

regreening

GREATER SUDBURY



Regreening Program

5 Year Plan

2016-2020



March, 2016

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Background

Since 1978, the City of Greater Sudbury has been engaged in the regreening of Sudbury's landscape through liming, grassing and tree and shrub planting initiatives. From 1978 to 2015, over 3,400 hectares of land were limed and grassed and over 9.5 million trees have been planted.

During the first decade of the Program, regreening activities focused mainly on high visibility sites along major road corridors and in urban neighborhoods, which offered easy access for workers.

In the 1990's, there was a shift toward watershed rehabilitation. After liming parts of the watersheds of Hannah and Robinson lakes, both land and water quality showed improvements. Several lakes were selected as focal areas over the first half of that decade as a means of both reclaiming barren lands and improving lake water quality.

A previous 5-year plan (1999 to 2003+) used Ministry of Natural Resources and Forestry (MNR) Forest Resource Inventory maps that included areas classified as 'barren rock' and 'sparse vegetation cover' within the general zone to be regreened. These areas were ground-truthed and prescriptions for their reclamation were determined. The areas selected varied from urban hilltops to watersheds to sites with difficult access. It was estimated that given the extent of areas outlined in the plan, greater than five years would be required to complete the plan. In fact, this previous 5-year plan was still being implemented up to 2008.

In 2009 the Sudbury Soils Study released the Ecological Risk Assessment (ERA) which evaluated the ecological risks associated with seven Chemicals of Concern (COCs): arsenic, cadmium, cobalt, copper, lead, nickel and selenium. The ERA found that terrestrial plant communities in large areas of Greater Sudbury have been and continue to be impacted by the COCs in soil. The study also found that local plant communities are affected by other factors, such as soil erosion, low nutrient levels, lack of soil organic matter, and soil acidity. This impact on vegetation was also concluded to be influencing wildlife populations indirectly by affecting habitat quality.

A Biodiversity Action Plan was then developed as a comprehensive way to address the risks to plant communities and wildlife habitat identified by the ERA. The 5-year plan 2011-2015, followed the general direction of the Biodiversity Action Plan. The 5-year plan 2016-2020 will be a continuation of these directives leading the Regreening Program into its 40th anniversary in 2018.

Over the next 5 years, the activities of the Regreening Program will be directed by this new plan, however, there has always been a history of being quick to act on funding from government or other sources. For this reason, the Regreening Program must remain flexible to take advantage of other funding opportunities and other partnerships as they arise. It is also important to maintain flexibility to accommodate changing community priorities.

Goals

1. **Mapping:** Update mapping information to include all planting and liming activities. Create watershed maps for use as management units and incorporate operational maps for better understanding of what areas have not yet received reclamation treatment.
2. **Completion Criteria:** The determining factors of completion as far as reclamation activity can be done will be assessed with recommendations ready by the end of 2020.
3. **Operations:** To continue to plant 40,000 understory trees and shrubs to increase local diversity of species planted and 50,000 pine seedlings on more barren sites annually. Continue our partnership with Vale's aerial seeding program and manually lime 10 hectares of land per year, and spread fertilizer and grass seed. Continue with forest floor mat transplants as donor sites permit and collect native seeds/berries to maintain healthy local seed supply.
4. **Research/Monitoring Initiatives:** Several established research/monitoring activities will continue this term.
5. **Educational Initiatives:** Educational initiatives that serve to promote the City's regreening success and raising awareness of local biodiversity will continue.
6. **Climate Change and Adaptation:** The Regreening Program will continue to test suitability of southern species in preparation for climate change.
7. **Biodiversity Action Plan:** This document will be reviewed and altered if deemed appropriate to reflect any changes in community priorities or environmental factors arising.

The Information Base

Updating the Map Record

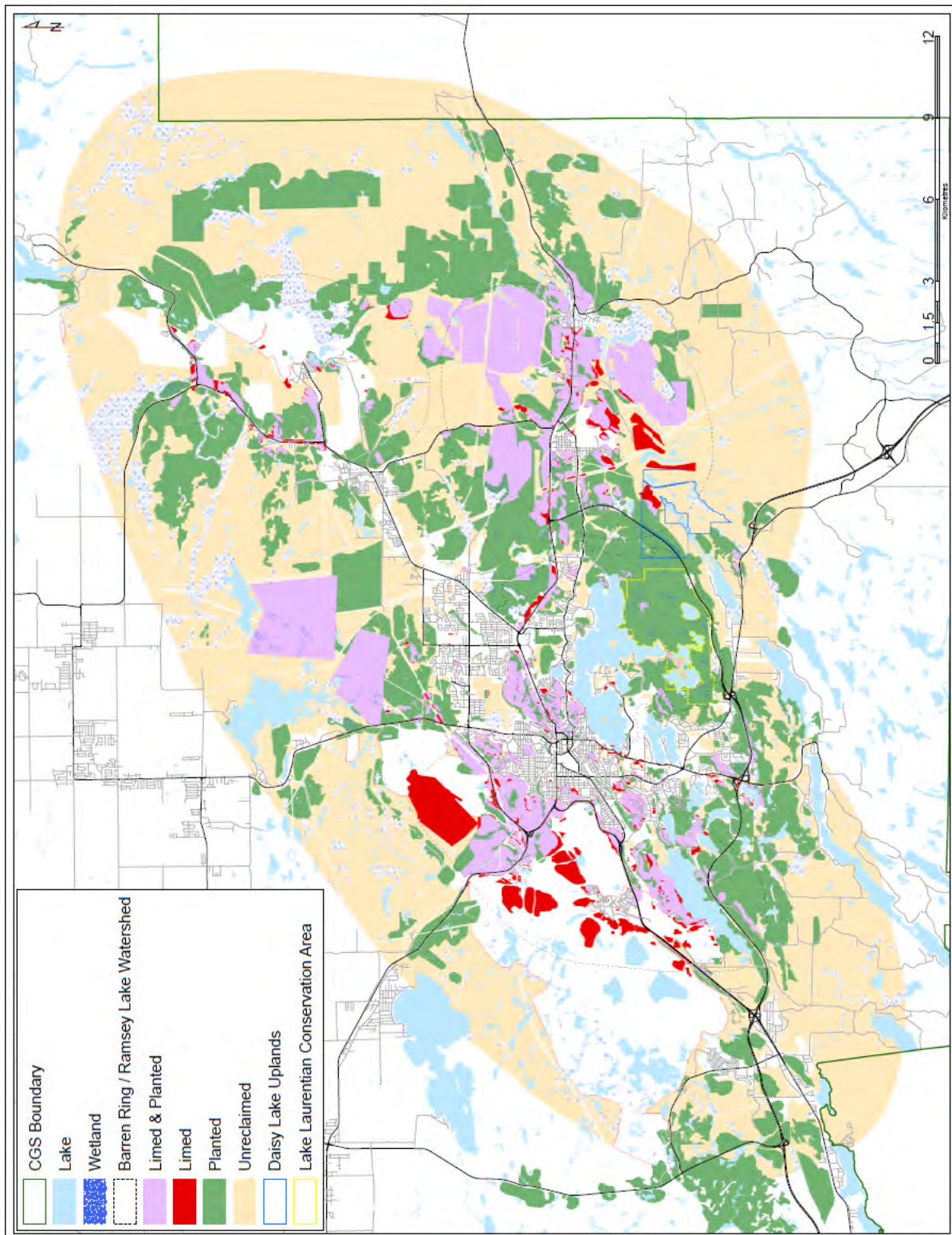
In 2015, all records of municipal activity from 1978 to 2015 in liming, grassing and planting were verified and updated in a geographical information system (GIS). Also included in the GIS are the records of regreening work accomplished by the Vermilion Forest Management Co. and Vale on lands outside of their gated boundaries. Other regreening areas completed by both Vale and Sudbury Integrated Nickel Operations, a Glencore Company, (Sudbury INO) situated within their gated boundaries were not included in the mapping as these areas are outside the scope of the Regreening Program. Barren and semi-barren rings were included on working maps since barren areas generally require lime first before any tree planting and the semi-barren limit generally outlines the outer extent of regreening operations. Given that the ERA determined that COCs are still limiting plant growth, many semi-barren areas may also require liming prior to any additional interventions (tree or shrub planting, forest floor mats, or compost).



Figure 1 shows areas that have been limed, areas limed and planted and areas planted. Also shown are the areas that are yet to be reclaimed (i.e., unreclaimed areas). The white areas within the impacted zone are outside the scope of the City's regreening mandate as they are either 1) outside the semi-barren limit, 2) are built environments that are not suitable for regreening work, or 3) are regulated by mine closure plans and under the direct responsibility of a mining company.

Records of regreening work will be updated annually over the period of this 5-year plan.

Figure 1: Updated Historical Mapping



Increasing Access to the Map Record

All data on Regreening activities (liming, fertilizer, seed, tree and shrub planting) as well as other relevant information will be developed into a format that will be easily accessible to the public through the City's website as part of the Open Data policy. These maps will be user-friendly and provide updated and accurate information on the accomplishments of the Regreening Program. The new format will also provide easier information access for staff and VETAC members during the planning stage of regreening activities.

It is anticipated that the interactive online maps of the regreening activities will be operational early within the period of this 5-year plan.

Mapping – Management Units

The Regreening Program has operated for nearly 40 years treating large tracks of land within the 82,000 ha of industrially impacted land. The need for different Regreening interventions varies across the landscape due to the spatially heterogeneous impacts of past industrial activities. The degree of intervention applied to date has also varied spatially. To better manage, plan and prioritize regreening efforts a systematic way to inventory all areas of impacted land is required. The formation of management units will assist in this process. These management units will be based on watershed/subwatershed boundaries defined at a geographical scale small enough to require several years of regreening work.

Once delineated, a full assessment of each management unit will be conducted to identify the regreening interventions still required to be undertaken within the unit. The assessment will include desktop GIS work as well as field investigations. The end result will be a clear picture of what is still remaining to be reclaimed, and what interventions are required.

Delineation of the management units is anticipated to be completed early within the period of this 5-year plan but the assessments of each unit will likely require the entire period.

Completion Criteria

The development of management units will allow for critical analysis of past interventions and the need for future interventions within these smaller areas. Several regreening interventions have been and may continue to be applied to management units. These include liming, fertilizing, seeding, initial tree seedlings planting, follow-up tree and shrub seedling planting to add diversity, transplanting of forest floor mats and transplanting of specialized forest floor plants. At some point, however, the need for further interventions within a management unit should be assessed to determine if all that can be done has been done and nature should be left to finish the work. The development of a comprehensive set of criteria is necessary to conduct the assessment of completion of regreening interventions within individual management units. These completion criteria may include biological and physiological functions of an ecosystem, such as plant species presence/absence, abundance and health, soil microbial activity, and animal species presence/absence. Climate change will also be a consideration in the development of the completion criteria.

Completion criteria applicable to Sudbury will be discussed and finalized toward the end of the period of this 5-year plan.

Operations

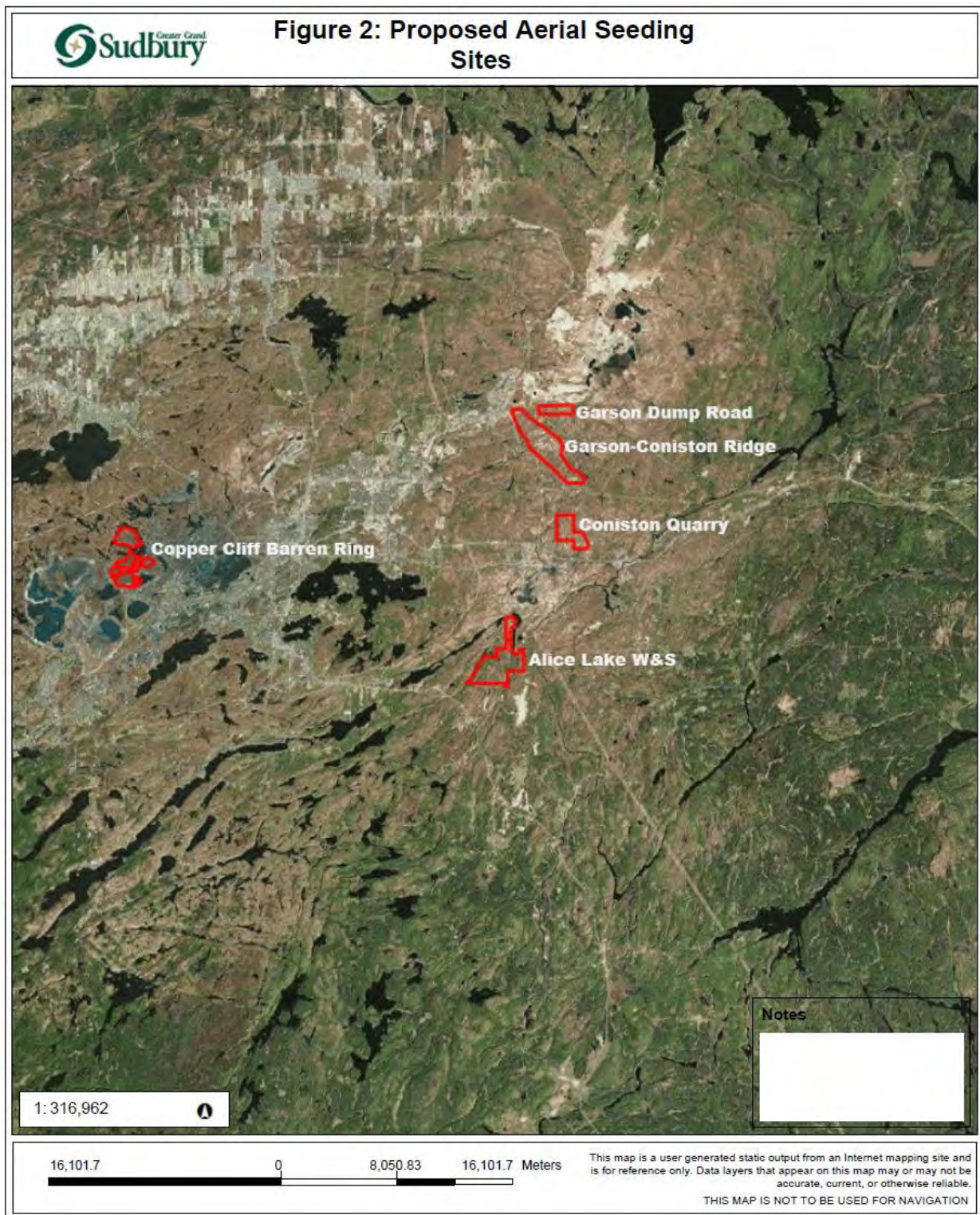
Aerial Seeding

Vale has continued to partner with the City and VETAC in an effort to restore barren lands through aerial seeding, which entails spreading crushed limestone, fertilizer and a grass/legume mixture using modified crop duster airplanes. Areas to be aerially seeded are selected by Vale in consultation with VETAC. Areas selected focus on large tracks of land that are not in close proximity to built environments and occur mainly within the barren rings, semi-barren areas that have little soil and watersheds that would benefit from reclamation activities. Partnership with Vale allows the City's Regreening Program crews to plant on the aerially seeded sites the following spring before the grass cover becomes too dense to allow the tree seedling roots to establish. Currently, Vale has been able to aerially seed approximately 100 hectares of land per year, on which 50,000 tree seedlings can then be planted. The prescription of seedlings for each of these areas is 40% Jack Pine (Pj), 40% Red Pine (Pr), 10% White Pine (Pw) and 10% White Spruce (Sw) or 20,000 Pj, 20,000 Pr, 5,000 Pw, 5,000 Sw (Table 1). In addition, 10,000 Green Alders (Ga) will be planted per year on these sites to increase nitrogen availability.

For the period covering 2016-2020, five sites have been selected for aerial seeding. Specific years are not attached to the list of sites to allow for greater flexibility. Some of the sites exceed Vale's current annual aerial seeding limit and may be scaled down for various reasons (e.g., presence of wetlands, electrical right-of-ways, quarry sites, etc.). Given the site sizes, a total of over 500,000 seedlings could be planted in these areas.

Areas selected for aerial seeding are shown in Figure 2 and include:

LOCATION NAME	AREA
Garson Dump Road	100 ha
Garson Coniston Ridge	300 ha
Coniston Quarry	100 ha
Alice Lake W&S	400 ha
Copper Cliff Barren Ring	200 ha



Manual Liming

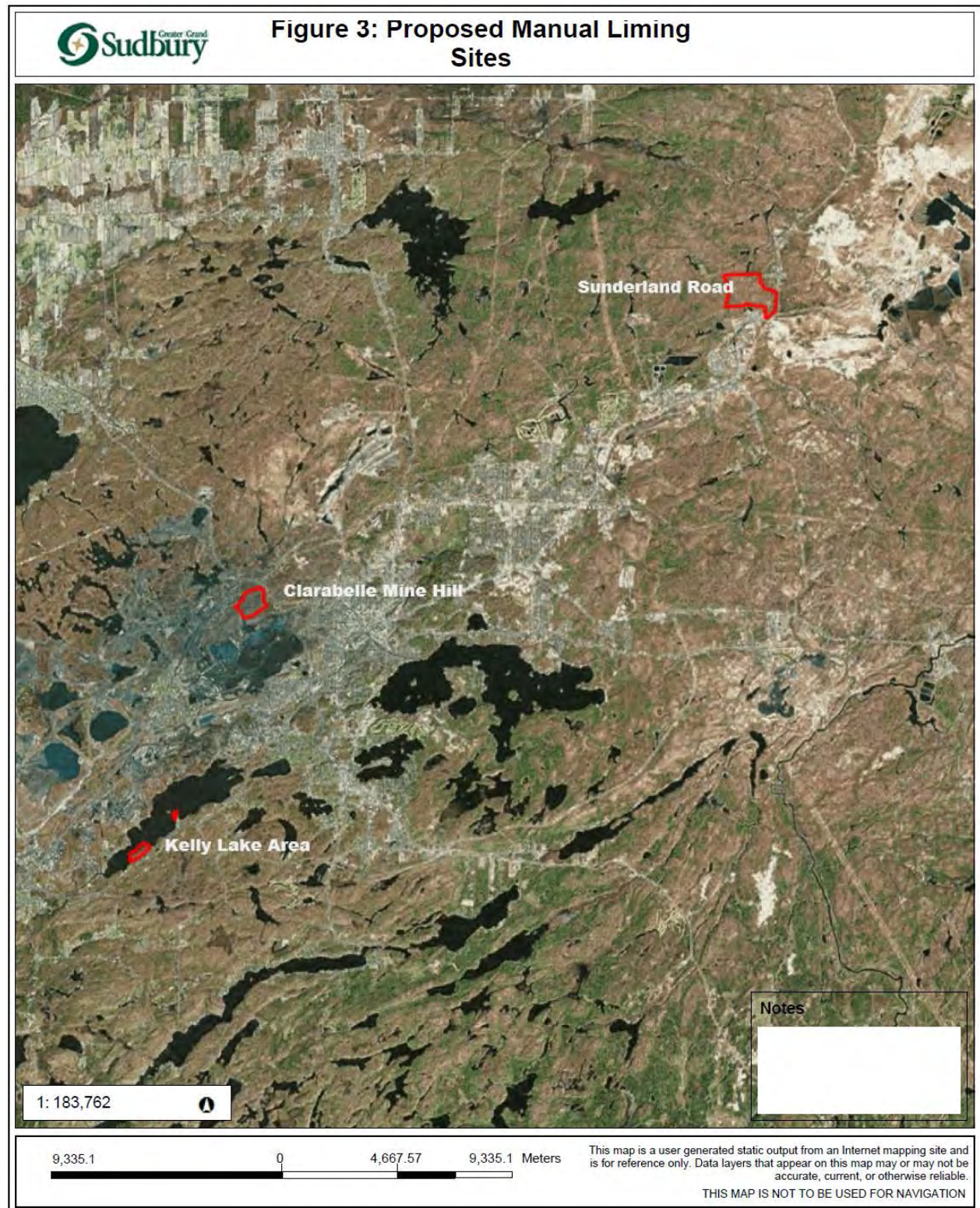
The goal as set out in the Greater Sudbury Biodiversity Action Plan is to manually lime 25 to 50 ha per year depending on terrain. The application rate for the crushed dolomitic limestone will continue to be 10 tonnes per hectare.



Once limed, the area is fertilized and seeded. The following year, the site is ready to receive trees. The prescription of seedlings for each of these areas is the same as for aerial limed sites and includes 40% Jack Pine (Pj), 40% Red Pine (Pr), 10% White Pine (Pw) and 10% White Spruce (Sw), with the addition of 100 Green Alder (Ga) per hectare to increase nitrogen availability in the soil.

Manual liming sites are shown in Figure 3 and include:

LOCATION NAME	AREA
Kelley Lake Area	17 ha
Sunderland Road	130 ha
Clarabelle Mine Hill	58 ha



Fertilization and Seeding

For the Regreening Program, the liming phase has traditionally been followed by the application of fertilizer and a mixture of grass-legume seeds. Application rate for the 6-24-24 fertilizer has been 400 kg/ha. Grass-legume seed mixture applied at a rate of 40 kg/ha, has evolved over time as shown in the following table:

GRASSES COMMON NAME	GRASSES SCIENTIFIC NAME	1979	1983,1988 & 1991	1995 TO 2010	2011 TO PRESENT
Redtop	<i>Agrostis gigantea</i>	12%	20%	10%	
Timothy	<i>Phleum pratense</i>	15%	20%	20%	
Canada Bluegrass	<i>Poa compressa</i>	-	15%	15%	
Kentucky Bluegrass	<i>Poa pratensis</i>	10%	15%	15%	
Tall Fescue	<i>Festuca arundinacea</i>	20%	-	-	
Creeping red fescue	<i>Festuca rubra</i>	28%	10%	15%	
Fall Rye	<i>Secale cereale</i>				90%
Poverty Oatgrass	<i>Danthonia spicata</i>				<1%
LEGUMES COMMON NAME	LEGUMES SCIENTIFIC NAME	1979	1983,1988 & 1991	1995 TO 2010	2011 TO PRESENT
Alsike Clover	<i>Trifolium hybridum</i>	10%	10%	10%	10%
Birdsfoot Trefoil	<i>Lotus corniculatus</i>	5%	10%	15%	

The grass-legume seed mix was considered important as the resulting vegetation improves the ground-level microclimate so that tree seedlings can survive being planted on the bare, wind-swept black rock on the barrens. Rapid vegetation growth from the grass-legume mix also helped reduce ongoing erosion of the exposed soil and encouraged natural colonization of poplars, birches and willows.

Over the years, the grass-legume vegetation has aggressively colonized certain areas making it difficult or impossible to plant additional tree seedlings or to introduce native shrubs or forest floor herbaceous mats. As expected, the grass-legume vegetation thrives best in deeper, moister soils.

The conditions that necessitated the establishment of non-native agricultural grass-legume vegetation are no longer as acute as they once were in many areas. The spread and development of low-bush blueberry, white birch, various native grasses and sedges, and planted pines and spruces have brought much needed shading and reduction of the desiccating winds.

Starting in 2011, the Regreening Program together with Vale's aerial seeding program altered its traditional operation of broadcast seeding of the grass-legume seed mix and spreading of fertilizer.

The manually applied grass mixture was altered to 90% fall rye with 10% alsike clover with good success. Handpicked poverty oat grass trials were successful and will be added to the mixture as available, since the seed is not currently available commercially. Reduction in the fertilizer rate proved fair; the full application rate of 400 kg/ha had better results. The seed mixture alterations will continue to be reviewed annually.

In 2012, Vale’s aerial seeding program adapted their seed mixture to include a large portion of native grasses and conducted large-scale trials. The results proved to be a robust and vigorous crop of less invasive native grass species. Alsike clover, although not native to North America, is an important nitrogen fixer so it remains in the manual and aerial seeding mixture.

The aerial seed mixture Vale used and will continue to use (pending monitoring results) is listed in the table below. Securing seed for some of the native species is quite difficult, which is reflected in the range of values for percentage seed mix content.

GRASSES COMMON NAME	GRASSES SCIENTIFIC NAME	PERCENTAGE OF SEED MIXTURE
Fall Rye	<i>Secale cereale</i>	40%
Slender Wheatgrass	<i>Elymus trachycaulus</i>	10-20%
Canada Wild Rye	<i>Elymus canadensis</i>	20-30%
Little Blue Stem	<i>Schizachyrium scoparium</i>	0-20%
LEGUME COMMON NAME	LEGUME SCIENTIFIC NAME	PERCENTAGE OF SEED MIXTURE
Alsike Clover (non-native)	<i>Trifolium hybridum</i>	10%

Tree and Shrub Planting

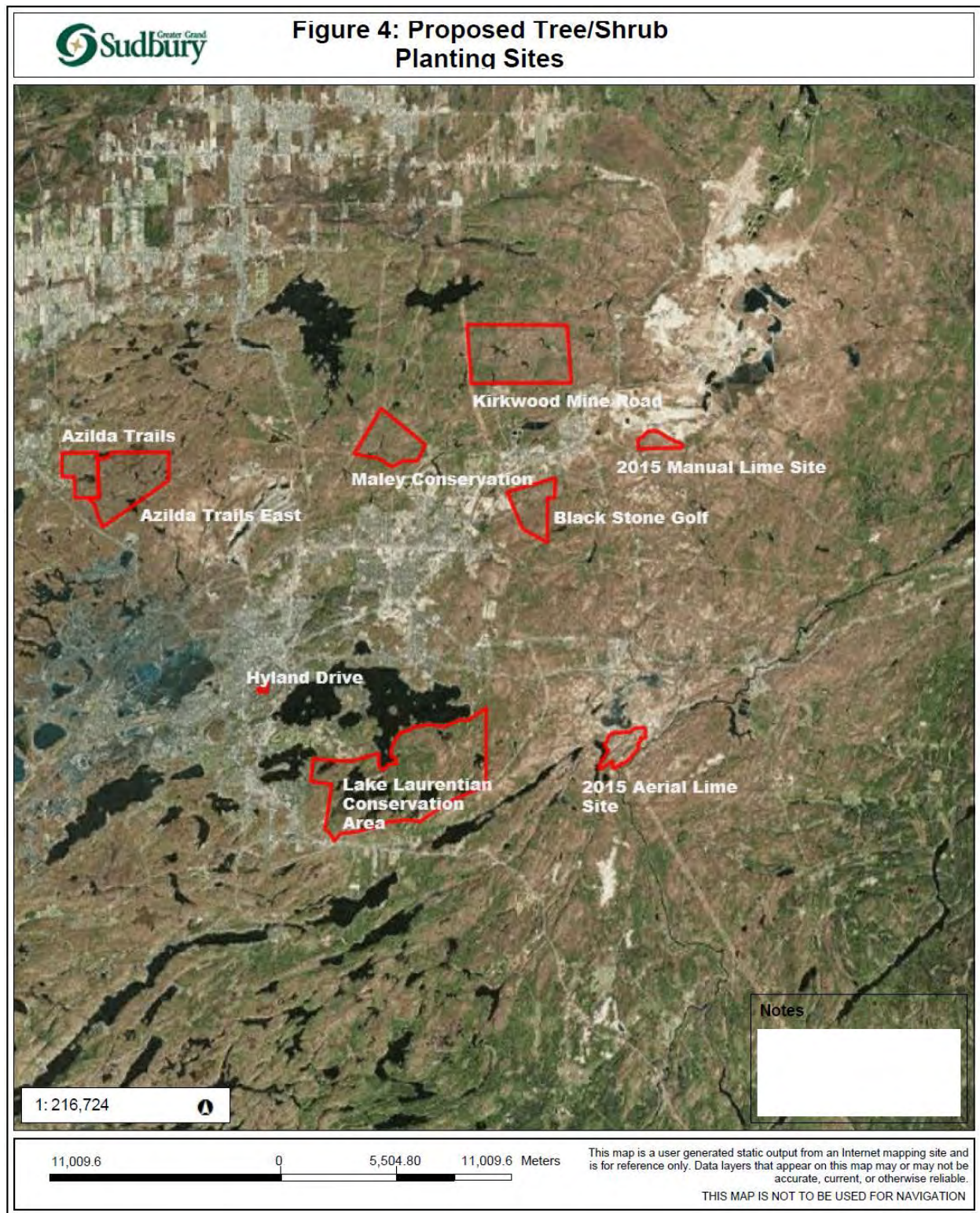
The Biodiversity Action Plan states that half a million conifer tree seedlings and 5,000 shrubs/deciduous tree seedlings are to be planted annually; the latter are 8 to 10 times more costly than conifer seedlings. For flexibility in any given year, the Biodiversity Action Plan makes allowance for planting any combination of the above numbers (i.e., fewer conifer seedlings and more shrubs). For the last 5-year Plan, 2011-2015, VETAC recommended increasing the plant diversity of areas that have already been planted with conifers in the past rather than focusing primarily on planting conifer seedlings. On average, 46,000 shrubs and deciduous tree seedlings and 70,000 coniferous seedlings were planted yearly over this period. VETAC maintains this recommendation for the 2016-2020 5-year Plan.

Tree and shrub planting areas are shown in Figure 4. The areas were selected based on a number of criteria, including: 1) site accessibility, 2) years since receiving lime and conifer seedlings and 3) general site suitability. Due to varying site conditions in the overall areas, only portions of the areas shown will likely be planted. Excessively rocky sites receive 350 trees per hectare whereas less rocky areas receive up to 500 trees per hectare.



Tree/shrub planting sites include the following:

LOCATION NAME	AREA
Azilda Trails	150 ha
Azilda Trails East	400 ha
Kirkwood Mine Road	640 ha
2015 Manual Lime Site	10 ha
Maley Conservation Area	230 ha
Black Stone Golf	190 ha
Hyland Drive	5 ha
Lake Laurentian Conservation Area	1200 ha
2015 Aerial Lime Site	110 ha



Numerous species were selected based on increasing biodiversity of species planted, suitability to the Sudbury area and, for some, ongoing influences of climate change. Species available for planting in any given year will be dependent on seed availability. The expected delivery of species over the term of this 5-year plan is listed in the table below.

COMMON NAME	SCIENTIFIC NAME	MOISTURE USE	SHADE TOLERANCE	5-YEAR TOTAL
Balsam Fir	<i>Abies balsamea</i>	Medium	Tolerant	10,000
Striped Maple	<i>Acer pensylvanicum</i>	Low	Tolerant	10,000
Mountain Maple	<i>Acer spicatum</i>	Medium	Tolerant	15,000
Green Alder	<i>Alnus viridis ssp. crispa</i>	Medium	Intermediate	50,000
Smooth Serviceberry	<i>Amelanchier laevis</i>	Medium	Tolerant	10,000
Red-twigged Serviceberry	<i>Amelanchier sanguinea</i>	Medium	Tolerant	15,000
Running Serviceberry	<i>Amelanchier stolonifera</i>	Medium	Intermediate	10,000
Bristly Sarsaparilla	<i>Aralia hispida</i>	Low	Tolerant	1,000
Bearberry	<i>Arctostaphylos uva-ursi</i>	Low	Intermediate	2,500
Black Chokeberry	<i>Aronia melanocarpa</i>	Medium	Tolerant	10,000
Yellow Birch	<i>Betula alleghaniensis</i>	Medium	Intermediate	25,000
Alternate-leaf Dogwood	<i>Cornus alternifolia</i>	Medium	Tolerant	5,000
Round-leaf Dogwood	<i>Cornus rugosa</i>	Low	Tolerant	5,000
Red-osier Dogwood	<i>Cornus stolonifera</i>	High	Intolerant	2,500
Black Huckleberry	<i>Gaylussacia baccata</i>	Low	Tolerant	400
Mountain-holly	<i>Ilex mucronata</i>	High	Intermediate	2,500
Winterberry Holly	<i>Ilex verticillata</i>	High	Intermediate	2,500
Common Juniper	<i>Juniperus communis</i>	Low	Intolerant	2,500
Hop-Hornbeam	<i>Ostrya virginiana</i>	Low	Tolerant	1,000
Staghorn Sumac	<i>Rhus typhina</i>	Low	Intermediate	2,500
Prickly Wild Rose	<i>Rosa acicularis</i>	High	Tolerant	1,000
Smooth Wild Rose	<i>Rosa blanda</i>	Medium	Intolerant	1,000
Swamp Rose	<i>Rosa palustris</i>	Medium	Tolerant	500
Common Elderberry	<i>Sambucus canadensis</i>	Medium	Intolerant	1,000
Red Elderberry	<i>Sambucus pubens</i>	High	Intermediate	2,000
Buffalo Berry	<i>Shepherdia canadensis</i>	Medium	Intermediate	2,000
Steeplebush	<i>Spiraea tomentosa</i>	Low	Intolerant	1,000
Snowberry	<i>Symphoricarpos albus</i>	Medium	Intolerant	500
Canada Yew	<i>Taxus canadensis</i>	Medium	Tolerant	250
Eastern Hemlock	<i>Tsuga canadensis</i>	Medium	Tolerant	1,000
Wild Raisin	<i>Viburnum nudum var. cassinoides</i>	Medium	Tolerant	20,000
			Total	212,000

In addition to the shrubs and deciduous tree seedlings, 50,000 conifer tree seedlings per year will be planted by the City's Regreening crews in the Vale aerially seeded sites as discussed earlier. These seedlings will likely come from Vale's greenhouses but, as a back-up, can be purchased from a forestry nursery.

Finally, 2,000 to 5,000 tree seedlings will be obtained every year to accommodate organized group planting activities and the annual tree giveaway to residents during the Garden Festival at the end of May.

Transplanting of Forest Floor 'Mats'

The Regreening Program has determined that digging out and transplanting forest floor vegetation mats is a viable and practical method for increasing plant diversity on damaged sites undergoing ecological recovery. This method has the added benefit of introducing other organisms besides plants, including soil bacteria, microorganisms, fungi, and insects, as well as needed organic matter to reclamation sites. In 2010, VETAC partnered with the Ontario Ministry of Transportation to salvage vegetation mats along the Hwy 69S four-lane construction corridor. Since then, partnership with KGHM International Ltd has been established and the opportunity for vegetation salvage will be available again in 2016. Receptor sites for this vegetation will be within the same general areas as those selected in the past. Efforts will be made to secure additional opportunities for transplanting forest floor mats beyond 2016.

Seed Collection

Collecting and propagating seeds from local sources is an effective strategy for obtaining viable plants for use in the Regreening Program. The subsequent planting and re-introduction of these native plants contributes to species diversity and helps maintain a healthy local seed supply.

Productive seed sites for mountain-holly (*Ilex mucronata*) (formerly known as *Nemopanthus mucronatus*), wild raisin (*Viburnum nudum* var. *cassinoides*), green alder (*Alnus viridis*), Canada yew (*Taxus canadensis*), bristly sarsaparilla (*Aralia hispida*), mountain maple (*Acer spicatum*), bearberry (*Arctostaphylos uva-ursi*), alternate-leaf dogwood (*Cornus alternifolia*) and native mountain-ash (*Sorbus* sp.) were located and harvested over the past few years. Efforts will be made to continue to locate sites for collecting seeds or vegetative cuttings for a long-term supply of local stock for various other shrub and tree species. Multiple seed collection sites still need to be identified and recorded for each target species to avoid potential issues associated with overharvesting.

Collected seeds will be sent to the City's contracted propagator for processing and storage. Cuttings will be collected for immediate shipment directly to a specialized grower. Seed and cutting collection sites are recorded on a Google map accessible to VETAC members for collaboration purposes to assist in future planning.

Educational Initiatives

Outlined below are a number of different educational initiatives that will serve to promote the City's regreening success stories and raise awareness of local biodiversity. New opportunities will continue to be developed, implemented, and evaluated.

Edible Berry Project

In 2014, a new project was initiated involving the introduction of trees and shrubs that produce edible berries into unmanaged (non-manicured) areas of city parks. The main purpose of this project is to provide a source of edible berries for the general public for wild foraging, promote awareness of native edibles and enhance plant and animal biodiversity in urban areas. Trees and shrubs producing edible berries were also offered to the public through VETAC's annual tree giveaway to help in the promotion of native edibles.

This initiative will continue in the coming years.

Regreening Presentations, Tours and Conferences

As in the past, staff of the City's Regreening Program and VETAC members will continue to present at conferences and give presentations and regreening tours to student and adult groups. It is expected that presentations will continue to be requested by the Regional Heritage Fair as well as some local schools, visiting university students, dignitaries and others. These conferences, presentations and tours provide an effective way to educate broadly about Greater Sudbury's ecological recovery story.

Roots and Shoots

The Regreening Program has been actively involved with Roots and Shoots, the Jane Goodall initiative that is spear-headed locally by Science North. Roots and Shoots provide school-aged children (grade 6 to high school) with learning activities relating to the environment. Over the past

few years, the Regreening Program has worked with Science North to offer outdoor learning activities including liming and planting of tree seedlings. In 2010, the Regreening Program offered an additional activity for a few high school classes involving transplanting of forest floor mats salvaged from the Highway 69 construction corridor. Participating youths learned about the importance of local biodiversity to healthy, self-sustaining ecosystems.

The Regreening Program will once again participate in the local Roots and Shoots initiative in 2016.

Biodiversity on School Grounds

Many schools have remnant wild areas on their grounds that require ecological restoration or are within a short walk of such areas located on City-owned property. A database has been created identifying schools that have such areas available to them and will be scouted by City staff to determine specific regreening needs at each site.

Schools could participate in regreening activities in these areas once actions are specified. Students would be responsible for monitoring the vegetation development of these plots as part of their environmental curriculum.

These activities provide ideal opportunities for students to learn about the importance of forest biodiversity and to take ‘ownership’ of monitoring a biodiversity site on the grounds of their school.

VETAC will work towards hiring a science communications student to deliver talks to various elementary and secondary grade levels on the history of the Regreening Program.

Ugliest Schoolyard Contest

VETAC has been overseeing the Ugliest Schoolyard Contest since 2005. Since that time, 39 schoolyards have received much needed ‘make-overs’ through generous donations from various community partners, including a major sponsorship from Sudbury Integrated Nickel Operations, a Glencore company, starting in 2007. The Ugliest Schoolyard Contest provides an opportunity for children to gain first-hand biodiversity lessons by greening their schoolyard, including planting shrubs and wildflowers.

The Regreening Program added further value to the schoolyard regreening activities by encouraging greater use of native plant material during schoolyard regreening. A maintenance manual for winning schools that includes activities for every season was also developed to engage the school community in their new schoolyard.

This youth engagement activity will persist as long as funding is made available.

Local Biodiversity Engagement

Locally themed biodiversity posters of four habitats types (rock barrens, forests, wetlands and lakeshores) were developed and interactive posters were placed on the website. Printed copies have been produced and will be made available for purchase as well as donated to schools for their classrooms starting in 2016. These posters will help educate and engage students and the general public about local species and their habitats.

Post cards of native species were developed, printed and made available to the general public through the local libraries to help increase awareness of local biodiversity. Twelve species were profiled on the postcards, one for each month of the year. Information about each species was posted on the website in 2015. There may be an opportunity to continue this type of communication with the public, as this project was well received.

A colouring poster featuring 35 native species was also developed and posted on the website. Starting in 2016, promotion of this poster will begin by having local restaurants use them as colouring pages for customers and having them available for youth at various events.

Community-based Biodiversity Monitoring

There are many province-wide programs in which members of the public can participate in tracking plants and animals. In 2010, the International Year of Biodiversity, the Regreening Program made a special effort at promoting biodiversity tracking programs within the Greater Sudbury community by holding special events and information sessions. Community-based tracking of plants and animals will only gain a foothold with sustained efforts at building relationships with interested individuals.

In 2011, the Regreening Program promoted an initiative aimed at residents reporting whip-poor-wills through their breeding calls. Whip-poor-wills are designated as ‘threatened’ in Ontario and are protected under the Endangered Species Act. These nocturnal birds are present in Greater Sudbury during the summer and their distinctive call is easily recognizable and unmistakable making this species relatively easy to track by inexperienced birders. Numerous residents were engaged in submitting their records of whip-poor-wills in to the City, which are now posted online at: www.greatersudbury.ca/living/environmental-initiatives/biodiversity/citizen-ecological-surveys/whip-poor-will/.

Bird Studies Canada, in cooperation with Cornell University, hosts a popular Feeder Watch Program that is simple and engaging for people to participate in. Data collected is pooled across Ontario and Canada. Bird Studies Canada has agreed to share any Sudbury data with the City’s Regreening Program. Promotion of this Program will be made locally during this 5-year plan period in attempts to gain additional participation by the Greater Sudbury community.

Research/Monitoring Initiatives

The municipal Regreening Program is a direct result of the findings of research conducted at Laurentian University in the early 1970s. Research continues to play an important role in improving the techniques used in regreening as well as their positive environmental influences. As well as undertaking its own research and monitoring initiatives, the Regreening Program has benefitted from and, at times, collaborated in research and studies undertaken at all three local post-secondary institutions: Laurentian University, Cambrian College and Collège Boréal. In recent years, the Regreening Program has benefitted from the multi-year TALER (Terrestrial Aquatic Linkages for Ecosystem Recovery) research program coordinated by the Vale Living With Lakes Centre at Laurentian University. For example, this research shed light on the important role that revegetation of the watershed has on the contribution of high quality organic matter to the biological recovery in lakes and streams. As a result of these findings, the Regreening Program now sets priorities for revegetation and increases planting density within 100 metres of streams, lakes and

wetlands. The TALER research also has lent support to the Program's use of lichens to revegetate barren rocks and to the need to continue to regreen remnant natural sites in urban areas. Other research, such as that lead by Dr. Kabwe Nkongolo at Laurentian University, has highlighted the need for continued liming to promote ecological recovery in Greater Sudbury and the sustainability of local conifer and deciduous tree populations based on adequate genetic diversity. Dr. Nkongolo's research on soil micro-organism dynamics following regreening will also likely provide an important contribution to the development of completion criteria discussed previously.

Collège Boréal has participated in trial propagation studies using seeds provided by the Regreening Program and has conducted tree seedling success evaluations on behalf of the Program for Tree Canada. A professor and his students from Cambrian College conducted a winter snow track survey of snowshoe hare in the vicinity of shrub evaluation transects whose results could be used to correlate browsing damage on the shrubs.

Outlined below are some of the Regreening Program's research and monitoring initiatives planned for the period of this 5-year plan. Not included are the numerous research projects planned or underway by professors and students at local post-secondary institutions. The City's Regreening Program will assist in promoting/reporting the results from this research to the wider Greater Sudbury community through various means.

Plant Community Succession

Beginning in 2012, the Land Reclamation Program began conducting re-assessments of the same sites that Brian Amiro (former graduate student at Laurentian University) studied in 1978 to answer the questions of 1) are plant communities changing over time, if so, how?, 2) does site location in relation to the three smelter impact zones affect plant species present?, and 3) are regreening activities affecting plant communities, and if so, how?

In 2015, Brian Amiro generously provided his original data to the Regreening Program. These data will allow better comparisons to be made between his initial data and the newly collected data. In addition, his original plot location maps will allow his sampling sites to be more accurately relocated for sampling purposes. Thus far, 64 of Amiro's 142 research plots have been resampled.

At least 40 additional Amiro plots will be resampled during the period of this 5-year plan. Once all sites have been completed, analysis of the changes in community types, the final goal of this project, will be determined.

A Flora of Greater Sudbury

Herbariums act as a permanent, historical record of plant occurrences in an area. In partnership with Dr. Sabah Nasserulla and Dr. Peter Ryser at Laurentian University (LU) Herbarium, Regreening Field Interns have been identifying and cataloguing plant specimens collected during each field season as well as organizing historical specimens collected in the CGS region. The goal of the Flora of Greater Sudbury project is to compile a physical and digital inventory of all plant species that characterize the City of Greater Sudbury landscape. This information can be used to track changes in Sudbury's plant communities over time.

Using the LU Herbarium to identify and catalogue plant specimens aid in the understanding of plant species distribution in the City of Greater Sudbury area and how it is changing over time. This information helps to provide an understanding of ongoing reclamation practices and can aid in the direction of future initiatives. In addition, up-to-date voucher specimens in the herbarium are useful for researchers working within the region to confirm plant identification.

It is beneficial to continue biological inquiries in the future with the goals of: (1) tracking local changes in biodiversity (2) of developing a Flora of Greater Sudbury database, and (3) use of local native plants. Lichen and mosses will be added to this record during the period of this 5 year plan.

Vegetation Salvage Plots

Forest floor plants will continue to be harvested from various donor sites. Harvesting involved manually cutting mats of vegetation and soil measuring about 60 cm by 55 cm and between 6 and 15 cm thick. These mats were then transported into Greater Sudbury and placed into plots, each measuring 4 by 4 metres. To date, 1.44 ha of material has been strategically placed throughout Greater Sudbury's impacted area. Over time, the plants will spread out of the original plots and colonize the surrounding wooded areas thereby increasing the biological diversity of the developing forest. In turn, this added plant diversity will attract different species of animals, insects and micro-organisms, which will further foster healthy, self-sustaining forest ecosystems.

The establishment of forest floor plots presents a highly valuable outdoor laboratory for studying features and processes of ecological recovery. The City's Regreening Program will promote the research potential of these plots to professors and undergraduate students in the hope that they will use these for fourth year projects or for some, post-graduate work.

Whether or not the academic community makes use of the network of vegetation plots, the Regreening Program will continue to monitor some of the plots every five years to determine survival and spread of individual species.

Shrub and Tree Survival and Growth

Since 1978, the City's Regreening Program has planted tens of thousands of shrub and deciduous tree seedlings in addition to the millions of pine and spruce seedlings. Recently, follow-up on the survival and growth of the shrub and deciduous tree seedlings has been undertaken in a comprehensive, systematic way. Permanent shrub and deciduous tree seedling evaluation areas have been established and additional ones will continue to be introduced as new species are tested.

Shrubs planted within these areas will continue to be evaluated annually for survival, growth, and cause of mortality (e.g., browsing by snowshoe hare). The information collected will be used for future selection of shrub and deciduous tree species for planting in Greater Sudbury's impacted areas. Climate change is anticipated to profoundly influence local plant survival and growth over the next few decades and it will be important to stay 'ahead of the curve' by continually planting and evaluating shrubs and trees that currently grow to the south of Greater Sudbury.

Lichen 'Seeding'

Lichen 'seeding' experimental plots were initiated in 2010. Aerial seeding operations in 2010 and 2012 incorporated dry crushed lichen fragments. After evaluation of the 2010 aerial drop site 5 years later, the lichen was found to be rooting although in limited amounts. Manual plots were also established since 2010 and after two years, the plots appeared healthy and alive.

All sites will be monitored during the period of this 5-year plan and recommendations submitted for future interventions.

Climate Change & Adaptation

Adapting to climate change can be like adapting to the unknown. We know climate will change but how exactly that presents itself is not certain. It is not just an increase or decrease in temperature, other factors like length of growing season, amount of precipitation and type of precipitation can play key roles in the sustainability of local ecosystems. There are some data models (Natural Resources Canada's Plant Hardiness website www.planthardiness.gc.ca/?m=23) available that can be useful in forecasting plant community shifts over time. These models have and will continue to be used by the Regreening Program staff and VETAC to predict a changing ecosystem.

The Regreening Program has already established several experimental plots to assess the survival of trees and shrubs that grow close to the south of the City. These plots will continue to be monitored and expanded upon in the future as additional species are tested for suitability to the Sudbury area.

Biodiversity Action Plan Update

During the early period of this 5 year plan, it is VETAC's intention to review the Biodiversity Action Plan document. Public consultation will be requested as each section and community priorities are taken into account. The updated document will then appear on the website, accessible to the public.



For further information please contact:

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