4.4.3.4 Impairment Evaluation

Impairment of water quality in GSMNP and along the AT would not occur under the No-Action Alternative, Monetary Settlement Alternative, Laurel Branch Picnic Area, and the Partial-Build Alternative to Bushnell. The Northern Shore Corridor is not likely to impair water quality in GSMNP or along the AT based on the information obtained to date. Due to the magnitude of this alternative, it is likely that additional NEPA documentation would be required to address site specific impacts not currently known and to determine detailed mitigation measures as they relate to final design. The impairment determination related to water quality would be re-evaluated in such documentation.

4.4.4 Aquatic Ecology

4.4.4.1 Methodology for Assessing the Aquatic Ecology Impacts

Analysis of impacts to aquatic wildlife within the lake, streams, and wetlands (collectively referred to as aquatic habitat) utilizes the approximate acreage expected to be permanently lost or temporarily affected by the presence of a road and/or disturbances that would occur during construction. The locations of streams and wet habitats in the project study corridors are depicted in Figure 3-5. Area of aquatic habitat potentially impacted and linear feet of impacts to riparian buffers were calculated using ArcGIS software (Appendix M). Direct impacts would occur from loss of habitat within the construction footprint of the potential road design. Indirect impacts would occur as a result of the potential road design, such as alteration of hydrology, vegetation, or other environmental factors that influence the composition and function of the habitat. Indirect impacts to aquatic habitats were defined as those that could affect aquatic habitats within 330 feet (100 m) upstream and 1,320 feet (400 m) downstream of the construction footprint.

Type

Impacts are beneficial and/or adverse. Beneficial impacts are defined as having a positive effect on aquatic wildlife. Adverse impacts have a negative effect on aquatic wildlife.

Duration

Short-term impacts are those that would occur for less than 1 year, typically as an episodic or temporary event. These impacts may occur as land disturbing activities begin or when BMPs fail. Typically, the source of the impact would be stabilized or repaired. Long-term effects occur as a result of construction activities at a specific location throughout the life of construction (this is assumed to be between 1 year and 15 years), but the impact is more than that of a temporary event. Permanent impacts are considered to be anything that persist throughout the construction period.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Context

Context is defined as site-specific, local, or regional. Site-specific impacts would affect the portions of aquatic habitat within construction footprints. These also are referred to as direct impacts. Local impacts to aquatic wildlife are based on current NCDOT procedures for road crossings and mussel surveys associated with transportation crossings over streams. Local impacts would occur within 330 feet (100 m) upstream/upslope and 1,320 feet (400 m) downstream/downslope of the construction footprint also referred to as indirect impacts. Regional impacts are those that would occur in the area bounded on the south by Fontana Lake, on the north by the North Carolina/Tennessee state line, on the west by Twentymile Ridge, and on the east by Noland Creek.

Intensity

Intensity is the degree to which resources are affected and is categorized as negligible, minor, moderate, or major. The definitions of each category are based on the best available scientific information and are specific for this DEIS. The definitions for the impacts to aquatic wildlife are based on the current USACE requirements associated with permitting for linear transportation projects (Nationwide Permit 14). However, potential impacts, the degree of public controversy, and the potential for impacts to other resources make it likely that the USACE would require an individual permit. For all permits, USACE requirements utilize acreage impacts per linear transportation crossing to determine permitting and mitigation needs. These definitions are used to compare the alternatives.

No/Negligible

No impacts occur, or if impacts occur they are not detectable and have no observable effects on aquatic wildlife. These impacts are not expected to be significant or observable.

Minor

Impacts associated with the filling of or complete loss of less than 0.10 acre (0.04 ha) of aquatic habitat and/or occurring when the proposed project does not cross aquatic habitat but is parallel to and within 50 feet (15.2 m) of the habitat.

Moderate

Impacts associated with the filling or total loss of between 0.10 acre (0.04 ha) and 0.50 acre (0.20 ha) of aquatic habitat or less than 0.10 acre (0.04 ha) of aquatic habitat that is ranked G1 or G2, meaning a globally rare community. More information on the global ranking of wetlands is in Section 3.4.1.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Major

Impacts associated with the filling or total loss of more than 0.50 acre (0.20 ha) of aquatic wildlife habitat or more than 0.10 acre (0.04 ha) of aquatic wildlife habitat ranked G1 or G2, meaning a globally rare community.

4.4.4.2 Summary of Impacts

The following factors may cause impacts to aquatic wildlife, both directly and indirectly as a result of the potential road designs. Impacts to wetland habitat are summarized in Table 4-17a and b and impacts to stream habitat are summarized in Table 4-18. A table of all impacts to aquatic wildlife, including approximate area of impacts, is in Appendix M (Attachment M-1). Refer to this table for the approximate amount of area impacted and the summary of impacts for all the options and alternatives. Impacts to federally protected and state protected aquatic species are discussed in Sections 4.4.10.1 and 4.4.10.2.

Sedimentation

Sedimentation may occur from road construction due to creation of spoil piles, exposed or unvegetated surfaces, and dust accumulation. Habitat degradation from sedimentation includes fewer pools, relatively uniform riffles and runs, an embedded substrate, elevated conductivity, sediment deposition, bank erosion, and abundant periphyton. Increased impervious surfaces in areas such as recreational facilities and parking areas would increase surface runoff. Increased velocities may cause erosion around culverts, ponding upstream of culverts, and transport of larger sized particles, resulting in gravel washout.

The Primitive Park Road provides a larger source of sedimentation material as compared with the Principal Park Road. While the amount of potential impervious area would be reduced with the Primitive Park Road, dust and runoff from the gravel road surface would be additional sources of sedimentation causing adverse habitat impacts. The Primitive Park Road would require more maintenance than the Principal Park Road. Ground disturbance, resulting from maintenance activities such as road blading, could result in direct sediment delivery to adjacent streams (Sheehy 2001).

Elevated levels of sediment and turbidity can reduce the biological productivity of aquatic systems. Intolerant fish species such as darters may avoid what once was optimal habitat and resort to a sub-optimal habitat. Sedimentation may lower the diversity of fish populations, and more tolerant fish species may become more abundant. Silt accumulation results in reduced substrate permeability, velocity, and dissolved oxygen which may impact the success rate of fish reproduction. Research has shown that the mortality of incubating eggs increases as the levels of silt and sand accumulation increases (American Fisheries Society 2004). Sediment decreases visibility in the water column, affecting species that rely on sight to capture their food. Most fish species feed by watching for food items from low-velocity cover and moving into high-velocity areas to pick out food particles.

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Excessive sedimentation can smother eggs of many amphibians and alter food sources. The North American dusky salamander (*Desmognathus fuscus*) is reportedly very sensitive to effects of bank erosion, sedimentation, and turbidity (Adamus 1990). High stream flows causing streambank erosion along with carrying sediment runoff from side slopes could cause a great deal of streambed movement and stream turbidity. Streambed movement can crush and dislodge developing salmonid embryos and fry (Burns 1972). Hellbenders feed primarily on crayfish, earthworms, fish, frogs, and a variety of invertebrates. Sedimentation may lower the abundance of these food sources for hellbenders and other aquatic organisms.

Increased sediment deposition affects the feeding and resulting growth, habitat, and community composition of macroinvertebrates. Sedimentation can impede filter-feeding by clogging the food-trapping apparatus and reducing the area of suitable attachment surfaces (Ryan 1991). Fine sediments impact macroinvertebrate habitat by infiltrating the interstitial spaces between coarser substrates and blocking connections between surface and hyporheic sediments (Waters 1995). This may make macroinvertebrates more susceptible to predation and the effects of floods, and is likely to result in greater exposure to high current velocity, thus increasing energy expenditure (Harding et al. 2000). Increased sediment will initiate drift of animals from an impacted site, and long-term exposure will alter the type, number, and density of species (Resh and Rosenberg 1984). Species with adaptations to withstand high sediment load may become more abundant. For example, some species of Chironomidae that are protected by a movable case or can burrow will avoid or be protected from sedimentation (Rosenberg and Wiens 1980). Some species of Ephemeroptera have the capacity to inhabit alternative microhabitat as substrate becomes filled with sand (McClelland and Brusven 1980).

Fish Passage Barriers

Improperly designed stream crossings can create barriers to fish passage, resulting in habitat fragmentation and habitat loss. A passage barrier may result in local fish populations being divided into smaller, isolated populations. Isolated populations have a greater risk of extinction due to random processes and loss of genetic diversity (Ruediger and Ruediger 1999).

Riparian Buffer

Alteration of stream riparian zones is known to influence the numbers and composition of organisms present within streams. Stream temperatures may increase in areas where the canopy has been removed, which could result in avoidance behaviors by fish. Impacts to salamander habitat may also occur from canopy removal, which would increase temperatures and possibly reduce the moisture regimes of the adjacent communities. For benthic macroinvertebrates, temperature serves as a cue to life-cycle responses; therefore, alterations in temperate could have measurable impacts. Riparian buffers provide organic carbon, nutrients, and woody debris that aquatic invertebrates especially favor for food and habitat. Removal of riparian buffers could also cause a shift in the food chain.

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The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Hydrology

A road and associated stream crossings would alter the hydrology of streams and wetlands. Upstream of the road, there may be an increase in hydrologic events due to the damming effect from the road. Downstream of the road, hydrologic functions may be lost due to culverts, concentrating water at a point, which could result in fluctuations of water levels in jurisdictional wetlands and special aquatic habitat areas. These fluctuations may alter the quality and quantity of aquatic habitat, which could result in species immigration, emigration, and decreased breeding of certain species and their predators.

4.4.4.2.1 No-Action

The No-Action Alternative would not impact aquatic wildlife within the project study corridors.

4.4.4.2.2 Monetary Settlement

The Monetary Settlement Alternative would not directly impact aquatic wildlife in the project study corridors. Impacts resulting from this alternative outside GSMNP would depend on how Swain County uses the funds. Indirect impacts to aquatic wildlife inside GSMNP would be unlikely.

4.4.4.2.3 Laurel Branch Picnic Area

Lakes

There are no direct impacts to aquatic wildlife within Fontana Lake from this alternative. Indirect impacts to aquatic wildlife habitat may be expected from factors such as increased sedimentation and changes to water quality. These impacts are anticipated to be adverse, negligible, regional, and long-term to permanent.

Streams

During stream surveys, a federal species of concern and state species of special concern, the smoky dace, was observed within the Noland Creek watershed. Direct impacts are anticipated to be adverse, moderate, site-specific, and permanent. Indirect impacts are anticipated to be adverse, moderate, local, and short-term to long-term.

Wetlands

No wetlands were identified within the project study corridor for the Laurel Branch Picnic Area; therefore, no direct or indirect impacts would be anticipated.

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The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

4.4.4.2.4 Partial-Build Alternative to Bushnell (Primitive and Principal Park Roads)

Lake

The baseline Partial-Build Alternative to Bushnell includes a boat ramp would impact approximately 0.34 acre (0.14 ha) of aquatic habitat within Fontana Lake. Impacts from the boat ramp would be anticipated to be adverse, moderate, site-specific, and permanent. Indirect impacts to aquatic habitat within Fontana Lake would be anticipated to be adverse, moderate, regional, and long-term and permanent.

Streams

Based upon the area of impact, the baseline Partial-Build Alternative to Bushnell would have adverse, major, site-specific, and permanent direct impacts and adverse, major, local and regional, long-term indirect impacts from both potential road types. The Primitive Park Road would cross Forney Creek, which contains two FSC species, the olive darter and the hellbender, and Chambers Creek, which has the hellbender. The Principal Park Road would avoid impacts at Forney Creek but would cross Chambers Creek.

Wetlands

The baseline Partial-Build Alternative to Bushnell would have adverse, moderate, site-specific, and long-term and permanent impacts to wetland habitat within the footprint of the Primitive Park Road and major impacts from the Principal Park Road. Indirect impacts due to changes in hydrology, vegetation, and water quality would have adverse, major, local, long-term and permanent impacts to aquatic wildlife within wetlands.

Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)

Lake

No change in impacts from the baseline Partial-Build Alternative to Bushnell is expected.

Streams

The Southern Option at Forney Creek Embayment, which has one bridge crossing, would avoid impacts to the olive darter and hellbender populations in Forney Creek. There would still potentially be impacts to the hellbender at Chambers Creek. The potential for direct and indirect impacts is reduced from the baseline Partial-Build Alternative to Bushnell for both road types by crossing approximately 50 percent fewer streams.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Wetlands

This option would avoid all impacts to aquatic wildlife within wetlands around Forney Creek. There would be no direct impacts to wetland wildlife habitat within the construction footprint of the Primitive Park Road, and direct impacts from the Principal Park Road would be reduced by approximately 67 percent. However, the local (indirect) impacts would increase from the baseline Partial-Build Alternative to Bushnell by approximately 21 and 54 percent for the Primitive and Principal Park roads, respectively.

4.4.4.2.5 Northern Shore Corridor (Primitive and Principal Park Roads)

Lake

The baseline Northern Shore Corridor would have negligible direct impacts to aquatic wildlife habitat associated with Fontana or Cheoah Lakes. Indirect impacts to aquatic wildlife habitat within the lakes could occur from upstream runoff causing adverse, negligible, regional, long-term and permanent impacts.

Streams

The baseline Northern Shore Corridor would have adverse, major, site-specific, and permanent direct impacts to aquatic wildlife habitat within streams for both the Primitive and Principal Park Roads. The olive darter was found in Forney Creek, Hazel Creek, and Chambers Creek. The smokey dace, a federal species of concern, was observed in Hazel and Eagle creeks. The hellbender was found in Forney, Hazel, and Chambers creeks, and is suspected to be in Eagle Creek. An undescribed crayfish species was found in Hazel Creek. Indirect impacts are anticipated to be adverse, major, local, long-term and permanent. This alternative could potentially impact greater than 0.5 mile (0.8 km) of riparian buffers along three streams: Shehan Branch, Hazel Creek, and an unnamed tributary to Cheoah Lake.

Wetlands

The direct and indirect impacts from both road designs would be adverse, major, site-specific, and long-term to permanent for the baseline Northern Shore Corridor.

Southern Option at Forney Creek Embayment (Primitive and Principal Park Roads)

Lake

No change in impacts from the baseline Northern Shore Corridor is expected.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Streams

The Southern Option at Forney Creek Embayment would avoid impacts to Forney Creek and the olive darter and hellbender. This option would reduce direct impacts of the Primitive and Principal Park Roads by approximately 10 percent as compared with the baseline Northern Shore Corridor. Indirect impacts would still occur, but would be anticipated to be reduced from the baseline Northern Shore Corridor.

Wetlands

The Southern Option at Forney Creek Embayment would avoid impacts to aquatic wildlife in the wetlands associated with Forney and Gray Wolf creeks. This option would reduce direct impacts by approximately 17 and 18 percent, respectively, for the Primitive and Principal Park Roads as compared to the baseline Northern Shore Corridor. Indirect impacts would be decreased by approximately 4 and 8 percent, respectively, for the Primitive and Principal Park Roads.

Southern Option at Hazel and Eagle Creek Embayments (Primitive and Principal Park Roads)

Lake

No change in impacts from the baseline Northern Shore Corridor is expected.

Streams

The Southern Option at Hazel and Eagle Creek Embayments would avoid impacts to the smoky dace, the olive darter, the hellbender, and the undescribed crayfish species. Direct impacts would be reduced by approximately 36 and 41 percent, respectively, for the Primitive and Principal Park Roads, as compared with the baseline Northern Shore Corridor. Indirect impacts would be expected, but could be reduced from baseline Northern Shore Corridor due to fewer stream crossings.

Wetlands

The Southern Option at Hazel and Eagle Creek Embayments would avoid impacts to Hazel Creek, Eagle Creek, and Shehan Branch, thereby avoiding impacts to the wetland habitat associated with these streams. As compared to the baseline Northern Shore Corridor, direct impacts to aquatic habitat would be reduced by approximately 7 and 5 percent for the Primitive and Principal Park Roads, respectively. Indirect impacts would be reduced by approximately 8 and 7 percent, respectively, for the Primitive and Principal Park Roads.

Clarification of the term “baseline” for this project:
The Partial-Build Alternative to Bushnell and the Northern Shore Corridor include a baseline route, as well as options to that route. Baseline routes and options are detailed in Section 2.5 and shown on Figure 2-8. Baseline routes have been compared to existing conditions. Impact analyses for the options are shown as a difference from the associated baseline route.

Southern Option Crossing Fontana Dam (Primitive and Principal Park Roads)

Lake

No change in impacts from the baseline Northern Shore Corridor is expected. This option would avoid all indirect impacts to Cheoah Lake.

Streams

The Southern Option Crossing Fontana Dam would avoid up to 16 streams crossings potentially reducing the direct and indirect impacts to aquatic wildlife streams by approximately 11 percent for each potential road type.

Wetlands

Selection of this option would reduce direct impacts by 51 percent for the Primitive Park Road and by 39 percent for the Principal Park Road as compared with the baseline Northern Shore Corridor. Indirect impacts would still occur, but would be reduced by 26 percent for each road type.

4.4.4.2.6 Cumulative Impacts

Past actions in the study area, described in Section 4.1.2 affected the aquatic ecology of the study area, with the 1944 completion of Fontana Dam having the most evident impact. Fontana Lake and other impoundments on the Tennessee River have caused the elimination of aquatic habitat for many species while creating open water habitat for other aquatic species. The impoundments isolated certain species and limited habitat causing many of these species to be rare (see Section 4.4.10 for more information on protected species). Aquatic habitats within the study area have been altered by commercial and residential development, mining, tourism, timber operations, and agricultural practices that have channelized and straightened streams and eliminated wetlands.

Aquatic ecology continues to be affected by on-going private development. Other actions in the study area vicinity that would affect aquatic ecology include the Ravensford Land Exchange, and Foothills Parkway. Construction of other roadways, such as NCDOT TIP projects and thoroughfare plan projects, could also impact aquatic ecology in the study area vicinity.

Sediment may impact Fontana Lake if the Dillsboro Dam, located upstream on the Tuckasegee River in Dillsboro, North Carolina, is removed. A decision has not been made concerning the future of the dam. The Dillsboro Dam is at approximately River Mile 31.7, which is approximately 25 river miles (40 km) upstream from the mouth of Noland Creek on Fontana Lake. An estimated 102,168 cubic yards (78,113 m^3) of sediment are stored behind the dam (Duke Energy Corporation 2004). Removing this dam would release the sediment into the Tuckasegee River and could ultimately impact aquatic wildlife within Fontana Lake. The

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combined release of sediment from the Dillsboro Dam removal and the construction of any of the alternatives are not expected to significantly impact aquatic wildlife in Fontana Lake. Short-term impacts may decrease visibility and cause fish avoidance behavior, but no long-term or permanent impacts are anticipated to community structure or habitat quality.

Impacts to lakes, streams and wetlands that may result from either of the two partial-build alternatives or the build alternative for the proposed project would contribute to any cumulative effects on aquatic ecology in the study area and region. These effects could include changes in hydrology and water quality and resulting degradation of aquatic habitats. Mitigation to protect and enhance water quality would minimize the potential cumulative effects on the region's water resources.

4.4.4.3 Options to Address Potential Impacts

NPS would employ a sequence of steps to avoid adverse impacts to aquatic wildlife to the extent practicable, minimize impacts that could not be avoided and mitigate for unavoidable adverse impacts. These practices are discussed in Sections 4.4.1.3 (Wetlands), 4.4.2.3 (Streams), 4.4.3.3 (Water Quality), and 4.4.10 (Protected Species). Due to the unique nature of the aquatic wildlife and habitat present within the project study corridors, it is unlikely that suitable mitigation for all unavoidable adverse impacts will be possible.

Avoidance Techniques

Final avoidance strategies could not be determined unless and until delineations and habitat evaluations are completed. Once that is done, a road could be evaluated to avoid direct and indirect impacts whenever possible. Listed below are techniques that could avoid impacts to aquatic wildlife.

- Avoidance of direct impacts to aquatic wildlife in Fontana Lake would be achieved through a steel-arch bridge design, which would not use footers in the lake.

- Direct impacts to streams and wetlands could be avoided by changing the footprint of the road. Indirect impacts from changes in hydrology could be avoided by bridging entire streams and/or wetland systems.

Minimization Techniques

Where no alternatives that avoid adverse impacts to aquatic wildlife habitat were found to be practicable, minimization steps would have to be employed to reduce adverse impacts. Implementation of these steps would require design modifications and implementation of BMPs to limit and control impacts during and after project construction. Listed below are techniques that could minimize impacts specific to aquatic wildlife.

- Bottomless culverts could prevent passage barriers and eliminate destruction of available substrate, providing habitat connectivity for aquatic organisms.

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- Timing impacts to avoid interruption of critical natural cycles such as breeding and migration seasons.
- Maintaining buffers around aquatic habitat, including streams, lakes, and wetlands.
- Impacts due to dust from the gravel road can be minimized by the application of stabilizers. A list of potential types of stailizers is included in Appendix M.

Mitigation Techniques

After avoidance and minimization techniques have been applied to the maximum practicable extent, remaining impacts to aquatic wildlife would be offset through mitigation. Restoration of degraded systems would create habitat for aquatic species. If mitigation is necessary, the NPS is committed to keep mitigation efforts within GSMNP to maintain the quantity and quality of aquatic habitat in GSMNP. On-site mitigation of areas that might be impacted during disturbance activities (such as construction) could be addressed after the disturbance period. For example, loss of species due to changes in water quality could be mitigated through re-introduction of species after water quality has stabilized. Mitigation includes the enhancement of impacted habitat or education about aquatic wildlife.

4.4.4.4 Impairment Evaluation

Impairment to the aquatic wildlife of GSMNP and the AT would not occur under the No-Action Alternative, Monetary Settlement Alternative, Laurel Branch Picnic Area, and the Partial-Build Alternative to Bushnell. The Northern Shore Corridor is not likely to impair the aquatic wildlife of GSMNP or the AT based on the information obtained to date. Due to the magnitude of this alternative, it is likely that additional NEPA documentation would be required to address site specific impacts not currently known and to determine detailed mitigation measures as they relate to final design. The impairment determination related to aquatic wildlife would be re-evaluated in such documentation.

4.4.5 Vegetation Communities

4.4.5.1 Methodology for Assessing Impacts to Vegetation Communities

The following sections define the duration, context, and intensity for evaluating impacts to vegetation communities and summarize the impacts of the alternatives. Impacts on ecosystems involve the evaluation of component resources, as well as the spatial and temporal organization (patterns and process) of these components with consideration for rare species and biological communities in ecosystems. For the purposes of this analysis, communities were considered rare when the Global Rank was G1 or G2 or when the global rank indicated an uncertainty (G2? or G3?) that included the potential for a G1 or G2 community. All other community global ranks (G3, G4, G5, GD, GW) were considered as secure. It should, however, be noted that under this ranking system that G3 communities are defined as vulnerable, but not imperiled. Table 3-9

Clarification of the term “baseline” for this project:
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