SMALL SWALE

CONCEPTUAL PLAN

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WSP CANADA INC.
3330-237, 4 Avenue SW
Calgary, Alberta

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1 INTRODUCTION

A Conceptual Plan has been developed to guide future improvements aimed at enhancing the Small Swale (the site), considering both the natural assets and Human Use. This plan is intended to serve as the foundation for future site improvement planning and design, offering direction on aspects such as infrastructure, planting, and operational maintenance. The Conceptual Plan outlines the design program, proposed improvements, construction implementation, maintenance, monitoring, phasing, and costing. As the name suggests, all recommendations are conceptual only and will require further detailed design studies and approval prior to implementation.

The Conceptual Plan is a continuation of the Small Swale Natural Area Management Plan (Small Swale NAMP) which details the long-term management of the site. The Conceptual Plan is intended to be read in conjunction with the Small Swale NAMP as it builds upon the recommendations therein.

1.1 SITE OVERVIEW

The site is an ecologically and historically significant natural area comprised of native and modified grasslands, native tree stands, a wetland complex, and the Riddell Paleontological Site. It is home to species of management concern and is a beloved natural feature within the City. Located in the northeast of Saskatoon near the Saskatoon Wildlife Federation, the site spans approximately 85 hectares of the greater Small Swale complex. Portions of the site south of McOrmond Drive are currently used for snow storage, materials handling, stormwater handling, and agricultural purposes. Consequentially, the ecological health of the site varies from poor to good, with the healthiest communities being located north of McOrmond Drive. A full description of the existing features and uses of the site can be found in the NAMP.

1.2 DESIGN PROGRAM

A design program has been developed for the site to guide the development of future improvements. A design program is a synthesis of the goals for the site, outlining what should be considered in future planning. As such, the design program considers the goals and targets outlined in the Small Swale NAMP, balancing the Natural Assets and Human Use of the site. The design program (see**Table** 1-1 Design Program) is intended to guide future design decisions, ensuring that all future improvements support either the Natural Assets and/or the responsible Human Use of the site.

The proposed improvements further discussed in Section 2 – Proposed Improvements often have overlap between the Natural Assets and Human Use management of the site. For instance, the proposed circulation route (i.e. trails) not only allows for an engaging experience for visitors, but it also helps to sustain the natural assets by guiding visitors away from known sensitive habitats and species. Regardless of the improvement, it is recommended that the approved designs consider safety, accessibility, and climate change mitigation.

Table 1-1 Design Program

	DESIGN PROGRAM	
	NATURAL ASSETS	**HUMAN USE**
PROGRAM CONSIDERATIONS	– Design considers the maintenance or enhancement of the natural assets in support of the Conservation Targets (see Small Swale NAMP).	– Design considers responsible passive recreation, opportunities for historical and cultural connection, and opportunities for education and connection to nature. In support of the Human Well-Being Targets (see Small Swale NAMP).
SUPPORTING IMPROVEMENTS	– Buffering improvements (along the perimeter and within the site). – Restoration or reclamation improvements. – Ecological connectivity improvements. – Species of Management Concern (SOMC [Flora and Fauna]) improvements. – Stormwater improvements.	– Human Use improvements, such as site access, circulation, destinations, communications programming, and site amenities. – Historical and Cultural improvements.

2 PROPOSED IMPROVEMENTS

The proposed improvements for the site support both the identified natural assets and the Human Use targets. Consequently, the Conceptual Plan focuses on a blend of ecological enhancements and human-use programming. **Figure 1** illustrates the spatial layout of the proposed improvements, adhering to the Management Zones established in the Small Swale NAMP that provide guidance on the appropriate programming in relation to known natural assets. It should be noted that **Figure 1** is conceptual only and intended solely to show possible relationships between features and the proposed programming. Each element of the Conceptual Plan carried forward into future designs must undergo detailed design and approvals prior to implementation.

The Conceptual Plan for the site includes recommendations for the following improvements:

- Buffering improvements.
- Human Use Improvements.
- Historical and Cultural Improvements.
- Restoration/Reclamation Enhancements and Improvements.
- Ecological Connectivity Improvements.
- SOMC (Flora & Fauna) Improvements.
- Stormwater Improvements.

COORDINATION

As part of ongoing management and execution of the Conceptual Plan, coordination with, and input on all adjacent land use changes will be critical in the future planning and implementation of the proposed features, particularly the circulation system, site access improvements, and wildlife connectivity conservation. It is recommended that future planning be a collaborative effort between the City of Saskatoon, Meewasin, and adjacent landowners to ensure alignment of proposed and installed infrastructure. It is recommended that future improvements be designed and implemented in collaboration and/or engagement with site users, easement holders, and adjacent landowners.

2.1 BUFFERING IMPROVEMENTS

In support of "Strategy #3 – Buffering of Adjacent Lands" presented in the Small Swale NAMP, an approximately 30 m in width 'Greenway' which includes an ecological buffer, trail zone, and transition zone is recommended to be constructed outside and along the boundary of the site where adjacent to incompatible land uses. The buffer is recommended to be widened to allow for an alley way (approximately 5m wide) should houses back onto the Greenway. This buffer will mitigate the negative effects of future incompatible land uses, provide uncontrolled run-on pollution prevention, reduce undesirable seed rain effects, and preserve a portion of the pre-development local wetland catchments.

The design and construction of the Greenway will require coordination with the future adjacent landowners as the feature will fall outside the boundaries and scope of this conceptual plan. However, the following is recommended to be considered when designing the Greenway:

Table 2-1 Buffering Improvements

	FUNCTION & LOCATION	DESCRIPTION
GREENWAY (OFF-SITE)	– To act as a buffer between the site and future incompatible land uses.	– Recommended to follow the design of the Northeast Swale Greenway. – Recommended to include dark-sky compliant lighting, seating nodes, naturalized planting pockets, waste receptacles, accessible pathway, and an alley way if the backs of the houses face the Small Swale. – Recommended to allow for multiple Secondary Access Points between the Small Swale and the Greenway.

2.2 Human Use Improvements

Responsible Human Use is intended to support the passive use of the site, while sustaining the identified natural assets. Proposed Human Use improvements adhere to the permitted uses of the site as recommended by the Small Swale NAMP, with a focus on passive recreation, education, and connection to nature. In support of "Strategy #11 – Human Use Programming" the following improvements are proposed:

– Controlled site access.

– Circulation route and seating nodes.

– Destinations and gathering areas.

– Communications programming.

– Site furniture and materials.

All proposed infrastructure is intended to support the natural assets and Conservation Targets outlined in the Small Swale NAMP. As such, the proposed improvements consider ways in which to minimize disruption to the natural assets identified, incorporate engagement and education of visitors, and allow for sustainable connections to the landscape.

2.2.1 CONTROLLED SITE ACCESS

Controlled site access is proposed to provide protection from illegitimate uses, control access in-and-out of the site, define boundaries, and assist in wayfinding. It is proposed that the perimeter of the site be fenced on the interior, and accessible from the following designated entry points: 1) Main Entry Points, and 2) Secondary Entry Points. **Table 2-** describes the difference between the two types of entry points and the supporting infrastructure required.

Table 2-2 Site Access Types

	FUNCTION & LOCATION	SUPPORTING INFRASTRUCTURE
MAIN ENTRY POINTS	– One main entry point located adjacent to the proposed lookout north of McOrmond Drive. – Two main entry points located south of McOrmond Drive adjacent to the proposed gathering areas. – To be coordinated with the construction of adjacent development(s).	– Main entry signage. – Gates & blockades. – Boot cleaning station. – Waste receptacle. – Parking lot (off-site). – Restroom facilities (off-site).
SECONDARY ENTRY POINTS	– Multiple secondary entry points along the length of the site to facilitate controlled movement between the adjacent land uses and the site. – To be coordinated with the construction of adjacent development(s).	– Secondary entry signage. – Gates & blockades. – Boot cleaning station. – Waste receptacle.

SITE ACCESS - SUPPORTING INFRASTRUCTURE

The following infrastructure is proposed to support site access (**Table 2-**). Per the recommendations of the Small Swale NAMP, parking lots and restrooms should be located outside the boundaries of the site. External infrastructure improvements will require coordination with the adjacent landowners to accommodate the implementation of all proposed infrastructure.

Table 2-3 Site Access Infrastructure

INFRASTRUCTURE TYPE	FUNCTION & LOCATION	DESCRIPTION
PERIMETER FENCING	– To visually signify importance of the site and restrict human entry while allowing for permeable wildlife movement. – To encircle the entire site along the property line.	– Wildlife-friendly (i.e., 3-strand wire) to allow for permeable movement of wildlife while discouraging human access. – Fence entirety of perimeter to limit disruption to the site and restrict access for vehicles and illegal dumping.
MAIN ENTRY SIGNAGE	– Located at main entry to site and easily visible from road. – To serve as wayfinding, location identification in emergencies, permitted uses, and site branding.	– Refer to “Signage” in **Table 2-4**.
SECONDARY ENTRY SIGNAGE	– Located at secondary entry points. – To serve as wayfinding, location identification in emergencies, permitted uses, and site branding.	– See “Signage” in **Table 2-4**
GATES & BLOCKADES	– To be located at each entry point. – To restrict vehicular access to maintenance vehicles only, and to allow for pedestrian access.	– Swing gate with lock for maintenance vehicle access. – Pedestrian access fitted with infrastructure (i.e. gate or boulders) to restrict vehicular access.

INFRASTRUCTURE TYPE	FUNCTION & LOCATION	DESCRIPTION
		– Coordinate with City of Saskatoon emergency services to ensure compliance of infrastructure.
BOOT CLEANING STATIONS	– To be located at both the main and secondary entry points. – To support invasive species control, and to allow visitors to clean boots of seeds prior to entering and leaving the site.	– Boot brush with signage to educate visitors on the spread of invasive species and preventative measures.
WASTE RECEPTACLES	– To be located at both the main and secondary entry points for ease of maintenance.	– Consider wildlife-proof containers. – Size to be sufficient to handle expected volume of visitors. – Design to consider ease of maintenance.
PARKING LOTS (OFF-SITE)	– To facilitate responsible parking in designated areas adjacent to the main entry points. – To be located off-site in areas of existing disturbance in conjunction with future adjacent land-use planning.	– Consider anticipated volume of visitors, and parking/drop-offs for busses. – Consider dark-sky compliant lighting set to timers that will turn off lighting during certain times to conserve energy and to limit any interfere with wildlife behaviour (light pollution).
RESTROOM FACILITIES (OFF-SITE)	– To facilitate responsible use of the site, restroom facilities are to be located off-site and are to be positioned near the main entrance points or within parking lots in conjunction with future adjacent land-use planning.	– Infrastructure to consider safety, accessibility, and volume of use.

SITE ACCESS - COORDINATION

The proposed site access points identified on **Figure 1** are illustrative only and are intended to show the possible relationship between the adjacent future land-uses and the trail system proposed for the site. The final location of the access points and related infrastructure (i.e., parking lots and restrooms) will require targeted coordination with the adjacent landowners and proposed future land use changes.

2.2.2 CIRCULATION ROUTE & SEATING NODES

A thoughtfully placed circulation route is recommended to allow for controlled movement through the site while sustaining the identified natural assets from human disturbance (e.g., foot-traffic). The proposed circulation route considers movement through the site to areas of rest, destinations, and access points. It is composed of two trail types (i.e., Primary and Secondary Trail Types) of distinct function.

TRAIL DESIGN

During the future detailed design of the circulation route, it is recommended that the function, environment, safety, and accessibility of each design element be thoroughly evaluated. **Table 2-4** below outlines the recommendations for the individual design considerations related to the proposed trails. These recommendations are based on the City of Saskatoon's Standard Construction Specifications: Parks (2023) and The Meewasin Trail Study (2014).

Table 2-4 Trail Design Considerations and Recommendations

DESIGN CONSIDERATION	GENERAL RECOMMENDATIONS	RECOMMENDATIONS PER TRAIL TYPE
LAYOUT & FUNCTION	– Function: Circulation system connects visitors to the adjacent land uses and entry points, guides visitors through the site, and allows for controlled access to points of interest and opportunities for education. – Layout: Proposed layout of trails is conceptual only. The final layout should be determined following a legal land survey of the property line, and location of sensitive species. – Environment: Layout considers the location of sensitive natural features and considers the path which will require the least amount of disruption both during construction and maintenance. – Safety: Circulation system provides a safe route throughout the site, avoiding potential hazards, such as steep topography or water-related hazards. – Accessibility: Provides accessible route for a variety of user groups, including those who utilize mobility devices.	Primary Trail: – Connects visitors to the Main Entry Points and to points-of-interest. – Provides efficient route through the site. Secondary Trail: – Provides meandering off-shoots from the Primary Trail for a more immersive experience with nature.
SURFACE & MATERIALS	– Function: Stable, durable materials of various visual types, which are efficient to maintain. – Environment: Surface materials durable and comfortable to avoid pedestrians going off-trail to avoid unsafe or uncomfortable conditions. Consider materials which would cause minimal disruption to natural processes when constructing and when used. – Safety: Surface materials durable and slip-resistant to avoid slips, trips, and falls. – Accessibility: Surface materials of durable and even material to allow for ease of use.	Primary Trail: – Durable material, such as crushed gravel is recommended for long-term use of the trails. – Mown trails may be considered for the first implementation of the plan and upgraded to a more durable material depending on the amount of use. Should the trails begin to show signs of erosion or deterioration due to use, it is recommended that the surface be upgraded to a more durable surface. – At-grade boardwalks where topography and water levels dictate. An above-grade boardwalk is proposed to traverse the proposed naturalized stormwater pond. Secondary Trail: – Mown or natural surface trails. At-grade boardwalks where topography dictates. Water conditions of wetter years will be taken into consideration.
GRADE	– Function: Grade of trail designed to avoid rutting along sides of the routes and provide comfortable experience to avoid volunteer trails. – Environment: Grade of trail limits erosion of trail and encourages users to stay on path. – Safety: Grade of trail designed to allow for adequate drainage of surface to avoid pooling of water or formation of ice (2% cross slope), and comfort of walking (5% maximum slope). – Accessibility: To allow for mobility device accessibility, it is recommended that slopes be	Primary Trail: – Maximum 5% longitudinal slope, minimum 2% cross slope. Secondary Trail: – To existing grade, with a recommendation to avoid areas steeper than 5%.

DESIGN CONSIDERATION	GENERAL RECOMMENDATIONS	RECOMMENDATIONS PER TRAIL TYPE
	kept to 5% or less to meet the Canadian Standards for Accessibility (CSA).	
WIDTH	– Function: Minimum trail widths should consider the City's Construction Specifications and Meewasin's trail development standards. – Environment: Width wide enough to accommodate two people walking side by side to avoid people walking off-trail. – Safety: Adequate width to allow for users to comfortably pass without conflict. – Accessibility: Adequate with to allow for two mobility devices to pass.	Primary Trail: – 3.0 minimum width with a mown shoulder to allow for access for maintenance vehicles. Secondary Trail: – 2.0-3.0 m minimum depending on the width of the mower deck.
SIGHTLINES & OBSTRUCTIONS	– Function: Maintain adequate sightlines to avoid user conflicts and avoid obstructions along the trail. – Environment: Consider growth of vegetation and potential sightline and obstruction conflicts. – Safety: Maintain sightlines around curves, at junctions, and at entrances. Avoid sharp curves along trail system. Keep structures and plant material a minimum of 2.0m from edge of trail with an overhead vegetation clearance of a minimum of 3.0m above the trail surface. – Accessibility: Ensure trail is not obstructed to inhibit accessibility.	Primary Trail: – Adhere to general recommendations (column to the left). Secondary Trail: – Adhere to general recommendations (column to the left).
MAINTENANCE	– Function: Regular maintenance of trail system to ensure working order. – Environment: Regular maintenance is encouraged to avoid degradation of trail system and volunteer trail formation for those seeking an alternative route (signage should encourage users to stay on trail). – Safety: Regular maintenance is encouraged to avoid degradation of trail system, rutting, and hazards. – Accessibility: Regular maintenance is encouraged to avoid degradation of trail system, rutting, and hazards, and barriers.	Primary Trail: – Adhere to general recommendations. Secondary Trail: – Adhere to general recommendations.
SITE FURNITURE	– Function: Site furniture to support the use of the trail system. – Environment: Field fit to ensure sensitive species are avoided. Adequate areas of rest provided to avoid users creating volunteer areas of rest and unintentionally disturbing sensitive ecosystems. – Safety: Locate areas of rest at a regular frequency to prevent fatigue. Locate furniture at a safe distance from the side of the pathway to avoid conflict. Avoid locating seating nodes in remote areas to avoid crime. – Accessibility: Consider accessible designs for such things as benches and signage. Locate areas of rest at a regular frequency to prevent fatigue.	Primary Trail: – Benches located at proposed locations of interest. Secondary Trail: – Benches proposed locations of interest.

DESIGN CONSIDERATION	GENERAL RECOMMENDATIONS	RECOMMENDATIONS PER TRAIL TYPE
SIGNAGE	– Function: To provide wayfinding and information on use of trails. Work with user groups to design new signage. – Environment: Discourage volunteer trail formation through use of proper signage to guide users through the site. – Safety: Install signage at site entrances, and at trail junctions. Signage to clearly indicate location of user, trail system, and location of entrances and emergency gathering areas. – Accessibility: Accessibility enhanced through clear communication of length of pathways to destinations, and notation of which routes are accessible.	Primary Trail: – Wayfinding signage and educational signage located at trail junctions and at areas of interest or ecological importance. Secondary Trail: – Wayfinding signage and educational signage located at trail junctions and at areas of interest or ecological importance.

CIRCULATION ROUTE & NODES - COORDINATION

The future circulation route as illustrated on **Figure 1** is illustrative only and is intended to show the relationship between the adjacent future land-uses and the site. It is recommended that the layout of the circulation route be re-evaluated and designed in-tandem with upcoming adjacent developments such as UH3 Neighbourhood design or extensions of the Meewasin Valley Trail system. It is also recommended that the layout be verified on site prior to construction, and field fit to avoid sensitive natural features and provide a safe and accessible route throughout the site.

2.2.3 DESTINATIONS & GATHERING AREAS

Proposed destinations within the site consider areas of interest, need for gathering, and educational opportunities. Two gathering areas are proposed south of McOrmond Drive, while a lookout of the wetland and grassland are proposed north of McOrmond Drive. A summary of each type of destination and supporting infrastructure is described below in **Table 2-5**.

Table 2-5 Destinations& Gathering Areas

	FUNCTION & LOCATION	SUPPORTING INFRASTRUCTURE
GATHERING AREAS	– Allow for community engagement, rest, education, and ceremonial uses. – Easily accessible from main access points. – Accessible from Primary Trail Type for accessibility. – Located in area of existing disturbance or poor ecological health to prevent disturbance to healthy ecosystems. – Final location to be determined through detailed design to ensure compatibility with natural assets.	– Seating: Benches, picnic tables, accessible furniture, and stone circles. – Signage: Educational & wayfinding (see **Table 2-6**). – Waste receptacle, if accessible for maintenance vehicle.
LOOKOUT	– Allows for access to areas of interest without causing damage to natural features. – North of McOrmond Drive, overlooking the wetland and native grassland communities. – Accessible from the Primary Trail Type for accessibility. – Field fit to prevent disturbance to natural ecosystem, while allowing engaging viewing experience. – Final location to be determined through detailed design to ensure compatibility with natural assets.	– Seating: Natural stone or benches. – Signage: Educational (see **Table 2-6**). – Barrier at entrance to trail to prevent vehicular access. – Telescope, or other, for engaging experience. – Barrier (fencing) at lookout terminus to prevent unwanted access. – Waste receptacle: At parking lot/trail entrance.

2.2.4 COMMUNICATIONS PROGRAMMING

Five types of signage are recommended for the site as part of the communications programming (**Table 2-6**). A comprehensive communications program addresses the need for site recognition, wayfinding, education/interpretation, and rules. It is recommended that as part of detailed design a communications program be developed to ensure accessibility, site branding, and application of City policies.

Table 2-6 Signage Types

	FUNCTION & LOCATION	DESCRIPTION
SITE MAP	– Function to orient users when arriving to the site and provide context of permissible and prohibited uses. – Preferred location to be at the Main Entry Points.	– Largest in scale than the other signage types. – To include at a minimum the site name, entry location information for emergencies, emergency contact information, site map, hours of use, and permissible and prohibited uses.

	FUNCTION & LOCATION	DESCRIPTION
		– Information to be compliant with the City of Saskatoon's Crime Prevention Through Environmental Design (CPTED) policies.
SECONDARY ENTRY MAP	– Function to orient users when arriving on site and provide context of permissible uses. – Location to be at the Secondary Entry Points.	– Smaller in size than the Site Maps. – To include at a minimum the site name, entry location information for emergencies, emergency contact information, site map, hours of use, and permissible and prohibited uses.
WAYFINDING POSTS	– Function to orient users along the circulation system through the site. – Location to be at trail junctions.	– Small trail markers with trail map and location of user. – Graphics to be a simplified version of the entry maps, with a focus on indicating the circulation system and main destinations in icon format.
EDUCATIONAL SIGNAGE	– Function to be focused on educating visitors to the site on topics such as the history and environmental significance of the site. – Location to be at significant historical, cultural, and environmental features. – "Restoration in progress" signage to be considered for locations of proposed planting initiatives.	– As part of signage and communications program, determine which historical, cultural, and environmental features to celebrate.
PROHIBITED USE	– Function of signage is to discourage prohibited use of the site. – Location to be at the site entrance and at areas in need of protection.	– Content to discourage prohibited use of the site, such as motorized vehicles, dumping, or access to sensitive areas.

2.2.5 SITE FURNITURE & MATERIALS

Site furniture and materials are recommended to be chosen based on durability, maintenance, aesthetics, sustainability, costs, comfort, accessibility, local availability, and resistance to vandalism and theft. The materials palette is recommended to be complimentary to the natural surroundings, including elements such as natural stone, wood, native plants, and weathered metals. To create a cohesive and visual connection to the Northeast Swale, it is recommended that the materials palette for the Small Swale be similar in nature.

2.3 Historical and Cultural Improvements

In support of "Strategy #8 – Historically and Culturally Significant Species & Features Management" **Table 2-7** summarizes the various improvements proposed.

Table 2-7 Historical & Cultural Improvements

	FUNCTION & LOCATION	INFRASTRUCTURE
FENCING	– Riddell Paleontological Site to be fenced to limit disruption.	– Wildlife-friendly (i.e., 3-strand) to allow for permeable movement of wildlife while discouraging human access. – Fence entirety of perimeter to limit disruption to the site.
EDUCATIONAL SIGNAGE	– Educational signage to engage and inform the public on historically and culturally significant topics. – Locate outside adjacent to the historically and culturally significant features.	– Recommended to comply with signage program (**Table 2-6**) in "Human-Use" improvements.
PLANTING	– Inclusion of culturally significant species in restoration/reclamation improvements.	– Will require engagement with Indigenous communities.

2.4 RESTORATION/RECLAMATION IMPROVEMENTS

The site would benefit greatly from future reclamation and restoration work. These two environmental terms are often used interchangeably but have their own distinct meaning. While reclamation refers to the process of repurposing natural resources that have been altered by human activities (e.g., mining, agriculture), restoration refers to intentionally returning degraded ecosystems to its original or natural state (definition adapted from Gann et al., 2019). The Small Swale NAMP outlines the restoration or reclamation feasibility of two locations at the site, the Snow Storage Facility and a grassland area in the northeast corner.

In reclamation projects, the aim is to make the disturbed land usable for a new purpose, which may not necessarily involve returning the project to its original state. In restoration projects, the aim is to rehabilitate the ecological function and native biodiversity of a system as close as possible to pre-disturbance conditions. In the site, areas north of McOrmond Drive will be restored, while the Snow Storage Facility and associated roads will be reclaimed.

With past land use activities, such as the construction of McOrmond Drive or the presence of the Snow Storage Facility, the site suffered ecosystem degradation and habitat fragmentation. Adjacent development projects and agricultural lands surrounding the Small Swale create further threats as the Swale's margins are continuously disturbed and modified. The Society for Ecological Research (Gann et al., 2019) has identified eight principles for ecological restoration that are listed in the table below.

Table 2-8 Ecological Restoration Principles

PRINCIPLE	HOW IT IS APPLIED
Engages stakeholders	The successful engagement of stakeholders is detailed through the Social Benefits Wheel which focusses on improving social-ecological resilience (see section 2.4.2 – Ecological Recovery Wheel (ERW)).
Draws on many types of knowledge	The attempt of knowledge enrichment is detailed through the Social Benefits Wheel which focusses on creating new relationships (see section 2.4.2 – Ecological Recovery Wheel (ERW)). Using the Social Benefits Wheel provides an opportunity to engage with Indigenous communities to have their voices and needs heard. Efforts should be made to incorporate their restoration goals into the restoration process.
Is informed by native reference ecosystems	The restoration process of the site is informed and compared to native reference ecosystems. The southern part of the Small Swale is deemed to be recovered when it resembles the northern parts of the Small Swale, while the northern Small Swale part succeeded in recovery when comparable to Kernen Prairie.
Supports ecosystem recovery processes	The restoration of the wetlands and the grasslands on site will aid in the recovery of ecosystem processes by creating an overall healthier biodiversity structure that is more resilient to future stresses.
Is assessed against clear goals and objectives	The restoration process will be assessed against clear targets, goals, and objectives which are outline in the 2023 Small Swale Natura Area Management Plan.
Seeks the highest level of recovery possible	The restoration process, including targets, goals, and objectives, will be evaluated every 10 years ensuring that adaptive management will achieve the highest level of recovery possible (Principle 6). The Ecological Recovery Wheel (Section 2.4.2 – Ecological Recovery Wheel (ERW)) aids in the guidance and tracking of the progress of the ecological restoration projects. Restoration processes can be repeated and intensified until full recovery is achieved. Full recovery is achieved when the two to-be-recovered ecosystem types resemble their reference ecosystems named above.
Gains cumulative value	Once the restoration processes are complete, cumulative benefits are gained. The construction of the stormwater pond, for example, will help balance the hydrology in part of the site's watershed. Additionally, enhancing grasslands to a healthier state might increase the rate of carbon sequestration by greater production of plant and animal biomass contributing to slowing climate change.
Is part of a continuum of restoration activities	Overall, the restoration of the site falls within the remediation (improving ecosystem management), and ecological restoration (partially/fully recovering native ecosystems) categories of the restorative continuum (**Figure 2-1**). The Snow Storage Facility will be remediated to a stormwater pond, which will improve the ecosystems' management in regard to hydrology. The grasslands and wetlands observed in the Small Swale will be ecologically restored to closely resemble their respective reference ecosystems.

Figure 2-1 below shows the restorative continuum created by Society for Ecological Research (Gann et al., 2019) to categorize the restoration type and status goal that the restorable ecosystem will achieve under full recovery.

Figure 2-1 Continuum of Restorative Activities

Creating habitats that cater to the wildlife and vegetation specific needs is recommended to enhance wildlife and vegetation populations, ecosystem stability, and overall biodiversity health. By conserving and enhancing habitat for wildlife and vegetation, environments conducive to their natural behaviours, reproductive processes, and ecological requirements are created.

A framework for site reclamation and restoration has been created by WSP and provided in the following sections. The framework includes six primary categories:

- Detailed baseline collection.
- Identification of goals/objectives.
- Site selection.
- Site design.
- Planting materials and seed sourcing.
- Determining species mix composition.
- Planting methodologies.
- Site management and monitoring.

This framework is enhanced by adaptive management principles, which will allow the exploration of alternative ways to meet restoration goals and predict the outcomes of these alternatives based on current knowledge. After implementing the alternatives, the results can be used to adjust restoration practices. Each project identified during the management of the site will require iterative approaches to manage location specific conditions, which should be identified during the detailed baseline collection phase.

2.4.1 DETAILED BASELINE DATA COLLECTION

The baseline conditions of the site should be recorded in detail prior to the implementation of any reclamation or restoration activities. Appropriate baseline information should also be used to select appropriate sites for either activity.

At a minimum, the data collected will be used to determine species lists, appropriate site management for invasive, noxious, or nuisance weeds, create areas of prioritization for restoration activities, identify locations where seed can be harvested, and provide a baseline condition to measure success against.

Baseline surveys should utilize pre-existing methodologies and be approved by experienced technicians or biologists (for example, Meewasin). Data collection may include but is not limited to:

- Documentation of invasive, noxious, or nuisance species recording their species, density, distribution, and phenology.
- Inventory general wildlife species and targeted SOMC for spatial distribution, movement and use.
- Completion of detailed vegetation inventories of all species (native and non-native) recording cover, indicating dominant species, and identifying areas of bare ground, or accelerated erosion.
- Completion of habitat classification for the site using the Saskatchewan Rangeland Ecosystems (Thorpe 2007) for uplands and Stewart and Kantrud (1971) for wetland habitats.
- Completion of condition assessments using Rangeland Health Assessments for Native Grassland and Forests (PCAP 2008).
- Identification of potential soil contaminants and/or water quality testing.

2.4.2 ECOLOGICAL RECOVERY WHEEL (ERW)

The ERW is a structured tool developed by the Society for Ecological Restoration (SER) to guide and track the progress of ecological restoration projects (Gann et al., 2019). It is designed as a visual framework to emphasize that ecological restoration is a dynamic and always-changing process that requires consideration of multiple environmental and anthropogenic factors (**Figure 2-2**).

The ERW presents six attributes with three sub-attributes each to rank the subsections on a five-star scale, where five stars represent an ecosystem being fully recovered (**Figure 2-2**). The "to be restored ecosystem" in this process is compared against a reference ecosystem to make appropriate management decisions. The reference ecosystem resembles a healthy state of restorable ecosystem with similar succession stages. Thorpe (2014), for example, can be used as a guide to assess and restore the Native Grassland areas on site. Definitions of the six categories as well as the five-star system are explained in **Table 2-9** and **Table 2-10** respectively.

The ERW also provides the opportunity to track the recovery of the restoration project regarding social benefits on a social five-star scale, or SBW (**Figure 2-3** and **Table 2-11**). The combination of ecological recovery and improvement in social benefits may lead to enhanced social-ecological resilience. Humans benefit from healthy environments, not only based on ecological functions like improved air quality, but on a mental and spiritual level. Engagement with nature can relieve stress and boost physical and mental health. Restoration projects will also benefit Indigenous communities as these nature-based cultures are being reinforced and celebrated (Gann et. al., 2019).

It is important to note that not all attributes of both the ERW and the SBW will apply to every project. The templates, especially the sub-attributes, should be adapted to suit the social and ecological goals of every project.

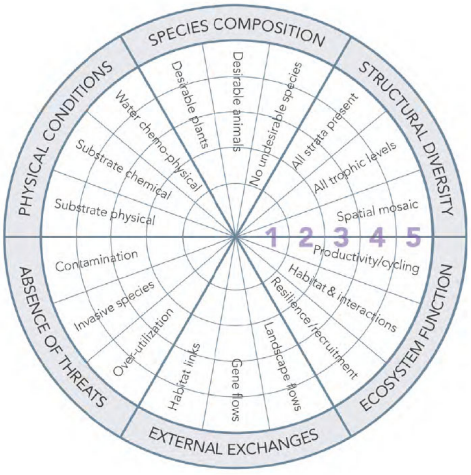


Figure 2-2 Ecological Recovery Wheel

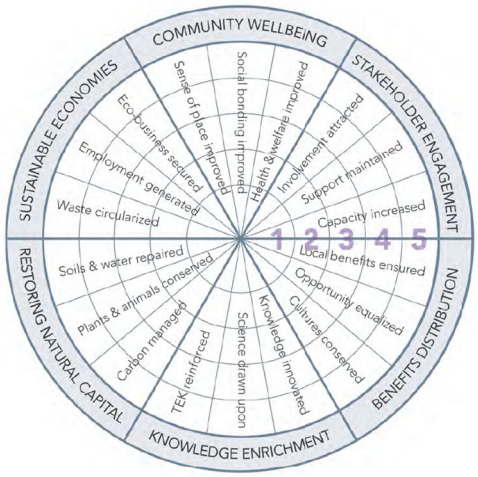


Figure 2-3 Social Benefits Wheel

The ecological site of the ERW is comprised of six key ecosystem attributes (with three sub-attributes each) that, when ranking high, contribute to ecosystem integrity. These six attributes (defined in **Table 2-9**) are used to characterize the reference ecosystem, evaluate the baseline conditions of the 'to be' restored ecosystem, set restoration project goals, and monitor the recovery of the restoration site.

Table 2-9 Description of Key Ecosystem Attributes Used to Characterize the Reference Ecosystem, Evaluate Baseline Conditions, Set Project Goals, and Monitor Recovery on Restoration Site[(a)]

ATTRIBUTE	DESCRIPTION	SUB-ATTRIBUTES	DEFINITION
Absence of threats	Direct threats to the ecosystem such as overutilization, contamination, or invasive species are absent	Over-utilization	Any form of harvesting or exploitation of an ecosystem beyond its capacity to regenerate those resources. Examples include overfishing, over-clearing, over-grazing, and over-burning.
		Invasive species (external)	Harmful plants and animals that were not originally present within an ecosystem but were directly or indirectly introduced into or spread in the ecosystem as a result of human activities.
		Contamination	Chemical contamination (e.g., over-fertilizing, pesticide spills) or biological contamination (e.g., introduction of invasive species including undesirable pathogens).
Physical conditions	Environmental conditions (including the physical and chemical conditions of soil and water, and topography) required to sustain the target ecosystem are present.	Substrate physical	The physical composition of soil, sand, rock, shell, debris or other medium where organisms grow, and ecosystems develop.
		Substrate chemical	The chemical composition of soil, sand, rock, shell, debris or other medium where organisms grow, and ecosystems develop.
		Water chemo-physical	The physical and chemical makeup of water.
Species composition	Native species characteristic of the appropriate reference ecosystem are present, whereas undesirable species are absent.	Desirable plants	Plant species from the reference ecosystem (or sometimes nonnative nurse plants) that will enable the native ecosystem to recover. The corollary of desirable plant species is undesirable species, which are often but not exclusively nonnative species.
		Desirable animals	Wildlife species from the reference ecosystem (or sometimes nonnative nurse plants) that will enable the native ecosystem to recover. The corollary of desirable wildlife species is undesirable species, which are often but not exclusively nonnative species.
		No undesirable species	The corollary of desirable plant species. Undesirable species are often but not exclusively nonnative species.
Structural diversity	Appropriate diversity of key structural components, including demographic stages, trophic levels, vegetation strata and spatial habitat diversity are present.	All strata present	Vegetation layer or layers in an ecosystem; often referring to vertical layering such as trees, shrubs and herbaceous layers.
		All trophic levels	Stages in food webs (e.g., producers, herbivores, predators, and decomposers).
		Spatial mosaic	The spatial structure of ecosystem components (in vertical or horizontal plane) that arises due to differences in substrate, topography, hydrology, vegetation, disturbance regimes, or other factors.

ATTRIBUTE	DESCRIPTION	SUB-ATTRIBUTES	DEFINITION
Ecosystem function	Appropriate levels of growth and productivity, nutrient cycling, decomposition, species interactions, and rates of disturbance.	Productivity, cycling etc.	Productivity: the rate of generation of biomass from the growth and reproduction of plants and animals. Cycling: The transfer (between parts of an ecosystem) of resources such as water, carbon, nitrogen, and other elements that are fundamental to all other ecosystem functions.
		Habitat interactions	Accessible habitat or the amount of habitat that can be reached from a focal habitat patch (Eigenbrod, Hecnar, & Fahrig, 2008).
		Resilience, recruitment etc.	Ecosystem resilience: The degree, manner, and pace of recovery of ecosystem properties after natural or human disturbance. In plant and animal communities this property is highly dependent on adaptations by individual species to disturbances or stresses experienced during the species' evolution. Social-ecological resilience: the capacity of a complex social-ecological system to absorb disturbance and reorganize while undergoing change such that it retains similar function, structure, identity, and feedback. It is a measure of the extent to which a complex social-ecological system can adapt and persist in the face of threats and stresses. Recruitment: Production of a subsequent generation of organisms. This is measured not by numbers of new organisms alone (e.g., not every hatchling or seedling) but by the number that develop as independent individuals in the population.
External exchanges	The ecosystem is appropriately integrated into its larger landscape or aquatic context through abiotic and biotic flows and exchanges.	Landscape flows	Exchanges that occur at a level larger than individual ecosystems or sites (including within aquatic environments) and including flows of energy, water, fire and genetic material. Exchanges are facilitated by habitat linkages.
		Gene flow	Exchange of genetic material between individual organisms that maintains the genetic diversity of a species' population. In nature, gene flow can be limited by lack of dispersal vectors and by topographic barriers such as mountains and rivers. In fragmented landscapes it can be limited by the separation of remnant habitats. Gene flow between introduced and native populations can have negative impacts, such as outbreeding depression.
		Habitat links	An element that comprises no habitat area but represents the possibility of dispersal between two habitat patches. A link may correspond to a physical corridor, or it may symbolise the potential of an organism to directly disperse between two habitat patches through favorable land cover (Saura & Rubio, 2010).

a) Gann et. al., 2019

Table 2-10 below describes the state of the ecosystem to be restored against the state of the reference ecosystem. The lower the resemblance between the two ecosystems, the lower the star count. The explanations of the different levels will give an idea on how the different key ecosystem attributes need to be improved to receive a higher star count, which intern represents a healthier restoration score.

Table 2-10 Five Star Ecological Recovery Scale in the Context of the Six Key Ecosystem Attributes[(a)]

ATTRIBUTE	*	**	***	****	*****
Absence of threats	Some direct degradation drivers (e.g., overharvesting, overgrazing, active contamination) absent and conservation status secured, but others remain high in number and degree.	Direct degradation drivers (including, e.g., sources of invasive low but some may species, absence of remain intermediate in appropriate natural disturbances) intermediate in number and degree.	Number of direct degradation drivers low but some may remain intermediate in degree.	Direct degradation drivers, both external and on-site, low in number and degree.	Threats from direct degradation drivers minimal or effectively absent.
Physical conditions	Most physical and chemical properties of the site's substrates and hydrology (e.g., soil structure, nutrients, pH, salinity, hydrological conditions) still highly dissimilar to reference ecosystem but some showing improved similarity.	Physical and chemical substrates and hydrology, remain at low similarity levels relative to reference ecosystem but capable of supporting some biota of reference ecosystem.	Physical and chemical properties of substrates and hydrology stabilized within intermediate range of reference ecosystem and capable of supporting growth and development of many characteristic native biota.	Physical and chemical conditions of substrates and hydrology within high range of reference ecosystem and suitable for ongoing growth and recruitment of most characteristic native biota.	Physical and chemical conditions of substrates and hydrology very highly similar to that of the reference ecosystem with evidence they can sustain all characteristic species and processes.
Species composition	Some colonizing native species present (e.g., approx. 2% of the reference ecosystem). Very high levels of nonnative invasive or undesirable species.	A small subset of characteristic native species present (e.g., approx. 10% of the reference ecosystem) across site. High to moderate levels of nonnative invasive or undesirable species.	A subset of key native species present (e.g., approx. 25% of the reference ecosystem) over substantial proportions of the site. Moderate to low levels of nonnative invasive or undesirable species.	Substantial diversity of characteristic native species and genes present (e.g., approx. 60% of the reference ecosystem) across site and representing a wide diversity of functional groups. Low to very low levels of nonnative invasive or undesirable species.	High diversity of characteristic native species and genes present (e.g., >80% of the reference ecosystem), with high similarity to the reference ecosystem and high potential for colonization of more native species over time. Very low to nil invasive or undesirable species.

ATTRIBUTE	*	**	***	****	*****
Structural diversity	One horizontal stratum of the reference present but spatial patterning and community trophic complexity still largely dissimilar to reference ecosystem.	More than one stratum of the reference present but some similarity of spatial patterning and trophic complexity, relative to reference ecosystem.	Most strata of the reference present and intermediate similarity substantial similarity of trophic complexity relative to reference ecosystem.	All strata of the reference present and substantial similarity of spatial patterning and trophic complexity relative to reference ecosystem.	All strata present and spatial patterning and trophic complexity high. Further complexity and spatial patterning able to self organize to highly resemble the reference ecosystem.
Ecosystem function	Processes and functions (e.g., water and nutrient cycling, habitat provision, appropriate disturbance regimes and resilience) are at a very foundational stage only, compared to the reference ecosystem.	Low numbers and levels of physical and biological processes and functions, relative to the reference ecosystem (incl. plant decomposition, soil processes), are present.	Intermediate numbers and levels of physical and biological processes and functions, relative to the reference ecosystem (incl. reproduction and dispersal) are present.	Substantial levels of physical and biological processes and functions, relative to the reference ecosystem (including return of appropriate disturbance regimes) are present.	All functions and processes (including appropriate disturbance regimes) are on a secure trajectory towards the levels of the reference and are showing evidence of being sustained.
External exchanges	Positive exchanges flow with surrounding environment (e.g., of species, genes, water, fire) in place for only very low numbers of species and processes.	Positive exchanges with surrounding environment in place for a few characteristic species and processes.	Positive exchanges between the site and surrounding environment in place for intermediate levels of characteristic species and processes.	Positive exchanges with surrounding environment in place for most characteristic species and processes and likely to be sustained.	Evidence that exchanges with the surrounding environment are highly similar to the reference for all species and processes and likely to be sustained.

a) Gann et. al., 2019

The social five-star system in **Table 2-11** below describes the state of the restoration project. The lower the star-count, the more work that needs to be completed to achieve a high social resilience score. The definitions of the different levels give input on how higher scores can be received.

Table 2-11 Social Five-star system for evaluating progress toward social goals in the restoration program[(a)]

ATTRIBUTE	*	**	***	****	*****
Stakeholder engagement	Stakeholders identified and made aware of project and its rationale. Ongoing communication strategy prepared.	Key Stakeholders supportive and involved in project planning phase.	Number of stakeholders, support, and involvement increasing at start of implementation phase.	Number of stakeholders, support, and involvement consolidating throughout implementation phase.	Number of stakeholders, support, and involvement optimal, and self-management and

ATTRIBUTE	*	**	***	****	*****
					succession arrangements are on place.
Benefits distribution	Benefits to local communities negotiated, ensuring equitable opportunities and reinforcement of traditional cultural relationships to the site.	Benefits to local communities starting and equitable opportunities maintained. Traditional cultural elements integrated, as appropriate, into project planning.	Benefits to locals at an intermediate level and equitable opportunities maintained. Any traditional cultural elements well secured within project implementation.	Benefits to locals at a high level and equitable opportunities maintained. Substantial integration of any traditional cultural elements, increasing reconciliation prospects.	Benefits to locals and equitable opportunities very high, with optimal integration of any traditional cultural elements, substantially contributing to reconciliation and social justice.
Knowledge enrichment	Relevant sources of existing knowledge identified and mechanisms for generating new knowledge selected.	Relevant sources of existing knowledge (and potential for new knowledge) informing project planning and monitoring design.	Implementation phase making use of all relevant knowledge, stakeholder feedback, and early project results.	Implementation enriched by all relevant knowledge as well as from trial and error arising from the project itself; results analyzed and reported.	Implementation enriched by all relevant knowledge and results from the project disseminated widely including to others with similar projects.
Natural capital	Land and water management systems to reduce overharvesting and restore and conserve natural capital being put in place on site.	Land and water management systems resulting in low level recovery and conservation of natural capital of the site.	Land and water management systems resulting in intermediate level recovery and conservation of natural capital (including improved carbon budget).	Land and water management systems resulting in high level recovery and conservation of natural capital (including carbon neutral status).	Land and water management systems resulting in very high level of recovery and conservation of natural capital (including carbon positive status).
Sustainable economies	Sustainable business and employment models (applicable to the project or ancillary businesses) planned.	Sustainable business and employment models commenced.	Sustainable business and employment models in testing phase.	Trials of Sustainable business and employment models showing success.	Sustainable business and employment models with strong levels of success.
Community wellbeing	Core participants identifying as stewards and likely improving social bonding and sense of place.	All participants identifying and likely benefiting from improved social bonding and sense of place.	Many stakeholders likely benefiting from improved social bonding, sense of place, and return of ecosystem services including recreation.	Most stakeholders likely benefiting from increased social bonding, sense of place, and return of ecosystem services including recreation.	Public identification of the site as having wellbeing benefits from local participation and return of ecosystem services including recreation.

a) Gann et. al., 2019

2.4.3 DETERMINING AREAS OF PRIORITIZATION

Data collection should be used to prioritize restoration or reclamation activities. Examples of high priority restoration areas may include but are not limited to:

Table 2-12 Examples of High Priority Restoration Areas

CONSIDERATION	RATIONALE	EXAMPLE LOCATION
Rangeland Health Assessments Scores	Areas that are assessed as "Healthy with Problems" can be prioritized so they do not continue to deteriorate. Without management or some level of intervention, they are likely to decline in condition from threats such as invasive, noxious, or nuisance weeds.	North of McOrmond Drive, Grassland Assessment Plot 3 (which is located just outside of the site's boundary) has received a score of Unhealthy due to a significantly altered plant community, reduced vegetation layers and severe infestation of invasive species (EDI 2021). It is a shrubland community type and is dominated by nonnative graminoid species. Despite the plot not residing within the Small Swale boundary, it likely reflects the condition of the surrounding area. Additionally, crowfoot violet *(Viola adunca)* and plains rough fescue *(Festuca hallii)* observations were documented nearby.
Areas presenting a negative anthropogenic influence such as the Snow Storage Facility.	Sites left unmanaged will have a deleterious effect on the surrounding ecological core by increasing the density and distribution of noxious, nuisance, and invasive species.	The Snow Storage Facility provides an opportunity for reclamation into a naturalized stormwater pond.

2.4.4 IDENTIFICATION OF RESTORATION GOALS AND OBJECTIVES

Goals and objectives should be determined based on available funding, long term planning, stakeholder input, and ecological needs of the site. These goals and objectives are subject to change based on inputs from baseline data collection, available funding, or changes to local land use. Furthermore, if additional lands are secured, priority for restoration or reclamation may change over time. Based on that, the priority rankings should be renewed regularly.

Three initial goals have been identified to improve and enhance the site:

1. **Reclamation:** Reclaim the areas of degradation, including the existing Snow Storage Facility[1], materials handling yard, internal access roads, and any other identified areas during the various baseline data collection initiatives undertaken. Reclamation efforts can be intensive as heavy equipment will require site access to complete earthworks (e.g., grading, sloping). The ultimate goal is to have the Snow Storage Facility be reclaimed to naturalized land, including a stormwater facility.
2. **Upland Restoration:** Improve the areas of poor or fair health, which may include tame pasture or areas of agricultural use and enhance existing high-quality areas. Note that restoration techniques for tame pasture and agricultural lands will differ from improving high-quality areas.
3. **Riparian Restoration:** Enhance the riparian edges of the existing forebays, snow storage interfaces, or any additional wetland areas that may appear unhealthy based on ongoing reviews and management.

[1]The presence of the Snow Storage Facility has stabilized the wetland water supply due to a 'longer than typical' baseflow for a period after natural spring freshet.

2.4.5 RESTORATION AND RECLAMATION LOCATION SELECTION

Location selection for restoration or reclamation activities should be based on areas of prioritization (see Section 4.1 – Establishment and Maintenance) and stakeholder inputs. Preliminary location selection has been identified however, determination of the final location and size of the restoration/reclamation extent should be completed at the detailed design stage. Considerations for location selection may include:

- **Site access:**

  If the planting requires watering (such as for shrubs/trees or live plants [plugs or stakes]) consider equipment access, watering sources, and frequency of use.

  Public accessibility and the potential for pedestrian traffic may influence germination success. Public use of area might have to be limited or stopped for a certain amount of time until plants are established.

  Ensure that the size of the location is suitable for the size of equipment required. For example, consider whether materials can be brought in (such as chemical sprayers) and brought out (such as vegetative material removed during mowing) without degrading the habitat. If drill seeding, is there adequate space for the tractor to turn around and enter/exit the location.

- **Site features:**

  SOMC or natural site features may be in the location that can be enhanced and should be considered when developing the restoration/reclamation plan(s).

  Accelerated erosion or bare soil may be present and could require specialized management approaches.

- **Weedy species[2]:**

  Targeted restoration/reclamation area(s) could be dominated by problematic species that require multi-year management approaches, which will hinder the success of plantings.

  Dominance of broadleaf, graminoid, or woody invasive species generally require increasing levels of effort and budget to eradicate. Funding to undertake the restoration/reclamation plan(s) should consider the financial inputs required to reduce the prevalence of these species.

2.4.6 PRELIMINARY LOCATION

Preliminary locations have been identified for the site during the development of the Conceptual Plan (**Figure 2**). These locations represent the complete opportunities for improvements based on available data; however, these areas will require refinement to determine the targeted location for restoration or reclamation. Targeted locations to be determined through detailed design based on the recommendations listed above.

2.4.7 SPECIES SELECTION

Careful consideration should be taken in determining the most appropriate flora species to be used per each restoration/reclamation location identified. Species should be considered on a multitude of criteria including but not limited to:

[2] See Small Swale Natural Area Management Plan (2023) for a list of the noxious or nuisance weeds observed on site.

- Species native to the area.
- Cultural significance.
- Species appropriate to the site conditions.
- Timing of flowering.
- Local seed sourcing.
- Seed availability.
- Expected lifespan.
- Wildlife benefits.
- Height, spread, and growth behaviour.
- Species specific maintenance.
- Flowering time.
- Key species indicative of modal community.

Seed certificates should be obtained for graminoid or forb species purchased from vendors, to determine seeding rates, overall viability, and to ensure that the seed is clean from noxious or nuisance weeds. Locally sourced or wild collected seeds should be a priority and the plan timeframe should attempt to consider wildlife seed collection(s). All sourced material should be from areas clean from potential weed pollution. A species list should be approved by an appropriate party, which may be Meewasin, the City, or an external stakeholder.

2.4.8 DETERMINING PLANTING METHODOLOGY AND SEEDING RATES

Determining if forbs or grasses should be established using live plugs or seed will depend on availability, access for maintenance, budget, species survivorship, and project requirements (such as emergency erosion protection). Additionally, the scale or size of the location will dictate the most appropriate seeding methods utilized:

Drill/Mechanical Seeding: Preferred methodology if equipment can access the site. Appropriate for grass seed, wetland seed (if conditions allow), and some forb species. This method is most suited for reclamation activities where bare ground is prevalent, or vegetative competition is very low. In areas of pre-existing vegetation this may not be applicable.

Broadcast Seeding: In areas where site access prevents equipment, broadcast seeding with hand-seeders will likely be the best method. Broadcast seeding will require site preparation to expose bare soil for seeds to adhere to. It is more challenging to ensure seeds are buried at an appropriate depth using this method, however in the case of some small-seeded forbs (such as goldenrods [*Solidago sp]*, or pussytoes *[Antennaria sp]* this is the best method as they are best seeded onto the soil surface.

Hydroseeding: In areas where access for drill seeding is limited, where topography is steep, or where there are large areas in need of seeding. Hydroseeding will require site preparation and is not recommended where pre-existing vegetation is present.

Live Planting: This is applicable only for areas where watering the materials is possible. In the case of willow plantings, using a waterjet stinger (or other similar equipment) requires a water source (which may be the adjacent wetland), and frequency of watering is highly dependent on the seasonal conditions. For shrub or tree plantings, this is likely the only suitable method as growing these species from seed requires a significant time dedication. For plugs or potted plants, this endeavour can be costly and may require frequent maintenance (for example, watering on site may need to occur every three or four days for the duration of the first growing season).

Seeding rates for the methodologies should be determined based on local conditions and best practices determined by stakeholder input or referencing existing guides. For example, Restoring Canadas Native Prairies, A Practical Manual (Collicut, Morgan & Thompson, 1995) suggests the following:

- Drill/Mechanical seeding should be completed at an ideal rate of 15 lbs PLS/ac (pure live seed per acre). Upon approval from appropriate experts.
- Broadcast seeding should be completed at double the drill seeding rate (30 lbs/ac).
- Hydroseeding should be completed at 50 kg/ha.
- The final composition should be approximately 75% grasses, and 25% forbs.

2.4.9 PLANT MATERIAL AND SEED SOURCE

Plant material for each type of restoration goal is recommended to be considered based on multiple criteria. The final mix should be a diverse combination of native species which reflects the natural habitat community identified during the baseline data collection phase. Seed or plant material sourcing should be as local as possible, which may include seed harvesting events from established prairies within proximity to the site as indicated in the MVRMP (Braun et al., 2017). This will ensure local genetics to the general area are maintained, increasing resiliency to disease and pests, as well as providing an increased opportunity for success for germinating plants. As surrounding land use changes, either through commercial, residential, or industrial development, or land purchase and an increased acquisition of grasslands are acquired, this plan should be revisited as targeted species for restoration may shift over time.

Potential native species to consider have been provided in **Table 2-13**, **Table 2-14**, and **Table 2-15**. These mixes were determined based on species documented on site from the UH3 Neighbourhood Natural Screening Report, and community guides for Saskatchewan (Thorpe, 2007) once detailed habitat mapping has occurred (see section 4.1 - Establishment and Maintenance) modal species that represent the appropriate community should be included in the composition. Percentages of composition should be determined based on seed availability, viability of germination, size of seed, and desired final representation of species.

For the purpose of concept planning, species are split into habitat types:

- Upland (fescue prairie, mixed grassland),
- Lowland (low lying areas, subject to higher levels of moisture), or
- Wetland (areas immediately surrounding or within wetland boundaries).

This list is not exhaustive, and only provides some of the general considerations and benefits for species selection. Wetland species most appropriate for riparian restoration/reclamation should be determined following baseline inventories, referencing Stewart and Kantrud (1971) to identify modal species for the wetland zones identified.

Table 2-13 Potential Forb Mix for Use in Restoration of Reclamation

COMMON NAME	SCIENTIFIC NAME	COMMENTS [A], [B]	RESTORATION/RECLAMATION OPPORTUNITY
Blanketflower	*Gaillardia aristata*	Colourful, important to native bee species, and attracts butterflies.	Upland
Crowfoot violet	*Viola pedatifida*	Ranked S3 (Vulnerable) on NatureServe, documented on site.	Upland

COMMON NAME	SCIENTIFIC NAME	COMMENTS [A], [B]	RESTORATION/RECLAMATION OPPORTUNITY
Cut-leaved anemone	*Anemone multifida*	Early flowering shade tolerant species, best propagated through seed.	Upland and Lowland
Harebell	*Campanula rotundifolia*	Long lasting flowering species, ideal for growing on rocky dry sites.	Upland
Low goldenrod	*Solidago missouriensis*	Low growing goldenrod that thrives in sandy or gravelly soils.	Upland
Many flowered aster	*Symphyotrichum ericoides*	Easily establishes, local seed source available, tolerant of mesic soils.	Upland and Lowland
Prairie coneflower	*Ratibida columnifera*	Quick to establish, short lived, but easily reseeds.	Upland/Wetland
Prairie crocus	*Anemone patens*	Early flowering species important for native pollinators.	Upland
Silverleaf psoralea	*Pediomellum argophyllum*	Observed on site and culturally significant species.	Upland
Stiff sunflower	*Helianthus pauciflorus*	Late flowering species, important for overwintering pollinators and food source for avian species.	Upland/Wetland

Source: (a) Minnesota Wildflowers 2006-2023 (b) The Ladybird Johnson Wildflower Center n.d.

Table 2-14 Potential Graminoid Species Seed Mix for Use in Restoration or Reclamation

COMMON NAME	SCIENTIFIC NAME	COMMENTS [A] [B]	HABITAT
American slough grass	*Beckmannia syzigachne*	Mesic, cool season, short-lived bunchgrass.	Wetland and Lowland
Awned wheatgrass	*Elymus trachycaulus*	Rhizomatous spreading native species, quick to establish.	Upland
Baltic rush	*Juncus balticus*	Suitable for low lying areas.	Wetland
Blue grama	*Bouteloua gracilis*	Low growing bunchgrass, larval host to skipper *(Oarisma, Hersperia, Polites and Amblyscrites)* species.	Upland
Green needlegrass	*Nasella viridula*	Important food source for avian species, and typical component of mixedgrass or fescue prairies.	Upland
Junegrass	*Koeleria macrantha*	Low growing cool season bunchgrass.	Upland and Lowland
Needle-and-Thread	*Hesperostipa comata*	Early flowering bunchgrass, typical component of mixedgrass or fescue prairies.	Upland
Northern wheatgrass (Streamside wildrye)	*Elymus lancelolatus* ssp. *lanceolatus*	Rhizomatous spreading native species, quick to establish.	Upland and Lowland
Purple oatgrass	*Schizachne purpurascens*	Shade tolerant bunchgrass, suitable for moist forest conditions.	Lowland
Plains rough fescue	*Festuca hallii*	Ranked S3 (Vulnerable) by NatureServe, critical component of mixedgrass or fescue prairies.	Upland

COMMON NAME	SCIENTIFIC NAME	COMMENTS [A] [B]	HABITAT
Sweetgrass	*Hierochloe hirta*	Culturally significant species, early flowering, rhizomatous spreading native grass.	Lowland and Wetland

Source: (a) Minnesota Wildflowers 2006-2023 (b) The Ladybird Johnson Wildflower Center n.d.

Table 2-15 Potential Shrub Species for Use in Restoration or Reclamation

COMMON NAME	SCIENTIFIC NAME	COMMENTS [A] [B]	HABITAT
Bebbs willow	*Salix bebbiana*	Short lived but fast-growing riparian species. Larval host to the mourning cloak *(Nymphalis antiopa)* and viceroy *(Limenitis archippus).*	Wetland
Eastern cottonwood	*Populus deltoides*	Large canopy tree tolerant of sun and shade, prefers moist conditions. Culturally significant species, that also has numerous wildlife benefits and is resistant to browsing from ungulates.	Wetland and Lowland
Highbush cranberry	*Viburnum opulus var. americanum*	Early flowering species, tolerant of wet soils, important wildlife food source.	Lowland
Sandbar willow	*Salix interior*	Riparian species documented on site, important for erosion control and easily planted through cuttings from local population.	Wetland and Lowland
Saskatoon	*Amelanchier alnifolia*	Culturally significant species, important wildlife food resource.	Upland
Silver buffaloberry	*Sheperdia argentea*	Drought tolerant species.	Upland
Wolf willow	*Elaeagnus commutata*	Culturally significant species that is long lived and drought resistant.	Upland

Source: (a) Minnesota Wildflowers 2006-2023 (b) The Ladybird Johnson Wildflower Center n.d.

The MVRMP (Braun et al., 2017) identifies key steps on how to incorporate local seed into restoration or reclamation projects and has articulated very useful management recommendations to implement these strategies across the valley. In addition, the Northeast Swale Resource Management Plan (MVA, 2013) has been successful in implementing strategies identified by Meewasin, consideration of the steps suggested and possible consultation with target personnel executing both management plans should be considered at the detailed design stage.

2.4.10 ADAPTIVE MANAGEMENT AND MONITORING

Any restoration or reclamation project must include an adaptive maintenance strategy based on inputs received through targeted and ongoing monitoring. The frequency and survey types used to gain inputs will vary greatly depending on the site conditions and specific goals identified for that restoration/reclamation project. For restoration projects, comparison to the baseline data is imperative to measure success, and reclamation will require setting objectives (e.g., regulatory or stakeholder driven) to measure against. Overall, all reclamation/restoration projects executed should consider two monitoring scales, short term and long term:

Short term: Monitors the progress of activities within a target location and guides adaptive management decisions until milestone successes are reached. These are frequent surveys ideally occurring bi-weekly and may be less intense than long term surveys. These may include but are not limited to:

- Weed surveys, intended to guide the greater site and/or manage a project focused integrated pest management plan (IPM).
- Germination success, to identify areas that require reinforcement seeding or plantings.
- Browsing and animal use of the site.
- Anthropogenic influences on site.
- Accelerated erosion.

Management recommendations should be made and implemented based on field findings. For example, if browsing from ungulates or small mammals is observed on woody vegetation, consider caging the individual plants or fencing off the area.

Long term: This will monitor the overall trajectory of success of a project and detect changes over time. Frequency is to be determined based upon pre-existing protocols in consultation with qualified experts (such as Meewasin, select City departments or other invited stakeholders). These surveys may include but are not limited to:

- Permanent and temporary sample plot data collection methodologies.
- Rangeland Health Condition Assessments.
- Wetland classification and annual boundary delineation.
- Thatch assessments.
- Noxious and Nuisance weed inventories and mapping.
- Habitat mapping.
- Photologs.
- Prescribed burn monitoring.

2.4.11 RESTORATION AND RECLAMATION PRESCRIPTION

Considerations for each of the three proposed site enhancement types is provided below. These considerations are intended to provide an outline of expected effort and appliable variables that will need to be thoughtfully addressed to ensure success while maintaining room to be adaptable based ongoing data collection/monitoring.

RECLAMATION

Reclamation is generally the most labour intensive of the three restoration endeavours that may occur on site. It will require the highest degree of planning, earthworks, site management, and maintenance for the duration of each identified project. Poor hydrology, invasive species, and wildlife browsing have the potential to be the largest threats to reclamation success at the site. **Table 2-16** identifies general considerations for a reclamation project that should be considered. Note, this is not an exhaustive list and each project selected should be reviewed for any unique challenges requiring management.

Table 2-16 Reclamation Details

LOCATION	– Areas of existing disturbance or degradation, such as the existing materials storage area, and snow storage road, and bare soils.
GOAL	– Establish cover of native grassland similar to the area north of McOrmond Drive.
PLANNING	– Complete baseline inventories. – Apply for and obtain necessary permits. – Develop a Communication Plan or Strategy.
SITE PREPARATION	– Remove all existing deleterious material, such as gravel from road(s). See **Appendix D** for specific recommendations for the Snow Storage Facility. – Perform soil testing of existing topsoil and remove existing soil if required. – Control weeds if existing topsoil remains by means of herbicide application. – Control weeds in areas adjacent to the reclamation area to prevent pollution. – Identify any areas with high erosion potential. – Cultivate to reduce compaction. – Install clean imported topsoil. – Install temporary signage or fencing to eliminate access to the site. – Develop a communication plan to inform the public about reclamation intents. – Develop control methodology to reduce browsing of new plants from ungulates, small mammals, or waterfowl. If direct animal control is required develop a control plan and obtain the appropriate permits and/or approvals required to execute control initiatives (e.g., migratory bird control permit for geese, trapping licences for muskrats, etc.).
PLANTING	– Use an appropriate seeding methodology (drill seeding or hydro seeding) and applicable erosion control methods (blankets, and/or hydro mulch). – Plant mix of grasses, forbs, and shrubs to diversify vegetation cover. – Plant upland or mesic mix based on existing site conditions.
ESTABLISHMENT ACTIVITIES	– Water to establish seed and plants. – Protect plants during establishment period from pedestrian traffic. – Overseed and replace plants as required. – Control weeds per IPM plan(s). – Implement temporary strategies to limit browsing (e.g., Canada goose control for seeded areas, temporary fencing around shrubs to prevent small mammal or ungulate browsing). – Identify areas of erosion and implement erosion control measures as required (e.g., temporary addition of erosion control logs, or erosion control blanket as required).
PERFORMANCE MEASUREMENT	– Established cover three years post construction for seeded areas resemble desired community type with adequate cover (for example, >3 mature plants per square metre). – Plugs plantings have 80% survivorship and reflect the intended species composition. – Shrub plantings have 80% survivorship and condition of shrubs meets agreed upon standard (TBD). – See IPM plan(s) for weed species targets.

UPLAND RESTORATION

Upland restoration in the site will contain the improvement of areas of poor or fair health, which may include tame pasture or areas of historical agricultural use, and the enhancement of existing high-quality areas. Upland restoration differs from reclamation as, restoration refers to intentionally returning degraded ecosystems to its original or natural state, while reclamation refers to the process of repurposing natural resources that have been altered by human activities (e.g., mining, agriculture) (definition adapted from Gann et al., 2019). In reclamation projects, the aim is to make the disturbed land usable for a new purpose, which may not necessarily involve returning the project to its original state. In restoration projects, the aim is to rehabilitate the ecological function and native biodiversity of a system as close as possible to pre-disturbance conditions. This means efforts are focused on restoring tame grasslands and agricultural use lands as close as possible to a selected pre-disturbance condition. See details for upland restoration in the Small Swale in **Table 2-17** below.

Table 2-17 Upland Restoration Details

LOCATION	– Areas of existing poor or fair health, such as the areas used for agricultural purposes. These sites may have some existing native species; however, are at risk of degrading into a non-native dominated community type without intervention.
GOAL	– Increase native grassland species, similar to sites identified as healthy, north of McOrmond Drive.
PLANNING	– Complete baseline inventories. – Apply for and obtain necessary permits. – Develop a Communication Plan or Strategy.
SITE PREPARATION	– Complete detailed species inventory of existing native and non-native species. – Control weeds in areas adjacent to the restoration area to prevent pollution. – Control weeds though hand pulling, prescribed burns, and/or chemical treatment (as identified in the IPM species specific plan or by Meewasin).
PLANTING	– Drill seed or mechanically broadcast seed mix. – Determine suitable species for planting based on topography and soil conditions.
ESTABLISHMENT ACTIVITIES	– Control weeds per IPM plan or Meewasin IPM. – Protect plants during establishment period from pedestrian traffic. – Overseed and replace plants as required.
PERFORMANCE MEASUREMENT	– Native plants established by end of three years post project initiation. – See IPM plan for weed species targets.

RIPARIAN RESTORATION

Table 2-18 Riparian Restoration Details

LOCATION	– **Riparian edge of the existing forebay or existing wetlands on site.**
GOAL	– Increase species diversity, provide wildlife habitat, and maintain erosion control.
PLANNING	– Complete baseline inventories. – Apply for and obtain required permits, notices and approvals. – Develop a Communication Plan or Strategy.
SITE PREPARATION	– Complete detailed species inventory of existing native and non-native species. – Control weeds in areas adjacent to the restoration area to prevent pollution. – Control weeds though hand pulling, prescribed burns, and/or chemical treatment (as identified in the IPM species specific plan(s) or by Meewasin).
PLANTING	– Drill seed or mechanically broadcast seed mix (as conditions allow). – Plant riparian zone with plant mix. – Install live plantings of willows.
ESTABLISHMENT ACTIVITIES	– Control weeds per IPM plan(s). – Overseed and replace plants as required during the establishment period. – Install temporary fencing to prevent browsing on plant material.
PERFORMANCE MEASUREMENT	– Native plants established by end of three years post project initiation. – See IPM plan for weed species targets.

Seed availability is a limiting factor in riparian restorations. It is generally not commercially available, and local harvesting of appropriate species should be considered. Refer to Meewasin for potential seed sources, donor sites, or plant substitutions.

2.5 ECOLOGICAL CONNECTIVITY IMPROVEMENTS

Ecological connectivity in an area is achieved when both inter- and intra-connectivity are addressed. For the site, the biggest barriers to connectivity currently are McOrmond Drive and South Grid Road and to a lesser degree the trail systems and parking areas. However, future land use changes can also have a severe impact on wildlife movement if linkages are not maintained in a poste development context.

Very little information exists that details how animals are moving around and through the site. Prior to undertaking any work that may result in a connectivity impact, the following steps should be considered:

- Step 1: Collect Baseline Data
- Step 2: Identify areas of high use
- Step 3: Implementation
- Step 4: Monitoring

To maintain and enhance overall ecological connectivity, a general framework has been prepared (Ecological Connectivity Memo [ECM] provided in Small Swale Natural Area Management Plan) and should be considered when undertaking work within and adjacent to the site. A summary has been provided below.

2.6 SOMC (Flora and Fauna) Improvements

In support of "Strategy #7 – SOMC (Flora & Fauna) Management" and in conjunction with Section 2.4 – Restoration/ Reclamation Improvements and Section 2.5 – Ecological Connectivity Improvements, examples of targeted physical features that can be incorporated to enhance the SOMC presence on site are presented here. Some ideas for physical improvement features include badger or prairie dog burrow creations, native wildflower plantings, snag creations, vernal pool (temporary pools that form in wooded habitats in the spring) creations, bird and bat house installations.

The most cost-efficient upgrade would be building and hanging bird and bat houses in key locations throughout the site. This could attract certain SOMC fauna species to settle in the area or will provide shelter for already existing populations of known SOMC (e.g., bank swallow, barn swallow, loggerhead shrike). The table below gives some example resources to support the construction and subsequent installation of bird and bat houses.

Table 2-19 Example Resources for Bird and Bat House Construction, Installation, and Maintenance

TYPE	DOCUMENT NAME	DETAILS	REFERENCE
Songbird House	Bird Houses for Songbirds	Provides details on nest box dimensions for certain songbird species and how to construct them.	Armstrong, J. 2020. Bird Houses for Songbirds. Extension – Alabama A&M & Auburn Universities. Accessed November 2023 at: https://www.aces.edu/wp-content/uploads/2018/08/ANR-0550.REV_.2.pdf.
Waterfowl Box	Nest Box Guide for Waterfowl	Provides details on waterfowl and other occupants of nest boxes, and how to construct, install, and maintain a nest box.	Ducks Unlimited Canada. 2008. Nest Box Guide for Waterfowl – Alberta Addition. Accessed November 2023 at: https://crca.ca/wp-content/uploads/PDFs/reports-publications/DU_NestboxGuide.pdf.
	Build a Wood Duck Box	Provides a step-by-step guide on how to construct a wood duck box (and others).	Ducks Unlimited Canada. 2020a. Build a Wood Duck Box. Accessed November 2023 at: https://www.ducks.org/conservation/waterfowl-research-science/build-a-wood-duck-box.

TYPE	DOCUMENT NAME	DETAILS	REFERENCE
	Installing your Wood Duck Box	Provides details on preferred installation locations of boxes and how to maintain them.	Duck Unlimited Canada. 2020b. Installing your Wood Duck Box. Accessed November 2023 at: https://www.ducks.org/conservation/waterfowl-research-science/installing-your-wood-duck-box.
Bat House	Build a Bat House	Provides details on installation location requirements and step by step guide for constructing a bat house.	The National Wildlife Federate. N. d. Build a Bat House. Accessed November 2023 at: https://www.nwf.org/Garden-For-Wildlife/Cover/Build-a-Bat-House.aspx.
Swallow Nest	Swallow Bird House: The Best Type & How to Build One	Provides a step-by-step guide on how to construct swallow nests.	Summerville, T. 2023. Swallow Bird House: The Best Type & How to Build One. Songbird Hub. Accessed November 2023 at https://songbirdhub.com/swallow-bird-house/.

If establishment and persistence of other fauna and flora species is desired, the Species at Risk (SAR) public registry (Government of Canada, 2023) provides the mean of searching target species and describes their habitat requirements and possible options for supporting their conservation. As SOMC are listed under SARA and COSEWIC legislation, sufficient information should be available on the public registry website. Additionally, restoration techniques targeting flora species is also provided in sections 2.4.4 – Identification of Restoration Goals and Objectives to 2.4.11 – Restoration and Reclamation Prescription. Habitat improvement for amphibian species (e.g., northern leopard frog) are incorporated into the overall restoration scheme. By enhancing wetland and upland habitat, amphibian species will benefit from these improvements during their lifecycle.

Targeting the recruitment, establishment, and retainment of SOMC on site, can come with several challenges, which include but are not limited to:

- Installed features (e.g., bird houses) might be designed and intended to serve a targeted SOMC; however, non-SOMC species might end up occupying them.
- Insufficient data on SOMC population size, distribution, and ecological requirements, and uncertainty on threats or effective conservation measures might hinder improving habitat and conserving the target SOMC.
- Lack of resources, including financial means, expertise, or manpower, can limit the implementation of certain improvement structures.

Vegetation specific challenges lay in some species biologies. Populations naturally fluctuate annually based on seasonal conditions, responding to hydrology and temperature. Seed dormancy in native plants is a complex and ever evolving area of study, as many seeds require stratification to break dormancy (such as prairie clovers) and they may reside in the soil for many years before erupting.

2.7 Stormwater Improvements

Land use changes around the perimeter of the site is an eventuality and rehabilitation of the Snow Storage Facility is a top priority of NAMP. As the core of the site is a large wetland complex, stormwater management planning needs to be well thought out. Any changes to wetland catchments can alter the wetland hydroperiod and cause irreversible damage. Therefore, proactive planning is a key to ensure that wetland function is preserved post development.

A guide (Small Swale NAMP, **Appendix D** – Snow Storage and Hydrological Influences on the Small Swale Wetland Sustainability Guidance) has been developed to assist in undertaking the required proactive steps to maintain the hydrological inputs required to sustain the various wetlands present within the site and should be considered when land use changes are contemplated.

3 CONSTRUCTION IMPLEMENTATION

3.1 Standards

All construction shall adhere to the applicable standards and guidelines, including:

- Province of Saskatchewan's Environmental Management and Protection Act (2010).
- City of Saskatoon's Contractor Environmental Guidelines (2019).
- City of Saskatoon's Design and Development Standards Manual (Version 15).
- City of Saskatoon's Standard Construction Specifications: Parks (2023).

3.2 Construction Risks & Mitigation Measures

To minimize negative impacts to the site during construction, it is advised that the following mitigation measures be considered.

Table 3-1 Construction Risks and Mitigation Measures

RISK	MITIGATION MEASURE
Disruption to existing vegetation or vegetation communities.	– Stake limits of work prior to construction. – Conduct a pre-construction rare plant survey. Should rare plant species be observed, a qualified biologist should be consulted for appropriate mitigation measures. – Prepare and enforce a tree protection plan within and adjacent to areas of construction. – Field fit all infrastructure to avoid damaging vegetation, maintaining recommended offsets.
Disruption to wildlife habitat, movement, and mortality.	– Stake limits of work prior to construction. – Conduct a pre-construction wildlife sweep to protect sensitive wildlife features protected under The Wildlife Act (1998). Complete prior to clearing of vegetation during the sensitive wildlife period for nesting and rearing young, between April 15 to August 31. Site-specific wildlife features (e.g., nests, burrows, leks, dens) observed within the project area must be buffered by applicable setbacks and timing restrictions to minimize effects to sensitive wildlife and habitat features. – Additional wildlife and wildlife feature mitigations may be required if wildlife or wildlife features are observed during construction. All wildlife observations made during construction should be reported to a qualified biologist. The biologist will recommend mitigations depending on the species, as needed.

RISK	MITIGATION MEASURE
	– During the construction/operation phases of development, all wildlife attractants (e.g., petroleum products, human food, recyclable drink containers and garbage) should be secured in wildlife proof containers to discourage wildlife issues. – During construction, work activities should be limited to normal working hours and avoid work during the most wildlife-active portions of the day (e.g., dawn and dusk) to promote a gradual habituation to land use changes proposed. – Contractors should use down shielded lights for any lighting that may be required during construction to minimize light pollution and negative effects on the local wildlife. – Minimize disturbances to the smallest area possible to maintain connectivity between natural features to promote continued wildlife passage/use. – Field fit all infrastructure to avoid damaging wildlife habitat, maintaining recommended offsets.
Negative impact to water quality.	– Install effective erosion and sediment control measures before starting work to prevent sediment from entering the water body. – Should work be required within the waterbodies, timing shall respect sensitive species.
Disruption to native soils and erosion.	– Limit movement of heavy equipment and vehicles during wet conditions to reduce damage to substrates. – Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation. – Adhere to erosion and sedimentation control plan.
Introduction of invasive species.	– Material, equipment and machinery should arrive at the site washed, free of fluid leaks and clean of foreign materials (i.e., invasive species and noxious weeds).
Spills.	– Wash, refuel and service machinery and store fuel and other materials for the machinery at least 100m away from waterbodies, if possible. Should 100m not be possible, proper containment measures will need to be in place to prevent deleterious substances from entering the water. – Fueling stations must be isolated in case of spills. – An emergency spill kit shall be kept within the project area at all times. – A contingency plan in the case of sediment release and fuel or oil spills should be developed that includes procedures for containment, absorption, removal and reporting.
Disturbance to historical or archaeological features.	– Identify and protect historically and culturally significant features throughout construction.
Overhead and underground utilities.	– All offsets to utilities to be maintained and the applicable organization contacted prior to excavation. – Permits and permissions to be obtained from applicable utility company prior to construction. – SaskPower: o Easements shall not be impacted. o SaskPower crews must be able to traverse up and down the rights of way if needed. o No swales should be installed across the rights of way or within them without prior written consent. o No fencing should be put across or along the easement, without prior written consent. o Fencing or gates that are installed along or across easement require prior written consent and may require grounding. o If elevations are proposed to change within the easement, this will require prior written consent.

3.3 Construction Recommendations

The following is recommended to be considered during the detailed design and implementation of the proposed improvements.

3.3.1 INVASIVE SPECIES CONTROL DURING CONSTRUCTION

During construction, the contractor shall limit the spread of weeds, ensuring tools, vehicles, and clothing is free of weed species. Construction activities and disturbance shall be limited to avoid disruption of soil and seed banks. Overall activities should follow a project specific IPM plan developed in general compliance with the Meewasin Valley Authority and the Small Swale NAMP.

3.3.2 SITE PREPARATION AND DEMOLITION

All site preparation, including tree protection to adhere to City of Saskatoon Standard Construction Specifications: Parks (2023). Ensure erosion and sedimentation controls are in place prior to and throughout construction per the City of Saskatoon's Contractor Environmental Guidelines (2019).

3.3.3 GRADING

All grading to adhere to City of Saskatoon Standard Construction Specifications: Parks (2023). Grading activities are not proposed for the Small Swale, apart from minor grade adjustments for trails. Trails to be field fit to the topography, with any required grading matching that of the existing conditions to cause minor disturbance. The future stormwater pond will require further consultation to meet the requirements of the UH3 Neighbourhood development. Should grading be required in the future, it is recommended that the original topography be retained and designed so as not to cause disturbance to hydrological regimes.

3.3.4 LAYOUT

Layout and installation of trails, hardscape and site furniture to be verified on site prior to construction and field fit to limit disturbance. Detailed design is required to provide installation instructions and product/material selection.

3.3.5 PLANTING

Final location of planting to be verified on site and field fit as required. It is recommended that a detailed design be prepared for all planting, including plant quantities, plant material sizes, source of plants, and plant and seed installation details.

4 MAINTENANCE

Ongoing maintenance of the site will be required for the long-term health and functionality of the site. Maintenance refers to such elements as the establishment of planting efforts, upkeep of built infrastructure, and ongoing control of invasive vegetation species. Recommendations for maintenance of the proposed improvements and invasive species control is described below.

4.1 Establishment & Maintenance

All maintenance should adhere to the City of Saskatoon Standard Construction Specifications: Parks (2023). Recommendations for the maintenance of the proposed improvements are described in **Table 4-1**. A detailed maintenance plan is recommended to be developed as part of the detailed design for each of the proposed improvements and monitored as part of the overall management of the site.

Table 4-1 Establishment & Maintenance

	ESTABLISHMENT & MAINTENANCE ACTIVITIES
Restoration & Planting Areas	– During the establishment period, water newly planted areas per restoration planning requirements to initiate successful germination. Frequency and duration of watering and source of water to be determined through detailed design. Overall plan should contain a hardening stage to avoid shallow root production or elevated dependency on artificial inputs. It is recommended that the contractor submit a watering plan to be approved by the City prior to construction. – During the establishment period, monitor plant and seed mortality. Contractor to replace plants or overseed as required to meet the target success rates per the restoration plan. – During the establishment period, contractor to protect plants during the maintenance period to protect against third-party damage. Temporary fencing and signage are recommended to deter access to restoration areas from pedestrian traffic and browsing animals. – Monitor for invasive and undesirable species, and control as required in accordance with a project specific IPM Plan.
Site Furniture & Infrastructure (Fencing, Signage, Boardwalks, Gates, Benches)	– Ensure all site furniture and infrastructure is built to specification prior to issuing the Final Acceptance Certificate (FAC). – During the maintenance period, contractor to monitor and repair as required. – Post-FAC, City to monitor and repair as required. – A yearly inventory is recommended to note damage and required repairs.
Trails	– Mow trails at frequent intervals to maintain a heigh of grass less than 50 to 75 mm in height along the pathway. – Repair rutting as required. – Monitor for safety and hazards.
Waste & Damage	– Monitor for damage to site and illegal dumping. – Weekly maintenance of the site is recommended, as well as a spring and fall clean-up to remove waste and debris. – Regular waste disposal per the City of Saskatoon Standard Construction Specifications: Parks (2023).
Invasive Species Control	– Control per project specific IPM Plan.

4.2 Integrated Pest Management Plan (IPM)

An IPM plan is intended to be an adaptive plan for the long-term control of invasive vegetation species. All weeds are to be controlled in accordance with Saskatchewan's *Weed Control Act* (2010). A general IPM plan needs to be

developed and implemented for use across the entire site, and subsequently adapted and upgraded for each of the restoration or reclamation activities undertaken.

Table 4-2 and **Table 4-3** outline key considerations for a successful IPM site wide, and within areas of reclamation or restoration. Species specific management strategies that can support a successful IPM can be found within the MVRMP.

The frequency and effort for IPM within the reclaimed or restored areas should be higher than for the site wide plan. Germination success is highly dependent on weedy species prevalence, and if weeds are unmanaged the chances of a successful planting will be low.

Table 4-2. Considerations for an Effective Site Wide Integrated Pest Management Plan

Target Weeds	– **All prohibited noxious and nuisance weeds as listed under the Weed Control Act (2010).**
Mapping	– Complete a detailed inventory of all invasive species (e.g., heat map), prohibited noxious, and nuisance weeds throughout entire extent of the site. This documentation should include the spread, cover estimate, phenology, and distribution by species. – Annual monitoring should include weed mapping once per year with a record of IPM strategies implemented. If target locations are under management pre and post weed mapping should be considered within the growing season to determine success and guide frequency/effort – Maintain record of species, location, and density for comparisons between seasons/years.
Monitoring	– Complete a detailed inventory of all invasive species, prohibited noxious, and nuisance weeds throughout entire extent of the site. – Annual monitoring to include weed mapping updates once per year with a record of IWM strategies implemented. – Maintain record of species, location, and density.
Performance Measurement	– Develop species specific measure of success for all documented weed species (for example, a 25% reduction in the overall cover of common wormwood [*Artemesia absinthium]*) within a three-year timeline. – Effort and timeline should be targeted at highest priority areas. – Refer to the Meewasin Valley Authority for species specific targets.
Timing	– TBD based off of baseline inventory information and level of infestation.
Types of Control	– Mechanical: This may include mowing, hand pulling, or material extraction. – Chemical: This may include the use of herbicides. – Cultural: This may include prescribed burning, and planting of native species.

Table 4-3. Considerations for an Integrated Pest Management Plan in Reclamation or Restoration Areas

Target Weeds	– **All prohibited noxious and noxious weeds as listed under the Weed Control Act (2010).**
Mapping	– Prior to any construction, complete a detailed inventory of all invasive species, prohibited noxious, and nuisance weeds throughout entire extent of the site. This documentation should include the spread, cover estimate, phenology, and distribution across the site. – Annual monitoring Perform weed mapping once per year with a record of IWM strategies implemented. – Maintain record of species, location, and density.
Performance Measurement	– TBD on a species-specific scale, based off of the MVRMP.
Importation & Storage of Material	– Ensure any materials, such as topsoil is weed free prior to entering site.

	– Should topsoil be stockpiled, perform weed control as required.
Timing	– Weekly inspections (year 1-2) and maintenance as required. – Bi-weekly inspections (year 3) and maintenance as required.
Types of Control	– Mechanical: This may include mowing, hand pulling, or material extraction. – Chemical: This may include the use of herbicides – Cultural: This may include prescribed burning, grazing, and planting of native species.

5 MONITORING

Ongoing mapping, monitoring, and adaptive management is recommended for project success. Monitoring is recommended to record all observations and management activities so that future managers will be able to learn from the past, avoid repeating mistakes, evaluate the effects of management, and plan future management based on the record. Future monitoring programs implemented should reference the Meewasin Valley-wide Monitoring Framework (2021) for specific monitoring objectives and methodologies. Legislation and policy can dictate monitoring initiatives. **Table 5-3** and **Table 5-4** outline requirements.

A monitoring framework should be integrative, adaptive, and updated regularly with relevant findings as per Objective 1 in the Action Plan Summary **Table 5.5.6**. The intended purpose is to measure the status of targets and inform ongoing and future management.

The Meewasin Valley-Wide Monitoring Framework (2021) identifies functional categories for monitoring listed below:

- Wildlife Behaviour Monitoring
- Invasive Species Monitoring
- Vegetation Composition Monitoring
- Environmental Conditioning Monitoring
- Human-site Interaction Monitoring
- Collectively Powered Monitoring Networks

5.1 WILDLIFE BEHAVIOUR MONITORING

This type of monitoring includes any data collection effort that is relevant to understanding general wildlife behaviour, movement patterns, presence, abundance, and survivorship (MVA, 2021). **Table 5-1** provides a breakdown of monitoring initiatives that may be undertaken at the site, with examples of focus areas for study. However, this list in not exhaustive and should new information from other monitoring initiatives or projects be undertaken on site (such as the installation of new benches, paths, or boardwalks) the effects on wildlife should be studied, with special consideration to SOMC or other species protected under legislation (such as the *Migratory Birds Convention Act* and associated regulations). Existing survey protocols for wildlife are listed below in **Table 5-2**.

Table 5-1 Wildlife Monitoring at the Site

MONITORING INITIATIVE	EXAMPLES OF FOCUSED STUDY AREAS FOR THE SITE
Wildlife interactions with infrastructure	– Major barriers that likely inhibit wildlife movement across the site include McOrmand Drive and South Grid Road. The interaction between these roads and wildlife movement should be assessed to understand how best to facilitate wildlife movement across these roads. – The upcoming UH3 Neighbourhood will likely create barriers that should be considered in future assessments, and early mitigation measures should be implemented. – The Snow Storage Facility, parking areas, and use of informal trails may affect wildlife movement and behaviour. Assessments should be undertaken to understand how to best accommodate natural wildlife behaviour.
Presence and abundance of specific wildlife species	– SOMC identified as having a high likelihood of detection in the baseline summary (American badger (*Taxidea taxus taxus*), Baird's Sparrow (*Centronyx bairdii*), common nighthawk (*CHordeiles minor*), horned grebe (*Podiceps auratus*), lesser yellowleg (*Tringa flavipes*), monarch butterfly (*Danaus plexippus*), and short-eared owl (*Asio flammeus*)) should be surveyed for, to determine if they are on site. – Confirmed SOMC (bank swallow (*Riparia riparia*), barn swallow *(Hirundo rustica),* Loggerhead shrike (*Lanius ludovicianus excubitorides*), osprey (*Pandion laiaetus*), and rusty blackbird (*Euphagus carolinus*)) should be detailed further and investigated for population abundance and distribution.
Locations of important wildlife habitat	– Documentation of the northern leopard frog (*Lithobates pipiens*) population locations should be conducted.
Landscape fragmentation and movement corridors	– McOrmand Drive and South Grid Road are two roads that create landscape fragmentation and impede with wildlife movement to, and within the site. There is study potential here to identify the significance of these barriers, and to create mitigation solutions to improve connectivity. – Wildlife monitoring completed by EDI (2021) showed that ungulates moved between the Small Swale and the Northeast Swale in an east-west direction, mainly using two paths. This provides an opportunity to create two linear greenspaces or park features along these travel corridors.
Heightened activity period documentation (breeding and migration)	– Consider completing breeding bird surveys and amphibian surveys as per the methodology provided in protocols listed in **Table 5-2**. – Migratory bird counts for waterfowl could be considered as this would enhance the value of the wetlands on site, and potentially identify additional SOMC.

Table 5-2 Existing Wildlife Survey Protocols

TYPE	SURVEY NAME	CITATION
Amphibian and Reptile	Amphibian Auditory Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 1.0 Amphibian Auditory Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Amphibian Visual Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 2.0 Amphibian Visual Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Greater Short-horned Lizard Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 3.0 Greater Short-horned Lizard Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.

TYPE	SURVEY NAME	CITATION
	Snake Hibernacula Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 4.0 Snake Hibernacula Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.

TYPE	SURVEY NAME	CITATION
Birds	Burrowing Owl Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 5.0 Burrowing Owl Survey Protocol. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Short-eared Owl Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 6.0 Short-eared Owl Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Grassland Birds Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 9.0 Grassland Birds Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Forest Birds Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 10.0 Forest Birds Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Sharp-tailed Grouse Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Western Grebe Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Piping Plover Survey Protocols	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Yellow Rail Survey Protocols	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
	Common Nighthawk Survey Protocol	Government of Saskatchewan. 2020. Species Detection Survey Protocol: 15.0 Common Nighthawk Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.

TYPE	SURVEY NAME	CITATION
Mammals	Bats (Sensitive Species Inventory Guidelines)	Government of Alberta. 2012. Integrated Standards and Guidelines, enhanced Approval Process. Sustainable Resource Development, Lands Division. Edmonton, AB. [Online] https://open.alberta.ca/dataset/93d8a251-4a9a-428f-ad99-7484c6ebabe0/resource/f4024e81-b835-4a50-8fb1-5b31d9726b84/download/2013-sensitivespeciesinventoryguidelines-apr18.pdf. Accessed October 18, 2023.
	Swift Fox Survey Protocol	Saskatchewan Ministry of Environment. 2014. Swift Fox Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-17. 3211 Albert Street, Regina, Saskatchewan. 10pp.
	Ord's Kangaroo Rat Survey Protocol	Saskatchewan Ministry of Environment. 2014. Ord's Kangaroo Rat Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-18. 3211 Albert Street, Regina, Saskatchewan. 7 pp.
	Snow Track Survey Protocol	Saskatchewan Ministry of Environment. 2014. Snow Track Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-19. 3211 Albert Street, Regina, Saskatchewan. 8pp.

5.2 INVASIVE SPECIES MONITORING

Monitoring of invasive species involves initiatives to chronicle the occurrence, abundance, spread, and concentration of invasive species. This includes targeted efforts to locate, document, and control populations of particularly aggressive or problematic non-native species. This monitoring category informs invasive species control and other integrated resource management intervention strategies (MVA, 2021).

During the biophysical baseline review conducted as part of the NAMP identified four nuisance, seven noxious weeds and many invasive species. The IPM plan framework in the Conceptual Plan details the development and implementation for site wide IPM. Key strategies for site wide monitoring include but are not limited to:

- Completing a detailed inventory of all invasive species, prohibited noxious, and nuisance weeds throughout entire extent of the site. This would include documenting the density and distribution of each species and providing input on their effects to native vegetation.
- Annual monitoring to include weed mapping updates once per year with a record of integrated weed management strategies (IWM) implemented.
- Maintaining a record of species, location, and density.

A European buckthorn *(Rhamnus cathartica)* Control Program has been developed by Meewasin (MVA, 2023). Where possible, pre-existing monitoring and management strategies should be adopted to cohesively monitor the success of IWM strategies. As other programs are developed in the future, they should also be incorporated, as per Objective 6.1 and 15.1 – Invasive and Undesirable Species Management and Maintenance and Monitoring Programming from the Action Plan Summary

5.3 VEGETATION COMPOSITION MONITORING

General vegetation species monitoring assesses the abundance, presence, and composition of vegetation in plant communities. Mapping and documentation of native, rare, and at-risk plant species to inform conservation management efforts and development strategies should be emphasized (MVA, 2021) and follow the Species Detection Survey Protocol: 20.0 Vascular Plant. February 2021 Update (Government of Saskatchewan, 2021).

5.4 ENVIRONMENTAL CONDITIONING MONITORING

Initiatives within this category relate to the status of an environmental variable or natural feature that can be used to build datasets and form hypotheses about larger climatic trends within a system or area of interest. Efforts within this category include the study and documentation of pollutants and other variables that indicate adverse compositional changes linked to human behaviour, infrastructure development, and climate change (MVA, 2021).

5.5 HUMAN-SITE INTERACTION MONITORING

Collection of information that relates to human activities, access, and interactions with the site and site infrastructure. This information is important for identifying accessibility issues, demands for infrastructure development, cultural and historical significance, and threats that human activity poses to the natural environment. This category includes mechanisms for capturing, reporting, and documenting human activities (MVA, 2021).

5.6 COLLECTIVELY POWERED MONITORING NETWORKS

This category includes major partnership fueled information-generating projects, which produce monitoring data such as large scale (national, regional, and provincial) data collection efforts, Citizen Science networks and publicly sourced databases. The data gathered from these networks should inform many of the categories summarized in the above sections.

5.7 MONITORING FOR SUCCESS

As illustrated in the **Figure 5-1**, monitoring is a linear progression following defined pathways; and provides a workflow of potential steps and considerations for a project completed on site. This workflow is not exhaustive, and there may be additional steps required.

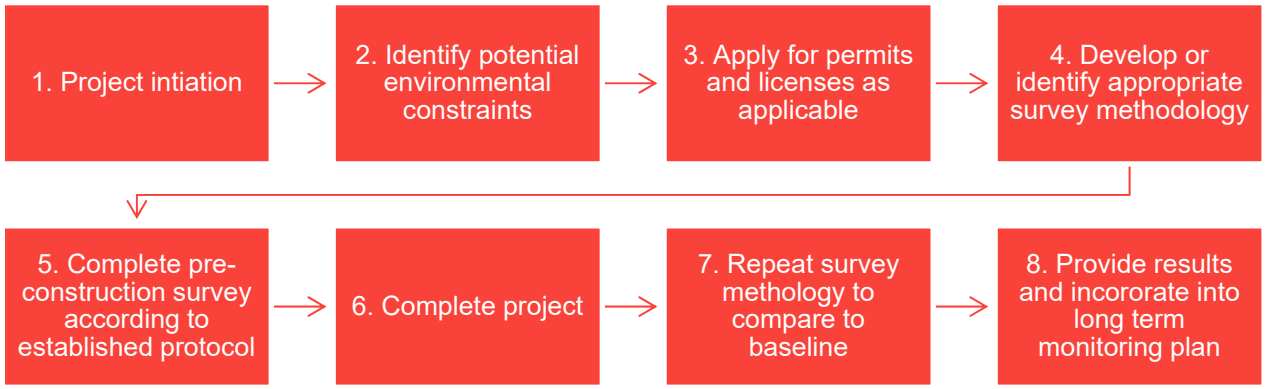


Figure 5-1 Measures of Success for Monitoring

Table 5-3 Detailed Success Monitoring

STEP	SITE SPECIFIC CONSIDERATION
1. Project Initiation	– Example: Boardwalk installation to enhance the viewing experience at a wetland
2. Identify Potential Environmental Constraints	– Potential habitat destruction – Potential damage to vegetative SOMC – Potential for reduced wildlife movement – Potential for impacts to water quality – Potential for pollutants or contaminates to spill into soil or waterbody – Potential disruption to breeding birds, breeding amphibians, or migratory species
3. Apply for Permits and Licenses as Applicable	– Submit an application to conduct an Environmental Impact Assessment (EIA) – Submit an Environmental Impact Statement (EIS) to the Ministry of Environment – See **Table 5-2** for Policy Documents
4. Develop or Identify Appropriate Survey Methodology	– A list of available survey methodologies is available in from the Government of Saskatchewan Species Detection Survey Protocols (SDSPs) website and Table 5-2
5. Complete Pre-construction Survey	– Following the established protocol, complete baseline surveys
6. Complete the Project	– Follow Environmental Best Practices for Erosion and Sediment Control (Saskatchewan Ministry of Highways and Infrastructure 2012) – Follow established City of Saskatoon Contractor Environmental Guidelines (COS 2019)
7. Repeat Surveys	– Following the established protocol, complete post construction surveys
8. Provide Results and Incorporate into Long Term Monitoring Plan	– Identify any changes from pre-construction condition. – Make raw data available for integration into a complete data set

Table 5-4 Policy Documents and Permits

NAME	DETAILS	CITATION
Amphibian Salvage Checklist	Submit this Checklist to apply to have Amphibian Salvage included in or added to a Species Detection Research Permit.	Government of Saskatchewan. 2020. Amphibian Salvage Checklist. August 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
Amphibian Salvage Policy	This document outlines the policy and procedures pertaining to amphibian salvage in Saskatchewan.	Government of Saskatchewan. 2020. Amphibian Salvage Policy. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/107478.
Research Permit – Bird Banding Application	This application is for individuals wanting to obtain a permit to band birds protected under The Wildlife Act, 1998. A federal banding permit is a pre-requisite.	Government of Saskatchewan. 2016. Research Permit Application – Bird Banding. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/69794.
Saskatchewan Activity Restriction Guidelines for Sensitive Species	These guidelines outline restricted activity periods and distance setbacks for rare and sensitive species to assist proponents in minimizing impacts to rare and sensitive species and habitats.	Government of Saskatchewan. 2017. Saskatchewan Activity Restrictions for Sensitive Species. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/79241.

6 FINAL ACCEPTANCE & PHASING

6.1 Final Acceptance

Acceptance of construction to adhere to the City of Saskatoon Standard Construction Specifications: Parks (2023) processes, including attainment of the following milestones: Substantial Completion Certificate (SCC), Construction Completion Certificate (CCC), and Final Acceptance Certificate (FAC).

As the work is intended to be completed in multiple phases under separate contracts, parameters for successful final acceptance will vary. In general, parameters for final acceptance should adhere to the minimum:

- All built work is completed and in working order.
- All defects and deficiencies have been addressed.
- Restoration and planting target rates have been achieved.
- All invasive species target rates, if any, have been achieved.
- Any damage caused during construction has been repaired.

6.2 Phasing and Cost Estimation

Recommendations regarding the proposed phasing and an estimation of construction costs has been included to support the proposed improvements within the Conceptual Plan. The following sub-sections describe the intended use of the recommended phasing and cost estimation.

6.2.1 PHASING OF IMPLEMENTATION

Guidance on the phased implementation of the proposed improvements is provided to suggest when elements of the Conceptual Plan could be implemented in a logical manner. Phasing is categorized into two phases: Phase 1 (short-term) and Phase 2 (long-term). These timeframes align with the recommendations within the NAMP regarding the order in which Actions would be most effective for meeting individual Objectives.

Table 6-1 outlines the proposed improvements to be implemented in each phase. The recommended phasing should be reviewed per the recommendations of the NAMP and adjusted as required. Prioritization of items should be based on further studies to determine the most effective use of resources and funds.

While this plan offers guidance on phasing, it is imperative that the improvements be implemented collaboratively with future adjacent developments. Future planning should involve coordination with adjacent landowners to ensure cohesive designs between the site and neighboring lands. For example, the circulation route and site entrances should align with the design of the future circulation route of the adjacent development, and the Greenway should be designed in tandem with the on-site circulation route.

6.2.2 COST ESTIMATION

Estimated costing has been prepared to allow for a high-level understanding of the costs associated with the construction of the proposed improvements (see **Table 6-1)**. Assumptions and exclusions include:

- Costs provided are estimates only. The estimate refers only to the costs for typical construction of the proposed features within the site, including supply, handling, and installation of materials.
- Estimated costs do not include:
    - Any pre-construction activities, such as, but not limited to: baseline studies and/or inventories, testing, surveys, engagement, consulting fees, detailed design, and/or approvals.
    - Any general requirements, such as, but not limited to: permits, insurance, mobilization & demobilization, testing, approvals, and/or disposal of materials.
    - Any post-construction activities, such as, but not limited to: establishment of plant material, long-term maintenance of the site (e.g. controlled burns, waste removal), and/or IPM.
    - Any proposed infrastructure which is located outside of the boundary of the site, or is tied to future developments, such as:
        - Naturalised stormwater pond.
        - Greenway and any related infrastructure within.
        - Restrooms.
        - Parking lots.
- Estimated costs include a 30% contingency upon the subtotal to account for variations in estimated costs.
- Unit prices are estimations only and have been derived from recent projects similar in scale.
- Assumptions on materials and quantities have been made solely to provide a high-level understanding of the future scope of the work. Additional analysis and costing will be required in the future. The cost estimate does not in any way reflect a construction ready approach or recommendations.
- Estimated costs are subject to change based on a number of factors, such as, but not limited to: timing; local market conditions; aspects and complexity of future design and construction programs; and regulatory requirements.
- A square metre price has been provided for restoration and reclamation efforts based upon the following assumptions:
    - Restoration assumes plugs at a density of 1 per square metre, and hand-broadcast seeding. Reclamation assumes a depth of 150mm topsoil, plugs spaced at a density of 1 per square metre, drill seeding, and hydromulch. Costs do not include weed control, site preparation, wildlife deterrent fencing, soil amendments, soil testing, mulch, or other future potential design decisions. These assumptions are intended for the purposes of conceptual cost estimation only and should not reflect the final design approach.
    - This unit price is a conceptual estimation only and should be verified and broken out per individual item (e.g. trees, shrubs, seeding, etc.). As designs can vary considerably due to such variables as availability of plant material, species, size, planting densities, and seeding methods, this unit price is intended to be a high-level estimation only.
    - The quantities within the cost estimate for reclamation or restoration are estimated at 50% of the total area identified in the Conceptual Plan (Figure 1). 50% is an estimate only and does not refer to the exact extent of restoration or reclamation that may be required in the future. Further studies and detailed designs will be required to determine the final extent of future work.

Table 6-1 Construction Phasing & Cost Estimate

ITEM NO.	ITEM	REMARKS	UNIT	QUANTITY	UNIT RATE	EXTENDED AMOUNT
	Phase 1: Short-Term					
1.0	Perimeter Fencing		LM	6,913.00	$50.00	$345,650.00
2.0	Riparian Restoration	Assumes 50% of the total restoration area.	M2	130,571.00	$15.00	$1,958,565.00
3.0	Upland Restoration	Assumes 50% of the total restoration area.	M2	254,529.00	$15.00	$3,817,935.00
	Phase 2: Long-Term	Assumes construction of the UH3 Neighbourhood and other future adjacent developments.				
4.0	Snow Storage Facility - Removal	Assumption of approach only. Detailed design is required. Does not include costs for soil testing or disposal of soil at specialized facility. Assumes material will be hauled and relocated within City limits.	M3	16,271.00	$10.00	$162,710.00
5.0	Snow Storage Facility - Reclamation	Assumption of approach only. Detailed design is required. Quantity refers only to the area not covered by the proposed Naturalized Stormwater Pond. Includes fill replacement, compaction, and grading, and the reclamation items.	M2	4,000.00	$35.00	$140,000.00
6.0	Wetland/Stormpond Boardwalk - Above Grade	Post installation of naturalized stormwater facility.	LM	164.00	$3,500.00	$574,000.00
7.0	Primary & Secondary Trails	Assumes 3m wide mown trail.	M2	9,486.00	$5.00	$47,430.00
8.0	Signage - Site Map		EA	3.00	$15,000.00	$45,000.00
9.0	Signage - Secondary Entry Map		EA	7.00	$10,000.00	$70,000.00
10.0	Signage - Wayfinding Posts		EA	7.00	$1,500.00	$10,500.00
11.0	Signage - Educational Signage	Quantity is an estimate only.	EA	5.00	$3,000.00	$15,000.00
12.0	Signage - Prohibited Use	Quantity is an estimate only.	EA	5.00	$500.00	$2,500.00
13.0	Gathering Area	Assumes site furniture and surfacing.	LS	2.00	$20,000.00	$40,000.00
14.0	Lookout	Assumes site furniture and surfacing.	LS	1.00	$15,000.00	$15,000.00
15.0	Bench		EA	3.00	$3,500.00	$10,500.00
16.0	Waste Receptacle	Quantity does not include waste receptacles located outside of the site.	EA	2.00	$3,500.00	$7,000.00
17.0	Gate		EA	5.00	$2,000.00	$10,000.00
18.0	Reclamation	Assumes reclamation of the existing road and materials yard.	M2	32,412.00	$30.00	$972,360.00
					Subtotal:	$8,244,150.00
					30% Contingency	*$2,473,245.00*
					Total Estimated Project Cost:	**$10,717,395.00**

BIBLIOGRAPHY

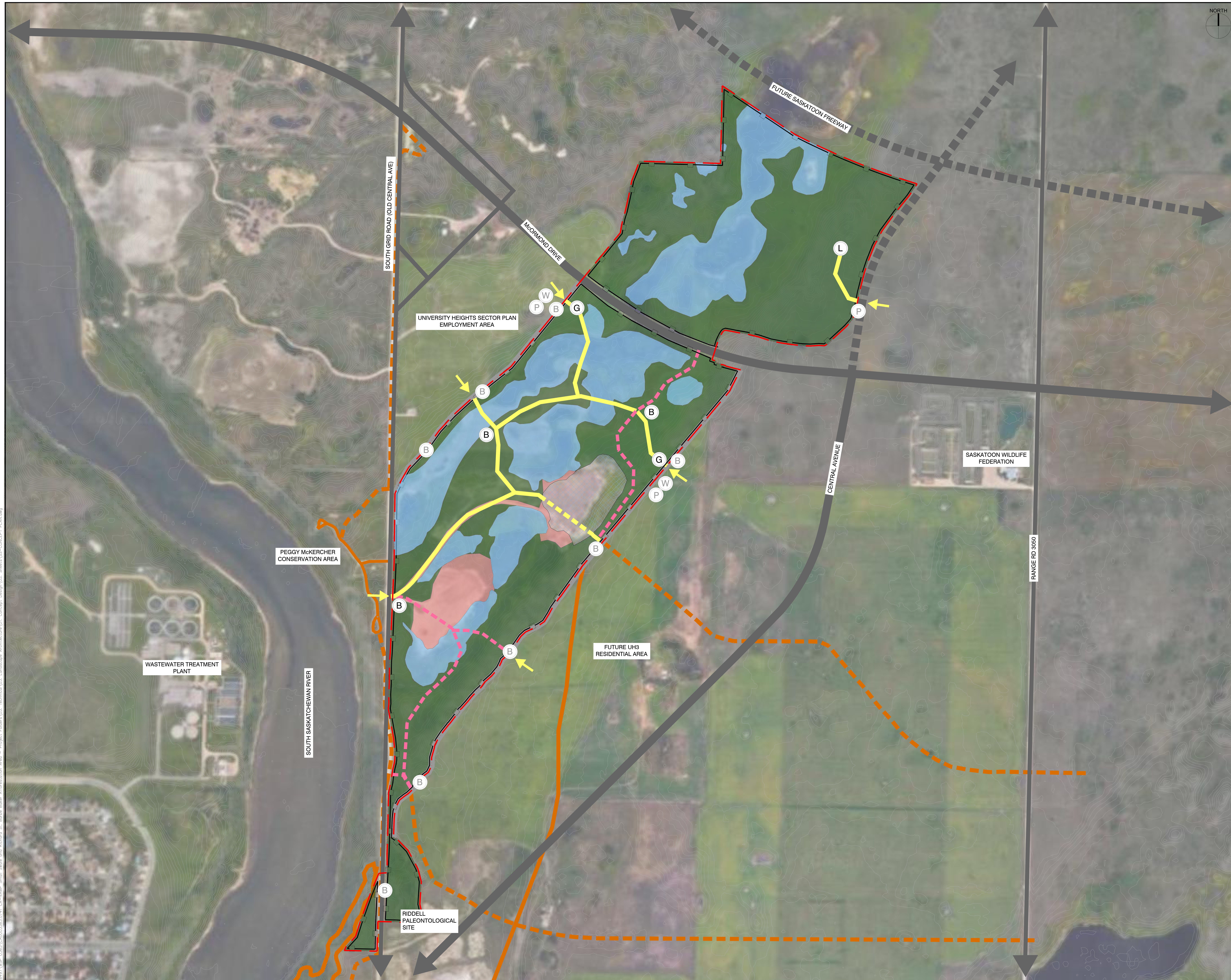
- Armstrong, J. 2020. Bird Houses for Songbirds. Extension – Alabama A&M & Auburn Universities. Accessed November 2023 at: https://www.aces.edu/wp-content/uploads/2018/08/ANR-0550.REV_.2.pdf.
- Braun, M., Grilz, R., Tomlinson, E. 2017. Meewasin Valley-wide Resource Management Plan. Meewasin Valley Authority. Saskatoon, Saskatchewan.
- City of Saskatoon. 2019. Contractor Environmental Guidelines. Version 1. Accessed November 2023 at: https://www.saskatoon.ca/sites/default/files/documents/contractor_environmental_guidelines_version1.pdf.
- City of Saskatoon. 2023. Design and Development Standards Manual (Version 15). Accessed November 2023 at: https://www.saskatoon.ca/business-development/development-regulation/specifications-standards/design-development-standards-manual.
- City of Saskatoon. 2023. Standard Construction Specifications. Accessed November 2023 at: https://www.saskatoon.ca/business-development/development-regulation/specifications-standards/specifications.
- Collicut, D., Morgan, J., Thompson, J. 1995. Restoring Canadas Native Prairies, A Practical Manual. Prairie Habitats. Argyle, Manitoba.
- Ducks Unlimited Canada. 2008. Nest Box Guide for Waterfowl – Alberta Addition. Accessed November 2023 at: https://crca.ca/wp-content/uploads/PDFs/reports-publications/DU_NestboxGuide.pdf.
- Ducks Unlimited Canada. 2020a. Build a Wood Duck Box. Accessed November 2023 at: https://www.ducks.org/conservation/waterfowl-research-science/build-a-wood-duck-box.
- Duck Unlimited Canada. 2020b. Installing your Wood Duck Box. Accessed November 2023 at: https://www.ducks.org/conservation/waterfowl-research-science/installing-your-wood-duck-box.
- Environmental Dynamics Inc (EDI). 2021. University Heights Neighbourhood No. 3 Natural Area Screening Report
- Eigenbrod, F., Hecnar, S. J., Fahrig, L. 2008. Accessible habitat: an improved measure of the effect of habitat loss and roads on wildlife populations. Landscape Ecology. 23(2), 159-168. doi:10.1007/s10980-007-9174-7.
- Gann, George & Mcdonald, Tein & Walder, Bethanie & Aronson, James & Nelson, Cara & Johnson, Justin & Hallett, James & Eisenberg, Cristina & Guariguata, Manuel & Liu, Junguo & Hua, Fangyuan & Echeverria, Cristian & Gonzales, Emily & Shaw, Nancy & Decleer, Kris & Dixon, Kingsley. 2019. International principles and standards for the practice of ecological restoration. Second edition. Restoration Ecology. 27. S1-S46.
- Government of Alberta. 2012. Integrated Standards and Guidelines, enhanced Approval Process. Sustainable Resource Development, Lands Division. Edmonton, AB. [Online] https://open.alberta.ca/dataset/93d8a251-4a9a-428f-ad99-7484c6ebabe0/resource/f4024e81-b835-4a50-8fb1-5b31d9726b84/download/2013-sensitivespeciesinventoryguidelines-apr18.pdf. Accessed October 18, 2023.
- Government of Canada. 2023. Species Search – Species at Risk Public Registry. Accessed November 2023 at: https://species-registry.canada.ca/index-en.html#/species?sortBy=commonNameSort&sortDirection=asc&pageSize=10.
- Government of Saskatchewan. 1998. The Wildlife Act. SS 1998, c W-13.12.

- Government of Saskatchewan. 2010. The Environmental Management and Protection Act. SS 2010, c E-10.22.
- Government of Saskatchewan. 2010. The Weed Control Act. Chapter W-11.1.
- Government of Saskatchewan. 2016. Research Permit Application – Bird Banding. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/69794.
- Government of Saskatchewan. 2017. Saskatchewan Activity Restrictions for Sensitive Species. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/79241.
- Government of Saskatchewan. 2020. Amphibian Salvage Checklist. August 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Amphibian Salvage Policy. Accessed November 2023 at: https://publications.saskatchewan.ca/#/products/107478.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 1.0 Amphibian Auditory Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 2.0 Amphibian Visual Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 3.0 Greater Short-horned Lizard Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 4.0 Snake Hibernacula Surveys. January 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 5.0 Burrowing Owl Survey Protocol. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 6.0 Short-eared Owl Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 9.0 Grassland Birds Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 10.0 Forest Birds Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 11.0 Sharp-tailed Grouse Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.
- Government of Saskatchewan. 2020. Species Detection Survey Protocol: 15.0 Common Nighthawk Surveys. April 2020. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan, Canada.

- Government of Saskatchewan. 2021. Species Detection Survey Protocol: 20.0 Vascular Plant. February 2021 Update. Saskatchewan Ministry of Environment, Fish, Wildlife and Lands Branch, Regina, Saskatchewan.
- Keller E., Grilz, R. W. 2021. Meewasin Valley-Wide Monitoring Framework. Strategy for Monitoring within the Meewasin Valley 2021-2026. Accessed November 2023 at: https://meewasin.com/wp-content/uploads/2021/08/Meewasin-Valley-Wide-Monitoring-Framework.pdf.
- Lady Bird Johnson Wildflower Center. n.d. Plant Database. Accessed November 2023 from: https://www.wildflower.org/plants/result.php?id_plant=muri2
- Meewasin (MVA) 2013. Northeast Swale Resource Management Plan.
- Meewasin (MVA). 2023. European Buckthorn Control Program. Accessed November 2023 at: https://meewasin.com/european-buckthorn-control-program/.
- Minnesota Wildflowers. 2006-2023. Minnesota Wildflowers – A guide to the flora of Minnesota. Accessed November 2023 from: https://www.minnesotawildflowers.info
- Saskatchewan Ministry of Environment. 2014. Swift Fox Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-17. 3211 Albert Street, Regina, Saskatchewan. 10pp.
- Saskatchewan Ministry of Environment. 2014. Ord's Kangaroo Rat Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-18. 3211 Albert Street, Regina, Saskatchewan. 7 pp.
- Saskatchewan Ministry of Environment. 2014. Snow Track Survey Protocol. Fish and Wildlife Branch Technical Report No. 2014-19. 3211 Albert Street, Regina, Saskatchewan. 8pp.
- Saskatchewan Ministry of Highways and Infrastructure. 2010. Environmental Best Practices and Sediment Control. Accessed November 2023 at: https://www.bing.com/ck/a?!&&p=24cbb7caf0281b3fJmltdHM9MTcwMDc4NDAwMCZpZ3VpZD0xNDgwZThkYy0wODMyLTZmMjAtMzQ1My1mOTA2MDkwOTZlMWMmaW5zaWQ9NTE5OA&ptn=3&ver=2&hsh=3&fclid=1480e8dc-0832-6f20-3453-f90609096e1c&psq=Environmental+Best+Practices+for+Erosion+and+Sediment+Control+(Saskatchewan+Ministry+of+Highways+and+Infrastructure+2012)&u=a1aHR0cHM6Ly9wdWJzYXNrZGV2LmJsb2IuY29yZS53aW5kb3dzLm5ldC9wdWJzYXNrLXByb2QvMTI0MzA0L0VQX0VTQyUyNTJCJTI1MjhGZWIlMjUyQjIwMTIlMjUyOS5wZGY&ntb=1.
- Saskatchewan PCAP Greencover Committee. 2008. Rangeland Health Assessment Native Grassland and Forest Field Workbook. Regina, Saskatchewan.
- Saura S. and Rubio L. 2010. A common currency for the different ways in which patches and links can contribute to habitat availability and connectivity in the landscape. Ecography. 33: 523-537.
- Stewart, R.E. and Kantrud, H.A. 1971. Classification of Natural Ponds and Lakes in the Glaciated Prairie Region (No. 92). U.S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife.
- Summerville, T. 2023. Swallow Bird House: The Best Type & How to Build One. Songbird Hub. Accessed November 2023 at https://songbirdhub.com/swallow-bird-house/.
- The National Wildlife Federate. N. d. Build a Bat Houe. Accessed November 2023 at: https://skylove.app/roost-box-building-instructions.
- Thorpe, J. 2007. Saskatchewan Rangeland Ecosystems Publication 1, Ecoregions and Ecosites. Saskatchewan Prairie Conservation Action Plan. Saskatchewan Research Council. Regina Saskatchewan.

– Thorpe, J. 2014. Saskatchewan Rangeland Ecosystems Publication 1 – Ecoregions and Ecosites (Version 2) A project of the Saskatchewan Prairie Conservation Action Plan.

– WSP Canada Inc. 2023. Small Swale Natural Area Management Plan. Prepared for City of Saskatoon.



LEGEND:

- SITE BOUNDARY
- EXISTING CONTOUR (0.5M INTERVAL)
- EXISTING ROAD
- PROPOSED ROAD (BY OTHERS)
- PRIMARY TRAIL (P2)
- SECONDARY TRAIL (P2)
- ABOVE-GRADE BOARDWALK (P2)
- EXISTING EXTERNAL TRAIL
- PROPOSED EXTERNAL TRAIL (BY OTHERS)
- PERIMETER FENCING (P1)
- RECLAMATION AREA (P2)
- UPLAND RESTORATION AREA (P1)
- RIPARIAN RESTORATION AREA (P1)
- NATURALIZED STORMWATER POND (P2)
- SITE ACCESS (P2)
- G GATHERING AREA (P2)
- B BENCH (P2)
- L LOOKOUT (P2)

BY OTHERS - OUTSIDE OF SITE

- GREENWAY
- P PARKING AREA
- W WASHROOM FACILITIES
- B BENCH

NOTES:

- PLAN IS CONCEPTUAL ONLY AND NOT FOR CONSTRUCTION.
- P1 REFERS TO PHASE 1 OF PROPOSED IMPLEMENTATION.
- P2 REFERS TO PHASE 2 OF PROPOSED IMPLEMENTATION.

0 30 60 90 120 150 180 210m

SCALE 1:4500

CONSULTANT:

WSP

CLIENT:

City of Saskatoon

PROJECT TITLE:

SMALL SWALE

SASKATOON, SASKATCHEWAN

DRAWING TITLE:

CONCEPTUAL PLAN