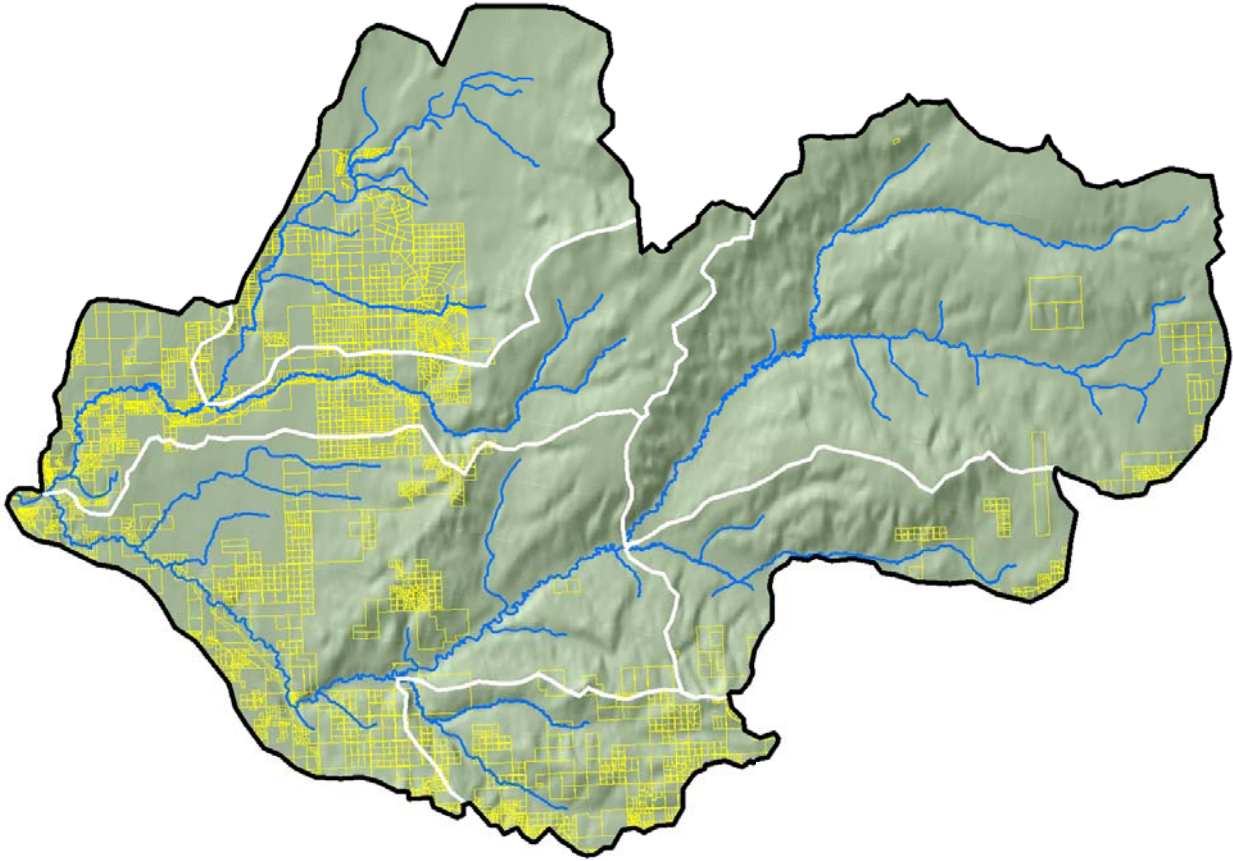




Anchor River Watershed Action Plan



Actions to Manage, Protect, Restore and Monitor
Watershed Health to Ensure Healthy Salmon Populations
for Future Generations

July 2007



ANCHOR RIVER WATERSHED ACTION PLAN

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Summary

The Homer Soil and Water Conservation District, in partnership with Cook Inletkeeper, has used data loggers to collect continuous temperature data in salmon streams on the lower Kenai Peninsula since 2002. Monitoring has revealed that water temperatures in the Anchor River are frequently above state-assigned standards set to protect spawning and passing fish. Water temperature is one of the most important factors in the health of stream ecosystems and the fish they support. To address temperature concerns as well as turbidity and habitat-related issues, the Homer District has identified action steps to manage, protect, restore and monitor watershed health to ensure healthy salmon populations for future generations. Actions are aimed at improving protection of stream-side vegetation, wetlands, and instream flows; increasing fish passage to small tributaries; and reducing anthropogenic sources of sediment. These actions will help build watershed resiliency and minimize impacts on salmon populations from climate change and increasing human development.

Action steps include:

- 1) provide relevant information to Kenai River Center, Kenai Peninsula Borough staff, and elected officials to improve existing ordinances for salmon habitat protection;
- 2) build public support to strengthen new Kenai Peninsula Borough road and sub-division ordinances that are currently being developed;
- 3) encourage new road and culvert design to protect riparian habitat and ensure fish passage into small tributaries;
- 4) prioritize funds for culvert restoration projects;
- 5) catalog anadromous fish presence throughout the Anchor River watershed especially in 1st order streams where data is typically lacking;
- 6) ground truth and update baseline impervious cover analysis and plan for future analyses;
- 7) work with local land trust organization to prioritize future partnerships based on temperature refugia information;
- 8) encourage and promote the use of Low Impact Development (LID) techniques;
- 9) replace Sterling Highway culverts with a bridge on the north fork of the Anchor River;
- 10) replace culverts along the south fork of the Anchor River that are impediments to fish passage;
- 11) inventory culverts in the North Fork Anchor River watershed and identify highest priority perched and damaged culverts that provide the greatest impediment to upstream habitat;
- 12) initiate planning for restoration of the Watermelon Trail/Beaver Creek crossing;
- 13) restore stream banks at the Picnic Hole site;
- 14) restore the old gravel pit site on the North Fork Road;
- 15) monitor water temperature trends in the Anchor River;
- 16) evaluate stream characteristics that help buffer water temperatures from the effects of warming air temperatures;
- 17) monitor macroinvertebrate communities to track recovery from the 2002 floods; and
- 18) maintain a stage gage on the Anchor River to monitor stream level trends.



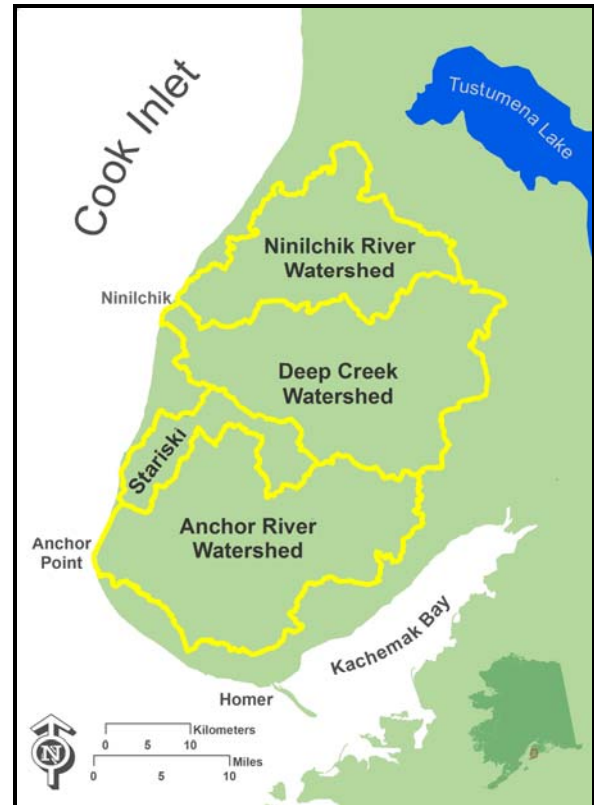
Where is the Anchor River Watershed?

The Anchor River watershed lies in the southern part of the Kenai Peninsula and encompasses 225 square miles. The region is bounded on the west by Cook Inlet and on the east by the Caribou Hills. The watershed includes 164 miles of anadromous (salmon-bearing) streams and is 48% wetlands.

The climate of the area is considered to be transitional between continental and maritime. Temperatures in Anchor Point, at the mouth of the river, range from 4 to 22°F in the winter and 46 to 66°F in the summer. Average annual precipitation is 20 inches in Anchor Point. Most of the rain falls during August, September, October, and November. High stream flows also occur in April and May when air temperatures increase, resulting in snowmelt and ice breakup.

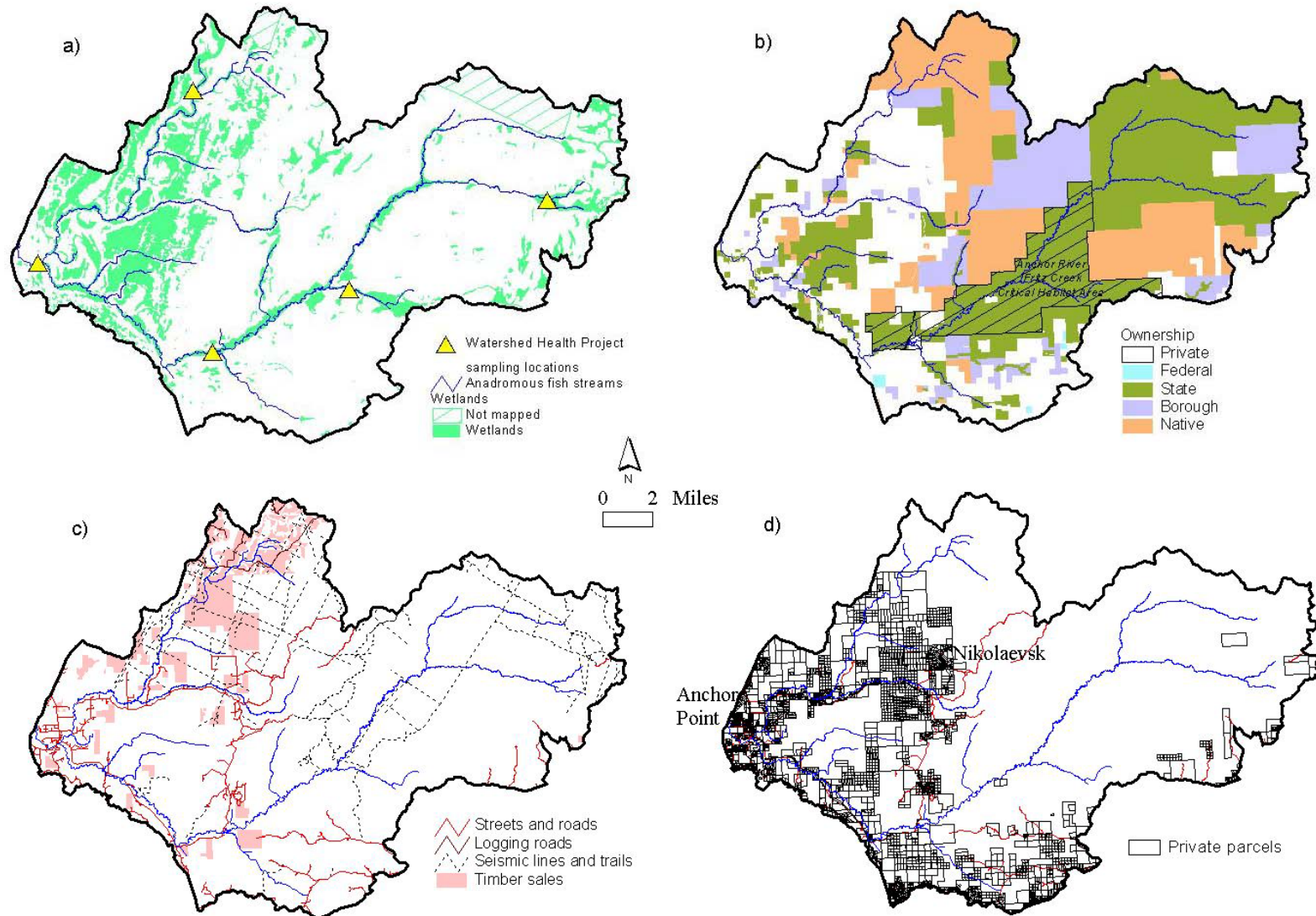
The watershed is home to many species of wildlife. A wide variety of seabirds, shorebirds, raptors, waterfowl, and songbirds live in the watershed. Moose, black and brown bear, fox, lynx, coyote, and many small mammals are found here. Finally, the streams host a variety of fish, including chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), Dolly Varden char (*Salvelinus malma*), and steelhead (anadromous) and rainbow (resident) trout (*O. mykiss*).

The unincorporated town of Anchor Point sits at the mouth of the watershed and presently has about 1,800 residents. The economic base of Anchor Point is commercial fishing, sport fishing, and tourism. The vast majority of the watershed is in state and native ownership. 27% of the watershed is privately owned.



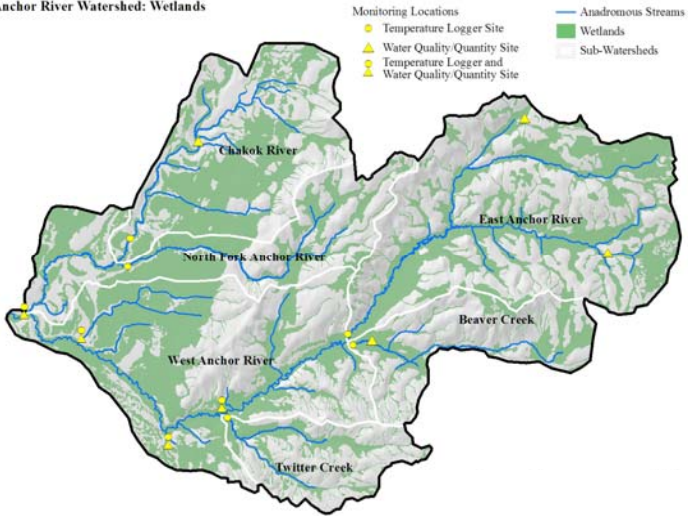
The boundaries of the Anchor River watershed are delineated on page 3. The extent of wetlands, anadromous streams, roads, timber sales, and land ownership are illustrated based on data collected in 1998. These maps were updated with more current information in 2005 and sub-watershed boundaries were delineated (page 4). An inventory of watershed and sub-watershed characteristics is on page 5.

WATERSHED DELINEATION (1998): Anchor River watershed: a) wetlands and anadromous fish streams; b) land ownership; c) roads, trails, and timber sales; and d) communities and private parcels. Anadromous streams mapped by Alaska Department of Fish & Game; wetlands mapped by US Fish and Wildlife Service National Wetlands Inventory; and ownership, timber sales, trails and roads from Kenai Peninsula Borough data.

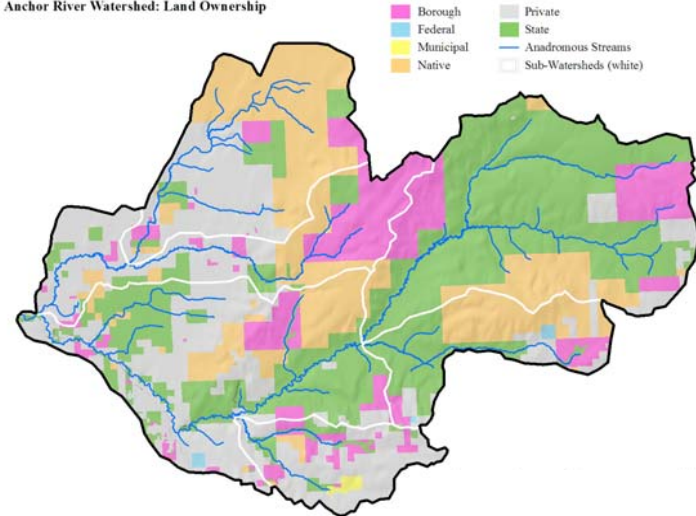


SUB-WATERSHED DELINEATION (2005): Watershed and sub-watershed characteristics have been updated with information from the Alaska Department of Fish and Game (anadromous streams, 2005), Kenai Peninsula Borough (land ownership, road and harvest data, 2005), Alaska Geographic Data Committee (sub-watershed boundaries, 2005 unpublished), and the Kenai Watershed Forum (wetland, trail and seismic data, 2005).

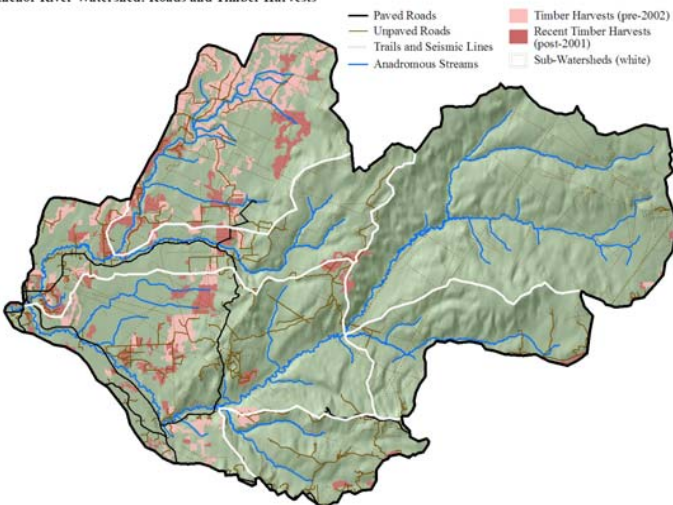
Anchor River Watershed: Wetlands



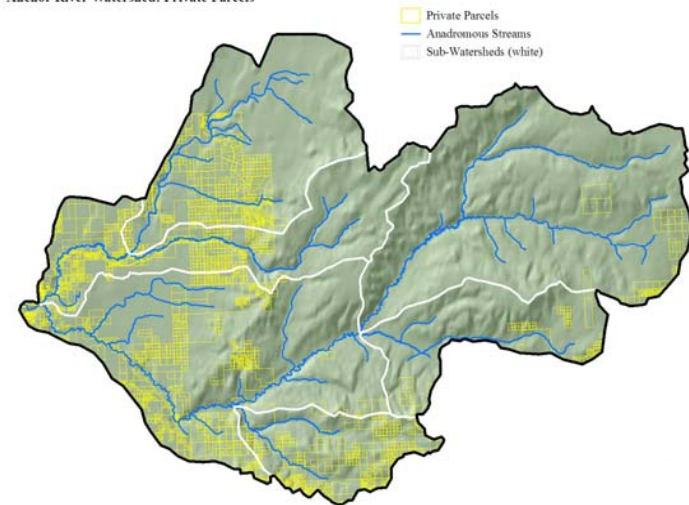
Anchor River Watershed: Land Ownership



Anchor River Watershed: Roads and Timber Harvests



Anchor River Watershed: Private Parcels



WATERSHED INVENTORY: Anchor River watershed and sub-watershed characteristics based on 2005 GIS analysis. Impervious cover determined using Quickbird satellite imagery (2' pixel) from 2002-3.

	Watershed	Sub-watersheds					
	Anchor River	East Anchor River	Beaver Creek	Twitter Creek	Chakok River	North Fork Anchor	West Anchor River
Drainage Area (sq. miles)	224.9	65.2	20.0	15.7	38.1	30.9	55.0
Anadromous Streams (miles)	164.1	43.5	12.5	9.4	30.0	25.9	42.8
Total Roads (miles)	231.3	5.7	11.4	31.6	41.3	49.5	91.8
paved	40.7	0.0	0.0	3.6	1.9	11.8	23.6
unpaved	190.6	5.7	11.4	28.0	39.4	37.7	68.2
Total Crossings (#)	42	1	3	0	10	11	17
paved roads	12	0	0	0	0	3	9
unpaved roads	30	1	3	0	10	8	8
Land Ownership (%)							
Borough	14.1	15.4	9.9	16.1	7.3	30.3	9.2
Federal	0.3	0.0	1.6	0.0	0.0	0.0	0.5
Native	22.0	12.7	37.2	3.6	48.9	17.8	16.5
Private	26.6	5.2	14.1	63.0	34.0	38.5	35.1
State	36.8	66.7	37.3	13.8	9.8	13.4	38.7
Municipal	0.2			3.5			
Total Wetlands (%)	48.2	46.4	34.7	32.9	53.3	51.9	54.03
Total Timber Harvest (% of area)	10.3	0.7	0.7	3.6	30.8	13.5	11.1
Recent Timber Harvest (% , 2001 - 2005)	4.5	0.5	0.7	1.5	10.2	7.1	6.0
Impervious Cover (2002-2003)	1.16	0.12	0.28	1.15	1.09	2.39	2.06



What do we know about the health of the Anchor River?

INITIAL WATERSHED CONCERNS

Land use in the Anchor River watershed has rapidly changed over the last twenty years with increased road building and logging. Prior to 1990, much of the watershed was relatively undeveloped with access into the backcountry provided only by trails along seismic lines. Logging activity increased after the forested lands were infested by the spruce bark beetle (*Dendroctonus rufipennis*) and concerns grew about fire danger due to downed or standing beetle-killed trees. Point source concerns identified at the start of the project included road building, logging, and gravel mining. Non-point source pollution concerns were related to sedimentation and increasing urbanization.

MONITORING PLAN

The Lower Kenai Peninsula Watershed Health Project was developed in 1998 by the Homer Soil and Water Conservation District, in partnership with Cook Inletkeeper, with an objective to inventory water quality and characterize the health of the Ninilchik River, Deep Creek, Stariski Creek, and Anchor River watersheds. The study was designed under the direction of a Technical Advisory Committee of scientists from federal, state and local agencies as well as Tribal associations, community groups, and the University of Alaska.

Using methods outlined in the project's EPA- and DEC-approved Quality Assurance Project Plan, four sites on the Anchor River were monitored for discharge, temperature, dissolved oxygen, pH, conductivity, nitrate-nitrogen, ortho-phosphate, ammonia-nitrogen, total phosphorus, color, turbidity, settleable solids, total suspended solids and bacteria.

Monitoring goals were to 1) collect baseline data and determine natural variability over time for each parameter, 2) compare data with state water quality standards and federal recommendations, and 3) educate local citizens about water quality issues. Biological monitoring and habitat assessments were added to the project in 2003 using University of Alaska Anchorage, Environment and Natural Resources Institute's (ENRI) technical-level bioassessment methods.

BASELINE DATA

With significant support from the Alaska Department of Environmental Conservation through Section 319 Clean Water Act grant funds, the Homer District and Cook Inletkeeper collected year-round water quality and quantity data from 1998-2004. Bioassessment data was collected in 2003-2004 with support from an EPA Regional Geographic Initiative grant. The impervious cover analysis was supported by a U.S. FWS Alaska Coastal Program grant.

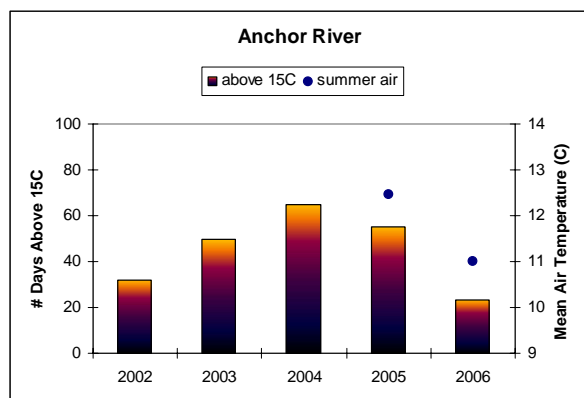
ANNUAL REPORTS

Annual reports were produced in January 2000, August 2000, September 2001, September 2002, and October 2003. Reports were distributed widely to landowners, land managers, resource users, policy makers and elected officials and made easily accessible on the web. Outreach efforts included presentation to fishing groups, community groups, agency personnel, and local researchers with press releases sent to local and statewide radio and newspapers.

FIVE YEARS OF BASELINE DATA

In November 2004, the Homer Soil and Water Conservation District and Cook Inletkeeper produced a comprehensive report that compiled more than five years of baseline data on the Anchor River. Based on these data, water quality is high in this salmon stream. However, temperature exceedances are increasing and may pose a risk to migrating salmon as well as egg and fry survival. In addition, twenty-two percent of the total phosphorus measurements are above the level suggested by EPA for streams and rivers. Determining turbidity exceedances is difficult because Alaska's standard requires an understanding of natural conditions within the watershed. Since this was baseline data, prior natural conditions are not known.

In October and November 2002, the lower Kenai Peninsula experienced flood events not seen in the last 50-100 years. Channel scour, back erosion and major habitat alteration reshaped salmon stream channels and riparian habitat. Based on results from sampling macroinvertebrate communities on the lower Anchor River, diversity has not returned to pre-flood levels and abundance numbers show a notable downward trend.



In 2006, water and air temperatures were cooler and the number of exceedances decreased at the lower Anchor River site.

PRIORITY ISSUES

In 2004, monitoring was redesigned to address the specific actions detailed on the Alaska Clean Water Action (ACWA) Priorities List, with water quality being a primary concern for temperature and turbidity on the Anchor River. Stream bank degradation related to fishing pressure and ATV crossings was also a priority concern.

1. Temperature - Temperature monitoring in 2004 - 2005 reveal that summer water temperatures continue to violate water quality standards in the Anchor River. From 2002-2005, high temperatures in the lower reaches occurred more often and earlier in the season, which may influence timing of migration to spawning beds. Warm temperatures also extend into the middle and upper reaches of the river.

There is a very tight relationship between water and air temperatures collected at Anchor River sites. The relationship between air and water temperature can change due to natural and human influences. Possible natural influences include: shade, flow rate, precipitation, water volume, channel width, channel depth, solar angle, wind speed, cloud cover, and relative humidity. Possible human influences include: loss of shade by removal of stream-side vegetation, lower stream flows due to water withdrawals, loss of floodplain connectivity due to channel straightening, increasing sedimentation by removal of upland vegetation, and less water storage due to wetland loss.

Extensive historical water temperature data are not available so there is no way to be certain if elevated temperatures are typical in the Anchor River or if they are new phenomena related to climate change. However, 73 years of daily climate data from the Homer Airport reveals an upward air temperature trend that began

worldwide in 1977 and appears to be accelerating. Since air and water temperatures have a strong relationship in the Anchor River, recent high air temperatures suggests that high water temperatures are also a more recent phenomena.

In 2006 - 2007, more intensive monitoring occurred to evaluate stream characteristics that help buffer temperatures to provide insight into the extent of thermal refugia for salmon and help determine the spatial variability of temperatures in rearing and spawning areas. Preliminary results from the Anchor River suggest that overhanging vegetation is an important habitat characteristic for cool water refugia.

2. Turbidity - Coble Geophysical (CGS) was hired by Community Rivers Planning Coalition to collect turbidity data in the North and South Forks of the Anchor River. The project's conclusions state: Clearly the turbidity of the Anchor River is affected by conflicting resource interests outside of natural conditions. The examples presented in this report include turbidity caused by general development (culvert installation), and by resource extraction (gravel). Presumably these activities will continue to grow with the rapid population and development growth currently occurring in the Anchor River watershed.

3. Stream Bank Impacts - Two years of monitoring and meetings with the South Peninsula State Parks Advisory Board and Community Rivers Planning Coalition identified the 90 Hole and the Picnic Hole as areas of concern on the lower Anchor River.

At the 90 Hole, sloughing rates on the left streambank appear to be both naturally and human caused. River energy is naturally eroding the streambank, yet fishing pressure on the bank is causing compaction and increasing the likelihood of erosion.



At the Picnic Hole, the streambank is sloughing and erosion rates are increasing, as seen by the increased exposure of the culvert on the left bank.

ATV Impacts -Off-road vehicle trail stream crossings can contribute to riparian zone degradation and bank alteration, which may increase sedimentation rates. The Watermelon Trail has a stream crossing at Beaver Creek that is a priority concern.





Actions to Manage, Protect, Restore and Monitor Watershed Health to Ensure Healthy Salmon Populations for Future Generations

The Homer District and Cook Inletkeeper have identified actions aimed at improving protection of stream-side vegetation, wetlands, and instream flows; increasing fish passage to small tributaries; and reducing anthropogenic sources of sediment. These actions will help build watershed resiliency and minimize impacts on salmon populations from climate change and increasing human development.

MANAGEMENT ACTIONS

1. Provide relevant information to Kenai River Center, Kenai Peninsula Borough staff, and elected officials to improve existing ordinances for salmon habitat protection.

The Kenai Peninsula Borough (KPB) has two relevant ordinances on the books to protect salmon habitat: Kenai Peninsula Anadromous Streams Habitat Protection Ordinance and the KPB Floodplain Ordinance. Both of these ordinances could benefit from new information garnered through this watershed assessment process. The Habitat Ordinance establishes a 50 horizontal feet set back on anadromous streams. This set back requirement should be reviewed to consider critical areas that provide important refuge from warm stream temperatures. The Floodplain Ordinance needs more updated maps using current imagery and could be revised to include a greater upstream extent. The ordinance currently only includes areas below the Sterling Highway bridge.

2. Build public support to strengthen new KPB road and sub-division ordinances that are currently being developed.

The Kenai Peninsula Borough has two ordinances pending that could benefit from greater consideration of riparian habitat and potential fish passage concerns. Ordinance 2007-10 would amend KPB Chapter 14.06, Road Standards; Ordinance 2007-11 would amend KPB Title 14, "Streets, Sidewalks, Roads and Trails" and KPB Title 20 "Subdivisions," Providing for the Construction of Roads to Borough Maintenance Standards Prior to Final Plat Approval.

3. Encourage new road and culvert design to protect riparian habitat and ensure fish passage into small tributaries.

There is a need to elevate the discussion with the Alaska Department of Transportation and Public Facilities about new road and culvert designs as an effective tool to maintain watershed resilience to climate change in areas of expanding population growth. Consideration of environmental factors before the project's design phase at ADOTPF will prevent environmental issue from being considered an impediment to the lowest cost design.

4. Prioritize funds for culvert restoration projects.

Fish passage must become a higher priority for availability of state-wide transportation funds. Culvert restoration projects need to be coordinated with new or rehabilitating road work. Legislators should be educated about culvert and fish passage concerns and the need to increase ADOTPF's fish passage improvement fund grant.

PROTECTION ACTIONS

5. Catalog anadromous fish presence throughout the Anchor River watershed especially in 1st order streams where data is typically lacking.

The Anadromous Fish Act (Alaska Statute 41.14.870) requires that an individual or government agency provide prior notification and obtain permit approval for all activities within or across a specified anadromous waterbody and all instream activities affecting a specified anadromous waterbody. The location of specified anadromous waterbodies is contained in the "Catalog of Waters Important for the Spawning Rearing or Migration of Anadromous Fishes." The Catalog is updated annually after public review. The catalog is lacking fish presence data on most first order streams in Alaska including those in the Anchor River watershed. Cataloging fish presence in the watershed will provide greater protections under the Anadromous Fish Act.

6. Ground truth and update baseline impervious cover analysis (2002-2003) and plan for future analyses.

Cook Inletkeeper performed an impervious cover analysis with Quickbird imagery from 2002-2003 to develop a baseline layer of impervious cover in the Anchor River watershed. More ground truthing is necessary to assess the degree of error. In addition an overlay of Borough platted roads (not constructed) should be added to provide a perspective on likely future development. This analysis should be completed every 5-10 years; planning for the next set of imagery should begin now.

7. Work with local land trust organization to prioritize future partnerships based on temperature refugia information.

Kachemak Heritage Land Trust has gathered data on the Kenai Peninsula to identify private parcels with the greatest conservation values. KHTL has identified 46 high priority parcels containing salmon habitat on the lower Anchor River. Of these 46 parcels, 4 are already protected by either KHTL or The Nature Conservancy. The Homer District should provide temperature refugia information to overlay important reaches that provide thermal refugia to KHTL maps. This important layer of information will strengthen these maps as valuable tools to identify conservation priorities for future land trust partnerships in the Anchor River watershed.

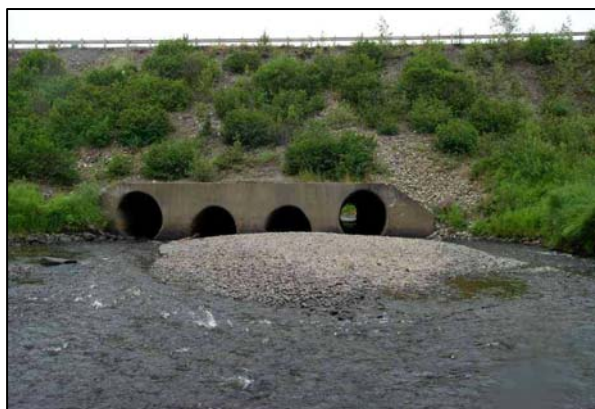
8. Encourage and promote the use of Low Impact Development techniques.

Low Impact Development (LID) is an approach to site planning, design and development that reduces stormwater impacts. LID aims to mimic pre-development hydrology, treat storm-water as close to its source as possible, and preserve natural drainage systems and open space. This contrasts with conventional stormwater management approaches geared to concentrating and collecting runoff and exporting it off-site as a waste product. Outreach efforts should be targeted at the Borough level, as well as at area businesses and local developers. Actions should include dissemination of information, organizing workshops and creating tax incentives for implementation of LID techniques.

RESTORATION ACTIONS

9. Replace Sterling Highway culverts with a bridge on the north fork of the Anchor River.

During the 2002 Floods this bank of culverts threatened to give way, which would have resulted in considerable infrastructure and habitat damage. This project needs to be a priority on the State Transportation Improvement Program list for human safety, infrastructure threats and anadromous stream protection.



10. Replace culverts along the south fork of the Anchor River that are impediments to fish passage.

Together with the Alaska Department of Fish & Game, the Kenai Watershed Forum has identified priority culverts to be replaced along the lower Anchor River: Sterling Highway/Two Moose Creek, Sterling Highway/Ruby Creek, North Fork Road/Ruby Creek. A great deal of quality rearing habitat is likely inaccessible due to poorly maintained and perched culverts.

11. Inventory culverts in the North Fork Anchor River watershed and identify highest priority perched and damaged culverts that provide the greatest impediment to upstream habitat.

A culvert inventory and assessment will be valuable for identifying priority culverts for restoration. This assessment has been done on the south fork of the Anchor River. Upstream habitat suitable for rearing fish should be assessed to prioritize culverts for restoration.

12. Initiate planning for restoration of the Watermelon Trail/Beaver Creek crossing.

The Watermelon Trail provides rare access into the upper reaches of the Anchor River watershed. The trail becomes an erosional gulley as it approaches Beaver Creek, which is in the Anchor River/Fritz Creek Critical Habitat Area. Planning should be initiated to rehabilitate this ATV crossing.

13. Restore stream banks at the Picnic Hole site.

Approximately \$70,000 has been acquired by Alaska State Parks to restore the Picnic Hole. These funds have been placed on the construction list with the other deferred maintenance items on the Anchor River State Recreation Area's 2007 work list. Construction of a trail and access to the river from the left streambank would be ideal, but on-site conditions and limited funds may prohibit this. Providing proper fishing etiquette information is recommended and could serve to reduce streambank impacts.

14. Restore the old gravel pit site on the North Fork Road.

During the 2002 floods, an old gravel pit site was recaptured by the North Fork of the Anchor river. Excessive sediment is entering the stream channel; connectivity to riparian habitat is minimal thus providing minimal shading. Planning for restoration of this reach should be initiated.

MONITORING ACTIONS

15. Monitor water temperature trends in the Anchor River.

Continued temperature monitoring will provide an understanding of the rate of rising temperatures and which tributaries are contributing the warmest water. With 5 years of temperature logger data already, the goal should be for a long-term (>20 years) data set.

16. Evaluate stream characteristics that help buffer water temperatures from the effects of warming air temperatures.

Habitat complexity, such as deep pools, overhanging vegetation, undercut banks, and large woody debris should provide some refuge from the warmest temperatures. Evaluation of stream characteristics that help buffer stream temperatures will provide insight into the extent of thermal refugia for salmon and help determine the spatial variability of temperatures in rearing and spawning areas. Preliminary work in the Anchor River suggests that overhanging vegetation is an important feature.

17. Monitor Anchor River macro-invertebrate communities to track recovery from the 2002 floods.

Bioassessment or macroinvertebrate monitoring should continue in order to track flood recovery. In cooperation with UAA, Environment and Natural Resources Institute (ENRI), future macroinvertebrate samples will be used to obtain ASCI scores and will be compared with previous samples and other regional streams. The recovery time of biological communities from floods events will provide another measure of watershed health.

18. Maintain a stage gage on the Anchor River to monitor stream level trends.

Water volume is likely to change in the coming years as climate change alters watersheds by affecting flooding frequencies, precipitation levels, surface and ground water volumes and other hydrologic characteristics. Summer baseflows may decrease with less snowpack, increased development, loss of wetlands, and increased water withdrawals. The City of Homer presently gets its drinking water from the Bridge Creek Reservoir, a tributary to the Anchor River. Future drinking water needs may require more water withdrawals from the Anchor River watershed. Stage gage data will provide the necessary hydrologic data needed to assess the instream flow reservation in the lower watershed.