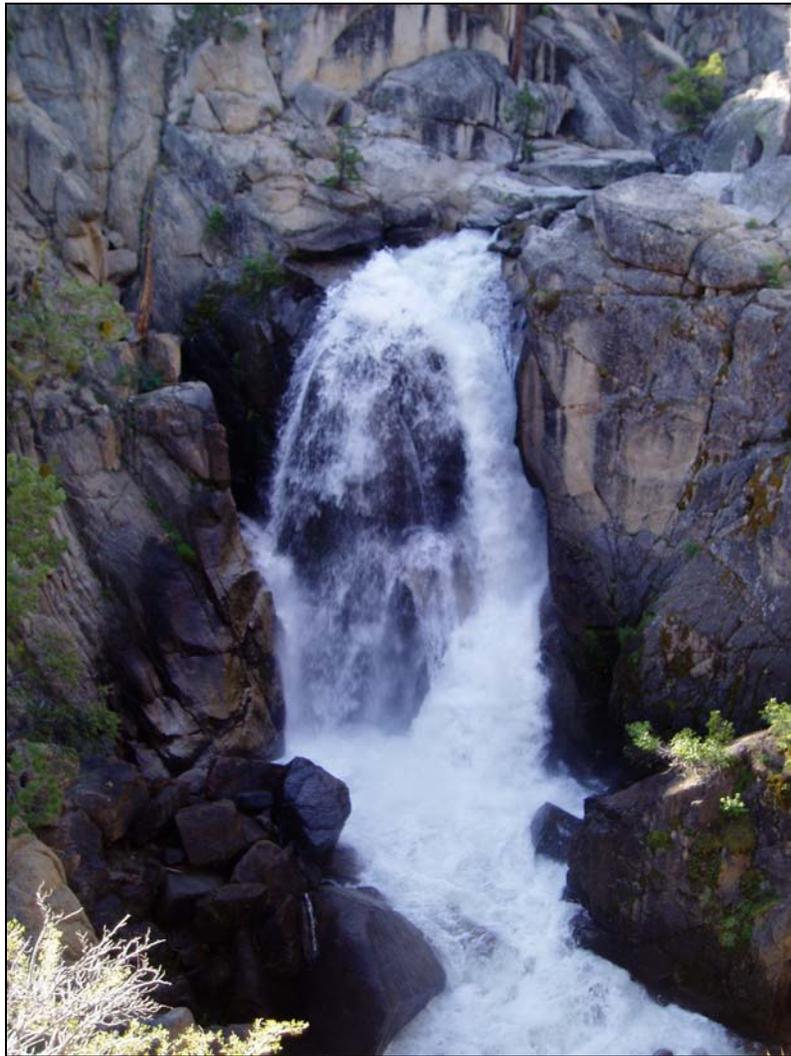


# **East & West**

## **Carson River Watersheds**

Alpine County, California & Douglas County, Nevada

2008 Summary Report  
for the 2006 & 2007 Stream Habitat Surveys



Carson Falls: East Fork Carson River

Prepared by:

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## Introduction

Historic Lahontan cutthroat trout (LCT) distribution in the Carson River drainage probably included most of the drainage downstream from Carson Falls on the East Fork and Faith Valley on the West Fork. It is doubtful that any lacustrine Carson River populations existed. Kling and Mellison (2008) estimate that at least 405 miles of coldwater stream habitat within the Carson River drainage were once accessible to Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*). Populations of these salmonids within the watershed were interactive and interconnected, and therefore these metapopulations likely had high genetic diversity and were capable of long term persistence through adverse conditions.

At present, no self-sustaining populations of genetically pure LCT are known to occupy historic habitat within the Carson River basin and since all of the drainage has been surveyed it is doubtful that any such populations remain to be discovered. The introduction of nonnative trout before the turn of the century is believed to be largely responsible for the extirpation of LCT within the Carson River drainage.

Although naturally occurring cutthroat trout populations have been eliminated from the Carson River drainage, small populations have been established in the formerly fishless headwaters of the East Fork Carson River above Carson Falls and in the tributaries Murray Canyon Creek, Golden Canyon Creek, and Poison Flat Creeks above impassible barriers. California Department of Fish and Game planting records for 1939 and 1940 reveal that Murray Canyon Creek and the East Fork Carson River above Carson Falls was planted with hatchery reared fry (fish of Carson River origin produced from eggs collected from transplanted fish in Blue and Heenan lakes). The population in Golden Canyon Creek was planted in 1978 with transplants from Murray Canyon Creek. The exact origin of LCT in Poison Flat Creek is unknown. Early day shepherders who frequented the region may have planted fish in Poison Flat Creek, Murray Canyon Creek, and the East Fork Carson River above Carson Falls with cutthroat trout collected from below the falls. Pure populations of LCT also occur in Red Lake, Heenan Lake, Heenan Creek, and possibly in Raymond Meadows Creek. Hybridized populations of LCT occur in Jeff Davis Creek and in Leviathan Creek upstream of Leviathan Mine. The artificially established pure populations of LCT in the East Fork Carson River watershed occupy about 17 miles of stream habitat: approximately 4.2% of the total miles that LCT presumably occupied historically.

The East Fork Carson River watershed is located in Alpine County, California and Douglas County, Nevada. The headwaters of the East Fork Carson River originate at an elevation greater than 10,350 feet near Sonora Pass, approximately 2 miles north of Highway 108. The East Fork Carson River flows in a northerly direction for approximately 57 miles to the confluence with the West Fork Carson River near Minden, NV (Approx. Elevation 4680 feet). The majority of the watershed is located within the boundaries of the Humboldt-Toiyabe National Forest (HTNF), and the upper watershed is primarily located in the Carson-Iceberg Wilderness. In the lower reaches the East Fork

Carson River passes through land managed by the Bureau of Land Management, private parcels, and a section owned by the Washoe Indian Reservation.

The West Fork Carson River watershed is also located in Alpine County, California. The headwaters of the West Fork Carson River originate close to 8,200 feet near Lost Lakes, approximately 4 miles south of Carson Pass off Highway 88. The West Fork Carson River flows in a northeasterly direction for approximately 40 miles to the confluence with the East Fork Carson River near Minden, NV. The majority of the upper watershed is located within the boundaries of the Humboldt-Toiyabe National Forest. In the lower reaches the West Fork Carson River passes through mostly private parcels of land.

### **Purpose and Need**

The 1995 Lahontan Cutthroat Trout Recovery Plan requires that ecosystem management plans be developed for the Truckee and Walker River basins in order to both determine objectives for the future desired conditions of these watersheds, and to create strategies for achieving these objectives. Similar management plans are recommended for the Carson and Humboldt River basins. In 1998 Truckee and Walker River Basin Recovery Implementation Teams were organized to develop strategies for Lahontan cutthroat trout (LCT) restoration and recovery efforts in the Truckee and Walker River basins. In August 2003 both recovery teams completed Short-Term Action Plans for Lahontan Cutthroat Trout Recovery in the Truckee and Walker River Basins. The short-term action plans outline specific tasks to be completed within five years. Many of the short-term tasks identified in the Truckee and Walker River Basin Short-Term Action Plans are similar to one another and are applicable to recovery of LCT in the Carson River basin. The Carson Ranger District adopted some of the short-term tasks identified in the Truckee and Walker River Basin Short-Term Action Plans and began implementing these actions under an informal plan for the Carson River basin. These tasks include: (1) identifying and evaluating fish passage and existing barriers within the Carson River basin, (2) developing a watershed analysis of the physical components of the Carson River basin, and (3) initiating habitat surveys to evaluate potential LCT introduction streams and validating against existing LCT inhabited streams.

The primary causes for the decline of LCT include: 1) reduction and alteration of stream discharge; 2) alteration of stream channels and morphology; 3) degradation of water quality; and 4) introductions of non-native fish species. The East Carson River watershed downstream of Carson Falls and the West Carson River watershed are primarily inhabited by non-indigenous salmonids which include, but are not limited to: rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*). These competitive and aggressive introduced fishes have displaced the endemic Lahontan cutthroat trout.

Long term survival and recovery of LCT within the Carson River watershed will require sustained cooperation and effort from multiple federal and state agencies, including the Forest Service and personnel of the Humboldt-Toiyabe National Forest. Gaining information through immediate action can aid in prioritizing future objectives for the

restoration of LCT. The 2006 and 2007 Carson River watershed surveys were conducted to gain information about streams in the basin, and furthermore to provide an inventory of potential fish habitat for LCT. The surveys included the tasks of identifying potential fish passage barriers and evaluating physical characteristics that pertain to the success of the native LCT. Should recommendations be made to re-introduce LCT, these surveys can provide baseline information for future management of the fishery. All the streams listed in Table 1 were surveyed during summer 2006 and 2007 by members of the Carson Ranger District of the Humboldt-Toiyabe National Forest. In addition, the members of the Carson Fisheries Department have also compiled individual reports for most of the streams listed in Table 1. The surveyors included Jason Kling, Brian Hodge, Robert Omann, Joel Ingram, Harrison Davis, and Kevin Rybacki. Each of the individual reports was reviewed by Jason Kling, Zone Fish Biologist on the Carson and Bridgeport Ranger Districts.

## **Materials and Methods**

Forest Service personnel surveyed the East and West Carson River watersheds by hiking the watercourse for each of the streams listed in Table 1 in an upstream manner. A short section of the East Fork Carson River was surveyed by floating the watercourse. Interesting and relevant features were documented, photographed, and recorded into a Trimble GPS unit. These features included but were not limited to: adjacent road impacts, beaver dams, campsites, diversions, erosion concerns, fish barriers, fish sightings, photo points, road-stream crossings, trail concerns, trail crossings, tributaries, etc. Appendix I includes maps for each stream surveyed. Each map shows the location of each feature collected. Each feature was assigned a site number and each feature has a corresponding photograph that has also been assigned the same site number. Most of the streams in Table 1 have their own individual stream habitat survey report. Each of those individual reports contains the pictures for each feature collected.

Fish passage barriers were noted and categorized into one of four categories: natural-permanent, natural-seasonal, artificial-permanent, and artificial-seasonal. A permanent barrier is categorized as an obstacle, waterfall, or drop in excess of 5ft that would prevent passage of fish year-round (specifically LCT). A stadia rod was used to measure barriers where applicable and safe. Barriers categorized as permanent barriers may actually be seasonal barriers, and some seasonal barriers may actually act as a permanent barrier.

## **Results and Discussion**

A total of 33 streams within the East and West Carson River watersheds were surveyed in 2006 and 2007. Approximately 170 miles of stream habitat was surveyed; approximately 135 miles in the East Carson drainage and 35 miles in the West Carson drainage. Information and pictures were collected for nearly 900 features. Approximately 125 miles of potential Lahontan cutthroat trout habitat was identified and approximately 17 miles of occupied Lahontan cutthroat trout habitat was identified.

Fish passage barriers were documented at 246 different locations. Natural permanent barriers were found at 123 locations, natural seasonal barriers were found at 115 locations, artificial seasonal barriers were found at 3 locations, and artificial permanent barriers were found at 5 locations. A culvert on Horsethief Creek at Site 2, a culvert on Hawkins Creek at Site 15, and another culvert on Leviathan Creek at Site 12 are forming artificial seasonal fish barriers. Artificial permanent barriers are found on Bryant Creek, East Fork Carson River, Raymond Meadows Creek, and on Silver Creek. Bryant Creek has a concrete dam at Site 15 and a box culvert at Site 35. The East Fork Carson River has Ruhestroth Dam at Site 1, Raymond Meadows Creek has a concrete Dam at Site 9, and Silver Creek has a culvert at Site 36. With the exception of the artificial barriers on Bryant Creek, all the other artificial barriers are located in areas where natural barriers are also found in close proximity; therefore, restoring fish passage at these artificial barrier sites should be considered low priority restoration projects. Not a lot would be gained by restoring fish passage at an artificial barrier site if a natural barrier occurs just upstream or just downstream. Once water quality improves in Leviathan Creek and Bryant Creek, and fish are able to persist in Bryant Creek year round, restoring fish passage on Bryant Creek at Sites 15 and 35 should become a high priority project.

Adjacent road impacts were noted primarily in areas where a road is close to the stream and due to the close proximity, erosion impacts are occurring. Eleven adjacent road impacts were documented. Of all the streams surveyed, Bryant Creek and the East Fork Carson River are being impacted the most from adjacent roads. Adjacent road impacts were also documented in areas near Indian Creek, Mountaineer Creek, West Fork Carson River, and Wolf Creek.

Surprisingly, only three beaver dams were documented throughout the East and West Carson River watersheds. One beaver dam was documented on Mountaineer Creek and two beaver dams were documented on the West Fork Carson River. All three beaver dams appear to be old, no longer in use, and abandoned. Although an actual beaver was not seen, evidence of recent beaver activity was seen at one location in the lower section of Silver King Creek; downstream of the Snodgrass Creek confluence.

Approximately 200 campsites were documented throughout the survey area. Whenever a camping area was seen from the watercourse, information like total number of campsites, campsite dimensions, and the distance between the campsite and the watercourse was collected. Of all the streams surveyed, the East and West Carson Rivers are being impacted the most from camping. Approximately 66 campsites were documented on the East Fork Carson River and approximately 62 campsites were found on the West Fork Carson River. Approximately 18 campsites were found on Wolf Creek and 17 campsites were found on Hot Springs Creek. The other campsites are spread throughout the rest of the survey area. Nearly 65% of all the campsites documented are found on the East and West Carson Rivers.

Seven water diversion structures were identified throughout the survey area. Two diversions were documented on Hot Springs Creek, two on Raymond Canyon Creek, and one each on Mountaineer, Spratt, and Wolf Creeks. These diversions should be further

investigated to ensure that fish are not subject to terminal trips into irrigated pasture, etc. and to also ensure that water users are staying within the confines of their adjudicated rights.

Erosion concerns were noted in areas where the stream bank is unstable and often times sloughing off into the water. When an erosion concern was seen, the estimated height and length of the erosion was collected. Out of 33 total streams surveyed, erosion concerns were documented on 13 of the streams; Bryant Creek, Charity Valley Creek, East Fork Carson River, Hodge Creek, Hot Springs Creek, Jeff Davis Creek, Leviathan Creek, Mountaineer Creek, Silver Creek, Spratt Creek, West Fork Carson River, Willow Creek, and Wolf Creek. The East and West Carson Rivers had the most erosion concerns documented. The erosion concerns on the East Fork Carson River are spread throughout the drainage; whereas, the erosion concerns on the West Fork Carson River are primarily in the Faith and Hope Valley areas.

Fish sightings were obviously documented in several locations throughout the survey area. Whenever a fish was seen, crews collected a GPS location and recorded how many fish were seen. Of all the fish sightings recorded, the most surprising sighting was two large Lahontan cutthroat trout at Site 128 upstream of two permanent fish passage barriers at Sites 124 and 126 (See Map 5). It was not known that LCT existed that far up in the East Fork Carson River.

Grazing concerns were primarily documented as “other”. Although evidence of grazing was seen throughout the survey area, two areas, both on the East Fork Carson River, appear to be more heavily impacted than the other sites. The first area being heavily impacted from grazing is in Nevada between the California-Nevada state boundary and Ruhensroth Dam. The other area is near Bagley Valley and Vaquero Camp. See the pictures from Sites 81 and 82 in the 2006 East Carson River Stream Habitat Survey Report. Both areas on the East Fork Carson River had eroding stream banks, lack of vegetation, and the area near Bagley Valley had an abundance of algae in the river; possibly from a nutrient influx from the adjacent grazing.

Approximately 135 photo points were collected throughout the survey area. Photo points mostly consisted of general photos that captured the typical stream characteristics and vegetation for that section of stream.

Approximately 59 road stream crossings were documented throughout the survey area. Of the 59 road crossings, 27 are ford crossings, 9 are culverts, and 23 are bridges. Bryant Creek and the West Fork Carson River are being impacted the most by road-stream crossings. Bryant Creek has 17 road stream crossings and the West Fork Carson River has 12 road stream crossings. A few of the culverts are acting as aquatic organism passage barriers. These culverts are discussed in the fish barriers section of this report.

Six trail concerns were documented; one on the East Fork Carson River, two on Hot Springs Creek, and three on Wolf Creek. Trail concerns were documented when a trail was seen close to an area that had erosion occurring. Please see the East Fork Carson

River, Hot Springs Creek, and Wolf Creek individual reports for a more detailed description and photographs of the trail concern areas.

Twenty-one trail crossings were documented. Whenever a trail crossed a stream, the GPS location and a picture of the area was taken. Most of the trail crossings were ford crossings; however, one foot bridge crossing was noted on Hot Springs Creek at Site 23.

Approximately 150 tributaries were documented. At each tributary the location of the tributary (river right or river left) and the estimated percent contribution of the total overall flow were collected. A picture of each tributary was also taken.

As seasonal crews were conducting these stream habitat surveys, they were also identifying areas that provide potential LCT habitat so that potential LCT introduction streams could be identified and ranked as high, medium, or low candidates for restoration. As crews were searching for areas that provide potential LCT habitat, qualities that they were visually looking for included: 1) clean cold water streams, 2) pools in close proximity to cover and velocity breaks to provide hiding and spawning areas, 3) well vegetated, stable stream banks, 4) adequate cover: 50% or more of the stream area 5) rocky substrate in the riffle-run areas, absent of fine silt, 6) continuous stream/absence of barriers, 7) potential for restoring a metapopulation, 8) complexity of habitat: pool/run/riffle, 9) low-moderate gradient: < 15%, 10) current occupation by salmonids, and 11) amount of public use in the area. Based on all of these attributes potential Lahontan cutthroat trout habitat was identified, quantified, and streams were divided into three categories; high, medium, or low candidates for restoration. Table 2 summarizes the amount of potential LCT habitat that was identified for each stream surveyed, and it summarizes which streams were classified as high, medium, and low candidates for restoration.

**West Fork Carson River Watershed** (West Fork Carson River, Forestdale Creek, Red Lake Creek, Crater Lake Creek, Hawkins Creek, Willow Creek, and Horsethief Creek)

Opportunities do exist for restoring Lahontan cutthroat trout and small metapopulations in the East and West Carson River watersheds. The West Carson River watershed from its headwaters downstream to the area near Horsethief Creek provides potential LCT habitat and an opportunity for restoring a metapopulation of Lahontan cutthroat trout. Beginning in the headwaters of the West Fork Carson River and moving downstream, Forestdale Creek offers approximately 2 miles of potential LCT habitat (Map 36). The West Fork Carson River provides approximately 6 miles of potential LCT habitat between Sites 57 and 85 (Map 30). Within this entire area, approximately 5 miles on the West Fork Carson River between Sites 61 and 83 and approximately ½ mile on Forestdale Creek downstream of Site 6 would be accessible to a small metapopulation of LCT.

The West Fork Carson River also provides approximately 8 more miles of potential LCT habitat between Sites 27 and 57 (Maps 29 and 30). This entire 8 mile stretch is barrier-free. Red Lake Creek provides at least 2.2 miles of barrier-free (permanent) habitat (Map

34). Additional habitat may occur upstream of Site 13 on private and California State managed lands. Crater Lake Creek provides approximately 0.6 miles of barrier-free habitat (Map 35). Hawkins Creek provides approximately 1.3 miles of potential LCT habitat (Map 33); however, approximately 0.5 miles of that habitat is downstream of barriers and could be accessible by fish in the West Fork Carson River. Willow Creek offers at least 1.9 miles of potential LCT habitat between Sites 4 and 21 (Map 32). An additional 3 miles of barrier-free habitat probably exist between Site 1 and the West Fork Carson River on California State managed lands. So combined, the West Fork Carson River between Sites 27 and 57, Red Lake Creek, Crater Lake Creek, the area of Hawkins Creek downstream of Site 4, and the area of Willow Creek downstream of Site 1 is approximately 14.3 miles of potential LCT habitat that at minimum would be available for a metapopulation of LCT. In summary, due to the locations of all the barriers identified, the good habitat quality, and the potential for restoring a metapopulation of LCT in the West Fork Carson River watershed upstream of Site 27, the West Fork Carson River, Willow Creek, Hawkins Creek, Red Lake Creek, Crater Lake Creek, and Forestdale Creeks are all listed as high candidates for restoration on Table 2. Due to the high public use and fishing that occurs in the West Fork Carson River watershed, restoring a put-and-take recreational LCT fishery should seriously be considered.

Horsethief Creek provides 1.4 miles of potential LCT habitat (Map 31); however, none of this habitat is available to fish in the West Fork Carson River. Horsethief Creek would not provide any habitat towards a metapopulation of LCT. The potential habitat that was identified upstream of Site 7 is good quality habitat and several fish were observed. Horsethief Creek appears to have a high carrying capacity for fish. For all of these reasons, Horsethief Creek is listed as a medium candidate for restoration on Table 2.

The habitat on the West Carson River between Sites 1 and 27, although considered potential, the habitat is marginal, gradients are higher, and several seasonal barriers were identified. For these reasons, restoring the West Fork Carson River between Sites 1 and 27 should be considered a low priority. Additional information for each of the surveyed streams in the West Fork Carson River watershed can be found by looking at the individual stream habitat survey reports that were compiled.

### **East Fork Carson River Watershed**

The East Fork Carson River watershed also provides a great opportunity for future recovery of LCT. The entire 40 mile stretch of the East Fork Carson River below Carson Falls should be considered potential LCT habitat. The absence of significant fish passage barriers creates good continuous river habitat from Ruhstroth Dam up to the lower Carson-Iceberg Wilderness boundary. Between the lower Carson-Iceberg Wilderness boundary and Carson Falls, only one seasonal barrier (Site 87) with a height of 3.5 feet is present. Carson Falls, with a vertical height exceeding 80 feet, creates an irrefutably permanent fish passage barrier. Above Carson Falls the entire 9.5 mile reach between Sites 107-131 should be considered occupied LCT stream habitat. Lahontan cutthroat trout were positively identified with fish sightings at Sites 115 and 128; two locations separated by the presence of two permanent fish barriers (Sites 124 & 126) and a

longitudinal distance of more than six miles. The stream provides approximately 7.8 miles of continuous habitat between Carson Falls (Site 107) and the two permanent barriers at Sites 124 and 126. Both below and above Carson Falls, certain sections of the river provide more favorable habitat than others, though as a whole the watershed has both suitable habitat and suitable water quality for Lahontan cutthroat trout.

The widespread presence of non-native salmonids in the East Fork Carson River and the many tributaries prevents any immediate reintroduction of LCT into the main stem, unless LCT are stocked as a put-and-take recreational fishery. The ability of LCT to successfully persist in the presence of non-native salmonids within a large river system is unknown at this time. In small tributary streams, we do know that LCT are unable to persist successfully in the presence of non-native salmonids.

Land use largely determines the quality of the water and habitat in the East Fork Carson River. Since the majority of the main stem East Fork Carson River is managed by the Humboldt-Toiyabe National Forest, the Forest Service land management policies can be influential in maintaining and even enhancing the existing 50 miles of potential/occupied LCT habitat. In addition, Forest Service personnel may be able to cooperate with private landowners through land acquisition, cost-share agreements, or other means to achieve common goals.

#### **Lower East Fork Carson River Watershed** (Bryant Creek, Mountaineer Creek, Poison Creek, and Leviathan Creek)

Bryant Creek provides 4.8 miles of potential LCT habitat (Map 6). No natural barriers were found on Bryant Creek; however, two artificial permanent barriers were found at Sites 15 and 35. Bryant Creek combined with Mountaineer and Poison Creeks theoretically makes a good opportunity for restoring a metapopulation of LCT; however, Bryant Creek is heavily impacted from poor water quality and roads in the area. Unfortunately, Leviathan Creek (Map 9) is a tributary to Bryant Creek; therefore, until water quality and conditions improve at Leviathan Mine, Bryant Creek should only be considered a medium candidate for restoration. Mountaineer and Poison Creeks provide an opportunity for restoring a small metapopulation of LCT. Mountaineer Creek provides 5.4 miles of potential LCT habitat (Map 7) and Poison Creek provides 1.8 miles of potential LCT habitat (Map 8). Unfortunately, a natural permanent barrier occurs at Site 19 on Mountaineer Creek and at Site 13 on Poison Creek. The total area between Bryant Creek and these two barriers that would be accessible to a metapopulation of LCT would be approximately 3 miles. An additional 3.2 miles of habitat would exist upstream of Site 19 on Mountaineer Creek and 1 mile would exist upstream of Site 13 on Poison Creek. Mountaineer Creek has several seasonal barriers, but never-the-less, several fish were seen throughout the watershed. Many of the seasonal natural barriers were categorized based on complexity, not solely on the height of the barrier. In many instances the barrier height was only 1.5-2.5 feet high; however, the longitudinal distance was 4-5 feet or more, and passage would require fish to jump through root wads and an entangled mess. The fish carrying capacity of Mountaineer Creek also appears to be high. Based on the above assessment, good habitat quality in the area, and the small

metapopulation potential, Mountaineer and Poison Creeks are both listed in Table 2 as high candidates for restoration. Once water quality improves in Leviathan Creek, Bryant Creek should then become a high candidate for restoration. Additional information for each of the surveyed streams in the Lower East Carson River watershed can be found by looking at the individual stream habitat survey reports that were compiled.

**Lower Middle East Fork Carson River Watershed** (Markleeville Creek, Hot Springs Creek, Pleasant Valley Creek, Raymond Canyon Creek, Hodge Creek, Jeff Davis Creek, Spratt Creek, Musser and Jarvis Creek, Indian Creek, and Monitor Creek)

Opportunities exist in and near the Pleasant Valley and Hot Springs Creek drainages. No potential habitat was found in the surveyed areas on Pleasant Valley Creek; however, approximately 6 miles of barrier-free potential LCT habitat probably exist downstream of Site 1 to the Markleeville Creek confluence (Map 11). The area downstream of Site 1 was not surveyed because much of the area occurs on privately owned land and the private area is managed as a fly fishing preserve. The fly fishing preserve is a popular and heavily used area. Raymond Canyon and Hodge Creeks, both tributaries to Pleasant Valley Creek, have barriers and provide very little habitat for LCT (Maps 12 and 13). Jeff Davis Creek (Map 14) provides 1.7 miles of potential LCT habitat, but all of this habitat is upstream of natural permanent barriers and this area would not be accessible to fish that could probably occur in Pleasant Valley Creek downstream of Site 1. Although Jeff Davis Creek provides good habitat quality, if LCT were restored to this creek, they would be physically and genetically isolated. For these reasons, Jeff Davis Creek is listed as a medium candidate for restoration on Table 2 and Raymond Canyon and Hodge Creeks are listed as low candidates for restoration on Table 2. Pleasant Valley Creek is listed as a high candidate for restoration because downstream of Site 1, based on a topographic map and the popular fly fishing preserve, it presumably provides good habitat quality and has an absence of barriers. It could also provide important habitat for restoring a metapopulation of LCT in the Pleasant Valley Creek, Markleeville Creek, Hot Springs Creek, Spratt Creek, and Musser and Jarvis Creek drainages.

Hot Springs Creek, Spratt Creek, and Markleeville Creeks provide an opportunity for restoring a metapopulation of LCT. Markleeville Creek was not surveyed because it occurs entirely on private lands; however, based on looking at a topographic map, Markleeville Creek probably provides approximately 2.5 miles of barrier-free potential habitat. Hot Springs Creek provides at least 3.8 miles of potential LCT habitat (Map 10); however, 3.1 miles of this habitat occurs downstream of barriers and would be accessible to a metapopulation of LCT. Although not surveyed, an additional 1 mile of potential habitat on Hot Springs Creek probably occurs downstream of Site 1 to the confluence with Markleeville Creek. The headwaters of Hot Springs Creek provide 0.7 miles of habitat, but this habitat is upstream of barriers and if fish were restored there, those fish would be physically and genetically isolated. Charity Valley Creek, a tributary to Hot Springs Creek, provides at least 1 mile of potential habitat, but once again, this area is upstream of several barriers (Map 16). Charity Valley Creek may have an additional 2-2.5 miles of potential LCT habitat upstream of Site 22 on private land. Spratt Creek, another tributary to Hot Springs Creek, provides at least 1.7 miles of potential habitat

(Map 15), but most of this habitat is upstream of a permanent barrier at Site 4. Downstream of Site 4 to Hot Springs Creek 0.5 miles of potential habitat probably exist on the privately owned land. Musser and Jarvis Creek, although not surveyed, based on looking at a topographic map, probably provides 1 mile of potential habitat that would be available to a metapopulation of LCT. In summary, Markleeville Creek, Pleasant Valley Creek, Hot Springs Creek, Spratt Creek, and Musser and Jarvis Creeks could potentially provide 14 miles of barrier-free metapopulation habitat for LCT. To restore a self-sustaining pure population of LCT, a permanent barrier would have to be constructed on Markleeville Creek near the East Fork Carson River to prohibit non-native fish from the East Fork Carson River moving into the restored areas. The Markleeville, Pleasant Valley, and Hot Springs Creek watersheds are high public use areas, so restoring a put-and-take recreational LCT fishery should seriously be considered. Because of the good habitat quality, location of barriers, and metapopulation potential Spratt, Hot Springs, Markleeville, and Musser and Jarvis Creeks are all listed as high candidates for restoration on Table 2. For reasons described above, Charity Valley Creek is listed as a low candidate for restoration.

Indian Creek provides 1.5 miles of potential LCT habitat (Map 17). To restore a self-sustaining pure population of LCT to Indian Creek, a barrier would first need to be constructed near the East Fork Carson River confluence to prohibit non-native fish from the river moving into Indian Creek. Indian Creek also does not provide any opportunity towards restoring a metapopulation. For these reasons, Indian Creek is listed as a low candidate for restoration.

Monitor Creek does not provide any potential LCT habitat because it does not sustain perennial flows. During the months of July and August Monitor Creek often times will become dry.

**Upper Middle East Fork Carson River Watershed** (Silver Creek, Eagle Creek, Raymond Meadows Creek, Noble Creek, Wolf Creek, Dixon Creek, Bull Canyon Creek, Elder Creek, and Silver King Creek)

The Silver Creek watershed doesn't provide any opportunity for restoring a metapopulation of LCT. Silver Creek provides 5.4 miles of potential LCT habitat; however, 4.5 miles of that habitat occurs downstream of permanent fish passage barriers (Map 18). Approximately 0.9 miles of habitat occurs upstream of Site 39. Noble Canyon Creek provides 4.4 miles of potential habitat (Map 19); but once again, 1.2 miles of that habitat is downstream of Site 6 below the lowest permanent barrier. Eagle and Raymond Meadows Creeks (Maps 20 and 21) also provide habitat, but the entire potential habitat is upstream of permanent barriers and therefore this area would not be accessible to fish in lower Silver Creek and Noble Creek. In the 1980's CDFG stocked LCT into Raymond Meadows Creek between Sites 6 and 10-11. Through this 1500 foot section crews looked for fish, but none were seen. Because of the large number of barriers and no metapopulation potential, Raymond Meadows and Eagle Creeks are listed as low candidates for restoration on Table 2. Excluding the upper 0.9 mile section of Silver Creek and the 3.2 mile section of Noble Creek upstream of Site 6, lower Silver

Creek and Noble Creek combined provide approximately 5.7 miles of continuous potential habitat. Silver Creek especially provides good quality fish habitat. For these reasons, Silver and Noble Creeks are listed as medium candidates for restoration. Silver Creek receives high public use and fishing, so restoring a put-and-take recreational LCT fishery should seriously be considered. If Silver and Noble Creeks were to be restored to a self-sustaining pure population of LCT, a barrier would need to be constructed near the confluence with the East Fork Carson River to prohibit non-native fish from the river moving into the Silver and Noble Creek drainages.

The Wolf Creek watershed provides some opportunity for restoring LCT. Wolf Creek provides 11.5 miles of potential LCT habitat (Maps 22 and 23). The permanent barrier at Site 26 is questionable. The barrier at Site 26 may actually be a seasonal barrier; however, the barrier at Site 40 is definitely a permanent barrier at all times of the year. Of the 11.5 miles, 8.9 miles occurs downstream of Site 40 to the East Fork Carson River. Dixon Creek (Map 24) has several barriers and does not provide any potential LCT habitat. Bull Canyon Creek provides 1.2 miles of potential LCT habitat (Map 25), but all of this habitat is upstream of a permanent barrier and would not be accessible to fish in Wolf Creek. Elder Creek provides 1.5 miles of potential LCT habitat (Map 26), but once again, most of this habitat is upstream of a barrier and would not be accessible to fish in Wolf Creek. If LCT were restored into Bull Canyon and Elder Creeks, fish would be able to move downstream into Wolf Creek, but not back upstream; therefore, a true metapopulation wouldn't be established. Combined Wolf, Bull Canyon, and Elder Creeks provide approximately 14.2 miles of potential LCT habitat. The longest continuous barrier-free stretch would be the 8.9 mile section downstream of Site 40 on Wolf Creek. Wolf Creek provides great fish habitat and is a high public use and fishing area. If LCT were to be restored to the Wolf Creek watershed, restoring a put-and-take recreational LCT fishery should seriously be considered. To restore a self-sustaining pure population of LCT, a barrier would need to be constructed near the confluence with the East Fork Carson River to prohibit non-native fish from the river moving into the Wolf Creek watershed. For all of these reasons, Wolf, Bull Canyon, and Elder Creeks are all listed as medium candidates for restoration on Table 2.

The lower section of Silver King Creek provides 2.6 miles of potential LCT habitat; however, this section does not provide any opportunity for restoring a metapopulation of LCT (Map 38). To restore a self-sustaining population of LCT in the lower section of Silver King Creek, a barrier would need to be constructed near the East Fork Carson River to prohibit non-native fish from the river moving into the lower Silver King Creek watershed. Due to the flat meadow topography near the East Fork Carson River, building a barrier would be very difficult and expensive. For these reasons restoring the lower section of Silver King Creek to LCT is listed as a low candidate for restoration on Table 2.

**Upper East Fork Carson River Watershed** (Poison Flat Creek, Murray Canyon Creek, Golden Canyon Creek, and the East Fork Carson River upstream of Carson Falls)

Poison Flat Creek provides 1.3 miles of occupied LCT habitat between Sites 6 and 13 (Map 27). Upstream of Site 13, 0.7 miles of potential LCT habitat was identified. Although LCT were seen downstream of Site 13, no fish were seen upstream of Site 13. Capturing LCT from downstream of Site 13 and moving them upstream of Site 13 should be considered. Because LCT already occur in Poison Flat Creek, this stream is listed as a high candidate for restoration on Table 2.

Murray Canyon Creek provides 2.9 miles of occupied LCT habitat and Golden Canyon Creek provides 2.6 miles of occupied LCT habitat (Map 28). Golden Canyon Creek provides approximately an additional 2.9 miles of potential LCT habitat upstream of Site 4. Capturing LCT from downstream of Site 4 on Golden Canyon Creek and moving them upstream of Site 4 should be considered. Because LCT already occur in Golden Canyon Creek, this stream is listed as a high candidate for restoration on Table 2.

The East Fork Carson River upstream of Carson Falls provides 9.5 miles of occupied LCT habitat (Map 5). Lahontan cutthroat trout were seen at Sites 115 and 128. Seeing LCT at Site 128 is surprising because permanent fish passage barriers occur at Sites 124 and 126. Conducting a thorough survey of Poison Flat Creek, Murray Canyon Creek, Golden Canyon Creek, and the East Fork Carson River upstream of Carson Falls to determine LCT densities and exact distribution should be coordinated and completed with the CDFG. Because of the presence of LCT, the Murray Canyon Creek, Golden Canyon Creek, and the East Fork Carson River watershed upstream of Carson Falls should be considered a Critical Aquatic Refuge as part of the Sierra Nevada Forest Plan Amendment (Map 37). The Poison Flat Creek watershed should also be added to the Critical Aquatic Refuge area outlined on Map 37.

## **Recommendations**

### **Bryant Creek**

1. Consider the 4.8 mile section of Bryant Creek between Site 1 and Site 38 as potential LCT habitat and consider Bryant Creek a medium candidate for restoration.
2. Examine the possibilities of altering, enhancing, or replacing the box culvert under Forest Service Road 052 (Site 35) in order to assure a link between the main stem of Bryant Creek and the habitat in Mountaineer and Poison Creeks.
3. Work with Forest Service personnel and private land owners to close or restrict the OHV roads that parallel and repeatedly cross Bryant Creek between Site 23 and Site 35, in order to decrease erosion and the introduction of fine sediment.
4. Monitor the water quality and chemistry of Leviathan Creek to ensure that this tributary does not pose a threat to aquatic life in Bryant Creek.
5. Contact the owners/land managers of the section between Sites 16 and 17 in order to gain information about the habitat and presence/absence of fish barriers, or preferably to gain permission to survey this 2.23 mile section of stream.
6. Assess the efficiency and impact of the concrete diversion (Site 15) making sure it is not diverting a quantity of water that exceeds the adjudicated rights. Examine

the possibilities of altering, enhancing, or replacing the diversion structure to provide fish connectivity through this site.

#### Bull Canyon Creek

1. Consider the 1.67 mile section of Bull Canyon Creek between Site 5 and Site 17, and the 0.54 mile section of stream between Sites 18 & 22 as potential LCT habitat, and consider Bull Canyon Creek a medium candidate for restoration.
2. Monitor Bull Canyon to ensure that the current integrity of the creek, trail, and ecosystem are upheld.

#### Charity Valley Creek

1. Consider the 1.04 mile section of Charity Valley Creek between Site 14 and Site 22 as potential LCT habitat and consider Charity Valley Creek a low candidate for restoration (individually); however, if additional LCT habitat is found upstream of Site 22 on the private property, Charity Valley Creek could become a medium candidate for restoration.
2. Contact landowners regarding the private parcels upstream of Site 22 in order to gain information regarding the stream and/or permission to survey this reach.
3. Work with forest service personnel and private landowners to re-locate the social trail running through Charity Valley on the private parcels between Blue Lakes Road and the Burnside Lake trail intersection. If relocating the trail is not possible, consider establishing a formal right-of-way through the private land.

#### Crater Lake Creek

1. Consider the 0.63 mile section of Crater Lake Creek between Site 1 and Site 6 as potential LCT habitat and consider Crater Lake Creek a high candidate for restoration. Crater Lake Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Work with livestock owners and other Forest Service personnel to minimize the effects of cattle on the stream banks and the streambed near Sites 5 and 6.
3. Utilize signs and physical barriers to discourage/prevent people from parking and camping adjacent to Crater Lake Creek.
4. Decommission and disassemble those campsites found within 100 feet of water.

#### Dixon Creek

1. Consider the 0.67 mile section of Dixon Creek between Site 1 and Site 16 as not having potential LCT habitat.

## Eagle Creek

1. Consider the 0.73 mile section of Eagle Creek between Site 8 and Site 12 and the 0.23 mile section of stream between Site 13 and Site 15 (total 0.96 miles) as potential LCT habitat, and consider Eagle Creek a low candidate for restoration.

## East Fork Carson River

1. Recognize that the entire East Fork Carson River between Carson Falls and Ruhestroth Dam was historically inhabited by Lahontan cutthroat trout and that this section of river may be essential/necessary for the future recovery of the species. Do not allow any future management activities that would preclude this section of river from helping with the future recovery of Lahontan cutthroat trout within the Carson River watershed. For example, do not allow any fish passage barriers or water diversions to be constructed on the East Fork Carson River between Carson Falls and Ruhestroth Dam. Consider the entire East Fork Carson River between Ruhestroth Dam and Carson Falls as providing potential Lahontan cutthroat trout habitat.
2. Require recreational users to carry out all human waste.
3. Work with the local ranchers/private land owners to reduce/eliminate livestock grazing impacts within the East Fork Carson River riparian areas. Monitor and enforce terms of grazing permits. Investigate the effects of livestock with respect to nutrient loading (TMDL).
4. Increase public awareness of Leave-No-Trace principles along the East Fork Carson River, (i.e.) more signs at raft put-ins, trailheads, social trails, and access points).
5. Encourage the use of designated OHV trails (Cottonwood Canyon, Barney Riley, and Scossa Canyon) for access to the East Fork Carson River. Utilize maps, signs, and trail markers to make designated trails known. Close and decommission all non designated roads, unwanted spurs/roadways, and social jeep trails, especially where adjacent roads are impacting the river (removal from maps, earth berms, fallen trees, etc.).
6. Close and decommission all campsites within 100 feet of the East Fork Carson River. Only allow camping to occur more than 100 feet away from the river edge.
7. Investigate the impacts of contaminated tributaries at the confluence with the East Fork Carson River (i.e. Bryant Creek and Monitor Creek) and develop recommendations that will reduce/eliminate impacts from the contaminated tributaries.
8. Remove large trash/debris such as culverts, broken kayaks, etc. from the East Fork Carson River watercourse. Remove all barb wire fences not being used.
9. Eliminate noxious weeds (cheat grass and whitetop) where herbicides can be safely applied.
10. Designate the East Fork Carson River watershed upstream of Carson Falls as a Critical Aquatic Refuge (Map 37).
11. Develop and install Lahontan cutthroat trout interpretive panels that will educate the public about LCT in the East Fork Carson River.

12. Re-locate the Carson River trail near Site 108 to a location further away from the waters edge in order to minimize bank erosion.
13. Install additional fishing closure signs in the upper watershed where the river is closed to all fishing due to the presence of LCT.
14. Work with California Department of Fish and Game to conduct an LCT density and distribution survey above Carson Falls.

#### Elder Creek

1. Consider the 1.5 mile section of Elder Creek between Site 1 and Site 15 as potential LCT habitat and consider Elder Creek a medium candidate for restoration.
2. Monitor the impact of grazing in the area to maintain the existing integrity of the riparian corridor.

#### Forestdale Creek

1. Consider the 1.9 mile section of Forestdale Creek between Site 1 and Site 16 as potential LCT habitat and consider Forestdale Creek a high candidate for restoration. Forestdale Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Work with state personnel/agencies to prevent ford crossings just below Site 11
3. Cooperate with state personnel/agencies to designate camping areas at least 100 feet from waterways.
4. Consider the construction or placement of a toilet in a central location near Site 11 or Site 12.
5. Utilize signs to remind recreational users of Leave-No-Trace principles.

#### Golden Canyon Creek

1. Coordinate with the California Department of Fish and Game to conduct an LCT distribution and density survey in the Golden Canyon Creek watershed.
2. Consider stocking LCT into Golden Canyon Creek upstream of Site 4.
3. Conduct some routine trail maintenance on the trail that parallels Golden Canyon Creek. The trail was difficult to find in locations and several logs had fallen across the trail making horse access difficult.
4. Establish the Golden Canyon Creek watershed as a Critical Aquatic Refuge, as described in the 2004 Sierra Nevada Forest Plan Amendment (Map 37).

#### Hawkins Creek

1. Consider the 0.34 mile section between Site 1 and Site 4 and the 0.98 mile section of Hawkins Creek between Site 9 and Site 14 as potential LCT habitat and consider Hawkins Creek a high candidate for restoration. Hawkins Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Conduct a more thorough evaluation of fish passage at Site 15.

### Hodge Creek

1. Consider the 0.7 mile section of Hodge Creek between Site 3 and Site 9 as providing minimal LCT habitat. The 0.40 mile section between Site 3 and Site 6 offers the most favorable habitat in Hodge Creek. Consider Hodge Creek a low candidate for restoration.

### Horsethief Creek

1. Consider the 1.4 mile section of Horsethief Creek between Site 7 and Site 17 as potential LCT habitat and the 0.45 mile section of stream between Site 17 and Site 21 as seasonal LCT habitat. Consider Horsethief Creek a medium candidate for restoration.
2. Remove the trash culvert located in the stream at Site 16.

### Hot Springs Creek

1. Consider the 3.1 mile section of Hot Springs Creek between Site 1 and Site 25 and the 0.7 mile section between Site 31 and Site 33 as potential LCT habitat. The section of stream between Sites 25 and 31 could inhabit LCT that reach this section through incidental downstream movement, but their connectivity with the rest of the drainage would be limited. Consider Hot Springs Creek a high candidate for restoration. Hot Springs Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Assess the efficiency and impact of the diversion canal (Site 7), making sure it is not acting as a one-way fish trap, nor diverting a quantity of water that exceeds the adjudicated rights.
3. Decommission those campsites located directly adjacent to the stream (within 100 ft), and close roadways allowing vehicle access into these camps. (See Sites 8, 9, 11, & 12).

### Indian Creek

1. Consider the 1.52 mile section of Indian Creek between Site 1 and Site 9 as potential LCT habitat and consider Indian Creek a low candidate for restoration.
2. Examine the upstream reaches of Indian Creek to ensure that low flows are a natural condition and not created by water diversions, etc.
3. Consider minor road work to prevent a road slump or point-source of sediment at Site 8.

### Jeff Davis Creek

1. Consider the 1.71 mile section of Jeff Davis Creek between Site 11 and Sites 14/15 as potential LCT habitat and consider Jeff Davis Creek a medium candidate for restoration.

2. Work with the California Department of Fish and Game to conduct a population density and distribution survey of fish currently inhabiting Jeff Davis Creek.

#### Leviathan Creek

1. Consider the 1.58 mile section of Leviathan between Site 1 and Site 15 as having no potential LCT habitat and consider Leviathan Creek a low candidate for restoration.
2. Work with state and federal agencies to closely monitor the water quality in Leviathan Creek. Assess impacts of runoff from Leviathan Mine on Leviathan and Bryant Creeks, and work to minimize negative influences on the aquatic inhabitants.
3. Remove the trash culvert material found in the streambed at Site 11.

#### Mountaineer Creek

1. Consider the 5.3 mile section of Mountaineer Creek between Site 1 and Site 41 as potential LCT habitat and consider Mountaineer Creek a high candidate for restoration. Mountaineer Creek could contribute towards restoring a small metapopulation of LCT in the area.
2. Decommission and/or relocate the campsites at Site 37 to a place further away from the stream.
3. Investigate the algae blooms downstream of Site 37 to determine if the origin is natural, or the product of camping upstream.

#### Murray Canyon Creek

1. Coordinate with the California Department of Fish and Game to conduct a fish distribution and density survey of LCT in the Murray Canyon Creek watershed.
2. Establish the Murray Canyon Creek watershed as a Critical Aquatic Refuge, as described in the 2004 Sierra Nevada Forest Plan Amendment (Map 37).
3. Conduct some routine trail maintenance on the trail that parallels Murray Canyon Creek. The trail was difficult to find in locations and several logs had fallen across the trail making horse access difficult.

#### Noble Creek

1. Consider the 4.4 miles of Noble Creek located in the sections between Sites 1-6 and between Sites 9-30 as potential LCT habitat. Consider Noble Creek a medium candidate for restoration.
2. Discuss with the current livestock manager possible alternative easement plots that will benefit both livestock owners and the Noble Creek ecosystems.
3. Work with Forest Service personnel to disassemble campsites within 100 feet of the stream, leaving intact the well established campsites outside the riparian corridor.

### Pleasant Valley Creek

1. Consider the 3.4 mile section of Pleasant Valley Creek between Site 1 and Site 19 as having no potential LCT habitat. Pleasant Valley Creek probably offers approximately 6 miles of potential LCT habitat downstream of Site 1 on the privately owned fly fishing preserve. If possible, obtain permission to conduct a stream habitat survey downstream of Site 1 to verify this presumption. If 6 miles of potential LCT habitat exist downstream of Site 1, consider Pleasant Valley Creek a high candidate for restoration. Pleasant Valley Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Investigate the water management schedules for the several reservoirs in the upper part of the watershed, and investigate the possibility of allocating more water to flow into Pleasant Valley Creek during the driest part of the year.

### Poison Creek

1. Consider the 1.8 mile section of Poison Creek between Site 1 and Site 16 as potential LCT habitat and consider Poison Creek a high candidate for restoration. Poison Creek could contribute towards restoring a small metapopulation of LCT in the area.
2. Assess the soil and water conditions in Poison Creek Canyon in response to the unusually large number of dead trees found in the middle and upper portions of the surveyed reach.

### Poison Flat Creek

1. Consider the 1.3 mile section of Poison Flat Creek between Site 6 and Site 13 as occupied LCT habitat, and consider Poison Flat Creek between Site 13 and Site 17 as potential LCT habitat. Consider moving LCT from below Site 13 to upstream of Site 13.
2. Work with the California Department of Fish and Game to enact a closure or strict limitations on fishing in Poison Flat Creek. Make these regulations visible through posted signs and by publication in the annual California Department of Fish and Game fishing regulations handbook.
3. Coordinate with the California Department of Fish and Game to conduct an LCT density and distribution survey in Poison Flat Creek.
4. Establish the Poison Flat Creek watershed as a Critical Aquatic Refuge, as described in the 2004 Sierra Nevada Forest Plan Amendment (Map 37).

### Raymond Canyon Creek

1. Consider the 0.23 mile section of Raymond Canyon Creek between Site 11 and Site 13 as potential LCT habitat and consider Raymond Canyon Creek a low candidate for restoration.
2. Investigate the destination and impacts of the diversion canals located at Site 2 and Site 6. Ensure that fish are not subject to terminal trips into irrigated pasture,

and similarly ensure that water users are staying within the confines of their adjudicated rights.

3. Contact the private landowner to obtain permission to survey Raymond Canyon Creek upstream of Site 13.

#### Raymond Meadows Creek

1. Consider the 0.5 mile section of Raymond Meadows Creek between Site 19 and Site 21 as potential LCT habitat. Consider the 0.28 mile section directly upstream of Site 6 as occupied LCT habitat and consider Raymond Meadows Creek a low candidate for restoration.
2. Coordinate with the California Department of Fish and Game to conduct an LCT density and distribution survey in Raymond Meadows Creek.
3. If LCT are found in Raymond Meadows Creek work with the California Department of Fish and Game to enact a closure or strict limitations on fishing in Raymond Meadows Creek. Make these regulations visible through posted signs and by publication in the annual California Department of Fish and Game fishing regulations handbook.
4. Assess the efficiency and impact of the concrete diversion at Site 9 making sure it is not diverting a quantity of water that exceeds the adjudicated rights. Examine the possibilities of altering, enhancing, or replacing the diversion structure to provide fish connectivity through the site.

#### Red Lake Creek

1. Consider the 2.2 mile section of Red Lake Creek between Site 1 and Site 13 as potential LCT habitat and consider Red Lake Creek a high candidate for restoration. Red Lake Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Discuss with private land owners their interest in extending the distribution of LCT from Red Lake into Red Lake Creek.

#### Silver Creek

1. Consider the 4.5 mile section of Silver Creek between Site 1 and the Silver Creek Campground and the 0.86 mile section of Silver Creek between Site 39 and Site 41 as potential LCT habitat. Consider Silver Creek a medium candidate for restoration.
2. Post signs along the highway/stream interface reminding anglers and campers of personal responsibilities regarding trash, campsites, Leave-No-Trace, etc.
3. Consider managing Silver Creek as a put-and-take LCT fishery.

### Silver King Creek

1. Consider the 2.6 mile section of Silver King Creek between the East Fork Carson River and Site 6 as potential LCT habitat and consider this section of Silver King Creek a low candidate for restoration.

### Spratt Creek

1. Consider the 1.72 mile section of Spratt Creek between Site 1 and Site 20 as potential LCT habitat and consider Spratt Creek a high candidate for restoration. Spratt Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Investigate the destination and impacts of the diversion canal at Site 5. Ensure that fish are not subject to terminal trips into irrigated pasture, and similarly ensure that water users are staying within the confines of their adjudicated rights.
3. Consider a stream habitat survey upstream of Site 21 to verify the presence/absence of potential LCT habitat in this reach.

### West Fork Carson River

1. Consider the 18.25 mile section between Site 1 and Site 83 as potential LCT habitat and consider the West Fork Carson River as a high candidate for restoration. The West Fork Carson River has several tributaries that provide potential LCT habitat, therefore making the West Fork Carson River watershed a high candidate for restoring a metapopulation of LCT.
2. Close and decommission all campsites within 100 feet of the West Fork Carson River. Only allow camping to occur more than 100 feet away from the river edge.
3. Investigate the missing bridge for ATV use at Site 69 and utilize physical barriers and signage to encourage users to stay on designated routes.
4. Investigate the artificial stream bank at Site 77. Determine who constructed the bank and the purpose of the bank. Consider restoring the stream bank to a natural condition.
5. Work with the California Department of Fish and Game and Alpine County to develop and implement a stream bank restoration plan to restore and fix the stream bank erosion that is occurring in the Hope and Faith Valley areas.

### Willow Creek

1. Consider the 1.9 mile section of Willow Creek between Site 4 and Site 21 as potential LCT habitat and consider Willow Creek a high candidate for restoration. Willow Creek could contribute towards restoring a metapopulation of LCT in the area.
2. Consider the section of Willow Creek between Site 1 and Site 4, and the section between Site 21 and Site 23 as having no potential LCT habitat.

3. Discuss with ranchers/livestock managers the possibility of isolating a riparian corridor, and or limiting livestock access points to the creek. Consider cost-share in fencing these buffers.
4. Remove and disassemble all campsites within 100 feet of the stream.
5. Close and decommission all non-designated roads that lead to unwanted campsites and/or allow vehicles to drive onto stream banks.

#### Wolf Creek

1. Consider the 11.5 mile section of Wolf Creek between Site 1 and Site 56 as potential LCT habitat and consider Wolf Creek a medium candidate for restoration.
2. Work with trail crews and Forest Service personnel to relocate the trail at Site 33 to a path further away from the high bank. A wash-out appears to be eminent.
3. Discuss with private landowners the possibility of fencing a riparian corridor along Wolf Creek (Sites 11-12). Explore the possibility of funding/cost-share on fencing in exchange for retiring acreage.
4. Investigate and enhance the effectiveness of the diversion at Site 16 to ensure that the adjudicated quantity of water is diverted, and to ensure that fish are not being terminally recruited into an irrigation canal.
5. Work with Forest Service personnel to maintain the integrity of both Wolf Creek and the campsite at Site 17. Consider opening more camping space away from the stream in order to close the areas adjacent to the watercourse. Decommission infrequently used campsites in the Wolf Creek watershed and encourage campers to utilize well established sites located at least 100 feet from the stream.
6. Enhance the visibility of Leave-No-Trace principles at trailheads leading into the Carson-Iceberg Wilderness.

- East Fork Carson River
  - Bryant Creek
    - Mountaineer Creek
      - Poison Creek
  - Leviathan Creek
  - Hot Springs Creek
    - Pleasant Valley Creek
      - Raymond Canyon Creek
      - Hodge Creek
      - Jeff Davis Creek
  - Spratt Creek
  - Charity Valley Creek
  - Indian Creek
  - Monitor Creek
  - Silver Creek
    - Noble Creek
    - Eagle Creek
      - Raymond Meadows Creek
  - Wolf Creek
    - Dixon Creek
    - Bull Canyon Creek
    - Elder Creek
  - Silver King Creek
  - Poison Flat Creek
  - Murray Canyon Creek
  - Golden Canyon Creek
  
- West Fork Carson River
  - Horsethief Creek
  - Willow Creek
  - Hawkins Creek
  - Red Lake Creek
    - Crater Lake Creek
  - Forestdale Creek

**Table 1:** A summary of all the streams surveyed in the East and West Carson River drainages. Indented streams denote that stream is a tributary to the upper referenced stream. Streams are listed in order starting from the furthest downstream on the East and West Carson Rivers and working upstream.

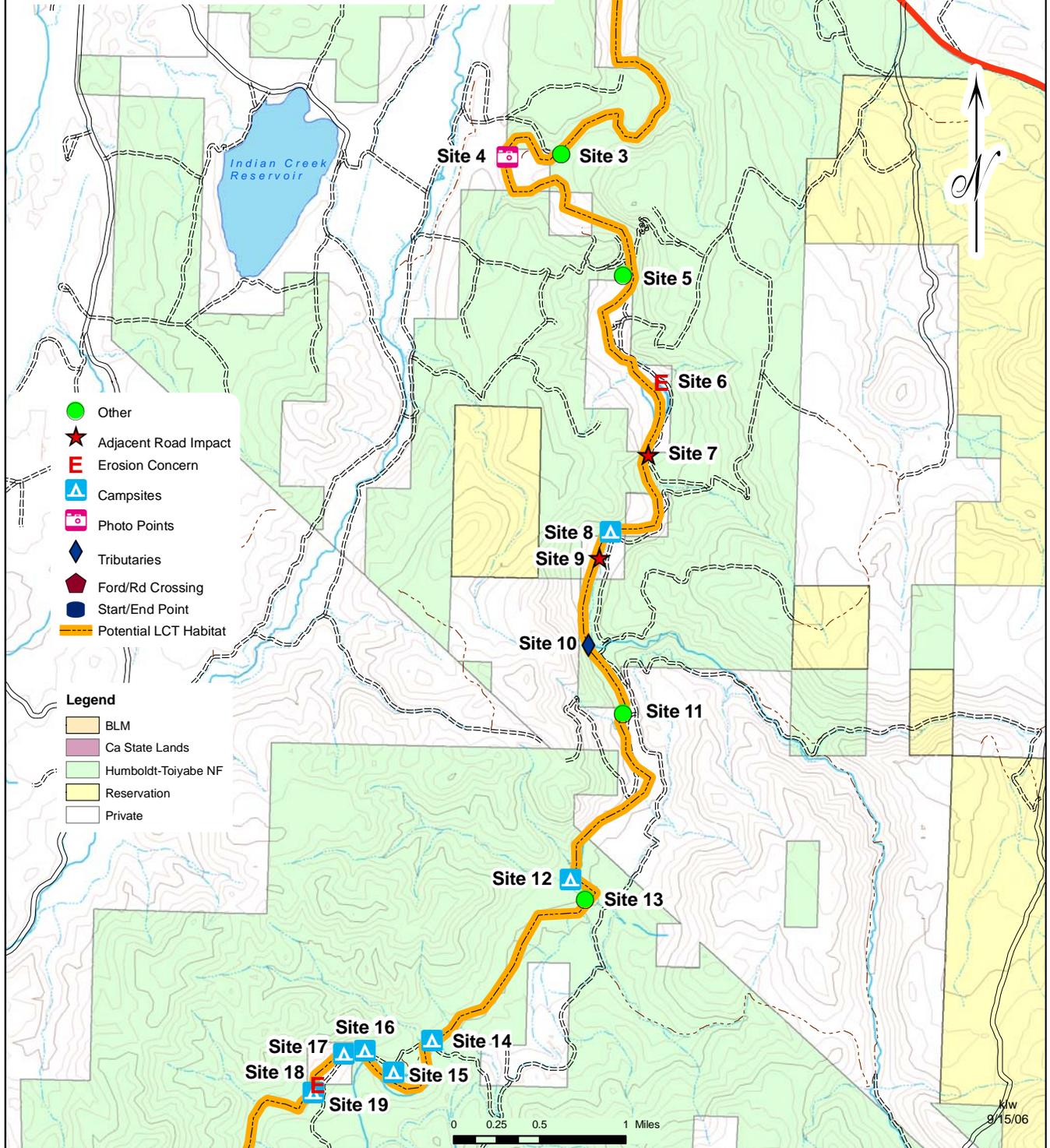
| Restoration Potential             | Stream Name             | Miles of Potential LCT Habitat Identified |
|-----------------------------------|-------------------------|---|
| High Candidates for Restoration   | West Fork Carson River  | 18.3                                      |
|                                   | Willow Creek            | 1.9                                       |
|                                   | Hawkins Creek           | 1.3                                       |
|                                   | Red Lake Creek          | 2.2                                       |
|                                   | Crater Lake Creek       | 0.6                                       |
|                                   | Forestdale Creek        | 2   |
|                                   | East Fork Carson River  | 40  |
|                                   | Mountaineer Creek       | 5.4                                       |
|                                   | Poison Creek            | 1.8                                       |
|                                   | Pleasant Valley Creek   | 6*  |
|                                   | Hot Springs Creek       | 3.8                                       |
|                                   | Spratt Creek            | 1.7                                       |
|                                   | Markleeville Creek      | 2.5*                                      |
|                                   | Musser and Jarvis Creek | 1*  |
| Golden Canyon Creek               | 2.9                     |   |
| Poison Flat Creek                 | 0.6                     |   |
| Medium Candidates for Restoration | Horsethief Creek        | 1.4                                       |
|                                   | Bryant Creek            | 4.8                                       |
|                                   | Jeff Davis Creek        | 1.7                                       |
|                                   | Silver Creek            | 5.4                                       |
|                                   | Noble Creek             | 4.4                                       |
|                                   | Wolf Creek              | 11.5                                      |
|                                   | Bull Canyon Creek       | 2.27                                      |
|                                   | Elder Creek             | 1.5                                       |
| Low Candidates for Restoration    | Leviathan Creek         | 0   |
|                                   | Charity Valley Creek    | 1   |
|                                   | Raymond Canyon Creek    | 0.2                                       |
|                                   | Hodge Creek             | 0.7                                       |
|                                   | Indian Creek            | 1.5                                       |
|                                   | Monitor Creek           | 0   |
|                                   | Eagle Creek             | 1   |
|                                   | Raymond Meadows Creek   | 0.5                                       |
|                                   | Dixon Creek             | 0   |
| Silver King Creek                 | 2.6                     |   |

**Table 2:** A summary of which streams are recommended as high, medium, or low candidates for restoration and how much potential LCT habitat each stream provides. Colored streams are areas that provide metapopulation potential and \* represents streams that were not surveyed; mileages are only presumed based on looking at a topographic map and using GIS.

## **Appendix I**

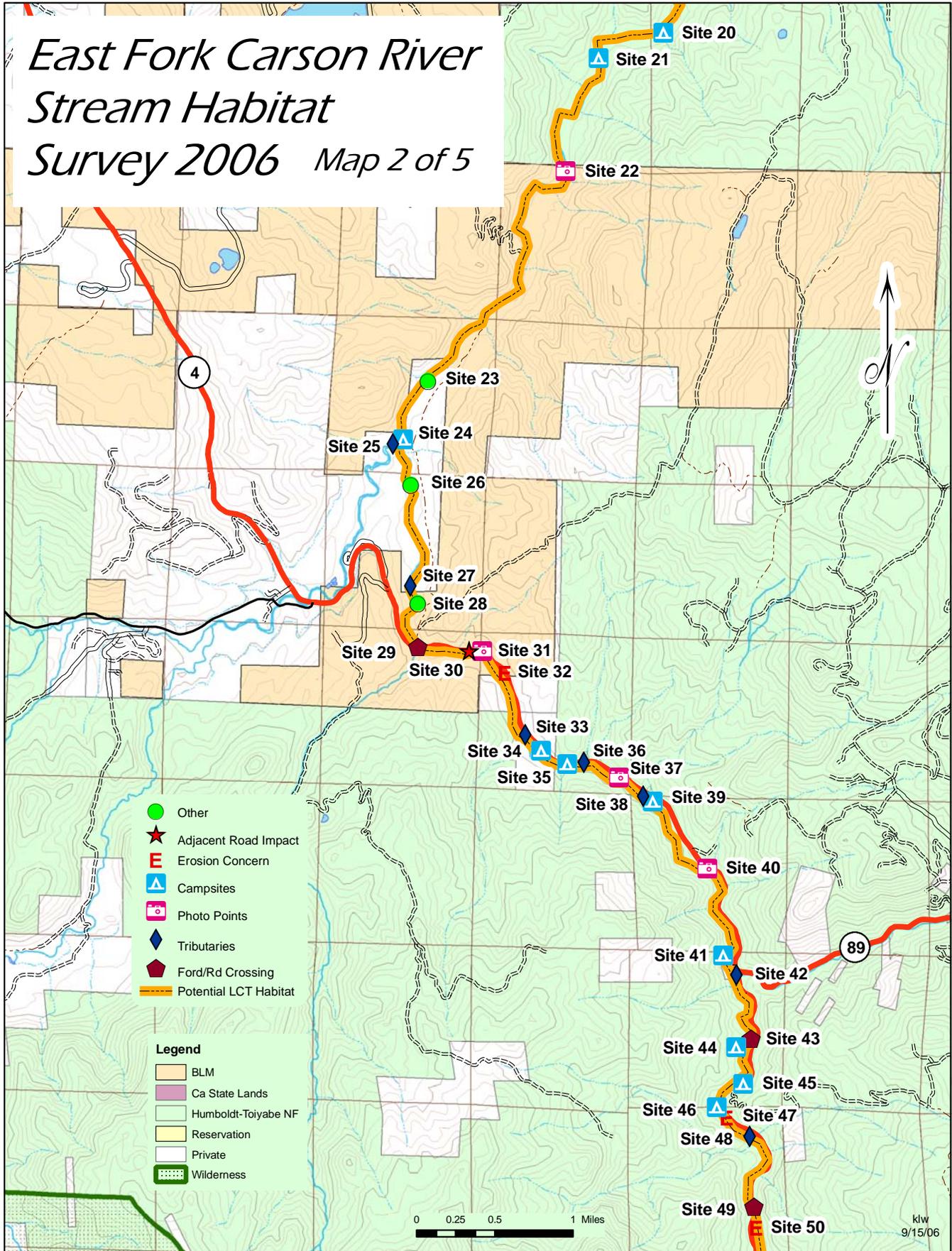
**Maps for each of the individual streams surveyed**

# East Fork Carson River Stream Habitat Survey 2006 Map 1 of 5



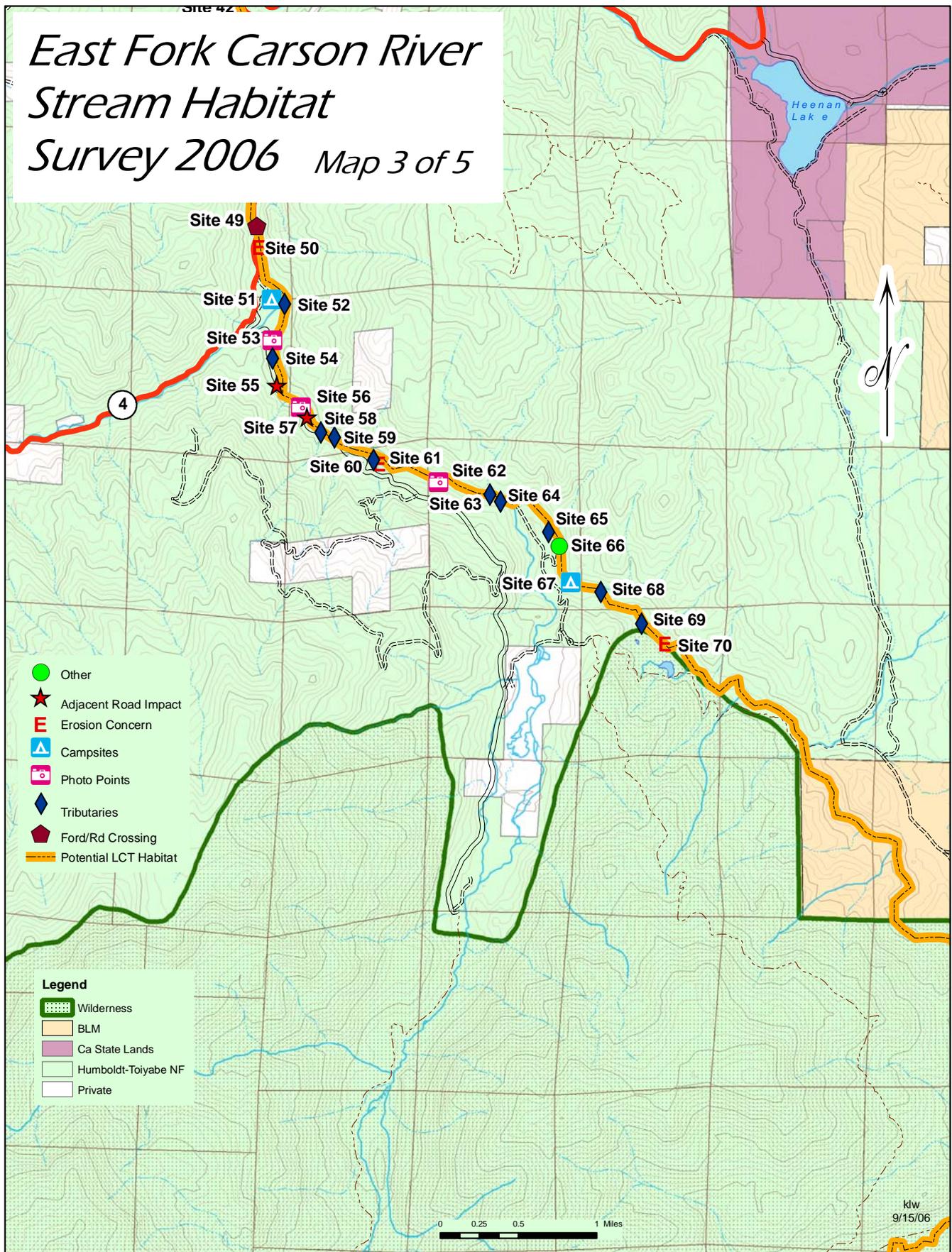
Map 1: Lower East Fork Carson River

# East Fork Carson River Stream Habitat Survey 2006 Map 2 of 5



Map 2: Lower Middle East Fork Carson River

# East Fork Carson River Stream Habitat Survey 2006 *Map 3 of 5*



- Other
- ★ Adjacent Road Impact
- E Erosion Concern
- ▲ Campsites
- Photo Points
- ◆ Tributaries
- ◆ Ford/Rd Crossing
- Potential LCT Habitat

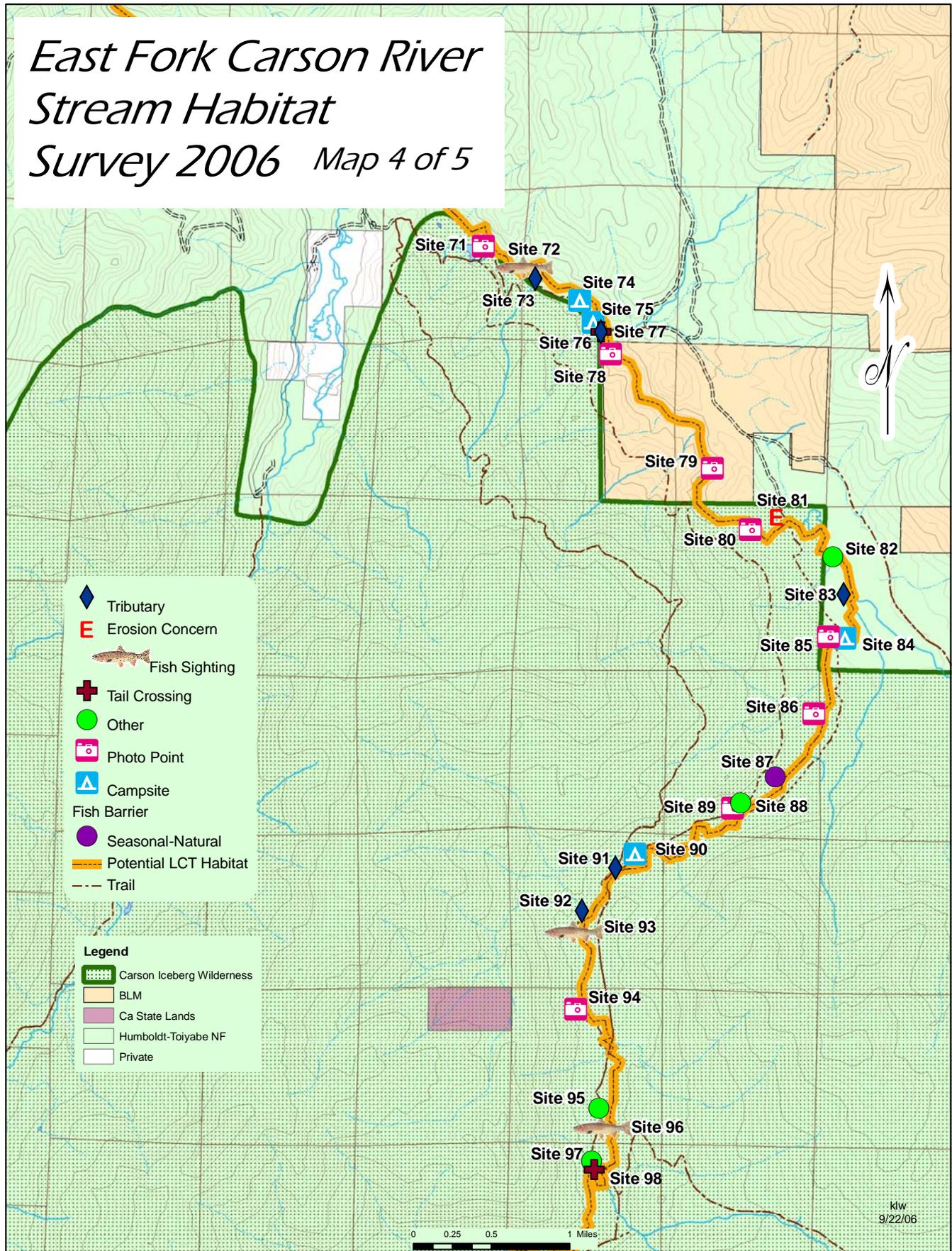
- Legend**
- Wilderness
  - BLM
  - Ca State Lands
  - Humboldt-Toiyabe NF
  - Private

0 0.25 0.5 1 Miles

klw  
9/15/06

Map 3: Middle East Fork Carson River

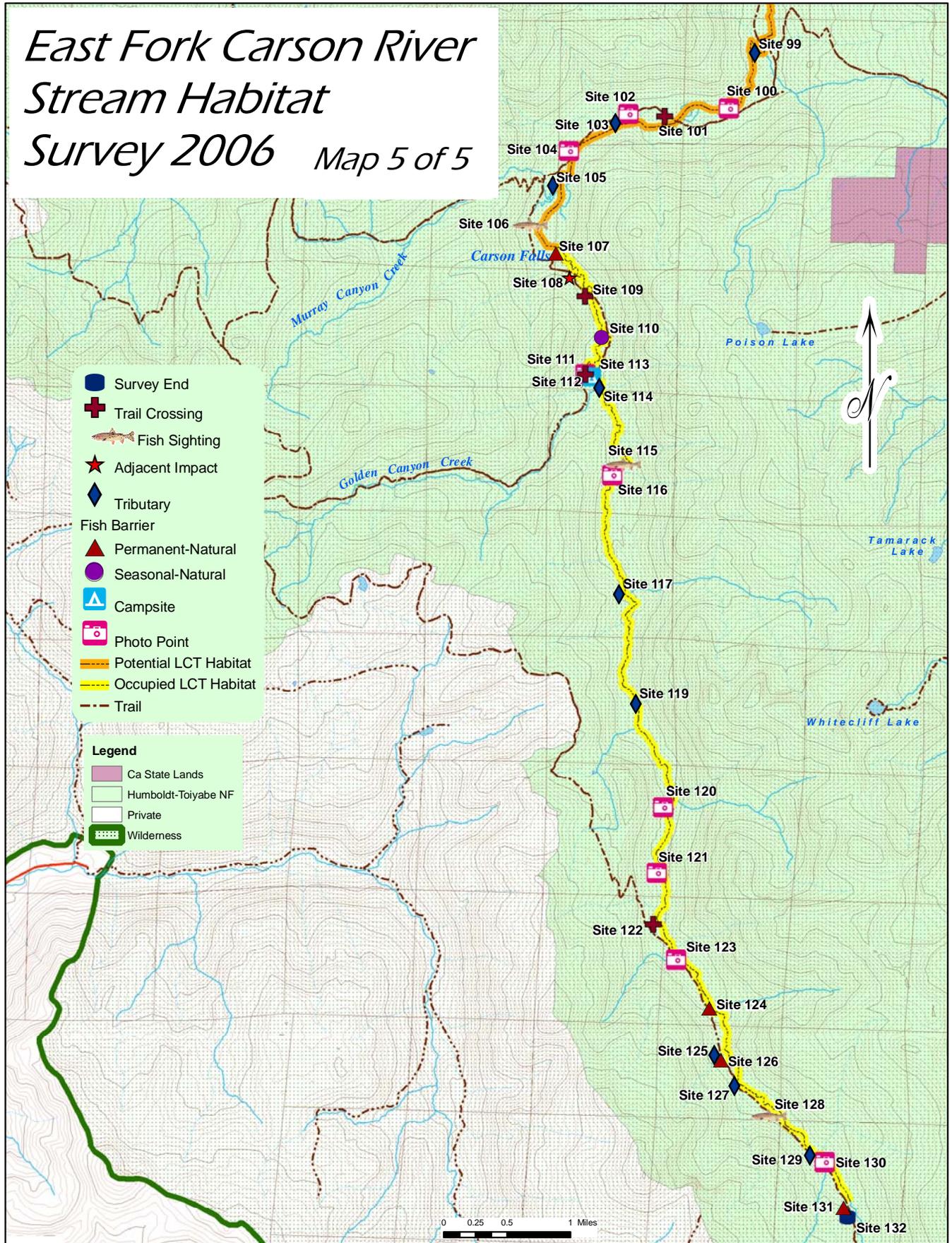
# East Fork Carson River Stream Habitat Survey 2006 Map 4 of 5



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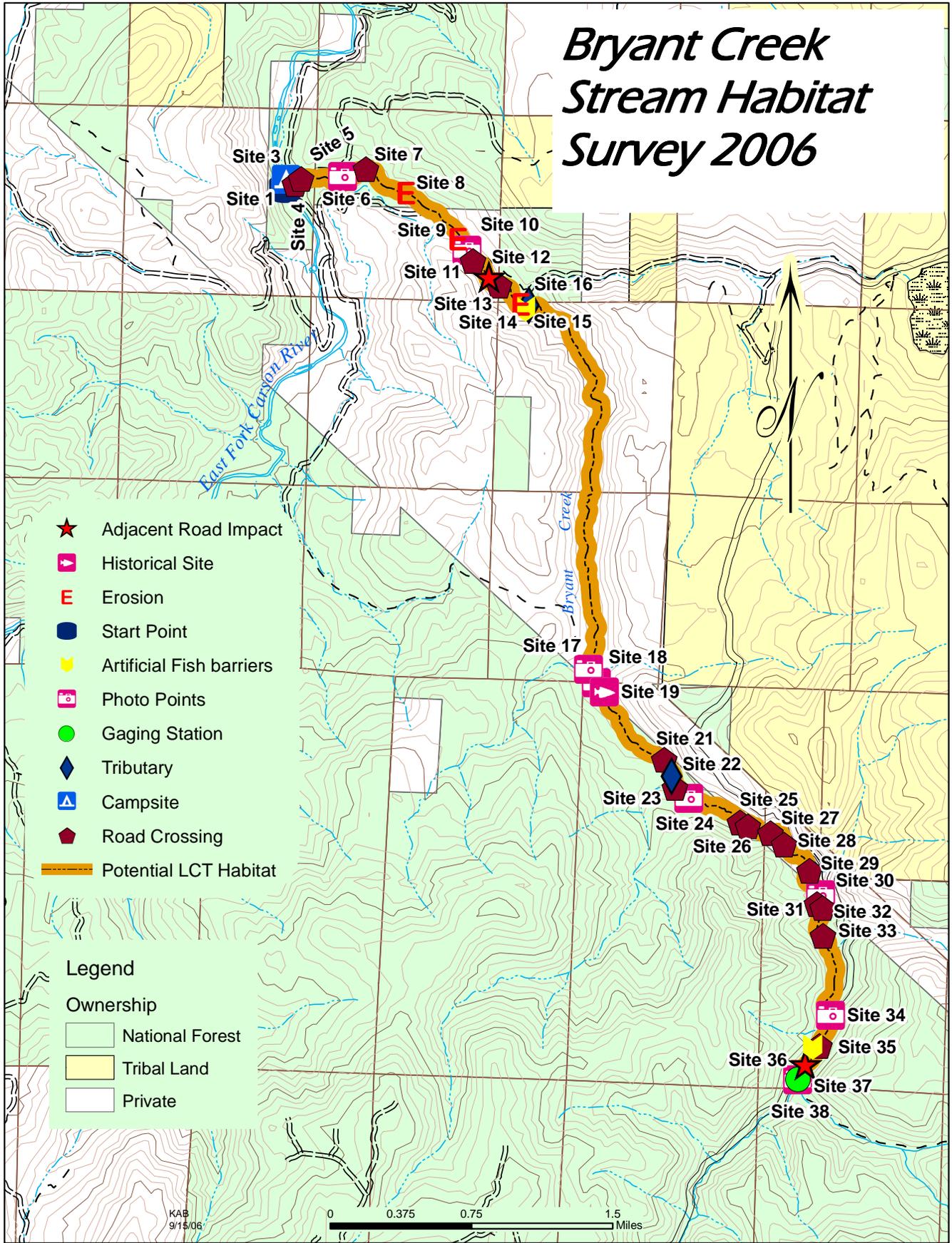
Map 4: Upper Middle East Fork Carson River

# East Fork Carson River Stream Habitat Survey 2006 *Map 5 of 5*



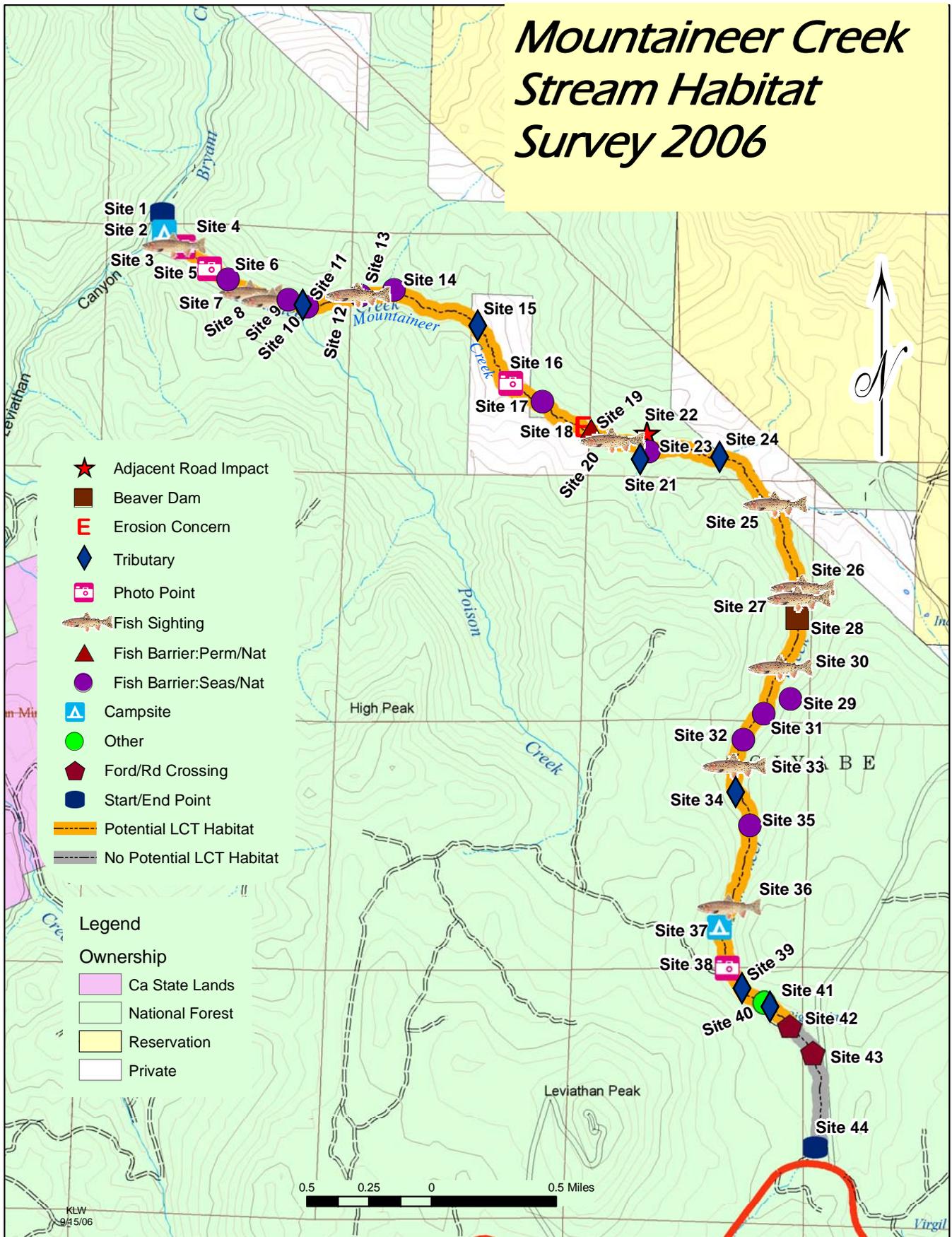
Map 5: Upper East Fork Carson River

# Bryant Creek Stream Habitat Survey 2006



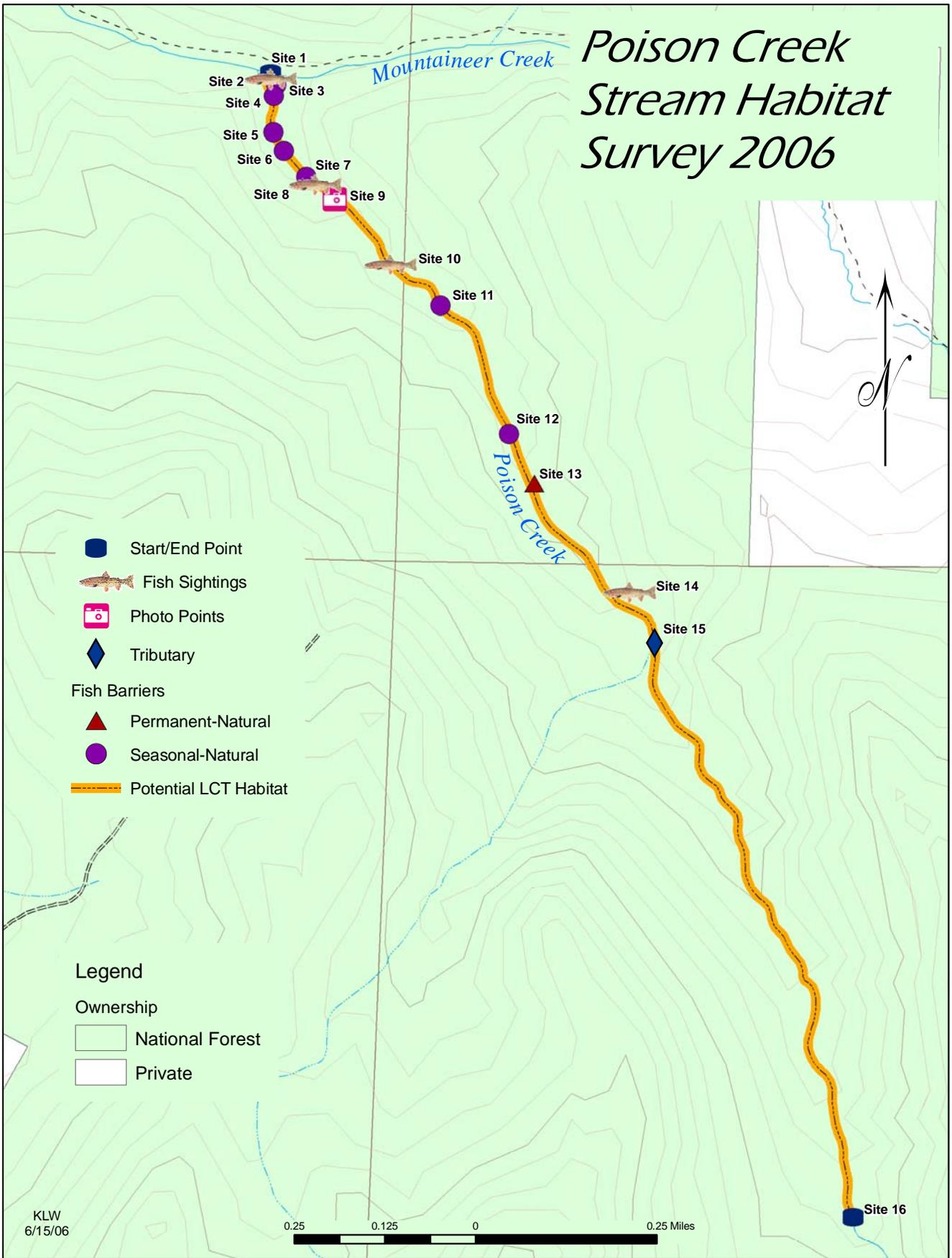
Map 6: Overview of Bryant Creek

# Mountaineer Creek Stream Habitat Survey 2006



Map 7: Overview of Mountaineer Creek

# Poison Creek Stream Habitat Survey 2006



- Start/End Point
- Fish Sightings
- Photo Points
- Tributary
- Fish Barriers**
  - Permanent-Natural
  - Seasonal-Natural
  - Potential LCT Habitat

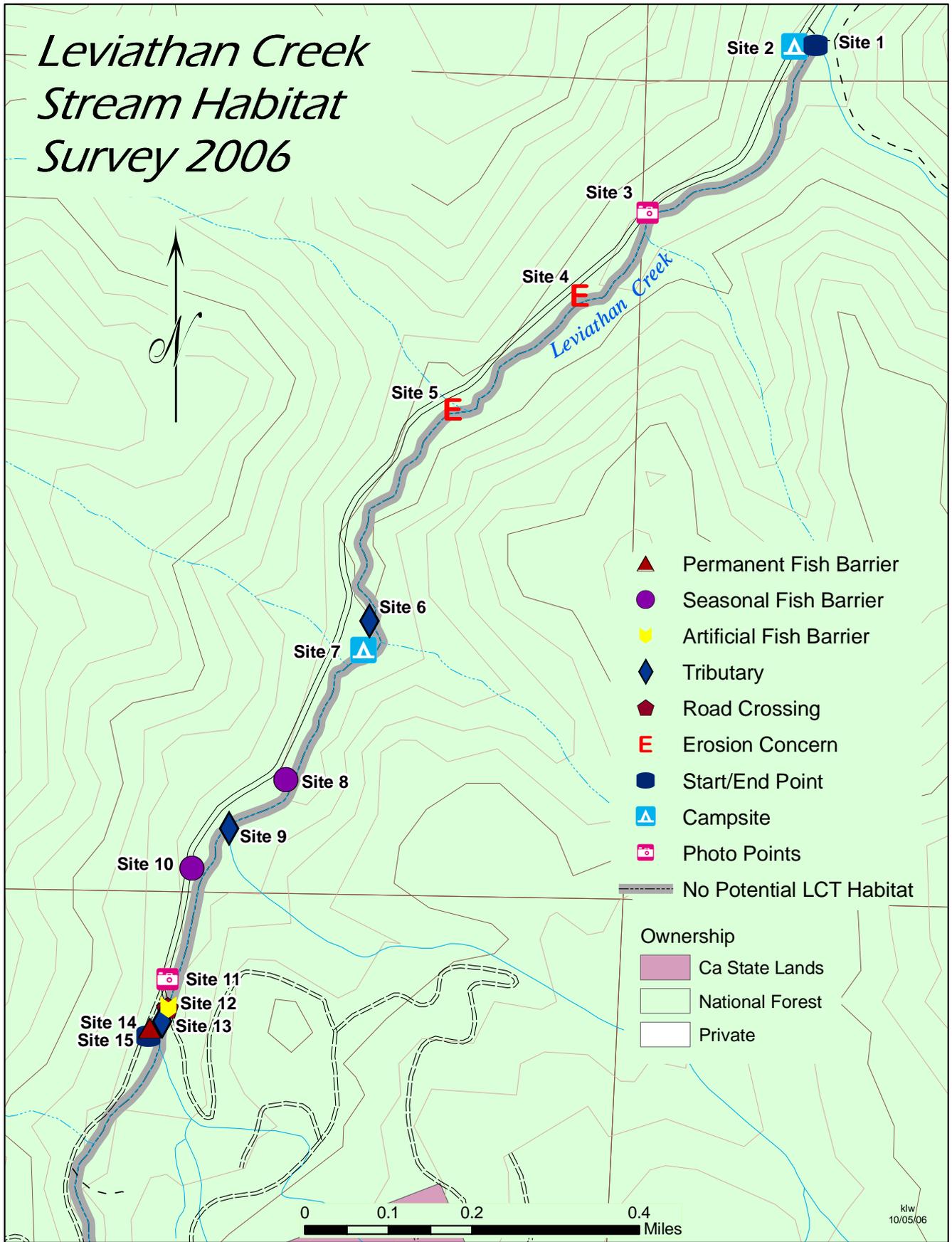
- Legend**
- Ownership**
- National Forest
  - Private

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6/15/06

0.25 0.125 0 0.25 Miles

Map 8: Overview of Poison Creek

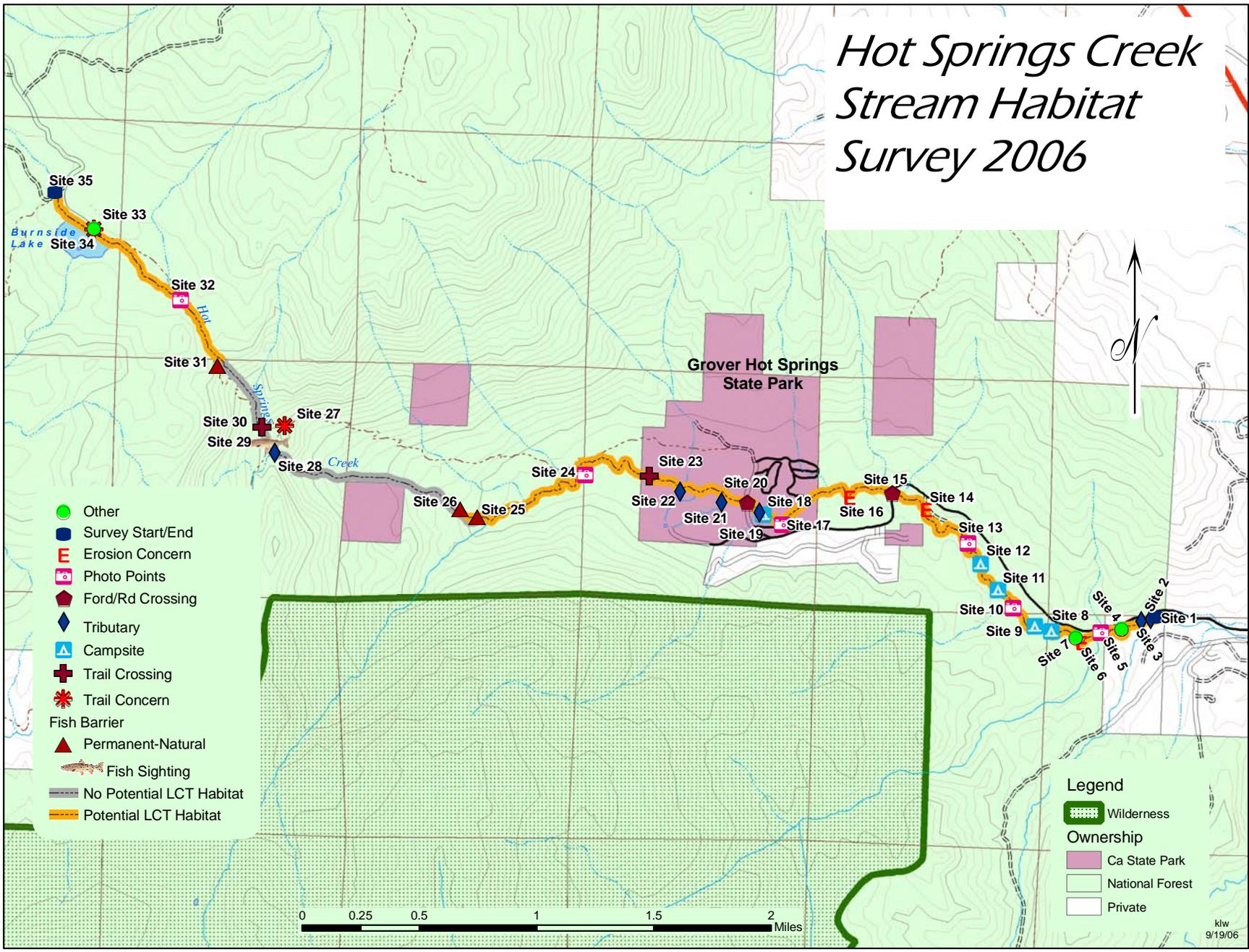
# Leviathan Creek Stream Habitat Survey 2006



Map 9: Overview of Leviathan Creek

klw  
10/05/06

# Hot Springs Creek Stream Habitat Survey 2006



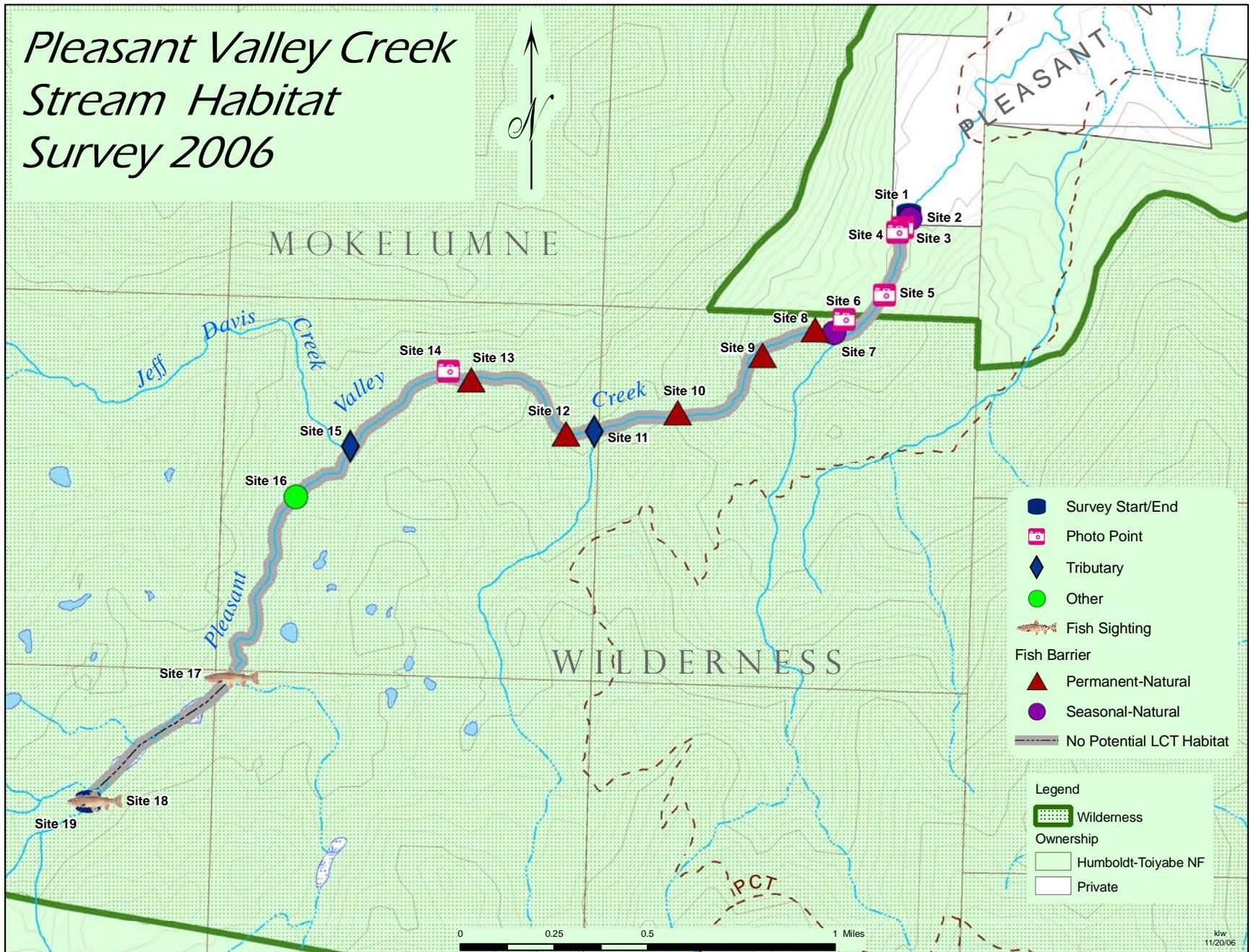
- Other
- Survey Start/End
- E Erosion Concern
- Photo Points
- Ford/Rd Crossing
- ◆ Tributary
- ▲ Campsite
- + Trail Crossing
- ✱ Trail Concern
- Fish Barrier
- ▲ Permanent-Natural
- 🐟 Fish Sighting
- No Potential LCT Habitat
- Potential LCT Habitat

- Legend**
- ▭ Wilderness
  - Ownership**
  - ▭ Ca State Park
  - ▭ National Forest
  - ▭ Private

klw  
9/19/06

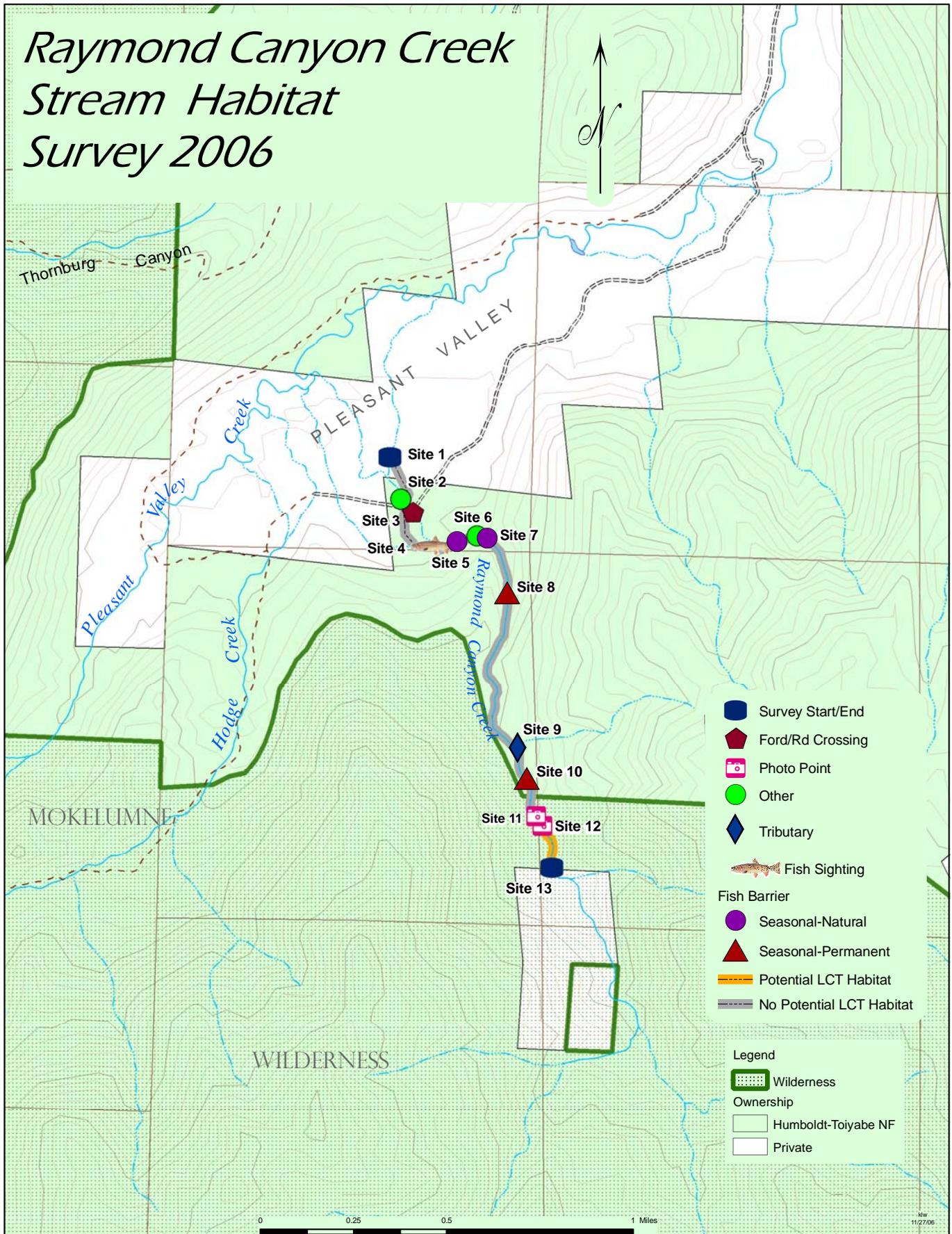
Map 10: Overview of Hot Springs Creek

# Pleasant Valley Creek Stream Habitat Survey 2006



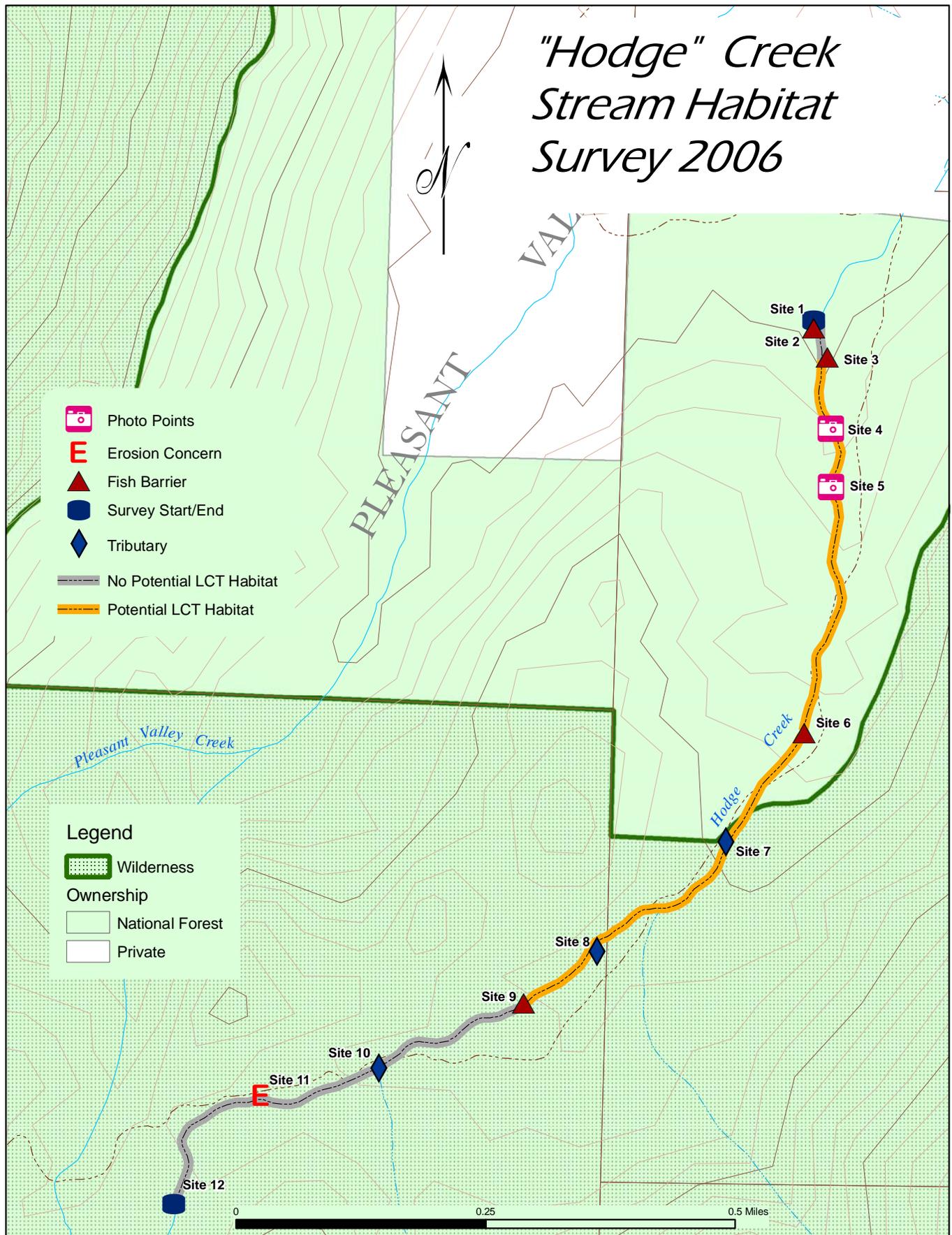
Map 11: Overview of Pleasant Valley Creek

# Raymond Canyon Creek Stream Habitat Survey 2006



Map 12: Overview of Raymond Canyon Creek

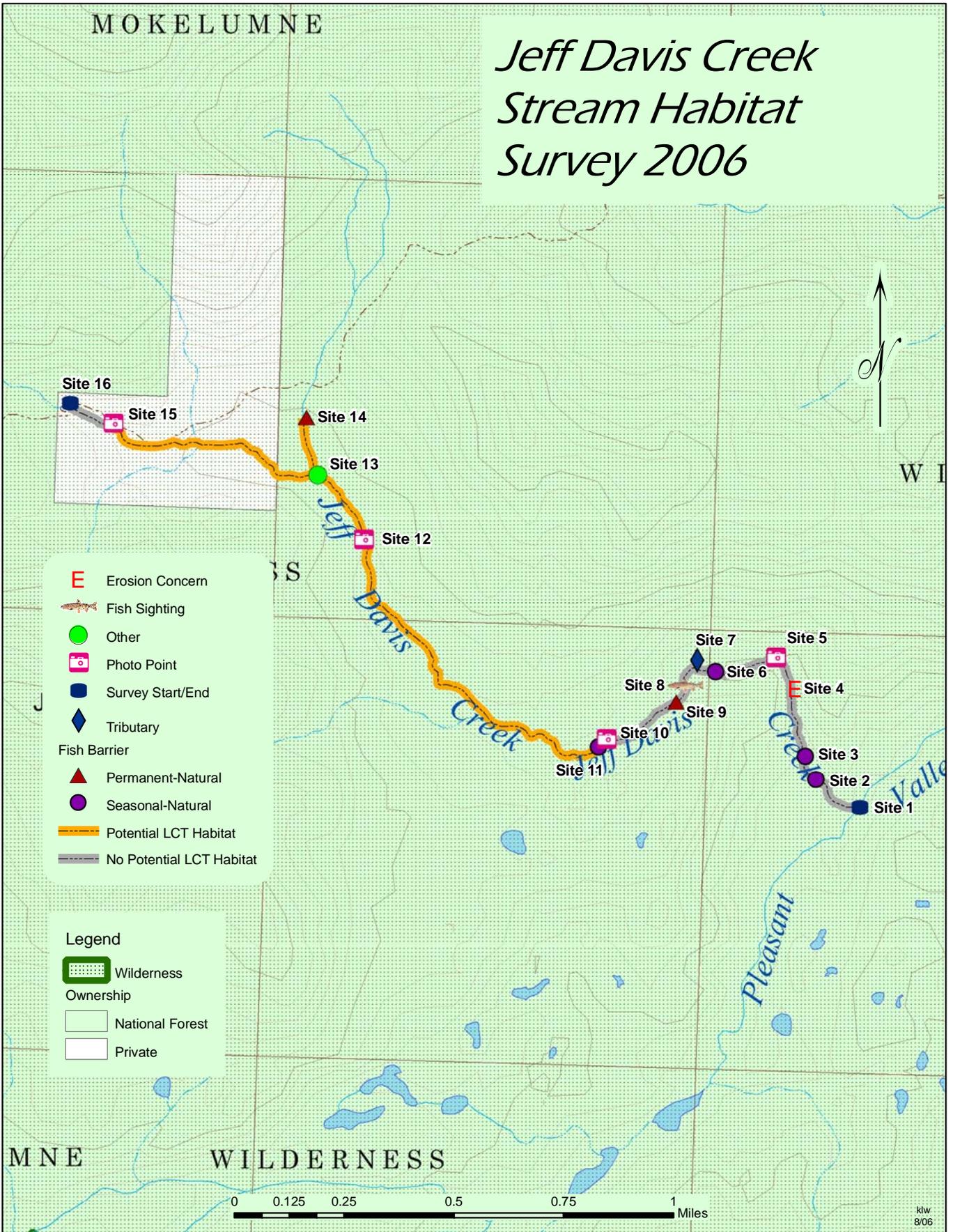
# "Hodge" Creek Stream Habitat Survey 2006



Map 13: Overview of Hodge Creek

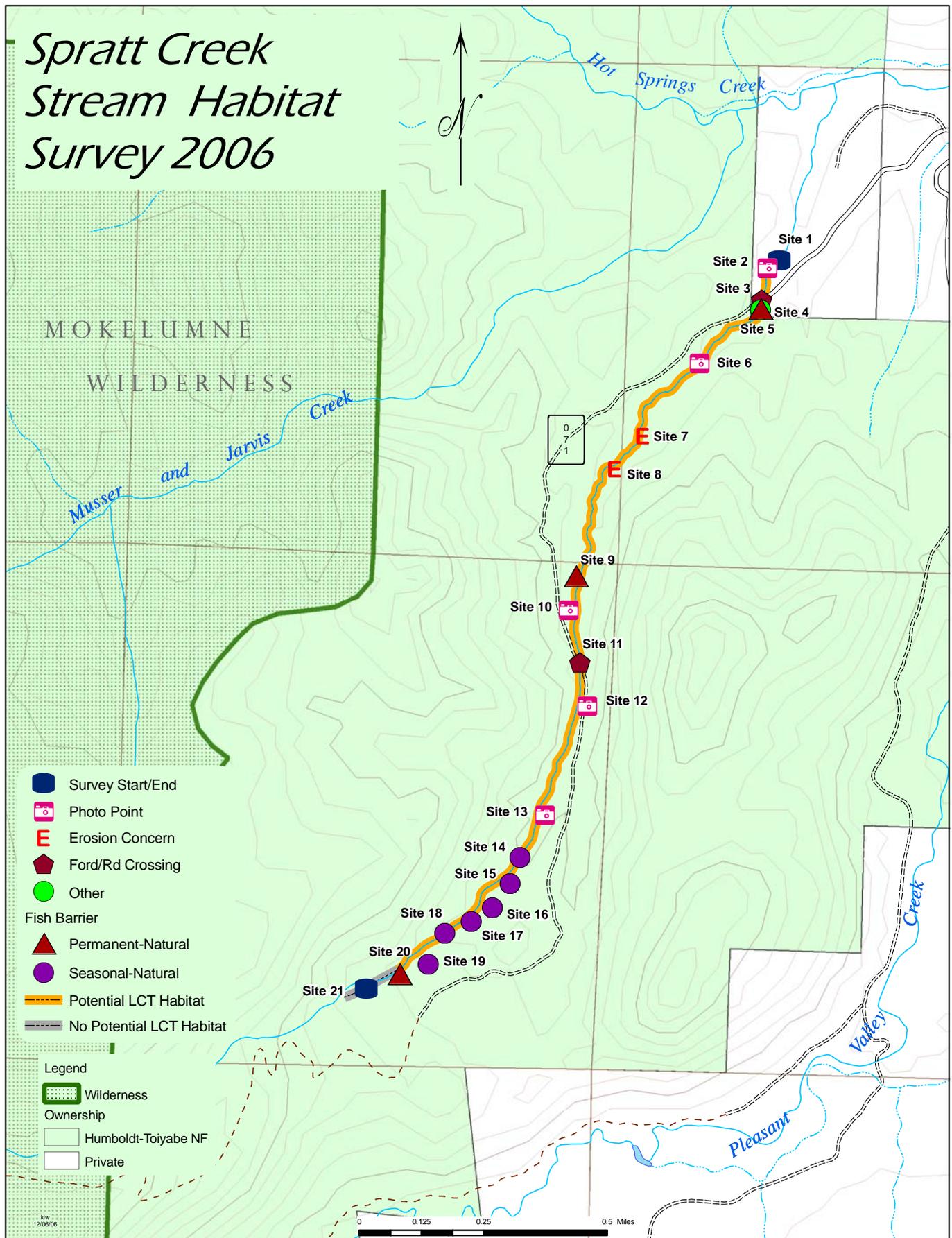
MOKELUMNE

# Jeff Davis Creek Stream Habitat Survey 2006



Map 14: Overview of Jeff Davis Creek

# Spratt Creek Stream Habitat Survey 2006



Map 15: Overview of Spratt Creek

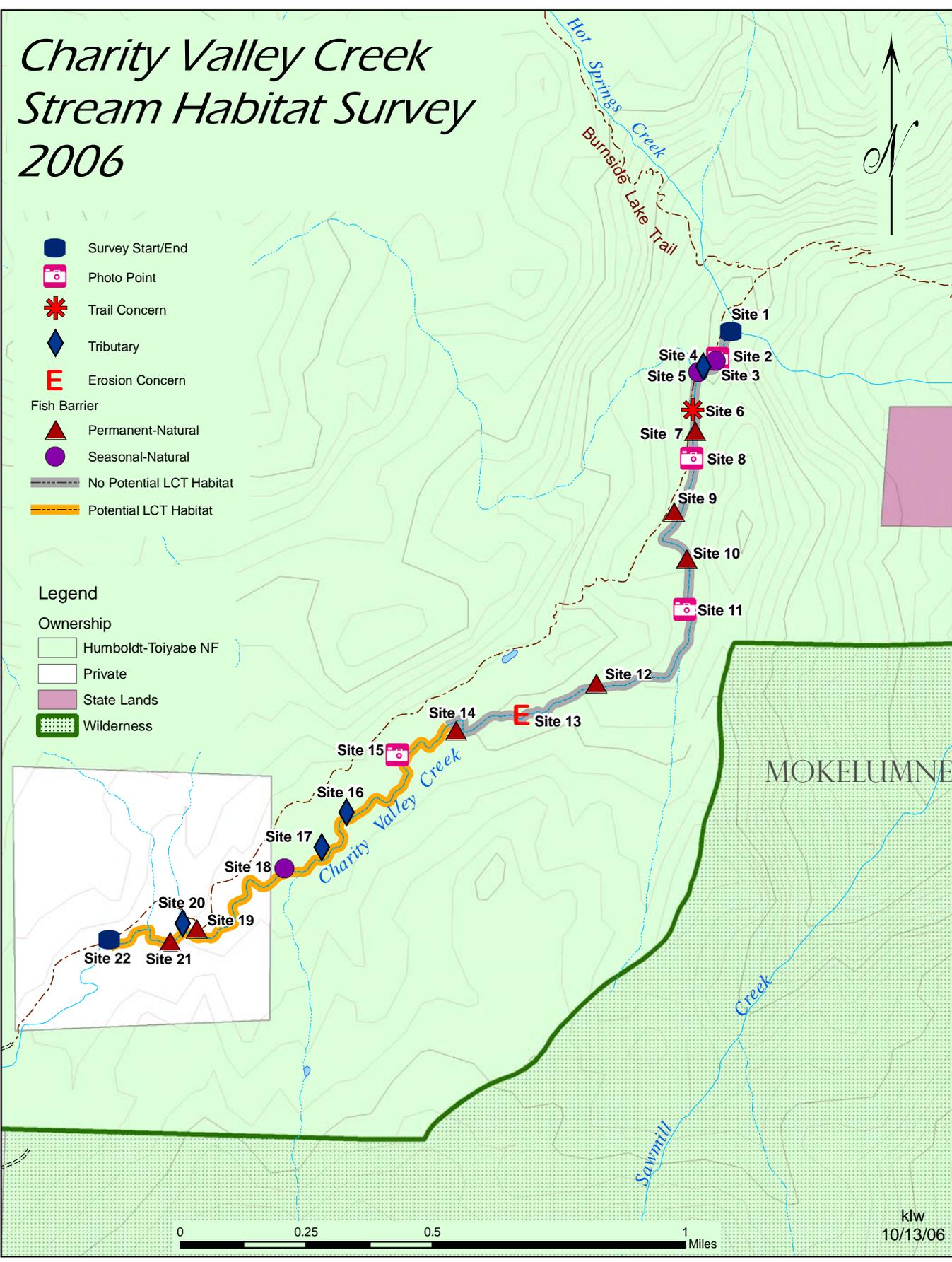
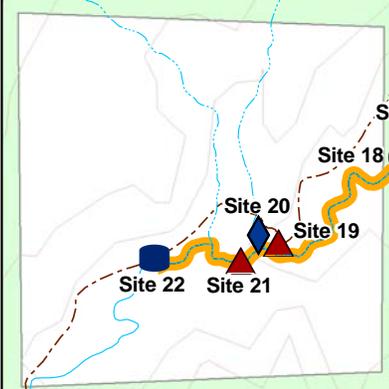
# Charity Valley Creek Stream Habitat Survey 2006



- Survey Start/End
- Photo Point
- Trail Concern
- Tributary
- Erosion Concern
- Fish Barrier
- Permanent-Natural
- Seasonal-Natural
- No Potential LCT Habitat
- Potential LCT Habitat

## Legend

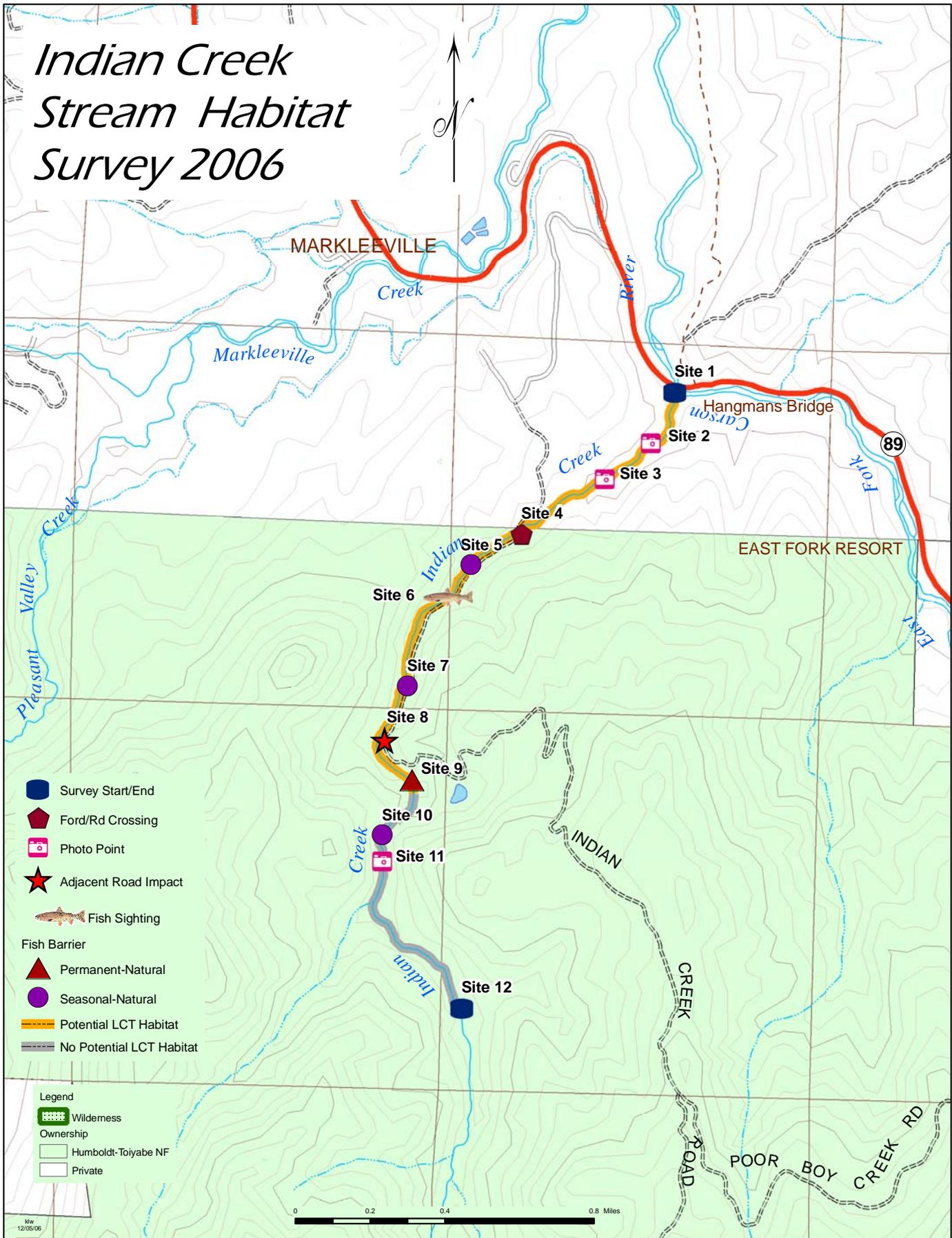
- Ownership
- Humboldt-Toiyabe NF
  - Private
  - State Lands
  - Wilderness



klw  
10/13/06

Map 16: Overview of Charity Valley Creek

# Indian Creek Stream Habitat Survey 2006



- Survey Start/End
- ▾ Ford/Rd Crossing
- Photo Point
- ★ Adjacent Road Impact
- Fish Sighting
- Fish Barrier
  - ▴ Permanent-Natural
  - Seasonal-Natural
- Potential LCT Habitat
- No Potential LCT Habitat

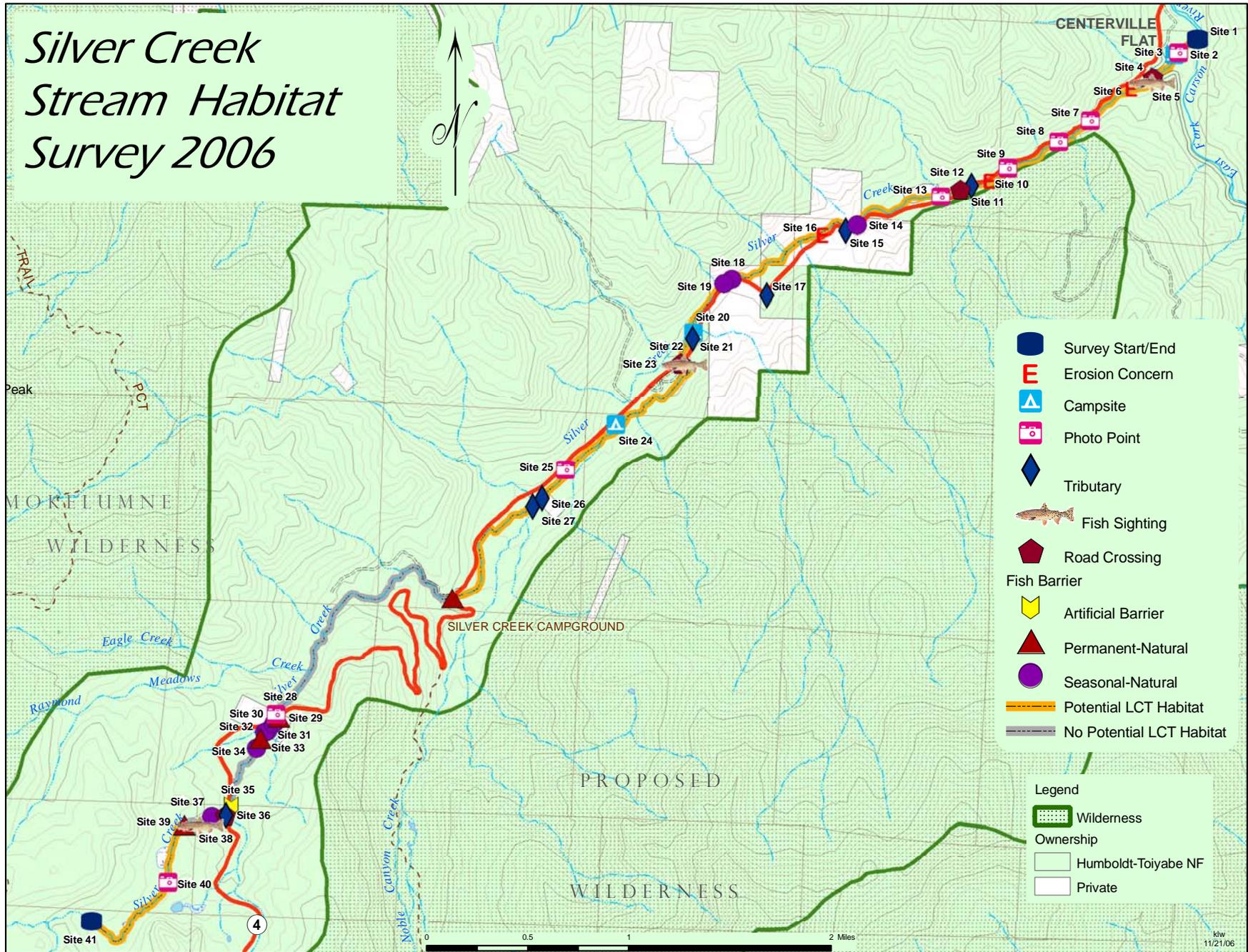
- Legend
- Wilderness
  - Ownership
    - Humboldt-Toiyabe NF
    - Private

0 0.2 0.4 0.8 Miles

10w  
12/06/06

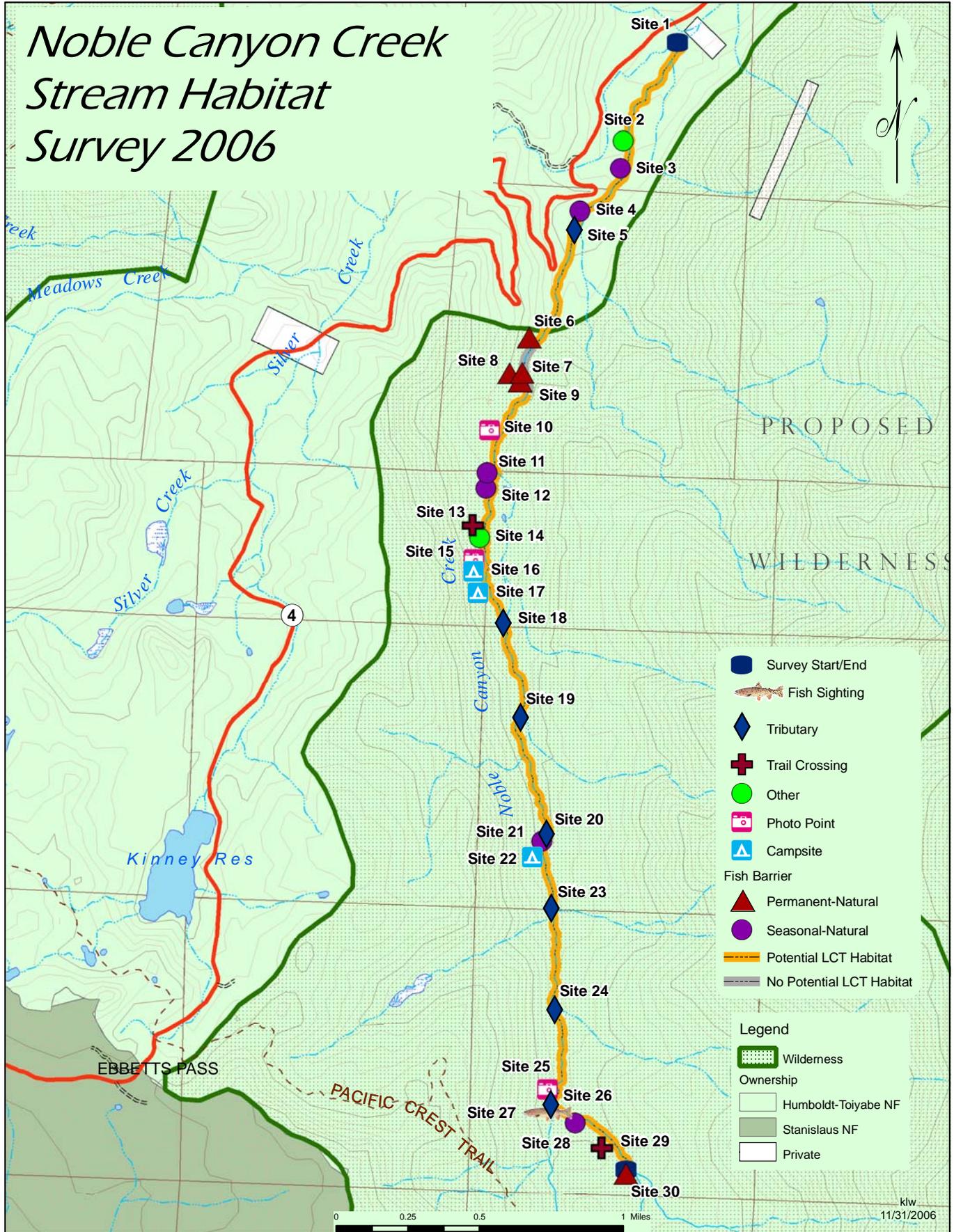
Map 17: Overview of Indian Creek

# Silver Creek Stream Habitat Survey 2006



Map 18: Overview of Silver Creek

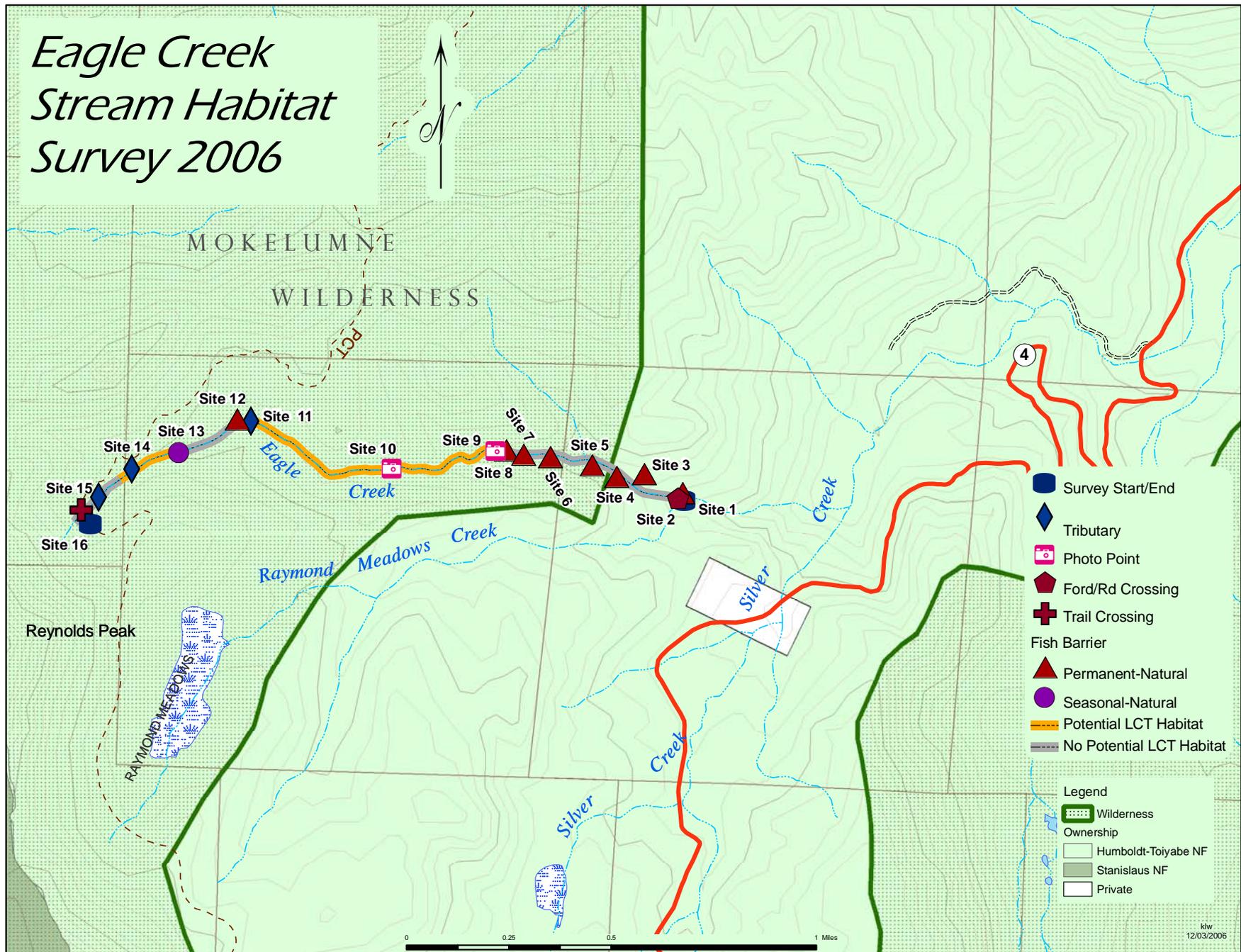
# Noble Canyon Creek Stream Habitat Survey 2006



Map 19: Overview of Noble Creek

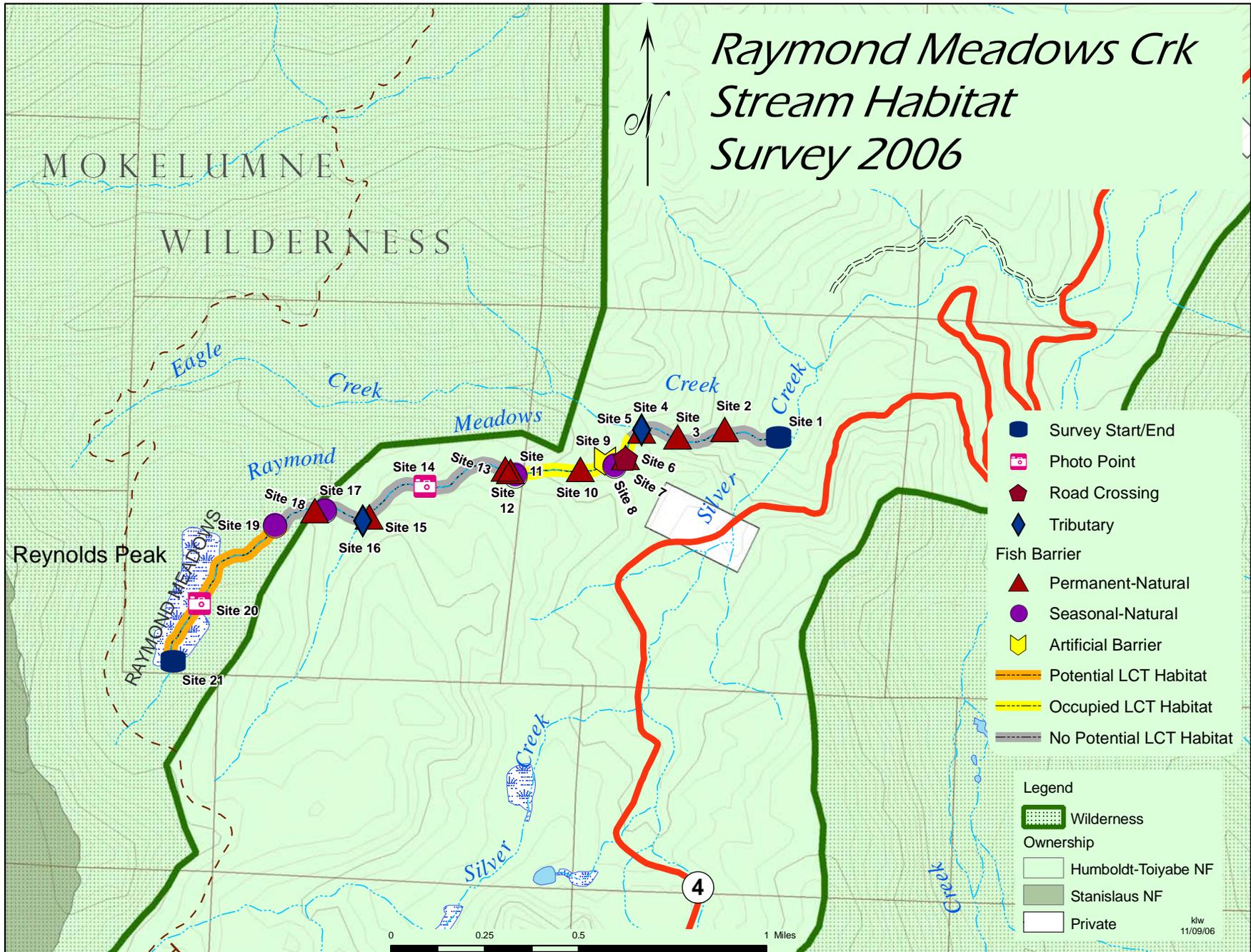
klw  
11/31/2006

# Eagle Creek Stream Habitat Survey 2006



Map 20: Overview of Eagle Creek

# Raymond Meadows Crk Stream Habitat Survey 2006

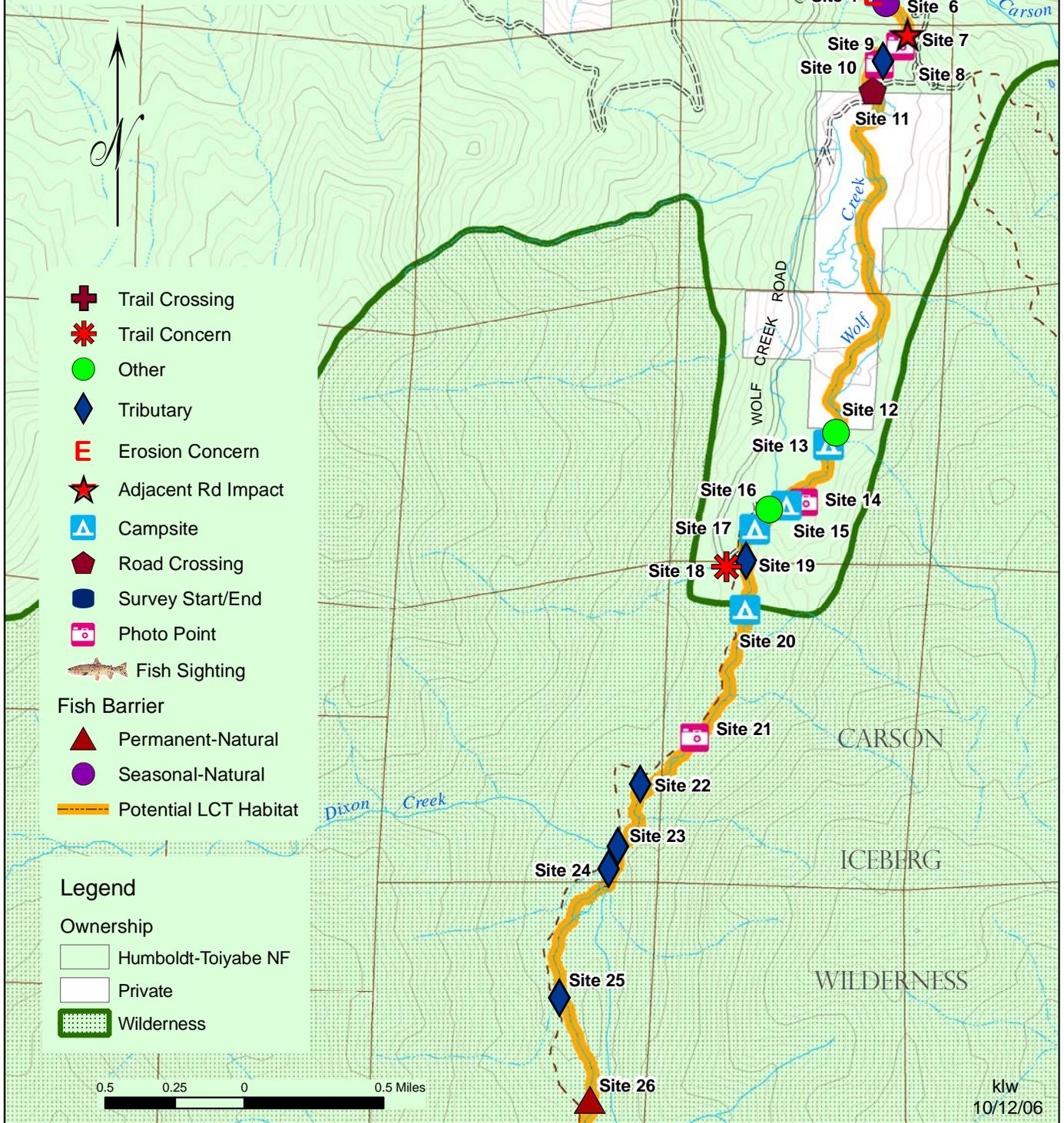


Map 21: Overview of Raymond Meadows Creek

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11/09/06

# Wolf Creek Stream Habitat Survey 2006

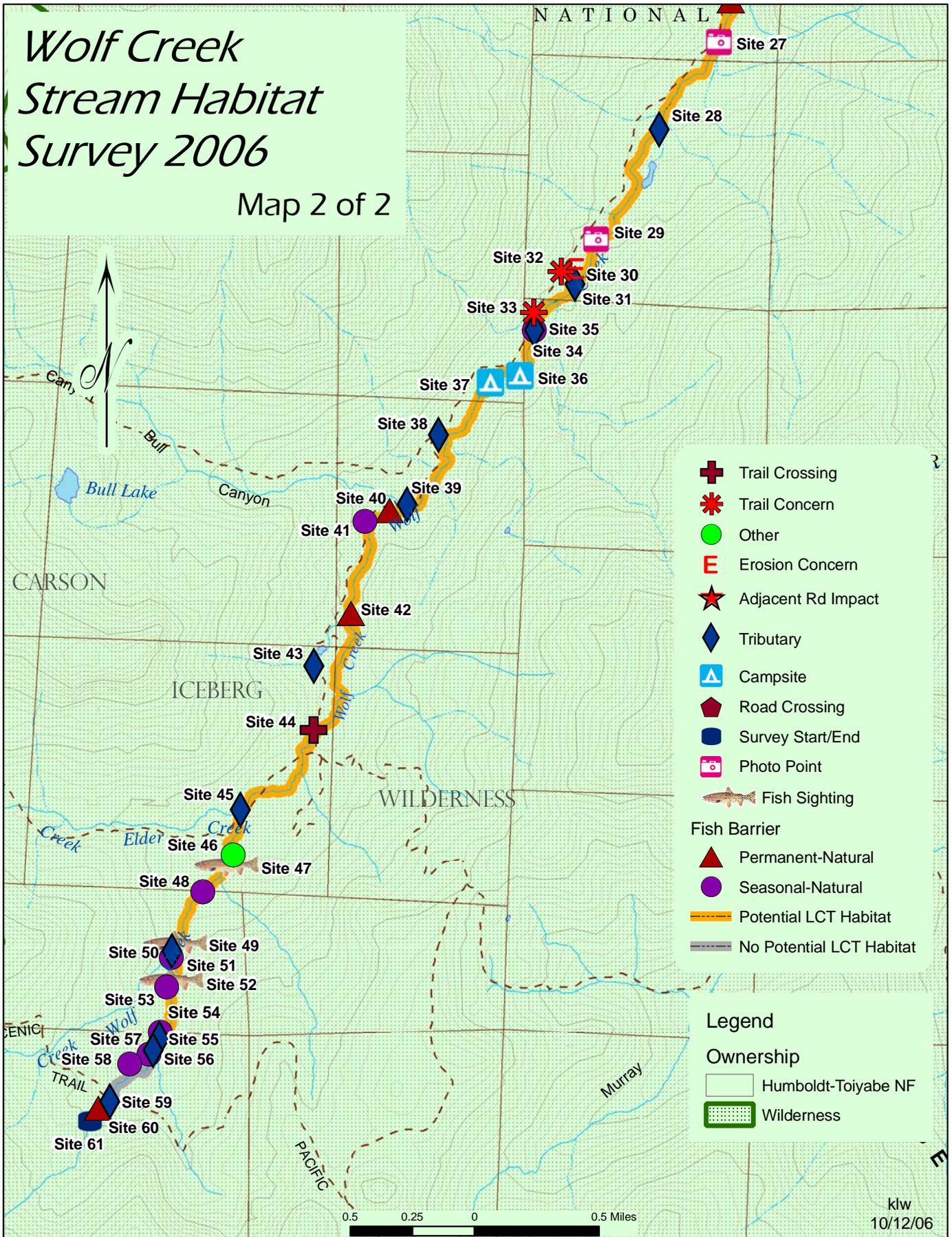
Map 1 of 2



Map 22: Overview of lower Wolf Creek

# Wolf Creek Stream Habitat Survey 2006

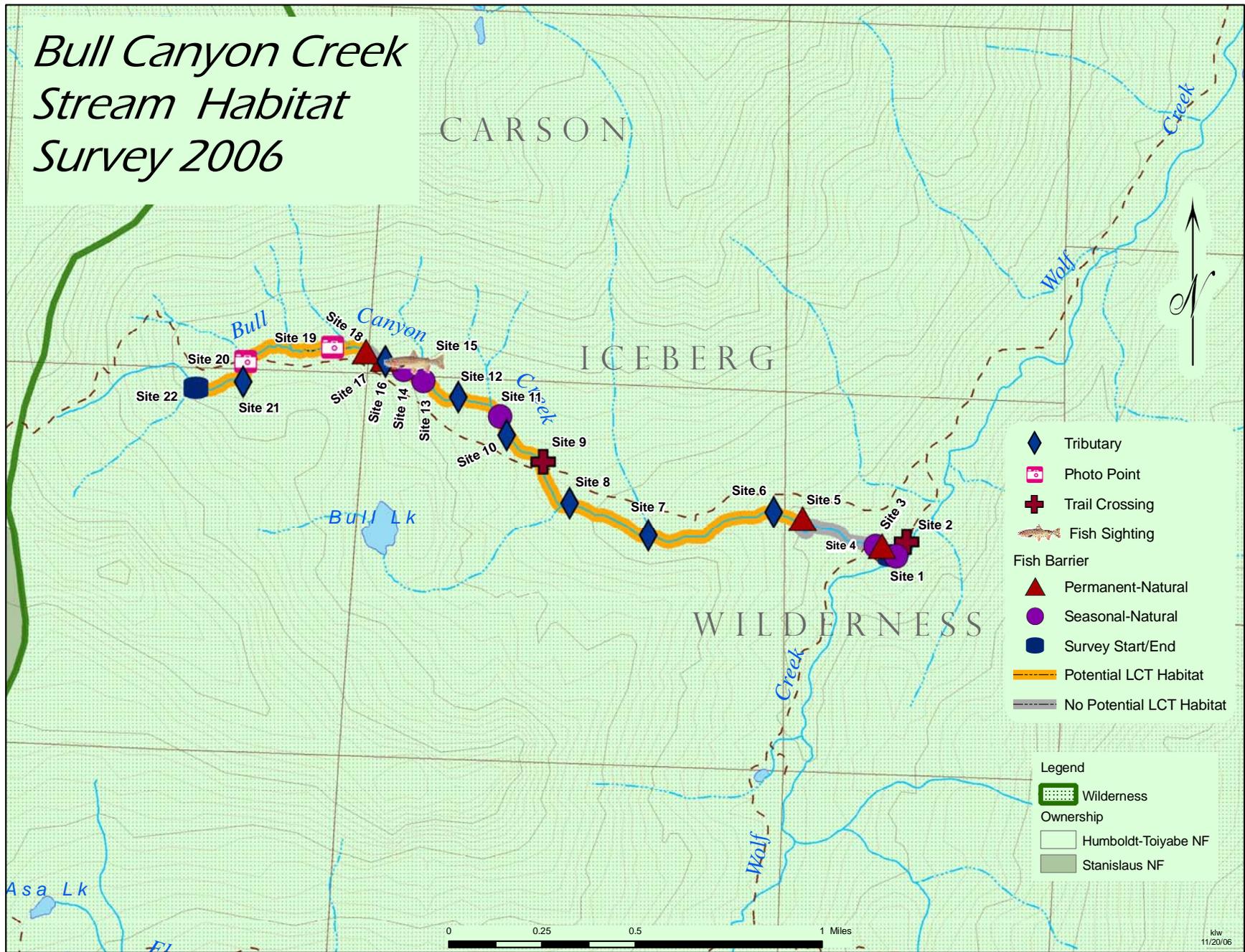
Map 2 of 2



Map 23: Overview of upper Wolf Creek

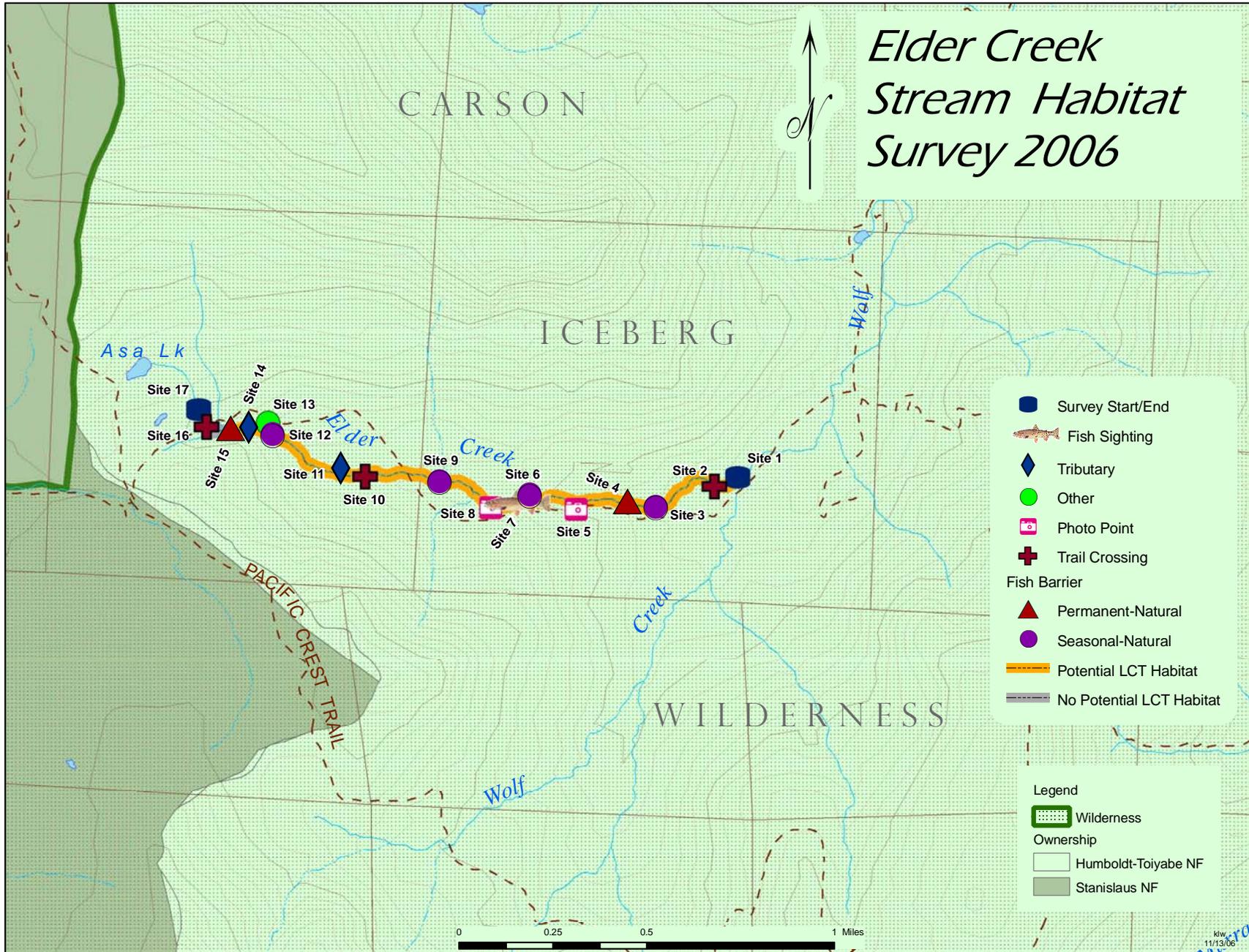


# Bull Canyon Creek Stream Habitat Survey 2006



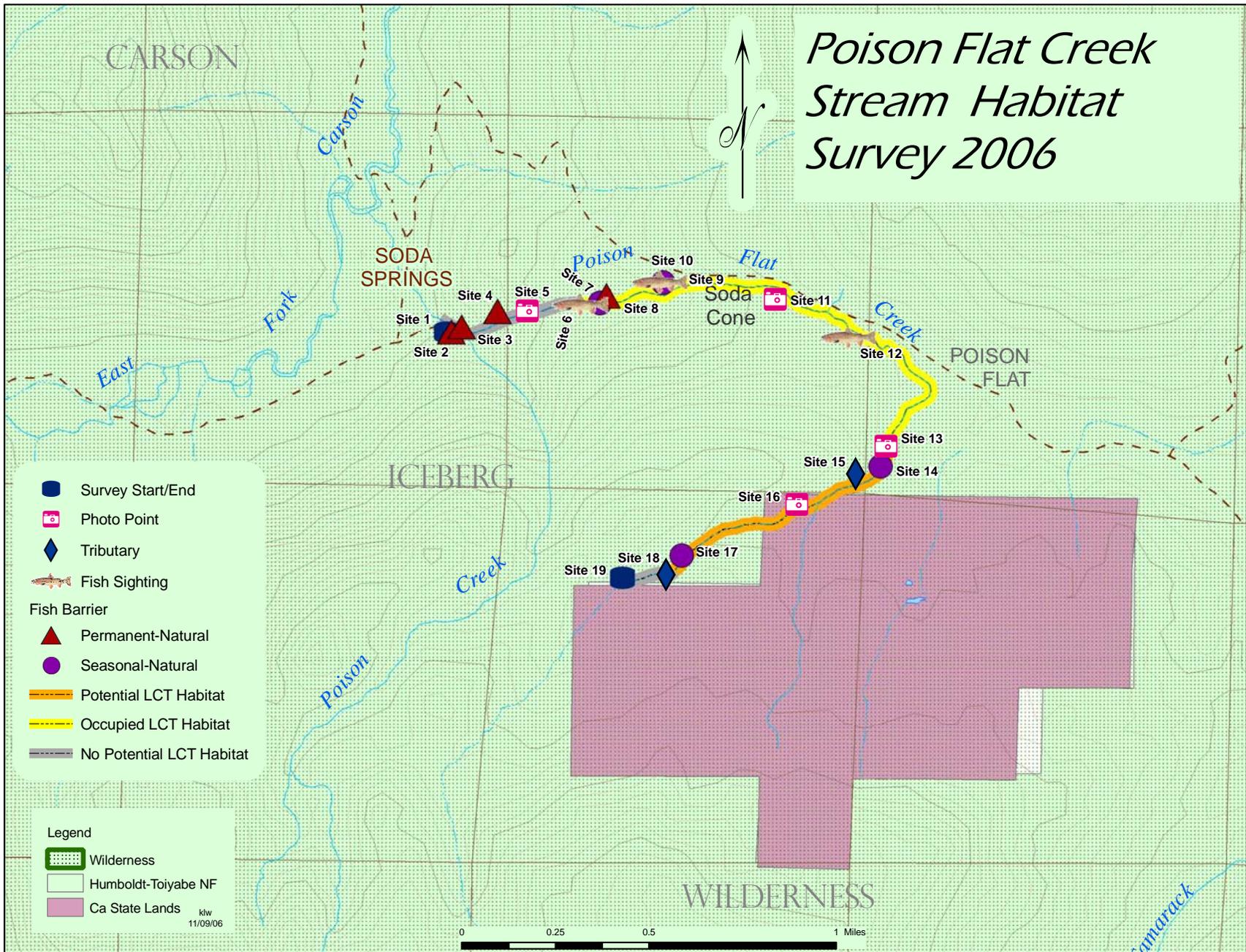
Map 25: Overview of Bull Canyon Creek

# Elder Creek Stream Habitat Survey 2006



Map 26: Overview of Elder Creek

# Poison Flat Creek Stream Habitat Survey 2006



- Survey Start/End
- Photo Point
- Tributary
- Fish Sighting
- Fish Barrier
  - Permanent-Natural
  - Seasonal-Natural
- Habitat
  - Potential LCT Habitat
  - Occupied LCT Habitat
  - No Potential LCT Habitat

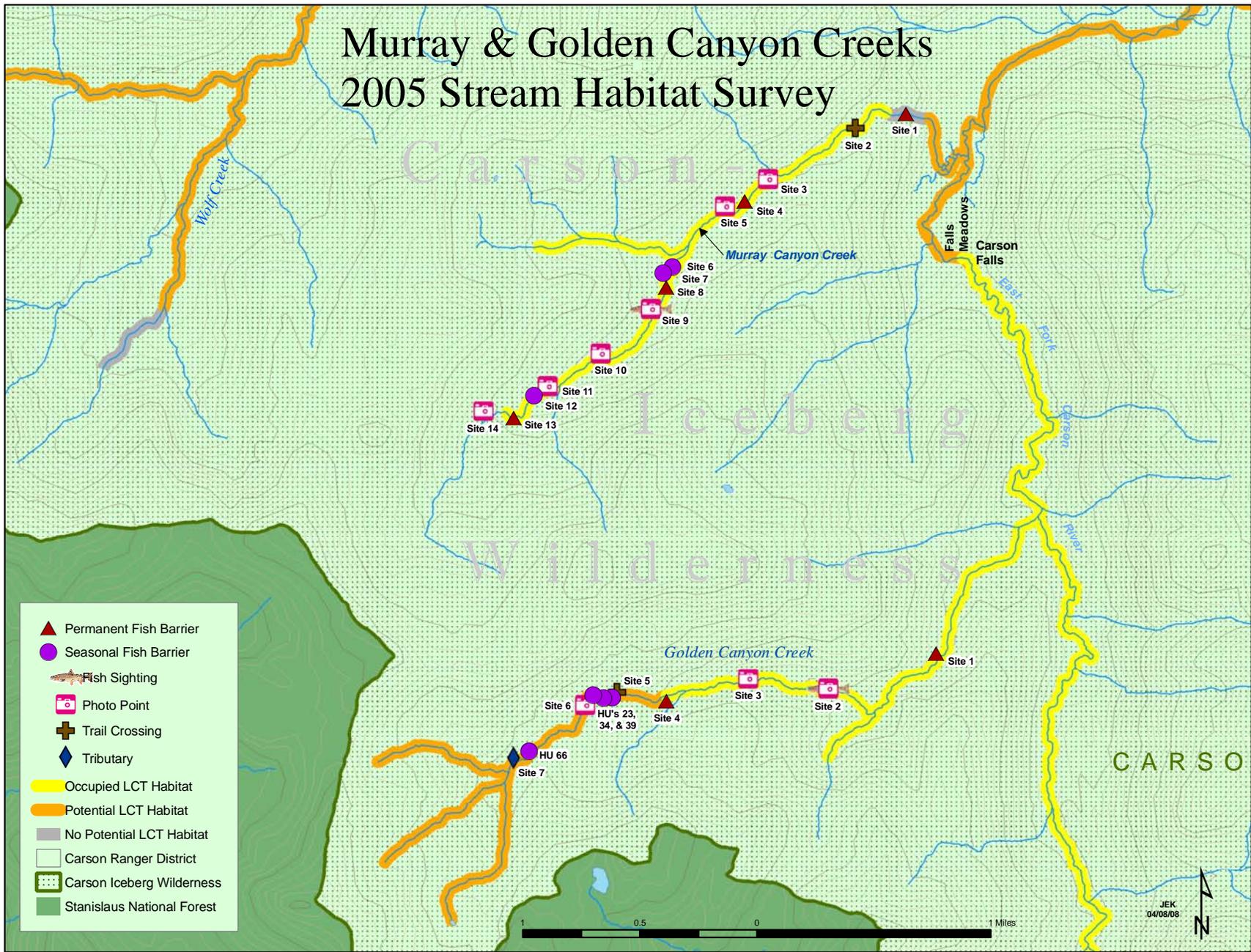
Legend

- Wilderness
- Humboldt-Toiyabe NF
- Ca State Lands

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11/09/06

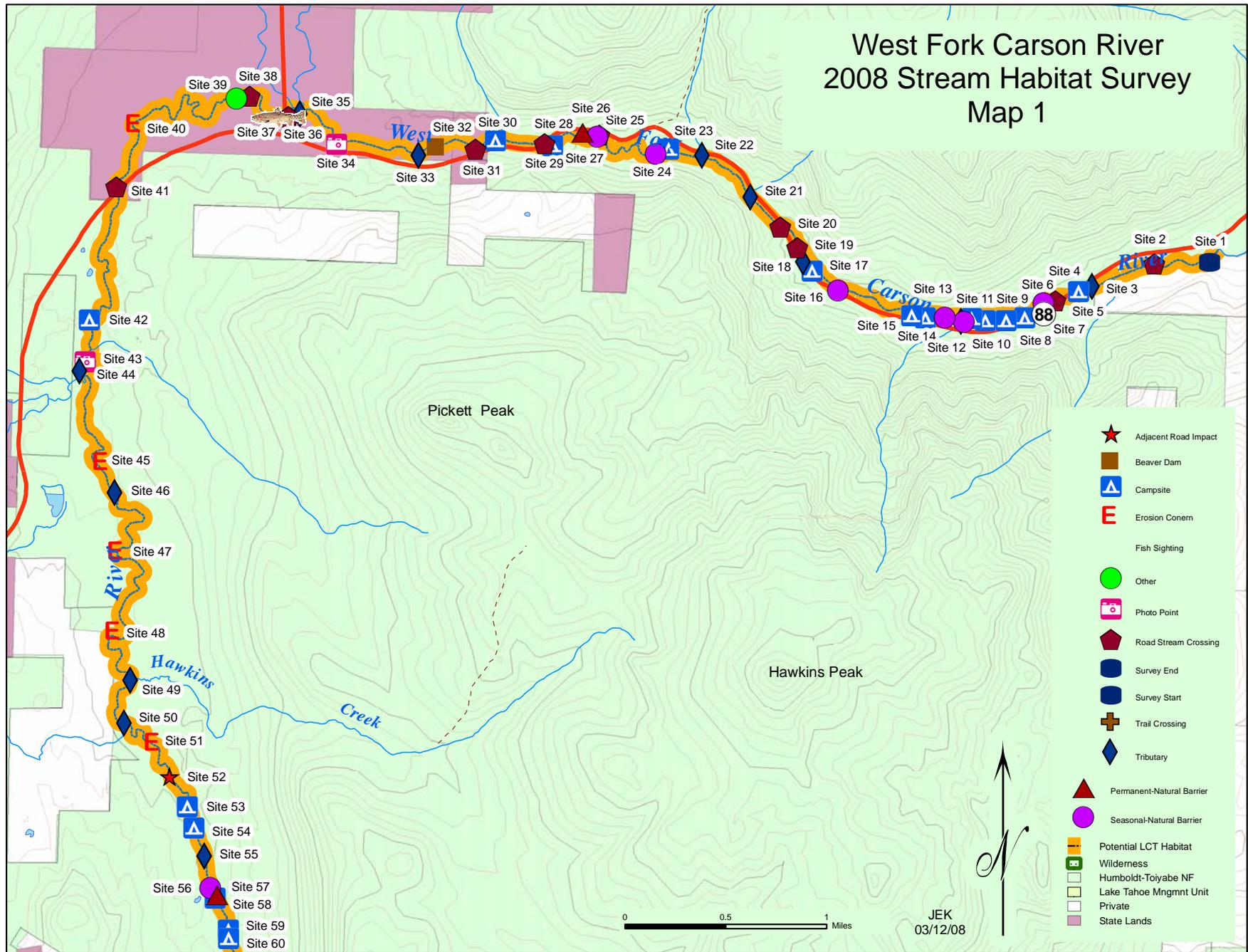
Map 27: Overview of Poison Flat Creek

# Murray & Golden Canyon Creeks 2005 Stream Habitat Survey



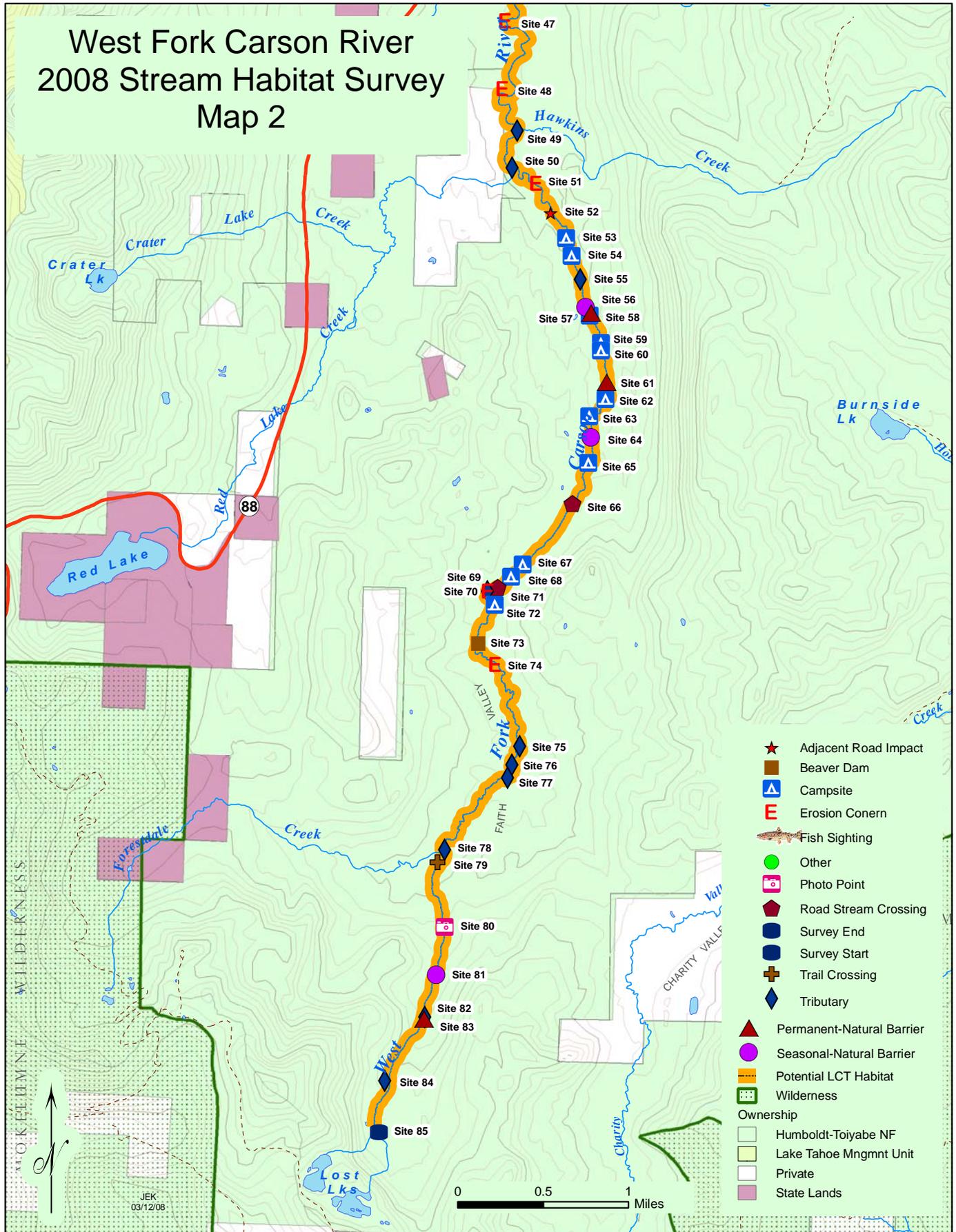
Map 28: Overview of Golden and Murray Canyon Creeks

# West Fork Carson River 2008 Stream Habitat Survey Map 1



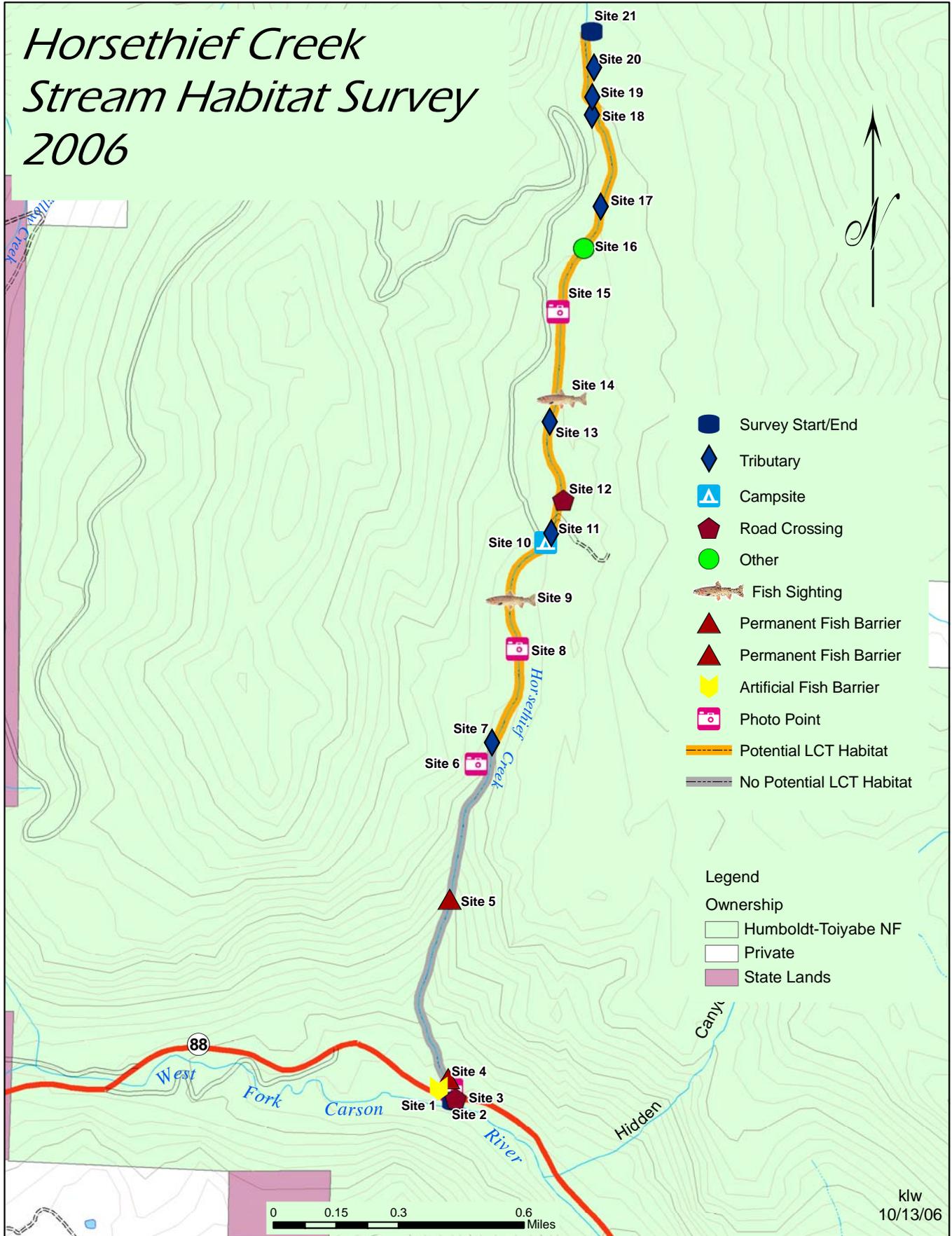
Map 29: Overview of the lower portion of the West Fork Carson River

# West Fork Carson River 2008 Stream Habitat Survey Map 2



Map 30: Overview of the upper portion of the West Fork Carson River

# Horsethief Creek Stream Habitat Survey 2006



- Survey Start/End
- Tributary
- Campsite
- Road Crossing
- Other
- Fish Sighting
- Permanent Fish Barrier
- Permanent Fish Barrier
- Artificial Fish Barrier
- Photo Point
- Potential LCT Habitat
- No Potential LCT Habitat

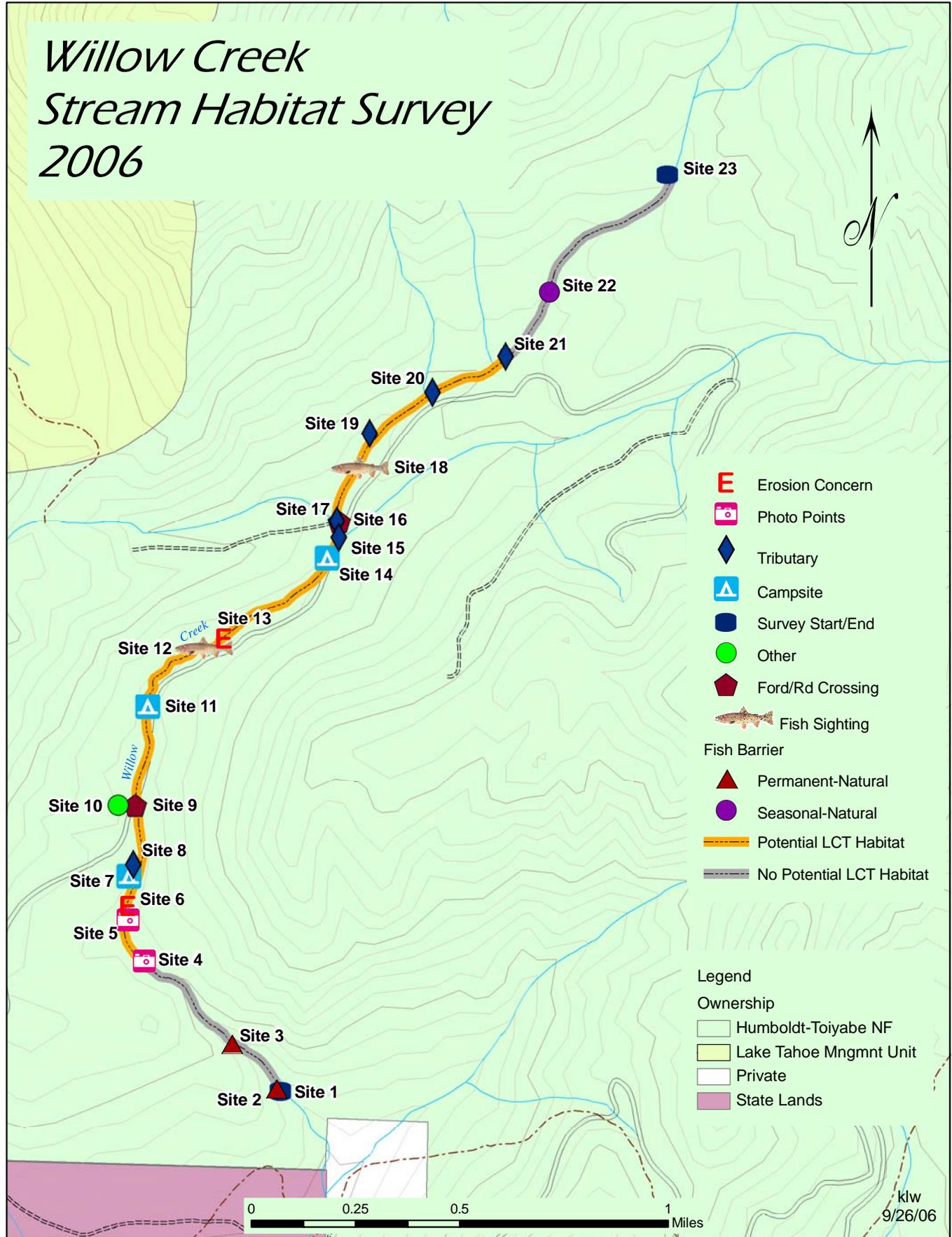
- Legend
- Ownership
- Humboldt-Toiyabe NF
  - Private
  - State Lands



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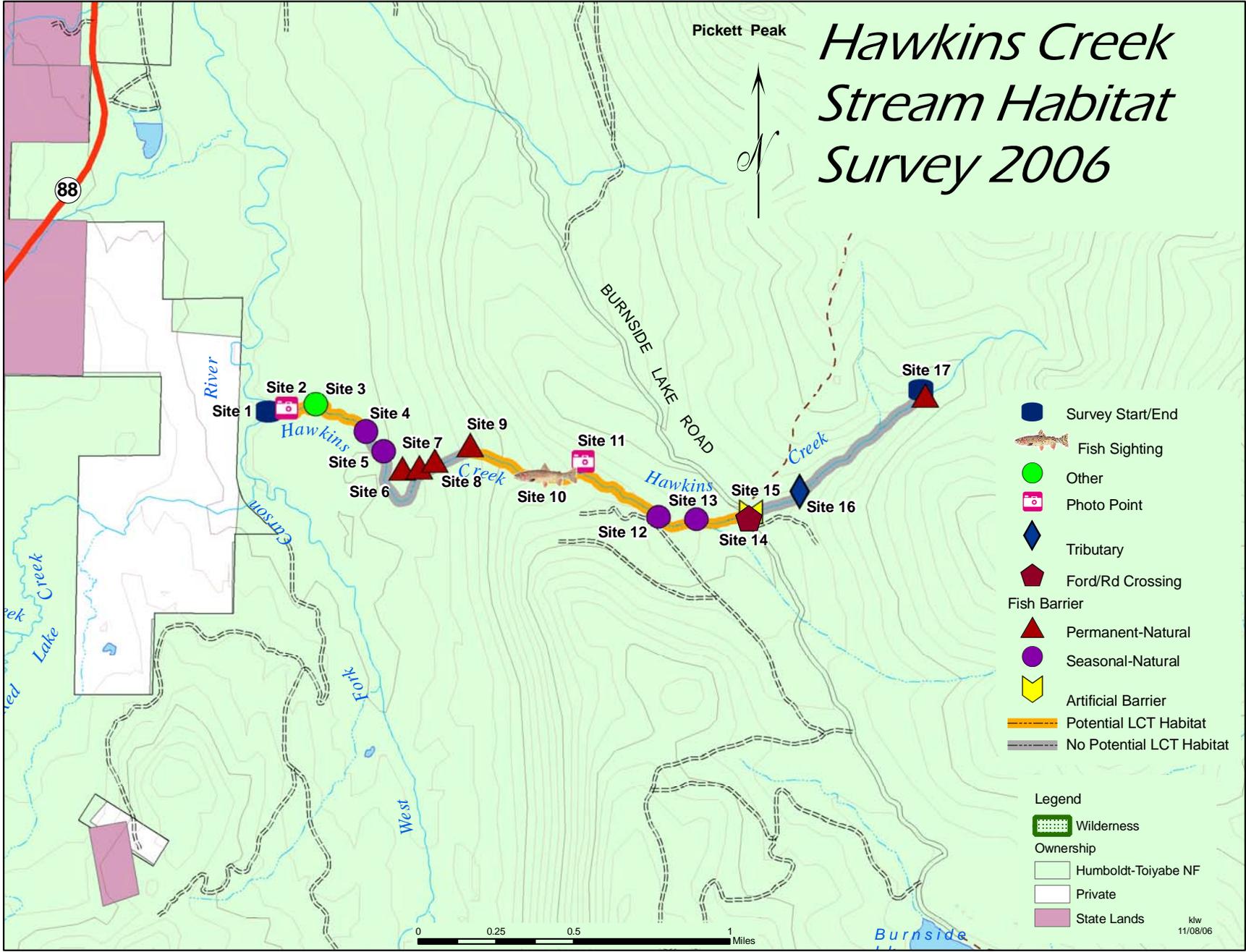
Map 31: Overview of Horsethief Creek

# Willow Creek Stream Habitat Survey 2006



Map 32: Overview of Willow Creek

# Hawkins Creek Stream Habitat Survey 2006



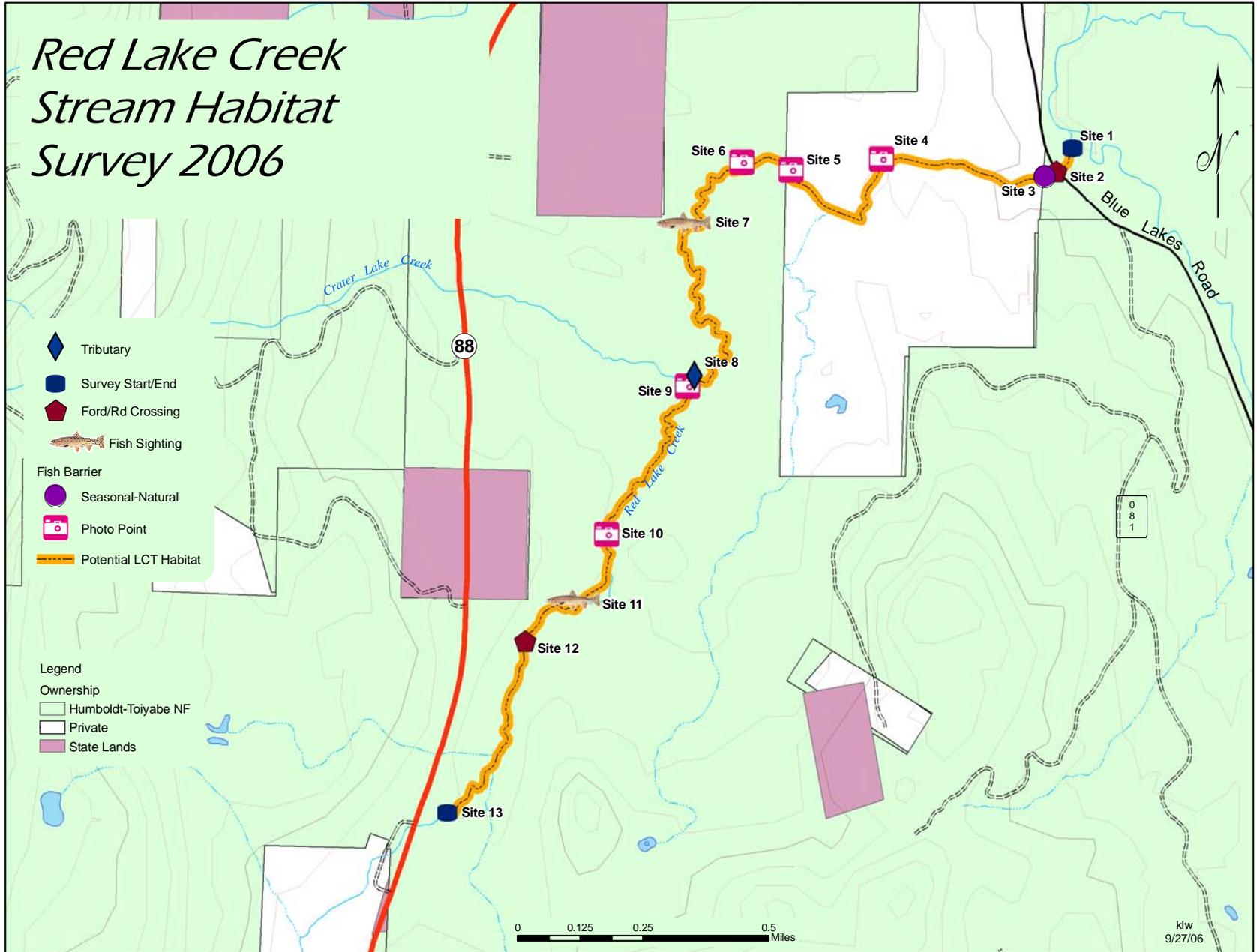
- Survey Start/End
- Fish Sighting
- Other
- Photo Point
- ◆ Tributary
- Ford/Rd Crossing
- Fish Barrier
- Permanent-Natural
- Seasonal-Natural
- Artificial Barrier
- Potential LCT Habitat
- No Potential LCT Habitat

- Legend**
- Wilderness
  - Ownership**
  - Humboldt-Toiyabe NF
  - Private
  - State Lands

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11/08/06

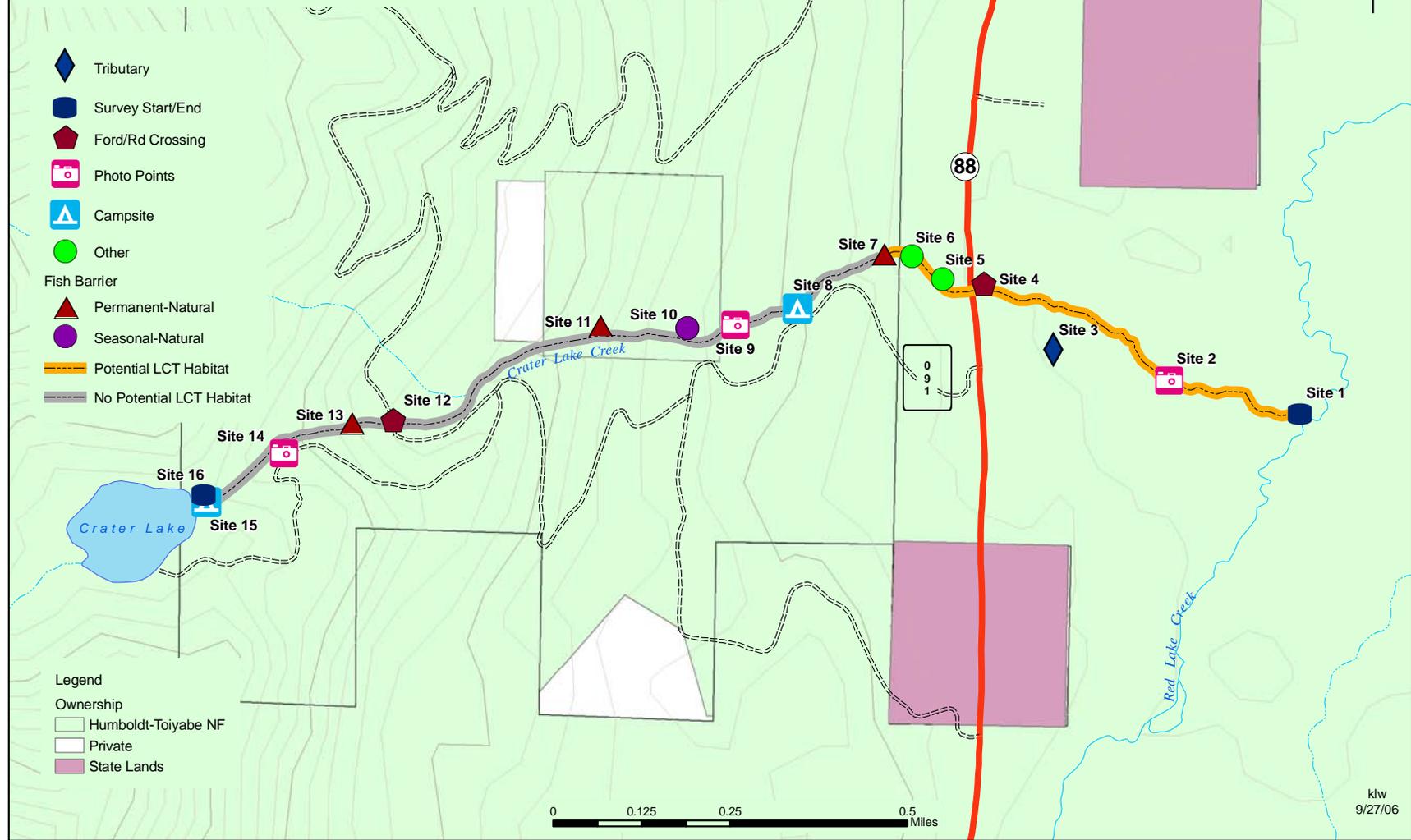
Map 33: Overview of Hawkins Creek

# Red Lake Creek Stream Habitat Survey 2006



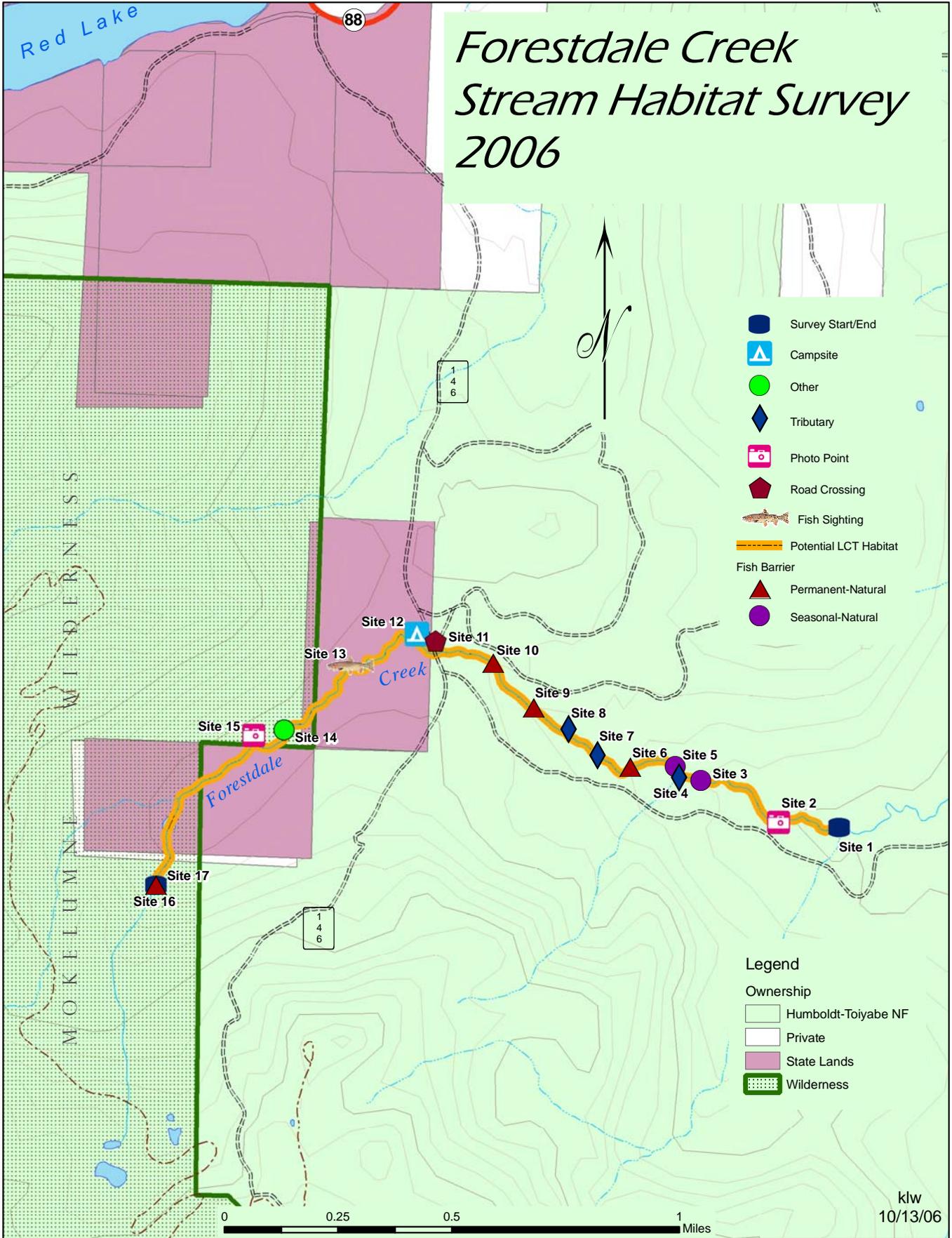
Map 34: Overview of Red Lake Creek

# Crater Lake Creek Stream Habitat Survey 2006



Map 35: Overview of Crater Lake Creek

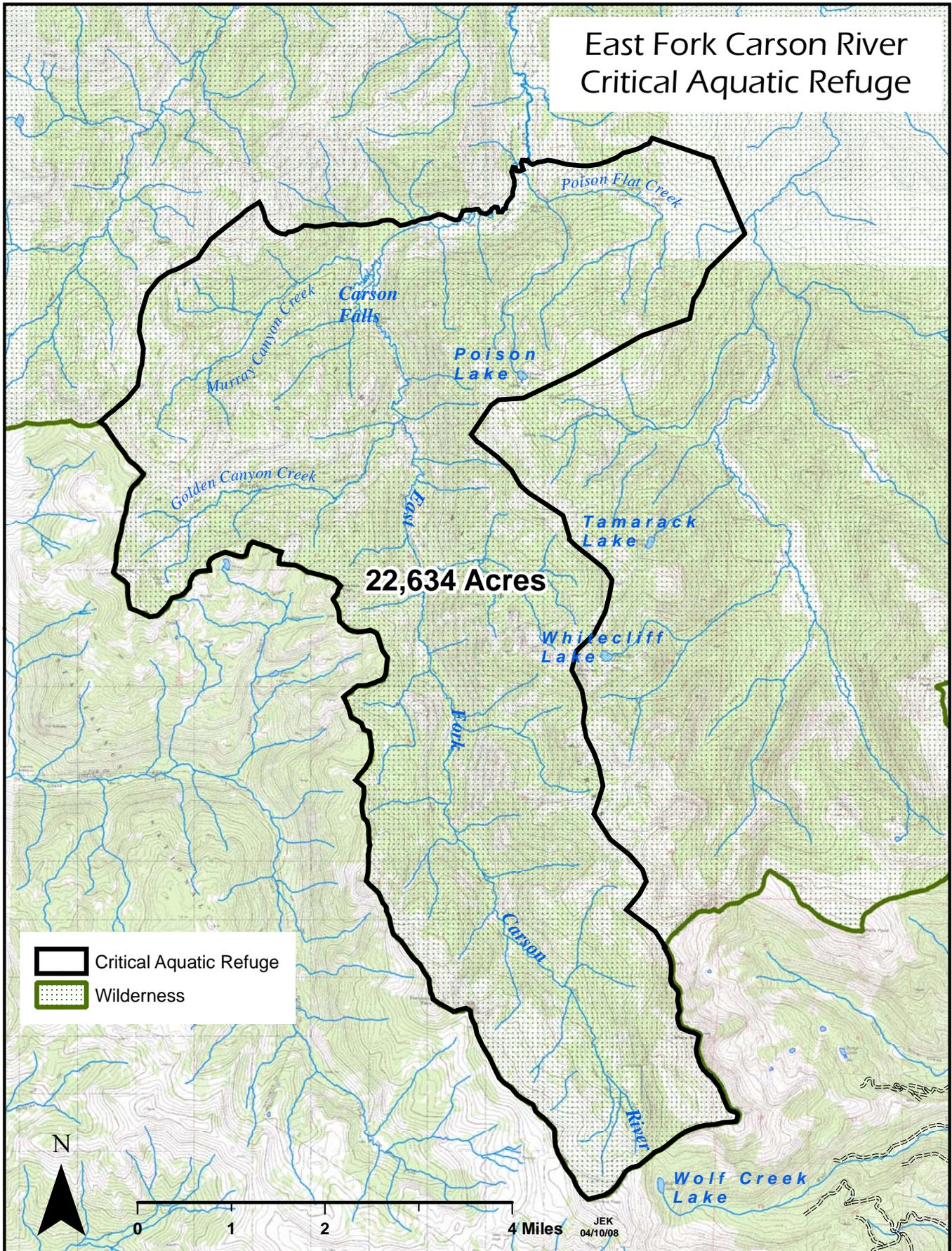
# Forestdale Creek Stream Habitat Survey 2006



Map 36: Overview of Forestdale Creek

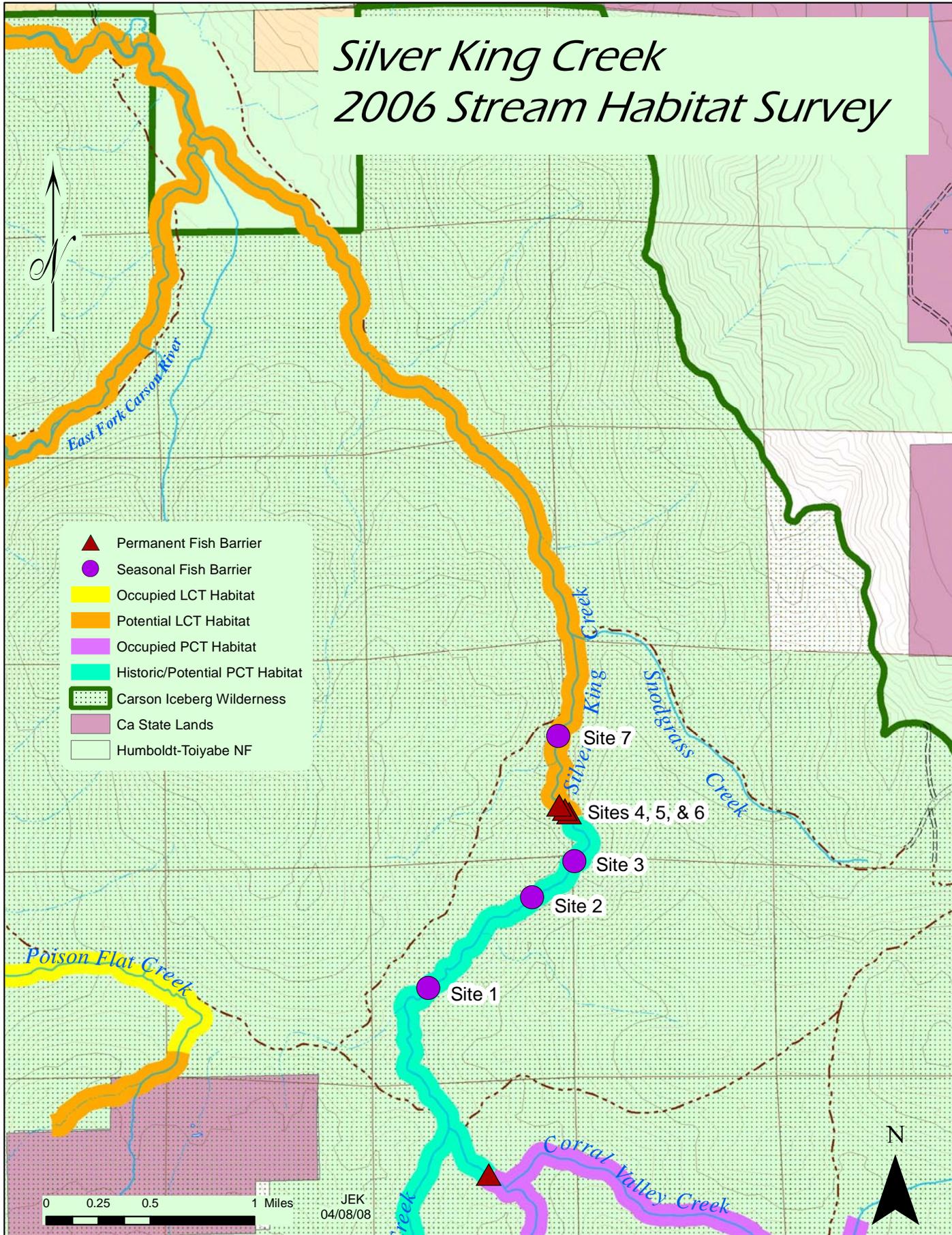
klw  
10/13/06

# East Fork Carson River Critical Aquatic Refuge



Map 37: Overview of the proposed East Fork Carson River Critical Aquatic Refuge

# Silver King Creek 2006 Stream Habitat Survey



Map 38: Overview of Silver King Creek