riffle habitat with gravel substrate. Creek chub are not typically found within pond habitat, they do occupy small lakes in nearshore areas. Although the farm pond is not its preferred habitat for creek chub they are a very common species and generalists in their habitat needs and as a result does not require additional specialized habitat.

Spawning habitat for White Sucker does not appear to be present in the farm pond as they tend to spawn in shallow flowing water over gravel substrate. In lake environments they will spawn over gravelly/sand shoals subject to wave action, this habitat is not present in the farm pond. White Sucker is also a tolerant species that does not demonstrate a preference for a specialized habitat type beyond spawning, and are tolerant of a wide range of water quality conditions including turbidity and low dissolved oxygen.

Riparian Habitat

Generally the vegetation community results in an open canopy with scattered trees and shrubs. Several mature trees, which include Basswood are growing at the top of the exposed bank, providing the only significant shading for the pond. The vegetation along perimeter of the southern end of the pond consists of purple loosestrife, water plantain, lance-leaved aster, queen anne's lace, cutgrass, and fox sedge. Several shrubs grow along the shoreline adjacent to the laneway amongst the cobble and concrete debris that forms the shoreline. A detailed species list associated with the pond is presented in the EIR.

Water Levels

As discussed the pond receives input from tributaries 14W-13 and 14W-14 at the north end and through surface flows from the relatively small catchment area from the adjacent table lands draining the pond. As a result, water levels can fluctuate by more than a meter during periods of heavy rains. The following pictures show the staff gauge installed at the south end of the pond at the deepest part of the pond. The photo on the left (Plate 1) was taken on (October 6, 2011 when Environment Canada recorded 0 mm of rainfall during the 24 hours prior, (26.5 mm of rain – 7 days prior). The photo on the right (Plate 2) shows the staff gauge on October 20, 2011 with when Environment Canada recorded approximately 60 mm of rainfall during the 24 hours prior (63.5 mm of rain – 7 days prior). The observation suggest that the pond is heavily influenced by the surface water contributions and that once the pond is no longer hydraulically connected to the downstream watercourse, there are no other inputs that assist in maintaining water levels. Instead the water level is decreased through evaporation.

Plate 1: Staff Gauge, October 6, 2011 **Plate 2: Staff Gauge, October 20, 2011**

Water Quality Monitoring

Water quality monitoring for dissolved oxygen and water clarity was recorded at the approximate location of the water temperature logger strings and at the approximate vertical position of the temperature loggers.

<u>*Dissolved Oxygen*</u>

Dissolved oxygen was sampled using (HANNA HI9146-04N Dissolved Oxygen Meter and was compared against the target of 6 mg/l identified in the OMB Mediation Item: Stormwater Management – Temperature and Dissolved Oxygen Targets. For Fourteen Mile Creek, the conservative DO target is 6 mg/l, which is the Provincial Water Quality Objective for coldwater fisheries associated with a water temperature of 20ºC. Dissolve oxygen measurements taken at the three temperature logger locations, representing the north, middle and south areas of the pond indicate that oxygen levels vary based on depth and the time of the year. As expected and likely due to surface agitation, the DO levels in the pond at the surface meet or exceeding the OMB target. As the depth increases, the DO levels continue to drop with DO levels at depths of 2.0 m or greater below the OMB target of 6 mg/l associated with recorded water temperatures between 20 and 24.3 ºC. This distribution of DO is not unexpected considering the shallow depth of the farm pond and the likelihood of mixing. The reduced DO in the deeper area is likely attributed to less mixing and bacteria activity in the sediment.

Water Clarity

Water clarity was also documented at each of the water temperature logger string locations using a Secchi Disk (Table 5). The Sechi Disk is a black and white circular plastic plate, 20 cm diameter. A measured line is attached to the center of the disk to allow the recorder to note the depth of the disk as it is lowered into the water. The depth at which the disk was no longer visible was recorded. The disk was then lowered slightly and slowly retrieved to a depth at which the disk became visible. This depth was also recorded. The Secchi Disk provides a quantitative way of identifying the level of clarity (transparency determinations) in natural waters. Water that is clear has a high transparency, resulting in a higher secchi depth reading, which indicates lower turbidity. Transparency in freshwater systems typically decreases in the summer when plankton, silt and organic matter are more likely to be prevalent. For reference, the most transparent lakes are usually seepage lakes as this characteristic greatly reduces the amount of silt bearing influents. Drainage lakes carry more silt and usually are less transparent. To minimize errors during the readings, the same observer was used, using the same method and all readings were taken between 10am and 2pm. The weather conditions on each reading were generally the same, with clear sunny skies.

Table 5: Summary of Secchi Depths for Stream Reach 14W-14A (2011)

Date	Sampling Location	Secchi Down (m)	Secchi Up (m)	Clarity Depth (m)
August 19	South Logger	0.75	0.60	0.675
	Middle Logger	0.60	0.50	0.55
	North Logger	0.60	0.60	0.60
August 24	South Logger	0.60	0.40	0.50
	Middle Logger	0.70	0.50	0.60
	North Logger	0.55	0.45	0.50
October 7	South Logger	0.55	0.45	0.50
	Middle Logger	0.54	0.52	0.53
	North Logger	0.52	0.51	0.515

Readings were taken at the approximately at the same time and were based on three separate readings. The water clarity in the pond showed little variation in water clarity throughout the pond and no marked improvement in water clarity during the sampling period. The highest reading was recorded in the deepest part of the pond at the south (0.675 m). However, the difference between the highest and lowest reading is 17.5 cm (0.175 m). This suggests that visibility within the water would range between 0.5 and 0.68 m during sunny, clear sky conditions, near the surface with light levels reaching plants at or below .68 m would be significantly reduced.

This is supported by the observation of submerged vegetation in greater density at the north end of the pond where the water was shallow. Using an underwater camera, visibility was extremely poor at the south end of the pond and although scattered stems of submerged vegetation were observed, the plants were sparse.

The lack of clarity would likely be attributed to a combination of wind action agitating the water thereby maintaining suspended sediments as well as phytoplankton.

3.4 Water Temperature

In recognition that additional water temperature data would likely be required, MMM Group initiated water temperature investigations in advance of receiving the August 5, 2011 e-mail, specifically the installation of water temperature loggers. Water temperature monitoring in the pond was initiated on July 4, 2011 and used water temperature loggers set to record data hourly. A total of nine loggers were installed, three at each string located along the length of the pond (Plate 3 and Figure 2). Each string was set up to record the water temperatures at the bottom, middle and top of the water column. The maximum depth of the bottom loggers (Logger String 1, south end) was approximately 3 m below the water surface at the time of installation (July 4, 2011). The minimum depth of the bottom loggers (Logger String 3, northern end) was 1.5 m below the water surface at the time of installation (July 4, 2011). Although maintaining the same distance from the bottom of the pond, the water depth relative to the surface for the middle and top loggers varied throughout the survey period due to fluctuating water levels. The middle loggers were generally positioned halfway between the surface and bottom loggers, approximately 1.5 m, 1 m, 0.75 m (Logger Strings 1, 2 & 3 respectively).

Although CH requested the installation of three loggers in the deepest part of the pond set at the bottom, 33% and 66% depth, the existing loggers were left in place due to the extent of the data collected and the distribution of a greater number of loggers than requested over varying depths was felt to provide sufficient coverage to cover the intent of the CH recommendation.

Through consultation with CH the water temperature data was analyzed using methods identified in *Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily maximum Air and Water Temperature* (Cindy Chu, et. al., 2009). In the study, the maximum daily water temperature recorded between July 1 and August 31 was plotted against the maximum daily air temperature within the period. Following consultation with CH, the temperature recorded at 4pm was selected as the maximum water temperature for the comparison which is consistent with the study that indicated that water temperature recorded between 4pm and 6pm represent the time during which water temperatures are most likely to be at their maximum. The resulting graph of temperature comparisons provided a tool to determine if the water temperature could be characterized as coldwater, cool-coldwater, coolwater, cool-warmwater or warmwater. The preferred nomogram used by CH staff for this purpose is Figure 7 on pg 1615 of the published study. The approximate temperature ranges for the thermal classifications are summarized in Table 6:

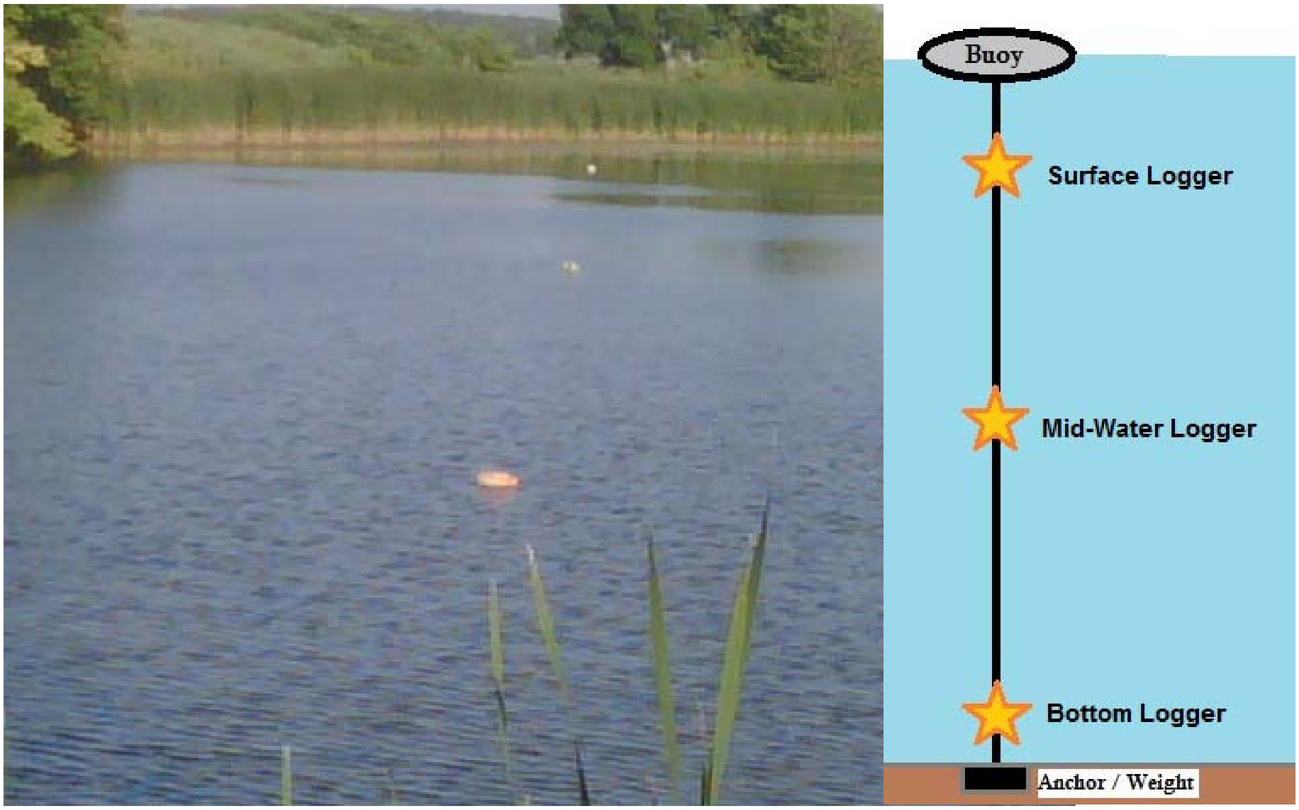

Plate 3: Facing north, showing the location of the temperature logger strings in the pond (left). Vertical position of loggers on each string (right)

Table 6: Approximate Thermal Classification Ranges for Watercourses, Based on Figure 7 Nomogram (Chu. et. al., 2009)

Thermal Classification	Maximum Water temperature Range at 24°C	Maximum Water temperature Range at 36°C	Est. Maximum Water temperature Range at 28 °C
Coldwater	10 °C to 15 °C	10 °C to 16 °C	10 °C to 16 °C
Cold-coolwater	15 °C to 17 °C	16 °C to 20 °C	16 °C to 18 °C
Coolwater	17 °C to 20 °C	20 °C to 24 °C	18 °C to 21 °C
Cool-warmwater	20 °C to 23 °C	24 °C to 28 °C	21 °C to 24 °C
Warmwater	23 °C to 32 °C +	28 °C to 32 °C +	24 °C to 32 °C +

Water temperature sampling was undertaken between July and October, 2011. For the purposes of analysis, only the water temperatures recorded at 4pm between July 4 and August 31, 2011 were used to determine the thermal classification of the pond. The maximum daily air temperatures recorded by Environment Canada for the weather station at Lester B. Pearson International Airport in Mississauga Ontario during the assessment period reported temperatures ranging from 22.3 °C (August 28, 2011) and 37.9 °C (July 21, 2011), with an average temperature of 28.69 °C. A weather station is also located in the Town of Oakville; however, the difference in temperature comparison when using the Town of Oakville air temperature is less than 0.5°C. As such, the use of the weather station at Lester B. Pearson was used as this is consistent with reference data for the EIS/FSS report (2009).

In order to identify the thermal stratification in the pond the temperature loggers were grouped according to the depth range where sampling occurred. These depths represent the surface (0-1 m), mid-water (1-2 m), bottom (2 m+) of the water column. As a result of the pond bathymetry profile, logger string locations, the nine loggers were assigned as follows: due to varying water levels during the season five loggers recorded temperatures at depths at 1 m or less (surface); two loggers occurred at depths between 1 and 2 m (mid-column) and 1 logger recorded at depths greater than 2 m (bottom). Figure 3 illustrates the thermal profile of the pond at 24 ^{o}C, 36 ^{o}C and at the average maximum air temperature recorded between July 4 and August 31. A linear trendline was established for each set of data points to determine the thermal classification that best approximates the temperatures recorded for the surface, mid-water and bottom of the water column in the pond, where y = water temperature and x = Air Temperature (^{o}C).

Surface

The linear trendline equation (Figure 4) for the average data at the surface of the column is:

$y = 0.404x + 15.585$

Based on this equation, the temperatures at 24 ^{o}C and 36 ^{o}C are calculated to be 25.28 ^{o}C and 30.13 ^{o}C, respectively. Based on the temperature ranges in Table 6, the surface of the pond falls within the warmwater range. Based on the average maximum air temperature the water temperature within the pond at the surface is estimated to be 27.18 ^{o}C (warmwater). The lowest recorded temperature is 22.74 ^{o}C, while the maximum temperature is 31.30 ^{o}C (difference: 8.56 ^{o}C).

The data for the individual surface loggers are shown in Figure 5.

Mid-Water

The linear trendline equation (Figure 4) for the average data within the mid-water column is:

$y = 0.3226x + 16.136$

Based on this equation, the temperatures at 24 ^{o}C and 36 ^{o}C are calculated to be 23.88 ^{o}C and 27.75 ^{o}C, respectively. Based on the temperature ranges in Table 6, the mid-water area of the pond falls within the warmwater to cool-warmwater range. Based on the average maximum air temperature the water temperature within the pond at the mid-water depth is estimated to be 25.39 ^{o}C (warmwater). The lowest recorded temperature is 21.65 ^{o}C, while the maximum temperature is 29.39 ^{o}C (difference: 7.74 ^{o}C).

The data for the individual mid-water loggers are shown in Figure 6.

Bottom

The linear trendline equation for the average data (Figure 4) at the bottom of the water column is:

$y= -0.1173x + 24.607$

Based on this equation, the temperatures at 24 ^{o}C and 36 ^{o}C are calculated to be 21.79 ^{o}C and 20.38 ^{o}C, respectively. Based on the temperature ranges in Table 6, the bottom of the pond falls within the coolwater to cool-warmwater range. Based on the average maximum air temperature the water temperature within the pond at the bottom of the pond is estimated to be 21.24 ^{o}C (cool-warmwater). The lowest recorded temperature is 17.4 ^{o}C, while the maximum temperature is 23.18 ^{o}C (difference: 5.78 ^{o}C).The data for the individual bottom logger is shown in Figure 7.

It is important to note that this cool-warmwater designation seems to conflict with the hydrogeological assessment that indicated that the pond is not receiving groundwater inputs that would assist with buffering of the thermal effects. It is suspected that the temperature logger in question was actually embedded in the substrate (pulled under by the anchor) thereby inaccurately recording the soft sediment temperature that is likely cooler than the water temperature. This is further indicated by the absence of buildup of crusts/slimes/filamentous algae as observed on the other loggers that were suspended in the water column. Essentially the general assessment of the pond as a whole remains the same as if this “cooler” water is present at the bottom of the pond it is not directly discharged into the receiving watercourse and detailed hydrogeological assessment confirms an absence of groundwater inputs into the pond during this period.

Table 7 summarizes the calculated temperatures based on the maximum water temperature comparison against maximum daily air temperature. Included in the table are the minimum, maximum and average recorded temperatures.

Table 7: Summary of Calculated Water Temperatures in the Pone (14W-14A) based on the Max Air Temp vs. Max Water Temp Trendline between July 4 and August 31, 2011.

Water Depth	Calc H_2O temp @ 24 ^oC (^oC)	Calc H_2O temp @ 36 ^oC (^oC)	Calc H_2O temp @ 28.69 ^oC (^oC)	Lowest recorded Maximum Water Temp (^oC)	Highest recorded Maximum Water Temp (^oC)	Average recorded Maximum Water Temp (^oC)
Surface (0-1m)	25.28	30.13	27.18	22.74	31.30	27.18
Mid-water (1-2m)	23.88	27.75	25.39	21.65	29.39	25.39
Bottom (2+m)	21.79	20.38	21.24	17.4	23.18	21.24

The water temperature data was also assessed using the protocol set forth in the *Ontario Stream Assessment Protocol* (OSAP) (Stanfield, 2005) and *A Thermal Habitat Classification for Lower Michigan Rivers* (Wehrly et al, 1999). The average weekly maximum and minimum water temperature was calculated for each of the first three weeks in July. This data was then used to calculate the average weekly temperature fluctuation for the watercourse. The watercourses were placed into one of three thermal regimes described by the MNR; coldwater (average maximum summer water temperature from 10°C to 18°C), coolwater (18°C to 25°C) or warmwater (25°C or warmer). Based upon water temperature fluctuations described in Wehrly et al (1999), the pond was then classified into one of three thermal range categories; stable (<5°C), moderately stable (5°C to 10°C) and extreme (> 10°C) (MNR, 2004; Stanfield, 2005; Wehrly et al, 1999). This assessment indicates that with the exception of the pond bottom at its deepest point (greater than 2 m) the thermal regime is moderately stable warmwater with a weekly average in July ranging from 25 to 27°C and maximums ranging from 26 to 30°C and in August from 24 to 25°C and maximums ranging from 25 to 29°C. In both months the higher weekly averages and maximums are attributed to the surface waters, the water that is discharged downstream when flows discharge from the pond.

3.5 Thermal Impacts of Proposed Conversion of Farm Pond to a SWMP

It acknowledged that a larger pond in this setting has the potential to be subject to increased thermal effects due to its size however, the reconfiguration of the pond into a managed Stormwater Management facility provides opportunities to mitigate these effects. The design of preventative thermal measures such as those proposed by the Credit Valley Conservation's study: Thermal Impacts of Urbanization including Preventative and Mitigation Techniques, January, 2011 including 'cooling towers' and floating vegetated islands along with a north-south pond and outlet channel orientation to maximize shading periods would assist in minimizing this effect. Given that the pond currently functions as moderately stable warmwater habitat, the mitigation measures included in the SWMP design have the potential to improve the temperature discharging from the future SWMP.

3.6 Phytoplankton/Zooplankton Production

It is acknowledged that this pond, like most open water habitats including SWM ponds, have self-sustaining phytoplankton and zooplankton populations however, the contributions to downstream habitats are limited due to the relatively small size of the pond as well as the intermittent discharge to downstream habitat during the low flow periods in its existing inlet/outlet configuration. It is anticipated that the production and contribution of zooplankton and phytoplankton in a SWM facility to the downstream fisheries will be similar to existing conditions.

3.7 Sediment Source

The configuration of the pond does not support the provision of sediment or bedload as a resource in the west branch of Fourteen Mile Creek. The intermittent flow in/flow out (through a single connection point) during high flow events only suggests the pond acts as a sediment trap and will act against the concept of dynamic equilibrium by removing sediment from downstream areas, resulting in a less stable bedload, and thereby facilitating downstream erosion when attempting to re-establish a stable bedload. In addition, the top-draw, uncontrolled discharge nature of the pond suggests that high flows may be sustained for longer periods as water flows out of the pond and into the watercourse system, creating extended periods of higher shear stress than naturally occurs.

3.8 Organic Material Source

The transport of coarse organic material such as leaves and twigs, to downstream fish habitat is limited by the intermittent connection to downstream fish habitat as well as the dense cattail growth at the inlet/outlet that would physically block the movement of this material. Furthermore, it is anticipated that if this pond was removed, its contribution can likely be addressed through riparian zone restoration/planting.

3.9 Headwater Wetland Function

Once again we would like to emphasize that this is an agricultural pond that has naturalized over time due to a lack of management as agricultural feature rather than a conscious decision to create/manage it as fish and wildlife habitat.

Generally headwater wetlands are wetlands associated with groundwater discharge zones that give rise to creeks and streams. Water level data from the pond as well as groundwater data indicate that the pond does not receive groundwater inputs in sufficient quantities that create discharge into the watercourses, the discharge from the pond is associated with surface water inputs. The lack of groundwater inputs is supported by the warmwater thermal regime of the pond. It seems more likely the pond is a 'sink' rather than 'source', receiving surface flows and losing water to evaporation rather than consistently contributing water from the pond to the downstream watercourse.

Furthermore the wetland vegetation communities present are common (cattail shallow marsh and duckweed shallow aquatic) and are typical of vegetation associated with stagnant ponds. The vegetation present is not obviously sustained by groundwater inputs to the pond, but rather appears to be sustained by the presence of surface water that occasionally flows into the pond from the watercourses. The wetland community present is typical of those found within SWM facilities in Halton Region, and could be replicated through standard SWM pond construction and re-vegetation practices.

3.10 Pond providing Pelagic and Littoral Habitat

Although the pond may have a secondary function providing pelagic and littoral habitat by its intrinsic function of storing water for agriculture, it is a farm pond that was created to facilitate agricultural activities. The limited availably of this type of habitat in the area is appears to be associated with the absence of naturally occurring open water habitat in North Oakville and the use of a farm pond to bolster a type of habitat that appears to be naturally limited in North Oakville seems unrealistic.

4 Conclusions

Generally the pond appears to function as warmwater habitat that supports a warmwater fish community. Given the current configuration of the pond with a single inlet/outlet feature that is principally influenced by surface water, it appears that this pond functioning as a basin storing water until such time that it overflows into the receiving watercourse. The resulting storage of water, intermittent connection to downstream watercourses and apparent lack of groundwater inputs results in water temperature increasing during the low flow period. This warmer water is then discharged into the receiving watercourse (Reach 14W-12) that supports Redside Dace. As a result of these influences the pond in its current form does not appear to match the intent of the management of the receiving watercourse (Reach 14W-12).

According to the DFO's *Working Around Water? Factsheet Series (Ontario Edition)* by-pass ponds *"… are also prone to dissolved oxygen and water quality problems, increases in water temperature, and sediment accumulation problems. Proposals* ***for bypass ponds on coldwater streams are generally not approved due to the potential that downstream water temperatures may increase beyond levels that coldwater fish need to survive****".* It has been our experience that the removal of pond habitat (i.e. by-pass, on-line), specifically those contributing to cool/coldwater habitats, is a measure often identified to improve water quality (i.e. water temperature) related to fish habitat and is frequently used as a compensation measure used to address a HADD. The *NOSCC Implementation Report* states that one of its broad level riparian corridor management recommendations to achieve certain targets on a system wide basis includes the removal of online ponds as they are considered detrimental from a temperature moderation perspective. Although the pond in question is not an online feature, its effects are similar and the removal of these adverse effects would be beneficial to the aquatic habitat of downstream reaches.

It is acknowledged that the proposal is not merely to remove the pond (Reach 14W-14A) to benefit the natural heritage system; instead it is a replacement of the existing pond with a SWM pond. SWM ponds are necessary to address the post-development flows and although the resulting SWM pond will be larger and likely subject to greater thermal impacts due to its size, there are mitigation measures that can be incorporated into the design that will assist in mitigating these effects. This proposed approach consisting of removing a farm pond that is detrimental to downstream habitat and using the area to construct a necessary SWM pond in its place represents a benefit over the the alternative of maintaining the farm pond (and its effects) and construction additional pond(s) on the landscape.

Notwithstanding the thermal influences of the pond, it is recognized that the pond does support a warmwater fish community and as a result the proposed works are subject to review under the Fisheries Act and Conservation Authorities Act. Due to its proximity and connection to Redside Dace habitat it is also subject to review under the ESA. As a result we request that CH and MNR review this information and provide comment.

We trust this information satisfies the additional information request presented in the August 3, 2011 email as well as the September 6, 2011 written correspondence and request that CH and MNR identify what specific functions of this feature (if any) considered worthy of retention in order that the feasibility of incorporating this type of feature in other locations can be examined.

5 References

- Chu, Cindy, N.E. Jones, A.R. Piggott and J.M. Buttle. Evaluation of a Simple Method to Classify the Thermal Characteristics of Streams Using a Nomogram of Daily Maximum Air and Water Temperatures, North American Journal of Fisheries Management 29: 1605-1619, 2009.
- Wehrly, Kevin; M.J. Wiley & P.W. Seelbach. A Thermal Habitat Classification for Lower Michigan Rivers. Michigan Department of Natural Resources. Fisheries Research Report No. 2038, 1998.

M:\Jobs\2009\14.09222.001.P01 - 407 West Employment Area\Ecology\Agency Correspondance\Conservation Authority\CH Sept 6 2011 comments\Sept 6 2011 HC Comments - FINAL Aquatic Memo-(2012 03 28).doc

Environmental Implementation Report / Functional Servicing Study for 14 Mile Creek West and the Lazy Pat Farm Property

Bathymetric Survey / Approximate Fish Community Sampling Locations

LEGEND

Contour Lines

Equipment Type / Sampling Method

- Minnow Trap (2011)
- Pot Trap (2011)
- Trap (MMM - 2002)

Electrofishing

- EF-A (2009)
- EF-B (2009)
- NRSI (2002)

Scale

0 5 10 20 30 40 m

Client	Prepared by
Bentall Kennedy	MMM GROUP
Date: February 2012	Project No.: 1409222001
Aerial Photo: © 2012 Microsoft Corporation Imagery © Microsoft © 2010 NAVTEQ	**Figure: 1**

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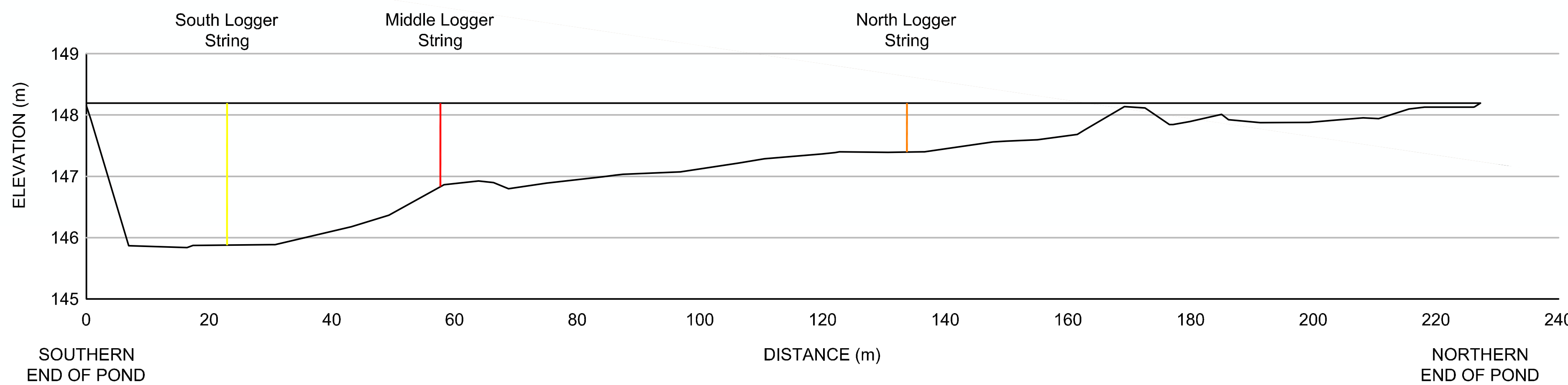


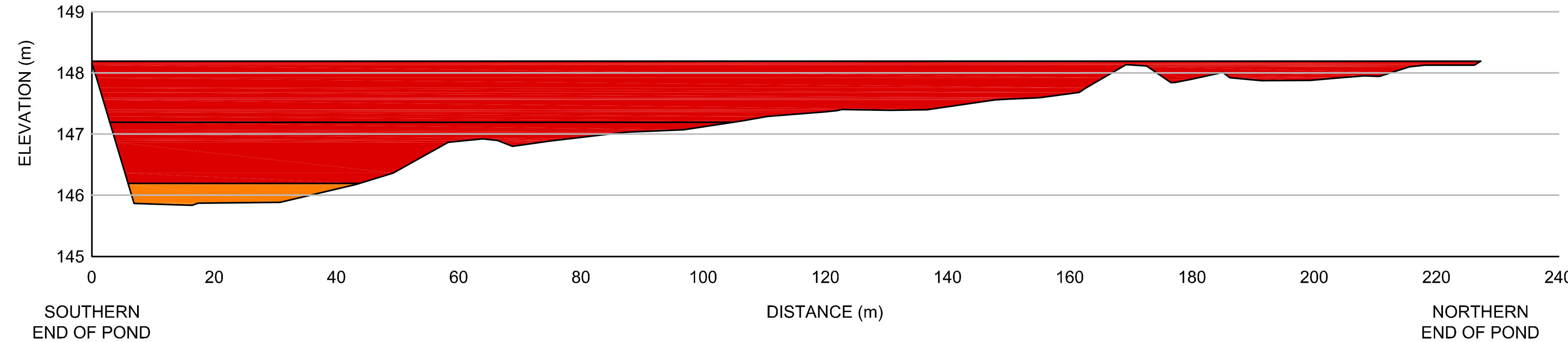
LEGEND

Logger Sampling Locations

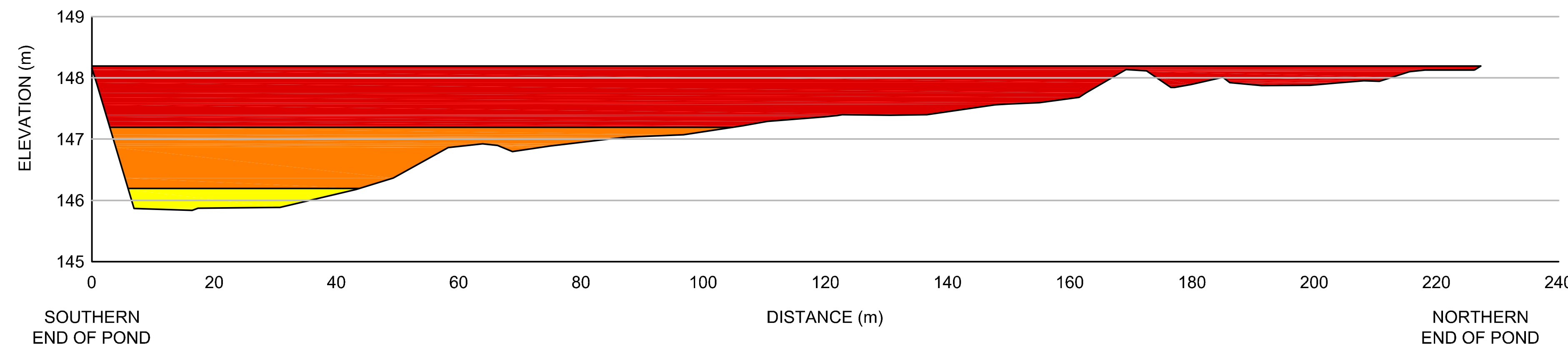
- North Logger String (1-2-3)
- Middle Logger String (4-5-6)
- South Logger String (7-8-9)

Client:	BENTALL KENNEDY
Title:	Water Temperature Monitoring (2011) Bathymetric Survey and Profile
Prepared by:	MMM GROUP
14.09222.001.EN1	Scale: NTS / Review: SR
Date: February 2012	Figure: 2

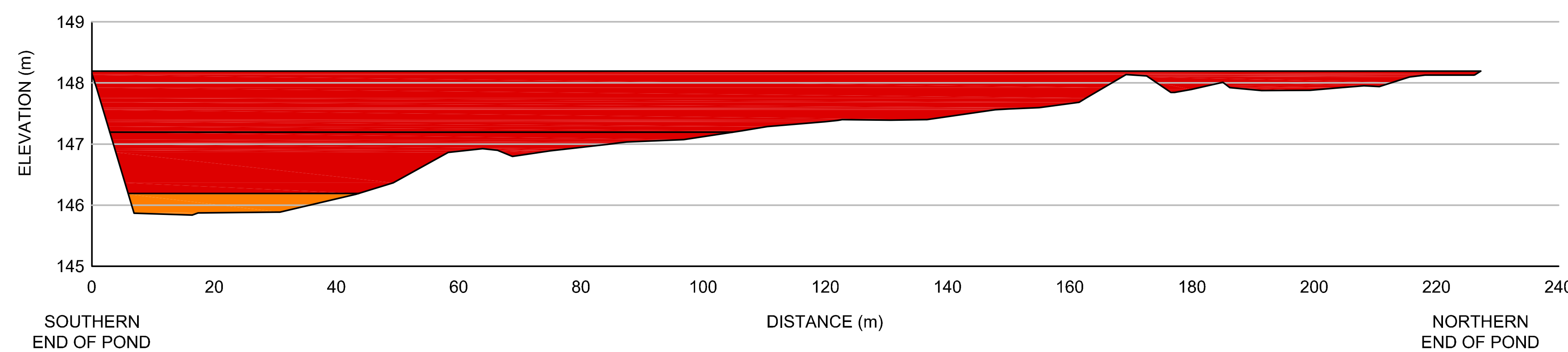
WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 24°C



WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 36°C



WATER TEMPERATURE AT MAXIMUM AIR TEMPERATURE OF 28.69°C



Thermal Classification (Colour Code)	Maximum Water Temperature Range at 24°C	Maximum Water Temperature Range at 36°C	Maximum Water Temperature Range at 28°C
Cold Water (BLUE)	0°C to 15°C	0°C to 16°C	0°C to 16°C
Cold - Cool Water (GREEN)	15°C to 17°C	16°C to 20°C	16°C to 18°C
Cool Water (YELLOW)	17°C to 20°C	20°C to 24°C	18°C to 21°C
Cool - Warm Water (ORANGE)	20°C to 23°C	24°C to 28°C	21°C to 24°C
Warm Water (RED)	23°C and higher	28°C and higher	24°C and higher

Client: BENTALL KENNEDY

Title: Pond Cross Section

Prepared by: MMM GROUP

14.09222.001.EN1	Scale: NTS	Review: SR
Date: February 2012	Figure: 3	

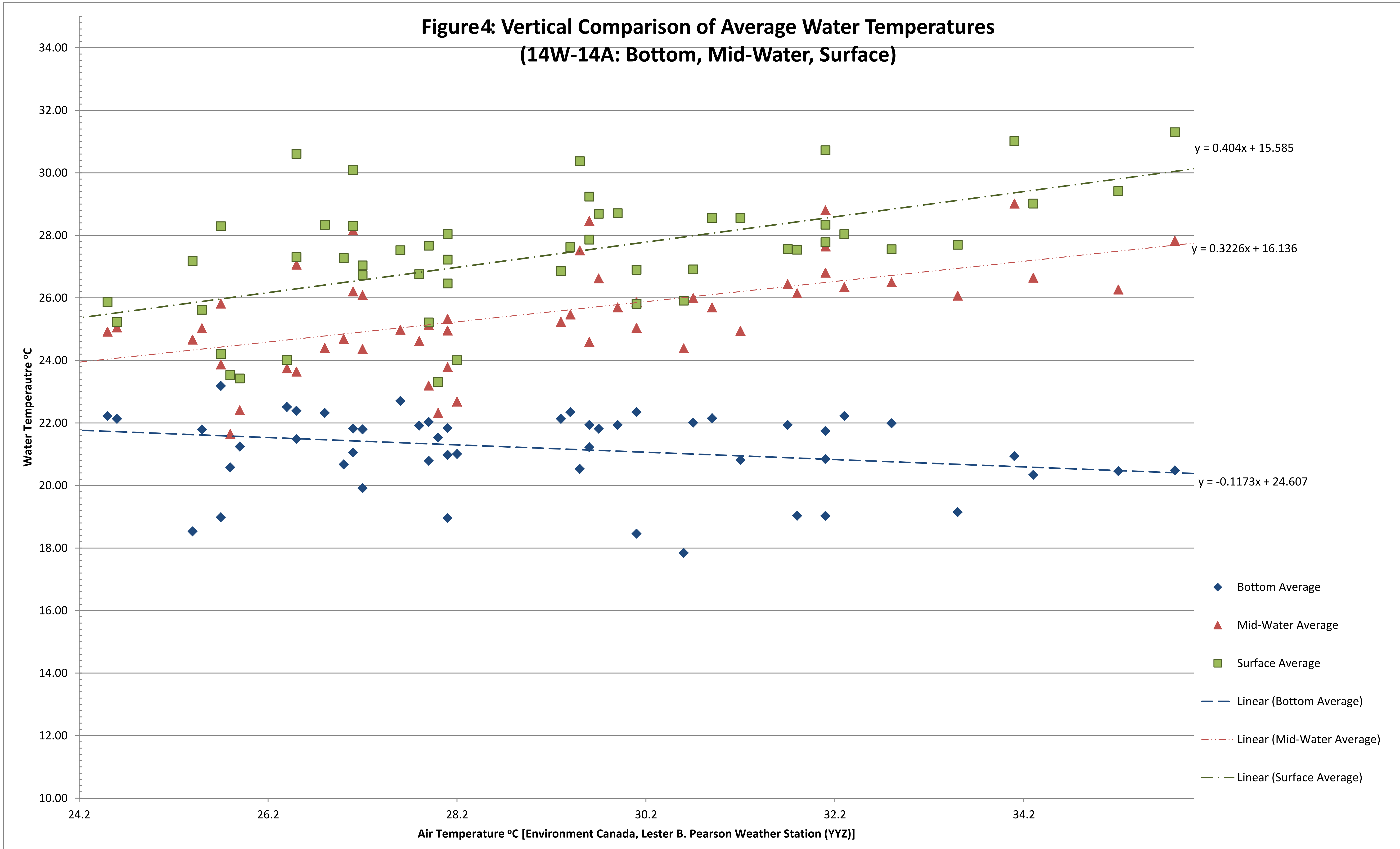


Figure4: Vertical Comparison of Average Water Temperatures
(14W-14A: Bottom, Mid-Water, Surface)
34.00
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
Water Temperautre ºC
24.2
26.2
28.2
30.2
32.2
34.2
Air Temperature ºC [Environment Canada, Lester B. Pearson Weather Station (YYZ)]
y = 0.404x + 15.585
y = 0.3226x + 16.136
y = -0.1173x + 24.607
Bottom Average
Mid-Water Average
Surface Average
Linear (Bottom Average)
Linear (Mid-Water Average)
Linear (Surface Average)

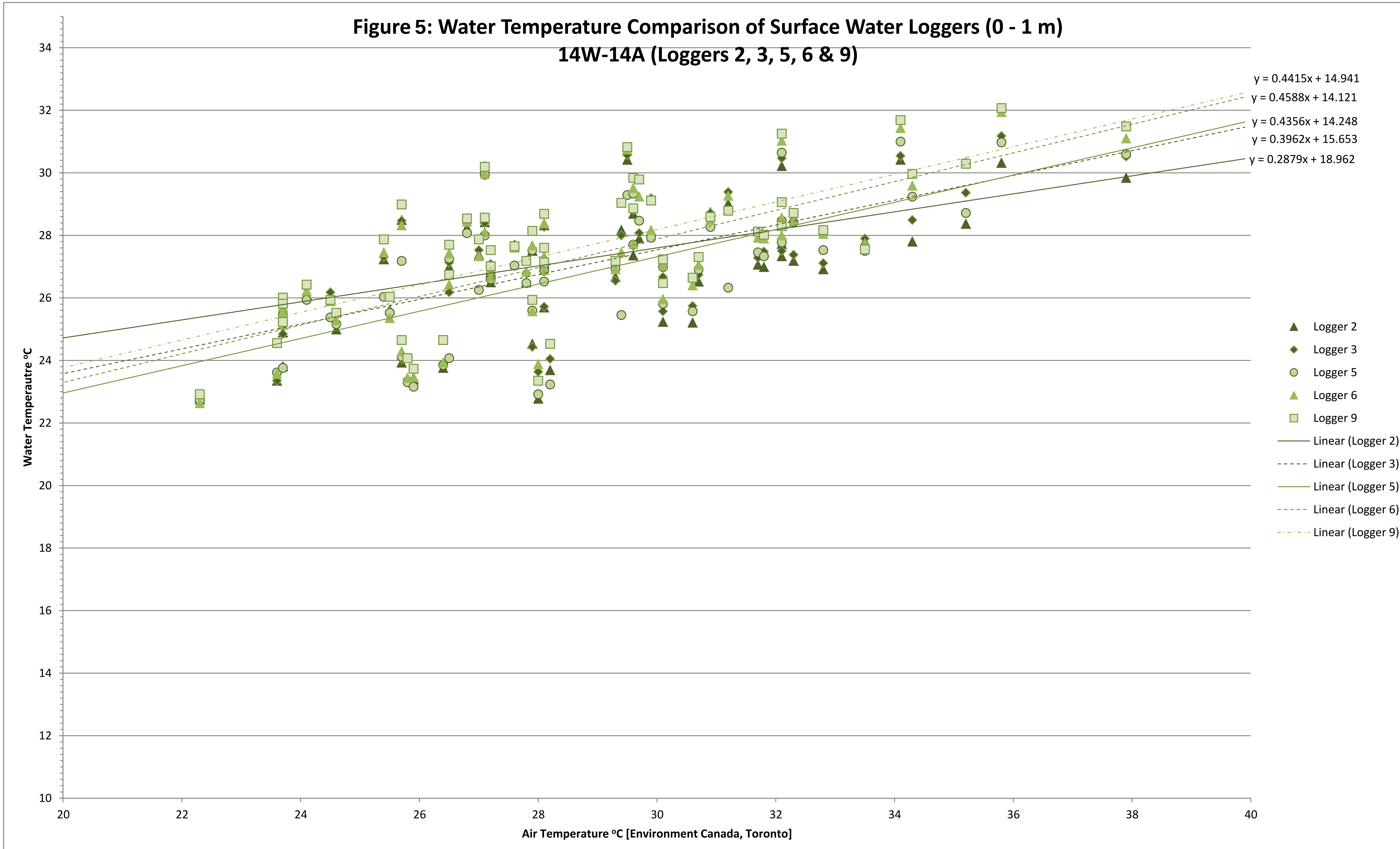


Figure 5: Water Temperature Comparison of Surface Water Loggers (0 - 1 m)
14W-14A (Loggers 2, 3, 5, 6 & 9)
y = 0.4415x + 14.941
y = 0.4588x + 14.121
y = 0.4356x + 14.248
y = 0.3962x + 15.653
y = 0.2879x + 18.962
Water Temperautre ºC
Air Temperature ºC [Environment Canada, Toronto]
34
32
30
28
26
24
22
20
18
16
14
12
10
20
22
24
26
28
30
32
34
36
38
40
Logger 2
Logger 3
Logger 5
Logger 6
Logger 9
Linear (Logger 2)
Linear (Logger 3)
Linear (Logger 5)
Linear (Logger 6)
Linear (Logger 9)

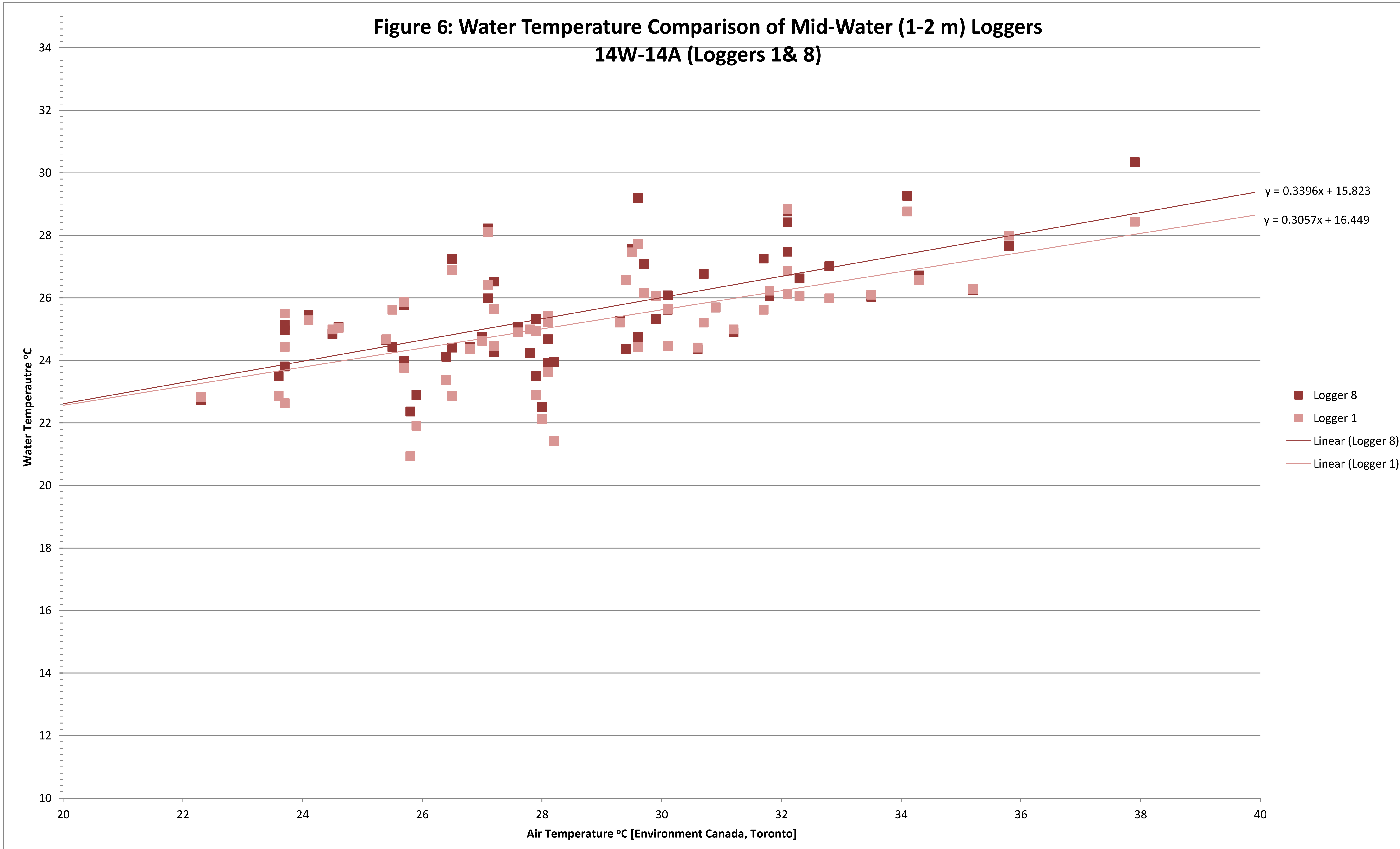


Figure 6: Water Temperature Comparison of Mid-Water (1-2 m) Loggers
14W-14A (Loggers 1& 8)
Water Temperautre ºC
Air Temperature ºC [Environment Canada, Toronto]
y = 0.3396x + 15.823
y = 0.3057x + 16.449
Logger 8
Logger 1
Linear (Logger 8)
Linear (Logger 1)
34
32
30
28
26
24
22
20
18
16
14
12
10
20
22
24
26
28
30
32
34
36
38
40

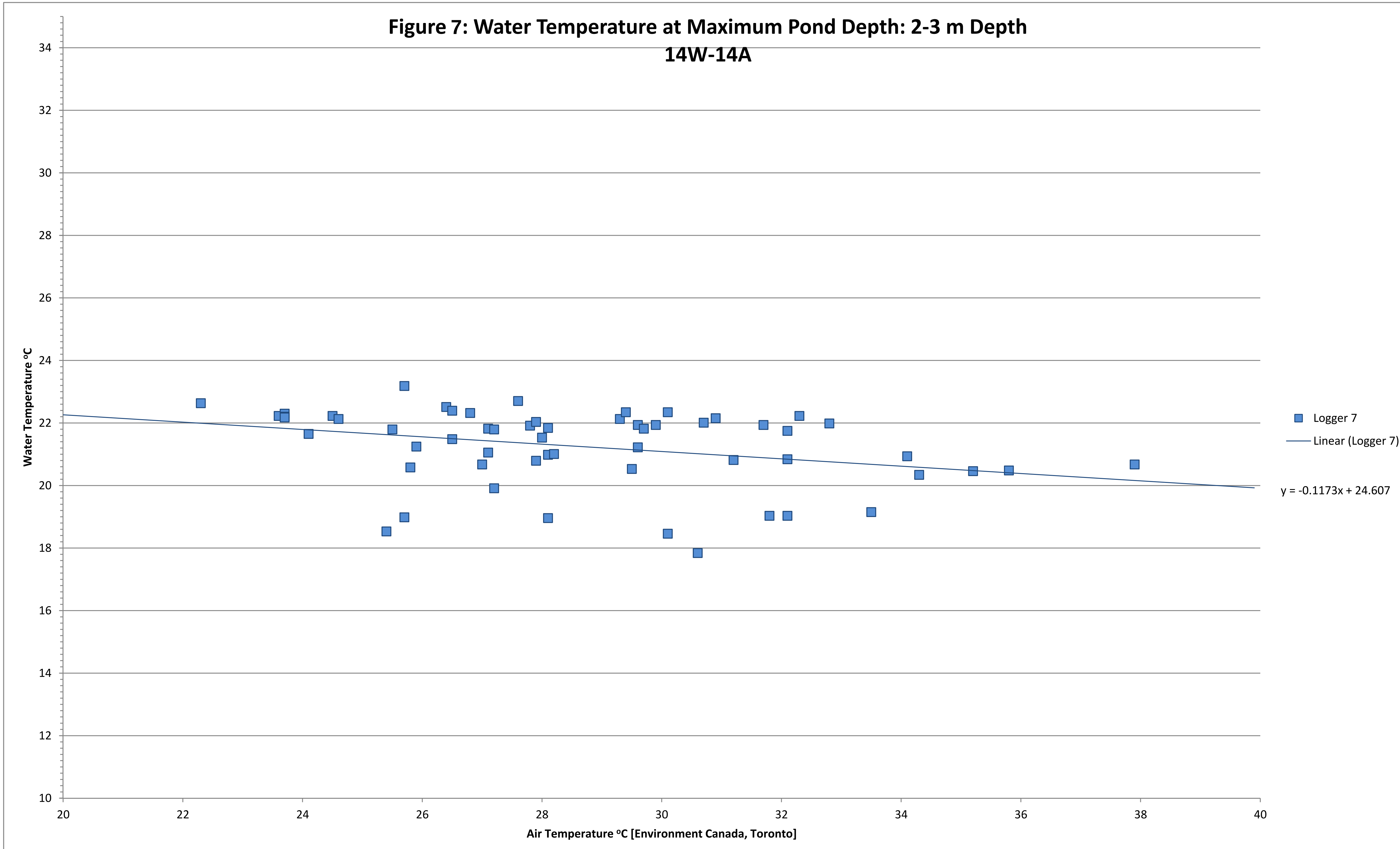


Figure 7: Water Temperature at Maximum Pond Depth: 2-3 m Depth
14W-14A
Water Temperature ºC
34
32
30
28
26
24
22
20
18
16
14
12
10
20
22
24
26
28
30
32
34
36
38
40
Air Temperature ºC [Environment Canada, Toronto]
Logger 7
Linear (Logger 7)
y = -0.1173x + 24.607