1996 FINAL REPORT
CHUGACH ELECTRIC ASSOCIATION, INC.

GIRDWOOD TO INGRAM CREEK RESTORATION PROJECT

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FOREWORD

The Alaska Plant Materials Center (PMC) is a section of the Division of Agriculture, Department of Natural Resources. The PMC is often called upon to assist in revegetation, reclamation and restoration projects throughout Alaska. The form of this assistance is often recommendations in technique and plant materials, as well as basic project design. It can involve developing recommendations and techniques for never before attempted projects. When this occurs, recommendations are based on experience with closely related projects, or basic familiarity with ecosystems and plant species.

Many projects do not have the luxury of time for in depth studies prior to implementation. While indepth studies would be ideal; real world requirements and economic realities do not always warrant or allow for academic studies. The PMC does, however, document all results obtained on the projects, no matter how simplistic. This information and data, while often not statistically verified or quantitative in nature, does provide industry with needed and useful information.

The Chugach Electric Association, Inc. (CEA) project described in this report is a typical example of how the PMC incorporates "research, past experience and professional knowledge" into a cost-effective and successful program with immediate results for the cooperator, in this case CEA. This method of cooperation has resulted in numerous win-win projects over the past twelve years.

Introduction

As part of Chugach Electric Association, Inc.'s (CEA) normal maintenance program, CEA was required to rebuild a portion of a main transmission line. This rebuild project started in the area of Girdwood and ended near Ingram Creek. In July 1994, CEA contracted the services of the Alaska Plant Materials Center (PMC) to assist in a restoration project. This contract initially covered the area between Girdwood and Twenty Mile River. The restoration project was needed to address surface damage as a result of the powerline rebuild program between Girdwood and Twenty Mile River. The PMC's multiple responsibilities under the contract were; 1) to provide a restoration/revegetation plan; 2) harvest and clean site specific native seed; 3) assist and train the selected contractor with the actual implementation of the plan; and 4) document results in the form of a final report. In April 1995, the contract was amended to include the portion of the powerline rebuild from Twenty Mile River to Ingram Creek.

Much of the land disturbed by the construction activity crossed coastal wetlands. This was especially true in the Girdwood area. These wetlands are also subject to periodic tidal flooding. The soils in the area are composed of silts and clay. The vegetation community consists of Lyngby sedge, *Carex lyngbyaei*; seashore arrowgrass, *Triglochin maritimum*, and other typical coastal wetland species.

The areas near Portage and extending to Ingram Creek are more upland in nature, however, the soils also tend to be wet. Species composition consists of alder, *Alnus* sp.; yarrow, *Achillea borealis*; lupine, *Lupinus nootkatensis*; hairgrass, *Deschampsia* sp.; and bluejoint, *Calamagrostis canadensis*. Species composition is much more diverse in these areas.

The true upland and sub-alpine areas affected by this project were determined to be low impact sites with a high potential for natural revegetation. Therefore, no restoration plan was developed for these areas.

A major concern associated with construction in the wetland areas near Girdwood and Portage, was the "visual impact". The Seward Highway is heavily used by the public and tourist industry. Much of the damage as a result of the rebuild would be adjacent to the Seward Highway and therefore in plain view. This type of "scarring of the land" often results in public complaints and "bad press"; two negative image factors no one wants or needs.

After the initial discussions with CEA and regulatory agencies, it was determined that only wetland areas and areas adjacent to the Seward Highway would be scheduled for restoration. This was based on the degree of visual impact, the amount of and potential for surface damage resulting from construction equipment, and the specific area's potential for natural revegetation. The resulting design was based on these

parameters. This resulted in different levels of restoration by Right-of-Way segment. The spectrum of restoration activity ranged from seeding and transplanting in conjunction with fertilizer to fertilizer only, and in some cases, doing nothing.

Background

Coastal wetland restoration is a relatively new practice in Alaska. The only other coastal wetland restoration project or study conducted by the PMC was the Anchorage Wastewater Utility (AWWU) project on Fish Creek in Anchorage. The findings obtained on the AWWU project were the basis of the CEA design. The most significant finding on the AWWU project was; coastal wetlands with silty soils and tidal inundation, require higher than usual fertilizer applications to achieve an acceptable vegetation response. This "indication of heavy fertilizer need" was employed in the design and construction of the CEA project.

Transplanting proved to be somewhat ineffective on the AWWU project and was therefore of secondary importance in the CEA project design. Its use was limited to a single severely disturbed area. Natural invasion as a result of heavy fertilization seemed to be the most effective method used on the AWWU project. In order to hasten the natural reinvasion process observed on the AWWU project, a program to harvest and apply local seed was used on the CEA project. The latter technique was never attempted or documented in Alaska prior to this project.

Seed Collection Results

During the four-day period from August 16 to 19, 1994, the PMC conducted a seed collection program for the project. Seed was collected from three Right-of-Way (ROW) areas.

Table 1 Seed Collection Areas

Site #	Location	Land Ownership
1	STR 32-2 to 32-6+	State: Division of Parks
2	STR 33-4 to 33-6	State: Division of Parks
3	STR 41-6 to 41-10	Federal: U.S. Forest Service

The majority of the seed harvest was conducted with a Prairie Seed Stripper towed behind a four-wheeler. Hand harvest was also conducted for species that were not suited for mechanical harvest, i.e.; isolated stands or low growing species. The harvest, cleaning and germination requirements for the species used on the project were not known prior to the actual harvest in 1994.

The permit to collect seed on state land was obtained from the state (Alaska Division of Parks) without problem. The permit to mechanically harvest seed on U.S. Forest Service land was at first rejected. This was later rescinded and the permit was granted provided all activities occurred within the CEA ROW. The Forest Service decision to allow mechanical harvest was in part based on observations of the action of the seed stripper on state land and the low ecological impact resulting from its use.

Figure Seed stripper harvesting Lyngby sedge STR 33

Figure 2. Seed stripper harvesting upland" mix native seed· yarrow lupine and beach wildrye STR ·8

Table 2. Native species used in the restoration program.

Species	Method of Harvest	Amount Clean Seed	Percent Germination	Collection Site*
Carex Lyngbyaei Lyngby sedge	Mechanical	156 pounds	72	1, 2
Poa eminens Spear bluegrass	Hand	1.5 pounds	58	2
Triglochin maritimum Seashore arrowgrass	Mechanical	1 pound	26	2
Lupinus nootkatensis Nootka lupine	Mechanical	2.7 pounds	83	3
Achillea borealis Yarrow	Mechanical	7.8 pounds	65	3
Hordeum brachyantherum Short squirrel tail	Hand	6 ounces	42	2, 3
Plantago maritima Seaside plantain	Hand	2 ounces	25	2
Lathyrus maritima Beach pea	Hand	1 pound	77	2
Leymus mollis Beach wildrye	Mechanical	6 pounds	38	3
Rumex fenestratus Sorrel	Hand	3 ounces	90	3

* As described in Table

Carex lyngbyaei (Lyngby sedge) was the primary target species in the restoration project. This was based on the species predominance and endemic distribution within the project area, especially near Girdwood. It appeared to be the critical species. The majority of the Lyngby sedge was used in single species applications; not in a mix with other species. The remainder of the collected species were incorporated into mixes with commercially acquired Bering hairgrass, *Deschampsia beringensis*; bluejoint, *Calamagrostis canadensis*; and a portion of the collected Lyngby sedge.

Plan as Carried Out (As-Built)

The original proposed schedule was adhered to without significant change. The specific areas to treat and methods of restoration were conducted as planned See the Appendix for the Plan as Presented and the Schedule of Activities.

Phase I covered the area from Girdwood to Twenty Mile River. Phase II ran from Twenty Mile River to Ingram Creek. Phase II restoration was conducted in 1996.

Changes to the Phase I plan did, however, occur in fertilizer application rates. This change was, in part, based on late analysis of the data obtained from the AWWU project. The factor that allowed the change (increased application rates) was the CEA estimate of disturbance width. Initial CEA calculations for fertilizer needs were based on a 100-foot right-of-way. In reality, the maximum width of actual disturbance rarely exceeded 50 feet and was usually less than 20 feet. This resulted in an excess of fertilizer. The limited width of disturbance is to the credit of both CEA and the contractor. The restoration crew started on the Phase I project June 1 and it was completed by June 8, 1995.

Table 3. Actual fertilizer applications

Site	Planned	Actual
PHASE I		
STR 31-6 to 32-1 and Temporary Access	500#/ac 20-20-10	1000#/ac 8-32-16
Seward Hwy Access Point 20-1 to ROW	350#/ac 20-20-10	700#/ac 20-20-10 2nd application 7/27/95 500#/ac 8-32-16
STR 32-2 to 32-6+	350#/ac 20-20-10	700#/ac 20-20-10
Seward Hwy Access Point 20-2A to ROW	500#/ac 20-20-10	1000#/ac 20-20-10
STR 32-7 to 33-3+	350#/ac 20-20-10	800#/ac 20-20-10
Seward Hwy Access Point 21-1A to ROW	500#/ac 20-20-10	1000#/ac 20-20-10
STR 33-4 to 33-5	350#/ac 20-20-10	1200#/ac 20-20-10
STR 33-5 to 33-6 & Access to Seward Hwy	350#/ac 20-20-10	1500#/ac 20-20-10
STR 38-4.5 to 38-6 & Access 23-2A	500#/ac 20-20-10	500#/ac 20-20-10
STR 40-5 to 41-5+	500#/ac 20-20-10	500#/ac 20-20-10
STR 41-6+ to 41-10 & Access to Parking Area	600#/ac 20-20-10	600#/ac 20-20-10
PHASE II		
STR 45-61-) to 45-7+	500#/ac 20-20-10	500#/ac 20-20-10
STR 47-1 to Hwy Crossing & Access Trail to Seward Hwy Pull-off	600#/ac 8-32-16	600#/ac 20-20-10

All seeding specifications outlined in the original plan were followed during the actual project. The over estimate of disturbance width also resulted in a surplus of seed. This surplus was used on the 1996 effort from Twenty Mile river to Ingram Creek.

The only remedial work conducted on the project was in the area around Access Point 20-1. This action was taken on July 27, 1995 after it was obvious that the original activity was not working. This area was once more seeded with Lyngby sedge seed and fertilized. The second fertilization program relied on 8-32-16 fertilizer applied at a rate of 500 pounds per acre.

Additional seed collection was not required for the 1996 phase and the remedial work in 1995. Sufficient seed was collected in 1994 to cover these needs.

Table 4. Seed application.

Site	Total	Rate
STR 31-6 to 32-1	30 lbs sedge	15/lbs/ac
Access 20-1 to STR 32-6*	40 lbs	8 lbs/ac
Access Point 20-2A	20 lbs	20 lbs/ac
Access Point 21-1A	5 lbs sedge	15 lbs/ac
STR 38-4 to 38-6 & Access Point & STR 45-61-) to 45-7+	8 lbs hairgrass 2 lbs beach wildrye 3 lbs yarrow .5 lbs spear bluegrass 10 lbs sedge	12 lbs/ac
STR 40-5 to 41-5 & STR 47-1 to Hwy Crossing & Access Trail to Seward Hwy Pull-off	36 lbs hairgrass 3 lbs bluejoint 4 lbs yarrow 8 lbs beach wildrye 2 lbs lupine 14 pounds sedge .5 lbs spear bluegrass .2 lbs sorrel	16 lbs/ac

* A portion of this area was re-seeded with sedge on July 27, 1995 at a rate of 15 pounds per acre.

Figure 3. Revegetation crew with equipment used to apply seed and fertilizer.

Transplanting

Transplanting was limited to the area around STR 31-6 and the Girdwood TAP. This area is also referred to as Girdwood Circuit Switcher and was originally disturbed in 1991 prior to the present rebuild project. Many local residents considered this site an eyesore and it was a source of many complaints. Special attention was given to the area after the 1994 construction activity. A small program of transplanting native species from adjacent undisturbed areas was attempted in this area as a special mitigation effort.

Table 5. Transplanting activity

Species	Perceived Value Prior to Project	Qualitative Results (Success)
Carex lyngbyaei, Lyngby sedge	High	Excellent
Potentilla Egedii, Pacific silverweed	Low	Good
Triglochin maritimum, seashore arrowgrass	Low	Fair

Lyngby sedge was the target species for transplanting as it was with seeding. The qualitative results of the transplanting are noted in Table 5. For the most part, this activity, while successful, provided very little to the site's resulting overall plant cover or composition.

Results

After the restoration activities for Phase I were completed in 1995, site visits and evaluation occurred on July 4, July 19, July 27, August 30 and September 17, 1995. During the July 27, 1995 site visit, the access point 20-1 and the area around STR 32-3 was re-seeded with five pounds of Lyngby sedge (15 pounds per acre). The area was also re-fertilized using 8-32-16 at a rate equivalent to 500 pounds per acre. This action was taken due to the relatively poor performance of the stand and the areas high visibility.

The information presented in this section is based on the data obtained during the 1995 and 1996 evaluations.

Phase II restoration activity was initiated and completed on June 25, 1996. Other activities that occurred in 1996 were the site evaluations. At each site visit, the entire project from Girdwood to Ingram Creek was evaluated. 1996 evaluations occurred on June 25, July 1, August 8 and September 3.

It must once more be noted that PMC assistance projects are intended to produce results; i.e., successful revegetation. The research aspects are secondary to the intent of the project. Therefore, rarely does this type of project have "controls" as required by the "scientific method" used in applied research. The results are qualitative and without statistical verification. Also, it must be noted that the PMC rarely conducts pure research. The PMC does however, do applied research (using the term "research" very loosely).

STR 31-6 to 32-1, Girdwood Circuit Switcher and Temporary Access

During August and September 1991, construction activities around the area known as the Girdwood Circuit Switcher caused a significant disturbance to the existing vegetation. The area failed to re-establish vegetation by natural means. CEA received numerous complaints regarding the "eyesore" caused by their activities. As part of the Girdwood to Twenty Mile River transmission line rebuild, additional construction activities were scheduled for this area resulting in additional surface disturbance. CEA was sensitive to the criticism received in the past and this area became a priority for restoration.

Figure 4. Girdwood Circuit Switcher, 1992.

Photo courtesy of Chugach Electric Association, Inc.

Figure 5. Girdwood Circuit Switcher area, May 31, 1995, prior to restoration.

Figure 6. Girdwood Circuit Switcher area, August 30, 1995

Figure 7. Girdwood Circuit Switcher Area, September 3, 1996.

The restoration activities conducted in Phase I (1995) greatly enhanced the overall appearance of the site. Natural reinvasion of native species expected after the 1991 construction project did not occur as hoped. However, After a single growing season in 1995 following the prescribed restoration treatment which included seeding with *Carex lyngbyaei* (Lyngby sedge), heavy rates of 8-32-16 fertilizer (1,000 pounds per acre), and transplanting, the area supported an excellent stand of natural vegetation. The restoration effort appears to have been effective and appropriate. It is interesting to note that though the transplanting activities were, for the most part, successful, they contributed relatively little to the overall success and appearance. The seeded sedge performed well and accounts for the majority of the vegetation composition; approximately 80% at the end of 1996. The most interesting finding at the end of 1996 was the increased occurrence of seashore arrowgrass, *Triglochin maritimum*. This species was not seeded, however, it contributed nearly 20% of the species composition. The presence of other species not seeded; i.e., *Plantago maritima, Potentilla Egedii* and *Hordeum brachyantherum* suggests the fertilizer is the critical component in coastal restoration programs. The true extent of fertilizer's role in the apparent success was not investigated. The overall cover in the area was estimated to range between 80-85% at the end of 1996. This is an exceptionally good cover value for two growing seasons.

Seward Highway Access Point 20-1 to ROW and STR 32-2 to 32-6

The access point and the area around 32-3 was initially the least responsive area on the project. As noted earlier, this site was seeded and fertilized twice. This action was taken when it was observed and noted that regrowth was not occurring to a rate nearly as good as other sites on the project. The reasons for the initial poor response are still speculation. However, evidence suggests that excessive equipment passes and turning may be in part the blame. Another possible explanation could be the action of ebbing and waning of extreme tides. The area is a major entry and exit point for these tides. The resulting current could be the detrimental force negatively affecting plant establishment (See Figure 12).

Figure 8. Access point 20-1, September 19

Figure 9. Access point 20-1, July 1995.

Figure 10. Access point 20-1, September 1995, after second treatment.

Figure 11. Access point 20-1, September 1996.

Figure 12. Access point 20-1 during an extreme high tide, August 1996.

By September 1995, the area began responding to the restoration activities. This area also exhibited a high degree of *Triglochin* and *Potentilla* invasion. At the end of the study in September 1996, the area was showing approximately a 40% cover and appeared to be slowly responding to the restoration effort. The area between STR 32-2 and STR 32-3 responded well to the original treatment. In September 1995, the area supported a decent stand of native vegetation to the point where signs of construction activity were nearly negated. By September 1996, all evidence of the construction was gone, with the exception of a slightly lighter green appearance.

Figure 13. Area from STR 32-3 to STR 32-2, September 1995.

Figure 14. Area from STR 32-3 to STR 32-2, September 1996.

The area from STR 32-3 and 32-6 responded well to the restoration effort. However, the track marks are still quite visible. This tends to be less noticeable as STR 32-6 is approached, suggesting that the number of equipment passes plays a role in a site's ability to recover. By September 1996, the width of the equipment tracks was reduced by 70% and as STR 32-6 was approached, were no longer visible. As sediment and vegetation matter fill the ruts, the trail will become covered with vegetation.

Figure 15 Typical view between STR 32-3 and 32-6, 1995.

Figure 16. Typical view between STR 32-3 and 32-6 in September 1996

Seward Highway Access Point 20-2A and STR 32-7 to STR 33-3

This access road, 20-2A, responded well to the restoration program. In September 1995, the trail supported a heavy growth of sedge seedlings. By September 1996, the trail supported a vigorous stand of sedge. It still, however, was showing signs of higher than normal fertilizer levels in the fact that the bright green color was still apparent. The bright color had, however, subsided from the level in 1995.

Figure 17. Access trail 20-2A, September 1994.

Figure 18. Access trail 20-2A, September 1995.

Figure 19. Access trail 20-2A, September 1996.

The ROW between STR 32-7 and STR 33-3 responded much like the area between STR 32-3 and STR 32-6. The overall width of the disturbance had been reduced to 12 to 8 feet. Track marks are barely visible; sedges are growing between the depressions left by the tracks. The degree of visible impact recedes as STR 32-7 and 33-3 are approached from the access trail; i.e., the far ends of the construction segment. At the end of the segment, signs of construction activity are almost non-existent.

Figure 20. Typical view of ROW segment between STR 32-7 and STR 33-3, September 1995.

Seward Highway Access Point 21-1A and ROW Between STR 33-4 and STR 34-1

Access trail 21-1A exhibited the best response to the restoration program out of the three access points crossing saturated wetlands. In September 1995, this area supported nearly an 80% cover of seedling sedges. Cover levels increased to 90% + in 1996.

Figure 21 Access trail 21-1A, September 1994

Figure 22. Access trail 21-1A, September 1995.

Figure 23. Access trail 21-1A, September 1996.

The ROW between STR 33-4 and STR 34-1 also responded better than the previously mentioned ROW segments. This is probably in part due to drier soils resulting from the increase in site elevation. By September 1995, only small vestiges of track marks remained between STR 33-4 and STR 33-6. No tracks were apparent from 33-6 to 34-1. When the site was last visited in September 1996, no signs other than a slight color difference in the vegetation, of construction were observed.

Figure 24. View from STR 33-6 to STR 33-5, September 1995.

Figure 25. View from STR 33-6 to STR 33-5, September 1996

Figure 26. View from STR 33-6 to STR 34-1, September 1995

Figure 27. Same area in September 1996.

Remainder of Project Areas to Twenty Mile River

These three segments; STR 38-4+ to STR 38-6, STR 40-5 to 41-5, and 41-6 to 41-10+, were not considered significant restoration problems. The higher surface elevations of the site and resulting drier soil reduced the potential for excessive damage by construction equipment. While significant damage could still have resulted, the contractor utilized low impact practices to prevent unneccessary damage. These areas also supported more upland types of vegetation allowing for a more traditional and proven approach to restoration.

Figure 28. Area around STR 41-5 looking back to STR 41-4, June 1995. Note: Only superficial vegetation damage occurred.

Figure 29. Same area around STR 41-5, September 1995.

Figure 30. STR 41-5 in September 1996.

Twenty Mile River to Ingram Creek

This portion of the transmission line rebuild was a minor problem in the overall project. The majority of this segment was out-of-view from the Seward Highway. This fact would allow the natural revegetation process to occur without intervention. The area was also more upland in nature. While some portions of this segment are subjected to extreme high tides and fresh water impoundment, the overall nature of the sites are much drier than other segments of the project, especially those areas near Girdwood.

Based on the fact that these sites would suffer minimal impact, natural revegetation potential was high and the majority of the disturbed areas posed no visual impact, only two areas were selected for restoration.

No additional supplies were needed to restore these two sites. The over estimation of actual damage during the 1994/1995 construction resulted in a surplus of seed and fertilizer. This surplus was sufficient to complete the 1996 active effort from Twenty Mile River to Ingram Creek. The areas were seeded and fertilized on June 25, 1996.

STR 45-6(-) to STR 47-7+ (Seward Highway Road Crossing)

This area was prone to freshwater ponding and was in direct view from the highway. Access from the highway required crossing saturated soils which resulted in rutting. The area also opened up dense stands of alder exacerbating the visual impact. The area was restored using the fertilizer and seed mix listed in tables 3 and 4 respectively.

Figure 31. STR 45-6 after restoration in September 1996.

Figure 32. View of STR 45-7 from highway in 1995.

Figure 33. View of STR 45-7 from highway after restoration in September 1996.

STR 47-1 to Highway Crossing and Access Trail Adjacent to Seward Highway

This area was the driest site of all. It was also a highly visible site. The species composition in the area is short shrub and grasses. Cursory observation indicated that the predominate grass species was hairgrass (*Deschampsia* sp.).

Figure 34. STR 47-5 viewed from the Seward Highway, 1995.

Figure 35. STR 47-5 viewed from Seward Highway, June 1996.

Figure 36. STR 47-5 from same general area, September 1996

The restoration effort in the area from Twenty Mile River to Ingram Creek was successful. Cover ranged from 60 to 80 percent in the seeding year (1996). Based on this performance and the performance of the area from STR 38-4 to Twenty Mile River, satisfactory results can be expected.

Tidal Influence on the Project

Very few areas worldwide are affected by tides to the extent as occurs on this project site. Maximum tides in the Turnagain Arm of Cook Inlet can exceed 42 feet. This takes the definition of inter-tidal zone to extremes. Other restoration projects have occurred in inter-tidal zones, but few areas that could be vegetatively classified upland are affected by tides as are portions of this project. The area is quite unique in this regard due to the extremely high tides. The affect of the tides in the actual restoration effort was not documented. It can be assumed that it did have an effect.

Questions regarding the tide influence alone are numerous. A few include:

- Did the tides move seed into and out of the seeded areas?
- Will the deposition of silt eventually fill the depressions left by equipment tracks?
- There are signs after each extreme high tide that silt is being deposited. The trace of silt was not measureable, therefore, not quantifiable. It will undoubtedly play some role in the recovery of the area.

Figure 37. Access point 20-1 during a 33.2+ tide at 8:09 a.m. on August 29, 1996.

Figure 38. Girdwood circuit switcher during a 33.2 + tide at 8:09 a.m. on August 29, 1996.

Figure 39. Twenty Mile area at slack water during the August 29, 1996 high tide.

Figure 40. Ingram Creek area during slack water on the August 29, 1996 33.2+ high tide. Approximately 8:30 a.m.

All the areas within these three segments now support heavy stands of native vegetation. The restoration project was the most successful in these segments. However, with the exception of the species used in the reseeding program, it was a standard restoration program using proven techniques, very different from the Girdwood area where techniques were new and unproven. A 90%+ cover exists on all these Portage segments. Overall, the species composition may have been altered in the seeded areas, because of hairgrass in the seed mix. Species composition should change over time.

Initial Conclusions as Reported in 1995

1. The restoration program has performed satisfactorily to date. Some aspects have exceeded expectations.
2. The use of *Carex lyngbyaei*, Lyngby sedge, as a seeded species is feasible. Further evaluation needs to be conducted to determine appropriate seeding rates.
3. Transplanting some coastal wetland species appears to be possible. Survival of transplants was satisfactory. However, seeding was more successful and cost-effective.

4 High rates of fertilizer application appear to be necessary for successful plant growth and restablishment in the coastal wetlands subject to tidal flooding.

5 The fertilizer formulation 8-32-16 appears to produce better results than a 20-20-10 formulation. This requires additional study.

6 *Triglochin maritimum*, seashore arrowgrass, may be a more important species than Lyngby sedge with regard to initial reinvasion. Perhaps, a seeding of this species can be attempted in the future. It appears that seashore arrowgrass may be the primary colonizer and Lyngby sedge the climax species.

7 The most significant factor adversely affecting successful restoration is the formation of ruts or depressions. This (at times relatively insignificant changes in elevation) allows for ponding of water which seems to preclude or slow vegetation establishment.

8 Fewer passes of equipment over the same track seems to facilitate restoration.

9 The bright green color of the vegetation in the disturbed areas where fertilizer was applied is temporary. This effect will disappear with time.

Final Conclusions

Seeding Lyngby sedge is practical and effective. Harvesting natural stands is also practical. Commercial production of Lyngby sedge may be possible, however initial attempts at an upland site at the Plant Materials Center were not successful. Managing natural stands appears to be the best approach for production of commercial quantities of seed.

2 Transplanting coastal wetland species is also an appropriate means of restablishing vegetation. The technique is, however, more time consuming and destructive to existing stands of vegetation. Seeding the species is more efficient and appears to produce better results. More research needs to be done with other species such as *Triglochin*.

3 High rates of fertilizer (1,000 to 1,500 pounds per acre) produces excellent results. The minimal amount of fertilizer needed to produce results is still not known. The actual amount needed could be between 600 and 1,000 pounds per acre. 8-32-16 fertilizer seemed to have some advantage over 20-20-10 fertilizer.

4 The low impact practices employed by Chugach Electric aided in restoration. Fewer passes over an area allowed better restoration to occur. Rutting the soil produced the most obvious disturbances. Rutting must be avoided if possible.

5. The Chugach Electric restoration project was highly successful. The science of restoring coastal wetlands has advanced significantly with this project.

APPENDIX

Schedule of Activities as Presented

Restoration Plan for Girdwood to Twenty Mile River as Presented

Restoration Plan for Twenty Mile River to Ingram Creek

Schedule of Activities for Girdwood to Twenty Mile River Transmission Line Rebuild Revegetation Project as Presented in the Restoration Plan June 19, 1994

1. Site Assessment: July - August 1994
   This phase will consist of on-site evaluation of the right-of-way and development of strategies for revegetation. Segments or areas will be rated for the potential of; a) natural revegetation, b) enhanced natural revegetation (fertilizer only), c) standard revegetation (seed and fertilizer); and, d) transplanting plugs of native plant material, and e) using seed of locally collected species.

   Also during this phase, potential collection sites for indigenous species (seed and transplants) will be identified. The Alaska Plant Materials Center will assist Chugach Electric Association in obtaining collection permits.

2. Report of Assessment Findings:
   A brief report suggesting revegetation treatments by R.O.W. segments will be provided to Chugach Electric Association.

3. Seed Collection: August - September 1994
   Seed collection and use efforts will be restricted to areas where traditional seeding, enhanced natural revegetation or natural revegetation have been determined inappropriate. Common or abundant species will be targeted for use in the specified areas. Following harvest, seed will be cleaned (October - November, 1994) and tested. Prior to the spring of 1995, the resulting seed will be given to Chugach Electric Association.

4. Monitor Revegetation Effort: June - July 1995
   The PMC will train and monitor Chugach-hired contractor in the use of transplanting and native seed application.

5. Final Report & Area Monitoring: November 1995 - November 1997
   November 1995 Chugach Electric will be provided a final report regarding the restoration effort. The report will cover success of the project and methods employed.

   Long-term Monitoring: The Alaska Plant Materials Center will monitor the area following completion in 1995 through 1997. If problems arise, they will be addressed by the PMC staff and remedial actions suggested.

Transmission Line Rebuild Restoration Plan
as Presented
August 24, 1994

1 Natural revegetation will, over a period of a few years, reclaim the disturbances created during the rebuilding of the transmission line. However, care should be taken by the contractor to avoid unnecessary damage to the landscape. Damage to the existing vegetation can be kept to a minimum with a few basic procedural precautions.

a. Keep the number of vehicular passes over the area to an absolute minimum.

b. Avoid sharp turns that require prolonged track braking.

As previously stated, the areas described in this report will quite probably naturally revegetate if damage is kept to a minimum. The revegetation requirements governing Chugach Electric seems to be more public and regulatory opinion than ecological processes. Therefore, the following segment by segment revegetative plan has been developed.

STR 31-6 to STR 32-1 and Temporary Access

1. Fertilize all areas showing damage with 20-20-10 fertilizer at a rate of 500 pounds per acre.
2. Transplant sedges from surrounding natural stands into the denuded area.

Access Point No 20-1 HWY to STR 32-5+

1. Employ low impact practices during construction.
2. Collect local sedge seed for re-distribution, June-July, 1995.
3. Fertilize area with 20-20-10 fertilizer at a rate of 350 pounds per acre

Temporary Access Point No. 20-2A to ROW

Note: This will be a high visibility area and requires the utmost in precautions to avoid unnecessary damage.

1. Employ low impact practices.
2. Seed area with indigenous species and fertilize with 20-20-10 fertilizer at a rate of 500 pounds per acre.

STR 32-7 to 33-3

1. Employ low impact practices.
2. Fertilize area with 20-20-10 at a rate of 350 pounds per acre.

STR 33-4 to STR 34-1

1. Same as 32-7 to 33-3.

Temporary Access Point No. 21-1A

1. Same as Temp. Acc. Pt. No. 20-2A

STR 38-5 to STR 38-6 and Temporary Access Point 23-2A

Note: This is a high visibility area. The utmost care should be used during construction to prevent unnecessary damage. Special care should be employed when working near the existing drainage channel. This area is the beginning of the "more upland" species communities and is marked by more species diversity.

1. Employ low impact practices.
2. Use seed mix composed of commercial Hairgrass at a rate of 8 pounds per acre and locally collected native species.
3. Fertilize with 500 pounds of 20-20-10 per acre.

STR 40-3 to STR 40-4

1. Use low impact practices.
2. Allow for natural revegetation.

STR 40-5 to STR 41-4

1. Use low impact practices.
2. Seed with a mix consisting of 5 pounds commercial Hairgrass, .25 pounds commercial Bluejoint per acre, and an undefined amount of sedge.
3. Fertilize with 20-20-10 at a rate of 500 pounds per acre.
4. In areas going through alder (shrub) thickets, allow for natural revegetation (do nothing).

STR 41-4+ to 41-6 (Highway Crossing)

Note: High visibility area.

1. Use low impact procedures.
2. Seed with a mix of commercial seed consisting of 8 pounds Hairgrass and .5 pounds Bluejoint per acre and an unidentified amount of native species including sedge, lupine and yarrow.
3. Fertilize site with 20-20-10 at a rate of 500 pounds per acre.

STR 41-6 to 41-10

1. Fertilize area with 600 pounds of 20-20-10 per acre and allow for natural revegetation.

STR 42-3 to 42-5

1. Allow for natural revegetation (do nothing).

The preceding recommendations are based on a predetermined level of surface damage. The recommendations also tend to be conservative based on the high visibility and potential scrutiny of the area. True damage to the site may be so minor that the entire site may not receive any form of assisted revegetation. However, the opposite may also come to pass, in which case, the plan as presented will not be sufficient.

This plan only addresses sites and areas highlighted by Chugach Electric Association. Areas outside the plan description, are well vegetated uplands and should not pose any problems, unless an erosion source is created during construction.

Restoration Plan for Twenty Mile River to Ingram Creek Portion of Transmission Line Rebuild December 5, 1995

Introduction

1. This portion of the Transmission Line Rebuild poses less of a restoration problem than the Girdwood to Twenty Mile River segment. This is due primarily to the fact that most of the activity is screened from the highway, and therefore natural revegetation can occur without causing a temporary visual impact. The second important factor is that different plant communities are affected. This area is, for the most part, more upland and therefore, natural revegetation will be more rapid. Also, the damage caused by construction equipment will tend to be more superficial. Based on these facts and observations during the summer and fall of 1995, the following restoration plan should provide adequate results.
2. **Twenty Mile River to STR 45-6**: Do nothing. Allow for natural revegetation unless a specific problem is noted by the landowner.
3. **Road crossing access points south to bend past STR 45-6 and north to bend past STR 45-7**:
    1. Fertilize all disturbed areas with 20-20-10 fertilizer at a rate of 500 pounds per acre.
    2. If areas are flooded, eliminate fertilizer requirement.

STR 47-1 to Highway Crossing and Access Trail from Seward Highway Pull-off to ROW:

1. Fertilizer disturbance (approximately 30' wide) with 8-32-16 fertilizer at a rate of 600 pounds per acre.
2. Seed area with seed remaining from 1995 restoration project (hairgrass and native seed). Chugach Electric Association is holding the needed hairgrass. The native seed mix is in storage at the Alaska Plant Materials Center.

Plan to conduct the restoration work between May 13 and June 21, 1996. A final report will be provided to Chugach Electric in December 1996. This report will document all activities and results of the 1995-1996 restoration program.