

Road layers were intersected with watersheds and then total road lengths were summarized within each watershed. Road length summary was divided by watershed area to yield road density which was then normalized on a scale of 0 to 1 based upon highest density. These data do not include motorized recreational trails. The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of this data is most appropriate at the subwatershed or larger scale.

In the Mat-Su Basin, additional and improved roads and railroad routes are required to accommodate population growth. Roads can modify natural drainage networks and can affect all aspects of a stream ecosystem. Improperly sited and designed roads can accelerate erosion and sediment loadings by destroying or altering wetland, riparian, and other native vegetation, and channel bank and bed characteristics. These alterations often result in loss of natural landcover, degraded water quality, and increased flows. Roads and railroads can also separate wetlands and stop the surface flow of water, which results in downstream wetlands drying.

Because most housing and urban development continues to occur in the Palmer-Wasilla core area and along the Parks and Glenn Highways, the greatest density of roads occurs here as well. Existing infrastructure is already contributing to altered riparian vegetation, loss of natural communities, and degraded water quality there. Road density also parallels total development density, including impervious surfaces not related to roads, and indicates areas where natural habitats have been lost.

Mat-Su Basin - Vulnerability Road Density

Major Roads

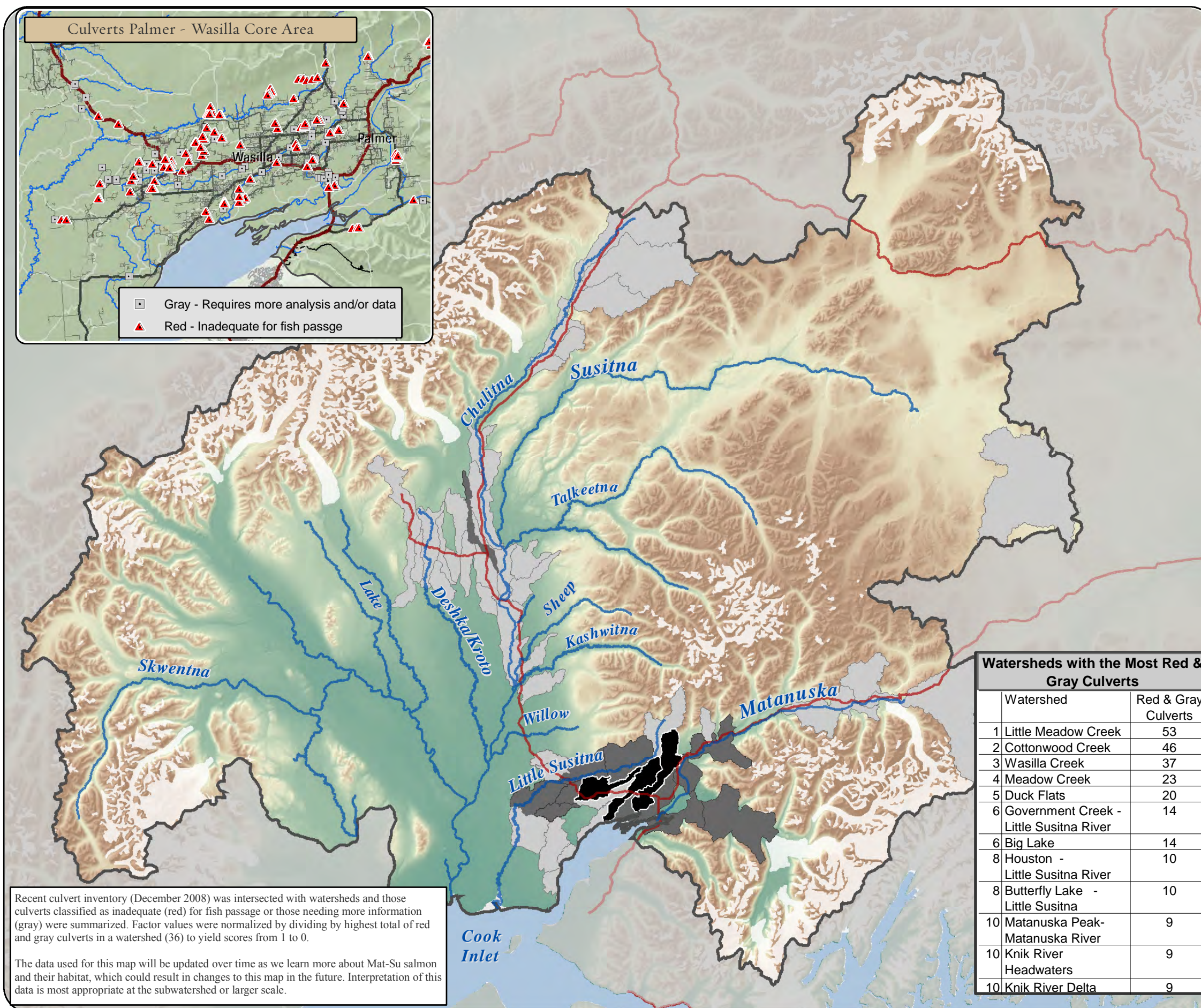
Road Density by Watershed

- high density
- medium density
- low density

0 10 20 40 Miles

0 20 40 80 Kilometers

DATA SOURCES:
Roads: Matanuska-Susitna Borough GIS, 2008., Municipality of Anchorage, 2008.

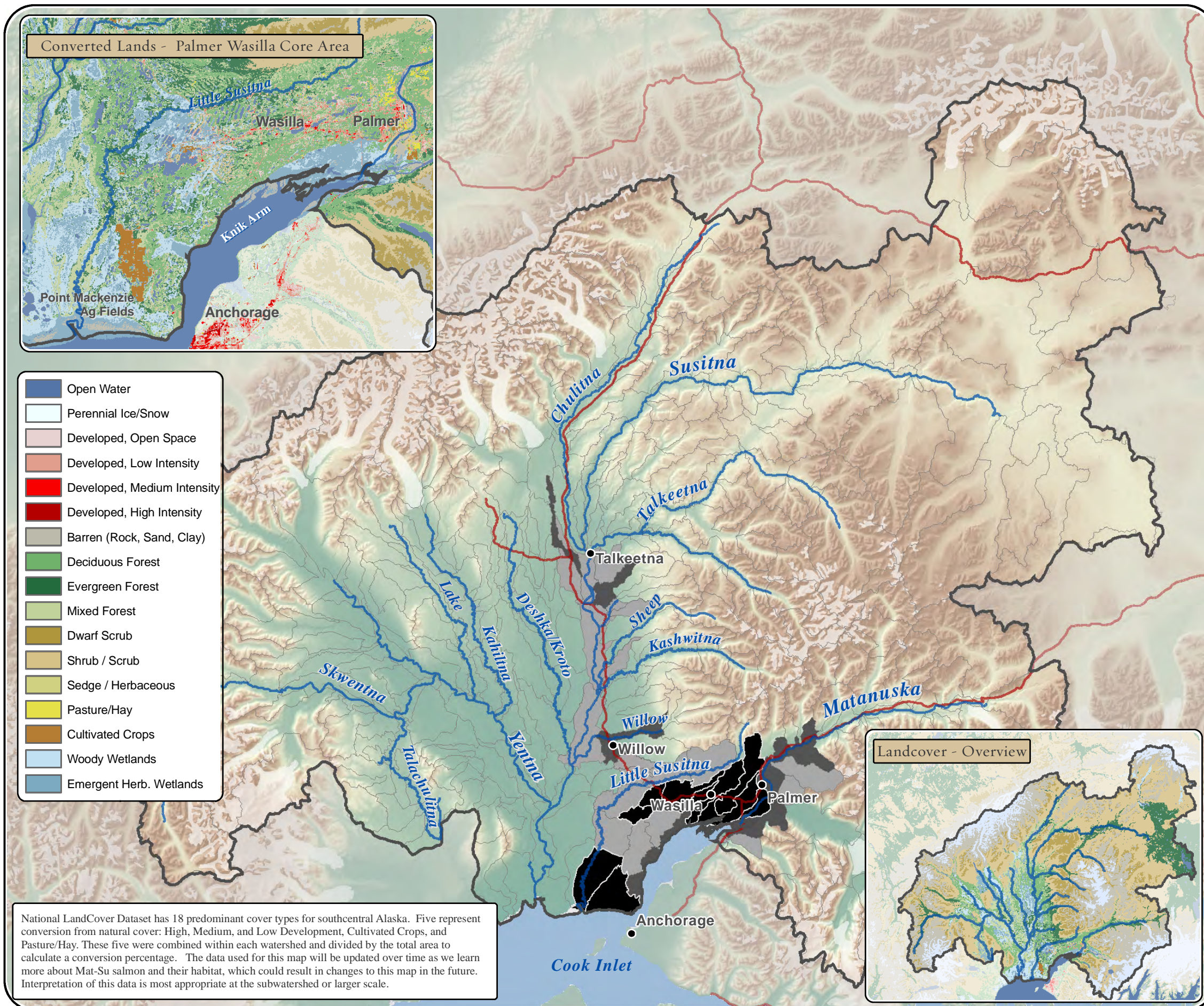


Alaska Department of Fish and Game (ADF&G) maintains an inventory of the location of over 320 culverts under private, state and borough roads and the railroad in the Mat-Su Basin. ADF&G assesses the culverts initially for fish passage based on juvenile (55 mm length) coho salmon. The assessment considers culvert slope, stream constriction, and culvert embedment or perch. Culverts receiving a 'Red' rating are considered inadequate for juvenile fish passage. A 'Green' rating indicates the culvert is adequate, and 'Gray' denotes culverts that require additional data and analysis to categorize fish passage. Within the Mat-Su Basin, more than one-third (130) of culverts are inadequate for fish passage; another 140 are considered unlikely to allow for adequate fish passage and require additional data and analysis to be assessed completely.

Conditions that impede passage are primarily high water velocity, turbulence, inadequate water depth, and elevated outfalls. In some cases, culverts that were designed to provide for fish passage may have not been installed properly or were inadequately maintained, becoming a fish passage impediment over time. Adult salmon may be able to navigate improperly sized or placed culverts, but these same culverts may prevent juvenile salmon from reaching productive rearing and overwintering areas.

Recent culvert inventory (December 2008) was intersected with watersheds and those culverts classified as inadequate (red) for fish passage or those needing more information (gray) were summarized. Factor values were normalized by dividing by highest total of red and gray culverts in a watershed (36) to yield scores from 1 to 0.

The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of this data is most appropriate at the subwatershed or larger scale.

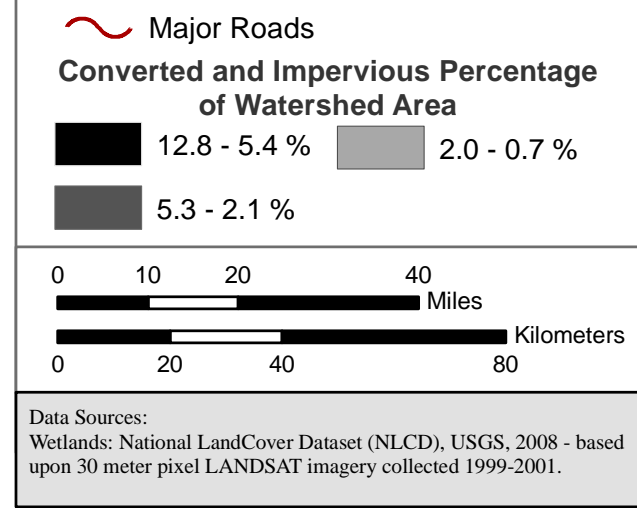


As watersheds are developed and urbanized, native vegetation is converted to lawns or replaced by impervious surfaces including rooftops, asphalt or concrete roads, and parking lots. This limits the amount of rainfall that can infiltrate the soils and be stored as groundwater. Runoff from watersheds with more impervious surfaces can cause more frequent and severe flooding, which can accelerate stream channel and bank erosion which in turns impacts spawning beds and rearing habitat. Severe flooding can reduce salmon production by flushing juveniles out of the system before they are ready to survive in the ocean.

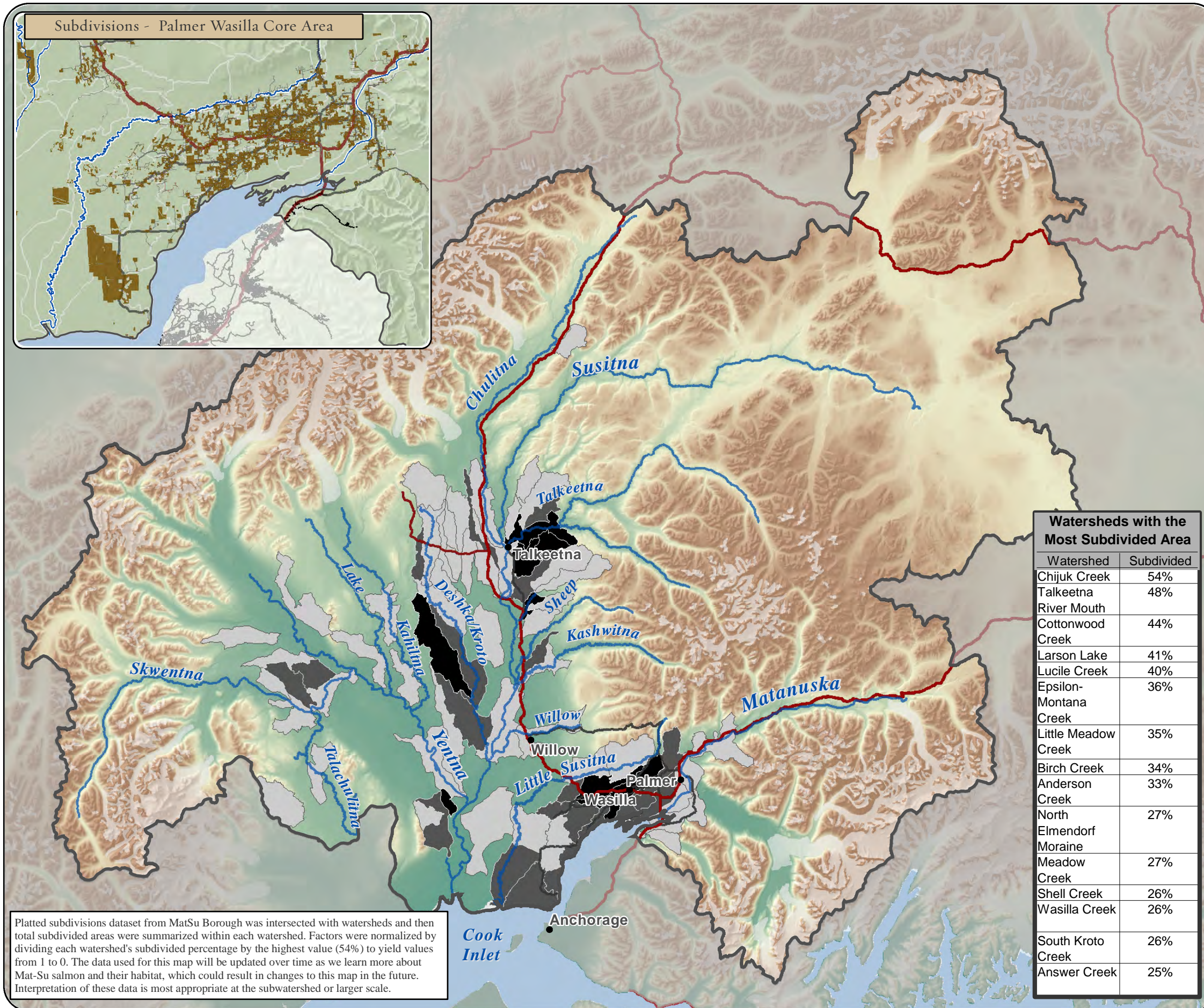
By increasing the rate of runoff, impervious surfaces also reduce base flows. Reduced base flows exacerbate temperature and dissolved oxygen problems; reduce the capacity of the water body to dilute pollution; reduce the area available to over wintering salmon; and expose spawning beds to drying up and freezing during winter and spring when low flows may already limit salmon production. Water quality can also be affected by contaminated runoff from roads, parking lots, and yards to streams.

Most current development is occurring in the Palmer-Wasilla core area. Growth is expected to continue to cause substantial landcover change in the next 50 years.

Mat-Su Basin - Vulnerability
 Converted and Impervious Land Cover



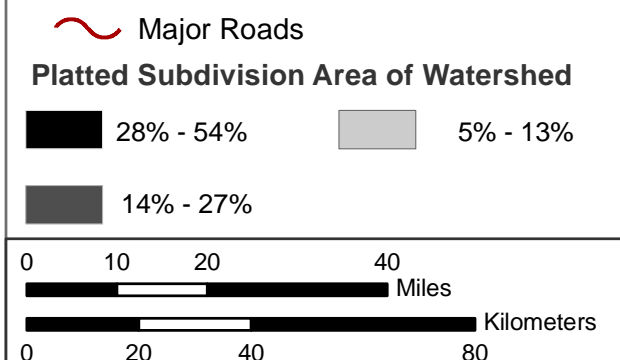
National LandCover Dataset has 18 predominant cover types for southcentral Alaska. Five represent conversion from natural cover: High, Medium, and Low Development, Cultivated Crops, and Pasture/Hay. These five were combined within each watershed and divided by the total area to calculate a conversion percentage. The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of this data is most appropriate at the subwatershed or larger scale.



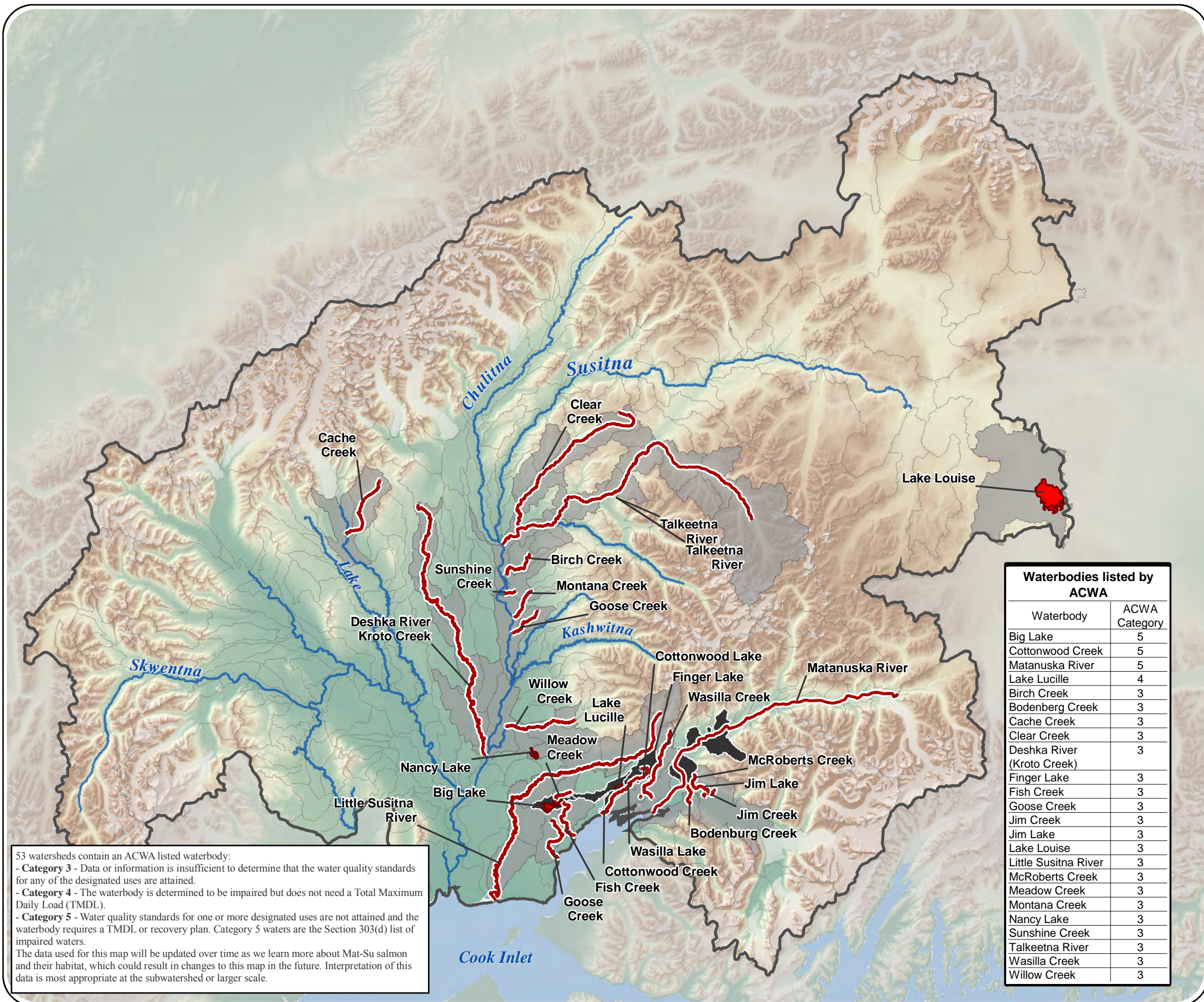
Development and uses associated with housing and urban areas include the actual clearing of land, construction of buildings, and the various activities on those cleared lands that have direct and indirect impacts on waterbodies. The primary affects of housing and urban development on salmon and their habitat are the loss of wetlands, alteration of riparian habitat, degraded water quality, and creation of impervious surfaces.

This map shows watersheds in the Mat-Su Basin where land has been subdivided and recorded with the Mat-Su Borough. Outside the Palmer-Wasilla core area, many of these subdivisions have been only minimally developed or not at all. Numerous platted subdivisions are remote with limited access, especially in the western Susitna basin. Lot size may vary from less than an acre to more than 40 acres per parcel. This map shows the potential for development in the Mat-Su Basin and the vulnerability of some watersheds to development.

Mat-Su Basin - Vulnerability Subdivisions



Platted subdivisions dataset from MatSu Borough was intersected with watersheds and then total subdivided areas were summarized within each watershed. Factors were normalized by dividing each watershed's subdivided percentage by the highest value (54%) to yield values from 1 to 0. The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of these data is most appropriate at the subwatershed or larger scale.



53 watersheds contain an ACWA listed waterbody:

- **Category 3** - Data or information is insufficient to determine that the water quality standards for any of the designated uses are attained.
- **Category 4** - The waterbody is determined to be impaired but does not need a Total Maximum Daily Load (TMDL).
- **Category 5** - Water quality standards for one or more designated uses are not attained and the waterbody requires a TMDL or recovery plan. Category 5 waters are the Section 303(d) list of impaired waters.

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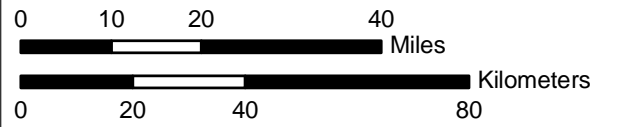
Waterbodies listed by ACWA	
Waterbody	ACWA Category
Big Lake	5
Cottonwood Creek	5
Matanuska River	5
Lake Lucille	4
Birch Creek	3
Bodenberg Creek	3
Cache Creek	3
Clear Creek	3
Deshka River (Kroto Creek)	3
Finger Lake	3
Fish Creek	3
Goose Creek	3
Jim Creek	3
Jim Lake	3
Lake Louise	3
Little Susitna River	3
McRoberts Creek	3
Meadow Creek	3
Montana Creek	3
Nancy Lake	3
Sunshine Creek	3
Talkeetna River	3
Wasilla Creek	3
Wasilla Lake	3
Willow Creek	3

Cold, clean water is necessary to support healthy salmon populations. The State of Alaska has implemented water quality criteria and standards necessary to support aquatic life. The Alaska Department of Environmental Conservation (ADEC) reviews water quality data to determine whether a waterbody meets water quality standards for a particular pollutant and lists it as an impaired waterbody when it does not. Other waters may not be listed as impaired but are considered high priority for completing specified actions. These designations focus attention on identifying and addressing sources of degradation; these waterbodies are typically included in stewardship actions identified by the Alaska Clean Water Actions program.

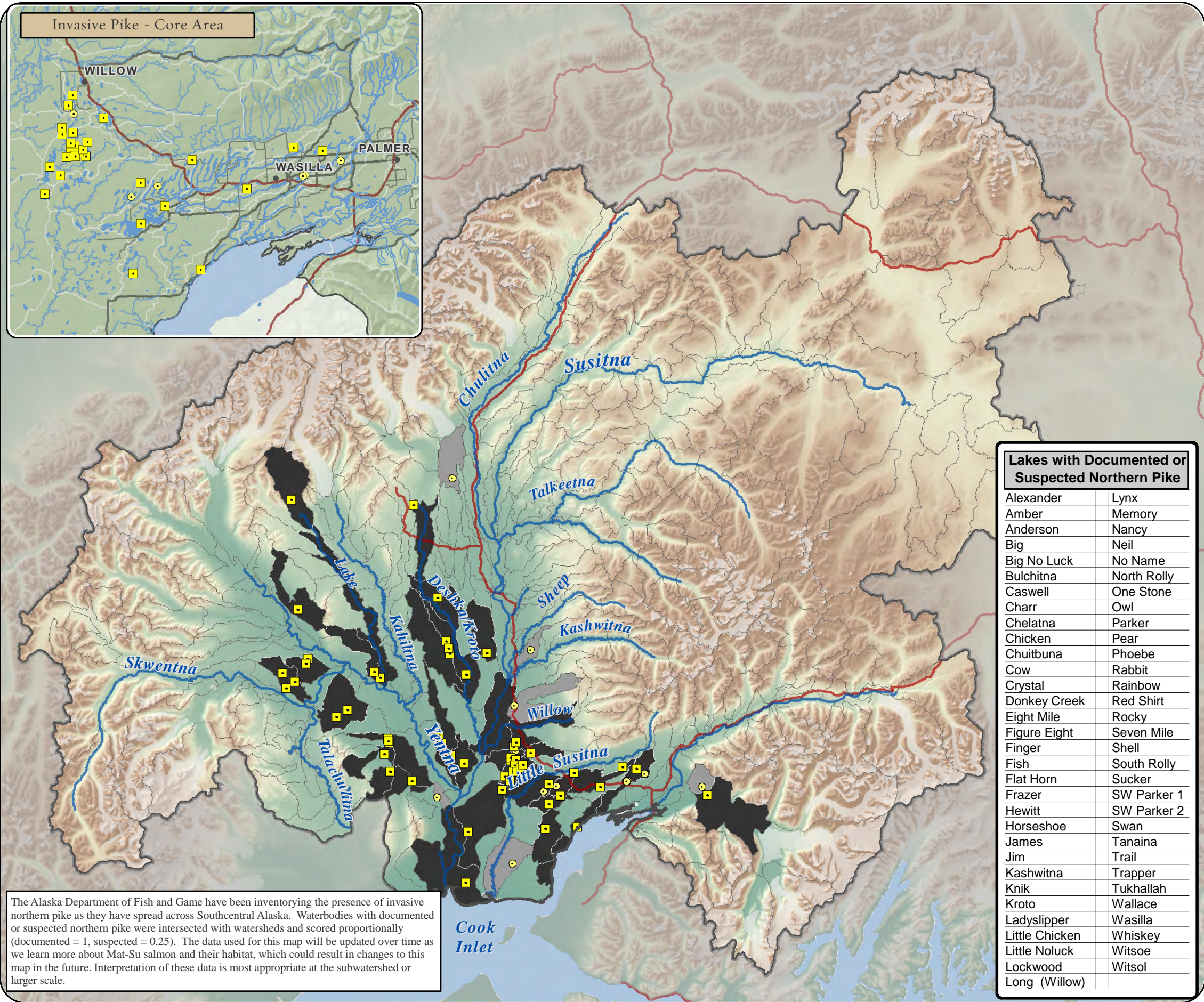
Twenty-four waterbodies in the Mat-Su Basin have been listed in three categories of concern or impairment (categories are described in the lower left box). Degraded water quality in many of these waterbodies stems from human activities related to development. Most negative impacts of development can be avoided or mitigated by maintaining vegetative buffers around waterbodies, keeping buildings and pavement at least 75 feet away from the water's edge, and preferably more, and minimizing the use of fertilizers on lawns.

Mat-Su Basin - Vulnerability Water Quality

- ACWA designated stream
- ACWA designated lake
- Watersheds with ACWA listed waters**
- ACWA Category 4 or 5, watershed vulnerability score = +1
- ACWA Category 3, vulnerability score = +0.25
- No ACWA listed waterbodies = 0



DATA SOURCES:
 Alaska Dept. of Environmental Conservation - Alaska Clean Water Action (ACWA), Alaska's Final 2008 Integrated Water Quality Monitoring and Assessment Report, April 1, 2008.



Lakes with Documented or Suspected Northern Pike	
Alexander	Lynx
Amber	Memory
Anderson	Nancy
Big	Neil
Big No Luck	No Name
Bulchitna	North Rolly
Caswell	One Stone
Charr	Owl
Chelatna	Parker
Chicken	Pear
Chuitbuna	Phoebe
Cow	Rabbit
Crystal	Rainbow
Donkey Creek	Red Shirt
Eight Mile	Rocky
Figure Eight	Seven Mile
Finger	Shell
Fish	South Rolly
Flat Horn	Sucker
Frazer	SW Parker 1
Hewitt	SW Parker 2
Horseshoe	Swan
James	Tanaina
Jim	Trail
Kashwitna	Trapper
Knik	Tukhallah
Kroto	Wallace
Ladyslipper	Wasilla
Little Chicken	Whiskey
Little Noluck	Witsoe
Lockwood	Witsol
Long (Willow)	

The Alaska Department of Fish and Game have been inventorying the presence of invasive northern pike as they have spread across Southcentral Alaska. Waterbodies with documented or suspected northern pike were intersected with watersheds and scored proportionally (documented = 1, suspected = 0.25). The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of these data is most appropriate at the subwatershed or larger scale.

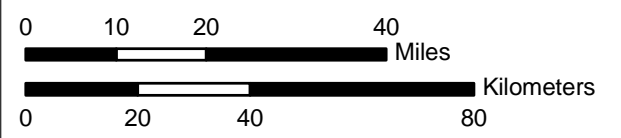
While Northern pike (*Esox lucius*) are native north and west of the Alaska Range, they are an introduced species to the Mat-Su Basin, where they are voracious predators of juvenile salmon and other native resident fish. Northern pike prefer cold shallow freshwaters and are saltwater tolerant when salinities are low. They spawn in marshy areas with shallow water, emergent vegetation, and mud bottoms covered with mats of aquatic vegetation.

Northern pike have direct impacts on salmon populations and indirect impacts on ecosystem health through decreasing biodiversity; removing salmon as a food source for terrestrial predators like bears and eagles; and reducing transfer of marine-derived nutrients to terrestrial ecosystems through decaying salmon carcasses.

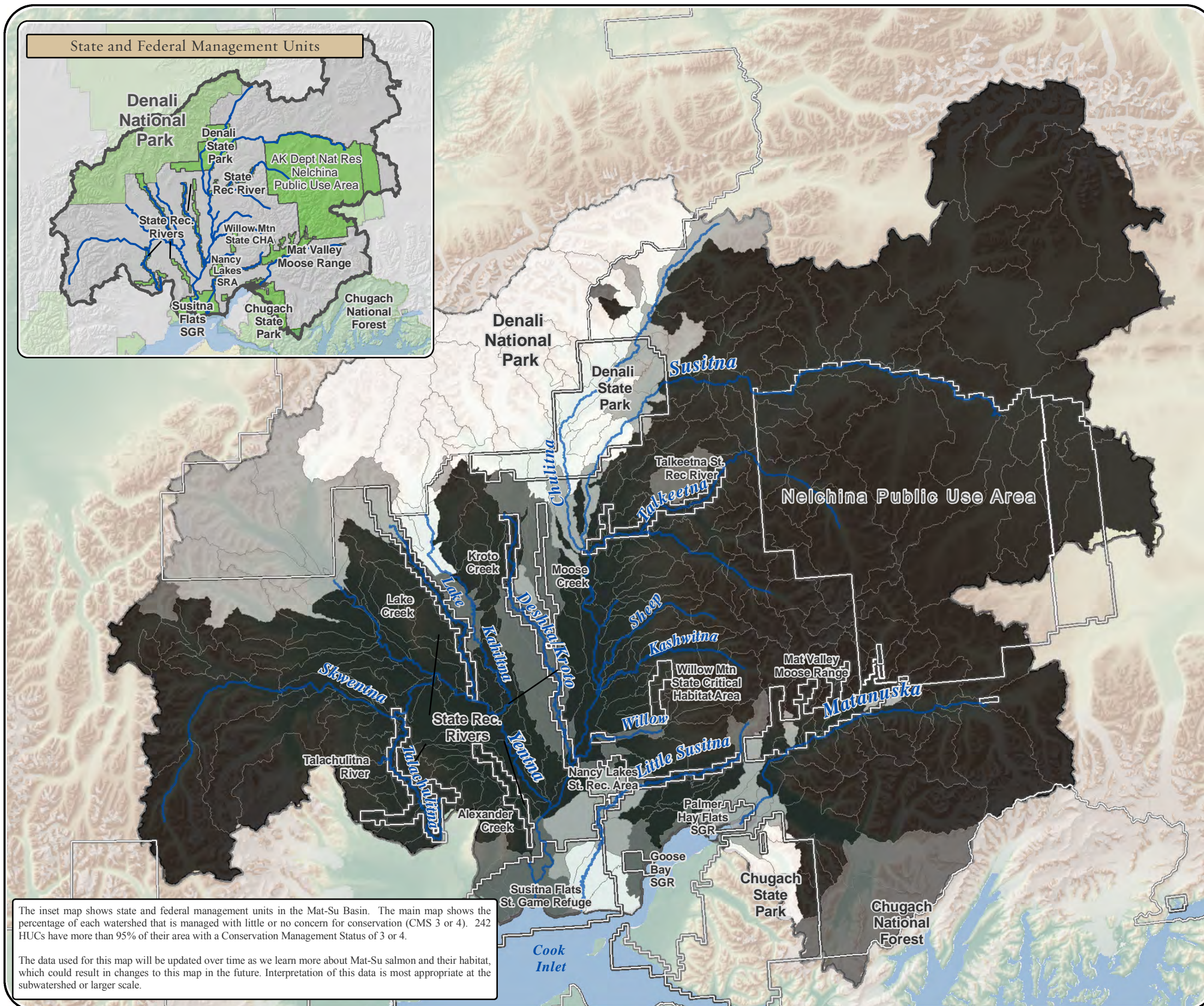
The potential threat of Northern pike is greatest for sockeye and coho salmon due to a preference for similar habitats. Northern pike have already eliminated sockeye salmon from several small streams which flow into the west side of the Susitna River. Several Chinook salmon systems have been severely impacted by Northern pike predation as well. Pink and chum salmon are the least affected because juvenile residence in freshwater is limited.

Mat-Su Basin - Vulnerability Invasive Northern Pike

Documented Pike Lake
 Suspected Pike Lake
Watersheds - Pike Status
 Pike documented
 Pike suspected



DATA SOURCES:
Pike: Alaska Dept. of Fish and Game, 2008.



The inset map shows state and federal management units in the Mat-Su Basin. The main map shows the percentage of each watershed that is managed with little or no concern for conservation (CMS 3 or 4). 242 HUCs have more than 95% of their area with a Conservation Management Status of 3 or 4.

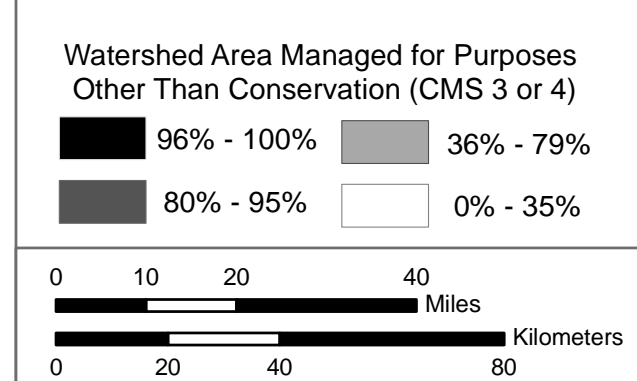
The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of this data is most appropriate at the subwatershed or larger scale.

The state and federal governments own lands in the Mat-Su Basin that are managed with an emphasis on conservation. Denali National Park covers many high elevation watersheds that drain from the Alaska Range to the Susitna River. The state manages 6 recreation rivers, 3 state game refuges (SGR), 1 critical habitat area (CHA), 1 state park, and 3 areas for recreation and public use (SRA). These designations offer protection to the natural systems in these watersheds. Watersheds with high percentages of land, both private and public, that are managed for multiple uses, resource extraction, or development, are more vulnerable to conversion that may negatively fish and wildlife habitat.

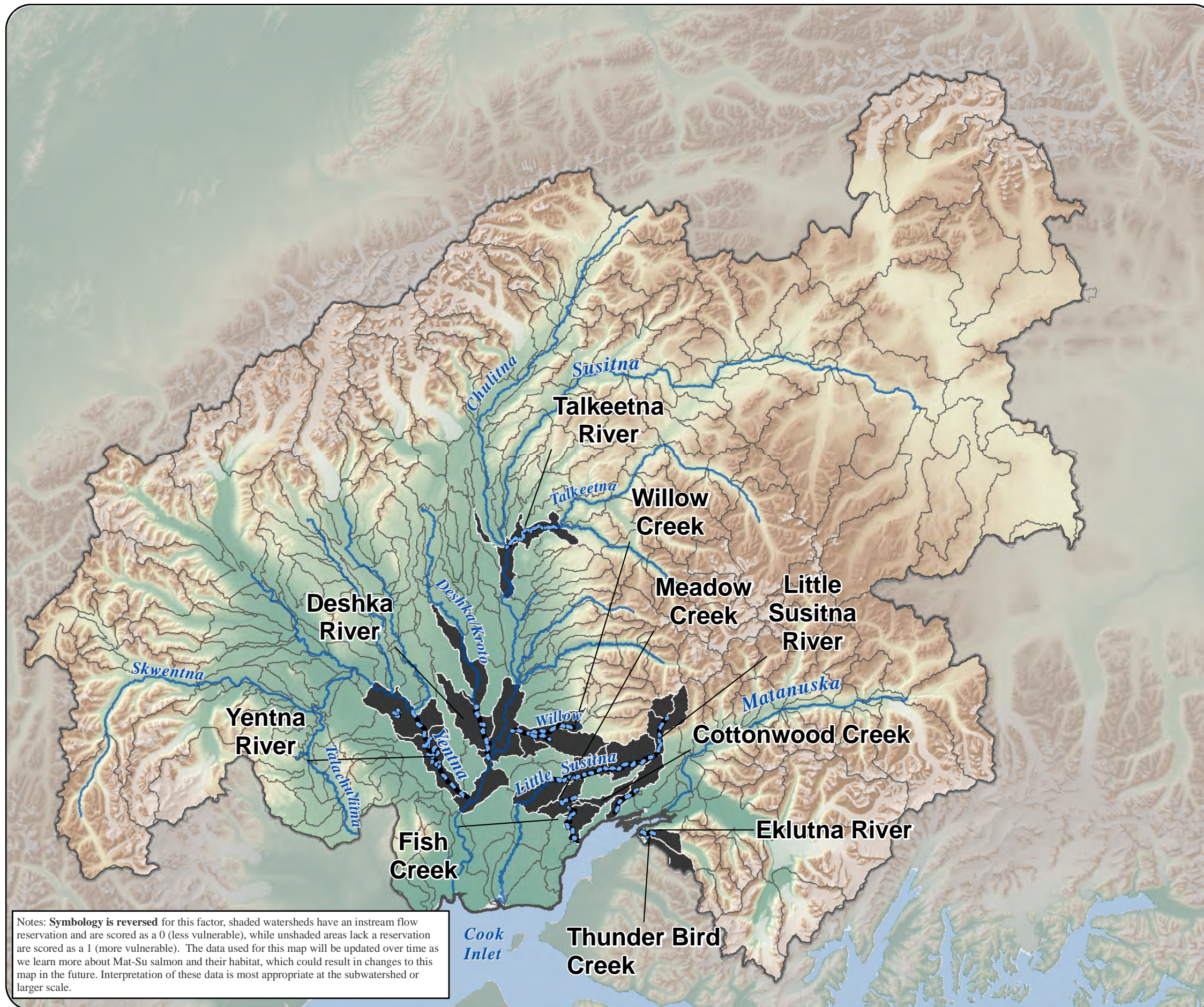
Conservation management status (CMS) describes the degree to which land, particularly public land, is legally designated and explicitly managed for biodiversity conservation. The U.S. Geological Survey's Gap Analysis Program (GAP) provides a framework for assigning conservation management status to different land management types. Criteria for CMS categories include size of area, what is protected, and the overall management intent.

In general, CMS 1 and 2 have a strong emphasis on conservation protections and have legal designations that are challenging to change. CMS 1 and 2 are assumed to provide high and medium protection, respectively, of species and landscape. Parks and refuges are usually classified as CMS 1 or 2. CMS 3 and 4 have little or no mandated conservation management or are used primarily for human activity. Many recreation and use areas are classified as CMS 3 due to level of use and management.

Mat-Su Basin - Vulnerability Conservation Management Status



Data Sources:
The Nature Conservancy using data from ADNR, BLM, NPS, and USFWS, 2005.






Notes: **Symbology is reversed** for this factor, shaded watersheds have an instream flow reservation and are scored as a 0 (less vulnerable), while unshaded areas lack a reservation and are scored as a 1 (more vulnerable). The data used for this map will be updated over time as we learn more about Mat-Su salmon and their habitat, which could result in changes to this map in the future. Interpretation of these data is most appropriate at the subwatershed or larger scale.

The Constitution of the State of Alaska reserves all surface and subsurface waters as a common public resource for the people of the state. A water right allows a specific amount of water from a specific water source to be diverted, impounded, or withdrawn for a beneficial use. The Constitution also allows water rights for water to remain instream, that is, not to be removed for consumptive or non-consumptive use. Water can be reserved for one or a combination of four purposes: protect fish and wildlife habitat, migration, and propagation; recreation and park purposes; navigation and transportation purposes; and sanitary and water quality purposes.

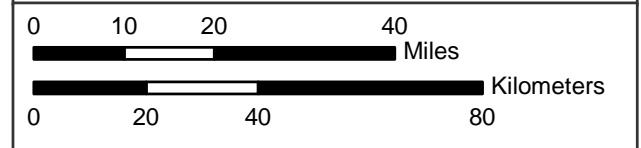
Reservations are primarily on the river mainstems, which may be more resilient than tributaries. Waterbodies and watersheds without this protection are more vulnerable to water withdrawals that may negatively impact salmon.

Salmon have adapted to, and their productivity is directly related to, the flow regime of the waterbody in which they are spawned and reared. Significant changes in the flow regime can impact salmon productivity and migration. By significantly altering flows during key life history periods, salmon spawning areas can be lost; side channels and other rearing areas can be reduced; pollution can be concentrated and more toxic; and fish passage can become blocked.

Mat-Su Basin - Vulnerability Instream Flow Reservations

-  Instream Flow Reservation (ISR)
-  Stream in watershed has an ISR
-  No ISRs within watershed

Note: some ISRs not yet adjudicated by Dept. of Natural Resources



DATA SOURCES: Instream Flow Reservations - Alaska Dept. of Natural Resources, 2008.
Alaska Dept. of Fish and Game - Sport Fish Division - 2008.