URBAN RECLAMATION STEPS FORWARD:
Converting Land from Agricultural to a Rebuilt Upland and Wetland for the Larch Park Pond

Michael Rawson Clark, M.Sc., P.Biol.,
Clark Ecoscience and Sustainability

Introduction

A STORM WATER MANAGEMENT FACILITY (SWMF) is a system that integrates a human-made 'pond', the pond's water inflow from the streets through pipelines, and the outflow into pipelines that drain into natural systems. It is a method of preventing or minimizing rain-driven water flow, some non-point source pollutants, and other organic and inorganic particles from flowing into natural systems. Pollutants are transferred from yards and roads into the SWMF during rain events and spring melting.

Storm water control systems have shifted from basic designs with individual goals to designs that are ecosystem service based. Early SWMF design was large, unnatural rectangles that collected and held neighbourhood off flow. Through the 20 – 21st centuries SWMF goals have been shifting to meet the human needs while replicating natural systems as much as possible. Restoration and rebuilt native ecosystem projects are commonly found to function and perform at levels below that of their natural models, and this is also the case for SWMFs.

In Edmonton, Alberta, a developer team from Melcor Developments and Arctos and Bird collaborated to make the residential neighbourhood, Larch Park, as 'sustainable' as possible. This was a challenge, as sustainability represents merging the best economic, social and environmental actions available. Many sustainability industry components are emerging in Alberta. One primary area identified was rebuilding the SWMF as a native ecosystem, from the soils up, across the wetland and upland areas. IBI Group, Clark Ecoscience and Sustainability (CES), and others collaborated with the developers to design, implement and care for the cutting-edge SWMF so that the rebuilt native ecosystem would succeed. An industry collaboration with the University of Alberta was then developed to maximize what would be learned for application to other projects.

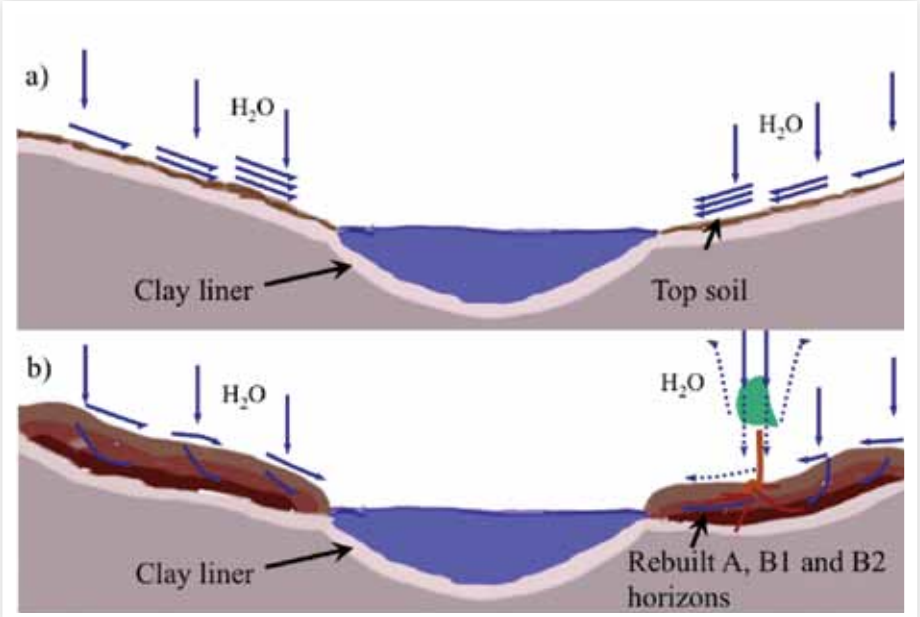

Figure 1. Storm water management facility soil rebuilding methods. (a) Conventional SWMFs have compacted clay with 10 to 15 cm of topsoil on them, unlike natural soils. Trees are installed into 'pots' dug into the compacted clay. The Larch Park SWMF had the A and B horizons collected, stored and replaced to support water flow above and below ground, and healthy vegetation root conditions.
Image from CES.

Building Process

The Larch Park SWMF is Edmonton's first rebuilt as a native ecosystem. The end goal is a biologically diverse native prairie – aspen forest uplands surrounding wetlands. All of this is to thrive under both wet and drought years. As of the time of this article, the vegetation communities and soils are within their fourth and fifth years of establishment.

Soil Rebuilding

Soil storage and planning were the first steps in the fieldwork. The goal was to re-install the A and B horizons after they were pulled out by large machinery during the pond digging to return conditions as closely as possible to those found before the SWMF was built. Natural soil profiles present before the digging of the SWMF supplied a model and materials to rebuild the pond's soils. Soils of the agricultural land were carefully stored to minimize microbial community loss and the carbon impact of shipping 'top soil' off site, and maximize invasive species control by tilling the soils as they germinated. Like other industries – but a first for the Edmonton SWMFs – soil B and A horizons were rebuilt over the sub-soil left after industry dug out the SWMF (Figure 1; Figure 2 on page 50).

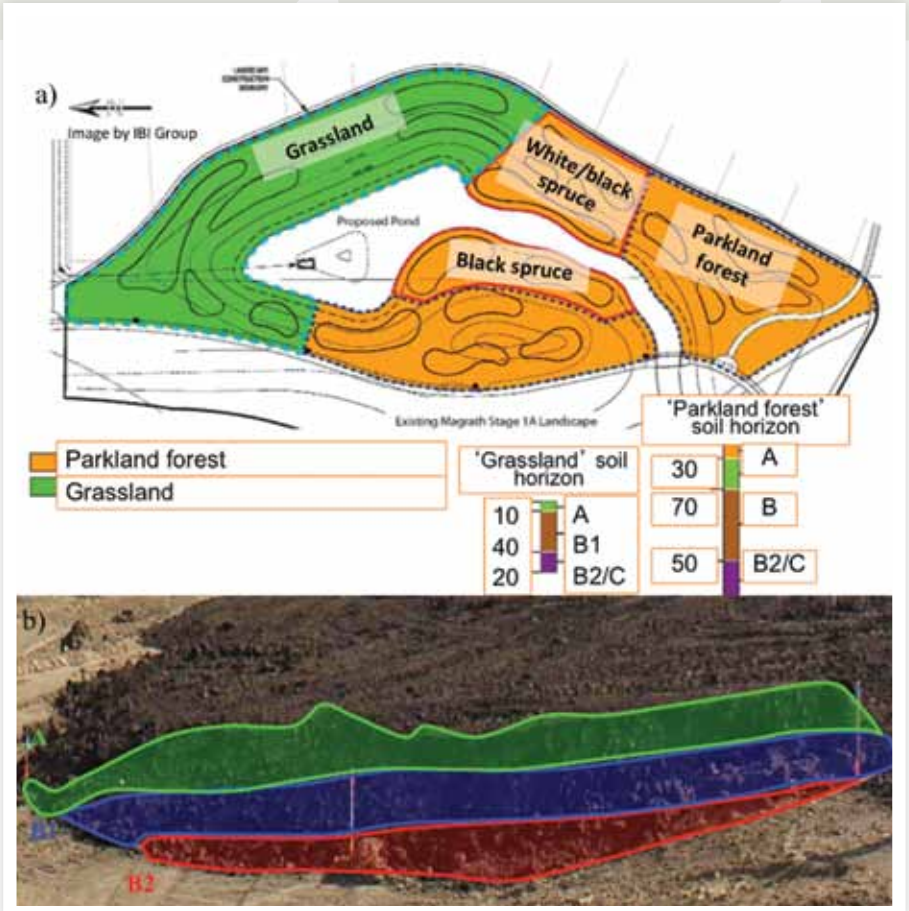

Figure 2. Diagram of the Larch Park SWMF design and actual soils during rebuilding. (a) The SWMF native vegetation communities and the associated soil depths of the forest and grassland areas. Areas with both spruce species installed into the Parkland forest are surrounded with the red borders. Image from IBI Group. (b) Soil layers after rebuilding. The depth in the center was ~ 2 m, while it decreased to ~ 20 cm near the water due to engineering constraints. This is the west side border of the parkland forest area, at the thinnest point. Image from CES.

Vegetation Communities

Four vegetation communities were installed based on environmental characteristics (Figure 2a). Grassland is at the north side and also throughout the site in experimental blocks assessing species establishment and reproduction under different conditions. A mixed-wood forest was installed through the southern half of the pond. Aspen and other deciduous species were installed to the south, with black spruce (*Picea mariana*) near the pond and white spruce (*Picea glauca*) in the center. Two to four meter tall trees were the focal points of the forest areas because SWMF construction requires that a minimum number of large trees be installed for human enjoyment. Wetlands were planted around the pond's perimeter.

Community arrangement is designed to incorporate long-term environmental variability. For example, Edmonton experiences long periods of droughts that inhibit tree growth. Dry years would lead to reduction of aspen trees, although not necessarily, and other forest species. Without the grasslands to move into these opening spaces, invasive species colonization would occur, causing a restoration failure. Over 90 species of grasses, forbs, trees and shrubs were planted to have a robust community. Seeds that many of these plants grew from were collected from the Larch Sanctuary nearby, and at the University of Alberta's Research Ranch, and are connected to the research project. Through the past four years the vegetation has begun to establish and spread in both the wetlands and the uplands. While some obvious species have spread, such as Canada goldenrod (*Solidago canadensis*), others are spreading beyond predictions, such as hairy arnica (*Arnica mollis*; Figure 3).

The City of Edmonton has had a great, positive interest in the successes and failures of the SWMF during the first four years of the SWMF development. Interest and support has ranged from the Mayor to technicians involved in the City's landscapes, and many professionals in between (indeed, the Mayor participated in a tour). Another example is City collaboration to develop the Integrated Pest Management system use of controlled pesticides with industry.

Figure 3. Larch Park, 2013.

Scientific Assessment and Establishment

Disturbance during development and the subsequent reclamation has drastic effects on ecosystem functions, and no matter the ecosystem that is developed there are tradeoffs between the different ecosystem functions that come afterwards (Bennett et al. 2009). For example, disturbance followed by land reclamation causes drastic changes in soil processes including elevated levels of nutrient availability compared to native areas, despite the fact that microbial biomass decreases (McMillan et al. 2007). Planting native grassland communities in rebuilt soils is hypothesized to return ecosystem function to something more reminiscent of natural grassland communities than lawn. At Larch Park, an industry-University of Alberta research collaboration is assessing soil and vegetation community establishment.

After four years, two result directions are occurring: social and scientific. Socially, before the ground was broken, the team set up new planning and design processes in their offices that allow them to make future native ecosystem projects less expensive and open to more Albertans. Additionally, connections with stakeholders and the City of Edmonton were made. New field work 'steps' were introduced to the urban industry (e.g., soil horizon storage). To ensure that these connections are positive, all concerns and ideas have been listened to, and many are being incorporated into this research project, or future research projects under development.

Scientifically, measuring ecosystem function of the SWMF and comparing it to native ecosystem and 'turf' sites is well underway. Work focuses on soils (e.g., microbial communities, carbon and nitrogen), vegetation establishment, growth and spreading, and invasive species colonization. Conversion of the basic science to ecosystem services is a goal of the last two years of the project to better understand financial benefits (e.g., converting native plant competition with Noxious and Invasive Noxious plants to dollar values for a cost-value explanation for local residents and the City of Edmonton).

This project has been well funded, with support from Alberta Conservation Association and MITACS, industry (Melcor and CES), and the University of Alberta. After four years this work is being submitted to scientific journals for publication with a goal to demonstrate that the developers' project is not 'greenwashing' for sales, but will help urban reclamation improve as a scientific step forward with all of the others done globally.

Rebuilding Native Ecosystems into the Future

While the Larch Park SWMF is small in size at less than a hectare, its impact helping the society become more sustainable is large. People in industry and government are interested in the results, and many are taking the methods used at Larch Park forward in other developments and projects. With the interest in developers to continue using the best urban reclamation methods possible, the City of Edmonton is a step towards achieving ecosystem service maximization goals and becoming a better place for its citizens.

References

Bennett E.M., G.D. Peterson, & L. J. Gordon. 2009. Understanding relationships among multiple ecosystem services. Ecology Letters 12:1394-1404.

McMillan R., S.A. Quideau, M.D. MacKenzie, and O. Biryukova. 2007. Nitrogen mineralization and microbial activity in oil sands relaimed boreal forest soils. Journal of Environmental Quality 36:1470-1478.

For more information, please contact Michael Rawson Clark, M.Sc., P.Biol., at michael@clarkecoscience.com or 780.862.0920.