Introduction

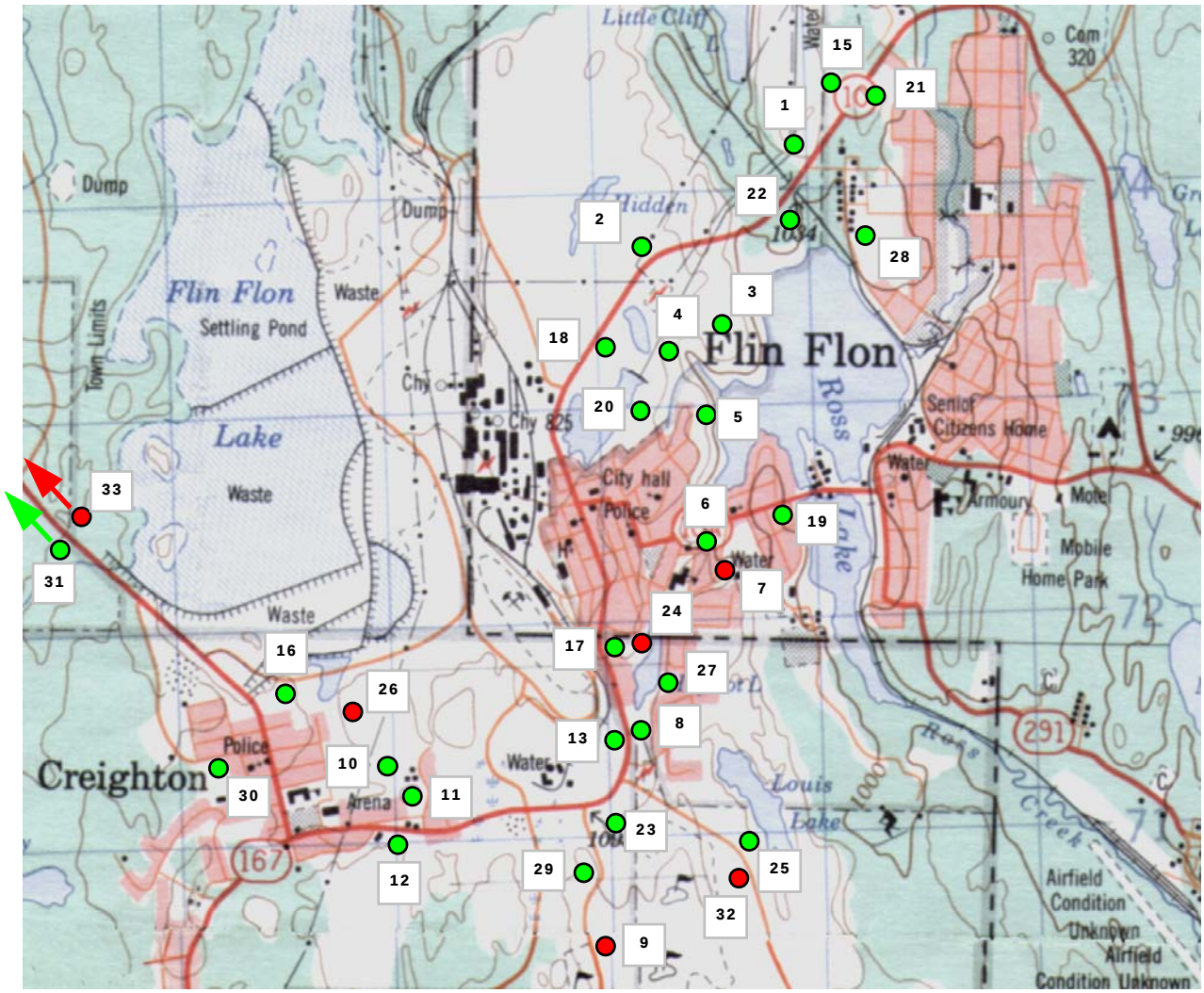
- 2007 was the eighth year for our community-based project.
- Our purpose is to accelerate the re-vegetation of barren areas in and around our communities by the application of crushed limestone.
- Because of the ruggedness of our terrain, it is not feasible to do the work by machine, so we use people-power, namely students from local schools and adult volunteers.
- Adequate rainfall, alternating with pleasantly warm spells during the summer of 2007 were good for growth. By fall, birch and poplars in some areas we had treated a few years earlier were over 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 2007 came from Hudson Bay Mining and Smelting Company Ltd. The City of Flin Flon, the Town of Creighton and Reg Hiebert of Northern Bus Lines 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 7 through September 25, we spread 81.2 yards of crushed (dolomitic) limestone in 6 areas to cover a total of 4.1 hectares (10.2 acres). The map below shows these areas. During the project period 2000-2007, we have treated 34.2 hectares (84.5 acres) with 784.2 yards of limestone.



Green circles indicate areas treated 2000 through 2006. Red circles indicate areas treated in 2007. *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.

Personnel

The work was carried out by 655 individuals during 29 sessions (593 students in 21 sessions, and 62 members of the general public in 8 sessions). At left below are grade 1 and 2 students from McIsaac School at our Phantom area in June. At right are students and staff from Many Faces Education Centre at our Sand Bar area in May.

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 and Knight North areas (treated in 2000 and 2001), some individuals are 4 metres or more high. As of the fall of 2006, self-seeded conifers were present in eight of our areas – they are now present in thirteen. Pines – commonly associated with old relict parents – are locally 2 metres high, and a single tamarack at our Knight area is 2.5 metres high. Alders were not noted in any of our areas until 2005 – they are still much less common than the other woody species. 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.

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 below left - taken in July, 2007 - shows part of the Creighton East area that was treated in 2005. The picture at right shows signs of life at Reservoir Hill – one of our 'slower' areas. It includes spruce seedlings planted by the Cubs and Beavers in 2005.

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 four 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 and in vegetation density from one area to another. We hope that scientific 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, 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 1-2m 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.

Pine and spruce cones were scattered in seventeen of our areas in 2002 through 2004. Germination has taken place in nine of the areas (all but one in Saskatchewan). Some of the pine seedlings from cones scattered by Saskatchewan Environment personnel at our Knight North area in February 2002 are now up to 1.9m. high. Seedlings in the other areas are up to 35-50cm. high.

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.

This year, 900 seedlings (buffaloberry x100, jackpine x350, red osier dogwood x100, white spruce x250, and woods rose x100 – donated by Saskatchewan Environment / Shand Greenhouse) were planted at our Balsam/Esso and Phantom

areas by local Cubs and Beavers and supporting adults, May 17 and 24. Later in the season, the conifers in particular had taken quite well, and had put on new growth – some were up to 40cm. high. 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 30-40cm high (see Photopage 2). The spruce and pine planted by the Cubs and Beavers 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.

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 will 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. Similar experiments are presently being conducted by consultants for Hudson Bay Mining & Smelting Company Ltd. (HBMS). In November and December, meetings attended by the Green Project and HBMS, together with the HBMS consultants and members of the faculty at the University of Saskatchewan's Department of Soil Science were held in Flin Flon and Saskatoon. The purpose of the meetings was to explore the possibility of setting up a multi-year research project to address the questions referred to above.

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

It may be appropriate to mention here that in July, Manitoba Conservation released a report titled 'Concentration of Metals and Other Elements in Surface Soils of Flin Flon, Manitoba and Creighton, Saskatchewan, 2006'. This release

stimulated a great deal of public and media interest both locally and across Canada. In the Flin Flon 'Reminder' of October 9 it was announced that '… HBMS has hired Ontario-based Intrinsik Environmental Sciences Inc. to conduct an independent probe into what the soil levels may mean in terms of human health risk …'. As of November, information on this study has been available at www.flinflonsoilsstudy.com

Photography

During our first seven project years we took 1,358 pictures, and in 2007 we took an additional 138. 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 shows Green Project coordinator Heather Acres admiring a Manitoba maple seedling at the Knight area in June, 2000 – about a month after the limestone treatment. On the left is the same scene in August, 2007.

Public Relations

Articles in the Flin Flon 'Reminder' and the 'Gazette' kept our project in the public eye again in 2007. An article titled "Going Going Green!" appeared in the July-August edition of 'Cottage North' magazine. We also had coverage from our local radio station CFAR, CBC North Country and Shaw Cable. A seventh 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 2008. The main activity will be at our Phantom, Creighton East, Reservoir Hill, Esso, Second Valley, Golf, Sand Bar and Hapnot North areas, together with the new 'Driving Range' area (see map on page 2). Our Committee plans to have its annual informational meeting in early June.

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 Ltd. and the Flin Flon Economic Development Commission provided funding to bring Professor Winterhalder up here in October 1999. His presentations to a number of groups 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. Later, the Green Project became 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 Science, Technology, Energy 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 Creighton[1], 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[2]. 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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[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 the late Professor Winterhalder.*

APPENDIX 3: Area Vegetation-Cover Scores at Fall, 2007

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	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-'07	2	2	0	0	4
8 - Hapnot (1.6km)	'00-'02	3	3	2	2	10
9 - Phant (2.5km)	'01-'03,'07	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	3**	3	2	2**	10**
15 - Esso (2.2km)	'02,'03,'04	2	2	2	2**	8**
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	2**	0	2**	6**
22 - RailRd (1.7km)	'03	2	2**	0	2**	6**
23 - PhantN (1.9km)	'03,'05,'06	3	2	2	2	9
24 – Hapnot North	'06,'07	1**	1**	2**	0	4**
25 - Louis (2.3km)	'04	2**	2	2	0	6**
26 - CrtEast (1.4Km)	'04-'07	3**	2	2	2	9**
27 - SoHudson (1.5km)	'05	3**	1	2	0	6**
28 - Roche (1.9km)	'05,'06	2**	1	2	0	5**
29 - PhantNW (2.1km)	'05	1**	1**	2**	0	4**
30 – RedMtn (2.1km)	'06	2**	1	2**	0	5**
31 – Hilary (2.4km)	'06	1**	1**	2**	0	4**
32 - Golf	'07	0	0	0	0	0
33 – Sand Bar	'07	0	0	0	0	0

A: Vegetation density - low/medium/high, score 1/2/3.
B: Maximum woody 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 2006.