

Natural Infrastructure Blueprint for The City of Calgary

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I. Executive Summary

The City of Calgary is well prepared to become a leader in utilizing nature to build economic and community resilience. **Natural infrastructure is real infrastructure** that can be combined with, or used in place of, grey infrastructure to provide vital services, often at lower cost and improved performance as compared with pure grey solutions. The City can take steps outlined in this *Blueprint* to apply academic research, best practices, and lessons learned from cities around the world to fully integrate natural infrastructure concepts and opportunities broadly into budgeting, project development, and long-term stewardship of The City's resources.

Each of the following steps is informed by the idea that change at the municipal level occurs most effectively as a recurring cycle of **awareness raising, place-based analysis/implementation**, and development of **supporting policies, procedures, and funding mechanisms** that locks in lessons learned over the long-term. Without awareness of natural infrastructure's capabilities, The City will lack political will and energy to implement a new, bold vision. Without place-based analysis and implementation, leaders and technical experts alike will not have the hands-on experience required to tune plans to meet changing conditions. Finally, without the support of well-understood and accepted policies and procedures, projects and results will fade over time from lack of funding and attention, a fate suffered by many initiatives around the world. Figure 1 summarizes this cycle of change.

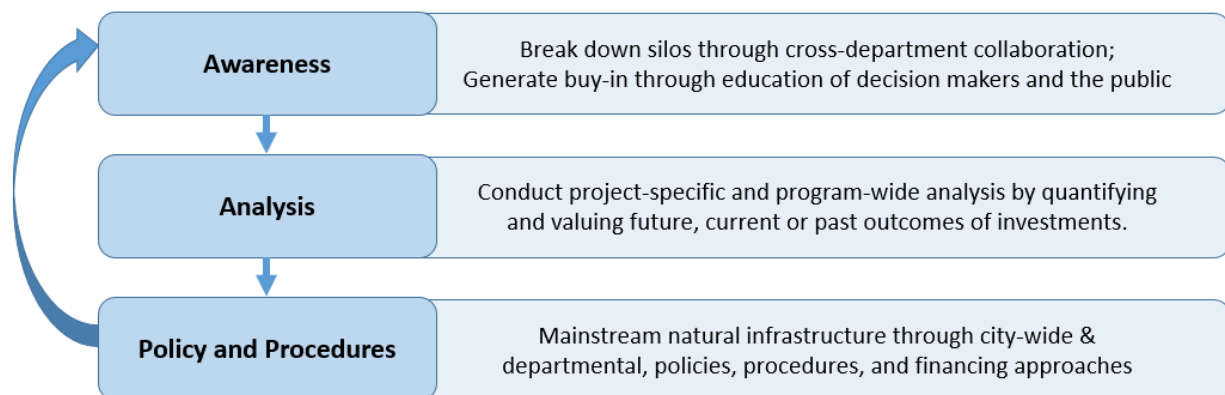


Figure 1: Cycle of Change

This *Blueprint* outlines four tangible steps that are both intuitive and challenging. The challenge will be in collaborating broadly to prioritize and invest in the protection of natural assets and to steward multi-disciplinary projects that are regionally appropriate and resilient to stresses and shocks. Applying natural infrastructure to meet civic challenges requires focus, constant learning, and persistence as each city has different assets, challenges, and culture. Adding complexity is that many natural infrastructure concepts are new and evolving, and approaches to natural infrastructure planning, management and maintenance vary.

The following four steps build on the cycle of awareness building, analysis, and policy/procedure development that The City (and its individual departments and business units) will cycle through numerous times over the coming years as knowledge and capabilities increase. With long-term commitment, The City can not only produce innovative solutions to its existing and pending challenges, but it can also be a role model and resource to other large cities around the world. The steps are as follows:

1. **Create Inventory:** Create a detailed and dynamic inventory of Calgary’s natural inventory. Without a full understanding of natural assets that Calgarians rely on and the many physical and financial benefits provided to the local community, decisions will be made with partial data, putting outcomes at risk and elevating costs.
2. **Set Targets and Design Innovative Projects and Programs to Meet Them:** Build awareness and set bold targets for natural infrastructure’s role in Calgary’s future. Thoughtful targets and a shared understanding can spur innovation, build public support, and create a vision. The City has an opportunity to identify (and if needed refine) existing targets and/or create new ones to focus the work and energy of all stakeholders to realize the full benefits of The City’s natural infrastructure over the next 100 years.
3. **Invest and Implement Projects and Programs:** Gather funding partners (City departments, other agencies, and the private sector, etc.) and implement a portfolio of projects. Natural infrastructure projects often require more creativity and collaboration to fund and implement than traditional grey projects. This is an opportunity to bring City departments together with their stakeholders to define and explore new ways of working together.
4. **Monitor Outcomes:** Monitor the health and performance of individual natural infrastructure assets along with measuring overall progress toward city or regional service targets to inform the next phase of planning and investment. This type of work is often new and challenging. As with any new field, there will be successes and shortfalls. Implementing a strong process to glean and apply lessons learned is vital to the efficiency, cost, and overall success of the initiative over time.

As shown in Figure 2, this Blueprint walks through each step and provides specific “activities” for The City to embark upon at each step. Accompanying case studies are provided where available, showing how other cities have experienced success across these different steps, as well as strategies for communicating concepts and collaborating across departments or business units. While the steps themselves are simple in concept, success requires serious focus and a commitment of capital and operating investment by City Administration and leadership over time.

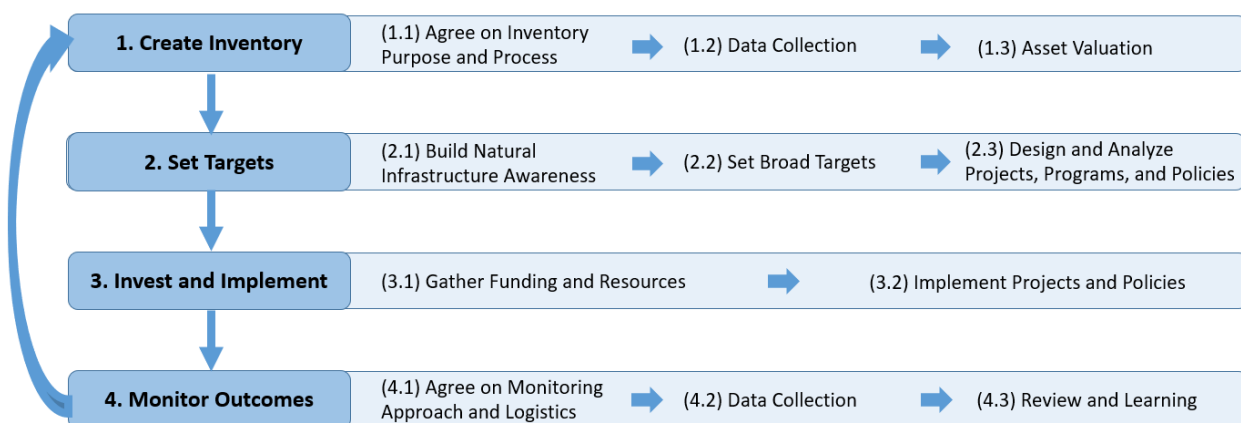


Figure 2: Blueprint for Advancing Natural Infrastructure

The key concept conveyed throughout this *Blueprint* is that natural infrastructure is real infrastructure that needs to be strategically planned, financed, and managed to provide municipal services and broader community benefit.

II. Introduction

Climate modeling predicts significant impacts for Calgary over the coming decades including extreme heat, wildfire, intense storms and flooding, and a variety of other stresses and shocks for residents and infrastructure.ⁱ Long term climate stresses and extreme weather shock events will have substantial social, economic, and environmental impact on The City over the next century.ⁱⁱ Together with aging built-infrastructure and projected population growth, Calgary will be compelled to make unprecedented infrastructure investments over the coming years. Today, The City has an opportunity to position the use of nature and natural infrastructure as a core strategy to effectively address many of these challenges at a regional scale while building community resilience and supporting Calgary's economic and social prosperity.

Calgary is already working to understand and prepare for current and anticipated stresses and shocks. In 2018 The City approved a *Climate Resilience Strategy* to define and strengthen climate change mitigation and adaptation plans.ⁱⁱⁱ The *Climate Resilience Strategy* identifies the creation and preservation of natural infrastructure as a strategic goal supporting The City's long-term vitality. Coupled with the *Resilient Calgary Strategy* (approved 2019), The City now seeks to define and execute tangible actions to fully incorporate natural infrastructure into corporate asset management, and infrastructure planning and investment. The City also seeks to create public-facing policies and programs for residents, businesses, and partners to support long-term natural infrastructure objectives.

To date, The City of Calgary has incorporated natural infrastructure-related policy and goals in several corporate plans, reports and strategy documents, including:

- The 2005 *Triple Bottom Line Policy Framework* confirms the importance of including economic, social and environmental factors in decision making with the goal to “create and sustain a vibrant, healthy, safe and caring community”.
- The 2007 *imagineCALGARY Plan for Long Range Urban Sustainability*, produced with substantial input from the community, defines 100-year goals on a variety of topics ranging from the natural environment to governance.
- Adopted in 2009, the *Municipal Development Plan* and *Calgary Transportation Plan* refine *imagineCALGARY* goals to establish a vision for the region's growth over the next 30 to 60 years.
- The *2020 Sustainability Direction Report*, produced in 2012, established key milestones to measure progress towards these long-term goals.

Following the 2013 Southern Alberta flood, The City built upon flood response and recovery with a renewed focus on resilience, and in November of 2014, Calgary City Council approved resourcing of resilience staff positions. The City researched approaches to resilience and in May 2016, Calgary was invited to join the 100 Resilient Cities Initiative to develop and implement a comprehensive resilience strategy and collaborate with resilience leaders from around the world. The resulting *Resilient Calgary Strategy* identifies economic, social, and environmental resilience-building measures to mitigate stresses such as economic uncertainty, climate change, and a lack of social inclusion as well as shocks such as drought, extreme weather, and economic crisis. Natural infrastructure has a fundamental role in addressing many of Calgary's stresses and shocks to achieve long-term city resilience.

To further the considered progress made thus far, the following *Natural Infrastructure Blueprint* presents an implementation framework with specific steps and activities that will help Calgary accelerate natural infrastructure policies and projects through integrated asset management, awareness building, target setting, detailed scenario analysis, and focused monitoring of outcomes. The steps and activities described below are derived from emerging best practices and case studies gleaned from the work within the 100 Resilient Cities network and efforts undertaken by resilience leaders throughout North America.

Appendix A provides examples of progress within The City of Calgary and its departments to integrate natural infrastructure with its strategies and plans.

III. Natural Infrastructure Defined

Natural infrastructure has overlapping definitions in use today which can lead to confusion. It includes a continuum of features from natural ecosystems (wetlands and grasslands) to highly engineered urban implementations (bioswales and green roofs). Figure 3 summarizes this continuum. Just like traditional grey infrastructure (levees, roads, and treatment plants), natural infrastructure provides services that can help cities meet municipal service targets, e.g. water supply and treatment, stormwater management, wastewater treatment, and public access to parks and open space. In addition, natural infrastructure provides a broad array of economic and social benefits including public health improvement, heat island reduction, attracting tourism and workforce talent with related economic investment, increased property value, and providing community gathering places.

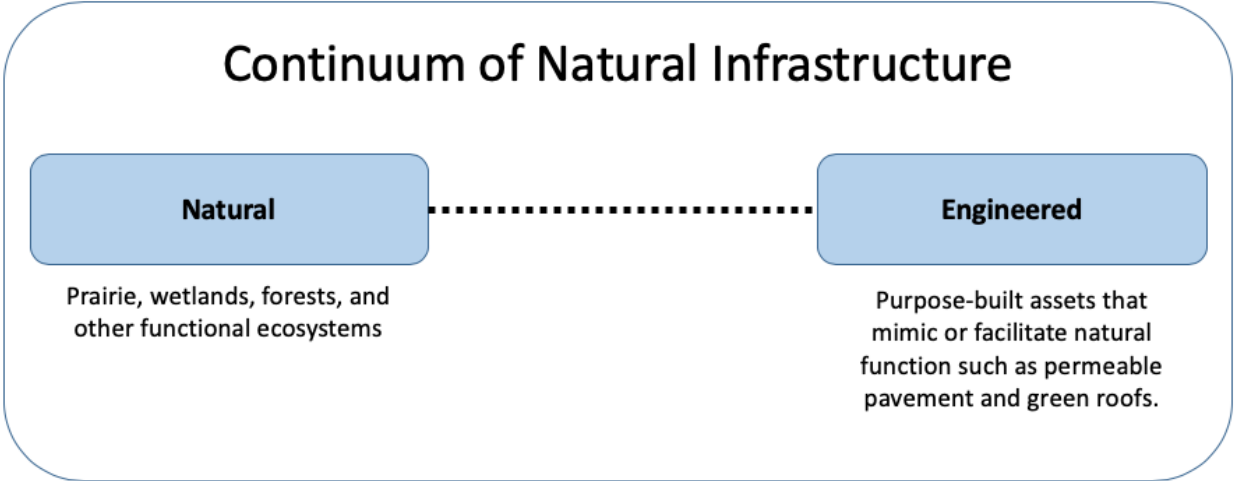


Figure 3: Continuum of Natural Infrastructure

Without functioning natural infrastructure, many of the benefits and amenities required to create a livable city could not exist or would need to be replaced at a high cost. These features and others that support livable cities are often taken for granted until they are lost. Today, as cities face global resilience challenges, city leaders are seeking cost-effective projects that offer predictable performance and long-term resilience. Protecting natural assets and building new natural infrastructure are becoming recognized as an integral resilience-building solution for many cities.

IV. Steps for Advancing Natural Infrastructure

Responsibility for investment in and care for The City’s natural infrastructure spans many of Calgary’s departments and service lines. To capture the full benefit of The City’s tremendous natural infrastructure, Calgary will need to establish a new level of cross-department collaboration and planning. This *Blueprint* provides tangible steps for how The City can further integrate natural infrastructure into asset management, capital investment, and stewardship activities.

The steps are informed by the idea that change at the municipal level occurs most effectively as a recurring cycle of **awareness raising, place-based analysis/implementation,** and development of **supporting policies, procedures, and funding mechanisms** that locks in lessons learned over the long-term. Without awareness of natural infrastructure’s capabilities, The City will lack political will and energy to implement a new, bold vision. Without place-based analysis and implementation, leaders and technical experts alike will not have the hands-on experience required to tune plans and projects to meet changing conditions. Finally, without the support of well-understood and accepted policies and procedures, projects and results will lag from lack of funding and attention, a fate suffered by many initiatives around the world.

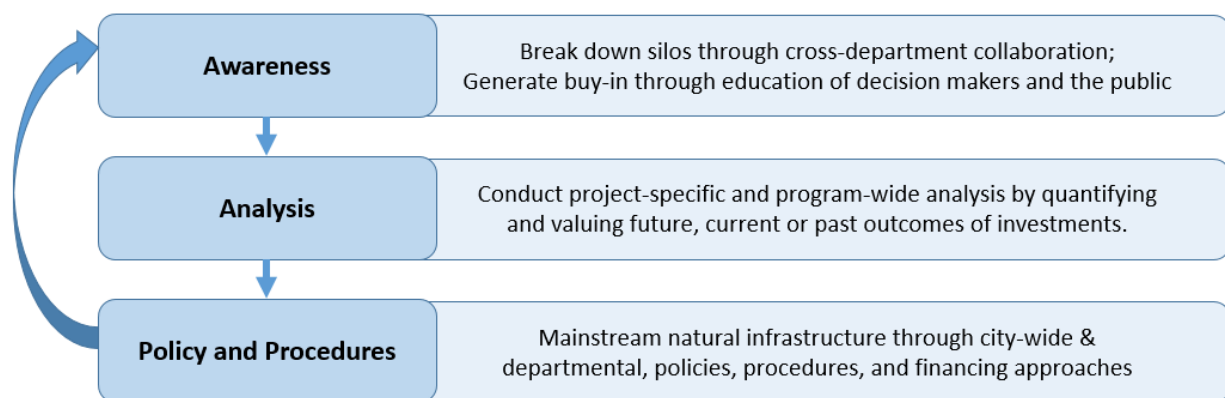


Figure 4: Cycle of Change

The following steps provide a path to consolidate past successes and advance the role of natural infrastructure in The City’s resilience and economic planning. The steps are as follows:

1. **Create Inventory.** Create a detailed and dynamic inventory of the natural assets Calgary relies upon.
2. **Set Targets and Design Innovative Projects and Programs to Meet Them.** Raise awareness and set bold targets for natural infrastructure’s role in Calgary’s future. Once targets are set, define the work (policies, programs, procedures, funding, etc.) needed to achieve them.
3. **Invest and Implement Project and Programs.** Gather funding partners (City departments, other agencies, and the private sector, etc.) and implement a portfolio of projects.
4. **Monitor Outcomes.** Monitor the health and performance of natural infrastructure to inform the next phase of planning and investment.

The following sections detail each step as a set of specific activities with supporting case studies and references.

Step 1: Create Inventory

Quantifying natural infrastructure in terms of geographic area, asset types, and services provided is a challenging first step. Most cities can report the number of hectares in their public park system but may not be able to report the area of green roofs, bioswales, or urban tree count with associated performance and health metrics. Cities are even less likely to be able to report the services provided by other natural assets. How many cubic meters of stormwater are captured by the community soccer field? How many degrees' cooler is the neighbourhood because of dense tree canopy cover and how does that benefit residents with lower utility bills? What is the avoided cost of flood damage due to a healthy riparian zone? Capturing this baseline data in a rich and dynamic way will provide The City with the information required for the next steps of target setting, project analysis, and long-term monitoring. Without this data, planning will be compromised due to limited information.

An inventory should also clarify if and how departments and business units are currently measuring and accounting for their natural infrastructure. Calgary's 2018 *Natural Infrastructure Questionnaire* distributed to business units has positioned The City to undertake an even more detailed inventory process. A full inventory answers the following questions:

- What natural infrastructure assets does the City currently own? (and if possible, what are the assets owned/managed by non-City stakeholders such as businesses, residents, and other governments in the region?)
- What services do those assets provide? (Cooling, stormwater retention, recreation etc.)
- How are those services measured in biophysical terms (litres stored) and valued in economic terms (avoided cost of damages due to flooding)?
- What is the health of the assets today? How will it be maintained or improved over time?
- What natural infrastructure has been lost over the past 20 years and why?
- How do The City's existing programs and policies help or hinder the development, maintenance, and preservation of natural infrastructure?

The following activities will help Calgary create a process and asset management resource that will ultimately answer each of these questions, and many others.

Activity 1.1: Inventory Purpose and Process. The first activity of the inventory process is to gather asset owners and stakeholders throughout The City (and outside) to agree on the goal and process of completing the inventory. It is important that the stakeholders include stewards of The City's current asset management system(s) who can share lessons learned and evaluate whether the existing system can be adapted to house natural asset data. This will begin with a gap analysis of the current asset data and reporting such as land improvements and engineered structures. If the gaps are significant then begin to fill them with a focused approach by single asset type or owner. Once that process is tested, it can then be rolled out more broadly.

While initial meetings and discussions should build awareness of natural infrastructure's benefits and its role in resilience, this group's work should quickly evolve into technical workshops to identify and answer questions about how this inventory can be efficiently created. This work includes agreeing on required

data, definitions, metrics, and process for capturing, storing, and maintaining the data. While some of the approaches here are consistent with capital asset management, there is currently no broadly accepted standard approach for natural infrastructure asset management, though several initiatives are underway to address this gap and various natural asset classes are already being monitored through various means. The Municipal Natural Assets Initiative is one example of such an effort in Canada, and the Water Research Foundation is funding a related project in the U.S.^{iv} This work can also leverage current asset management systems in use at The City of Calgary such as inforEAM and data improvement projects planned by Corporate Asset Management.

An important consideration in this activity is how non-City assets will be recorded. Private infrastructure from large tracts of land to planting strips on private property provide the same types of benefits as City-owned infrastructure. As well, Calgary relies on natural assets found outside its political boundaries such as its upstream watershed. Ideally, these assets and benefits will also be captured in the inventory for two important reasons. First, understanding the benefits received from private and regional land will help communicate the full value of natural infrastructure to The City. Second, City programs, regulation, and incentives may be able to preserve or increase the benefits of private and regional assets over time.

Once in place, the inventory provides the key resource for The City and the public to understand the magnitude and importance of existing natural infrastructure assets and define opportunities for future enhancement.

Activity 1.2: Data Collection. Once the purpose, process, definitions, and tools are in place, staff can begin to populate the inventory. Most likely there will be a good number of placeholders and gaps in the data that can be filled in later. The important elements are that the approach is robust and that a broad array of data is gathered. The City will also likely want to produce a set of standard biophysical data estimates that can be used to calculate asset services and performance until more detailed, site-specific data can be gathered. For example, a standard value for the amount of stormwater captured per hectare of local playfields or transportation right-of-way would be useful to recognize the magnitude of these benefits.

Activity 1.3: Asset Valuation. Most municipal decisions are supported with economic analysis, such as return-on-investment or cost-benefit analysis. Until natural infrastructure and natural infrastructure projects can be included in a traditional cost-benefit framework terms they will always be at a deficit to traditional grey infrastructure counterparts. Today, most cities do not consider the full economic value of their natural infrastructure assets – whether parks, urban trees, or raingardens – even though they provide tangible and economically valuable services, such as stormwater capture and storage, property value uplift, improved public health, or attracting tourism. When natural infrastructure assets are omitted from economic analysis, they are effectively valued as zero which can lead to inefficient capital investments, higher incurred costs, and poor asset management decisions.^{v,vi} To resolve this deficiency, The City can develop and apply valuation methods appropriate to the local asset portfolios and conditions. At The City level, a baseline can be developed to understand the overall dollar value of Calgary’s natural infrastructure portfolio and inform future target setting. At the project level, a rate of return can be determined for conservation and restoration investments, which can support increased implementation of natural infrastructure solutions and reduce overall incurred costs.^{vii,viii}

A variety of economic methods have been developed to estimate both market and non-market economic benefits of natural infrastructure. Methods like avoided cost, willingness-to-pay, and replacement value have been used to calculate the value of a park or wetland in well-controlled studies conducted

throughout North America. Further research is still required to fully quantify the services provided in complex circumstances. For example, the reduced healthcare costs conveyed by better air quality due to an urban forest are challenging to tease out from many other contributing factors. It is important for The City to gather a set of best-available economic valuation tools that are appropriate for local conditions and accepted by local experts for use in investment and project analysis. These economic tools can then be paired with biophysical asset data collected in Activity 1.2 to produce more targeted valuations for the inventory. An important step is to identify all the service outcomes provided by the natural infrastructure (such as flood mitigation, pest management, carbon reduction) and the value of those services rather than a simple traditional replacement cost.

In an ideal world, a single, user-friendly, natural infrastructure valuation tool would be available to every planner, engineer, and decision maker in Calgary. It is more likely that The City will move forward with a variety of tools and methods to allow customization and flexibility as the natural infrastructure field evolves. For example, a land cover-based approach using LIDAR or other GIS layers as proxies for identifying services and valuing natural infrastructure can be the most efficient approach for city-scale target-setting and certain types of project analysis. In other cases, a more granular customized breakdown of asset types – similar to traditional asset management – can be more appropriate.

The final mix will likely include rough spreadsheets and more polished and integrated analysis software. Below are examples of tools and approaches that are available today, and which may be helpful for supporting The City's goals (others may be found in the Canadian Government's guide *Ecosystem Services Toolkit, Completing and Using Ecosystem Service Assessment for Decision-making: An Interdisciplinary Toolkit for Managers and Analysts*^(x)):

- **A Standard Set of Benchmark Values:** A standard set of natural infrastructure values, such as those adopted by the Federal Emergency Management Agency (FEMA)^(x) in the United States, can serve as a useful benchmark for economic valuation decisions. Standard values in the appropriate units (per hectare, per sq. meter, per kilogram of pollutant removed, per visitor day, per tree etc.), representing expected benefits ensure that economic analyses have at least screening-level values for the services provided by natural infrastructure without requiring in-depth quantification. While standard values cannot match the precision or nuance of more detailed valuation approaches, they can provide a useful and efficient starting point for municipalities. Standard values can be maintained in a simple spreadsheet with guidance for appropriate use and can be updated regularly as new information become available.
- **Calgary Water Resources Triple Bottom Line Tool:** The Calgary Water Resources Department is developing a Triple Bottom Line (TBL) Cost-Benefit Analysis tool to evaluate capital investments like wastewater treatment and stormwater control infrastructure. The main objective of the TBL tool is to provide a standardized and transparent way to monetize and compare the costs and benefits of a capital investment and its alternatives to select the best performing option. The tool can consider natural infrastructure, grey infrastructure, or a combination of the two. Previously, infrastructure investment options were compared solely on financial performance – now, TBL impacts of projects including water quality, erosion control, flood avoidance, and energy consumption are considered. The tool also calculates the carbon mitigation potential of a proposed project. Through TBL analysis the costs and benefits are monetized using four common valuation methods: avoided cost, replacement cost, hedonic pricing, and contingent valuation based upon the net present value. In

addition to helping select the best performing infrastructure investment option, the tool can be used to prioritize capital investments across projects and communicate the total value to stakeholders.^{xi}

- **Autocase:** The Triple Bottom Line Cost Benefit Analysis (TBL-CBA) cloud-based software, Autocase^{xii}, automates cost-benefit analyses of buildings and natural infrastructure and low impact development projects by considering the financial, social, and environmental costs and benefits. TBL-CBA is an evidence-based economic method that combines Life Cycle Cost Analysis (LCCA) and Cost Benefit Analysis (CBA) techniques to quantify and attribute monetary values to the Triple Bottom Line (TBL) – financial, social, and environmental – of a given project.
- **Ecosystem Valuation Toolkit:** Earth Economics has created a repository, Ecosystem Valuation Toolkit (EVT), of values gleaned from academic studies estimating the economic benefit of natural infrastructure. EVT has over 2,000 values covering most land cover types and ecosystem services. Additional values are added every year as new research is published in academic, peer-reviewed journals. Using EVT, Earth Economics can generate localized valuation data for locations throughout North America.

The lack of a standard valuation criteria is cited as a common barrier to promoting natural infrastructure. As each city has different drivers, goals, and assets, a single neatly packaged valuation solution is not practical. By using and customizing the tools above, or creating new ones, stakeholders within and outside The City of Calgary can apply their own expertise and experience to value natural infrastructure in a way that makes sense in the local context and has support from the community.

Case Study: The City of Edmonton has identified Low Impact Development (LID) as a strategy to achieve their water quality target of no net increase in pollutants discharged to the North Saskatchewan River. Flood reduction is also a top priority for the city to build long-term resilience into the drainage system. Retrofitting the stormwater system is required in mature neighbourhoods built without sufficient controls and with undersized storm sewers. Two prototype private sites and a large portfolio of public sites were analyzed. The cloud-based automated Triple Bottom Line – Cost Benefit Analysis (TBL-CBA) software *Autocase for Sites* was used to estimate the project’s incremental lifecycle costs and monetary value of social and environmental impacts of LID retrofits on public and private lands. The team assessed over 33,000 LID retrofit opportunities to prioritize the most cost-effective investments and estimate the holistic value of broad LID implementation across the city. Of the significant net benefits calculated, the greatest monetary benefits are provided by avoided grey infrastructure costs, followed by social benefits such as flood risk mitigation and property value uplift. Environmental benefits such as air pollution reduction also contribute to the value of the investments. Autocase’s analysis found that Edmonton’s proposed Low Impact Development strategy would result in \$420 million in net benefits over the life of the project.

Step 2: Set Targets and Design Innovative Projects and Programs to Meet Them

Establishing the right bold, broad, and impact-oriented natural infrastructure targets for city-wide action can unite City departments, communities, the private sector, and even regional stakeholders in shared purpose. There seems to be a persistent sense in many cities that natural infrastructure is not up to the job of meeting important challenges. Implementing natural infrastructure at greater scale brings not only more benefits but also efficiencies in terms of staff focus, construction and operations and maintenance (O&M) costs, and better developed processes and procedures. For example, certain fixed costs associated with a permeable pavement program may be the same whether the program is targeting 10,000 or 100,000 square meters of permeable pavement (e.g. program design, machinery for O&M, staff training), so the relative transaction costs associated with designing a large program can be lower. Perhaps more importantly, scale increases the pace and value of feedback that allows The City to learn and improve the overall implementation process over time.

The scale of other infrastructure systems – transportation, water, wastewater – is measured in millions or billions of dollars and many thousands of infrastructure components. Natural infrastructure can provide valuable, durable solutions too but to do so projects must be deployed at a scale typically reserved for grey infrastructure projects. For example, the State of Louisiana is moving forward with several multi-billion-dollar Mississippi River diversions in an attempt to restore its degraded coastal wetlands.^{xiii} The City of Melbourne, Australia, is implementing a plan to increase its urban forest canopy by 40% over the next 20 years.^{xiv} Both efforts will provide massive benefits, including hurricane buffering for the City of New Orleans and heat mitigation for the residents of Melbourne, while contributing many additional benefits to the surrounding communities. In each case, natural infrastructure at scale offers the most cost-effective and resilient solution to the large-scale issues that these cities are facing. Thinking and planning with this sense of scale opens entirely new ideas and approaches to municipal strategy and planning.

The form of the target is less important than the fact that data can readily be gathered to measure and report meaningful progress over time. Ultimately, like any goal, the target must be challenging AND realistically achievable given resources and expertise available to The City. Targets that are too easy will not produce meaningful results. Targets that are too challenging will yield frustration and failure. Creating targets that fall at the sweet spot require excellent inventory data matched with careful analysis and collaboration to achieve success. The following three activities support the target setting work.

Activity 2.1: Awareness Raising. Target setting requires understanding among decision makers, technical staff, and the public that natural infrastructure can and should play a central role in The City’s resilience-building efforts. Without this core support, meaningful targets are unlikely to be adopted or supported when difficult budget and prioritization decisions are required. The awareness building activities need to be tailored to each group (e.g. residents compared with engineers) but will typically combine a mixture of presentation/education and more collaborative discussions and demonstrations. Visits to successful natural infrastructure projects are especially valuable in raising awareness.

Activity 2.2: Setting Bold Targets. Target setting is not an end in itself but rather a way to align resources and goals across City departments and with the larger community. Targets are “bold” if they require a significant, integrated, and collaborative approach to pursue them. Again, they must require innovation and stretch the City’s capabilities while being achievable. Since these targets will often take several years

to achieve, they also require waypoints where progress and performance can be measured. Compared with large, centralized grey infrastructure, one advantage of small-scale, decentralized natural infrastructure projects like bioretention, green roofs, and urban trees, is that they can be installed incrementally and often provide quantifiable service capacity and other benefits immediately. This incremental approach is especially useful in times of climate uncertainty where the nature and timing of change is not well characterized, and flexibility is required. In fitting with the concept of resilience, the overall approach can be tuned and improved over time as conditions and demands on the system change.

Target setting for Calgary can include both a review and rationalization of existing targets as well as the development of new targets. In reality, Activities 2.1, 2.2, and 2.3 represent a repeating cycle of activities. For existing targets, the projects, programs and policies supporting them should be reviewed to verify that the targets are in fact achievable, that activities are aligned with the target, and that performance monitoring is in place to verify progress and adjust as necessary. The City may decide to adjust, merge, or discard existing targets after going through this process. It may also become clear that new targets with supporting activities are needed to meet climate challenges and resilience goals. Again, once the initial targets are set, The City will design and plan the required projects, policies, and performance monitoring to achieve successful implementation.

Each target should clearly establish ‘what’ The City will do and how it will support the community and help achieve long-term resiliency goals. Measurable impact-oriented targets help to motivate action.

For example, one bold target would be to allow no-net runoff from a new community or highway, even under future climate projections. The direct benefit would be reduced stormwater runoff, less neighbourhood flooding and reduced strain on the existing, grey stormwater infrastructure. The resilience benefit may include improved public health and recreation by providing more urban green space. Again, this is a big goal that will require new thinking, deep collaboration amongst experts, careful project planning, and support across multiple levels (senior leadership to maintenance staff, as well as consultants and residents). Sadly, less bold, incremental goals or goals that are not broadly shared across stakeholders have proven insufficient to the challenges faced in many cities and may receive lower priority and attention, further reducing their chance of success.

The City can be creative with the kinds of metrics used to define its targets. Units could include percentage of impervious surface created/maintained; number of trees planted; percentage of total capital budget spent on natural infrastructure; gallons of water managed by natural infrastructure during a rainfall event; number of policies adopted on natural infrastructure; and so forth. The imagineCALGARY report has already established several goals and targets that should be reviewed for their status, long-term viability, and the likelihood that supporting projects, programs, and regulations will lead to success. Examples of targets are below:

- “By 2036, per capita water consumption is reduced by 30 percent”^{xv}
- “By 2036, land use efficiency increases by at least 30 percent, as measured by public transit threshold and increased density”^{xvi}
- “By 2036, the number and/or size of protected or restored habitats increases to a state of health and functionality.”^{xvii}

Case Studies: The City of Vancouver, BC^{xviii} adopted a policy target that every Vancouver resident be within a five-minute walk of a park or public greenspace by 2020. To achieve this target, Vancouver maps and monitors current greenspace, and targets new installation in areas with limited access. Vancouver estimates that through this intentional mapping and development effort 92% of residents live within a five-minute walk to public greenspace. Vancouver supports this target by investing in new natural infrastructure.

Similarly, the cities of Portland, Oregon^{xix} and Melbourne, Australia^{xx}, and many others, have set specific tree canopy targets while the City of Seattle, Washington has set specific targets for stormwater management achieved through green infrastructure.^{xxi} These targets allow cities to measure progress, unify departments around a shared goal, and structure policies and programs to achieve these objectives.

Activity 2.3: Design and Analyze Projects, Programs, and Policies. Once targets are established, the cross-departmental team can begin to outline, evaluate, and prioritize projects (more likely portfolios of projects) and regulatory changes to achieve the targets. For example, a target of increasing tree canopy by 10% could be achieved through a resident street-tree incentive program or via purchase and afforestation of a vacant tract of land. Using standard tools such as cost-benefit and return-on-investment analysis, a variety of options can be analyzed and tested against targets and resilience goals.

As another example, The City could bring together transportation, parks, and stormwater planners and engineers to imagine how stormwater management could be accomplished with NO new grey infrastructure, only natural infrastructure. While this may seem far-fetched, the challenge will spur new ways of thinking and test long-held assumptions about how urban stormwater is managed. Alternatively, The City could pursue a combination of natural and manmade infrastructure to achieve those targets. The key in these analyses, is to ensure that the broadest range of benefits and data (ideally collected as part of the inventory) is included in each analysis, from human health benefits to avoided flooding damages.

The City could consider adjusting programs and incentives that influence private investment in natural infrastructure. For example, this may include goals for high-density developments and incentives for private entities to build and maintain natural infrastructure like raingardens or bioswales. Ideally, the resulting projects and portfolios will follow a review and approval path through The City similar to the planning and analysis typical of grey infrastructure so that results are both familiar and comparable.

There are a variety of ways to inform the best mix of approaches to achieve targets. For example, the Insurance Bureau of Canada proposes the following order of priority for selecting projects, as a ‘rule of thumb’ for achieving the most cost-effective outcomes (in the context of using natural systems to mitigate flood losses):^{xxii}

1. Retain what you have;
2. Restore what you’ve lost;
3. Build what you must.

Calgary has already developed many natural infrastructure supporting policies, programs, and systems. A full inventory and analysis of this existing work would provide context, background, and institutional learning as Calgary strengthens its commitment to natural infrastructure. The development of projects

and initiatives will need to consider existing municipal regulations and procedures and how they will best support meeting the agreed targets.

Case Study: The City of Phoenix, AZ conducted an extensive regulation review of their municipal policies that influence natural infrastructure adoption. The review identified opportunities for enhancement and revision, resulting in significant changes to The City’s programs and policies. Phoenix now requires the use of drought tolerant plants in landscaping and onsite stormwater retention for up to a 100-year storm event. Phoenix also made changes to allow for rainwater harvesting and permit greywater use and set an ambitious 25% tree canopy cover by 2030 target.^{xxiii xxiv}

The Planning & Development Department can support Calgary’s natural infrastructure targets through review of the ways that the municipal regulation supports or hinders natural infrastructure investment and stewardship. For example, regulations related to impervious surfaces and urban trees have a direct impact on the volume of stormwater that can be captured in a rain event. In terms of sequence, it is important for The City to understand the current baseline level of services provided by natural infrastructure on public and private property, and then estimate anticipated physical change expected from regulatory changes in physical and dollar terms. Without this type of information, the full cost and benefit of a proposed investment or change is obscured, and a fully informed decision cannot be made. Estimating the benefits of privately held natural infrastructure also helps The City look at a challenge, such as stormwater management, in a more holistic way and can directly tie program and policy decisions to The City’s ability to achieve established targets.

The City of Calgary can further encourage natural infrastructure preservation and growth through the expansion and creation of incentives or rebate programs. The City should consider incentives for “smart” growth above and beyond the municipal regulatory standards. Calgary’s Water Resources business unit can also increase the presence of natural infrastructure in the city by providing rebates or incentives for customers who install rain gardens, trees, bioswales, or other natural infrastructure.

Case Studies: Washington DC created a code requirement that new developments greater than 5,000 square feet must be able to retain their stormwater runoff on site or purchase tradeable stormwater credits from other developments in the city. This created a market for “Stormwater Retention Credits” that encourages the development of effective water catchment facilities throughout The City.^{xxv} More than 200,000 Stormwater Retention Credits are transacted each year. The program has resulted in a ten-fold increase in the number stormwater retention projects developed each year.^{xxvi}

The City of Seattle provides significant rebates for residential customers who disconnect their downspouts from the city stormwater system and install natural infrastructure to manage the runoff. This program is part of their initiative to manage 700 million gallons of runoff, described in more detail in section 3.2, below.^{xxvii}

Bloomington, Indiana eases setback requirements for building developments that meet the City’s established water and energy efficiency goals.^{xxviii}

Step 3: Invest and Implement Projects and Programs

With targets set and a portfolio of projects defined and approved, funding and implementation is the next step. Because natural infrastructure tends to occupy a smaller component of project budgets and yet span

more departments in terms of benefits, funding and implementation can be challenging and require a high level of focus and collaboration. Again, a cycle of awareness building, analysis, and supporting policies and procedures can help to ensure the investment of sufficient resources and successful implementation of a portfolio of projects.

Activity 3.1: Gather Funding and Resources. Large scale, cross-departmental natural infrastructure projects are not common. This is partly because the breadth of these projects may require participation of multiple financial contributors (including city business units, other agencies, and the private sector) that do not often work together. This means that gathering funding and other resources will require a significantly higher level of awareness, motivation, discussion, and collaboration than funding and building more traditional grey infrastructure. Often the participating parties are eager to contribute but face a variety of roadblocks that slow or block them. Beyond proactive engagement, having a clear vision, active awareness-building, bold targets, and a portfolio of well-defined and carefully analyzed projects – as described in the earlier steps – holds the key to successful funding and resourcing of these initiatives.

Also, given that most infrastructure decisions are informed by return-on-investment projections and budget constraints; finance and accounting policies and strategies are critical to long-term, sustainable success of natural infrastructure initiatives. Many of Calgary’s departments influence the finance and accounting treatments applied to natural infrastructure, from initial strategy to ongoing maintenance. By expanding The City’s accounting treatments Calgary can ensure that such investments are counted as real infrastructure on the balance sheet and programs receive the required financial consideration and support over time. Stakeholders in these discussions should include both capital planning experts as well as operational managers responsible for the long-term stewardship of the natural infrastructure to ensure that funds for ongoing maintenance are adequate.

Activity 3.2: Implement Projects and Policies. Assuming clear targets, well defined projects, funding, and public support, implementation of natural infrastructure projects can be a straight forward step. That said, on-the-ground projects will likely have many stakeholders making coordination challenging and time consuming. When policy and procedure changes are required to support, for example, a public natural infrastructure incentive program, the timeline can extend further to adapt to The City’s internal review and approval processes. One caution during the implementation period is to ensure that the overall project goals aren’t compromised by last minute decisions that reduce the project benefits inadvertently. For example, converting a retention feature with native plants to grass might save money in the short term but may also reduce habitat, biodiversity, and stormwater capacity benefits. To avoid this type of last-minute consequence, natural infrastructure goals of each project need to remain top-of-mind as project success factors for project managers and other stakeholders.

Case Study: *Seattle’s 700 Million Gallons Initiative* is a collaborative partnership between The City of Seattle, Seattle Public Utilities, King County, and several other community organizations to work towards the target of capturing 700 million gallons of stormwater through natural infrastructure in Seattle by 2025. The initiative educates and solicits participation from the public in achieving these goals through individual actions such as planting trees and installing rain gardens. Through monthly public meetings, the Initiative engages and trains community members and departmental leaders to make progress towards their goal. The initiative maps and tracks natural infrastructure projects developed around the city and the county and reports progress towards the goal.^{xxix}

Step 4: Monitor Outcomes

Once implemented, creating a system to monitor investments in natural infrastructure vis-à-vis established targets, as well as the performance and resilience outcomes of those investments, is crucial to helping The City tune its approach and adapt to future stresses and shock events.

Though natural infrastructure, once established, can require less maintenance than grey infrastructure (e.g. restored riparian area compared to a flood wall), such projects can still decline and ultimately fail due to lack of monitoring and stewardship. Too often, natural infrastructure projects are built with little follow-up or monitoring, leaving stakeholders uncertain about the success or failure of the project. Using the asset management process to support long-term stewardship is especially important.

Capturing detailed data for natural infrastructure assets provides invaluable data for the planners considering long term strategy. As many natural infrastructure features are relatively new, there is still much to be learned from hands-on, local experience – especially related to maintenance costs, appropriate equipment, and staff expertise. There are still too many stories about quality projects that failed because of insufficient training or investment in monitoring and maintenance. The following activities are intended to ensure that quality data is collected and used to inform all the other steps and to communicate with internal and external stakeholders.

Activity 4.1: Agree on Monitoring Logistics. While most of the monitoring processes and expectations will have been decided during the inventory planning and data gathering process (Step 1), the monitoring performance and outcomes will require funding, coordination, and long-term focus. While a project's ability to capture stormwater could be validated in the first season, the community health and economic benefits of the same project may take some number of years to develop. Thus, it is important for The City to agree on how and when data will be collected and how the effort will be staffed and funded over time.

Activity 4.2: Data Collection. Monitoring the condition, function, and service delivery of natural infrastructure assets will assist The City's planning and operations experts in gathering project experience to direct current and future activities. A comprehensive condition assessment approach to monitoring is consistent with recognized grey infrastructure asset management protocols. i.e. What is the level of maintenance required? What is the condition of each asset, level of service, and risk of loss? What level of investment is needed to maintain performance and meet pre-established targets?

Activity 4.3: Review and Learning. Perhaps the most important part of the entire natural infrastructure initiative is learning from experience and adapting future projects and investments to both resolve past challenges and adjust to changing conditions. It may be that a flood control feature works well until rainfall projections are exceeded, for example. Gathering and learning from this type of information will make the entire program better. The review and learning process can track a similar path to the original awareness building activities. The goal is not only to both build awareness, across departments and business units, of how projects have performed, but also dig more deeply into shortcomings and failures, in order to learn and improve outcomes.

While it is relatively straightforward to determine the success of specific projects or programs, especially where targets and metrics have been set, measuring the progress of entire business units, departments, or the city as a whole can be more challenging. One approach would be to compare progress across broad targets set in Activity 2.2. A complementary approach would be to review Calgary's progress (at the City department, business unit or service level) across an even broader set of metrics. For example, The City

could use the framework developed by Earth Economics in its 2018 report *From Projects to Portfolios Mainstreaming Large-Scale Investment In Integrated Infrastructure*,^{xxx} which identifies several broad transformational shifts that cities should target. Calgary could ask a variety of questions around these shifts, including:

1. **Accessories --> Assets.** Is natural infrastructure being considered as a core component of City capital investment and service delivery, or is it still considered an “add-on” or “nice to have” feature of infrastructure projects?
2. **Champions --> Systems.** Does natural infrastructure still require a champion(s) within a department or business unit to be included in infrastructure planning, or is the concept mainstreamed sufficiently so that it is considered in all decisions (even by the most conservative engineers).
3. **Projects --> Portfolios.** Is natural infrastructure funded and implemented on a short term, case-by-case basis, or is it being integrated into a long-term portfolio of projects? (e.g. supported by asset management, capital investment)

As an exercise, Calgary could review its progress across these categories on an annual basis but should not expect to yield “yes or no” answers: The purpose of such an exercise would be to provide a “gut check”, and to generate discussion. The categories could also be discussed qualitatively, using a 1-5 scale for example.

V. Strategies for Robust Communication and Collaboration

The transition from seeing natural infrastructure as a “nice-to-have” accessory to a valued asset starts with clear communication and robust collaboration between subject experts throughout The City and with community stakeholders. The primary goal of this work is to impress upon stakeholders that natural infrastructure is real infrastructure and is a critical ingredient to a healthy, vibrant city. This section provides some additional approaches to strengthen communication and collaboration.

Too often, natural infrastructure is deployed as a project accessory to soften the edges of traditional grey infrastructure projects, if deployed at all. As an accessory, nature is also perceived as an added cost that can be pared down or eliminated to address schedule and budget constraints. This mindset establishes what systems thinkers call a ‘race to the bottom.’ As an example, a natural feature may be downsized and simplified to save time and money, which in turn degrades performance and increase maintenance requirements of the investment. The resulting failure to meet original objectives feeds the perception that natural infrastructure underperforms and is difficult to manage. This perception further reduces support and investment, making a poor outcome even more likely on the next project, hence the race to the bottom.

In contrast, a broad and well-structured engagement effort for internal and external stakeholders can help to build understanding and support for a more holistic and integrated approach to natural infrastructure as a strategic asset and core component of successful projects. Discussions with community and infrastructure leaders in the 100 Resilience Cities network and in local governments throughout North America has helped to identify the following steps as critical in the communication and collaboration process:

Establishing a shared vocabulary. Language is important. As an emerging field, natural infrastructure does not come with well-defined terms and definitions. While recognizing existing terms used for programming and operational purposes, The City of Calgary will benefit from defining common terms and ensuring that they are widely communicated and applied throughout The City, in policies and procedures, and in regular communication with residents and external stakeholders. In addition to a simple, user-friendly definition of natural infrastructure, The City should define and describe the concept of ecosystem goods and services, the difference between market and non-market benefits, the importance of ecosystem health, how economic methods can be used to estimate the value of natural infrastructure, and any other supporting terms and concepts. Well-defined terms and consistent definitions will support efficient and robust collaboration and simplify data sharing with other cities facing similar challenges.

Convening and Engaging Local Experts. While many cities have a small number of advocates who are knowledgeable about natural infrastructure, embedded in different groups related to water and parks, few cities have adopted these concepts in their mainstream municipal strategy and capital investment activities with broad support and rich collaboration from technical experts. Isolation of natural infrastructure knowledge and leadership within a business unit or similar group may be the most important barrier facing cities wanting to advance natural infrastructure at the scale required to address challenges such as climate change and growth.

Breaking Down Silos. The City has the opportunity to institutionalize broader engagement with cross-department technical training and working sessions with capital planning staff, engineering staff, and others through a working group and coordinated operations and maintenance. Ideally, these sessions are structured to maximize creativity and innovation and are focused on resolving specific urban challenges, as detailed earlier in the document. These sessions could include public health, tourism, and social justice staff to explore how natural infrastructure solutions provide benefits to their stakeholders such as reduced heat island effect or increased recreational opportunities. Including external planning and engineering consultants that support Calgary's grey infrastructure development in these sessions is vital. These experts will need to adopt The City's vocabulary and cross-disciplinary approach to ensure that their plans and designs support the mainstreaming of natural infrastructure. Note that this may not always be easy: a project risk is that consulting firms are frequently similarly siloed in structure and 'traditional' in their designs, however, external experts may provide a valuable conduit through which to gather and share knowledge from similar work in other cities.

Done well, collaboration events should be creative, fun, and effective. The goal is to create space to explore new ideas, build expertise, create scenarios focused on natural infrastructure, and bring together stakeholders in new combinations and with a new sense of purpose. This work is about mainstreaming a new way of thinking, embedding natural infrastructure assets into core planning processes: to establish a cycle where The City is experimenting with new approaches and quickly incorporating hands-on experience to inform the next project or initiative. Breaking down silos provides an opportunity to deepen collaboration and facilitate hands-on training and working sessions amongst technical staff within and across departments to look at natural infrastructure as an asset and tool.

Convey the Value of Nature to the Community. The importance of community support cannot be overstated, particularly for initiatives funded with taxpayer dollars. Residents and community organizations must understand that natural infrastructure, alone or paired with grey infrastructure, addresses issues important to them. Emphasizing the broad community benefits of natural infrastructure

including, improved public realm, improved human health, and long-term resilience, can help to reframe planning conversations into a discussion about community well-being and vitality.

Compared with traditional grey infrastructure projects, natural infrastructure projects lend themselves to earlier and more collaborative community engagement. The many benefits of these projects draw much broader stakeholder groups and offer many more implementation scenarios for consideration. With early, broad engagement, a wider set of benefits can be defined and achieved. For example, a linear pathway created along a river to manage flooding can also be an important alternative transportation route between lower income areas and large employers, bringing employers, community advocates, and city service leaders to the table. Similarly, this type of project may provide a critical habitat link that provides birds and animals with a safe path through the urban area, bringing wildlife advocates and government wildlife experts into the discussion. Community engagement builds political support, financial support, and community capital by establishing shared goals. Communication and collaboration are on-going practices where skills grow and evolve with time and experience.

Appendix A. Examples of Natural Infrastructure Related Policies and Programs at The City of Calgary

The City of Calgary has been a leader in including natural infrastructure in its strategies and plans. The City as a whole, and many departments and business units, explicitly or implicitly make decisions about Calgary's natural infrastructure, including:

- **The City's Triple Bottom Line Framework**, adopted in 2005, states that Calgary will consider and address social, economic, environmental and smart growth impacts in City planning.¹
- The **Planning and Development Department** produces and updates the *Municipal Development Plan* which includes the objective of connecting natural infrastructure in Calgary's urban fabric.¹ The department is in the process of creating a *Developed Areas Guidebook* which will set guidelines and priorities for sustainable development.
- The **Real Estate and Development Services Business Unit** makes decisions about land use and acquisitions that weigh environmental and financial considerations. Decisions have a direct impact on the quantity and quality of Calgary's natural infrastructure. For example, The City recently acquired Priddis Slough, a large riparian and wetland area. Planning and discussion around the use of this land are underway, and The City has the opportunity to retain the natural function of a portion of this land as a natural asset.¹
- The **Water Resources Business Unit** has developed and leads the *Riparian Action Program: a Blueprint for Resilience* which communicates the importance of riparian ecosystem services, assesses the health of riparian areas, maps all riparian areas in Calgary, creates riparian management categories and educates citizens on the value of riparian areas and healthy rivers in Calgary. Specific actions and riparian performance measurement are included in the overall Stormwater Management line of service. The business unit also produces the *Stormwater Management and Design Manual*, which defines the role of natural infrastructure in water management and erosion control, and establishes best practices for the development and maintenance of natural infrastructure installations.¹ The business unit has developed a *Source Water Protection Plan* for the Bearspaw and Glenmore watersheds, which emphasizes the role of preservation and restoration of natural infrastructure in the protection of The City's water supply.¹ The business unit also monitors and manages stormwater quantity and quality, and identifies properties at risk of flooding. As discussed earlier, the Water Resources business unit has developed a Triple Bottom Line tool to support capital investment decisions.
- The **Environment and Safety Management Business Unit** coordinates and stewards The City's progress towards environmental goals. The *Climate Resilience Strategy* was developed by the business unit to guide The City's actions to mitigate and adapt to changing climate conditions. The business unit serves as an advisor to internal clients across The City, as well as provides information on environmental and climate change initiatives to the broader community. Energy efficiency initiatives and greenhouse gas reporting and reduction initiatives are completed by this business unit as well. The business unit also administers the environmental management system (EnviroSystem) which is used to track and improve environmental impacts of business operations.
- The *Municipal Development Plan* directs the **Parks Business Unit** to lead in creating and managing the Ecological Network, a core/connectivity network that supports biodiversity, the urban forest,

play spaces, wetlands, pollinators, etc. Part of this ecological network includes 1,400 hectares of land surrounding the city's transportation system as well as 650 land parcels owned by Transportation for future consideration. Through a variety of plans and policies, Parks seeks to reduce the city's ecological footprint, promote smart growth, and protect/enhance the natural environment. Near transportation infrastructure, planners seek to use natural infrastructure to mitigate impacts such as salt/pollutant runoff, excess heat, flooding exacerbated by impervious surfaces, and noise pollution in the surrounding communities. As a whole, the business unit also seeks to build climate resilience to mitigate drought, flooding, and other pending challenges.

- The **Transportation Planning Business Unit** oversees strategy and design required to meet The City's long-term transportation needs. An emerging priority of the planning team is to better understand the ability to capitalize on multiple benefits through naturalizing rights-of-way and to understand potential new challenges and costs related to actively managing landscapes. Through programs like Complete Streets, the City's transportation planners implement an integrated approach that addresses transportation needs (pedestrians, bikes, cars, and transit) along with environmental challenges by controlling heat and stormwater and providing residents with a pleasing space and sense of community.
- The **Resilience & Infrastructure Calgary (RIC) Business Unit** has developed a Resilient Calgary Strategy that includes a "Future of Calgary's Natural Infrastructure" pillar with a goal that natural infrastructure assets are identified, protected, tracked, managed and used to inform investment and planning decisions. The pillar includes three outcomes, that Calgarian's are: aware of key natural infrastructure and its role in providing community benefits; supported through sound analysis of natural infrastructure value that informs decision making; and, supported through strategic investment in natural infrastructure. The outcomes and actions were informed by the steps outlined in this Blueprint. The business unit also includes Infrastructure Calgary (IC), a corporate program established to lead the creation and execution of The City of Calgary's capital investment strategy. IC establishes appropriate enterprise governance and manages the capital portfolio to ensure strategic alignment to Citizen Priorities, Council Directives and corporate strategy, including resilience. IC coordinates and optimizes investment activities across the organization through the development of processes, tools and systems to facilitate decision making, data collection, analysis and reporting. Multiple lenses are applied to the investment prioritization criteria, including Risk and Resilience.

The good work already underway in these business units provides an opportunity to deepen collaboration and facilitate hands-on training and working sessions amongst technical staff within and across departments to look at natural infrastructure as an asset and tool. These sessions would introduce a common vocabulary and tools to help meet challenging goals and should include planners, engineers, and operations staff with hands-on experience in planning, building, and maintaining natural infrastructure. For example, what type of cross-department collaboration can help meet a goal of improving stormwater management by 30%? Collaboration in this manner will uncover many operational questions and barriers that can be addressed to inform greater implementation of natural infrastructure initiatives. Ideally, these collaborative teams will learn and evolve with feedback and experience, leading to greater innovation.

Many departments in Calgary play a role in the ways in which the public interact and influence The City's natural infrastructure. Through the development of additional and intentional programs and policies, The City can further incentivize preservation and development of effective natural infrastructure.

- The **Planning and Development Department** establishes the municipal bylaws that seek to meet the planning goals laid out in the *Municipal Development Plan and Calgary Transportation Plan*. They also administer the development review and growth management review processes. The department has set goals for integration of natural and built infrastructure, and develops and maintains land-use bylaws and development processes to achieve those goals.
- The **Water Resources business unit** provides rebate programs for water efficient installations in multi-use and commercial buildings, which help to incentivize commercial efficiency.¹ The BU currently only provides rebates for high efficiency toilets. The Department's management of municipal water use plays a key role in the health and functionality of natural infrastructure both upstream and downstream.
- The **Environment and Safety Management business unit** promotes energy saving behaviors among city residents, in order to achieve the targets laid out in the Community Greenhouse Gas Reduction Plan.¹ and further described in the Climate Resilience Strategy, Mitigation and Adaptation Action Plans.¹ Currently, the BU focuses their community energy saving efforts on awareness building and education. A key action from the Climate Resiliency Strategy is to further the understanding of natural areas role in greenhouse gas mitigation.

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