LAKE FRANCIS WATERSHED RIPARIAN AND AQUATIC ASSESSMENT




WIWCD

A Report Prepared by
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PHOTOGRAPHS OF BARRIERS

LIST OF APPENDICES

1.0 INTRODUCTION

The West Interlake Watershed Conservation District (WIWCD) has been actively involved in improving the health of the watersheds within the conservation district. In 2009, the WIWCD completed an assessment of the riparian zones, instream habitat, and water quality within the Swan Creek Watershed (Lowdon 2010). Utilizing the information collected, the WIWCD has started to tackle numerous projects within the watershed to restore healthy riparian zones and provide better fish passage.

The WIWCD, with the assistance from the Manitoba Fisheries Enhancement Fund (FEF), initiated this assessment to gain a better understanding of those issues potentially affecting water quality, in-stream habitat, and the riparian health of the tributaries and drains found within the Lake Francis Watershed. The overall goal of the WIWCD is to design an integrated watershed management plan, in cooperation with all municipalities and area residents, to improve the function of each watershed within the conservation district (Figure 1 & 2). The WIWCD encourages sustainable development practices to assist in creating a healthy watershed, ultimately benefitting all user-groups.

The primary objective of this project was to provide a comprehensive overview of the riparian zones and aquatic habitat conditions found within the Lake Francis Watershed. The assessment was to identify areas within the watershed in need of habitat protection, rehabilitation and/or enhancement. Furthermore, the project will enhance measures in developing a watershed management plan to improve water quality and provide a foundation for understanding the state of the fishery and riparian conditions within the Lake Francis Watershed.

Specific objectives of the project include:

- Compile relevant historical data pertaining to water quality trends, in-stream flow requirements, hydrological data, and fish utilization of the Lake Francis Watershed;

- Describe riparian conditions and adjacent land use practices that may be negatively effecting water quality and valuable fish and wildlife habitat along the relevant drains within the Lake Francis Watershed;

- Describe the physical characteristics and hydrology of the watershed;

- Identify potential migration blockages or barriers to fish

- Gain a better understanding of fish species utilization of the watershed including, life stages, egg deposition sites, successful larval emergence, and upstream adult migration;

- Produce a list prioritizing sites potential rehabilitation efforts that can be undertaken to help improve water quality and in-stream habitat conditions within the watershed;

- Hold information meetings with the WIWCD Board; and

- Prepare a technical report to the WIWCD Board summarizing information gathered during field surveys.

This project will provide baseline data that the WIWCD can utilize to move forward and improve the riparian and aquatic habitat conditions that currently exist within the Lake Francis Watershed. This report also provides supporting documentation for future funding applications to carry out the enhancement initiatives.

1.1 STUDY AREA

The Lake Francis Watershed (illustrated as the Lake Francis Sub-District in Figure 2), can more accurately be described as the Lake Francis sub-watershed and the West Shoal Lake sub-watershed. Five additional tributaries not located within these sub-watersheds, but found within the Lake Francis Sub-District, (Bachman Drain, Wilson Creek, Wagon Creek Drain, Laurentia Drain, and Roy's Drain) are also included within this report. These tributaries flow directly into Lake Manitoba. Refer to Figure 3 for a schematic drawing illustrating the flow of water within the drains and tributaries of the Lake Francis Sub-District. Throughout the report when we refer to the term "Lake Francis Watershed", we are referring to all tributaries found within the Lake Francis Sub-District (Figure 2).

The Lake Francis Watershed is located within the Interlake Region of Manitoba along the eastern shores of Lake Manitoba (Figure 4). The watershed is of significant importance to a number of user groups including; areas residents, recreational and commercial fishermen, and those involved in domestic and agricultural practices. In particular, Lake Francis is of major importance to local sport and recreational fishing and hunting groups, as it is located within the Lake Francis Wildlife Management Area (LFWMA). The LFWMA Committee have been striving to create improved habitat within the lake for the benefit of ducks, waterfowl, and wildlife (pers. comm. Garth Ball – Manitoba Conservation).

Figure 1. Map of the Manitoba Conservation District boundaries. WIWCD is located on the east shore of Lake Manitoba.

Figure 2. Sub-district watershed boundaries of the West Interlake Watershed Conservation District.

Similar to the Swan Creek Watershed, the drains located within the Lake Francis Watershed have been channelized to help increase drainage within the area to improve agricultural development. These changes, although important for the agricultural community, likely had significant impacts on the fish community. The severity of the alterations to the drainage system within the Lake Francis Watershed, compared to those alterations observed within the Swan Creek Watershed, is however far less. In addition, unlike the Swan Creek Watershed, where most of the drains are major waterways (third, fourth, or even fifth order tributaries), Wagon Creek, Swamp Lake, and Laurentia Drains are the only waterways within the Lake Francis Watershed reaching third order status. Based on these attributes alone, one can predict there will be differences in habitat characteristics and fish utilization between the watersheds. Furthermore, sloughs, marshes, and wetlands were found to be more abundant within the Lake Francis Watershed in comparison with the Swan Creek Watershed.

The drains or tributaries assessed within the Lake Francis Watershed include:

- Bachman Drain,
- Wagon Creek Drain,
- Wilson Creek,
- Laurentia Drain,
- Swamp Lake Drain,
- Roy's Drain, and
- Viel Creek.

Wagon Creek Drain is by far the largest tributary within the Lake Francis Watershed, with a drainage area of approximately 48 km^2. All of the other tributaries have drainage areas ranging between 10.9 and 19.6 km^2. (For comparison, the smallest and largest drainage areas of an individual tributary within the Swan Creek Watershed were 30 and 1040 km^2, respectively.) The towns of St. Laurent, Oak Point, and Lake Francis are located within the watershed. Cottage development is also evident along most of the Lake Manitoba shoreline.

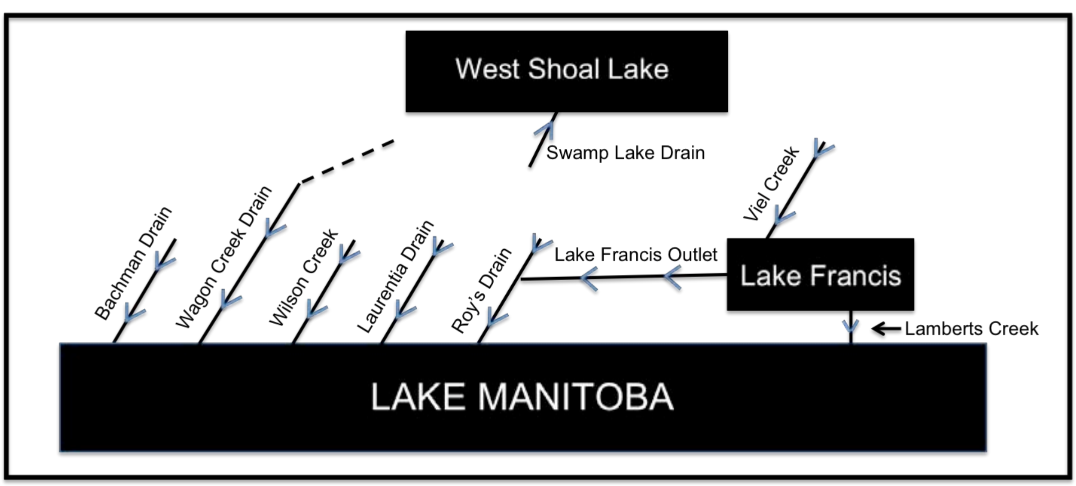

Figure 3. Flow chart illustrating water movement through out the Lake Francis Watershed.

Figure 4. Overview map of the Lake Francis Watershed illustrating the network of drains found within.

The climate within the area is typical of the northern temperate zone, characterized by short, warm summers and cold winters. The mean annual temperature is 1.2^{o}C, the average growing season is 175 days, and growing degree-days number about 1500. The mean annual precipitation is approximately 510 mm, of which nearly one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from spring through early summer.

In 2010, the Lake Francis Watershed experienced unusually abnormal weather conditions. As a result of an early spring, at the beginning of April, most, if not all the spring runoff had already left the land, leaving the drains and creeks essentially dry during the anticipated spring fish spawning migrations. This trend continued until the end of May at which time heavy rainfall events occurred. With all the tributaries now flowing, additional habitat became available for those late spawning fishes, including, Common Carp (*Cyprinus carpio*), Yellow Perch (*Perca flavescens*), and a number of forage fish species.

1.1.1 LAKE FRANCIS WILDLIFE MANAGEMENT AREA (LFWMA)

Lake Francis, along with eight additional lakes, account for the aquatic habitat within the LFWMA (Figure 5). With a surface area of 24.2 km^2 and a drainage area of approximately 68.9 km^2, the lakes within the LFWMA account for a large percentage of wetland habitat adjacent Lake Manitoba. The lakes, connected through a network of waterways, provide the aquatic community with an extensive littoral zone (the productive zones along shorelines of waterbodies). Littoral zones are typically very productive areas within watersheds as littoral macrophyte communities provide great habitat by providing cover, food, or refuge for many species of fish, invertebrates, ducks, waterfowl, and/or wildlife.

There are two tributaries that connect Lake Francis to Lake Manitoba. The first is a small creek named Lamberts Creek. This creek is one kilometer in length and only flows when water levels within Lake Francis are quite high. The second, and larger of the two tributaries (2.2 km on length), is called the outlet channel of Lake Francis (Figure 5). Located at the downstream end of this channel is a stop-log control structure. It was built in the 1960's to control or regulate water levels within the lake (Figure 6). In 2007, the LFWMA Committee installed screens on the control structure to prevent Common Carp (*Cyprinus carpio*) from entering the Lake. Common Carp is an introduced species to Manitoba waters and is known to cause ecological changes to the waterbodies they inhabit (Stewart and Watkinson 2004). Studies at Delta Marsh suggest Carp up-root aquatic vegetation by thrashing their tails during spawning activity and during feeding. As a result, habitat complexity within the marsh has been altered; with turbidity increasing and the abundance of submerged macrophytes decreasing (pers. comm. D. Watkinson). These changes affect fish, invertebrates, ducks, waterfowl and wildlife.

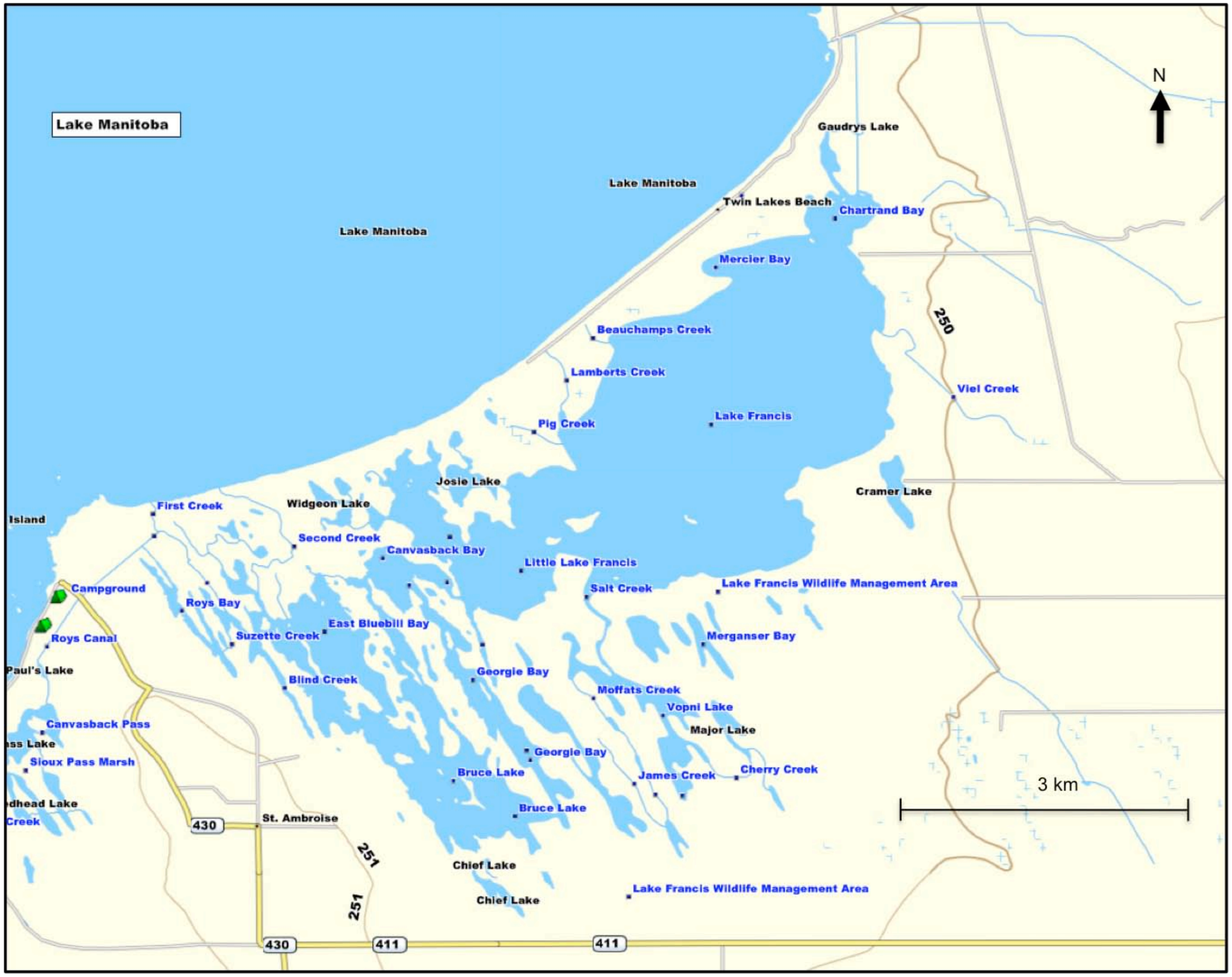

Figure 5. Overview map of the Lake Francis Wildlife Management Area.

Dr. Dale Wrubleski, a Research Scientist with Ducks Unlimited, is currently studying the fish community within Delta Marsh. Findings thus far, suggest a shift in species composition is taking place. Yellow Perch (*Perca flavescens*), once the most dominant species within the marsh, is now second to the Freshwater Drum (*Aplodinotus grunniens*). Interestingly, these two species have very different spawning strategies. Yellow Perch adhere their eggs to submerged aquatic vegetation during spawning (Holm et. al. 2009). They therefore rely heavily on a healthy macrophyte community to successfully reproduce. In contrast, Freshwater Drum is a broadcast spawner. Their eggs are released within the water column (Scott and Crossman 1979). Submerged vegetation or particular substrate types (sand, gravel, cobble) do not play an important role in the success of Freshwater Drum reproduction.

Figure 6. Photographs of the screened control structure within the outlet channel of the Lake Francis.

2.0 APPROACH AND METHODOLOGY

In order to document the riparian and aquatic habitat conditions within the Lake Francis Watershed, various sampling methodologies were utilized, including aerial surveys, ground truthing surveys, physical characteristics and hydrology assessments, water quality sampling, and fish utilization surveys. Refer to section 2.1 to 2.7 for detailed descriptions of the methodologies used to assess the individual sections of the riparian and aquatic survey.

2.1 RIPARIAN SURVEY

The riparian zone is defined as the transition zone between the terrestrial and aquatic environment. Found along lakes, rivers, streams, drains, and wetlands, a well-established riparian zone plays an important role for establishing a healthy ecosystem. Diverse vegetation within a riparian zone including plants, shrubs, trees, and/or grasses is essential for protecting the integrity of the aquatic environment. Healthy riparian zones provide:

- A natural filtration system preventing pollutants from entering the waterway (i.e., chemicals, pesticides, animal waste, high nutrient inputs, etc.),
- A natural means for protecting water quality within the aquatic environment,
- A means to control or alleviate erosion by stabilizing banks, and
- A means to reduce downstream flooding by slowing water movement along the boundaries of a waterway

Aerial and ground surveys were the primary methods used to document the state of the riparian zones along the tributaries of the Lake Francis Watershed. Specific characteristics examined during this assessment included documenting the width of the riparian zone, the type of vegetation within the riparian zone, and land use practices along the riparian corridors.

2.1.1 AERIAL SURVEYS

Aerial surveys were conducted along each tributaries and the shoreline of Lake Manitoba within the Lake Francis Watershed to achieve three goals;

1) Provide digital still images of the riparian zone along each corridor to aid in riparian zone classification;
2) Identify and document potential rehabilitation project sites; and
3) Identify land use practices that may be negatively affecting water quality along the tributaries of the Lake Francis Watershed.

AAE Tech Services chartered a slow flying fixed-wing aircraft (Cessna 180) from the St Andrews Airport on June 2nd and October 2nd of 2010. For the spring survey, the original plan was to conduct the survey in early May, typically when Walleye, White Sucker, and Northern Pike are utilizing the tributaries for spawning. However, due to extremely low water levels, most of the drains were dry during that period. Therefore, to document the habitat, and locate the waterways from the air, the survey was conducted in early June when the tributaries were flowing after receiving significant rainfall. During the second flight (October), flowing water was still evident in the main channels of the Lake Francis Watershed tributaries.

A digital SLR 30-D Canon camera, with image stabilization, was used to take still images during both flights. A Garmin 60CSx GPS unit was used to log and track the flight paths by recording waypoints (latitude and longitude coordinates) at one-second intervals. Photographs were then post-processed using a software program (GPS Photolink - standard edition) designed to link still images to their appropriate GPS coordinates by matching the time stamp produced by each device. In addition, the software program created files compatible with MapSource and ArcView software mapping programs, to allow one to display the flight path and linked photographs. The aerial photographs can also be viewed using Google Earth software. Upon completion of the aerial surveys, identified potential rehabilitation sites were then subject to additional ground truthing surveys.

2.1.2 GROUND TRUTHING SURVEYS

Ground surveys were conducted over the course of the study starting on June 4th and commencing October 16th of 2010. The primary objective of these surveys was to provide additional data and evaluate potential rehabilitation sites. Coordinates of specific sites of interest were recorded using a Garmin GPS unit. Digital photographs were taken using a Canon 30-D SLR camera.

2.1.3 LAND USE CLASSIFICATION

The aerial surveys were also used, along with ground truthing photographs, to identify land use practices along the tributaries within the Lake Francis Watershed. Similar techniques were used to document land use along the shoreline of West Shoal Lake, Lake Francis, and Lake Manitoba. Refer to Table 1 for a description of categories used to classify land use within the watershed.

2.1.4 RIPARIAN CLASSIFICATION

Once the aerial and ground truthing surveys were completed, all data was analyzed and the riparian zone corridors along each tributary were classified or grouped into one of three categories.

Class A Habitat - Little to no impact to riparian corridors. The riparian corridor within this category is considered adequate to protect the integrity of the aquatic environment. Typically buffer zones are greater than 10 m on each side of the waterway. Erosion control problems and sediment loading is not a concern.

Class B Habitat - Moderate impacts to riparian corridors. Riparian zones are typically less than 10 m and their function to the filter inputs (nutrients, sediment) into the waterway is degraded in comparison with a Class "A" riparian classification. Vegetation within the corridors may either be lacking as a result of minimal livestock grazing, is situated near a roadway, and/or agricultural practices encroach upon the waterway.

Class C Habitat - Severe impacts to riparian corridors. Riparian zones are less than 5 m on at least one side of the waterway and nutrient loading is likely. Vegetation within the corridors has extensive damaged as a result of either the presence of feedlots or livestock trampling near watering areas. Buffer zones are inadequate to protect the aquatic environment.

2.1.5 PROJECT SITE EVALUATION

Upon completion of the aerial and ground surveys a list of potential rehabilitation sites was generated. The primary focus was to provide the WIWCD with a list prioritizing sites that have the greatest negative impact on the watershed and are most important to put effort towards enhancing to improve the water quality and fish habitat within the Lake Francis Watershed. Types of sites included within the list included barriers to fish movement, confined cattle access areas negatively impacting the aquatic environment, and those sites with limited riparian zones inadequate to protect the waterways. General guidelines or recommendations on how to improve the habitat and water quality currently found within the Lake Francis Watershed are also provided.

Table 1. List of categories used for classification of land use adjacent to stream corridors in the Lake Francis watershed.

Land Use Category	General Description of Category
Meadow Grass Vegetation	Grass land along waterways
Prairie/Natural Grasses	Native grasses used for forage (Native Hay)
Native Pasture	Grass land that is being grazed
Grazed Shrub and Brush	Shrub and brush land that is being grazed
Shrub and Brush	Shrubs and brush habitat
Forest Stands	Treed land
In Channel Reservoir	Dug outs or watering holes along waterway
Marsh and Bogs	Wetlands
Urban Development	Cottage development, housing, campgrounds
Railway Crossing	Railway Infrastructure
Road Crossing	Developed road infrastructure
Roadway Crossing	Undeveloped road infrastructure

2.2 FISH HABITAT ASSESSMENT

Fish habitat is defined as those parts of the environment “on which fish depend, directly or indirectly, in order to carry out their life processes” (Fisheries and Oceans Canada 1986). This includes habitat used for migration, spawning, feeding and refuge. Diverse habitat makes for good fish habitat. Natural run, riffle, pool habitats found with natural waterways provide the essential characteristics for those fish utilizing the habitats to carry out their life processes. Cover in the form of water depth, woody debris, aquatic vegetation, boulders or undercut banks increase habitat diversity and thus created better fish habitat. Substrates dominated by sand, gravel, cobble and boulders typically are those selected by fish for spawning. All of these characteristics are typically found in pristine waterways undisturbed by man.

Extensive channelization of waterways likely reduced the amount of “good” fish habitat available to the fish community within these specific water bodies. Spring runoff is allowed to leave the land more quickly increasing the chance of stranding eggs, larval or adult fish. In addition, agricultural practices along waterways may also have negative impacts to the aquatic environment as pesticide, chemicals, and nutrients have the potential to enter the water column. Livestock grazing within the waterways likely degrade spawning habitat within waterways as coarse material is pushed beneath the silt and fine particles residing in the waterway. Barriers within waterways impede fish movement and ultimately reduce the available habitat for the fish communities. All of these factors can limit or degrade the fish habitat within waterways and affect the state of the fishery and fish communities.

For the purpose of this study, a fish habitat assessment was conducted in conjunction with the riparian survey. Fish habitat was documented along the corridors of each tributary and the lake shore of Lake Manitoba within the Lake Francis Watershed. Quantitative sampling was however, not conducted. Instead a general description of the habitat observed along each corridor of the tributaries was documented. Notes were also taken when valuable spawning habitat was observed.

2.3 BARRIERS TO FISH MIGRATION

Barriers to fish migration within this study included any structure potentially obstructing fish movement. Barriers that were identified and assessed included those anthropogenic in nature such as: perched culverts, undersized culverts (resulting in high water velocity) bridges, concrete structures, earthen dams, dikes, ford crossings, rock weirs, or commercial fishing nets. Natural barriers such as beaver dams, debris, log jams, or rapids were also assessed and documented. All barriers identified within this survey were photographed and location information recorded using with a Garmin GPS unit. Head differential and flow rates were also documented at each barrier.

The severity of a barrier was prioritized based on a number of key factors including, the location of the barrier, the type of barrier, and the length of time a specific barrier was situated within the watershed impeding fish movement. For example, if a barrier was located at the downstream end of a system, the barrier would likely be ranked as high priority as upstream habitat within the system would be unavailable to those fish migrating upstream to spawn from Lake Manitoba. Alternatively, if a barrier were either at the upper end of the tributary or transitional in nature (i.e. beaver dams), priority would likely be considered low. Each and every barrier has the potential to either segment habitat or reduce the amount of valuable habitat available to those fish communities utilizing the tributaries within the Lake Francis Watershed. Furthermore, the longer a barrier is situated within a tributary and blocking fish movement, the greater impact that barrier will likely have on the fish community. Valuable fish habitat is essential for maintaining and/or improving the fish stocks for those fish utilizing the Lake Francis Watershed.

It is however, important to state that a barrier identified during this study might not necessarily be considered a barrier in subsequent years. For instance, high velocities flowing through a culvert one year may impede fish movement. The same culvert assessed during lower flow conditions may in fact be passable and not considered a barrier.

2.3.1 CULVERT ASSESSMENT

To get a better understanding of flows, discharge, and potential barriers to fish movement, a detailed culvert assessment was conducted over the entire watershed. A total of 48 culverts at 22 crossings were assessed. Water velocity, water depth, discharge and diameter of each culvert were documented. A note was also made for those culverts that were perched or had water velocities of 1.0 m/sec or greater.

To determine the amount of water passing each culvert (m^3/s), at both upstream and down stream, it was necessary to calculate the surface area of the water passing each culvert and the velocity of that water. To determine the surface area of the water, where the fluid level was less than half the radius of the culvert, the following definite integral was used:

$$2 \cdot \left(\frac{y}{2}\sqrt{r^2 - y^2} + \frac{r^2}{2}\sin^{-1}\frac{y}{r} \right) \Bigg|_0^{depth}$$

where *r* is the radius of the culvert and *y* is the measured water depth (to the nearest cm). The water velocity (m/s), at both the upstream and downstream ends of the culverts, was measured using a Swoffer™ (Model 2100) current velocity meter at the top (0.8 · depth), middle (0.5 · depth), and bottom (0.2 · depth) of the water column. To calculate discharge (m^3/s), the surface area and the average water velocity were multiplied. This again was calculated for both the upstream and downstream ends of each culvert.

2.4 PHYSICAL CHARACTERISTICS AND TOPOGRAPHY

Prior to conducting fieldwork, each tributary was delineated into three sampling reaches, identified as the upper, middle, and lower reach. In some of the shorter tributaries only one or two reaches were assessed. To gain a better understanding of the physical characteristics of the waterways within the watershed; longitudinal profiles, cross-sectional profiles and sinuosity were assessed to measure slope, channel width, and curvature of the channel within the three sampling reaches of each tributary. Topographical 1:50,000 maps were also used to plot the longitudinal profile of the entire length of each tributary and delineate the watershed boundaries of the tributaries.

2.4.1 LONGITUDINAL PROFILES

Longitudinal profiles were conducted within the upper, middle and downstream reaches of each tributary, delineated prior to the start of the fieldwork, within the Lake Francis Watershed. A Top Con laser level and survey rod was used to measure slope of the water surface, channel bed, and floodplain. Four hundred meter segments were assessed within each sampling reach. Longitudinal profile methodologies were carried out using the methodologies outlined in Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994). Longitudinal profiles are an important component for better understanding of the topography, hydrology, channel morphology and fish habitat within the sampled reaches.

2.4.2 CROSS-SECTIONAL PROFILES

Cross-sectional profiles were conducted within the sampling reaches delineated prior to the start of the project for each tributary examined within the Lake Francis Watershed. A tape measure was extended across the channel at each cross-section. At 1.0 m intervals, the water depth (m) and velocity (m/s) were recorded. A Swoffer™ (Model 2100) current velocity meter was used to measure the water velocity at 40% (0.4 · depth) of the water column. A Top Con laser level was used to assess elevation of the cross-sectional profiles. Flood plain, water level, and the thalweg (the deepest part of channel bed) were documented. A Garmin GPS unit was used to mark sampling locations.

2.4.3 HYDROLOGY

Water velocity was documented at random locations within each tributary. More detailed hydrology surveys were conducted while assessing the flows and discharges during the culvert assessment.

WATER QUALITY

In order to understand the conditions fish face while utilizing the tributaries of the Lake Francis Watershed some basic water quality parameters were measured in situ (in the field) using a YSI multi meter (model 556) and a LaMotte 2020e/I turbidity meter. Parameters examined including, dissolved oxygen, pH, conductivity, turbidity, and water temperature. Samples were taken daily at random locations in conjunction with ground truthing and fish surveys. A Garmin GPS 276 unit was used to record locations of each sampling site. Samples were collected from March 15th to October 16th 2010. Refer to Appendix A for maps illustrating the sample locations.

Water samples were also collected from Wagon Creek Drain, Bachman Drain, Swamp Lake Drain, and the outlet channel of Lake Francis near its confluence with Roy's Drain. Samples collected were delivered to ALS Laboratory Group located in Winnipeg within 24 hours of their collection. Water quality parameters analyzed included; ammonia (NH_3), chlorophyll a, nitrate + nitrite-N, total phosphorous, total dissolved phosphorous, total dissolved solids, total kjeldahl nitrogen, and total suspended solids. Fecal coliform levels were also measured during these analyzes.

2.5.1 WATER TEMPERATURE

Water temperature loggers (Hobo® -Water Temp Pro) were placed within the main tributaries of the watershed to record and monitor water temperature throughout the study. Temperature loggers were positioned in Wagon Creek Drain, Swamp Lake Drain, Bachman Drain and in the Lake Francis outlet channel at the control structure. The locations of these loggers are displayed in Appendix A. The loggers were set to record and monitor water temperature every hour for the duration of the project. Minimum and maximum temperatures were therefore recorded daily at approximately 8:00 am and 8:00 pm respectively. Unfortunately, only two loggers were successfully retrieved, therefore water temperatures prior to April 19th were not documented hourly. Hourly water temperatures were successfully recorded from April 19th to October 16th 2010 within Wagon Creek Drain and the Lake Francis outlet. Water temperature (ºC) was also recorded daily during the fish surveys using a YSI multi-meter (model 580).

2.5 FISH UTILIZATION

2.6.1 SPRING

Fish inventories were conducted in the spring and summer of 2010 within the main tributaries of the Lake Francis Watershed. During the spring, hoop-nets were intended to be used as the primary method to access fish utilization, however, due to low water levels within the creeks, the nets, in most cases were not usable. Sampling was therefore carried out by the use of visual fish surveys (both day and night), backpack electroshocking, and seining. These methods were conducted regularly within each tributary to identify fish movements. Opportunistic interviews with commercial fishermen and area residents also contributed to the fish data collected within this report.

Sampling began on April 12th and commenced on May 13th. The hoop-nets successfully deployed were 1.2 m in diameter and constructed of 1.85 cm^2 nylon mesh. Attached to the first hoop of each net were two, 4.5 m wings, used to guide fish into the traps. The hoop-nets were set and monitored at random locations through out the study area. Captured fish were placed in a holding tank, identified, sex and state of maturity assessed, and fork length (FL) measured. Digital photographs of representative specimens were also taken. All fish were released unharmed. Sampling was conducted to gain a better understanding of which tributaries were being utilized by fish during the spring movements and also to identify important spawning habitats within the sampled reaches. For example, Walleye observed spawning on a gravel bar within a specific location along a tributary would help the WIWCD design a management plan to protect, restore, or enhance areas within the same sample reach.

2.6.2 SUMMER

Summer fish utilization of the Lake Francis Watershed was assessed using a Smith-Root Model LR24 backpack electroshocker. Electrofishing was conducted within each sample reach delineated at the start of the project. Refer to the maps in Appendix A for specific sampling locations. Sampling was conducted between June 29th and July 1st 2010. Fish captured were identified, had their fork length measured, and were released live. Digital photographs were taken of representative specimens. A voucher specimen of each species was also taken and preserved in 10% formalin to verify identification.

On two separate occasion, a small John boat was used to try to set multi-mesh gill nets in Lake Francis to get a better understanding of what fish are inhabiting the lake. We also intended to measure water depth and dissolved oxygen levels at numerous locations and observe the macrophyte community within the lake. Unfortunately, because of the abundant macrophytes within the channel, and high volumes of water exiting the channel, we were unable to get to the lake to test these parameters. The prop of the motor, constantly becoming plugged, prevented us for reaching Lake Francis. For future fish surveys within the lake, it is recommended to use an airboat to gain access to Lake Francis and the surrounding areas.

Dr. Dale Wrubleski, a Research Scientist with Ducks Unlimited, conducted sampling in Lake Francis on July 30th of 2009 and August 19th of 2010. Standard gang gill nets were used to assess the fish community. The nets consisted of 6 randomly linked nets (3.8, 5.1, 7.6, 8.9, 10.8 and 12.7 cm mesh), each 22.9 m long and 1.8 m deep. The nets were set in the morning and retrieved 24 hr later. All fish collected were processed back at the laboratory. The results are presented in the results section of this report.

2.6.3 EGG SAMPLING

Egg sampling was conducted from April 12th to May 13th within the various tributaries of the Lake Francis Watershed. Sampling was conducted over all substrate types (gravel, cobble, boulder, silt, sand, and vegetation), but with more emphasis on areas where available sand, gravel and cobble substrates were present. Within the Lake Francis Watershed, these sampling areas were located near Lake Manitoba as upstream habitat was segmented as a result of low water levels within the drains. No attempt was made to try and quantify or standardize egg counts per surface area.

Kick sampling was conducted by wading and disturbing the substrate in an upstream direction while dragging a dip net, with a mesh size of 0.250 mm and a surface area of 0.1 m^2, behind to capture the downstream drift. Eggs collected were counted, preserved in 10% formalin, and identified to family [Percidae (walleye), Catostomidae (suckers), Esocidae (northern pike), or unidentified] using a dissecting scope with 40 X magnification.

2.6.4 LARVAL DRIFT NET SAMPLING

Larval drift nets were used to capture larval fish that successfully hatched within the Lake Francis Watershed during the spring of 2010. Each drift net was positioned on two rebar rods that were embedded into the stream bottom. The traps were positioned into the flow as shown by in the photograph. The surface area of each trap opening was 0.02 m^2 and the water velocity (m/sec) and the lengths the traps were set was recorded. The traps were set approximately 0.30 m below the water surface in the faster moving water, when possible. Larval fish drifting downstream enter the funnel opening on the upstream end of the trap. Once inside, the larval fish are unable to escape. The mesh size of the nitex mesh lining is 0.250 mm. Larval fish collected were preserved in 10% formalin and then identified using a microscope with 40X magnification. The larval key entitled Identification of Larval Fishes of the Great Lakes Basin with Emphasis on the Lake Michigan Drainage (1983) by Nancy A. Auer was used to confirm identification.

Larval fish sampling was conducted within Bachman Drain, Wagon Creek Drain, Swamp Lake Drain and Roy's Drain downstream of the Lake Francis outlet channel. The other tributaries were essentially dry during spring runoff. Drift nets were primarily set near Lake Manitoba as upstream habitat within the creeks was reduced as a result of low water levels. Sample dates were chosen based on the stages of the eggs collected during the study.

2.7 BENTHIC INVERTEBRATE COLLECTION

Examining the benthic invertebrate communities within these water bodies is an important tool and good indicator for determining poor water quality within the waterways found within the Lake Francis Watershed. The absence of specific invertebrates, such as those in the orders Ephemeroptera, Odonata, and Trichoptera, can signify poor water quality. The invertebrates within these orders are typically very sensitive to poor water quality conditions and will not tolerate or inhabit these types of environments. In contrast, invertebrates such as Oligochaeta, (also known as tuberficid worms) or Chironomidae larva (order Diptera) can tolerate poor water quality and flourish with increased nutrient loading. By identifying the invertebrate community within a system one is able to determine the status of the water quality without having to pursue the analysis of costly water quality samples. Examining the invertebrate community provides an additional means for assessing the health of the ecosystem within the waterways. Furthermore, a diverse invertebrate community most often signifies diverse fish habitat and a well balance ecosystem.

Due to a limited budget quantitative invertebrate sampling was not conducted. However, invertebrates were collected as bi-catch to both the egg and larval drift net sampling surveys and were therefore assessed within this survey. Invertebrates collected were identified to order or family level. Sampling was conducted at various locations within each tributary within the Lake Francis Watershed.

3.0 RESULTS AND DISCUSSION

3.1 RIPARIAN SURVEY, CLASSIFICATION, AND AQUATIC ASSESSMENT

Results of this assessment identified several issues negatively affecting the water quality and instream fish habitat within the Lake Francis Watershed. Similar to the Swan Creek Watershed, the same types of impacts were identified within this study, including:

- Barriers to fish movement segmented habitat and restricted fish from reaching upstream spawning and nursery habitat;
- Extensive channelization of natural waterways reduced fish habitat diversity and altered natural flow regimes;
- Point source nutrient and sediment loading (i.e. confined cattle areas) reduced water quality within sections of individual drains;
- Unrestricted livestock access to the tributaries within the watershed degraded spawning habitat and reduced water quality; and,
- Removal and degradation of riparian zones adjacent waterways appeared to limit the ability of the riparian zone to protect the integrity of the aquatic environment

Unlike the Swan Creek Watershed, the tributaries within the Lake Francis Watershed are typically short drains, averaging 6.26 km in length, flowing only during the initial spring runoff or after heavy rainfall events. The available spawning habitat within these drains is therefore extremely dependant on the spring weather conditions. The natural drainage is very poorly developed over most of the watershed. Ridges and swales and scattered wetland habitat dominate the landscape.

Prairie/natural grasses and native pasture are the two most common land use practices identified within the watershed, accounting for 51.3 and 22.5% respectively (Table 3) (Refer to Table 1 for a description of the land use categories selected for this assessment). Meadow grass vegetation was the third most abundant land use within the watershed accounting for 11.0 % total land use. Shrubs and brush rangeland, grazed shrubs and brush rangeland, marsh and bogs, and urban development accounted for 4.1, 3.1, 2.3, and 2.2 % of the total land use, respectively. Instream channel reservoirs, road crossings, with developed infrastructure or without, and a railway crossing were also land use practices identified within the watershed accounting for 1.7, 1.3, 0.4, 0.1% total land use, respectively. Refer to Table 3 for a summary of the land use practices found along the tributaries within the Lake Francis Watershed.

Table 2. Riparian zone classification of the tributaries within the Lake Francis Watershed.

Tributary	Riparian Zone Classification	# of Reaches	Length (km)	Land Use % of Tributary
Wagon Creek Drain	Class A	3	0.5	3.1
	Class B	19	13.37	82.2
	Class C	18	2.4	14.7
	Total	**40**	**16.27**	**100**
Bachman Drain	Class A	6	4.47	53.3
	Class B	11	3.15	37.6
	Class C	12	0.76	9.1
	Total	**29**	**8.38**	**100**
Wilson Creek	Class A	1	1.61	82.1
	Class B	2	0.35	17.9
	Total	**3**	**1.96**	**100**
Laurentia Drain	Class B	7	4.66	97.3
	Class C	5	0.13	2.7
	Total	**12**	**4.79**	**100**
Roy's Drain	Class A	1	0.08	1.3
	Class B	9	4.57	75.3
	Class C	8	1.42	23.4
	Total	**18**	**6.07**	**100**
Viel Creek	Class A	1	1.15	54.5
	Class B	1	0.90	42.7
	Class C	1	0.06	2.8
	Total	**3**	**2.11**	**100**
Swamp Lake Drain	Class A	3	0.83	41.7
	Class B	3	0.93	46.7
	Class C	3	0.23	1.0
	Total	**9**	**1.99**	**100**
West Shoal Lake Drain Outlet Channel	Class A	1	2.27	100
	Total	**1**	**2.27**	**100**

For those drains found within the watershed, five out of the seven can be described as straight and channelized. This habitat typically was very uniform thus providing limited habitat for spawning, feeding, migration, and/or refuge. Managers or engineers designing or constructing drains do not always take into consideration the importance these waterways provide to the fish community. Drains are most often designed to allow water to leave the land as quickly as possible in order to reduce flooding on agricultural land. Drains should be designed, to not only provide adequate drainage, but also provide efficient means to increase habitat diversity within each drain to help sustain fish populations within the individual watersheds. For existing drains, enhancement efforts should be common practice in order to improve fish habitat to ultimately benefit all user groups.

Riparian zones along the corridors of each tributary were, more or less, sufficient to protect the aquatic environment from pollutants or nutrients entering the waterways. Riparian zones were typically less than the recommended 10 m, but were more often found adjacent hay land

(51.3%) or native pastures (22.5%) where chemicals, fertilizers and pesticides are rarely applied. Treed or brush and shrub reaches were identified at only a couple locations within watershed. This type of habitat, although limited, provides shade and cover to the fish community, increasing the habitat diversity within with watershed. Refer to Table 2 for a summary of riparian zone classifications along the tributaries within the Lake Francis Watershed.

Habitat feature maps illustrating the different classifications assigned to the riparian zones along the waterways are displayed in Appendix A. A total of 43.84 km of riparian habitat was assessed during this survey. The lake shore of Lake Manitoba within the watershed was also assessed (28.6 km). Sixty-three percent of the riparian zones examined were categorized as Class B habitat. Class B habitat consists or those riparian zones moderately impacted by either marginal livestock grazing or encroachment of agricultural practices upon the waterways. These riparian zones, are typically less than 10 m in width, and appeared adequate to protect the integrity of the aquatic environment. Although unrestricted livestock grazing was evident along most of the waterways within the watershed, grazing was considered light, and impacts appeared to be insignificant to impact the filtration function of the riparian zone. Waterways along the roads within the conservation district were also included as Class B habitat, as surface water runoff may likely to enter the aquatic environment.

Class A habitat accounted for a combined total of 24.9% of the riparian zones classified within the watershed (Table 2). Class A habitat was typically found within the sloughs and marshes along the drains near Lake Manitoba where human impacts were minimal. Class A habitat was identified on all drains within the watershed with the exception of Laurentia Drain.

Class C habitat, consisted of severely impacted habitat as a result of extensive erosion and/or extensive cattle trampling around watering areas. Riparian zones within this category are typically less than 5 m in width, and appear inadequate to protect the integrity of the aquatic environment. Class C riparian zone habitat accounted for 11% of all riparian zones along the waterways. The most severe cases were identified on Bachman Drain and Roy's Drain, where sections were heavily utilized by livestock for grazing and/or watering (Appendix A-2, A-5). Habitats located adjacent road crossings were also categorized as Class C habitat and were located on all drains, with the exception of Wilson Creek. Refer to the Appendix A and the list compiled of potential rehabilitation project sites (Appendix H) for more details regarding the Class C habitat within the identified tributaries.

Table 3. Land use classification of the tributaries within the Lake Francis Watershed.

Tributary	Land Use Class	# of Reaches	Length (km)	Land Use % of Tributary
Wagon Creek Drain	Meadow Grass Vegetation	2	0.99	6
	Prairie/Natural Grasses	11	8.07	48.9
	Native Pasture	11	5.34	32.4
	Shrub and Brush	2	1.35	8.2
	In Channel Reservoir	7	0.43	2.6
	Road Crossing	10	0.31	1.9
	Total	**43**	**16.49**	**100**
Bachman Drain	Meadow Grass Vegetation	3	2.65	31.8
	Prairie/Natural Grasses	11	4.12	49.4
	Native Pasture	8	1.16	13.9
	In Channel Reservoir	5	0.16	1.9
	Railway Crossing	1	0.03	0.4
	Road Crossing	3	0.07	0.8
	Roadway Crossing	6	0.15	1.8
	Total	**37**	**8.34**	**100**
Wilson Creek	Prairie/Natural Grasses	2	0.64	74.2
	In Channel Reservoir	1	0.06	5.8
	Marsh and Bogs	1	0.31	20
	Total	**4**	**1.01**	**100**
Laurentia Drain	Prairie/Natural Grasses	9	3.48	73.4
	Shrub and Brush	1	0.29	6.1
	Road Crossing	5	0.11	2.4
	Urban	1	0.86	18.1
	Total	**16**	**4.74**	**100**
Roy's Drain	Prairie/Natural Grasses	3	2.49	41.2
	Native Pasture	6	2.37	39.2
	Grazed Shrub and Brush	4	0.84	13.9
	Shrub and Brush	1	0.14	2.3
	Road Crossing	2	0.06	1
	Roadway Crossing	2	0.03	0.5
	Urban	1	0.11	1.8
	Total	**19**	**6.04**	**99.9**
Viel Creek	Meadow Grass Vegetation	1	0.34	16.1
	Prairie/Natural Grasses	2	1.25	59.2
	In Channel Reservoir	2	0.09	4.3
	Marsh and Bogs	1	0.43	20.4
	Total	**6**	**2.11**	**100**
Swamp Lake Drain	Meadow Grass Vegetation	1	0.17	8.5
	Native Pasture	4	0.99	49.7
	Grazed Shrub and Brush	2	0.52	26.1
	Marsh and Bogs	2	0.27	13.6
	Road Crossing	1	0.04	2.1
	Total	**10**	**1.99**	**100**
West Shoal Lake Drain Outlet Channel	Meadow Grass Vegetation	1	0.66	29.1
	Prairie/Natural Grasses	1	1.61	70.9
	Total	**2**	**2.27**	**100**

3.1.1 AERIAL SURVEYS

All aerial photographs taken during this project for both flights are included within the attached cd. The photographs are organized and separated into folders, identified by tributary name and flight data. Displayed on each photograph are the tributary name, time and date of the photograph, and the GPS coordinate locations of each photograph. In addition, files compatible with MapSource, ArcView, and Google Earth are included within the attached cd. These files allow one to display the flight path and location of the individual photographs using the selected software program (Figure 7).

Representative aerial photographs of each tributary can also be found within Appendix B. These photographs were compiled to provide a general summary of the habitat found along each corridor of the seven main tributaries of the Lake Francis Watershed. All photographs were captured at an altitude of approximately 500 feet.

Figure 7. A computer screen image of the flight path track and associated photographs of a selected reach using Google Earth software.

3.1.2 BARRIERS TO FISH MIGRATION

A total of ten barriers were identified within the tributaries of the Lake Francis Watershed. Five of the barriers were anthropogenic in nature (man-made). The identified barriers included water control structures, screened culverts, and a fence to prevent beavers from disrupting the natural flow regime within the waterway. Two types of natural barriers were identified within this assessment. They included, sections of tributaries choked off by dense vegetation growth and gravel deposits along the Lake Manitoba shoreline. The gravel bar deposits were likely formed as a result of ice or wave action scouring the shoreline. Unlike the assessment conducted on the Swan Creek Watershed, there where no velocity barriers at culvert crossings, no perched culverts, or no beaver dams identified within this assessment.

A series of photographs illustrating the barriers observed within the Lake Francis Watershed during the spring runoff in 2010 is compiled within this section of the report. Accompanying each photograph is a description of the barrier (i.e., beaver dam, high velocities at a culvert crossing, perched culverts, or man made control structures), site location information (tributary name, coordinates, upstream/downstream location, etc.) and potential impacts the individual barriers may have on the fish community (i.e. reduction of spawning habitat upstream). The locations of each barrier can also be viewed within the habitat-featured maps produced for each tributary (Appendix A).

Barrier 1. Stoplog control structure at the Lake Francis outlet channel.

Built in the 1960's, this control structure was designed to regulate water levels within Lake Francis. Under low flow conditions, this structure is likely a complete barrier to all fish movement. Upstream habitat typically would be utilized by Northern Pike, Yellow Perch and White Sucker (to name a few) for spawning, feeding and/or a nursery. Identified as barrier 1 on the habitat featured map (Appendix A-5)

Barrier 2. Screen installed on the Lake Francis stoplog control structure.

The screen or gates located on top of the stoplog control structure at the Lake Francis outlet were installed in 2007 by the LFWMA committee to prevent Common Carp from entering the lake. As previously stated, Carp may degrade habitats in which they inhabit. Unfortunately, this barrier also restricts most native fish species. The barrier is identified as barrier 2 on the habitat featured map (Appendix A-5)

Barrier 3. Screened culverts on Lambert Creek.

Lambert Creek is a small creek (0.9 km long) that connects Lake Francis to Lake Manitoba. The creek only flows when Lake Francis is experiencing high water levels. Similar to the screens located on the stoplog control structure, theses screens were designed to prevent Carp from entering the lake. The barrier is identified as 3 on the habitat featured map (Appendix A-7).

Barrier 4. Gravel bar located at the mouth of Laurentia Drain.

During ice or wave action, the gravel bar at the mouth of the creek formed a complete barrier to fish movement. This barrier was likely removed (notched by heavy machinery) after the area received heavy rain during June or July. It is likely to impede fish movement in subsequent years. The barrier is identified as 4 on the habitat featured map (Appendix A-4).

Barrier 5. Beaver gates positioned within Swamp Lake Drain.

Within Swamp Lake Drain, two fences where observed downstream of the culvert crossing PTH 518. These gates apparently were used to prevent beavers from plugging up the culverts and restricting their movements. However, when the gates were not in use they were left within the channel during the spring runoff. A female Northern Pike (noted in the picture) was entrained within the fence. Although, this barrier is only temporary and was likely not intended to impede fish movement, it does however provide a temporary barrier. The barrier is identified as 5 on the habitat featured map (Appendix A-2).

Barrier 6. Natural vegetation on Wagon Creek Drain.

At the upper end of Wagon Creek at PTH 415 there is a natural vegetation barrier. No defined channel is evident upstream. Interestingly, prior photographs of sections downstream of 415 suggest it too was not a defined channel. Evidence supports this as bare clay banks were observed along the edges of the waterway. There is approximately eight kilometers of upstream habitat within the drainage boundary of Wagon Creek Drain. The barrier was identified as 6 on habitat featured maps (Appendix A-1).

Barrier 7 and 8. A gravel bar and gated culverts prevent fish from entering Ennis Marsh.

Similar to Laurentia Drain, a gravel bar has formed along the Lake Manitoba shoreline. This barrier restricts fish from reaching Ennis Marsh and potentially valuable nursery or spawning habitat. Gated culverts also located on Ennis Marsh, provide an additional barrier to fish movement. Barrier is identified as 7 and 8 on habitat featured maps (Appendix A-3).

Barrier 9. PTH 518 road crossing the northwest tip of West Shoal Lake.

The northwest tip of West Shoal Lake is divided by PTH 518. Culverts crossing along the road allow fish to reach this divided section. However, fish are not always able to make it back to the lake to overwinter. In the spring of 2010, hundreds of dead fish were observed including Northern pike, White Sucker, and Black Bullheads. They died as a result of either winterkill via oxygen depletions or as a result of the water body freezing to the bottom.

Barrier 10. Dense vegetation along Roy's Drain.

There are many sections along the drain where vegetation appears to choke off the waterway, impeding fish movements. The sections can be view on the habitat featured map (Appendix A-5).

3.2.1 CULVERT ASSESSMENT

There were no culverts within the Lake Francis Watershed that appeared to provide a barrier to fish movement. The landscape within this watershed is extremely flat and the drainage areas of most creeks are relatively small (less than 48 km^2). Refer to Appendix B, the land use classification maps, for locations of culvert crossings assessed.

3.3 PHYSICAL CHARACTERISTICS

This section of the report summarizes the physical characteristics of the tributaries within the watershed including information regarding the drainage area, slope, length, and average bankfull width and depth. All data is displayed in Appendix D and E. In addition, representative photographs for each tributary are displayed within Appendix C. Descriptions and a summary of the fish habitat within each drain are also included within this section of the report.

Wagon Creek Drain

Wagon Creek Drain is the largest tributary in the Lake Francis Watershed. A ridge 2.3 km west of the northwest tip of West Shoal Lake is where the headwaters originate (Appendix A1). The defined channel is located between Lake Manitoba and PTH 415 and is 16.27 km in length. Wagon Creek flows through prairie and native grassland (48.9%), native pasture (32.4%), shrub and brush rangeland (8.2%), meadow grass vegetation (6.0%), in channel reservoirs (dugouts) (2.6%), and passes numerous road crossings (1.9%). A large section of the drain flows immediately beside Wagon Creek Road. The drainage area is approximately

48.0 km^2. The average bankfull width of the creek is 10.2 m and average bankfull depth is 1.3 m. The slope of the creek is 0.08%, dropping an average of 0.8 m per 1.0 km of channel. There is one slightly steeper reach within the drain, identified within the first eight km along side Wagon Creek Road. The slope within this section is 0.2%. The upper section of the drain (defined channel) is extremely flat with an average slope of 0.01%.

No barriers were observed within the defined channel on Wagon Creek Drain. However, upstream of PTH 415, dense vegetation restricts all fish movements. In fact, while flying and conducting the aerial surveys, it was extremely difficult to follow the drain within these upper sections. Scattered watering holes were the only visible characteristics of the drain that allowed us to follow the wetted swale (Appendix A-1). This barrier is identified above as barrier 6.

Although the drain is a uniform, straight, channelized waterway, there likely are a few reaches that will be selected by fish for spawning (White Sucker, Walleye, Yellow Perch, Common Carp or Northern Pike). These reaches are located along Wagon Creek Road and the first 8 km of the creek upstream of Lake Manitoba. As stated earlier, these reaches were identified as the steepest sections within the tributary. In June, Common Carp were observed spawning at these identified locations (Figure 11). In addition, spawning success was likely high as sand and gravel substrate types were commonly observed. Emergent vegetation, also commonly found along the entire length of the drain, provided additional spawning habitat for Northern Pike and Yellow Perch. These species typically lay their eggs on submerged aquatic vegetation.

Bachman Drain

Bachman Drain is the second largest drain within the Lake Francis Watershed. It has a drainage area of 15.1 km^2 and is 8.34 km in length. The drain originates within pasture land upstream of hwy 6. The drain flows predominately through prairie and native grasses (49.4%) through out its entire course. There are three areas along the drain utilized for livestock grazing and watering. These sections accounted for 13.9% of the total land use identified within the creek. Riparian damage (Class C Habitat) was identified in these reaches. The overall slope of the drain of 0.06% is similar to that observed on all drains within the Lake Francis Watershed. The average bankfull width and bankfull depth was 8.5 and 1.5 m respectively.

No barriers were identified on Bachman Drain (Appendix A-2).

Fish habitat within the drain is considered marginal. Silt substrates, observed along the entire course of the drain, do not appear to provide fish with the ideal spawning habitat conditions they require. Nursery habitat was however abundant, as the drain often experienced no flow conditions. Water depth, typically greater that 0.8 m, and an abundant submerged aquatic macrophyte community, likely provided refuge for juvenile or forage fish species. In both early spring and the summer months, juvenile Northern Pike were captured. During wet years, Walleye have been observed upstream of hwy 6 within the creek (pers. Comm. Bob Backman).

Wilson Creek

Wilson Creek is the smallest tributary within the Lake Francis Watershed. It originates at the highway 6 and flows west approximately 1.55 km before reaching Ennis Marsh. In 2010, Wilson Creek was dry for the most of the year, with the exception of a couple of remnant pools. The barriers located between Ennis Marsh and Lake Manitoba, enabled fish within Lake Manitoba from reaching Wilson Creek; therefore the only fish able to utilize this creek are those inhabiting Ennis Marsh. Wilson Creek has a drainage area of 10.9 km^2. Average bankfull width and depth were not assessed during this survey. The slope of the drain is 0.07%, dropping an average of 0.7 m along 1.0 km of channel.

Three were no barriers identified on Wilson Creek (Appendix A-2).

Fish habitat can be described as minimal. Substrate types within the drain are dominant by silt when exposed. Most of the drain is vegetated by native grass. Cattails were also very abundant along those areas where standing water was located. Due to a small drainage area, Wilson Creek would not likely be used for spawning or as nursery habitat.

Swamp Lake Drain

Swamp Lake Drain originates within Swamp Lake, a wetland upstream of West Shoal Lake (Appendix A-6). The drain is 2.0 km in length and only flows when water levels within Swamp Lake experience high water levels after rainfall events. The drainage area is 19.6 km^2. The drain has an average bankfull depth and width of 9.8 and 1.22 m respectively. Slope of the drain is 0.1%. This drain is a third order tributary.

No permanent barriers were identified on Swamp Lake Drain (Appendix A-4). A fence was observed within the creek at the PTH 518 crossing. This fence was used to stop beavers from plugging up the culverts at the crossing and to also impede beaver movements within the creek. The barrier was not a complete barrier to fish movement. It is recommended, if needed, to install the gates after the spring spawning run is complete and then remove them completely when not in use.

Swamp Lake Drain is the only tributary of West Shoal Lake and is therefore selected by many fish for spawning. The grass observed within Swamp Lake provides cover and excellent habitat for egg deposition, especially for White Sucker. Northern Pike, captured within this drain during spring movement, likely also utilize the upstream habitat for spawning.

<u>Roy's Drain</u>

Roy's Drain begins at hwy 6 and flows west until it reaches the outlet channel of Lake Francis before entering Lake Manitoba. The drain is 6.07 km in length and has a drainage area of 15.7 km^2. The slope of the drain is 0.14%. Average bankfull width and depth are 6.2 and 0.91 m respectively.

The only barriers observed on Roy's Drain in 2010 were a couple of sections choked off by dense vegetation growth. Because of the limited flow during the spring, it is unclear as to how much of an impact the vegetation barriers have on fish movement. In wet years, White Sucker upstream migrations usually ends within the ditches along number 6 hwy. Here many people have been observed to take advantage of this opportunity to capture the suckers (mullets) for food consumption.

Numerous sections of the drain were heavily impacted by livestock grazing. Significant sections of the drain had riparian zones of less than 5 m, and did not appear to provide adequate protection to the aquatic environment (Appendix A-5, B-5). The substrate was dominated by sand and gravel and likely provide good spawning habitat to those fish utilizing the drain during the wetter years. Flooded grasses within the waterways within upstream sections likely also provide good spawning habitat and cover for many fish species.

<u>Laurentia Drain</u>

Laurentia Drain is a small tributary, and is likely insignificant in providing valuable spawning habitat for the Lake Manitoba fish communities. The drain splits once it reaches the first crossing, with one section continuing on running east to number 6 hwy. The other section runs north behind cottage development for 1.68 km before turning west and reaching the town of St Laurent (Appendix A-4). The reach behind the cottage development is extremely flat with a slope of essentially zero. This reach more or less resembles wetland habitat. Vegetation growth is abundant along it course and thus provides cover for forage fish species. While conducting fish sampling within the drain, Fathead Minnow, Central Mudminnow, and Brook Stickleback were captured. These fish are all able to live in poor water quality conditions. The slope of the drain was 0.09%.

At the mouth of the Laurentia drain, during the anticipated spring runoff in 2010, a gravel bar prevented fish from reaching the creek. This bar, previously mentioned, was likely created by wave and/or ice action on the Lake Manitoba Shoreline. During wet years, flows may be sufficient enough to reopen the channel but should be monitored.

Viel Creek

Viel Creek is another small drain within the watershed (2.11 km). It is more or less an extension of Lake Francis. This drain is likely dry most years, with the exception immediately after rainfall events. The drainage area is 13.6 km^2. Average bankfull width and depth were not assessed during this survey. The slope of 0.11% was above average compared to other drains within the watershed.

No barriers were identified within Viel Creek (Appendix A-7).

Lake Francis

Lake Francis is a very large and productive system along the Lake Manitoba Shoreline. The Lake Francis Wildlife Management Association has been working at protecting the habitat for birds, ducks, waterfowl, and wildlife. In doing so the committee has installed barriers at those locations larger fish species (Carp, Northern Pike, Walleye, White Sucker) would enter the Lake (Lake Francis Outlet Channel and Lamberts Creek). This practice appears to be working, and providing better habitat for the ducks and wildlife, as the marsh is filled with abundant macrophyte communities. There is still, however, a concern about the loss of this habitat to the native fish communities. Discussions with research scientists at Ducks Unlimited, Fisheries and Oceans Canada, and Manitoba Water Stewardship recognize the importance of the watershed to the fish community but are also aware that if the marsh were re-opened to allow access to the native fish species, Carp too would gain access. If this occurred, the aquatic macrophyte communities could potentially decrease, described as the current situation within Delta Marsh.

Lake Manitoba Shoreline

Cottage development, housing, farmsteads, campgrounds, pastured land, treed reaches, and wetland habitats were the land use practices identified along the Lake Manitoba shoreline. Many inland channels or bays were observed. These habitats likely provide fish additional nursery habitat. Additional sampling would be required to better understand fish utilization of the shorelines of Lake Manitoba. Refer to Appendix A and B for riparian zone classification and land use of the Lake Manitoba Shoreline.

Fish sampling was not conducted within Lake Manitoba but it is presumed that in 2010 many fish would have utilized this habitat for spawning, as the drains within the Lake Francis Watershed were relatively dry. Many rock walls observed within the watershed boundaries, built to break waves along the shore, likely provide additional spawning habitat or cover for the fish community.

3.4 WATER QUALITY

Limited historical data of water quality trends was available for the Lake Francis Watershed. Manitoba Water Stewardship does not have a water quality station within the Lake Francis Watershed.

Good water quality is the foundation for having a healthy aquatic environment and balanced ecosystem. Fish, wildlife, and all those area resident, agricultural producers, commercial and recreational fishermen and those using the waterways for recreational activities depend on good clean healthy water. Because most of the tributaries run along agricultural land, used for either hay or pastured lands, agricultural practices are one of the primary topics within this report. In addition, since tourism, urban development, and cottage development are continuously increasing within this watershed, concerns are switching as interested parties are becoming aware of the impacts increased development may have on the aquatic ecosystem within Lake Manitoba. More people mean more nutrients within the system. More cottage development means more septic tanks. To get a better understanding of the impact additional development would have on nutrient loading to Lake Manitoba waters a more in depth study would be required.

Results of this study indicated that water quality within the tributaries within the region was quite good. Based on the classification system developed by Dodds et al. (1998), using Total Phosphorus (TP) as the indicator, all creeks within Lake Francis Drain would be classified as Oligotropich to Mesotrophic as TP was well below 0.075mg/L (boundary between Mesotrophic/Eutrophic). The pH within all tributaries ranged from 7.98 to 8.41, with the lowest identified on Bachman Drain and the highest documented on Roy's Drain (Table 4). Dissolved oxygen and water temperatures were well within the standards and normal ranges for Manitoba surface waters during the open water season. Dissolved oxygen levels within winter may become anoxic within some of the systems that have higher nutrient levels including Ennis Marsh, Lake Francis, and the northwest tip of West Shoal Lake divided by the municipal roadway. Microbial activity under ice conditions use oxygen within the water to carry out their life processes. This depletes oxygen within the water column, ultimately leading to anoxic conditions.

Turbidity was extremely low (clear water) within all of the waterways assess during the 2010 survey. High water levels within the drains in June and July increased the turbidity slightly but, as a result of grass and vegetation within and along the riparian zones, minimized sediment loads were prevented from entering the waterways. Livestock grazing within this watershed was minimal. Fish were likely the biggest cause of increased turbidity within the drains. In June, aerial photographs captured Carp spawning within Wagon Creek Drain (Figure 11). As you can see from the images, Carp stir up sediment, increasing turbidity within the waterways they inhabit.

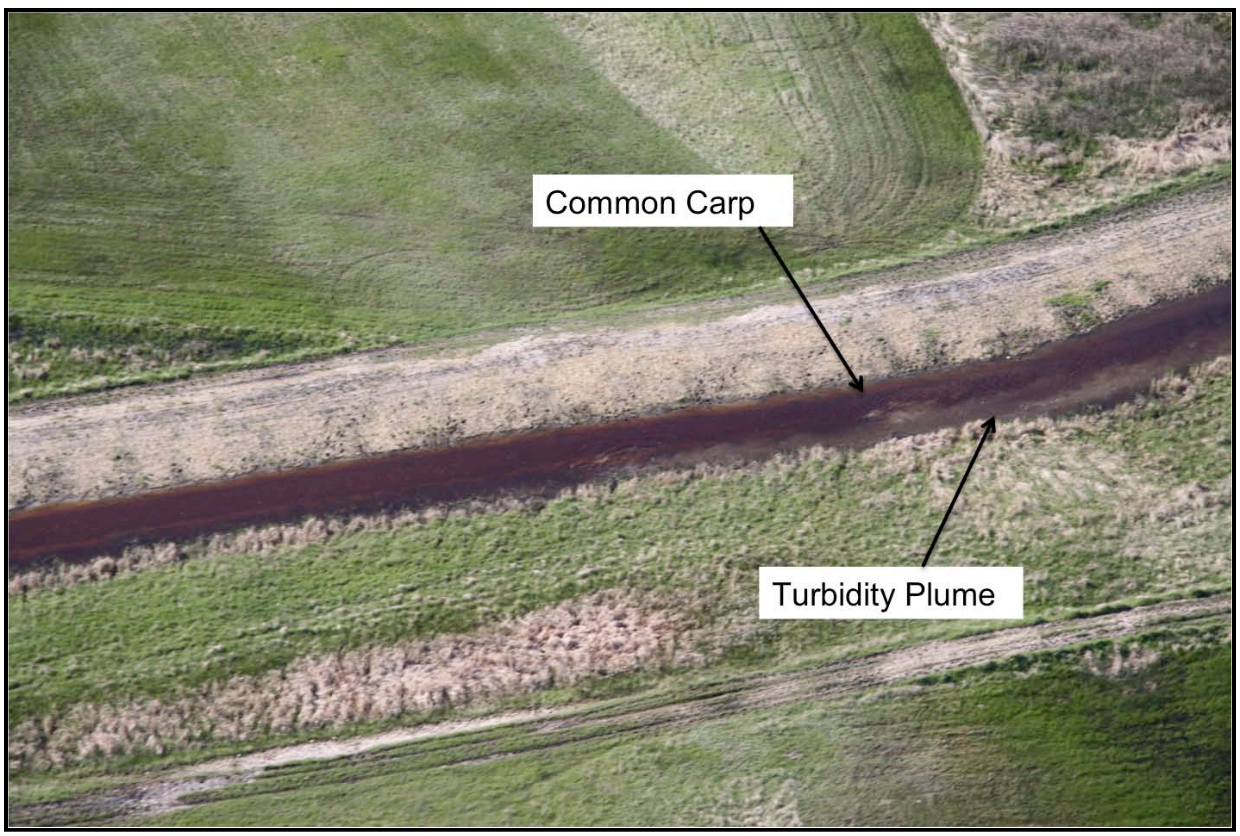

Figure 11. Carp Spawning within Wagon Creek during June of 2010.

Along the Lake Manitoba shoreline, several of the waterbodies connected to the lake could potential be sources of nutrient loading. Discussions with members of the West Interlake Watershed Conservation District brought it to our attention that several old retaining ponds and old manure piles were thought to be leaching into Lake Manitoba, adding to increase nutrient levels within the lake. Below are a number of photographs illustrating the types of habitats described above. Additional research is needed to address some of these issues.

Figure 12. Photographs taken of sloughs and marshes located along the Lake Manitoba Shoreline potentially leading to nutrient loading within Lake Manitoba.

Table 4. Water quality data collected on each tributary while conducting the fieldwork component of this project.

Tributary	Date	Conductivity (µs/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	pH	Turbidity (NTU)
Wagon Creek Drain	13-Mar-010	322	0.4	7.8	8.01	0.87
	20-Mar-10	320	4.2	7.9	7.95	1.71
	06-Apr-10	325	13.2	8.0	7.90	1.12
	09-Apr-10	318	12.2	10.2	8.03	1.55
	12-Apr-10	317	12.1	12.1	8.12	2.55
	17-Apr-10	317	14.2	12.0	8.10	2.66
	19-Apr-10	322	17.1	11.2	8.13	2.33
	21-Apr-10	333	19.2	10.9	8.12	1.58
	23-Apr-10	319	19.8	10.6	8.08	1.92
	30-Apri-10	330	10.2	10.5	8.08	1.33
	10-May-10	375	9.8	11.3	8.11	1.32
	29 Jun-10	370	21.4	11.1	8.19	2.65
Bachman Drain	06-Apr-10	525	13.8	9.0	7.66	1.33
	09-Apr-10	583	13.0	8.9	7.87	1.55
	12-Apr-10	514	12.7	10.2	7.99	1.62
	17-Apr-10	518	15.0	8.9	7.95	1.44
	19-Apr-10	517	19.1	9.2	8.13	1.16
	21-Apr-10	523	21.0	8.8	7.95	1.18
	23-Apr-10	564	20.3	8.7	8.05	2.1
	10-May-10	581	11.2	7.9	8.19	2.2
	29 Jun-10	542	23.0	7.1	7.98	3.8
Swamp Lake Drain	12-Apr-10	333	12.1	9.0	7.88	1.22
	17-Apr-10	345	13.1	8.8	7.75	1.22
	19-Apr-10	360	14.0	8.7	7.97	1.38
	21-Apr-10	362	16.5	8.3	8.14	0.77
	23-Apr-10	375	20.1	7.9	8.13	2.76
	10-May-10	500	9.5	7.8	8.06	2.07
	29 Jun-10	496	22.0	7.6	8.36	2.22
Oultet Channel Lake Francis	13-Mar-010	140	1.1	10.1	7.77	0.78-
	20-Mar-10	148	5.0	10.2	7.77	0.78
	06-Apr-10	143	12.1	10.6	7.77	0.88
	09-Apr-10	168	13.1	9.9	7.78	0.86
	12-Apr-10	169	13.3	9.2	7.82	0.92
	17-Apr-10	165	14.0	9.6	7.83	0.80
	19-Apr-10	166	14.5	9.4	7.79	0.66
	21-Apr-10	162	17.8	8.4	7.78	0.67
	23-Apr-10	167	17.1	7.9	7.77	0.70
	30-Apri-10	171	13.3	8.0	7.78	0.61
	10-May-10	180	11.1	7.8	7.80	1.03
Roy Drain	30-Apri-10	123	24.0	6.8	8.22	0.08
	10-May-10	125	10.2	6.9	8.24	0.15
	29 Jun-10	161	25.0	7.1	8.31	0.16

Table 5. Results of water samples collected within the tributaries of the Lake Francis Watershed. Samples were analyzed at ALS Laboratory Group in Winnipeg. Samples were collected on May 16th, 2010.

Water Quality Parameter	Units	Wagon Creek Drain	Bachman Drain	West Shoal Lake Drain	Lake Francis Channel
Ammonia (NH3) - Soluble	mg/L	<0.050	<0.050	<0.050	<0.050
Chlorophyll a	µg/L	0.31	0.56	0.55	11.2
Fecal Coliform	CFU/100	9	43	11	1
Phosphorus, Total	mg/L	0.0197	0.0309	0.0310	0.178
Total Dissolved Phosphorus	mg/L	0.0185	0.0201	0.0261	0.0518
Total Dissolved Solids	mg/L	292	624	256	616
Total Suspended Solids	mg/L	<5.0	5.0	<5.0	37.0
Nitrate+Nitrite-N	mg/L	<0.071	<0.071	<0.071	<0.071
Total Kjeldahl Nitrogen (TKN)	mg/L	1.07	1.18	1.05	2.59
Total Nitrogen	mg/L	1.07	1.18	1.05	2.59

3.4.1 WATER TEMPERATURE

Water temperature data for Wagon Lake Drain and the Lake Francis outlet channel is shown in Appendix F. Water temperatures were within normal ranges described for the area.

Average water temperatures for Wagon Creek Drain were as follows: April = 9.84°C; May = 14.00°C; June = 19.69°C; July = 23.04°C; August = 20.37°C; and September = 13.03°C. The maximum water temperature documented within the study was 29.41ºC, recorded near the end of July of 2010.

Average water temperatures within the Lake Francis outlet channel were as follows: April (April 16th-30th) = 12.97°C; May = 13.62°C; June = 18.16°C; July = 20.36°C; August = 18.59°C; and September = 12.48°C. The maximum water temperature of 23.18ºC, was recorded in mid August of 2010.

3.5 FISH SPECIES UTILIZATION

As a direct result of the limited runoff during the spring of 2010, most of the drains within this watershed did not support large spawning runs. Discussions with many locals acknowledged that it was not uncommon for the area to have minimal fish runs. Because of the relatively small size of the tributaries within the watershed, weather conditions play an important role in determining whether yearly spawning runs are going to be significant. Unfortunately, for this study, the unfavorable weather conditions made it difficult to examine fish utilization within the watershed. It was also difficult to identify the more significant reaches (valuable spawning habitat) for those fish utilizing the tributaries during spring migrations. The habitat identified within Wagon Creek, likely is the most productive within the watershed, as this creek is the largest drain and has the most flow within the watershed. Sand, gravel and substrate types, selected by those fish commonly found within the area for spawning, were located within the lower reaches of the drain. Locals also acknowledge that Walleye have been observed spawning within both Wagon Creek and Bachman Drains in previous years.

Sampling conducted within the spring identifying ten species utilizing the tributaries within the Lake Francis Watershed. At the confluence of Lake Francis outlet and Roy's Drain, downstream of the stoplog control structure, hundreds of fish were captured including, Fathead Minnow (83%), Spottail Shiner (13.7%), White Sucker (0.4 %), Brook Stickleback (2.3%), Emerald Shiner (0.2%) and Central Mudminnow (0.2%). In 2007, millions of Spottail Shiners were observed within this same reach of the drain (Figure 11). It is thought that these fish entered the drain to take advantage of warm water and the abundant food supply drifting out of Lake Francis. Similar results were observes on April 17th, 21st and 23rd.

Fish sampling was also successful on Swamp Lake Drain. On the first day of sampling, over a four-hour sampling period on April 12th, a total of 61 White Suckers and one Northern Pike were captured, measured, and released. Most White Suckers were male and not yet ripe and running. The Northern Pike captured was a female, 545 mm in length (fork length). Similar catches were documented within this drain on April 17th, 21st and 23rd.

Fathead Minnow, Central Mudminnow, and Brook Stickleback were captured in Laurentia Drain on April 24th. A gravel bar located at the mouth prevented additional fish from reaching upstream habitat. Wilson Creek, Viel Creek, and Roy's Drain were dry during April and May of 2010. Black Bullhead (*Ameiurus melas*) was identified within West Shoal Lake. This was the first discovery of a Back Bullhead in West Shoal Lake. In the spring, hundreds of dead fish were observed along the PTH 518. They died as a result of winterkill. White Sucker, Northern Pike, and Black Bullhead were among the dead.

Summer surveys were conducted under more favorable conditions. Flows were higher and fish within the drains were abundant. Fish captured included White Sucker, Northern Pike, Fathead Minnow, Central Mudminnow, Yellow Perch, Common Carp, and Brook Stickleback. Refer to Appendix G for the fish catch data. Wilson Creek, Viel Creek where still dry and no additional species were identified in Laurentia Drain. Northern Pike, Yellow Perch, Brook Stickleback and Central Mudminnows were captured on Bachman Drain.

The fish communities within Lake Francis were not examined during this survey. However, Ducks Unlimited shared their information they collected during July of 2009 and August of 2010. A total of 36 Northern Pike were captured in 2009 and 86 in 2010. Fish ranged in size from 205 to 718 mm fork length. Because fish passage was restricted by the control structure on the outlet channel of Lake Francis, these fish likely overwintered within the Lake. Dissolved oxygen assessed in February in both years, indicated levels were adequate for overwintering. A White Sucker and a Yellow Perch were captured during the gillnet surveys.

Table 6. Number and size of fish captured in a single standard gang gillnet in Lake Francis, 30 July 2009 and 19 August 2010.

			Length (mm)		Weight (gm)	
Year	**Species**	**Number**	**Mean**	**Range**	**Mean**	**Range**
2009	Northern Pike	36	363	225 - 592	403	78 – 1,593
2010	Northern Pike	86	378	205 - 718	447	59 – 2,541
	White Sucker	1	195		112	
	Yellow Perch	1	172		74	

Table 7. Fish species potential utilizing the Lake Francis Watershed. Information collected from Stewart and Watkinson (2004).

Common Name	Family	Genus	Species	Occurrence	COSEWIC Status	Known Occurrences
Goldeye	Hiodontidae	*Hiodon*	*alosoides*	Native	not listed	Lake Manitoba
Mooneye	Hiodontidae	*Hiodon*	*tergisus*	Native	not listed	Delta Marsh - Lake Manitoba
Common Carp	Cyprinidae	*Cyprinus*	*carpio*	Introduced	not listed	**Lake Francis Watershed**
Pearl Dace	Cyprinidae	*Margariscus*	*margarita*	Native	not listed	Unknown
Golden Shiner	Cyprinidae	*Notemigonus*	*crysoleucas*	Native	not listed	Lake Manitoba (The Narrows)
Emerald Shiner	Cyprinidae	*Notropis*	*antherinoides*	Native	not listed	Lake Manitoba
Spottail Shiner	Cyprinidae	*Notropis*	*hudsonius*	Native	not listed	**Lake Francis Watershed**
Northern Redbelly Dace	Cyprinidae	*Phoxinus*	*eos*	Native Rare, Tributaries	not listed	Lake Manitoba
Finescale Dace	Cyprinidae	*Phoxinus*	*neogaeus*	Native Rare, Tributaries	not listed	Lake Manitoba
Fathead Minnow	Cyprinidae	*Pimephales*	*promelas*	Native	not listed	**Lake Francis Watershed**
Longnose Dace	Cyprinidae	*Rhinichthys*	*cataractae*	Native	not listed	Unknown
Creek Chub	Cyprinidae	*Semotilus*	*atromaculatus*	Native	not listed	**Lake Francis Watershed**
Quillback	Catostomidae	*Carpiodes*	*cyprinus*	Native	not listed	Lake Manitoba
White Sucker	Catostomidae	*Catostomus*	*commersonii*	Native	not listed	**Lake Francis Watershed**
Bigmouth Buffalo	Catostomidae	*Ictiobus*	*cyprinellus*	Native Rare	special concern	Delta Marsh - Lake Manitoba
Silver Redhorse	Catostomidae	*Moxostoma*	*anisurum*	Native	not listed	unknown
Shorthead Redhorse	Catostomidae	*Moxostoma*	*macrolepidotum*	Native	not listed	Lake Manitoba
Black Bullhead	Ictaluridae	*Ameiurus*	*melas*	Native Recent	not listed	**Lake Francis Watershed**
Brown Bullhead	Ictaluridae	*Ameiurus*	*nebulosus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Channel Catfish	Ictaluridae	*Ictalurus*	*punctatus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Tadpole Madtom	Ictaluridae	*Noturus*	*gyrinus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Northern Pike	Esocidae	*Esox*	*lucius*	Native	not listed	**Lake Francis Watershed**
Central Mudminnow	Umbridae	*Umbra*	*limi*	Native Recent	not listed	**Lake Francis Watershed**
Cisco	Salmonidae	*Coregonus*	*artedi*	Native	not listed	Lake Manitoba
Lake Whitefish	Salmonidae	*Coregonus*	*clupeaformis*	Native	not listed	Lake Manitoba
Rainbow Trout	Salmonidae	*Oncorhynchus*	*mykiss*	Introduced	not listed	Lake Manitoba
Brown Trout	Salmonidae	*Salmo*	*trutta*	Introduced	not listed	Lake Manitoba
Brook Trout	Salmonidae	*Salvelinus*	*fontinalis*	Transplanted (Native Manitoba)	not listed	Lake Manitoba
Trout Perch	Percopsidae	*Percopsis*	*omiscomaycus*	Native	not listed	Lake Manitoba
Burbot	Gadidae	*Lota*	*lota*	Native	not listed	Lake Manitoba
Brook Stickleback	Gasterosteidae	*Culaea*	*inconstans*	Native	not listed	**Lake Francis Watershed**
Ninespine Stickleback	Gasterosteidae	*Pungitius*	*pungitius*	Native	not listed	Lake Manitoba

Table 7. Continued….

Common Name	Family	Genus	Species	Occurrence	COSEWIC Status	Known Occurrences
Mottled Sculpin	Cottidae	*Cottus*	*bairdii*	Native	not listed	Lake Manitoba
Rock Bass	Centrarchidae	*Ambloplites*	*rupestris*	Native	not listed	Lake Manitoba
Iowa Darter	Percidae	*Etheostoma*	*exile*	Native	not listed	**Swan Creek Watershed**
Johnny Darter	Percidae	*Etheostoma*	*nigrum*	Native	not listed	**Swan Creek Watershed**
Yellow Perch	Percidae	*Perca*	*flavescens*	Native	not listed	**Lake Francis Watershed**
Logperch	Percidae	*Percina*	*caprodes*	Native	not listed	**Lake Francis Watershed**
River Darter	Percidae	*Percina*	*shumardi*	Native	not listed	Lake Manitoba
Sauger	Percidae	*Sander*	*canadensis*	Native	not listed	**Lake Francis Watershed**
Walleye	Percidae	*Sander*	*vitreus*	Native	not listed	**Lake Francis Watershed**
Freshwater Drum	Sciaenidae	*Aplodinotus*	*grunniens*	Native	not listed	Lake Manitoba

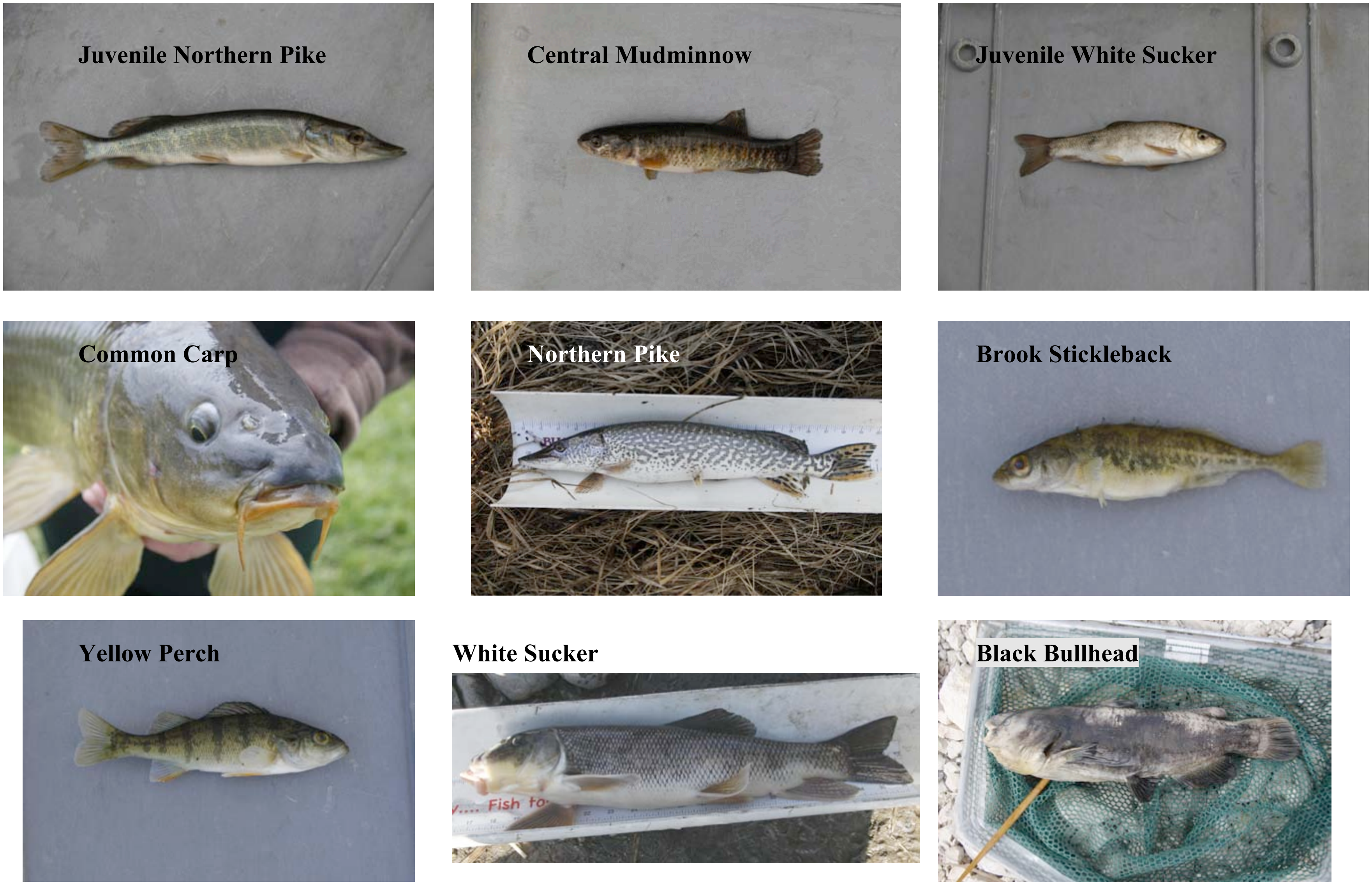

Figure 10. Photos of representative fish species captured during the fish inventory within the Lake Francis Watershed, 2010

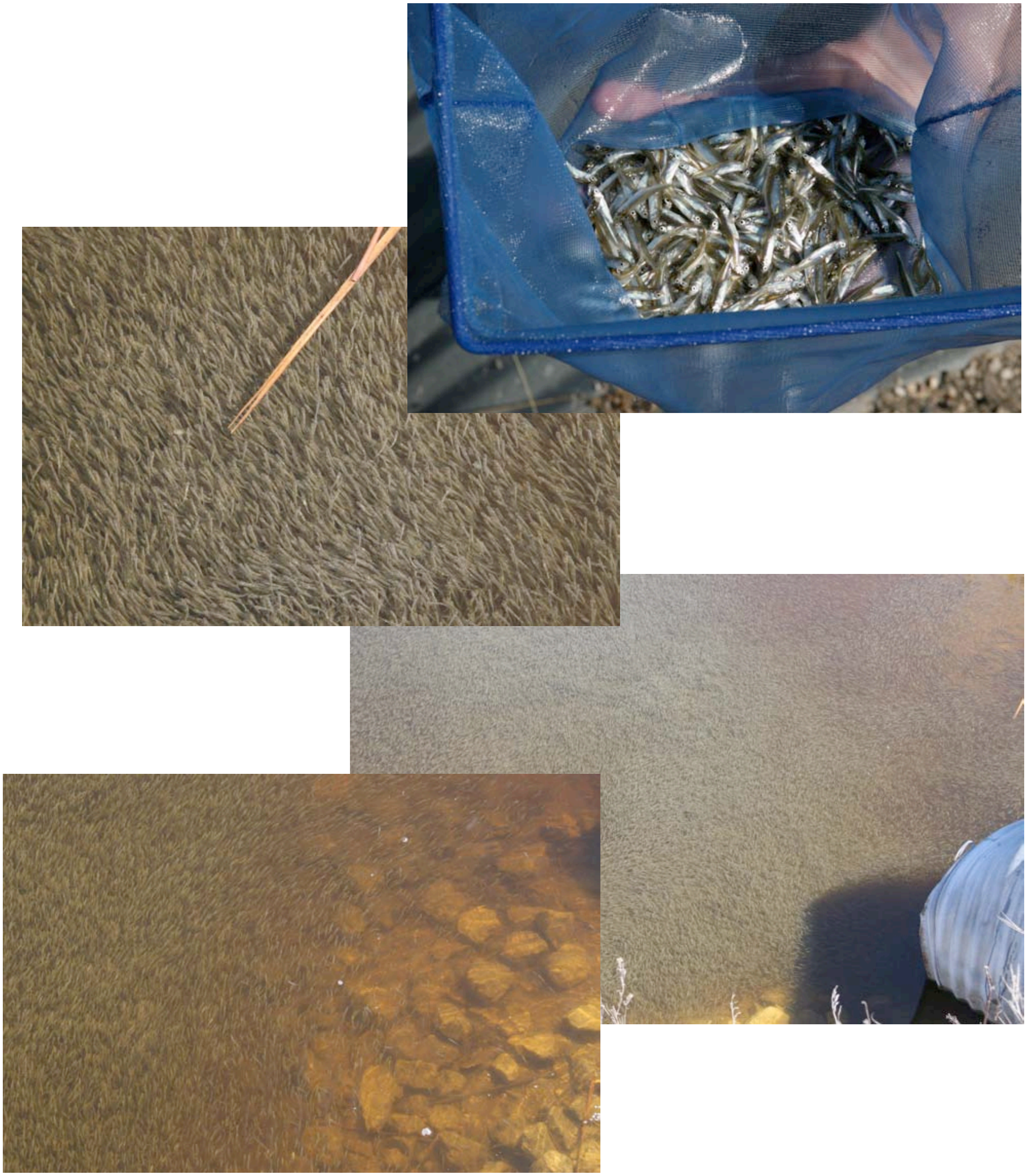

Figure 11. Photographs of millions of juvenile Spottail Shiners in 2007 utilizing the tributary downstream of the Lake Francis outlet channel.

3.5.1. EGG SAMPLING

Egg sampling was restricted to the inlets of the drains near Lake Manitoba since upstream habitat was most often dry. Unfortunately, sampling in 2010 was therefore not able to provide additional data to better understand which reaches where being utilized by fish for spawning. No Walleye, Northern Pike or Yellow Perch eggs were captured during this survey. White Sucker eggs were identified in Swamp Lake Drain and on the Lake Manitoba shoreline near its confluence with the Lake Francis outlet channel. Carp were observed spawning at numerous locations within Roy's and Wagon Creek Drains during early June.

3.5.2 LARVAL DRIFT

Due to the extremely low water levels during the spring runoff, larval drift was not captured within most waterways sampled. It is thought that either flows, at the mouth of the drains, were insufficient to guide fry into the traps, or once inside the traps the fry were able to swim out. Another possibility is that fish of all species were spawning along the lake shore of Lake Manitoba where conditions were likely more favorable? To get a better understanding of successful larval emergence and return rates of the species utilizing the creeks, extensive sampling would be required. This assessment was essentially done to document upstream successful larval emergence.

3.6. BENTHIC INVERTEBRATE COMMUNITY

The invertebrate community within the Lake Francis Watershed, although not heavily sampled, appeared diverse. Odonata, Ephemeroptera, and Trichoptera, the most sensitive species to poor water quality, were collected in most of the tributaries sampled. More effort however should be taken to sample the invertebrate community within known livestock watering areas, areas with limited diversity, and areas where riparian zones appear inadequate. By having a good understanding which types of invertebrates are found within the different tributaries, the WIWCD will be able to determine how healthy each system is. Invertebrates are excellent indicators of poor water quality conditions.

Table 8. Invertebrates (Insects) identified within the sample reaches of each tributary within the Lake Francis Watershed. Sampling was qualitative.

Invertebrates Identified	Wagon Creek Drain			Bachman Drain	Swamp Lake Drain	Lake Francis Outlet Channel	Laurentia Drain
Sampling Reach	**1**	**2**	**3**	**1**	**1**	**3**	**3**
Amphipoda	y	y	y	y	y	y	y
Odonata	y	y		y	y	y	
Trichoptera		y				y	
Ephemeroptera		y				y	
Hemiptera/Corixidae				y	y		
Diptera/Ceratopogonidae						y	y
Diptera/Simulidae		y		y		y	
Diptera/Chironomidae		y	y	y	y	y	y
Water mites							y
Leeches						y	y
Planorbidae	y		y	y	y	y	y
Lymnaeidae			y	y	y	y	
Oligochaetes							
Cladocerans						y	

4.0 POTENTIAL REHABILITATION SITES

A list of 8 rehabilitation projects that AAE Tech Services feel are important to improve the aquatic ecosystem within the Lake Francis Watershed can be found within Appendix H. The projects range from riparian enhancement to removing or providing fish passage at those barriers identified within the waterways. General recommendations are also provided to enhance or create fish spawning habitat within the selected tributaries. Efforts are going to have to be put forth to stop a downward trend of decreasing fish habitat occurring around Lake Manitoba (D. Milani 2000). The WIWCD must work and collaborate with local landowners, government agencies, municipalities and producers to jointly improve the conditions within the Lake Francis Watershed and other watersheds within the conservation district.

5.0 SUMMARY

The WIWCD initiated this study to better understand the waterways within the conservation district. Results were intended to assist the WIWCD to effectively restore, enhance, and protect the aquatic environment within their conservation district to develop a healthy aquatic ecosystem for the benefit of all user groups.

Results of this assessment identified a few barriers impeding fish movement, identified damaged riparian zones along waterways, and described the lack of aquatic habitat diversity within the watershed. This assessment also discussed the role and importance productive and established nursery habitats around Lake Manitoba are to fish communities of Lake Manitoba. Lake Francis, West Shoal Lake, and Ennis Marsh are the major waterbodies and nursery habitats within the watershed. Yellow Perch and Northern Pike (to name a few) spawn on aquatic vegetation. They select habitat types found within marshes and the littoral zones of larger water bodies to spawn. It is very important, to not only have spawning habitat for Walleye and other sought after sport fish species, but also a balanced approach is needed to protect and improve our entire aquatic ecosystem.

This study revealed many positives with regards to the health of the watershed. Most tributaries, although very uniform, had riparian zones adequate to provide protection to the aquatic environment. Only 11% of the riparian condition was considered severally impacted. In addition, urban development within the watershed was minimal. Most of the land use along the tributaries was either native prairie grass for forage or native grassland for pasture. These types of environments are not typically associated with excessive nutrient loading to the aquatic environment; with the exception of heavily livestock grazed sections were bank trampling is common.

Although the spring runoff was inadequate to allow for a large spawning run, the results of this survey provided much needed data to understand the state of the fish habitat along the tributaries within the Lake Francis Watershed. As previously stated, there is a severe lack of habitat diversity within the tributaries of this watershed. Nursery habitat was abundant, but barriers restricted fish movements into these waterbodies. The drains within the watershed have been straightened and channelized. As a result, a significant amount of habitat has likely been lost. In addition, the habitat remaining within the drains was simple, with limited cover, limited spawning habitat, and a lack of nursery habitat.

Many enhancement efforts can be undertaken to improve the habitat. The WIWCD is going to have to partner with local landowners, commercial fishermen, agricultural producers, municipalities, and government agencies to accomplish the ultimate goal of providing a healthy ecosystem within the watershed to benefit all user groups. This project was intended to provide recommendations on how to improve the health and sustainability of the watershed for user groups and fish and wild life. Numerous recommendations can be found below.

6.0 RECOMMENDATIONS

The recommendations below are based on the results of this study and discussions had with the West Interlake Watershed Conservation District and Provincial and Federal Government Agencies.

- Hold information meetings with local landowners to discuss future plans of the WIWCD. By getting everyone involved within the community will help with future enhancement initiatives.

- Use this report to tackle or enhance the potential rehabilitation sites listed within to improve fish habitat, water quality and the health of the aquatic ecosystem.

- Work in cooperation with the Lake Francis Wildlife Management Area Association to develop a plan to effectively protect the habitat within the Lake Francis for ducks, waterfowl and wildlife, but also to provide native fish species with the opportunity to utilize this habitat. AAE Tech Services recommends managing the gates more effectively by allowing all fish to enter the lake prior to Common Carp spring movements. Common Carp typically ascend waterways to spawn and feed in late May and early June. White Sucker, Walleye, and Northern Pike spawning migrations occur much earlier, closer to ice-off. We are proposing to leave the gates off for at least three weeks after ice off and then re-install them prior to Carp movements. In late August or early September, the screens could be removed to allow fish to exit the marsh to overwinter in Lake Manitoba. This strategy will allow native fish species the opportunity to utilize the valuable nursery habitat within Lake Francis, and at the same time, prevent Carp from entering the lake. The same strategy can also be used on Ennis Marsh (gated culverts). Whenever a man-made control structure is built along a waterway, it must be properly managed to not impact the native fauna.

- Install fish gates allowing fish to move in only one direction on the Lake Francis control Structure. These gates could be installed to reduce the risk of those fish exiting the marsh from becoming entrained within the screen at the outlet channel.

- Remove rock barriers at the mouth of Laurentia Drain and the unnamed drain flowing into Ennis Marsh annually to allow fish the ability to reach upstream spawning and nursery habitat.

- Better manage the beaver fences within Swamp Lake Drain. The fences must be removed completely from the waterway during the spring fish spawning migrations.

- Build spawning shoals within Wagon Creek Drain to increase habitat diversity and provide additional spawning habitat for fish.

- Conduct similar riparian and aquatic assessment studies on other tributaries within the WIWCD to better understand the fish and fish habitat within those water bodies.

- Conduct more thorough studies on Lake Francis, documenting bathymetry (water depth), dissolve oxygen levels, fish utilization, and macrophyte communities found within the Lake. Many studies are being conducted on Delta Marsh; looking at the impact Carp have on the aquatic ecosystem. Lake Francis, being so close to Delta Marsh, should be examined to compare macrophyte, fish invertebrate, ducks, waterfowl, and wildlife populations between systems. More research is also needed to help better manage Lake Francis and its ecosystem to provide greater benefits for all user groups.

- Conduct fish surveys along the Lake Manitoba shoreline to get a better understanding of these habitats and how fish are utilizing them, i.e. spawning, nursery, feeding, refuge.

- Take water samples and dissolved oxygen measurement within the sloughs, dugouts, and marshes along the Lake Manitoba shoreline to determine their effect to nutrient loading within the lake.

- Conduct fish salvages during October within the divided section on West Shoal Lake to save some of the stranded fish. These salvages could be tied to school outings to teach children about the biology of fish, fish habitat, sampling gear used to study fish and the importance clean water is to help sustain abundant fish populations.

7.0 ACKNOWLEDGEMENTS

Thanks to everyone on the West Interlake Watershed Conservation District for giving AAE Tech Services the opportunity to conduct this riparian and aquatic survey on the Lake Francis Watershed and for being so interested and helpful throughout the course of the study.

Special thanks to Linda Miller, Manager of the WIWCD, for helping with all aspects of the project. Thanks to Doug Oliver and the WIWCD board for their dedication and support to the Conservation District. Thanks to Elliot Macdonald, Adam McFee, Logan Queen, Tyler White, Matt Keough and Kristin–Yaworski-Lowdon for assisting with the fieldwork component of the project. Thanks to all the landowners that took the time to provide their knowledge of fish utilization of the tributaries within the watershed. Thanks to Derek Kroeker, and Ken Kansas (Manitoba Water Stewardship), Doug Watkinson (Fisheries and Oceans Canada), Dale Wrubleski (Ducks Unlimited), and Garth Ball (Lake Francis Wildlife Management Area Association) for providing addition information regarding the fish communities within the watershed. Thanks to Ducks Unlimited for providing fish catch data on Lake Francis. Finally, thanks to Laureen Janusz (Manitoba Water Stewardship) for the collection permit. I sincerely apologize if anyone was missed. So many people helped with this project.

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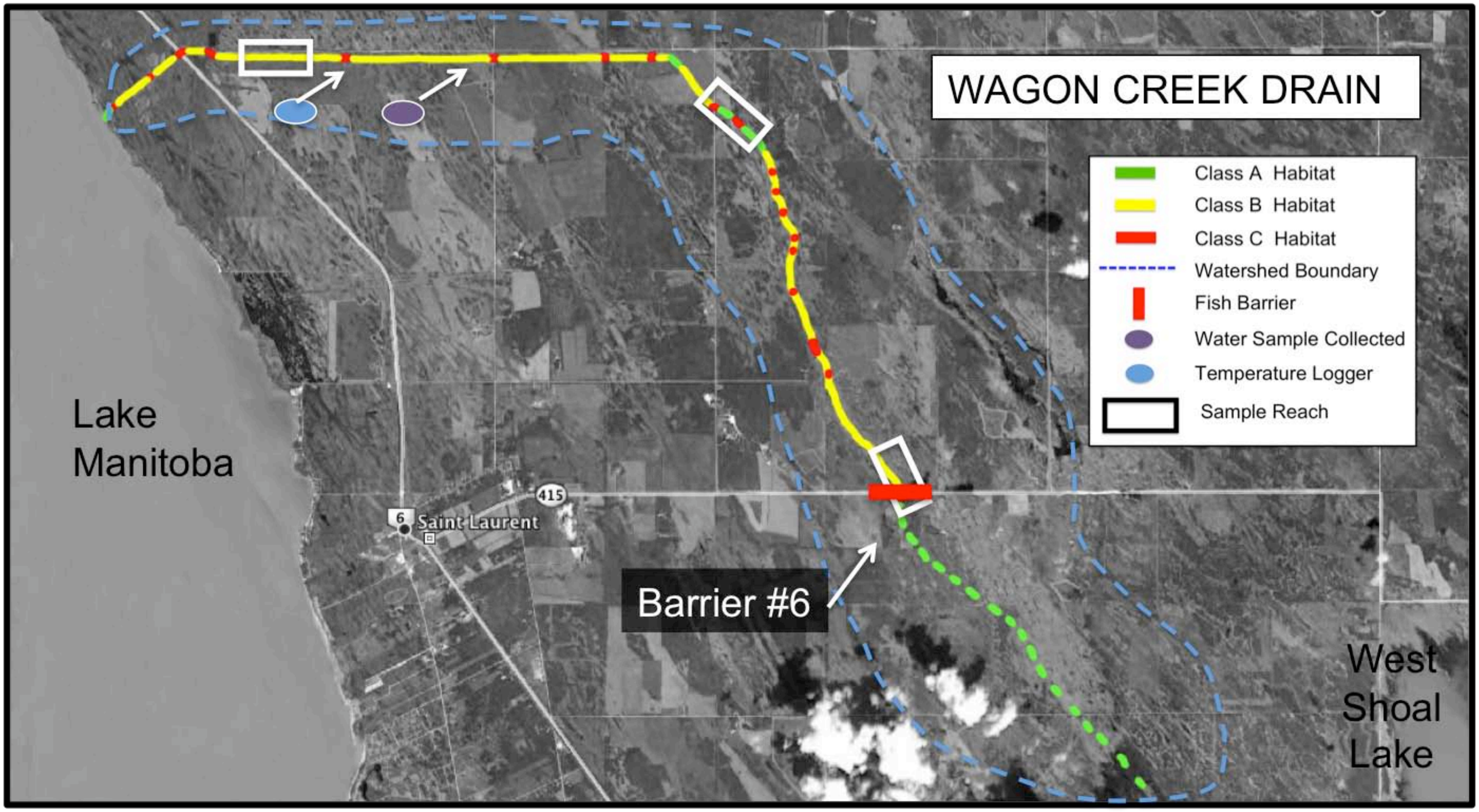
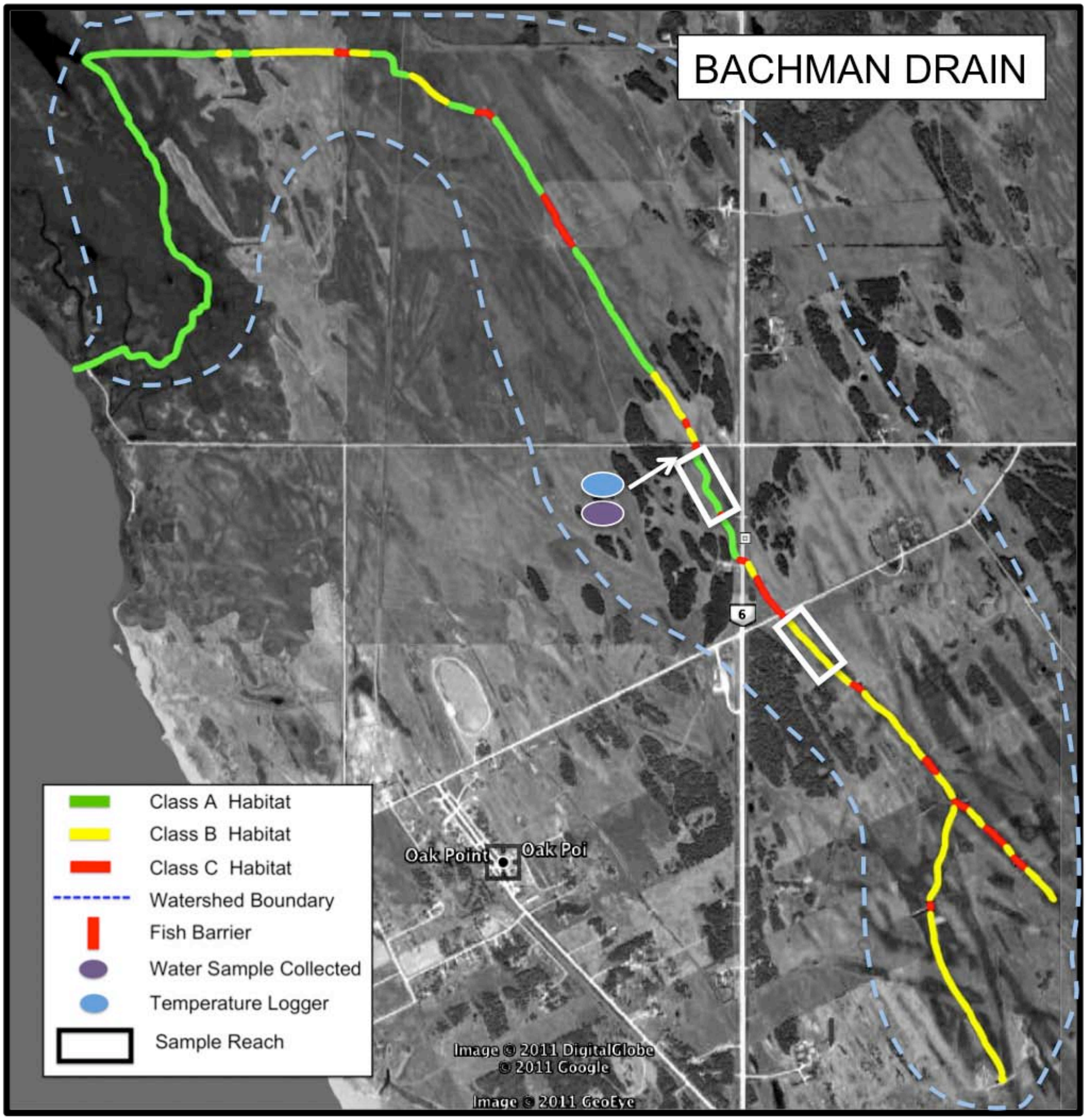
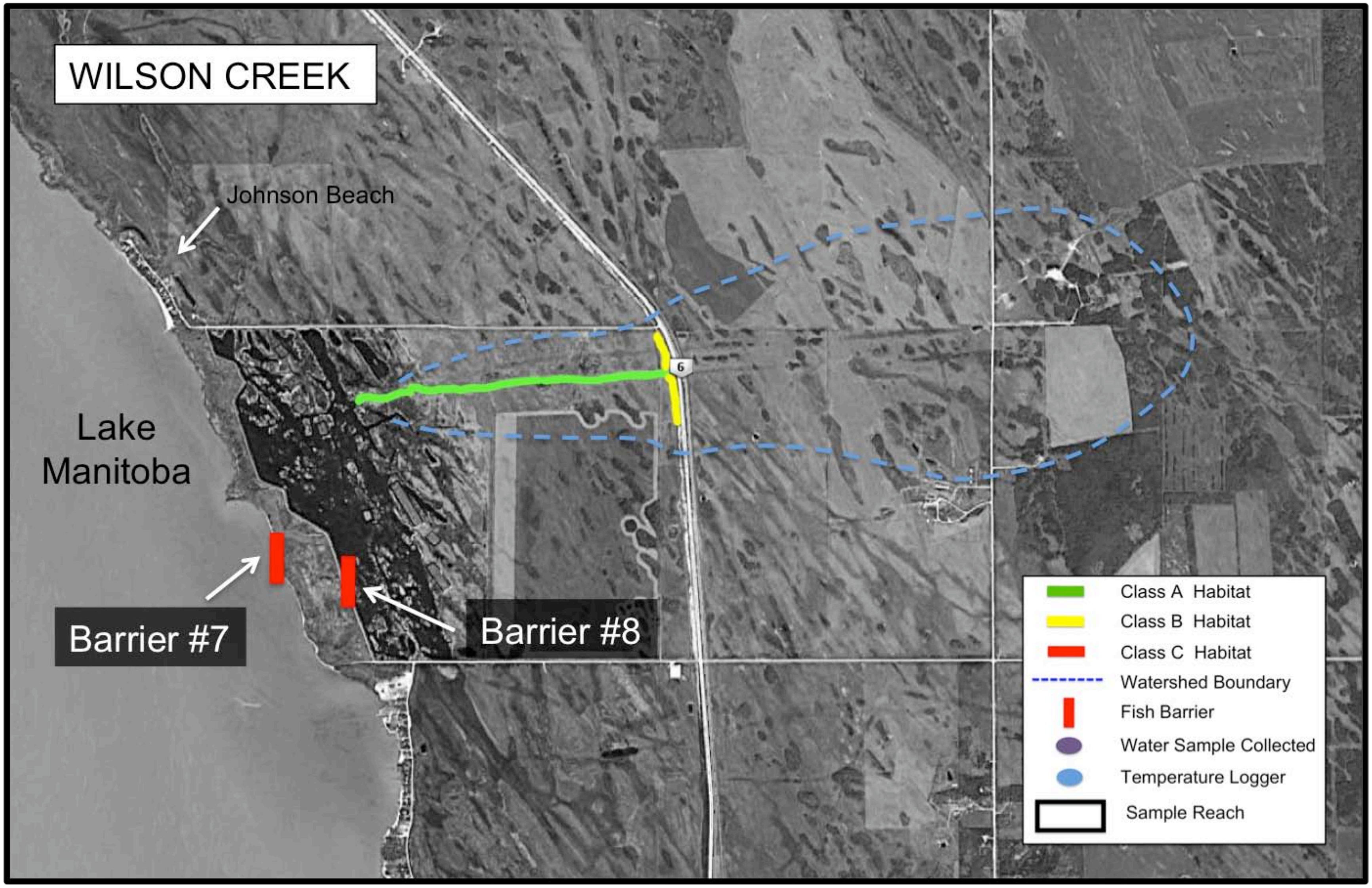
APPENDIX A: Habitat featured maps illustrating the riparian zone classification of the drains within the Lake Francis Watershed. Locations of barriers are included on the maps.



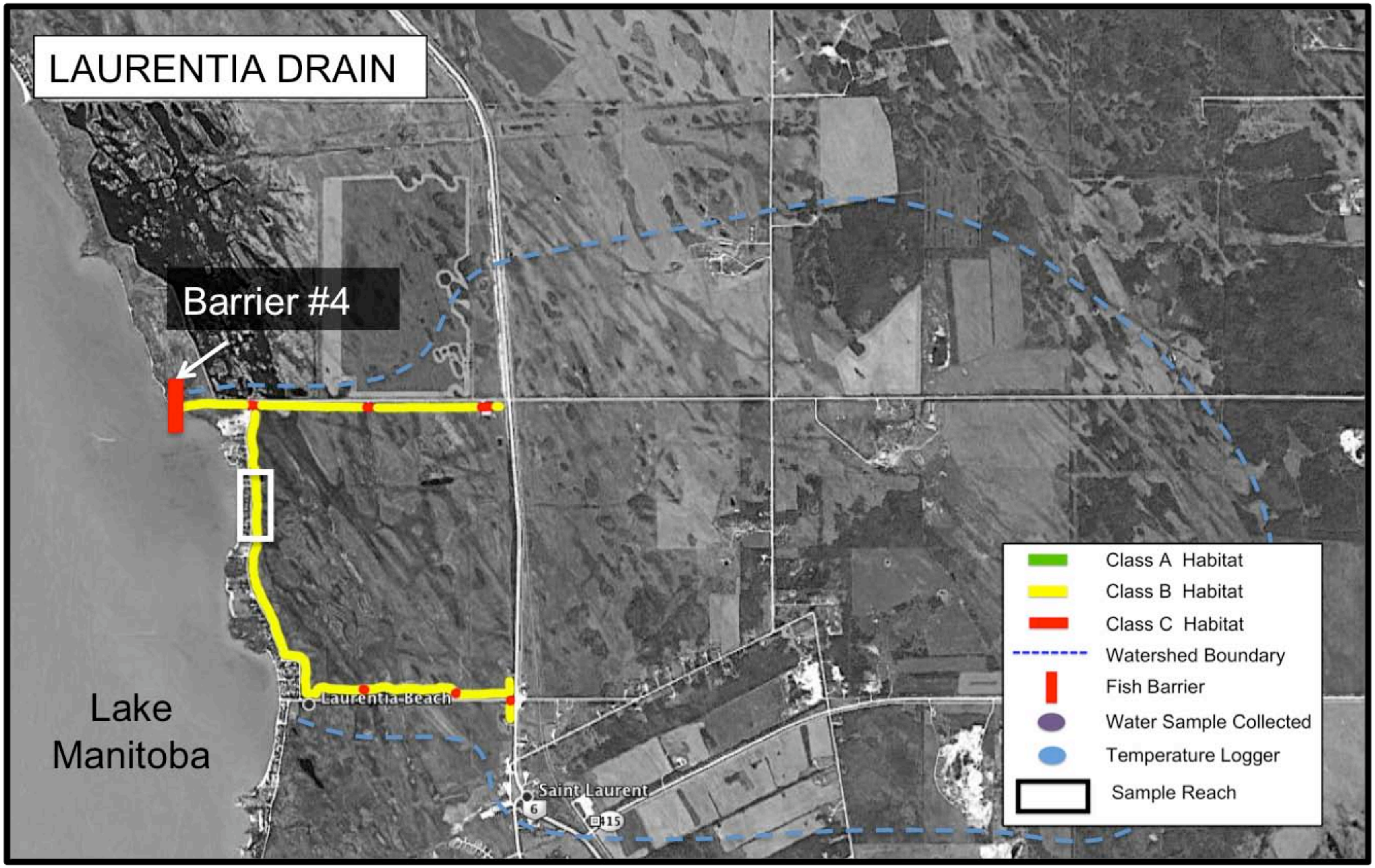
Appendix A-1. Wagon Creek Drain riparian zone classification habitat featured map



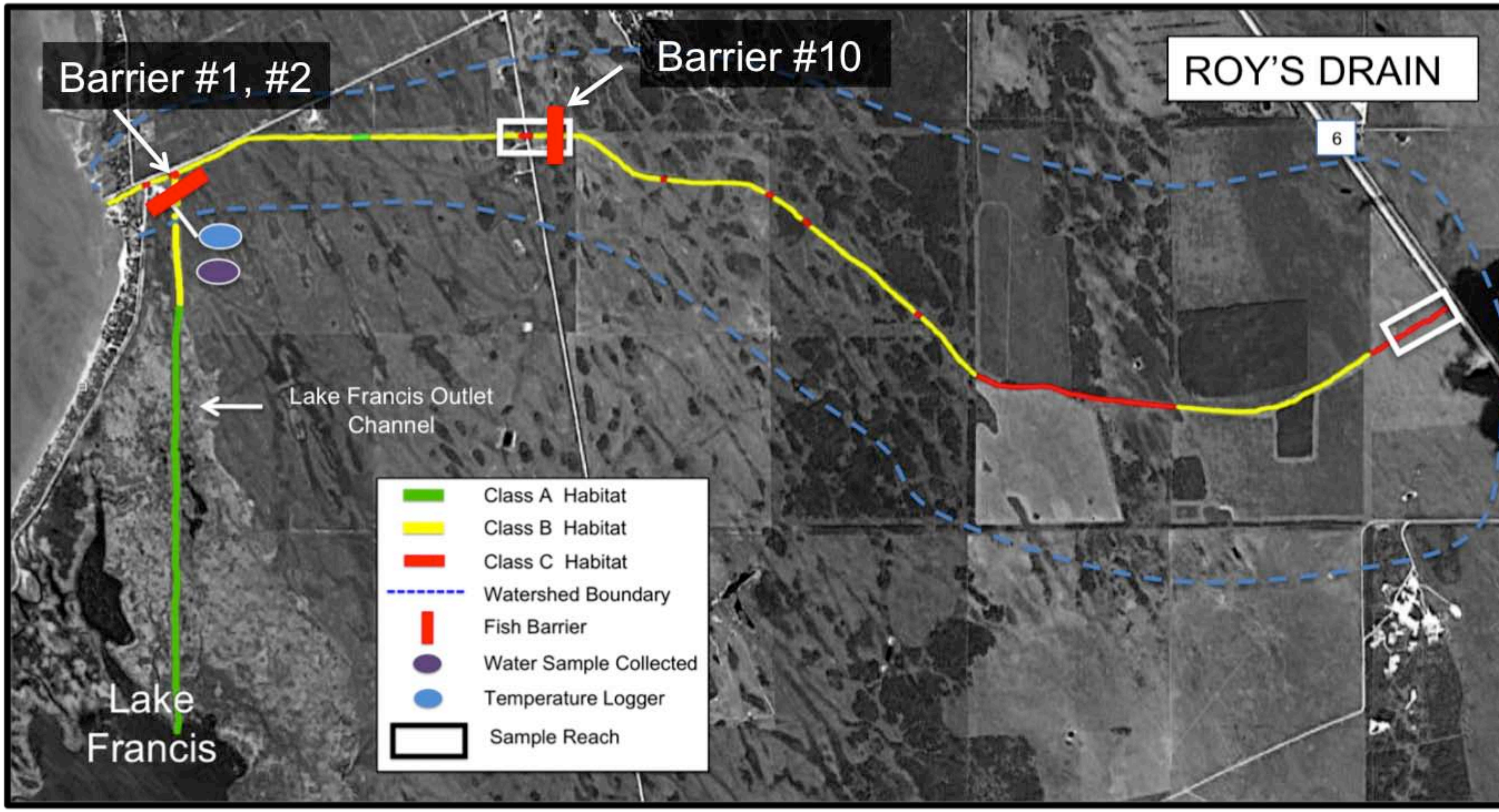
Appendix A-2. Bachman Drain riparian zone classification featured map**.**



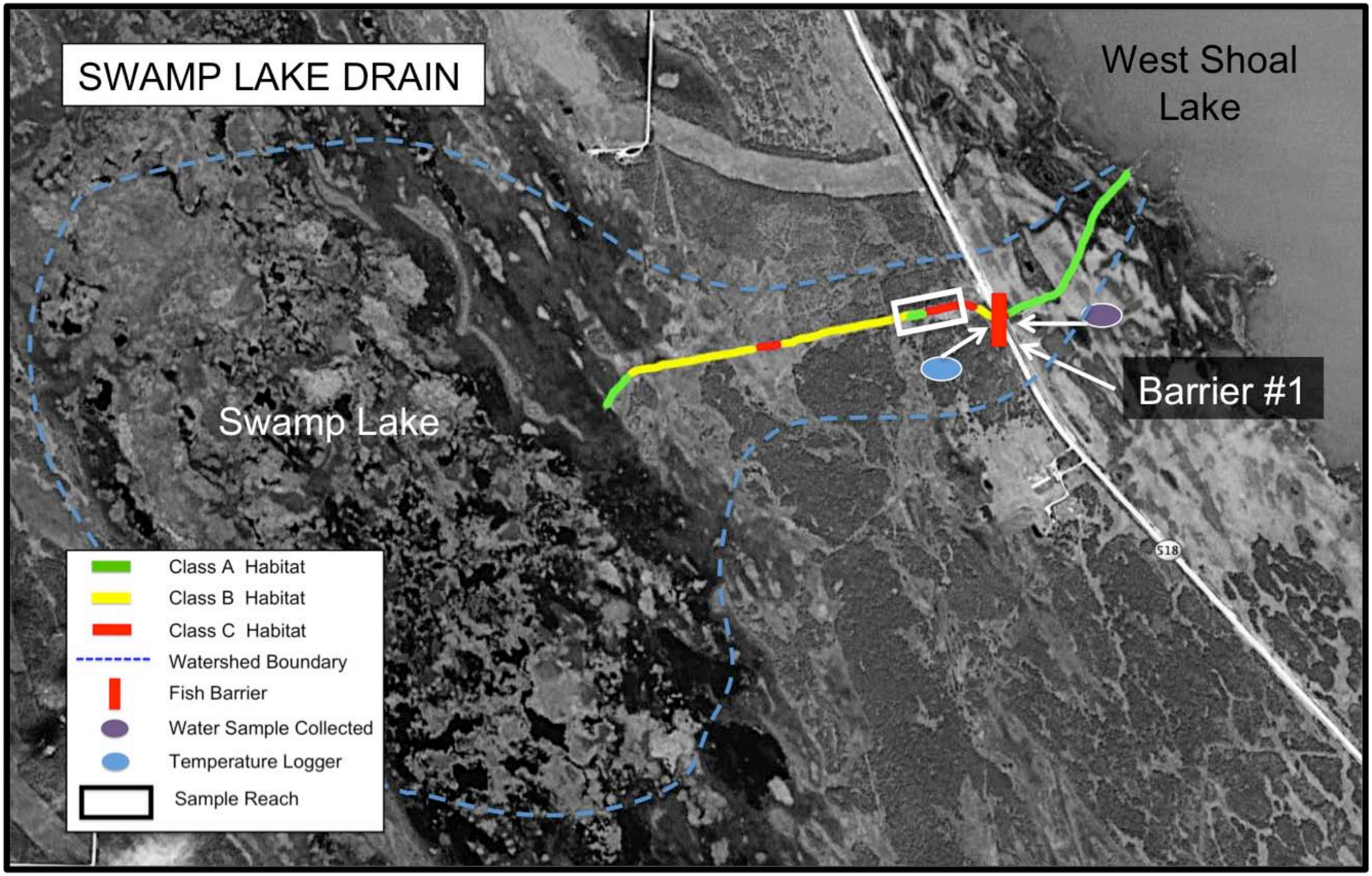
Appendix A-3. Wilson Creek riparian zone classification featured map.



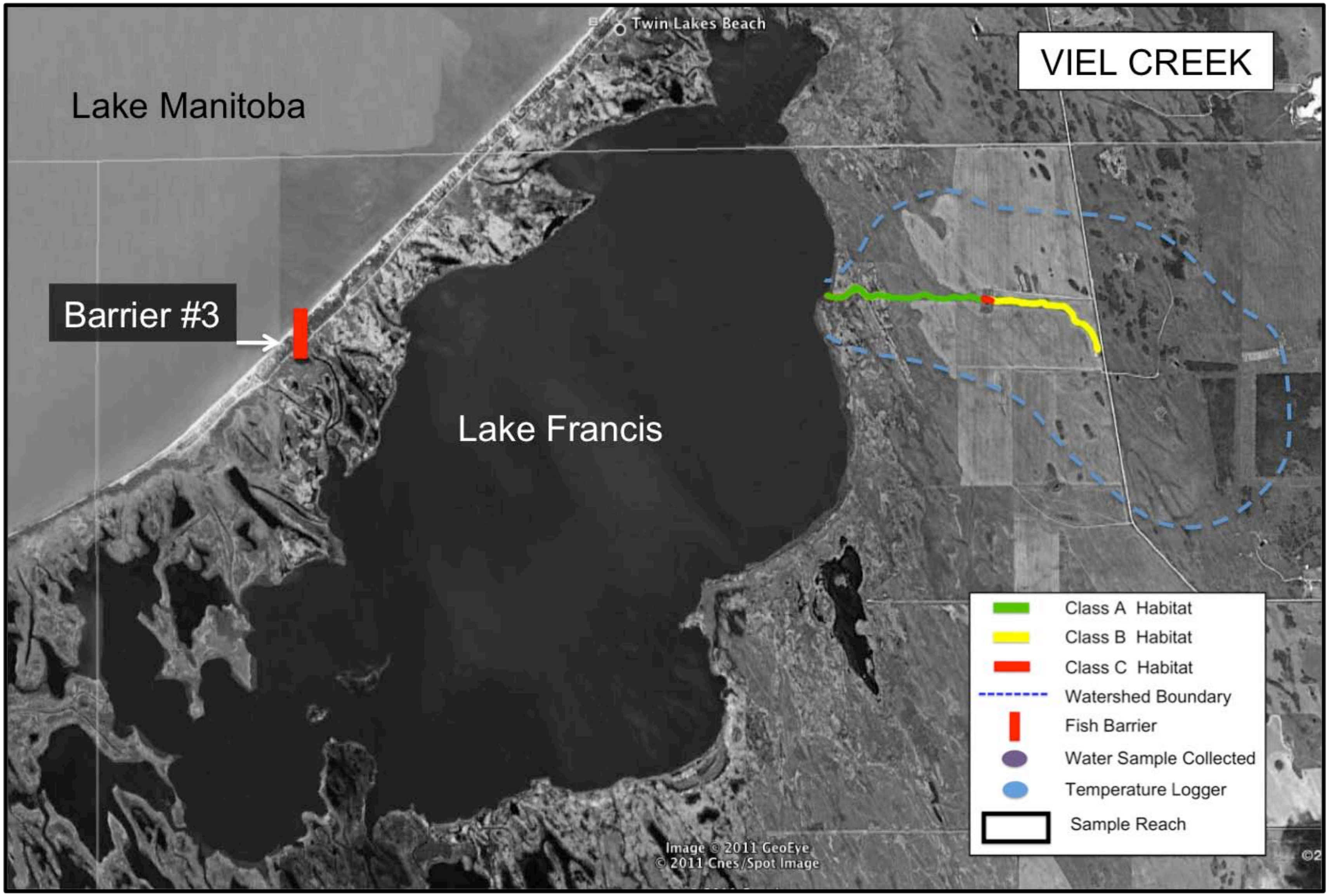
Appendix A-4. Laurentia Drain riparian zone classification featured map**.**



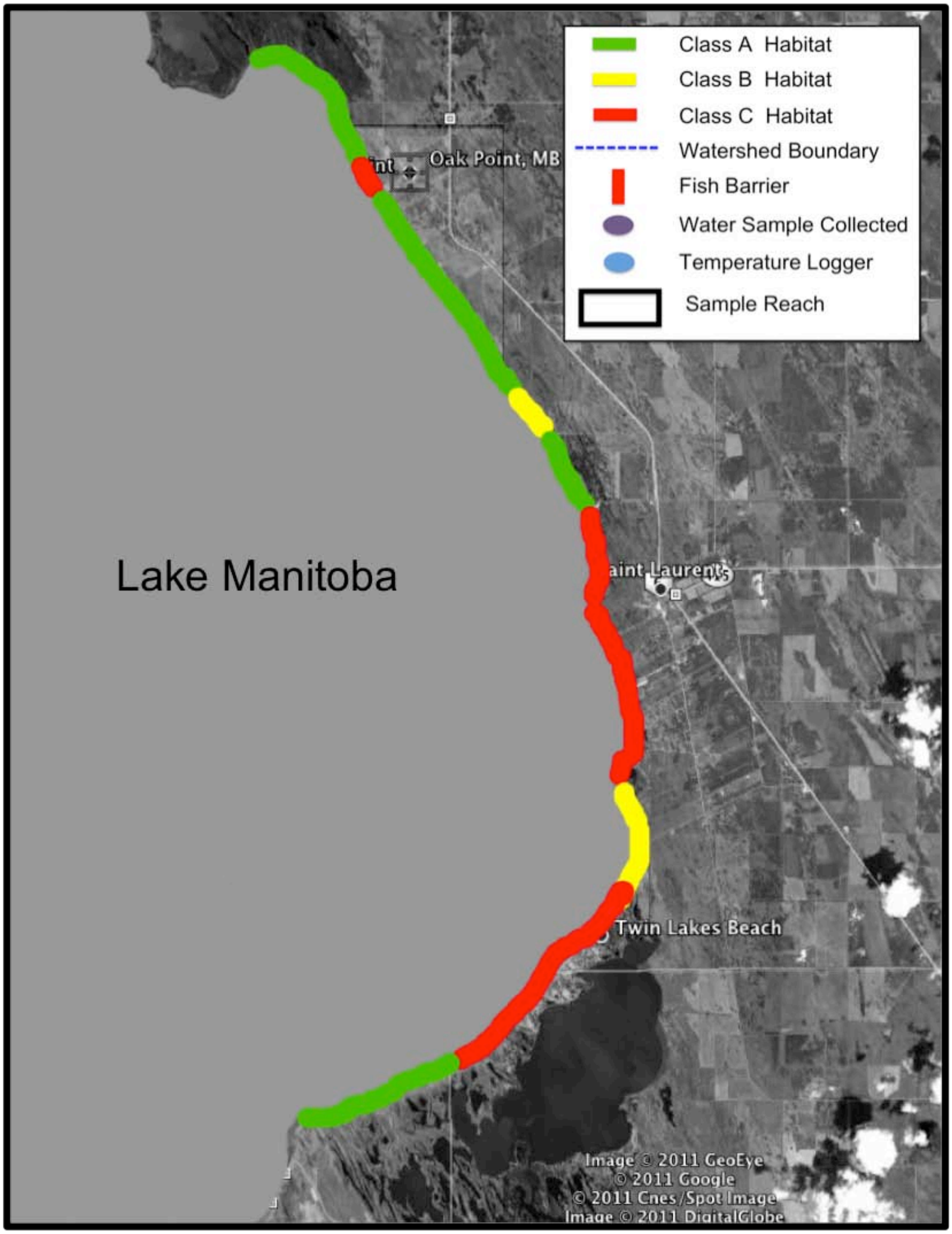
Appendix A-5. Roy's Drain riparian zone classification featured map.



Appendix A-6. Swamp Lake Drain riparian zone classification featured map.

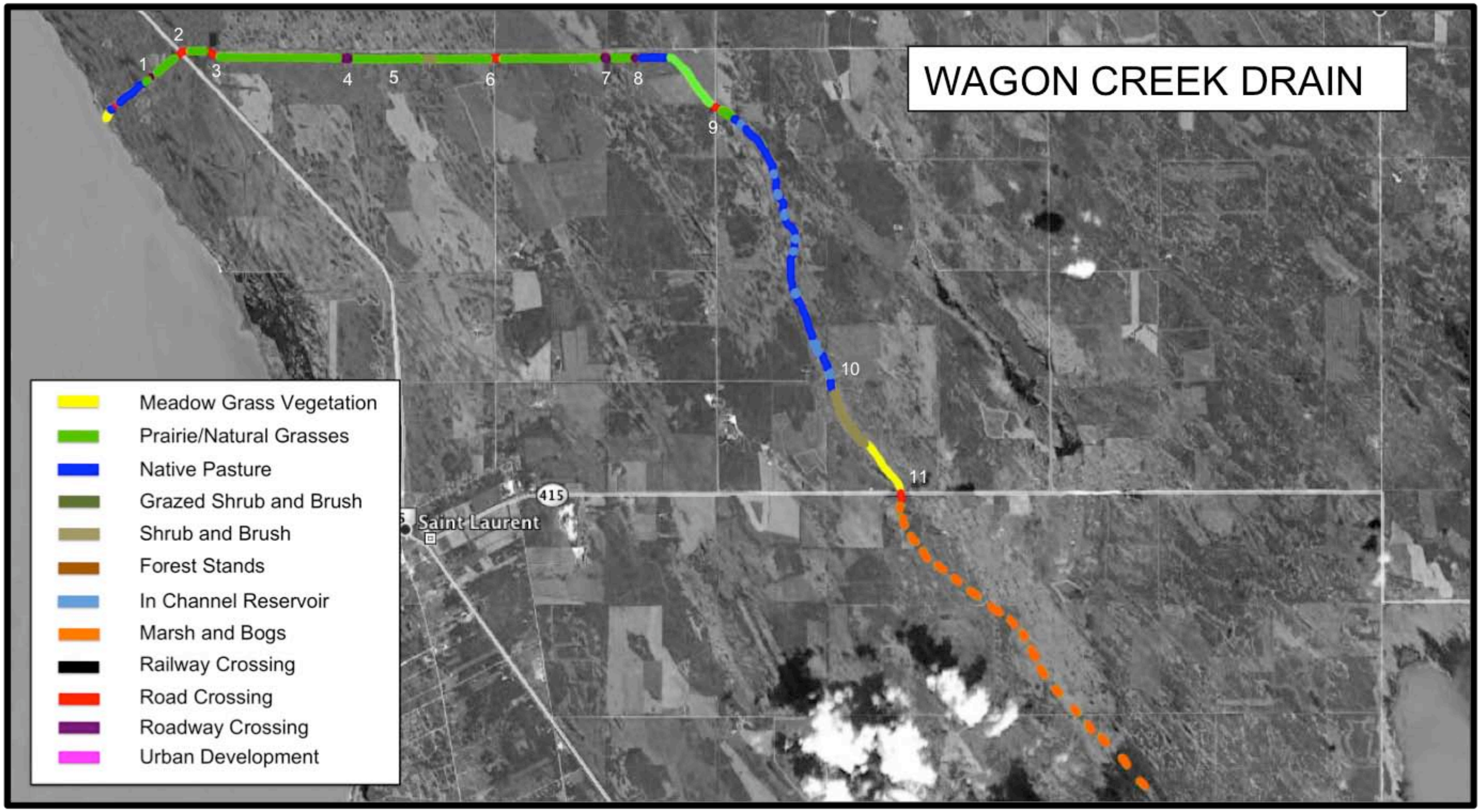


Appendix A-7. Viel Creek riparian zone classification featured map.

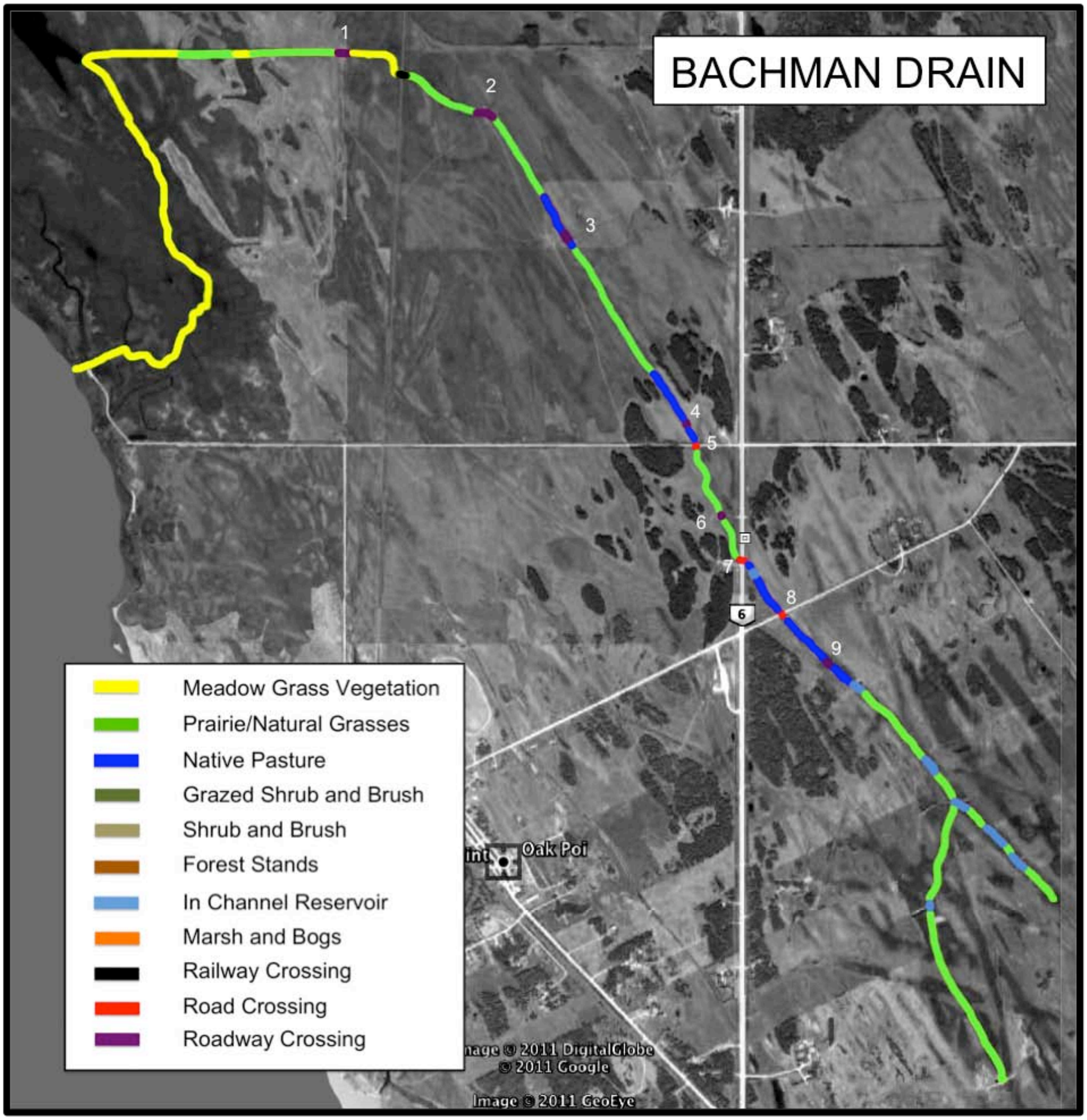


Appendix A-7. Lake Manitoba shoreline riparian zone classification featured map

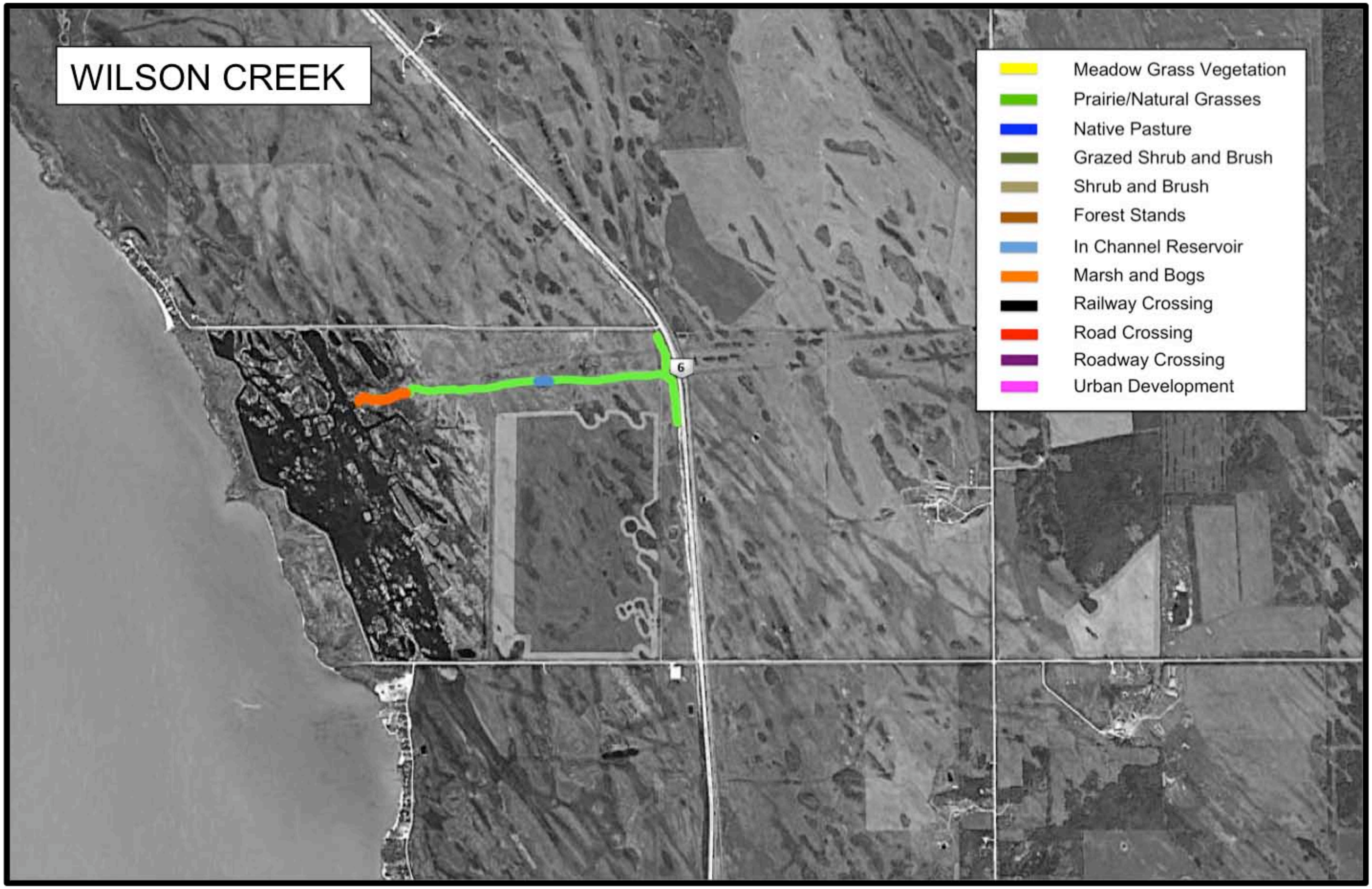
APPENDIX B: Land use classification maps of the drains within the Lake Francis Watershed.



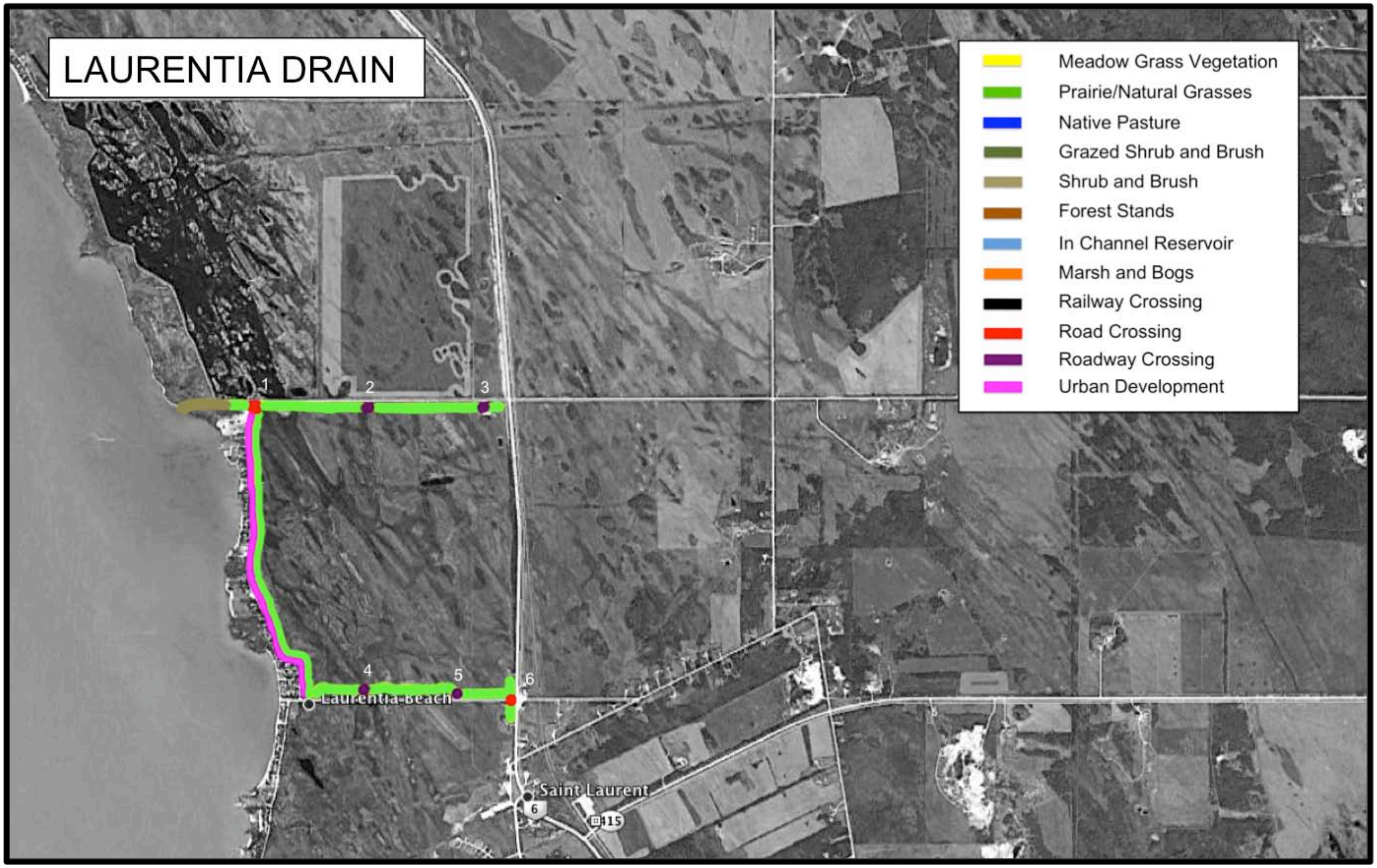
Appendix B-1. Wagon Creek Drain land use classification map.



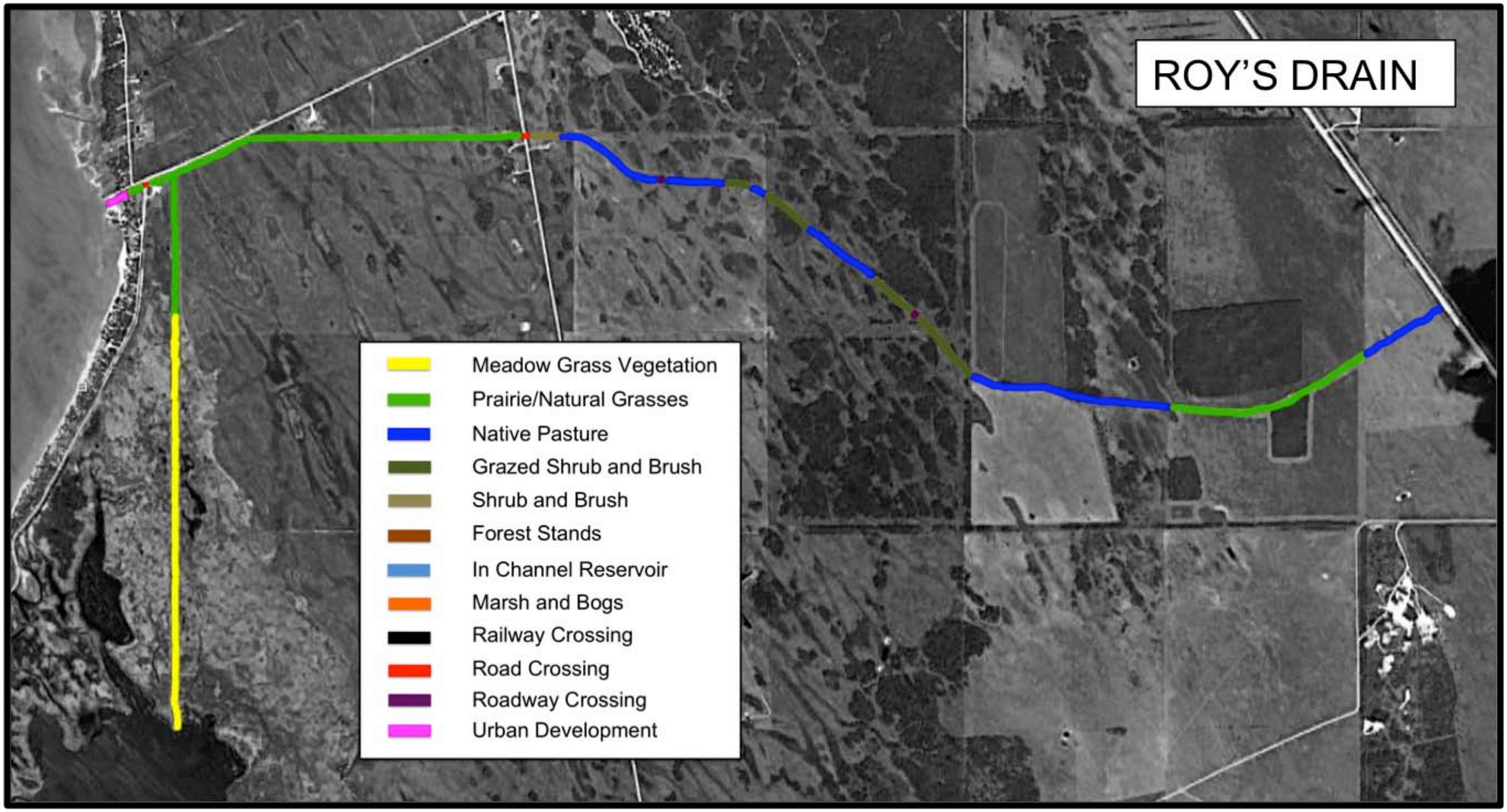
Appendix B-2. Bachman Drain land use classification map**.**



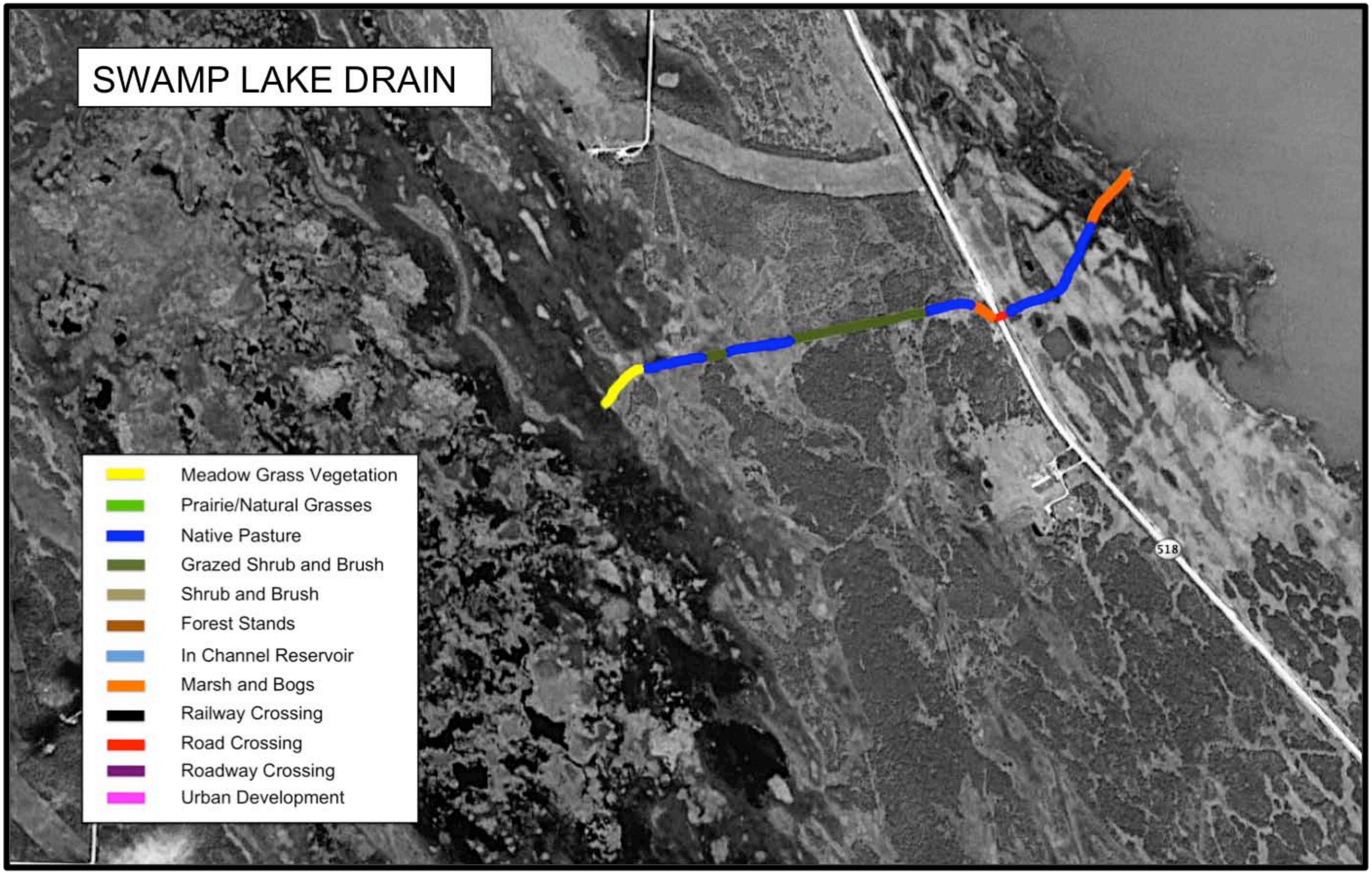
Appendix B-3. Wilson Creek land use classification map.



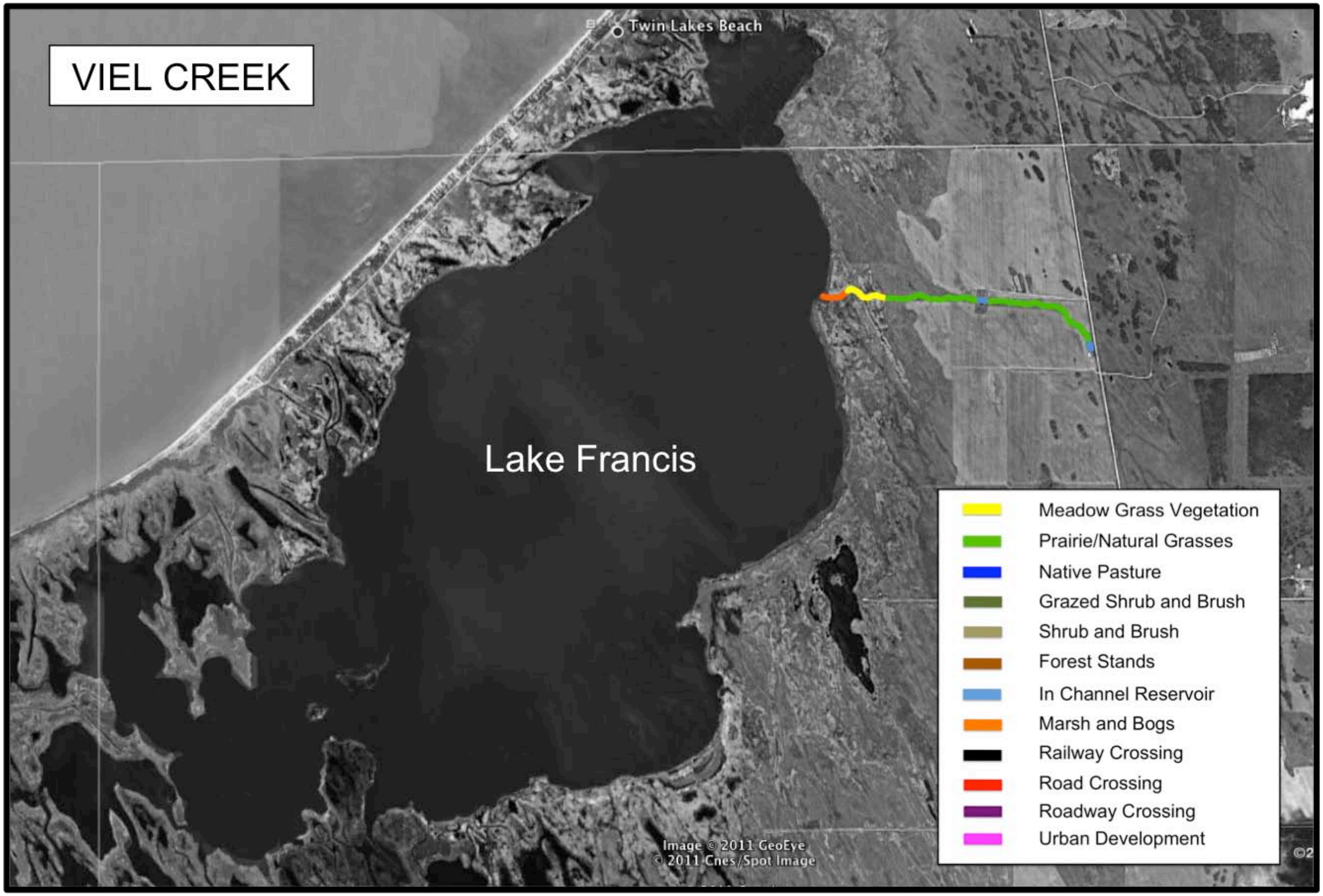
Appendix B-4. Laurentia Drain land use classification map.



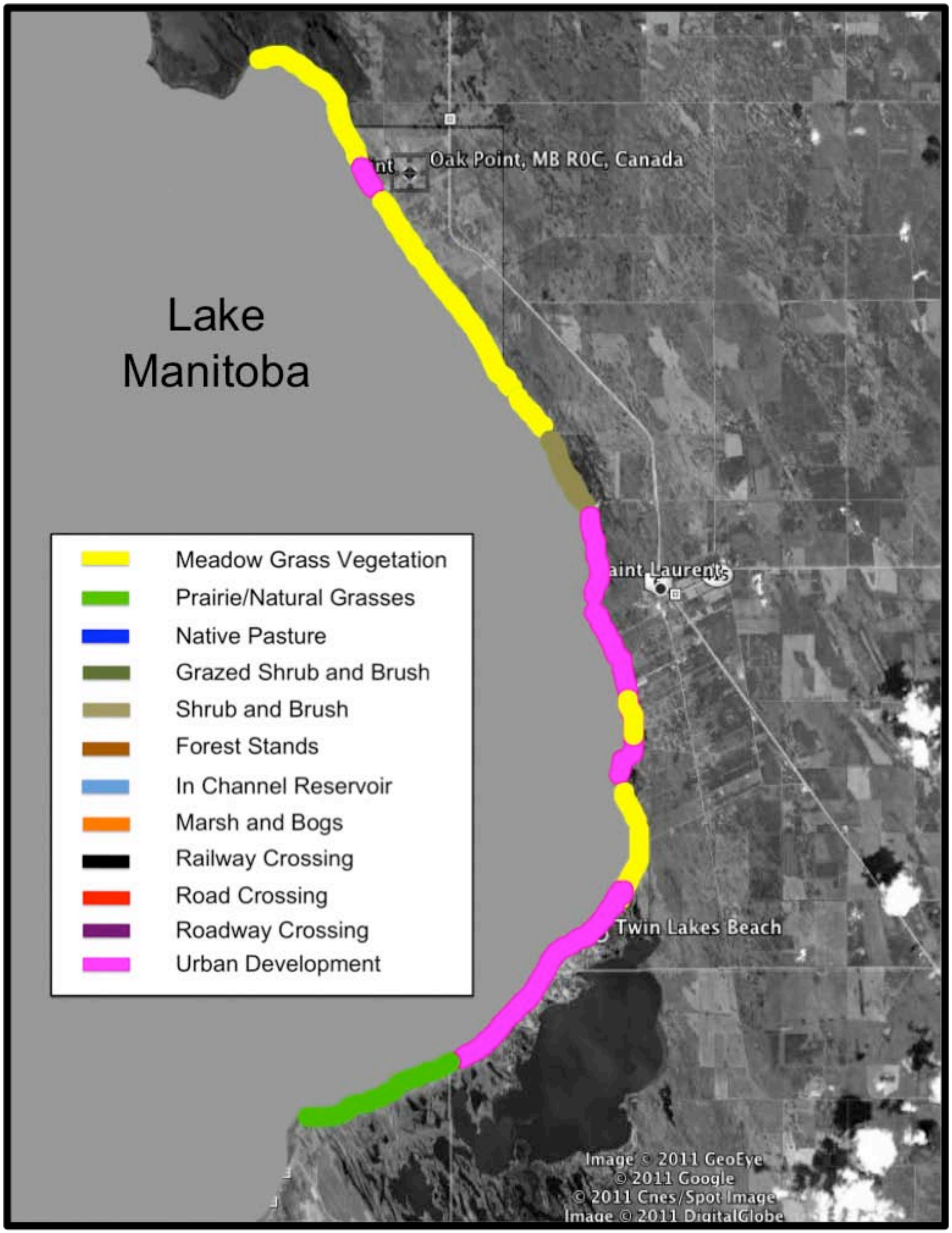
Appendix B-5. Roy's Drain land use classification map.



Appendix B-6. Swamp Lake Drain land use classification map.



Appendix B-7. Viel Creek land use classification map.

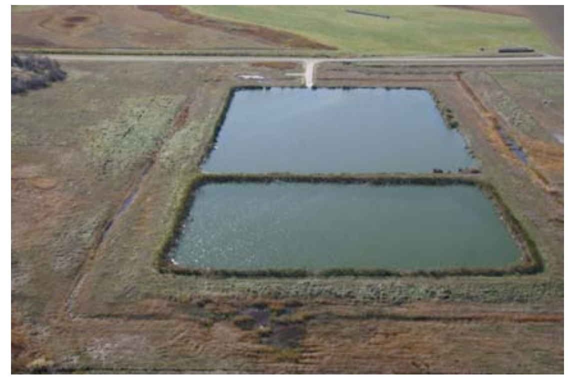


Appendix B-7. Lake Manitoba Shoreline land use classification featured map.

APPENDIX C. Aerial and ground photographs representing the characteristics of the Lake Francis Watershed tributaries.

BACHMAN DRAIN
(Appendix B-1)

WAGON CREEK DRAIN
(Appendix B-2)



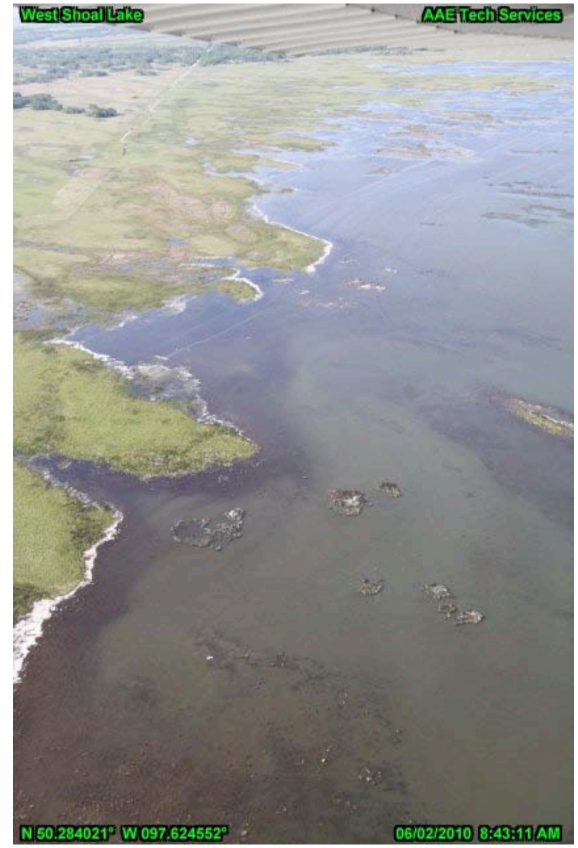



ROY'S DRAIN
(Appendix B-3)



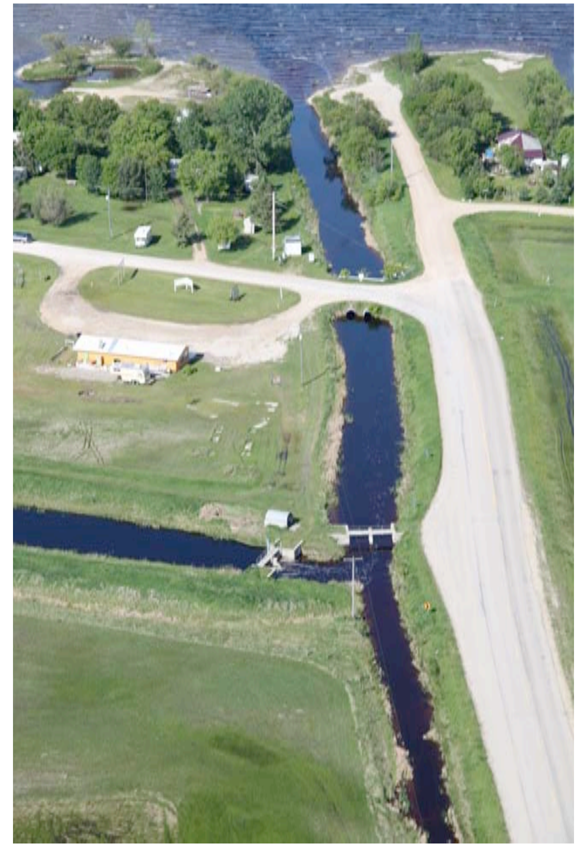

LAURENTIA DRAIN &
WISON CREEK &
ENNIS MARSH
(Appendix B-4)

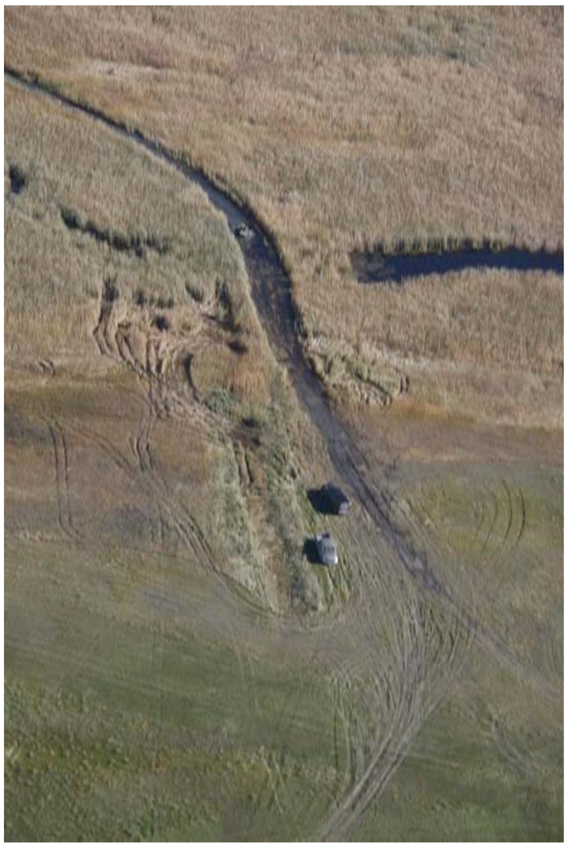
SWAMP LAKE DRAIN
(Appendix B-6)



WEST SHOAL LAKE
(Appendix B-7)

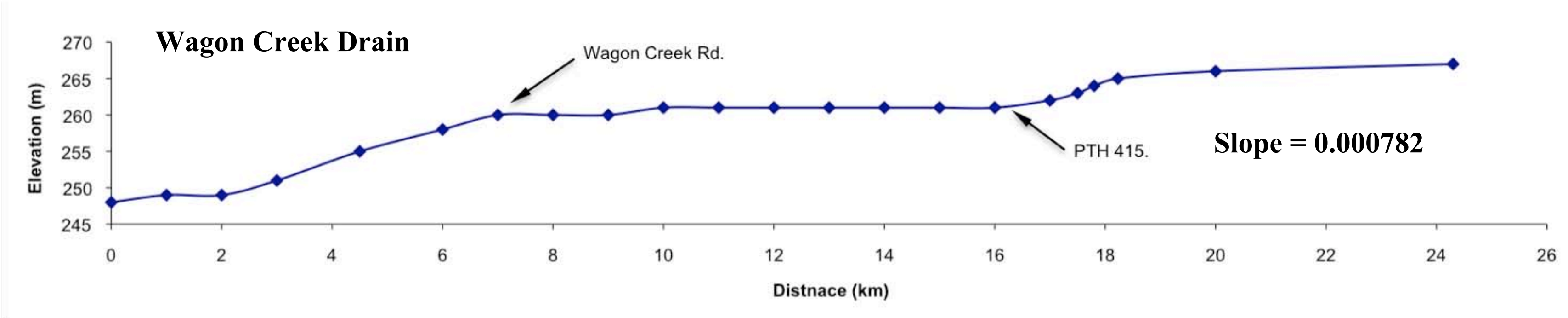
LAKE MANITOBA SHORELINE
(Appendix B-7)

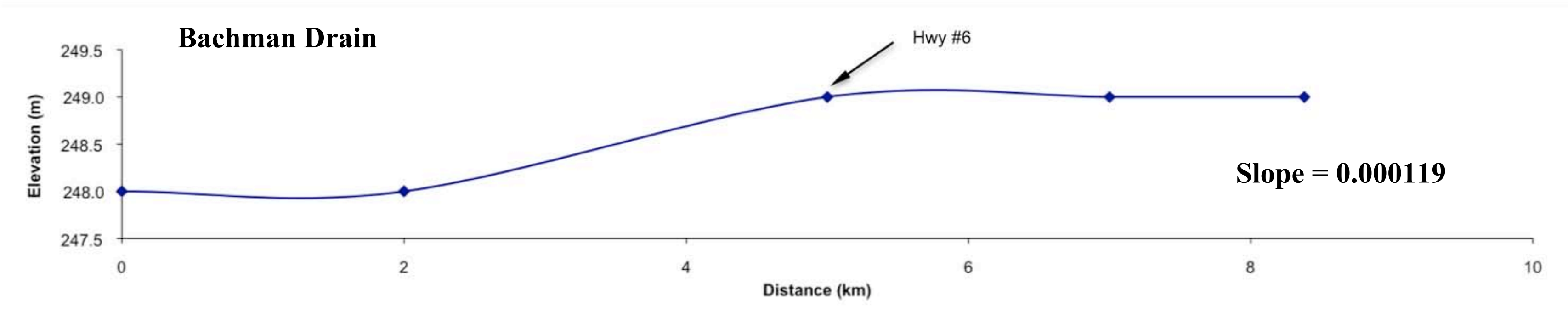


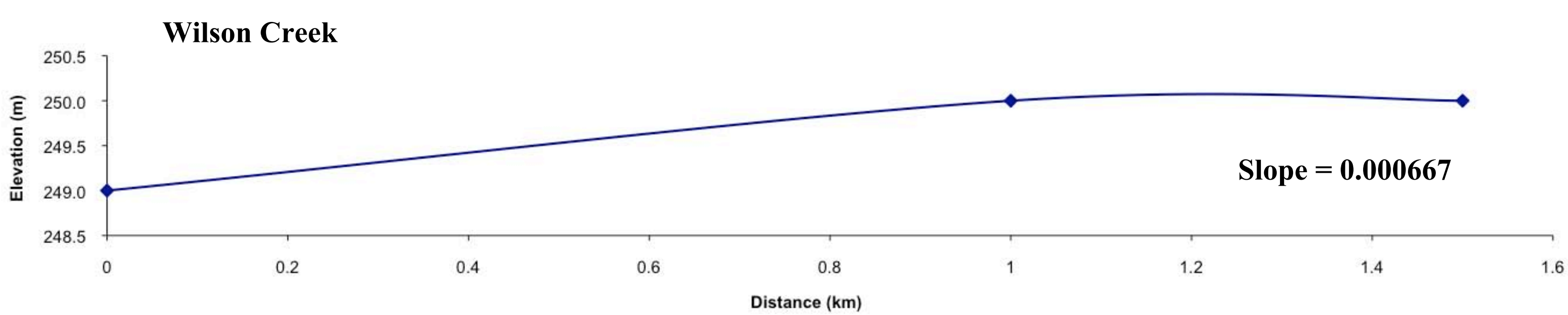


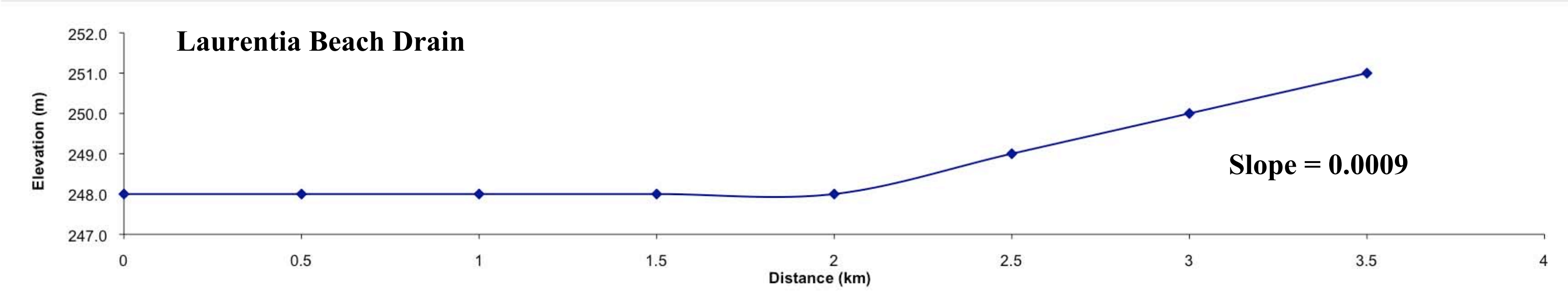
LAKE FRANCIS & VIEL CREEK
(Appendix B-6)

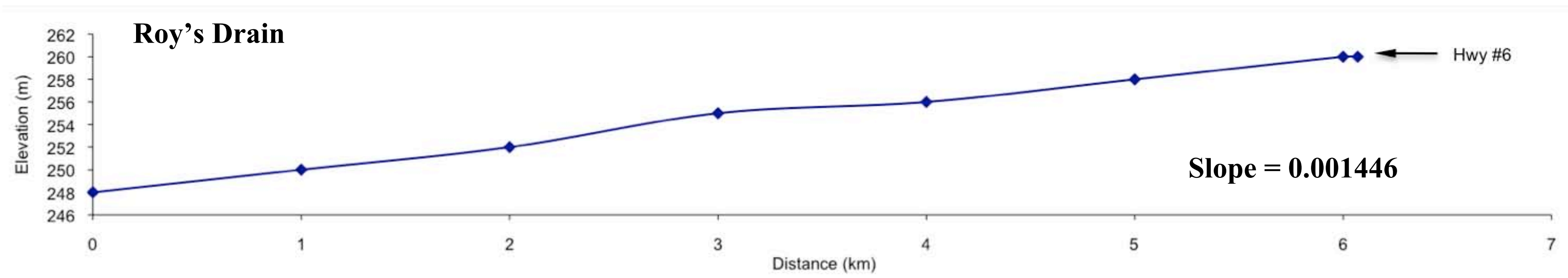
APPENDIX D. Longitudinal profiles incorporating the entire length of each tributary of the Lake Francis Watershed. Produced from 1:50,000 topographic maps

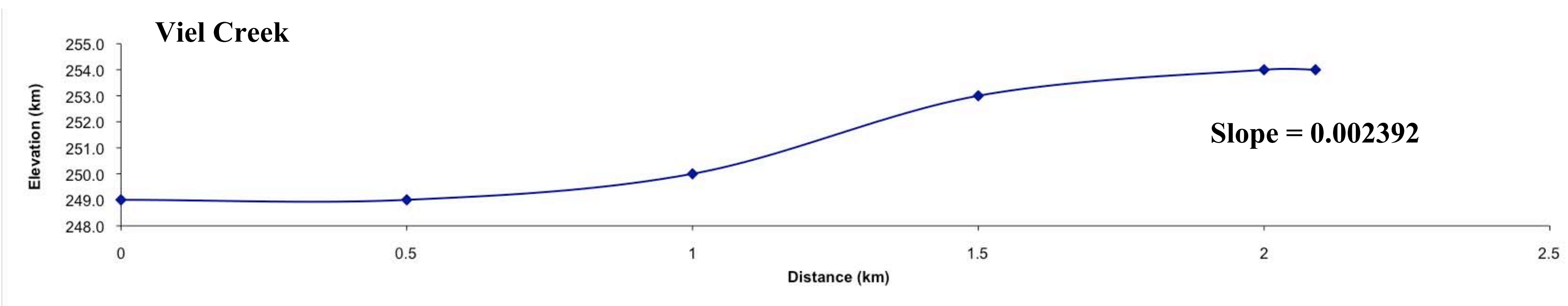

Wagon Creek Drain
Wagon Creek Rd.
PTH 415.
Slope = 0.000782
Elevation (m)
Distnace (km)

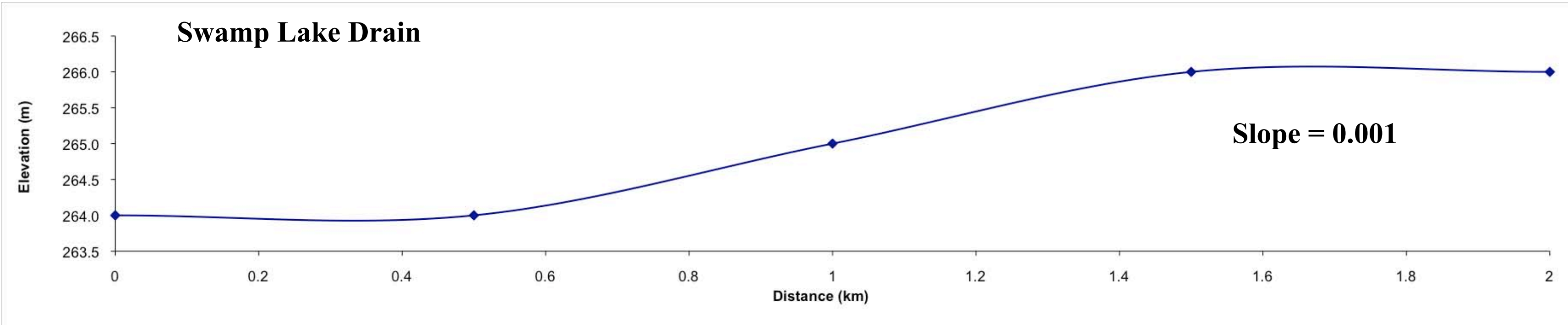

Bachman Drain
Hwy #6
Slope = 0.000119
Elevation (m)
Distance (km)


Wilson Creek
Slope = 0.000667
Elevation (m)
Distance (km)

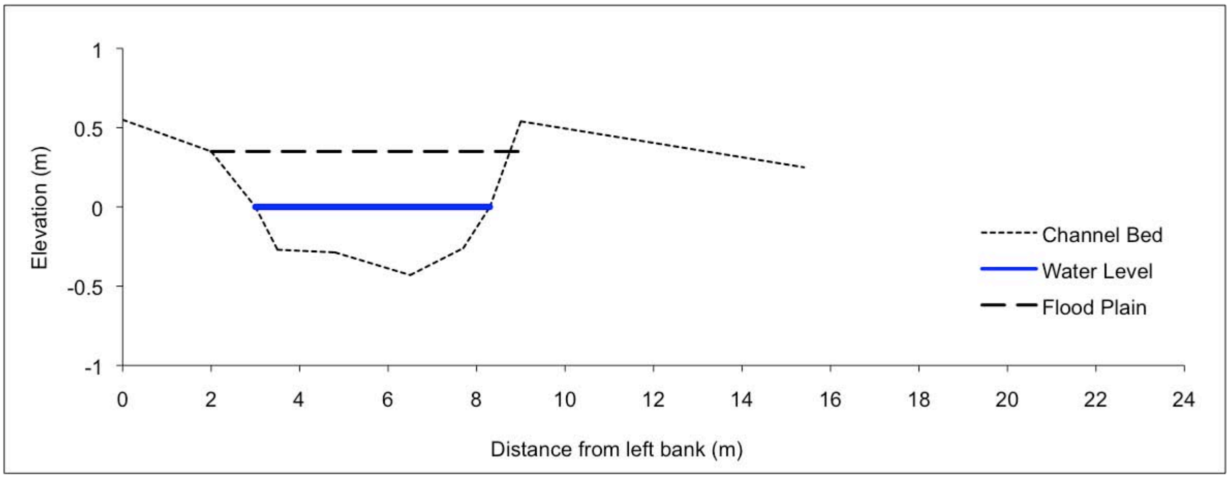

Laurentia Beach Drain
Slope = 0.0009
Elevation (m)
252.0
251.0
250.0
249.0
248.0
247.0
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)

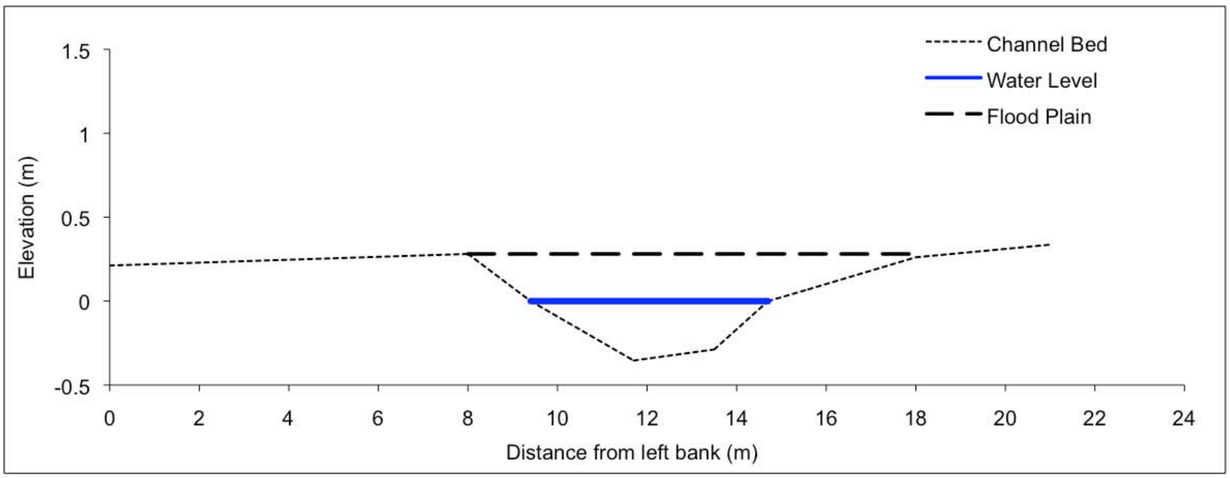

Roy's Drain
Hwy #6
Slope = 0.001446
Elevation (m)
262
260
258
256
254
252
250
248
246
0
1
2
3
4
5
6
7
Distance (km)

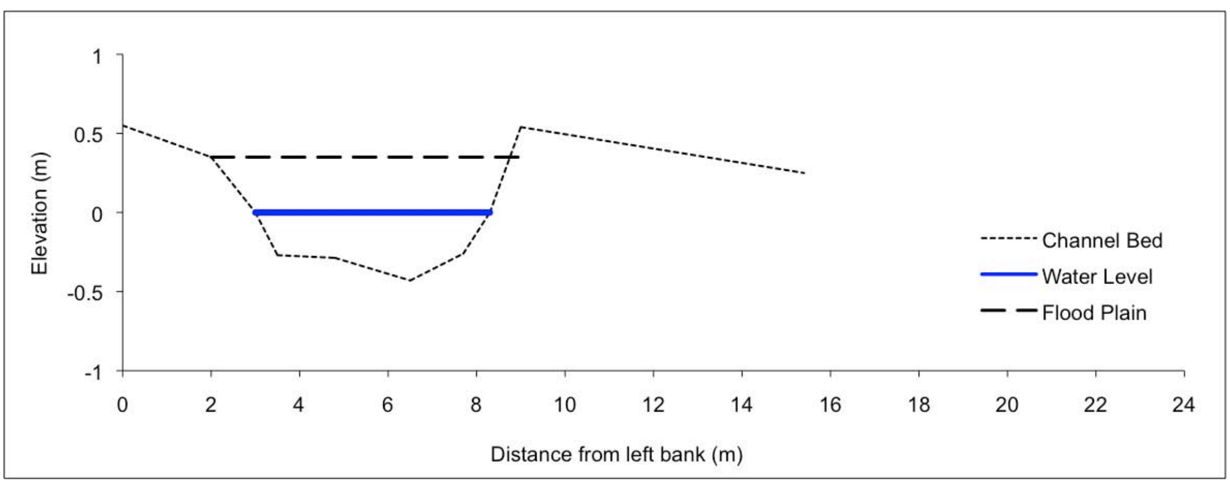

Viel Creek
Slope = 0.002392
Elevation (km)
255.0
254.0
253.0
252.0
251.0
250.0
249.0
248.0
0
0.5
1
1.5
2
2.5
Distance (km)


Swamp Lake Drain
Slope = 0.001
Elevation (m)
266.5
266.0
265.5
265.0
264.5
264.0
263.5
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Distance (km)

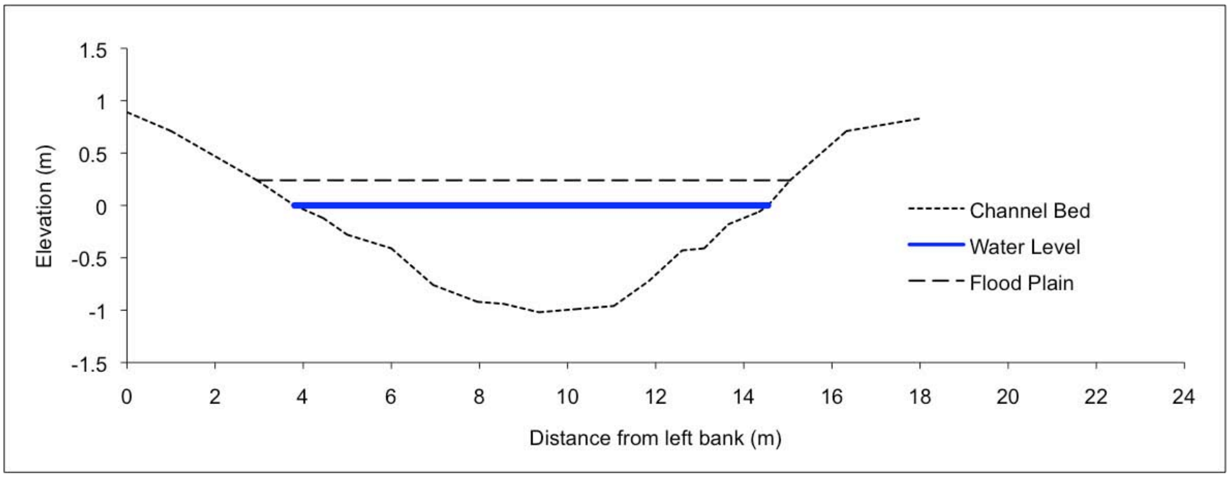
APPENDIX E: Cross-sectional profiles within the sampled reaches of the tributaries examined within the Lake Francis Watershed.



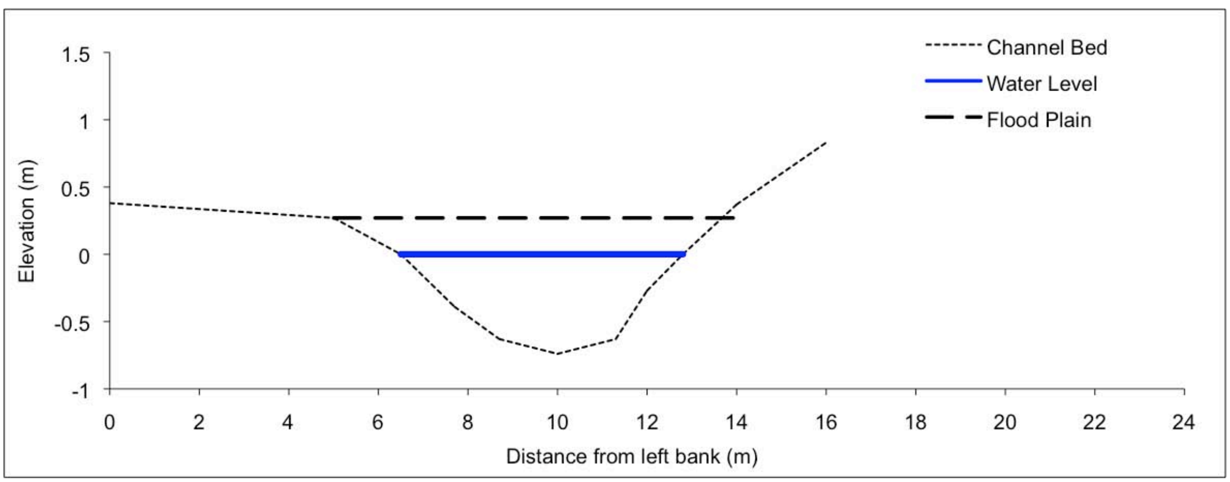




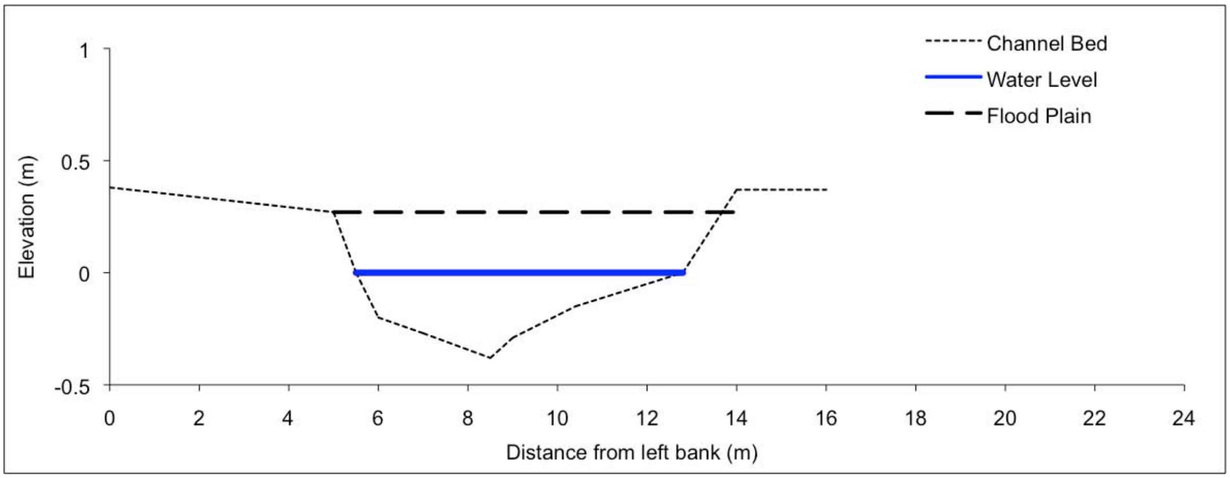
Appendix E-1. Wagon Creek Drain cross-sectional profiles for the upper, middle and lower reaches of the tributary.



Appendix E-2. Swamp Lake Drain cross-sectional profile
.



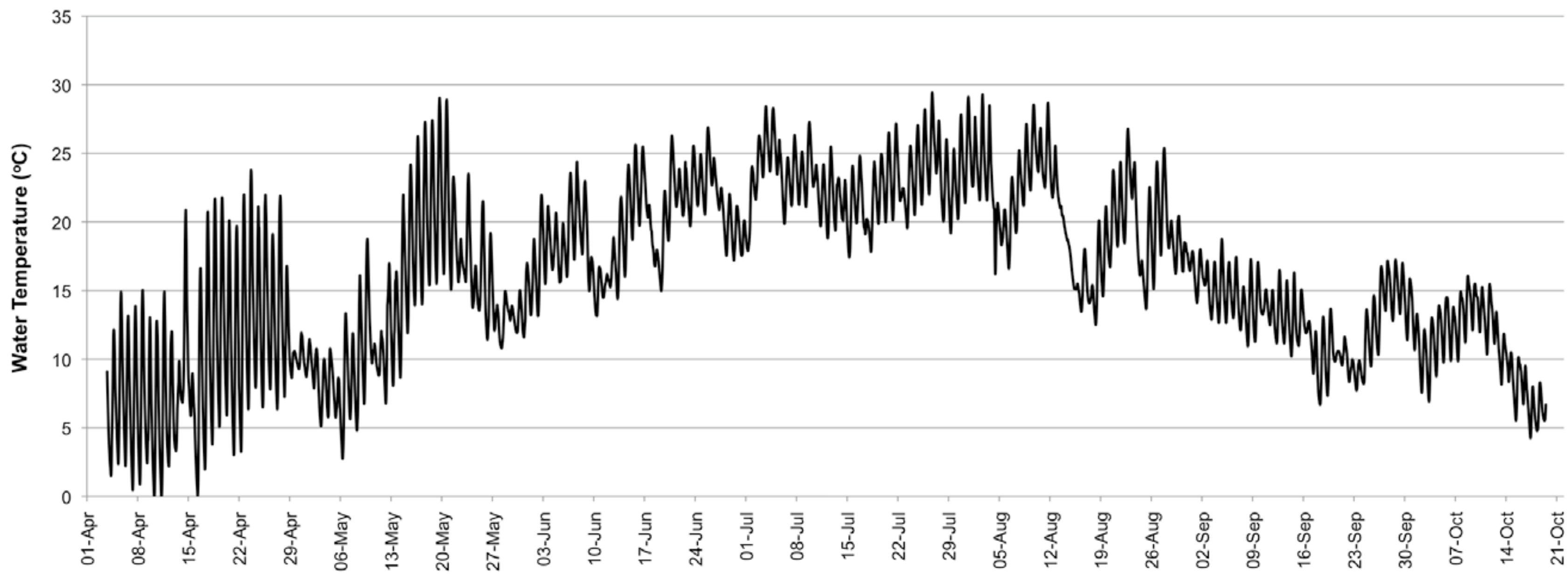
Appendix E-3. Bachman Drain cross-sectional profile.



Appendix E-4. Roy's Drain cross-sectional profiles for the middle reach of the tributary.

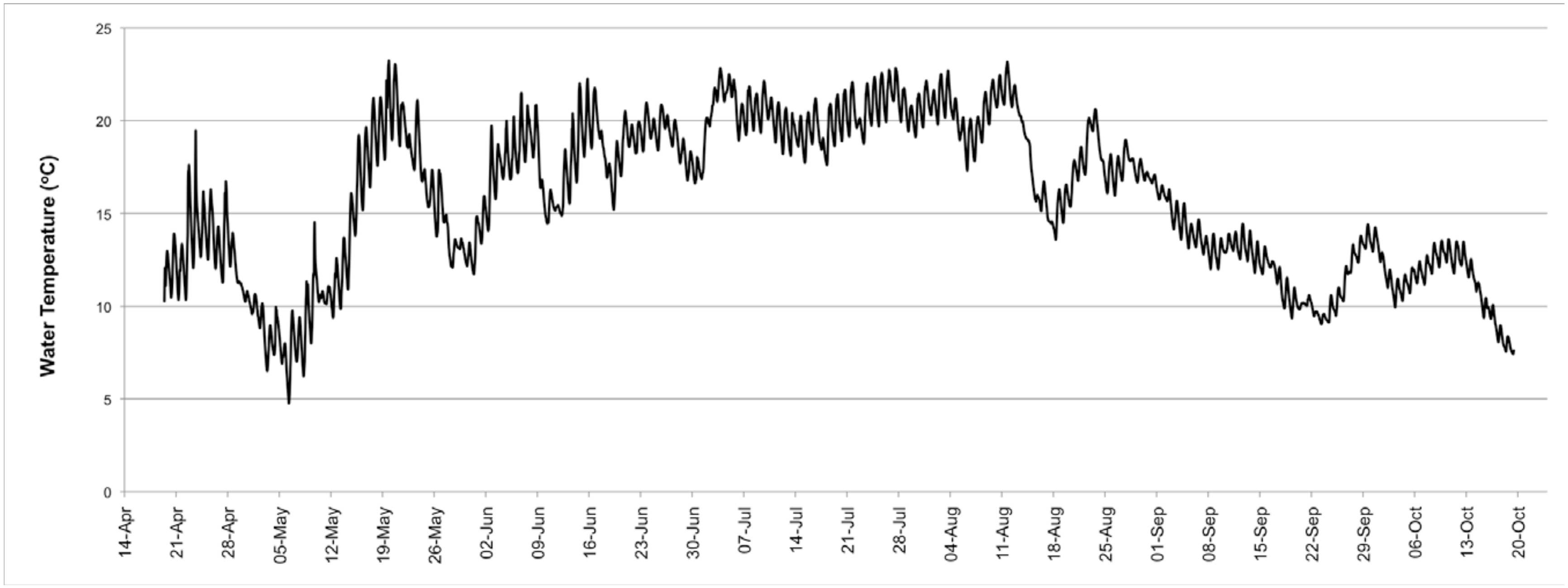
APPENDIX F: Water temperature data for the tributaries within the Lake Francis Watershed.

Water Temperature - Wagon Creek Drain



Appendix F-1. Water temperature within Wagon Creek Drain during the 2010 open water season. Temperature logger was positioned approximately half a mile upstream of PTH 6.

Water Temperature - Lake Francis Drain at Gated Control Structure



Appendix F-2. Water temperature within Lake Francis Drain during the 2010 open water season. The logger was positioned at the gated control structure at the confluence with the Twin Lakes Drain near Lake Manitoba.

Appendix G. Fish collection data for the 2010 Lake Francis Watershed riparian and aquatic survey. Symbols VO – Visual Observation; HN – Hoop-nets; EF – Electrofishing; SH – Seine Haul; DN – Dip netting.

Drain	Date	Method	Effort	Common Name	Genus	Species	# of Fish	FL (mm)	Sex
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	420	--
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	470	M-rr
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	392	F
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	360	m-rr
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	300	M
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	324	F
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	376	F
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	394	?
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	350	F
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	300	M
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	302	M
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	482	F
Lake Francis OC	12-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	1	202	?
Lake Francis OC	12-Apr-10	SH	40 m	Fathead Minnow	*Pimephales*	*promelas*	405	--	--
Lake Francis OC	12-Apr-10	SH	40 m	Spottail Shiner	*Notropis*	*hudsonius*	67	--	--
Lake Francis OC	12-Apr-10	SH	40 m	White Sucker	*Catostomus*	*commersonii*	2	--	--
Lake Francis OC	12-Apr-10	SH	40 m	Brook Stickleback	*Culaea*	*inconstans*	11	--	--
Lake Francis OC	12-Apr-10	SH	40 m	Emerald Shiner	*Notropis*	*atherinoides*	1	--	--
Lake Francis OC	12-Apr-10	SH	40 m	Central Mudminnow	*Umbra*	*limi*	1	--	--
Lake Francis OC	17-Apr-10	SH	40 m	Fathead Minnow	*Pimephales*	*promelas*	303	--	--
Lake Francis OC	17-Apr-10	SH	40 m	Spottail Shiner	*Notropis*	*hudsonius*	102	--	--
Lake Francis OC	17-Apr-10	SH	40 m	White Sucker	*Catostomus*	*commersonii*	10	--	--
Lake Francis OC	17-Apr-10	SH	40 m	Brook Stickleback	*Culaea*	*inconstans*	15	--	--
Lake Francis OC	17-Apr-10	SH	40 m	Emerald Shiner	*Notropis*	*atherinoides*	3	--	--
Lake Francis OC	17-Apr-10	SH	40 m	Central Mudminnow	*Umbra*	*limi*	5	--	--
Lake Francis OC	21-Apr-10	SH	40 m	Fathead Minnow	*Pimephales*	*promelas*	608	--	--
Lake Francis OC	21-Apr-10	SH	40 m	Spottail Shiner	*Notropis*	*hudsonius*	234	--	--
Lake Francis OC	21-Apr-10	SH	40 m	White Sucker	*Catostomus*	*commersonii*	5	--	--
Lake Francis OC	21-Apr-10	SH	16 hr	Brook Stickleback	*Culaea*	*inconstans*	16	--	--
Lake Francis OC	21-Apr-10	SH	16 hr	Emerald Shiner	*Notropis*	*atherinoides*	5	--	--
Lake Francis OC	21-Apr-10	SH	16 hr	Central Mudminnow	*Umbra*	*limi*	6	--	--
Lake Francis OC	23-Apr-10	SH	16 hr	Northern Pike	*Esox*	*lucius*	1	365	F

Appendix G. Continued...

Drain	Date	Method	Effort	Common Name	Genus	Species	# of Fish	FL (mm)	Sex
Lake Francis OC	23-Apr-10	SH	40 m	Fathead Minnow	*Pimephales*	*promelas*	45	--	--
Lake Francis OC	23-Apr-10	SH	40 m	Spottail Shiner	*Notropis*	*hudsonius*	234	--	--
Lake Francis OC	23-Apr-10	SH	40 m	White Sucker	*Catostomus*	*commersonii*	5	--	--
Lake Francis OC	23-Apr-10	SH	40 m	Brook Stickleback	*Culaea*	*inconstans*	16	--	--
Lake Francis OC	23-Apr-10	SH	40 m	Emerald Shiner	*Notropis*	*atherinoides*	7	--	--
Lake Francis OC	29-Jun-10	VO	16 hr	Common Carp	*Cyprinus*	*carpio*	40	4	--
Lake Francis OC	29-Jun-10	ES	16 hr	Common Carp	*Cyprinus*	*carpio*	1	581	--
Lake Francis OC	29-Jun-10	ES	16 hr	Unidentified fry	*Catostomus*	*commersonii*	1000's	--	--
Lake Francis OC	29-Jun-10	ES	16 hr	Central Mudminnow	*Umbra*	*limi*	11	--	--
Lake Francis OC	29-Jun-10	ES	16 hr	Brook Stickleback	*Culaea*	*inconstans*	13	--	--
Lake Francis OC	29-Jun-10	ES	16 hr	Spottail Shiner	*Notropis*	*hudsonius*	4	--	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	420	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	470	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	392	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	360	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	300	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	324	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	376	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	394	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	350	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	300	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	302	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	482	--
Swamp Lake	12-Apr-10	HN	6 hr	White Sucker	*Catostomus*	*commersonii*	--	202	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	383	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	442	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	366	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	378	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	400	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	466	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	441	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	398	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	372	--

Appendix G. Continued...

Drain	Date	Method	Effort	Common Name	Genus	Species	# of Fish	FL (mm)	Sex
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	445	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	441	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	385	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	366	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	327	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	344	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	422	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	426	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	355	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	298	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	409	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	226	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	365	--
Swamp Lake	17-Apr-10	HN	5.5 hr	White Sucker	*Catostomus*	*commersonii*	--	450	--
Swamp Lake	17-Apr-10	HN	5.5 hr	Northern Pike	*Esox*	*lucius*	--	444	F
Swamp Lake	17-Apr-10	HN	5.5 hr	Northern Pike	*Esox*	*lucius*	--	332	F
Swamp Lake	17-Apr-10	HN	5.5 hr	Northern Pike	*Esox*	*lucius*	--	330	F
Swamp Lake	17-Apr-10	HN	5.5 hr	Northern Pike	*Esox*	*lucius*	--	445	F
Swamp Lake	21-Apr-10	HN	6.5 hr	Walleye	*Sander*	*vitreus*	--	584	--
Swamp Lake	21-Apr-10	HN	6.5hr	Walleye	*Sander*	*vitreus*	--	580	--
Swamp Lake	21-Apr-10	HN	6.5 hr	Walleye	*Sander*	*vitreus*	--	689	--
Swamp Lake	21-Apr-10	HN	6.5hr	White Sucker	*Catostomus*	*commersonii*		--	--
Swamp Lake	21-Apr-10	HN	6.5 hr	White Sucker	*Catostomus*	*commersonii*	--	436	--
Swamp Lake	21-Apr-10	HN	6.5hr	White Sucker	*Catostomus*	*commersonii*	--	430	--
Swamp Lake	23-Apr-10	HN	4.5 hr	White Sucker	*Catostomus*	*commersonii*	--	418	--
Swamp Lake	23-Apr-10	HN	4.5 hr	White Sucker	*Catostomus*	*commersonii*	--	425	--
Swamp Lake	30-June-10	EF	402 s	Brook Stickleback	*Culaea*	*inconstans*	35	492	--
Swamp Lake	30-June-10	EF	402 s	Central Mudminnow	*Umbra*	*limi*	8	394	--
Swamp Lake	30-June-10	EF	402 s	Fathead Minnow	*Pimephales*	*promelas*	15	387	--
Swamp Lake	30-June-10	EF	402 s	Northern Pike	*Esox*	*lucius*	4	~150	--
Bachman Drain	19-Apr-10	EF	384 s	Northern Pike	*Esox*	*lucius*	2	~150	--
Bachman Drain	21-Apr-10	SH	40 m	Northern Pike	*Esox*	*lucius*	3	~150	--
Bachman Drain	23-Apr-10	HN	40 m	Northern Pike	*Esox*	*lucius*	1	~150	--

Appendix G. Continued...

Drain	Date	Method	Effort	Common Name	Genus	Species	# of Fish	FL (mm)	Sex
Bachman Drain	30-Jun-10	SH	40 m	Northern Pike	*Esox*	*lucius*	3	--	--
Bachman Drain	30-Jun-10	SH	40 m	Central Mudminnow	*Umbra*	*limi*	2	--	--
Bachman Drain	30-Jun-10	SH	40 m	Yellow Perch	*Perca*	*flavescens*	1	--	--
Wagon Creek Drain	19-Apr-10	EF	551 s	Central Mudminnow	*Umbra*	*limi*	2		--
Wagon Creek Drain	19-Apr-10	EF	551 s	Brook Stickleback	*Culaea*	*inconstans*	15		--
Wagon Creek Drain	19-Apr-10	EF	434 s	Central Mudminnow	*Umbra*	*limi*	8		--
Wagon Creek Drain	19-Apr-10	EF	434 s	Brook Stickleback	*Culaea*	*inconstans*	25		--
Wagon Creek Drain	19-Apr-10	EF	331s	Northern Pike	*Esox*	*lucius*	1	162	--
Wagon Creek Drain	19-Apr-10	EF	331s	Central Mudminnow	*Umbra*	*limi*	2	--	--
Wagon Creek Drain	19-Apr-10	EF	331 s	Brook Stickleback	*Culaea*	*inconstans*	40	--	--
Wagon Creek Drain	19-Apr-10	EF	331 s	Fathead Minnow	*Pimephales*	*promelas*	4	--	--
Wagon Creek Drain	29-Jun-10	EF	805 s	Yellow Perch	*Perca*	*flavescens*	--	--	--
Wagon Creek Drain	29-Jun-10	EF	805 s	Central Mudminnow	*Umbra*	*limi*	--	--	--
Wagon Creek Drain	29-Jun-10	EF	805 s	Brook Stickleback	*Culaea*	*inconstans*	--	--	--
Wagon Creek Drain	29-Jun-10	EF	805 s	Fathead Minnow	*Pimephales*	*promelas*	--	--	--
Wagon Creek Drain	29-Jun-10	VO	805 s	Common Carp	*Cyprinus*	*carpio*	--	--	--
Laurentia Drain	24-Apr-09	SH	40 m	Fathead Minnow	*Pimephales*	*promelas*	~25	--	--
Laurentia Drain	24-Apr-09	SH	40 m	Brook Stickleback	*Culaea*	*inconstans*	~100	--	--
Laurentia Drain	24-Apr-09	SH	40 m	Central Mudminnow	*Umbra*	*limi*	~20	--	--

APPENDIX H: Potential Rehabilitation Sites.

Appendix H. A list of potential rehabilitation sites to improve water quality and fish habitat within the Lake Francis Watershed.

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Lake Francis	Barrier to Fish Movement	- a stoplog control structure obstructs fish movement to Lake Francis - Plenty of valuable fish habitat was documented upstream	- Work with the LFWMA to better manage operation of screen on control structure to allow fish passage of native species	- allow fish to reach upstream spawning and nursery habitat	N50.35721	W97.94380
Swamp Lake Drain	Barrier to Fish Movement	- fences used to control beaver activity within the creek provide a barrier to fish movement - Plenty of valuable fish habitat was documented upstream	-remove barrier during spring spawning runs - manage use of barrier better, completely remove from waterway when not in use	- allow fish to reach upstream spawning and nursery habitat	N50.30145	W97.69687
Bachman Drain	Class C Habitat	- reaches upstream and downstream of #6 highway flow through confined livestock operations - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment.	- provide off site watering stations - fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N50.53014 N50.51580	W98.02504 W98.01280

Appendix H. Continued…

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Wagon Creek Drain	Fish Habitat Enhancement	- enhancement efforts are need to restore the habitat and provide valuable spawning habitat for the fish communities of Lake Manitoba. - Wagon Creek Drain is the largest drain within the watershed and has great potential to provide excellent spawning habitat	- provide additional spawning habitat by constructing spawning shoal or riffles within the channel	- creating spawning habitat to increase the spawning success of Lake Manitoba fish species	N50.47718	W97.97133
Roy's Drain	Class C Habitat	- the habitat downstream of #6 highway flows through unrestricted livestock areas - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment along sections of the drain	- fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N50.35418	W97.86781
Ennis Marsh	Barrier to Fish Movement	- Gravel bar has blocked channel and prevented fish from reaching Ennis Marsh Gated culverts also restrict fish movement into Ennis Marsh - Plenty of valuable fish habitat was documented upstream	- Remove barrier yearly Manage culverts to allow native fish to enter marsh	- allow fish to reach upstream spawning and nursery habitat	N50.43703	W97.97075

Appendix H. Continued…

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Wagon Creek Drain	Fish Habitat Enhancement	- There is limited cover within all drains of the watershed -By increasing vegetation (shrubs and trees) along the riparian zone fish habitat diversity is gained.	- plant willows, shrubs, or trees along Wagon Creek Drain to provide additional habitat cover for fish	- provide fish with increased habitat and protection	N50.41818	W97.82811
Swamp Lake Drain	Riparian Zone Enhancement	- The riparian zone immediately upstream of PTH 518 is encroaching upon waterway.	- move fence back 10 m to allow riparian zone to naturally re-vegetate	- provide shade, increase fish habitat, and improve water quality	N50.30159	W97.70024