



Introduction

- 2006 was the seventh 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.
- Frequent periods of rain, alternating with pleasantly warm spells during the summer of 2006 were good for growth. By fall, birch and poplars in some areas we had treated a few years earlier were close to four metres high.
- The organizational and scientific backgrounds to our project are explained in Appendices 1 and 2 - below.

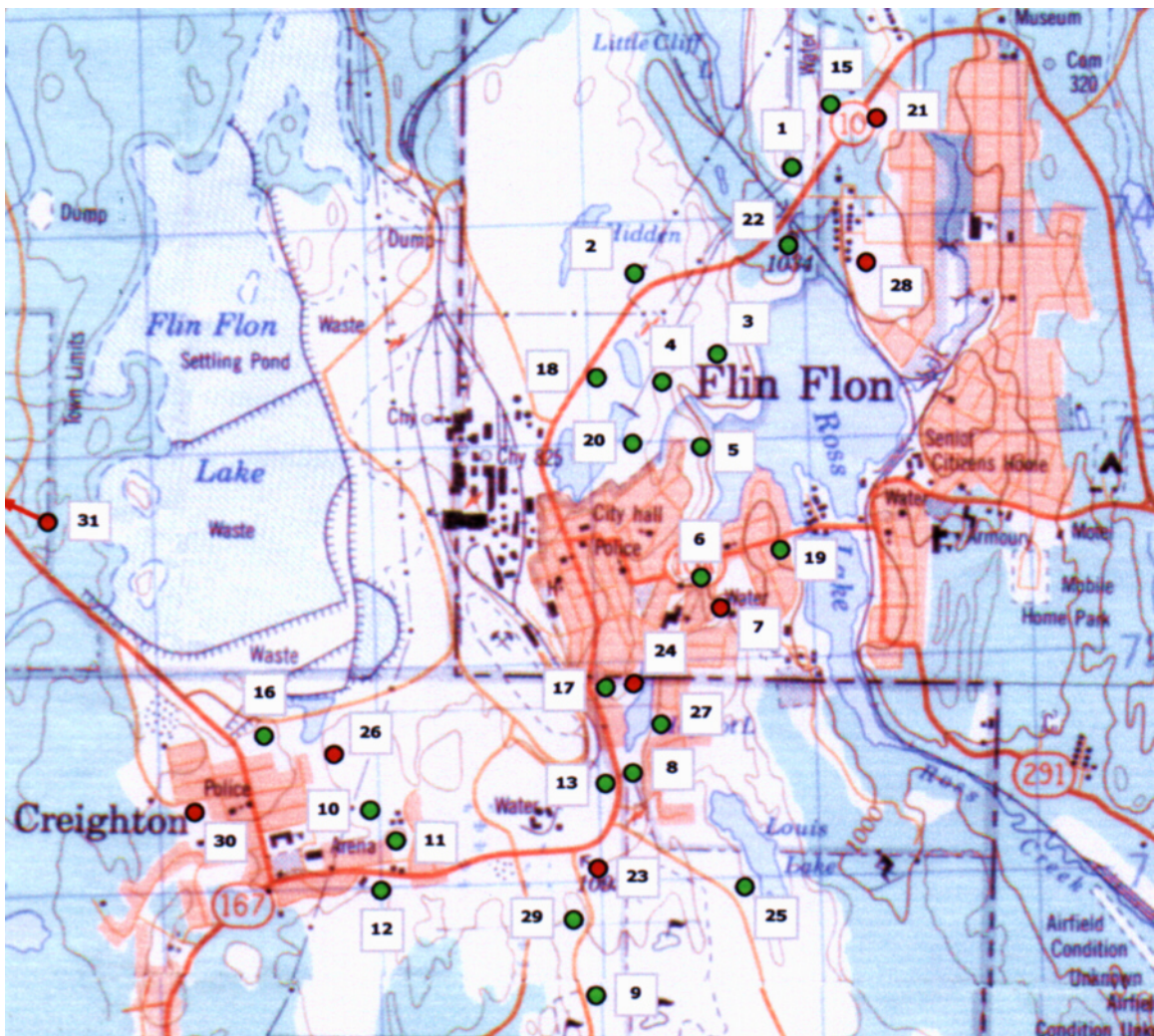
Our Partners

We gratefully acknowledge that our project has been made possible through the generosity of our partners. Major funding for the work in 2006 came from Hudson Bay Mining and Smelting Company Limited. The City of Flin Flon, the Town of Creighton and Hudson Bay Mining and Smelting Company Limited 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 Limited supplied us with air photographs. Flin Flon

and District Environment Council helped us with project administration. Home Hardware donated supplies.

Area Treated and Personnel

During a field season lasting from May 12 through September 21, we spread 64.2 yards of crushed (dolomitic) limestone in 8 areas to cover a total of 3.32 hectares (8.19 acres). During the project period 2000-2006, we have treated 30.05 hectares (74.25 acres) with 703 yards of limestone. The map shows the locations of the areas treated.



The green circles indicate areas treated 2000 through 2005. Red circles indicate areas treated in 2006. 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.

The work was carried out by 402 individuals during 28 sessions (338 students in 13 sessions, and 64 members of the general public in 15 sessions). This lower than usual participation rate is partly accounted for by the loss of 7 sessions due to rain and/or poor ground conditions. Some of our workers are shown below. On the left are McIsaac G1 and 2 students at our Roche area in June. On the left are a group of our community volunteers after an evening's work at our Hapnot North area in July.



New Growth in Treated Areas

The areas we are treating are either totally barren, or have a few scattered tufts of the 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 overwinter well, the others flourish, and in the second season grow to about half a metre. Some birches and poplars in our Knight, Knight North, Pizza and Hapnot areas (treated in 2000 and 2001) are now 3.2-3.8 metres high. Spruce seedlings are quite widespread in our Saskatchewan areas, as are



pine - the latter are generally closely associated with parent 'relict' pines. Understory species such as Bicknell's geranium, fireweed, raspberry and bearberry are quite widespread, but tend to be few and far between. Our South Hudson area (which was treated in 2005) is unusual in that it has a much higher density and variety of understory plants than other areas - see picture above left. This may be because it is surrounded on three sides by gardens - which would be a source of 'weeds'. Appendix 3 provides an indication as to how well our areas are doing. It is notable that the 4 areas characterized as 'poorest' are within about a kilometer of the stack. The 4 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 germination and growth from one area to another. We hope that studies presently underway (see below) will provide an explanation for this.

Planting and Seeding

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

On May 13, local Cubs and Beavers and supporting adults planted 350 roses and 350 lodgepole pines (secured by local Saskatchewan Environment personnel from SaskPower's Shand Greenhouse) at our Phantom area. The roses took well, but by August, only about 50% of the pines were surviving. More than 90% of the spruce planted by the Cubs and Beavers at our Reservoir Hill and Second Valley areas in 2005 are surviving and doing well - they are around 30-35cm high. The spruce and pine planted at the Second Valley area in 2003 are in general less healthy, with significant mortality (particularly among the pines) in squares 1, 2 and 4. The spruce seedlings put in by Green Project staff in 2005 at our Balsam, Triple Seven and Railroad areas are doing well - some are up to 50cm high. Pine and spruce cones were scattered in 17 of our areas in 2002 through 2004. Germination has



taken place in all 8 of the southern (Saskatchewan) areas, and in 2006 - for the first time - conifer seedlings were noted in three of our northern areas as well. Some of the pine seedlings from cones scattered by Saskatchewan Environment personnel at our Knight North area in February 2002 are now up to 1.25m. high - see picture above. Seedlings in the other areas are up to 30-50cm. high.

Although understory forbs and shrubs are found in most of our treated areas, they are generally few and far between. In July 2004 - at the suggestion of our technical consultant, the late Professor Keith Winterhalder - experimental transplant lines were established at four of our areas, and small 'gardens' at four others. The plants were taken from the bush on the outskirts of Flin Flon, in addition, some plants were supplied by Edgar and Mary Wright from their garden at Denare Beach. The purpose of the experiment was to determine how well the various species would take to being transplanted, and whether or not, once established, they would act as nuclei from which they would spread. The table below indicates the status of the transplants at fall, 2006.

Area	Survival Rate	Survivors	Non-survivors
Esso	43%	Rose, Trailing raspberry, Red clover	Bunchberry, Fireweed, Blueberry, Spreading dogbane
Triple Seven	0%	None	Black-eyed Susan, Harebell, Columbine, Prairie lily, Grass of Parnassus, Bog cranberry, Blueberry, Mayflower, Fireweed, Bunchberry, Bearberry, Rose, Wild raspberry, Gooseberry
Phantom	75%	Black-eyed Susan,	Harebell, Bearberry*,

		Pussytoes, Columbine, Blueberry, Three-toothed cinquefoil, Rose, Bog cranberry, Gooseberry, Wild raspberry, Vetch, Saskatoon berry(?), Blueberry	Mayflower*
Knight	50%	Rose, Fireweed, Trailing raspberry, Mayflower, Red clover	Blueberry, Bearberry, Bunchberry, Lowbush cranberry, Sarsaparilla

**These are either dead or barely surviving*

Harebell and black-eyed Susan are survivors at most of the gardens - harebell seems to be starting to spread at the Second Valley square 4 garden. The other plants have either not survived, or are barely hanging on.

Supplementary documentation on our 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, some are coming along more slowly, while in a few the response has been minimal. What accounts for this varying response? Is it due to variations in the base-metal content of the soil? What treatment in addition to the application of crushed limestone will be needed to enhance germination and growth in our 'slow' and 'poor' areas? 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. Similar experiments are presently being conducted by consultants for Hudson Bay Mining & Smelting Company Ltd.

Photography

During our first six project years we took 1,223 pictures, and in 2006 we took an additional 135. 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 was taken shortly after treatment in July, 2000. At right is the same scene in August 2006.



Public Relations

Articles in the daily 'Reminder' and the weekly 'Gazette' kept our project in the public's eye again in 2006. We also had coverage from our local radio station, CFAR. A sixth issue of our newsletter 'Green Project News' was released last 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 2007. The main activity will be at our Phantom, Creighton East, Hilary, Louis and Reservoir Hill areas. We plan to update our outdoor informational signs, and put up a new one at the Creighton tourist office in 2007.

Additional Information

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and check out our web site at: www.greenproject.ca

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. Hudson Bay Mining and Smelting Company Limited and the Flin Flon Economic Development Commission 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. As a result, the decision was made to establish the Green Project. A committee was formed, and planning meetings were held in March and April 2000. Through the generosity of McKeen's Trucking - who donated 130 yards of crushed limestone - we were able to start work in May 2000. Since then, the Green Project has become an affiliate of the Flin Flon and District Environment Council.

Present members of the committee are: Flin Flon School Division - Youth Mentor program, Creighton School Division, City of Flin Flon, Town of Creighton, Flin Flon and District Environment Council, Hudson Bay Mining and

Smelting Company Limited, Manitoba Industry, Economic Development and Mines, and Saskatchewan Environment.

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 walk over the ground, and once we decide on our areas, we divide them into 50 x 50 metre squares. The crushed limestone is then trucked in and dumped as close as possible to the squares. We mark out the sides of the squares with rope. Our volunteers fill their pails at the dump then spread the limestone in a strip between a pair of 'moving ropes'. As each strip is filled, we move the ropes and continue in this way until the whole square is covered.

APPENDIX 2: Environment and Science

In and around the communities of Flin Flon and Creighton¹, 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 plants². 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,

¹ *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.*

² *This paragraph is from information supplied by Professor Winterhalder.*

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 Limited 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.

APPENDIX 3: Area Vegetation-cover Scores at Fall, 2006

Area (& Distance)*	Years Treated	A	B	C	D	Total Score
1 - Balsam (1.9km)	'01	2	3	2	0	7
2 - Rk Cut (1.1km)	'01	1	1	0	0	2
3 - SecV-N (1.1km)	'00-'02	2**	2	2	0	6**
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,'06	2**	2	0	0	4**
8 - Hapnot (1.6km)	'00-'02	3	3	2	2	10
9 - Phant (2.5km)	'01-'03	3**	2	2	2	9**
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	2	3**	2	0	7**
15 - Esso (2.2km)	'02,'03,'04	2	2	2	0	6
16 - Crtnor (1.6km)	'02,'03,'04	3	3**	0	2**	8**
17 - Sup-K (1.2km)	'02	3	2	0	0	5
18 - TripSev (0.6km)	'02	1	2**	0	0	3**
19 - Markt (1.4km)	'02	1	2	0	0	3
20 - ResHill (0.7km)	'02,'03,'05	1	2**	0	0	3**
21 - Lanc (2.3km)	'03,'06	2**	1	0	0	3**
22 - RailRd (1.7km)	'03	2**	1	0	0	3**

23 - PhantN (1.9km)	'03,'05,'06	3	2	2	2	9
24 - Hapnot North	'06	0	0	0	0	0
25 - Louis (2.3km)	'04	1	2**	2	0	5**
26 - CrtEast (1.4Km)	'04,'05,'06	2**	2**	2**	2**	8**
27 - SoHudson (1.5km)	'05	2**	1	2	0	5**
28 - Roche (1.9km)	'05,'06	1**	0	2**	0	3**
29 - PhantNW (2.1km)	'05	0	0	0	0	0
30 - RedMtn (2.1km)	'06	1	1	0	0	2
31 - Hilary (2.4km)	'06	0	0	0	0	0

A: Vegetation density - low/medium/high, score 1/2/3.

B: Maximum bushy seedling height - <50cm/50-150cm/>150cm, 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 2005

