

RECLAMATION PLANTING
IN
WATERTON LAKES NATIONAL PARK

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At the request of the National Parks Service in October 1974, four sites were examined in Waterton Lakes National Park to assess the problem of their reclamation to a more natural state. The sites (Figure 0) were: 1) the campground and north end of Cameron Lake; 2) the service centre, or townsite of Waterton; 3) the bridge that carries Highway 5 across Blakiston Brook; and 4) the golf course.

The above sites were examined by an operational research team consisting of Mr. W. Henderson and Max Winkler of the National Parks Service, Waterton; G. M. Coen (Pedologist) of the Alberta Institute of Pedology, Soil Survey, Edmonton; and S. Kojima (plant ecologist) and W. D. Holland (pedologist) of the Canadian Forestry Service, Edmonton.

The conclusions and recommendations were arrived at by using the existing knowledge of the soils (Coen and Holland) and vegetation (Lopoukhine; Kuchar), along with the field examination of the sites and previous experience within the Park. Additional information on insect and disease conditions of the golf course site was provided by G. J. Smith of the Canadian Forestry Service, Edmonton.

Maps and detailed soil and vegetation and cultural descriptions that provide useful background data are found in the references at the end of this report. However, they do not provide quantitative data on the site changes brought about by human and other disturbances.

1. The campground and north end of Cameron Lake

a) General conditions:

The site composes a relatively small area of approximately 25 acres at the north end of Cameron Lake. It includes areas that have been used for camping, car parking, and Park services. The soil mapping units include Nos. 31, 48, 64, and 190 + 53 (Coen and Holland). Units 31 and 190 + 53 (Figure 1) are poorly to very poorly drained and have not been used to any extent because of their wetness and it is suggested that these units be left undisturbed, thus providing the natural drainage to the other areas. Units 48 and 64, that have been disturbed, originally supported a dense forest of Engelmann spruce, alpine fir, and false huckleberry and associated plants (Table 1).

The disturbance to the area has resulted in the reduction of the amount of plants and severe damage to those remaining on the site. The soils show visual evidence of compaction and structural changes, especially in the shallowness of the surface organic layers caused by physical disturbance and lack of litter deposition. These layers (L, F, and H horizons) have a direct influence on such soil qualities as moisture retention and infiltration. It was noted that numerous roots are exposed at the soil surface of the disturbed areas, and an examination of adjacent undisturbed forest area showed similar shallow rooting habits of the trees; however, exposure is confined to proximity of tree trunks.

Tree crown features indicate a prevailing wind from the south end of the lake.

b) Reclamation techniques: The following reclamation techniques were discussed:

Underplanting -

The use of native species would seem to be the most effective method of planting, as they are best adapted to the local environment through natural selection. Most non-native species, even if they are successful initially, would be replaced by the native species if natural succession is allowed to occur. However, it is necessary to select natural species for the plantation so that the best ecologically fitting species are introduced to the particular habitat. Shrubs and low growing ground cover plants may be transplanted from nearby areas. A suggested source is the Akamina roadway area. Some root-pruning (Figure 2) could be done one year in advance of transplanting in order to insure transplanting success. Planting of young Alpine fir and Engelmann spruce is possible (Table 2); however, natural regeneration in this area is good.

The juniperus varieties indigenous to the Park are not considered to be suitable for this site because of their intolerance to the relatively dense shade and high moisture found on this site.

Finally, it is mandatory to protect the underplanting from disturbance (both human and natural) if acceptable reclamation is to be achieved.

Scarification: This technique can be used on the parking and driveway areas of the park facilities area (e.g. near warden's cabin) and would be beneficial for loosening and exposing the soil prior to reclamation planting. However, scarification should not be too close to existing trees (at least crown width or more away from the tree trunks) as tree roots could be injured (Figure 3).

Aeration by mechanical means is not expected to be of significant benefit to the compacted areas because the presence of large roots and stones in the soil will prevent the efficient use of aerating machines. An alternative method of ameliorating compacted soil areas is by utilizing the freezing and thawing action of soil water in open winters. This action will loosen soil quite efficiently. This is achieved by the addition of irrigation water during the late fall.

Organic Matter: The addition of organic matter to the disturbed areas could be beneficial in restoring the moisture relationships of the site. Two to four inches of raw, weed-free semi-decomposed to raw organic material is preferred and would be sufficient.

Planting techniques: The main planting techniques emphasized for reclamation projects are (as described in numerous publications, e.g. Toumey and Korstian; Youngman and Randall):

1. vigorous, healthy plants must be used,
2. the hole receiving the plant must be large enough and deep enough to accommodate the root system (Figure 2),
3. proper back-filling of soil, tamping of soil, and thorough irrigation immediately after planting are mandatory to planting success,
4. root systems must be kept moist during the transplanting process,
5. top-pruning may be necessary after planting,
6. container grown plants are easier for difficult planting situations.

Fertilizer: The physical and chemical analyses of the soils of Waterton (Appendix A; Coen and Holland) indicate low quantities of nitrogen and phosphorus with moderate to high levels of potassium and calcium. The addition of a high nitrogen in both nitrate and ammonium forms and high phosphorus would be beneficial to plant growth. Application is less risky in

the year following planting, rather than immediately after or at planting time. A suggested rate of application is between 100 and 200 lbs of 16-20-0 or 11-48-0 per acre. Fertilizers should be evenly distributed. Increased efficiency of fertilizer use may be obtained by splitting the fertilizer into a spring and early summer application.

Pruning: Correct pruning requires parallel and flush cuts (Figure 4) with a sharp and suitable instrument sterilized between each cut by dipping the instrument into a dilute lysol or javex solution. Use of a tree wound treatment chemical is desirable. Damage from other causes (axes, bark stripping, etc.) may be repaired so that the bark will heal over the wound and any jagged wood remnants will require removal with a knife or chisel. Many horticultural texts, agricultural, or commercial establishments describe correct pruning and wound repair techniques. A tree pruning course is offered yearly at Brooks Horticultural Center.

Design: Use of indigenous plants can be blended into the overall reclamation design in such a way that natural appearance is achieved while retaining the intended functional purposes, which are diagrammatically represented (Figure 5). These plant groupings provide protection against human disturbance and simultaneously are environmentally sound.

Figure 5 also illustrates how successive use of increasing plant heights can be arranged to provide protection from the prevailing winds. The use of boulders (Figure 5) on the shore is suggested for prevention of wave erosion. While not necessary at Cameron Lake, it is felt to be necessary on the southern townsite beach. The reader is referred to McHarg (and other publications) for further detailed comments on the importance and application of environmental design principles.

Irrigation: Irrigation of this site is required at the time of planting, but is not mandatory thereafter as the site is situated in one of the moistest areas of the Park.

As previously noted a fall irrigation just prior to freeze-up promotes loosening of compacted soils by the freezing and thawing action during the winter.

2. The service centre; townsite of Waterton:

a) General conditions:

This area, a fan of Cameron Creek, extends over approximately 175 acres, of which probably 25 to 30% or more could be successfully planted to indigenous trees and shrubs. The dominant map units (Coen and Holland: Waterton Soil Report and Appendix D.) are 21 and 22. Approximately 75% of this area has been severely disturbed by physical

activity associated with the development of the townsite. The extent of the service centre development is easily discernible on an air photo of Waterton, which is reproduced on the cover of Appendix D (Coen and Holland).

The Service centre occupies all of this low-lying and relatively gently sloping fan. The coarse textured fan was formed by deposition of material into Waterton Lake by Cameron Creek. In addition to being droughty because of its coarse texture, it is also located in a drier and warmer position than the Cameron Lake site. It is also subjected to a much higher evapotranspiration rate because of being situated in the path of the strong prevailing winds from the south. The establishment of vegetation, especially in the southern portion of the fan is necessary to provide protection from the wind. More vegetation would also provide greater aesthetic appeal to the entire service centre area.

It is also noted (Stelfox) that the fan is frequented by sufficient numbers of deer, especially during the winter, that they may effect establishment of certain plants on this site. This means, for example, that larger sized Douglas fir might be planted in order to prevent browsing of leaves and small branches (Figure 6).

b) Reclamation techniques: The following reclamation techniques were discussed:

Planting: On this area, and especially along the southern shoreline, reclamation techniques must recognize the drier conditions of the site, the severe wind effect, the deer problem, and the intensive human

use of the service area. Planting techniques discussed in 1, b) above may be applied here; however, more emphasis must be placed on the following factors:

1. The use of massive plant groupings (a mixture of various indigenous species that are well adapted to the particular environment (site) is best suited for mass plantings. A single species plantation (mono-cultural type) is more susceptible to impact from disturbances, both physical and biotic).
2. The use of successively increasing plant heights (Figure 5) in order to offset wind effects.
3. The use of larger plantings in order to prevent deer browsing. Larger plants will require topsoil for back-filling of the excavations and removal of the very coarse gravelly sub-horizons.
4. Choice of proper species. As indicated by Figure 5, the initial windward plants could be low growing indigenous junipers, followed by Symphoricarpos occidentalis (snowberry), then Prunus varieties, and eventually evergreens such as Douglas fir and white spruce. Douglas fir is found on this and similar fans (e.g. Bertha Creek). It is a

desirable species, especially after it has achieved some size, because its thick, strong bark is a protective feature against fire, scarring from knives, etc., thus very suitable on such an intensively used site. Spruce is good plant for the area as its branches can be kept close to the ground and the stiff, prickly needles tend to keep disturbers away. Also, the use of prickly species such as junipers and Rosa are not to be overlooked in such an intensively used area. Use of plantings established in biodegradable pots is suggested for ease of plant establishment on this site, particularly in view of the large number of plants that are required.

Organic matter: It is difficult to maintain and to provide sufficient quantities of organic matter on an intensively used area. However, certain practices can be implemented to assist solving the organic matter problem. For example, all areas do not need constant mowing, especially those containing group plantings. Also, those areas that are mowed, provide a considerable quantity of clippings that can readily be recycled back into the soil, with or without composting. A layer of weed-free peat can be used in a band around each individual plant in order to provide the

plant with protection against grass and weed competition and for moisture and nutrients (Figure 7). The addition of nitrogen fertilizer will assist in increasing the amount of organic matter.

Fertilizer:

Nitrogen fertilizer is beneficial for growth of grass and plantings, especially in an area of intensive use, where quick growth response is essential. It is pointed out that growth response from the addition of fertilizer to this site will require the addition of irrigation water in correct quantities and timing.

Phosphorous fertilization may be beneficial, but it is doubtful if potassium is needed, and the addition of lime is definitely not needed. (Coen and Holland, appendix A, Waterton report). Rates and application may be the same as for the Cameron Lake site.

Scarifying:

It is not needed on this site unless design changes require loosening of the compacted soil of former roadways and parking areas. Again, scarifying should not be too close to existing larger trees (Figure 3), nor should it be too deep on this site as such action could result in bringing many coarse rock fragments to the surface.

- Pruning: Being a dwarfing process, pruning must be kept to a minimum if growth is desired. The same rules discussed in 1, b above and Figure 4 apply to this site.
- Design: See previous discussion. The use of mass plantings and successively increasing plant heights (Figure 5 and Figure 8) cannot be over-emphasized. Mass planting techniques can be applied throughout the entire service centre area. Some of the better examples of the mass grouping technique were observed in the fish hatchery area.
- The use of successively increasing plant heights (Figure 5) is a planting technique that can be used to advantage in many situations and will be especially beneficial along the south shore.
- Irrigation: Required at the time of planting. Since much of the site is already being irrigated as a result of lawn irrigation, it should be a simple matter to extend such irrigation to include new plantings. The results will be beneficial. The internal soil drainage of this site is such that it is doubtful that over-irrigation can occur, except that applied nutrients may be leached from the soil.

3. The bridge that carries Highway 5 across Blakiston Brook

The problem at this site is a geological one of sedimentation

that is mainly confined to the creek bed. The area is described under map unit no. 20 (The Soils of Waterton; and Appendix D).

Blakiston Brook is obviously a stream having a wide variation from high to low volumes of flow. The main fan matrix is largely composed of loose fissile coarse rock fragments that are easily shifted by sudden increases in the water flow. The pattern of stream channels, the cut-and-fill nature of the materials described under map unit 20, the occurrence of coarse materials over former soil surfaces, all indicate that the fan of Blakiston Brook is still aggrading and is likely to do so for the foreseeable future. It is also noted that the bridge is located on the apex of the fan where the greatest amount of shifting and stream disturbance is likely to occur.

The problem of continued aggregation of materials is inevitable, and some form of management is required to prevent damage to the bridge. It is suggested that the geologic-engineering-hydrologist area of expertise be consulted regarding this problem.

4. The golf course site:

a) General conditions:

The problem on the golf course is one of die-back of native trees, mostly trembling aspen but including some lodgepole pine. The establishment of new plantings has not had a good history of success. Browsing deer during the winter months also appears to be part of the general environmental problem.

The golf course occurs mainly on map unit no. 1 (Coen and Holland). Examination of the vegetation information (Lopoukhine; Kuchar) and further analyses (Patterson, et al, p 13; Petty and Ives, p11) indicates that the golf course is situated in a tension zone location on the interface of the forest and the prairie. Thus, during a moist climatic cycle, trees tend to encroach on the prairie zone, whereas during a dry climatic cycle the trees die out and the prairie vegetation remains. The problems outlined above are probably accentuated by the edaphic effects of map unit No. 1 and the increased evapotranspiration rate in the golf course area caused by prevailing southerly winds.

Plants that grow under the conditions outlined above are subjected to great environmental stress, part of which may result from Chinook occurrences. Petty and Ives (1971) emphasize the incidence of poplar borer on trees "of low vigor caused by poor site conditions and climatic stress" (P 11). They further (p.12,13) report Armillaria root disease on trees "subject to stress conditions". Hypoxyylon canker (p 16), again, occurs in "those stands that have been subject to stress". On the Forest Insect and Disease Hazard Rating map, and legend (p 19, 20) note that poplar stands in Waterton are all subject to a high insect and disease hazard rating. On the map, note that the aspen on the golf course is colored red, the highest hazard rating.

Many suckering aspen shoots are evident in the treed portions of the golf course, but appear to be infected with the above noted

diseases at an early age. Also to be noted is the fact that those trees that do manage to become somewhat mature are short, of scrubby form, and slow growing, again indicating stress site conditions.

b) Reclamation techniques:

Planting: The use of indigenous, drought tolerant trees and shrubs is probably best carried out with potted specimens in bio-degradable containers, as the golf course site is a difficult one for large transplants, although some larger specimens are necessary as a safeguard against browsing by deer. The obvious species are Rocky Mountain Juniper, Douglas fir, and lodgepole pine.

It should be noted that growth will not be rapid on this marginal site.

Organic matter: A banding mulch (Figure 7) around the stem of new plantings will assist in moisture conservation, and prevention of competition by grass and other plants. Mowing is best kept to a minimum to protect young natural aspen regeneration.

Fertilizer: The greatest need is for a nitrogen and phosphorus fertilizer (appendix A, Coen and Holland). Potassium and lime are not needed. Because of the coarse soil texture and its porous nature, the

fertilizer should be applied in split applications; that is, one half of the annual rate should be applied early in the spring and the second half in late June or early July. The suggested rate is the same as for Cameron Lake.

Scarification: Not needed on this site.

Pruning: Required if transplants are used, but not required if potted specimens are used.

Design: The best results will be from massed groupings with as much protection from the wind as is possible.

Irrigation: As in every case it is mandatory at the time of planting. Since fairways are already being irrigated it should not be difficult to extend it to the desired plantings. The coarse substrate of the soil suggests light to moderate quantities of water be applied at frequent intervals.

The aspen that presently exist on the golf course site could be assisted in their growth by use of the cultural techniques discussed. Removal of some of the disease sources may slow up the deterioration of aspen on the site.

Discussion

With the exception of the Blakiston Brook stream bed site, all sites can be reclaimed and made more amenable to Park use if

proper cultural techniques are used. These basic techniques are:

1. Planting the correct species in large numbers in proper plantations.
2. Organic matter should be added wherever possible and feasible and existing organic matter protected with mulch banding used on the service centre and golf course plantings.
3. Nitrogen and phosphorus fertilizers are definitely necessary (Appendix A, Coen and Holland). Potash and lime are not needed. Between 100 and 200 lbs of 16-20-0 or 11-48-0 per acre are recommended yearly until such time as the plants and satisfactory growth rates are established. Split applications are necessary for the golf course and may be beneficial for the first two sites.
4. Scarification is needed in a few small areas where roadways or parking areas are being reclaimed.
5. Pruning must be properly carried out to repair damage on existing trees and reduce leaf area on transplants.
6. Design of groupings and use of incremental succession of heights are two techniques that can assist in establishing new plantings (Fig 5, Fig 8).
7. Irrigation is mandatory immediately after planting. The Cameron Lake site is located in a moist area. The service centre and golf site are in drier, warmer locations with a high rate of evapotranspiration because of the wind. Thus, supplemental irrigation will be beneficial during the growing season. A late fall

irrigation may be beneficial in reducing winter damage on new plantings.

Recommendations:

1. Plantings must be on sufficient scale to reclaim the areas described; that is one tree per acre is insufficient for the intended result, but 200 to 400 may be enough on a moist site, depending on planting stock size. Also greater numbers of plants afford protection for each other. It is recommended that a sufficient quantity of trees and shrubs be planted. For example; the service centre area could easily require 5,000 trees exclusive of shrubs. If 100 (a low number) trees per acre are planted, then the total quantity required is arrived at as follows:

- 1) 43,560 square feet = acre

43,560 = 435 Square feet per tree, a distance of more
100 trees than 20 feet between trees.

- 2) There are approximately 175 acres of land composing the fan underlying the service centre area.

If only 25% of the area is to be planted, the acreage requiring trees is between 40 and 45 acres.

- 3) At 100 trees per acre assumed,

40 x 100 = 4,000 trees

45 x 100 = 4,500 trees

- 4) Considering the three sites, the required tree plantings could easily total 10,000 trees. An additional 20,000 shrubs

would not be excessive, thus developing a requirement for at least 30,000 plants. Allowing for mortality and other damage, plus a need for plants on other sites, the Park can probably use 50,000 plants per year quite readily in the early years of reclamation, with lesser quantities for continuing maintenance of the sites.

2. Demonstrations of cultural techniques, including planting, pruning, etc. can be arranged with the Canadian Forestry Service, Edmonton. At the risk of being repetitious in imparting information to people who already have knowledge for reclamation, it is nevertheless recommended that such demonstrations be arranged periodically. Evidence to date suggests that there is no danger of this type of over-communication.
3. Transplanting is always risky and such risk is probably increased as the quantity of transplants is increased. That is, it is quite an easy task to keep roots moist and adhere to all cultural requirements when planting 10 or 20 trees, but the transplanting task becomes much more critical when the quantity of plants reaches into thousands. For this reason it is recommended that suitable, vigorous plants be grown in biodegradable containers before transplanting into the field. Canadian Forestry Service assistance and advice on how to produce container grown stock can probably be arranged for if necessary.
4. Design has been discussed throughout this report; however, the scale of the work indicates the need for detailed landscape

planning. It is recommended that such a plan be prepared in detail, especially for the service centre area, using the aid of a consultant if necessary.

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(P. 216, browsing animals; p. 348, transplanting; p. 436, pruning; p. 446 spring planting; p. 447, spacing; Chapter XVIII, planting methods and techniques.).

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* Inter-library loans may be arranged with Mr. P. Jordan, Librarian, Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta.

Reference

- Soil map unit 64
- Present campground 
- Present parking and picnic 
- Park service facilities 

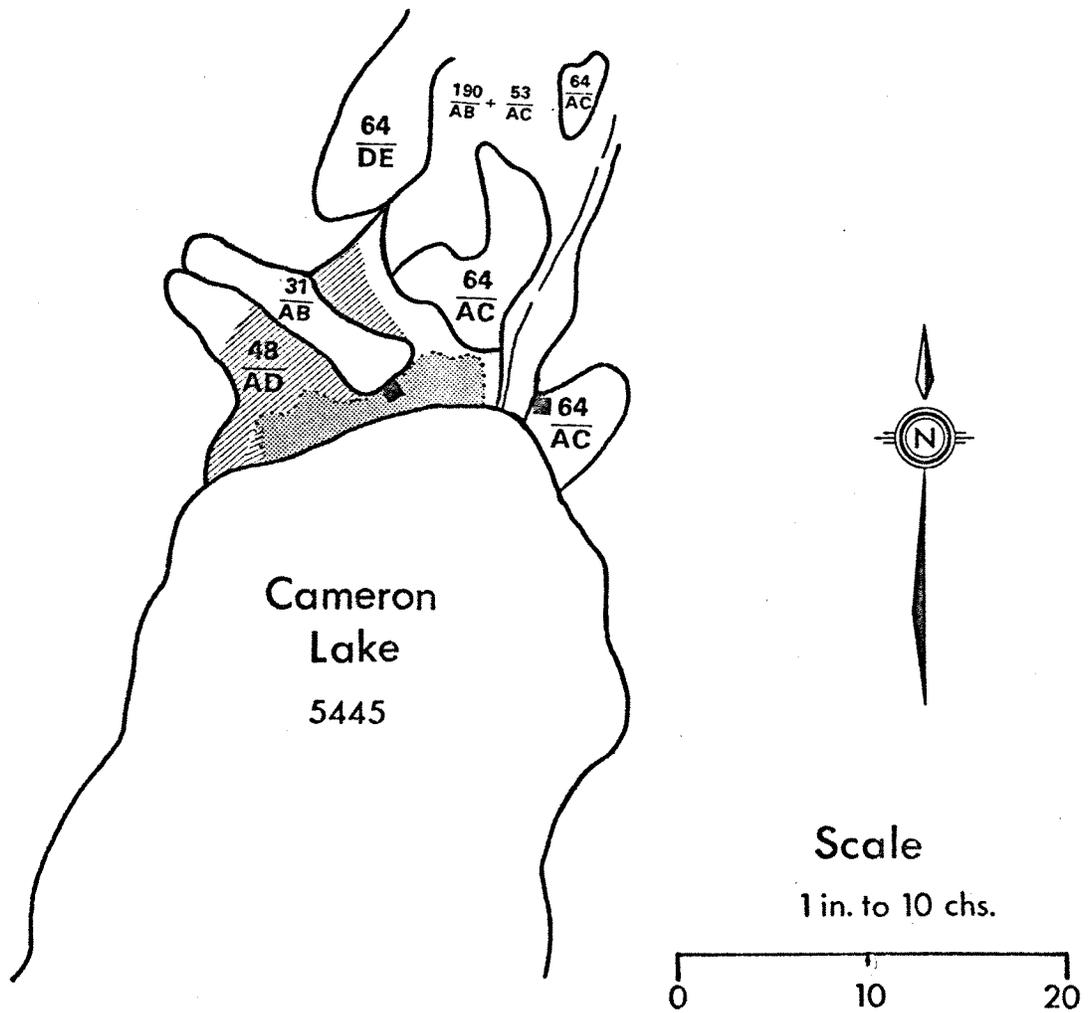
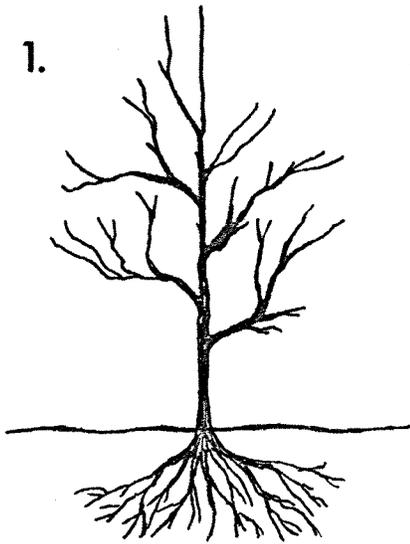
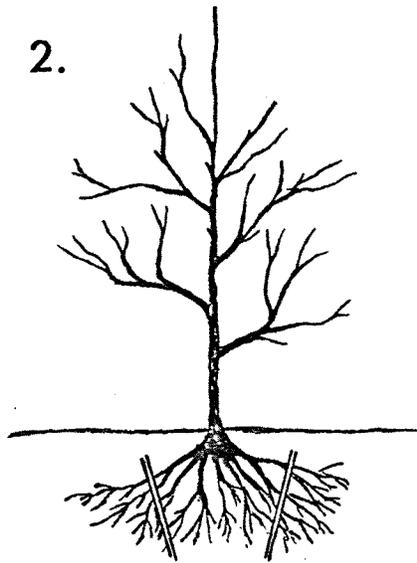


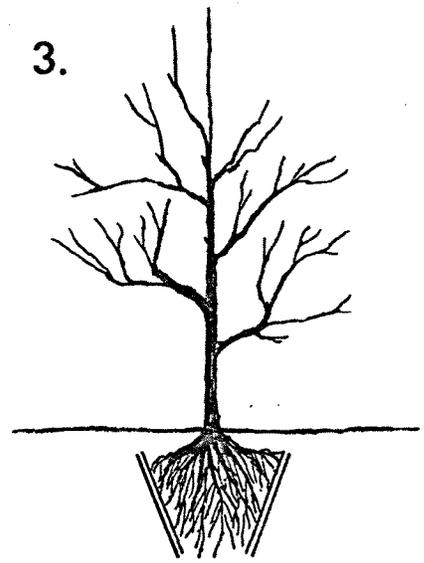
Figure 1. Soil map units at north end of Cameron Lake.



Tree or shrub prior to transplanting.

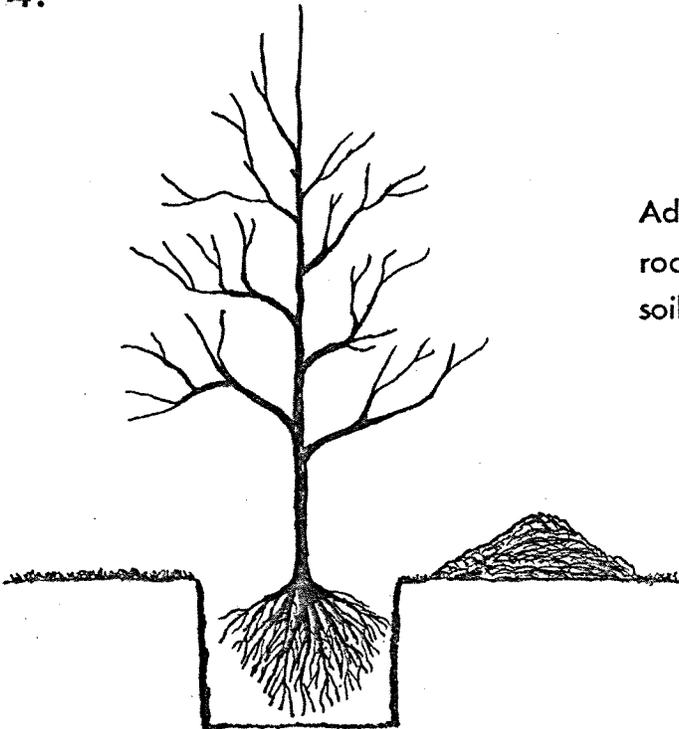


Root pruning one year prior to transplanting.



Dense root ball one year later; plant is now ready for relocation.

4.



Adequate sized hole allows room for root system and proper back-filling, soil tamping and watering.

Figure 2. Diagrammatic sketch of root-pruning techniques.

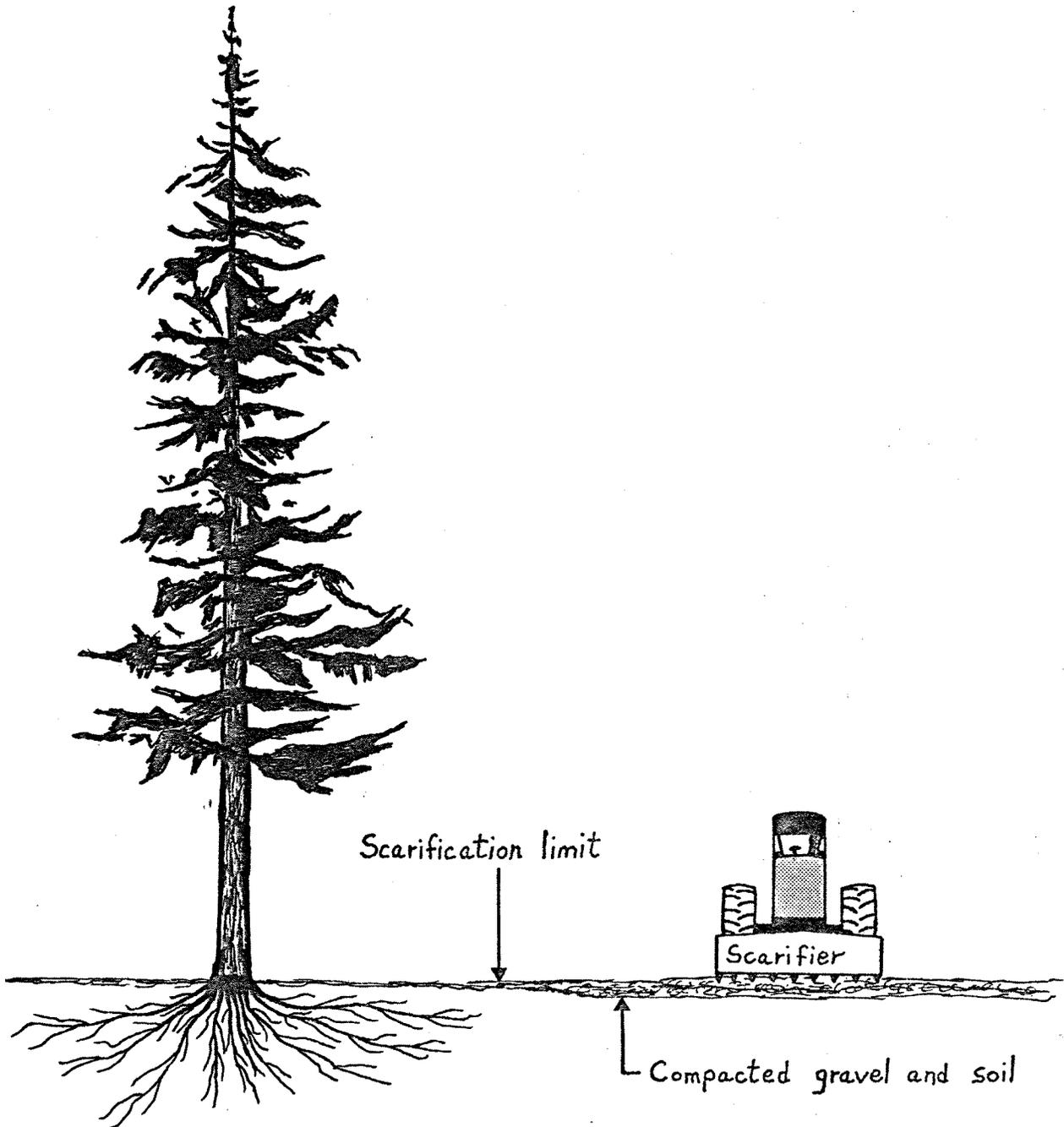
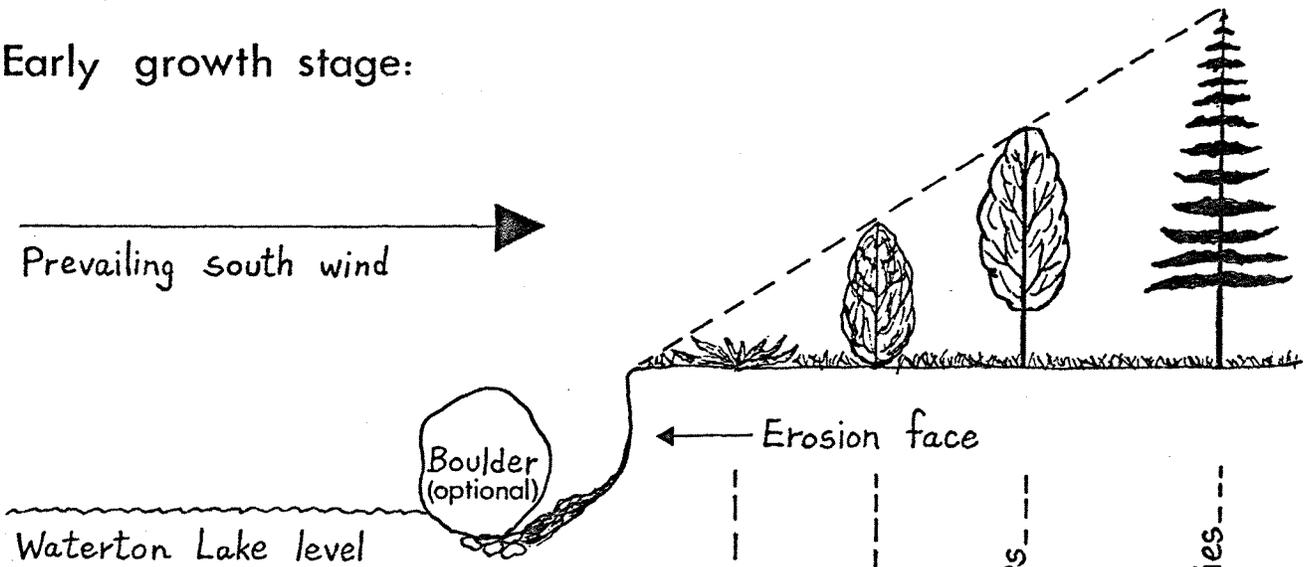


Figure 3. Scarification of compacted surfaces should not be too close to existing trees if root damage is to be minimal during planting reclamation.

Early growth stage:



Advanced growth stage:

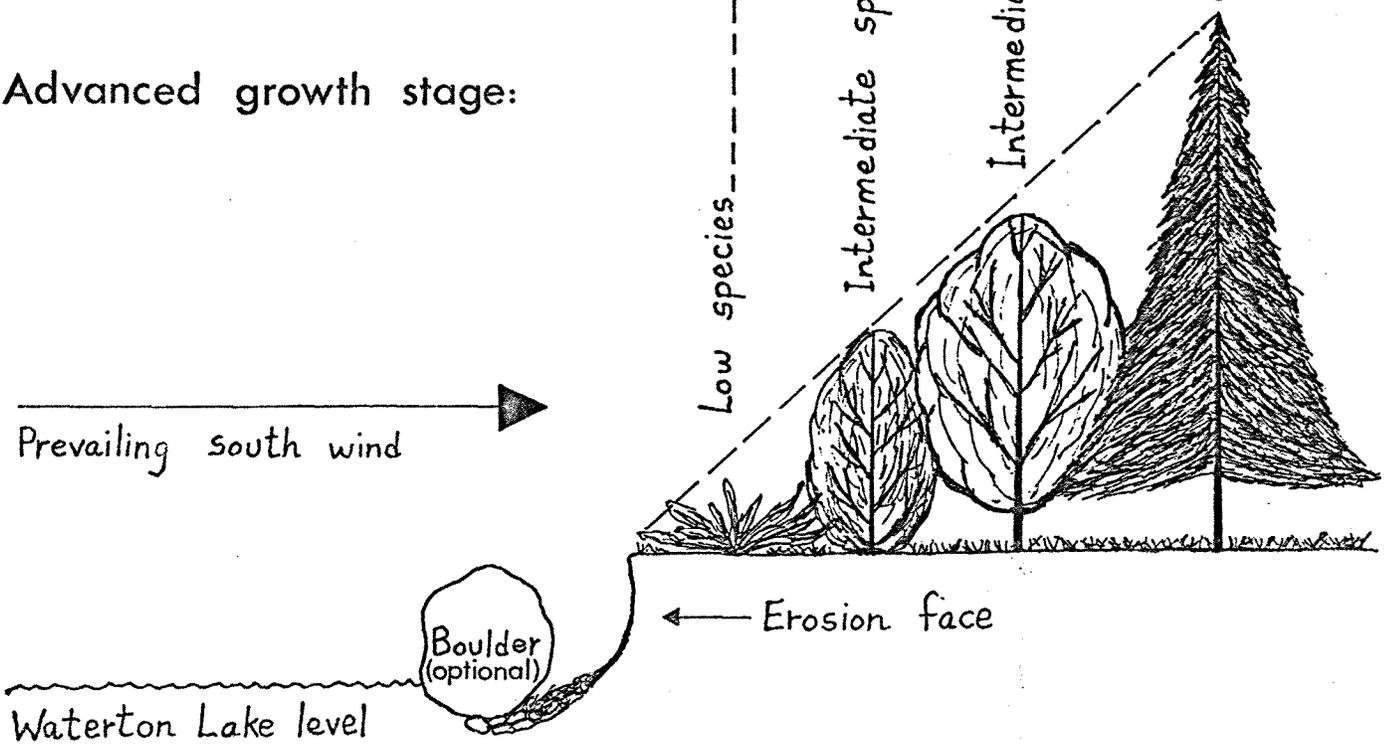
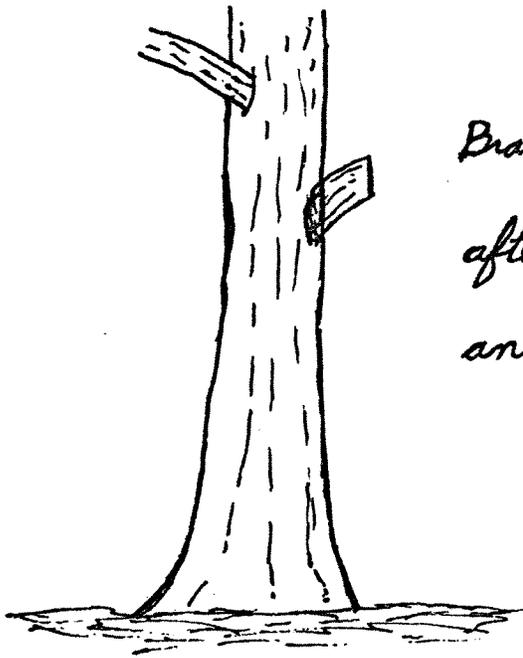
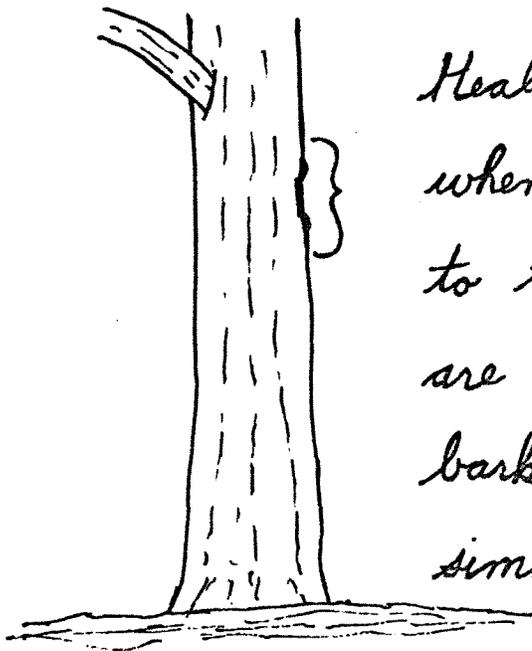


Figure 5. Diagrammatic representation of planting design cross-section and grouping for north end of Cameron Lake and the south edge of the townsite. The plant materials differ for the two sites. Note changing effect over time using successive incremental plant heights.



Branches that have stubs remaining after pruning do not heal; infection and rot can occur.



Healing of wounds will occur when pruning cuts are parallel to the branch or tree trunk and are flush (or recessed) with the bark. Other damage may be similarly treated.

Figure 4. Correct pruning techniques will help save existing trees.



Figure 6. Douglas fir plantings must be of sufficient height to prevent deer from any extensive browsing of the needles.

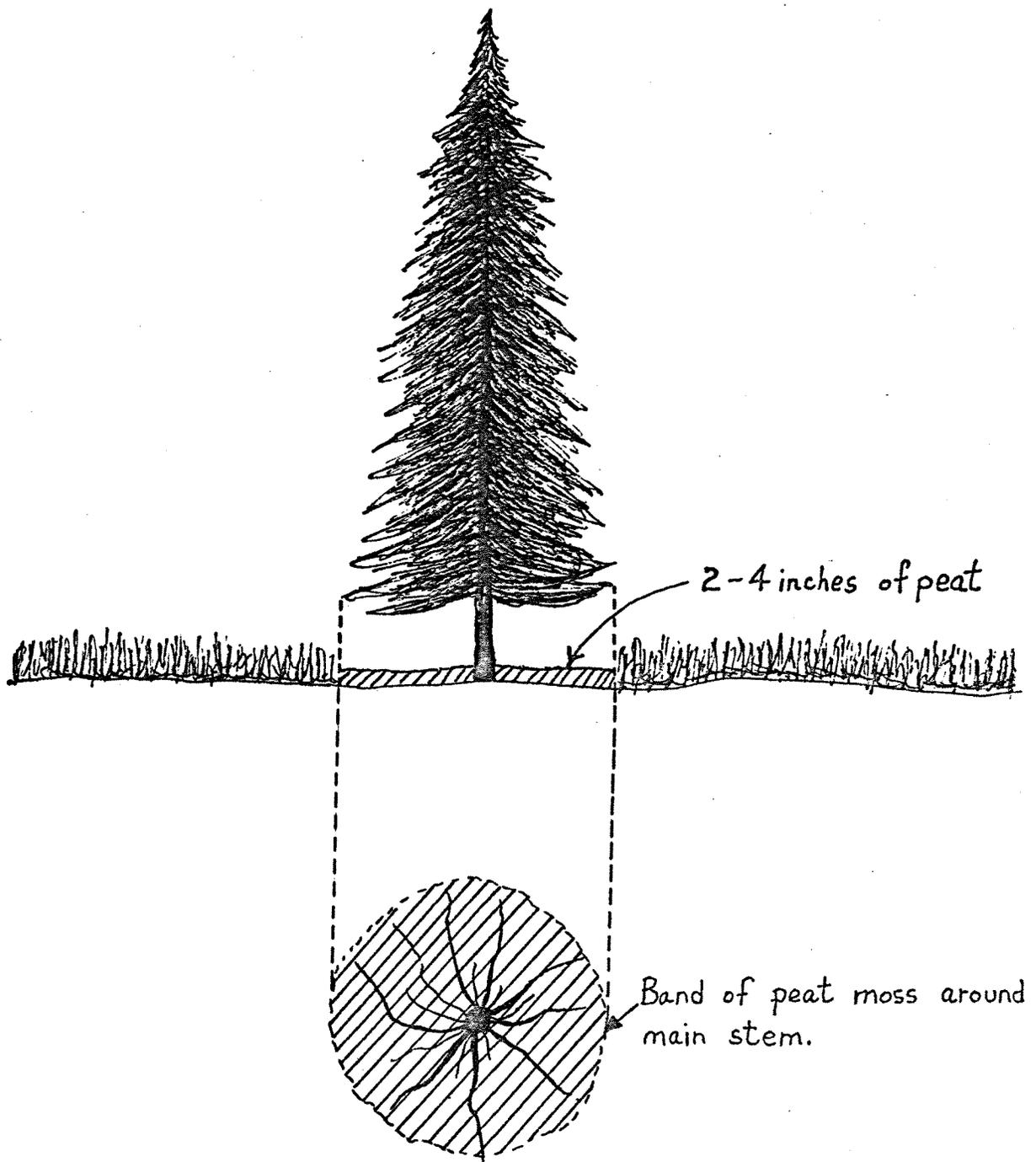


Figure 7. Banding of peat around new plantings to prevent competition by grass for nutrients and moisture.

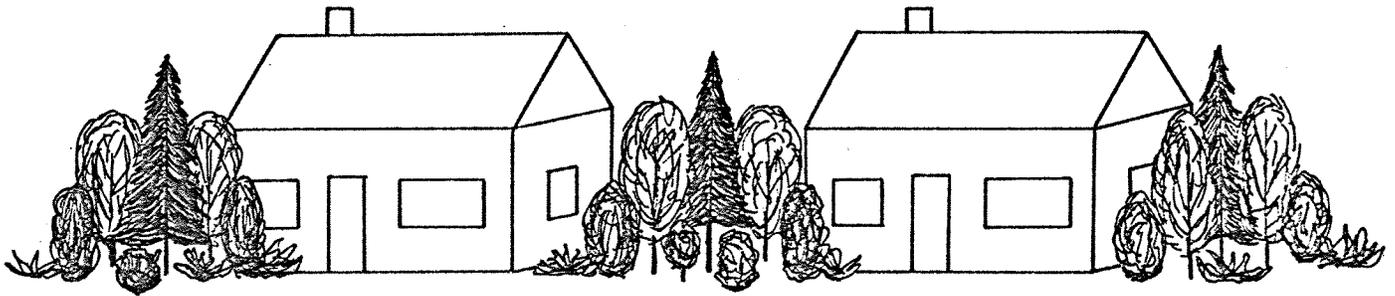


Figure . Use of successive incremental planting design for general landscaping purposes.

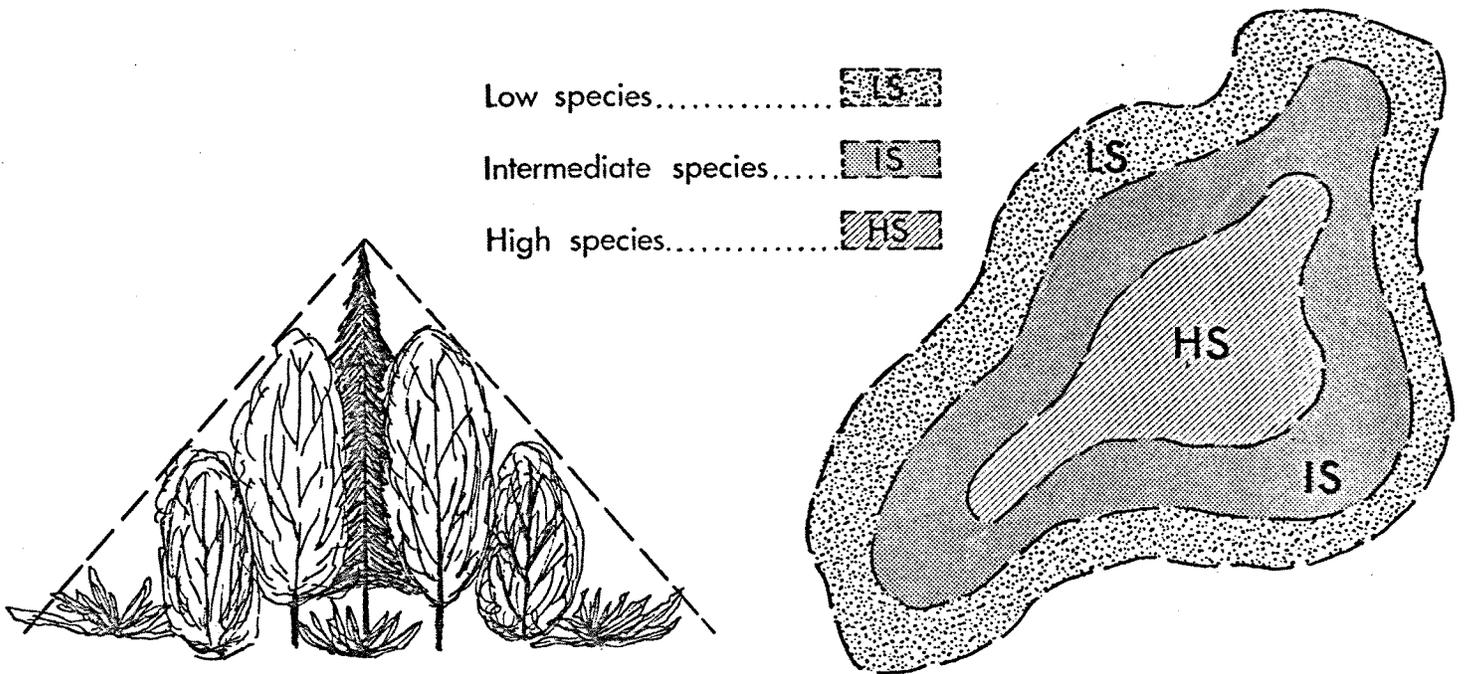


Figure 8. Variations of this design can be used in larger more open spaces.

Table 1: Existing Soil-Vegetation Relationships on Disturbed Sites in Waterton.

Site Examined	Soil Map Units	Observed Vegetation		
		Botanical name	Common name	
1. Campground and north end of Cameron Lake	31	<i>Picea engelmannii</i>	Engelmann spruce	
	48	<i>Abies lasiocarpa</i>	Alpine fir	
	64	<i>Xerophyllum tenax</i>	Bear grass	
	190+53		<i>Menziesia ferruginea</i>	False huckleberry
			<i>Vaccinium scoparium</i>	Pink-fruited grouse-berry
			<i>Vaccinium membranaceum</i>	Tall blueberry
			<i>Tiarella unifoliata</i>	False mitrewort
			<i>Pedicularis bracteosa</i>	Bracted lousewort
			<i>Mitella nuda</i>	Mitrewort
			<i>Luzula parviflora</i>	Small-flowered wood rush
			<i>Arnica cordifolia</i>	Heart-leaved arnica
2. Service centre, or Waterton townsite	21	<i>Pseudotsuga menziesii</i>	Douglas fir	
	22	<i>Picea glauca</i>	White spruce	
		<i>Populus trichocarpa</i>	Black cottonwood	
		<i>Prunus</i> sp.	Cherry	
		<i>Symphoricarpus occidentalis</i>	Buckbrush	
		<i>Rosa acicularis</i>	Prickly rose	
		<i>Rubus idaeus</i>	European raspberry	
		<i>Achillea millefolium</i>	Common yarrow	
		<i>Geum macrophyllum</i>	Yellow avens	
3. Highway #5 bridge across Blakiston Brook	20	No vegetation		
4. Golf course	1	<i>Populus tremuloides</i>	Trembling aspen	
		<i>Pinus contorta</i>	Lodgepole pine	
		<i>Rosa acicularis</i>	Prickly rose	
		<i>Symphoricarpus occidentalis</i>	Buckbrush	
		<i>Mahonia repens</i>	Creeping mahonia	
		<i>Vicia americana</i>	Wild vetch	
		<i>Vicia cracca</i>	Wild vetch	
		<i>Agropyron</i> sp.	Wheat grass	
		<i>Bromus ciliatus</i>	Fringed brome	
		<i>Anaphalis margaritacea</i>	Pearly everlasting	

Table 2: Indigenous Species* Recommended for Planting on Disturbed Sites in Waterton Lakes National Park.

Site	Recommended species in terms of suitability and height growth					
	Low (under 3ft.)		Intermediate (3 to 15 ft.)		High (over 15 ft.)	
	Botanical name	Common name	Botanical name	Common name	Botanical name	Common name
1. Campground and north end of Cameron Lake.	① <i>Arctostaphylos uva-ursi</i> ② <i>Xerophyllum tenax</i> ① <i>Linnaea borealis</i> ①-② <i>Pachystima myrsinites</i> (Regeneration not expected to be a problem on this relatively moist site.)	Kinnikinnick bear grass twin-flower mountain lover	③ <i>Menziesia ferruginea</i> ② <i>Alnus crispa**</i> ② <i>Alnus tenuifolia**</i> ①-② <i>Lonicera involucrata</i> ② <i>Shepherdia canadensis</i> ①-② <i>Cornus stolonifera**</i> ②-① <i>Acer glabrum</i> ② <i>Viburnum edule</i>	false huckleberry green alder river alder bracted honeysuckle Canadian buffalo-berry red osier dogwood mountain maple low-bush cranberry	① <i>Picea engelmannii</i> ① <i>Abies lasiocarpa</i>	Engelmann spruce alpine fir
3. Highway #5 bridge across Blakiston Brook.	Not applicable, because of no vegetative growth in active creek bed.					
2. Service centre or Waterton townsite. 4. Golf course.	① <i>Juniperus communis</i> ① <i>Juniperus horizontalis</i> ① <i>Symphoricarpos occidentalis</i> ①-② <i>Rosa woodsii</i> ② <i>Rosa acicularis</i> { <i>Ribes viscosissimum</i> ①-② <i>Ribes hudsonianum</i> { <i>Ribes triste</i> { <i>Ribes oxycanthoides</i> ①-② <i>Spiraea lucida</i>	ground juniper creeping juniper buckbrush common wild rose prickly rose sticky currant wild black currant wild red currant wild gooseberry white meadowsweet	① <i>Juniperus scopulorum</i> ①-② <i>Prunus virginiana</i> { <i>Prunus pennsylvanica</i> ① <i>Amelanchier alnifolia</i> ② <i>Shepherdia canadensis</i> ①-② <i>Crataegus douglasii</i> ① <i>Elaeagnus commutata</i> ① <i>Ceanothus velutinus</i>	Rocky Mountain juniper choke cherry pin cherry Saskatoon-berry Canadian buffalo-berry hawthorn silver-berry deer brush	①-② <i>Pseudotsuga menziesii</i> ②-③ <i>Picea glauca</i> ② { <i>Populus balsamifera</i> { <i>Populus trichocarpa</i>	Douglas fir white spruce balsam poplar black cottonwood

Notes:

Shade tolerance

① Low

② Moderate

③ High

④ Extremely high

* Inclusive of those species that already exist on the site.

** To be planted on the moister portions of an already moist site.