The Current State of Stormwater on the University of Winnipeg Campus

Final Project

Course: Critical Environmental Issues: Campus Sustainability

ENV – 4614 – 001

Professor: Dr. Alan Diduck

Student: Samantha Leech

Student #: 3037179

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Purpose

Stormwater management is an important component of environmental sustainability in the urban environment including university campuses and especially those located in downtown areas with combined sewer overflow (CSO) systems, such as the University of Winnipeg. Figure 1 below is a schematic of a combined system. During a heavy rainfall or snow melt, with proper management, water can be diverted from the combined sewer system and held in a cistern until the combined system is sufficiently drained. In downtown areas, much of the landscape is either paved, or built upon and the impermeability of this construction increases surface runoff and susceptibility of local flooding. Further, water harvested from roofs of buildings can be used on lawns, flowerbeds and for other landscaping purposes. Currently, the University of Winnipeg uses stormwater storage in the Richardson Green Corridor between the RecPlex (also known as the Fieldhouse) and the Richardson College for the Environment and Science Complex. Water is being held to prevent CSO, but is not reused on campus. This paper aims to inform the reader of these aspects of stormwater management.

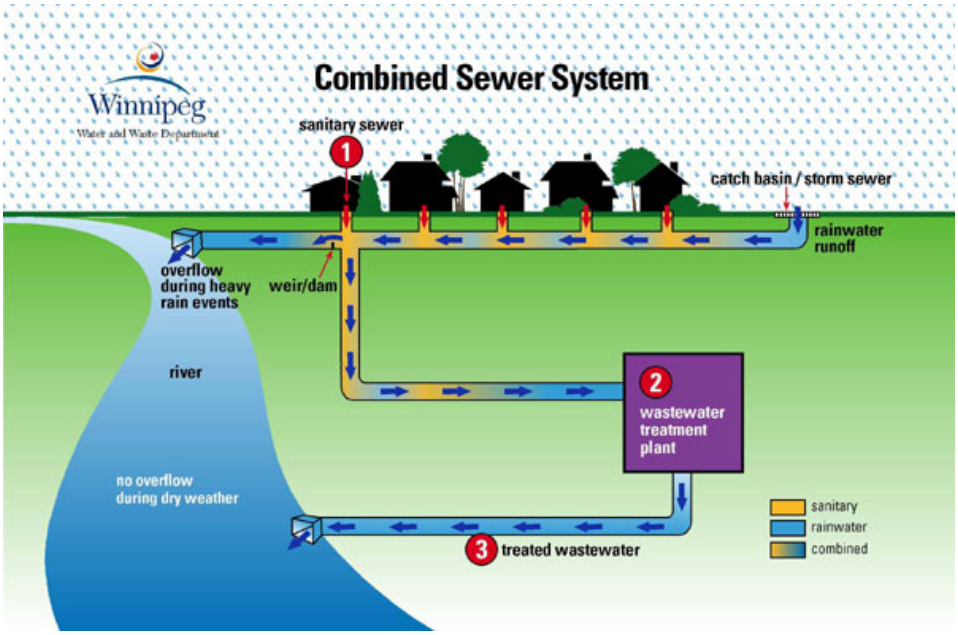

Fig. 1 Combined sewer system schematic

Objectives

The primary objective of this project was to identify the current stormwater management techniques on campus, and the barriers restricting further development. Stormwater retention tanks were incorporated into goals and policy plans for the design and construction of the RecPlex (completed; Augsut 2014) so that stormwater may be harvested and used on campus to reduce potable water used in landscape maintenance. Unfortunately, neither of those goals were reached. This project thus identified the economic barriers that hindered the installation of stormwater holding tanks under the RecPlex building, and how such installations are of significance to sustainability. This project was mainly concerned with the RecPlex, as it is the most recently constructed building on campus and information is current and relevant. However, information regarding previous stormwater proposals and diversion techniques in the Richardson Green Corridor are included in this report.

Primary Methods and Information Sources

Individuals who kindly provided key information regarding stormwater on campus through consultation and/or through e-mail:

- Alana Lajoie-O'Malley – Director, Campus Sustainability Office;
- Alex Wieb – Sustainability Officer, Campus Sustainability Office;
- Dave Torz – Chief Engineer of Physical Plant Services;
- Kyle MacDonald – Building Systems Manager of Physical Plant Services;
- Linda Palmer – Project & Property Manger UW Community Renewal Corporation;
- Greg Hasiuk – Partner and Practice Leader at Number TEN Architectural Group; Head Architect on the RecPlex building; and

- Professor Alan Diduck and my classmates in ENV-4614 – Cody Lapointe, Patrick Carty, Tessa Ausborn, Maureen Hanlon and Nadine Kanik (along with frequent class guest Justine Backer).

Literature and documents used and referred to throughout this project were found either online or graciously provided by individuals mentioned above:

- The University of Winnipeg Water Use Management Policy. http://uwinnipeg.ca/sustainability/docs/policies/water-use-mgmt-policy.pdf
- Sustainability Tracking, Assessment & Rating System (STARS) Sustainable Campus Index. University of Winnipeg Scorecard – OP-27: Rainwater Management. https://stars.aashe.org/institutions/university-of-winnipeg-mb/report/2015-03-03/OP/water/OP-27/
- Number TEN Fieldhouse (RecPlex) Parkade Floor plan.
- Number TEN UW United Health & RecPlex Design Description.
- University of Winnipeg Storage Colony Combined Sewer District – Chris Macey, AECOM & David Morgan, TetrES Consultants INC.
- AECOM Memorandum: Storage Facility for University of Winnipeg.

Rationale and Importance

This project identifies environmental problems associated with infrastructure lacking ideal stormwater management practices. The importance of these environmental issues have been realized by the University, and plans to improve stormwater management techniques are highlighted in the Water Use Management Policy. Further, the Sustainability Tracking, Assessment & Rating Systems (STARS) awards points to institutions achieving measurable sustainable action, in which stormwater management (listed as OP-27: rainwater management) is

a category. Here I will highlight relevant aspects of both the university policies and STARS certification.

University Policy

The University's Water Use Management Policy in regards to goal #6:

> "6. Encourage research, education and innovation respecting water conservation with a view to preventing and reducing adverse impacts on the environment and the economy now and for future generations" (Water Use Management Policy, 2007).

Ensuring new building development does not strain the combined sewer system is crucial. When natural landscapes are developed into building space, there is increased surface runoff, which enters the sewer system. Our campus is located in the combined sewer systems known as the Colony combined sewer district (CSD) (AECOM Memorandum, 2010). One architectural method to reduce the strain on these sewer systems is to collect rainwater from the roofs of buildings and hold the water in cisterns until water levels have decreased sufficiently to release the held water. Doing so would aid in the reduction of adverse impacts on the environment, such as sewage entering local water bodies as a result of CSO. When sewage enters a water body, nutrients like nitrogen and phosphorus cause eutrophication. Inorganic or toxic wastes can be extremely harmful to a number of aspects in an ecosystem for example; pharmaceuticals enter water bodies when sewage has not gone through proper treatment. It would also help reduce negative impacts to the economy if diversion prevented localized flooding.

Goal #2 of the same policy is to:

> "2. Strive continuously to reduce, as far as practicable, the University's demand for potable water, the discharge of pollutants to water, and the production of waste water

from all University programs, facilities, and operations through the hierarchical application of demand reduction, reuse, recycling and recovery."

This goal would be achieved if collected storm water was reused for landscaping to reduce the amount of potable water used currently for such purposes. Rather than collecting water solely for diversion reasons (although still serving this important function), this water, if collected from rooftops could be used to water green spaces such as lawns and flowerbeds on campus. Currently 100% potable (drinkable) water is used for this purpose.

STARS Certification

Currently the University holds STARS rating of Silver, and achieved a total score of 58.86/100 overall. STARS stands for Sustainability Tracking, Assessment & Rating System. Participating in STARS allows institutions to measure their sustainability efforts over time, compare themselves to institutions worldwide, generate new ideas regarding policies, planning and budgeting as well as to incentivize institutions to continuously improve their efforts. Assessments are based on self-reported data and points are awarded to sustainable practices outlined in such reports. Ratings include; Reporter, Bronze, Silver, Gold and Platinum. Submitting to STARS requires lengthy data collecting and should be viewed as a success regardless of rating. Campuses can resubmit to STARS every three years. Our last submission was March 5th, 2015. Therefore, the University will be permitted to resubmit in March of 2018. Under the category OP-27: Rainwater Management our University scored 1.00/2.00. One point awarded for our Water Use Management Policy, but we failed to receive a second point because we lack 'Low Impact Development (LID)' practices. Such developments could include policies or standard practices to reduce stormwater runoff volume and improve outgoing water quality.

Criteria in this category would likely have been satisfied if the proposed storm water holding cisterns were incorporated into the construction of the RecPlex. Under 'OP-26: Water Use', a score of 1.51/3.00 was earned. It is possible that this rating could also be improved, depending on the amount of potable water (US gallons/cubic meters) that would be replaced with non-potable, recycled stormwater.

Results of Consultations

In one of our first meetings as a class, we toured buildings on campus. We had heard that the newest building on campus, the RecPlex, was built with stormwater retention tanks. As a class we decided this was an interesting topic for a course project and I then chose to learn more about our stormwater management systems. We soon learned that the tanks had not been built as proposed in initial design plans. With help from the individuals mentioned above, I discovered that our campus indeed does have retention tanks, i.e., the tanks located in the Richardson Green Corridor, built a few years before the RecPlex, but water stored there is not reused in any way by the university. I also discovered that stormwater management systems are much more complicated than I had originally expected and that was reflected in costs. According to the websites of retailers of such tanks, a tank the size the proposed RecPlex tank (40,000 US gal) ranges from $25,000USD-$50,000USD. In addition to the tanks, piping is required and addition plumbing and filtration is required if the intent is for the water to be reused, further adding to cost. Ultimately, the university decided that it was too expensive to invest in such a system at the time of construction.

Feasibility

In discussion with Greg Hasiuk, the head architect at Number TEN involved in the construction of the RecPlex, I was informed of the cost savings associated with abandoning the

plans for the building's stormwater systems. I was informed that in October of 2012 "The decision was made to delete the on-site stormwater retention for a cost savings of approximately $175,000." He stressed that the building design came in over-budget several times at it was challenging to maximize sustainability, recreational value and community program space into the building given its limited budget (which was approximately $30M, according to the Design Description from Number TEN). The RecPlex has many sustainable design features that include LED lighting, an Energy Dashboard which will shut-off unnecessary energy consumption when the building is not in use, and low-flow showers and toilets. These features are considered as having a shorter payback period than features like storm water retention tanks. According to the university's Building Systems Manager of Physical Plant, Kyle MacDonald, after a 'value-engineering' phase of cost-benefit analysis, "things that have a longer payback period are usually the first to go as the fundamental systems and structures need to remain." Simply put, this system was too costly upfront and with a much slower payback period than other sustainable features, like LED lighting, it was economically infeasible at the time of construction.

Current Tanks

The complications of stormwater management became increasingly apparent the further I researched the topic. For example, I discovered that without intricate filtration systems water collected as surface runoff can only serve the purpose of diversion from combined systems to reduce the risk of flood. Only water that is collected above ground (most commonly from roofs) can be reused in landscaping etc. with the use of simple and less expensive filtration techniques. This is because surface runoff is exposed to pollutants such as salts and heavy metals from streets and sidewalks, making it unsuitable for use in lawn and garden maintenance on campus (Macey & Morgan, 2009). As well, I learned that since the proposed retention tank system for

the RecPlex included a plumbing and complex filtration system (because the water was intended for reuse), the system was much more costly than the tanks installed under the Richardson Green Corridor.

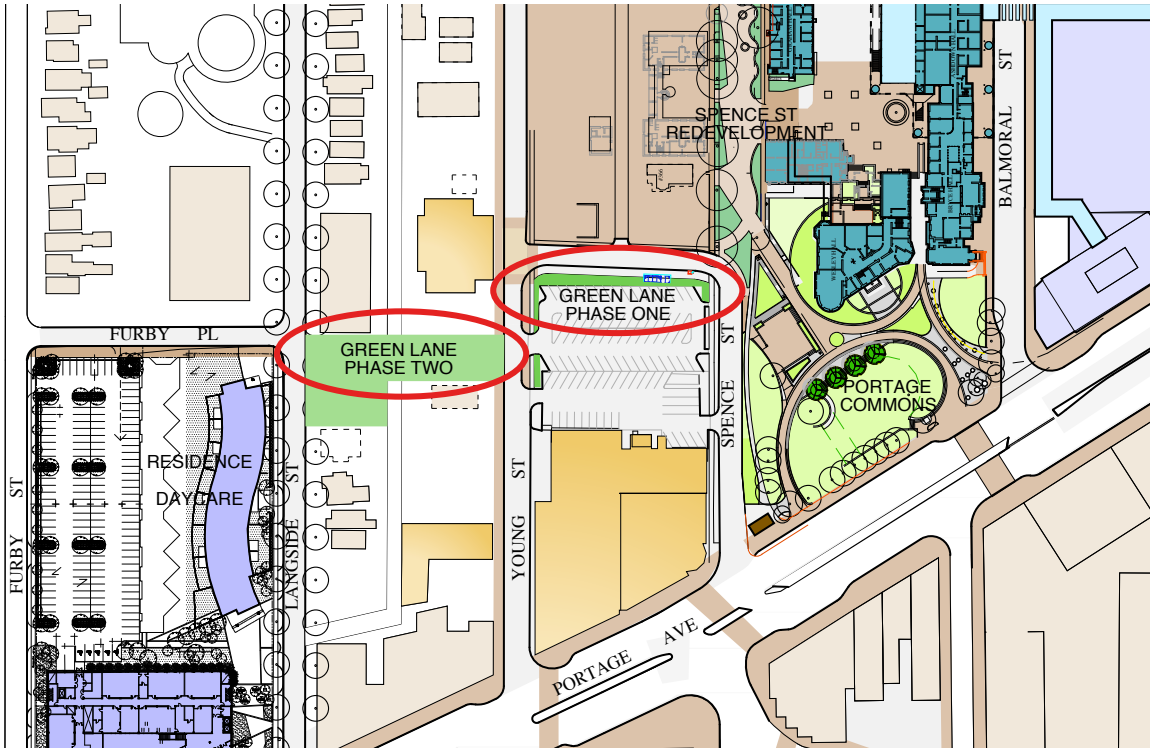

Fig. 2. Schematic of proposed cistern locations

Figure 2 is a schematic of the part of the campus where two locations for retention tanks were proposed. Green lane phase one was ruled out and cisterns were built underground in green lane phase two (more commonly known as the Richardson Green Corridor). Since this schematic was produced, the RecPlex has been built between Young St. and Spence St. located on green lane phase one. Through discussion with the Chief Engineer of Physical Plant, Dave Torz, it was discovered that in these cisterns, water is collected and redistributed to the combined sewer system. Water is collected from surface runoff and given our current infrastructure could not be reused on campus without first being treated.

Fig. 3. Current cistern location

Figure 3 is a photograph of the location of the current retention tank, facing Spence Street. This is the Richardson Green Corridor, or the green lane phase two shown in Figure 2. In this picture, one cannot see the physical tanks, but you can see there is a large pipe in the lower left corner. The large pipe is a pressure-release mechanism that will remove excess gases in the cisterns. This is the only physical proof that there is a stormwater retention tank under the corridor. As mentioned, water held in these tanks are used solely for diversion purposes during a heavy rainfall or melt period and will be redirected back to the combined sewer system once water levels are low enough to handle the extra load.

Future Possibilities

While the stormwater retention tanks were removed from the RecPlex plans during the value-engineering phase of construction, there is a possibility for tanks to be added to the building in the future. Greg Hasiuk informed me that there were no alternative tank locations for the RecPlex, but the prospect of a roof-top tank is possible if it were to become feasible for the

university. A large feasibility study would be necessary and would likely only be possible for the university if external funding, such as a government grant, were received. This is likely a project that would take several years and an in-depth cost-benefit analysis. That being said, Kyle MacDonald thought that there are options for the RecPlex that might not be as intensive and could be quick and attractive sustainability enhancements.

Fig. 4a and 4b. Possible alternative tank locations on the east side of the RecPlex

Figures 4a & 4b are images of possible alternative tank locations outside of the RecPlex. Kyle mentioned that aside from applying for a large project like a roof-top tank, the university may more likely be able to justify a smaller scale project in this location because of the unfinished nature of the east side of the building. While a roof-top tank would be ideal, it is not feasible at this point. He felt that "if piping could be re-routed up into a small holding tank, maybe this would be a quick project that is easy to sell." Essentially, this area outside of the RecPlex is unfinished, and could serve as a location for a stormwater holding tank. This is the east facing wall of the building, it is the paved corridor between the RecPlex and main campus. In the future if this project were to be continued, this is likely the quickest and most probable way for a stormwater retention tank to be installed on campus for the purpose of reuse. Water collected from the rooftop of the RecPlex would not be in contact with the ground, and therefore

would not be exposed to reuse-inhibiting pollution. This of course is a good "selling point" because using this water would reduce potable water consumption ad the payback period of the project. This would be a good next step if this project were to continue.

Concluding Comments

Stormwater management is much more complicated and costly than I had originally presumed. The cost savings for the university for removing the plan for a storm water retention tank in the development of the RecPlex was $175,000. These systems are complex because there are many different options depending on size, use, and location of the tanks (above or underground). There is no doubt that the collection of stormwater from a roof-top for the purpose of reuse on campus in landscape maintenance would be beneficial to our sustainability practices. Unfortunately, it was too costly at the time of construction to accommodate such infrastructure on the RecPlex. A major component in the completion of the RecPlex is to have a sustainable building. Future-proofing measures are an important feature in the building for new development to occur. It is possible for tanks to be added in the future, and a further feasibility study would reveal where, when and what size of tank could be possible to incorporate to the building. To continue this project, the best next steps would be to begin this feasibility study with an in-depth cost-benefit analysis and to identify the most efficient location and tank size to suit desired purposes. Application for a government grant would be a crucial next step in the realization of a stormwater management system on campus.

Acknowledgements

I would like to thank Alana Lajoie-O'Malley and Alex Wieb for taking time to come and help our class with all of our projects and suggesting further actions and next steps throughout

the course. I am grateful to Kyle MacDonald for showing us first hand some of the sustainable features of our campus, and for providing me with and redirecting me to information about stormwater, stormwater tanks and stormwater tanks on campus. I am also grateful to Dave Torz for touring me around the RecPlex and sharing information regarding the physicality of stormwater retention tanks both already in use and proposed. Thank you to Linda Palmer for getting me in contact with the head architect in the building of the RecPlex. Many thanks to Greg Hasiuk for answering my questions about the economic barriers the university and the architectural firm felt during construction of the building, and providing further information on subsequent decisions. As well, thank you to Alan Diduck and all of my classmates; Cody, Patrick, Tessa, Nadine and Maureen (and Justine) for offering information and suggestions throughout the course.

Appendix A – Sources

The University of Winnipeg Water Use Management Policy. (2007). Retrieved from: http://uwinnipeg.ca/sustainability/docs/policies/water-use-mgmt-policy.pdf

STARS.AASHE Sustainable Campus Index. (2015). University of Winnipeg Scorecard – OP-27: Rainwater Management. Retrieved from: https://stars.aashe.org/institutions/university-of-winnipeg-mb/report/2015-03-03/OP/water/OP-27/

Number TEN Fieldhouse (RecPlex) Parkade Floor plan.
Shows size (40,000 US/Gal) and location (underground parkade) of proposed RecPlex cistern. Provided by Kyle MacDonald.

Number TEN Architectural Group UW United Health & RecPlex Design Description.
Information includes; cost of RecPlex project, sustainable design features including Future Proofing.
"Stormwater Run-off Control: A large underground storage cistern will temporarily store rainwater run-off from the roof to reduce the rate of water entering the City's combined storm water system during a large rain event."
Provided by Kyle MacDonald.

Macey, C. & Morgan, D. (2009). University of Winnipeg Storage Colony Combined Sewer District. For City of Winnipeg Water and Waste. Provided.

Toupin, E. (2010). AECOM Memorandum: Storage Facility for University of Winnipeg. Provided.

Appendix B – Figures

Figure 1 – Combined Sewer System Schematic

City of Winnipeg Water and Waste Department. Retrieved from:

http://www.winnipeg.ca/waterandwaste/sewage/combinedSewerOverflow.stm

Figure 2 – Schematic of Proposed Cistern Location

Provided in an email from Kyle MacDonald.

Figure 3 – Current Cistern Location

Photograph taken by myself.

Figure 4a & 4b – Possible Alternative Tank Locations on the Eastside of the RecPlex

Photographs taken by myself.