Water Balance in the Holland Marsh
Project Proposal

Globomatics Inc.

DIG
DRAINAGE INVESTMENT GROUP

GIS Geospatial Management
Niagara College

nc Niagara College Canada

Globomatics Inc.

Project ID: 201415-07

12/5/2014

December 5, 2014
Project ID: 201415-07

Mr. Brett Ruck
Executive Director
Drainage Investment Group
4321 Queen Street
Niagara Falls, Ontario
L2E 2K9

Dear Mr. Ruck

RE: Project Proposal Report – Water Balance in the Holland Marsh

Please accept this letter as Globomatics Inc.'s formal submission for Project 201415-07: Water Balance in the Holland Marsh for the Drainage Investment Group.

The goal of this project is to calculate the water balance of the Holland Marsh and identify areas of high susceptibility to nutrient intake. The project will provide an understanding of climatic trends within the Holland Marsh, allowing for greater land management practices. These goals will be reached by completing the following objectives:

- Obtain and manage meteorological data.
- Undertake an analysis of meteorological data over the previous decade.
- Identify potential areas of increased nutrient loading.

This document outlines the proposed schedule for the water balance project, including major tasks, methodology, and the budget, along with the benefits and potential risks.

This project has begun as of October 2014 and will run until June 2015, concluding with a formal report and presentation. The total cost of this project is $44,400.00, to be covered by Globomatics Inc. in collaboration with Niagara College.

If you have any questions or concerns about the details contained in this document, please feel free to contact us at josh8valenti@gmail.com or by phone at (905) 515-2666.

Regards,

Josh Valenti
BSc (Hons.) Physical Geography
GIS-GM Graduate Certificate Candidate
J.V/

Enclosures: Project 201415-07 Water Balance in the Holland Marsh
Cc: Ryan Roque – GIS Analyst, Ian Smith – Project Advisor

Executive Summary

Globomatics Inc. is a newly founded consulting organization created in association with Niagara College, in September of 2014. The company strives to provide the best quality geospatial solutions for Southern Ontario for both private and public organizations. Their technical and management skills in conjunction with GIS and professional expertise of advisor, Ian Smith, will provide the client (DIG) with a unique business opportunity.

The main deliverables for this project will include three presentations and reports. The first phase will conclude with a proposal presentation and report, which will be completed on December 5, 2014. The second phase consists of a presentation and report, outlining the progress done in terms of data collection and data development. The final phase will finalize the water balance project with a concluding presentation and report, summarizing the analyses done in the Marsh.

The successful completion of the project poses a few financial, technologies, technical, and product risks. A proposed schedule is outlined, with the total work coming to 435 hours. The cost for this project is estimated to be approximately $44,400.00, which includes project resources such as personnel, software, and initial costs. By following these projected work and budget estimates, the study can be completed successfully by June 12, 2015.

Through the investigation of the water balance in the Holland Marsh, this study will be contributing to a much larger overall project. Globomatics, in collaboration with DIG and Niagara College, will be providing this analysis for the benefit of any future river restoration and management initiatives.

As will be outlined in this proposal report, Globomatics Inc., in association with Niagara College is strongly qualified for the successful completion of this project.

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1. Introduction

1.1. Project Background

The Holland Marsh is a remarkably unique area in terms of farmland and agricultural activity. The Marsh is referred to as the "Salad Bowl of Ontario" because of its fertile soil and ability to grow a wide variety of fresh produce. Located in Bradford, Ontario, Canada, the Holland Marsh is one of only two designated Specialty Crop Areas in Ontario, along with the Niagara Peninsula's Tender Grape and Fruit Area (Greenbelt, 2014). Covering an area of 2900 hectares, the Holland Marsh is home to approximately 250 farms with 100 farmers. The main crops produced include carrots and onions, with each contributing to approximately 40% of total crop yield. Annually, the Marsh produces over one billion dollars in revenue with some of the most productive soil in Canada (Ontario Ministry of Agriculture, Food and Rural Affairs, 2013).

1.2. Project Understanding

The Marsh was drained in the early 1920's strictly for agricultural use. This process consisted of the building of the canal that travels along the north and the south borders of the marsh, allowing for the Holland River to flow through the heart, draining north into Cook's Bay of Lake Simcoe. Over the last decade, the Holland Marsh has experienced drainage issues, causing valuable land to flood and as a result, destroying crops. Along with flooding, soil erosion has become a primary concern, as the water flow has become a key factor in depleting the land available for agricultural production.

To mitigate against such events from destroying the land, a water balance will be determined. A water balance is an analysis over an area calculating the amount of incoming water and outgoing water flow fir a system. A surplus of water has been occurring recently within the marsh, causing fields to be completely submerged under water. A surplus occurs when the amount of incoming water (precipitation, inflows from surface and groundwater) exceeds that of the storage capacity and the output of a system.

1.3. Study Area

The location of the study area is the very fertile Holland Marsh. The Holland Marsh contains some of Canada's most fertile soil.. Located in Bradford, Ontario, the Holland Marsh is located 50 kilometers north of Toronto, producing more than 95% of Toronto's Asian greens. The ability to grow and harvest one billion of produce per year, is a result of the incredibly fertile muck soil. Figure 1, on the following page shows the location of the Holland Marsh.

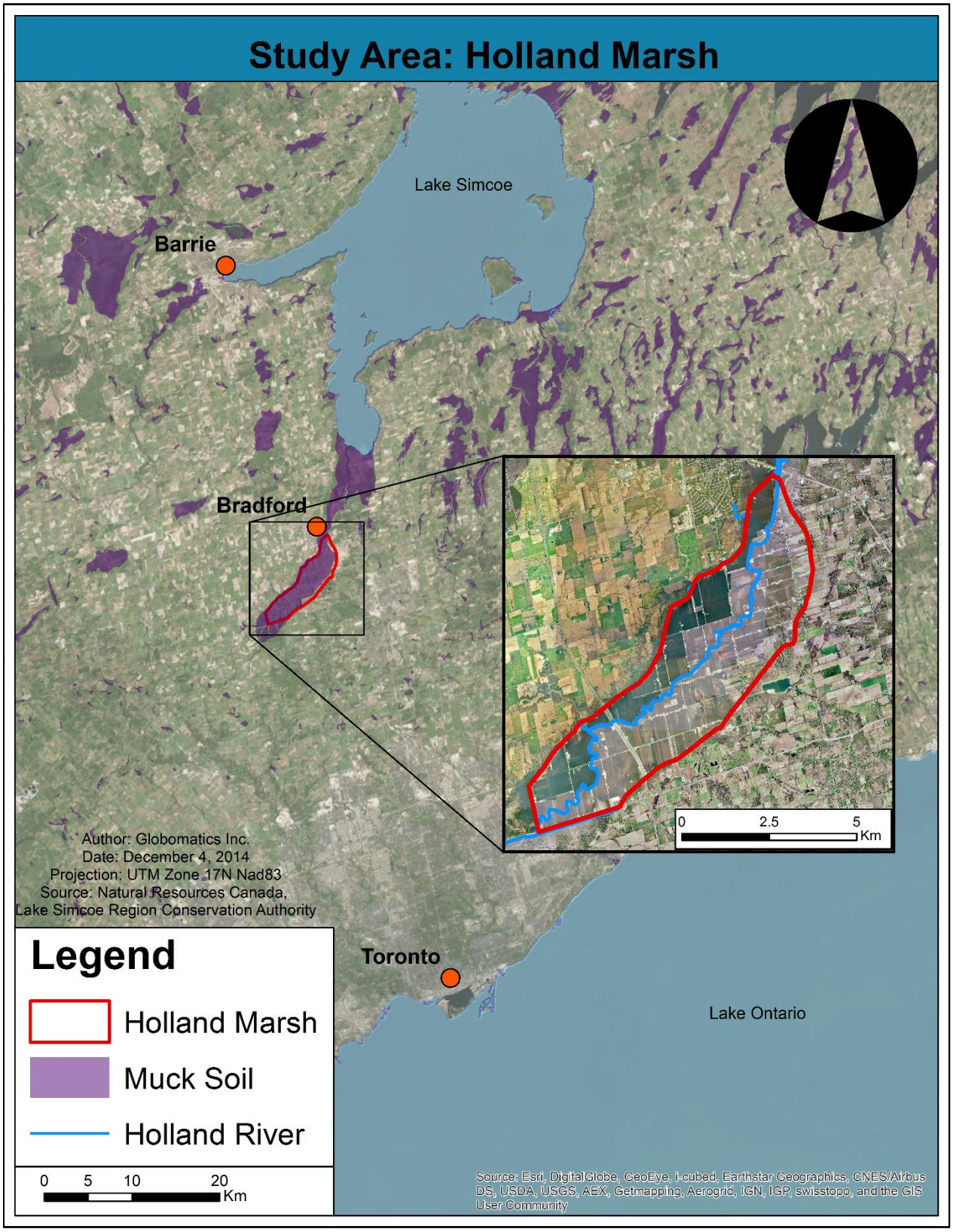


Figure 1 - Study Area: Holland Marsh

2. Project Goal and Objectives

2.1. Project Goal

The overall goal is to calculate the water balance of the Holland Marsh and identify areas of high susceptibility to nutrient intake. This will be done by initiating an analysis of climate data in the Holland Marsh area. By investigating past climatic trends such as temperature, precipitation, and major storm events, the water balance can be calculated to highlight areas vulnerable to nutrient loading.

2.2. Project Objectives

To calculate the water balance of the Holland Marsh, an analysis of climate data from the last decade will be undertaken to identify trends in climatic variables (Temperature, Precipitation, Storm Events, etc.). From there, potential areas of increased nutrient loading to the Holland Marsh River will be analyzed (more particularly, nitrogen and phosphorus, produced from agricultural activities). In return we will be able to identify areas that have excess or deficit of water within the lower South-West region of the Marsh.

The goal of this project will be reached by following and completing the following objectives:

- Obtain and manage meteorological data;
- Undertake an analysis of meteorological data from the previous decade, identifying trends in climatic variables;
- Identify potential areas of increased nutrient loading to the Holland Marsh River (primarily nitrogen and phosphorous).

Identify the areas that have excess or deficit of water into the lower part (South-West) of the Holland Marsh River watershed.

2.3. Project Deliverables

The goal and objects stated above will be initiated, starting in October 2014, and completing in June 2015. The project deliverables are outlined below in Table 1, including expected submission dates and estimated work hours required to complete each stage.

Table 1 - Project Deliverables

Deliverable	Submission Date	Status
Project Overview Statement	November 11, 2014	Complete
Project Proposal	December 5, 2014	In Progress
Project Progress Report	March 20, 2015	Incomplete
Final Project Report	June 12, 2015	Incomplete

3. Project Team

The following is a summary of the project team, however further details can be reviewed via the Curriculum Vitae section in Appendix C.

3.1. Globomatics Inc.

Globomatics Inc. is a newly founded consulting organization created in association with Niagara College, in September of 2014. The company strives to provide the best quality geospatial solutions for Southern Ontario for both private and public organizations. The Globomatics Inc. team consists of founder and Project Manager Josh Valenti and GIS Analyst Ryan Roque. Their technical and management skills in conjunction with the GIS and professional expertise of advisor, Mr. Ian Smith, will provide the client (Drainage Investment Group) with a unique business solution.

3.2. Josh Valenti, Project Manager, BSc (Honours), GIS: GM Certificate Candidate

Mr. Josh Valenti is the founder of Globomatics Inc. a GIS consulting firm based out of St. Catharines, Ontario. Obtaining an Honours BSc in Physical Geography at Brock University, Mr. Valenti is currently furthering his knowledge and understanding within the Geospatial industry as he currently attends the GIS: Geospatial Management graduate program at Niagara College. Over his years in academia, Mr. Valenti has gained experience in project management situations that will ensure this project meets both the required deadlines and the high quality work the client is expecting.

3.2.1. Project Experience

Mr. Valenti has several years of experience within the geomatics industry prior to the founding of Globomatics Incorporated. Through his academic career at Brock University, Mr. Valenti has gained several years of experience within remote sensing image analysis, ArcGIS and cartographic applications.

In previous years, Mr. Valenti has completed a wide variety of projects displaying such applications. The following projects outline some examples of GIS application experience:

- A water quality analysis of a sub-watershed in southern Alberta. This project is an ongoing research paper, connecting a social network analysis geospatially to the watershed and its impact on the surrounding watershed.
- Completion of a research project on nitrogen concentration in surface water, and how it varies from change in surrounding landscape (land-use/land-cover).
- Completion of a climatic research project using satellite imagery and land-use/lan-cover classification to measure the Urban Heat Island over the Greater Toronto Area between 1987 and 2005.

In addition to the previous research projects, Mr. Valenti has also gained experience in Project Management and Public Speaking:

- Organized and co-chaired the student Geomatics Paper Session at the Canadian Association of Geographers.
- Presented and co-authored three papers presented at the 2014 Canadian Association of Geographers Conference.

3.3. Ryan Roque, GIS Analyst, BSc (Honours), GIS: GM Certificate Candidate

Mr. Ryan Roque is currently an undergraduate student attending Brock University in St. Catharines, Ontario. He began his post-secondary studies in 2012 and is majoring in Physical Geography with a concentration in Geomatics. Through this four year university program, Mr. Roque has been able to enroll in the Niagara College post-graduate certificate program in Geographic Information Systems - Geospatial Management prior to completing his undergraduate studies.

Ryan's key responsibilities in this project will include:

- Identification of areas vulnerable to nutrient loading in the Holland River.
- Creation of maps to illustrate any major findings.
- Contribution towards the proposal, progress, and final presentations and reports.
- Collection of data for the analysis of climatic trends in the Marsh and correlations to water balance.

3.3.1. Project Experience

As a current undergraduate student, Ryan has gained experiences through courses completed at Brock University. His skills developed through geomatics based courses, such as Geographic Information Systems and Remote Sensing, will be extremely valuable when dealing with geospatial analyses of the Holland Marsh. Specifically, Ryan effectively implemented a study on the impacts of a soil contamination site last year. This process was extremely rewarding as it helped him to build a solid foundation of project

planning, data collection, data processing, and map production. Furthermore, Ryan has completed a variety of physical geography courses which will allow him to gain a better understanding of this project. Courses such as Water Resources, Soil Science and Geomorphology in particular, has provided him with sufficient knowledge of analysis and research techniques.

In addition to being a student, Ryan is also employed at Niagara College as a GIS Research Assistant for Niagara Research. Through his work, he has gained valuable experience with precision agriculture techniques and applications. In his time working with Niagara College, Ryan has developed research, time management, and organizational skills.

3.4. Ian Smith, Project Advisor, B. Math, MSc, OLS, OLIP, EP

Globomatics Inc. in association with Niagara College would like to acknowledge the addition of professional advisor Mr. Ian Smith to the project team. Mr. Ian Smith offers years of expert advice within the Geospatial industry. With the completion of a MSc in Fluvial Geomorphology and a founding member of Trout Unlimited Canada, Niagara's Chapter, Mr. Smith has had a successful career within the Geospatial industry.

3.5. Client Overview – Drainage Investment Group (DIG)

Drainage Investment Group (DIG) is a not-for-profit organization that secures funding to allow for environmental enhancements to Municipal Drains (Drainage Investment Group, 2014). With the application of these enhancements, DIG aims to provide societal benefits by improving water quality and fostering better water management. By working in collaboration with educational institutions, environmental associations and various levels of government, DIG provides a science-based program. The Water Balance project is a preliminary study supporting the restoration of the Holland Marsh.

4. Proposed Major Project Tasks

The proposed major project tasks can divided into three main phases. Each of these phases are within the timespan of one term, concluding in formal reports and presentations. For a detailed account of proposed tasks, scheduling and cost estimates, refer to the Gantt Chart in Appendix D.

4.1. Project Management

For the purpose of accountability, in reference to work performed for the completion of this project, a series of meetings and status reports will take place, bi-weekly. A set of meetings will take place with the Globomatics Team, and the Project Advisor Ian Smith, while another set will take place with the client (DIG). During these meetings, bi-weekly status reports will be constructed and presented to all parties, ensuring that any concerns or questions from both the client and the consultant are addressed on a regular basis. The project management expectations are summarized in the Gantt Chart in Appendix D, including estimated working hours, duration, and status of each task.

4.2. Project Initiation

The first phase consists of initiation and planning of the project. Familiarization of the key goals, objectives and deliverables are critical in this stage. As the beginning phase of the project, most of the duration will include initial research of the Holland Marsh area in order to gain a complete understanding of the study site. This phase begins right after the Project Acceptance Confirmation (September 16, 2014) and is concluded with this Formal Project Proposal Report (December 5, 2014). Table 2 outlines the main tasks required for the completion of phase 1. Highlights of project initiation include a Site Visit with DIG, in which Globomatics travelled to the Holland Marsh to gain background information for their project.

Table 2 – Phase 1

Phase 1: Project Initiation
Deliverable 1.1: Project Acceptance Confirmation (September 16, 2014)
Deliverable 1.2: Project Kick-off Meeting (October 3, 2014)
Deliverable 1.3: Project Overview Statement (POS) (November 11, 2014)
Deliverable 1.4: DIG Holland Marsh Site Visit (November 28, 2014)
Deliverable 1.5: Project Proposal Presentation (December 2, 2014)
Deliverable 1.6: Project Proposal Report (December 5, 2014)

4.3. Progress Report

In the second phase, the main focus will be data collection and data evaluation. The data required to produce and run the water balance model will be collected, managed and manipulated. The results of this phase will then be summarized by means of a progress presentation and report. The proposed tasks are indicated below in Table 3.

The main sources of data required to complete the project, is a set of meteorological data over the past decade. This data is proposed to be collected by Globomatics and will take up the majority of the data collection period. The data provided by DIG, was retrieved in early November and contains orthoimagery, digitization of the Holland River, and elevation of the Marsh. Following the collection of data, a geodatabase is scheduled to be created and managed in January of 2015.

Table 3 - Phase 2

Phase 2: Data Evaluation and Progress Report
Deliverable 2.1: Data collection (November 2014 – March 2015)
Deliverable 2.2: Geodatabase Creation (January 2015)
Deliverable 2.3: Bi-weekly status reports (January 2015 – May 2015)
Deliverable 2.4: Project Progress Presentation (March 2015)
Deliverable 2.5: Project Progress Report (March 2015)

4.4. Project Finalization

This final phase will wrap-up the project, providing a detailed report and presentation that will highlight the findings of the Water Balance study in the Holland Marsh, completion dates shown below in Table 4.

Table 4 - Phase 3

Phase 3: Preparation of Final Report and Presentation
Deliverable 3.1: Final Project Presentation (June 2014)
Deliverable 3.2: Final Project Report (Hardcopy and digital) (June 12, 2014)

5. Resources

To undertake the Water Balance within the Holland Marsh a set of data and tools will be needed. The Drainage Investment Group along with Niagara College have provided a large portion of the resources while Globomatics Inc. will be responsible for the remaining.

5.1. Required Data

Data provided by the Drainage Investment Group covers the South-West portion of the marsh. This data set consists of orthoimagery with a spatial-resolution of 4mm, a Digital Elevation Model (DEM), and a digitized drainage polygon. Climatic Data will also be a main aspect to complete the water balance. This data has not been provided, and will be collected by Globomatics Incorporated.

5.2. Required Software

To complete this project, ArcGIS Desktop will be used for the geospatial analysis portion and the Microsoft Office Suite will be used for reports, presentations, and project management. The required Software packages will be provided by Niagara College.

5.3. Required Hardware

The computer hardware and stationary equipment required to complete this project has been provided by Niagara College. The Globomatics team has acquired access to the needed hardware 24 hours a day, 7 days a week, to complete all tasks and meet all deadlines.

6. Proposed Methodology

The following section will provide a brief summary of all major project tasks required to meet the goals and objectives previously stated. For a full summary of tasks and budget, please refer to the Gantt Chart located in Appendix D.

6.1. Project Research

A background literature review will be completed at this stage of the project. The background research will provide Globomatics Inc. with a thorough understanding of water balance, with a review of previous studies regarding water balance, and specific calculation techniques in vulnerable agricultural areas.

6.2. Data Collection

To complete this project, a large variety of data must be collected and subsequently processed. DIG has previously provided Globomatics with a set of data to initiate the project. These data consists of:

- Orthoimagery with a 4mm spatial resolution of the southwest portion of the marsh.
- Digitized polygon of the Holland River, southwest portion.
- Elevation derived from the orthoimagery of the southwest portion of the marsh.

In addition to the data acquired from DIG, Globomatics will have to collect the meteorological data for the Holland Marsh. There are no climate stations found within the marsh itself, however Environment Canada has a wide number of stations surrounding the marsh. These data will be collected, organized, and placed into a database, for the past decade.

6.3. Assemble Geodatabase

Once Globomatics has acquired all the data, this data will be organized, and quality checked. Once everything has been verified, a database of the meteorological data will be created. Following the creation of a meteorological database, a geodatabase will be constructed over the Holland Marsh with all the necessary datasets.

6.4. Data Processing

Once everything is organized, verified and ready for processing, the meteorological data will be interpolated. Since there is no climate stations within the marsh, an interpolated dataset will be constructed. The surrounding stations will undergo statistical analysis to acquire an accurate climatic dataset covering the Holland Marsh.

After the meteorological data has been interpolated across the Holland Marsh, climatic maps and graphs will be constructed for the 10-year period. These maps and data will then be incorporated into constructing a model to calculate the water balance for the marsh.

6.5. Project Finalization

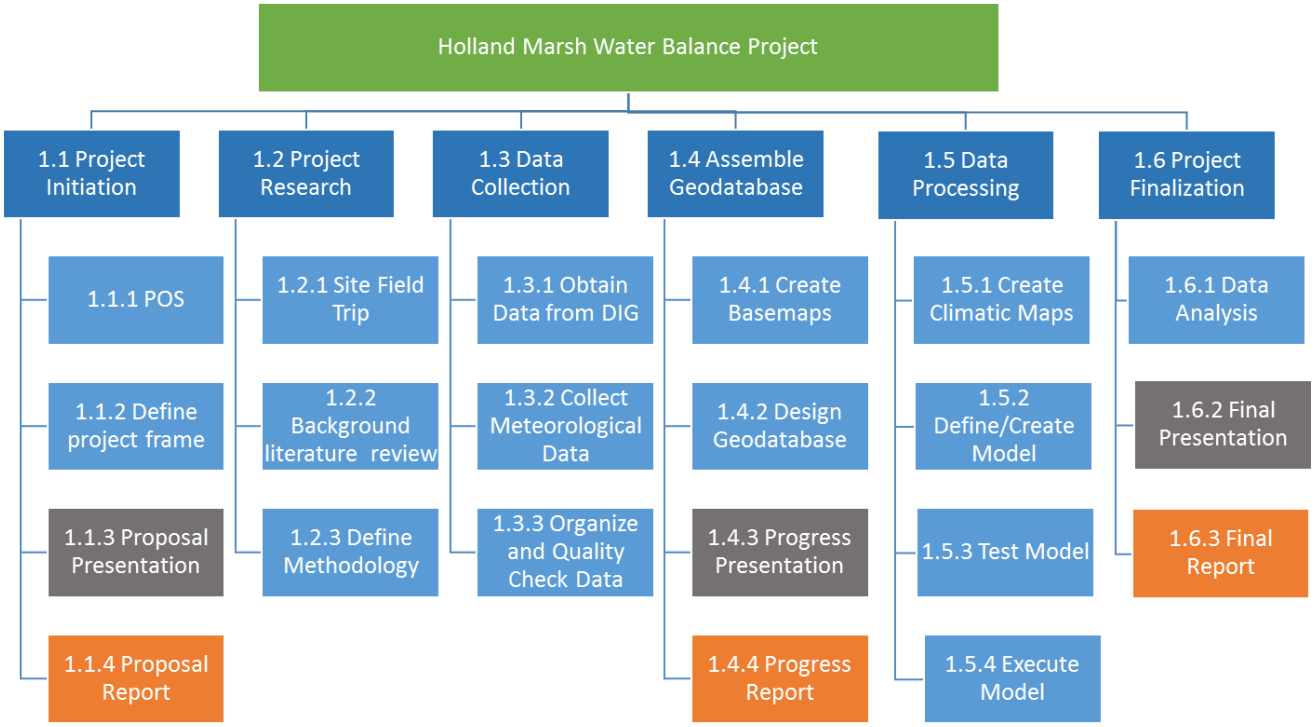
Globomatics will do a thorough data analysis on the climatic trends and water balance within the Holland Marsh. This will conclude with the final report being completed by June 12, 2015, following the project presentation earlier in June, 2015.

7. Project Management

7.1. Work Breakdown Structure

A work breakdown structure (WBS) was created to display and understand the steps that Globomatics will follow in completing this project for the Drainage Investment Group. See Figure 2 below for the complete WBS.

Figure 2 - Work Breakdown Structure



7.2. Schedule

This project began in October 2014, and will be completed by June 14, 2015. Within this time a number of deadlines will be meet, producing a Project Proposal by December 5, 2014 followed by a Project Progress Report by March 2015, concluding with the Project Final Report by June 12, 2015. A complete schedule can be seen below in Table 5.

Table 5 - Schedule

Task Name	Start	Finish
Holland Marsh Water Balance Project	**Wed 10/15/14**	**Fri 6/19/15**
Initial Costs	**Wed 10/15/14**	**Fri 6/19/15**
Computers and Hardware	Fri 6/19/15	Fri 6/19/15
Stationary, Printing, Binding	Fri 6/19/15	Fri 6/19/15
Field Trip Expenses	Fri 6/19/15	Fri 6/19/15
Project Initiation	**Wed 10/15/14**	**Fri 12/5/14**
Project Kick-off Meeting	Fri 10/3/14	Fri 10/3/14
Project Overview Statement	Mon 11/10/14	Tue 11/11/14
Define Project Outline	Wed 11/26/14	Thu 11/27/14
Proposal Presentation	Thu 11/27/14	Tue 12/2/14
Proposal Report	Fri 11/28/14	Fri 12/5/14
Project Research	**Fri 11/28/14**	**Tue 1/27/15**
Site Field Trip	Fri 11/28/14	Fri 11/28/14
Background Literature Review	Fri 11/28/14	Wed 1/21/15
Define Methodology	Tue 1/20/15	Tue 1/27/15
Project Management	**Thu 1/8/15**	**Fri 6/19/15**
Advisor Meeting with Ian Smith (Bi-weekly)	Thu 1/8/15	Fri 6/19/15
Client Meeting with DIG (Bi-weekly)	Fri 1/9/15	Fri 6/12/15
Data Collection	**Thu 10/30/14**	**Fri 2/13/15**
Obtain Data from Client (DIG)	Thu 10/30/14	Wed 1/7/15
Collect Meteorological Data	Fri 12/12/14	Mon 1/12/15
Organize/Quality Check Data	Mon 12/15/14	Fri 2/13/15
Assemble Geodatabase	**Fri 1/16/15**	**Fri 3/20/15**
Create Basemaps	Fri 1/23/15	Wed 1/28/15
Design Geodatabase	Thu 1/22/15	Mon 1/26/15
Progress Report Presentation	Wed 3/18/15	Fri 3/20/15
Progress Report	Mon 3/16/15	Fri 3/20/15
Data Processing	**Thu 3/26/15**	**Fri 5/29/15**
Create comparative maps and graphs of climate change	Thu 3/26/15	Fri 4/10/15
Define/Create Water Balance Model	Mon 5/11/15	Wed 5/20/15
Test Model	Wed 5/20/15	Fri 5/22/15
Execute Model	Fri 5/22/15	Wed 5/27/15
Project Finalization	**Wed 5/27/15**	**Fri 6/12/15**
Climate change analysis	Tue 5/26/15	Fri 5/29/15
Identify areas of increased nutrient loading	Tue 5/26/15	Fri 5/29/15
Report of analysis and methods used	Mon 6/1/15	Wed 6/10/15
Create maps and graphics	Fri 6/5/15	Wed 6/10/15
Final Presentation	Wed 6/10/15	Fri 6/12/15
Final Report	Fri 6/5/15	Fri 6/12/15

7.3. Project Budget

Note: This Project Budget has been prepared for the learning purposes and in no way is the client expected to incur these prepared costs. The value of this project will be donated to the client organization by the student consultants, Niagara College and the advisory staff.

The total budget for project is an estimated $39,300.00 with a 10% contingency built in to account for any unforeseen circumstances that may arise. This budget was then further broken down by work hours allotted to each task (Figure *3*) as well as by cost per task (Figure 4).

Table 6 - Total Budget

Total Budget	$35,700.00
Total + Contingency	$39, 270.00
HST (13%)	$5,100.00
Total + HST	**$44,400.00**

Figure 3 - Work Hours Per Task

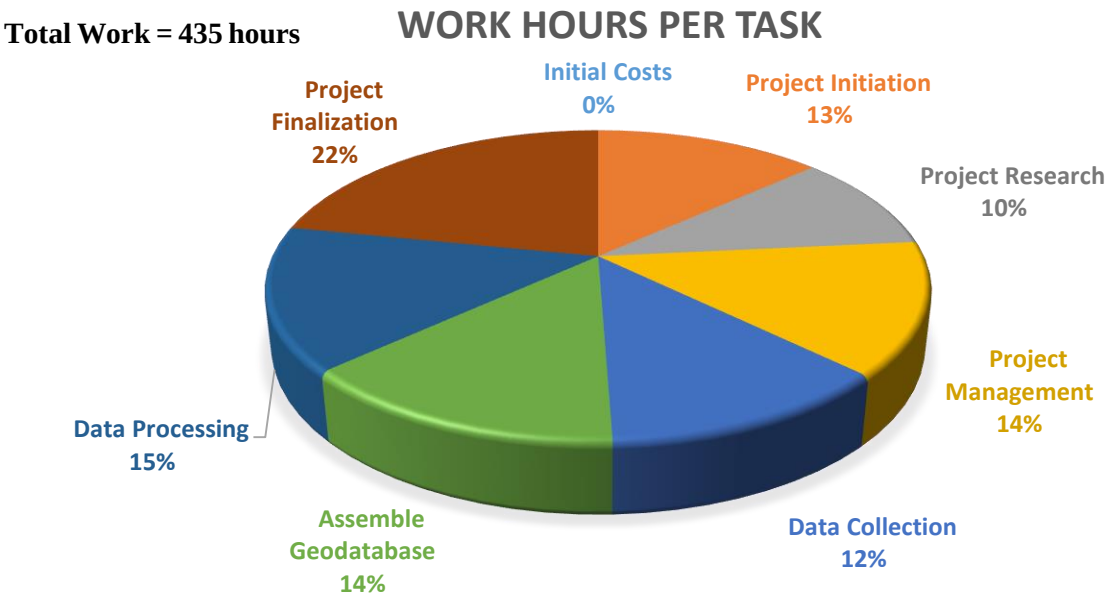
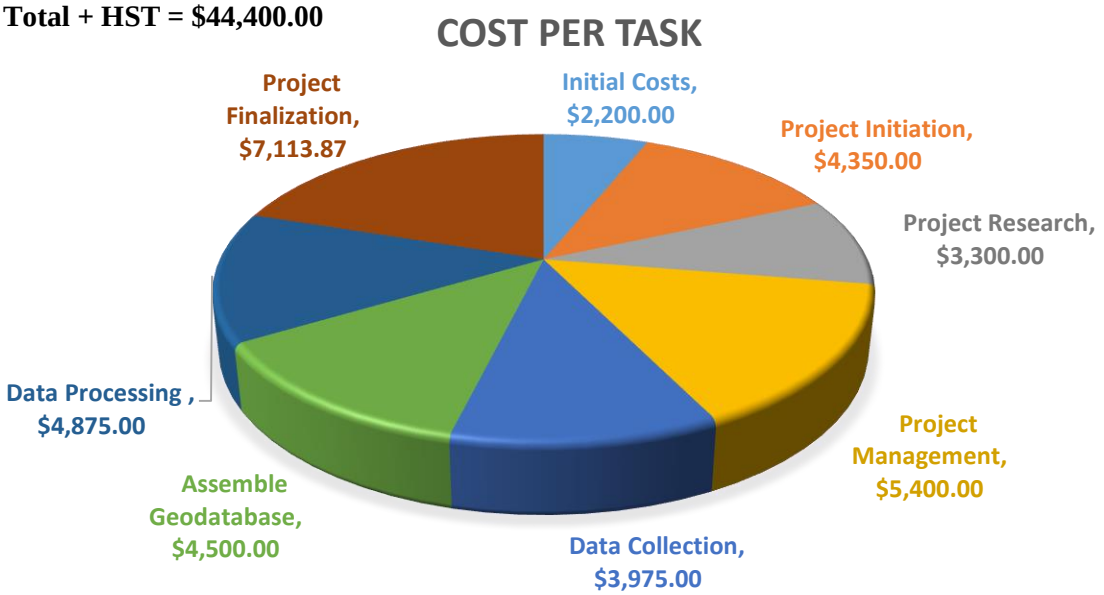


Figure 4 - Cost Per Task

Total + HST = $44,400.00



7.4. Project Resource Cost

To account for the resources used to complete this project, a flat rate of $2,000.00 was allocated to cover the computer hardware and software provided from Niagara College. In addition the project advisor (Ian Smith) will be allocated $150.00 per hour for their expertise while the project manager and project GIS analyst will be allocated $80.00 and $70.00 respectively per hour respectively. Table 7 displays a more detailed breakdown of the project cost.

Table 7 - Budget Breakdown

Task Name	Cost Per Task
Initial Costs	$2,200.00
Project Initiation	$4,350.00
Project Research	$3,300.00
Project Management	$5,400.00
Data Collection	$3,975.00
Assemble Geodatabase	$4,500.00
Data Processing	$4,875.00
Project Finalization	$7,113.87
Contingency	$3,571.39
Subtotal	$39,285.26
HST	$5,107.08
Total	**$44,392.34**

8. Risk Assessment and Challenges

8.1. Assumptions

Assumptions are specific circumstances or events which are critical for this project to be successful. These events are most likely to happen according to the DIG. Some of the main assumptions are:

- Data will be provided by Drainage Investment Group (DIG) and Niagara College,
- Aerial Photography, Digital Elevation Models, etc.,
- Additional data, such as climatic data, will be obtained by Globomatics,
- All the objectives and deliverables can be completed successfully within the given time period,
- Access to the GIS lab, necessary hardware and software will be provided by Niagara College, and
- Additional fieldwork will not be required for an effective analysis of the water balance.

8.2. Risks

With every project, there is some sort of risk. Since this project will not involve any intensive fieldwork, most of our risks pertain to errors in software, data or methodologies.

- All software packages and storage devices may crash, resulting in loss of work and/or data.
    - In order to avoid this, proper use of software and constant back-up practices must be done to keep data safe.
- The data provided and collected may not be entirely correct, accurate or precise.
    - To avoid using incorrect data, a data quality check must be done.
    - Not all obtained data are required to be used.
- Water balance calculation method may not yield an accurate and precise result.
    - Suitable calculation methods must be researched through academic articles.
    - Calculations must be tested multiple times to improve the quality of the results.

8.3. Issues and Constraints

- All deliverables must be fully completed by each set deadline.
    - Major tasks like presentations and reports have a hard deadline.
    - The project must be completed by June, 2015.
- Management of costs and time to keep project under budget and on time.
    - This is essential to ensure that the project runs as scheduled, and also to make sure that the project is finished before the due date.
- Any travel to the Marsh will be difficult due to travel and time restrictions.

- This means that a limited amount of *in-situ* observations can be done.
- Information from site field trips must be valued and taken in account for this study.

9. Conclusion

The Holland Marsh is known to be of significant importance in terms of agricultural practices and growing fresh produce in Ontario. Analysis of climate data is important for the understanding of how historic trends has impacted the area. Further studies of nutrient loading in the water will be initiated to determine the area which are vulnerable to these pollutants produced from agricultural activities. Finally, a water balance model will be created for the calculation of deficit or excess of water levels in the Holland Marsh.

The main deliverables for this project will include three presentation and reports. The first phase will conclude with a proposal presentation and a proposal report which will be completed around December 2014. The second phase consists of a presentation and report, outlining the progress done in terms of data collection and data development. The final phase will finalize the water balance project with another presentation and report, summarizing the analyses done in the Marsh.

Project management is an important aspect when it comes to effectively undergoing this study. A proposed schedule is outlined, with the total work coming to 435 hours. The cost for this project is estimated to be approximately $44,400.00, which includes project resources such as personnel, software, and initial costs. By following these project work and budget estimates, the study can be completed successfully.

By investigating the water balance of the Holland Marsh, this study will be contributing to a much bigger project. Globomatics in collaboration with DIG and Niagara College, will be providing this analysis for the benefit of any future river restoration and management initiatives.

Globomatics Inc. is fully capable of completing this project successfully. Through past GIS experiences and knowledge of physical geography, our team is thoroughly prepared for this task. We are eager and looking forward to be working on this year-long project in collaboration with Drainage Investment Group.

10. Bibliography

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Appendix A: Terms of Reference

GIS Postgraduate Student/Consultant Project for

2014-15

Project ID: **201415-07** (for our office use only)

Contact Person & Organization Details

Contact Person	Name:	Brett Ruck
	Title:	Executive Director
	Telephone:	289-296-0701
	Fax:	
	Email:	bruck@digcorp.ca
Organization	Name:	Drainage Investment Group (DIG)
	Address:	4321 Queen Street, Niagara Falls, ON, L2E 2K9
	Website:	www.digcorp.ca
Date:		

Water Balance in the Holland Marsh

Project Details

Project Background

Project Problem/Opportunity: The Holland Marsh area is known as the "Salad Bowl of Ontario" producing over $1billion in revenue annually from what is possibly the most fertile soil in Canada. This area is made up of 125 farms covering 2900 hectares just 50km north of Toronto in Bradford, Ontario. The Holland River flows through the marsh and drains into Cook's Bay of Lake Simcoe. Of particular concern is the continued infiltration of nutrient contaminates.

Business Goal: To calculate the water balance of the Holland Marsh and identify areas of high susceptibility to nutrient intake.

Primary Project Objectives [Provide a list of the project objectives.]

- Undertake an analysis of climate data from the last decade to identify trends in climatic variables (Temperature, Precipitation, Storm Events, etc.).
- Identify potential areas of increased nutrient loading to the Holland Marsh River, mainly nitrogen and phosphorus.
- Identify the areas that have excess or deficit of water into the lower part (South-West) of the Holland Marsh River watershed.

Primary Project Deliverables [Provide a list of the project objectives.]

- Create comparative maps and graphs of climate change over the last decade.
- Undertake an analysis of climate change in the last decade and their impact on the Holland Marsh River.
- Performed detailed report of the analysis and methods used to calculate the water balance, including maps and graphics

For the Attention of the Students: This project will be used as part of the GIS postgraduate course GISC9302, GISC9309, and GISC9310. Forward letter of interest (including GIS project posting Number) and resume to Janet Finlay (jfinlay@niagaracollege.ca) via WORD attachment by **5 pm, Thursday, September 11, 2014**.

Requirements

Number of students required to complete the project:	2
Equipment required (if any):	None
Data required (if any):	DIG will provide data
Software required (if any):	ArcGIS, Office Suite
Confidentiality	TBD

Appendix B: Project Overview Statement

Project Overview Statement (POS)

Executive Summary

Project Name:	Water Balance in the Holland Marsh
Last Updated Date:	Tuesday, November 11, 2014
Author(s):	Josh Valenti, Ryan Roque
Project Manager(s):	Josh Valenti
Project Members:	Ryan Roque
Client Name:	Brett Ruck (Executive Director), bruck@digcorp.ca, 289-296-0701
Client Organization:	Drainage Investment Group (DIG)

Project Business Case

Business Problem/Issue/Opportunity

The Holland Marsh produces over one billion dollars in revenue annually, from what is possibly the most fertile soil in Canada. The wide variety of fresh produce grown in the area is the reason why it is referred to as the 'Salad Bowl of Ontario'. Located in Bradford, Ontario, the marsh covers 2900 hectares and contains about 250 farms. The Holland River is of particular significance because of its watershed, which flows through the marsh and drains into Cook's Bay of Lake Simcoe.

Project Business Goal

The overall goal is to calculate the water balance of the Holland Marsh and identify areas of high susceptibility to nutrient intake. This will be done by initiating an analysis of climate data in the Holland Marsh area. By investigating past climatic trends such as temperature, precipitation, and major storm events, the water balance can be calculated highlighting areas vulnerable to nutrient loading.

Primary Project Objectives

Primary Project Objectives

- Undertake an analysis of climate data from the last decade to identify trends in climatic variables (Temperature, Precipitation, Storm Events, etc.).
- Identify potential areas of increased nutrient loading to the Holland Marsh River, mainly nitrogen and phosphorus.
- Identify the areas that have excess or deficit of water into the lower part (South-West) of the Holland Marsh River watershed.

Project Benefits

Project Benefits

- Gain knowledge of climatic variables and water balance trends, for future analysis of areas with high susceptibility nutrient intake in the Holland Marsh River.
- Results may be used to develop future monitoring methods for water sustainability and prevention of high nutrient intake.
- Understand where and why the incoming and outgoing water flows in the Holland Marsh area, in order to sustain fertile soil for agricultural activities.

Primary Project Deliverables

Phase 1: Project Initiation

- Deliverable 1.1: Project Acceptance Confirmation (September 16, 2014)
- Deliverable 1.2: Project Kick-off Meeting (October 3, 2014)
- Deliverable 1.3: Project Overview Statement (POS) (November 11, 2014)
- Deliverable 1.4: Project Proposal Presentation (December 2, 2014)
- Deliverable 1.5: Formal Project Proposal (December 5, 2014)

Phase 2: Data Evaluation and Progress Report

- Deliverable 2.1: Data collection (November 2014 - April 2015)
- Deliverable 2.2: DIG Holland Marsh Site Visit (November 28, 2014)
- Deliverable 2.3: Bi-weekly status reports
- Deliverable 2.4: Project Presentation and Progress Report (March 2015)

Phase 3: Preparation of Final Report and Presentation

- Deliverable 3.1: Final Project Presentation (June 2014)
- Deliverable 3.2: Final Project Report (Hardcopy and digital) (June 12, 2014)
- Deliverable 3.2.1: Comparative maps and graphs of climate change over the last decade
- Deliverable 3.2.2: Analysis of climate change in the last decade and their impact on the Holland Marsh
- Deliverable 3.2.3: Details of analysis and methods used to calculate the water balance, including maps and graphics

Project Conditions

Project Assumptions and Risks

Assumptions:

- Data will be provided by Drainage Investment Group (DIG) and Niagara College.
- The objectives can be completed successfully within the course of each time period.
- Access to the GIS lab, hardware and software will be provided by Niagara College.
- Additional fieldwork is not necessarily needed for a successful analysis of the water balance.

Risks:

- All software packages and storage devices may crash, resulting in loss of work and/or data.

- The data provided and collected may not be entirely correct or accurate.
- Suitable calculation method of the water balance must be determined by researching academic articles.

Project Issues and Constraints

- All deliverables must be fully completed by the set deadline.
- Management of costs and time to keep project under budget and on time.
- Any additional fieldwork will be difficult because of time and travel restrictions.

Project Critical Success Factors (Key Performance Indicators)

Project Critical Success Factors

- Completion of reports, presentations and all other deliverables by each deadline.
- Excellent teamwork and communication between team members, project advisor and client.
- Understanding of the tasks required to efficiently and effectively meet each set objective.
- Full utilization of given resources (Personnel, software, data).

Project Duration Estimates

Project Phases	Date Estimate
Project Start Date	2014-09-16
Phase 1: **Project Initiation**	2014-09-16 – 2014-12-05
Phase 2: **Progress Report and Data Evaluation**	2014-11-01 – 2015-03-20
Phase 3: **Preparation of Final Report and Presentation**	2015-03-20 – 2015-06-12
Project End Date	2015-06-12

- **APPROVALS (sign on the dotted lines)**

PREPARED BY ..... **DATE** .....
(PROJECT MANAGER)

APPROVED BY ..... **DATE** .....
(PROJECT / EXECUTIVE / CLIENT SPONSOR)

By signing this document, the above objectives, statements and dates have been agreed upon. However, due dates are only an estimate and are qualified to change based on certain situations and issues.

Refer to http://www.tenstep.com/open/miscpages/94.3Glossary.html for terms used in this document.

Appendix C: Curricula Vitae

LYDIAN ENVIRONMENTAL CONSULTING

21 Longspur Circle
Fonthill
ON L0S 1E2
Tel: 905.321.2331
eMail:
ismith@Lydenv.com

IAN D. SMITH, B. MATH., M. SC., OLS, OLIP, EP

PRINCIPAL/FLUVIAL GEOMORPHOLOGIST

Ian Smith is a Fluvial Geomorphologist and a Land Information Specialist with specialized experience in erosion control, bank stabilization, and natural channel design plus the design of constructed wetlands for residential, municipal, landfill, agricultural and industrial wastewater treatment. Ian has extensive practical experience developing GIS and geomatics systems for a wide variety of applications including river/stream systems analysis, ecosystem and environmental analysis and infrastructure management. Ian led the team that designed the award winning (OPWA Project of the year, 2008 and SWANA Excellence award, 2010) Chedoke Creek Bank Stabilization/Restoration for the City of Hamilton.

REPRESENTATIVE CLIENTS

- *City of Hamilton*
- *Town of Fort Erie*
- *City of London*
- *City of Brantford*
- *Middlesex County*
- *Regional Municipality of Niagara*
- *City of St. Catharines*
- *Town of Caledon*
- *City of Niagara Falls*
- *Private Property Owners*

REPRESENTATIVE PROJECTS

- *West Hamilton Landfill and Chedoke Creek Phases 1 and 2 (Phase 1: OPWA Project of the Year, 2008; SWANA Bronze Medal Project, 2010, Phase 2: 2014)*
- *Beaver Creek Fluvial Geomorphic Assessment and SAR Habitat Design: 2011*
- *Little Bear Creek/Drain, Channel Stability and SARA/ESA Assessment, DFO: 2014*
- *Thorold, Rice Road Closed Landfill Treatment Wetland Design: 2006; On-going Monitoring: 2006 - 2014*

AFFILIATIONS

- *ECO Canada Certified Environmental Professional (EP)*
- *Professional Surveyor; Designated Geographic Information Manager (OLS/OLIP – GIM)*
- *Society for Ecological Restoration (SER)*
- *Drainage Superintendent's Association Ontario (DSAO)*
- *American Geophysical Union (AGU)*
- *American Society for Photogrammetry and Remote Sensing (ASPRS)*

EXPERIENCE

FLUVIAL GEOMORPHIC ANALYSIS, DESIGN AND PROJECT MANAGEMENT

- ❑ Geomorphic Analysis and Stabilization Works Pre-design, *CNR Rail Channel, City of Woodstock*
- ❑ *Little Bear Creek/Drain* in Chatham-Kent, Stability analysis, exploration of opportunities for drainage improvement and Species-at-Risk habitat enhancement*, Fisheries and Oceans Canada*
- ❑ *Tributary to 12 Mile Creek*, St. Catharines, Design of stabilization structures (Newbury Weirs and Natural Plunge Pool), *Regional Municipality of Niagara and City of St. Catharines*
- ❑ Design of J-Hook Vane structures for energy deflection, Nith River at Paris*, Brant County*
- ❑ Fourteen Mile Creek (Oakville) Meander Assessment/Risk Analysis and Low Impact Design (LID) strategies for SWM facilities (groundwater recharge)*, Infrastructure Ontario*
- ❑ Mohawk Park Slope Stabilization (ephemeral channel), Analysis and Design*, City of Brantford*
- ❑ Upper Humber River Meander Assessment/Risk Analysis, *Private Property Owner, Dufferin Co.*
- ❑ Geomorphic Analysis/Assessment for a tributary to the Thames River ("Watercourse 4"); Design natural channel for high gradient SWM pond outlet, Design Newbury Weirs for energy dissipation and LID water balance protection in an intermittently flowing ravine, Old Victoria Subdivision*, City of London*
- ❑ Geomorphic Assessment of numerous streams crossing proposed Hwy 407 extension*, MTO*
- ❑ Fluvial geomorphic analysis/assessment and SAR habitat design; construction supervision; post construction monitoring, Municipal Drain Preliminary Engineer's Report, Town's Technical Consultant to DFO Species at Risk Working Group: *Beaver Creek, Town of Fort Erie*
- ❑ Fluvial geomorphology, geomorphic field investigations, hydraulic modeling, Old River Road Class EA: *Thames River, Municipality of Middlesex Centre*
- ❑ Hydrologic modeling (HEC-geoHMS), Turk Road Culverts Design: *Northumberland County*
- ❑ Hydrologic modeling (HEC-HMS), Drainage Channel to the Niagara River: *OPG's Sir Adam Beck Generating Station, Niagara Falls*
- ❑ Fluvial geomorphic field investigations, analysis, hydrologic and hydraulic modeling (HEC-HMS and HEC-RAS), rehabilitation plan: *Creditview Drainage Channel, Town of Caledon*
- ❑ Fluvial geomorphic field investigations, analysis, environmental assessment, approvals and design: *Nith River, Paris Landfill Bank Stabilization, County of Brant*
- ❑ Fluvial geomorphic field investigations, analysis, hydraulic modeling (HEC-geoRAS), natural channel design, approvals and construction contract supervision/observation: *Chedoke Creek Restoration; West Hamilton Landfill/Kay Drage Park, City of Hamilton*
- ❑ Fluvial geomorphic field investigations, analysis, hydrologic/hydraulic modeling (HEC-HMS and HEC-geoRAS): *Warren Creek EA; Warren Woods Master Plan, City of Niagara Falls*
- ❑ Assessment of erosion, fluvial geomorphic field investigations and analysis; environmental assessment: *Oakhill Drive Bank Stabilization, Grand River, City of Brantford*
- ❑ Assessment of erosion, fluvial geomorphic field investigations, analysis, approvals; slope stabilization design and construction supervision: *Water Treatment Intake Channel (Grand River), City of Brantford*
- ❑ Fluvial Geomorphology field investigations, analysis and approvals, Four Mile Creek diversion, Design of two embedded culvert systems with plunge pools: *Town of Niagara-On-The-Lake*
- ❑ Niagara River Erosion Study, geomorphic field investigations, erosion monitoring network: *Niagara Whirlpool Jet Boats, Niagara-on-the-Lake*
- ❑ Slope stability assessment (overland flow impact assessment): *Brock University Escarpment Lands, St. Catharines*

EDUCATION

- *1985 – Diploma (Engineering Technology), Mohawk College*
- *1992- Postgraduate Diploma (Environmental Assessment), Lakehead University*
- *1994 - Bachelor of Mathematics, University of Waterloo*
- *2004 - Master of Science (Earth Sciences – Fluvial Geomorphology), Brock University*

FLUVIAL GEOMORPHIC ANALYSIS, DESIGN AND PROJECT MANAGEMENT (CONTINUED)

- ❑ Fluvial geomorphology; field investigations/modeling/assessment, approvals, design, construction supervision: *Upper Red Hill Creek & Upper Ottawa St. closed Landfill, City of Hamilton*
- ❑ Fluvial geomorphology, field investigations, analysis, hydrologic/hydraulic modeling, approvals, construction supervision, Six Mile Creek Restoration: *Private Property Owner, Niagara-On-The-Lake*

NATURAL SYSTEMS ANALYSIS, DESIGN AND PROJECT MANAGEMENT

- ❑ Constructed Wetland for Stormwater and Landfill Leachate treatment; pre-design, Certificate of Approval, detailed design, construction supervision and long-term hydraulic monitoring: *Rice Rd. closed Landfill, City of Thorold*
- ❑ Constructed Wetland Pre-design including flow monitoring of runoff/leachate, and Environmental Assessment: *Closed Quarry Rd. Landfill Site, Regional Municipality of Niagara*
- ❑ Constructed Wetland for Stormwater treatment; pre-design, OWRA approval, and detailed design: *Parking facilities expansion, Brock University*
- ❑ Constructed Wetland Pre-design (Grey water treatment), Wilds of Pelee Island (NGO): *Township of Pelee Island*
- ❑ Prototype Vertical Flow Constructed Wetland research; Manager of thermal research: *Environment Canada, United States EPA, US Army Corps CRRL, Niagara-On-The-Lake*
- ❑ Line 5 Landfill Stormwater Collection system analysis: *Region of Niagara, Niagara-On-The-Lake*
- ❑ Design of a SWM Wetland for parking facilities expansion: *Brock University, St. Catharines*
- ❑ Analysis and design of wetlands/wetland hydrology for water storage and treatment in the Melencue area of Argentina: *EcoSUR, Santa Fe, Argentina*
- ❑ Sewell Commission working group for CSO management strategies in the City of Toronto: *Ministry of the Environment, City of Toronto*
- ❑ Creation of an automated, telemetered meteorological monitoring network: *Region of Niagara*
- ❑ Constructed Wetland to treat high strength agricultural runoff while promoting agricultural water re-use; research under Ontario Ministry of Agriculture and Niagara Peninsula Conservation Authority, design, approvals, construction supervision and monitoring: *Tall Elms Farms, Township of Glanbrook*
- ❑ Analysis and restoration of Nagavera Kere Wetland and Lake complex for water re-use and grey water diversion: *Government of Karnataka, Bangalore, India*

GEOGRAPHIC INFORMATION SYSTEMS AND GEOMATICS

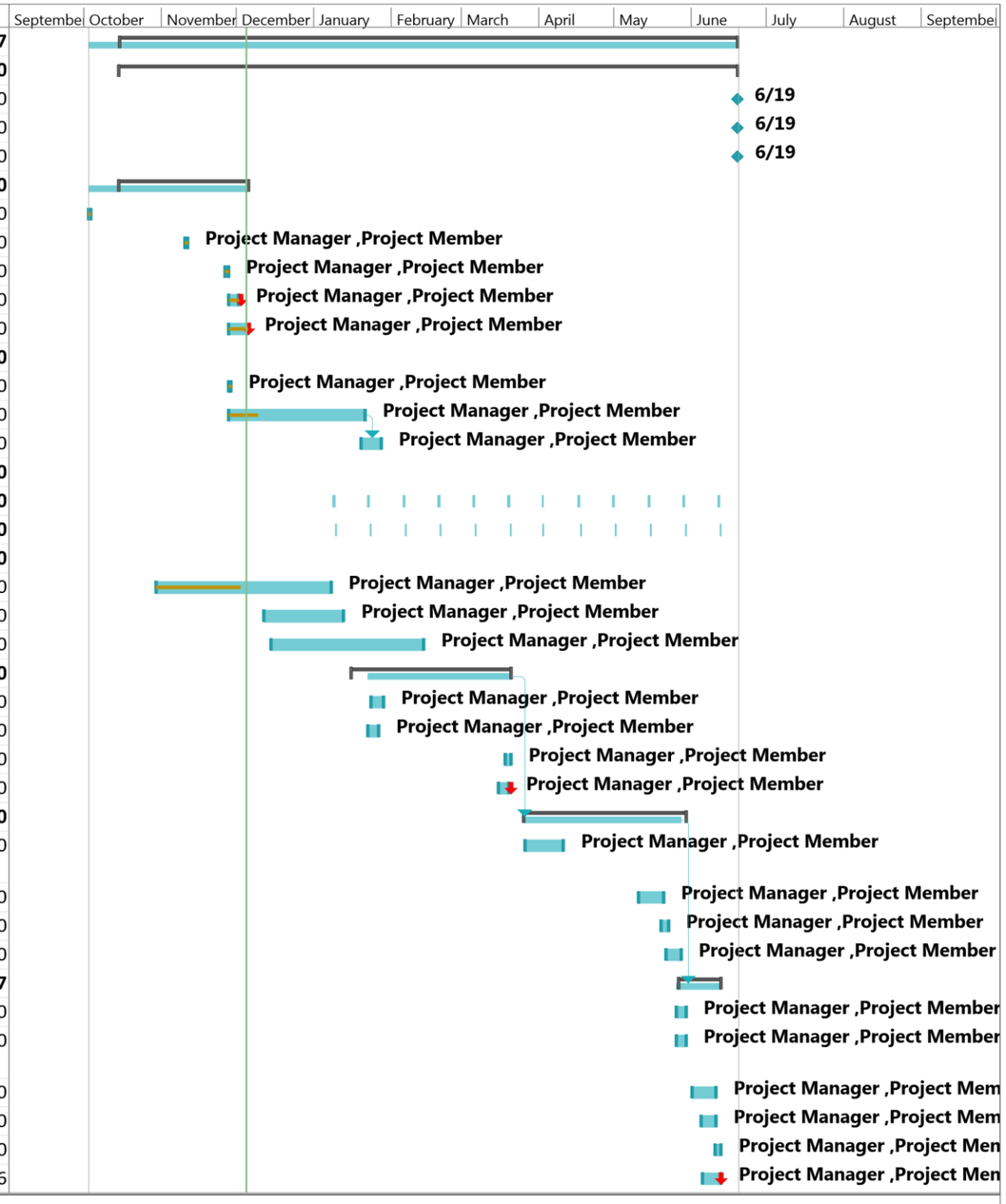
- ❑ International Advisor, visiting Professor for the creation of a number of GIS teaching programs at Universities and Polytechnic Institutes in: *the Middle East (Jordan), Asia (India) and South America (Argentina) as well as North America (First Nations)*
- ❑ Topographic analyses and terrain modelling for numerous proposed and existing residential, industrial and commercial developments: *Niagara Region, City of Hamilton, Norfolk and Brant Counties (Local and Regional Governments, Private sector)*
- ❑ 3D Fluvial Terrain Model for the Niagara River and Niagara Gorge complex: *Hornblower Cruises Niagara Inc.*
- ❑ Creation of an Environmental GIS for the preservation of open spaces in the Gudabunda Talek of Karnataka State, India: *Governments of Karnataka and India*
- ❑ Investigation of a GIS based risk management system for climate and crop insurance: *Santa Fe Province, Government of Argentina*

EMPLOYMENT AND VOLUNTEER HISTORY

Jan. 2012 - Present	Trout Unlimited Canada, Niagara Chapter	Founding Member, Projects Chair
Apr. 2001 – Present	Urban & Environmental Management Inc.	Partner, Fluvial Geomorphologist
Oct. 1995 – Present	Niagara College	Professor
Aug. 1996 – Aug. 1998	Niagara College Eco. Restoration	Program Advisor
May 1996 – May 1997	Friends of Fort Erie's Creeks	President
Jan. 1994 – Present	Lydian Environmental Consulting Inc.	Principal
Oct. 1994 – Oct. 1996	USEPA/Environment Canada	Thermal Research Manager
July 1986 – Aug. 1998	Region of Niagara, Env. Mon. & Analysis	Manager
Aug. 1985 – July 1986	Region of Waterloo	Planning/Engineering Tech

Appendix D: Gantt Chart

WBS	Task Name	Start	Finish	Work	% Complete	Cost
1	**Holland Marsh Water Balance Project**	**Wed 10/15/14**	**Fri 6/19/15**	**435 hrs**	**18%**	**$35,713.87**
1.1	**Initial Costs**	**Wed 10/15/14**	**Fri 6/19/15**	**0 hrs**	**100%**	**$2,200.00**
1.1.1	Computers and Hardware	Fri 6/19/15	Fri 6/19/15	0 hrs	100%	$2,000.00
1.1.2	Stationary, Printing, Binding	Fri 6/19/15	Fri 6/19/15	0 hrs	100%	$100.00
1.1.3	Field Trip Expenses	Fri 6/19/15	Fri 6/19/15	0 hrs	100%	$100.00
1.2	**Project Initiation**	**Wed 10/15/14**	**Fri 12/5/14**	**58 hrs**	**100%**	**$4,350.00**
1.2.1	Project Kick-off Meeting	Fri 10/3/14	Fri 10/3/14	0 hrs	100%	$0.00
1.2.2	Project Overview Statement	Mon 11/10/14	Tue 11/11/14	10 hrs	100%	$750.00
1.2.3	Define Project Outline	Wed 11/26/14	Thu 11/27/14	10 hrs	100%	$750.00
1.2.4	Proposal Presentation	Thu 11/27/14	Tue 12/2/14	18 hrs	100%	$1,350.00
1.2.5	Proposal Report	Fri 11/28/14	Fri 12/5/14	20 hrs	100%	$1,500.00
1.3	**Project Research**	**Fri 11/28/14**	**Tue 1/27/15**	**44 hrs**	**19%**	**$3,300.00**
1.3.1	Site Field Trip	Fri 11/28/14	Fri 11/28/14	16 hrs	100%	$1,200.00
1.3.2	Background Literature Review	Fri 11/28/14	Wed 1/21/15	10 hrs	20%	$750.00
1.3.3	Define Methodology	Tue 1/20/15	Tue 1/27/15	18 hrs	0%	$1,350.00
1.4	**Project Management**	**Thu 1/8/15**	**Fri 6/19/15**	**60 hrs**	**0%**	**$5,400.00**
1.4.1	**Advisor Meeting with Ian Smith**	**Thu 1/8/15**	**Fri 6/19/15**	**36 hrs**	**0%**	**$3,600.00**
1.4.2	**Client Meeting with DIG**	**Fri 1/9/15**	**Fri 6/12/15**	**24 hrs**	**0%**	**$1,800.00**
1.5	**Data Collection**	**Thu 10/30/14**	**Fri 2/13/15**	**53 hrs**	**22%**	**$3,975.00**
1.5.1	Obtain Data from Client (DIG)	Thu 10/30/14	Wed 1/7/15	8 hrs	50%	$600.00
1.5.2	Collect Meteorological Data	Fri 12/12/14	Mon 1/12/15	20 hrs	0%	$1,500.00
1.5.3	Organize/Quality Check Data	Mon 12/15/14	Fri 2/13/15	25 hrs	0%	$1,875.00
1.6	**Assemble Geodatabase**	**Fri 1/16/15**	**Fri 3/20/15**	**60 hrs**	**0%**	**$4,500.00**
1.6.1	Create Basemaps	Fri 1/23/15	Wed 1/28/15	15 hrs	0%	$1,125.00
1.6.2	Design Geodatabase	Thu 1/22/15	Mon 1/26/15	15 hrs	0%	$1,125.00
1.6.3	Progress Report Presentation	Wed 3/18/15	Fri 3/20/15	10 hrs	0%	$750.00
1.6.4	Progress Report	Mon 3/16/15	Fri 3/20/15	20 hrs	0%	$1,500.00
1.7	**Data Processing**	**Thu 3/26/15**	**Fri 5/29/15**	**65 hrs**	**0%**	**$4,875.00**
1.7.1	Create comparative maps and graphs of climate change	Thu 3/26/15	Fri 4/10/15	20 hrs	0%	$1,500.00
1.7.2	Define/Create Water Balance Model	Mon 5/11/15	Wed 5/20/15	20 hrs	0%	$1,500.00
1.7.3	Test Model	Wed 5/20/15	Fri 5/22/15	10 hrs	0%	$750.00
1.7.4	Execute Model	Fri 5/22/15	Wed 5/27/15	15 hrs	0%	$1,125.00
1.8	**Project Finalization**	**Wed 5/27/15**	**Fri 6/12/15**	**95 hrs**	**0%**	**$7,113.87**
1.8.1	Climate change analysis	Tue 5/26/15	Fri 5/29/15	20 hrs	0%	$1,500.00
1.8.2	Identify areas of increased nutrient loading	Tue 5/26/15	Fri 5/29/15	10 hrs	0%	$750.00
1.8.3	Report of analysis and methods used	Mon 6/1/15	Wed 6/10/15	20 hrs	0%	$1,500.00
1.8.4	Create maps and graphics	Fri 6/5/15	Wed 6/10/15	15 hrs	0%	$1,125.00
1.8.5	Final Presentation	Wed 6/10/15	Fri 6/12/15	10 hrs	0%	$741.30
1.8.6	Final Report	Fri 6/5/15	Fri 6/12/15	20 hrs	0%	$1,497.56



Project: HollandMarsh_GantCha
Date: Fri 12/5/14

Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress