Appendix C
Assessment Protocol and Data Tables

Yellowstone Cutthroat Trout Range-wide Database Update:
Historical Range, Current Status, Risk and Population Health Determinations, Population Restoration Potential and Expansion Protocols
2006
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This revision provides information for updating a range-wide status and conservation database for Yellowstone cutthroat trout (YCT; *Oncorhynchus clarkii bouvieri*) including separate information on the large and fine spotted forms. This update will: 1) refine estimates of historically occupied habitat; 2) update information on current distribution and identify specific attributes associated with current distribution; 3) identify any new conservation populations and revise information for currently identified populations, including assessing relative population health using a ranking system approach adapted from Rieman et al. (1993) and evaluating risks associated with genetic introgression and catastrophic disease; and 4) evaluate potential for further expansion and restoration of conservation populations within historical habitats. This revised protocol is similar to protocols recently used for assessing Bonneville and Colorado River cutthroat trout status and conservation and is based on initial protocols developed for assessing westslope and Yellowstone cutthroat trout (May et al. 2003; Shepard et al. 2003). Portions of this database are substantially based on expert opinion and these portions, particularly for describing historically occupied range, are qualitative. However, where data are available these data are used and referenced. The protocol represents a modified version of the original Yellowstone cutthroat assessment protocol that improves and updates the previously compiled information on YCT status. This database update is being done as a critical component of the coordinated range-wide conservation effort for YCT. Completion of this update will help meet the objectives of the Multi-state YCT conservation effort in a number of respects. First, the initial status update completed in 2001 was intended to be the first formal "snap shot" in time, or benchmark, for YCT distribution, relative population health, and risk status. This 2006 update will evaluate changes that have occurred over the past five years based on new information collected to date.

Second, this update will use National Hydrography Dataset (NHD) as the base geographic information system (GIS) hydrography layer for the effort (see **http://nhd.usgs.gov/** for more information on NHD). The 2001 status assessment used a 1:100,000 latitude-longitude stream identifier (LLID) layer. The NHD layer has become the most nationally accepted GIS layer for displaying stream and river hydrography. In addition, much of the stream and river mapping has been done at the 1:24,000 scale for NHD, and this update will use this scale for areas where it is available. However, 1:24,000 scale NHD data are not available for some watersheds, so 1:100,000 scale NHD hydrography will be used for these areas and an effort will be made to correct the information to the 1:24,000 scale as it becomes available. We expect that most of the area of concern will be available at the 1:24,000 mapping scale. The USFS Natural Resource Information System (NRIS) has ArcGIS tools available that should greatly assist with this process. An event creation tool, developed by the NRIS team, will be used to geo-reference YCT population segments. This tool utilizes a "point–and-click" user interface to reference these population segments against the NHD stream network.

Third, to maintain continuity and consistency, only those streams identified on the NHD stream layer will have information entered into the database. Applying this criterion will mean that some intermittent and ephemeral streams that could potentially provide habitats used or occupied by YCT, especially during high-flow periods, will be omitted. It is anticipated that these streams will be added during subsequent efforts to update the NHD stream layer. This version of the database will include information for lakes and reservoirs identified on the NHD lake layer.

Fourth, sources of information will be identified and linked to rated levels of reliability to better judge reliability. Data source tables will be created to track how information was derived (Table 1). Information associated with judgment calls and anecdotal sources, in general, may be viewed as being less reliable and/or accurate than information developed as part of detailed surveys and studies that have undergone substantial analysis and review.

Finally, all data will be entered in "real-time" at workshops with groups of experts evaluating all waters within a 4th code HUC and GIS and/or database experts entering and editing those evaluations until the entire group has reached consensus within a particular HUC. There are 39 4th level HUCs within the historic range of YCT. During the completion of the assessment for each HUC, the teams will be asked to employ a systematic approach to ensure that all information is included in the database. The use of 4th level HUCs will be for accounting purposes only. All data will be geo-referenced as either points (e.g., barrier locations), cutthroat mapping segments (e.g., stream segments occupied by YCT), or discrete populations that make up conservation populations, using a team approach that will include fishery biologists and the GIS-data entry person as a critical member of the team.

Table 1. Example look-up table for data sources with relative index values for information reliability and accuracy.

Information Source	Relative Degree of Reliability
Anecdotal information	Lower 1
Letter	Lower 1
Professional judgment	Lower 2
Data files	Moderate 3
Agency report	Moderate 3
Thesis or dissertation	Higher 4
Published paper	Higher 5

This protocol is partitioned into four primary components for conducting this database update. First, the historical range that was occupied by YCT at the time of the first European exploration (approximately 1800) of the Northern Rocky Mountains, as determined in the 2001 assessment, will be adjusted with any new information. Second, new information associated with current distribution of YCT along with density, genetic status, phenotype (spotting pattern), presence of non-native species and habitat information will be developed and displayed on a mapping segment basis (e.g., stream or lake). Third, all conservation populations (either as an individual stream or a network of streams and lakes [lacustian/adfluvial] occupied by YCT) will be identified, and the relative health and risks to persistence for each population will be evaluated based on three aspects: 1) genetic introgression, 2) disease, and 3) population size and demographics. Health and risk determinations represent relative evaluations indicating higher or lower levels of concern. Locations of lakes that support YCT will be shown on the maps. To track status information for both spotted forms, each data table will have an identifier to indicate

fine spotted only, large spotted only and large and fine spot YCT in sympatry. YCT populations supported entirely by annual or routine stocking will not be included as part of this assessment. The exception would be those populations serving as wild broods that require periodic stocking to bring in new genetic material as part of the brood maintenance plan. The fourth component of the database will provide information on the potential for creation or expansion of conservation populations within the conservation planning boundary.

The definitions of terms used for this protocol are provided in italics as they are first used.

Population mapping unit (segment) – each YCT occupied stream, or segment of stream, will be treated as a separate mapping unit or segment. Specific information relative to stocking record, presence of non-native fish, YCT density, habitat quality and relative steam segment width will be recorded for each segment. Connectivity between these segments will be the basis for identification of conservation populations.

Conservation Populations – conservation populations represent a combination of mapping segments that when united together represent a conservation unit. The identification of conservation populations is primarily the responsibility of the State fishery agencies. Conservation populations can exist in a genetically unaltered condition (e.g., core conservation populations with genetic analysis indicating greater than 99% purity and/or there is reason to believe that the genetics are unaltered) and/or they can be based on unique ecological, genetic and behavioral attribute of significance even with some level of genetic introgression (See Cutthroat Trout Management: A Position Paper – Genetic Considerations Associated with Cutthroat Trout Management). Conservation populations may exist as a network of subpopulations or streams; or they may exist as an independent stream or stream segment.

Core Conservation Population – *Those conservation populations that are known to be genetically unaltered by hybridization or with an extremely high probability that the population is unaltered by hybridization. Stream segments for these conservation populations have been tested and found to be unaltered or stream segments that are suspected to be unaltered and also have no record of stocking with potentially hybridizing species and no potentially hybridizing species present.*

Networked-population *– infers that interbreeding between subpopulations (population mapping segments) can occur within a few generations (3-15 years). Also referred to as a connected or meta-population. These populations occupy two or more stream segments that are connected or networked together. All subpopulations within a networked population must have at least the potential for genetic exchange among all other subpopulations within the networked population.*

Sub-Population – *A discrete component of a meta-population or networked population. Usually associated with individual streams and/or stream segments.*

Non-Networked Population (Isolated or Independent Population) *– populations that occupy a single stream or stream segment.*

Genetic Integrity Risk *– risk of initial or on-going genetic introgression (hybridization) with introduced species or subspecies.*

Relative Population Health *– evaluation of relative health based on several characteristics associated with the population. These characterizations can be linked to the influences of deterministic or stochastic factors that could lead to reduced viability for a population.*

Linked to temporal attributes, population size, production considerations and degree of connectedness.

Significant Disease (Pathogens) Risk *– Those diseases and the associated pathogens that have the potential to cause significant population decline. Including, but not limited to, the following: whirling disease, furunculosis, infectious pancreatic necrosis virus, etc.*

Competing Species *– Those species that compete with cutthroat trout for food and space. Can be salmonid or non-salmonid. Generally, non-natives that have been introduced within cutthroat trout habitats. Certain competing species (i.e., brown and brook trout) are predatory on cutthroat trout. Introduced rainbow trout can be viewed as both a competing and hybridizing species.*

Hybridizing Species *– Those species or subspecies of trout that readily hybridize with YCT, primarily introduced rainbow trout. Can also include subspecies of cutthroat trout that have been introduced into habitats outside of their respective historic range.*

Genetic, density and habitat information will be developed for each mapping segment. Genetic and disease risks along with a relative population health determination will be completed for each conservation population.

Barriers

All new barriers, and new information on existing barriers, of significance to YCT conservation will be added to the existing database. Since barriers to fish movement (either long-term historical, natural short-term, or anthropogenic barriers) are significant components to conservation, each known significant passage barriers will be identified as a map point. Specific information associated with each barrier will be used to assess whether individual stream segments were likely historically occupied by YCT, to assess potential influences of genetic introgression or disease to existing YCT populations, or to determine whether existing subpopulations are connected with other subpopulations. The identification of barrier location and distinguishing characteristics are very important.

To determine the historical distribution, those barriers that represent long-term geologic features that would serve to influence historical distributions will be identified, where known. These are barriers that would have precluded YCT occupation on or before 1800 (i.e., the segments were historically barren of YCT). These barrier locations will be located (as points in ArcGIS) on the stream and river hydrography layers. During mapping of current YCT distributions, other significant barriers (e.g., natural short-term and/or anthropogenic barriers) will be identified and located (as points in ArcGIS) and their associated characteristics, including barrier type (Table 2), blockage extent (Table 3), and significance (Table 4), will be determined and entered into data tables that are linked to the GIS points. Only barriers believed to have a significant influence on cutthroat distribution or population integrity will be identified. An attempt will be made to include all total barriers; however, surveys of all waters within the historical range of YCT to identify fish barriers have not been completed, so only known barriers will be identified. The source of information used to locate each barrier and document its associated characteristics will be entered into a separate data table (Table 5). If a particular barrier extends over an long distance (e.g., temperature or chemical barrier) the downstream point will be located on the GIS. Barrier identification will be the first action taken of the four parts of the database update. Starting with the lower-most portion of the 4th code HUC, barriers will be located from the downstream most to the upstream-most reaches in a systematic fashion until the mainstem and all tributaries and sub-tributaries are covered, and all known significant barriers have been identified. Barrier significance is linked either to how a barrier is influencing current distribution, or how a barrier could be important to future conservation.

Table 2. Types of barriers to upstream fish movement (Check the one that best applies to each barrier).

Code	Barrier Type
1	Water diversion
2	Fish culture facility/research facility
3	Temperature
4	Bedrock
5	Culvert
6	Debris
7	Insufficient flow
8	Manmade Dam
9	Manmade temporary restoration barrier
10	Pollution
11	Beaver dams
12	Velocity barrier
13	Waterfall
14	Unknown

Table 3. Extent of blockage caused by barriers (Check the one that best applies).

Code	Blockage Extent
1	Complete
2	Partial
3	Unknown

Table 4. Barrier significance (Check all that apply for each barrier).

Code	Barrier Significance
1	Historically significant – Limited historical distribution
2	Prevents or limits introgression
3	Prevents ingress of competing species
4	Temporary, but presently prevents introgression or ingress of competing species
5	Confines population to small area of usable habitat
6	Limits or precludes opportunity for population re-founding
7	Limits expression of life history characteristics
8	Unknown

Table 5. Information sources associated with the barrier (Check one that best applies).

Code	Barrier Information Source
1	Judgment - Anecdotal and/or extrapolated information from other streams
2	Judgment - Ocular reconnaissance
3	Minor sampling – Minor amount of data collected (e.g., height or velocity)
4	Major sampling – Major amount of data collected including fish tagging

Part 1 – Historical Distribution

The historical distribution of YCT, including lakes, will be identified and any changes to past information or new information on historical distribution will be recorded. To the extent possible, historical distributions of both spotting forms will be identified. The historically occupied range of YCT will be assessed based on their hypothesized distribution at the time Europeans first entered the Rocky Mountain West (approximately 1800). The NHD hydrography layers (1:24,000 and 1:100,000 scales) will be used to maintain consistency of information. Fishery professionals familiar with each major drainage basin (4th code HUC) will define historical distribution by adjusting the NHD stream layer within each HUC. The historical range will be based primarily on historical fisheries data, fisheries reports, and published historical accounts, augmented with personal knowledge of the area, known anecdotal information, known habitat restrictions, and known barriers of historical significance. Barriers of historical significance are those that would have precluded YCT from occupying stream segments at any time prior to 1800. These barrier determinations, by necessity, will be based primarily on professional judgment (Table 6).

Table 6. Reasons to exclude or include a stream and lake segments as historical YCT habitat.

Include or exclude		Reason
Exclude		Habitat limited – Primarily based on judgment regarding gradient, elevation, temperature
Exclude		Geologic barrier – Based on judgment. Must correspond to a mapped barrier location.
Include		Anecdotal information (e.g., newspaper, letter, journal, etc.)
Include		Historical scientific survey data (e.g., published report)
Include		Judgment

Part 2 -- Current Distribution--Genetic Status, Densities and Habitat Conditions

The existing database will be updated with all new information on current distribution information for streams and lakes. The current distribution information will also be tracked by spotting pattern. This part of the analysis will identify all stream segments and lake units currently occupied by YCT without regard to genetic makeup. This is not an identification of conservation populations, which will come in Part 3. Before identifying those stream and lake segments currently occupied by YCT, the process of identifying all other barriers significant to current distribution of YCT must be completed. These additional barriers should include any barrier that does, or could, significantly influence YCT distribution, life history expression, spawning, competition and hybridization. After locating these barriers, the lower and upper bounds of all stream segments and lakes presently occupied by self-sustaining populations of YCT will be located. For each stream segment and lake segment that currently supports self-sustaining YCT, the data, and data source, used to justify inclusion will be identified (Tables 7 to 23). Two potential types of self-sustaining YCT populations could be present: 1) aboriginal populations; or 2) restored populations (Table 8). A determination will be made relative to the migratory nature of the YCT that occupy each stream and lake segment (Table 9). Only self-sustaining populations (i.e., no routine augmentation with hatchery fish) of YCT will be addressed in this status assessment. To complete Part 2 each 4th-code HUC working group will review the May et al. (2003) information displayed on mapped stream and lake layers and make any changes based on current information for all habitats currently occupied by YCT. All potentially occupied habitats must be reviewed, so workgroups will work in a systematic fashion from the downstream end of each HUC to the headwaters. The specific information associated with current occupancy will be tracked either by stream segment or by each lake or reservoir (Tables 7 to 23). Current occupancy by spotting pattern will be tracked. When delineating stream segments currently occupied by YCT, barrier locations must be considered and included in the rationale for delineating each segment (in addition, barrier significance attributes may be adjusted as the workgroup determines how each barrier might be affecting YCT within each stream segment). Information associated with each stream segment occupied by YCT must be recorded as each segment is identified (Tables 7 to 23). Remember, each identified stream segment currently occupied by YCT must have all attributes in common. If one or more attributes change, a new segment is created. For lakes, the attributes will represent a generalized view of the entire lake. There will be identifiers associated with each table to denote whether the information in the respective tables are associated with lake or stream habitats and with the respective spotting patterns. Table 7 identifies the source of information associated with current distribution displayed in the GIS layer. Table 11 identifies fish stocking associated with the occupied stream or lake segments. Genetic information and status will be identified for each

YCT mapping segment (Tables 12 and 13). For Table 13, base the category determination on genetic information from the largest sample and/or the most recent sample.

Relative density information will used to approximate effective population size for conservation populations identified in Part 3 of the protocol. Relative density or density estimates for a stream mapping segments will be recorded as the number of sexually mature YCT adults (e.g., 15 cm and longer for small streams and 30 cm and longer for large streams and rivers; Tables 14 and 15). If a stream mapping segment supports both non-migratory and migratory YCT (including those YCT that occupy lakes but use streams for spawning), base the density estimate on fish 30cm and larger. When actual density estimates are reported they must be linked to the estimator that was used to make the estimate (Table 14). There will be no density information associated with lake segments; YCT associated with lake mapping segments will be included as part of the density estimates of the stream segments used for spawning by lake dwelling YCT. Habitat information will be identified for each YCT mapping unit (Table 17-21). The presence of non-native fish will be recorded for each stream segment and lake occupied by YCT (Tables 22 and 23). Total stream length and lake surface acres currently occupied will be developed through GIS capabilities.

Table 7. Source of information associated with mapped components (lakes or streams) of YCT current distribution (Check <u>one</u> that best applies).

Code	Source of YCT density information
1	Judgment-extrapolated information from other areas
2	Judgment - Ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed population sampling
6	Unknown

Table 8. Origin of self-sustaining YCT population (Check one that best applies).

Code	Origin
A	Aboriginal – naturally occurring population
R	Restored – human restoration to start population
U	Unknown

Table 9. Stream habitat mapping segment provides habitat for the following life histories. (Check those that best apply).

Code	Life Histories Associated with Mapping Segment
	Non migratory
	Migratory
	Combination
	Unknown

Table 10. Source of information associated with Tables 8 and 9 (Check one that best applies).

Code	Source of YCT density information
1	Judgment-extrapolated information from other areas
2	Judgment - Ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed population sampling
6	Unknown

Table 11. Fish stocking associated with the occupied stream segment or lake (Check all that apply).

Code	Fish Stocking Status
1	No record of fish stocking
2	Record of rainbow stocking
3	Record of brown trout stocking
4	Record of brook trout stocking
5	Record of lake trout stocking
6	Record of fine-spotted YCT stocking
7	Record of large-spotted YCT stocking
8	Record of other cutthroat trout subspecies being stocked. Specify:
9	Other non-native fish stocked. Specify:

Table 12. Genetic status of YCT within a stream segment or lake (Check one that best applies

Code	Genetic Status
1	Genetically unaltered (<1% introgression detected) as a result of introduced species interaction– tested via electrophoresis or DNA
2	>1% and ≤10% hybridized with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
3	>10% and ≤25% hybridized with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
4	>25% hybridized with introduced species – tested via allozyme or DNA and introgression indicated to be from a hybrid swarm
5	Not genetically tested -- Suspected unaltered with no record of stocking or contaminating species present
6	Not genetically tested -- Potentially hybridized with records of introduced hybridizing species being stocked or occurring in stream
7	Hybridized and pure populations co-exist (sympatric mixed-stock) in stream (use only if there is evidence of reproductive isolation, non-random mating, and/or genetic testing has been completed)

NOTE: These categories are compatible with the interstate cutthroat genetics white paper.

Table 13. Specify the specific information associated with genetic sampling and analysis. More than one entry can be made for a stream segment or lake. (Add the specific genetic information in this table).

Sample Number	Collection Date	Collection ID	Number of Fish Sampled	Analysis Date	Analysis Code	% Non-YCT Genes

Analysis Code	Genetic Analysis
1	Allozymes
2	PINES
3	Microsatellites
4	DNA

Table 14. Population density (numbers per mile) of sexually mature adults (15 cm small streams with non-migratory fish and 30 cm for larger streams and rivers with non-migratory and migratory fish) within stream mapping segment. Include the spawning density of migratory fish that use the segment for reproduction (Check the one that best applies).

Code	Mapping Segment Adult Fish Density
1	0 to 50 fish per mile (Specific density within this range, if available_____)
2	50 to 150 fish per mile (Specific density within this range, if available_____)
3	151 to 400 fish per mile (Specific density within this range, if available_____)
4	401 to 1000 fish per mile (Specific density within this range, if available_____)
5	Over 1000 fish per mile (Specific density within this range, if available_____)
6	1001 to 2000 fish per mile (Specific density within this range, if available _____)
7	Over 2000 fish per mile (Specific density if available _____)
8	Unknown

Table 15**.** Population estimates of YCT 15 cm and larger) expressed as number per mile (Complete with specific sample information that applies). Use this information to provide the specific density value for Table 11.

Sample ID	Sample Date	Estimated fish/mile	Coefficient of Variation %	95% Confidence Interval	Estimate Type Code

Code	Population Estimate Type
	3 pass removal
	2 pass removal
	Relative abundance expansion
	Mark-recapture
	Census from spawning trap

Table 16. Source of population density information (Check <u>one</u> that best applies).

Code	Source of YCT density information
1	Judgment-extrapolated information from other areas
2	Judgment - ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed population sampling

Table 17. Relative quality of occupied stream habitat (Check one that best applies). Refer to attachment B for optimal desired habitat reference conditions.

Code	Habitat Quality Determination
1	Excellent habitat quality (e.g., majority of attributes in optimal condition, ample pool environment, low sediment levels, optimal temperatures, quality riparian habitat, etc.)
2	Good habitat quality (may have some habitat attributes that are slightly less than ideal)
3	Fair habitat quality (has a greater number of attributes that are less than ideal)
4	Poor habitat quality (most habitat attributes reflect inferior conditions)
5	Unknown

Table 18. For stream segment habitat quality determinations rated as good to excellent, identify the three most important habitat characteristics that influenced the quality determination (Check the three that best apply). Refer to attachment B for optimal desired habitat reference conditions.

Code	Quality Characteristics of Primary Importance for Good to Excellent Habitat
	Substrate fine sediment (less than 6.3 mm) levels generally within 0 to 24%.
	Water temperatures within 8 to 16 C during spawning and incubation periods.
	Pool habitat within 35 to 60% of total stream habitat area.
	Amount of stream habitat in excess of 6 miles.
	Stream shading within 50 to 70% during mid-day.
	Streambank vegetative cover greater than 25%
	Streambank stability greater than 90%

Table 19. For stream segment habitat quality determinations rated as fair to poor, identify the three most important habitat characteristics that influenced the quality determination (Check the three that best apply). Refer to attachment B for optimal desired habitat reference conditions.

Code	Habitat Quality Determination
	Substrate fine sediments (less than 6.3mm) exceed 25%.
	Water temperatures in summer consistently above 16 C or below 8C.
	Amount of pool habitat either below 35% or above 60%
	Amount of stream habitat less than 17 miles.
	Mid-day stream shading either less than 50% or greater than 70%.
	Streambank vegetative cover less than 25%.
	Streambank stability less than 75%.

Table 20. Approximate width of occupied stream segment (Check one that best applies).

Code	Average width of occupied stream segment
1	< 5 feet
2	5 to 15 feet
4	15 to 25 feet
5	25 to 50 feet
6	Over 50 feet
7	Unknown

Table 21. Source of stream habitat quality and width information Check **one** that best applies).

Code	Source of habitat information
1	Judgment-extrapolated information from other streams
2	Judgment - ocular reconnaissance
3	Spot habitat sampling
4	Trend habitat sampling
5	Detailed habitat sampling

Table 22. Presence of non-native fish sympatric with YCT in the mapping segment stream or lake. In situations where fine-spotted and large-spotted YCT are in natural sympatry do not list either as non-native. (Check all that apply).

Code	Presence of Non-Native Fish
1	No non-native fish present
2	Rainbow trout
3	Brown trout
4	Brook trout
5	Lake trout
6	Fine-spotted YCT
7	Large-spotted YCT
8	Other cutthroat trout subspecies. Specify:
9	Other trout. Specify:
10	Other fish. Specify:
11	Unknown

Table 23. Source information associated with presence of non-native fish (Check one that best applies).

Code	Source of non-native fish information
1	Judgment-information extrapolated from other streams
2	Judgment -- ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed sampling
6	Unknown

Part 3 -- Change in Focus – Identification of Individual Conservation Populations and Application of Relative Health and Risk Evaluations for each Population

At this point the assessment will change from a focus on YCT occupied mapping segments to a level of assessment related to specific conservation populations and factors that have potential to influence the well-being of these populations. A determination will be made relative to which occupied mapping units (i.e., lake and streams) will be combined into specific conservation populations each having conservation as the primary management focus. Please refer to the definition of conservation populations. Remember: genetics is only one of many factors that can be used to identify a conservation population.

A connected or population network cannot have a total barrier within the population's stream network. Both networked populations and independent populations can serve as conservation populations. Identify the nature of subpopulation networks or connectedness of the population (Table 24). Conservation populations can be genetically unaltered (i.e., core conservation populations), or they can reflect a focus on unique traits and characteristics in the presence of documented or potential hybridization (i.e., conservation populations) (Table 25). Identify the life history attributes of the population (Table 26). Information on conservation activities and

human-uses (e.g., land uses) will be identified for each conservation population (Tables 27 and 28). It is also important to note that no degree of significance is attributed to the conservation activities or the human uses that are identified as being associated with each conservation population. The significance of the conservation activities and/or human uses to each specific conservation population will have to be addressed in subsequent specific assessments.

Table 24. Degree of network or connectedness associated with the conservation population (Check one that best applies).

Code	Degree of Connectedness
1	Strongly networked. Migratory forms (fluvial/ad-fluvial) must be present and migration corridors must be open (significant connectivity). Occupied habitat consists of numerous (> 5) individual streams w/ sub-populations.
2	Moderately networked. Migratory forms are present but connection periodically disrupted. Genetic exchange limited at times. Occupied habitat consists of a few (4-5) individual streams w/ sub-populations.
3	Weakly networked. Questionable whether migratory forms exist within connected habitat; however possible infrequent straying of adults within occupied connected habitat. Occupied habitats consist of 2 to 3 streams w/ sub-populations.
4	Population not networked or connected. Population functions as an independent entity (single stream or stream segment with no interaction with other sub-populations.

Code	Source of connectedness information
1	Judgment-information extrapolated from other streams
2	Judgment -- ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed sampling
6	Unknown

Table 25. Conservation population qualifier (Check one that best applies)

Code	Conservation Population Qualifier
1	Core Conservation Population (must be tested genetically unaltered – greater than 99% YCT genes and/or only have stream and lakes segments suspected of being unaltered…Tables 12 and 13).
2	Known or Probable Unique Life History (fluvial, ad-fluvial, or non-migratory) Or may include populations that represent the last, best YCT populations within a given watershed or drainage basin.
3	Known or Probable Ecological Adaptation to extreme environmental condition (e.g., temperature, alkalinity, pH, sediment)
4	Known or Probable Predisposition for large size or unique coloration
5	Other – There is insufficient information to place the population in another category but professional judgment indicates the population and the habitat that is occupied are likely to become part of the YCT conservation focus.

Code	Source of connectedness information
1	Judgment-information extrapolated from other streams
2	Judgment -- ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed sampling
6	Unknown

Table 26. Specific life history attributes associated with the conservation population (Check all that apply).

Code	Life History Attributes
1	Fluvial disperses locally in one stream or a group of small streams as the home range)
2	Individuals moving from larger river into tributaries to spawn.
3	Lacustrine (lake) fish moving into lake tributaries to spawn
4	Lake fish moving into outlet stream to spawn
5	Unknown

Code	Source of connectedness information
1	Judgment-information extrapolated from other streams
2	Judgment -- ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed sampling
6	Unknown

Table 27. Conservation activities associated with the conservation population (Check all that apply).

Code	Conservation Actions
1	Water lease/In-stream flow enhancement
2	Channel restoration
3	Bank stabilization
4	Riparian restoration
5	Diversion modification
6	Barrier removal
7	Barrier construction
8	Culvert replacement
9	Installation of fish screens to prevent loss
10	Fish ladders to provide access
11	Spawning habitat enhancement
12	Woody debris placement
13	Pool development
14	Increase irrigation efficiency
15	Grade control
16	In-stream cover habitat
17	Re-founded population
18	Riparian fencing
19	Physical removal of competing/hybridizing species
20	Chemical removal of competing/hybridizing species
21	Public outreach efforts at site (Interpretative site)
22	Population Expansion (e.g., expanding the occupied area of a specific population)
23	Population supplementation (e.g., to implement genetic swamping or to reduce potential of bottle necking, etc.)
24	Special Angling Regulations
25	Land-use mitigation direction and requirements (e.g., Forest Plan direction, regulation, permit req., coordination stipulations, etc.)
26	Population covered by special protective mgt emphasis (e.g., Nat'l Park, wilderness, special mgt area, conservation easement, etc.)
27	Other:
28	None:

Table 28. Human-use associated with conservation population. (Check all that apply).

Code	Activity
1	Timber harvest
2	Range (livestock grazing)
3	Mining
4	Recreation (non-angling)
5	Angling
6	Roads
7	De-watering
8	Fish stocking (e.g., non-native fish)
9	Hydroelectric, water storage and/or flood control
10	Other
11	None
12	Unknown

Conservation Population Risk and Health Evaluations

Only conservation populations will be evaluated for relative genetic and disease influences and general population health. It is important to note that these evaluations are not intended to define the inherent probability of persistence or exclusion, but rather to identify index conditions that put a population at greater or lesser risk based on certain attributes.

Genetic Stability Assessment

A genetic stability ranking will be made for each conservation population (e.g., Network- or non-networked) using an index ranking of 1 to 4 to indicate lower to progressively higher levels of possible risk (Table 29). The index should not be viewed as an absolute but rather as an indicator of possible or potential genetic influences

Table 29. Genetic index ranking (Check one that best applies).

Rank	Genetic stability or Risk Characterization
1	Introduced potentially hybridizing fish cannot interact with existing YCT population. Barrier provides complete blockage to upstream fish movement or potentially hybridizing fish are not present in same or adjacent drainages.
2	Introduced potentially hybridizing fish are in same stream and/or drainage further than 10 km from YCT population, but not in same stream segment as YCT, or within 10 km where existing barriers exist, but may be at **risk of failure.**
3	Introduced potentially hybridizing fish are in same stream and/or drainage **within 10 km of YCT population and no barriers exist** between introduced species and YCT population. However, introduced hybridizing species have not yet been found in same stream segment as YCT population.
4	Introduced potentially hybridizing fish are **sympatric** with YCT in same stream segment.

Significant Disease Influence Assessment

A significant disease influence ranking will be made for each (networked or non-networked population) using a ranking index of 1 to 5 to indicate low to progressively higher levels of risk associated with the possible or potential influence of significant diseases (Table 30). Population isolation and security are important considerations, but cannot be viewed as absolutes. The diseases of concern are those that cause severe and significant impacts to population health and include, but are not limited to, whirling disease, furunculosis, infectious pancreatic necrosis virus, etc. The assessment should be completed and/or reviewed by fish health professional. The level of influence should not be viewed as an absolute but rather as an indicator of possible or potential disease influences.

Table 30. Significant diseases risk influence index (Check one that best applies).

Rank	Risk Characterization
1	Significant diseases and the pathogens that cause these diseases have very limited opportunity to interact with existing YCT population. Significant disease and pathogens are not known to exist in the stream or watershed associated with YCT population. Barrier provides complete blockage to upstream fish movement. Stocking of fish from other sources does not occur.
2	Significant diseases and/or pathogens have been introduced and/or identified in same stream and/or drainage further than 10 km from YCT population, but not in same stream segment as YCT, or within 10 km where existing barriers exist, but may be at risk of failure**.** Stocking of fish from others source areas requires fish health screening and pathogen free clearance.
3	Significant diseases and/or pathogens have been introduced and/or have been identified in same stream and/or drainage within 10 km of YCT population and no barriers exist between disease and/or pathogens and diseased fish species and the YCT population. However, diseases and/or pathogens have not yet been found in same stream segment as YCT population.
4	Significant disease and/or pathogens and disease carrying species are sympatric with YCT in same stream segment but YCT have not tested positive.
5	YCT population is known to be positive for significant disease and/or pathogens are present. YCT population has a history of impacts from significant diseases. Environmental and/or biological conditions may have intensified disease impact.

Conservation Population Relative Health Assessment

A relative population health assessment will be completed for each networked or non-networked population using an index ranking that includes consideration of four factors (see attachment A). General population health will be indexed from low to high by using a 1 to 4 ranking system based on four variables identified by Rieman et al. 1993 (Table 31). The ranking for temporal variability will be derived as a cumulative total length of stream segments identified as being part of the conservation population. Population size of YCT that are sexually mature (see criteria above) will be derived from the density information associated with the stream segments and lakes that make up each conservation population. Population production will be ranked using stream segment information associated with habitat quality, presence of non-native fish, and potential for disease (see attachment A). The degree of connectedness will be taken from Table 24. These four main factors will be weighted to derive a final index as follows: Temporal Variability = 0.7; Population Size = 1.2; Population Production (Growth/Survival) = 1.6; and Isolation = 0.5 (D. Lee, USDA Rocky Mountain Research Station, Boise, Idaho, personal communication). The index value for relative population health should not be viewed as an absolute but rather as an indicator of possible or potential health.

Table 31. Ranks of various types of general health indicators associated with conservation populations. Individual variable rankings to be generated from the information associated with currently occupied habitat data and specific conservation population information.

Variable	Description	Rank	Criteria
Temporal Variability – Influence of stochastic catastrophic events on a whole population	Habitat Quantity -- Stream length occupied will be used to index temporal variability. Assumption is that larger habitat patch sizes will be less likely to be in synchrony with regard to stochastic events and, to a degree, with deterministic influences. Ranking for temporal variability will be derived as a cumulative total of stream segments identified as being part of the conservation population. If a lake is part of the habitat supporting a population adjust the ranking to the next higher level.	1	At least 50 miles of occupied habitat
		2	20 to 49 miles of occupied habitat
		3	6 to 19 miles of occupied habitat
		4	< 6 miles of occupied habitat
Population Size – Associated with the number of mature, potentially sexually reproductive fish in the YCT population.	Defined as the number of fish greater than 15 cm for small streams and 30 cm for larger rivers (refer to density determinations and/or specific population survey information … Tables 14 and 15). Population size will be derived from summing the demographic information associated with the stream segments identified for each conservation population and adjusting the total to reflect the amount of occupied habitat.	1	> 2,000 Adults
		2	500 – 2,000 Adults
		3	50 – 500 Adults
		4	< 50 Adults
Population Production (Growth/ Survival) - Influence of deterministic demographic factors on whole population See Attachment A	Factors that influence population production include habitat quality, disease, competition, and predation. Important considerations include land-use influence on habitat that could be influencing a population's potential. As important would be the application of enhancement actions targeted to improve population condition.	1	Greater than 50% of habitat in excellent condition; no non-native competitive species present; no catastrophic diseases present.
		2	Greater than 50% of habitat in good and excellent condition; non-native competitive species maybe present in low numbers; catastrophic diseases present in close proximity.
		3	Greater than 50% of habitat in fair, good and excellent condition; non-native competitive species may be present in high numbers; catastrophic diseases present in close proximity.

Variable	Description	Rank	Criteria
		4	Greater than 50% of habitat in poor condition Population associated with poor quality habitat; non-native competitive species present in high numbers; catastrophic diseases, if present, sympatric with population.
Population Connectivity	Relates to the degree of networking associated with the conservation population. Select from information in Table 24.	1	Strongly networked. Migratory forms must be present and migration corridors must be open (connected). Occupied network consists of numerous streams (>5).
		2	Moderately networked. Migratory forms are present, but connection with migratory populations disrupted at a frequency that allows only occasional genetic exchange. Occupied network consists of several streams (4-5).
		3	Weakly networked. Questionable whether migratory form exists within connected habitat; however, possible infrequent straying of adults into area occupied by population. Occupied network consists of 2-3 streams.
		4	Population not networked. Population functions as a single entity. Generally only one stream or stream segment involved.

While headwater YCT populations may include those isolated by impassible barriers to upstream fish movement (and thus could not be re-founded or receive external genetic material without human intervention), these headwater populations may be important sources for re-founding and augmenting lower populations.

Part 4. Evaluation of Potential YCT Population Restoration and Expansion Opportunities.

This evaluation will be based on an initial range-wide review of historically occupied stream segments and lakes that are not currently associated with conservation populations. This

mapping exercise will facilitate assessment of potential restoration and/or expansion opportunities for these stream segments and lakes. Similar to the mapping exercise associated with currently occupied stream segments and lakes, lower and upper bounds of all stream segments within the historical range that are believed to have habitat suitable for supporting self-sustaining populations of YCT will be identified and evaluated. Using the base historical hydrography layer within each 4th level HUC over laid with currently occupied habitat specifically for conservation populations, each team will systematically proceed to identify and evaluate YCT restoration and expansion potentials on a stream and lake segment basis. Locations of complete barriers, or partial barriers having the potential to be upgraded to complete barriers, are logical break points.

Only historically occupied habitat will be evaluated in this exercise. Other suitable habitat (i.e., suitable habitat that exists above historical barriers and other suitable habitats where YCT were likely extirpated prior to 1800) will be dealt with in a subsequent assessment. The initial step in this assessment of restoration and/or expansion potential will be to identify which historically occupied stream segments are currently unsuitable for sustaining YCT populations. The associated reasons for the unsuitable determination will be linked to physical habitat (e.g., insufficient flows or degraded habitat), temperature conditions or both (Table 32 and 33). An effort will be made to evaluate all historical habitats that remain suitable. The assessment teams are encouraged to identify as large a number of segments as possible. The specific information will be tracked on a stream segment or individual lake basis.

Table 32. General habitat inability to support self-sustaining populations of Yellowstone cutthroat trout. (Identify the one that best applies)

Code		Non-native Fish Stocking and/or Presence Status
1	H	The stream or stream segment has habitat that is incapable of supporting a self-sustaining population of YCT (i.e., there are severe habitat deficiencies).
2	T	The stream or stream segment has water temperatures that preclude supporting a self-sustaining population of YCT (i.e., water temperature that are too high or too low).
3	HT	The stream or stream segment has both habitat and temperature deficiencies.

Table 33. Source of habitat capability to support self-sustaining populations of Yellowstone cutthroat trout information. (Identify the one that best applies).

Code	Source of habitat information
1	Judgment-extrapolated information from other streams
2	Judgment - ocular reconnaissance
3	Spot habitat sampling
4	Trend habitat sampling
5	Detailed habitat sampling

Consideration of barrier locations will be important in defining the nature of stream segments. Remember, each identified stream segment must have all attributes in common. If one or more attributes change, a new segment should be created. Table 34 addresses fish stocking and/or fish presence associated with the stream segment. Table 35 identifies habitat attributes associated

with the stream segment. Table 36 identifies the relative significance of any fishery associated with the segment. Table 37 identifies the relative complexity of removal (chemical and/or physical removals) of any existing fish within the potential restoration or expansion segment. The sources of information from the above tables will be combined in Table 38.

Table 34. Fish stocking and/or presence of fish associated with the restoration or expansion stream segment. (Check the one that best applies)

Code	Non-native Fish Stocking and/or Presence Status
1	No record of fish stocking and the segment or lake is barren
2	Record of stocking YCT and/or hybridized YCT are the only trout present but they are not part of a conservation population.
3	Record of non-native trout stocking and/or the presence of non-native trout in low numbers. Includes all non-native trout: rainbow, brown, brook, lake, and other cutthroat. Hybridized YCT may or may not be present.
4	Record of non-native trout stocking and/or the presence of non-native trout being present in high numbers. Includes all non-native trout: rainbow, brown, brook, lake, and other cutthroat. Hybridized YCT may or may not be present
5	Unknown presence or stocking record of non-native trout.

Table 35. Habitat quality of the potential restoration or expansion segment. (Check the one that best applies)

Code	Habitat Quality Determination
1	Excellent habitat quality (e.g., ample pool environment, low sediment levels, optimal temperatures (summer and winter), quality riparian habitat, ample depths and good water quality etc.)
2	Good habitat quality (may have some habitat attributes that are slightly less than ideal)
3	Fair habitat quality (has a greater number of attributes that are less than ideal)
4	Poor habitat quality (most habitat attributes reflect inferior conditions)
5	Habitat quality unknown

Table 36. Relative significance of any fishery associated with the potential restoration or expansion segment or lake. (Check the one that best applies)

Code	Relative Significance of a Fishery
1	No fishery present
2	Minor fishery (i.e., minimal use, use days generally less than 100 days/year)
3	Moderate fishery
4	Major fishery (i.e., significant level of use, use days generally exceed 1000 days/year)
5	Significance unknown

Table 37. Relative complexity associated with removal of any fish associated with the potential restoration or expansion segment or lake. (Check the one that best applies)

Code	Relative Complexity of Non-native Fish Removal
1	No fish present
2	Minor complexity (e.g., simple drainage, few fish, low flows, simple habitats, small lake etc.)
3	Moderate complexity
4	Major complexity (e.g., significant flows, multiple channels, many fish, complex habitats, large lake etc.)
5	Unknown complexity

Table 38. Source information for the potential YCT restoration or expansion stream or lake segment. (Check the one that best applies to the combination of the four attributes)

Code	Description
1	Judgment-information extrapolated from other streams
2	Ocular reconnaissance
3	Spot sampling
4	Trend sampling
5	Detailed sampling
	Unknown

A generalized restoration or expansion opportunity assessment for each potential restoration stream and lake segment will be done by electronic ranking of the information contained in Tables 34 through Table 37. Restoration potentials will be ranked using a 1 to 4 ranking system for each of the four variables identified above (Table 39). The ranks assigned to each of the variables will be combined into a rating of overall restoration potential for each stream segment. The four variables will be weighted equally to derive the overall restoration ranking. The overall score will be divided into logical rankings associated with restoration potential (High Restoration Potential = 4 to 6; Intermediate Restoration Potential = 7 to 9; Low Restoration Potential = 10 to 13; and, Very Low Restoration Potential = 14 to 16). If a complete or partial barrier that has the potential to become a complete blockage occurs in the lower portion of a segment, the ranking will be elevated to the next higher restoration or expansion rank. The identification of one or more unknown conditions associated with the restoration variables will result in labeling that segment as having unknown restoration potential.

Table 39. Summarization of the factors considered in the assessment of restoration or expansion potential.

Variable	Description	Rank	Criteria
Biological considerations associated with YCT restoration opportunities	Specifically addresses the biological considerations associated the presence of other trout in potential restoration segments (Table 28).	1	No record of fish stocking and the segment is barren
		2	Hybridized YCT are present in the absence of other trout and segment is not part of a conservation population.
		3	YCT maybe present and non-native trout present in low numbers. Segment not part of conservation population.
		4	YCT maybe present and non-native trout present in high numbers. Segment not part of conservation population
Habitat	Specifically addresses habitat quality of	1	Excellent habitat quality

Variable	Description	Rank	Criteria
considerations associated with YCT restoration opportunities	potential restoration segments. See habitat quality ranking in Table 19	2	Good habitat quality
		3	Fair habitat quality
		4	Poor habitat quality
Social and political considerations associated with YCT restoration opportunities	Specifically addresses the relative significance of an existing fishery (Table 36).	1	No fishery present.
		2	Minor fishery (i.e., minimal use)
		3	Moderate fishery
		4	Major fishery (i.e., significant use level)
Relative complexity considerations associated with YCT restoration opportunities	Specifically addresses the complexity of non-native trout or hybrid YCT removals (chemical or physical) (Table 37).	1	No fish present
		2	Minor complexity.
		3	Moderate complexity.
		4	Major complexity.

Attachment A

Relative Population Health Evaluations

As indicated in the status update protocol each conservation population will receive a generalized population health assessment based on four (4) variables identified by Rieman et.al. (1993). Variables will be ranked based on information contained in the current distribution portion of the geo-database. The variables are related to both deterministic (e.g., changes that are predictable) and/or stochastic (e.g., changes due to chance events) processes that could influence the well-being of a population of YCT. It should be noted that this relative health evaluation should not be viewed as an absolute but rather as a relative index of possible or potential health influences associated with the population.

Temporal Variability As used in this health evaluation, temporal variability is linked to the population's ability to withstand stochastic influences to the occupied habitat. As such, the amount of occupied habitat becomes a significant indicator of how influential environmental (e.g., fire or drought) or hydrologic (e.g., flooding) events are likely to be to the population. The assumption is that increased habitat provides a greater opportunity for increased habitat complexity and a greater resistance to catastrophic events that could influence the entire population. To receive a low temporal risk ranking we are calling for at least 50 miles of occupied habitat to be present. On the other end of the scale, a very high temporal risk ranking would be associated with occupied habitat of less than 6 miles. The temporal risk ranking will be derived as a cumulative total of stream segments identified as being part of the specific conservation population.

Population Size Variability of Individuals Larger than 15 cm in small streams and 30 cm in rivers. As used in this risk evaluation, this is the population density of the combined mapping segments. The size thresholds are viewed as reasonable lengths associated with YCT that would be sexually active (e.g., related to the effective population). The concept of effective population size plays an important role in the long-term conservation scenario of a population by being

related to genetic drift, loss of genetic diversity and population inbreeding. Effective population size is also important in maintaining "critical population mass" needed for adjustments from migration and natural selective influences. A larger sexually active population size, in general, reflects conditions where all life stages are represented in the population. The population size will be derived from the density information. To receive a low adult population size risk ranking we are calling for an adult population size of greater than 2000 individuals. At the other end of the risk scale, a very high risk ranking would be associated with an adult population size of less than 50 adults.

Population Production (Growth/Survival) Variability Factors that influence population production include habitat quality, disease, competition and predation. Human uses and land management activities that influence habitat quality as well as efforts to enhance habitat are important but their effects will not be addressed in this assessment. In this assessment these activities are listed, but no degree of significance or influence is determined for a YCT population. To incorporate this type of information would require site-specific detail, which was not included in the database, and it would rely on interpretation of the effects. To a significant degree population production factors reflect deterministic processes. The development of a ranking for population production will include consideration of the database information associated with habitat condition, presence of competitive fish and presence of catastrophic disease associated with the conservation population. For the purposes of developing an initial ranked score associated with population production, habitat quality will be the primary consideration. The final population production score assigned to the conservation population will be increased by one level if non-native fish are sympatric with the population and/ or disease is present. The composite scores for population production variable ranking can range from 2 to 8 with a 2 being the best production ranking and 8 being the worst ranking. Partitioning of the initial ranked scores for population production follows: High Population Production = 2; Intermediate Population Production = 3 to 4; Low Population Production = 5 to 7; and, Very Low Population Production = 8. The final ranked score will reflect an adjustment to account for the presence of non-native fish competition and predation. If non-native fish are sympatric with the conservation population, the ranked score should be adjusted to the next higher population production level (i.e., Example: If the initial ranked score falls within the intermediate population production range (score of 3 to 4) and non-native fish are present; the final ranked score will automatically be changed to the low population production level). The final ranking will be inserted as the population production potential ranking in Table 31.

Table A1. Ranks of the various habitat quality and disease determinations for the population production factors

Variable	Description	Rank	Criteria
Habitat quality –	Habitat Quantity – Derived from the occupied stream segment habitat quality information contained in the database (Table 19).	1	> 50% of occupied stream segments judged to have a excellent habitat rating.
		2	> 50% of occupied stream segments judged to have excellent and good habitat ratings.
		3	> 50% of occupied stream segments judged to have excellent, good and fair habitat ratings.
		4	> 50% of occupied stream segments judged to be in poor habitat condition.
Presence of catastrophic disease	Developed from the risk assessment associated with significant disease (Table 30).	1	Significant diseases not known to exist and/or complete barrier to fish migration present.
		2	Significant diseases not in close proximity and/or barriers at risk of failure.
		3	Disease in close proximity and no barrier exists.
		4	Disease sympatric with population and/or known to be infected.

Population Connectivity (network) Viable Populations of YCT exist as either independents or networks. Independent populations operate as a discrete entity usually within a single stream. A population network (often referred to as a meta-population) consists of several local streams (sub-populations) operating with a level of movement and genetic exchange. Most often population networks represent several local sub-populations each occupying a specific component (e.g., specific streams) of a drainage network. In general, the diversity of local sub-populations and the nature of connectivity within the population network contribute to the stability of the population, especially in terms of how stochastic events might influence population performance through time. The basis for ranking population connectivity will be taken directly from the database (Table 19).

These four main factors will be weighted to derive a final index value using the following weighting criteria: Temporal Variability = 0.7; Population Size = 1.2; Population Production (Growth/Survival) = 1.6; and Isolation = 0.5. The individual factors and the final composite index scores represent only a relative indicator of population health. They should not be viewed as absolutes but rather as indicators of possible or potential health influences associated with each population.

Attachment B

Riverine Habitat – Quality Reference Conditions for Cutthroat Trout Habitat. The values identified in the table should not be viewed as absolutes or management standards. They are intended to provide reference conditions reflecting quality and quantity considerations for this status assessment. Application of this specific habitat information will require professional judgment by qualified biologists. Not all habitat attributes are applicable to every stream situation.

HABITAT - Reference Conditions	Reference Condition Values	Sources
SPAWNING HABITAT		
Substrate composition Surface fines Granitics Other geologies	<20%(B&E channels) <25% (C channels) <20% (All channels)	10
Fines by depth - % Fines (less than 6.3 mm)	0-24%	1,2,8,9
- % Fines (2.3 mm)	0-10%	3,4,5,9
% Gravel (0.5 - 3.0 in)	50%	9
Water temperature - mean daily range during spawning and incubation. (C)	8-13	3,4,5,13,14
Spawning access	As needed to protect and/or provide for the specific population.	9
Quantity-% of total spawning area	>5%	3,4
REARING HABITAT (Juvenile and Adult)		
Rearing access	As needed to protect and/or provide for the specific population.	9
Pool habitat – Percent of total area	35-60%	3,4,5,14
Percent of pools rated "high quality and complexity"	>30%	3,4,5
Habitat quantity – General length of occupied habitat associated with high habitat quality and high density. Length associated with lower quality habitat and density.	>6 miles >17 miles	12,13,15
Pool habitat – Number of "primary" pools per mile B Channels – Combined geologies	60 (0-5' wet width) 61 (5-10' wet width) 53 (10-15' wet width) 40 (15-20' wet width) 24 (20-25' wet width) 20 (25-30' wet width) 15 (30-35' wet width) 11 (35-40' wet width)	10
C Channels – Combined geologies	99 (0-5' wet width) 99 (5-10; wet width)	10

Note: For pool frequencies in other geologies, see reference 10.	56 (10-15' wet width) 53 (15-20' wet width) 21 (20-25' wet width) 30 (25-30' wet width) 44 (30-35' wet width) 12 (35-40' wet width) 4-16 (>40' wet width)	
Streambed composition Embeddedness Predominant sizes	 <30% >50% C+B	 2,9 3,4
Stream shading (%) (between 10:00 am to 2:00 pm)	50-76	3,4
Stream Cover Streams in meadows dominated by grass, sedge, forb – shading would be provided by low growth overhanging vegetation; % of potential based on vegetation type plus instream cover (%) (all forms combined)	>25	3,4,9
Streambank stability (% of potential based on inherent capability associated with natural riparian communities	>90	6,10
HABITAT – Reference Conditions	**Optimal Condition Values**	**Sources**
REARING HABITAT - Continued		
Instream debris (instream LWD in meadow situations would not be applicable). Number of LWD per mile (LWD = pieces of wood over 4" in diameter) B Channels – Combined geologies	 50 (0-5' wet width) 171 (5-10' wet width) 217 (10-15' wet width) 207 (15-20' wet width) 95 (20-25' wet width) 113 (25-30' wet width) 79 (30-35' wet width) 75 (35-40' wet width) 42-49 (>40' wet width	 10
C Channels – Combined geologies	60 (0-5' wet width) 60 (5-10' wet width) 187 (10-15' wet width) 120 (15-20' wet width) 74 (20-25' wet width) 138 (25-30' wet width) 132 (30-35' wet width) 68 (35-40' wet width) 32-48 (>40' wet width)	10
Note: For LWD frequencies for other geologies, see reference 10		

Water Temperatures (mean daily range C)	8-16	3,4,5,10
Watershed area – (Sq Miles)	>9 sq miles (approx 15 sq km)	14
Base stream flow (% of average annual daily)	>50	3,4,7

The following codes apply: Source codes are reference sources (see below for citations and in literature for references); substrate size codes are F = fines, G = gravel, C = cobble, B = boulder, and Bed = bedrock. Number 9 indicates that the present fisheries staff working on cutthroat has made this determination based on professional field observation and personal review of existing literature. In the case of spawning habitat, sediment levels would be associated with substrate strata that are related to egg pocket formation (for the smaller trout species this would generally be less than 4" in depth). Base stream flow guidelines may exceed that contingent upon existing water rights.

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