Introduction

- 2008 was the ninth year for our community-based project.
- Our purpose is to accelerate the re-vegetation of barren areas in and around our communities by the application of crushed limestone.
- Because of the ruggedness of our terrain, it is not feasible to do the work by machine, so we use people-power, namely students from local schools and adult volunteers.
- Conditions were very dry through mid-June, but precipitation and temperature were more or less 'normal' thereafter. Birch, poplar and other woody species are now commonly up to 3m. high in treated areas – and in a few areas are over 4m. high. Cones appeared on pines in several of our areas for the first time in 2008.
- The organizational and scientific backgrounds to our project are explained in Appendices 1 and 2 - below.

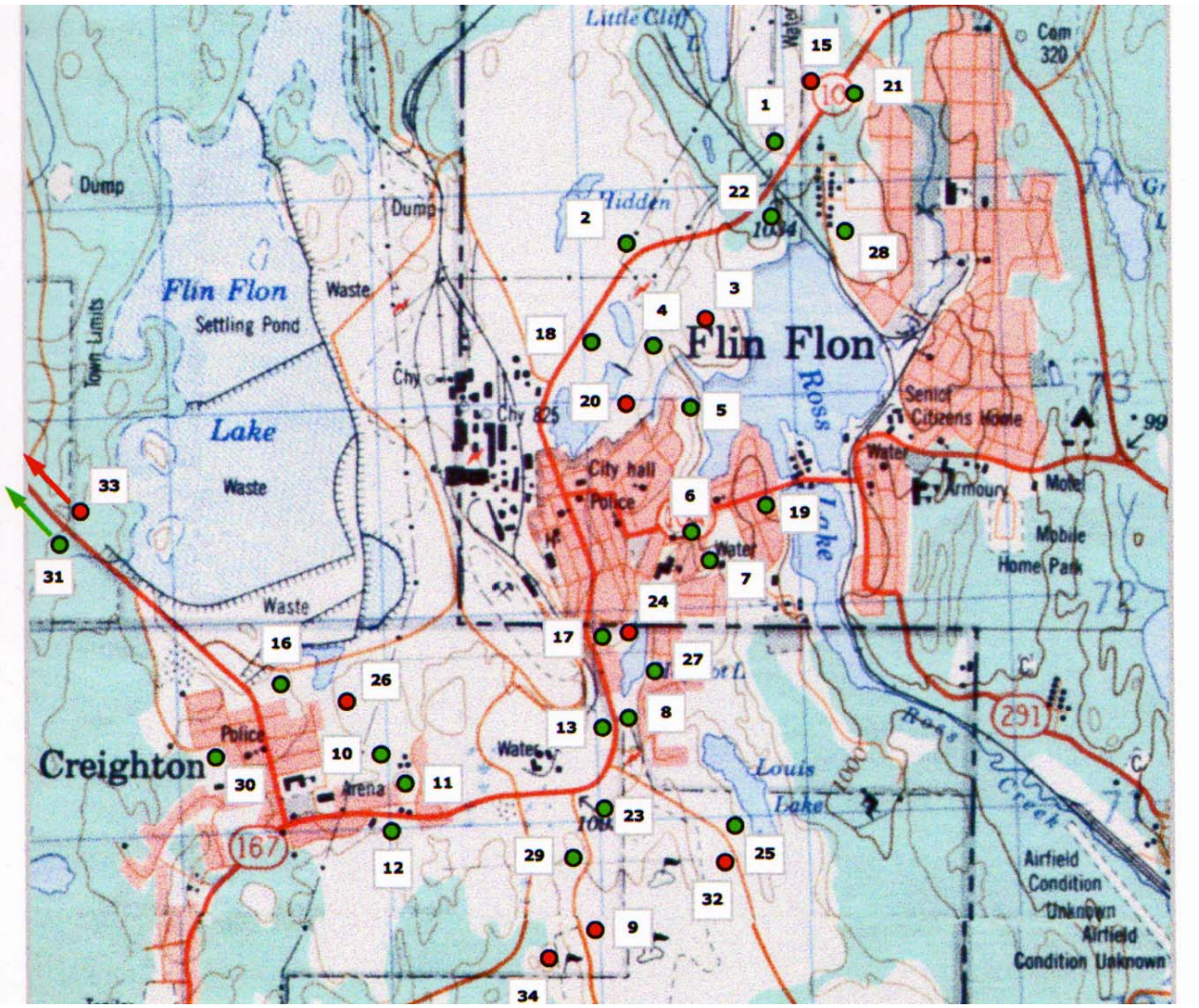
Our Partners

We gratefully acknowledge that our project has been made possible through the generosity of our partners. Major funding for the work in 2008 came from Hudson Bay Mining and Smelting Company Ltd. (HBMS.). The City of Flin Flon and the Town of Creighton hauled the limestone to the areas to be treated. Flin Flon School Division and its Youth Mentor program, and Creighton School Division supplied the bulk of our workforce. Hudson Bay Exploration and Development Company Ltd. supplied us with air photographs. Home Hardware donated supplies. Edgar and

Mary Wright provided us with seeds and seedlings of various understory species, and Kelly Gilmore supplied birch seeds.

Area Treated

During a field season lasting from May 22 through September 11, we spread 65 yards of crushed (dolomitic) limestone in 9 areas to cover a total of 3.8 hectares (9.4 acres). The map below shows these areas. During the project period 2000-2008, we have treated 37.9 hectares (93.8 acres) with 849 yards of limestone.



Green circles indicate areas treated 2000 through 2007. Red circles indicate areas treated in 2008. *1: Balsam, 2: Rock Cut, 3: Second Valley North, 4: Second Valley West, 5: First Avenue, 6: Hiawatha, 7: Grandview, 8: Hapnot, 9: Phantom, 10: Knight North, 11: Knight, 12: Pizza, 13: South Main, 15: Esso, 16: Creighton North, 17: Super K, 18: Triple Seven, 19: Market, 20: Reservoir Hill, 21: Lancaster, 22: Railroad, 23: Phantom North, 24: Hapnot North, 25: Louis,*

26: Creighton East, 27: South Hudson, 28: Roche, 29: Phantom Northwest, 30: Red Mountain, 31: Hilary, 32: Golf, 33: Sand Bar, 34: Driving Range.

Volunteer Field Personnel

The work was carried out by 761 individuals during 40 sessions (672 students in 28 sessions, and 89 members of the general public in 12 evening sessions). At left below are pre-kindergartners from Creighton Community School at the Driving Range area in June. At right are community volunteers after an evening session at the Golf area in August.

New Growth in Treated Areas

The areas we are treating are either totally barren, or have a few scattered tufts of the acid- and metal-tolerant grass Agrostis stolonifera, and a few stunted relict poplars, birches, and willows. Original organic topsoil is commonly entirely absent, or where present is thin. The ground surface is a combination of bare rock outcrop, and sandy or silty gravel with a variable content of pebbles and boulders. Areas treated in May and early June of each project year have generally shown some signs of life (typically Manitoba maple) within a month. By August, seedlings of birch, aspen, balsam poplar, and a variety of willows appear. Although the maples tend not to over-winter well, the others flourish, and in the second season grow to about half-a-metre. Conifer seedlings tend not to appear until a year or two after the treatment.

Birches and poplars in several of our areas are now better than 3 metres high, and at our Knight, Knight North and Hapnot areas (treated in 2000 and 2001), some individuals are 4 or more metres high. As of the fall of 2007, self-seeded conifers

were present in thirteen of our areas – they are now present in fourteen. Pines – commonly associated with old relict parents – are locally up to 2.4 metres high, and a single tamarack at our Knight area is 2.7 metres high. This year - for the first time[1] – cones appeared on pines (self-seeded and transplanted) in several of our areas. Alders were not seen in any of our areas until 2005 – they have now been noted in eight. The densest patch of alders – some over 2 metres high - is at our Knight North area. Their distribution strongly suggests that the seed came from a single alder transplanted to the area in 2001. The only alders noted at our Phantom and Hapnot areas are also closely associated with 2001 transplant parents.

Although understory species such as Bicknell's geranium, fireweed, raspberry and bearberry are quite widespread, they tend in general to be few and far between. The grass A. stolonifera tends to spread following treatment, and a few other grass and sedge species have appeared in some areas. Some of our best areas in terms of density of woody species – such as Creighton North - still have almost no understory vegetation.

The picture at left below shows cones – which appeared for the first time in 2008 – on the pine at the Balsam 'plantation'. At right are black currant and another understory species at the Louis area.

Appendix 3 provides an indication as to how well each individual area is doing. It is notable that the four areas characterized as 'poorest' are within about a kilometer of the stack. The five areas characterized as 'best', are all south and southwest from Flin Flon. We have recognized since the early years of the project that some areas are 'slower' than others, that is, there is a variation in the rate of

[1] *In fact, a single old cone – presumably from 2007 - was noted on a self-seeded pine in the Phantom area.*

germination and growth and in vegetation density from one area to another. We hope that studies presently underway (see below) will provide an explanation and a remedy for this.

Planting and Seeding

Although we are depending primarily on the natural 'seed rain' to do the re-vegetating for us, we have done some small-scale experimental planting and seeding.

In September 2001, following advice from our consultant the late Professor Winterhalder, small 'plantations' were established in ten of the areas we had previously treated. In each we put four spruce seedlings, one alder (a nitrogen fixer) and one pine or tamarack. These were taken from the right-of-way along the Kisseynew Lake road during a very wet spell. To date, survival in the plantations has been close to 100%. It is of interest to note that growth and state of health in the plantations varies from area to area, and closely parallels the variation in area 'vegetation scores' in appendix 3. Plantation conifers in some areas categorized as 'best' (such as Knight and Knight North) are very healthy and up to 2.7m high, while those our 'poor' areas (such as Rock Cut and First Avenue) are more sickly-looking and are not a great deal bigger that when they were put in. Pines at the Balsam and Knight plantations produced cones for the first time in 2008.

Pine and spruce cones were scattered in seventeen of our areas in 2002 through 2004. Germination has taken place in eleven of the areas. Some of the pine seedlings from cones scattered by Saskatchewan Environment personnel at our Knight North area in February 2002 are now up to 2.5m. high. Seedlings in the other areas are up to 0.6-1.0m. high. The pines at the Knight North area produced cones for the first time in 2008.

Spruce seedlings supplied by Saskatchewan Environment Creighton office personnel from SaskPower's Shand Greenhouse, and put in by Green Project staff in 2005 at our Balsam and Railroad areas are doing quite well – some are up to 50cm high. Those put in at the Triple Seven area are in general less healthy, and there has been some mortality.

In 2003 and 2005-2007, local Cubs and Beavers planted hundreds of spruce and pine seedlings – as well as several other species – at the Second Valley, Reservoir Hill, Phantom and Balsam/Esso areas. Survival rate for the conifers has been high – probably better than 90% in most areas – many individuals are now 40-60cm. high. Those planted at squares 1, 2 and 4 at Second Valley in 2003 are in general less healthy, with significant mortality (particularly among the pines.)

Supplementary documentation on the above, and some of our other planting and seeding projects is available on request, and will shortly be posted on our web site.

Scientific Studies

As noted above, many of our areas have responded very well to the limestone treatment, others are coming along more slowly, while in a few the response has been minimal. What accounts for this varying response? Might it be due to variations in the base-metal content of the soil? What treatment in addition to the application of crushed limestone might be needed to enhance germination and growth of woody species in our 'slow' and 'poor' areas – and to encourage growth of understory species? At the time of his death in October 2005, our consultant Professor Keith Winterhalder had been conducting greenhouse experiments with a view to providing answers to these questions.

Following preliminary discussions with HBMS and Green Project coordinators in late 2007, members of the faculty at the University of Saskatchewan's Department of Soil Science drafted a proposal for a multi-year research project aimed at significantly expanding on the work initiated by Professor Winterhalder. A start was made in 2008 on field components of the project, as well as on laboratory work back in Saskatoon.

A Manitoba Conservation ecosystem monitoring specialist visited Flin Flon in 2008 to resume monitoring vegetation on transect lines set up by Professor Winterhalder in a number of our areas.

The study on the health implications of elevated levels of some metals and other elements in the soils of Flin Flon and Creighton, which was referred to in last year's Report of Activities, is ongoing. Information on this study – which is being carried out on behalf of HBMS by Intrinsik Environmental Sciences Inc. - is available at www.flinflonsoilsstudy.com

Photography

During our first eight project years we took 1,496 pictures, and in 2008 we took an additional 122. These will serve as a permanent record of the project, and are being used for public relations purposes. Pairs of 'before-and-after' pictures illustrate in a dramatic way, how effective the limestone treatment is proving to be. The picture at left below – taken in June, 2000 - shows part of the Knight area shortly after treatment. The picture at right shows the same area in August, 2008.

Public Relations

In June, we were informed by Municipal Administrator Mark Kolt that the City of Flin Flon was planning to nominate the Green Project for a 'Manitoba Excellence in Sustainability' award. In November, Manitoba's Minister of Conservation Stan Struthers informed us that we had received an honourable mention in the 'Community Group' category. There were 22 attendees at our annual informational meeting in early June. Articles in the Flin Flon 'Reminder' kept our project in the public eye again in 2008. Local radio station CFAR kept the public informed of our activities over the summer months. An eighth issue of our newsletter 'Green Project News' was released in May, and copies were distributed to interested parties and deposited at Flin Flon Public Library – and made available for download on our web site – www.greenproject.ca . We made posters and brochures which were distributed to local schools. Presentations were made to several classes in Flin Flon and Creighton schools.

Future Plans

We aim to treat another five hectares in 2009. The main activity will be at our Esso, Second Valley, Hapnot North, Phantom, Phantom North, Driving Range, Golf, and Sand Bar areas (see the map on page 2). The Committee plans to have its annual informational meeting in June.

Additional Information

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APPENDIX 1: Organizational Background and Procedures

In the late 1960s and early '70s, botanists at Laurentian University – among them our technical consultant, the late Professor Keith Winterhalder – found that the application of crushed limestone to the barren acidified and metal-contaminated soils around Sudbury led to the regeneration of vegetation. A major program of limestone application since then has led to a transformation of the Sudbury landscape.

In the early 1990s, Rena Gummerson and later Cathy Hynes of the Creighton /Denare Beach Economic Development Committee contacted Professor Winterhalder to see if he might be interested in helping to set up a re-vegetation program in our area. This resulted in his first visit up here in 1994. In 1999, Heather Acres and Clarence Pettersen of Flin Flon School Division thought that re-vegetation would be a good project for their Youth Mentor program and the Green Project was launched with the support of the School Division. Hudson Bay Mining and Smelting Company Ltd. and the Flin Flon Economic Development Commission generously provided funding to bring Professor Winterhalder up here in October 1999. He spoke to a number of groups and generated a high level of interest and enthusiasm. A community-based committee was formed, and planning meetings were held in March and April 2000. McKeen's Trucking generously donated 130 yards of crushed limestone, and this allowed us to put our first groups of students to work in the field in May of that year.

Present members of the committee are: Flin Flon School Division, Creighton School Division, City of Flin Flon, Town of Creighton, Flin Flon and District Environment Council, Hudson Bay Mining and Smelting Company Ltd., Saskatchewan Environment and various community group leaders and members.

The first stage in planning our field operations involves checking out maps and air photographs. From these we get a general idea as to which areas might be suitable for treatment. We then ground-check the areas. Once their suitability has been confirmed, the crushed limestone is trucked in. Volunteers fill their pails at the dumps and spread the limestone as evenly as possible. The coordinator/supervisor makes sure no gaps are left. Work continues until the designated area is completely covered.

APPENDIX 2: Environment and Science

In and around the communities of Flin Flon and Creighton[2], there are large areas with little or no vegetation. Old tree stumps show that these areas were once forested.

In the 1920s and '30s when our communities and the smelter complex were first established, many trees were cut for fuel and lumber. Others were cut to make fire breaks, or were burned in forest fires. As production from the Flin Flon and other mines increased, so did the amount of sulphur dioxide smoke from the smelter. The smoke is harmful to vegetation, so the forest was not able to recover. The increasing acidity and metal content of the soil meant that only a very few hardy types of plant were able to survive. As the plants died, the thin topsoil washed away.

High levels of metals such as copper and zinc in the soil are toxic to plants[3]. This toxicity is accentuated by acidity, which makes the metals more soluble, and therefore more accessible. When seeds germinate in metal-contaminated soil, growth stops immediately on contact with the toxic soil solutions. The carbonate ion in the limestone tends to neutralize soil acidity, thus making the metals less soluble, and less toxic. Another component of the limestone, calcium, contributes to reducing soil toxicity by competing with zinc ions for uptake by plant roots. Calcium ions also have a strengthening effect on the plasma membranes in the root cells. This membrane is responsible for determining what is absorbed by the roots.

Since the early 1970s, Hudson Bay Mining and Smelting Company Ltd. has spent hundreds of millions of dollars to improve technology at the smelter complex, with the result that emissions of sulphur dioxide and metal oxide dust are now significantly reduced. The natural vegetation is slowly starting to recover. Our project is accelerating this recovery.

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[2] *Flin Flon and Creighton are situated on either side of the Manitoba/Saskatchewan boundary about 600 kilometres north of the Canada/US border. A large copper-zinc ore body was discovered at Flin Flon in 1915, and production – which started in 1930 – continues to the present day.*

[3] *This paragraph is from information supplied by the late Professor Winterhalder.*

APPENDIX 3: Area Vegetation-Cover Scores at Fall, 2008

Area (& Distance)*	Years Treated	A	B	C	D	Total Score
1 - Balsam (1.9km)	'01	2	3	2	2	9
2 - Rk Cut (1.1km)	'01	1	1	2*	0	4*
3 - SecV-N (1.1km)	'00-'02,'08	2	3*	2	0	7*
4 - SecV-W (0.9km)	'00,'01	0	0	0	0	0
5 - FirstA (1.0km)	'00	1	2	0	0	3
6 - Hiawa (1.1km)	'02,'04	3	2	2	0	7
7 - Grandv (1.3km)	'01,'05-'07	2	2	2*	0	6*
8 - Hapnot (1.6km)	'00-'02	3	3	2	2	10
9 - Phant (2.5km)	'01-'03,'07,'08	3	3*	2	2	10*
10 - KtNor (1.7km)	'01	3	3	2	2	10
11 - Knight (1.8km)	'00	3	3	2	2	10
12 - Pizza (2.0km)	'01,'03,'04	3	3	2	2	10
13 - SoMain (1.6km)	'02,'03,'04	3	3	2	2	10
15 - Esso (2.2km)	'02,'03,'04,'08	2	3*	2	2	9*
16 - CrtNor (1.6km)	'02,'03,'04	3	3	0	2	8
17 - Sup-K (1.2km)	'02	3	3*	0	0	6*
18 - TripSev (0.6km)	'02	1	2	0	0	3
19 - Markt (1.4km)	'02	1	3*	0	0	4*
20 - ResHill (0.7km)	'02,'03',05,'08	1	2	0	0	3
21 - Lanc (2.3km)	'03',06	2	2	0	2	6
22 - RailRd (1.7km)	'03	2	2	0	2	6
23 - PhantN (1.9km)	'03,'05,'06	3	3*	2	2	10*
24 – Hapnot North	'06,'07,'08	2*	2*	2	0	6*
25 - Louis (2.3km)	'04	3*	3*	2	0	8*
26 - CrtEast (1.4Km)	'04-'08	3	3*	2	2	10*
27 - SoHudson (1.5km)	'05	3	2*	2	0	7*
28 - Roche (1.9km)	'05,'06	2	2*	2	0	6*
29 - PhantNW (2.1km)	'05	2*	2*	2	2*	8*
30 – RedMtn (2.1km)	'06	2	2*	2	0	6*
31 – Hilary (2.4km)	'06	2*	2*	2	0	6*
32 - Golf	'07,'08	1*	1*	0	0	2*
33 – Sand Bar	'07',08	1*	1*	0	0	2*
34 – DrivgRge (2.8km)	'08	0	0	0	0	0

A: Vegetation density - low/medium/high, score 1/2/3.
B: Maximum bushy seedling height - <0.5m/0.5-1.5m/>1.5m, score 1/2/3.
C: Two or more understory varieties present – score 2.
D: Self-seeded spruce/pine seedlings present – score 2.

* Approximate distance of area from HBMS Co. stack.
* Score improved since 2007.