ISL Engineering and Land Services

Inspiring sustainable thinking

CANADIAN CONSULTING ENGINEERING AWARDS 2012

Didsbury North Industrial Stormwater Wetland

Category:	Water Resources
Client/Owner:	The Town of Didsbury
Subconsultants:	Sabatini Earth Technologies Inc. Hallstrom Associates Environmental Tronnes Surveys (1976) Ltd.
Contractors:	Foran Equipment Ltd. Rubydale Asphalt Works (2006) Ltd.

May 2012

From Stormwater Management to Wider Community Benefits

INTRODUCTION

Originally selected to design and construct a 'standard' stormwater management facility, ISL Engineering and Land Services worked with the Town of Didsbury to expand the project scope from a typical wet or dry pond facility, not frequented by the public, to a 3-hectare constructed wetland and the creation of the largest park area in Didsbury. Delivered more than one million dollars under budget, the innovative approach to resolving a stormwater management problem also provided town residents and visitors with a unique public amenity consisting of this naturalized park, 1500 m of new pathway (effectively doubling the town's existing paved pathway system), plus the wetland, boardwalks and wildlife viewing platforms for passive recreation and education opportunities. With the wetland and associated stormwater upgrades, the project effectively addresses the original issue of untreated and uncontrolled storm flows from the nearby industrial area and a large portion of the town.
To reach this more comprehensive solution, a more in-depth and far-reaching sustainability analysis was applied than the conventional Triple Bottom Line Approach. The approach involved analysis of design solutions against a combination of the Town's sustainability framework, Town experience, engineering design properties and project outcome indicators. It incorporated a formal evaluation process tailored to the Town's newly adopted Integrated Community Sustainability Plan (ICSP) where Economic, Social/Cultural, Environmental and Governance factors are weighted equally for unbiased consideration. From what could have been just a stormwater management solution, this approach added further environmental, aesthetic and recreational benefits. Consequently, this municipal infrastructure project enabled the Town to demonstrate the practical application of its ICSP and sustainability commitment to *"Moving progressively into the future by enhancing [the] community, its beauty and quality of life."*

BACKGROUND

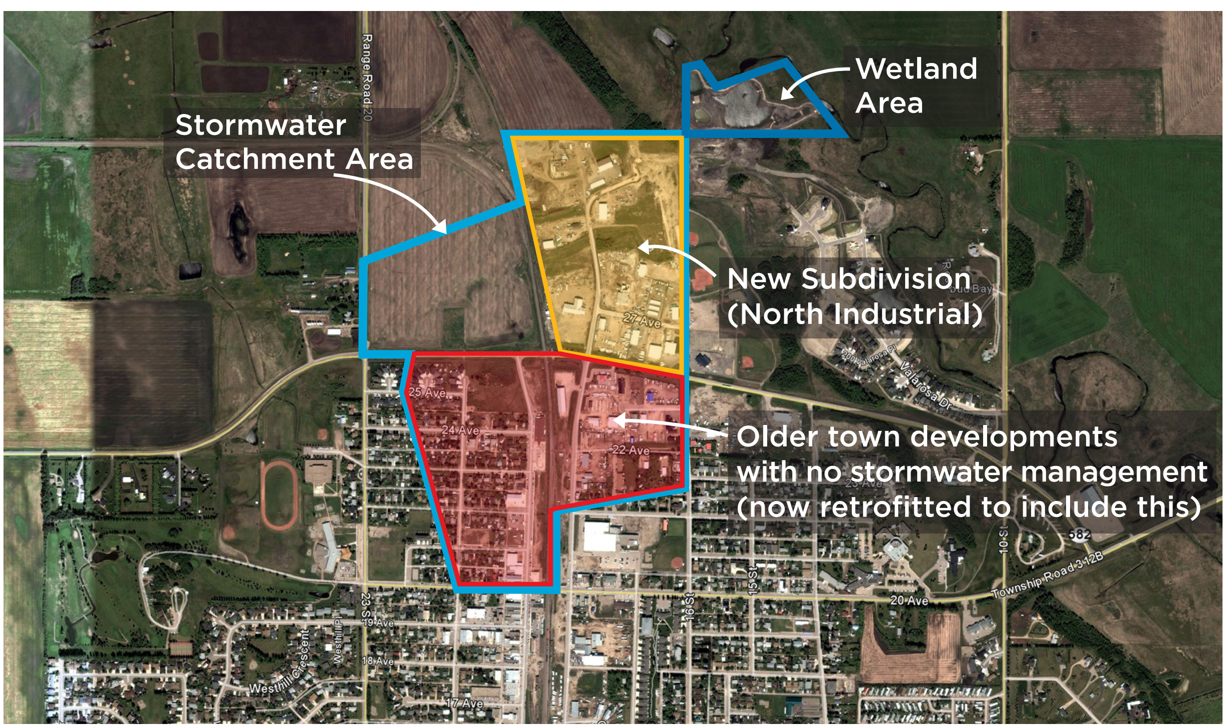
Municipal Infrastructure for a Growth Community

The Town of Didsbury is a mid-sized town (population just under 5000) with big ideas. The town is in a prime location in Canada: situated at the foothills of the popular Rocky Mountains and in the main transportation corridor between what Statistics Canada identifies as two of the fastest growing census metropolitan areas in Canada – Calgary and Edmonton (Statistics Canada 2011 census). Didsbury's own population grew 8.7 per cent since 2001, such that in 2010 Alberta Venture business magazine rated it one of the top five growth communities in Alberta. As it grows, the town is expanding its infrastructure to support development in existing areas and new subdivisions. To the north of the town, the North Industrial Subdivision is one of these new subdivisions.

In 2006, the Town engaged ISL Engineering and Land Services (ISL) for an Infrastructure Study that included review of stormwater drainage and management, and roadway/sidewalk systems in the town. The study highlighted the requirement for a Stormwater Management Facility (SWMF) to manage storm flows produced by the recently constructed North Industrial Subdivision, as well as some runoff flowing through the area and coming from the northern section of the town (a total stormwater catchment area of 59 hectares).

Before the project, the area where the new subdivision was located had only a temporary rural style stormwater management system in place with no SWMF to control discharged flows. This meant that rainwater was picking up pollutants as it flowed overland, causing erosion in its path during storm events, and eventually depositing the water, untreated, into the nearby Rosebud River.

Originally, the study called for a traditional wet or dry pond to store and treat this stormwater. Everything changed when, on December 16, 2008, the Town formalized its commitment to sustainability by adopting the Town of Didsbury Integrated Community Sustainability Plan (ICSP).



Wetland area and stormwater upgrades provide stormwater management and treatment for whole catchment area

STORMWATER MANAGEMENT FROM A SUSTAINABILITY PERSPECTIVE

From ICSPs to Stormwater Solutions

Canadian municipalities are now required to develop Integrated Community Sustainability Plans (ICSPs) to access funding from the Federal Gas Tax revenues. As part of this, municipalities are faced with a new challenge: how to evaluate (and justify) infrastructure projects in the context of their ICSPs.

For the Town of Didsbury, it was vital that a new stormwater treatment facility fit within the criteria of the Town's new ICSP. To achieve its sustainability goal of "Moving progressively into the future by enhancing our community, its beauty and quality of life", the Town had five over-arching objectives:

- Ensuring long-term fiscal viability
- Providing effective, efficient and responsive governance
- Being environmentally sensitive
- Encouraging cultural and recreational diversity
- Contributing to municipal leadership

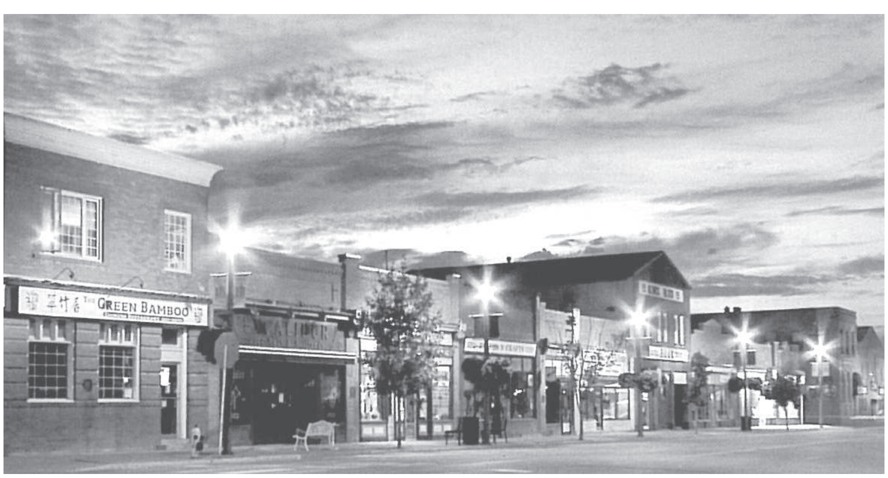
In Canada, ICSPs typically recognize the following as core pillars of sustainability: Environment, Social, Cultural, Economy and Governance. The Town of Didsbury's own ICSP also indicated that a tool needed to be developed to evaluate Town projects based on these core themes.

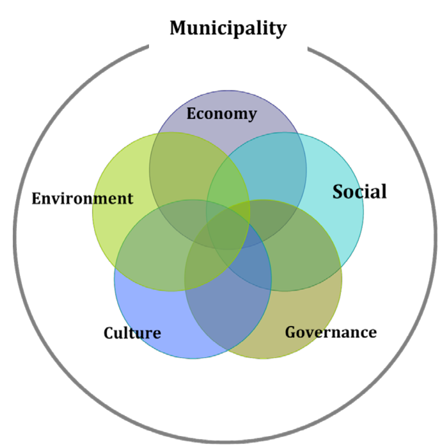
Towards Sustainable Design

In March 2009, funding from the Building Canada Fund (BCF) enabled the project to go ahead as part of Federal infrastructure stimulus funding. The Province of Alberta and the Federal Government each matched the Town's capital expenditure dollar for dollar, allocating roughly $6 million for the three-year project, which included the wetland, associated stormwater and roadway upgrades in the upstream catchment area. The project was a chance to demonstrate the exemplary results possible with the support of Federal stimulus funding and the involvement of all three levels of government.

For the Town of Didsbury, it represented the first major opportunity for its Council to tangibly demonstrate its commitment to sustainability—and the resultant benefits—to residents and the wider community.

Based on the Town's new sustainability commitment, ISL's first step was to conduct a comparative sustainability analysis of the design options to manage stormwater: dry pond, wet pond and constructed wetland. The analysis considered a combination of the Town's ICSP pillars of sustainability and objectives, a series of project outcome indicators for sustainability, Town experience, engineering design properties, and costs.





Left: Didsbury's main street (from the cover of the Town's ICSP). Right: The pillars of sustainability from the Town's ICSP.

A New Application of Sustainability Technology: Stormwater Management in Canada

A key component of this sustainability analysis was the use of ASPIRE software to create a quantifiable and visual snapshot of the sustainability of each design option based on rigorous evaluation. This software was selected since it provided the Town with a formal evaluation tool that enabled design options to be objectively assessed against core themes of their Integrated Community Sustainability Plan or ICSP (i.e. Environment, Society/Culture, Economy, and Governance).

ASPIRE 1.1 is an advanced computer program used to assess the sustainability of infrastructure projects during the design process. It was originally developed by Engineers against Poverty and ARUP to evaluate large infrastructure projects in developing countries. Ultimately, it recognizes the fundamental role infrastructure plays in contributing to the development of any resilient, sustainable community.

While it has been used in the USA and Britain, the use of ASPIRE in Canada is in its infancy. This project is believed to be one of the first examples of its use in this country. In the context of a Canadian municipality, ISL applied it to evaluate the sustainability of a stormwater management facility solution in accordance with that municipality's ISCP.

Going beyond Triple Bottom Line methodology (which considers Environmental, Social and Economic factors), each design option was evaluated against 96 sub-themes within the areas of Environment, Society/Culture, Economy, and Governance/Institutions. These fit extremely well with the core pillars of the Town's ICSP and also with the sustainability dimensions that are typically promoted in Canadian templates for ICSPs (such as that produced by the Alberta Urban Municipalities Association).

With engineering input in this advanced technology design options for the Stormwater Management Facility could now be objectively compared within the framework of the ICSP. The sustainability of each option could be quantified and graphically displayed in a way to highlight areas for improvement.

Didsbury ICSP Strategy Areas

- Environment
- Economy
- Social
- Culture
- Governance/ Institutions

Didsbury The Place to Grow

ASPIRE Software Categories

- Environment
- Economics
- Society
- Institutions (i.e. Governance)

This Approach: Sustainability Quantified

- Environment
- Economy
- Social/Culture
- Governance/ Institutions

From Didsbury's ICSP to this Project: Sustainability Analysis Categories

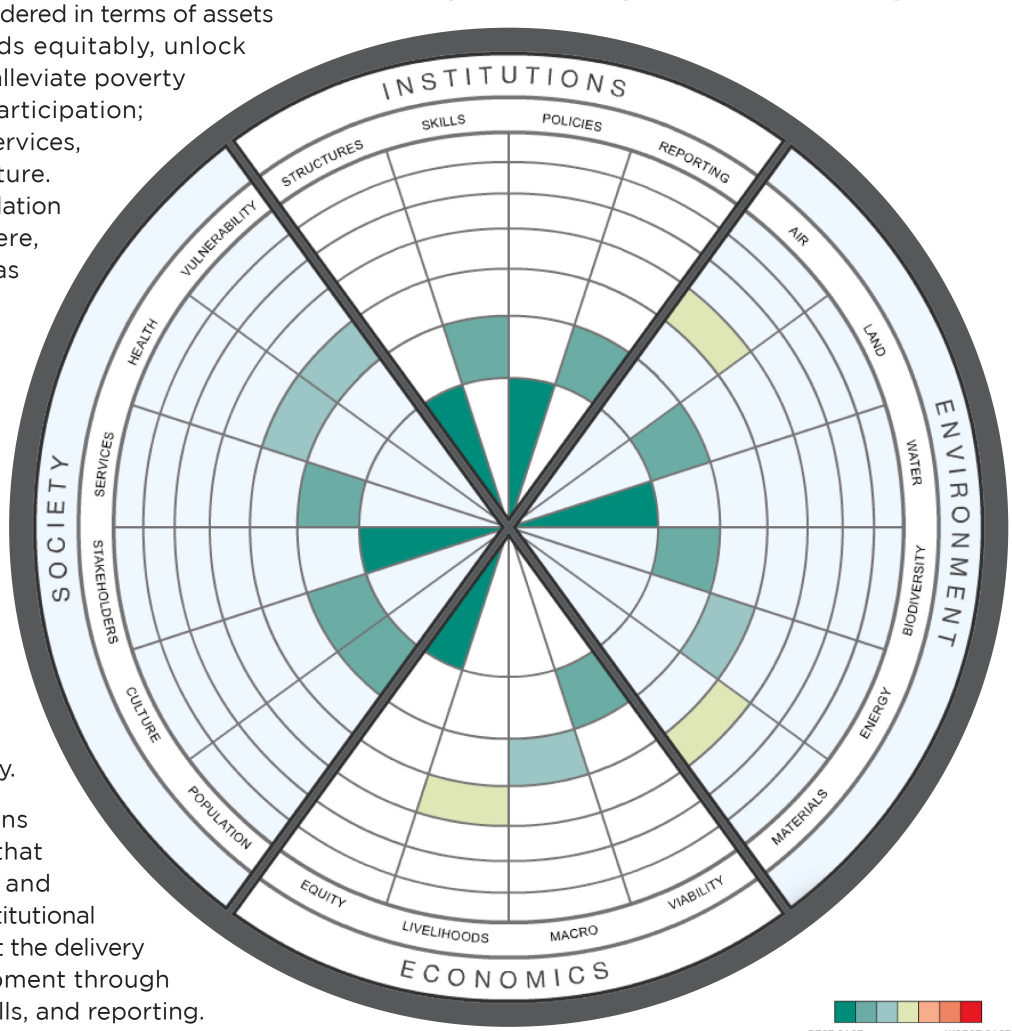
New Parameters for Risk Evaluation

Addressing project risks from a sustainability perspective was a major innovation. This meant that issues not normally considered as risks in a conventional project risk assessment could now be taken into account in the evaluation of SWMF design options. Now the risks associated with the design and construction of a large infrastructure project could be addressed not just from the perspective of direct impact on the project, but from the more comprehensive perspective of impact on the community, the local government and the environment.

This was a good fit for evaluating the sustainability of the stormwater solution in relation to the ICSP. Like the Town's ICSP, the ASPIRE software model breaks project risks down into four (4) interconnected themes as follows:

- Environment is considered in terms of enhancing and minimizing impact on natural assets: air, land, water, biodiversity, and materials. Energy is also considered here, recognizing the increasing importance of renewable energy sources and energy efficiency.
- Society/Culture is considered in terms of assets required to meet needs equitably, unlock human potential and alleviate poverty through stakeholder participation; as well as access to services, public health, and culture. Vulnerability and population are also considered here, including issues such as conflict, exposure to natural hazard, and displacement.
- Economy encompasses sub-themes that contribute to economic vitality: project viability long term, macro-economic effects (such as inflation and competition), livelihood opportunity and equity of economic opportunity.
- Governance/Institutions includes sub-themes that consider the capacity and effectiveness of the institutional environment to support the delivery of sustainable development through policy, governance, skills, and reporting.

Keystone Diagram: Wetland Option

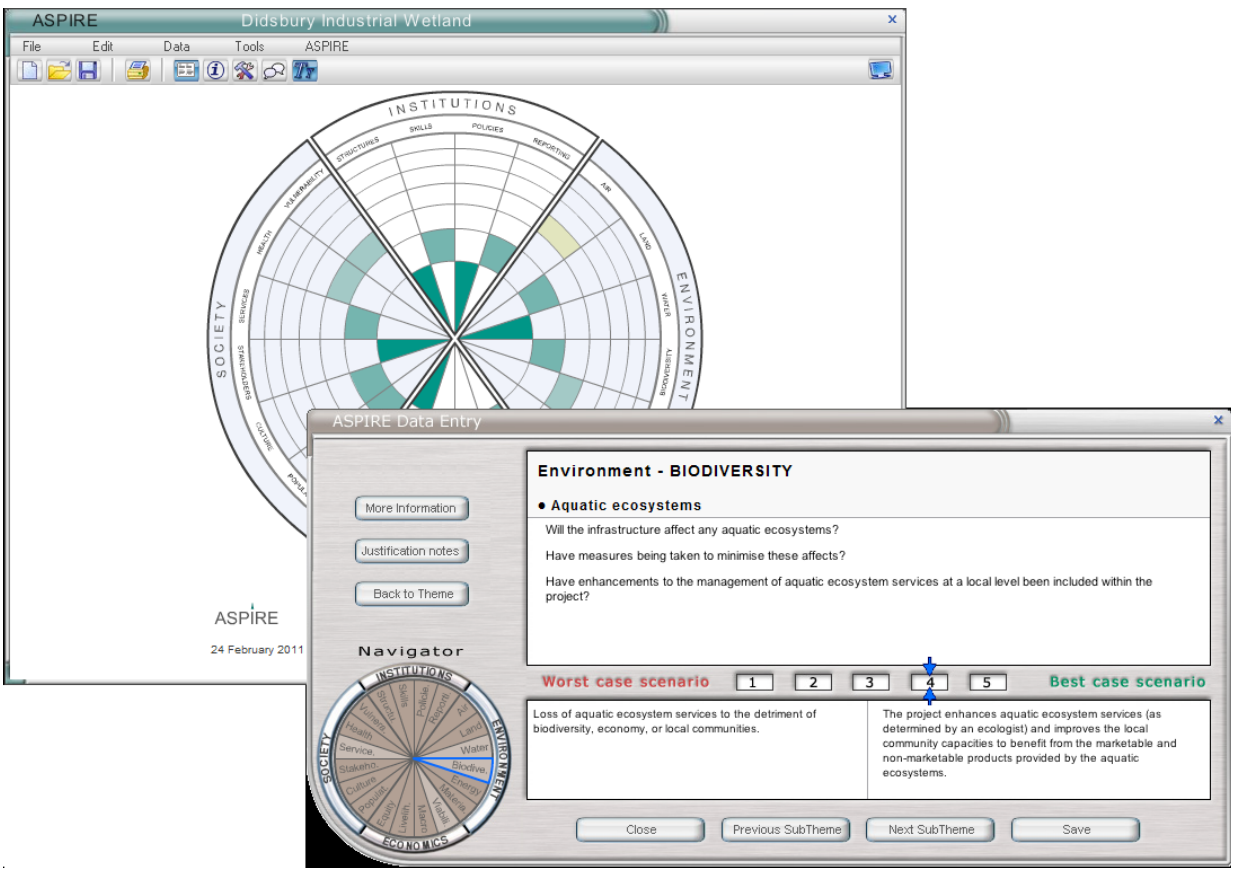


The responses given under each of the themes' questions indicated that the wetland option was the most sustainable of the three. This was visually displayed by the amount of green colour and the placement of results closer to the centre of the circle—closer to achieving a bulls-eye for sustainability!

Under these four core themes, the sustainability of each design option (dry pond, wet pond and wetland) was evaluated against 20 topics and 96 associated sub-topics and their associated questions. (ISL considered only those sub-themes applicable to the Canadian context.)

This resulted in a colour-coded (red-amber-green) keystone diagram for each option that graphically summarizes its performance against these themes and highlights areas for improvement. The more sustainable the design: the more cells that are highlighted near the centre of this keystone diagram (and the more cells that are coloured green). The colours from amber to red indicate areas for improvement (red is the worst case scenario).

A circular diagram is used to indicate equal weighting of the Environment, Social/Cultural, Economy and Governance/Institutions themes. Through the lens of the Town's formal vision of sustainability, all design solutions could be compared objectively within the same context. No theme takes priority and as a result the Town receives a holistic and unbiased comparison of each design option.



Sample screenshot of ASPIRE showing questions under the Aquatic Ecosystem subtopic of the Environment theme

Comparison of Design Options

Based on the engineers' input in the ASPIRE technology, Table 1 gives a numerical comparison of the summarized results for each theme and associated key topics. The rows that are bolded indicate parameters that vary for each design option. Doing the analysis ultimately enabled the team to consider and recommend solutions to improve scoring in key areas. This resulted in a far more rigorous and far-reaching sustainability evaluation, which, in turn, enabled the original scope to be expanded upon for greater community benefits.

Table 1: Comparison of Scores for Each Design Option (ASPIRE)

Environment	Dry Pond	Wet Pond	Wetland
Air	4	4	4
Land	**4**	**5**	**6**
Water	**5**	**6**	**7**
Biodiversity	**4**	**4**	**6**
Energy	4	5	5
Materials	4	4	4
Social/Cultural			
Population	**5**	**5**	**6**
Culture	6	6	6
Stakeholder	7	7	7
Services	**5**	**5**	**6**
Health	5	5	5
Vulnerability	5	5	5
Economy			
Viability	6	6	6
Macro	5	5	5
Livelihoods	4	4	4
Equity	7	7	7
Governance/Institutions			
Structures	7	7	7
Skills	6	6	6
Policies	7	7	7
Reporting	6	6	6
TOTAL (/140)	**107**	**109**	**115**

Results for all three design options (dry pond, wet pond and wetland) prove similar in the areas of Economy and Governance/Institutions. However, the **wetland option provides better results in the land, water and biodiversity topics of the Environment theme.** The wetland provides a higher quality of stormwater treatment and retention. It also maintains/enhances biodiversity in the area by providing a large wetland area and more diverse habitat for local wildlife, while an associated environmental reserve provides a further buffer to protect the sensitive riparian zone of the river.

The wetland's score is also higher in the areas of population and services. The analysis had highlighted areas for improvement within the design of a stormwater management facility, including its integration into the existing landscape and how to make it a positive facility for public use. So, from a Social/Cultural perspective, part of the wetland option included a more naturalized park along with a pathway system linked to a planned residential development in the area. The project also took into account the Town's prior experience of dry and wet ponds: as closed-off facilities that served no further function than stormwater management. The comprehensive wetland option clearly provided a better service to the community.

ENGINEERING SOLUTIONS: SUSTAINABLE STORMWATER MANAGEMENT

Once the wetland was selected as the preferred sustainable design, the team worked on engineering solutions for design and construction of the wetland in the chosen location. The experience of incorporating this formal sustainability analysis into the design process encouraged the designers to maintain a sustainable design ideology, and apply it to all proposed design solutions.

Responding to Degree of Difficulty

The proposed wetland was to be located below the subdivision, in an area of agricultural pasture where storm flows naturally come together within the Rosebud River valley. A major advantage of the chosen location was that the site is a natural drainage collection point, meaning that stormwater runoff from the surrounding lands naturally drains into the site. This was a significant asset for the operability and sustainability of the wetland.

However, the wetland's location also introduced many technical and construction challenges. First, there was the question of managing the velocity of storm flows caused by the very steep slopes. Storm flows from the catchment area are released from the industrial subdivision to the wetland approximately 20 m below, on the bottom of the Rosebud River valley. This large change in elevation occurs over a very small distance, accelerating the $6m^3/s$ peak storm flows to extremely high velocities. The speed of these large storm flows introduced a level of flow termed 'supercritical' as it risked damaging the proposed pipes conveying the stormwater to the wetland below, and risked damaging the wetland.

The engineers' solution was to incorporate a stilling basin into the design to initiate a hydraulic jump and slow flows before they reached the wetland, thereby protecting it. Inclusion of the stilling basin in the design process was also helpful since it allowed the engineers to control where the hydraulic jump occurred so that they could come up with design considerations to stabilize the storm sewer and stilling basin and allow the air to flow.

Second, being a natural drainage collection point, the high groundwater and saturated soils presented significant problems during construction of the wetland. The clay soils were more prone to soil compaction issues. Without mitigation, the site would also fill with water during construction. Consequently, the preventive methods that were put in place in the construction phase included dewatering the site, design and development of geotechnical berms (Sabatini Earth Technologies Inc.), as well as managing the construction schedule to reduce soil compaction.

Third, the wetland's location next to the sensitive riparian zone of the Rosebud River introduced extensive flora and fauna considerations. As part of this process, Hallstrom Associates Environmental carried out a biophysical impact assessment. Also, ISL's landscape architectural team selected native species of plants for aesthetics as well as their ability to thrive in local conditions. The vegetation design included a variety of native wetland plant material to improve local habitat diversity. This step included installing wetland planting plugs in locations and anticipated water depths to help the vegetation establish. The vegetation for the project area was chosen to better integrate the landscape into the riparian zone and provide continuity of this natural wildlife corridor.

Locating the wetland within the Rosebud River valley imposed an additional constraint: long-term potential flood elevations of the river needed to be considered when setting wetland geometry and elevations. Designing for potential future floods was critical to ensuring the wetland and its vegetation are able to thrive long into the future and placed a limiting elevation on the design of the wetland. To help achieve this, the site was carefully selected to be outside the 1:100 year floodplain and to avoid possible historical resource sites within the river meanders.

Understanding the Drainage System for the Catchment Area

Since the main purpose of the project was to control and treat stormwater flows coming into the area, it was vital to first understand how the drainage system worked in the area and also the effect that storm events would have on the proposed wetland. Once the engineers understood these two components, they could then design the wetland and stormwater upgrades to meet these needs.

The stormwater drainage system in the project area consists of two components. The first is the **surface drainage or major system**. This system has two major contributing catchment areas:

CATCHMENT AREA 1 The first routes runoff from the industrial subdivision onto, and along the roadway surface. Surface runoff is then picked up by catchbasins and enters the minor drainage system (i.e. storm sewer).

CATCHMENT AREA 2 Surface drainage from the northern part of the town makes up the second catchment area. These flows are conveyed overland to a ditch system that flows into the project area.

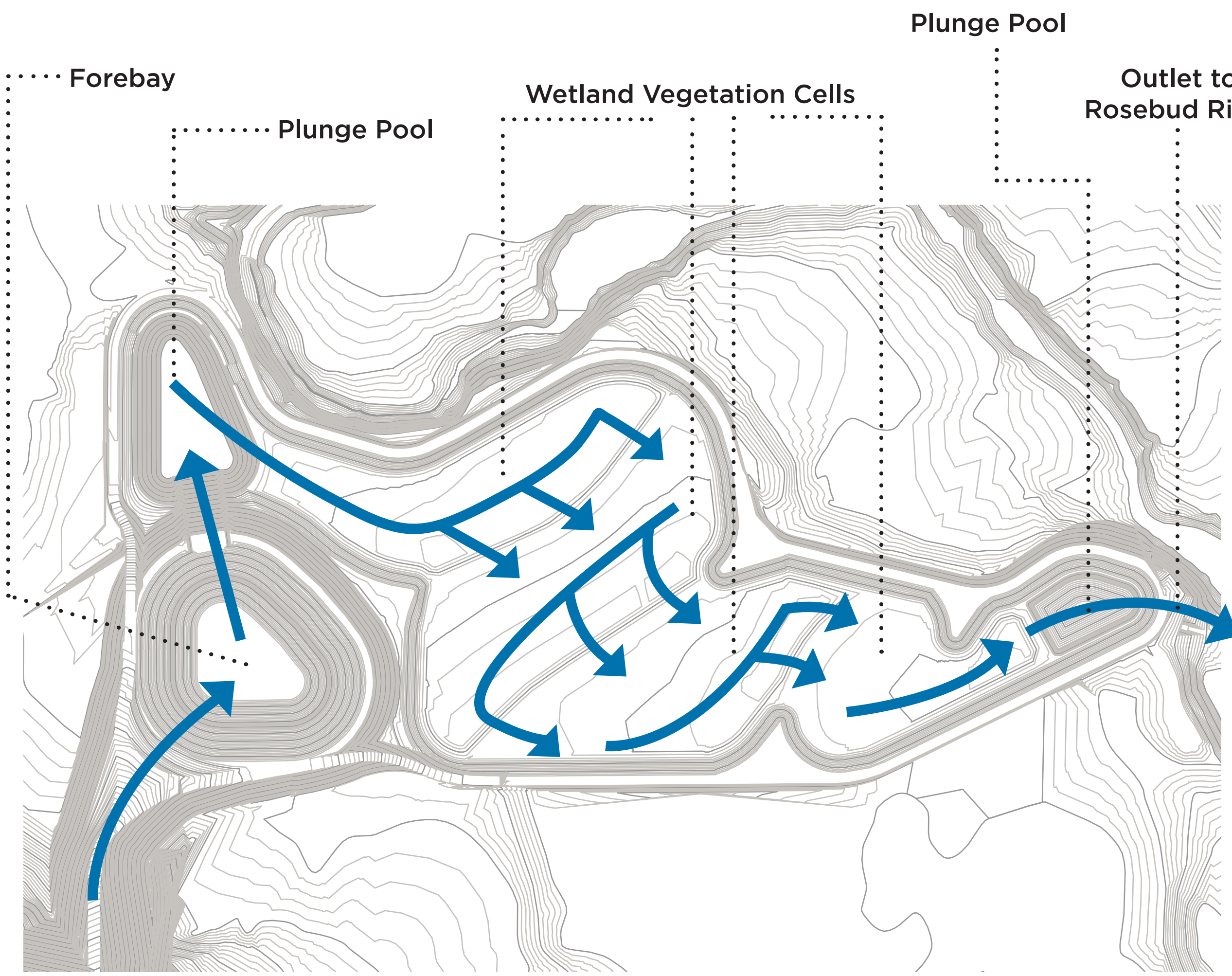
The second component is the **minor drainage system,** i.e., the subsurface storm sewer system. All the stormwater that flows overland eventually enters the storm sewer system, which pipes the stormwater into the forebay before entry into the wetland. The wetland ultimately releases the treated stormwater into Rosebud River via an outfall.

Modelling the System for Robust Design Solutions

ISL developed and refined an XP-SWMM hydrologic/hydraulic computer model for the area to more accurately simulate the interaction between the major and minor systems as well as the detailed hydraulics present in the wetland control structures. XP-SWMM is a dynamic model capable of unsteady flow simulation; this allows it to deliver more realistic, and therefore more accurate, results than most hydraulic models. XP-SWMM features an enhanced graphical user interface, making it easy to review the created models and customize graphic output. The model was quite complex. Data inputted into the model for the project area included catchment areas, major segments, minor segments, and the stormwater management facilities (the pipe network, the stilling basin, forebay and constructed wetland). For the engineer, the modelling work means better design solutions, such as improving the design of the forebay so that it prevents large frequent changes in water level that would damage the wetland.

Design progression of the wetland from undeveloped land through to final result (aerial from 2011).

The hydrology of a wetland is mainly one of slow flows and shallow water depth. This allows sediments to settle as the water passes through the wetland. Consequently, they can be very sensitive to high intensity, short duration storms. This project required that the wetland be sized to manage a significant storm event, classed as one that could occur once in every hundred years (the 1:100 Year event). Taking all this into account, a suitable design storm was simulated: a 1:100 Year return period-Chicago distribution of 24-hour duration. By simulating the storm's effect on the model, ISL was able to design wetland and structure geometry to successfully manage these kinds of storms.



The wetland grading plan and drainage flow through the wetland (design concept)

SUSTAINABLE DESIGN SOLUTIONS

Three hydraulic components were used to control of the rate of storm flow, improve water quality, and protect the wetland habitat.

COMPONENT 1

Upstream Piped Conveyance Network: Overland storm flows were consolidated into a central piped conveyance system. Storm mains range from 525 mm to 1650 mm in diameter at grades ranging from 0.3%-8%. Super-catchbasins were used in multiple locations to capture large overland flows.

COMPONENT 2

Stilling Basin: The wetland is located approximately 20 m below the industrial subdivision in the Rosebud River valley. This rapid drop in elevation, introduces a high velocity to the large storm flows ($6m^3/s$) being conveyed down the valley. ISL's engineering team designed the stilling basin, constructed inside a 3m x 3m Box section, to ensure that flows are reduced in volume and speed before they reach the wetland (thereby preventing damage).

Stilling basin employed to dissipate energy at bottom of slope

COMPONENT 3

Forebay: A unique aspect of the Didsbury wetland is the additional function of the forebay: in this case it is used to store runoff in storm events, thereby acting as a buffer to protect the wetland. Traditionally, forebays are implemented to reduce total suspended solids and other pollutants by introducing a calm pool that encourages particulate settling. In this case, storing runoff is particularly important since wetland ecology can be negatively impacted by frequent large swings in water elevation of greater than 1 m. Consequently, ISL designed the forebay with 2 m of active storage depth (11,500 m^3), which will allow it to fill to the spillway elevation in as low as a two-year intensity storm event. Once the storm event has passed, an internal control orifice will slowly release the remaining flows stored in the forebay. With the forebay acting as a buffer, the maximum increase to wetland water levels in a 1:100 year intensity storm event is less than that from a typical forebay configuration.

Also, in the event of a harmful spill from the industrial area upstream, multiple weir walls have been included to isolate the forebay from the rest of the wetland so that cleaning can take place and the wetland can be protected from any spill.

An additional spill containment system has been provided at the wetland outlet—this will also protect the river in the event of a catastrophic pollutant release in the industrial area.

Forebay

Considering the growth in the area, the engineers also incorporated a rectangular gate orifice to allow adjustment of the overall outfall rate. This means that future developments near the subdivision can also come online and use the wetland.

MEETING THE CLIENT'S SUSTAINABILITY OBJECTIVES

Construction of the wetland project, stormwater upgrades and path network began in 2010 and was completed in 2011. What started off as a simple stormwater management project considered and *met* all five of the Town's over-arching sustainability objectives in their Integrated Community Sustainability Plan (ICSP).

Long term fiscal viability was achieved since the wetland is a self-sustaining system once constructed. Only minor maintenance and cleaning is required over its lifecycle, i.e. the standard park's maintenance and sediment removal from the Stormwater Management Facility (SWMF). The cost difference of adding the park and pathway was relatively small in the context of the overall project costs and the wider benefits of the project to the community (and to the municipality in demonstrating the application of their ICSP). In fact, the project came in more than one million dollars under budget. These cost savings were achieved throughout the project through proactive risk management of potential construction issues both before and during construction.

Effective, efficient and responsive government was demonstrated by using a formal sustainability evaluation to ensure that the Town's commitment to their ICSP objectives was met through this project. The Town now has a formal evaluation process that allows infrastructure projects to be objectively evaluated and improved upon within the context of their vision of sustainability. The tools developed in this project are expected to be used when the Town's southeast reservoir is constructed, particularly in relation to park integration. Regarding long term sustainability, this stormwater management solution is designed to serve not only the new industrial subdivision and the existing part of town but future residential developments in the area (their controlled outlet flows will be routed through the constructed wetland).

Sensitivity to the environment, through stormwater management and treatment, was the main rationale for this project. In this regard, the parameters set by the following minimum criteria were critical in the design of a sustainable wetland solution:

- A pre-development runoff rate of 2.5 L/s/ha needed to be maintained as the outlet rate for the stormwater management facility.
- The quality of post-development runoff had to be sufficient so as not to degrade the quality of surface water or groundwater in the area, requiring 85% removal of particles 50 microns and larger under a 1:100 year rainfall event. *(Alberta Environment's standards require 85+% removal of 75 microns and larger on an annual basis, so this design would actually be* ***removing 98+% on this basis, i.e. significantly better water treatment than that required****.)*
- The SWMF must be sized for the 1:100 year event.

Close-up of the boardwalk (rendering)

Recognition was given for the high quality of the final constructed wetland. Pre-construction, the project area consisted of pasture land and a small 1.5 ha wetland. Typically, Alberta Environment requires 3:1 land compensation for impacting existing wetlands (i.e. three new constructed wetlands for one natural). However, recognizing the high quality of the constructed wetland and the resulting increase in biodiversity and animal habitat, Alberta Environment reduced their compensation requirements for impacting the existing wetland to 1.26:1.

Once wetland plantings are complete in 2012, water quality monitoring is expected to further demonstrate the wetland's improvement of stormwater quality above the mandated standards. With more diverse habitat, anecdotal evidence suggests that there has also been an increase in wildlife usage since development of the wetland.

The project responds to the ICSP Natural Areas Strategy by protecting and enhancing ecosystem integrity and biodiversity in Didsbury. It serves as an example of how natural features in recreational and developed areas can be protected and managed in the context of new developments.

For example, this project also took into consideration that the Rosebud Valley serves as a major natural and environmental corridor, and one which the community has committed to protect and appreciate. Local stewards were involved in providing additional input for the preservation of natural areas. In the end, this project is an example of how parks and recreational areas can be designed to minimize human impact and preserve natural habitats.

Encouraging recreational diversity was another benefit of the project. The Recreation and Leisure Strategy of the ICSP was taken into account in the comprehensive wetland solution. Before the project, Didsbury did not have a large amount of pathways and park amenity space in a naturalized environment. The team had noted that the existing pathways around the Town's Memorial Park ball diamonds saw heavy traffic…. The sustainability analysis early on in the project led to further thinking outside the box. As the project progressed the team considered: *in what other ways could this project make a difference in the community in keeping with the Town's ICSP?*

This led to a park and pathway system being incorporated within the wetland area. The result was the creation of the largest park area in Didsbury and the Town's total paved pathway being doubled in length. The project's associated pathway network linked with plans for future residential development to the south (ongoing) and east (in design stage). The team also identified a logical pathway link that connected the wetland area to the Memorial Park ball diamonds. Finally, the wetland boardwalks and wildlife viewing platforms provide passive recreational opportunities for the community.

Wetland boardwalk and viewing area provide added value to park visitors (rendering)

The project was formally opened on Tuesday, September 13, 2011, when the Town of Didsbury hosted a grand opening ceremony with officials from the Government of Canada, the Province of Alberta and the Town of Didsbury in attendance.

To date the Town has received extremely positive feedback from the community about the recreational trail system and wetland, including the following statements:

- ***"This is going to be a great place for the community."***
- ***"These wetlands will not only help clean up runoff water [but] they will have the opportunity for the public to relax and check out the wildlife."***
- ***"There are a number of benefits, including recreational opportunities, environmental improvements. It is obviously a great benefit to the community."***
- ***"We went out just yesterday walking the trail, and saw tons of birds! What a treat to have this beautiful addition to our town."***
- ***"I would just like to say Wow! Although I have walked my dog many, many times in the park, I have kept to the south path through the construction. But when I decided to investigate today, was I surprised to see the wetland, and pathways and cows and ducks and look-out points. It was a very pleasant walk. We will walk there often. What a beautiful addition to our town. Thank you...WOW!"***

New pathway system (area during development)

3D rendering of wetland viewed from the west

CONCLUSION

A Sustainable Stormwater Solution that Enhances the Community, its Beauty and Quality of Life

Stormwater management is traditionally considered a requirement to development rather than an opportunity to provide wider benefits to society. In this case, what started off as a stormwater engineering project became a community solution.

ISL's innovative approach incorporated a formalized sustainability evaluation that allowed the environmental and social benefits of the wetland solution to be formally identified, expanded upon and justified in the context of the Town's Integrated Community Sustainability Plan (ICSP). Keeping the ICSP sustainability goals at the forefront of decision-making throughout project design is a progressive stance for municipalities (and engineering teams) to take. In the words of the Town's Mayor Brian Wittal:

"Not only did ISL Engineering present a unique way for the Town to address its stormwater issues, they incorporated and enhanced the town's pathway system and [added] observation boardwalks along the pathway adjacent to the wetland area which improved the quality of life for Didsbury residents. This project is a valuable addition to our community and will be for years to come."

The Town of Didsbury now has a practical example of meeting its sustainability commitment of ***"moving progressively into the future by enhancing our community, its beauty and quality of life."*** The wetland and associated stormwater upgrades provide the best possible benefits in terms of protecting the beauty of the river valley from erosion issues caused by previously uncontrolled storm flows and enhancing water quality. More than that, the whole project serves to enhance quality of life in Didsbury: now residents and visitors can enjoy more park space and a substantial increase in paved pathways for greater community access. They can visit the wetland, walk the boardwalks and look out onto more diverse wildlife habitat. This unique public amenity adds diversity to the landscape, provides an attractive feature and a place for the community to gather or quietly enjoy. Altogether, these social and cultural benefits add significant value to the original stormwater management mandate.

This project proved to be a great example of the exemplary results possible with the support of Federal stimulus funding and the involvement of all three levels of government. It received positive comments from all.

"Our Government is proud to have supported the development of this important new wetland, which gives the Town of Didsbury space for active recreation while enhancing stormwater accommodation in the area," said Blake Richards, Member of Parliament for Wild Rose, on behalf of the Honourable Lynne Yelich, Minister of State for Western Economic Diversification.

For the Province, Richard Marz, MLA for Olds Didsbury Three Hills, added ***"This new wetland project will help improve quality of life for the residents of Didsbury and serve the municipality for many years to come....The Province is pleased to continue to work in co-operation with the federal government and municipalities on this and other shared funding programs for Alberta communities."***

The success of project has enabled the Town of Didsbury to demonstrate the fifth sustainability objective of **municipal leadership** in the design and construction of a large infrastructure project that fits with their ICSP. The approach and tools are very applicable to other Canadian municipalities seeking to demonstrate their ICSP commitment through a municipal project. To conclude with Mayor Brian Wittal:

"It shows we've tried to plan something very forward-thinking and incorporate it into the landscape...To realize that what we had built in Didsbury was a very unique, leading edge, one of a kind project that incorporated long term, environmentally friendly, interactive and sustainable planning principles...[this will be] a showcase for Didsbury and a benchmark for municipalities nationwide!"

DIDSBURY NORTH INDUSTRIAL STORMWATER WETLAND - AT A GLANCE!

Innovation	• Provided a customized, technical, formal and quantified sustainability evaluation of design options in the context of the Town of Didsbury's ICSP • Forebay designed to also buffer the wetland from major and minor storm surges • High velocity hydraulics, caused by area's steep grades, now controlled by a stilling basin
Complexity	• High water table of area introduced many constructability issues • Steep grades created site stability and design challenges • Detailed XP-SWMM hydrologic/hydraulic modelling to simulate the complete drainage system and impact of storm events on the design • Limited wetland geometry caused by the Rosebud River flood elevation • Constructed wetland integrated into natural landscape (vegetation and topography)
Meeting and Exceeding Client's Needs	• One of Didsbury's largest capital expenditures—delivered more than $1 Million under budget • Long term stormwater management for the industrial subdivision, northern part of town, and potential future developments in the area • Project example for the Town to demonstrate leadership and sustainability commitment in the practical application of its ICSP
Environmental Impact	• Previously uncontrolled storm flows controlled to pre-development rates • Water quality improvement of storm flows to the Rosebud River (previously untreated) • Biodiversity and wildlife habitat increased • Constructed wetland integrated into natural landscape
Social and Economic Impact	• Largest park area in Didsbury created and a 25% increase in the Town's total park area • Unique amenity site provided for town residents and visitors • Town's total paved pathway was doubled in length (1500m new!) • Boardwalks and wildlife viewing platforms for passive recreation and education opportunities

Didsbury North Industrial Stormwater Wetland:
2 PAGE HIGHLIGHTS

Originally selected to design and construct a 'standard' stormwater management facility, ISL Engineering and Land Services worked with the Town of Didsbury to expand the project scope from a typical pond facility, not frequented by the public, to a 3-hectare constructed wetland and the creation of the largest park in Didsbury. Delivered more than $1 Million under budget, the innovative approach incorporated a formal evaluation process tailored to the Town's Integrated Community Sustainability Plan.

BACKGROUND

In Didsbury, Alberta, stormwater from a new industrial subdivision and part of the town was flowing, uncontrolled and untreated, into the Rosebud River below. To manage the problem, the Town of Didsbury needed a Stormwater Management Facility (SWMF) as well as associated stormwater upgrades in the upstream catchment area. Based on a previous study, ISL Engineering and Land Services (ISL) was selected for the work. Originally, the project called for a traditional wet or dry pond to store and treat stormwater. Everything changed when the Town formalized its commitment to sustainability by adopting the Town of Didsbury Integrated Community Sustainability Plan (ICSP). ISL's innovative approach included analysis of stormwater management' design solutions against a combination of the sustainability themes and objectives from the Town's ICSP, a series of project outcome indicators for sustainability, Town experience, engineering design properties, and costs. Once the facility type was selected, ISL had to design for the complexity of its location, simulate the natural drainage in the area to enhance the design, and ensure the whole stormwater management system could handle minor and major storms—while maintaining a sustainability design ideology throughout.

FROM COMMUNITY SUSTAINABILITY PLANS TO STORMWATER SOLUTIONS

Many Canadian municipalities now have Integrated Community Sustainability Plans (ICSPs), helping them access Federal Gas Tax Funding. However, these municipalities are faced with the challenge of how to evaluate (and justify) major infrastructure projects in the context of their ICSPs. ISL's innovative approach incorporated a formal evaluation process for selecting stormwater management solutions based on the Town's newly adopted Integrated Community Sustainability Plan. It's an approach that is very applicable in municipalities across Canada since the analysis was based on the Town's sustainability themes, which are the same as those commonly promoted in many Canadian templates for these sustainability plans: Economic, Social/Cultural, Environmental and Governance.

A New Application of Sustainability Technology: Stormwater Management in Canada

This project appears to be the first example of the use of one advanced software program (ASPIRE) in a Canadian context and in the context of evaluating the sustainability of design options for a stormwater management facility. The engineers carefully evaluated each design option (dry pond, wet pond, and wetland) against questions within 96 sub-themes of the larger sustainability themes of Economic, Social/Cultural, Environmental and Governance. It was also far more comprehensive a sustainability analysis than the conventional Triple Bottom Line methodology (which only considers Environmental, Social and Economic factors). The resultant scores and keystone diagram for each design option graphically summarized its performance against these themes and highlighted areas for improvement. This approach allowed the environmental and social benefits of the wetland solution to be formally identified, expanded upon and justified in the context of the Town's Integrated Community Sustainability Plan (ICSP). Applying a formal sustainability analysis early on in the design process encouraged the engineers to apply a sustainable design ideology in all subsequent design solutions.

ADDRESSING COMPLEXITY IN STORMWATER MANAGEMENT

Addressing Issues of the Location

Once the wetland was selected as the preferred sustainable design, the team worked on engineering solutions for its design and construction in the chosen location. A major advantage of the wetland's proposed location, below the subdivision and in the Rosebud River valley, was that stormwater runoff from the surrounding lands naturally drained down into the area, thereby helping with the wetland's operability and sustainability. However, the steep valley grades created site stability and design challenges.

First, during major storms, the speed of the large storm flows coming down the valley slope risked damaging both the wetland below and the proposed pipes conveying the stormwater to it. ISL's design solutions included a stilling basin to initiate the required hydraulic jump and slow flows before they reached the wetland, thereby protecting it.

Second, as a natural drainage collection point, the high groundwater and saturated soils presented significant problems during construction. The team addressed this by dewatering the site, using geotechnical berms, as well as managing the timing of construction to limit soil compaction.

Third, the wetland's location next to the Rosebud River's sensitive riparian zone introduced extensive vegetation and wildlife considerations. The solution included a biophysical impact assessment (subconsultant), as well as a native vegetation design to integrate the landscape of the wetland and park into the riparian zone and provide continuity of this natural wildlife corridor. The site was also carefully selected to be outside the 1:100 year floodplain and to avoid possible historical resource sites within the river meanders.

Modelling the System for Robust Design Solutions

Wetlands can be very sensitive to high intensity, short duration storms. ISL developed and refined a detailed XP-SWMM hydrologic/hydraulic computer model to simulate the complete drainage system and impact of storm events on the design. Data incorporated into the model for the project area included catchment areas, major segments, minor segments, and the stormwater management facilities (the pipe network, the stilling basin, forebay and constructed wetland). This project required the wetland to be sized to manage a significant storm event, classed as one that could occur once in every hundred years. Taking all this into account, a suitable design storm was simulated. For the engineer, the modelling work meant better design solutions, such as improving the design of the forebay so that it prevents large frequent changes in water level that would damage the wetland.

Sustainable Design Solutions

Three hydraulic components were designed to control of the rate of storm flow, improve water quality, and protect the wetland habitat. First, the upland piped conveyance network included a central piped conveyance system and super-catchbasins to capture large overland flows in multiple locations. Second, ISL's engineering team designed a stilling basin with an innovative additional function: ensuring that flows are reduced in volume and speed before they reach the wetland (thereby preventing damage). Third, the team incorporated a forebay, with an unusual, additional function: to store runoff in storm events, thereby acting as a buffer to protect the wetland. Also, in the event of a harmful spill from the industrial area upstream, multiple weir walls have been included to isolate the forebay from the rest of the wetland so that cleaning can take place and the wetland can be protected from any spill. An additional spill containment system was provided at the wetland outlet, which will also protect the river in the event of a catastrophic release of pollutants from the industrial area.

CONCLUSION:

A Sustainable Stormwater Solution that Enhances the Community, its Beauty and Quality of Life

Stormwater management is traditionally considered a requirement to development rather than an opportunity to provide wider benefits to society. In this case, what started off as a stormwater engineering project became a community solution. All three levels of government were involved in funding the project and all held it up as an example of what can be achieved in improving community' quality of life through a stormwater infrastructure project. Keeping the ICSP sustainability goals at the forefront of decision-making throughout project design is a progressive stance for municipalities (and engineering teams) to take. It allowed the project team to consider the other ways the project could make a difference in the community in the context of the Town's ICSP. This led to a major new naturalized park area and a pathway system being incorporated with the wetland area. It also included boardwalks and wildlife viewing platforms for passive recreation and education opportunities. The success of project has enabled the Town of Didsbury to demonstrate municipal leadership with an example of a large infrastructure project that meets all the objectives of their Community Sustainability Plan.

"Not only did ISL Engineering present a unique way for the Town to address its stormwater issues, they incorporated and enhanced the town's pathway system and [added] observation boardwalks along the pathway adjacent to the wetland area which improved the quality of life for Didsbury residents. This project is a valuable addition to our community and will be for years to come....It shows we've tried to plan something very forward-thinking and incorporate it into the landscape... [this will be] ***a showcase for Didsbury and a benchmark for municipalities nationwide!"***
Didsbury Mayor Brian Wittal