# Streamline
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Watershed Management

# Planning a resurrection: Resurrection Creek, Alaska


**Brian Bair, Dave Blanchet, Paul Powers, and Anthony Olegario**


Waste rock (tailings) from mining operations can pose a number of environmental problems. For instance, miners may deposit tailings on floodplains, which will reconfigure channels and cause fish and wildlife habitat to deteriorate. Without human intervention, such problems will persist for centuries. In this article, we describe the Resurrection Creek project in Alaska as one example of how we can strategically plan rehabilitation of watersheds affected by mine tailing deposits.

The information in this article is modified from portions of the report entitled "Resurrection Creek Stream Channel Restoration Analysis River Kilometer 8.0 to 9.3" (Bair et al. 2002).

## Background

Resurrection Creek was home to Alaska's first gold rush nearly a century ago. Hydraulic and shovel mining operations created tons of mine tailings and deposited them on the floodplain. These tailings have confined and straightened the stream. This material has significantly increased the channel slope so that there is now a nearly continuous riffle with few pools and limited spawning gravel. The mine tailings occupy 54% of the historic floodplain and are composed of coarse sediment that is difficult to revegetate. Within the disturbed reach, these deposits have greatly reduced the historic 7:1 ratio of flood-prone widths to bankfull channel width. At present this ratio is 1:1.

Moreover, the tailings have formed dikes that prevent the deposit of fine sediment and organics onto the floodplain. This interferes with the natural fertilization and soil augmentation mechanisms needed to re-establish riparian vegetation. The tailings have thus seriously degraded fish and wildlife habitat within the watershed. Although the disturbance occurred nearly a century ago, riparian vegetation and wildlife habitat have not recovered at a natural rate of succession.

Riparian trees in the disturbed reach are typically very small in diameter, and there is a noticeable absence of dead standing and downed woody debris. The project plan noted that unless we intervene to regenerate riparian vegetation habitat, conditions over the next few hundred years will be extremely limited for fish such as char and salmon, as well as for bears, bald eagles, and moose.

In May of 2002, a riparian restoration team arrived at Resurrection Creek to survey and analyze stream channel conditions. Team members were from the United States Forest Service Wind River Restoration Team based in


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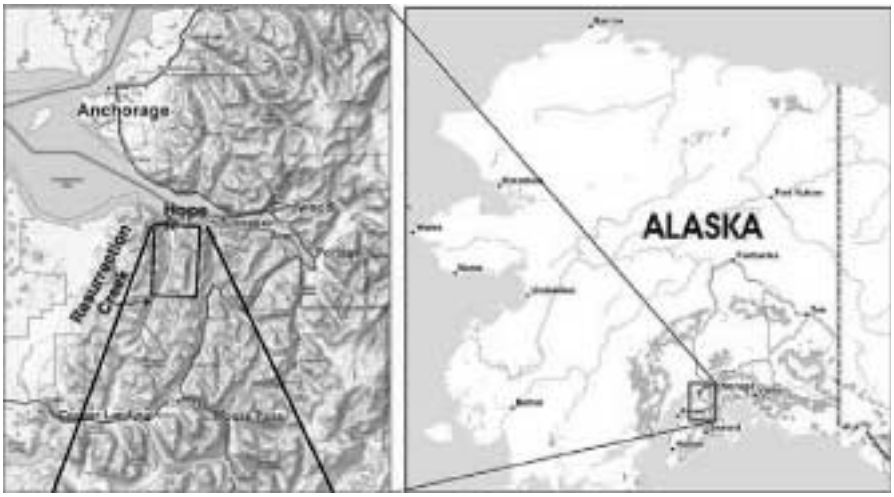


***Location of Resurrection Creek***

Carson, Washington. These riparian experts helped the Chugach National Forest staff to develop a strategic stream channel restoration plan that included rehabilitation alternatives and recommendations. The scientific team surveyed one disturbed reach at kilometre 8.0 and one relatively undisturbed reference reach located upstream.

## Planning Methodology

The goals of the project were to collect and analyze data and develop restoration goals and objectives for a section of Resurrection Creek. The section slated for restoration was located between 8.0 and 9.3 kilometres in a critical habitat area for spawning and rearing coho, chum, pink and chinook salmon (Hart Crowser Inc. 2002). This area has recently been withdrawn from mineral entry, and the Landscape Analysis (Hart Crowser Inc. 2002) therefore identifies the area as a potential pilot reach for restoration.

The Resurrection Creek team used various methodologies to analyze, design, and develop their restoration strategy. These included methods that Rosgen (1994) and Montgomery (1993) have discussed as suitable for evaluating similar channels. Readers can find other methods for more detailed restoration strategies and design on the Web (***http://www.usda.gov/stream_restoration)***. The Resurrection Creek project area was also suitable for the meander geometry methods we describe below. These methods can be applied to other similar, low gradient (%), unconfined alluvial stream channels (Williams 1986).

A key part of the plan for Resurrection Creek was to establish a reference reach. We define a reference reach (or relic analog) as: an undisturbed stream reach that possesses channel morphology, hydrology, sediment regime, and biota similar to the disturbed site to be analyzed, rehabilitated, or restored (Bair et al. 2002). A reference reach should be upstream of the disturbed reach. As the definition suggests, it should also contain the same riparian eco-class, slope, discharge, sediment budget, and channel confinement or entrenchment characteristics. When a stream in need of rehabilitation does not have a suitable, undisturbed reference reach, it is possible to use, in part, adjacent undisturbed watersheds and stream channels for reference. In addition, disturbed reference reaches can serve as surrogates. These can offer information about how the channel may cope with the altered sediment budget, hydrology, and riparian biota, and provide a time reference for recovery. At Resurrection Creek, project workers chose such a

minimally disturbed reach as a surrogate to provide some reference data (Bair et al. 2002).

Once a team has decided on the reference reach, their next step is to measure and compare its channel morphology with that of the disturbed reach. The comparative elements are vegetation composition and structure, thalweg slope, bankfull width, average depth, meander belt width, entrenchment, and large woody debris (LWD). In addition to this channel morphology data, contour maps and vegetation surveys are needed for development of restoration templates, goals, and objectives.

Channel geometry equations and methods at Resurrection Creek helped to evaluate reference conditions and suggest design templates. Team members used data from relic and disturbed reference sites to evaluate against the channel geometry equations. This provided a cross-check of the results. Such a cross-check reduces cost and risk of resource damage, and should accelerate the recovery of Resurrection Creek riparian areas, water quality, and the populations of animals that depend upon this habitat (Bair et al. 2002).

After project team members collected and analyzed their data in 2002, they derived the following restoration goals for Resurrection Creek:

- to restore and reconnect the historic floodplain, stream channels, and riparian areas; and
- to recover the natural range of aquatic and riparian habitat conditions for fish and wildlife.

The restoration plan clearly lays out proposed actions that will accomplish the goals and objectives (see above proposed actions).

The plan also contains six alternative approaches (including "no action") to aid the recovery of Resurrection Creek. Of all the available options, the team selected two they believed to be the best approaches to meet the restoration goals and objectives. They then applied a cost-benefit analysis to compare these two. Based on this analysis, the project team decided to reconstruct the stream channel and floodplain network. To accomplish this, they planned to grade and contour an estimated 103,886 cubic metres of existing mine tailings mostly composed of the historic streambed substrate. This recontouring would

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## PROPOSED ACTIONS TO ACCOMPLISH OBJECTIVES

- **Mechanically manipulate mine tailings to recover floodplain width and elevations.**
- **Reconstruct meander pattern, channel profile, pools, and spawning habitat.**
- **Develop multiple relief channels and off-channel ponds within the floodplain.**
- **Extract beetle-killed spruce trees in high-risk fire hazard areas to use as a source of in-stream and terrestrial woody material and to enhance snags.**
- **Augment soils in reclaimed riparian areas to provide soil/landform and drainage conditions that can support native plant communities.**
- **Thin existing overstocked riparian sapling spruce and cottonwood stands.**
- **Use natural vegetation where seed source and site conditions are favourable to achieve revegetation objectives.**
- **Use native plant species in revegetation/restoration projects when natural revegetation conditions are not favourable.**

Olegario

***Mine tailings and stream channel confinement in the Resurrection Creek project area.***

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accomplish two objectives. First, it would increase average bankfull width to flood-prone width ratios from 1:1 to 8:1, thus allowing flood flows access to the historic floodplain. Second, it would increase channel length by 260 metres and sinuosity from 1.01 to 1.5, decreasing channel thalweg slope from 1.5% to 1.1%.

Side channels, wetland complexes, and off-channel rearing ponds, according to the design plan, will maintain 5-20% of the perennial flow. Having recently constructed off-channel rearing ponds and side channels, workers will then modify these or incorporate them into the network. Boulder tailings provide an excellent source of native material for in-stream structures such as grade controls within pool head-breaks, side channel entrances, and river bend apexes.

The proposed work begins at the downstream end of the project area and proceeds up the channel. Where practical, channel excavation, meanders, side channels and ponds, woody structure placements, and gravel bar construction will take place out of flowing water. The next steps are to complete new channel segments, then to create "push-up" dams composed of native substrate to divert water into the newly constructed channels. This construction will tend to strand fish in the dewatered sections, so workers will need to rescue and transport these above the project area. After workers extract approximately 5,000 whole trees (half of them with roots attached), they will haul these to the project area and stockpile them at designated locations along the project reach. During channel construction, project personnel will incorporate the trees into structures, distribute them throughout the reclaimed floodplain, and replant them for snag habitat.

On a site-specific basis, riparian workers will mulch and apply sod mats to islands within the channel, thin overstocked sapling stands, and use thinned material as coarse mulch throughout the new floodplain. Workers will promote natural vegetation of mechanically disturbed areas where seed source and site conditions are favourable. As an alternative, workers will plant native plant species originating from local genetic stocks in areas where natural revegetation conditions are not favourable.

Olegario

***Typical in-stream woody material and riparian cover in the Reference Reach area of Resurrection Creek.***

## Results

The Resurrection Creek report is a planning document that summarizes the analysis of the existing riparian and stream channel conditions and investigates the best two potential restoration alternatives for a mined reach of Resurrection Creek. Project team members preferred alternative C, and expect that the decision to proceed will be made later this year (2003). The team will undertake further planning in 2004 and begin construction in 2005. It will take approximately two years to complete the restoration work. Within a period of two to ten years after the team implements the restoration strategy, the results will bring Resurrection Creek back to its original potential for fish and wildlife habitat.

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