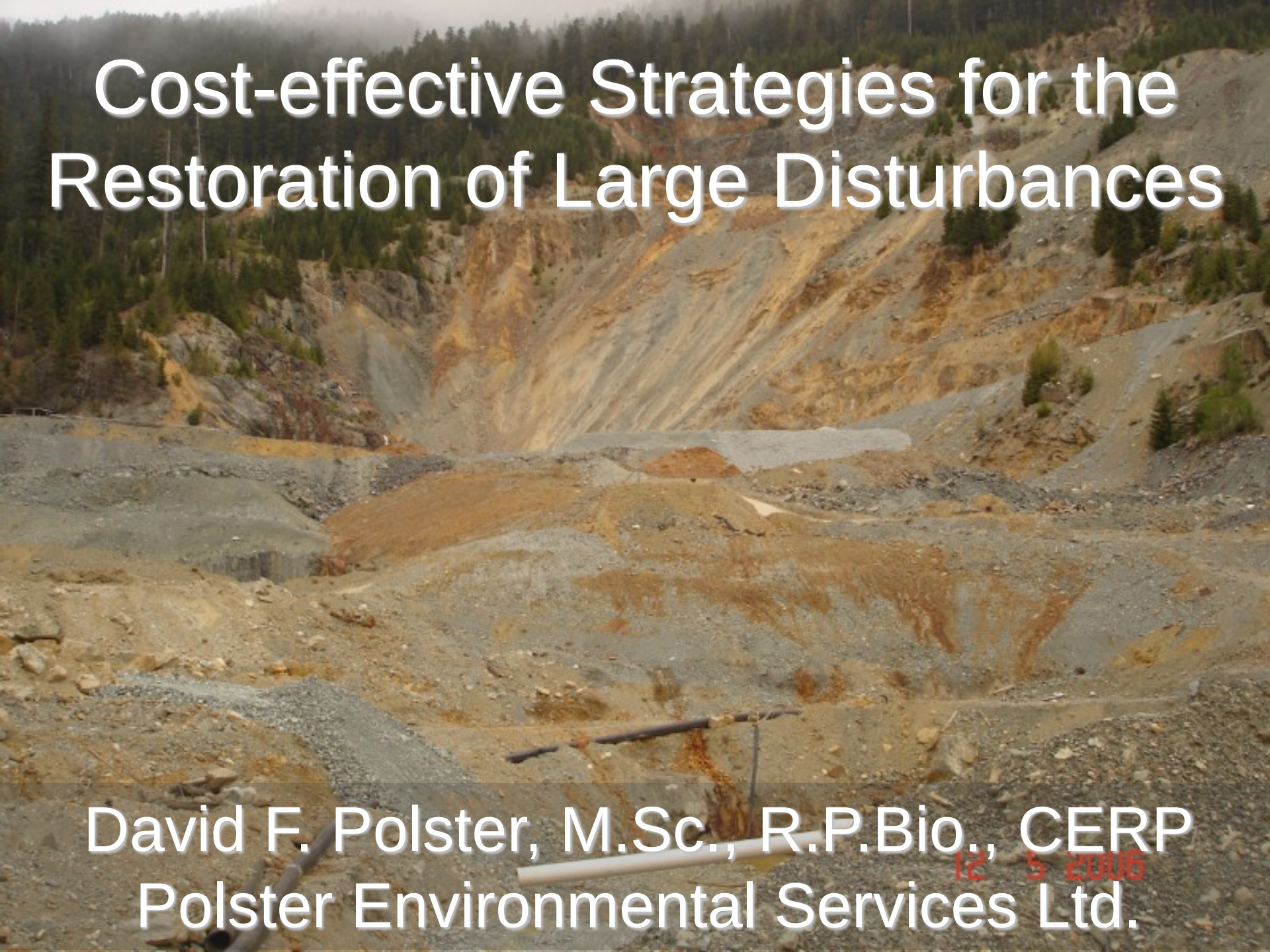
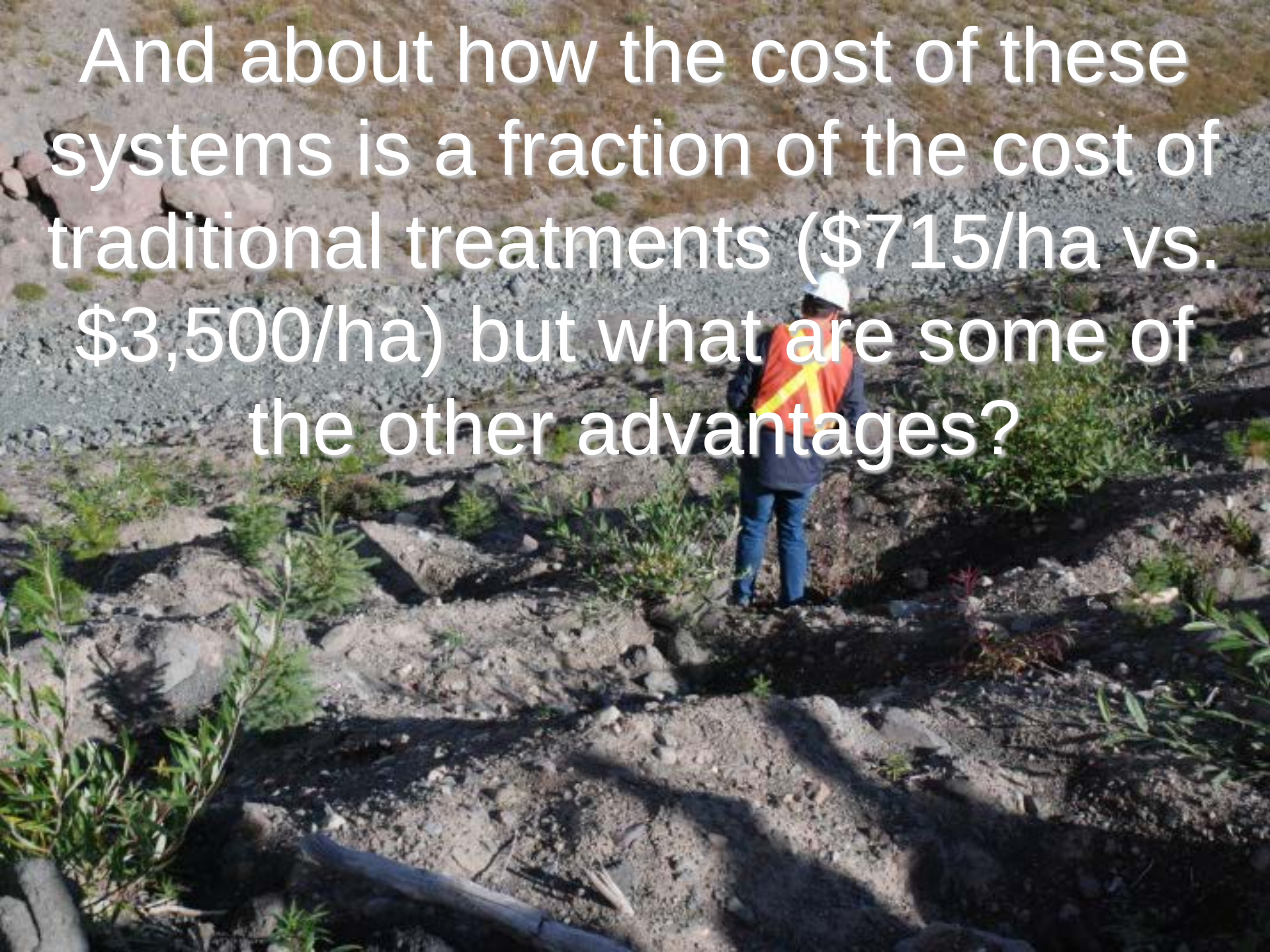
Cost-effective Strategies for the Restoration of Large Disturbances



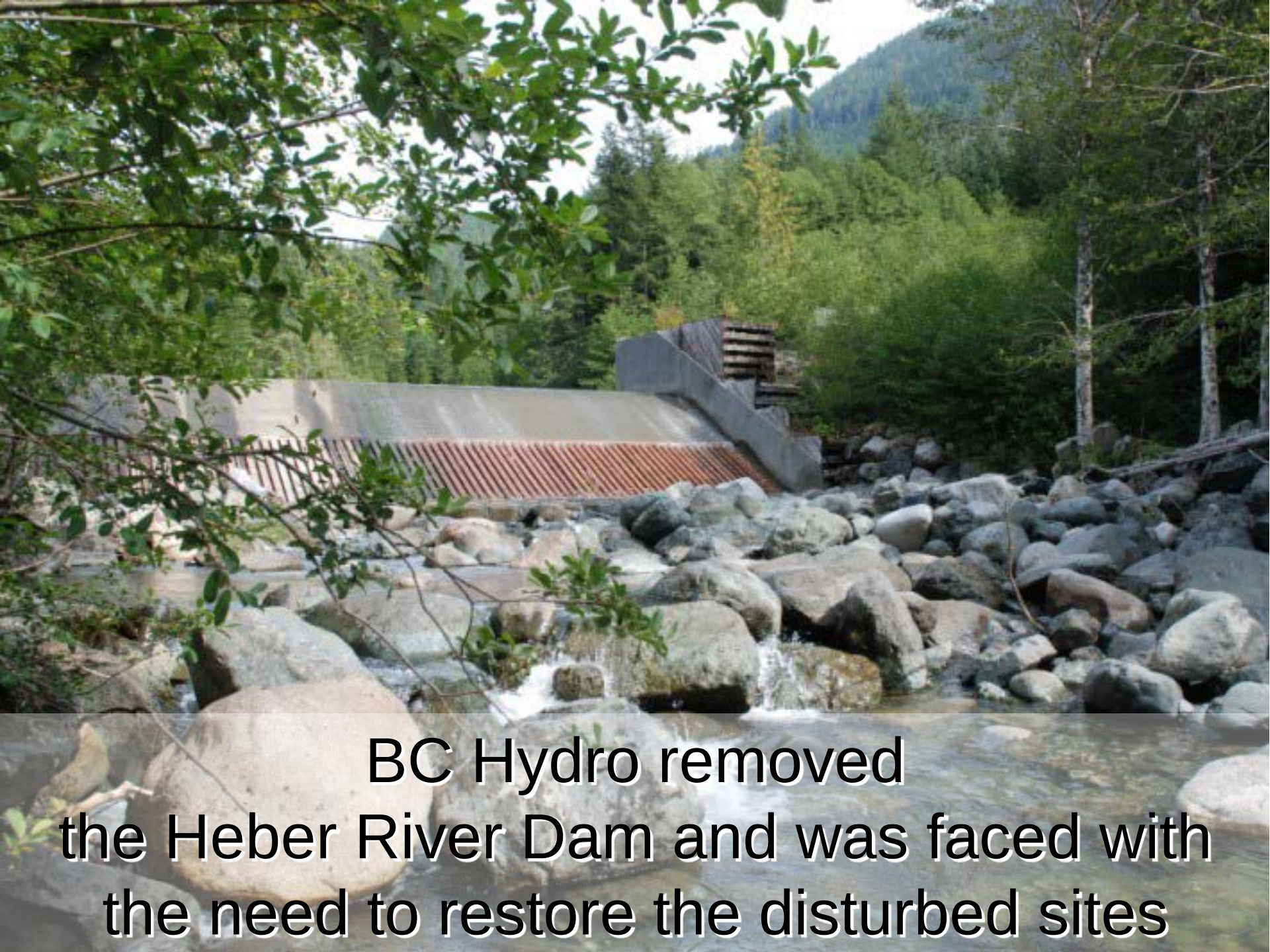
David F. Polster, M.Sc., R.P.Bio., CERP
Polster Environmental Services Ltd.


We have learned about how natural systems (rough and loose) can control erosion and foster recovery.
11 8 2005

And about how these systems can deal with the filters that prevent recovery, like compaction,


And about how the cost of these systems is a fraction of the cost of traditional treatments ($715/ha vs. $3,500/ha) but what are some of the other advantages?


Plants grow well on rough and loose substrates, and do so for free.



BC Hydro removed
the Heber River Dam and was faced with
the need to restore the disturbed sites

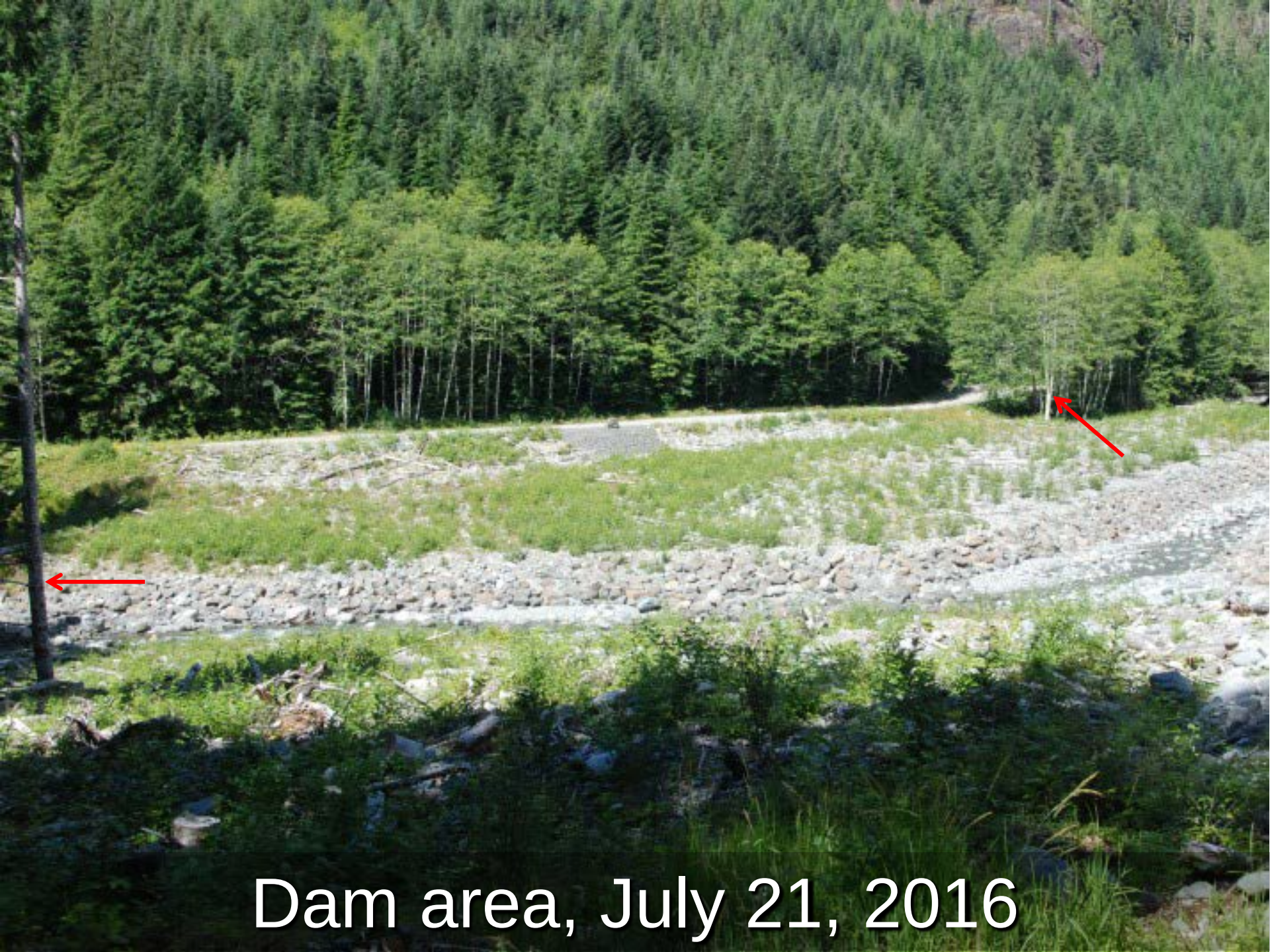
There was a 3 km penstock that was also removed.

What are the constraints or filters preventing natural recovery?

What are the successional patterns that operate in the region?


So we made project sites rough and loose
(= increased topographic heterogeneity)
and covered them with woody debris
(October 7, 2012).

Dam area, October 7, 2012

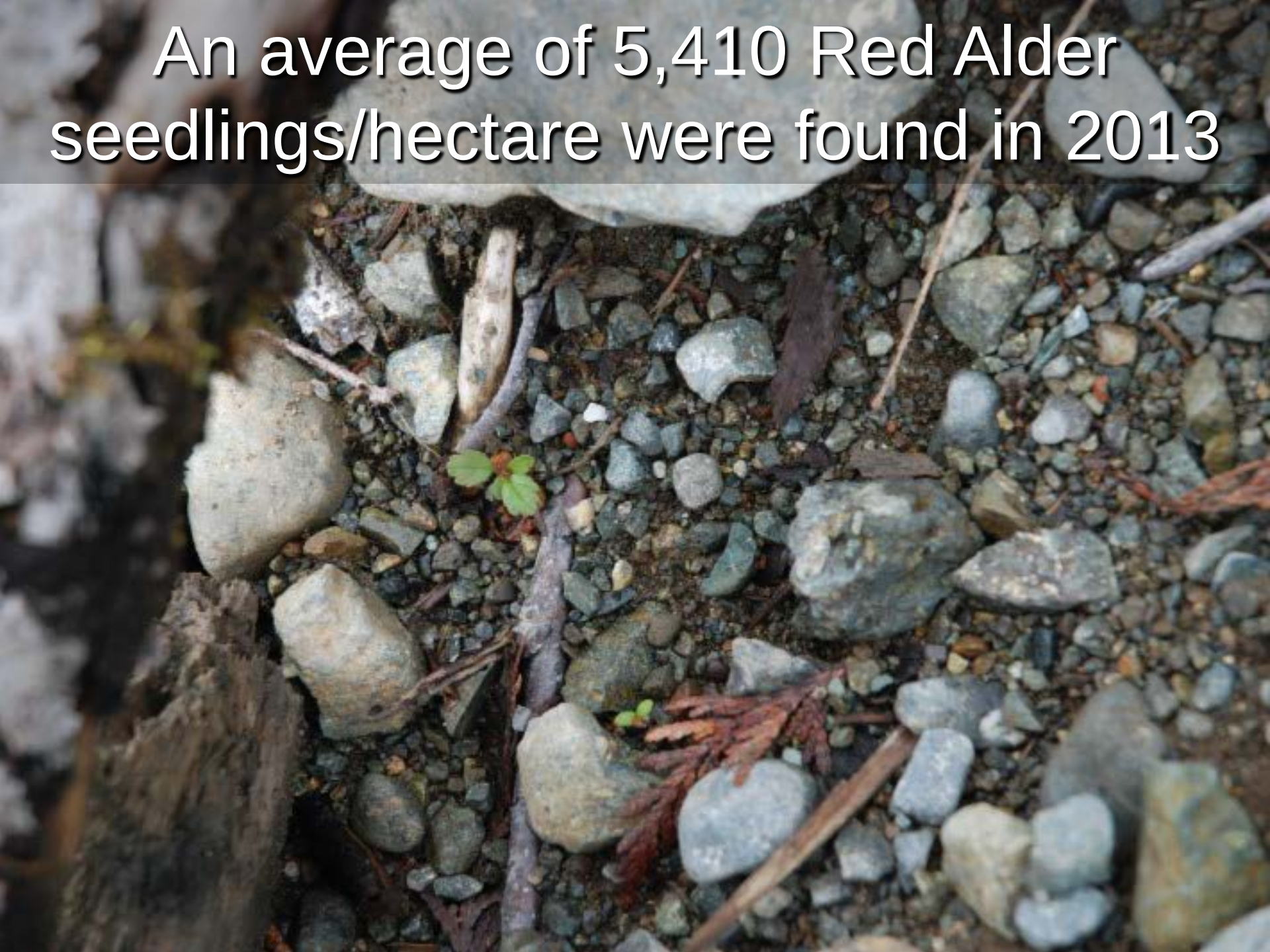

Dam area, July 21, 2016


By November 13th, 2012 the project sites were ready for winter.

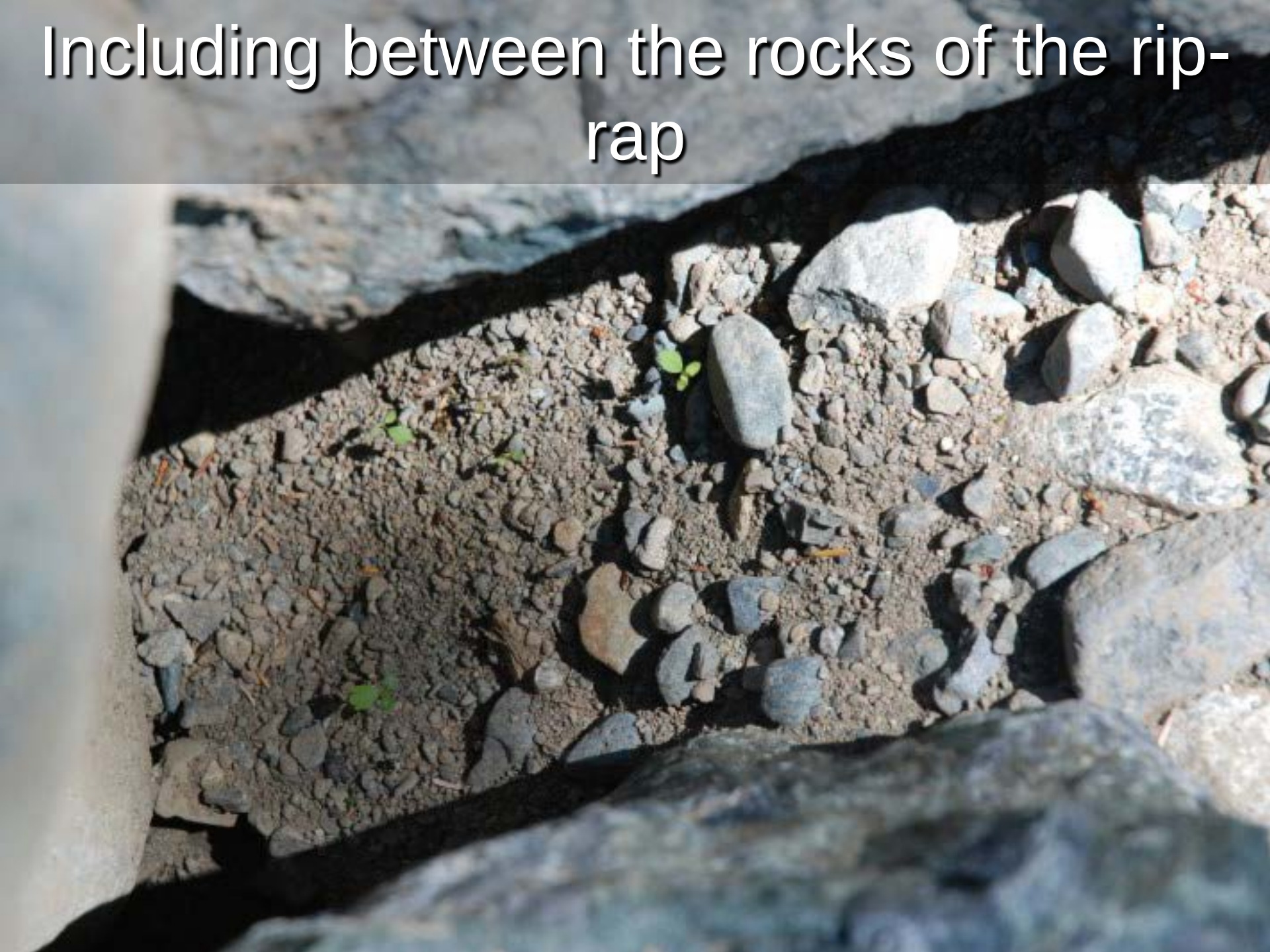

Monitoring transects were established at 5 project locations, July 16, 2013
Dam area, July 16, 2013

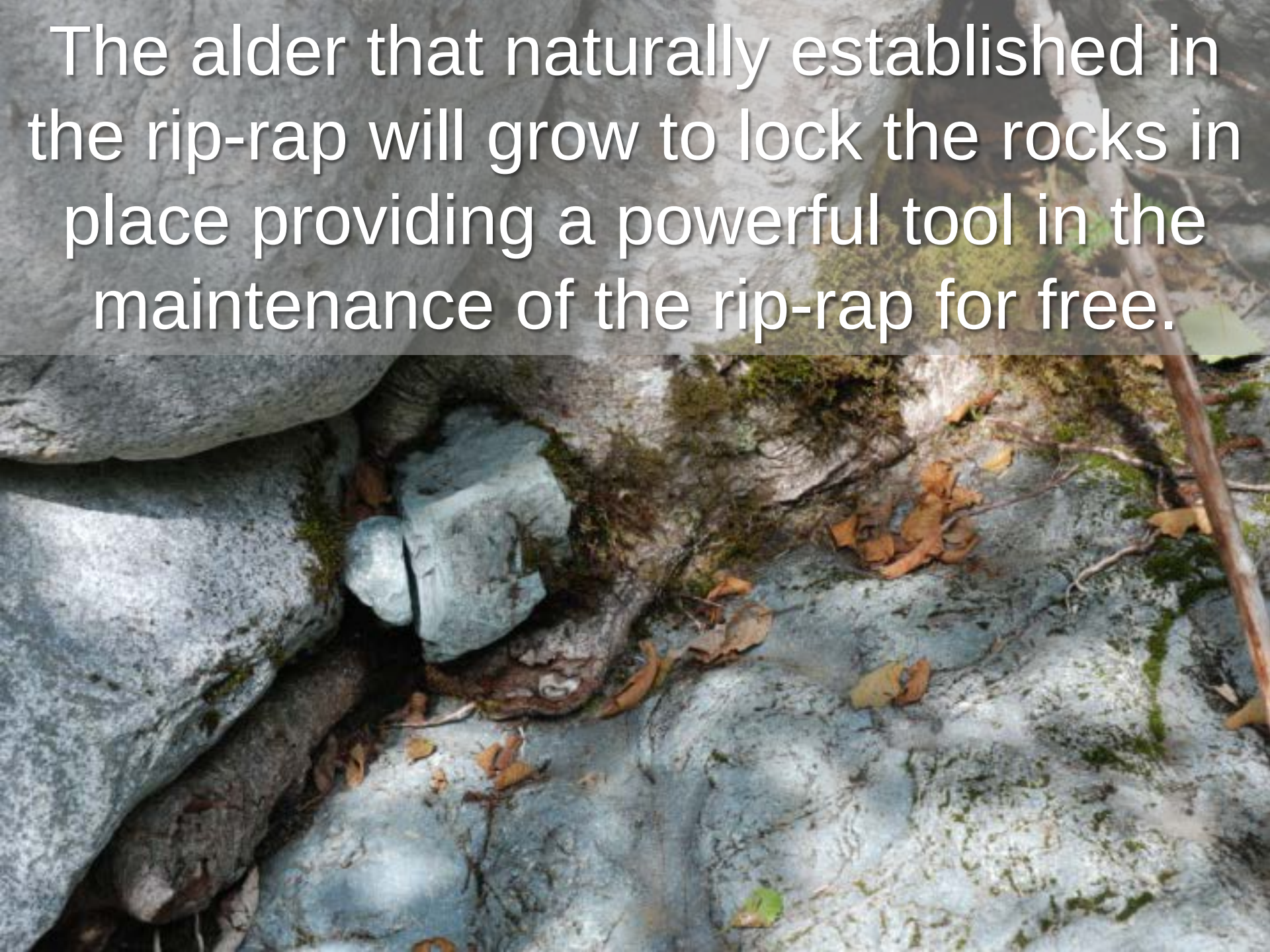
Woody debris is an important natural process for bringing in other species.


In 2016, fruit bearing plants were found in 90 % of the 50 plots.


An average of 5,410 Red Alder seedlings/hectare were found in 2013

Including between the rocks of the rip-rap




The alder that naturally established in the rip-rap will grow to lock the rocks in place providing a powerful tool in the maintenance of the rip-rap for free.

By 2014 an average of 8,554 Red Alder seedlings/hectare (and 67 other species) were found

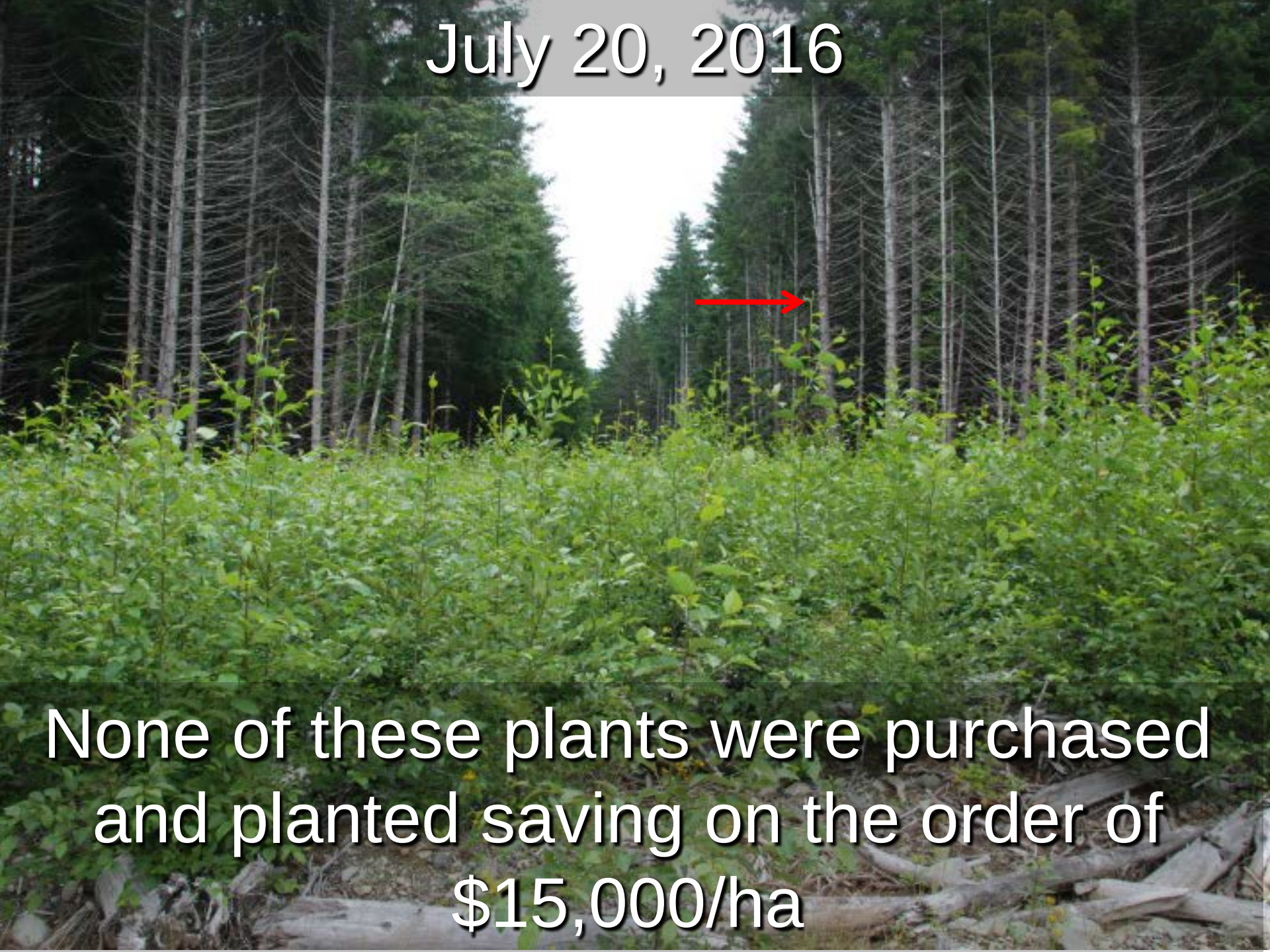

In 2015 an average of 5,392 Red Alder seedlings/hectare were found along with 80 other species


By 2016 an average of 6,162 Red Alder seedlings/hectare were found along with conifers in most plots.


July 16, 2013


July 23, 2014

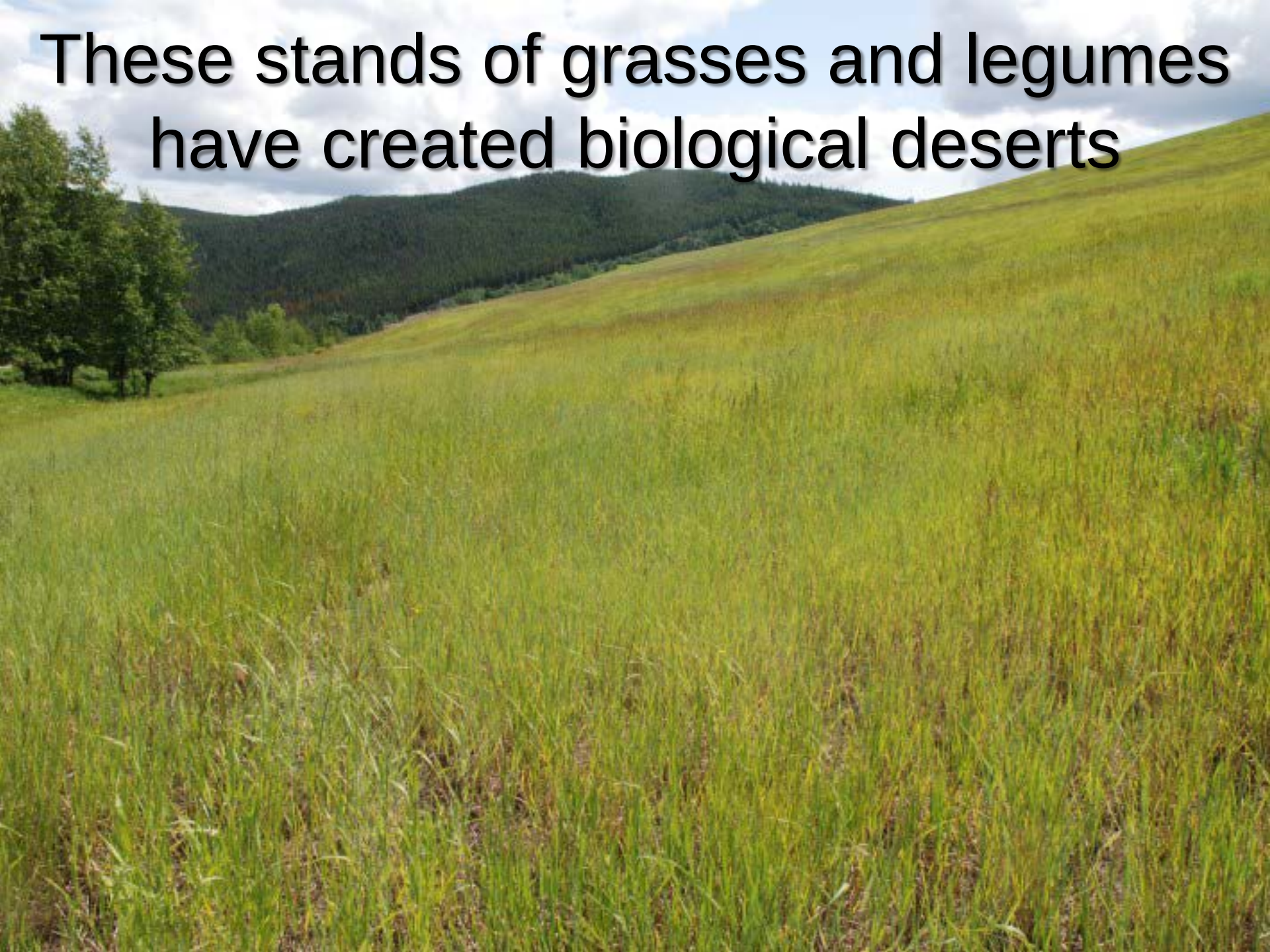

July 6, 2015


July 20, 2016
None of these plants were purchased and planted saving on the order of $15,000/ha

In addition, the diversity of species that have established (over 80 different species) means that the restored ecosystems have a high degree of ecological resilience.

Enhancing Biodiversity on Drastically Disturbed Sites


Traditional reclamation has created vast stands of successionally stagnant grasses and legumes
29 6 2005


These stands of grasses and legumes have created biological deserts


Sparse vegetation cover limits site productivity = limited diversity

Slow, sparse growth limits diversity

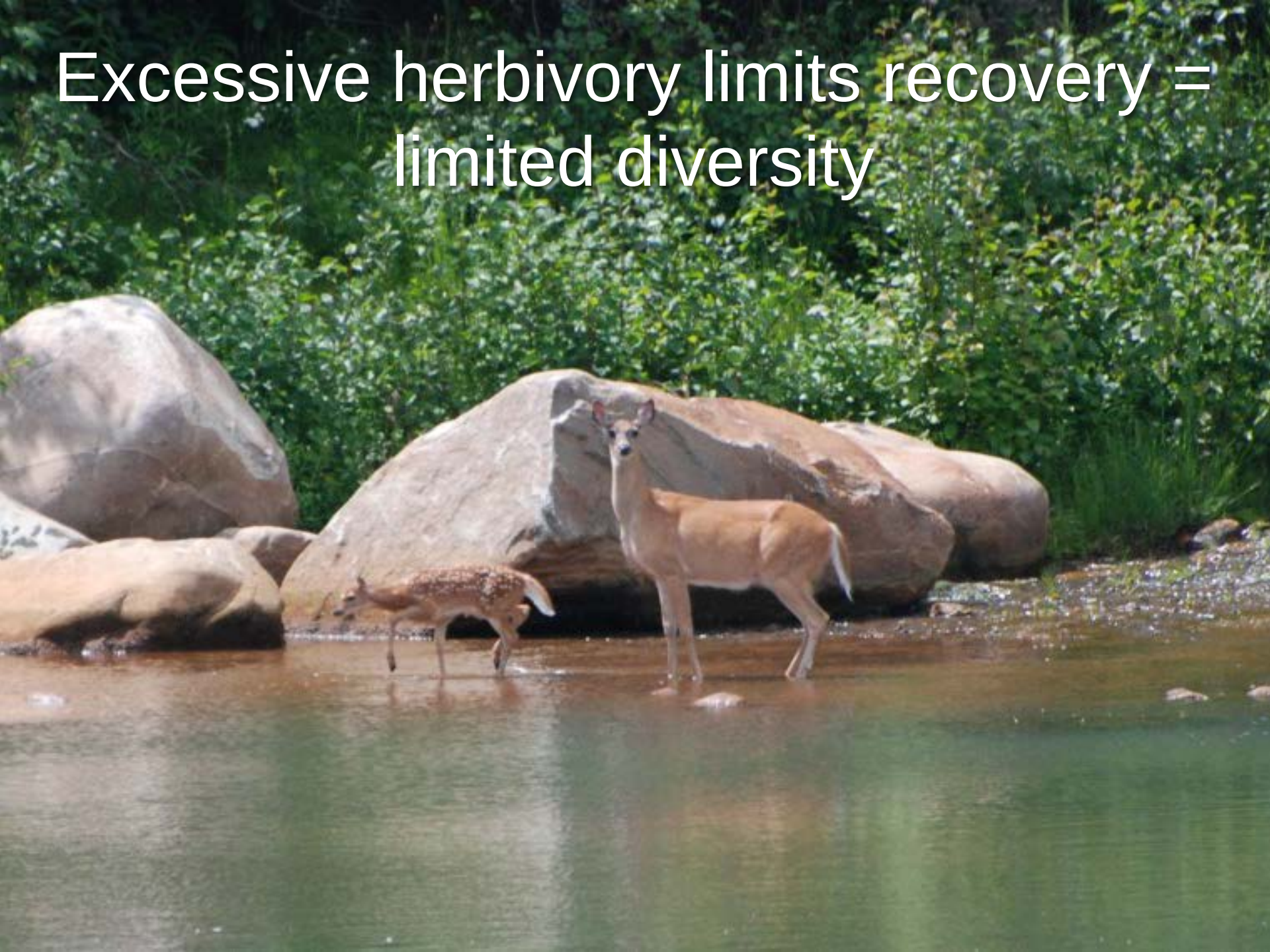
Long, unstable dump slopes prevent recovery = limited diversity

Unstable slopes and compacted benches = limited productivity = limited diversity

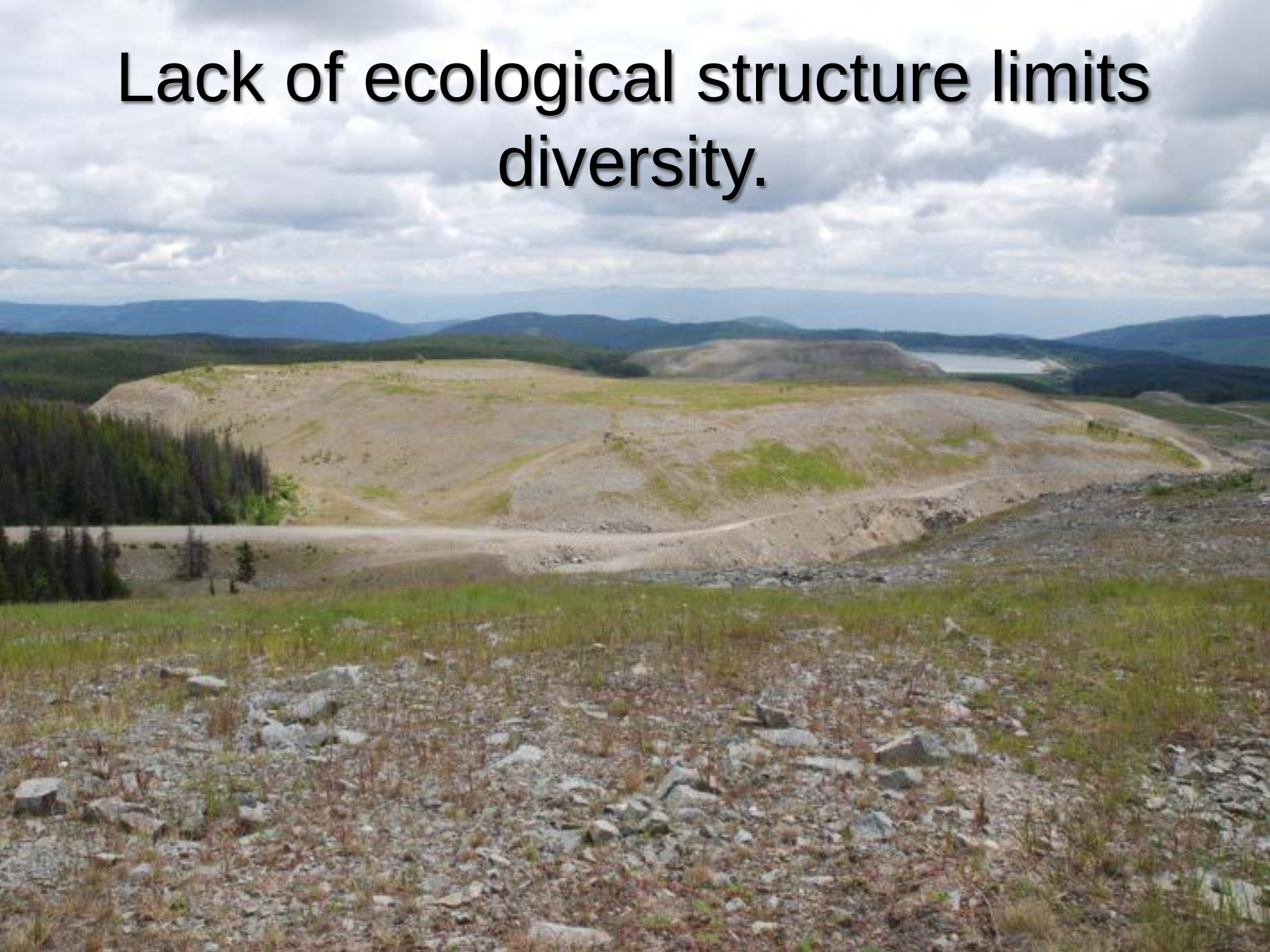
Seeded grasses and legumes coupled with no shooting zones creates an explosion of ungulate populations


These animals reduce shrub cover, limiting nesting habitat for songbirds

Excessive herbivory limits recovery = limited diversity



Lack of ecological structure limits diversity.



Limited diversity limits resilience.

So, what can be done?

Making sites rough and loose creates instant diversity, costing about 1/2 hour of machine time/patch.

Topographic heterogeneity

Covering 10% of the mine with rough and loose patches will enhance the biodiversity while reducing costs.

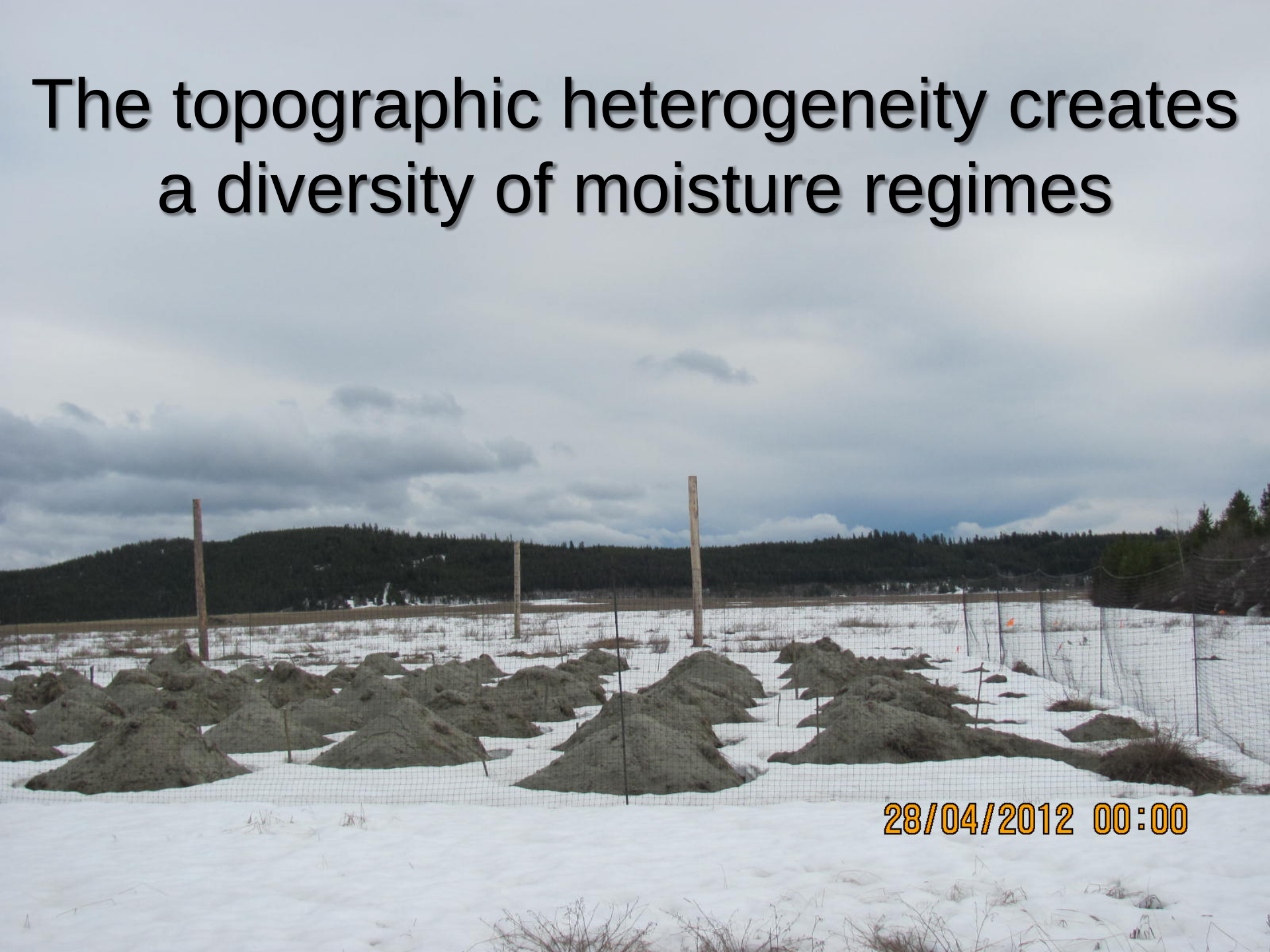

Treatments in various locations creates spatial heterogeneity

Treatments over a number of years creates temporal heterogeneity

At a big mine, there are lots of opportunities

Rough and loose sites address several issues

The topographic heterogeneity creates a diversity of moisture regimes



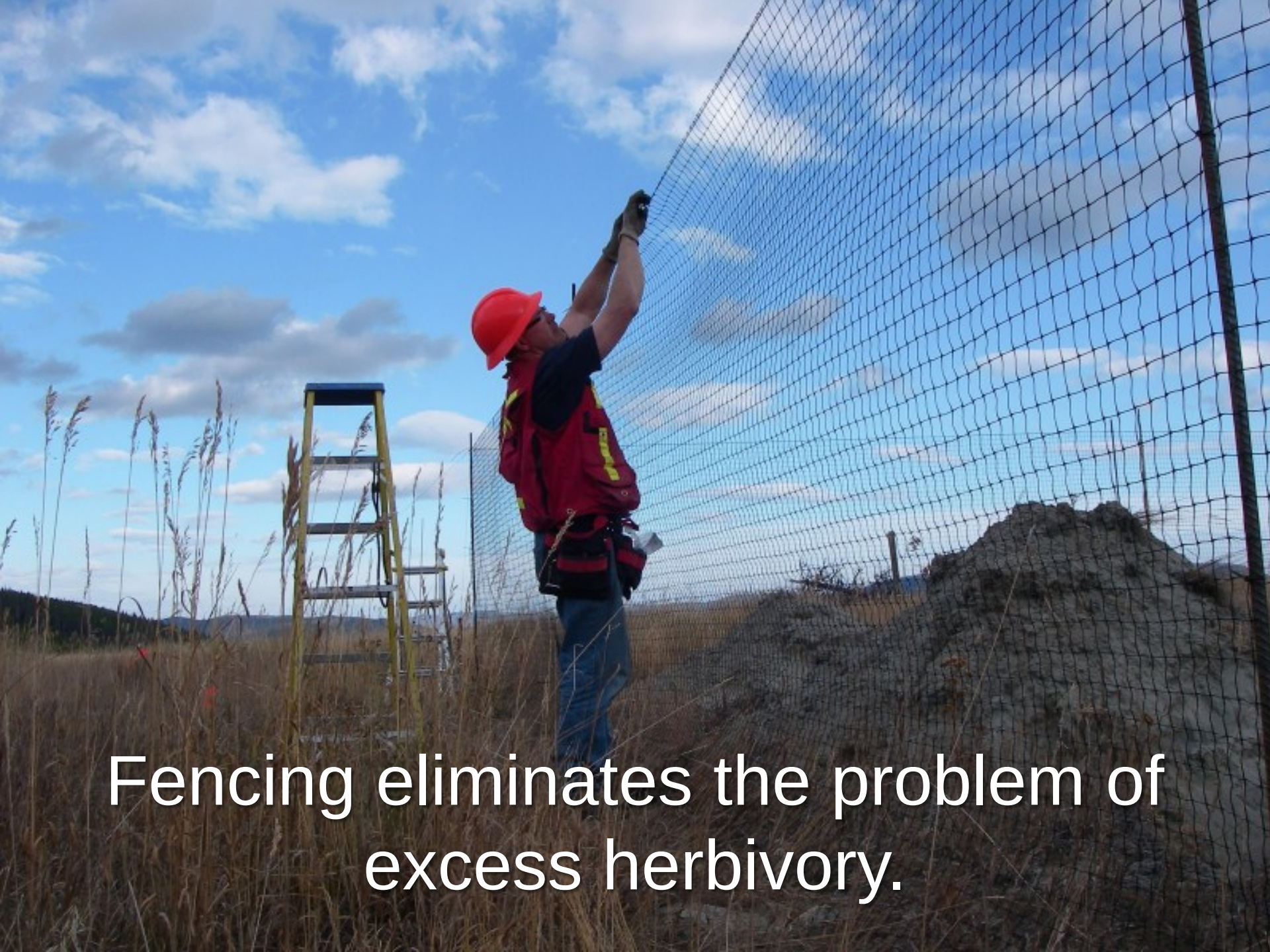
The loose substrate provides opportunities for live staking

Even on waste rock sites the rough and loose treatment makes live staking easy.


Cuttings planted deeply and plugs planted on the surface creates a system of niche complementarity = increased diversity

Pioneering species can be used to initiate successional trajectories.


The symbiotic relationship between *Alnus* spp. And *Frankia alni* creates conditions that foster successional advancement.



Fencing eliminates the problem of excess herbivory.

Brush piles can add habitat complexity and ecological structure.

Nest boxes bridge the gap between young forests with no cavity trees and old forests.

Bluebird boxes bring back these charismatic birds*.

*Can build social licence.


Mountain Bluebirds moving in June 5, 2012
The value of a photo like this in the local paper compared to a photo of the Mount Polley Tailings disaster can not be calculated.

Bat boxes and a Kestrel box add further habitat diversity.


Cuttings starting to grow
June 5, 2012


August 9, 2012


May 13, 2013


May 18, 2015


September 20, 2016

Live staking with pioneering species initiates a recovery trajectory.

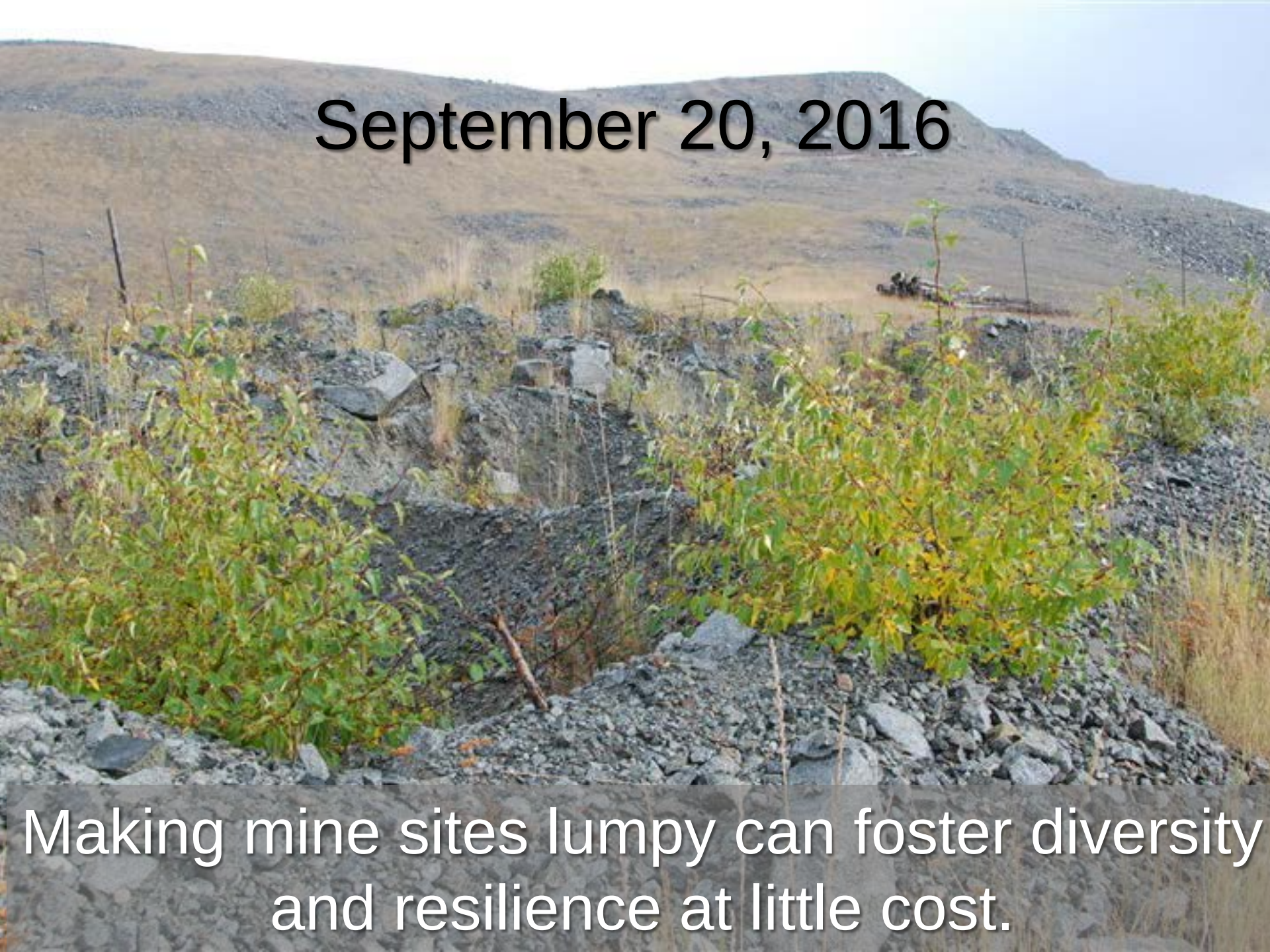
August 9, 2012


May 18, 2015

September 20, 2016

On waste rock sites once compaction is reduced, good growth is obtained. Pioneering species build soils.


May 18, 2015
Creating perching sites for raptors fosters diversity.


September 20, 2016
Making mine sites lumpy can foster diversity and resilience at little cost.

Natural Processes for the Restoration of Timmins Area Sites

June 25, 2016

Traditional reclamation treatments -

How much did this cost?

Are these treatments effective?

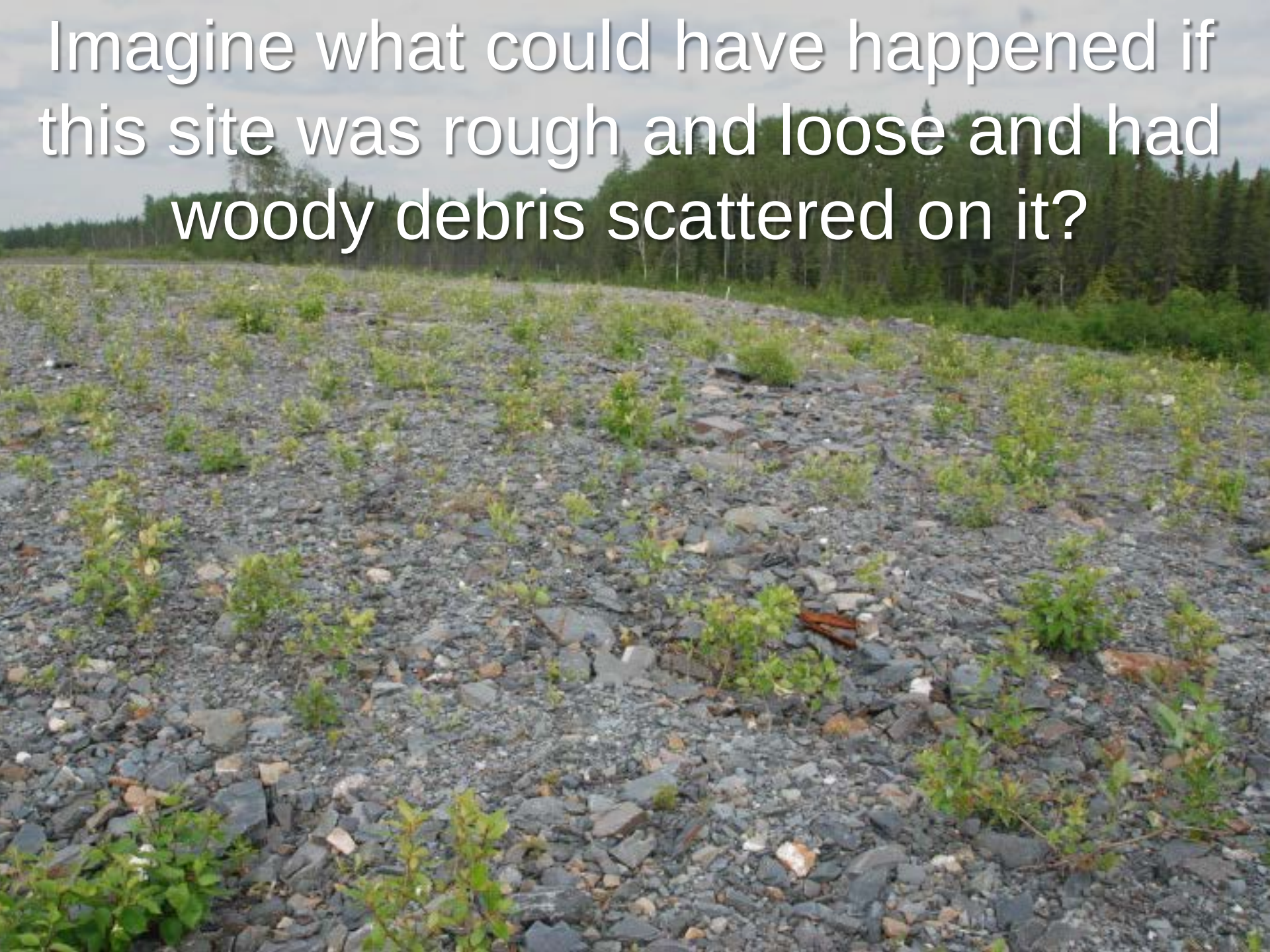
What about erosion control?

What are the filters preventing recovery?

Seeded agronomic grasses and legumes prevent recovery of these ecosystems.

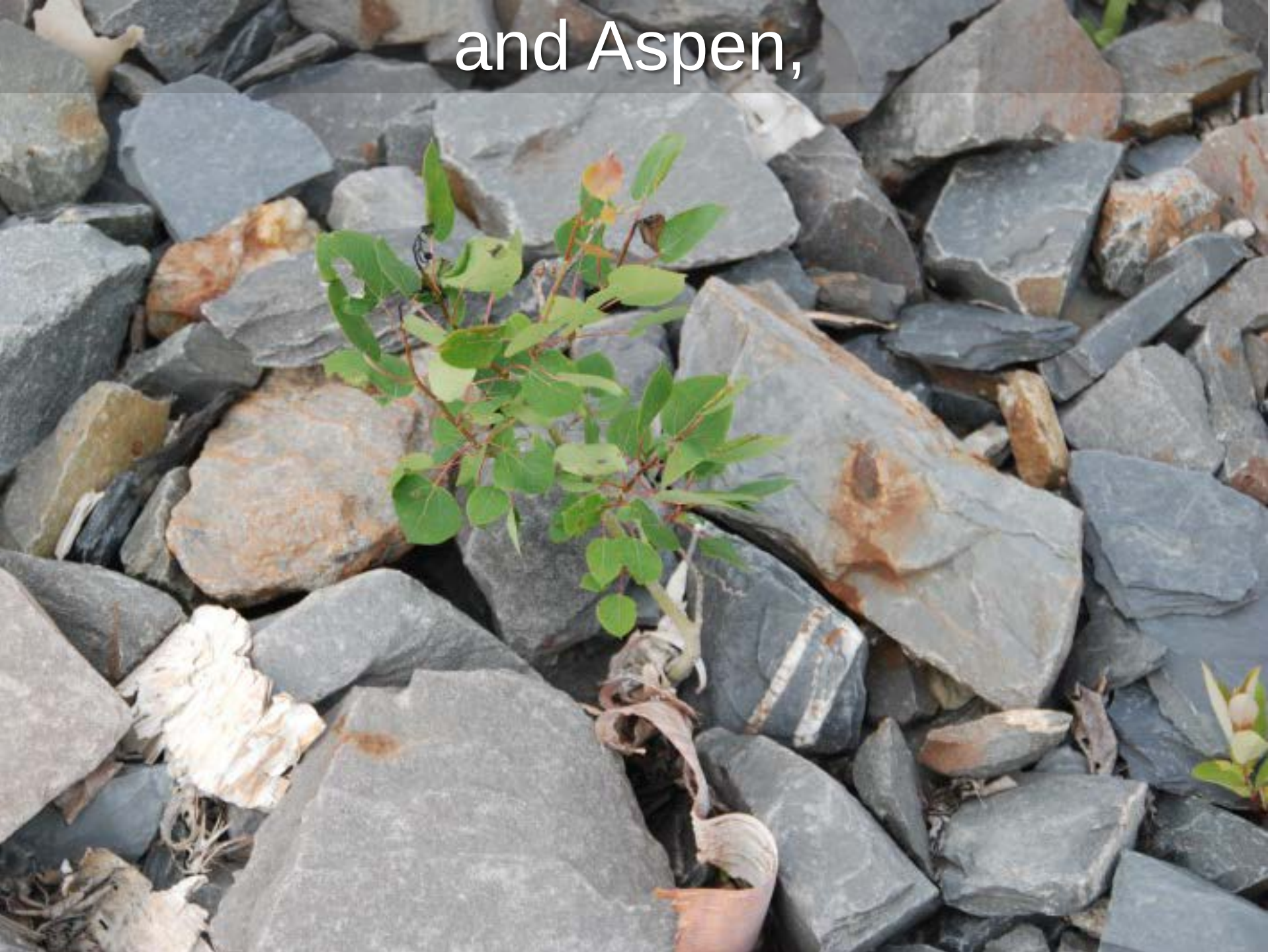
How much does all this grass and legume seeding cost? What about the weed control?


Natural processes establish a variety of species for free on this compacted waste rock area.

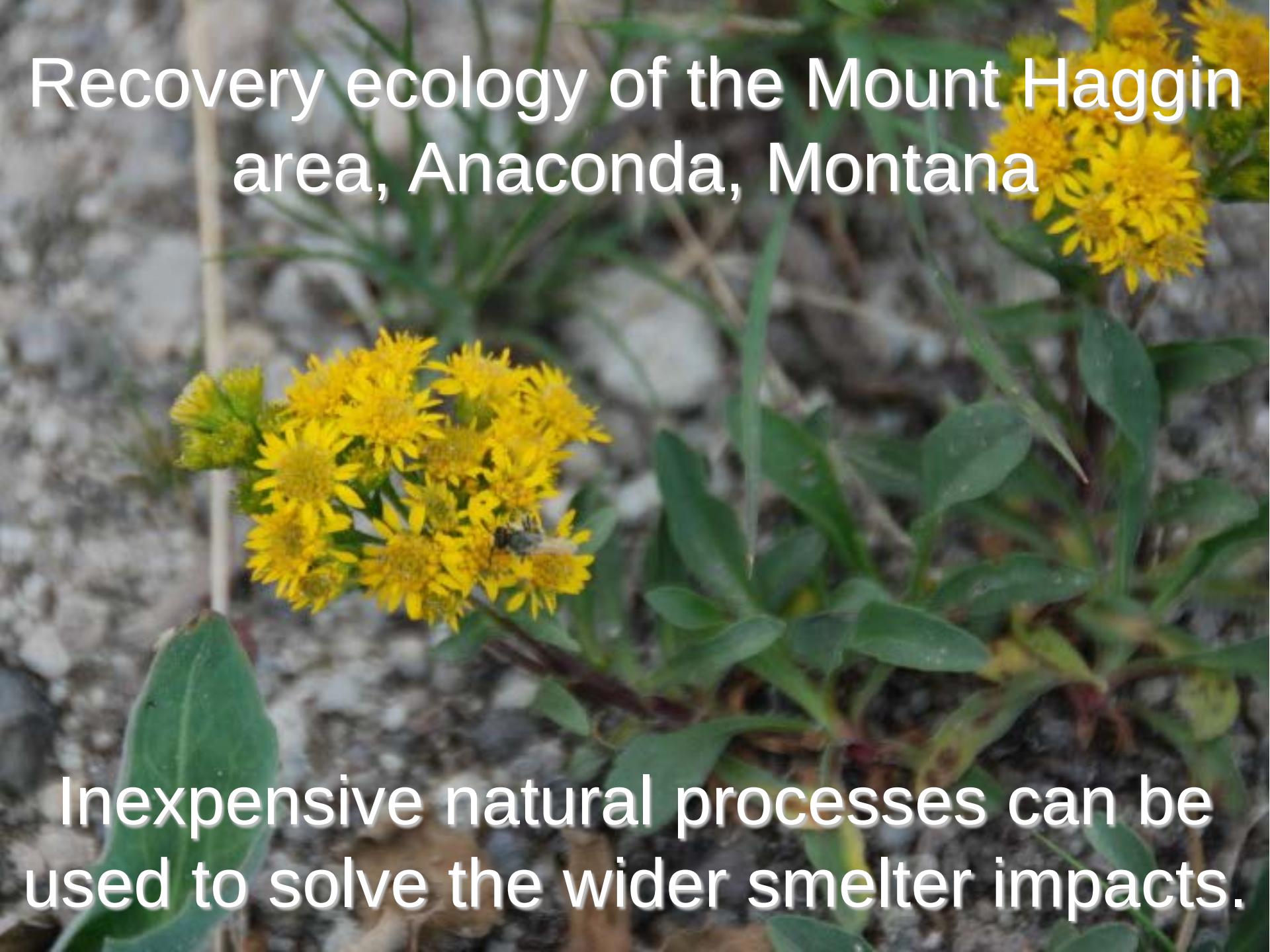

Imagine what could have happened if this site was rough and loose and had woody debris scattered on it?


The dominant species is Balsam Poplar.


There is also willow,


and Aspen,


and Spruce
All this for free!

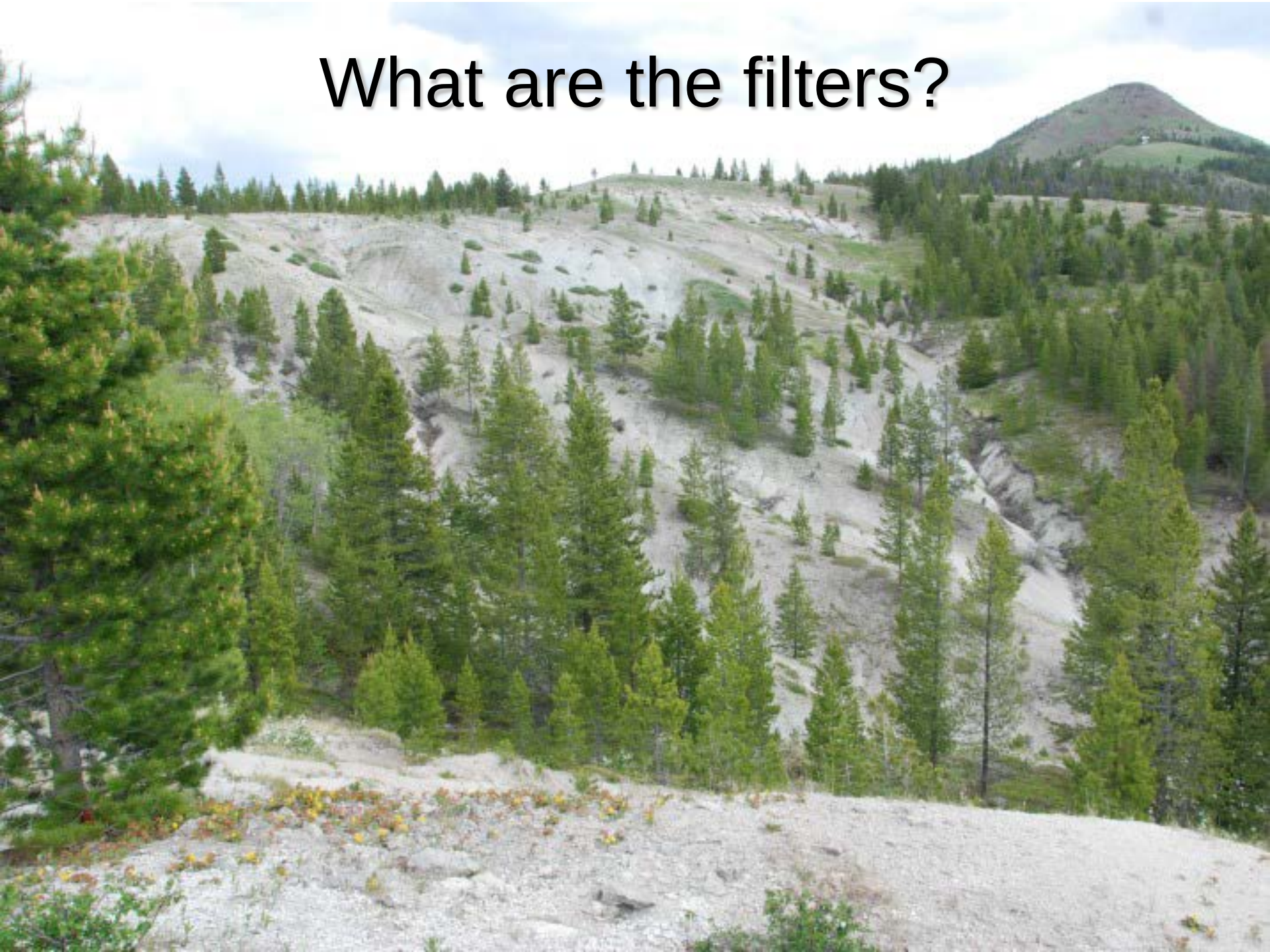

Recovery ecology of the Mount Haggin area, Anaconda, Montana
Inexpensive natural processes can be used to solve the wider smelter impacts.


Historic SO_2 emissions impacted the regional landscape

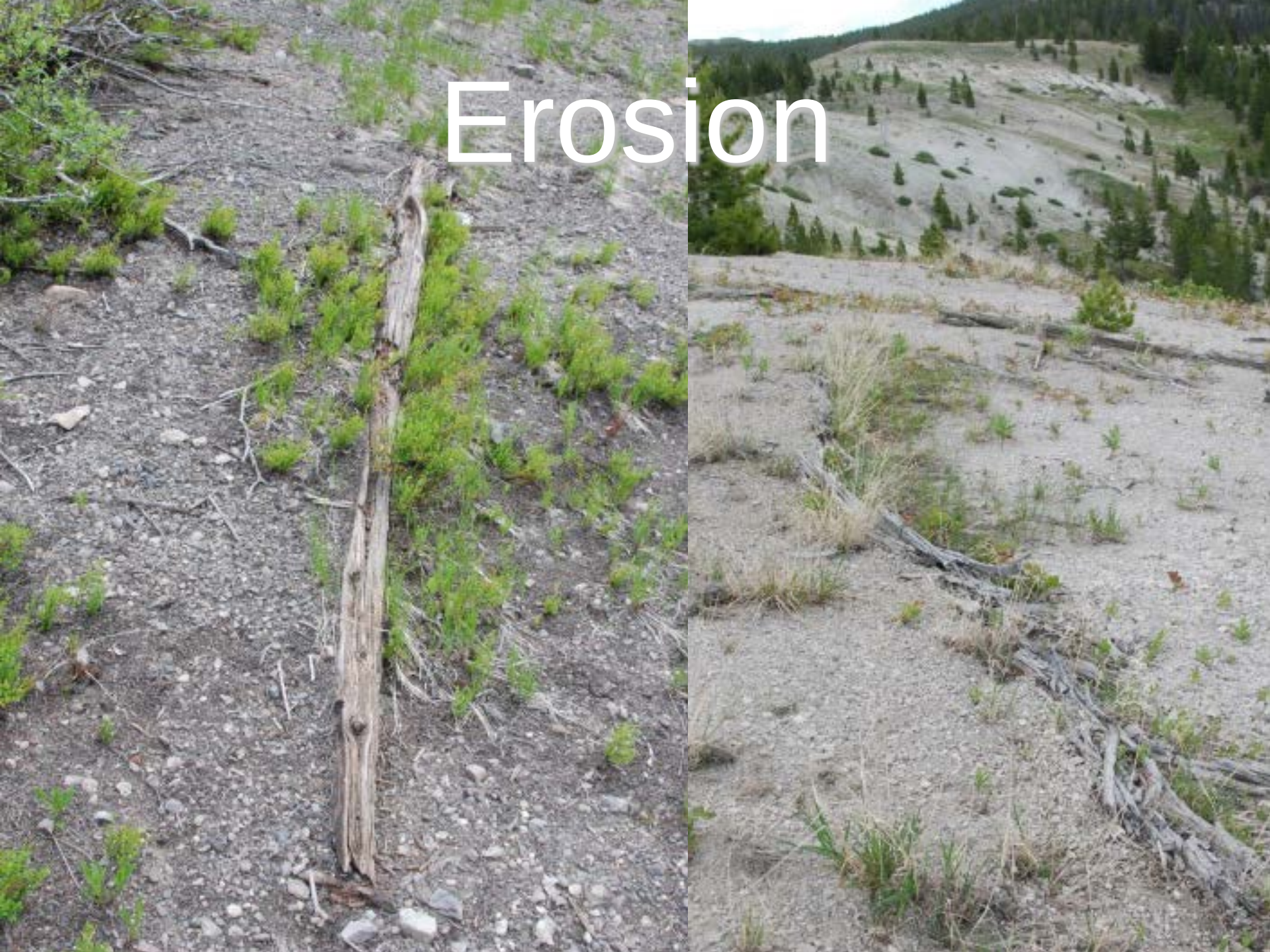
Work is underway to collect and cap the metal contaminated soils around the old smelter.


But what about impacted areas outside of the smelter area?

What are the filters?



Erosion



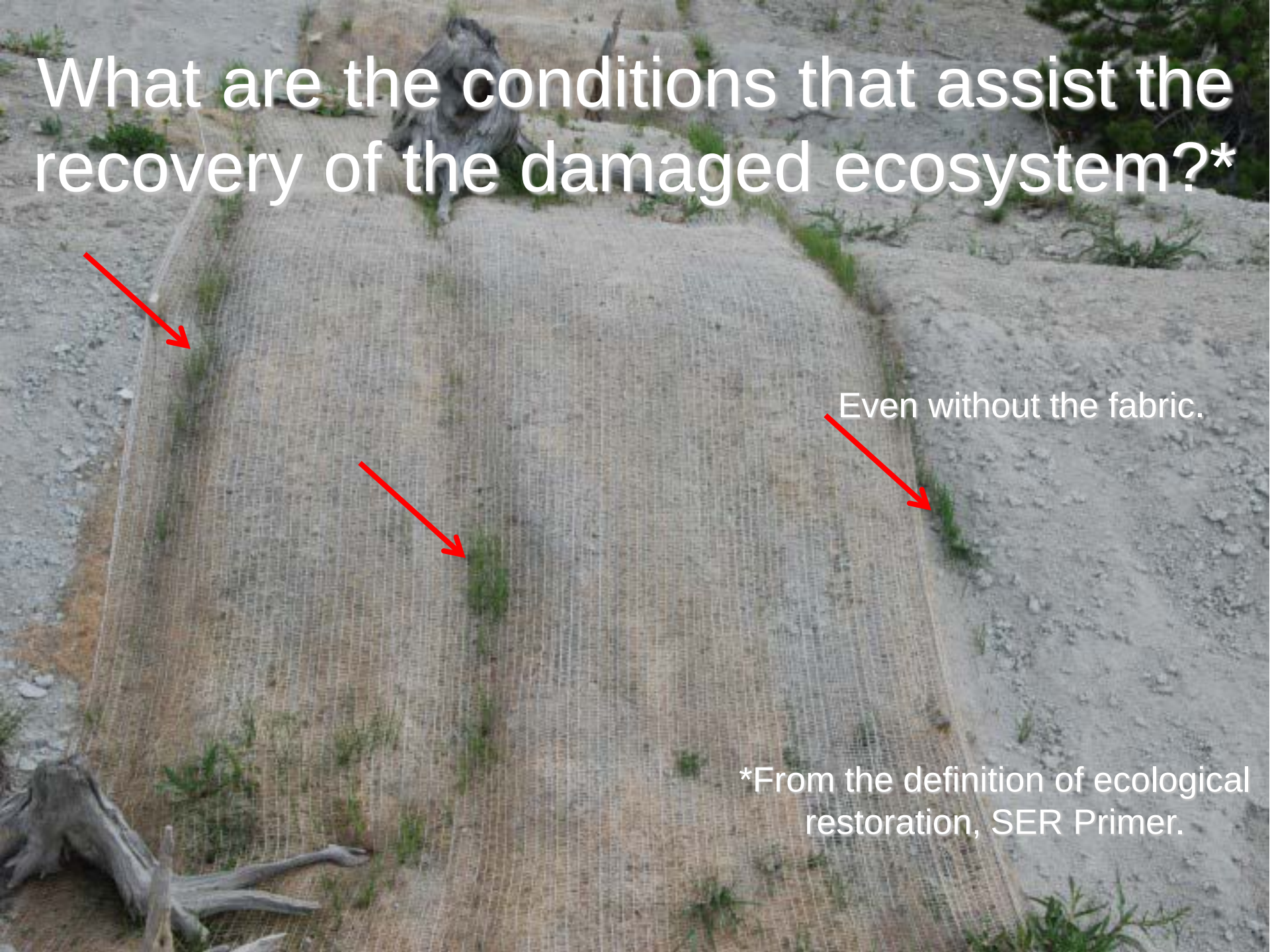

Eroded sediments build up on the uphill side of logs on the slope
Almost 25 cm at this log

How can we control erosion over large areas?

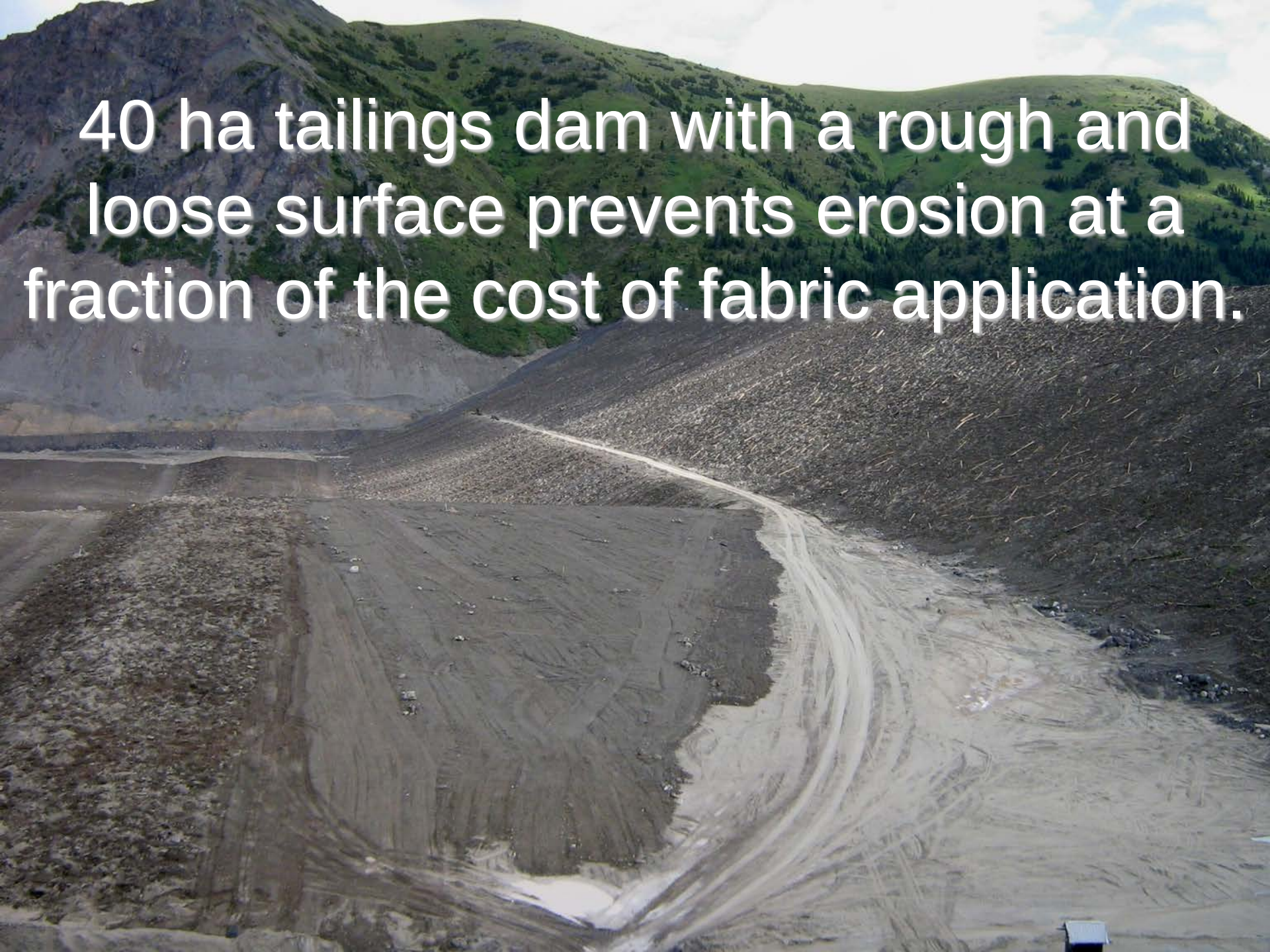

It is clear the fabrics that have been applied are not controlling erosion.


In fact, these fabrics are actually preventing recovery.

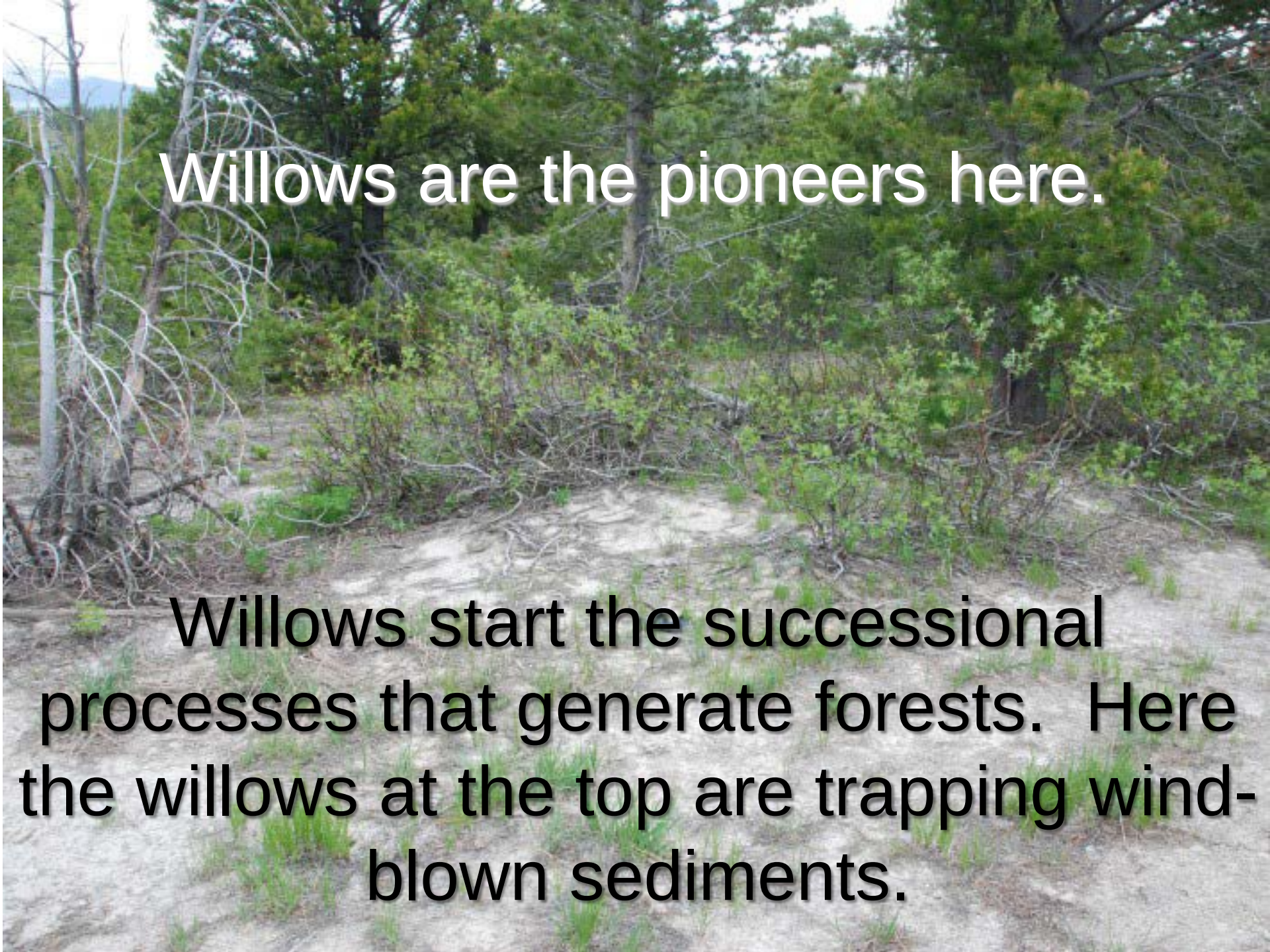

There are as many establishing plants
not with the fabric as there are with it.


What are the conditions that assist the recovery of the damaged ecosystem?*
Even without the fabric.
*From the definition of ecological restoration, SER Primer.


The small trenches built as part of the fabric installation encourage growth.
So on large areas???


40 ha tailings dam with a rough and loose surface prevents erosion at a fraction of the cost of fabric application.


Planting pioneering species is easy in rough and loose ground.
Remember, making sites rough and loose only costs about $715/ha.


Willows are the pioneers here.
Willows start the successional processes that generate forests. Here the willows at the top are trapping wind-blown sediments.


Willows are found all over the hillside.


Willows create conditions that promote
the establishment of conifers


They can be heavily browsed by ungulates.

Is there enough moisture for willows?

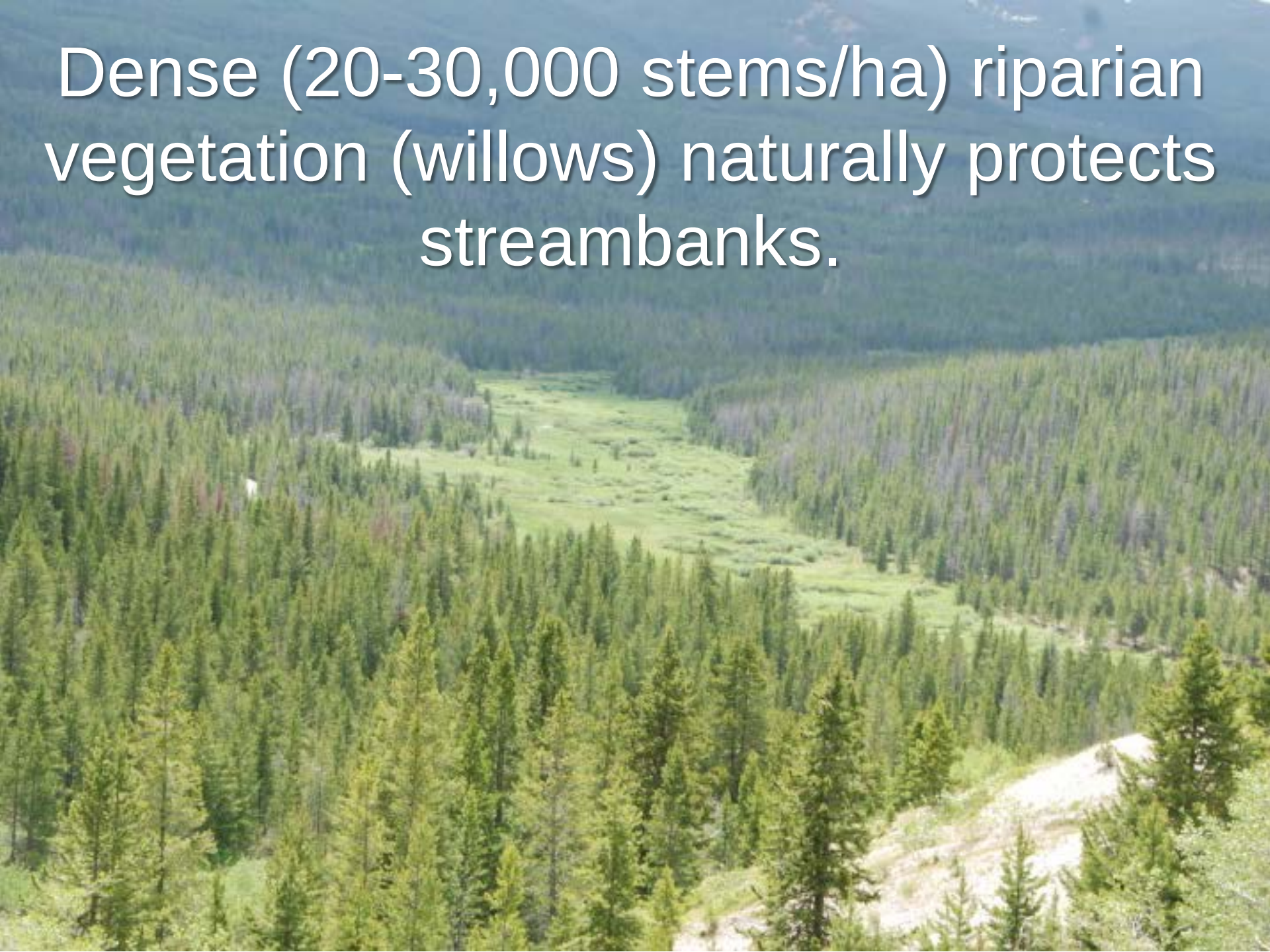

The fact that there are willows all over the hill suggests that there is ample moisture.

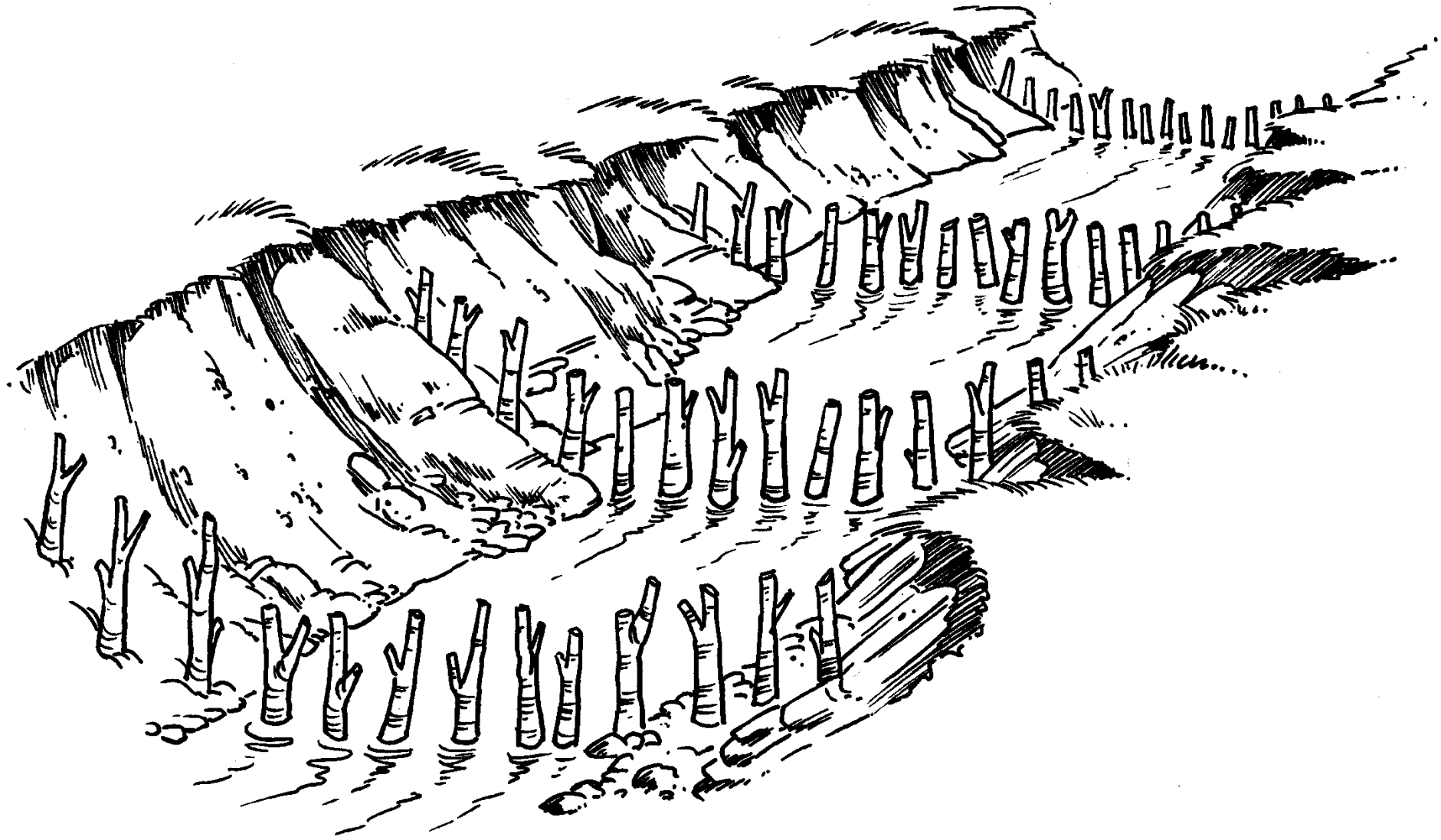

Even up at the top,


there is ample moisture to sustain willow growth.


What about the gullies?


Brush has been installed in most gullies,
but this does not solve the problem as the brush will degrade and the gullies will remain.


Dense (20-30,000 stems/ha) riparian vegetation (willows) naturally protects streambanks.

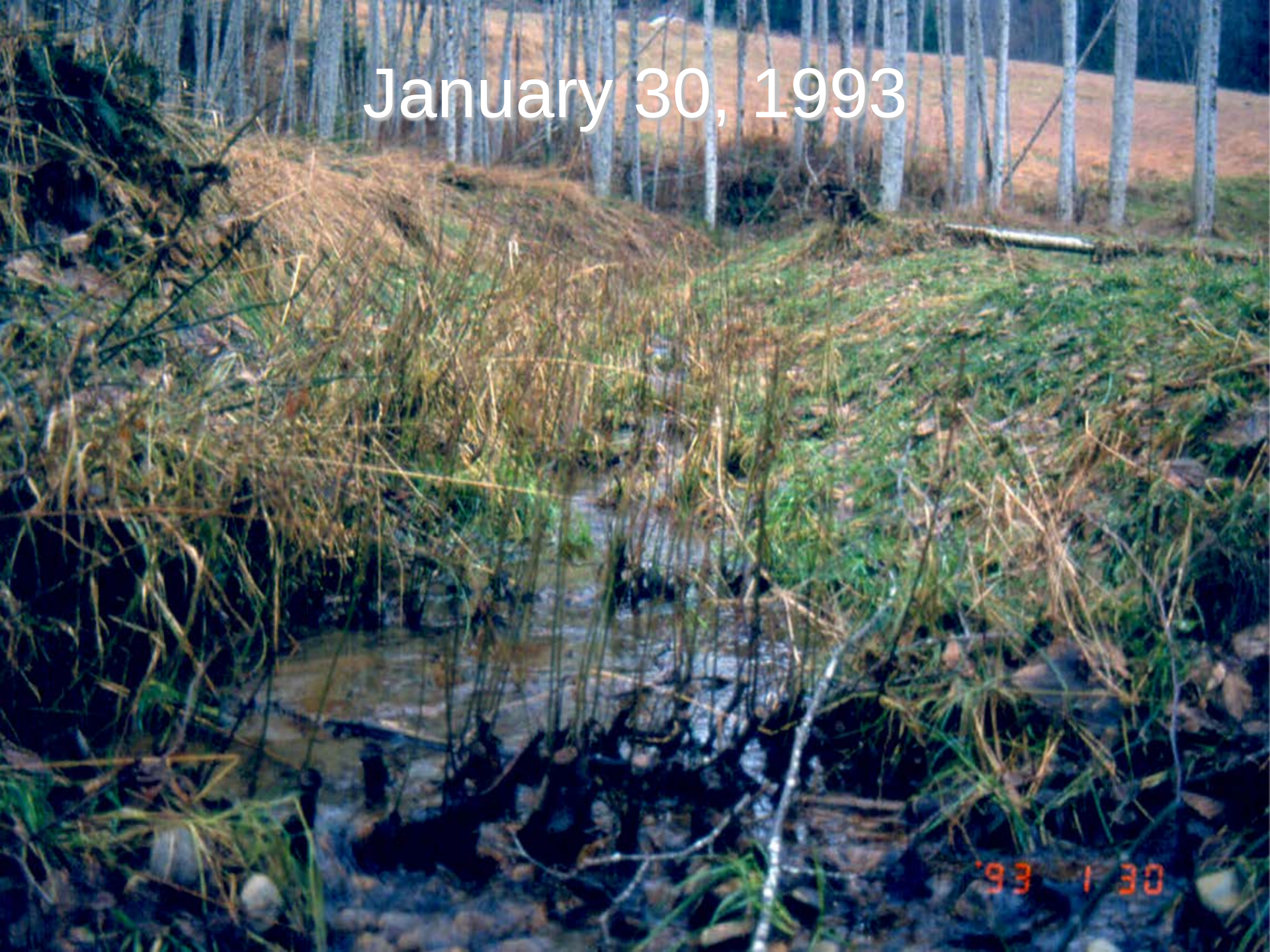


Live silt fencing slows flows and allows sediments to drop out


A high-tech solution, live silt fences, February 20, 1992
Vancouver Island Gas Pipeline above the Qualicum River fish hatchery.

A few hours with the crew to start the recovery process.

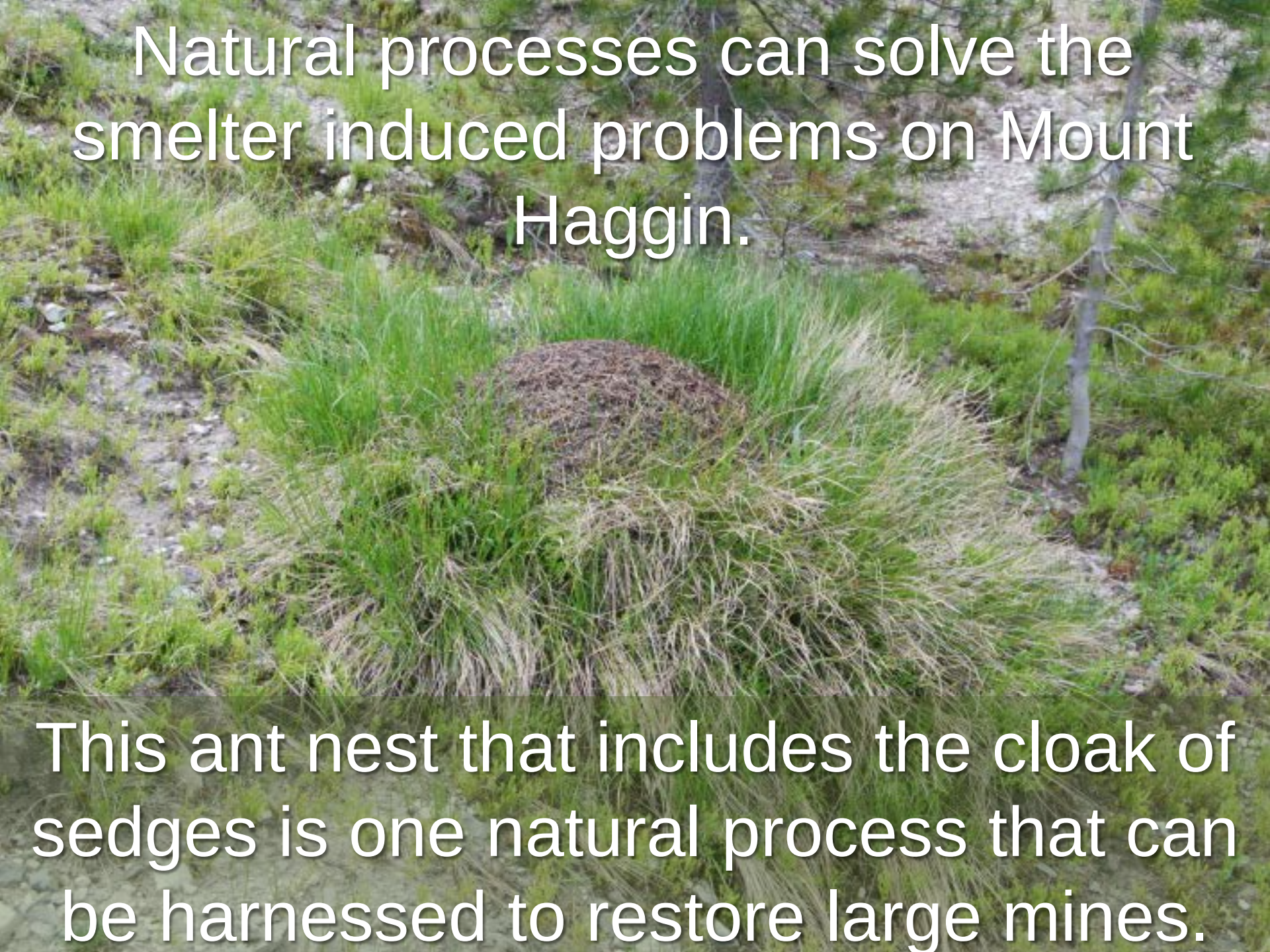

May 11, 1992


January 30, 1993
'93 1 30


April 9, 1997


April 9, 1997


Live silt fencing can be used in all of the gullies on the slope. The growing willows will solve the gully problems forever.


Natural processes can solve the smelter induced problems on Mount Haggin.
This ant nest that includes the cloak of sedges is one natural process that can be harnessed to restore large mines.


Questions???

Consider applying to become a Certified Ecological Restoration Practitioner