Case Studies

Photo: Will Menheere (Fairbanks Gold Mining Inc.)

A recontoured and revegetated mine site at the Fort Knox mine, north of Fairbanks

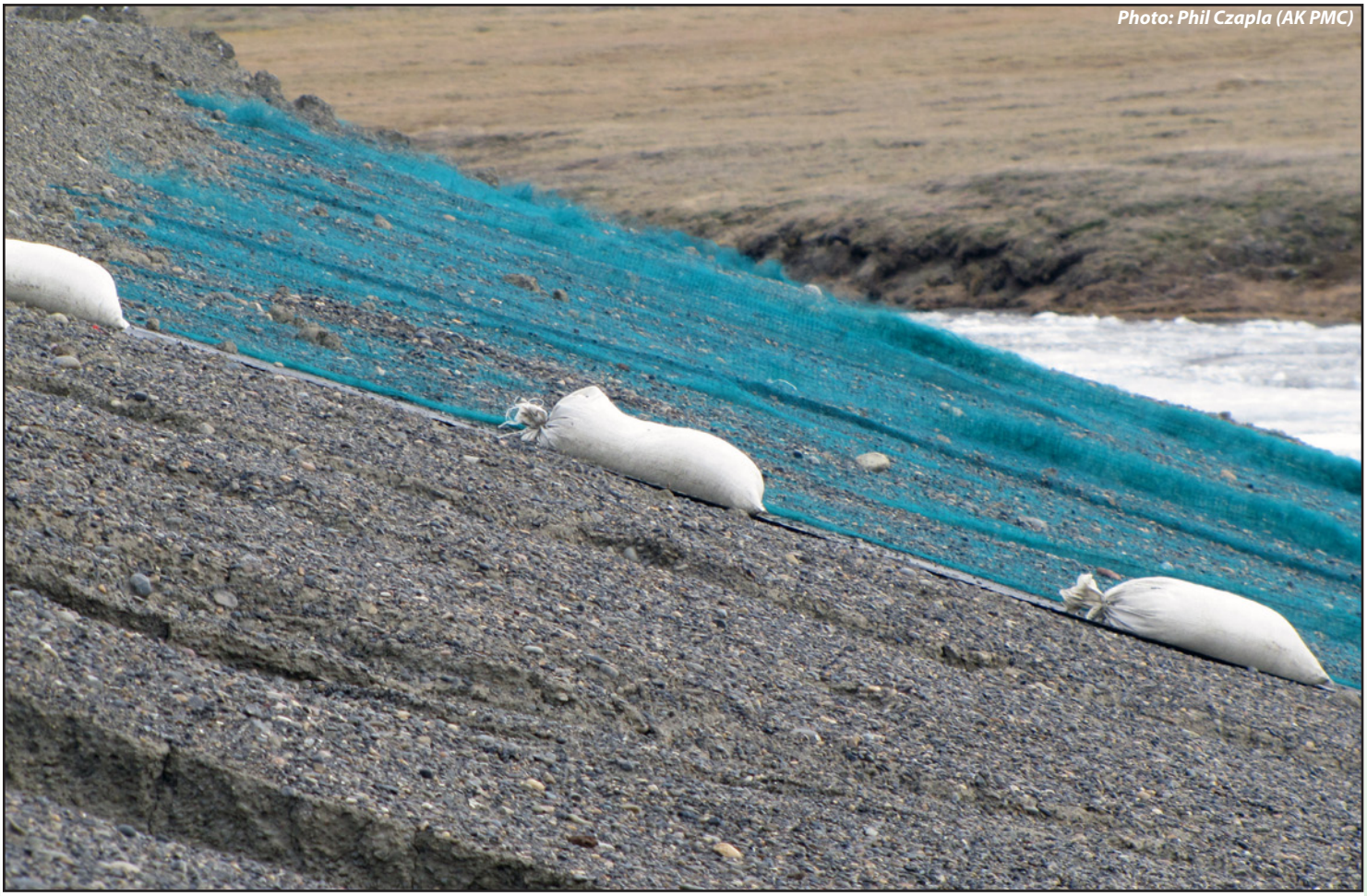
Section 4:

Interior Alaska Revegetation Projects

- *True North Mine Reclamation, Fairbanks;*
- *Chistochina River Wetland Restoration;*
- *Kanuti Pit Rehabilitiation, Dalton Highway;*
- *Partial Landfill Closure, Fairbanks;*
- *Riparian Reclamation of Nome Creek -*
  White Mountains National Recreation Area; &
- *Illinois Creek Mine Site Revegetation, Kaiyuh Mountains.*

Case Studies

Acknowledgements:



Geo-textile fabric armoring protects a constructed slope from wind and water erosion.

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- **Will Menheere** - Fairbanks Gold Mining Inc.,
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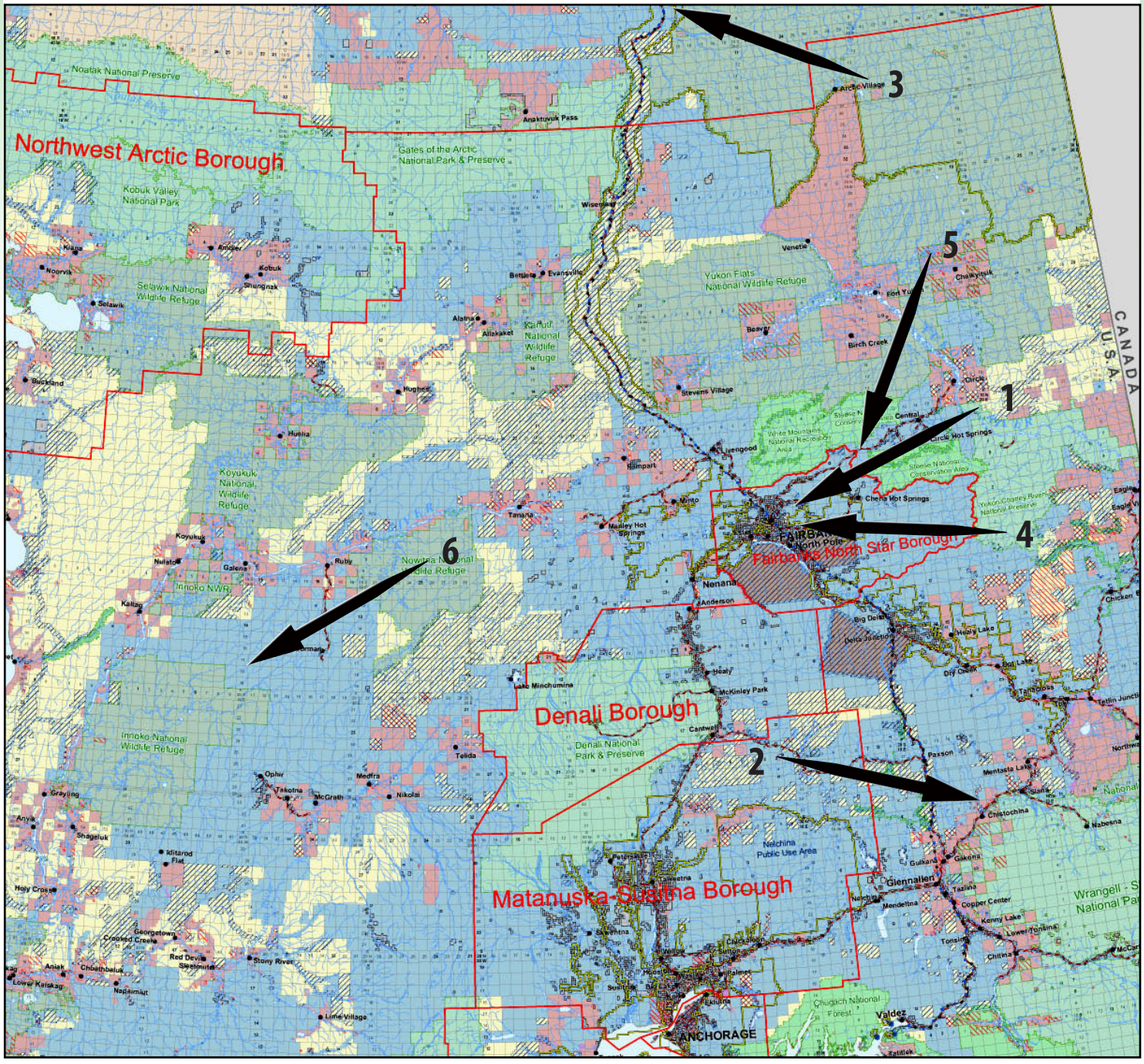
- **Steve McGroarty** - Alaska Department of Transportation & Public Facilities, and
- **Andy Nolen** - Alaska Department of Natural Resources, Division of Agriculture, Alaska Plant Materials Center.

Revegetation Projects

Interior Alaska Revegetation & Erosion Control Guide

1. True North Mine Reclamation
2. Chistochina River Wetland Restoration
3. Kanuti Pit Rehabilitation
4. Fairbanks Partial Landfill Closure
5. Riparian Reclamation of Nome Creek
6. Illinois Creek Mine Site Revegetation



True North Mine Reclamation

Submitted by Will Menheere, Fairbanks Gold Mining Inc.

Introduction / Objective:

In 1999, Kinross Gold Corp. acquired 100% ownership of the True North mine from the True North Joint Venture Project, a partnership between Newmont Alaska Limited and La Teko Resources. In 1999, Fairbanks Gold Mining Incorporated (FGMI) continued geologic exploration and baseline hydrologic data collection activities at the True North mine site.

Prior to construction of the mine facilities; placer, exploration, and other mining activities had disturbed approximately 68 acres within the True North Mine area. This disturbance does not include trails, historic ditches, cabin sites, and small-localized disturbances that existed before exploration. Some of these previously disturbed areas are located where the Hindenburg pit, East pit, and waste rock dumps are situated.

Mining occurred at the True North mine from early 2001 until late 2004, when it was decided that the mine would be put into "care and maintenance" status. Operations at True North mine were subsequently discontinued, and reclamation activities began in 2007. Reclamation activities occurred in 2007, 2009 and 2010, with the bulk of work completed in 2009 and 2010.

Methods of Revegetation:

Retaining and putting aside growth media is an important step in the reclamation process. Growth media is defined as all native soil material with the physical and chemical properties capable of germinating and sustaining vegetation growth with or without amendments.

The term growth media is synonymous with the terms topsoil and subsoil. Subsoil material is the unconsolidated material that lies between the topsoil horizon and bedrock and exhibits no chemical characteristics that will inhibit vegetation development. Approximately 12 inches of growth media was applied to areas of unsuccessful growth to promote natural re-invasion by native plant species.

Mine related disturbances can result in compacted surfaces unsuitable for revegetation. Thus, preparation of a seedbed suitable for plant germination and growth is a critical task in any successful land reclamation project.

At True North mine, the general method of seedbed preparation was ripping or scarifying along the contour using a D8N CAT equipped with a 2 or 3-shank ripper. Ripping occurred along contours of sloped areas to create a suitable seedbed and provide a measure of erosion control.

Following the application of growth media (if necessary) specific sites were prepared for seeding by scarifying on the contour to roughen the surface. A broken, roughened surface serves to trap moisture, reduce wind shear, minimize surface erosion by increasing infiltration, and create micro-habitats conducive to seed germination and development.

Specific fertilization requirements depend on the quality of growth media being used. At True North, the rate of fertilizer application generally ranged from 100 to 300 pounds per acre of 20N-20P-10K for a spring seeding or 10N-20P-10K for an early fall seeding. The fertilizer was applied using aerial broadcasting prior to, after, or during the seeding operation.

Species Used:

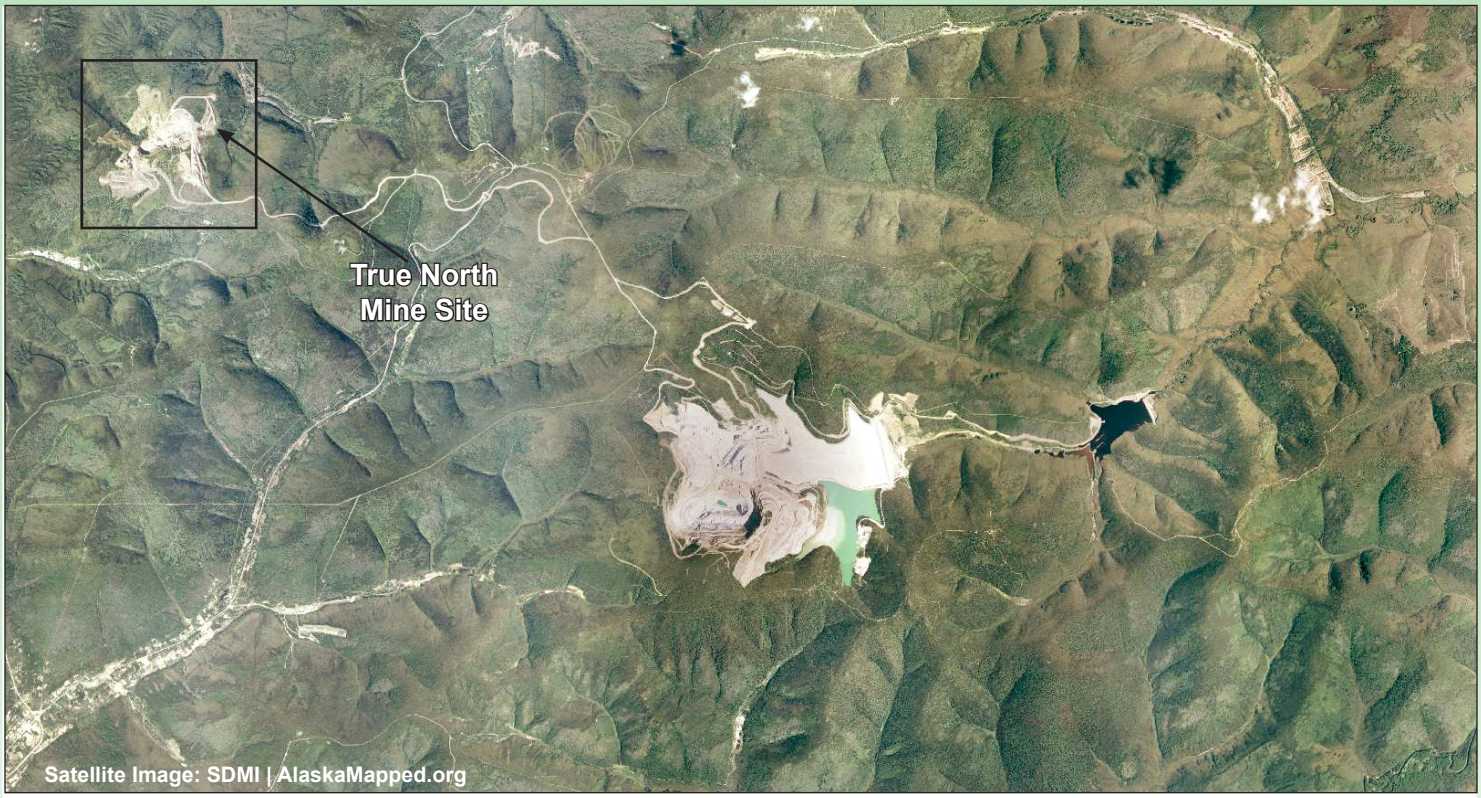
The grass seed mix used at True North mine consisted of:

- 50% 'Arctared' **Red Fescue**
- 20% 'Gruening' **Alpine Bluegrass**
- 20% 'Tundra' **Glaucous Bluegrass**
- 10% 'Nortran' **Tufted Hairgrass**

The primary purpose of the seed mix was to achieve quick vegetative cover to minimize soil erosion. Seeding was accomplished using aerial broadcast application, at a rate of 11 to 18 pounds of pure live seed per acre. The need for mulch application will be evaluated if seed germination becomes a limiting factor in the re-establishment of vegetation.

Results:

Since the initiation of reclamation, revegetation efforts have been successful at True North. To date, approximately 70% of the disturbed areas have been seeded and are achieving adequate growth. To ensure the continued growth of these areas, vegetative maintenance (seeding and fertilization) will be performed as needed.



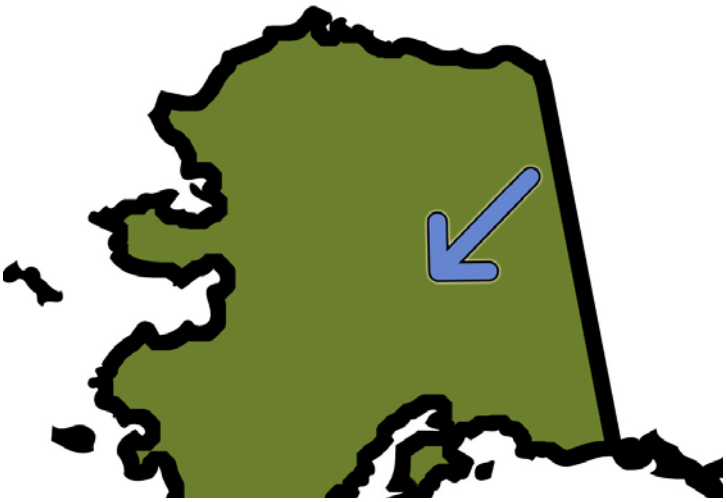
In addition to the applied seeding, natural re-invasion of native species has occurred throughout the mine. Areas such as the pit walls where no revegetation effort was made now contain eight-foot high birch saplings (volunteer species) on several benches. Areas reclaimed in 2007 now contain large patches of willow/alder/birch in addition to seeded grasses.

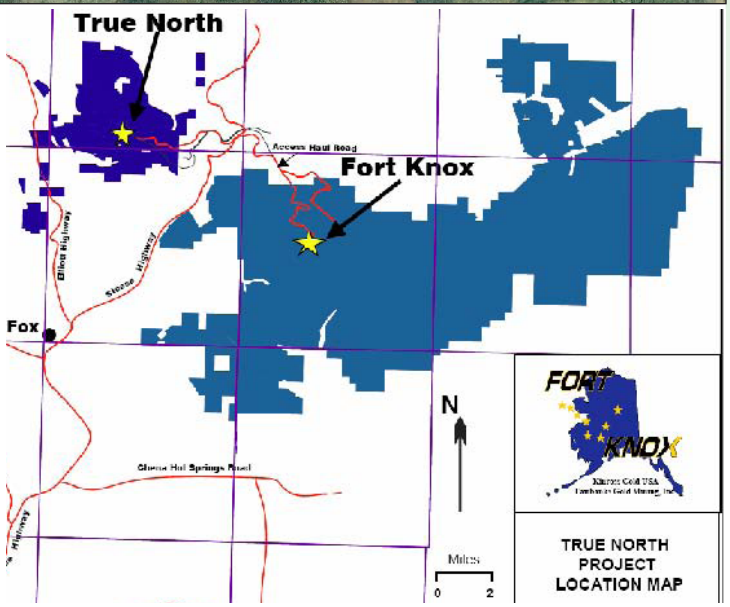
References:

Menheere, Will 2010. Interior Alaska Revegetation Report. Fairbanks Gold Mining Inc., 17 pp.

Project Location:

The True North mine is within the Chatanika River watershed, located on the northwest flank of Pedro Dome, approximately 25 miles northeast of Fairbanks.





Aerial seeding - mid September, 2010

North Shepard dump - mid September, 2010 (seeded mid-August, 2010). Note furrows along horizontal contour of slope.

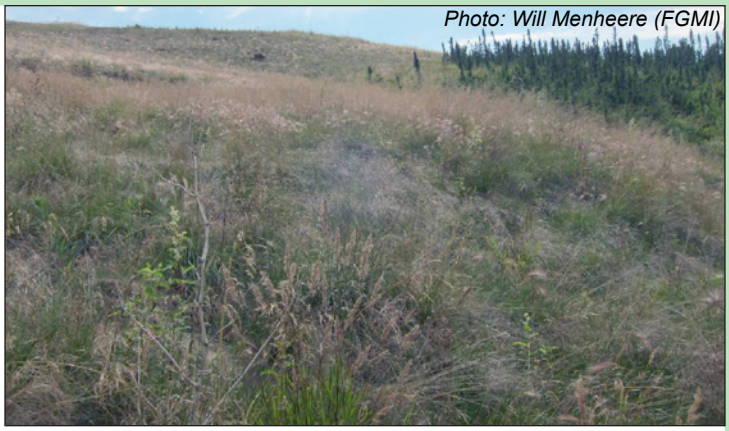
North Shepard dump - 2005

North Shepard dump - mid August 2010.
Area reworked in July, 2010; surrounding area seeded in 2007.

Tall grass at north Shepard dump - mid-September, 2010

View of north Shepard dump - mid September, 2010

Zepplin / Hindenburg dump - Summer 2007



Hindenburg dump - September 2010 (seeded late 2005)

Zepplin / Hindenburg dump - July 2010

Shepard pit vegetation - August 2010. Note: Pit walls were never seeded; growth is due to natural reinvasion.

Louis dumps; area seeded late August 2009

South Shepard dump revegetation progress - early September, 2010 (area seeded late July, 2010)

Louis dumps - mid September, 2010

Chistochina River Wetland Restoration

Contributions by Andy Nolen, Alaska Plant Materials Center

Introduction / Objective:

In conjunction with a roadway realignment and bridge replacement project by the Alaska Department of Transportation and Public Facilities (DOT&PF), three wetlands were created along the Chistochina River in 2006. The planning and revegetation for the three newly constructed wetlands was done by the Alaska Plant Materials Center (PMC).

Methods of Revegetation:

Site revegetation began in June 2006. Revegetaton methods included seeding, fertilizer application and live staking of dormant willow cuttings. Bundles (facines), and transplants of wild collected grasses and sedges were also installed. The three wetland areas are referred to as **northwest**, **southwest**, and **northeast**.

The **northwest wetland** was the largest area and first to be revegetated. Willow bundles, live stakes, and transplants of sedge and Bluejoint Reedgrass were installed. Afterwards, the entire area was treated with 450 lbs/acre of fertilizer and 40 lbs/acre of grass seed mix. Following seeding, a harrow was pulled behind an ATV to incorporate the seed and fertilizer into the soil.

The **northwest wetland** also contained two special treatment areas. One treatment area received only fertilizer, while the other area received fertilizer and wild-collected sedge seed of the species *Carex aquatilis* and *Carex utriculata*.

The **southwest wetland** was revegetated in much the same way as the northwest site. Live willow stakes and bundles were installed, as well as sedge and bluejoint transplants. Fertilizer was applied at a rate of 450 lbs/acre followed by 40 lbs/acre of the revegetation mixture.

Live willow stakes were planted in the **northeast wetland** also. After cuttings were installed, fertilizer and seed mix were applied, at rates of 450 lbs/acre and 40 lbs/acre, respectively.

Species Used:

Prior planning was necessary before revegetation species were selected. Initial site visits were conducted in 2004 at the Chistochina River and nearby wetlands. This was done to examine species present and identify revegetation techniques that would achieve the restoration goals of the project. Sedge species, Bluejoint Reedgrass, and some woody species like alder, cottonwood, and aspen were identified.

Collection procedures for willow, as well as implementation guidelines for live stakes and bundles were taken from Streambank Revegetation and Protection: A Guide for Alaska (2005). Felt-leaf Willow (*Salix alaxensis*) cuttings were collected in April 2006. Approximately 6000 cuttings were harvested with hand pruners and stored in a walk-in cooler (at 35 degrees Fahrenheit) to maintain dormancy. Stored willow cuttings were prepared for transport later in 2006. 1500 cuttings were used to create 20 bundles while the remaining 4500 cuttings were planted as live stakes.

Seed for the project was acquired from commercial sources, or collected from the project area. Field collection of seed occurred in the fall of 2004 and 2005 with the use of a mechanical seed stripper towed behind an ATV. The area selected for harvest was easily accessible and had the desired wetland plant material present, consisting of Water Sedge (*Carex aquatilis*), Northwest Territory Sedge (*Carex utriculata*), and Bluejoint Reedgrass (*Calamagrostis canadensis*). A total of three pounds of seed was collected in 2004.

An additional collection of the same species took place in 2005, resulting in 1.5 pounds of usable seed. Collected seed was used to produce plugs in the greenhouse, and later transplanted to the project sites. Greenhouse plug production consisted of 3000 plugs of Bluejoint Reedgrass (*Calamagrostis canadensis*), 500 plugs of Water Sedge (*Carex aquatilis*), and 500 plugs of Northwest Territory Sedge (*Carex utriculata*).

Commercial seed and fertilizer used at the project site was purchased from Alaskan suppliers. 2000 pounds of 20N - 20P - 10K fertilizer was used. The seed purchase consisted of:

Lbs	Common Name	Scientific Name
10	**Chamisso Sedge**	*Carex pachystachya*
15	'Arctared' **Red Fescue**	*Festuca rubra*
15	Wainwright **Slender Wheatgrass**	*Elymus trachcaulus*
15	'Gruening' **Alpine Bluegrass**	*Poa alpina*

Lbs	Common Name	Scientific Name
15	'Alyeska' **Polargrass**	*Arctagrostis latifolia*
20	'Egan' **American Sloughgrass**	*Beckmannia syziachne*
30	'Nortran' **Tufted Hairgrass**	*Deschampsia caespitosa*

Two seed mixtures were prepared from the purchased seed - one adapted to wetter, low lying areas of the project, and one for the drier upland areas. These mixes were spread on the three wetland sites. Seed mixtures, by weight, were comprised of the following species:

Wet Mix:

15%	'Arctared' **Red Fescue**
25%	'Nortran' **Tufted Hairgrass**
10%	Wainwright **Slender Wheatgrass**
10%	'Gruening' **Alpine Bluegrass**
15%	'Egan' **American Sloughgrass**
15%	'Alyeska' **Polargrass**
10%	**Chamisso Sedge**

Dry Mix:

15%	'Arctared' **Red Fescue**
25%	'Nortran' **Tufted Hairgrass**
15%	Wainwright **Slender Wheatgrass**
15%	'Gruening' **Alpine Bluegrass**
15%	'Egan' **American Sloughgrass**
15%	'Alyeska' **Polargrass**

Results:

Revegetation material planted on the project site has become established. Vegetation growth and vigor was greatest near the water's edge in all three wetland locations. This is probably due to increased moisture availability in these lower areas. A large portion of the project site had soil consisting of sandy gravel, with little moisture holding capacity. About 80% of the dormant willow cuttings that were planted survived.

Conclusions:

The planning, plant material acquisition (cuttings, transplants & seed), and revegetation phases all met expectations. Plant material installation in June, 2006 provided plenty of time for the plantings to become established.

An uncontrollable factor that did not favor the project was the water level. During planting, the Chistochina River was at or near the high ordinary water line. This did not impede installation of plant materials, but better results might have occurred with lower water levels. The sedge species planted are obligate, meaning wet conditions are required for survival. Sedges were planted at the water's edge during installation, but receding water levels increased the relative distance from the plants to the water line. The potential for sedge transplant failure existed. For future projects, installation of sedges should be timed to coincide with lower water levels.

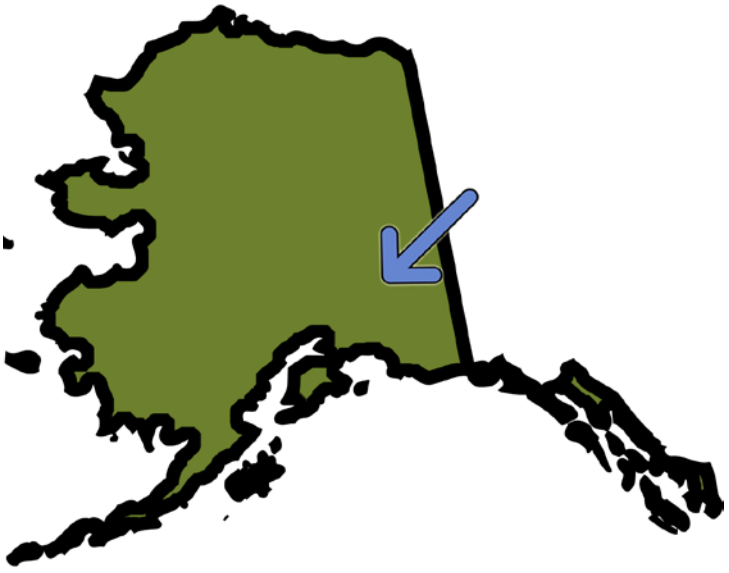
References:

Nolen, Andy. [2007] Chistochina River Wetland Restoration Tok Cutoff 30E Project. State of Alaska, Department of Natural Resources, Division of Agriculture, Alaska Plant Materials Center. 15 pp.

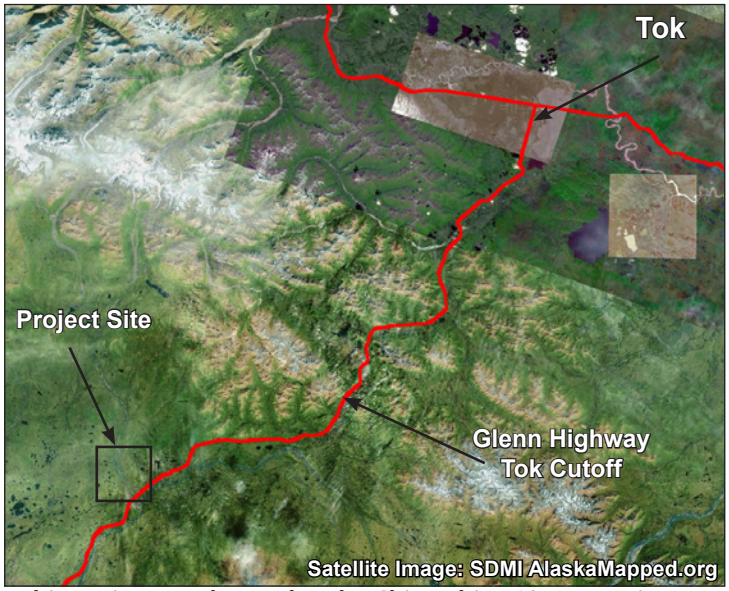
Nolen, Andy. [2008] Chistochina River Wetland Restoration Tok Cutoff 30E Project - One Year Evaluation. State of Alaska, Department of Natural Resources, Division of Agriculture, Alaska Plant Materials Center. 10 pp.

Project Location:

This wetland complex is located near mile 35 of the Tok cutoff.



Site Photos:



This project was located at the Chistochina River crossing on the Glenn Highway (Tok Cutoff).

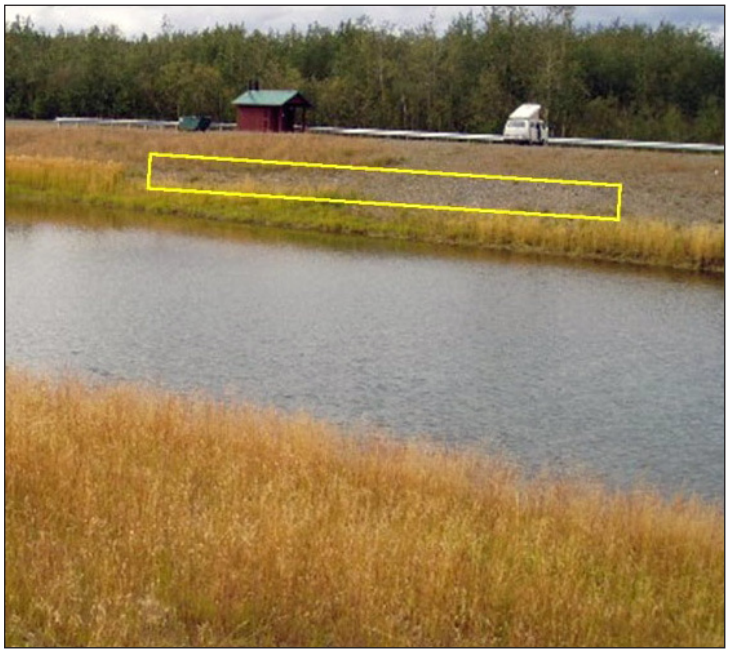
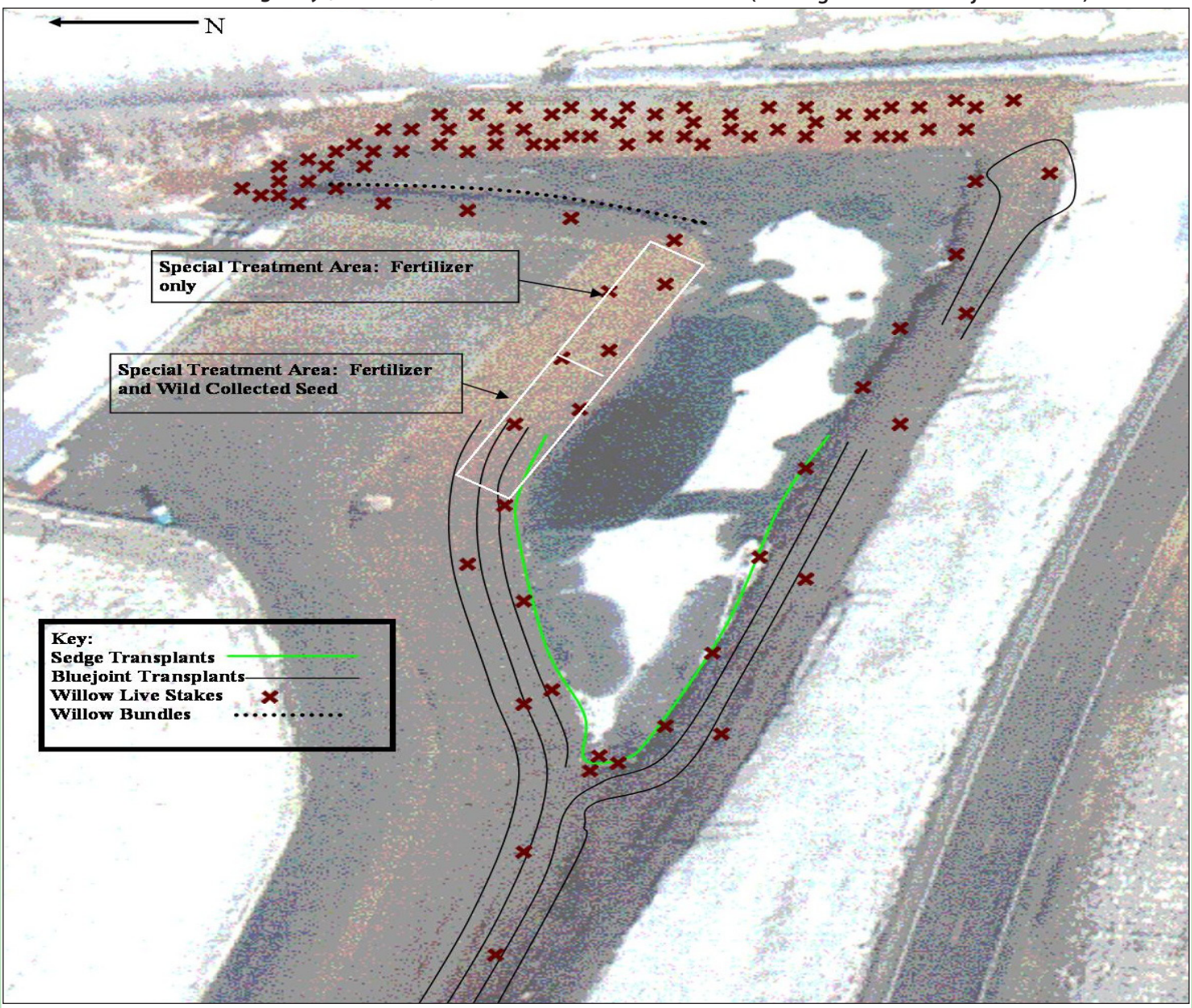


Photo: Andy Nolen (AK PMC)

Approximation of the northwest wetland special treatment area (less vegetation than adjacent areas).



Northwest wetland revegetation area

Photos: Andy Nolen (AK PMC)

Northwest wetland - mid June, 2006

Northwest wetland - late July, 2006

Northwest wetland - late August, 2007

Well established leaves on willow live stakes

Northwest wetland- mid June, 2006

Northwest wetland - late July, 2006

Northwest wetland - late August, 2007

Northwest wetland - late July, 2006

Northwest wetland - late August, 2007

Northwest wetland - late August, 2007

Northwest wetland - mid June, 2006

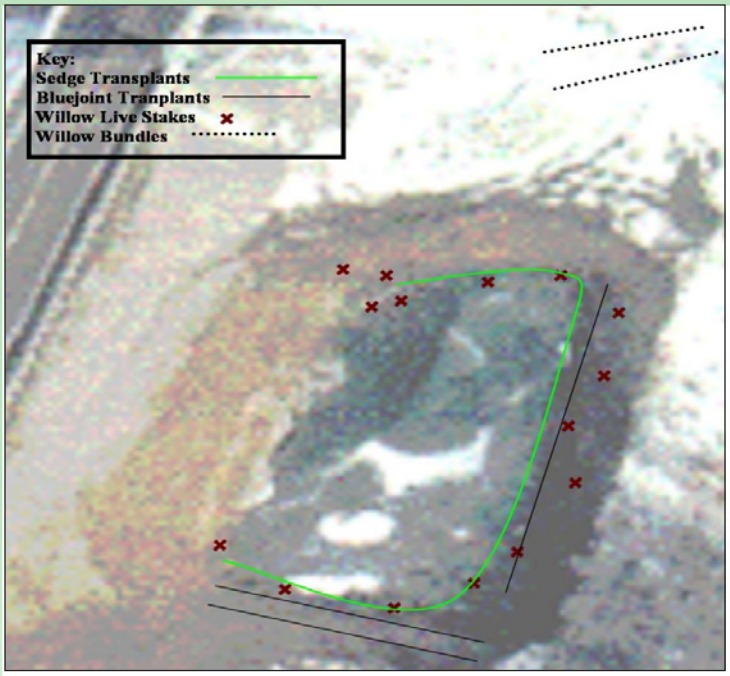
Northwest wetland - mid June, 2006

Northwest wetland - late July, 2006

Northwest wetland - late July, 2006

Northwest wetland - late August, 2007

Photos: Andy Nolen (AK PMC)



Southwest wetland revegetation area

Southwest wetland - mid June, 2006

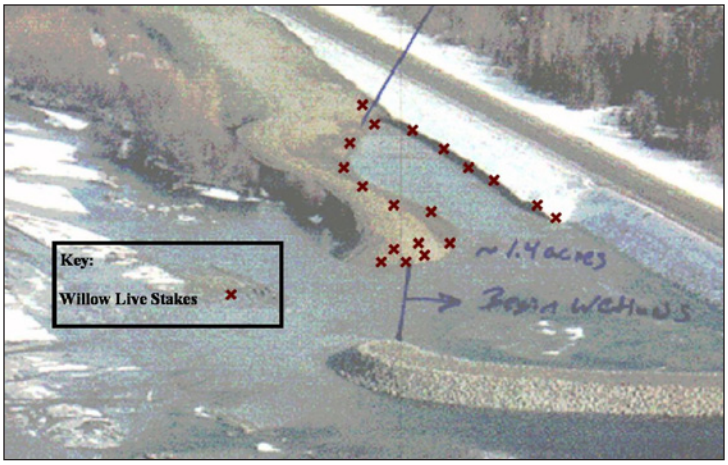
Southwest wetland - late July, 2006

Southwest wetland - late August, 2007

Established seedlings and transplants

Thriving sedge transplant

Photos: Andy Nolen (AK PMC)



Northeast wetland revegetation area

Northeast wetland - mid June, 2006

Northeast wetland - late July, 2006

Northeast wetland - late August, 2007

Right-of-Way collection area with desired wetland species

Mechanical seed stripper towed by an ATV

High survival rate for planted dormant willow cuttings

Photos: Andy Nolen (AK PMC)

Kanuti Pit Rehabilitation

Introduction / Objective:

The Alaska Plant Materials Center (PMC) assisted the Alaska Department of Transportation and Public Facilities (DOT&PF) with revegetation and monitoring of a 19.5 acre materials site (gravel pit) at milepost 105 of the Dalton Highway. The Kanuti Pit was used by Alyeska Pipeline Service Company to build the Dalton Highway in the 1970's.

In 2001, asbestos was found in the pit and a closeout program for the site was subsequently developed. Rehabilitation goals for the site included soil stability, plant growth, water retention, and wetland habitat creation. The goal was that the rehabilitated site match the surrounding landscape.

Methods of Revegetation:

Site preparation began in 2002. The area containing asbestos was capped with organic overburden material from the Bonanza Creek material site. The site was then contoured to establish littoral wetland areas.

Site preparation continued in 2003, with the spreading of organic soils by a dozer. To encourage invasion of alder and willow species, 'ripping' of the site was specified in the revegetation plan. The dozer did not include a ripper, however. Instead, the site was track-walked to created micro-catchments for seed and fertilizer and moisture.

Seed and fertilizer was applied on July 31, 2003, using hand held or ATV mounted broadcast spreaders.

Species used on the site:

The seed mixture used consisted of native grasses. Seeding occurred at a rate of 20 lbs / acre, with 20N-20P-10K fertilizer applied at a rate of 450 to 500 lbs / acre. The seed mix used was:

%	Common Name	Scientific Name
25	Wainwright **Slender Wheatgrass**	*Elymus trachycaulus*
25	'Nortran' **Tufted Hairgrass**	*Deschampsia caespitosa*
25	'Gruening' **Alpine Bluegrass**	*Poa alpina*
15	'Egan' **American Sloughgrass**	*Beckmannia syzigachne*
10	'Arctared' **Red Fescue**	*Festuca rubra*

All of the selected species were bunch grasses, with the exception of 'Arctared' Red Fescue, a sod forming grass. The bunch grasses component of the seed mix better allowed for natural re-invasion of native species.

Results:

Monitoring of the site occurred yearly from 2003 to 2007, and again in 2010. Two 300 feet transects were installed in 2007, for quantitative measures of species diversity and plant cover. Observations were taken at one foot intervals along the transect, resulting in a total of 300 hit-points per transect. Qualitative monitoring consisted of photo point pictures documenting the overall revegetation performance over time.

In 2010, satisfactory performance of seeded grasses was observed. High density plant cover was also noted in the 2010 monitoring. Planted species were evident and natural re-invasion of other native species was observed. Wetland areas were holding water, promoting the development of niche wetland habitats. Monitoring will continue through 2013.

Conclusions / Lessons Learned:

The shortcomings of the Kanuti Pit Rehabilitation resulted from poor planning and not having the right equipment. The dozer was not equipped with a ripper as called for in the work plan. The track-walking technique used was the next best option. A ripping implement would have reduced soil compaction and created larger catchments for seed, fertilizer, and moisture. It may have also better supported woody species establishment.

Application of the seed and fertilizer was to be overseen and directed by a PMC staff member. Due to scheduling and communication issues, this did not happen. The work plan specified that the seeding and fertilizer boundary would encompass the entire pit area. It appeared during 2003 monitoring that seed and fertilizer were only applied to those areas that were completely void of vegetation. Had the bordering area also been fertilized, it would have encouraged seed production of colonizing species present in the area, thus promoting the natural re-invasion of native plants.

One area of the project exhibited less plant cover than other areas during the 2006 monitoring. Soil in this area consisted of sandy gravel. This area was also inaccessible during the site preparation phase, due to snow drifts. The low plant coverage may be due to no organic soil being spread in this area. Organic soil in this area would increase the moisture holding capacity of the sandy gravel soil and provide a better substrate for vegetation growth.

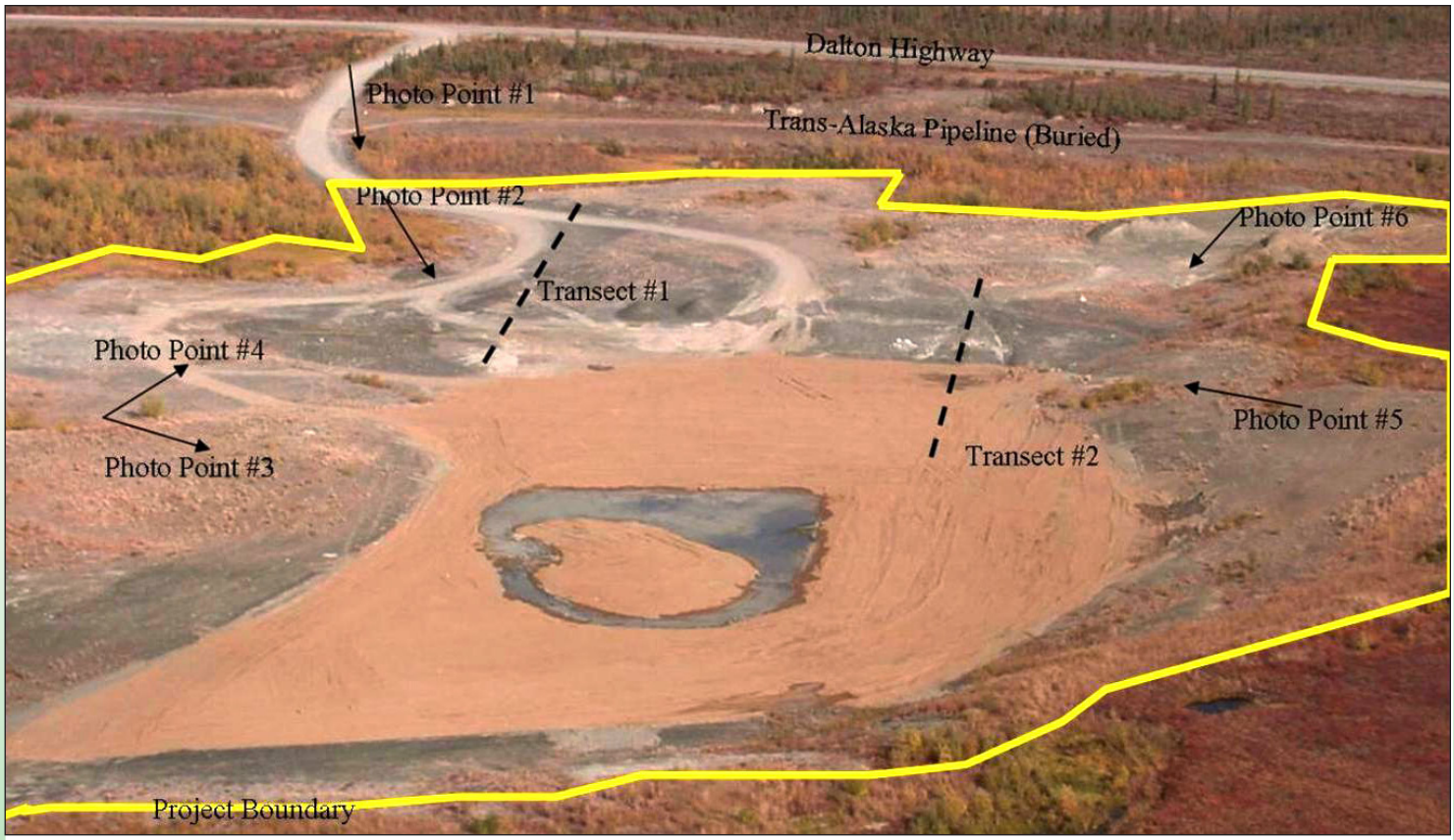
References:

Nolen, Andrew, 2008. Rehabilitation of the Kanuti Pit Materials Site 65-9-031-2 Located at Milepost 105 of the Dalton Highway. State of Alaska, Department of Natural Resouces. 15pp.

Project Location:

The approximately 19.5 acre Kanuti Pit (Material Site 65-9-031-2) is located at milepost 105 on the Dalton Hwy, just south of the Kanuti River, USGS Bettles (B-2) T18NR14W-Sec. 31&32, Fairbanks Meridian.

Site Photos:

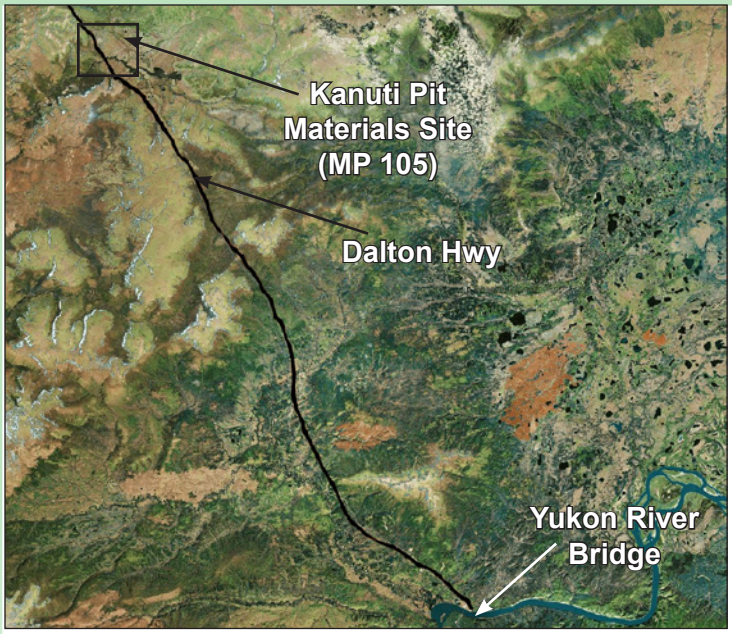


Photos: AK PMC

Aerial overview of Kanuti pit materials site, after grading and site preparation - Summer, 2002

This photo depicts the planned seeding and fertilizer application boundary (in yellow) with the actual application boundary (in red), based on monitoring observations.

Dozer spreading organic soil during site preparation phase - June, 2003



Satellite Image: SDMI | AlaskaMapped.org

Kanuti Pit is located 49 miles north of the Yukon River crossing.

Photo point 1 - early June, 2003

Photo point 1 - mid September, 2010

Photo point 2 - early June, 2003

Photo point 2 - mid September, 2010

Photo point 3 - early June, 2003

Photo point 3 - mid September, 2010

Photo point 4 - early June, 2003

Photos: AK PMC

Photo point 4 - mid September, 2010

Photo point 5 - early June, 2003

Photo point 5 - mid September, 2010

Photo point 6 - early June, 2003

Photo point 6 - mid September, 2010

Photos: AK PMC

Photo: Lyubomir Mahlev (AK PMC)

Rehabilitated Kanuti pit materials site - Summer, 2009

Fairbanks Partial Landfill Closure

Introduction / Objective:

Great Northwest Inc. was contacted to assist the Fairbanks North Star Borough with the closure of a landfill. The objectives were threefold:

1. Provide gas collection wells and piping systems,
2. Provide a leachate recirculation system, and
3. Provide closure cover and surface drainage for up to 28 acres.

Methods of Revegetation:

After reconstruction of proper site topography and slopes to specifications, a 6 inch layer of topsoil was applied. Topsoil is very fertile and contains the nutrients and microorganisms that enhance revegetation success. Prior to seeding the surface was scarified using a Bobcat T-200 with a land planer attachment. Scarifying along the contour roughened the soil surface and provided favorable micro-sites for seed germination and growth.

Ninety percent of the project area was drilled in one direction using a Bobcat T-200 with a drill seeder attachment. After drill seeding, the areas were sprayed with a light application of Eco-Fibre/Plus, containing tackifier in the mulch. The purpose of the mulch application was to moderate soil surface temperatures, conserve soil moisture, and increase seed germination.

The ditch and the berm were the only areas hydroseeded. Two load applications were applied within eight hours of each other. This was necessary to provide a thriving stand of vegetation. Cell C/D received 2 feet of N-Viro (treated sludge from the Borough) with 6" of topsoil on top.

Species used on the site:

The seed mixture was applied at a rate of approximately 2 pounds per 1,000 square feet. This was followed by 20N-20P-10K fertilizer, dispersed by hand at a rate of 5 pounds per 1,000 square feet. The grass seed mix used consisted of:

%	Common Name	Scientific Name
50	'Arctared' **Red Fescue**	*Festuca rubra*
25	'Nortran' **Tufted Hairgrass**	*Deschampsia caespitosa*
25	'Gruening' **Alpine Bluegrass**	*Poa alpina*

Results:

The drill seeded areas displayed good germination results within 8 days, and a very uniform and thick stand of vegetative cover was present within 30 days. The hydroseeded areas did not produce the cover expected and re-seeding was necessary over 40% of the area. By the end of summer, 2010, 80% coverage was established in the ditches and berms.

Erosion, for the most part was a non-issue. Some minor erosion occurred along a berm, which prevented water from flowing down slope. This intensified the run-off volume along the length of the berm, carrying soil and seed away. The area was subsequently re-contoured and seeded.

Conclusions / Lessons Learned:

Drill seeding is the preferred method of seeding when site conditions allow. Hydroseeding required more human maintenance (watering), so this method may not be appropriate for remote sites or areas without an available water supply.

References:

Schlosser, Gordon, 2010. Solid Waste Partial Landfill Closure of Cell C/D and Cell #1. Great Northwest Inc, Fairbanks, Alaska. 2 pp.

Project Location:

Fairbanks, Alaska.

Site Photos:

View of site prior to construction activities - mid April, 2010

Site recontoured before topsoil placement - mid June, 2010

Two feet of N-Viro treated sludge was deposited on cell C/D - early June, 2010

Salvaged topsoil was applied in a 6" layer all over the site.

A rubber liner was placed along the length of the ditch in late June, 2010.

The ditch was filled in a three step process: 6" of gravel was placed over the rubber liner, followed by 18" of silt, and then capped with 6" of topsoil in early July, 2010.

Photos: Gordon Scholsser (Great Northwest, Inc)

Photos: Gordon Scholsser (Great Northwest, Inc)

A Bobcat T-200 dozer with a drill seeder attachment applies a seeding mixture to the site.

A hydro-mulch application of Eco-Fibre / Plus with tackifier was lightly sprayed over the area after drill seeding in mid July, 2010.

Seeded species establishment - mid July, 2010

Riparian Reclamation of Nome Creek

Introduction / Objective:

Nome creek is a tributary of the Beaver Creek National Wild River, located within White Mountains National Recreation Area, a BLM land holding. Land disturbance activities by way of placer gold mining had a large effect on portions of the drainage. Over seven miles of stream was disturbed by miners, and by the 1980s the floodplain was obliterated in many areas.

Nome Creek's accessible location relative to the Beaver Creek Wild and Scenic River Corridor and plans to develop Mount Prindle Campground and Nome Creek Road made riparian reclamation and stream channel reconstruction of this area a priority. This project was directed by BLM's Steese/White Mountains District (SWMD), now called the Eastern Interior Field Office. Project objectives were three-fold:

1. Keep the stream within a single channel;
2. Eliminate debris piles and settling ponds contributing to sediment runoff; and
3. Stabilize and revegetate the floodplain.

Reclamation work began in July of 1991. A D8 bulldozer was the primary piece of equipment used. Channel reconstruction began with the filling in of settling ponds using material from tailings piles and then grading the area flat. A pilot stream channel was constructed to avoid these ponds and meander down the valley at a relatively uniform grade.

Periodic flooding, from storm runoff, summer rains, and overflow icing resulted in erosion of the floodplain and destruction of willow plantings adjacent to the stream. This occurred during the summers of 1991, 1994, 1998, 2000, and 2003. The flooding problem was partially corrected by widening the pilot channel, flattening meanders on the inside of bends, and floodplain regrading.

Methods of Revegetation:

The Steese/White Mountains District fisheries began organizing willow cutting and planting for reclaimed areas along the creek in 1992. District personnel harvested dormant felt-leaf willow cuttings in mid April, 1992. Selected cuttings were approximately 12 inches long with at least 2 years growth. Cuttings were stored in a freezer until late June when they were taken to the site and placed in gravel using a dibble. The cuttings were planted with at least ¾ buried below the surface, with the above-ground portion containing 1 to 2 viable buds. Also, about 24 willow bundles, each consisting of 8-12 willow cuttings were lashed together and armored into the stream bank.

In June of 1993, additional felt-leaf willow cuttings were harvested, this time during the summer, and planted at the site using a dibble. Again, cuttings approximately 12 inches long with 2 years of growth were taken, and planted with ¾ below ground and 1 to 2 visible buds. To reduce water loss, green leaves were stripped off the cuttings after planting.

A site approximately 3 acres in size was seeded in late June, 1993. The seed mixture applied included 70% 'Arctared' Red Fescue, 20% Bering Hairgrass, and 10% Annual Ryegrass. A fertilizer mix consisting of 50% 10N-20P-20K and 50% 10N-10P-20K was broadcast concurrent with seeding. Hand-held broadcaster seeders were used to distribute the seed and fertilizer.

Species used on the site:

Planting techniques included the planting of both dormant and live willow cuttings and grass seedings. Approximately 2000 dormant cuttings of felt-leaf willow were planted in 1992, and 1250 live felt-leaf willow cuttings were planted in 1993.

The grass seed mixture was applied at a rate of 55 lbs/acre. The original seeding rate called for 42 lbs/acre, but the initial acreage estimate was too high resulting in the higher rate. The seed mix consisted of:

70% 'Arctared' **Red Fescue** (*Festuca rubra*)
20% **Bering Hairgrass** (*Deschampsia beringensis*)
10% **Annual Ryegrass** (*Lolium multiflorum*)

Results:

Willow Monitoring:

Six 5 meter square plots were established in the 1992 and 1993 willow planting areas in late August of 1993, for a total of 12 plots. Within each of these plots the number of willow cuttings planted, number alive, and volunteer plants present were counted. Willow bundle survival was quantified by establishing a 30 meter transect along the stream bank.

The results of the willow monitoring are as follows:

1992 willow plantings:

Average survival for the willow cuttings was 90%, and nine willow bundles were encountered along the transect, with all nine alive and well.

1993 willow plantings:

Average survival of willow cuttings was 87%.

Grass Seeding Area 1993:

Twenty-two 1 m² plots were established along a transect in August 1993. This was done to determine composition of the seeding area. The percent cover of rock, grass, bare ground, mosses/liverworts, exposed rock, and other plant species was recorded. The average grass cover was 68%. This high establishment rate could be attributed to the slow steady rain lasting for several hours shortly after seeding. Also, many precipitation events throughout the summer aided seedling growth.

1996 Evaluation of Willows & Grass Seeding:

A large portion of willows were lost due to flood scouring and earthwork with heavy equipment. Those willows that were planted as cuttings continued to show high survival, more so than naturally occuring willows. The total % cover of willows planted from cuttings was observed to be much lower than that of colonizing willows.

The performance of the seeded grasses was disappointing. The grasses created a dense, tough sod and much of the grass was dead or dying in 1996. Live cover of the three seeded species was estimated at only 15%, with dead grass litter averaging 69%. Native species colonization was also low with only a small amount of forb and willow cover documented.

An adjacent area with limited fines and topsoil did not receive the seed or fertilizer treatment. This area was beginning to show desirable grass and willow cover by the 1996 monitoring. Live grass cover of native *Calamagrostis* and *Carex* species was 34%. 9% willow cover was also observed in this area.

Conclusions / Lessons Learned:

The grass seeding and fertilizer applied resulted in a very dense vegetative cover that was effective for erosion control. It appears that the high seeding rate of red fescue, a sod forming grass, hampered the recolonization of native species and left a thatch of dead grass.

A portion of the seeded area did not receive fertilizer. The seeded grasses established there but not to the size or density as the areas which were seeded and fertilized. This oversight left more space for natural colonization and resulted in a higher proportion of live to dead grass.

Seeding and fertilizing at lower application rates may promote natural revegetation. With lower seeding and fertilizer rates, colonizing seed from the surrounding area are more able to move in and find available space and micro-climates needed for growth. Had the acreage not been overestimated and original seeding rate of 42 lbs/acre been applied instead of 55 lbs/acre, survival and cover may have also been improved.

References:

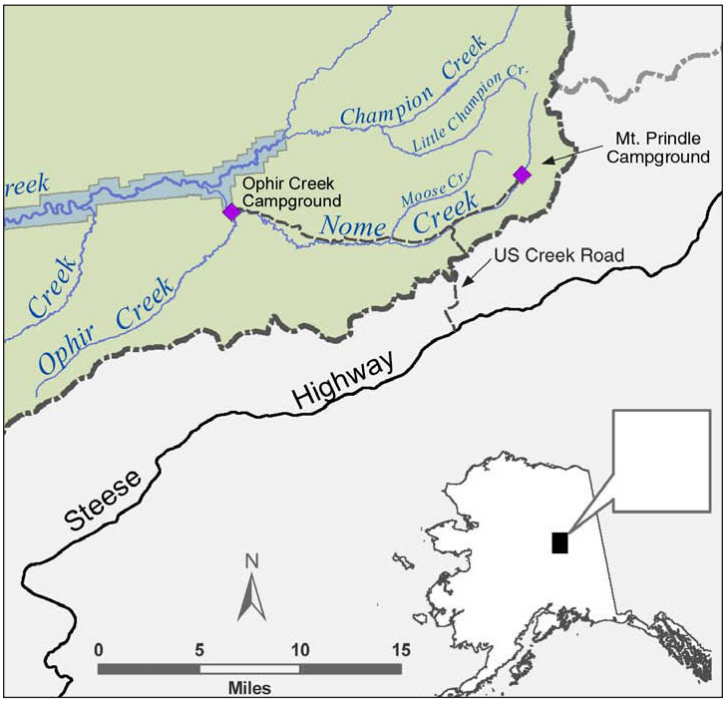
Kostohrys, Jon. (2007). Water Resources and Riparian Reclamation of Nome Creek, White Mountains National Recreation Area, Alaska. U.S. Department of the Interior, Bureau of Land Management. Fairbanks, Alaska. 19 pp.

Bogaczyk, A. Brian. (1994). Nome Creek Reclamation Project - Revegetation Report. *in* "Appendix C. Nome Creek Reclamation Project - Revegetation Report" U.S. Department of the Interior, Bureau of Land Management. Fairbanks, Alaska. 4pp.

Herriges, Jim. (1996). 1996 Field Evaluation. *in* "Appendix C. Nome Creek Reclamation Project - Revegetation Report". U.S. Department of the Interior, Bureau of Land Management. Fairbanks, Alaska. 2pp.

Project Location:

Locator Map: BLM



Nome creek is located within the White Mountains National Recreation Area, approximately 75 mi. Northeast of Fairbanks

Site Photos:

Archive Photo: BLM

Drag-line used by a placer mining operation on Nome Creek in the early part of the 20th century.

The initial step in reclamation was to fill the settling ponds using the material from the surrounding tailings piles.

After filling the ponds, the bulldozer then graded the floodplain as flat as possible.

Photo: Jon Kostohrys (BLM)

The bulldozer constructed the channel using short, almost level grading to deepen the pilot channel.

Aerial photo of Nome Creek before reclamation

Upper Nome Creek, road, and campground after reclamation

The lower portion of the Nome Creek drainage is surrounded by low hills near the confluence with Beaver Creek.

Photo: Jon Kostohrys (BLM)

Upstream portion of the reclaimed area, showing grass establishment in 1993. Most of this grass was dead or dying by 1996.

Illinois Creek Mine Site Revegetation

Introduction / Objective:

Illinois Creek Mine Project was a gold/silver deposit operated by USMX, a subsidiary of USMX/ Dakota Mining. Gold production began in early 1997, although the mine operation shut down within a few months, due to financial difficulties. Operations began again later that year, but ceased again when USMX declared bankruptcy in 1998. Using the reclamation bond put up by USMX, the State of Alaska took control of the leases and the mine site in 1999.

The $1.6 million from the reclamation bond was not sufficient, and the State estimated an additional $ 1.0 million was needed. A “mine to reclaim” plan to operate the mine in order to generate funds for complete closure of the facility was implemented by the American Reclamation Group (ARG). A $3.76 million reclamation plan and estimate was submitted by ARG in 2000, detailing mining activities and reclamation tasks for each site facility.

This case study documents the reclamation actions taken at a few of the facility areas. Specific sites are listed under Methods of Revegetation, detailing the reclamation activities conducted by ARG.

Methods of Revegetation:

Central Pit:

Sections of the Central Pit were back filled with waste rock generated during mining. This allowed for shorter haul distances and minimal expansion of the waste rock dump during backfilling. Recontouring of the slopes was done by dozer and topsoil and vegetative debris was spread over the site.

Central Pit Waste Rock Dump:

Dozers were used to smooth the slopes to a 40% grade and blend various benches. Work started at the highest bench and proceeded downward to the original ground surface. Stockpiles of topsoil were dumped at the top of slopes and pushed downhill with dozers to a thickness of approximately 8 inches. Initial track-walking of slopes was done to form catchments for seed and water. This left the slopes too smooth, however, and erosion features were evident. Slope recontouring helped prevent erosion by roughening the soil surface.

The flat areas of the dumps were ripped with a Cat 12G grader. Haul trucks dumped windrows of topsoil over the site. The topsoil was then spread with dozers. Areas compacted during topsoil haulage were ripped a second time. Hand-held broadcast seeders were used to apply the seed to the slopes.

Road between Central and West Pits:

The access road between the central and west pits was ripped with a dozer. Topsoil and vegetative debris set aside during commissioning of the road was then spread back over the road, and followed with an application of seed and fertilizer.

West Pit:

Reclamation of the West Pit began by backfilling the pit with waste rock acquired from the Central Pit. Backfill material placement continued until the waste rock was significantly above the groundwater level in the West Pit. This additional backfilling also reduced the height of the remaining highwalls (unexcavated faces of exposed overburden). Highwall steepness was further reduced by utilizing a dozer to recontour the slopes.

Topsoil and vegetative debris was spread on the slopes and portions of the pit. Only those areas that received topsoil were seeded and fertilized. The portion of the pit that did not receive topsoil was expected to be colonized by native plant species, through the deposition of sediments and fines (conducive for vegetation growth) in storm events.

West Pit Waste Rock Dump:

Vegetation and topsoil was set aside and stockpiled in windrows prior to development. Waste rock was backfilled into the pit and recontoured using a dozer. The vegetative debris was spread back over the site and left in a roughened condition. Application of a seed and fertilizer mixture followed.

Species used on the site:

Central Pit:

Vegetative debris already present on the site was used for revegetation.

Central Pit Waste Rock Dump:

Vegetative debris and seed were used for revegetation. Fertilizer was applied at a rate of 500 pounds per acre using 20N-20P-20K.

Access Road between Central and West Pits:

Vegetative debris, seed and fertilizer were used to revegetate the roadbed.

West Pit:

Vegetative debris was spread across the site after the slopes were recontoured. A portion of the site received topsoil. Later, seed and fertilizer was also applied to these areas.

West Pit Waste Rock Dump:

Vegetative debris, seed and fertilizer were used to revegetate this area.

Results:

Each reclamation component associated with each of the project areas was approved by the Department of Natural Resources. Natural revegetation, enhanced natural reinvasion, and a common approach of surface preparation, seeding, and fertilizer were used to revegetate the project areas. Future monitoring will continue in order to observe revegetation performance and evaluate any erosion concerns.

Conclusions / Lessons Learned:

The most costly lesson from this project was that the reclamation bond paid to the State of Alaska was insufficient to meet the actual costs of restoring this mine site. Speaking to the Anchorage Daily News in 2005, the former director of the Division of Mining Land and Water, who had originally approved the mine and the reclamation bond, said of the $1.6 million bond: “The amount should have been twice that”.

This was the Alaska DNR’s first experience with the bankruptcy of a large mining operation. For some time, it was uncertain whether the State would be stuck with the reclamation bill. Initial attempts to lease the mine to new operators were unsuccessful; Viceroy Resources abandoned the project one year after taking it over in 1998, under an emergency lease agreement.

The reclamation effort relied upon proven methodologies, and no surprises or technical challenges were encountered. A trust fund for the continued monitoring of the Illinois creek mine was set up, receiving a $200,000 contribution from ARG.

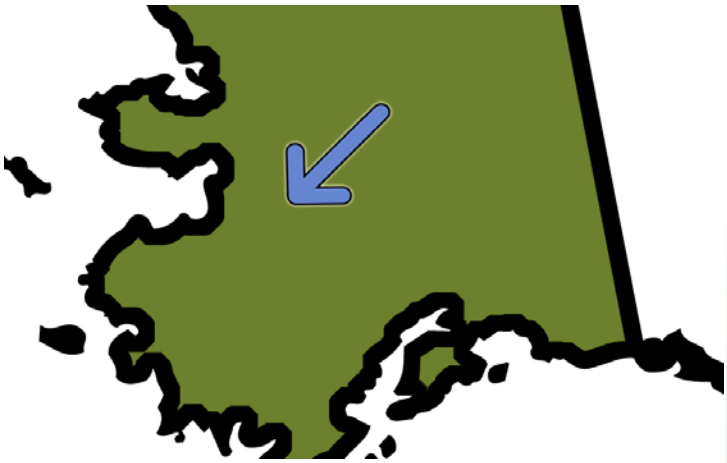
References:

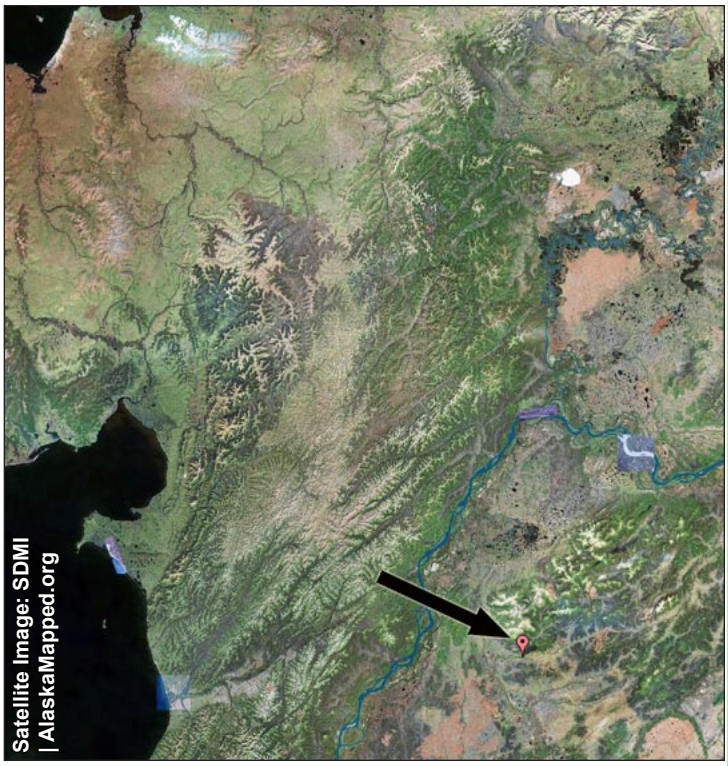
Dobbyn, Paula (2005) Illinois Creek Mine - Inadequate Reclamation Bonding. Anchorage Daily News, November 4th, 2005 edition. Anchorage AK.

McGroarty, Steve (2005) Illinois Creek Mine Final ARG Reclamation Report. State of Alaska, Department of Natural Resources, Division of Mining, Land, & Water. Fairbanks, AK.

Project Location:

Illinois creek is located on state lands within the Kaiyuh Mountains. The site is only accessible by air, and is 23 miles east of the Yukon River and 57 miles from Galena.





The Illinois Creek site is located 23 miles east of the Yukon River.

Site Photos:

Aerial photo of Illinois Creek site - October, 2008

IC trail between old mills site and heap - October, 2008

IC trail between old mills site and heap - August, 2009

West pit waste rock dump - July, 2003

West pit waste rock dump - July, 2005

Central pit waste rock dump, before regrade - August, 2001

Recontoured slope at central pit waste rock dump - August,

Initial vegetation cover at central pit waste rock dump - July,

Revegetated central pit waste rock dump - October, 2004

Photos: American Reclamation Group

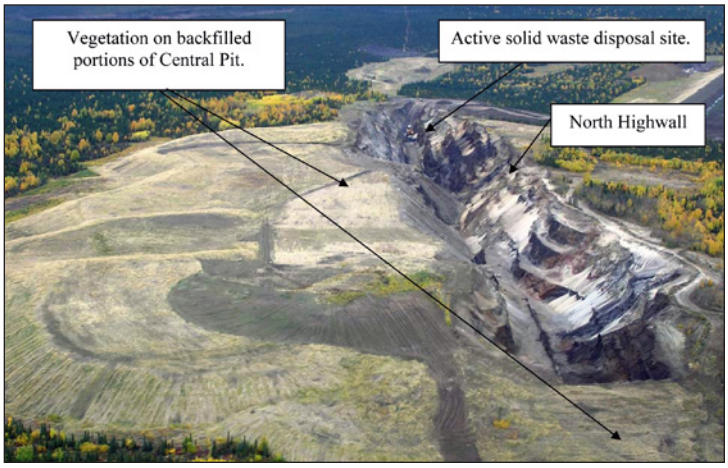
SW corner of central pit waste rock dump - August, 2002

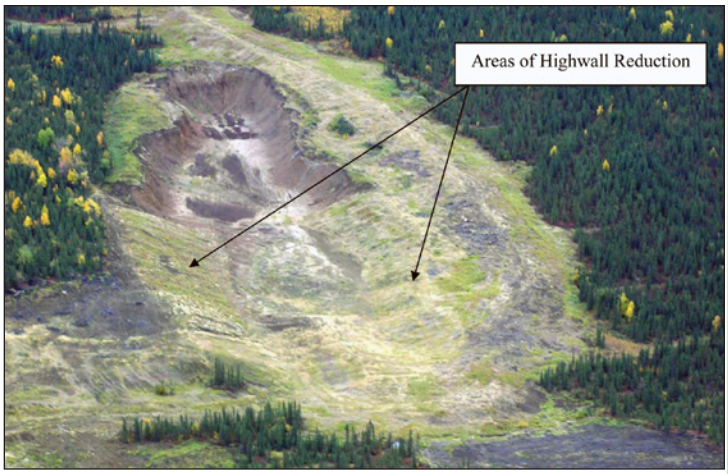
SW corner of central pit waste rock dump - July, 2003

SW corner of central pit waste rock dump, - October, 2004

Office / shop area - September, 2005

Reclaimed office / shop area - June, 2009





Photos: American Reclamation Group