Kaxdigoowu Héen watershed scoping, 2010 updates, 2019&20

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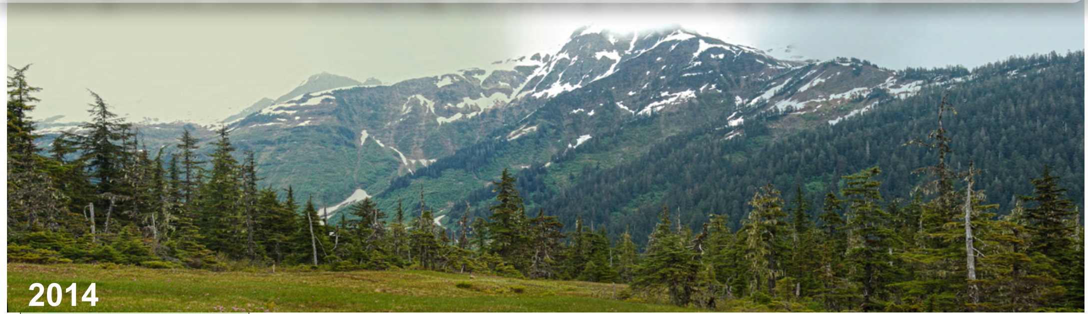
Kax̱dig̱oowu Héen: Scoping for interpretive signage & publications



Preface 2019: I began this collection in 2009, during Discovery's interpretive work for CBJ Parks & Recreation. It has 3 parts: ● **I Scoping**, a standard bedrock-to-bugs natural history. ● **II Journals**, excerpts from visits to portions of the watershed. and ● **III Appendices**.

As of 2019, preparing for a talk with John Hudson on the watershed, I'm tidying up the document. I won't spend too much time updating for Lingít place names, but have added a few key examples.

I Scoping

Introduction

Note November 2021: I'm posting to *JuneauNature* a reduced-size version of this document on request from SAWC/CBJ. That version **does not include** *Part II, Journals*, but they are available on request.

The trails along Kax̱digoowu Héen, *going back clearwater* (Montana Creek) are among the 3 trail systems on CBJ land studied and described by Discovery Southeast (DSE) under Phase 3 of our work for the City.[1] This document assembles natural and cultural history information to be used in signage, interpretive booklets, brochures and web products.

The overview map on next page subdivides the Montana Creek trails into 4 sections, not including the adjacent Kax̱digoowu Héen Dei, which must be taken for a short distance to get to the beginning of the lower Kax̱digoowu Héen trail. For reasons that will become clear as we investigate glacial history, it is unrealistic to do a natural history interpretation of the Kax̱digoowu Héen/McGinnis watershed without reference to the greater Áak'w Táak (Mendenhall Watershed) that had so profound an effect upon it.

1 Trail systems in **Phase 1**: Amalga Trails; Treadwell Historical Trail; Dzantik'i Heeni, & Jensen-Olson Arboretum. **Phase 2 trails**:Rainforest/Outer Point; Auke Lake; Fish Creek. **Phase 3 trails**: Gold watershed complex; Montana Creek; Cowee-Davies.

Cover: Kax̱digoowu Héen, March, 2015. Dense meanders and abundant down logs. ● **Left**: ENE to Mt McGinnis from divider ridge between Kax̱ and McGinnis Creeks

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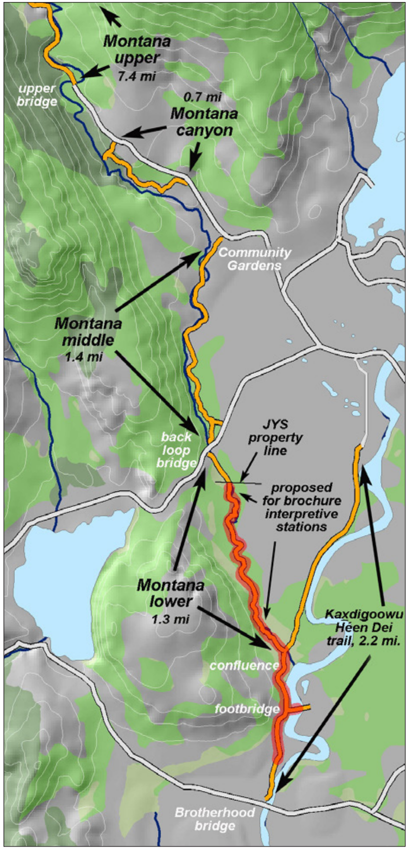


On the other hand, it would be geographically awkward to scatter interpretive stations over all of the trails shown on this map. So, for the dozen-or-so stations to be described in the 4-fold brochure, I propose limiting them to 'lower-montana' trail, and a short section of Kax̱digoowu Héen Dei near the footbridge (area highlighted in red on this map).

As for my 3-panel trailhead sign, this will of course include a full watershed intro in the same style as the other 9 CBJ interpretive sites. More thoughts on interpretive priorities follow in the *Geography* section, below.

Discovery's history at Montana Creek

Discovery's connection with Montana Creek and lower Mendenhall River as an educational setting began in 1998 during the Alaska Water Watch program (Carstensen, 1999). We also explored the Montana watershed during amphibian studies for ADF&G (Carstensen *et al*, 2003). My personal (pre-Discovery) introduction to the watershed was during wetland bird assessments in 1986 (Adamus, 1987). And most recently, the Bosworth team spent many days in this watershed during the 2014 field season, mapping wetlands on contract with CBJ. Insights and conclusions from all of these projects are summarized here.

Place names convention: In my writing and cartography since publication of *Haa L'éelk'w Hás Aani Saax'ú: Our grandparents' names on the land* (Thornton & Martin *eds* 2012: abbreviated "T&M12"), I've used Lingít place names whenever available, followed by translation *in italic*, and official "commemorative name" in parentheses. In this update to a document started prior to adopting that convention, I've 'back-edited,' inserting prior placenames. My convention is explained here.

It's especially unfortunate that we have no Lingít name for McGinnis Creek, which drains a much larger and steeper basin than the USGS-mapped mainstem of "Montana Creek." I default to the name McGinnis for this reach. However, when referring to the overall watershed, I call it Kax̱dig̱oowu Héen.

As for "Montana," neither Orth (1967) nor DeArmond (1957) could learn where the name originated. Orth lists a Montana Bill Creek at Cook Inlet, which is interesting because a man by that name lived on "our" M-creek. Probably he was a different guy, though, who took his name from the creek rather than vice versa.

Some elders have expressed disapproval of abbreviating or shortening Lingít names: for example, using DZ instead of Dzantik'i Héeni. While I agree and try to respect name integrity by proper spelling, etc, when repeated many times, a name like Kax̱dig̱oowu Héen fairly begs for a friendly condensation. After several repetitions on a page, I may relax to Kax̱. [1]

As an 'inland' watershed, Kax̱dig̱oowu Héen has few recorded Lingít names—but there's frequent reference in this document to adjoining places:

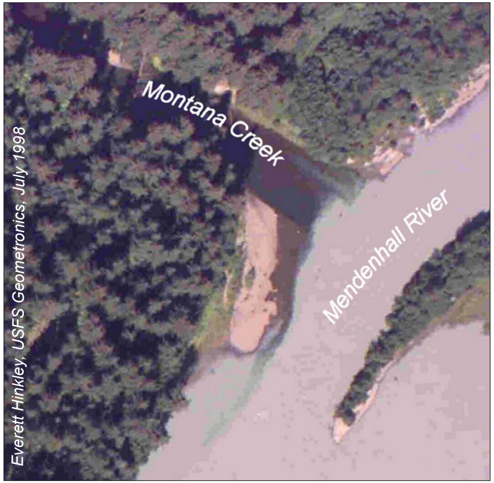
- Áak'w, *little lake* (Auke Lake)
- Áak'w Ḵwáan Sít'i *Auk people's glacier* (Mend Glacier)
- Áak'w Tá, *little lake bay* (Auke Bay)
- Áak'w Táak, *inland from little lake* (Mend.Valley)
- Aanchg̱altsóow, *nexus town* (Auke Rec)
- Chookan Aaní, grassy land (Mend. Peninsula)
- Sít'.áa, *glacier lake (post-1910)* (Mend. Lake)
- Taayushee, *river/tide/mud flats* (Mend. Wetlands)
- Woosh eel'óox̱'u héen, *river that's murky together* (Mend River)

There are other simple ways to sidestep *ad nauseum* commemoration. We're *not* stuck with em! Around here, everyone knows what you mean if you just say "the Valley, the Lake, the River" (all Mendenhall, *duh*): "the Channel" (Gastineau), or Downtown (Juneau).

1 Fall, 2021: Since this 'interim decision' to condense Kax̱dig̱oowu Héen to Kax̱ after first use on a page, I've heard more of the backstory for opposition to shortening. Lingít place names are gifts to us from the elders, and it shows disrespect to alter them. So whether or not we understand that opposition, adherence is in order. I'm currently trying to package this document for CBJ dissemination, and don't have time to axe every last "Kax," but on future revisions of this and other documents, will take more care.to find them. After all, I don't like it when people call me "Dick."

In the mid-to-late 1990s, Discovery Southeast undertook Water Watch—a Middle-school watershed experiential-learning project—on request from biologists at the Alaska Department of Environmental Conservation (ADEC), with funding from the EPA. As Water Watch expanded, we kept annexing new watersheds: Duck, Switzer, [2] Mendenhall, and finally Kax̲digoowu Héen. In addition to educational activities, I represented DSE on the Duck Creek Advisory Group, a consortium of biologists and agency administrators focused on rehabilitation of Duck Creek and other impaired watersheds, along with public education about the need for such work. This group eventually morphed into today's Mendenhall Watershed Partnership.

Of our 4 Water Watch focal watersheds, the ones that apply directly to this interpretive project are the lower Mendenhall—context of the Kax̲digoowu Héen Dei trail—and of course lower Kax̲digoowu Héen. In the following pages, I'll show some examples of the watershed summary information we produced. My standard procedure was to create historical series from air photos and early maps. Water Watch 1995-99 was pre-GIS—for me at least—so most of these examples are hand-drawn.



Two centuries at Riverbend

Following descriptions go with the 5-panel series, next page:

1750 We start here because this was the peak of the Little Ice Age. Wushi l'ux'u héen, *milky water* (Mendenhall River) had not yet formed. Kax̲digoowu Héen [3] flowed directly to the salt marsh, which extended farther up valley than today because land was 5 to 10 feet lower relative to sea-level. Mature hemlock forest covered upland slopes to the NW. Large spruces grew on stream deposits, and younger cottonwoods dominated the more active glacial floodplain of the eastern valley. Kax̲digoowu Héen probably served as a productive seasonal fish camp for people of Aanchg̲altsóow, *nexus town* to the west. [4]

Because glacial rebound had not yet begun in 1750, the salt marsh is shown here abutting the mature riparian forest. There was no intervening belt of uplift meadow or brush.

1910 Duck and Jordan creeks [5] no longer served as glacial outwash channels. The receding ice had just begun to uncover Sít'.áa, *glacier lake* (Mendenhall Lake), now drained by a large river that captured Kax̲digoowu Héen about a half mile

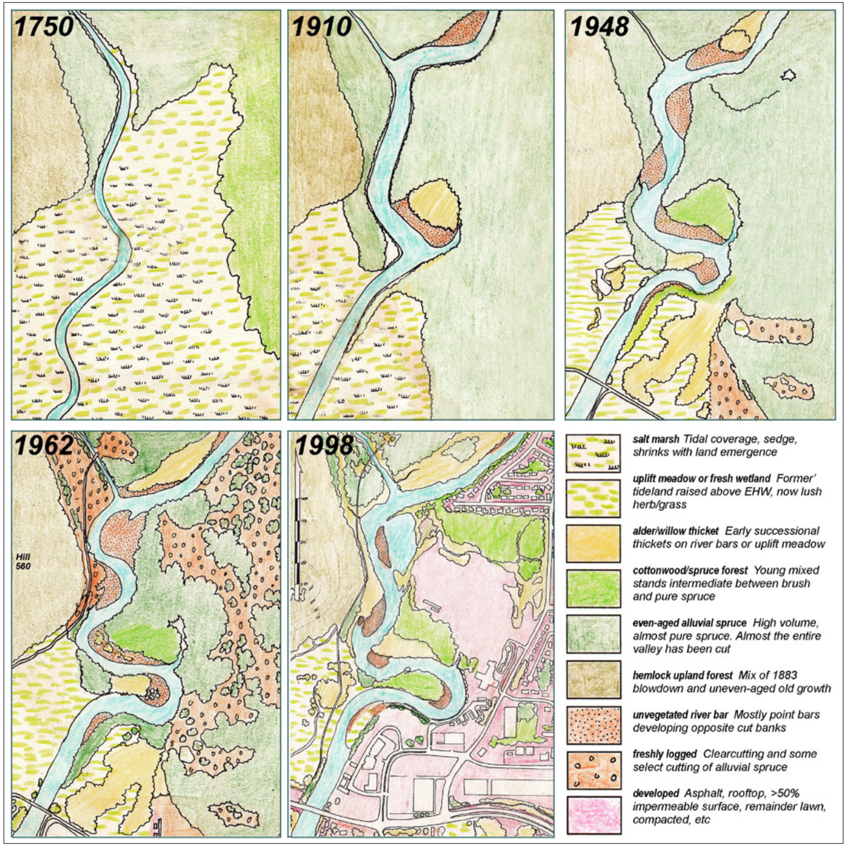
2 For examples of our Waterwatch activities and productions in the Switzer watershed, see *DZ-scoping.pdf.*

3 In Tlingit, this has been translated *clearwater stream,* or *going back clearwater*. It's interesting to consider the antiquity—or lack thereof—of this name. Standing at the confluence today it's obvious why one might call it that; the difference betweenKax̲digoowu Héen's clear water and the glacial *milky water* almost demands such a name. But in the historical series below, we see that not until sometime in the 1800s did the 2 streams meet. Before that, Montana would have had no more claim to the name *clearwater* than any other non-glacial creek. In fact, as we will see in the following historical series, it probably flowed cloudy with Mendenhall sediment from as far up as today's Community Gardens during much of the Little Ice Age. Even today, it often runs cloudy after storms.

Thoughts on the confusingly named River trail (Kax̲digoowu Héen Dei) are in GIS Series footnote-1).

4 *Human history* section has information on the 500-700-year-old fish trap found at the confluence.

5 It's not surprising these creeks have no remembered Lingít names because they're pathetic remnants of the glacial rivers that ran here when the L'eeneidí hunted and fished this valley. *Those* would certainly have been named.



above the estuary. A violent storm in 1883 blew down most of the forest on the NW hill. Meadow plants reached into the raised former tide marsh.

In general, the river as mapped by Knopf in 1910 was less 'snakey' than today. Above the terminal moraine, large boulders have constrained the channel, but from that moraine downriver to Brotherhood bridge, 3 large meander loops have lengthened as the river's erosive forces are thrown against outer banks.

Albert Pederson grazed cattle on tidal sedges and meadow plants west of the river, and Knudsen's ranch (later, Kendlers') was on the east. A large-tree spruce forest clothed most of the valley floor.

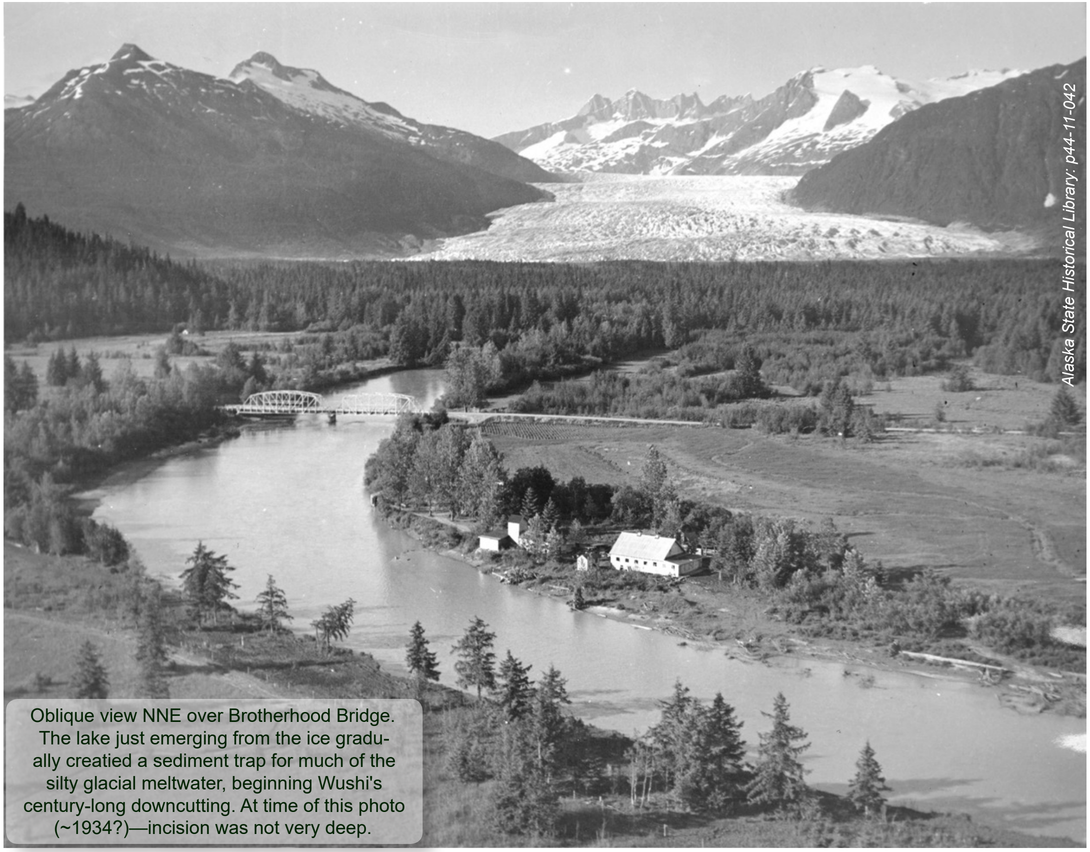
1948 Wushi l'ux'u héen became snakier as meander bends lengthened, eroding banks and building point bars. Most human influences were confined to the southern half of this scene. Joe Kendler logged off an impressive stand of young 'wolf trees' at today's Riverside/Egan intersection, to grow grass and clover for hay. Alder thickets advanced into the future Vintage Park area, probably on meadow disturbed by humans and livestock. Bare garden plots showed in the west-side meadows.

Stereo examination of 1948 aerials shows a mosaic of pre-logging forest types—tall and short, dense versus open—responding to outwash patterns between the terminal moraine and Little Ice Age high tide line near today's Riverbend.

1962 Since 1948, the chainsaw had matured from cumbersome novelty to major landscape modifier. A road punched into Kaxdigoowu Héen, ending in a clearcut. Forests east of the river were more selectively cut. Dairies were going out of business, and houses were built in former Kendler hay meadow. Wushi l'ux'u héen cut back the freshly logged and destabilized banks just down from Kax confluence, all the way to bedrock at the base of Hill 560.

1998 Riverbend Neck was now only 80 feet across, and could cut through at any time.[6] It's being eroded not only on the upriver side (north) but from the south as well. The enlarging eastern end of the meander loop has been armored with riprap, but erosion continues at the downriver margin of these placed boulders. Dikes that once contained the old Red Samm dredge pond have long collapsed, and much of the current flows through the former pond.

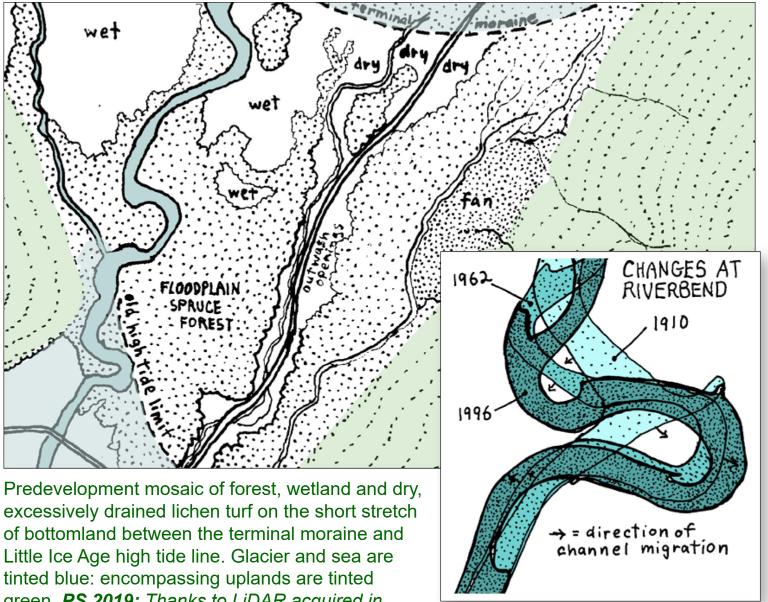
The entire valley east of the river is pavement, rooftop, lawn or playing field, with the valuable exceptions of remnant forest patches on the north and south ends of Dimond Park [*PS 2009: Both have since been mostly logged, for the covered play area and the new high school*]. *Kax̱digoowu Héen Dei* (Clearwater Creek Trail) is extremely popular with valley residents seeking relief from traffic noise and malls. [7]



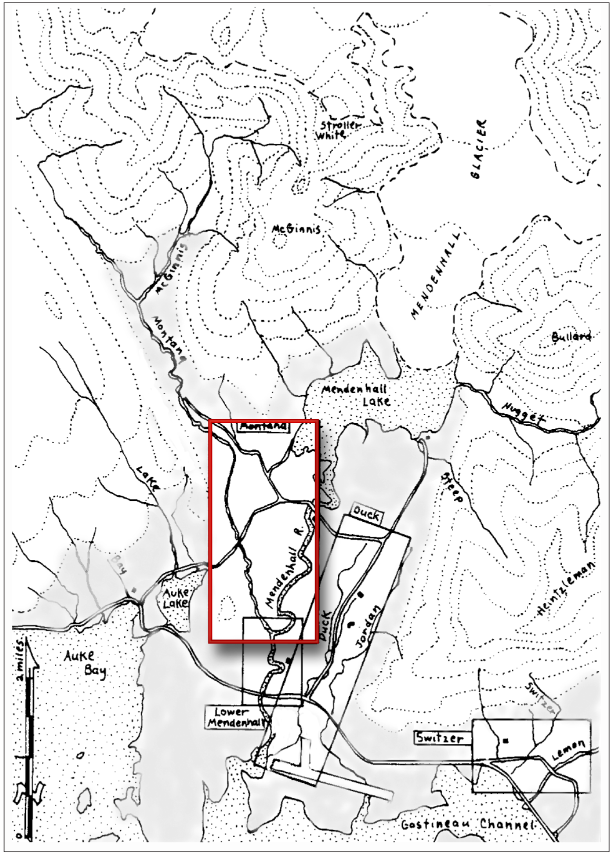
Oblique view NNE over Brotherhood Bridge. The lake just emerging from the ice gradually creatied a sediment trap for much of the silty glacial meltwater, beginning Wushi's century-long downcutting. At time of this photo (~1934?)—incision was not very deep.

6 PS, 2019: This was written a decade ago; It finally cut through during a summer jökulhlaup in 2018, and continues to downgrade, with unknown consequences to unfold farther downstream.

7 In addition to these brief, one-paragraph descriptions of the historical panels, the original Waterwatch Notebooks—three-ring binders distributed to all Juneau schools and collaborating agencies—contain lengthier narratives running



Predevelopment mosaic of forest, wetland and dry, excessively drained lichen turf on the short stretch of bottomland between the terminal moraine and Little Ice Age high tide line. Glacier and sea are tinted blue: encompassing uplands are tinted green. ***PS 2019:*** *Thanks to LiDAR acquired in 2014, we can now show with greater precision just how far Little Ice Age high tides reached into Áak'w Táak (Mend. Valley)*



Context map showing locations of all 4 historical series that I created during the EPA-funded Water Watch program, 1995 to 1999. The following series is the largest in geographic scope: the tall red rectangle reaching from Community Gardens down to the confluence.

Two centuries on Kax̲dig̲oowu Héen

Preface, 2009:

This 3-part historical series treats the lower part of Kax̲digoowu Héen, from its confluence with Wushi l'ux'u héen up to where it becomes contained by a canyon below the rifle range. This is the reach that underwent dramatic changes during the Little Ice Age, when the glacier *nearly overran the stream. Upstream in the canyons, there were certainly changes—related especially to glaciation and landslides in McGinnis sub-basin—but of course little in the way of channel migrations that might be detectable in a map series like this one. I'll say more about upper Kax̱digoowu Héen later.*

This map series was originally colored by hand, and copied by xerox, but scanned reproductions look unacceptably "blotchy." So I went back to an original B&W line-art version, and re-added the color in Photoshop. These 3 panels are thus intermediate in evolution between my pre-GIS style, and the more automated maps that follow in the GIS Series.

For this series, specific to lower Kax̱digoowu Héen watershed, I'm including the full original description from the Juneau Schools Waterwatch notebook, Section 2. GIS has since opened up new possibilities for interpretation, such as 10-foot lidar contours, updated digital photography, more precise overlays, etc. In several places, I've added new illustrations or narrative summaries, reflecting this subsequent information.

1750

Hydrology During the mid-1700s, Áak'w K̲wáan Sít'i *Auk people's glacier* (Mendenhall) reached its maximum down-valley position. Most of the meltwater flowed through Duck and Jordan Creeks (no TNs?), just to the right of the panel on next page. [1] At the time, these creeks were braided, high-energy rivers. Soil profiles in the western Valley (Barnwell & Boning, 1968, in *Scoping>Hydrology*, below) show finer, more poorly drained sediments. Apparently there were few significant outwash channels on the marshy west side. Today's River probably didn't become the dominant glacial channel until the late 1800s.

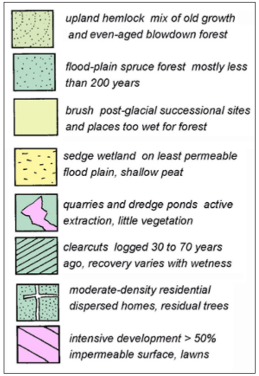
Kax̱digoowu Héen has probably flowed close against the west valley wall throughout the building and waning phases of the Little Ice Age (LIA). This is because aggrading glacial rivers like Wushi l'ux'u héen build an imperceptibly domed flood plain, highest

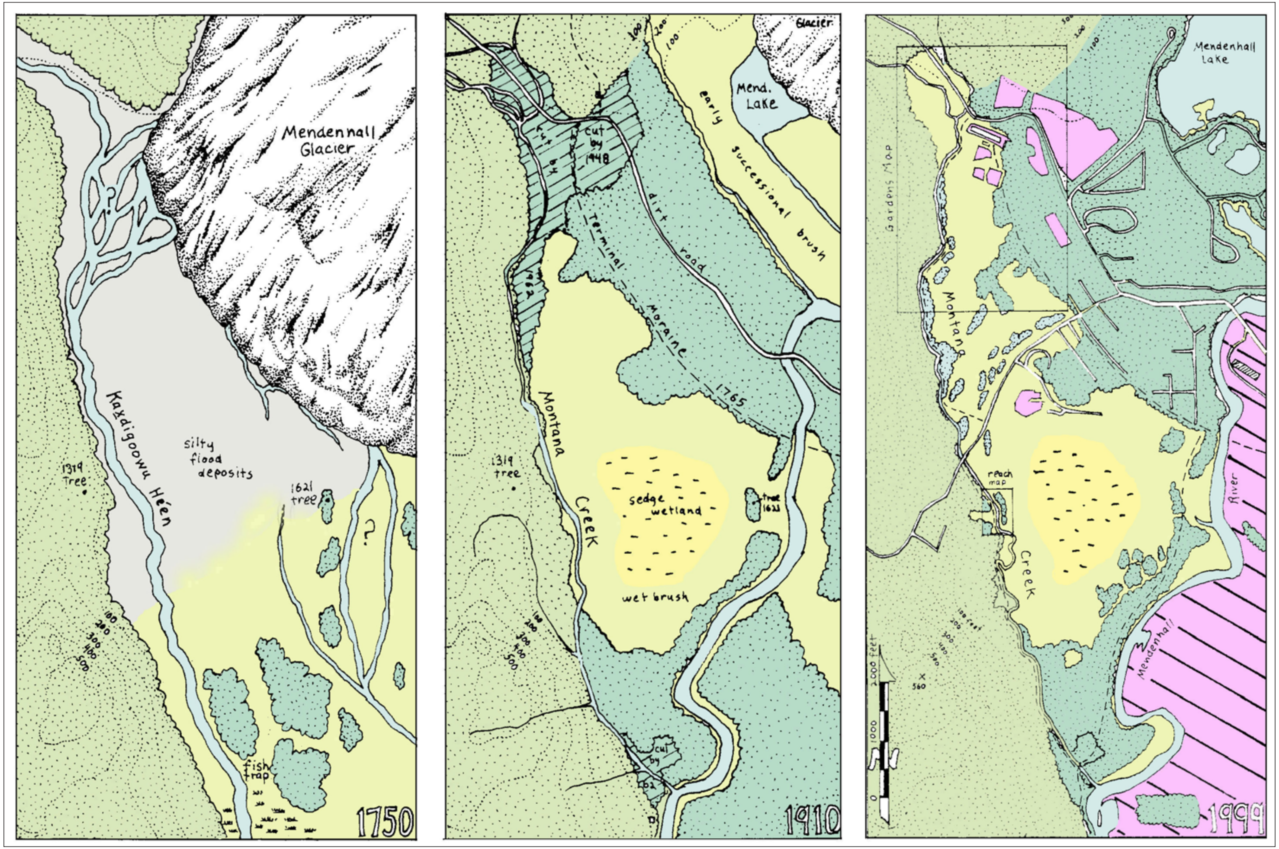
1 See *Two centuries on Duck Creek*, Carstensen 1999, Water Watch notebook.

Panorama of beaver-modified wetlands on the Kax̱digoowu Héen flood plain west of Community Gardens. Taken in June, 2003, during amphibian surveys with Bob Armstrong. Pre-logging photographs in 1948 show that a large-tree forest once grew here. After logging, **beaver** moved in, ensuring the forest would not succeed to closed-canopy doghair, as in so many upland post-logging stands.

in the center and lower against the bedrock valley walls. Such subtle contours often result in marginal or '*yazoo*' streams on the periphery of larger flood plains. Kax̲ and Jordan are both yazoo streams.

Cores from a buck-bean marsh in center of the large wetland now enclosed between Kax̲ and Wushi show shallow (*ie* youthful) peats over a bed of clay, which in turn





Panorama taken 20090921 of the alluvial-fan scrub forest at "Little Appalachia," just below where Kax breaks out of the canyon and braids into the perennially saturated alluvium. Road shoulder on right shows the steep, ~5-foot high berm that constrains fan sediments and storm flows from spreading.

overlies sand. I interpret the sand as flood deposits from both Kax and precursors to today's River, before the latter became incised to its present depth. The clays indicate a quiet backwater during waning of the LIA. Initial colonists on this surface were probably horsetails and small willows. Then came sedges and mosses like *Drepanocladus* that thinly blanketed fines with peat. Kaxdigoowu Héen formed the western edge of this silty plain, and like the River it carried a fairly heavy sediment load. At high flows, the river built marginal levees that eventually supported exceptionally fast-growing spruces, once LIA flooding grew less frequent and pervasive.

Even without a contribution of glacial melt water from the swollen glacial ice front, Kaxdigoowo Héen would have conducted much larger flows than today's at peak LIA. The 7.5-square mile McGinnis Creek basin still has one small glacier at 4,000 feet straddling its northern divide, which would have been larger 250 years ago. This, plus deeper, longer-lasting snowfields on the NW side of McGinnis Mountain probably kept Kax flowing at more than its modern volume.

Evidence for glacial flow from the River into Kax is mixed. Obvious glacial channels such as those in the headwaters of Duck and Jordan creeks are lacking. Probably they're buried under recent layers of fines in the area south of Community Gardens. These sands and silts were subsequently deposited by Kax's overbank floods after the River backed away and outwash waters ran southeastward behind terminal and recessional moraines. [*see 1835 view in the GIS map series, following*] Steadily thickening glacial outwash material below (SW from) the Gardens moraine would have had a damming effect on Kax if the latter's own aggrading fan could not keep pace. RD Miller's surficial geology map indicates a modern, actively building fan in the area now refered to as "little Appalachia." Miller commented about this area in an open-file report—that "*the water table is unusually high in the alluvial fan deposits along Montana Creek.*" Normally, coarse materials in fans allow rapid infiltration. Perhaps the Kax̲ fan has one or more layers of fines caused by damming behind the River's glacial outwash, which now serves as a barrier to infiltration. The already-saturated fan makes storm flooding and channel-shifting especially problematic in this area.

Gravel in the bed of Kax̲ by the gardens is mostly slate chips mined from the gorge upstream. The imported granodiorite material that marks Duck and Jordan as former glacial rivers is not common here. Maybe such a glacial signature is buried under the last 2 centuries of Kax̲ slate. It's hard to imagine the River getting so close to Kax̲ without for at least a short time sending melt waters into it. Extensive dredging and quarrying below the gardens confuses interpretation, but the gravel that excavators sought was yet another indication of high energy flows. How much was placed by the glacial source and how much by Kax̲digoowo Héen?

On upland slopes framing Kax̲, Miller's map shows an ancient delta. This is an underwater deposit created 10 to 12,000 years ago when sea levels were several hundred feet higher than today (*Scoping>Surficial geology*).

Land-sea relations At the bottom edge of the 1750 panel, I've shown the northern limits of the tidal marsh. Land was 5 to 10 feet lower than today. [2] Upper limits of the salt marsh (Extreme High Water) are shown at today's 30-foot contour. The belt of land in Áak'w Táak, *inland from little lake* (Mend. Valley) sandwiched between ice face and saltwater was scarcely a mile wide, compared to 5 miles today. And that terrain was only sparsely vegetated due to migrating outwash channels. You could have seen the glacier from the beach.

2 PS, Study of the 2013 LiDAR indicates a total of 11 feet of uplift, consistently expressed in wave-cut escarpments throughout the CBJ. I now consider the high-water mark to be at 32 feet.

Succession Upland forests on the hilly western portion of this map panel were not erased by glaciation or outwash during the LIA. However, they've always been prone to windthrow. A major storm in 1883 leveled much of the forest on Hill 560. [3] Today, this slope and much of the forest on the west edge of this map is dominated by century-old western hemlocks. The even-aged stands are easy to detect on air photos because of their smooth canopy texture.

Very old, multi-generational forests do exist, however. In 1948, on the back loop road about 1000 feet SW from the Montana bridge, Professor Donald Lawrence took a slab at ground level from an 18-inch spruce tree felled for a power line right of way. It had 630 rings, tight in the center, showing it came up beneath an existing forest. This slow-growing forest on deep, waterlogged peat has probably changed little in appearance or species composition for millennia. Several years ago, after Professor Lawrence's death, my friend Mark Noble donated the historic 1319 AD slab to Discovery Southeast. It still bears Don's pencilled annotations. This tree is described in his 1958 paper, and served as proof that Áak'w K̲wáan Sít'i had not reached the Channel in the Little Ice Age, as was believed by the local populace and even professional foresters when he began his post-glacial succession studies here.

People About the time Professor Lawrence's spruce was sprouting, a Native weaver created a fish trap from spruce and hemlock branches. It lay preserved in anaerobic muds for 700 years at what was to become the confluence of Kax̲digoowo Héen and Wushi l'ux'u héen. At that time, however, the Glacier was probably far upvalley, and an old-growth forest occupied the valley's flood-plain surface.

By the time of the glacial maximum, these mature forests had been obliterated and the open glacial flood plain near the expanded glacial ice front would have resembled the outwash plain near today's Herbert terminus (no TN?). It surely attracted Áak'w people from the nearby central village

3 See *Two centuries on lower Mendenhall River*, Carstensen 1999, Water Watch notebook.

of Aanchgaltsóow, *nexus town* (Auke Rec), perhaps to hunt mountain goats in spring as they descended to brushy cliffs above the ice. An overland trail certainly existed, most likely along the route of today's back loop road. This trail gave quicker access to glacial forelands than paddling around Chookan aaní, *grassy land (*Mend Pen), then having to deal with the long tidal mudflat.

1910

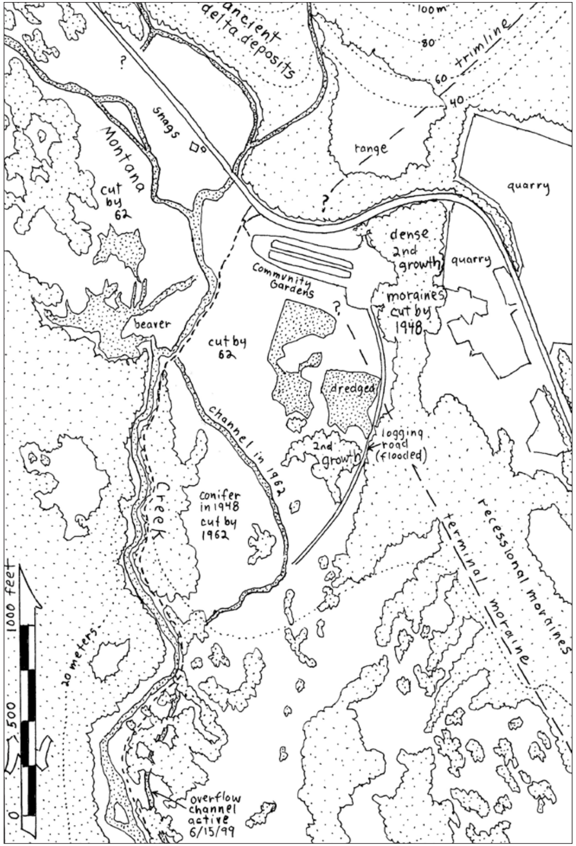
This panel is traced from Adolph Knopf's geologic map of 1910. Forest cover is added by comparison with early air photography, and assumptions about successional patterns.

Hydrology Knopf showed Kax̲ in roughly the same position as today, but more heavily braided just below its emergence from the canyon in the NW corner of the map. Overlaying the Knopf map on the 1996 NASA air photos shows several places where the Kax̲ channel flowed as much as 500 feet to the east or west of today's positions. Comparing the more obvious of these "channel jumpings" gives insight into the post-LIA dynamism of this stream.

South from today's Community Gardens, Kax̲ ran much closer to the terminal moraine in 1910. In the 1962 photos, just after logging of about 60 acres of the finest timber in the watershed, Kax̲ was again running in the easterly channel showed by Knopf. This 1962 channel showed clearly on true-color aerials [*Hinkley 1998s*] as an orangey, back slough full of iron floc. Probably nobody has recorded how many times during the past century Kax̲ has 'jumped' between these and other alternate routes. Most channel-shifting takes place during floods like we experienced in late October, 1998.

Downstream about 500 feet from the confluence of the 1962 stream and main channels, Knopf shows Kax̲ running a few hundred feet to the east of its present location. Hiking the trail June 5, 1999, we found both channels carrying water; the westerly one easily detected on 1996 aerials, and Knopf's more easterly version. Kax̲ splits in 2 at this location. These 'simultaneous channels' are described below in the hydrology section for 1999.

From about 1000 to 3000 feet above the River confluence, Knopf's map shows Kax̲ hugging the base of Hill 560, about 500 feet west of its current location. The actual confluence was the same in 1910 as today. However, an



The complex of moraines, outwash, and poorly drained marshes near Community Gardens is the most fascinating and puzzling part of the Kax̲ flood plain. How did glacial advance and retreat influence these fickle channels?

alternate confluence can be found 500 feet downriver from today's, meeting the river just above the recently exposed bedrock outcroppings.

Land-sea relations The land was about 4.5 feet lower than today in 1910. Extreme high tides were felt at the Kax̲/Wushi confluence, but the flood plain surface was now uplifted beyond the tidal marsh and supported young spruce forest.

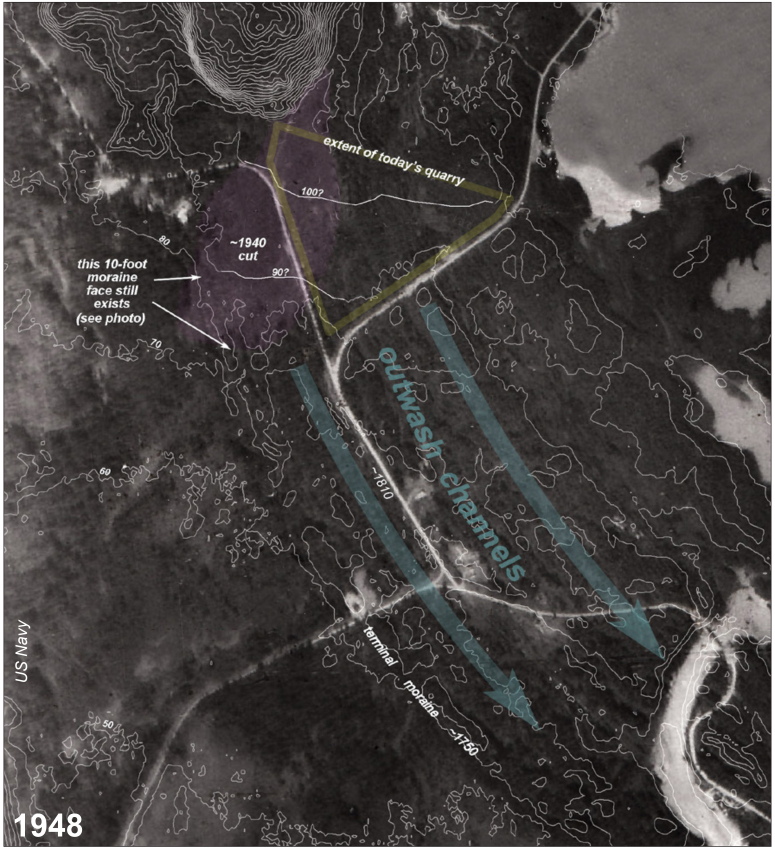
Succession Many upland slopes were scenes of devastation in 1910. See *Two Centuries at Riverbend* for comments on the 1883 blowdown.

The Lake was just emerging from the ice in 1910. The valley's only road ran along an intermorainal drainage formed in about 1810. This was an ideal roadbed requiring no logging or fill, because outwash waters left coarse material, excessively drained and too drought-prone for rapid forest colonization. Encompassing moraine tops by this time had young spruce trees.

The only early clearcut showing in subsequent 1948 air photos was a 35-acre denuded patch where the terminal moraine intersected the valley wall, at a hill called Tolch Rock. This area became a quarry shortly after the logging, so any drainage patterns were erased, but the fact that this site was chosen is a pretty good clue that the borrow material was sorted outwash rather than unsorted glacial till.

The upvalley (NE) side of this logged patch [4] was raised perceptibly above

4 See *GIS SERIES: Middle Montana maps* for outline of this clearcut. which is first shown on the 1962 panel, transected by the quarry.



Scans of the 1948 aerials are often muddy and rather low-res, but a great deal of additional information can be gained from stereo views. The 35-acre clearcut was recent, probably around 1940. I've tinted it pink. I also redrew the CBJ 10-foot lidar-generated contours in the area of todays quarry, to show how the fan was probably graded originally. The 90 and 100-foot contours swung E-W (question marks indicate uncertainty about actual position). My interpretation of this fan is that it built up from outwash emerging from the western edge of the ice—still pressing against the valley wall—as the glacier backed off its terminal moraine. Outwash then ran southeastward through intermorainal swales (blue arrows).

View south down the terminal moraine crest, covered with ~70-year-old second growth. Taken 20090914. Position shows on previous 1948 aerial.

the terminal moraine side. You can actually see this relief in stereo on the 1948 aerials, conveniently stripped of obscuring forest canopy. As the glacier backed away toward this northeastern edge, its melt waters no longer connected with Kax̲ through today's Gardens area, and instead ran SE behind the terminal and recessional moraines.

The terminal moraine can still be seen immediately east of the Gardens (photo next page). But the forest on it looks quite unlike the other places where intact conifers remain, such as the River Road trailhead to Kax̲digoowo Héen Dei. At that River Road site the spruces are twice the size, and some are more than 200 years old. The Gardens moraine forest was logged about 70 years ago and now has a 'doghair' second-growth stand.

Glacial till generally doesn't grow giant trees. Most of that ~1940 clearcut—probably logged with the very first 2-person chainsaws—was on much more productive outwash, where average tree size was much larger.

Along the braids of middle and lower Kax̲, a unique large-tree forested wetland developed. Usually we think of forested wetlands as scrubby and unproductive. Here, on slightly raised stream levees and hummocky microsites, spruces grew rapidly. Today's middle and lower Kax̲ trails thread through the remains of this forest, but the best 60 acres were logged before 1926. Some of these first-generation spruces are 4 feet in diameter and 150 feet high. Many stand on slight rises surrounded by wet swales with skunk cabbage, normally associated with much smaller trees.

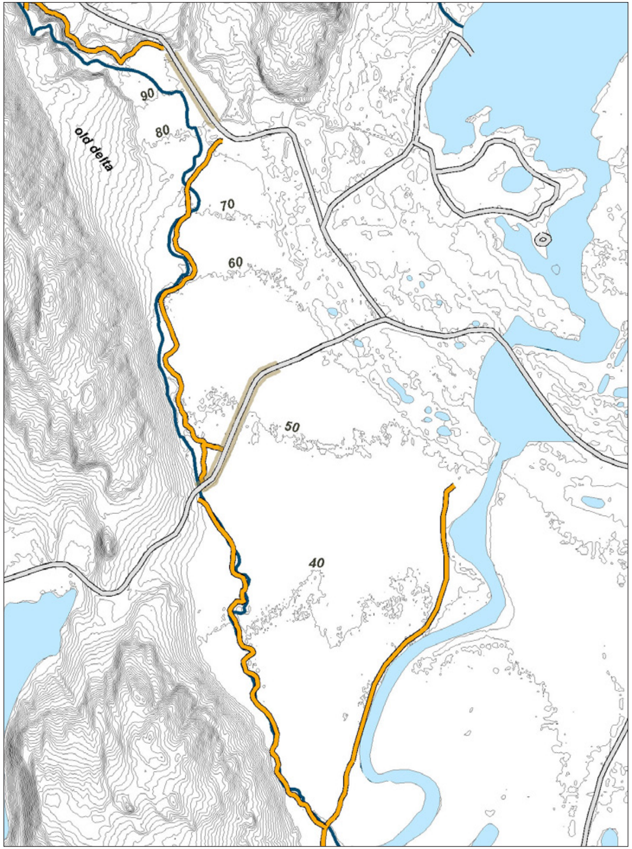
People The dirt road shown by Knopf runs all the way to the Kax̲/Windfall divide, with foot trails extending beyond to cabins and prospects. The significance of a road from Knudsen's Ranch (today's airport area) to upper Kax̲digoowu Héen can only be appreciated when one notices that in 1910 there were no coastal roads anywhere in the Juneau area—not even from town to the Valley. Although Knopf shows trails lacing into virtually every drainage and sub-basin, and high onto ridges within the gold-bearing Berners formation, there were only 3 roads of appreciable length: Knudsen's-to-Kax̲; the horse tram to the gold town at Amalga, and the Bessie mine corduroy access. Knopf shows only 2 cabins within this Kax̲ map area. One is at Tolch Rock, near today's Gun Club, and the other is downriver from the Kax̲/Wushi confluence.

1998

Hydrology Although some of its glacial sources have withered, Montana is still a fiesty stream. During the period of October 19 to 21, 1998, Juneau had more than 6 inches of rain, and Montana exceeded its projected 100-year flood, carrying 3,200 cfs at the back loop bridge. Nearby driveways were under water. Calculations for 100-year and 500-year flood levels don't factor in Little Ice Ages, however; it's unlikely that 1998's "100-year flood" could match even the annual high-water event on Kax̱digoowo Héen in 1750 AD.

But Kax̱ still shifts its channels, which means it is still aggrading. Hydrologist Margaret Beilharz and I walked the banks on June 15, 1999, during fairly high water resulting from the long-lingering winter snowpack. About 2,000 feet downstream from Community Gardens, the creek's flow divided into 2 channels. A secondary overflow channel carried at least half of the volume contained in the westerly main channel. I've indicated this overflow channel on the preceding Gardens map, but position is approximate because it can't be detected on any of my air photos. We traced it downvalley for a hundred yards or so, but gave up in dense brush. At 2 locations the swiftly flowing secondary channel swung within 20 yards of the mainstem, then veered away again. Apparently this flow does not rejoin the mainstem as surface water above the loop road, nor does any well-defined channel cross beneath the road for several hundred yards NE of the bridge. It seems instead to disperse into the large sedge and willow scrub wetland.

30-inch spruce felled during the storm of October 19 to 21, 1998. Photo taken 20090614 to the SE from photopoint tree shown on the following stem map on Kax̱. The storm dropped dozens of trees like this one, which was leaning at a 20° angle over the stream in a July 1998 air photo. Green needles distinguish the October trees from those that fell earlier. The yanked-up root pad leaves a gouge in the bank that focuses further erosion.



In June 1986, censusing birds for the Adamus wetlands survey, I made several E-W transects through this area, and encountered knee-deep, clear, slowly flowing unmapped streams loaded with coho fry. I didn't try to trace the flows. They must add greatly to the fish-rearing potential of Kax̲digoowu Héen.

2009 hydrology summary: *To repeat the question; why did Kax̲ exceed its 100-year flood level in October 1998 (even the 500-year by some calculations), while no other stream in the Juneau area came close?* [5] *In hydrologists' lingo, why is Kax̲ so flashy?*

There's no single answer. Several factors have already been mentioned [others are introduced below, in the sections on surficial geology and hydrology]. A short list might include:

1) *Active glaciers in McGinnis sub-watershed perennially deliver fine suspended sediment into the Kax̲ mainstem. This helps to keep the lower reaches aggrading. Aggrading systems are more dynamic than degrading, or incising ones.*

2) *Landslides in McGinnis valley introduce big slugs of sediment that periodically sweep through the canyon reaches and spread new layers over the flood plain below. There are also many eroding escarpments between McGinnis junction and the canyon.*

3) *For some reason, as noted by R.D. Miller, the water table is unusually high in the flood-plain reach below the canyon. So during storms, the already-saturated sediments do little to buffer runoff.*

4) *Where the creek emerges from the canyon, changing from confined to alluvial fan (see following surficial geology map by Miller), it remains boxed in by the ancient delta landforms. Stream gradient is about 1.2% very gentle for a fan (see stream profile in following section on Hydrology). This fan is rather atypical; it doesn't have complete freedom to expand. This may contribute to 'flashiness,' and possibly to the high water table mentioned by Miller.* [6]

5 "An intense storm on October 20, 1998, resulted in a peak discharge on the Mendenhall River of about 12,400 ft^3/s, which was determined to have a recurrence interval of about **10 years**. The same storm resulted in a peak discharge on Montana Creek of about 3,800 ft^3/s, which has a recurrence interval **greater than 100 years**. (Neal, 1999)

6 But in my Adamus survey notes—following sidebar, 19860617—note question about how the big spruce got established here in the first place. Snags were class III decay in 1986, so may already have been dead when Miller visited in the late 1960s and early 70s. Apparently the fan has not always been so dynamic. This points toward an anthropogenic contribution to the problem, possibly the road: item 6, below.

__5)__ For the last 2 centuries and probably longer, the lower flood-plain portion of Montana has lived in the shadow of the much larger and more sediment-rich Mendenhall outwash system. An examination of the 10-foot CBJ lidar contours bears this out. Between 40 and 70 feet, they bulge downvalley, clearly reflecting delivery of sediments from outwash coming off the terminal moraine. Kax̱digoowu Héen *has always been elbowed against the valley wall by this deposition. Topography dictates that its riparian will be more swampy than if it were the dominant stream on the flood plain. (See also the stream gradient profile in following section on Hydrology.*

6) Two major road berms through saturated flood plains (enveloped in brown on this contour map) have further impaired Kax̱digoowu Héen's ability to disperse sediment and flood water. You need hip waders to step off the road in these places.

While most of the Kax̱ watershed is still aggrading, Wushi l'ux'u héen has incised dramatically during the past century, possibly as much as 15 feet near the Kax̱ confluence. For a short distance upstream from this

Unrectified digital aerials taken 19980728 by Everett Hinkley, USFS Geometronics, in a transect down Kax̱. Everett pioneered the use of digital air photos on the Tongass. Recently, I georeferenced them for key reaches of the stream. Branching sloughs to the west are beaver backwaters that contained large spruces in the 1948 aerials, logged before 1962. The area now provides superb fish, bird and mammal habitat. Asterisk shows panorama on next page.

Panorama of ~1960 “clearcut” from treetop at SW corner of Gardens ponds, 20030507. **Beaver** sloughs in foreground. Roof of covered area at the gardens shows in upper left. Photopoint shown with asterisk on preceding Hinkley aerial.

junction, Kax̱ has correspondingly entrenched. (Such downcutting is the reason the fish trap was uncovered.) Forests here are thus better drained than those about 3000 feet upstream, where cutbanks are not so high, and groundwater is nearer to the surface.

People Humans have had mixed impacts on Kax̱digoowu Héen; not all of them negative. Conservationists might not appreciate me pointing out that the finest wildlife habitat in the corridor is centered on the 1960s logging. Granted, it was not at all a typical clearcut; for one thing, many trees were left standing. Picking my way over beaver dams, surrounded by waist-deep water, I was puzzled by how the logged trees were removed. Bob Armstrong later explained that the stand was cut in the winter, and yarded out over snow and ice to a local mill on Montana Creek Road. Beaver flooding then precluded the normal succession to doghair tangles of second growth that soon become unsuitable for anything but porcupines.

Studying the 1962 aerials in stereo, it seems that loggers in Mendenhall Valley were less than meticulous about dropping every tree. Some of the cuts look almost like thinning operations, with lots of residuals. In east valley areas that were later developed, the residuals were later taken down, but on Montana, just downstream from the canyon, they remained to provide habitat. Many were killed by **beaver** flooding, and by 1986 they were riddled with sapsucker cavities, and used by everything from owls to chickadees.

If we can create such superb habitat by accident, then think what we could do by intention!

Adamus surveys, 1986

Paul Adamus is a consulting wetland ecologist–founder of a widely-adopted wetlands assessment protocol–who was hired to survey and describe wetlands throughout the CBJ in the late 1980s.

With Koren Bosworth, I worked on the Adamus field team, running transects across NWI wetlands, collecting data on vegetation and birds. In addition to these quantitative data, I kept a daily journal, with not only biotic observations but thoughts on geomorphology, glacial history, etc. A good deal of my work was in Kax̲ watershed. Here, I've excerpted highlights on geomorphology and vegetation; later, in the Wildlife *section, there are selected observations on birds and mammals.*

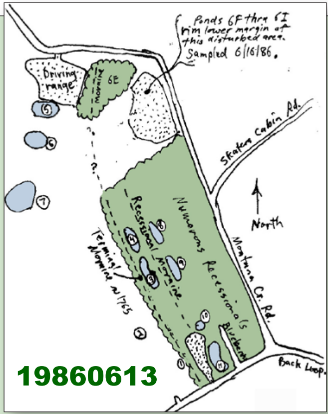
19860604 Large wetland between Kax̲ and Wushi. This area originated as a quiet backwater during the LIA, where fine sediments precipitated, creating a "proto-bog." Sphagnum is present but not dominant. Don Seigel and Paul Glaser cored in a buckbean pond, the wettest part near the southern end. Shallow peat covers a bed of true clay, which in turn overlies sand. *Ledum* is especially common in this wetland, forming a denser cover than in mature bogs, where it grows more dispersed.

19860613 Toured the terminal and recessional moraines downvalley from Montana Creek road, and some ponds in a proglacial outwash area that was forested in the 1962 photography but has since been logged and bulldozed. Stations 1 and 2 are tiny kettles, slightly downvalley from the terminal moraine, but could have been formed by ice blocks tumbling away from the ice face at its neoglacial maximum. Ponds behind the moraines are shallow and elongated parallel to the ridges, thus not icemelt kettles but simply formed in the inter-morainal depressions where enough fines accumulated to seal them.

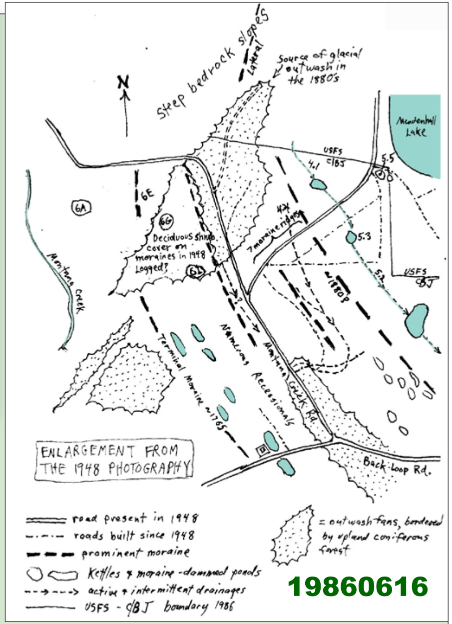
Stations 3 and 4 just behind the terminal are at ponds about 200 years old. Stations 8 through 11 are on younger ponds, with more remaining alder on margins.

Wetland #8 is now dry[1], and I didn't bother with a station. The forest surrounding the moraine-dammed ponds is young spruce-dominated dry upland, with dense blueberry on the older moraines and more open understory on the younger. Zonation of Sphagnum mosses on the pond margins is striking: a submerged species, a floating-leaved species, and a carpet-forming species on the upper edges. METR is rapidly invading.

The ponds labelled 6A and 6D on the aerials are in proglacial outwash, since restructured by bulldozers, with cobbles to 4 inches and coarse sand. Other younger



outwash flats in the valley are excessively drained, and even where kettle pits have formed from ice-melt, their bottoms are dry. This is also the case with most of the pits in area 6H (visited 0616). Probably the water table is high right now, but will drop. The dominant in pond 6D is *Equisetum arvense*, tolerant of a wide range of moisture and not typically submerged perennially, as with *E. fluviatile*.



19860616 Montana Creek Road outwash ponds. Ponds 6F through 6I rim the lower margins of large, bull-dozed area below the road. Even on 1948 photography the area appeared lacking in coniferous cover typical of recessional moraine ridges, and I felt it to be a continuation of the outwash fan that heads in the 1880 recessional-lateral. On the 1962 aerials, however, a series of recessionals are evident beneath the alsers, and my revised interpretation is that the 6F-6I area is intermorainal, but was the first of many clearcuts along the Montana Creek Road. In "wetland" 6H are many small pits with dry or nearly dry bottoms. They are rimmed with sedges and often floored with the moss *Drepanocladus*,

1 Wetlands identified by numbered orthophotos, referenced in Adamus 1987.

indicating that water fills them when the table is higher.

At the east and west margins of Mendenhall Valley, where the terminal and early recessional moraines converge with laterals leading up to the valley walls, the fluctuations of the ice face were less pronounced than in center valley. Associated longer still-stands of the terminus have resulted in greater morainal relief, and the 1948 stereopair show that the 1880 recessional-lateral area is not only raised above the more southeasterly portions of the same moraine, but quite a bit higher than the older recessional moraine (since largely plowed down) just down-valley from Montana Creek Road before its sharp E-W turn. Don Lawrence's tree cores show this moraine was formed in about 1810.

This relief has produced an outwash fan that covered over any intervening moraine ridges and replaced them with sorted alluvium. That's why this was the first clearcut; trees were no doubt larger here than on the moraines.

Opening 6F has been heavily reworked by machinery, and is covered with an unidentified lichen resembling a cross between Peltigera and Fucus. Pond 6I has the alga *Chara*, or stonewort.

19860617 Montana mainstem and several tributaries. Today I covered a good deal of the Montana drainage below its emergence from the canyon onto alluvium.

Creek 6.5 is irony, with SCMI. Creek 6.4 is clear, with steeper gradient, more filamentous green algae on the bottom, and abundant coho fry. Above its junction with 6.4, Creek 6.5 is irony. It can be traced under the road at the foot of the steep grade (double 48-in culverts) and all the way back to the Montana mainstem. The uppermost reach before this junction is presently dry, but can be considered an overflow channel of Montana. Between the overflow junction and the road is clear. A thick reddish sludge is seeping from a point source below the steep road banks into the stream, discolored from there on down. Six spruces on the road berm near the seep have been killed, class I, dead less than 5 years.

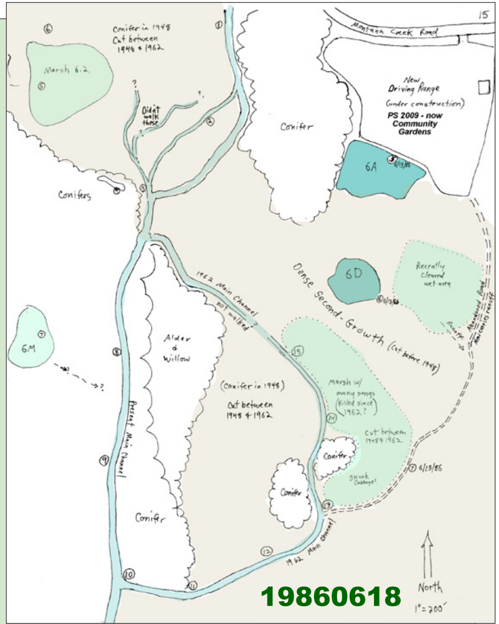
Stations 11-13 on Montana mainstem are almost completely dominated by barclay willow. A rise in water level of only one foot from present elevation would flood considerable portions of the riparian zone, and alder cannot apparently tolerate the frequent siltation. The area is well stocked with large snags, ranging from decay class I to IV, killed over a wide time span. Dan Bishop says this indicates very active migrations of the channel, and there have been recent property disputes because of this.

What I can't figure out is how this spruces got established in the first place. Apparently this reach has become more dynamic during the past half century. Few young recruits are coming in to replace the killed spruces.

19860618 Montana Creek and tribs downstream from 0617 sampling. The section of Montana marked 6.8 is only one of several main channels running through this meadow. 6.8 is wider than the other braids, with presently exposed gravel/cobble bars, and therefore shows most clearly on the 1984 photography. Another braid at station 2 is narrower but much deeper, and possibly of equal volume.

Between stations 1 and 3 I had to cross 3 channels too deep to wade on log bridges. The reunion of these channels is at station 3, where there are pools up to 5 feet deep. Meadows between these incised channels are more mature in character than the annually flooded willow riparian strip between 0617 stations 11 and 13. They have *Heracleum* and other species indicative of long-stablized channels.

Wetland 6.2 (my stations 5 and 6) is a large swamp with many class III snags > 18. Navigating here was difficult with only 14-inch boots. It was selectively logged a few decades ago; *Cornus* and spruce seedlings grow on the stumps. Bob Armstrong says that cutting was done in winter on frozen surfaces. F&G has records of the date of logging, and info on the mill on Montana Creek road.



19860618

Wetland 6M (station 7) is a mature sedge/sphagnum bog rimmed with Viburnum, unaffected by recent migrations of Montana Creek, or by logging.

This sketch map was traced from the 1984 wetlands boundary photography, with my stations (and 0613 stations 5-7), and reconstructions of the former main channel. The abandoned road that leads to 0613 station 7 is now a runoff channel carrying water from the driving range disturbed area down into the former 1962 channel. This creek (stations

11-13) is sedate and irony, but betrays its ancestry by the firm bed of sorted 3-to-4-inch cobbles.

In 1948, closed coniferous forest covered the entire area of this map, excepting a recently clearcut block in the upper right corner that extended just beyond pond 6D. Between 1948 and 1962, much of the large-tree spruce forest was cut. Remnant trees, now snags, appear to have been alive in the 1962 aerials. Probably they were bypassed as defective or under-sized. At some time since 1962, the main channel jumped westward to its current position. Residual flows in the 1962 channel were then dammed by beaver at several locations, raising the water level and killing the residual spruces. The 0613 station 7 swamp [2] has an odd assortment of species, some of which don't "belong" in a young, post-glacial marsh; most notably skunk cabbage. These plants can live up to 70 years, and are certainly remnants from the former forest understory. At station 14 a dam is still intact, but no evidence was found of recent activity.

19860626 Kettles and moraine-dammed ponds near River Road and Steelhead. [*PS 2009: not exactly in the study area but these generalizations about ponds apply also to older moraines bracketing Montana Creek Road.*] Willow and *Ledum* communities on fines below terminal moraine. Although separated by only 1000 feet along the axis of ice movement, ponds sampled today vary in surface age by 100 years. The oldest, just behind the terminal moraine, were exposed in about 1780; the youngest in the 1880s. Recession was slow during the first century after 1780, and large differences in upland and wetland habitats are apparent over short distances. Moving from young to old sample stations, cottonwood overstory decreases, *Vaccinium* understory increases, and diversity of vascular and bryophyte aquatic species increases. Value of pond and pond-margin habitats to nesting birds probably depends on the amount of deciduous fringe (ALCR, SABA, POTR), which is greater in the younger ponds and inter-morainal drainages.

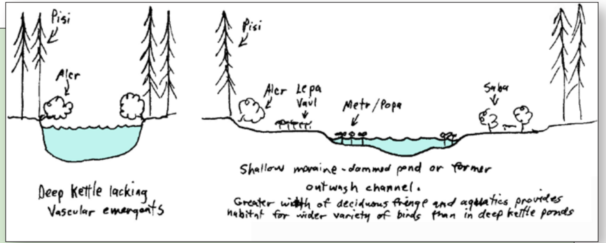
19860629 Montana Creek and adjacent meadow&scrub upstream from back loop bridge. Stations 1-3 are similar to the nearby *Carex aquatilis* wet meadows forming the western part of the large "greenbelt" wetland [*PS 2009: now owned by JYS. I don't have a sketch map of my 0629 stations but I believe some of the first ones were later developed by Spruce Meadows trailer park.*]. There are several small creeks here that should be mapped.

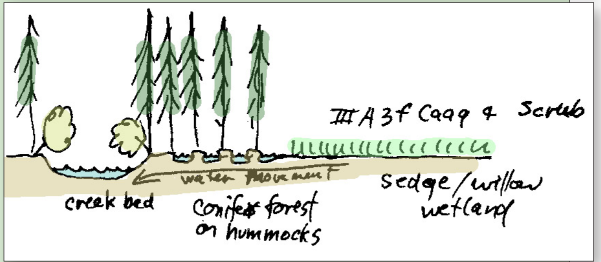
Station 6 was on a rapidly flowing stream with EQFL growing almost to the center, stems vibrating in the current. I've previously seen it only in quiet water. Above the emergent horsetails are sedge and bluejoint, then willow/alder scrub, then spruce, with many class II snags and one class II with recently excavated sapsucker holes. Other spruce are dying, indicating recently elevated water levels here.

Wetlands 14 and 16B include some of the least travelled and best fish and wildlife habitat in the Valley.

Stations 9 and 10 are in fairly closed spruce forest but are definitely wetland. Station 9 has spruces about 100 years old on hummocks, with slowly flowing water in the depressions. #10 has big, 36-inch spruce on

2 The term "swamp" should be technically reserved for wetlands with trees. In SE AK there are few genuine swamps with *living* trees, conifer or deciduous. About the only habitats to which I apply the term "swamp" are these early-phase **beaver** workings with drowned spruces. My impression is that they last for about 40 years before most have fallen, at which point they become "marshes."





hummocks, with most of the typical upland forest forbs and bryophytes, but deep standing water in between, actually overhung by the hummocks in many places. I have not seen wet forests like this before, but perhaps they are not uncommon as stringers separating channels from adjacent sedge wet meadows.

Beginning at station 11, I found an unmarked overflow channel that departs from Montana Creek at station 14, and swings out through stations 13 and 12. This is a sizable channel cut into silt, with clear water about 2 feet deep. Between this channel and Montana Creek, just north from station 12, the forest has been cut. As with the logging described 0619, it took place sometime between 1948 and 1962.

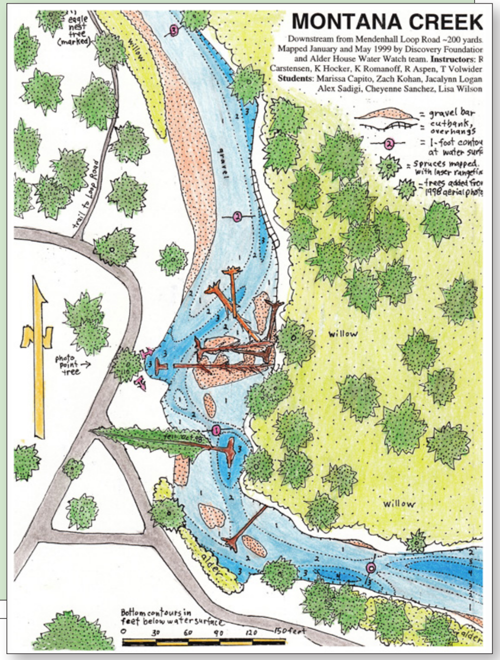
Stumps in the ~1960 clearcut west of today's Community Gardens. Shallow puddles and exposed mud indicate a recently dewatered **beaver** complex. White blossoms in foreground pond are whitewater crowfoot that only grows in clear water; other ponds are opaque with orangey iron flocculent. Photo taken during **amphibian** surveys, with Bob Armstrong.

Water Watch reach mapping

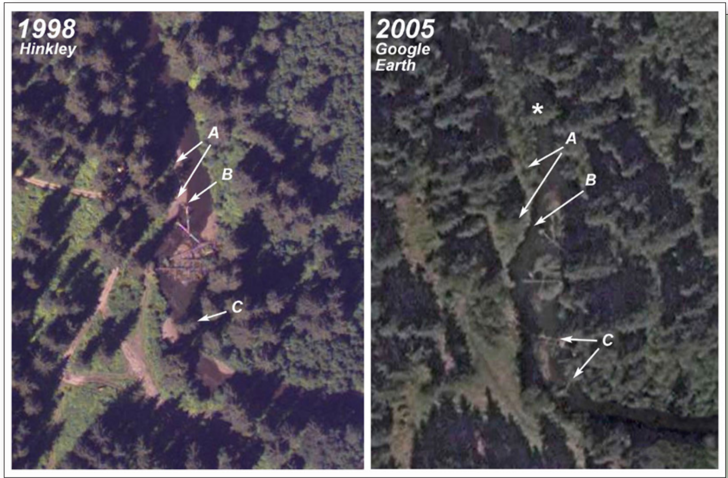
A good deal of the Water Watch notebook (Carstensen 1999) is devoted to mapping. In addition to the preceding examples of historical series, done from air photo overlays, we developed a protocol for mapping 200-foot reaches of our study streams with middle school students. We partitioned off sections of the stream with tapes, and marked positions of key channel features, as well as encompassing forest structure. For smaller, first and second-order streams [1] like Duck and Switzer, a 200-by-100-foot map adequately captures the creek and its riparian context, but as we graduated to 4th-order Kax̲dig̲oowu Héen in 1999, a 200-foot reach map would have been like photographing the knee of a basketball player. Fortunately, the newly affordable laser rangefinder, combined with 'old-fashioned' plane-table methods, came to the rescue. It allowed us to quickly make this 700-by-500-foot map, showing bars, cutbanks, thalweg, large woody debris, etc. Some of the tree crowns were later added by projecting the 1998 Hinkley aerial, below.

Circled numbers show

1 Two 1st-order streams meet to create a 2nd order. Two 2nd orders create a 3rd order and so forth.



Mapped with plane table and laser rangefinder by Discovery Southeast Water Watch class from Dzantik'i Héeni.



1-foot contours on the water surface, measured with tripod-braced hand level. The stream falls 3 feet over 700 feet of run, for a gradient of 0.4%. That's a bit steeper than average (~0.25%) for this part of the creek (*Hydrology*, below)

Examining 1984 high-resolution air photos in stereo, log jams were in roughly the same places 25 years ago. But with a few exceptions, they're new arrivals, not original trees. The 1984 logs are now waterlogged and battered, with tops settled deep into the gravel, and root pads nursing young saplings. The mix of old and new logs offers a diversity of habitat, and a range of different aquatic insect 'guilds' keying into various stages of decay.

The conclusion to be drawn from this study of successional change on Kax̱ is that hydrologic "disturbance" can be a positive force that boosts productivity on medium-sized streams. These flood-plain reaches of Montana Creek probably have an optimum combination of stability (big, fairly long-lived riparian trees and long-lasting down wood) and volatility (floods that keep introducing new wood to the stream, and create mosaics of early-seral bank habitats that provide nutritious deciduous leaf litter to the aquatic community).

Kax̱digoowu Héen weathered its "100-year" flood just fine, thank you. Who knows, maybe it even cranks out a few extra bushels of **salmon** smolts per year as a result of that little climatic tantrum?

Above: Air photos taken of our mapped reach show 7 years of changes. The 1998 photo was taken 3 months before the "100-year flood" that added several new logs to the stream.

A) This bar was essentially unvegetated in both the 1998 aerial and our reach map. By 2005, it's greening up well, and a strip of alder/willow appears upstream. This may be related to an eastward migration of the channel in the northern third of the photo. Note the asterisk over the leaning spruce in 2005. Our 1999 map shows a cutbank here.

B) Just downstream, erosion has shifted to the west bank. Notice the down logs in this section (shown in B&W photo below) remained in place over the 7-year interval. But the distance between the rootpads and the west bank has widened. What used to be a building point bar is now cutting back.

C) In 1998 this 30-inch spruce was leaning over the river. Our 1999 map–and my photo, previous page–shows it spanning the creek On the 2005 aerial this log and the one just downstream have not moved appreciably in 6 years.

Right: View east from same photopoint tree as previous oblique. Three trees with small branches fell in the past few years, but before the October 98 storm. Moss-covered log with top in gravel, second from right, spanned bank-to-bank in the 1984 aerial photographs. It has now [2009] sheltered **coho** fry for at least a quarter century.

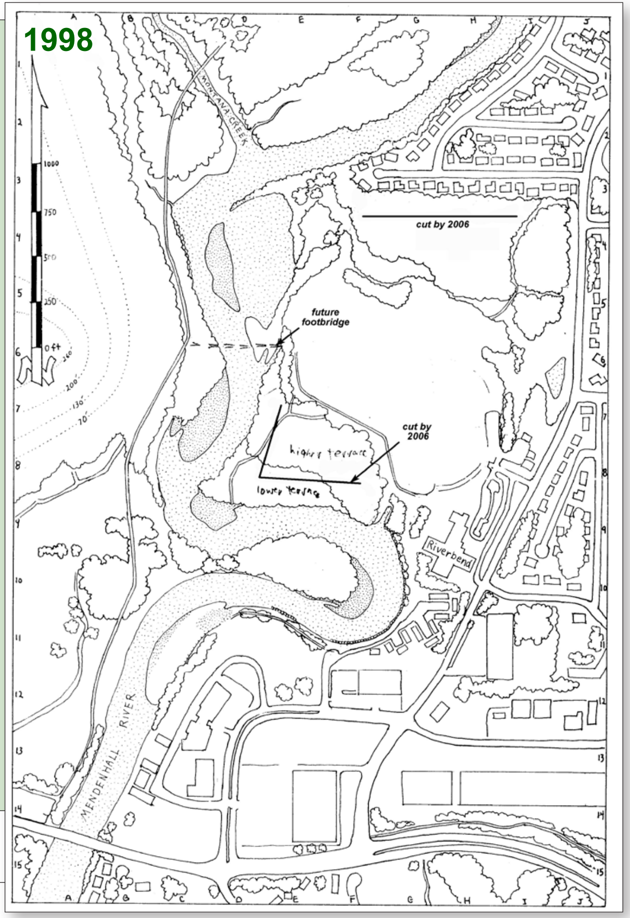
Forest assessment tables

Completed on visits to Riverbend site by Dzantik'i Heeni Water Watch students, Feb. & March, 1998
Instructors: R. Carstensen, Kathy Hocker, Scott Sundberg.

Stand description (incl map coordinates)	elev.	species ratios	ave dbh	ave hieght	spacing, crown gaps	age structure	substrate, understory, wildlife sign, etc.
E-7.5 Mixed spruce-cottonwood stand west of school	~30′ old channels cut lower	50:50 spruce: cottonwood	~12″ largest to ~25″	70′ measured on north edge of stand	crown moderately open in Feb, with cottonwoods still bare.	even-aged no stumps primary succession 115 yr spruce cored	This is the first forest to colonize alluvial/estuarine sand. Only intact stand near school east of river. Other older & higher volume forests were logged. Few mosses - smothered by cottonwood leaf litter. Scattered devil's club. Porky nip-twigs and squirrel middens common. Easy walking
H-4 Second growth, cut between the 1948 & 1962 air photos	~30′	95:5 spruce: hemlock	~12″ largest to ~20″	60′	trees clustered many gaps much rougher texture than E 7.5 on photos	combination of ~40 yr seed-ins & older release trees from sub-canopy	We cored 2 spruce & 2 hemlocks. Oldest go back to the 1920s & 30s. Three were released in the 1960's & 70's & one may have seeded in after logging. It had 37 rings, plus missed pith, all rings large. Gaps have luxuriant devils club & blueberry. Canopy is closing rapidly over alder. Slash & tangle = slow bushwhacking
F-4 Stump pile, trees apparently pulled from the sports field area. (no living trees remain)	~30′	mostly spruce	2 to 3 ft.	? probably 100 to 150 feet	medium-closed on 1948 air photos	"young" old-growth spruce on fresh alluvium	Ring pattern needs more study, but age averages ~200 yrs with 1st ~50 rings tight, followed by release. This suggests an initial suppression under alder thicket, which makes sense for primary succession on river overbank deposits.
A.5-10.8 Alder stand at Brotherhood Park	27′	pure alder *Alnus crispa*	~8″	45′	will be shady in summer when leafed out	<30 yrs. No trees or saplings show on 1962 air photos	Strong elderberry + fern understory, some crabapple. Substrate is sands + silts. 1948 photos show bare patches, probably gardens. We saw magpie, jay, downy woodpecker & siskin. In summer, unusual birds like warbling vireo sing here.
C.6-9.8 East edge of big spruce at oxbow cutoff site	30′	pure spruce canopy; scattered hemlock below	~2 to 3 ft	100 to 120′	fairly open, with strong side lighting as stand shrinks	~200 yr. dominants?	Largest tree cored is 50″ dbh, 135′ tall. 147 rings in the outer 13″ Missed 12″ of the 25″ radius. Inner rings ave. ¼″, thus ~50 rings missed. 147 + 50 = ~200 yrs old. Oxbow is only 81 feet across at narrowest point. Squirrel middens common. Kingfisher holes in bank.
A.5-4 Upland hemlock forest	125′	90:10 hemlock: spruce	hemlock 12″ spruce 18″	120 to 130′	tight, interlocking canopy	even-aged ~100 yr trees w/ scattered older survivors	On till & schist bedrock upland slope (outcrops on river at C4) This appears to be part of the widespread 1883 blowdown forest. Shady, even-height canopy results in sparse blueberry understory. Down logs with mature hemlocks growing on them are aligned mostly to the NW, possibly knocked over by the southeasterly 1883 storm. Squirrels in this forest use hemlock - normally a 2nd choice after spruce. Cache trees have mounded hemlock branches w/ attached cones - whole branch clipped rather than individual cones as with spruce.

Water Watch habitat notes

Our Dzantik'i Héeni student team collected these forest type descriptions on-site, keyed to coordinates on sketch map at right. This map was made in 1998, prior to construction of the footbridge or high school. I've noted where these changes will occur.



GIS SERIES: Lower Mendenhall—aerials

The preceding notes and historical series for the Riverbend area and lower Montana watershed were created in the 1980s and 1990s, with a few subsequent inserts taking advantage of GIS mapping technology, and more recent aerial imagery. Here, I repeat the historical series, using that same early imagery, but with the advantage of being able to precisely "georeference" it, and overlay vector data for easy comparison of changed features.

In the above series, I've used today's Kax̲digoowu Héen Dei trail [1] as the "constant." It of course did not exist during some of the earlier maps and aerials, but superimposing it shows us exactly what the conditions were for each

1 Dei means trail. So technically, adding "trail" to this expression is redundant. It's much like the error in saying "Auke Lake," because Áak'w itself means *little lake*. Henceforth in this document, Kax̲digoowu Héen (or Kax̲ for short) refers to the creek or watershed, and Kax̲digoowu Héen Dei identifies the misleadingly named trail, that only briefly crosses Kax̲, then follows Wushi l'ux'u héen, *milky water* (Mend River)

part of today's trail, at 4 different times in the past.

On following pages, I've traced each of these panels, creating simpler maps that highlight the key hydrologic changes.

1910 Adolf Knopf geology map There was a cabin on the River, just below the Kax̱ confluence. Knopf didn't identify it, but I'm guessing it was a fish camp, because unlike most of the cabins he mapped in 1910, no mining trails led to or from. [2] At this time, "riverbend" was only a right-angle dogleg.

1948 Navy B&W air photo This photo is low-res compared to the others, but valuable because it shows the texture of forests that were logged by 1962. Examining these forests under a stereoscope, they were clearly the tallest, densest stands west of the river. Incision of Kax̱ near its mouth had lessened the frequency of overbank flooding here. These patches were better drained than the narrow strip of large trees framing Kax̱ along its levees upstream, where skunk cabbage grows between trees. (Profile sketch in Adamus notes sidebar for 19860629.)

1962 USFS B&W air photo The clearcut patches show well on both sides of Kax̱. Note also that today's alder patch in Brotherhood Park was not then apparent. (In the 1948 photo, it was grazed and possibly gardened.)

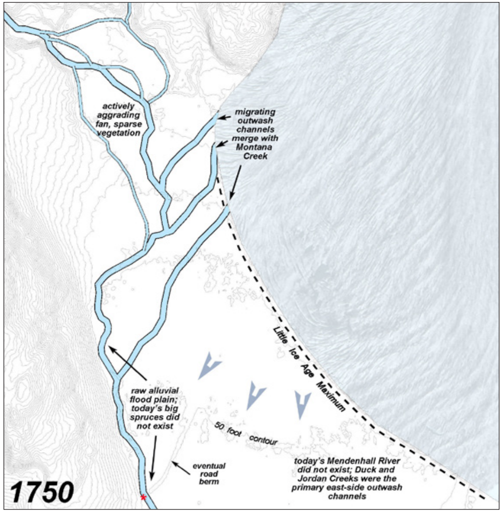
It could be that the logging destabilized the banks, and contributed to bank cutting downstream. Note how much closer the river is to the trail just below the clearcut, compared to 1948.

1984 USFS true color air photo In only 22 years, the Kax̱ second growth had become tall enough that you might not guess from the photo it was logged. The biggest impact was the Red Samm borrow pits, across the river from the Kax confluence. Isolating dikes would soon was out.

2006 CBJ-commissioned digital air photo mosaic Taken before construction of Thunder Mountain High School. River's main flow now comes through the Red Samm borrow pits. Footbridge spans the river, providing instant access to fantastic field destinations for both elementary and high school students. Neck of the oxbow has almost cut through.

Middle Montana—maps

Zooming in closer, let's examine changes in the key section of Kax̱digoowu Héen—the part most influenced by the Glacier at the peak of the Little Ice Age, 250 years ago. I've used the CBJ 10-foot lidar contours as a base for this series, because they help to explain (and are explained by) some of the hydrologic patterns that developed as ice crested and receded.



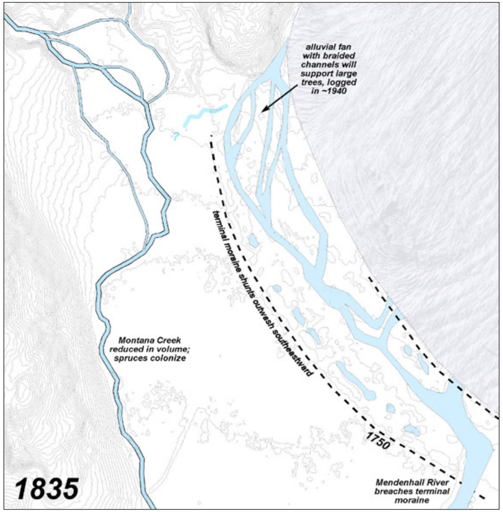
1750 Little Ice Age maximum When a steep-fronted lobe of ice loomed above the eastern edge of today's Community Gardens, melt waters must have traversed the short distance to Kax̱digoowu Héen. We can only guess at the actual channels (mapped wider here than in subsequent views), because, for one thing, they shifted rapidly as alluvium built up; channels were shallow, wide and ephemeral. Also, since the 1940s, human activities in this nexus have erased or at least strongly rearranged the alluvial landforms.

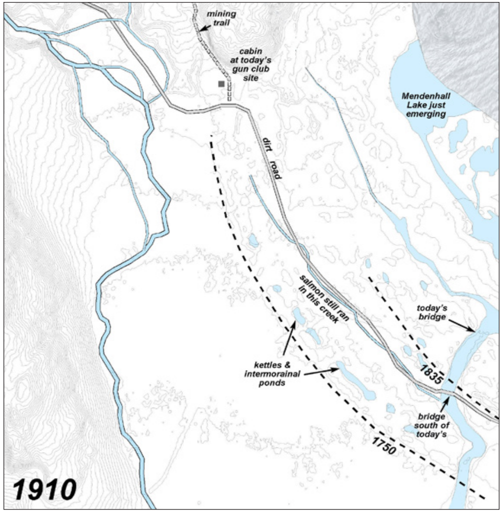
2 PS 2019: Correct assumption. In 2013, Liana Wallace, L'eeneidi, told us the story of the shaman-caretaker of this confluence area.

Note the alignment of today's 50-foot contour that swings roughly E-W across the valley floor. I've added blue arrows indicating the general direction of migrating outwash that accounts for this curvature. Such an alignment results from the dominance of sediment from Wushi l'ux'u héen, *milky water* (Mend River) over the relatively minor contributions from Kax/McGinnis, and is the fundamental reason that, even today, Kax is elbowed into a narrow corridor against the valley wall

The linear southwestward protrusion of the contour line is today's elevated roadbed. This flow-barrier constitutes yet another 'shackle' on Kax hydrology, helping to explain the 'temperamental' behavior of the stream's flood-gauge, which is situated right in the bottleneck of today's back-loop bridge (asterisk)

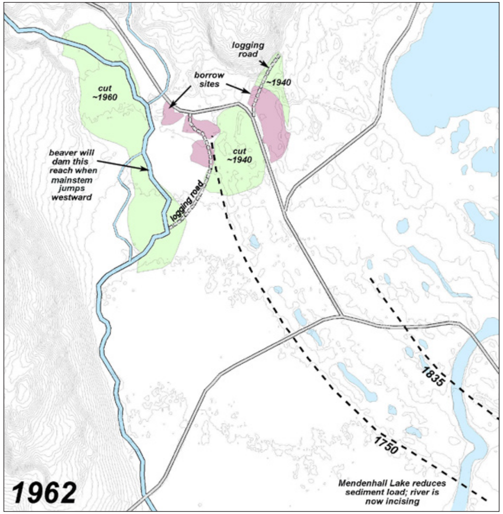
1835 This panel is as speculative as the 1750. It's my attempt to explain 2 things: 1) the formation of the fan that would be logged by 1948 and quarried by 1962, and 2) the creation of Wushi l'ux'u héen, for which we have no precise date. At some unknown date—possibly long after 1835—the terminal moraine was breached in the lower right corner of the panel, and Wushi l'ux'u héen was born.

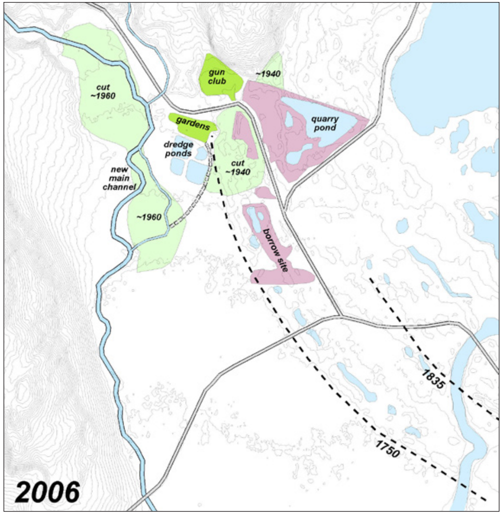




As for the northern fan, which contributed a good deal of the river's volume, today's contours are so altered by quarrying that I had to reconstruct them in the preceding 1948 aerial (p10). But they hint at a predominantly southeastward flow pattern that was, blocked by terminal and recessional moraines from the earlier routes that flowed more southwesterly towards Kax. As indicated by my solitary blue channel ending in a "?" it is possible that a minor component of the braided fan continued to connect with Kax for almost a century after recession began. My dashed black line for the 1750 terminal does *not* connect all the way up to gun-club uplands. Today, it can only be traced up to the SE edge of the gardens. Was it overtopped by alluvium from the fan, later to be removed for fill?

1910 Retreating ice exposed the SW corner of what would become Sít'.áa (Mend. Lake). The only mapped habitation was at the site of today's gun club, next to the miner's trail that once accessed claims in McGinnis basin. But by 1910, a recently constructed government road ran all the way up into the Kax/Windfall saddle, probably





causing those earlier trails to fall into disuse. Crossing the River at a point downstream from today's bridge, this road ran up an intermorainal swale, paralleling a creek that now runs through land owned by Judy Maier on River Road. Judy's father-in-law claimed that in the old days people caught spawning **salmon** here. Today, the tiny creek is choked with iron floc, with sometimes imperceptible flow, barred from salmon access by the river's deep incision

1962 Two clearcuts (or partial cuts in some places) are mapped in green. One, on the site of today's largest gravel quarry, was cut prior to the 1948 photography. The other happened only shortly before the 1962s. The main Kax̱ channel ran closer to today's gardens, in a channel dammed by beavers shortly after logging. Gravel extraction was taking place not only east of the road, but on the site of today's gardens. Compare locations of this activity to the fan indicated on the 1835 panel. Plain, unsorted glacial till—as found in the terminal and recessional moraines—is unsuitable to construction uses. Borrow sites on the 1948, 62, 84, 96 and recent aerials are solid evidence that these landforms were mostly alluvial, even though their original topography has been massively altered.

2006 Kax̱ mainstem jumped westward, probably during a single big storm flow. The easterly channel still conducts water but has been slowed by **beaver** workings. South of Community Gardens, 4 irony dredge ponds were gouged out of the deep deposits of alluvium. In the largest quarry, extraction has expanded to the property boundaries, probably targeting even sub-optimal glacial till as water-washed gravels become scarce (or protected by regulations) throughout the CBJ. Another quarry extends southeastward, down an intermorainal swale.

Middle Montana—aerials

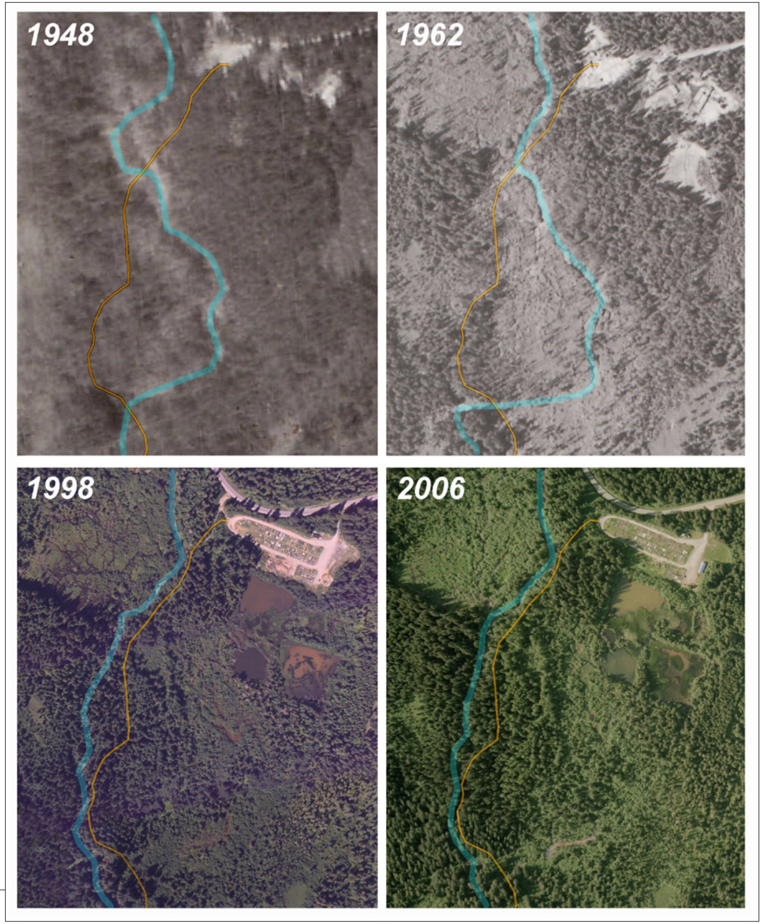
Zooming in closer still, an air photo series elucidates dynamics of that geologic hotspot where River's outwash once met the Little Ice Age Kax̱digoowu Héen. Today’s trail is superimposed on the earlier photos in orange as a point of reference.

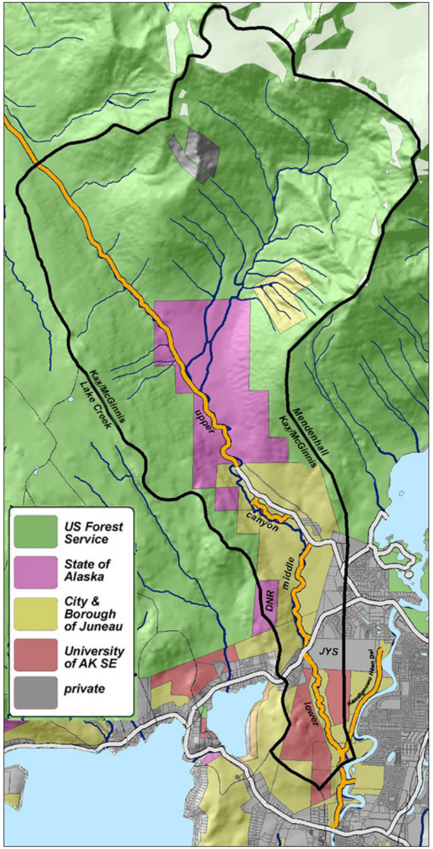
1948 Resolution is poor along the left margin of this image, but you can roughly make out the coarse texture of the forest that would be logged by 1962. Initial gravel extraction had occurred in the future Gardens area.

1962 The Gardens area appears to have been a construction staging site. A small percentage of the trees (<5%?) in the “clearcut” were left standing, which subsequently contributed a great deal to the wildlife values of this fan-flood-plain complex.

1998 My georeferenced photo-collage from the Everett Hinkley series is useful for comparison with the subsequent CBJ imagery. Note especially the dendritic maze of **beaver** channels in the upper left corner. These became hard to detect by 2006.

2006 Two things have happened to account for that: 1) abandonment or at least reduced dam maintenance has caused dewatering (see photo on page 16); there is considerably less open water than in 1998; 2) dewatering has allowed brush and herbs to invade. This most open portion of the fan is succeeding toward willow thicket. Has trapping pressure reduced beaver activity here?





Geography, ownership, sign location

The bold black line on this map is the Kax̱/McGinnis watershed boundary. Other adjacent boundaries are shown in narrower, dashed lines. It wasn't until I highlighted Kax̱ in this way that I noticed the watershed takes the shape of the removed front leg of a deer. McGinnis basin is the scapula. (Sorry, must be hunting season.)

I've changed several units on the CBJ parcels layer (state to cbj, etc) to match page 11 in the 2007 Trout Unlimited atlas, which I assume is pretty up to date. Reflecting on these ownership patterns, I think they support my inclination to: 1) feature the lower Montana; 2) wrap the River trail (Kax̱digoowu Héen Dei) into the interpretation, and; 3) de-emphasize the middle Montana trail, at least as far as describing it in ways that overtly encourage people to hike there.

Dale Gosnell and I discussed the best location for a trailhead sign. Siting is a bit challenging for this one because the end with the most traffic (southern extremity, at the mouth of the creek) is not on a road, but in fact must be accessed via another trail—the Kax̱digoowu Héen Dei.

Our tentative conclusion was to place the sign on that trail, where it meets the western end of the Mendenhall River footbridge. I've shown this location on the following orthophoto with a red dot. Options we considered but ruled less strategic are shown with yellow dots. I'll list pros and cons for them first:

1) Sign at the east end of the bridge on the school grounds would be seen by more students, but would be missed by hikers accessing lower Kax̱ from Brotherhood Bridge trailhead. It would also probably have the highest vandalism risk.

2) Similarly, a sign at Brotherhood would be seen by lots of resident and tourist hikers, and even folks just pulling up for the view—but would be missed by anyone coming from the school via the footbridge. It would also compete with several other existing signs.

3) A sign here at the actual Kax̱ trailhead would perhaps best conform to the featured trail section (lower Montana). But this site does not feel much like a 'portal.' Many who take the Kax̱ trail primarily for exercise would zip by without stopping. And those who go only a short distance on Kax̱—from either Brotherhood or the footbridge—would not see it.

4) Of the 5 siting options, this is the only one where the featured trail section (lower Montana) intersects a road. But a sign here would be viewed by substantially fewer people than at any of the south-end options.

Our first choice location (red dot) is at a major trail intersection. Although it is not a road-based trailhead, this area does have more of a 'central feel' than option 3. People often linger here, talking. Some folks come across the footbridge just for a lunch break or short stroll. A sign here would catch the attention of people approaching from either

Brotherhood or the footbridge.

If my watershed-based interpretation focused *only* on Kax̱/McGinnis—to the exclusion of its interconnections with the Little-Ice-Age Áak'w Glacier system—I'd probably be inclined toward a sign at site-option 3. But it feels to me as though an interpretive sign featuring the dyamic Kax̱/Wushi story would be quite appropriate at this footbridge intersection. I would estimate that the Kax̱ trail sees approximately 100 times the traffic of the lower Kax̱ (and the lower Kax̱ probably 10 times as much as the unmaintained middle Kax̱).

Kax̱digoowu Héen Dei already has interpretive signs, so I accept the rationale that Kax̱ is the 'next in line,' and deserves its own interpretation.[1] As the Trout Unlimited publication (TU 2006) points out, the Kax̱ corridor is a major asset to Juneau that faces many threats. My fish-habitat model for Juneau-area streams ranks Kax̱/McGinnis third, with only Cowee/Davies and Herbert/Windfall scoring higher. Public education is vital to ensure stewardship of this watershed, and DSE interpretation could facilitate that increased awareness.

The TU 2006 publication recommends an improved trail system uniting the currently disparate elements of the Kax̱ trail system.

Meantime, however, there are some issues to be considered before we can settle on just the right approach to signage and brochures for Kax̱digoowu Héen:

- Wildlife sensitivity: this is the best fish and game habitat in the valley area. Increased use would have impacts. In certain sections–particularly middle Kax̱—we may not want to promote this.
- Risk/liability: The middle section is especially brushy and difficult to follow in portions. George Schaaf says it was brushed this summer, but is already overgrown.
- Ownership: We are of course not restricted to CBJ lands in our overall interpretation, but it would be nice to focus the majority of our detailed site descriptions–and maybe all of the post-marked brochure stations–on city property. Another ownership issue that George pointed out is the Juneau Youth Services property at the north end of the lower reach. JYS considers the trail a liability.

On the aerial, I've placed white asterisks at potential interpretive stations on the Kax̱ trail. Map on page 3 highlights the most promising section for brochure descriptions.

1 Note, however, that the existing Kax signs shoot pretty low, and are weathering poorly. There isn't a great deal of content overlap between the existing interpretive material on the Kax trail and the watershed-focused approach that I'm taking for Montana and the other 9 trail systems in this DSE/CBJ project.

Bedrock geology

Superimposed are old mining roads and trails, along with cabins, mines and prospects. For key to the numbered claims, see following Knopf map.

KJgv Volcanic rocks of the Gravina belt (Cretaceous and Jurassic):. Augite bearing flows, volcanic breccia, and intercalated tuff, volcanic graywacke, phyllite and slate; andesitic to basaltic composition; weathers dark greenish gray; relict augite phenocrysts.

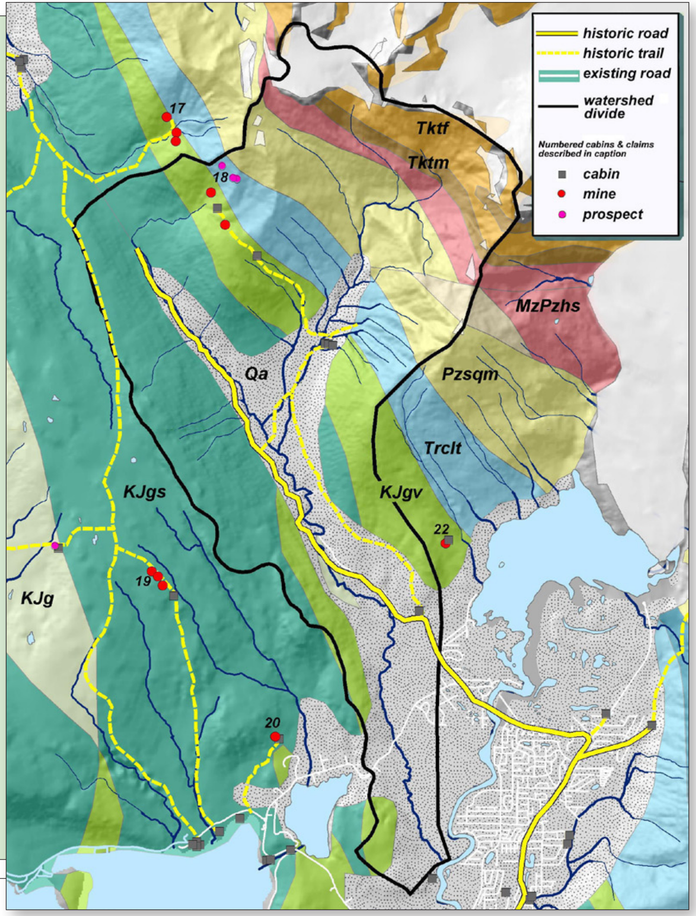
KJg Sedimentary and volcanic rocks of the Gravina belt, undivided (Cretaceous and Jurassic): Mixed and undifferentiated rocks, inter-tonguing of Seymour Canal Formation (KJss) and the Douglas Island Volcanics (KJsd); exposed on mainland and Douglas Island Graywacke, dark gray slate and argillite (locally calcareous), polymictic conglomerate, fine- to coarse grained volcaniclastic rocks and breccia, and augite porphyritic mafic flows. Unit is at least 3000 m thick.

KJgs Sedimentary rocks of the Gravina belt (Cretaceous & Jurassic): In Juneau area, graywacke, slate, and minor conglomerate; volcanic debris, except for the conglomerates, which are polymictic and contain granitic clasts; most graywacke and slate were turbidites; weathers dark greenish gray. Graywacke and slate/argillite are locally calcareous and lighter colored; sedimentary structures common. Limestones nodules and lenses to 50 cm thick are common in the argillite. On Douglas Island this unit hosts the Treadwell “albite diorite” sill, which is the host rock for the Treadwell gold deposits. Unit at least 2500 m thick.

Trclt Carbonaceous slate, phyllite, and limestone (Triassic). In Juneau area, includes dominantly well foliated and commonly lineated dark gray fine-grained phyllite with minor thin dark gray semischist interlayers, weathers medium to dark gray; with some extensive areas of interlayered green phyllite that weathers light green; the former are probably derived from a fine grained clastic section; the latter from either tuffs or fine grained volcanogenic sediments; metamorphic grade generally increases from prehnite pumpellyite/low greenschist facies in the southwest to upper greenschist facies in the northeast.

TrPv Mafic volcanic and volcaniclastic rocks, undivided (Triassic and Permian): Chlorite and hornblende schist; minor green semischist, slate, metagraywacke, and fine grained black marble and limestone west of Coast Mountains plutonic-metamorphic complex unit between Mendenhall Glacier and Taku Inlet and between Stephens Passage and that same unit southeast of Taku Inlet (Gastineau Group). Age and correlation: In Juneau area includes Gastineau Group of the Taku assemblage. Permian megafossils reported from Taku Inlet (Ford and Brew, 1977),

PzZyp Paragneiss and marble (Paleozoic and Precambrian): In Coast Mountains, from Atlin to Ketchikan, includes dominantly well foliated, well layered, locally lineated fine to coarse grained quartz-biotite-feldspar gneiss with lesser amounts of garnet-quartz-biotite-plagioclase schist and still less hornblende-plagioclase schist and gneiss. In Tracy Arm, includes interbedded marble, quartzite,



and subordinate metapelite. Proterozoic and Archaean detrital zircons indicate some quartzites must be metaclastic rocks. Some quartzite layers retain fine lamination textures. Association with marble suggests marine protoliths. Rock types alternate on a scale of a meter or less. Amphibolite to granulite facies.

Pzsqm Siliceous metasedimentary rocks and marble (Paleozoic): Quartzite, carbonate-rich metaturbidites, marble, and siliceous and quartzofeldspathic schist, with subordinate mafic metavolcanic rocks, pelitic schist, and orthogneiss. Quartzite includes pure orthoquartzite, calcareous quartz metasandstone, lithic quartz metasandstone, with subordinate interlayered pelitic schist, marble, and mafic to silicic metavolcaniclastic rocks and flow rocks. In Port Houghton, schist contains two generations of garnet. Middle to Early Proterozoic zircons from the quartzites in this unit are used to infer a continental source terrane. Protoliths are probably Silurian-Devonian.

MzPzhs Hornblende schist and gneiss of the Coast Mountains (Mesozoic and Paleozoic): In Juneau area, Poorly to well foliated, locally lineated, interlayered hornblende schist, semi-schist, and lesser amounts of biotite schist; fine to coarse grained; weathers greenish gray, dark greenish gray fresh; probably derived form intermediate to mafic volcanic flows, tuffs, or volcanic sediments, but some may be from fine grained sills, metamorphic grade increases towards the northeast from upper greenschist facies to amphiboite facies and is compatible with metamorphic facies of nearby biotite schist and gneiss unit (MzPzbs).

TKtf Foliated tonalite (Tertiary and Cretaceous): Correlated with the tonalitic plutons that form thick sills extending for at least 800 km along the west margin of the Coast Mountains plutonic metamorphic complex. In Juneau area, homogeneous, well foliated, non-layered; locally lineated; medium to coarse grained; color index averages 25, range 12 to 40; gray fresh, weathers darker gray; locally hornblende porphyritic with phenocrysts up to 2 cm; some bodies have distinctive skeletal garnet; inclusions and schlieren of dioritic composition common; gneiss inclusions occur locally. Mapped with Quattoon pluton in BC, and foliated tonalitic bodies forming the eastern margin of the Coast batholith in SE AK.

TKtm Migmatite (Tertiary and Cretaceous): Migmatite consists of intimately intermixed paragneiss and orthogneiss, with widespread injection gneiss. In Juneau area, Amphibolite facies (hornblende) biotite quartz feldspar schist and gneiss invaded and deformed by tonalite; schist and gneiss are fine to medium grained, locally include calc-silicate layers, and typically weather rusty; invader is generally the Biotite-Hornblende and Hornblende-Biotite Tonalite, etc. unit (TKto), characterized by its foliation and local aligned hornblende phenocrysts.

Qa Quaternary surficial deposits: raised former tideland at the mouth of Fish Creek.

For more detail on rocks and gold, see following section on *Human history*.

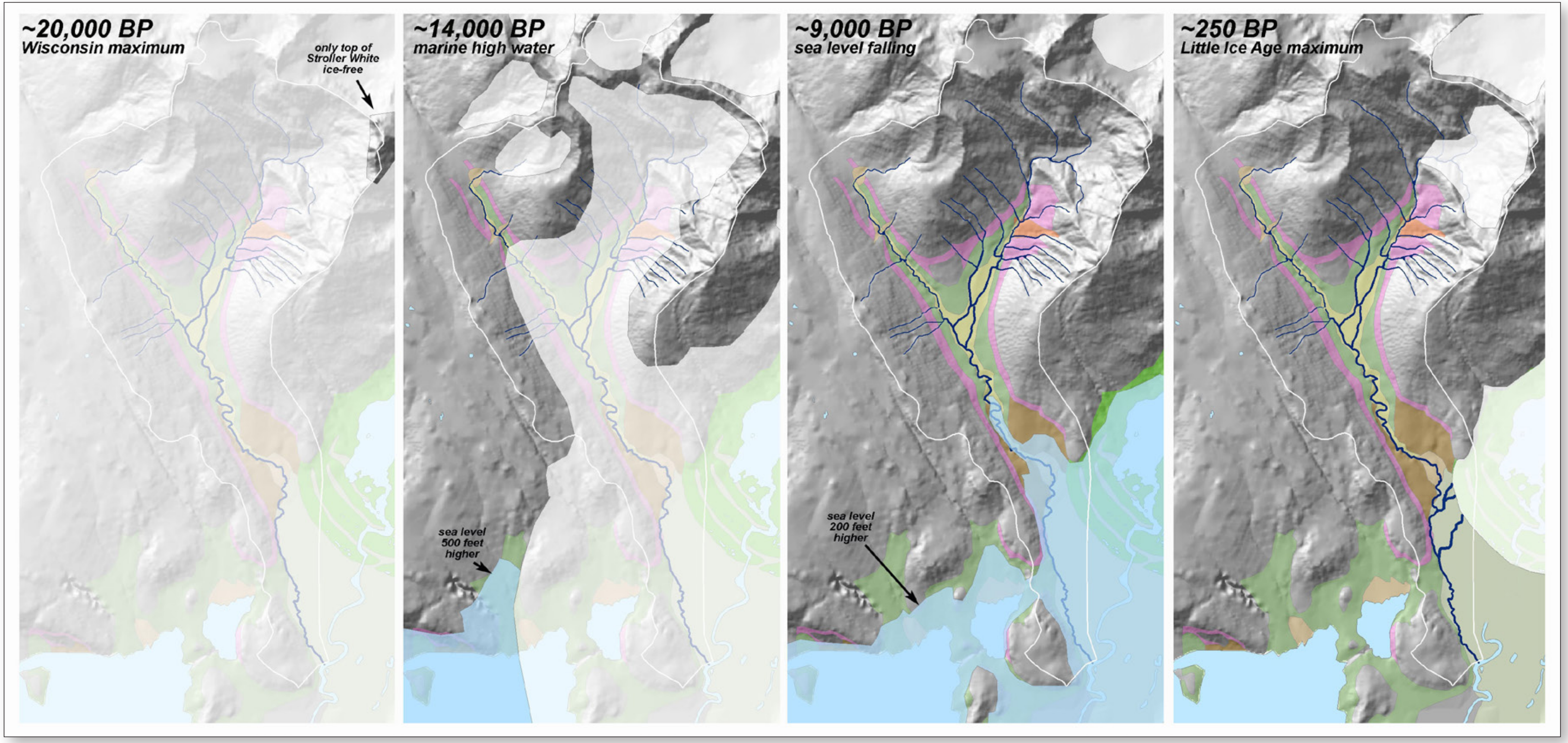
Andrew Allison with ancient delta exposed at top of deeply incised Kax̱ meander bend..

Surficial geology

The series on next page is my attempt to set the stage for the R.D Miller (1973) map of surficial landforms in the following sidebar. I've included that map—faded back considerably—in this series to show relationships of the various landforms to historical ice or sea cover. The thin white outline shows the Kax̱/McGinnis watershed.

20,000 BP Ice level was at about 5,000 feet. Only Stroller White stuck out.

14,000 BP Miller's radiocarbon dates for local marine terraces range from 12,000 to 9,000 years ago. There are



actually marine sediments reported at 700 feet somewhere in Kax̲ valley, but the highest consistently-found glaciomarine deposits are at 500 feet, where I've mapped the shoreline in this panel. There was probably a time after the dominant Lynn Canal Glacier had receded, when valley glaciers from McGinnis and Áak'w Táak (Mendenhall) valleys merged, calving into proto-Áak'w Tá (Auke Bay). As this scene shows, the Kax̲ branch of the upper watershed was much less glacial, perhaps hosting a remnant cirque glacier in the Grandchild Peaks area.

9,000 BP By this time, the proto-Áak'w (Mend) Glacier had probably retreated back up into the icefield. Land had not fully recovered from depression under the Wisconsin-age ice, so the valley became a bay. Kax and McGinnis creeks created a delta (dark brown) that was gradually exposed as relative sea level fell.

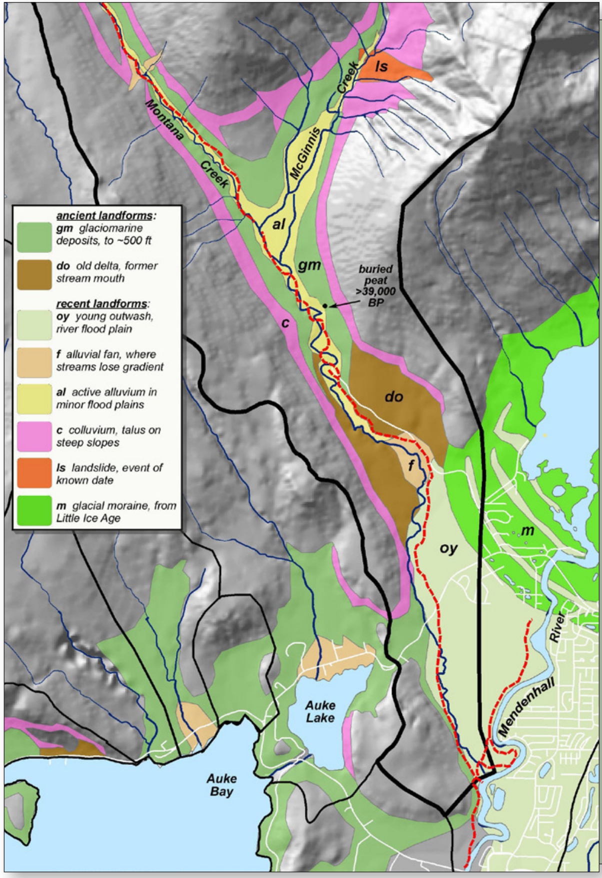
250 BP Áak'w Kwáan Sít'i *Auk people's glacier* (Mend Glacier) advanced almost far enough to backwater Kaxdigoowu Héen. Outwash from the western side of the terminus merged with Kax. Widespread flooding erased any old growth that grew on the pre-neoglacial flood plain. A cirque glacier expanded on the northwest side of Mount McGinnis, causing a similarly aggrading dynamic on McGinnis Creek.

Surficial geology codes

from Miller (1972), an unpublished, 'open-file' report with extensive documentation for RD's wonderful map published in 1975.

ancient landforms

older glacial alluvium [*This was written **before** USGS learned the date of >39,000 BP shown on the 1975 Miller map. Miller predicted just from the context that this was a major discovery.*] "Gravel here is older than the overlying diamicton in the glaciomarine deposit, thus >10,000. It's exposed only upvalley from the bedrock gorge on Montana Creek but south of the mouth of McGinnis. An exposure in the bluff along the creek reveals 9 feet of sandy gravel beneath the glaciomarine diamicton, but more importantly, shows the gravel ***overlying*** a 2-foot thick intensely compacted peaty, woody zone. The exposure was discovered by Carl Blanchard, USGS, and called to my attention. It may be one of the most geologically significant exposures relative to



the glacial history in the Juneau area. The compressed peat suggests a surface that predates the depression and submergence of the land owing to the weight of glacial ice. Peat samples have been submitted for C14 and pollen and seed determinations.

The bedrock at the gorge along lower Montana Creek rises above an older valley floor, and perhaps was a barrier to deposition of the alluvium. Similar bedrock ridges occur at the mouths of all major stream in the Juneau area. It's possible that the older glacial alluvium accumulated in a lake dammed behind the ridge.

do old delta The older deltas that lie at an altitude of about 250 feet contain the upper blanket-forming diamictons, believed to relate to a pause in the rebound of the land during isostatic readjustment. This 250-foot level is consistent throughout Juneau, and at Skagway and Haines. [1]

gm glaciomarine deposits The surface of the deposit along lower Montana Creek slopes downstream under a cover of muskeg and forest. Scarps generally no more than 10 feet high commonly separate the third phase deposits from the somewhat older, higher and more extensive deposits of the first phase [*I haven't separated the 3 phases on this version of the Miller map*.]

c colluvium While some of these deposits are recent in age, in total they span the time interval from very recent to prehistoric, and probably back as far as late Pleistocene times.

recent landforms

ls landslide Most landslides in the Juneau area apparently result from loss of shear strength by loosening of rock along joint fracture in response to stress release continuing since retreat of glacial ice in late Pleistocene time. Other factors are weathering of joint surfaces or of mineralized zones parallel to cliffs or steep slopes and loss of friction because of water filling joint fractures.

The landslide deposit along McGinnis Creek lies below a V-shaped scar on the slope leading down to the slide deposit. Some of the joint sets on the ridge above the cliff are almost parallel to the cliff face. Those striking N43°W dip 78°NE. and those that strike N35°W dip 55°SW. They're almost parallel to the vertical cliff face at the top of the landslide area. Another set strikes N45°E. and dips 75°SW, and transects the other joints allowing the freeing of large blocks of rock.[2]

The McGinnis Creek slide may have started as a rockfall when part of the rock in the steep west face of McGinnis Mountain fell freely for some distance

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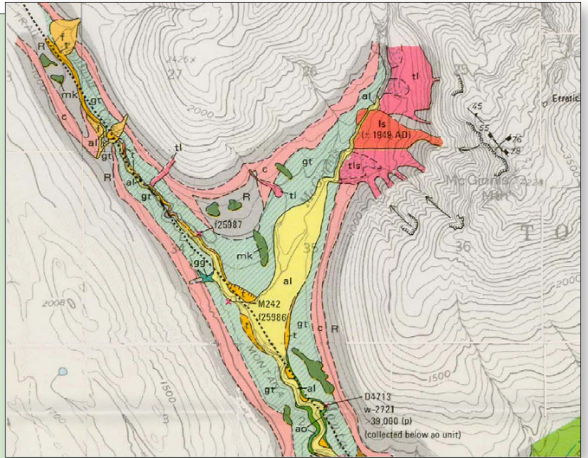
1 PS 2019: on receipt of the 2013 LiDAR-based DEM, we began to recognise this "*250-foot level . . . pause in rebound*" throughout the more protected shorelines of the CBJ. I wrote about it in a sidebar to my *Supplement*, page 18. Turns out a prominent wave-cut scarp was eroded at elevations between 230 and 240 feet, traceable on the bare-earth hillshade all the way up the Sayéik, *spirit-helper* (Douglas Island) side of Séet Ka (Gastineau Channel). I can't detect this escarpment in the Kax̱/McGinnis valley. Instead here are many, less-continuous 'stairsteps,' cut not by a still-stand ocean beach but by river erosion at the outside of meander bends.

As for Miller's suggestion that the 250-foot pause level extends all the way north to Deishú (Haines) and Shgagwei (Skagway), it will be fun to search, once we get LiDAR for those regions, enabling armchair-geomorphologists less astute than the great RD Miller to analyse ancient marine landforms.

http://juneaunature.discoverysoutheast.org/content_item/supplement-to-the-cbj-wetlands-surveys-2014/

2 I don't think RD could have measured these strike/dips to such accuracy without actually thrashing around in the slide zone. The dude was dedicated!



Left: Google Earth close up of the site Miller described as "*older glacial alluvium*," where a pre-Wisconsin alluvial deposit was found underlying the glaciomarine deposits. For general location see preceding Miller map. On this photo, the site is marked with an asterisk. Arrow shows photopoint on road from which view of escarpment on right was taken.

Right: Vignette from Miller (1975)

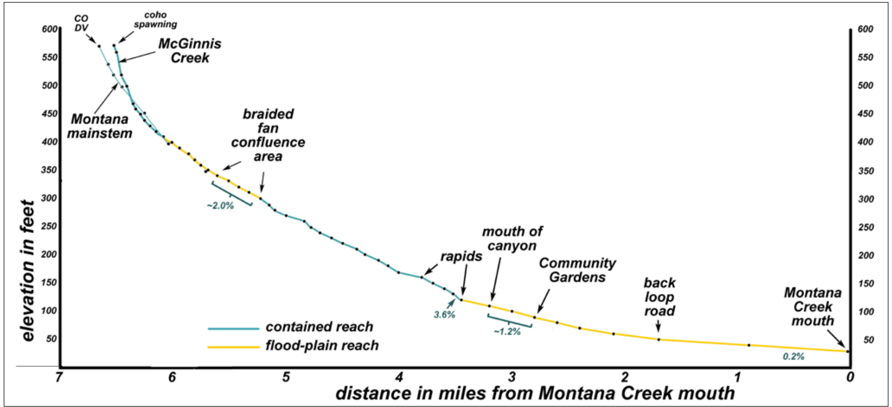
before sliding down the mountain. This slide apparently is in an area of recurring rockfalls and slides. The last major slide reported was about 1949 when blocks 10-15 feet long dammed a lake 30-40 feet wide and about 300 feet long, according to Mr R.E. Reed, who was operating a mining claim along McGinnis Creek at the time. Dust was seen along the steep face on Mt McGinnis during my mapping in 1968 and may have been caused by small rockfalls.

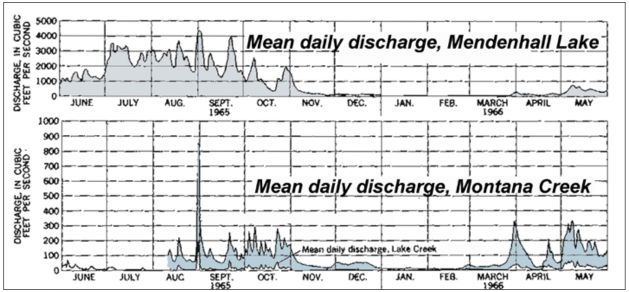
oy young outwash Consist principally of gray silty fine sand. The silt, fine sand and muskeg in the area above the confluence of Montana Creek and the Mendenhall River probably accumulated from overbank flooding along Montana Creek. The presence of the late neoglacial Mendenhall Glacier probably stabilized the deposition in the main valley, whereas the absence of large, valley-filling glaciers within the Montana Creek drainage resulted in seasonal floods or extremely high runoffs.

The radiocarbon age of one of the buried trees along the Mendenhall River channel restricts the start of rapid deposition of the younger outwash to about 860 years ago. Whether this deposition started before the glacier reached its end moraine is not known. One of the oldest stands of trees on the outwash is on the channel of the Mendenhall River, where one spruce about 38 inches dbh was cored and revealed 250 rings with the center >2 inches beyond the borer tip, i.e. missed ~50 rings. Thus an age of about 300 years. Lawrence found a similar-aged tree, cut in 1948 where the loop road crosses Duck Creek. [*germination ~1680*]. These old trees were growing before ice retreated from the terminal moraine. The radiocarbon age of the buried tree combined with the ages of these advance-regen trees suggests a total depositional period for the young outwash of about 560 years.

Water table in the oy is 2 to 10 feet below the surface.

f alluvial fan Water table is unusually high in the alluvial fan deposits along Montana Creek





Above: Comparisons for Áak'w and Kax̲, from Barnwell & Boning, (1968)
Left: Elevations from CBJ's 10-foot lidar contours (black dots); distance measured along USFS-mapped stream in ArcMap. Gradients in % slope for selected reaches. For comparison, Wushi l'ux'u héen gradients range from 0.1% in tidal reaches to 1.2% at the back loop bridge (Neal 1999).

Hydrology

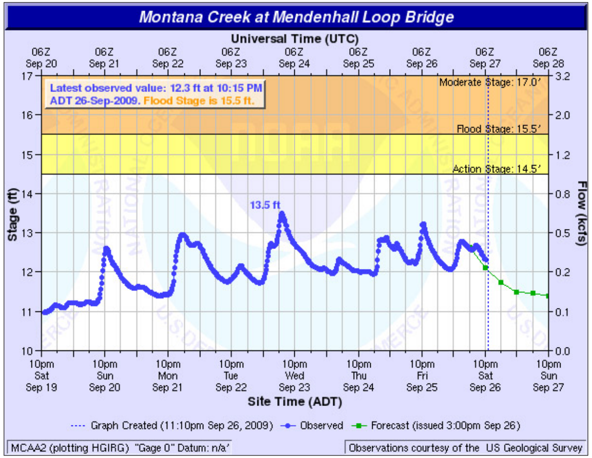
As I puzzled over the question of why Kax̲digoowu Héen is hydrologically such a hair-trigger system (see *2009 hydrology summary*, end of *Two Centuries on Montana Creek*, above), I wanted to know more about gradients. Computing 'rise over run' from the new CBJ 10-foot lidar contours, I learned that Kax̲'s gradient drops about an order of magnitude between the upper reaches above the canyon, and the final run over the Wushi l'ux'u héen (Mend River) floodplain to its mouth.

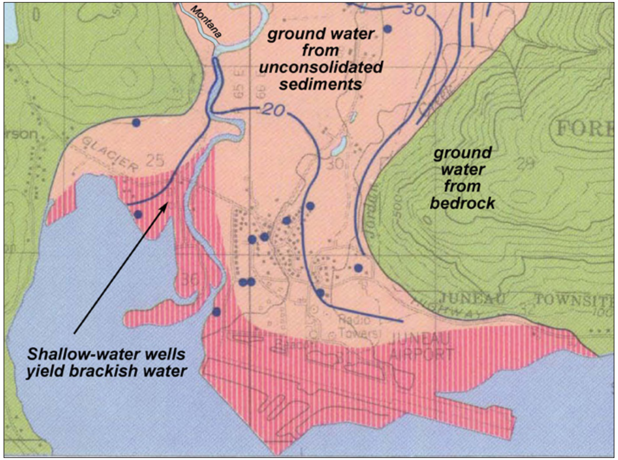
Barnwell & Boning, (1968) compared discharge for Kax̲ against Wushi (chart, above right). Annual peak on the glacial River is temperature controlled—July through September is the period of most rapid icemelt. Kax̲ has the typical bimodal pattern, with fall peaks in September and October during heaviest rains, and spring peaks in April and May responding to snow melt. The chart also shows much smaller Lake Creek in the adjacent watershed, with an identical seasonal pattern.

The National Weather Service website[1] has a fantastic, real-time flow record for Kax̲digoowu Héen, one of only 17 index streams for Southeast Alaska. Records go back to 1965. **McGinnis Creek typically contributes more than half of the flow**. The chart on next page shows a week's worth of flow data. The 10 highest known flows (historical crests) are:

(1) 17.36 ft on 10/20/1998
(2) 16.80 ft on 09/25/1996
(3) 16.77 ft on 08/23/1966
(4) 16.58 ft on 11/19/2005
(4) 16.58 ft on 08/24/1974
(6) 16.42 ft on 09/10/1995

1 *http://aprfc.arh.noaa.gov/ahps2/hydrograph.php?wfo=pajk&gage=mcaa2*





Far left: A week's flow data from the National Weather Service website.
Left: Well locations from Barnwell & Boning, (1968)

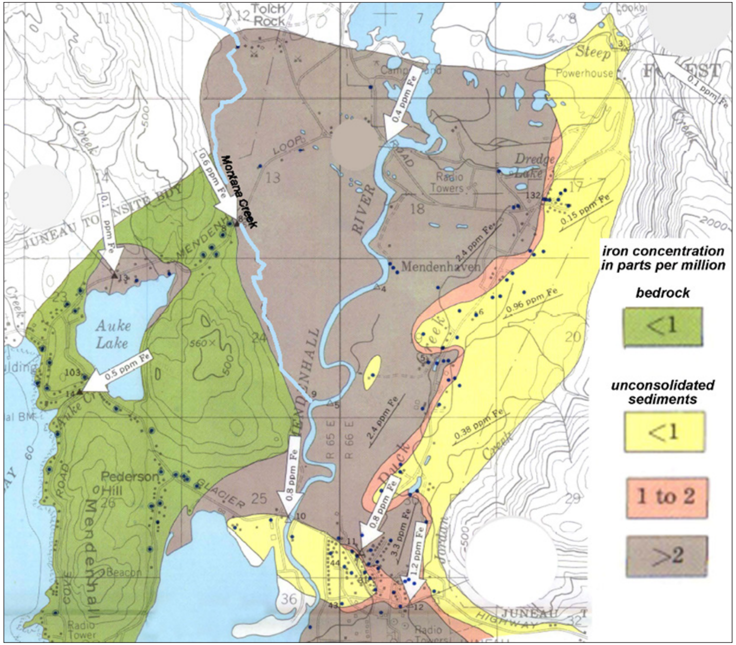
(7) 16.32 ft on 09/29/1970
(8) 15.82 ft on 10/20/1999
(9) 15.78 ft on 08/18/2009
(10) 15.76 ft on 10/06/1972

In theory, peak flows *could* occur in non-glacial systems in the spring, when rain falls on snow over frozen ground. But all 10 of these peak flows were in fall. According to NOAA, half of the 15-ft-plus flood events happened in the last quarter of the 40-year period of record. That's a pretty strong testament to climate change.

According to Neal (1999), flow from Wushi l'ux'u héen (Mend River) has a shorter time of concentration and is unlikely to coincide with the peak flows of Wushi, which usually peaks 9 to 48 hours after Kax̲. This is fortunate, in that compounded pulses rarely threaten bridges and structures downriver from the confluence.

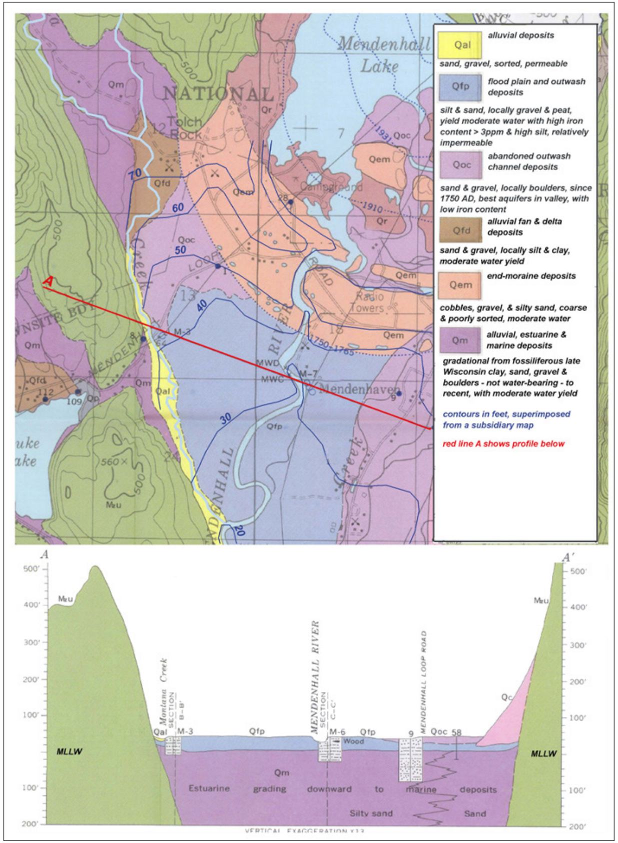
Barnwell & Boning (1968) correlated availability and quality of ground water to surficial geologic landforms. Here are some excerpts from their report.:

> *"The iron content greatly increases [relative to surface flows] when water enters the ground and moves through the sediments. . . Content of more than 0.3ppm is considered unacceptable for domestic use by US Public Health Service standards. Most of the water in the study area exceeds this limit and causes staining of household fixtures.*
>
> *The amount of iron taken into solution may be related to the amount of organic material in sediments and possibly to length of time during which water has been moving through the subsurface rocks. Ground water from the NE side of the valley contains less iron than from the central valley. This . . . may be related to more porous and permeable sands and less organic material. Iron-free water entering the subsurface in this area moves rapidly through coarse sands into silty, fine-grained flood-plain, estuarine, and marine sediments, with notable increase in iron. Water from bedrock with no organic material contains less than 1 ppm iron, even though much is composed of iron-rich volcanic rocks.*
>
> *Salt-water intrusion*
>
> *Brackish water occurs in shallow estuarine deposits in parts of the southern valley and is*

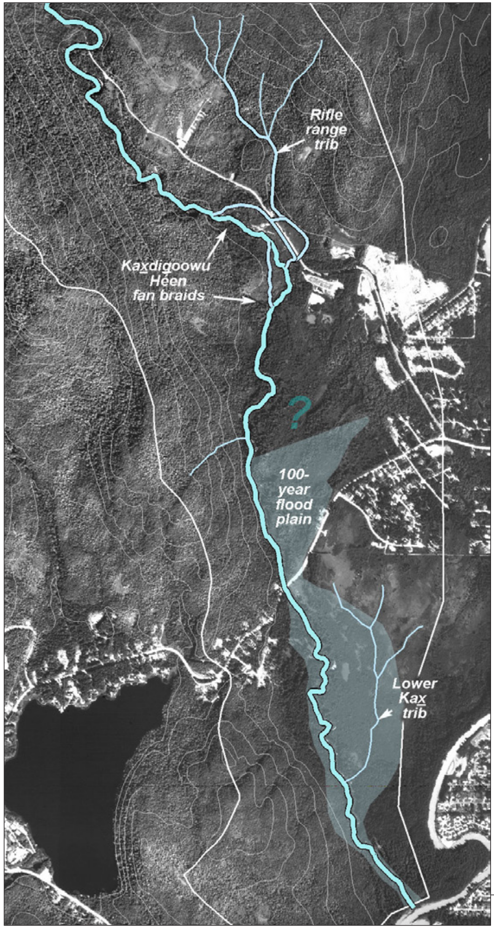


Left: Iron content in groundwater, from Barnwell & Boning, 1968. Compare with landforms map on right.

Right: Iron content correlates with % of fines in the sediments, which in turn is explained by Little Ice Age glacial landforms.



reported from deep wells in the central valley. Some may have been left from deposition of the valley-filling sediments. Salt water also occurs in the Mendenhall River as far north as the mouth of Montana Creek, the limit of the tidal effects. In [nearby] wells . . there is some indication that the salt content of ground water increases rapidly with depth. Wells on the western side of the valley south of Glacier Highway have penetrated salt water [see map excerpt]. Although fresh water may occur as lenses in the surficial deposits, all wells drilled south of the intrusion line [below] are likely to penetrate salt water at shallow depth. Increased pumping



. . . may cause the saltwater interface to move northward, causing contamination or increases in chloride content of water in wells.

Unconsolidated sediments *Fine-grained silty detritus in common in glacial sediments. Their permeability is diminished by deposition of glacial flour. As water flows into the sediments, much of the flour (clay and silt particles) is deposited along the water-sediment interface, or is carried a short distance into the void spaces between grains. Water moves more rapidly through deposits of coarse, well-sorted, washed sands.*

For hydrologic characteristics of Kax̲dig̲oowu Héen that are especially relevant to fish habitat, see following section on *Fish*.

Most of the maps in this scoping document use the USFS channel type layer to depict Kax̲dig̲oowu Héen. The AWC layer by ADF&G catches a few catalogued tributaries, but they conform poorly to the new CBJ 10-foot lidar contours. This is my up-graded version:

1) I redrew the section of braided streams in the fan area below the canyon, based upon ground-truthing and most current imagery.

2) Added the Rifle Range tributary, which Cathy Pohl scouted for DNR Habitat. Here and for the following trib, I relied on clues from the 10-foot contours.

3) Added the Lower Kax̲ trib that shows on the TU 2006 maps, but is not on a FS or F&G GIS layer.

4) Added the 100-year flood plain, from same document. “?” is north of their map. Has USGS mapped the flood plain in these middle reaches.

Left: Adult **spotted frog** in pond south of Community Gardens, 20030723. Master Gardener Ed Bugliosi alerted us to these frogs when Bob Armstrong, Mary Willson and I studied amphibians for ADF&G. Although all age classes were present, indicating a breeding population, we strongly suspect this population was introduced. The nearest known natural occurrances wee on Taku River.

Kax̲digoowu Héen corridor was probably once a stronghold for **western toad** as well, but these have declined, due apparently to chytrid fungal infection. Our surveys turned up no toads on Montana in 2002 through 2003, nor have I seen or heard of any since. ● **Right**: Spring **nubbin** buck in **beaver** workings west of the Gardens, 20030507.

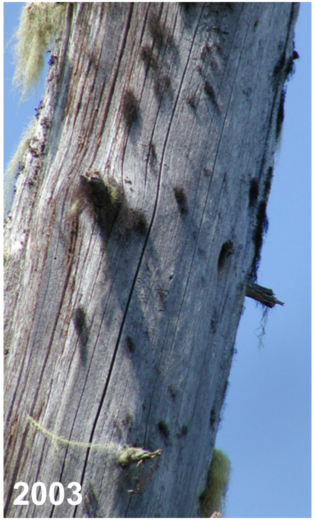
Wildlife

Notes on wildlife excerpted from Water Watch Notebook (Carstensen, 1999):

Loud chirpings, like a robin would make if it weighed 10 pounds, come from a patch of mashed-down skunk cabbage beside Kax̲digoowu Héen. Stalking to within 20 feet, I can finally peer over at a pair of otters, slick as frogs from recent emersion, engrossed in somersaulting and atypically oblivious. Suddenly, one lopes directly toward me, staring at my legs but not identifying them. At 5 feet I lose nerve and say “Hello, otter!” and it veers and plunges back into the clear, cold water.

Sunlight streams through spacious gaps between fat, towering spruces, lighting jungly gardens of cow parsnip, shoulder-high lady fern, and thick-stemmed twisted stalks. Below are tasty edibles like violet and spring beauty, some pushing up through fresh, nutrient-rich deposits of flood-borne silts. Little overflow ponds bustle with diving beetles, hunting into the tender maze of submerged and emergent plants. At berry time, devil’s club, highbush cranberry, currants and elderberries dangle over the stream and flourish in the open understory. The high water table prevents trees from growing too close together, At the large scale of our Montana reach map, trees must be mapped as individuals rather than an interlocking stand.

To a naturalist, the Kax̲digoowu Héen corridor feels like a last sanctuary for the beleaguered ecological integrity of Áak'w Táak, *inland from little lake*



Ponds and wetlands near Community Gardens are exceptional bird habitat, hosting not only an abundance of common species but several species that are uncommon elsewhere in Southeast Alaska. **Left to right: Sapsucker** hole in beaver-drowned spruce snag was re-occupied by a **chestnut-backed chickadee** at time of this photo. • Bob Armstrong being dive-bombed by a young male **red-winged blackbird** at a nest box in the sedge wetland south of the gardens. • **Western wood pewee** is locally rare. Like the chickadee, it is a secondary cavity dweller, benefitting from the holes of **red-breasted sapsuckers** (and they in turn from **beaver**).

(Mend. Valley)

. On the one hand, I want all residents to see and understand it; on the other, I'm glad that so few currently hike its fishing access trail.[1] **Dog** tracks are present but not abundant, as on most other Valley trails. Partly for this reason, many of the muddy banks show hoof prints of **deer**. [2] Throughout the entire length of Kax̱, deer can move safely from the upland forest to the much lusher forage at streamside. This can no longer be said of any other Valley stream. It was encouraging to see so much deer sign after the severe winter of 1998-99.

Black bears are drawn to Montana Creek not just for **salmon** but for the same reasons that deer congregate. Compared to the upland hemlock forest, the riparian swath along Montana is like a salad garden. The upland forest's ground dogwood/blueberry understory is more of a winter refuge. In summer, given a choice, deer and bear move down to graze the rich streamside herbs. In June, big, blackened piles of scat with plant fibers and pulped leaves lie fermenting on the muddy trail.

From the streamside willow thickets, **Wilson's** and **orange-crowned warblers** sing, and from taller mixed conifer/deciduous stands come sounds

1 See my comments on potential trail upgrades in the following *Conservation issues* sidebar from the TU 2006 report.

2 This was written in 1999. On my explorations in 2009, deer tracks have been pretty scarce, following 3 hard winters in a row.

of **yellow-rump, ruby-crowned kinglet**, and 4 **thrush** species. In marginal wetlands are locally uncommon birds like **yellowthroat** and **alder flycatcher.** Two of the 4 **western tanagers** I've located in my 32-year residency in Southeast were on Kax̱digoowu Héen.

When I did bird census work for the Adamus wetland survey in 1986, the richest bird diversity in the entire summer's hiking came from the snag-filled **beaver** marshes near what later became Community Gardens. **Western wood pewees** carried lichens into **sapsucker** holes. Nearly all of the common terrestrial birds of Juneau, plus **northern waterthrush, Vaux's swift,** and **saw-whet owl**, responded to the unique environment of the upper Montana flood plain. I even found a territorial-acting male **brown cowbird** on a slough near the livestock yards in "little Appalachia."

The accompanying sidebar has more observations from my Adamus surveys.

Adamus bird notes, 1986

The Adamus survey protocol involved running transects across all mapped NWI wetlands, simultaneously collecting data on vegetation and birds. Here are some highlights from my daily journal. (IWGNs not purged):

19860528 Visited the slope bog just west of the new pistol range with Koren Bosworth, Don Siegel and Paul Glaser to collect peat cores. We discovered a nesting **greater yellowlegs** that had sat quietly only 10 yards away for more than an hour while we were coring! So they don't invariably yell at you when you approach too close to their nest. . . .On return visits to this site I found several **olive-sided flycatchers** and a **townsend's solitaire**. Rich Gordon reported a **northern 3-toed woodpecker** here.

19860604 Transects across the large wetland in the triangle between Montana Creek, Mendenhall River, and Back Loop Road. Most consistent singer was **orange-crowned warbler**. Also found **yellowthroat** and **alder flycatcher.**

19860613 Toured the terminal and recessional moraines downvalley from Montana Creek road. The most consistent singer was **Townsend's warbler**. However there was enough alder on the pond fringes for occasional **Wilson's** and **orange-crowns**.

A **mallard** with 8 young was swimming in pond 6A, occasionally hiding in emergent sedges. During my entire stay in the vicinity of 6A and 6D I was rushed by a pair of **greater yellowlegs**. This is not typical of their nesting habitat, and Bob Armstrong later suggested that this might be the pistol range nesters, whose young, hatched 0602, are old enough to have made the trip down from the bogs.

An old dirt road leads south from the SE corner of the newly-graded prospective driving range [*PS 2009: this later became Community Gardens*]. This road has become an intermittent drainage, and there is now 2 to 5 inches of rapidly flowing water in it. Following this, I did one station (#7) in wetland 6L. This is wonderful bird habitat. Class III snags indicate beaver kill 20 to 30 years ago. Many are soft enough for primary excavators. The mix of aquatic and emergent plants is rich. I mentioned this place to Rich Gordon and he later visited it. Between us, our list for this site is: SASP, LISP SOSP, AMRO, HETH, OCWA, WIWA, NOWA, RCKI, **red-winged blackbird, vaux's swift**, NOGO, **white-winged crossbills** and a pair of **western wood pewees** at a nest

Along with beaver, red-breasted sapsuckers could be considered keystone species in the Gardens-area post-logging swamps. Abandoned cavities boost breeding bird diversity here.

19860617 Montana mainstem and tributaries below the canyon. Snags [PS: "little Appalachia area"] are riddled with **sapsucker** holes, and several were observed. Dominance of willow makes for prime yellow warbler habitat, and I heard the first of my transects, but they are not common. (Right now they are the dominant singers on Steep Creek).

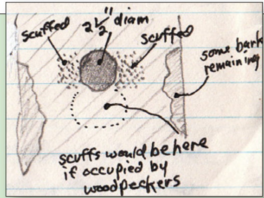
The area along the road between stations 2 and 13, where irony creek 6.5 crosses back under to meet 6.6 and 6.7 is probably the best bird-listening spot in Mendenhall Valley. **Mallard** prints were in the mud at the junction. All 5 common SE warblers were heard, plus **waterthrush**. PSFL sing from conifer edge, and **alder flycatchers** from the brush. SOSP are common; these have only recently begun to sing from freshwater marshes in the 20 years since Rich Gordon came to Juneau. Five thrushes sing here: AMRO, VATH, HETH, SWTH and **grey-cheeked**. Other species include: CBCH, RUHU, SASP, STJA, BASW, **Vaux's swift, dipper**. At 4:30, station 2 I heard and sketched a probable **cowbird**. RG was unable to relocate it, but a transient later showed up at the King's bird ranch at Sunny Point. So far cowbirds are only known here in migration.

At station 5, near junction of creeks 6.4 and 6.5, I heard a probable **western tanager**. RG gets about one per year in the Juneau area. A resident here reported a small "white-faced owl" to Rich, probably a **sawwhet**.

19860618 Rifle-range bogs, then hiked down the canyon. Started well before shooting began. Calvin Heusser did pollen analysis from 2 bogs in this area (Heusser, 1960). Commonest bog-fringe singer dark-eyed junco. Saw several 3-bird chases by RUHU.

In the canyon, commonest singer in plots was PSFL. VATH usually at greater distance. Streamwalking twice required ascents of 100 to 200 feet to get around slate buttresses [*PS 2009, I seem not to have known about the higher trail - or perhaps was instructed to follow the creek? See journal notes from 20090921.*]

At station 20 I flushed a **spotted sandpiper** at only 5 feet on a cobble bar with 3 to 8-inch seedlings of willow and alder. She immediately went into a broken wing display so I froze and scanned until I found the nest with 4 eggs. on 0619 I returned to this site with Bob Armstrong and Rich Gordon, so Bob could photograph the nest. We saw **Vaux's swifts** high over the canyon, and a **dipper** flying back and forth, probably to a nest nearby.



19860619 Wetland 6.2, Montana Creek. Large swamp with class III snags > 18 inches. One of these, the biggest, and broken-topped, had 8 **sapsucker** holes in one side and an active nest near the top, visited just once by the parent during my 20-minute stay. As with the 0602 Jordan Creek nest, the active hole had a worn, brownish area just below, from removal of the grey weathering on trunk exterior. Other snags are also class III and presumably killed by the same water-level changes, but are not so riddled with holes. Maybe collapse of the crown hastened decomposition, encouraging excavators.

19860629 Montana Creek and adjacent meadow&scrub upstream from back loop bridge. Stations 1-3 are similar to the nearby *Carex aquatilis* wet meadows forming the western part of the large "greenbelt" wetland. Song sparrows nest here, but not in the greenbelt wetland. Perhaps this is because standing water in the latter dries up by late June. Above the road, flowing and some standing water is available throughout the nesting period.

Station 7 has a **chickadee** nest in an abandoned woodpecker hole. It's 35 feet up in a broken-topped snag with incompletely sluffed bark, thus intermediate between decay classes II and III. An adult entered the hole as I watched, landing first to the side of the entry. Corresponding scuff marks occur on either side of the hole, instead of just below it, as in the sapsucker nests found on Jordan and Montana. Adult and young were silent, unlike the very obvious sapsuckers, and I would have missed this nest if I hadn't noticed the odd scuff marks. This experience suggests that CBCH may not vocalize near the nest.

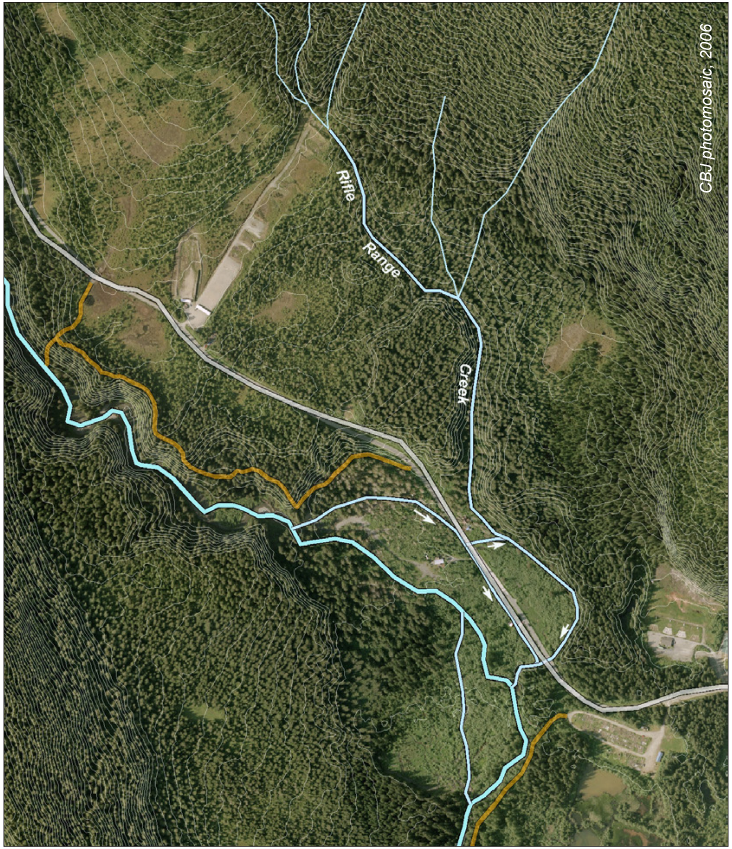
19860703 Lower Montana Creek, from Mendenhall confluence to lower "greenbelt wetland." Stations today were widely dispersed. The hike was generally in mature coniferous forest with little deciduous fringe along the creek, easily characterized in terms of birds and vegetation.

The glamour bird today was a **western tanager** singing repeatedly at station 2, who allowed me to call him close enough for a fleeting glimpse of red face peering over a cottonwood leaf. Otherwise, singing birds were the conifer forest guild, until I emerged in the sedge wet meadow 18.9. **Yellowthroats** and **alder flycatchers** sing here.

Rich Gordon visited my tanager site twice and eventually relocated the bird. Nearby, he also found his first **magnolia warbler** for the Juneau area. At the same site he also recorded **redstart** and **northern waterthrush**, and 4 of our 5 common warblers. This is probably the most exciting birding site discovered this summer.

PS 2009: Reviewing Adamus (1987) for wildlife values of Montana Creek, I see he concluded:

"Further downstream on Montana, the expansive wetland complex (UM1) behind the driving range . . . very likely (on a per-unit-area basis) contributes the most to regional diversity of breeding birds. . . The lower Montana wetland (LM1) is also quite diverse for it size . . . The Montana Creek subarea is probably the richest part of the study area for mammals. Deer, black and brown bears, mountain goat, river otter, beaver and many other species occur here."



Fish

The following sidebar from the Bethers *et al* 1995 report has a comprehensive summary of Montana/McGinnis fisheries. Here are some additional notes from Adamus (1987):

Of all Juneau streams quantified in the study, Montana was the widest, with the greatest variety of depth-velocity classes (some slow & shallow; some deep & fast. Mean maximum velocity per reach on Montana was 3.19 ft/s, limiting the stream's value to rearing fish, compared to a slower stream like Jordan. Aquatic vegetation was low on Montana.

In upper Montana, flow is fast and there are pools with overhead and instream woody cover. In the middle section, gradient is lower and pools are larger. In the lower section, gradient is low and summer rearing for coho and cutthroat is better.

Compared to other study area streams, Montana had the most cobble-gravel, LWD, max depth & velocity, and the least shade.

A little-explored tributary joins the Montana mainstem in Little Appalachia. On this aerial I've named it Rifle Range Creek. It's catalogued by AWC, but inaccurately mapped. I redrew it, along with several overflow channels, to give my best interpretation of the complex braiding on the fan below the canyon. The Rifle Range Creek supports rearing **coho**. Lead from the range potentially impacts water quality in this creek and receiving waters downstream.

ADF&G fisheries description

from Bethers et al 1995:

"Montana Creek is the largest tributary to the Mendenhall River. It originates in a high mountain meadow and flows for approximately 8 miles before entering Mendenhall River about 1 mile from Glacier Highway.

The watershed drains a 15-square-mile area. The stream gradient varies from steep in the upper drainage to low in the lower section. The water is clear with a brownish tint.

McGinnis Creek is the main tributary of Montana Creek and actually provides more water to the Montana Creek system than the headwaters of Montana Creek.

Little McGinnis Creek enters Montana Creek about 1/4 mile downstream from the end of the Montana Creek Road. It is a clear, spring-fed stream approximately 3/4 mile long and 6 feet wide at the mouth. McGinnis Creek at flood levels actually flows down Little McGinnis Creek. [*see further descriptions for these creeks, below*]

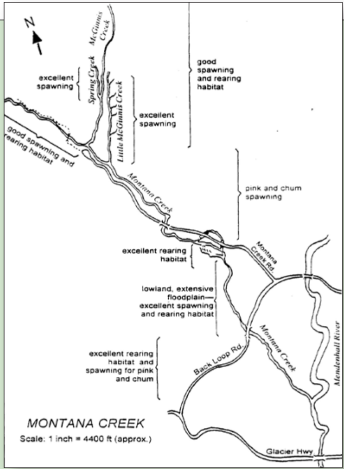
Montana Creek has wild stocks of **coho, pink, chum,** and **sockeye salmon, cutthroat and rainbow steelhead trout,** and **Dolly Varden**.

King salmon adults straying from the Mendenhall Ponds salmon rearing facility spawned in Montana Creek from 1976 through 1978, but did not produce a self-perpetuating run. [*seeding and smolt-stocking in the creek itself in 1952 & 1986, respectively, also failed*]

Montana Creek has a very small run of wild steelhead. In 1976, 1986 and 1987, steelhead smolts were released into Montana Creek to provide new sport fisheries; however these releases were not successful, and viable fisheries failed to develop.

Montana Creek fish populations have been documented through trap surveys and salmon escapement counts, intermittently since 1960. Montana Creek is a very important producer of coho and chum salmon for Juneau fisheries. A DV mark and recapture study in 1983 revealed that at least 19,000 dollies to 6 inches used Montana in the summer season.

The drainage provides a wide variety of fish habitat. In the upper reaches, the water flows fast, and there are numerous pools with excellent overhead and instream woody cover.



In the middle section, the gradient is lower and the pools are larger. In the lower section the gradient is low, and the stream provides excellent rearing conditions for coho salmon and cutthroat trout.

Chum and coho salmon, Dolly Varden, and cutthroat trout spawn in the middle and upper reaches, with the heaviest spawning occurring in the upper mainstem of Montana, Little McGinnis and McGinnis Creeks.

Numerous small inlets are found in the wetlands adjacent to the lower mainstem and they provide excellent seasonal rearing habitat.

Montana Creek has been a favorite location for sport fishing for many years. Conservative DV regulations reduced angling effort for a period of years, and Montana Creek is currently the only stream open to sport fishing that is restricted to the use of artificial lures only.

Montana Creek presently provides thousands of angler hours of effort. The ADF&G Sport Fish Division, in cooperation with CBJ, constructed an angler access trail from the mouth of Montana Creek upstream to the rifle range bridge in 1989. This trail is used extensively, both by anglers and hikers.

A gravel road impacts a section of the creek. Sedimentation from the road and pollution from 3 houses on the floodplain currently pose the greatest habitat problem for Montana Creek.

There is currently some recreational gold mining activity in Montana Creek. Panning is allowed any time of year; however the use of small dredges is allowed only during the month of June.

McGinnis tributary: McGinnis Creek is about 3 miles long, 15 feet wide, and 2-5 feet deep, with a moderate gradient, swift flow and numerous pools. The streambed substrate ranges from large boulders to small gravel. The stream is seasonally glacial. The streamflow fluctuates greatly and moves a lot of bedload and large woody debris during floods.

A clear, spring-fed tributary called (unofficially) Spring Creek enters McGinnis about 1/2 mile above the confluence of McGinnis and Montana Creeks. The stream is about 3/4 mile long, 8 feet wide and up to 1 foot deep.

Left: Excavating the Kax̲ fish trap. • **Right**: Reconstructing the trap at the Alaska State Museum.

Human history

For Tlingit land use of the 10 watersheds described in this CBJ interpretive project, I've relied mostly upon Goldschmidt & Hass (1946). Although it has useful detail for most of the named streams reaching the coast between Daxanáak, *between 2 points* (Berners Bay) and T'aak̲ú Kunaa Geeyí, *glacier-bidding bay* (Taku Inlet), there is only one passing comment about Kax̲digoowu Héen, in a discussion of Áak'w, *little lake* (Auke Lake):

> *"The natives did not fish Auke lake, but they did trap and hunt in this territory, and also up the Montana Creek which flows nearby. A native named Fish Creek John trapped . . .the whole area between Eagle River and Mendenhall Glacier. This area is no longer [1946] used by Juneau Natives."*

Partly, this low level of use [1] by mid-Century would have been the result of pre-emption by white miners who for the previous 50 years had laced the Juneau back-country with trails and cabins. They no doubt also emptied the land of venison and furbearers. But another factor is that the Tlingit were very coastally oriented people; most of their encampments and permanent villages were on estuaries or shorelines with good views. Kax̲digoowu Héen—as important as it was ecologically—has not reached the coast for about 200 years (see *Two centuries at Riverbend*).

But prior to the peak of the Little Ice Age, when land was lower and relative sea-level higher, you could have paddled a canoe from Aanchgaltsóow, *nexus town* (Auke Rec) around the peninsula and up to today's lower Kax̲ footbridge. Old-growth forest dominated the proto-Valley, and the riparian spruces on Kax̲digoowo Héen were probably older and larger than today's post-LIA 'teenagers.' The Kax̲ channel was probably not as confined to the valley wall by Mendenhall flood-plain deposition as it is today, therefore freer to meander and probably less flood-prone. It was at this time that someone built the famous fish trap—*Kax̲degoowo Héen Sháali*–discovered by retired ADF&G fish biologist Paul Kissner in 1989.

The fish trap The trap was a long cylinder, anchored in the bottom sediment of the stream, with a funnel in one end that admitted fish but discouraged exit. The opening may have been too small for salmon, instead targetting smaller fish like *Dolly Varden*. Longitudinal staves were made of hemlock, while the bent hoops were of spruce branches. Lashings were of spruce root.

Radiocarbon dates suggest the trap was used 500- to 700 years ago. It was the first basketry-style trap to be discovered *en situ* on

1 The CBJ fish trap brochure says that "*in recent times, the Tlingits gaffed fish out of Montana Creek.*" It also notes that the "*traditional caretakers of Montana Creek are members of the Dipper House of the Dog Salmon Clan from the Raven moiety.*" It is not specific about the time period referred to.

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the Northwest Coast. Apparently, the trap was buried quickly by an advancing river bar. High iron content in the groundwater (see preceding map of iron levels by Barnwell & Boning) helped to preserve the wood.

The best on-line description of the trap and its re-assembly is from Ellen Carrlee: [2] I refer you to her website for most of these details. Most interesting to me, as a landscape-scale naturalist and student of human history, is her refreshingly frank discussion of age and provenance. There exists throughout Lingít Aaní an almost reflexive tendency to claim any pre-contact artifacts or midden, regardless of age, as Tlingit (or to the south, Haida or Tsimshian). Most archeologists and anthropologists, in the interests of continued respectful collaboration, say little to question this. Some, in fact, actively promote it. I consider this anti-scientific, and worry that it's taking us down paths that will be hard to turn from if or when new evidence suggests more rapid cultural turnover on the Northwest coast (***boldface*** is mine):

> *" In 1991, salvage archaeology rescued a **500-700 year old basketry fish trap** in Juneau, Alaska. . . . Ownership of the trap was complicated from the beginning. The area where the trap was found is the traditional fishing territory of the Auk Kwaan of the Tlingit people. (A kwaan is a region controlled by several clans.) Genealogical reckoning indicates these people arrived from the Stikine River area near modern Wrangell **several hundred years ago**. Montana Creek is a freshwater river, but also influenced by tidal action. It was therefore somewhat unclear if the location was today the property of the City of Juneau, or the State of Alaska. Non-navigable freshwater rivers are the jurisdiction of the City, while navigable freshwater rivers and intertidal areas are the jurisdiction of the state. At the time of excavation, the City formally declined ownership, although the waterway has some tidal influence and is only navigable by a canoe or kayak. The Alaska State Museum (ASM) has not accessioned the trap into its permanent collection, and local Native groups including the Sealaska Corporation, Tlingit-Haida Central Council, and the Auk Kwaan continue to take an active interest in the trap."*

I admire Ellen for pointing out (though you have to read between the lines) that this trap was probably here ***before*** Aak'w Kwaan arrived ~peak LIA. That idea is a tough sell in communities rebuilding their cultural identities and searching for messages from the ancestors.

The miners Kax̲-McGinnis area watershed saw some of the earliest prospecting in the Juneau area. According to Orth (1967):

> *"The origin of the name [Montana Creek] is unknown. The name was in use in the 1880s, but the stream was called Brennan River in 1881 by Edward J. Brennan who with John McInnis located placer claims along the stream."*

Gastineau Channel Memories, Vol II, (Pioneer Book Committee, 2004) suggests that logging on Kax̲—assuming it was done in the late 1950s or early 1960s, was probably by Long and Hamlin. Joe Smith's entry says:

> *"Joe Murphy and I started a logging and sawmill business at Lemon Creek. The sawmill was later enlarged and moved to Montana Creek. In 1953, the sawmill operation was sold to Maurice Long and Stan Hamlin."*

Other post-contact activities are detailed below in several sidebars. As for the existing Kax̲ Trail(s), TU (2006) says:

> *"In the lower reach, ADF&G and CBJ built a trail in 1989 connecting the Mendenhall River to the rifle range. This trail facilitates access to the creek, however it is not maintained."*

2 https://ellencarrlee.wordpress.com/2009/03/19/conservation-and-exhibit-of-an-archaeological-fish-trap/

Montana Basin prospects

From Knopf 1912:

"On the head of Montana Creek, at altitudes of about 2,500 feet, a considerable number of stringer lodes have been discovered in the footwall of the schist belt. They embrace some of the oldest lode locations in the district, having been made as early as 1882. They have been difficult of access, but the recent construction of the Government road up the main valley of Montana Creek has ameliorated this difficulty.

At Patton claim [*18 on map*] a quartz vein trending obliquely across the strike of the country rock is exposed along a series of open cuts for several hundred feet. The inclosing rocks are thinly stratified, fine-grained biotite schists; they strike N40°W and dip 50°NE. . . .The ore body is narrow . . . from a few inches to 2 feet. The quartz is stained by iron oxide and shows no sulfides but carries fine colors of free gold.

The mineralized zone in Montana Basin extends northward into Windfall Basin. On the Smith & Heid property [*17 on map*], 2 tunnels, aggregating 500 feet in length, have been driven to prospect a body of highly arsenical quartz ore exposed on the surface at 2,000 feet. . . [the ore] carries good values in gold.

Knopf also described the Mendenhall Group [22 on map], just north of Tolch Rock:

"The Mendenhall Group consists of 6 claims extending end to end, situated on the north-west side of Mendenhall Glacier near its foot. The main developments consist of an open cut 30 feet wide and a crosscut tunnel 85 feet long that attains a depth of 30 feet beneath the outcrop. The ore body is a stringer lode consisting of a belt of black slates . . .penetrated by numerous veinlets of quartz. The rocks strike N20°W and dip vertically.

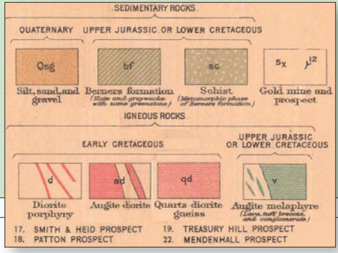
Another prospect of greatly different character consists of the mineralized portions of a massive amphibolite dike. . . irregularly cut by veinlets of albite and calcite. . . .At the main open cut about 15 feet of such rock is exposed; free gold can be panned here.

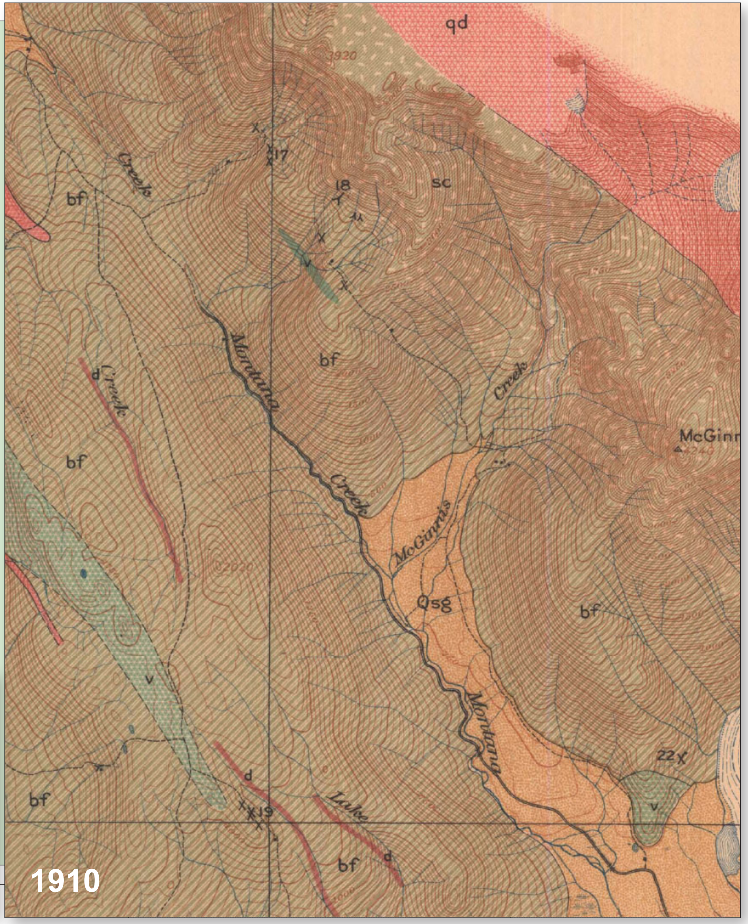
For description of the Treasury Hill Prospect, see auke-scoping.pdf.

McGinnis mines

From Roehm 1940:

"The McGinnis Creek Mining Group of claims adjoins the Mansfield group of patented claims on the north at a point on McGinnis Creek 2 miles above its junction with Montana Creek. The property is accessible via . . . Montana Creek Road's termination at Watson's cabin. Thence a trail leads to the junction of Montana Creeks





and along the left limit of McGinnis Creek to the Sunrise claim at an elevation of 480 feet, and a distance of 2 miles.

The group of 9 claims . . . were staked during the spring and summer months of 1939. The present owners and original stakers are S. Whitfield, L. Sibley and G. Graff of Juneau, Alaska.

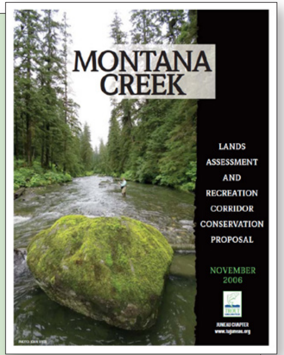
McGinnis Creek cuts greenstone, greenstone schist with intercalated slates along its low course. The bands of greenstone and slates vary in width from a few feet to several hundred. The general strike is N30ºW, and the dip is steep to the northeast. The dip gradually becomes steeper as one proceeds up the creek. The formations, as an approach is made to the main batholith to the east, become more intensely sheared and schistose and contain greater amounts of sulfides. Since McGinnis cuts the formations at nearly right angles, NE-SW, a good cross-section of the formation can be seen along the walls.

On the Sunrise claim the creek valley narrows to a canyon 100 feet in width with walls 40 to 50 feet high. The canyon walls consist of hard greenstone somewhat schisted. Numerous boulders and coarse gravels are found in the creek bed.

At the NE end of the Sunrise claim, elevation 535 feet, the canyon ends and the upper basin valley begins. At theis point a band of graphitic slate 150 feet in width shows on the banks. This band is highly folded and schisted. The footwall contains numerous veinlets and stringers of quartz formed by the folding. These are mineralized with pyrite and the owners reported assays to $135/ton in gold. The hanging wall of this band is a schist of greenstone variety somewhat mineralized, but softer than the greenstone below.

At a point 200 feet above the line of the Sunrise claim, on the Wyoming claim on the left limit of the creek at the junction of a small tributary, ground sluice mining was attempted. A cut into a talus slide up the tributary extended from creek level at 580 feet for a distance of 130 feet. The cut at the face was 30 feet deep. . . A section of the cut 50x20x6 feet produced 3 ounces in gold. . . The creek bed is steep and contains numerous boulders from this point up for a considerable distance and would be unsuitable for placer mining.

Conservation issues



From Trout Unlimited, 2006:

"This document provides the CBJ with an overview of the value of the Montana Creek Watershed to Juneau residents and an outline of management recommendations to ensure the sustainability of fish habitat and recreational and educational opportunities.

Threats to Montana Creek include development of floodplains and wetlands, non-point source pollutants, and resource extraction activities. Watersheds such as Duck Creek have suffered from a lack of stream setbacks and prudent land use designations and zoning. To avoid repeating these mistakes, forward-looking municipal planning should recognize the existing multiple uses and values of the riparian lands in the Montana Creek Watershed.

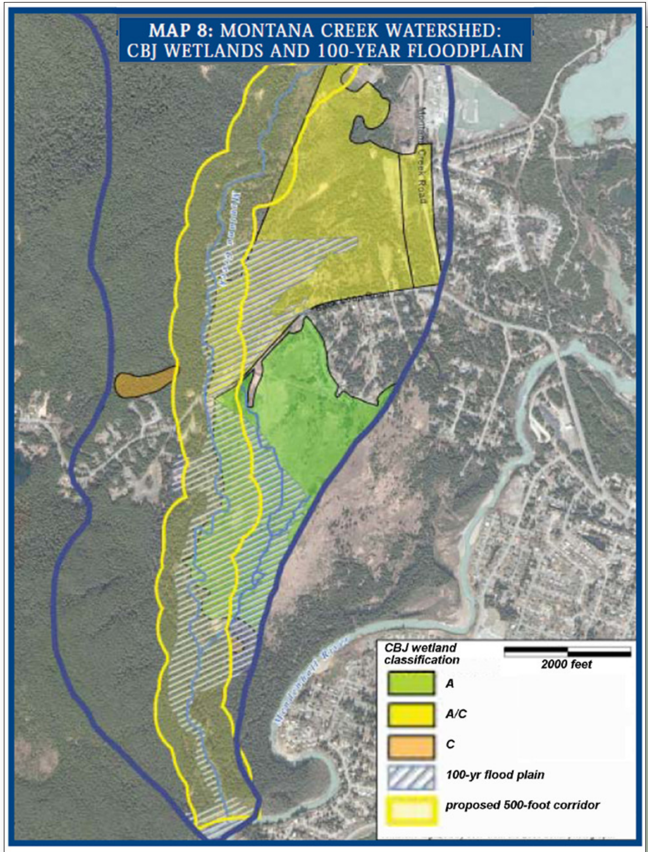
We specifically recommend the following:

1. Establish a Stream Conservation Corridor extending 500 feet from either bank of Montana Creek. The proposed corridor is only .78 square miles or 5.1% of the entire 15.23 square mile Montana Creek Watershed. An estimated 74% of the corridor is classified as a wetland and/or lies within the 100- year floodplain and is largely unsuitable for development. A wider corridor is needed to protect side channels and wetlands that are vital salmon, trout, and char habitat and to protect Montana Creek from contaminated runoff.

2. Protect all CBJ wetlands associated with Montana Creek. Wetlands provide benefits such as flood attenuation, groundwater recharge, nutrient storage and contributions to surface water systems, and fish and wildlife habitat. CBJ should cease granting permits for developmenton Class A wetlands associated with Montana Creek.

3. Build a trail along Montana Creek and link it to the existing trail network. This trail will greatly increase access for hikers, anglers, and other user groups. In the CBJ West Mendenhall Valley Greenbelt Plan a proposed trail parallels Montana Creek to the west. The trail connects the existing paved bike path along the Mendenhall River to Back Loop Road. It then continues on the east side of the creek to Montana Creek Road near Community Garden. We propose the construction and maintenance of a gravel trail for non-motorized use, similar to the recently improved Herbert River Trail.[1] To avoid conflicts with private property

1 RC: Having recently hiked all of this proposed trail corridor, I find it unrealistic. To construct a high-grade trail in this dynamic flood-plain–bridging dozens of overflow channels–designed to survive 15-ft+ floods (See *Hydrology*) would cost millions of dollars, and have unacceptable impacts to fish and wildlife. In theory, I agree that trails increase public appreciation for wild land, and built a constituency for stewardship. But a Montana trail system comparable in grade to the new Herbert trail would cause more problems than it would solve.



owners and wildlife habitat along the stream banks, it would be sited a minimum of 300 feet from Montana Creek and a minimum of 100 feet from the outer boundary of the corridor. Currently this stretch of Montana Creek is very difficult to access due to a lack of connectivity between existing trails and their unmaintained condition. This trail will greatly increase access for hikers, anglers, and other user groups. It will fulfill the CBJ Greenbelt Master Plan goal of connecting neighborhoods with trails and will offer an ideal connection to a trail circumnavigating Auke Lake.

4. Abandon both the potential road corridor connecting Montana Creek with the Herbert/Eagle River area via Windfall Lake and planning for a heliport. A road or a heliport within the watershed would be detrimental to recreational values and would pose serious threats to water quality and adjacent riparian habitat.

5. Educate the public on stream stewardship. Montana Creek is an ideal location for youth education programs and represents a living laboratory for other areas of study by Juneau students as well as UAS.

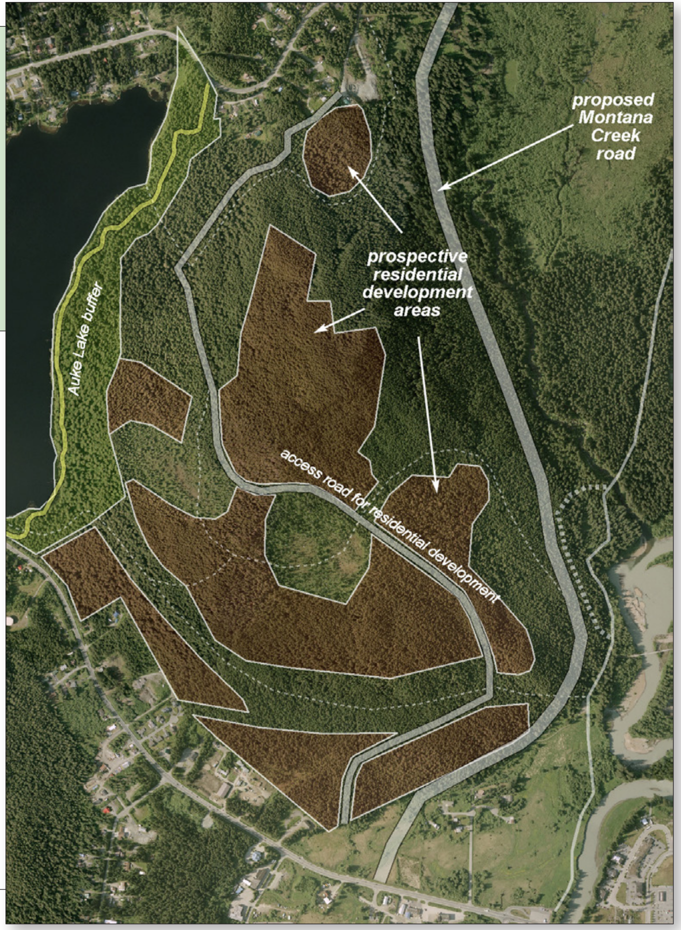
6. Enforce laws and ordinances protecting fish habitat and watershed resources. Illegal off-road vehicle use in the upper watershed has damaged wetlands adjacent to Montana Creek as well as portions of the McGinnis Creek headwaters. While ATVs are allowed on the road right-of-way in upper Montana Creek, off-road vehicle recreation is subject to local ordinances governing riparian disturbance as well as state regulations that protect anadromous fish habitat (AS 41.18.870). Enforcement is difficult and often does not occur. Trout Unlimited proposes partnering with the Juneau Police Department and Alaska State Troopers so that off-trail ATV use and illegal dumping may be curtailed."

The Montana Creek road idea

From JWP (2009):

"The 2004 "Auke Bay Corridor Study" by the DOT&PF mentions their long-term transportation goal of creating a bypass of the Auke Bay community starting at Industrial Blvd., following the east side of Hill 560, crossing Back Loop Road at Goat Hill and continuing behind the community of Auke Bay and to connect Glacier Highway near Auke Nu Creek. These proposed projects would be the largest development in the watershed since construction of Back Loop Road."

It's interesting that this road proposal is still out there, popping up in various forms. The latest is its inclusion in the prospective development map for Hill 560, on which it is labeled: "*Toner-Nordling, 1985"* The map helpfully notes "*adjusted to avoid equestrian trail.*" Considerate of the planners to avoid impacts to horses!



III Appendices

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