Introduction

- 2011 was the twelfth 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.
- There was not much precipitation through mid-June, but significant rainfall in early July through late August led to flooding and exceptionally high lake levels. The period September through early October was very mild. Periods of unusually high precipitation alternating with periods of pleasant summer weather made this a very good growing season. Some birch and aspen in our best areas are now more than 5 metres high.
- The organizational and scientific backgrounds to our project are explained in Appendices 1 and 2.

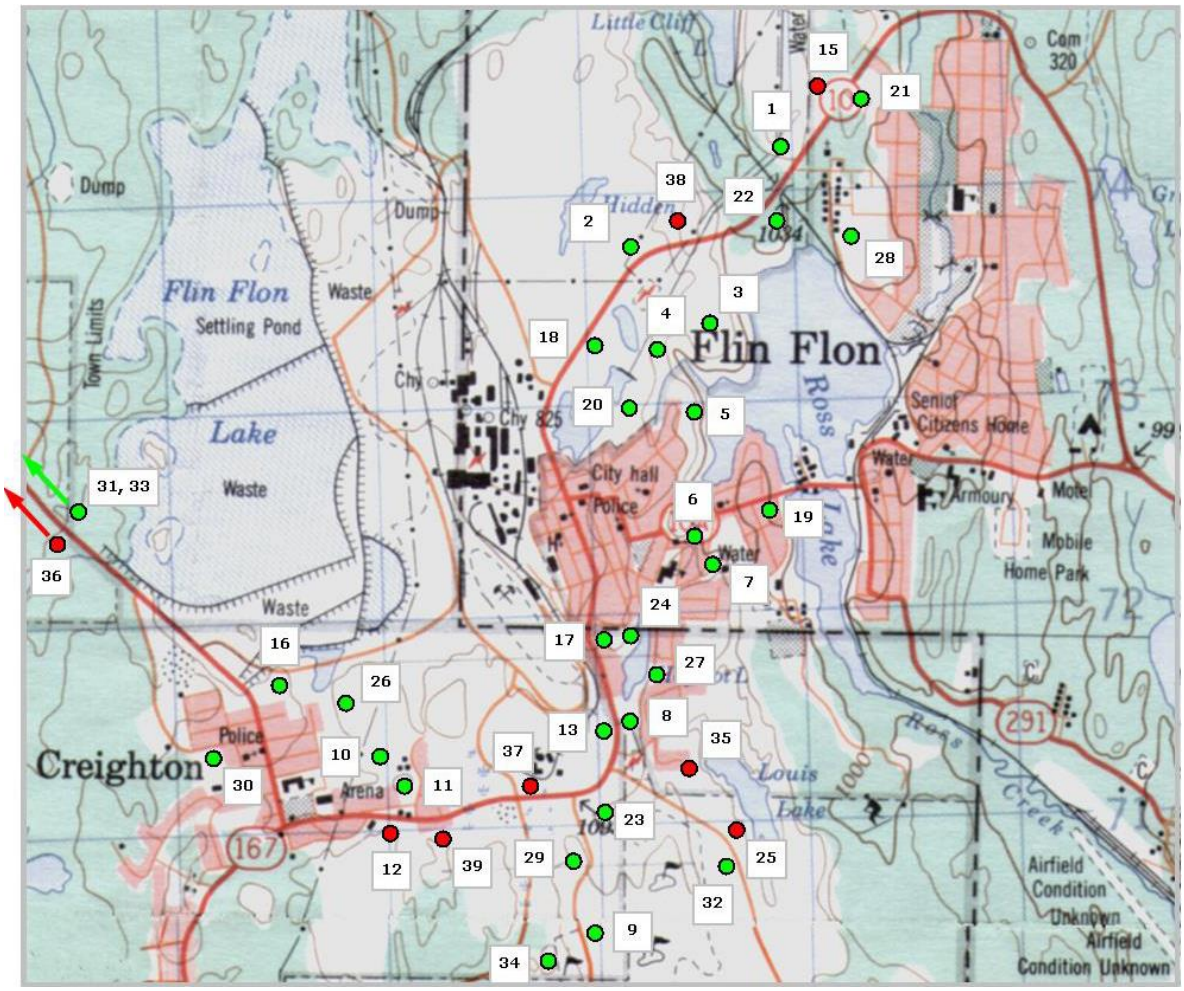
Our Partners

We gratefully acknowledge that our project has been made possible through the generosity of our partners. Major funding for the work in 2011 came from HudBay Minerals Inc. (HMI). Crews from the City of Flin Flon the Town of Creighton hauled limestone to some of our new areas. 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. Edgar and Mary Wright and Donna Lundquist and her colleagues at the Saskatchewan Ministry of Environment helped us with plant identification.

Area Treated

In the map below, green circles indicate areas we treated in 2000 through 2010, red circles indicate those treated in 2011. Area names are as follows: 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, 35: Icehouse, 36: Creighton Creek, 37: Headframe, 38: Rock Cut North, 39: Larson.



During a field season lasting from May 18 through September 29, we spread 64 yards of crushed limestone (dolostone) in 8 areas to cover a total of 3.3 hectares (8.15 acres). Appendix 3 tabulates limestone usage. During the project period 2000-2011, we have treated 50.13 hectares (123.9 acres) with 1,076 yards of limestone (an application rate of 21.5 yards/hectare).

Volunteer Field Personnel

The work was carried out by 866 individuals during 40 sessions (846 school students in 38 sessions and 20 members of the general public in 2 evening sessions). Included in the student number are 7 members of the University of Saskatchewan Soil Science group who joined Hapnot students for one of their sessions. Overall, volunteer numbers were our best ever. This is in part accounted for by the unprecedented level of participation by students from Hapnot Collegiate. On the other hand, attendance at our evening sessions in July and August was disappointing. Details on personnel distribution are tabulated in Appendix 4. At left below are McIsaac grade K and 3 students after a work session at our Icehouse area in May. At right are Creighton grade 3s at our Creighton Creek area in June.

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.

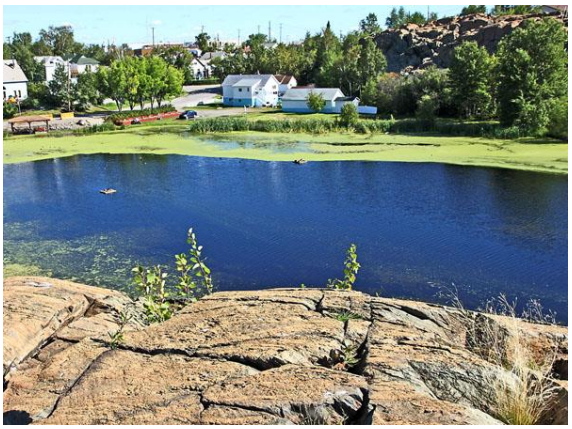
Birch, poplar and aspen in several of our areas are now 3-4 metres high, and at our Knight, Knight North and Hapnot areas (treated in 2000 and 2001), some individuals are over 5 metres high. As of the fall of 2008, self-seeded conifers were present in fourteen of our areas – they are now present in twenty five. Jack pines – commonly associated with old relict parents – are locally up to 4 metres high. Cones were first noted on pines (self-seeded and transplanted) in several of our areas in 2008. Cones were first noted on a spruce at our Knight North 'plantation' (see below) in 2009, and on a self-seeded spruce at the Hapnot area in 2010. This year, cones have also been noted on spruce at our Balsam, Knight and Pizza 'plantations'. At left below is a 5 metre-high birch at our Knight area. At left are cones on a black spruce at our Balsam 'plantation'.

Until 2009, self-seeded tamarack had been noted only at our Knight area (three individuals) - the tallest is 3.1 metres high. The small tamarack seedling first noted at our Creighton East area last year is doing well. Individual Scots pines were noted for the first time at the Knight and Knight North areas in 2010. These were presumably seeded from imported trees planted in local yards – the individual at the Knight area is now 2.45 metres high. Alders were not seen in any of our areas until 2005 – they have now been noted in fifteen (one more than in 2010). In five of these areas, it appears that the seed came from individual alders put in at our 'plantations' in 2001. Individuals and small clusters of dwarf birch were first noted

at our Knight area some years ago. Dwarf birch has now been recognized in three areas.

Although understory species such as fireweed, rough cinquefoil, raspberry and bearberry are quite widespread, they tend in general to be few and far between. Our best areas in terms of variety and density of understory species are South Hudson and Roche. It is of interest to note that there is a greater variety and number of understory species coming through in areas we treated at our Louis and Esso areas in 2010 than in adjoining areas that were treated in earlier years. A rush (Juncus?) put in a first appearance in damp depressions on top of a rock outcrop at our Golf area this year. 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 'Duck Pond' (which appears on maps as 'Hapnot Lake') is a small water body (460 metres from north to south) straddling the inter-provincial boundary at the south end of Flin Flon's uptown area. In 2010, for the first time to the knowledge of area residents, a bloom of duckweed (Lemna minor) appeared – sometimes covering the entire surface of the pond.



The same bloom has been present this past summer also. What accounts for this sudden appearance? The catchment area for the pond is very small and there are no streams running into it (the outlet is at the southwest corner via a culvert under South Main Street). The total perimeter of the pond is about 1,080 metres. Three of our Green Project areas (Hapnot, Hapnot North and South Hudson) abut the pond along a total shoreline length of 373 metres, that is, about one third of the total perimeter. No doubt our activities have impacted the water chemistry of the

Duck Pond. Is this what accounts for the sudden appearance of the duck weed? At a recent seminar coinciding with the release of Saskatchewan Ministry of Environment's 'Field Guide to the Ecosites of Saskatchewan's Provincial Forests', Michael McLaughlan, one of the Guide's co-authors, suggested that this probably was the case.

As noted in last year's newsletter, carpets of dead leaves which have started to accumulate in some of our most densely vegetated areas constitute the beginnings of a new organic topsoil. The mushroom Amanita muscaria was first noted in one of these shady and leaf-carpeted spots at our Knight North area in 2010. This year, Amanita was also noted at our Knight area. Several ant colonies were noted at squares 63 and 64 at our Phantom area in May – the first we have seen in any of our treated areas. This is no doubt indicative of local positive changes in soil characteristics.

Appendix 5 provides an indication as to how well each individual area is progressing. It is notable that the four areas characterized as 'poorest' are within about a kilometer of the HMI 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 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 depend 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 most 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 very good. A grass fire in June 2010, which reached the west end of the Balsam plantation, killed the pine and the alder and singed one of the spruce. Vandals broke off the main trunks of the two pines at the Hapnot plantation at knee-height in 2010, but growth of the lower branches continues. 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' - see appendix 5. Plantation conifers in some areas categorized as 'best' (such as Knight and Knight North) are very healthy and up to 3.9m 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. Since then, cones have appeared on the pines at the Second Valley, Hapnot, Pizza and Rock Cut plantations. The tallest spruce in our Knight North plantation produced masses of cones in 2009 – these were the first spruce cones to have appeared in any of our treated areas. This year, cones appeared on spruce at our Balsam, Knight and Pizza plantations – see page 4.

Pine and spruce cones were scattered in sixteen of our areas in 2002 through 2004. Germination has taken place in eleven of these areas. Some of the pine seedlings from cones scattered by Saskatchewan Ministry of Environment personnel at our Knight North area in February 2002 are now up to 4.3 metres high. Seedlings in the other areas are up to 2.9 metres high. The pines at the Knight North area produced cones for the first time in 2008. Since then, cones have appeared on pines at our South Main, Phantom North and Creighton North areas.

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. Results to date are best at the Balsam/Esso area where some pines are up to 1.25 metres high. Since 2010, some have had cones. Results are more patchy at the Second Valley area where mortality for both spruce and pines is high at square 1, but healthy spruce up to 75 centimetres high are quite widespread at squares 5, 6 and 8. It is no longer possible to pick out the Cub and Beaver spruce and pines from among the many self-seeded conifers that are coming through in the Phantom area.

Spruce seedlings from SaskPower's Shand Greenhouse were supplied to us by Saskatchewan Ministry of Environment Creighton office personnel in 2005. They were put in by Green Project staff at three of our areas. Those at our Balsam and Railroad areas and are doing quite well and are up to a metre high. Some are healthily green and filling out (particularly at Balsam), while others are smaller,

thinner and less regular, and tend to be a bit yellowish. Those put in at the Triple Seven area were buried during HMI landscaping activities in the fall of 2008.

In April 2009, Donna Lundquist of the Saskatchewan Ministry of Environment donated 14 kilograms of jack pine and white spruce seeds. These had been collected in 1995 and 1978 respectively, and were being removed from inventory because of their low (estimated 40%) viability. They were scattered in six of our areas by Green Project staff on April 25, 2009 and by Creighton grade 4 students at the Sandbar area June 8. This year, no seedlings were found at our Market area, but good densities were present elsewhere. Dominant pines were associated with fewer and smaller spruce. Pines at the Reservoir Hill and Railroad area were up to 30-35 centimetres high, while some at the Hilary area were up to 50 centimetres.

Supplementary documentation on the above, and on 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?

Our consultant Professor Keith Winterhalder made brief visits to Flin Flon in the summers of 2000 through 2003. He monitored vegetation growth and pH changes in the soil in areas we had treated – he also checked up on experimental plots he had established south of Creighton in 1994 and 1997. He submitted reports on his findings to the Green Project and to HMI in 2001 through 2004. At the time of his death in October 2005, he had been conducting greenhouse experiments on mixtures of Flin Flon soils with other additives. Manitoba Conservation ecosystem monitoring specialist Geoff Jones visited Flin Flon in 2008 to resume monitoring vegetation on the transect lines set up by Professor Winterhalder. A detailed report on this work was submitted in June, 2009. A further five days of field

work was carried out in July, 2009. We were saddened to learn that Geoff passed away in January, 2010.

Following preliminary discussions with HMI 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. Funding secured from HMI and the Natural Sciences and Engineering Research Council of Canada (NSERC) allowed the project to go ahead for an initial three-year period. Additional NSERC funding - in place as of June 2011 - will allow the project to continue for two more years. Site assessment – which included detailed soil mapping and collection of soil samples for laboratory characterization – was carried out in 2008 and continued through 2009. Other project components include development of amendment strategies, metals characterization and speciation, and soil ecology and ecosystem sustainability. Green Project coordinators, HMI staff and Soil Science faculty and students met in Flin Flon in June and on the campus in Saskatoon in December to review progress.

A study on the health implications of elevated levels of some metals and other elements in the soils of Flin Flon and Creighton, was referred to in our 2007-2010 Reports of Activities. The final study report was released in June, 2010. This report, together with other information on the study – which was carried out on behalf of HMI by Intrinsik Environmental Sciences Inc. - is available at www.flinflonsoilsstudy.com.

Photography

Pairs of 'before-and-after' pictures illustrate in a dramatic way, how effective the limestone treatment is proving to be. At left is a view of the north end of our South Main area taken shortly after treatment in 2002. At right is the same scene in August this year. During our first ten project years we took 2,001 pictures, and in 2011 we took an additional 182. These will serve as a permanent record of the project, and are being used for public relations purposes.

Public Relations

Our annual public informational meeting (29 attendees) was held at the Flin Flon School Division office June 3. Presentations were given by faculty members from the University of Saskatchewan Soil Science Department and by Green Project coordinators. Flin Flon's new MLA (and co-founder of the Green Project) Clarence Pettersen, used his first private members statement on October 25 to give his fellow legislators a glowing account of our project. Articles in the Flin Flon 'Reminder' kept our project in the public eye again in 2011. Local radio station CFAR kept the public informed of our activities over the summer months. We made posters and brochures which were distributed to local schools. Our web-site – www.greenproject.ca – was updated.

Future Plans

We aim to treat another five hectares in 2012. We will continue work at our Esso, Icehouse, Headframe and Larson areas and start work at our new Soccer area (between the driving range and the Phantom soccer field).

Additional Information

Please contact project coordinators:

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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, 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 consultation group 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 consultation group 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 Ministry of 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[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[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. spent hundreds of millions of dollars on improving technology at the smelter complex, with the result that emissions of sulphur dioxide and metal oxide dust were significantly reduced. The natural vegetation started to slowly recover. Our project is accelerating this recovery. In June 2010, the copper smelter was closed down, resulting in a complete cessation of gaseous and particulate emission from the stack.

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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.*

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

APPENDIX 3: Crushed Limestone Usage in 2011

Areas	Remaining from 2000-'10	Delivered 2011 (yards)	Remaining at end of 2011	Used in 2011	Hectares covered	Applicn. rate (yd./ha.)
Balsam	1	-	1	-	-	-
Rock Cut	1	-	1	-	-	-
Sec.Val.	5.97	-	5.97	-	-	-
FirstAv.	-	-	-	-	-	-
Hiawath.	1.03	-	1.03	-	-	-
Grand.	0.93	-	0.93	-	-	-
Hapnot	-	-	-	-	-	-
Phantom	10.24	-	10.24	-	-	-
Knight N.	2	-	2	-	-	-
Knight	1.5	-	1.5	-	-	-
Pizza	4.9	-	3.87	1.03	0.091	11.32
So. Main	1.18	-	1.18	-	-	-
Esso	14.42	10*	17.88	6.54	0.366	17.87
Crtn. N	4.7	-	4.7	-	-	-
Super-K	0.3	-	0.3	-	-	-
Triple 7	5.8	-	5.8	-	-	-
Market	-	-	-	-	-	-
Resr. Hill	4.02	-	4.02	-	-	-
Lancaster	4.27	-	4.27	-	-	-
Railroad	-	-	-	-	-	-
Phant. N	5.09	-	5.09	-	-	-
Hap.Nor.	1.71	-	1.71	-	-	-
Louis	11.28	-	6.49	4.79	0.212	22.59
Crtn.E	10.52	-	10.52	-	-	-
So. Hudson	3.69	-	3.69	-	-	-
Roche	2.38	-	2.38	-	-	-
Phant. NW	2.2	-	2.2	-	-	-
Red Mtn.	7.06	-	7.06	-	-	-
Hilary	4.46	-	4.46	-	-	-
Golf	2.42	-	2.42	-	-	-
Sand Bar	2.7	-	2.7	-	-	-
Driv. Rge.	3.82	-	3.82	-	-	-

Areas	Remaining from 2000-'10	Delivered 2011 (yards)	Remaining at end 2011	Used in 2011	Hectares covered	Applicn. rate (yd./ha.)
Icehouse	-	20	8.69	11.31	0.762	14.84
Crtn. Creek	-	10	3.2	6.8	0.25	27.2
Headframe	-	30	15.25	14.75	0.589	25.04
Rock Cut N	-	15	3.66	11.34	0.639	17.75
Larson	-	15	7.1	7.9	0.417	18.94
Total	**120.59**	**100***	**156.13**	**64.46**	**3.326**	**19.38**

The total area covered to date (2000 – 2011) is 50.13 hectares. The total limestone used during the period has been 1,075.87 yards. The overall rate of limestone application to date has therefore been 21.46 yards per hectare.

*McKeens donated 10 yards in the summer of 2010 (delivered to Esso area).

APPENDIX 4: Personnel Distribution for 2011

Date	Area	Square*[1]	Group	Number*[2]
May 18pm	Louis	286,287	HapG9,11	13
May 18pm	Louis	284	HapG8,9	24
May 19am	Headframe	291,292,293	HapG?	39
May 19am	Headframe	291,292,293	HapG?	7
May 19pm	Headframe	291,292,293	HapG?	10
May 19pm	Headframe	291,292,293	HapG?	29
May 20am	Icehouse	301,302	HapG?	14
May 20pm	Icehouse	301,302	HapG?	25
May 24am	RkCutNorth	307	McIGK	19
May 24pm	Esso	314,316	McIG5	21
May 25am	RkCutNorth	307,309	McIG2	19
May 25pm	RkCutNorth	307,309	McIG2	29
May 26am	Esso	313,314,315,316	McIG4	23
May 26pm	RkCutNorth	309,310	McIGK,4,5	38
May 27am	Esso	314	McIG3	20
May 30am	Icehouse	301,304,305	McIG1	24
May 30am	Icehouse	301,304,305	RBG5,8	18

Date	Area	Square*[1]	Group	Number*[2]
May 30pm	Icehouse	301	McIGK,?	33
May 31am	Icehouse	299,302	McIG1	17
June 2pm	Esso	281,283	HapG?/UofS	7/7
June 6pm	Larson	317,324	CrtnGPreK,4	34
June 8am	Pizza	274,275	CrtnG4	17
June 9am	Headframe	294,295	HapG?,?	34
June 9pm	Headframe	293,294	HapG?	10
June 10pm	RkCutNorth	308,309,310	RBG1	17
June 13pm	Larson	317,324	CrtnG4	15
June 14am	Crtn. Creek	320,321	CrtnG5	16
June 14pm	Icehouse	301,302,304,305	RBG6	24
June 15am	Icehouse	296,297	RBGK	22
June 17am	Louis	285,287	McIG3	23
June 17pm	Larson	317,318,319	CrtnG5	19
June 20am	RkCutNorth	307,308	RBG2	14
June 20pm	Larson	318,319	CrtnG4	19
June 21am	Crtn. Creek	322,323	CrtnG3	32
June 21pm	RkCutNorth	308	RBG2	36
June 22pm	RkCutNorth	309	RBG1	20
June 23pm	Icehouse	296,297,298,299	RBG5	24
July 13evg	Larson	319	Comm. Vol.	12
Aug 3evg	RkCutNorth	308,310	Comm. Vol.	8
Sep 29pm	Headframe	291,292,293,294	Hap/MFG9	16/8

*[1] *Each area is divided into 50x50metre numbered squares.*

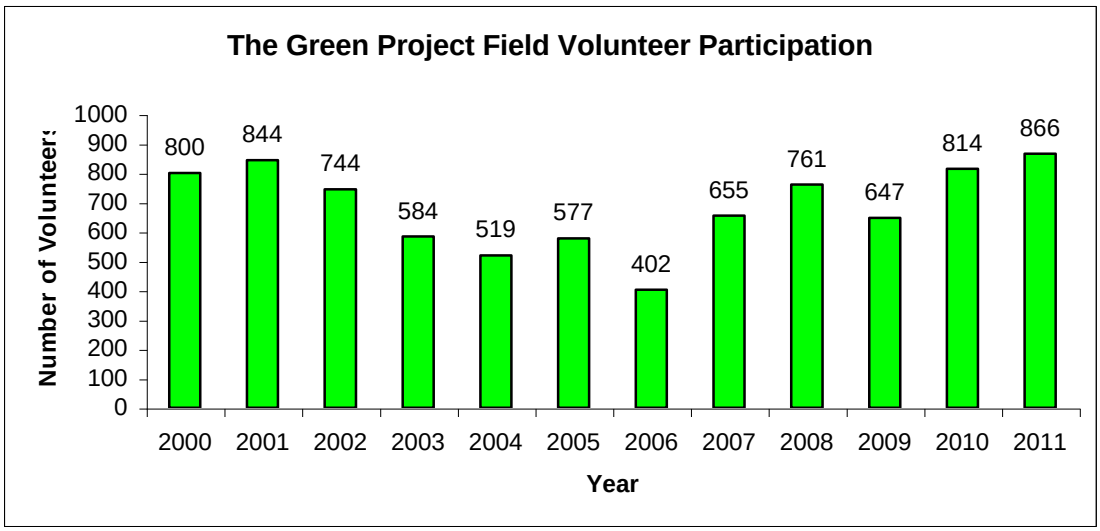
*[2] *Note that 'Number' includes supervisors, school mentors, and teachers.*

Personnel Distribution ~ Summary Tabulation 2011

Group	Sessions	Number*[3]
McIsaac School	11	266
Ruth Betts School	8	175
Creighton School	7	152
Hapnot Collegiate	11	238
Many Faces E.C.	0.5	8
U. of S. Soils Group	0.5	7
Community Volunteers	2	20
Total	**40**	**866**

*[3] *Because some individuals worked in more than one session, the actual number of participants in the Green Project is less than this.*

Personnel Distribution ~ 2000-2011



APPENDIX 5: Area Vegetation-Cover Scores at Fall, 2011

Area (& Distance)*	Years Treated	A	B	C	D	Total Score
1 - Balsam (1.9km)	'01	3*	3	2	2	10*
2 - RkCut (1.1km)	'01	1	2*	2	0	5*
3 - SecV-N (1.1km)	'00~'02, '08~'10	2	3	2	2*	9*
4 - SecV-W (0.9km)	'00, '01	0	0	0	0	0
5 - FirstA (1.0km)	'00	1	3	0	0	4
6 - Hiawa (1.1km)	'02, '04	3	3	2	0	8
7 - Grandv (1.3km)	'01, '05~'07	2	3	2	0	7
8 - Hapnot (1.6km)	'00~'02	3	3	2	2	10
9 - Phant (2.5km)	'01~'03, '07~'09	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, '10, '11	3	3	2	2	10
13 - SoMain (1.6km)	'02~'04	3	3	2	2	10
15 - Esso (2.2km)	'02~'04, '08~'11	3*	3	2	2	10*
16 - CrtNor (1.6km)	'02~'04	3	3	0	2	8
17 - Sup-K (1.2km)	'02	3	3	0	2	8
18 - TripSevn (0.6km)	'02	1	2	0	0	3
19 - Markt (1.4km)	'02	2	3	2*	0	7*
20 - ResHill (0.7km)	'02, '03' ,05, '08	2	3	0	0	5
21 - Lanc (2.3km)	'03, '06	2	3	0	2	7
22 - RailRd (1.7km)	'03	2	3	0	2	7
23 - PhantN (1.9km)	'03, '05, '06, '09	3	3	2	2	10
24 – HapNor (1.5km)	'06~'09	3*	3	2	2	10*
25 - Louis (2.3km)	'04, '09~'11	3	3	2	2	10
26 - CrtEast (1.4Km)	'04~'08	3	3	2	2	10
27 - SoHudson (1.5km)	'05	3	3	2	2	10
28 - Roche (1.9km)	'05, '06	2	3	2	2	9
29 - PhantNW (2.1km)	'05, '10	3*	3	2	2	10*
30 – RedMtn (2.1km)	'06	2	3	2	2*	9*
31 – Hilary (2.4km)	'06	3*	3	2	2	10*
32 – Golf (2.7km)	'07~'09	3*	3	2	2*	10*
33 – Sand Bar (2.5km)	'07~'09	2	2	2*	2	8*

Area (& Distance)*	Years Treated	A	B	C	D	Total Score
34 – DrivgRge (2.8km)	'08, '09	2	2	2	2	8
35 – Icehouse	'11	1*	0	0	0	1*
36 - CrtnCreek	'11	0	0	0	0	0
37 - Headframe	'11	1*	0	0	0	1*
38 - RockCutN	'11	1*	0	0	0	1*
39 - Larson	'11	1*	0	0	0	1*

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 the HMI stack.
* Score improved since 2010.