A REPORT ON THE AFFORESTED AREAS AND GRASSLANDS

Of

THE RESORT VILLAGE OF MISTUSINNE

to the

Council of the Resort Village of Mistusinne, Saskatchewan

by

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EXECUTIVE SUMMARY

This report describes our filed investigation of the afforested and grass covered public areas of the Resort Village of Mistusinne. The village area is in a dryer part of the mixed grassland ecoregion. The village is 8 km south Elbow on the east shore of Lake Diefenbaker reservoir.

Appropriate to the area ecology and particularly the semiarid environment, we consulted references on plant physiology, stand structure (shelter value), and vegetation (trees and grasses) management practices.

Existing afforestation (rows of tree plantations) consists mostly of monoculture and even aged trees, at potential risk of diseases and mortality. Stand composition is of single to several rows of deciduous trees, predominantly hybrid poplars and Manchurian elm. Poplars appear to be nearing their life span earlier than the expected years. This could be due to semiarid environmental conditions and continued deep tilling and pruning.

A tree replacement program will offer an opportunity to introduce other drought tolerant species and to enhance the aesthetics of tree cover. Such a replacement program would be based on an understanding of the area ecology.

Continued close cropping/mowing of grassed areas will continue to alter the composition of the grass community to less vigorous plant cover and increase the exposure of light sandy soils to the risk of ever-present wind erosion.

We question the advisability of continued tilling and pruning of afforested areas for indefinite periods. We introduce examples from nature to encourage an adoptive management approach to the sustained care of treebelts.

In our opinion, continuation of current practices, namely indefinite pruning of trees, inter-row and peripheral deep tilling, and close cropping or mowing of grasses, will at the very least incrementally diminish the vigour of afforested areas and grass fields.

We recommend no further tree planting until the village has an afforestation plan and a long-term management plan for the area landscapes. We outline the elements of such a landscape management plan. Initially we recommend rehabilitation of existing tree rows to shelterbelt values and also recommend aesthetic enhancements in places.

No additional costs are anticipated with the recommended changes in maintenance, as we advocate way less pruning and more “near zero” tillage. However, the cost of mulching as an alternative weed control will be an additional cost.

We recommend the village acquire a tree shredder for recycling tree material for mulching around plantations and for private use on a fee-for-use basis. To assure a core supply of seedlings to replace and augment aging plantations, the village could should reinstate a tree holding nursery (hybrid poplar and willow cuttings, Scots pine, blue spruce, mugho pine, and so on).

Considering the past investment in trees and the anticipated flow of fuel wood material from future tree salvage and the market price of fuel-wood, the village could institute a fee for fuelwood.

INTRODUCTION

This report was initially intended to be only a fieldtrip report of our August 15, 2006 onsite visit and observations of some of the ecological conditions at the Resort Village of Mistusinne. We volunteered to share our observations with the Council, at no cost.

The village is 8 km's south of Elbow, on the east shore of Lake Diefenbaker. I am grateful to Messrs Hnatiuk and Pepper for their insights during the site visit and the preparing this report, to Lynne Saas for edit, also to Lynne Saas and Jane Corney for interviewing Mr. David MacTavish, senior maintenance person, about current tree and grass maintenance practices (see: response to sample questions in Appendix A).

Visitors to the resort village are pleasantly surprised to find an oasis of trees (Photo 1. Afforestation of treebelt plantations since the late 60's) is thriving under semiarid conditions. The intensively kept tree belts and the mowed open grass areas are a testament to the high priority the village and volunteers have been placing on managing the area landscape.

We take the reader through our filed observations of the landscape and cultural practices; discuss the physiology of plants under drought conditions and the management of native grass lands applicable to the area ecology of the resort village, followed by wide ranging recommendations from plant selection to cultural practices and calling for an area landscape management plan.

These recommendations call for a shift in current management practices while posing questions about when to prune, when not to cultivate, and how much grass to cut, and for how long to provide 'intensive management' of plantations. The rationale for our recommendations rests on employing ecological and physiological guidelines relevant to the dryer portion of the "moist mixed grassland" ecoregion. We also point to examples from nature.

POTENTIAL USE OF THIS REPORT

This report may be useful as:

- A resource document for the *Committee on Maintenance*;
- A reference point for the preparation of an environmental policy and for a vegetation management plan; and, as
- An interim guide for projects such as the procurement of planting stock, a silvicultural guide and grass management.

METHODS

- Onsite reconnaissance of only the trees and grasses on public lands (Crown lands) and photography.
- Identification of the ecological context of the local area and village landscape for an understanding of plant communities in a semiarid environment.
- Visits to nearby abandoned farm yards.
- Published and unpublished references applicable to local area conditions.
- Interview with senior maintenance staff.

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Limitations - Our remarks are specific to the management of trees and grass area on the Crown land portion of the resort village and are intended to draw attention to:

- The state of tree plantations.
- Current management practices.
- Some user impacts.

Aside from our focus on plant vigour, we saw invasion of exotic plants (brome grass, thistle, Russian thistle, as well as volunteer cotoneaster seedlings from residential landscaping, and so on). We are aware of reported leafy spurge infestation in the eastern end of the Elbow pasture (Thorpe and Goodwin. 1997. See "Regional vegetation management plan for the Douglas Provincial Park and Elbow PFRA pasture"). Although we saw no evidence of leafy spurge or other noxious weeds, vigilance is advised.

ECOLOGICAL CONTEXT OF THE RESORT VILLAGE

Area ecology

Water, plants and semiarid environment

Management efforts

Awareness of the *area ecology* (Acton, et. al. 1998) is the first requirement for the management of vegetation in the village. Knowledge of *physiology of plants* and *management of afforested areas* and *native grassland* under drought conditions is the second most important consideration in practicing an adoptive management of the area landscape. The third consideration is the *level of awareness and informed effort* the village is willing to commit to managing and maintaining area landscapes. Increased management efforts, such as pruning, mowing, fertilizing and watering may be expensive, and in some instances counter productive, if pursued contrary to conditions characteristic of the local ecology.

AREA ECOLOGY

Climate

Geology and soils

Hydrology

Flora and fauna.

Climate

The area in and around the Mistusinne Resort Village is in a semiarid climate. A resource inventory report (Blood, 1976) for the adjacent Douglas Provincial Park reported:

- Summers are warm (July warmest) and short.
- Winters are very cold (January the coldest).
- 50% of annual precipitation (14") is during the three summer months; 8"of this during May-September; June is the rainiest.

- The start of growing season is about April 20 followed by emergence of first growth of grass; end of plant growth is about October 15. The last spring frost is about May 31; the mean fall frost arrives about September 10. The average frost free period is about 100 days.
- Moisture deficiency (or net moisture loss) in the area is about 7" to 9" due to evaporation (soil) and transpiration (plants).

Geology and soils

As in most of southern Saskatchewan, soils of the resort village area are over the shales and sandstones of the Bearpaw Formation. Each year a portion of this formation is exposed during the 40 foot draw-down of the reservoir (Lake Diefenbaker). The current surficial deposits in the resort village and outside area to the east and south are glacio-fluvial (glacial river) or lacustrine (lake) origin. The Resort village is located on the southwestern edge of the Brown Soil Zone (Mitchell at. al. 1944) in the dryer southwestern edge of the "moist mixed grassland" ecoregion.

Soils in the Resort Village and surrounding area are characterized by sandy and medium textured soils developed from glacial deposits and are course-textured, originating from glacial deposits, and coarse textured soils originating from alluvial (water) deposits. Examples of these are encountered during excavations for foundations and soil profiles along the eroding shoreline of Lake Diefenbaker.

These dry and well drained sandy soils are fragile for development, susceptible to wind erosion where vegetation cover is diminished, removed, or trampled. During the winter and spring draw-downs on the lake, the shoreline area is exposed to continuous wave action and winds. Full supply level is 1,827 ft. in late summer and full draw-down is 1,790 ft. in the spring. Some years when full supply level is not reached; the shoreline area is invaded by weeds (Russian thistle) that tumble into the village in unsightly pileups along treebelts.

Late summer and fall, storms caused shoreline erosion. Northwest winds moved the shoreline area sand southeastward. These natural forces have been changing the shoreline configuration since the reservoir reached its full supply level of 1,827 ft in 1968. Risk of sand-blowout (Photo 2 - "mini sand dune") at breached shoreline 'cliffs' is ever present (Photos 3 and 4). During strong northwesterly winds, sands from the shoreline area become airborne into the village.

Awareness of these fragile area-site conditions led village planners to lay out the village in its current *clusters* to reduce impacts on the area landscape cover (sand stabilized by plant communities) and to the *building setback* from the reservoir shoreline, to avoid property damage from shoreline erosion and to avoid windborne sands during wind storms. Several ratepayers have commented about sand blown into their cabins from exposed tracks used by ATVs and dirt bikes.

Hydrology

Rainfall over the resort village quickly drains into the sands, some is then stored in aquifers and some seeps out to merge into springs along the shoreline of Lake Diefenbaker reservoir. Back from these seepage locations, sand point wells are about 8 to 15 feet deep. In locations away from the village, nearness of the watertable is evident from foundation excavations and well established treebelts. Elsewhere aquifers are deeper, some with saline content. Not all cottagers have a reliable water source on their properties.

The lake could be a good source of water for non-domestic uses (watering, irrigating trees, and for fire standby) as a back-up during extreme droughts.

Westerly winds off the large reservoir surface hold the potential for enhanced snow management by trapping snow in the resort village, especially following fresh snowfalls.

Flora and fauna

The region, in its natural state, exhibits flora and fauna species common to the mixed grasslands on dark brown soils (Acton et. al. 1998). Because of the sandy drought-prone nature of the soils in the resort village, the plants tend to be more characteristic of the dryer, brown soil zone. Grasses (spear grass, blue gramma and sun loving sedge) are common. A number of wild flowers or forbs such as dotted blazing star, prairie crocus, early yellow locoweed, purple prairie clover, mouse-eared chickweed and hairy golden aster, occur in association with the grass. Woody plants include: choke cherry, wolf willow, buffalo berry, snow berry, dwarf honeysuckle, rose, creeping juniper on drier sites, along with poplars, dogwood and willows near wet lands and seepage areas.

Mule deer, white tailed deer, and coyotes are notable wildlife. Elk from the area around the lake could find their way into the village during harsh winters. In some years, porcupines are encountered in plantations (Scots pine, willows); tracks of raccoons were reported along the shoreline of Lake Diefenbaker. Weasels, significant predators of mice and ground squirrels, have been reported. Mink are common along the shoreline; skunks common in surrounding agricultural areas, occur in the village. Authentic sightings of cougars have been reported in the Elbow and Gardiner Dam area. Lynx, in response to snowshoe hare populations, regularly invade southern Saskatchewan and have been reported in the Elbow area.

Western meadow lark, numerous grassland sparrow species, Hungarian partridge and sharp-tailed grouse, are typical birds of the grass-shrubby areas. Bluebirds, kingbirds, yellow warblers and warbling vireos typify the treed areas while killdeer, spotted sandpiper, piping plover, gulls, and mallard ducks are birds typically found along the shores of the lake.

'Spear and whet grass' plant community exists on sandy loam soils and on a narrow strip of alluvium soils along the top of the inundated Qu'Appelle Valley. These areas are relatively more productive (when moisture is available) than the 'spear grass /blue grama' community over rapidly drained sandy loam and sand in most parts of the resort village. Until the 60's when the land was set aside for subdivision development the area has been under pasture improvement.

The developed and mowed part of the resort village is covered by 'spear grass (needle-and-thread)/blue grama' plant community. Whether this plant community is the 'original' natural cover or the result of mowing practices is hard to discern. Under heavy mowing, the 'green needle grass and wheat grass' plant community has a tendency to change to a less productive 'spear grass/blue grama' community and to other increasers/replacers. Spear grass, blue grama, cacti, and the occasional ground juniper provide sparse vegetation cover.

In the resort village, in places, particularly where the 'spear grass (needle-and-thread)/blue grama) dominate, 'midgrasses' of medium height grasses are inhibited by the dry climate and drought susceptible soils. Hence there is much less fiber cover (for example, most of the golf course and the open space between Loop 5 and Loop 6, see Photos 19 and 20). These and similar areas elsewhere are susceptible to loss of soil productivity and wind erosion.

As illustrated above, there are notable and subtle differences in plant communities in response to soils and underlying water tables in the resort village. These differences, hardly perceptible to the unaware eye on the ground, are important to note for plant selection and vegetation management. Examples of the differences in site conditions include:

- Dry sandy 'hills/rises' with excessive drainage deep water table,
- Some areas with shallow water table (hybrid poplars and willows), and
- Sandy to coarse sandy soils (Scots pine).

These differences ought to be given careful attention in afforestation and landscape management practices. Clearly one solution will not fit all conditions.

TREE PLANTATIONS

Inside the village

Outside the village

Inside the village, on August 15 2006, we saw:

1. A good portion of the afforestation (poplar, maples and green ash) on dryer sites exhibiting drought stress.
2. Tree plantations are even aged and in a monoculture (same species) composition. Under even aged origin, tree mortality will set in within a given time period, with a potential to remove large

numbers of trees from one area (Photo 5). Under monoculture, the risk of disease spreading is also higher as is the onset of earlier mortality under deep tillage.

3. Certain plantations in the resort village exhibit more vigor than others due to:
    - Choice of species and site conditions (pines on sandier sites, poplars close to the watertable. Photo 6) and 'silvicultural practice' (certain maintenance practices, Photo 7).
    - Composition, structure, and management of certain tree 'plantations' (Photo 8)

4. Existing tree plantations/belts could serve as nurse crops to introduce other trees and shrubs (consider an enrichment planting program to diversify from monoculture/single species to mixed species and different age class - for sustainability and enhanced aesthetics).

5. The afforested areas and native three groves (Photo 8) in the village may provide insight into sustainable management of treebelts. The following are examples of what could work, and given time, in an adaptive (onsite-observations) vegetation management program. For example:

- Trees planted over certain areas appear to thrive better than in other areas (certain trees more appropriate to soil conditions, roots reaching water table);
- Unlike single row of trees, tree groves appear to benefit from their symbiotic relationships (and nurse crop effect) and from the local microclimate (shade cover at the base of trees) and reduced evapo-transpiration (a shelterbelt value);
- 'Closed in' tree bluffs at their understory/groundcover appear to have 'natural regeneration' of certain shrubs and trees (Photo 9); and,
- Examples from nature (Photo 8) and established plantations - near boat launch (Photos 10 and 23); established trees left alone north of boat launch (Photo 10).

Outside the village:

6. "Extreme" examples from outside the village show what have worked under 'neglect' on fine sandy loam, light textured soils in the vicinity of Bridgeford. These photos are from two abandoned farm yards and a hayfield. The point is that after trees have been established, they can survive without cultivation, mowing and pruning within their 'micro environment' for quite a while. No doubt there is a tradeoff for adoptive management. The examples:

- Scots pine and hybrid poplar about 20 to 30 years old, 2 miles north on east side of Highway # 19, thriving on an abandoned farmyard without maintenance for at least the last ten years (Photo 11).
- "Old Grove" about 40 to 70 years; old willow, maple, green ash and poplar, at Jct. of Highway #'s 19 and 367, one mile west of Bridgeford (Photo 12).
- Shelterbelts with gaps, through hayfields, on sandy loam, two miles northwest of Bridgeford (Photo 13).

PLANT PHYSIOLOGY AND SEMIARID ENVIRONMENT

Water

Environmental Factors

Choice of Plants

Cultural Practices

Water is key to photosynthesis for the existence of plants, especially in the semiarid climate of the resort village. Among the many variables, environmental factors influence water use; so does the choice of plants selected. Also, cultural practices play an important role in managing the afforested areas in a dryland environment. References applicable to the area conditions of the resort village are reviewed and discussed below.

Environmental factors:

Shade

Humidity

Wind

Temperature

Just as for wet laundry on a clothesline, environmental factors - shade, humidity, wind, and temperature - will speed or slow the rate of drying in plants. For a full discussion, refer to: *"Physiology of drought in stressed plants"* by Karen K. Tanino and Brian Baldwin, Department of Horticulture Science, University of Saskatchewan. 2006. Their report is posted on-line*, www.gardenline.usask.ca:1608/misc/xeris.html.*

The reader is also referred to a published paper reprinted from the American Midland Naturalist136:248-261 in 1996 on *"Comparison of the microclimates of a small aspen grove and adjacent prairie in Saskatchewan"*, by O. W. Archibald, E. A. Ripley, and D. L. Bretell from the University of Saskatchewan. The study area (a small aspen grove and a surrounding open prairie, 8 km northeast of Saskatoon) was monitored between December 1993 and April 1995. The grove had an understory dominated by smooth brome grass and a vigorous regeneration of aspen through root-suckering on the perimeter of the grove. 3% of the area in the center was relatively open where older poplars had died and fallen, typical of prairie aspen groves where the life span of trees is less than 50 years.

Shade can greatly reduce the water needs of a plant by lowering temperature, hence losing about 25% less water than on the sunny side (Tanino and Baldwin, 2006). A lone free-standing tree in the sun and exposed to wind (Photo 14) loses considerably more water than a tree shaded by many neighbouring trees. Shade also reduces solar radiation to the ground inside the small aspen grove (down to 23%, reported by Archibald et. al. 1996), hence lowering the soil temperature inside the grove (Photo 15)

compared to the adjacent prairie. *Pruning reduces shade, increases solar radiation to the ground as well as increases the risk of sun scalding* (Photo 16).

The self shaded grove may have less water to use at times because its roots have to compete with other trees and shrubs. However, the roots of a well designed treebelt will reach beyond the planted area for the youngest roots to absorb moisture. **Tillage** *into upper roots can severely disrupt water from the soil into the root as deep tillage can cut connecting roots to feeder roots at the outer end of roots* (Photo 17).

Humidity affects water use. In a dense canopy, transpiration will humidify the air surrounding the leaves. The humidified air inside the canopy will slow the rate of water loss from other leaves (Tanino and Baldwin, 2006). The Saskatoon study (Archibald et. al. 1996) reported 14% higher relative humidity inside a small aspen grove than on the adjacent open prairie. *Pruning reduces canopy density (*Photos 18, 19, 20 and 21*), hence the reduced humidity values.*

Wind increases the drying rate faster than in calm air. Windspeed inside the grove was reduced to 7% and 28% of the external (on the open prairie) speed during summer and winter, respectively (Archibald et. al. 1996). The aspen grove south-east of Saskatoon trapped up to 45 cm (17.7") of additional snow. Well **designed and placed treebelts** (for example on the golf course, back of the putting greens for winter protection) could play an important role in moisture retention and trapping snow in the resort village. Reduction in windspeed factored into 15% **lower windchill values** inside the grove, an important consideration for winter habitat for wildlife. *Pruning diminishes the shelterbelt value of plantations* in summer and winter.

Temperature. Plants will lose water more quickly in hot weather (refer to ***Shade***). Archibald et al reported that temperature of near-surface soil was 6-8 C warmer on the prairie than inside the poplar grove during midsummer. However, spring drying during hot spring day while roots are still locked into cold soil may cause dieback on evergreens. We saw no lasting evidence of this during our visit.

Choice of plants for reduced water use

It is advisable to choose plant material normally found naturally or successfully introduced into the same environment. Within limits of moisture availability, certain species of plants may be found where others do not grow well. Some species are more drought tolerant than others as their guard cells (stomates) respond more quickly to dry soils and less water is lost during periods of drought. During water stress a plant may close its guard cells in the leaves and stop photosynthesis, a primary means of generating food supply for the plant. In drought prone areas frequent shutdown of photosynthesis decrease growth of the plant; therefore it is smaller than where water is available. On certain sites

several hybrid poplar and stunted green ash plantations (Photo 22) have exhibited repeated drought stress. Stressed plants are also more prone to diseases.

Plant selection is essential in establishing a more drought tolerant landscape. Some plants are more drought tolerant than others because of features (examples: silvery leaves to reflect light to shade the tree, small hairs on leaves to reduce air movement) to conserve water. For example, from the deciduous tree, the silvery *Russian olive* (*Elaeagnus angustifolia*) and its relative, the silvery *wolf willow* (*Elaeagnus commutata*), are both well suited to xeriscape conditions. The native *silver buffalo berry*, sea-buckthorn (a Siberian import), the native *snow berry*, *shrubby cinquefoil*, *Manitoba maple*, *green ash* and *bur oak*, native to parts of the prairie, are also well suited to dry conditions. Once a planted bur oak (*Quercus macrocarpa*) has been established, it is drought tolerant with a deep tap root.

The wolf willow is also good nitrogen fixer and aids in the establishment of aspen (Photo 23). As it spreads by long rhizomes (roots), it competes successfully with grass and further aids in 'colonization' of stabilized sandy areas by setting in motion successional changes from grass to shrubs and trees (See: *Ecology of the aspen parkland of western Canada in relation to land use* by Ralph D. Bird, 1961, publication 1066, Canada Department of Agriculture, Ottawa. P. 155).

Drought tolerant evergreens suitable to Mistusinne include: Colorado blue spruce, mugho pine, and the "evergreen" Siberian larch with deciduous needles. A combination of these trees that are well suited to dry conditions can be used to advantage to enrich existing and new treebelts in species diversity and increased aesthetic values (Photos 24, 25, 26 and 27, from vicinity of the Saskatoon Forestry Farm).

A major factor in tree selection is its root system including deep tap toots to reach water lower in the soil and shallow surface roots to capture moisture from light rains. *Scots pine* has this combination of root system, ideal for Mistusinne Resort Village.

Clearly, under present and anticipated climate change, choice of xeriscape compatible plants should be an important part of the landscape management strategy for this resort village. Recommendations from a 2006 report (Carr, et. al. 2004) for the Saskatchewan Forest Centre on *Climate change implications in Saskatchewan's boreal forest fringe and surrounding agricultural areas* has direct relevance for establishment and maintenance of suitable treebelts (examples: Scots pine, Colorado blue spruce, hybrid poplars) in there sort village.

Tree Plantation Management practices to reduce water use.

In addition to area-appropriate plant selection, cultural practices such as weed control (cultivating, mulching, and herbicides), pruning, watering, and fertilizing are also important under certain management regimes (intensive vs. extensive cultural practices). Scarcity of available water to plants, the highly porous soils and associated costs would rule out regular watering during the lifespan of trees. Also, use of herbicides is inadvisable on the highly permeable porous soils of the village.

WHY CULTIVATE/TILL AND FOR HOW LONG?

Existing tillage running at one width of the implement, on both sides of treebelts, was estimated at 17.8 km (17,800 meters) or 11.0 miles (measurements from 1996 air photo). This does not include inter-row runs at the golf course, the plantation north of the boat launch, nor the five lakeshore plantations planted before the 1967 subdivision survey of the village. Cultivation recommendations include:

1. At least until trees/shrubs are established, it is important to maintain a weed-free area around the planted trees and shrubs to reduce competition for water and suppression (light source) from other plants. This can be achieved by a number of means: cultivating (mechanical or hand-hoeing); plastic mulching and organic mulching; repeated and early mowing; and inadvisable chemical weed control.

2. After planting trees and shrubs, *we recommend inter-row 'zero' or shallow tillage (start with less than 2"deep, then observe and avoid* root damage according to the Saskatchewan Forest Centre) *or hand-hoeing,* until adequate closed canopy is reached. Hand hoeing may be the preferred choice to allow branches to reach the ground under tight planting arrangement/design (Eliminates the need for pruning to allow passage of maintenance equipment and root damage from deep tillage).

3. *We recommend discontinuation of deeper tillage* (several spot checks showed 4" - 6" deep tilling) due to concern about severe root damage and introduction of diseases. Current practice is to set the tiller for 8" depth (See Appendix).

4. We *recommend the discontinuation of "pruning - tilling" practice* as it is destructive to the 'micro-environment' and injurious to the surface root system. Further, surface feeder roots are way beyond the narrow tilling (about a four foot strip close to the tree trunk). Exposed sandy soil surface is highly susceptible to wind-erosion and hence loss of any of the meager soil material. As a general guideline, tilling should yield to spreading branches by tilling along the 'new' edge and not into it.

5. Inter row shallow cultivation with a shallow rototiller may be used with care to avoid disturbing

the root system. Between the rows, tractor driven tillers would require continued pruning to allow passage of equipment and operator, delaying if not ruling out reaching the "bluff/grove" structure stage. Perimeter shallow tillage (lees than 2" deep) or frequent close cut mowing (Photo 7) during the early growth period may be required longer. These practices should yield to the extension of tree and shrub branches and the practice of not mowing down undergrowth just to make room for the tiller/mower, while still leaving a 'cared for appearance' along plantations.

6. We *recommend discontinuing indefinite tillage* around tree bluffs (given: appropriate "density", species composition and shaded ground-floor from planting trees and shrubs) deemed established (closed-in canopy/shade cover and suppressing competing weeds). Some areas will not perform and natural openings may be the solution. This could be one aspect of an adoptive management approach (supported by on-site examples in the resort village and from nearby areas (Photos 9, 12, 13, 28, and 29).

7. Alternate weed control methods (plastic mulching, organic mulches as well as hand hoeing the immediate area around the trees and mowing) may be advisable. Repeated (every three weeks) close mowing during growth cycle of weeds and grasses will deplete root reserves and weaken competition (see page 132, in *Guide to farm practice in Saskatchewan*, revised 1984). Brush, cascading branches, and volunteer regeneration/suckering should not be touched, to encourage "closed canopy"/cover.
8. Grass cutting and raked leaves off private property is a good source of organic mulches. The village could, on a trial basis, designate supervised dump site near certain treebelts. Then such organic material could be used as mulch and soil additive in and along treebelts.

PRUNING AND THINNING

The practice of pruning would need to be reviewed to achieve bluff/tree stand/belt sustainability for beneficial environmental factors for plants. As a general guideline, with few exceptions such as tree selection, we do not recommend continued pruning to accommodate maintenance equipment.

Initially, pruning may be required (second or third year from planting) where trees are forking, to select a leader. But one should clearly understand the purpose of plantations (to aim for green shelter with built-in environmental and aesthetic values) and that *pruning is a management tool* to that end.

There are some instances when pruning is practiced as a management tool, such as in intensive forest management/silviculture and arbor culture, where the objectives would be wood quality (clearer wood or fewer knots for lumber or veneer), or in a well kept landscape, to accent the form of a specimen tree. Or pruning may be required around shelter belts to avoid interference with machinery; or, near power

lines. Pruning may also be required to remove diseased and dead wood; hazardous trees (danger to life and property).

Pruning is rarely advised to establish 'shelter values' for the resort village. Under dry soil conditions, and with no assured continuous watering of trees, generally, limbs on trees should not be removed unless improved visibility is essential for security and safety (road intersections without sufficient sight distance or sight triangle). This practice significantly reduces the trees' value as a wind break, a wildlife habitat and as a cooling agent during the heat of the summer.
Similarly, in *treebelts* where a certain stand structure or "density" is required for beneficial microclimate and windbreak purposes, *pruning is rarely advised* (examples: disease control and carefully selected release cutting for under planting or for freeing up suppressed trees such as blue spruce or Scots pine may occasionally be required).

Thinning may be advisable later as a tree stand has matured, to cut out over mature or defective trees; or for *release cutting*; or for replacement/in-fill planting. Such operations would be identified in an annual operating plan (see: Treebelts management plan). Some over mature and defective and downed trees may be left as suitable habitat for birds.

Hazardous trees would be identified and removed on an as-needed basis, following accepted guidelines on what and where trees pose a hazard to life, property or utilities (tree failure near a playground, parking lot, power line and so on).

MANAGEMENT OF DRYLAND GRASSES

By the time of our site visit, August 15, 2006, natural grass cover throughout the resort village was near the end of its growth cycle for the growing season, save for a wet fall. The vigour of the grass community in the resort village varied in response to the environment, soil conditions and influence of current management practice and user impacts. Most of the new green grasses are produced in May, June, and July and very little after July. The following are our observations:

1. The appearance of a good portion of the grass covered areas in the inner part of the resort village resembles heavily grazed pasture land. Mowing too frequently and too closely (short stubble) reduces the ability of grasses to photosynthesize and to produce grass cover. Excessive mowing pressure and inadequate resting periods usually give low-growing plants a competitive advantage (Photo 30).

We understand some of the rationales for mowing include:

- reduction of fire hazard (fuel mass),

- keeping grass short on parking areas to avoid threat of or spread of potential fire (Photo 42),
- reduced competition from grasses in plantations,
- ratepayers' preferences, such as the appearance of neat and well kept grounds.

2. We measured grass stubble at 1"to 2" and occasionally at 3" height after mowing dryland grass along internal streets, in grassy fields, along the road to the boat launch (Photo 31), and in parking areas (near the boat lunch). In places we observed exposed bare ground/sand, and signs of wind erosion (Photo 32). Grass stubble along the shoulders of Highway No. 19 was left at 6" to 8", still leaving the traveler with an impression of a well cared-for roadway appearance. In contrast, under intensive grass management, the recommended height is not less than 2" to 3" for regularly irrigated and fertilized front lawns. What is the purpose of extensive mowing in the village?

3. Leaving enough leaf area on grasses allows plants to perform photosynthesis, to recover plant vigour and establish plant operations quicker. Given sufficient rest period, in most instances these trends can be reversed. Some of the benefits of a rested grass community are:

- Taller grass helps avoid increased exposure to the sun's rays at the unprotected soil surface during summer, avoiding evaporative loss of soil moisture.
- Rested grass areas are more able to tolerate unfavorable growing conditions such as drought and low winter temperatures.
- Rested grass areas are able to resist takeover by weedy plants and short grasses (increasers, such as pasture sage, moss phlox, dense club moss, cactus, plains reed grass, scarlet mallow, blue grama, and so on).
- Such undisturbed grass cover provides improved habitat for ground nesting birds and other wildlife.
- Soil conditions improve and are protection from wind erosion.

4. *What would be a sufficient time of rest before mowing could resume*? Parallel to haying and grazing management, some lessons from haying and grazing also apply to managing grasses of the resort village. Simply put, resting fields from haying and grazing restores plant vigour; so does resting from mowing grasses. The relative sensitivity of plant communities under certain uses (grazing, mowing and recreational use) can best be demonstrated by the example of recovery time (resiliency) from grazing. Given a certain level of forage capacity and growing conditions, crested wheat grass can recover in 6o days from grazing; native plants can take over a year more to recover. Further, it is advised to delay grazing (or mowing) on native pasture until after middle of June (after natural seeding to help with the recovery). A much longer recovery time is expected under mowing compared to grazing as, during grazing, grasses are clipped selectively by cattle while under mechanical mowing all standing grasses are cut. Further, plants that are grazed or mowed lightly recover their vigour faster than do heavily grazed/mowed plants. Heavily grazed or mowed area may take one to several years to recover their

productivity (see J.T. Romo, 2006. “Resting forage plants, a beneficial grazing management practice on native rangeland”, University of Saskatchewan, posted online).
When growing conditions are unfavorable, as in several areas of the resort village with rapidly draining sandy soils), or during drier summers, recovery of grasses may require a longer recovery period.

5. The impact of mowing will differ during the plant’s growth cycle. Mowing early in the spring when plants are beginning growth may set leaf area production back more than if native grasses are mowed when their growth is well advanced (after mid June) or completed (end of July).

6. Mowing, especially heavy mowing (high frequency and leaving short stubble) encourages increases of low growing grasses and sedges. Productivity declines as midgrasses disappear, followed by invaders of weed species (pasture sage, moss phlox, dense club moss, cactus, plains reed grass, scarlet mallow, blue grama, and so on) and exposed soil surface, leading to increased risk of wind erosion.

Examples of early and over-mowed field conditions abound in the resort village. See Photo 33, showing area frequently mowed on the left side of Siberian elm tree rows is covered with sparser native grass cover and more invasive short plants than the less frequently mowed area on the right side of these rows.

7. Keen observation and comparison to known well rested areas in the village can provide valuable benchmarks to assess recovery. Fields of rested grass-cover along the backshore, north of the boat launch and the golf course are examples that may be used as benchmarks for management of grass under natural conditions, particularly to gauge the recovery of grasses in mowed areas as well as to observe plant succession from grass to shrubs and trees.

8. Mowing is not necessarily a bad management practice if applied with care under certain circumstances. For example, where tillage is not possible, intensive and repeated close mowing every three weeks early in the growth cycle, can be useful for controlling grasses and tall growing weeds to encourage establishment of well structured plantations (shelterbelt values) and stand densities (shade cover).

We recommend the following changes to mowing practices, at considerable cost savings as well as gains in environmental values.

1. Set objectives and standards for the open areas (roadways, open areas, along trails, parking lots) for desired outcomes (fire protection, appearance, soil conservation) and on the golf course (player acceptance). For example:

- Along roadways mow only the width of the mower (about 4 - 6 feet); let the lot owner take care of the rest to their liking at their expense.
- Along main roads do not mow the remaining distance (in some instances over 100' now) to the green belt; for that cared look or neatness only mow one or two widths (a total of 8' - 12').
- Along trails make only one pass one 4' width; these mowed trails may be rotated from year to year to rest the 'old path'.
- On parking areas (at the south and north beach and at the boat launch parking areas) mow frequently to reduce fire hazard from idling cars.

2. Rotate strips of "mow/cut" and "no mow/cut" (rest) to offer 'firebreak' value and "rest period" in the open green area.
3. Avoid early mowing of open areas (May and mid June, or later, depending on moisture and growth). Green grass is less of a fire hazard than mowed hay. Try to cut open areas in July. Observe and evaluate. Keeping records would be of help for adaptive management.
4. Less frequent mowing (see comments under "rest before mowing could resume" - Management of dryland grasses, numbered paragraph 4, page 15).
5. Don't cut the grass so close - leave higher stubble (about 6", or don't cut at all in short grass/invasives).
6. Monitor these practices and environmental conditions (moisture, temperature and wind). Someone might volunteer to do this as a hobby. The village might consider inviting an an occasional expert visit to share observations.

We refrained from commenting in detail about the golf course. Still, the same general guidelines could apply particularly concerning: species diversity, drought tolerance, pruning practices, snow management over putting greens, and drygrass fairway management. For example, well placed tree and shrub belts could provide summer and winter protection to the greens. These tree/shrub belts introduced could be maintained by trickle irrigation from nearby taps.

What about the close-cropped dry fairways on the windswept the golf course? What could be a satisfactory solution to the players?

PROTECTION OF VILLAGE LANDSCAPE COVERS

The village forest and grasses may be at risk from three destructive forces: fire and the less spectacular ones, insects and disease. Threat of potential fire hazards deserves attention. No doubt the "Emergency Response Committee" will address protection more thoroughly.

Threat of fire may be from a number of sources:

- Private property (burning of debris, unattended fire pits, wood stoves with no spark arresters). These are usually easily detectable and actionable before they would get out of hand. Each occupant has a direct responsibility for taking preventative and preemptive (imminent) action, and having fire extinguishers on hand.
- Fire crackers. In the past these posed no threat when set off on the beach under supervision and standby contingencies. Recently incendiary devices have been set off with more frequency on private property and elsewhere in the village where hot cinders could land on roofs and dry grass, sometimes unknown to the 'funsters'. These are a real concern to residents and an imminent threat to the village during hot dry conditions and windy days.
- Sparks from beach fires, and unattended smoldering embers and hot ash (Photo 34) exposed to prevailing winds off the lake could be blown into the village.
- Motor vehicles (recent incident by 'south' beach where a vehicle got stuck and got on fire). Restricting vehicles to designated parking areas would reduce such risk.
- Natural causes such as lightening into dry grass or standing dead trees. There have been no reported cases of these in the village. A periodic check of dry snags (dead trees) after lightning is advised.

Has the village considered having an emergency pump to supply water from the lake? Does the village have adequate hand tools (for example, rakes, shovels, pack pumps - canvass or metal ones)? Canvas ones are easier to carry to the fire empty as long as there is water to fill them.

EROSION CAUSED BY NATURAL AND HUMAN IMPACTS

In places the back shore lands reveal active sand blow-outs where the shoreline has been breached by natural and human causes. *At the very least, vehicles should be excluded from these areas and limited to designated 'parking lots'.* Other solutions may include 'snow fencing off certain areas as have been tried successfully elsewhere in the province. Roads and trails also show signs of wind erosion.

See Photo 35, for examples of erosion from breached shoreline (dirt bikes and ATV's, followed by wind blow-out), loss of dirt from wind erosion on an uncapped road (Photos 36 and 37) and from an un-reclaimed borrow area (Photo 38) back of the north beach. Damage to these areas could be mitigated by keeping vehicles out.

Light sandy roads and trails are highly susceptible to wind erosion (Photo 39). Photos from the Elbow Lutheran Bible camp offer a possible solution of applying gravel over sandy roads to reduce wind erosion (Photos 40 and 41).

RECOMMENDATIONS

1. To deal with recommended changes, provide education to address sociological concerns (perceptions vs. ecological realities) and to build acceptance for a change in management practices.

2. Develop a tree replacement and enhancement program based on understanding tree performance, growing conditions, and plant selection. Such a program would include:
   - Scheduled replacement of diseased and aging trees.
   - Species diversity (concerns over monoculture).
   - Under planting (part of beneficial stand structure for 'micro' environment).
   - Enhance grove/shelterbelt structure of existing treebelts.
   - Incorporate, where appropriate, snow traps on the wind side of the treebelt/shelterbelt.

3. Prepare a natural resource management policy based on:
   - Acceptance of ecologically based guiding principles in establishing and maintaining trees and grasses.
   - Resource management policy for landscape management of open fields, roadsides, and trails.

   The village might consider the suggested guidelines below:
   - Maintenance of natural grass cover that is allowed to follow natural processes of ecological succession of the area (mixed grasslands),
   - Management practices that will minimize changes in the natural environment resulting from human influences,
   - Promotion of a healthy natural grass cover that will play an important role in soil maintenance and the reduction of wind erosion
   - Establishment of the purpose of treebelts being to provide both esthetic and shelterbelt values (windbreak, snow retention, wildlife habitat) and carbon sequestration (to capture carbon dioxide – greenhouse emissions – and store it permanently) or all of the above**.**
   - Introduction of an adaptive management approach modeling "best practices" (examples of what worked and did not work in the village, along with examples from nature and abandoned farmyards).
   - Planned approach to the orderly and sustained management of the afforested and grass areas, describing how those resources should be handled on a sustained basis.

5. Develop a plan for the 'forested' areas of the resort village based on:

- A 20 year management plan including objectives, tree species, silviculture, treebelts renewal, protection (disease and fire) and plans to advance afforestation in strategically placed new treebelt plantations.
- An operating plan for the next several years about release cutting (thinning), afforestation or reforestation of old treebelts (including scheduling of ground preparations), plans for procurement of planting stocks, plans for enrichment planting (species variety, 'designed landscapes' in visually prominent areas such as along internal roads and parts of the golf course) and up-dates to fire protection plans.
- An annual plan for the coming year including tree planting projects, pruning juvenile stock, sanitation pruning/thinning, removal of deceased and over mature trees, suspected and imminent hazard trees (assessed as to possible threats to property and life).
- A data base recording the location, date, tree species planted and removed, replanted areas, records of silvicultural events (such events as: tilling, hoeing, mulching, mowing, pruning, thinning); and results.
- Revisions to the management plan in light of information up-dates (and results from adoptive management).
- Corollary to these plans, periodic training of staff and volunteers is recommended in those silvicultural activities and complementary safety.

6. Strive for sustainable "tree and grass" practices including:
   - No pruning as a general rule unless advisable (operations plan),
   - Shallower tilling or "zero tilling" (replaced with close and repeated mowing)
   - More recovery period for grass between mowing (less frequent and higher leave stubble), or at a minimum, do the least harm to the trees and grasses.
7. As part of the budgeting process, have an annual operation plan as a direction for where and what to plant and grass management activities for the next year.

9. Encourage the use of native species for planting including some wildflowers that would enhance aesthetics and attract interesting wildlife (examples: hummingbirds, orioles and goldfinches).

10. Given the increase in more tree salvage due to aging poplars, invest in a tree shredder for recycling and mulching. This service could be extended to villagers for a fee for service. [However, in remote areas, some leave trees could be left to enhance bird habitat]

11. Develop a holding or small tree nursery to assure a core supply of seedlings (hybrid poplar willow cuttings, Scots pine, blue spruce, mugho pine, and so on) near the maintenance yard, close to a source of water.

12. Because tree salvage will yield a stream of firewood supply (considering the costs of past investment in tree maintenance and the market price of fuel-wood), the village could institute a fee for fuel wood and reinvest the proceeds in a tree fund..

13. Continue to encourage a community volunteer program to participate in planting trees and their maintenance. Offer training and recognition.

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PHOTOGRAPHS
(by Joe Jozsa)

List of photographs

1. Oasis of trees.
2. Risk of sand-blowout back of north beach, August 2006.
3. Breached shoreline 'cliffs'. Extremely fragile landscape. . . . dirt bikes breached the 'cliffs' leaving inroads for ATVs.
4. One of the causes of shoreline erosion.
5. Several diseased and dead (11 out of 58) trees removed up to 2006 . . .
6. Poplars close to watertable, Loop 2 & 3.
7. Branches encouraged to reach the ground; not pruned, not tilled for 20 years; 4'perimeter (shaded) mowed close; foreground mowed.
8. Afforested and native tree groves, N. of boat launch.
9. Closed in tree bluff with natural regeneration (green ash and Saskatoon berry).
10. Established trees left alone.
11. Hybrid poplar in abandoned farmyard, N. of Bridgeford, along Highway No. 19.
12. "Old Grove", about 40 – 70 years old; willow, maple, and green ash, at junction of Highway No. 19 and 367.
13. Shelterbelt with gaps, on sandy loam in a hayfield, 2 miles W. of Bridgeford.
14. Free standing trees in the sun, near boat launch.
15. Small 'grove' off loop No. 6.
16. Sun scalding (scar on second tree); trees pruned to allow passage of tiller, near maintenance yard.
17. Suckers on right side of tilled area, in response to severed roots from 6"deep tilling (2"or less the recommended depth).
18. Pruning reduces shade to the ground.
19. Tree rows pruned up, between Loop 2 and 6; pruning to allow tilling close to the trees; and close mowing on near-bare ground; ATV trail on dry sand . . .
20. 'See through' trough pruned up tree rows, near old pump, off Loop 6.
21. Un-pruned Manchurian elm, edge of tennis court, 'see trough' Manchurian elm row in the background.
22. Green ash and hybrid poplar tree row, drought stressed, along road into Loop 6.
23. Wolf willow and hybrid poplars, note absence of pruning and tilling for several years.
24. to 27. Examples for potential enrichment (species) and aesthetic enhancement (shape, texture, foliage and colour) of treebelts in Mistusinne. Photos near the Saskatoon Forestry Farm, September 2006.
28. Shrubs and trees blending into the grassed area, far end of golf course, near the boat launch.
29. Remnant poplars, abandoned farm yard, NW of Bridgeford (toward old Aitkow district).
30. Mowing can lead to low-growing plants.
31. Mowed roadside, disappearance of grass cover, under active wind erosion. Road to boat launch.
32. Potential for wind erosion, exposed soil, trampling effect by "fun vehicles". Vegetated area may be hard to manage due to aridity and repeated impacts.
33. Tree rows, pruned up, tilled both sides; close mowing, sparse ground cover.

34. Fire pit, south beach. Potential fire risk – sparks and hot coals could be blown into the bush.
35. Erosion, south beach, shoreline breached by “fun vehicles”.
36. Wind blow-out from road surface, back of maintenance yard. Extensive tree pruning.
37. Wind blow-out from road surface, junction of north beach road and boat launch road.
38. Erosion back of north beach, shoreline breached by an abandoned borrow ‘pit’ and followed by “fun vehicles”.
39. ATV trails source of degradation of grass cover on sandy soil; an example of a fragile landscape.
40. Road into the Elbow Bible Camp, gravel over sandy road a possible solution to reduce wind erosion. Note narrow width of mowed grass area on both sides of the road.
41. Road inside the Elbow Bible Camp; gravel placed over car trail to reduce wind erosion of road surface.
42. Grass kept short on left side to reduce risk of fire, ‘original’ prairie grasses on right side (also an example of rested grass).

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1. Oasis of trees in a dryland, approaching Mistusinne.
2. Sand-blowout back of north beach, August 2006; used by dirt bikes and ATV's.

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3. Breached shoreline ‘cliffs’. Extremely fragile landscape. In 2001 this was a continuous shoreline as suggested at the far end; dirt bikes breached the ‘cliffs’ leaving inroads for ATVs.
4. One of the causes of shoreline erosion and annoyance to sunbathers; if ATV’s and dirt bikes are allowed to continue to use the North Beach and backshore, it will deteriorate into a shale covered ‘beach’ and the sand could advance into the village.

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5. Several diseased and dead (11 out of 58) trees removed up to 2006; windswept grass green on the right, back of No. 1. Brush pile on the right to trap snow cover over grass green.
6. Poplars close to watertable, along Loop 2 & 3.
7. Branches encouraged to reach the ground; not pruned, not tilled for 20 years; 4'perimeter (shaded) mowed close; foreground mowed by village.
8. Afforested and native tree groves, N. of boat launch; pruned plantation (left).
9 Closed in tree bluff with natural regeneration (green ash and Saskatoon berry); facing S. inside tree bluff (No 7).
10. Established trees left alone N. of boat launch; no tilling, pruning or mowing for several years.

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11. Hybrid poplar in abandoned farmyard, N. of Bridgeford, along Highway No. 19.
12. “Old Grove”, about 40 – 70 years old; willow, maple, and green ash, at junction of Highway No. 19 and 367.
13. Shelterbelt with gaps, on sandy loam, in a hayfield 2 miles W. of Bridgeford.
14. Free standing trees in the sun, near boat launch.
15. Small ‘grove’ off loop No. 6; user impact (exposed sand) in foreground.
16. Sun scalding (scar on second tree); trees pruned to allow passage of tiller, near maintenance yard.

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17. Suckers on the right side of tilled area, in response to severed roots from 6"deep tilling (2"or less the recommended depth). 18. Pruning reduces shade to the ground. **19. Tree rows pruned up, between Loop 2 and 6; pruning to allow tilling close to the trees; and close mowing on near-bare ground; ATV trail on dry sand – ideal conditions for evapo-transpiration and wind erosion.**
20. 'See through' trough pruned up tree rows, near old pump, off Loop 6.
21. Un-pruned M. elm at edge of tennis court, 'see trough' M. elm row in the background.22. Green ash and hybrid poplar tree rows, drought stressed (stunted growth), along road into Loop 6.

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33. Tree rows, pruned up, tilled both sides; close mowing, sparse ground cover.
34. Fire pit, south beach; potential fire risk – sparks and hot coals could be blown into the bush.

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39. ATV trails source of degradation of grass cover on sandy soil; an example of a fragile landscape.
40. Road into the Elbow Bible Camp, gravel over sandy road a possible solution to reduce wind erosion. Note narrow width of mowed grass area on both sides of the road.

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41. Road inside the Elbow Bible Camp; gravel placed over car trail to reduce wind erosion.

42. Grass kept short on left side to reduce risk of fire, 'original' prairie grasses on right side (also an example of rested grass), inside Mistusinne.

APPENDIX - Interview response from Mr. Dave MacTavish, recorded by Jane Carney and Lynne Saas in September, 2006.

Tilling (roto-tilling along tree belts):

Question 1: frequency of tilling - once a year, or more than, or, less than once a year.

At least once a year, in early spring.
For a few spots, it may be necessary till a second time if the weeds grow up.

Question 2: what was the usual depth of tilling (2", 4", 6", 8"or more; or don't know)? Is it the same throughout; or, are there variations to the depth?

8 inches, same throughout.

Cutting of grass:
Question 1: When was the first cut of the year (May, June, July)?
-along roads; in open spaces

First cut is in the last part of May. Road edges are probably done more than the open spaces.

Question 2: What was frequency of cutting grass (once, twice, three times; or more)?
- along roads; open spaces between tree belts; near cottages; away from cottages

I concentrate on the public areas, along the roadways and do the green spaces less often. Certainly the big areas over along the lakeside only ever get one cutting per year. Roadsides can be as often as three times. Green spaces are typically once a year in a typically dry year. But it depends on the rainfall. During drought, I leave the grass alone.

Question 3: What was the height of mower set at (1", 2", 3", 4", 6" or more; or, don't know)?
- along roads; open spaces between tree belts.

Set at 2" In a few of the rough areas, out back, the mower is raised to 3-4 inches.

Question about rain fall at Mistusinne:

Was it a dryer year; a typical average year; or received more precipitation than previous year so far (end of August)?
Growing season:
- in April
- in May
- in June
- in July
- in August

April to June was above average rainfall. July – August was typically dry.

Winter- past winter (was it colder, the same; or warmer than usual? more or less snow?)

Last winter was mild until February. The ground did not freeze until January. There was less snow than usual.

What parts of the village seem to have more snow accumulation from snow drifts (or blow troughs)?

More snow along the edge of the lake; it is collected in the ice ridges there.
At the entrance to the village and around the big curve toward block six. These are because of the prevalent north-west winds.

In addition, any observations about overall trends would be very useful.

The last five years have been milder winters than before. We used to get a lot more snow.

Diseases:

Was there any infestation of trees/shrubs during the year; any idea of what sort of infestation?

Some tent caterpillars along the highway and near the playground. Volunteers cut them out and put them in bags. Jane reported some mealy bugs on pines – I washed down the bark with a pressure washer.

There are way more dandelions to what we once had. We don't apply any chemicals

Records kept on plantations

Are there any records kept on the Mistusinne tree plantations - year established, silvicultural treatment (weeding, tilling, pruning; watering, mulching); history of diseases, injuries (wind damage, and so on); trees removed and replaced?

None

Last year we put some trees into the other side of fairway #3. 200-300 – some survived – they aren't watered. The only watering is on the greens.
Dale Yarie did a lot of tree planting.

Pruning – along major public areas – we trim up in order to be able to get in to roto-till - about 5 ft. We remove major dead branches. We remove dead standing with the co-operation of Larry and Father Rip who cut up and remove the big stuff; we haul away the branches.

Question re sucker trees? **If they are along the line with the big trees, we leave them alone as eventually replacement trees and to hold the snow for moisture. If they are in the way, we may remove them.**