

Toward natural asset management in the **Township of Langley**

British Columbia

Summary of inventory results and implications April 2021

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Municipal Natural Assets Initiative





Invest in Nature

The Municipal Natural Assets Initiative (MNAI) is a Canadian not-for-profit that is changing the way municipalities deliver everyday services - increasing the quality and resilience of infrastructure at lower costs and reduced risk. The MNAI team provides scientific, economic and municipal expertise to support and guide local governments in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and developing leading-edge, sustainable and climate-resilient infrastructure.

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Please cite as:

Municipal Natural Assets Initiative (MNAI). (2021). Toward natural asset management in the Township of Langley, British Columbia: Summary of inventory results and implications. MNAI.ca

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1 Purpose

This document summarizes the results of a project to develop a natural asset inventory in the Township of Langley, and documents steps the local government can take to proceed to a full natural asset management initiative.

2 Introduction

What are municipal natural assets

The term *municipal natural assets* refers to the stock of natural resources or ecosystems that a municipality, regional district, or other form of local government could rely upon or manage for the sustainable provision of one or more local government services¹.

Why manage natural assets

A growing number of local governments recognize that it is as important to understand, measure, manage and account for natural assets as it is for engineered ones. Doing so can enable local governments to provide *core* services such as stormwater management, water filtration, and protection from flooding and erosion, as well as *additional* services such as those related to recreation, health and culture. Outcomes of what is becoming known as *municipal natural asset management* can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity.

How to manage natural assets

There are numerous ways for local governments to manage natural assets. The Municipal Natural Assets Initiative (MNAI) uses methodologies and tools rooted in standard asset management, and provides a range of advisory services to help local governments implement them. MNAI has developed the methods and tools with significant investments, piloting, refinement, peer review, and documentation of lessons in multiple Canadian provinces. MNAI's mission is to make natural asset management a mainstream practice across Canada, and in support of this, for local governments to accept and use the methodologies and tools in standard ways across the country.

¹ mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf

What is a natural asset inventory

Inventories provide details on the type of natural assets a local government relies upon², their condition, and the risks they face. As depicted in Figure 1 and explained in detail in the Annex, a natural asset inventory is the first component of the Assessment phase. The Assessment phase, in turn, is the first of three phases of a full natural asset management project. By itself, an inventory will not give a sense of asset value, but is an essential first step in the full natural asset management project.



Figure 1: The Asset Management Process. MNAI has adapted this for use with natural assets.

2 Note that many local governments rely on services from natural assets they do not own.



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3 Local government context

3.1. General



Figure 2: Township of Langley

The Township of Langley³ (population ~134,000) is a district municipality in southwestern British Columbia. Not to be confused with the nearby City of Langley, the Township extends south from the Fraser River to the U.S. border, and west of the City of Abbotsford.

The Township is largely agricultural but has recently experienced substantial development. It has three main interests in natural asset management. First, the Township wants to develop a baseline of the natural assets on which it relies and/or manages, and related to this, an understanding of the interconnectivity between built infrastructure and natural assets. Second, the Township wants to build a foundation for a natural capital asset management plan, which it is planning on developing beginning in 2021. As part of this, the Township also wants to complete tasks highlighted in the Strategic Asset Management Plan and Climate Action Strategy.

Third, the Township is aware that the natural assets upon which it relies have been impacted by climate change and population growth. Accordingly, the

Township wants to increase the extent to which it understands and effectively manages natural assets. The Township also views natural asset management as a means to reduce climate change impacts; this is a matter of importance given that its Climate Action Strategy notes health impacts to residents, increased stress on local ecosystems, higher costs for weather event clean-up, increased pressure on water supply and municipal infrastructure, and increased service disruption.

The Township receives crucial municipal services from natural assets including water from aquifers, stormwater services such as runoff and infiltration, recreation services, and reduction of heat island effects to reduce energy consumption and water consumption. The Township has identified watercourses and trees as natural assets of high priority and notes the importance of managing invasive species. The Township currently faces challenges such as increased risk of flooding, tree stress, and increasing energy consumption as a result of warmer nights.



³ Retrieved March 4, 2021 from webfiles.tol.ca/CorpAdmin/Maps/Langleys%20Map.pdf

3.2. Asset management readiness assessment

As part of inventory development, MNAI helps local governments determine their overall state of asset management maturity. To do this, MNAI adapted the Federation of Canadian Municipalities (FCM)'s asset management readiness assessment tool⁴ to help local governments measure their progress on both asset management and natural asset management in four competency areas, with each area describing outcomes based on five levels of progress or maturity.

The completed assessment helps the Township prioritize actions that will increase its effectiveness in managing all assets, including natural ones.

The Township is on its way to fully integrating asset management as a business process and has achieved levels 3 to 5 in all readiness scale outcome areas for engineered assets. Progress is required to fully incorporate natural asset management; this inventory will support the Township in this respect. Council is supportive of incorporating natural asset management into core asset management practices.

The Township has a Council-endorsed Asset Management Policy that guides actions for built infrastructure and Council understands the importance of natural assets in contributing to service delivery. The Township has been following its five-year road map, which will be updated within the next two years. The roadmap includes performance measures across service areas, but the Township has not yet developed baseline data for the performance of natural assets.

The Township has an Asset Management department comprising a crossfunctional team that supports and improves Asset Management systems within the organization. The team does not currently have a specific role for natural asset management; the team as a whole applies a natural asset management "lens" in decision-making.

Related to the data and information competency, the Township has basic inventory data for some critical assets and is working on developing performance data for built infrastructure. For natural assets, the Township is building knowledge around how to determine the condition of the natural assets and how well they perform in delivering municipal services. Financial information is not currently linked to natural assets.

In terms of asset investment planning and decision making, the Township has a structured asset investment planning approach, but application is inconsistent. For example, one department is responsible for conservation and protection of natural assets, but it is not typically included in asset investment planning or in evaluating natural assets in relation to their municipal services.

⁴ See fcm.ca/sites/default/files/documents/resources/tool/asset-managementreadiness-scale-mamp.pdf for details

The Township prepares an annual capital budget based on an annual reassessment of current needs. Budgets include operations and maintenance costs for natural assets where they exist alongside engineered infrastructure assets being maintained (e.g., culverts, roadside ditches).

4 Natural asset inventory

4.1. Inventory overview

MNAI's natural asset inventories have two main components to express natural asset information: an asset registry (which is a tabular representation of the data) and an online dashboard. MNAI provided the registry to the Township in an Excel file and the dashboard as a website address. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

4.2. Inventory data

To establish the inventory, MNAI obtained data from the Township and from Metro Vancouver's open data portal. MNAI combined the spatial data layers to establish a comprehensive depiction of natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment.

TABLE 1: DATA SOURCES SUMMARY					
DATA	SOURCE	PURPOSE			
Municipal Boundary	Township of Langley	Used to delineate study area			
Land Cover Classification 2014 – 5m Hybrid (Raster)	Metro Vancouver Open Data	Used to create the base asset inventory			
Sensitive Ecosystem Inventory	Metro Vancouver Open Data	Used to create the base asset inventory			
2016 Generalized Land Use Classification	Metro Vancouver Open Data	Used to determine the general land use of each natural asset			
Env_ Watercourses4_0_2016	Township of Langley	Used to add watercourse information intersecting with assets			
Agricultural Land Reserve (ALR)	Township of Langley	Used to add area of asset overlaid by ALR			
ConservationArea	Township of Langley	Used to indicate assets in conservation zones and details of conservation zones			
Env_Watersheds_2003	Township of Langley	Used to assign assets to relevant watershed			
Env_CaptureZones	Township of Langley	Used to indicate assets within capture zones and capture zone details			

TABLE 1: DATA SOURC	TABLE 1: DATA SOURCES SUMMARY						
DATA	SOURCE	PURPOSE					
Env_Flood_Plain_2007	Township of Langley	Used to indicate assets/area of assets in flood plain					
Env_SurficialGeology	Township of Langley	Used to indicate an assets surficial geology class					
HeritageLocations	Township of Langley	Used to indicate which assets have heritage locations within them, their name, and type					
Land_Ownership_public vs private	Township of Langley	Used to indicate asset ownership by area					
ParksComplete	Township of Langley	Used to summarize area of asset within parks and assign park name/type					
TOL_DevActivity_ PolygonsCurrent	Township of Langley	Used to indicate if natural asset within development area					
Trees	Township of Langley	Used to count number of trees within an asset					
ENV_Aquifers	Township of Langley	Used to determine area of assets within aquifers and display on dashboard. The name/type/class of the aquifer where the majority of the asset area resides was also assigned to each asset					
dem_bareearth	Township of Langley	Used to assign mean elevation in metres to each asset					

The inventory project defined a total of 115,418 individual assets, covering 13,486 hectares (ha) of the municipal area, as noted in Table 2. The majority of this area was forest cover, followed by riparian assets.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Grassland	94	419	4.46
Riparian	683	2,906	4.25
Wetland	313	1,148	3.67
Water	965	160	0.17
Forest	96,413	8,269	0.09
Shrub	16,950	584	0.03
Total	115,418	13,486	0.12

4.3. Asset registry

MNAI gathered the data, sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the project area. Each asset has a unique identification number that allows individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into an asset registry. An excerpt from the Township's registry showing natural asset characteristics and details is in Table 3.

Summary

Asset Registry

Condition

TABLE 3: EXCERPT FROM THE REGISTRY

Lang	ley Nat	ural Asset	Inventory
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Natural As	set Registry	/														
Asset ID	Asset Type	Asset Area (ha)	Sub Asset Area (ha)	Watershed Name	Majority Aquifer Name	Sub Class	SEI Rating	Total Carbon (tC)	Crown Federal (ha)	Crown Provincial (ha)	Mean Elevation (m)	Adjacent Land Use Score	Permeability Score	Relative Size Score	Road Density Score	Total Score
FOR-592232	Forest	0.00	0.00	Upper Nicomeki River 3	Salmon River;South of Murrayville C/Beaver River B	Coniferous	No Rating	0			13.16	5	10	1	1	17
FOR-592233	Forest	0.00	0.00	Upper Nicomekl River 3	Salmon River;South of Murrayville C/Beaver River B	Coniferous	No Rating	0			13.06	4	10	1	1	16
FOR-592235	Forest	0.00	0.00	Upper Nicomekl River 3	Salmon River;South of Murrayville C/Beaver River B;West of Aldergrove B	Deciduous	No Rating	0			28.64	9	10	1	1	21
FOR-592236	Forest	0.00	0.00	Upper Nicomekl River 3	Salmon River;South of Murrayville A;South of Murrayville B;West of Aldergrove B	Coniferous	No Rating	0			29.10	9	10	1	5	25
FOR-592248	Forest	0.00	0.00	Upper Nicomekl River 3		Deciduous	No Rating	0			7.52	6	10	1	1	18
FOR-592252	Forest	0.01	0.01	Upper Nicomekl River 3	Salmon River	Deciduous	No Rating	1			10.06	7	10	1	1	19
FOR+592256	Forest	0.00	0.00	Upper Nicomekl River 3	Salmon River,South of Murrayville C/Beaver River B	Deciduous	No Rating	0			38.93	8	10	1	5	24
FOR-592257	Forest	0.00	0.00	Upper Nicomeki River 3	Salmon River;South of Murrayville C/Beaver River B;West of Aldergrove B	Coniferous	No Rating	0			27.20	8	10	1	1	20
FOR-592258	Forest	0.01	0.01	Upper Nicomekl River 3	Salmon River;South of Murrayville A;South of Murrayville B;West of Aldergrove B	Deciduous	No Rating	2			33.64	9	10	1	5	25
FOR-592262	Forest	0.01	0.01	Upper Nicomeki River 3		Deciduous	No Rating	1			9.03	4	10	1	1	16
FOR-592265	Forest	0.01	0.01	Upper Nicomekl River 3	Salmon River;South of Murrayville C/Beaver River B	Deciduous	No Rating	1			14.20	6	10	1	1	18
FOR-592266	Forest	0.02	0.02	Upper Nicomekl River 3	Salmon River;South of Murrayville C/Beaver River B;West of	Coniferous	No Rating	3			29.22	9	10	1	1	21

4.4. Natural asset carbon storage

The availability of detailed carbon storage data from Metro Vancouver⁵ made it possible to estimate the amount of carbon stored by the natural assets in the Township's inventory.

Carbon storage was estimated using the Carbon Soil and Carbon Biomass raster datasets from the Metro Vancouver Open Data Catalogue. The data resolution is 2m, meaning each pixel represents an area of 4m². The carbon stored in each pixel is in units of tC/ha. To convert raster cell values into tC, the tC/ha value of each pixel was multiplied by 0.0004. Carbon soil and carbon biomass for all pixels within the asset were then summed to get tC for each asset. Total carbon storage is the sum of soil and biomass.

⁵ Metro Vancouver. (2019).

TABLE 4: NATURAL ASSET CARBON STORAGE					
ASSET TYPE	BIOMASS CARBON (tC)	SOIL CARBON (tC)	TOTAL CARBON STORAGE (tC)		
Forest	894,960	813,877	1,708,837		
Grassland	3,071	4,756	7,827		
Riparian	297,552	240,929	538,481		
Shrub	2,574	5,400	7,974		
Water	369	2,546	2,915		
Wetland	63,131	129,080	192,211		
Total	1,261,657	1,196,588	2,458,245		

4.5. Online dashboard

Inventories may provide more insights when displayed visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular asset. Figure 3 is a screen shot from the dashboard that MNAI provided to the Township. The full version can be accessed at *go.greenanalytics.ca/langley*.



Figure 3: Screenshot of main inventory summary

Township of Langley, British Columbia Summary of inventory results and implications



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Condition of natural assets 4.6.

Documenting the condition of natural assets is a key aspect of natural asset inventories. A natural asset condition assessment provides an understanding of both the ecological health of natural assets and the ability of natural assets to provide services. This information, in turn, can support the effective management of natural assets, be reflected in the registry as well as the dashboard, and updated over time.

MNAI completed a desktop condition assessment and built it into the inventory to provide an initial understanding of the status of the natural assets for the Township. Table 4 summarizes the condition assessment steps and indicators. A portion of the Township's assets are covered by the Sensitive Ecosystem Inventory (SEI) published by the Government of British Columbia. The SEI data was obtained from Metro Vancouver's open data portal. For the assets covered by the SEI data, the SEI rating is provided in the inventory and in the dashboard.

TABLE 5: CONDIT	ION ASSESSMENT APPROACH AND INDICAT	ORS
Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a 3, those within the middle third of the ranking received a 2, and those within the bottom third of the ranking received a 1.	Natural asset inventory
Road density	Measures the density of the roads in and around the assets according to high density (assets with more than 2km of roads per square km), medium density (assets with between 1km and 2km of roads per square km) and low density (assets with less than 1km of roads per square km).	Natural asset inventory plus spatial representations of roads
Surface permeabilityThe permeability of surfaces is ranked on a scale of nil (0) to high (10) depending on the type of landcover present.Urban areas, roads and industrial areas are ranked as nil. Assets within impervious surfaces are assigned as low permeability.Agriculture and shrublands are ranked as medium.		Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA data.nasa.gov/dataset/ Clobal Man mode
Wetlands, waterbodies and forests are ranked as high.		Global-Man-made- Impervious-Surface-GMIS- Dataset-Fr/dkf4-4bi3



TABLE 5: CONDITION ASSESSMENT APPROACH AND INDICATORS

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Adjacent land use (nearest neighbours)	Considers the distance to, and the nature of, the area surrounding natural assets. Intense land uses (e.g., airports) in close proximity to natural assets result in a poor rating, while distant land uses that are less intense (e.g., agriculture) result in a good rating.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density rated as either low (10), medium (5) or high (0).
- Surface permeability rated as high (10), medium (5), low (1), or nil (0).
- Adjacent intensive land use (0 for intense land uses such as roads and buildings, otherwise 10).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- **Good** assets with a score of 30 or higher
- **Fair -** assets with a score between 20 to 29
- **Poor -** assets with a score between 10 to 19
- **Very Poor -** assets with a score lower than 10

The results of the condition assessment for the Township, as displayed in the online dashboard, are presented in Figure 4.





Figure 4: Screenshot of condition assessment results

Using MNAI's desktop condition rating approach, which as noted above includes four metrics for condition, 11,084 ha (82 per cent) of assets were rated good and 2,401 ha (17 per cent) of assets were rated moderate.

Of the assets for which SEI data was available, about 550 ha (or 4 per cent) of natural assets were assessed in good condition and 2,340 ha (or 17 per cent) were assessed in moderate condition. Note that the results of MNAI's desktop condition assessment are not directly comparable to the condition results obtained from the SEI data given the different metrics associated with each approach.



Table 6 summarizes condition ratings based on the SEI data and Figure 6 summarizes SEI condition by natural asset type.

TABLE 6: SUMMARY OF NATURAL ASSET CONDITION RATINGS					
Condition Rating	Number of Assets	Total Area (ha)	Average Total Score		
Good	71	550	7.74		
Moderate	422	2,340	5.55		
Poor	858	2,806	3.27		
Very Poor	380	689	1.81		
Total	1,731	6,385	3.69		

Table 6: Summary of natural asset condition ratings



4.7. Maintaining the inventory

Inventories are not static. Both the registry and the dashboard can be expanded as new information becomes available. For example, asset condition might improve as a result of restoration efforts or new studies may add insights on the condition of the assets. Furthermore, the level of desired detail may evolve as asset management readiness increases or as areas of natural management focus emerge. However, inventories should grow in detail and sophistication only insofar as they remain aligned with the capacity of the communities to maintain them and the uses to which they will be put. Their evolution and development should be a function of the monitoring, reporting and lessons of the asset management cycle and be driven by the imperative of ensuring sustainable, cost-effective delivery of services to the community, which is the core of asset management.

5 Risk identification

5.1. Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance in self-administering it.

Risk management is a four-stage process that includes risk identification, analysis of probability and consequence, development of risk mitigation strategies, as well as control and documentation. The use of the risk identification tool informs the first and second stages of risk management through the identification of top risks to natural assets and their associated services, and a high-level analysis of impacts and consequences.

Risk types relevant to natural asset management typically include:

- Service risk: the risk of an asset failure that directly affects service delivery.
- **Strategic risk:** the risk of an event occurring that impacts the ability to achieve organizational goals.
- Operations and maintenance risk: risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset.
- **Financial risk:** risks related to the financial capacity of the Township to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics.

5.2. Using the risk identification tool

Using the risk tool, the Township considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails
- Non-sanctioned trail development
- Dumping
- Flooding (current and future)
- Natural forest fire
- Human caused forest fire
- Invasive species
- Development pressure
- Pollutant loading from various sources



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- Drought (current and future)
- Erosion
- Lack of annual monitoring reports
- Construction activity
- Political policy change
- Natural resources on residential lands
- Increased snowfall
- Increased windstorms
- Change in tree species
- Longer growing season

Each risk was then ranked low, medium or high according to the probability of an impact occurring, and the relative magnitude of its negative consequences. To assess impact and consequence, the Township considered four questions:

- 1/ what impact is likely to happen?
- 2/ what is the consequence of that impact happening?
- 3/ what can be done to mitigate the impact probability and/or consequence?
- 4/ what cues will signal the need for mitigation?

5.3. Results of the risk identification process

The risk identification process revealed:

- 9 high-level risks (non-sanctioned trail development, dumping, flooding, invasive species, development pressure, drought, erosion, construction activity, and longer growing season)
- 3 medium-high level risks (pollutant loading, political policy change, and increased windstorms)
- 3 medium-level risks (overuse of trails, natural resources on residential lands, and increased snow fall)
- 1 medium-low level risk (human-caused forest fire)
- 3 low-level risks (lack of annual monitoring reports, change in tree species, natural forest fire)

The identified risks affect natural assets across the entire area within the Township's boundaries - particularly forests, urban greenspaces, creeks, and agricultural lands.



Risk Matrix



Legend
Minor
Moderate
Major
Severe

Figure 6: Results of risk management process

6 Implications

This section provides insights that can be gained from considering both the inventory, including the condition and risk assessments, and the asset management readiness assessment. It is divided into (a) potential priorities for the local government (b) possible actions for the further development of the inventory, and (c) issues the Township can consider to advance to a full natural asset management initiative.



6.1. Potential priorities for the local government

Combining the results of the condition assessment with the outcomes of the risk identification highlights potential priorities on which the Township can focus natural asset management efforts. These include:

- Non-sanctioned trail development: Non-sanctioned trail development can impact forests, urban greenspace, creeks, and trails. As trail use increases, forest damage can result due to erosion, compaction and trampling of the vegetation. The Township has identified a number of mitigation actions including signage for environmentally sensitive areas, the promotion of web trail etiquette, and preventative maintenance programs.
- Dumping: Dumping of litter and illegal waste pollutes streets, urban greenspaces, forests, and creeks, costing taxpayers more than \$400,000 a year⁶. Discarded waste attracts wildlife, promotes the spread of invasive species, and pollutes waterways. Recognizing that incidents of illegal dumping was set to increase with population growth, the Township developed a Litter and Illegal Waste Management Strategy in 2015⁷. The Strategy provides recommendations grouped into five key areas: Bylaw Enforcement and Reporting; Education, Awareness and Campaigns; Infrastructure and Staffing; New Programs; and Public Space Waste Management Strategy.
- Flooding: Flooding events in the Township often relate to Fraser River freshet flooding, heavy rainfall and aging infrastructure not built to handle current rainfall levels. Repercussions may include damage to natural assets (e.g., contaminated water in rivers, creeks, wetlands, and waterbodies; and negative impacts to aquatic biodiversity), agricultural lands (damage to crops and livestock; forced evacuation of livestock; and nutrient loading of waterways), and community (safety hazards, increased disease and pest vectors, and decreased enjoyment of affected area). The Township has a comprehensive flood risk reduction program, which it reviews annually⁸. This includes river monitoring, preventative maintenance programs, education, green infrastructure strategies, and agricultural viability programs such as the Ecological Services Initiative⁹.
- Invasive species: Invasive species pose a risk to the health and safety of people, animals, property, and natural assets (forests, urban greenspaces, creeks, wetlands, agriculture). Himalayan Balsam, Ivy, Lamium, Japanese Knotweed, Blackberry, Hogweed, and Canary Grass

- 7 Township of Langley, 2015.
- 8 Township of Langley, 2021.
- 9 www.tol.ca/your-township/plans-reports-and-strategies/agricultural-viabilitystrategy/ecological-services-initiative/#:~:text=The%20Langley%20Ecological%20 Services%20Initiative,services%E2%80%9D%20that%20benefit%20us%20all.



⁶ Township of Langley, 2021.

can all be found in the region. Some of these (e.g., Japanese Knotweed) can ruin homes, roads, and water and sewage infrastructure. In response, the Township runs an invasive species program, engages in trail and soil deposit inspections, road maintenance, attends Invasive Council of BC and Invasive Species Council of Metro Vancouver meetings, and runs educational programming.

- Development pressure: Overall, development pressures have had a significant impact on forests and agricultural lands and threatened water supply at some private and community wells. In particular, the forests of Latimer Creek, Palmateer Creek, and Pleasantdale Creek are in poor condition. The Township is engaged in replanting, but recognizes the time required to return the environment to healthy condition.
- Drought: The Township recently completed a Climate Action Strategy (2021)¹⁰. Drought resulting from warmer temperatures was identified as a significant concern as it can stress water supplies (surface, groundwater, and aquifers), result in failing crops, impact urban green spaces, and negatively affect community health. Responses to these impacts include the use of nature-based infrastructure to manage stormwater and limit erosion, increasing the tree canopy and planting drought-resistant species for community cooling, and the development of a Biodiversity Conservation Strategy¹¹. Many of these activities are planned to start in one-to-two years.
- Erosion: Erosion is a common challenge in the Township, impacting forests, urban greenspace, and creeks. The Township is installing detention ponds for flow attenuation in developed or developing areas. Geotechnical assessments of affected areas on Township property have also been completed.
- Construction activity: Construction activity has affected urban greenspace, agricultural lands, and forests. The Township follows regulatory environmental requirements and re-plants riparian areas to mitigate impacts. The development of a natural asset program can help identify where services are being provided by intact natural areas and direct construction to the most beneficial areas.
- Longer growing season: Approximately 75 per cent of land in the Township is part of the Agricultural Land Reserve. Local climate projections of a longer growing season could lead to increased land clearing for crops. This could result in a net loss of urban greenspace and forests, and increased bacterial growth in waterbodies and rivers. This, in turn, can threaten terrestrial and aquatic biodiversity. The Township is aiming to mitigate impacts through the continuation and expansion of the Ecological Services Initiative, the promotion of best management practices, and education programs.

¹⁰ Township of Langley, 2021.

¹¹ Ibid.

TABLE 7: RISK MITIGATION STRATEGIES					
Accept	Risk may be acceptable if probability and consequences are small				
Minimize	Risk under local government's control that warrants exposure reduction				
Share	Partners in a project permit the sharing of larger risks to reduce it for each				
Transfer	Insurance, fixed price contracts, and other risk transfer tools				

Table 7 lists and provides brief descriptions of risk mitigation strategies.

Opportunities to strengthen natural asset management at an organization-wide level

Immediate next steps for the Township could include developing its natural asset management plan. As part of this process, the Township could collect baseline performance data for natural assets, which has not yet been done. The Township also identified the need to develop an ecosystem-based management activity plan for the next three-to-five years.

Because asset management plans for critical services are based on available information about service levels and risk management, the Township feels an important next step will be to develop detailed asset management plans for all services based on actual data. Those plans should include needs forecasts and risk management strategies for most assets.

The Township noted that it would be interested in expanding the current inventory and financial data models it uses to include more natural assets and to use its Long-Term Financial Plan model to tie costs associated with natural assets. The Township sees a need to incorporate investment plans for natural assets into its overall asset investment planning in coordination with related service areas and departments.

The Township could consider defining roles and responsibilities for natural asset management as they are not currently defined in its Asset Management Department and no specific person is responsible for natural asset management. The Township noted that a next step could be to fill a natural asset management position.

In order to develop staff capacity in natural asset management, a key next step could be to complete a staff competency review to identify required skillsets for natural asset management and to fill any essential gaps.



6.2. Possible actions for the further development of the inventory

Based on the inventory, the Township could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Expand the risk identification to include to field verification of results.
- Determine acceptable levels of risk to inform the Township's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment using local climate projections, land use modelling, and other data already at their disposal.
- Identify linkages between services and assets, and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services. From a drought, flooding and stormwater management perspective, the wetlands and forested areas in the watersheds will be key.
- Identify linkages between initiatives at the Township (e.g., Climate Action Strategy, Biodiversity Conservation Strategy, Natural Asset Management) to reinforce and strengthen early actions.
- Share the inventory with adjacent local governments to stimulate collaboration.
- Add more condition ratings for example, canopy cover which also links to stormwater management services.
- Initiate or enhance monitoring for example, using gauges, water level sensors, and loggers to improve understanding of trends, feed into condition ratings of assets, and gather information for modelling.
- Schedule regular updates (e.g., every three-to-five years) of the inventory, condition and risk to understand trends.
- Maintain interest and momentum in natural asset management to move towards a full natural asset management project.

6.3. Steps to a full natural asset management project

If the Township wishes to proceed with a full natural asset management project, including implementation, it could consider the following:

1/ Confirm scope, roles and responsibilities. Undertake a meeting or workshop to confirm (a) assumptions [for example, that water management and development pressure are the primary services of concern] (b) roles, responsibilities and capacities (c) community capacity to undertake a larger project.



- 2/ Fill essential knowledge gaps. If discussions on scope and certainty and related data needs for modelling indicate the need for additional data, these could be filled.
- 3/ Modelling. Modelling the levels of service that natural assets currently provide, as well as the levels of service under different potential management, local climate change projections, and rehabilitation or restoration scenarios, is central to natural asset management as it gives communities the ability to explore how different actions will affect the health and corresponding performance of natural assets.
- 4/ Economic assessment. The economic assessment component provides a market-based indication of (a) the current value of the services from natural assets if they had to be provided by an engineered means, and (b) the costs and values of different interventions in terms of service delivery.
- **5/ Planning**. This step allows local governments to explore different scenarios such as "what happens to the services provided by the wetland if there is significant building upstream?" or "what happens to the services if the forest is restored?" Using modelling, changes in service levels can be understood and quantified. Corresponding values can also be determined through continued economic assessment. Based on this, local governments can begin to consider and prioritize actions ranging from status quo to planning, regulatory, financial operations, maintenance, acquisition, and monitoring interventions.
- 6/ Implementation. The natural asset implementation phase is part of an adaptive management cycle, not a finite journey. It is during this time that actions identified based on the previous steps can begin to be implemented. MNAI can provide ongoing advice / guidance on policy pieces and integration of the above information for 12-18 months. After this point, the local government, together with local partners and service providers, would ideally have the capacity to continue these efforts on their own.
- 7/ Ongoing monitoring. Project monitoring is essential to learn whether interventions are working and to share lessons and learnings from other communities undertaking natural asset management. MNAI would typically stay involved with the community for three years through a monitoring arrangement to be established with the communities.



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Annex: Results of the Township's risk identification

This Annex contains the results of the Township's use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 1 was the main product, developed by Township personnel, that resulted from the exercise.

Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails/dumping
- Flooding (current and future)
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams
- Storm surge
- Lack of flood hazard mapping
- Lack of land management plans
- Lack of monitoring reports
- Construction activity
- Political policy change



Step 2: Complete survey

TABLE 1: SIMPLIFIED RISK IDENTIFICATION SURVEY						
Risk ID	Identified Risk to Natural Assets	Natural Assets Affected	Impact of Failure (L/M/H)	Probability of Occurrence (L/M/H)	Notes	Existing Mitigation Strategies at TOL:
1/	Overuse of Trails	Natural assets on all public lands (e.g., parks and natural areas)	Μ	Μ	Soil erosion, compaction, root exposure: high impact to trees, surface erosion, Popular site locations over others, Increase preventative maintenance in high traffic corridors could change probability	Web Trail Etiquette information; ESA locations signage; Fisheries signage, Preventative maintenance program
	Non- Sanctioned Trail Development	Forests, Urban Greenspace, Creeks, Trails	Η	Η	Destruction of veg and trail, not built to a standard, significant safety concerns, erosion potential, hazardous tree exposure	Removal of unsanctioned Bike Parks, Forts and other built things. Restoration of unsanctioned trails via removal of access and planting strategies, decompaction where required. Use of natural barriers instead of built barriers to deter interest
2/	Dumping	Forests, Urban Greenspace, Creeks	Η	Η	Residents backing Greenspace on conservation areas; Potential of chemical storage, attraction of wildlife, increase in invasive species, Waterway damage via oil and other pollutants, metal leeching etc. Homeless camp impacts via biohazards	Regular walk-throughs of high traffic areas in conservation or ESA zones; Adopt a Trail program, litter and illegal waste strategy (I.D.I.O.T. campaign and hotline) Letter campaigns to inform residents of impacts, Household Hazardous waste event

TABLE 1: SIMPLIFIED RISK IDENTIFICATION SURVEY						
Risk ID	Identified Risk to Natural Assets	Natural Assets Affected	Impact of Failure (L/M/H)	Probability of Occurrence (L/M/H)	Notes	Existing Mitigation Strategies at TOL:
3/	Flooding	Creeks, Rivers, Waterbodies, Wetlands, Agriculture	Η	Η	Trending higher as infrastructure ages and climate change advances, Built infrastructure not to appropriate levels. Beaver Management impacts, education and strategies around green infrastructure (rain gardens, etc.) Trail washouts causing sediment deposits and creating safety hazards. Damage to crops/animals when agricultural lands flood. Increased risk of livestock evacuation with increased Fraser freshet risk. Increased contaminated run-off for decreased water quality and negative impacts to the biodiversity of fish and other aquatic species. Increased vectors for mosquitos with increased flooding and wet weather leading to increased cost for treatment and decreased enjoyment of affected outdoors	Preventative maintenance programs (ditching, mowing, sed removal, etc.) and inspections on dykes, culverts, bridges and key stream locations. Agriculture Viability Strategies (use of nutrient loads etc. around impact to creeks, etc.) Ecological Services Initiative
4/	Natural Forest Fire	Forests, Urban Greenspace	L	L	Air quality impacts, Loss of forest canopy	Healthy Understory to limit impacts
5/	Human caused Forest Fire	Forests, Urban Greenspace	L	Μ	Air quality impacts, loss of forest canopy, brush fires, grasslands may increase impact	Healthy Understory to limit impacts

TAE	TABLE 1: SIMPLIFIED RISK IDENTIFICATION SURVEY						
Risk ID	Identified Risk to Natural Assets	Natural Assets Affected	Impact of Failure (L/M/H)	Probability of Occurrence (L/M/H)	Notes	Existing Mitigation Strategies at TOL:	
6/	Invasive Species	Forests, Urban Greenspace, Creeks, Agriculture, Wetlands	H	H	Himalayan Balsam, Ivy, Lamium, Japanese Knotweed, Blackberry, (minimal) Hogweed, canary grass	Invasive Species Program, Trail inspections to monitor for Invasives, Stem injections for knotweed, Attend Invasive Council of BC meetings, roads budget to control Knotweed (recently expanded), Signage to identify invasives, LEPS - Education and programming around invasive species removal, Invasive Species Council of Metro Vancouver, Soil Deposit inspection for invasives	
7/	Development Pressures	Agriculture, Forests, Water Supply (Wells)	Н	Н	Replantings etc. to contribute back, can take years to pay back to the environment		
8/	Pollutant Loading from various sources	Creeks, Rivers, Waterbodies, Wetlands	М	Н		Water quality monitoring program	
9/	Drought	Forests, Urban Greenspace, Creeks, Agriculture, Wetlands, Waterbodies, Rivers, Aquifers	Η	Η	Highest concern identified in Climate Adaptation Plan, increased stress on water supply both underground and from MetroVan reservoirs, increased water use for irrigation, failing crops		

TABLE 1: SIMPLIFIED RISK IDENTIFICATION SURVEY							
Risk ID	Identified Risk to Natural Assets	Natural Assets Affected	Impact of Failure (L/M/H)	Probability of Occurrence (L/M/H)	Notes	Existing Mitigation Strategies at TOL:	
10/	Erosion	Forests, Urban Greenspace, Creeks	H	Η	Common issue	Detention ponds for flow attenuation in developed/developing areas. Geotechnical assessments/ inspections of known trouble areas on TOL property (i.e., Anderson Creek Slope Stability assessment)	
11/	Storm Surges	Creeks, Rivers, Waterbodies, Wetlands			Tidal impact from the Fraser River (may fall under flooding instead)		
12/	Lack of updated Flood Mapping	Creeks, Rivers, Waterbodies, Wetlands, Agriculture	L	L		Fraser River floodplain mapping is provided by the Province. Flood mapping of other creeks/river systems in TOL are contained within historical ISMP's (Integrated stormwater management plans) and drainage studies	
13/	Lack of Land Management plans	Urban Greenspace, Agriculture, Forests	L	L		Riparian area setbacks and development planning	
14/	Riparian area setbacks and development planning	Forests, Urban Greenspace, Creeks, Agriculture, Wetlands, Waterbodies, Rivers	L	L		Annual water quality monitoring reports for watersheds in accordance with the requirements of Metro Vancouver's Monitoring and Adaptive Management Framework for Stormwater	

TABLE 1: SIMPLIFIED RISK IDENTIFICATION SURVEY							
Risk ID	Identified Risk to Natural Assets	Natural Assets Affected	Impact of Failure (L/M/H)	Probability of Occurrence (L/M/H)	Notes	Existing Mitigation Strategies at TOL:	
15/	Construction Activity	Urban Greenspace, Agriculture, Forests	Η	Η		Following regulatory environmental requirements (i.e., DFO and MFLNRORD) to reduce construction impacts. Re-planting of riparian areas	
16/	Political Policy Changes	Forests, Urban Greenspace, Creeks, Agriculture, Wetlands, Waterbodies, Rivers	L	Η	Green planning initiatives looking to improve the Natural Assets, not impact them negatively		
17/	Natural Resources on Residential Lands	Waterbodies	Μ	Μ	resources spent dealing with feuding neighbours, hard to manage, find out issues after damage is done		
18/	Increased Snowfall	Forests, Urban Greenspace, Argiculture, Creeks and Rivers	Μ	Μ	Tree Damage, melt stressors		
19/	Increased Windstorms	Forests, Urban Greenspace	Н	М	Street Trees and Trails at risk		
20/	Change in tree species	Forests, Urban Greenspace	L	Μ	Change in tree species ranges affects viability of trees in the community		
21/	Longer Growing Season	Urban Greenspace, Agriculture, Forests, Waterbodies, Rivers	Η	Η	Longer growing season and warmer weather generally may lead to more land clearing for crops. Land clearing decreases tree canopy. Water will have increased bacterial growth requiring more treatment. Increased stream temperatures and lower flow lead to decreased health of fish and other species		

Municipal Natural Assets Initiative

