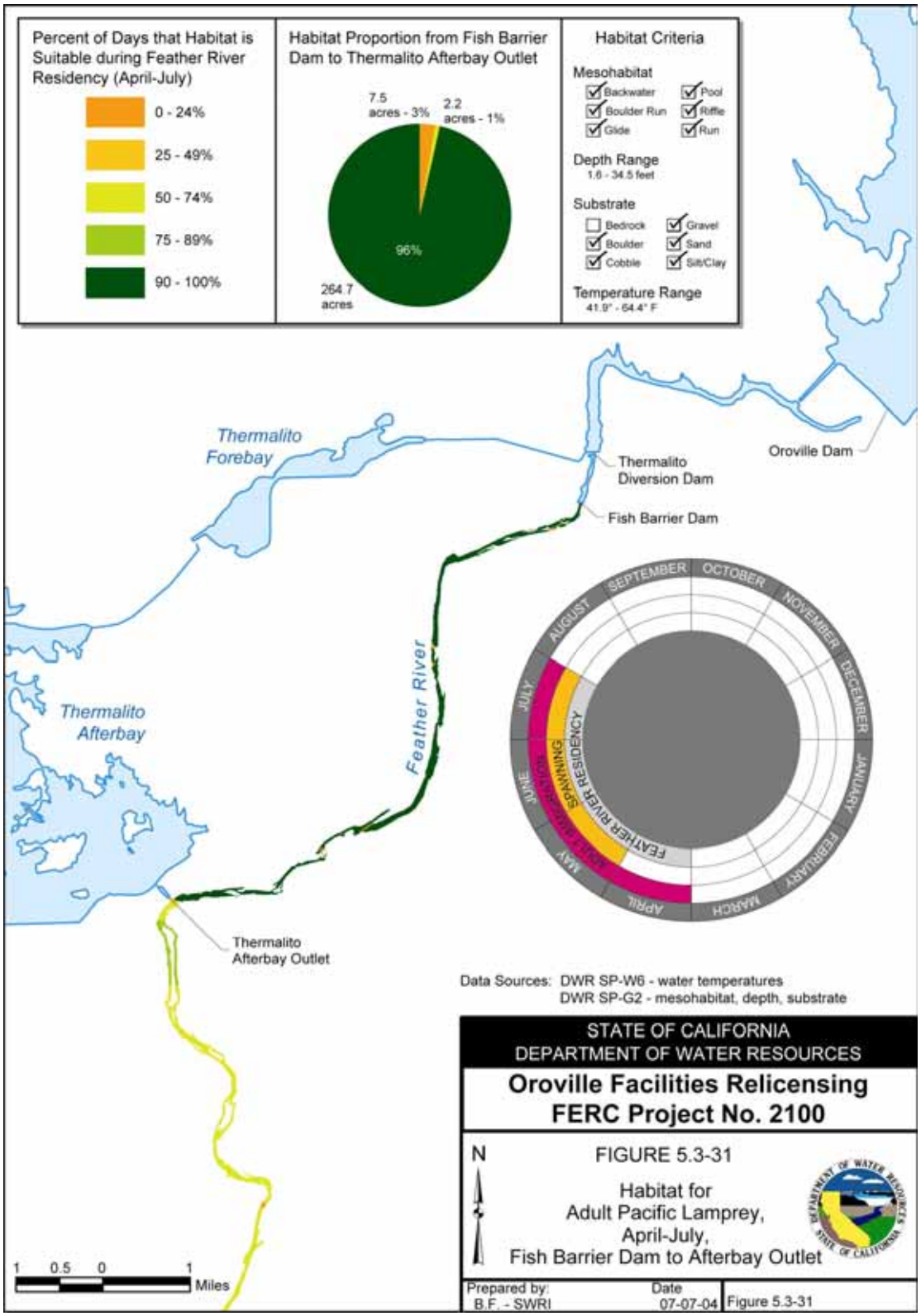

Figure 5.3-31. Pacific lamprey habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

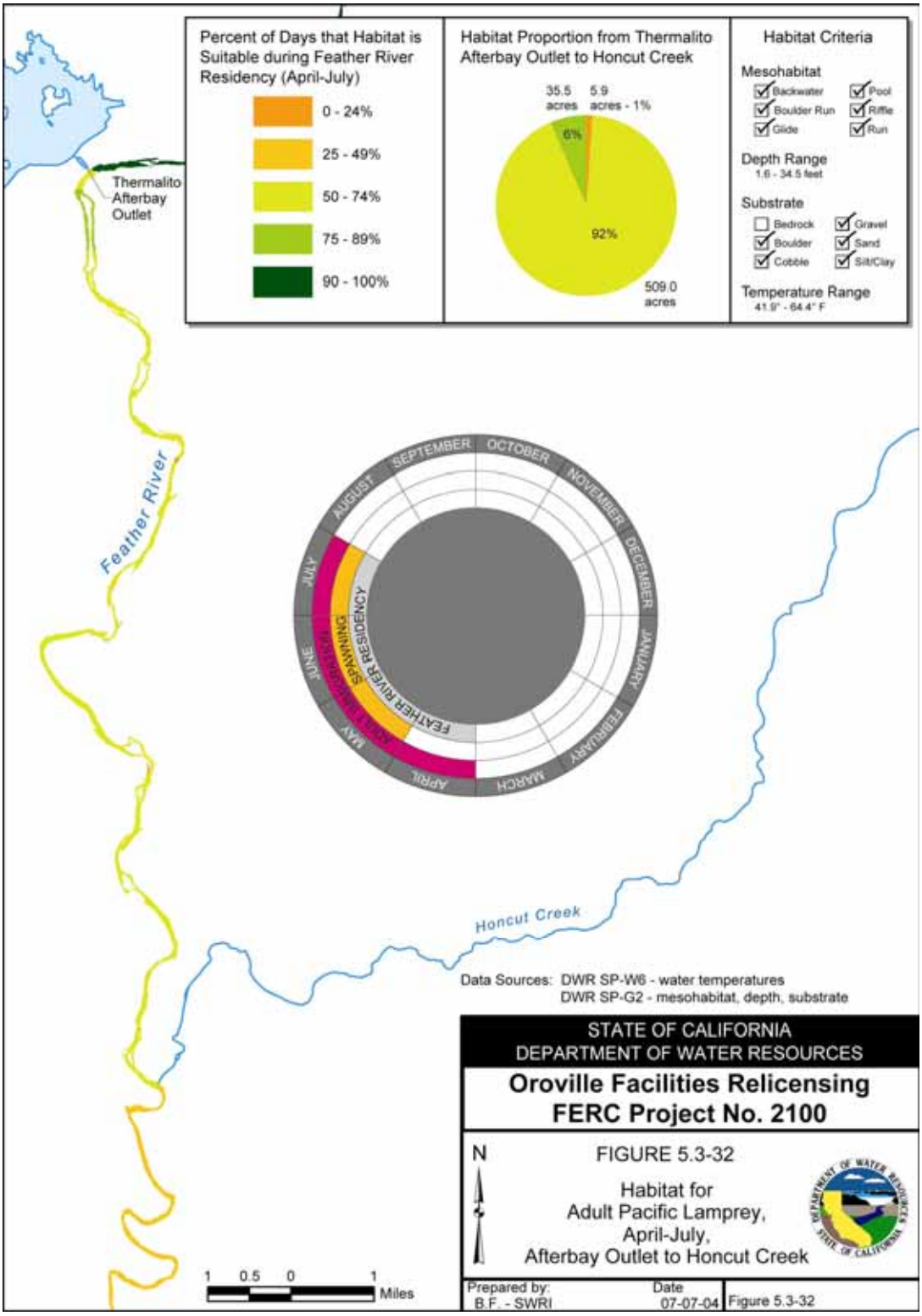

Figure 5.3-32. Pacific lamprey habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

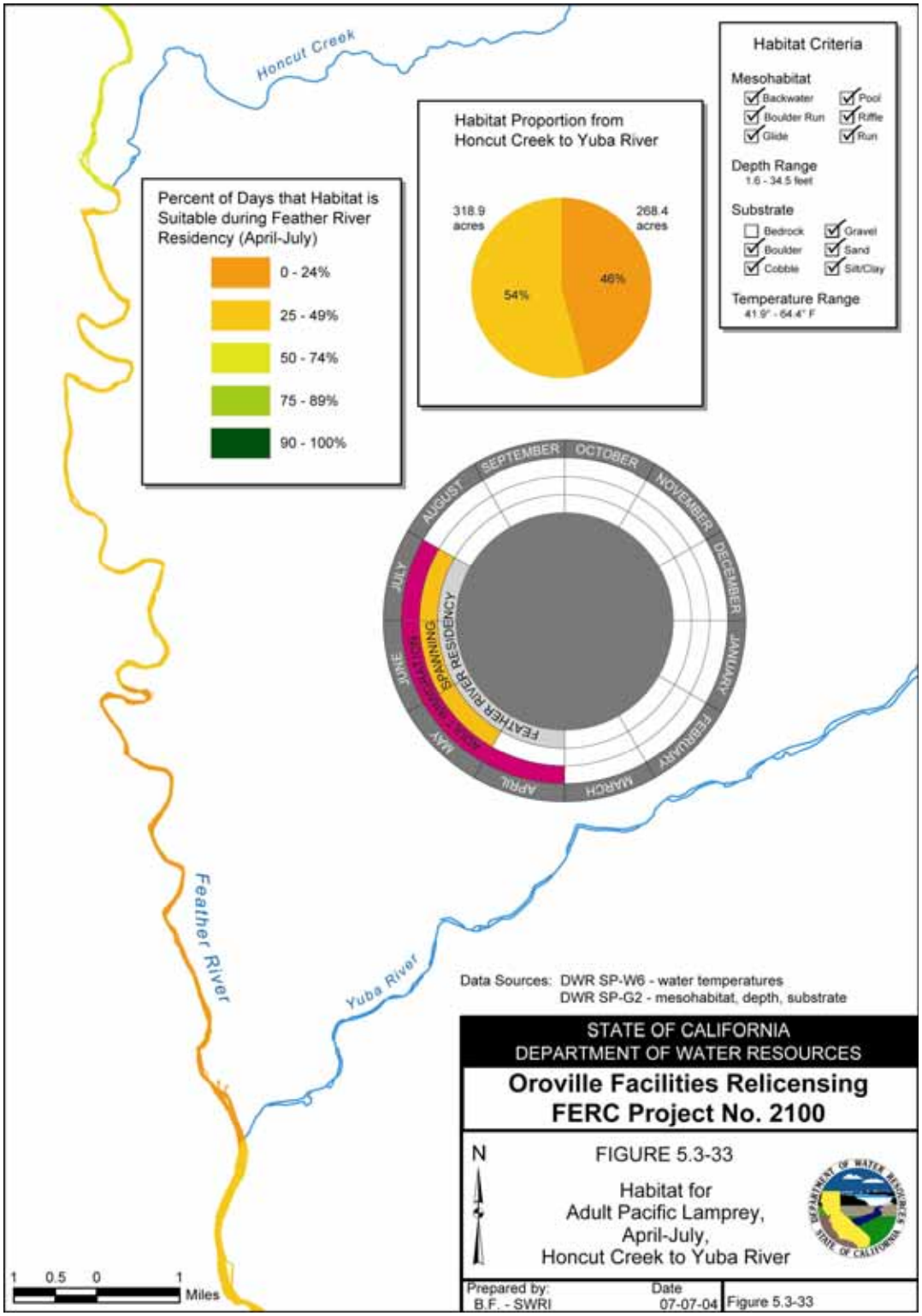

Figure 5.3-33. Pacific lamprey habitat in the lower Feather River from Honcut Creek to the Yuba River.

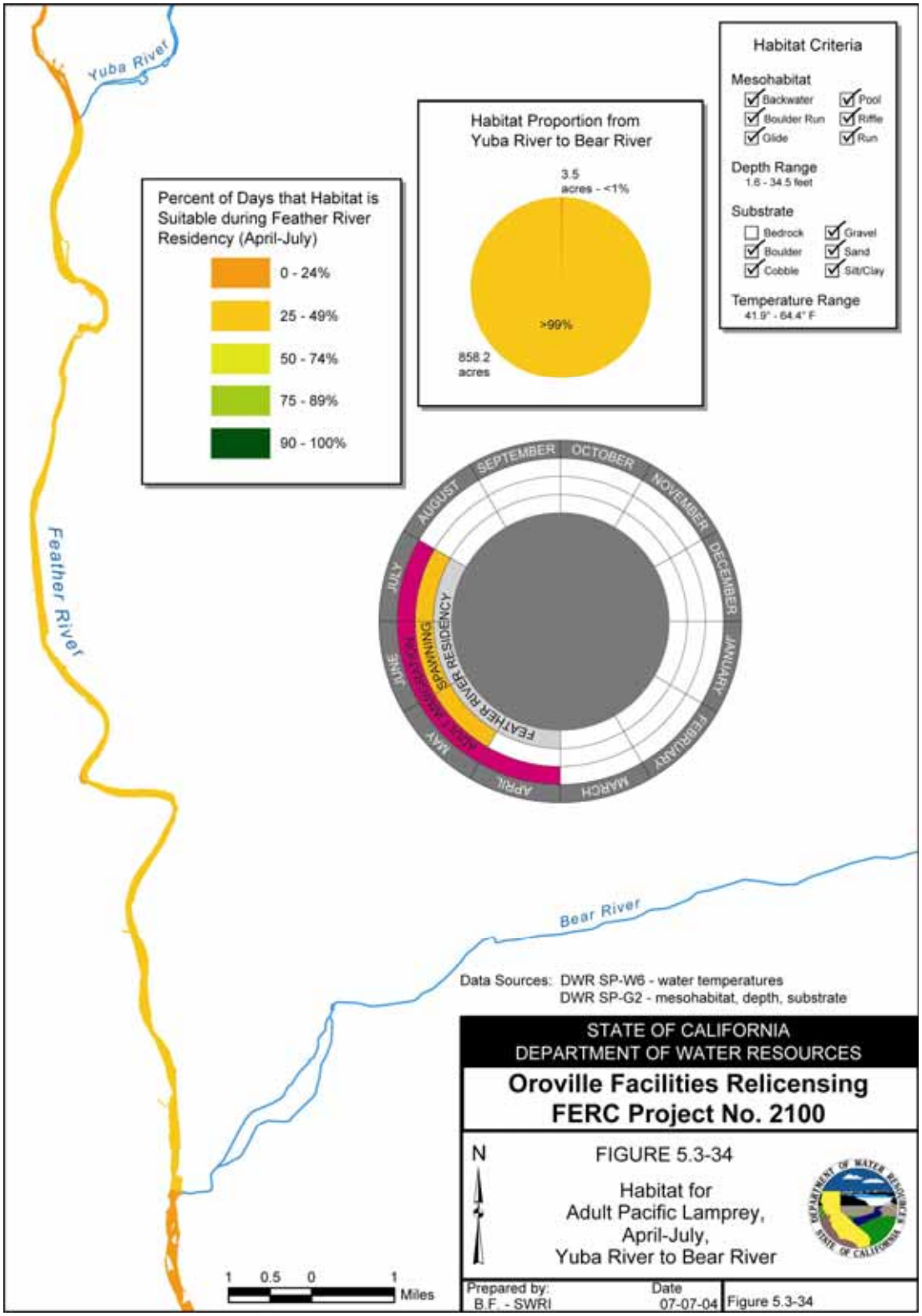

Figure 5.3-34. Pacific lamprey habitat in the lower Feather River from the Yuba River to Bear River.

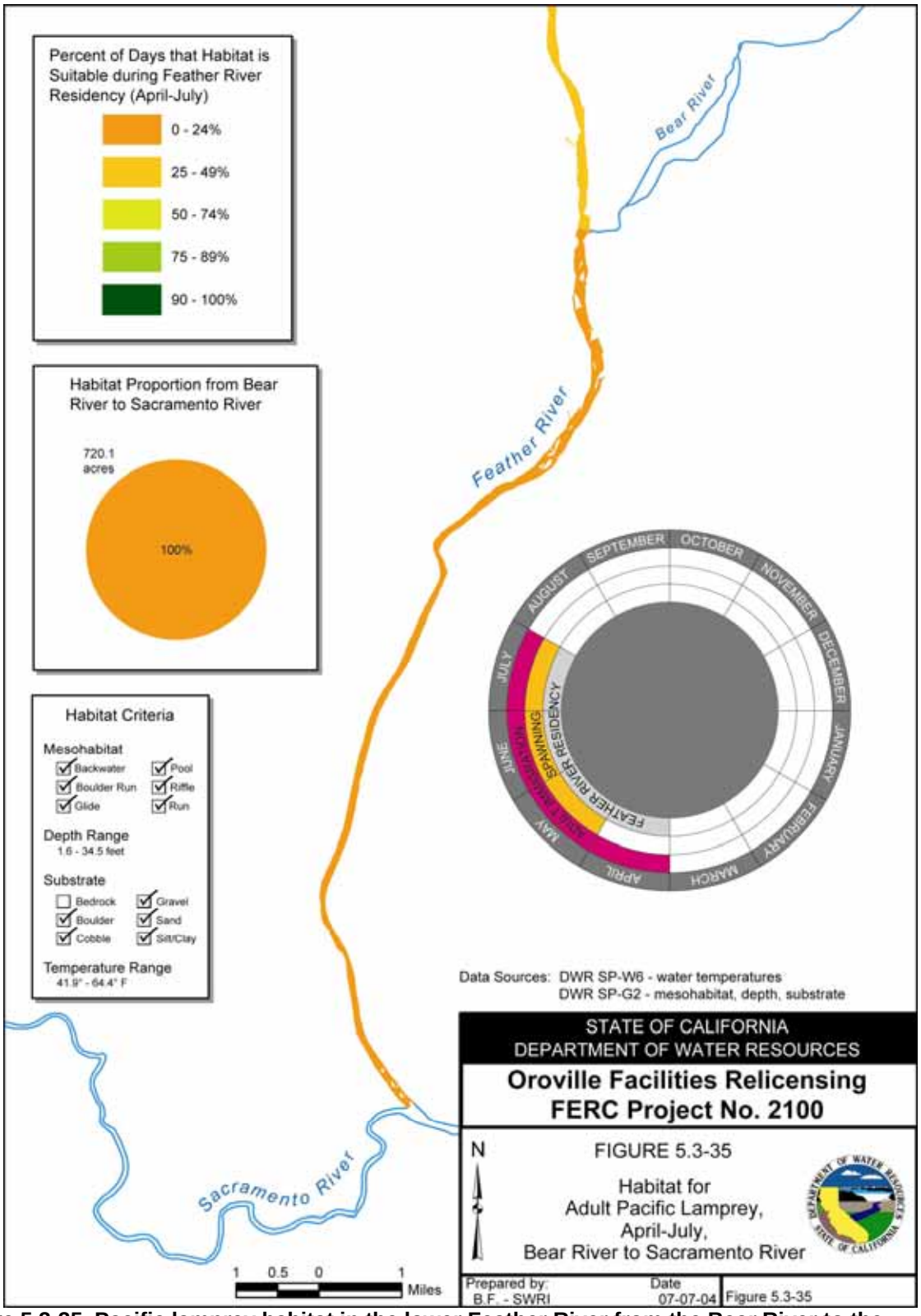

Figure 5.3-35. Pacific lamprey habitat in the lower Feather River from the Bear River to the Sacramento River.

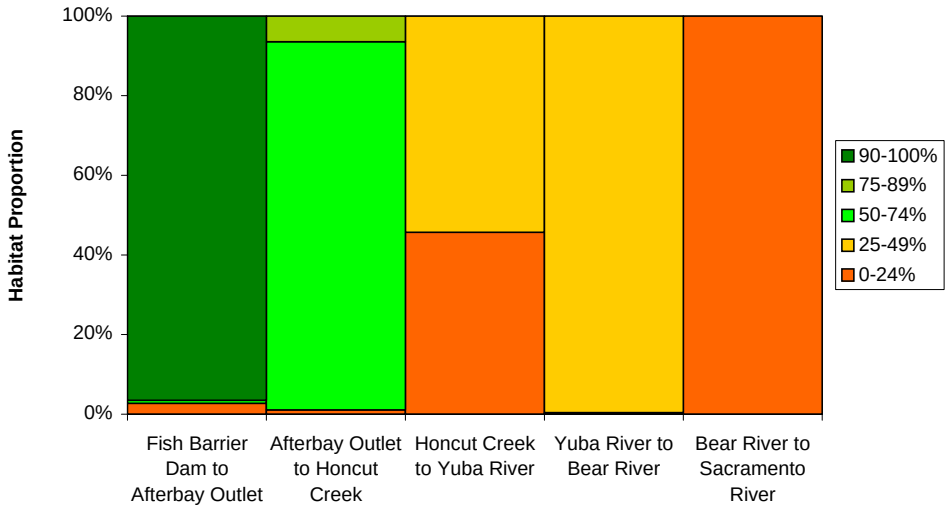

Figure 5.3-36. Proportion of Pacific lamprey habitat in the lower Feather River by reach.

5.3.1.7 River Lamprey

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 76 acres (i.e., 3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for river lamprey, 2 acres (i.e., 1 percent) of total available habitat fell into the 75 percent to 89 percent proportion of relative habitat suitability class, and 265 acres (i.e., 96.5 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-37).

Between the Thermalito Afterbay Outlet and Honcut Creek, 6 acres (i.e., 1 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for river lamprey, 415 acres (i.e., 75 percent) of total available habitat fell into the 75 percent to 89 percent proportion of relative habitat suitability class, and 130 acres (i.e., 24 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-38).

Between Honcut Creek and the Yuba River, 1 acre (i.e., 0.2 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for river lamprey, 267 acres (i.e., 46 percent) of total available habitat fell into the 50 percent to 74 percent proportion of relative habitat suitability class, and 319 acres (i.e., 54 percent) of total available habitat fell into the 75 percent to 89 percent proportion of relative habitat suitability class (Figure 5.3-39).

Between the Yuba River and the Bear River, 4 acres (i.e., 0.4 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for river lamprey, and 858 acres (i.e., 99 percent) of total available habitat fell into the 75 percent to 89 percent proportion of relative habitat suitability class (Figure 5.3-40).

Between the Bear River and the Feather River confluence with the Sacramento River, 257 acres (i.e., 36 percent) of total available habitat fell into the 25 percent to 49 percent proportion of relative habitat suitability class for river lamprey, 464 acres (i.e., 64 percent) of total available habitat fell into the 50 percent to 74 percent proportion of relative habitat suitability class for river lamprey (Figure 5.3-41).

A relatively small proportion of total available habitat for river lamprey fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) and only occurred in the two most upstream reaches of the lower Feather River upstream from Honcut Creek. However the only reaches that contained any available habitat that fell into the lowest proportion of relative habitat suitability class for river lamprey also were the two most upstream reaches. Figure 5.3-42 shows the proportion of habitat and proportion of relative habitat suitability classes for pacific lamprey by reach.

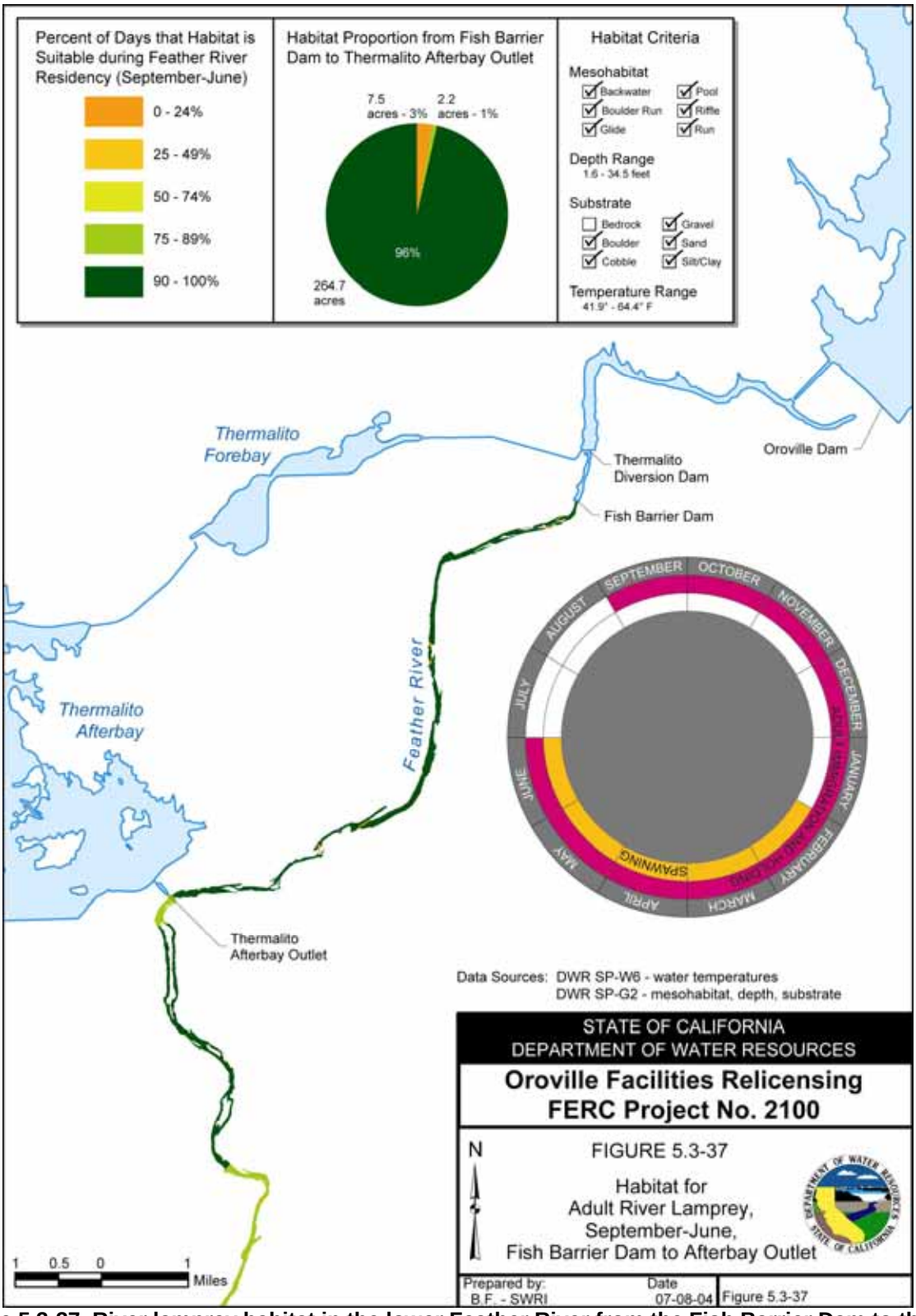

Figure 5.3-37. River lamprey habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

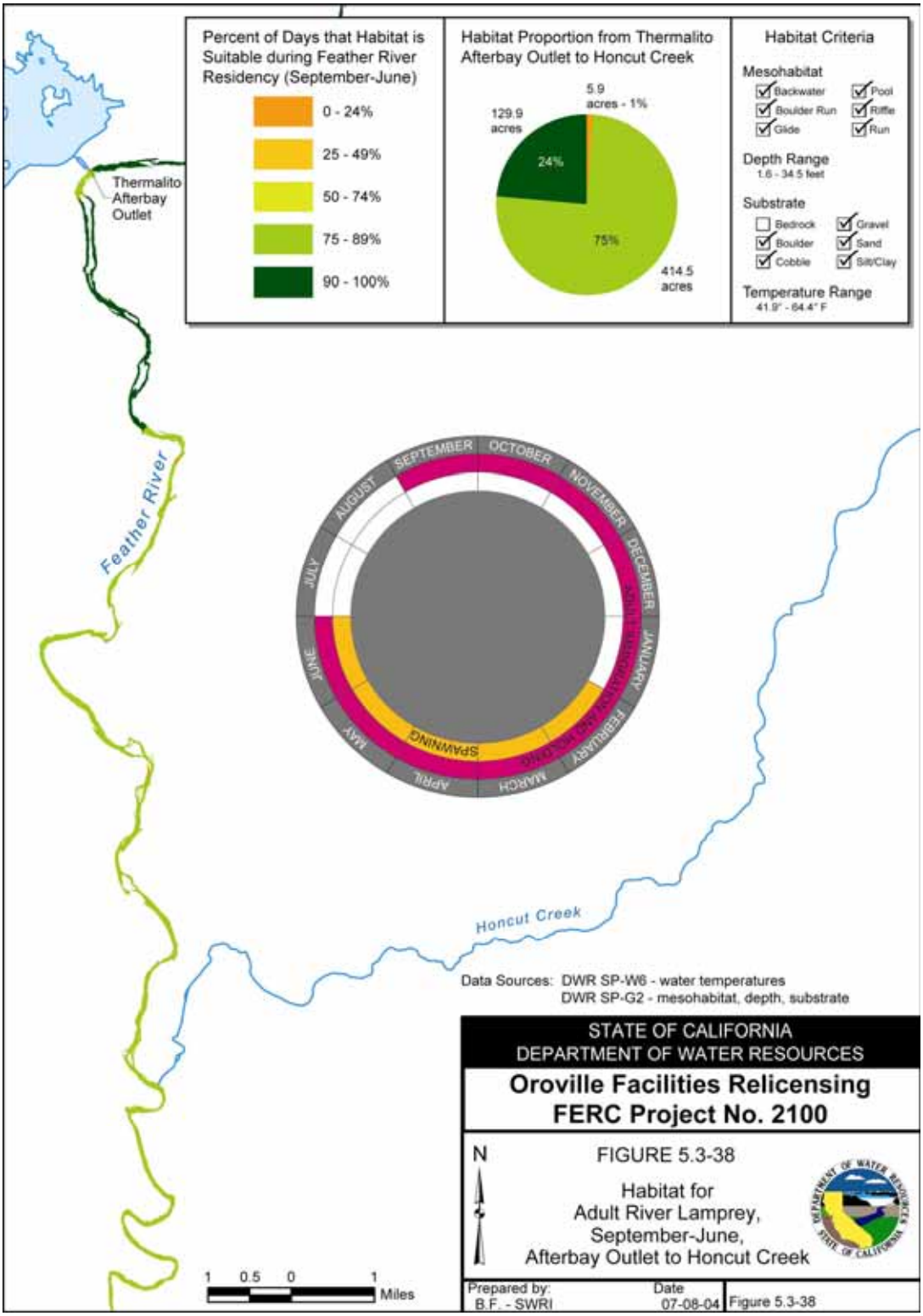

Figure 5.3-38. River lamprey habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

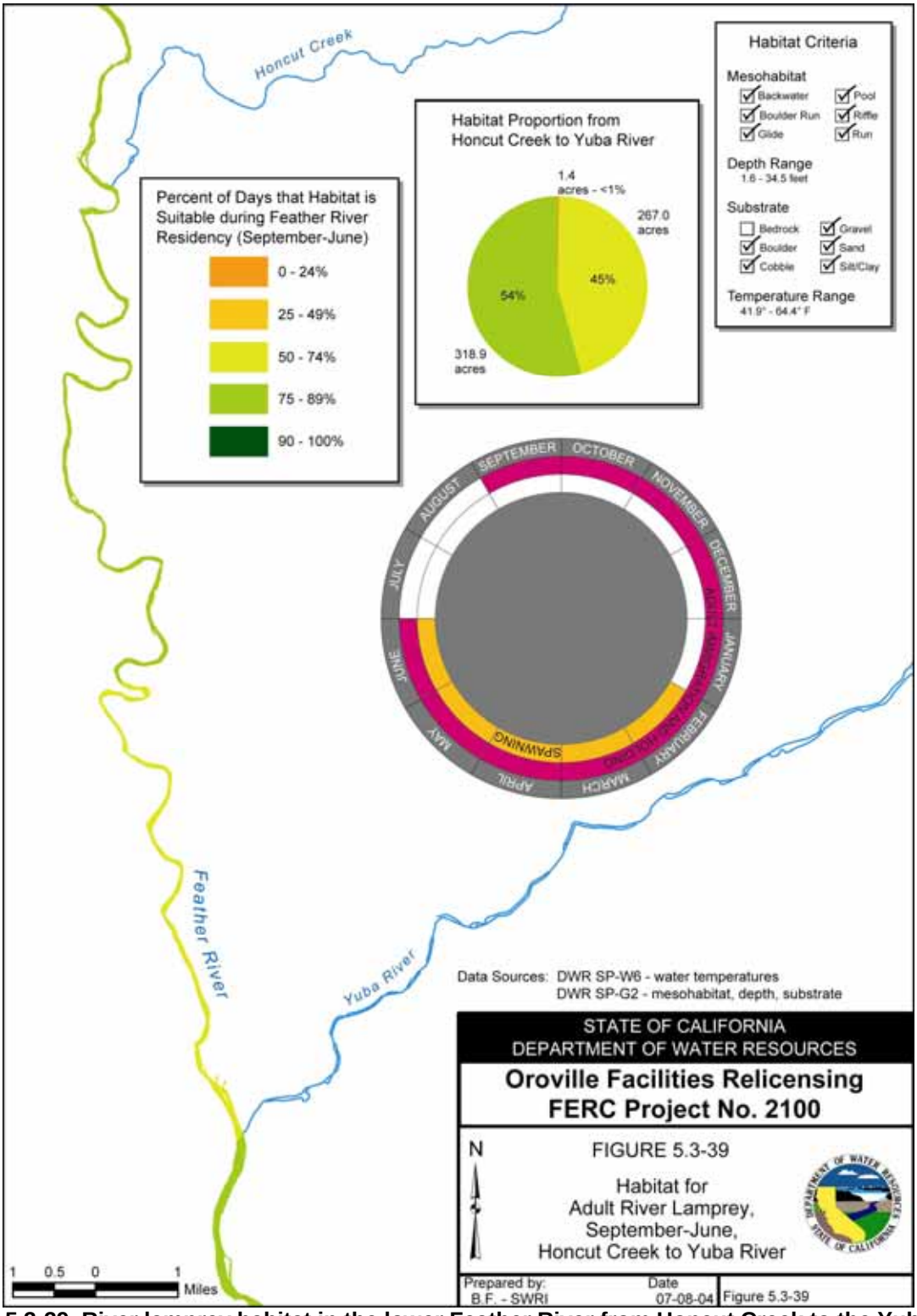

Figure 5.3-39. River lamprey habitat in the lower Feather River from Honcut Creek to the Yuba River.

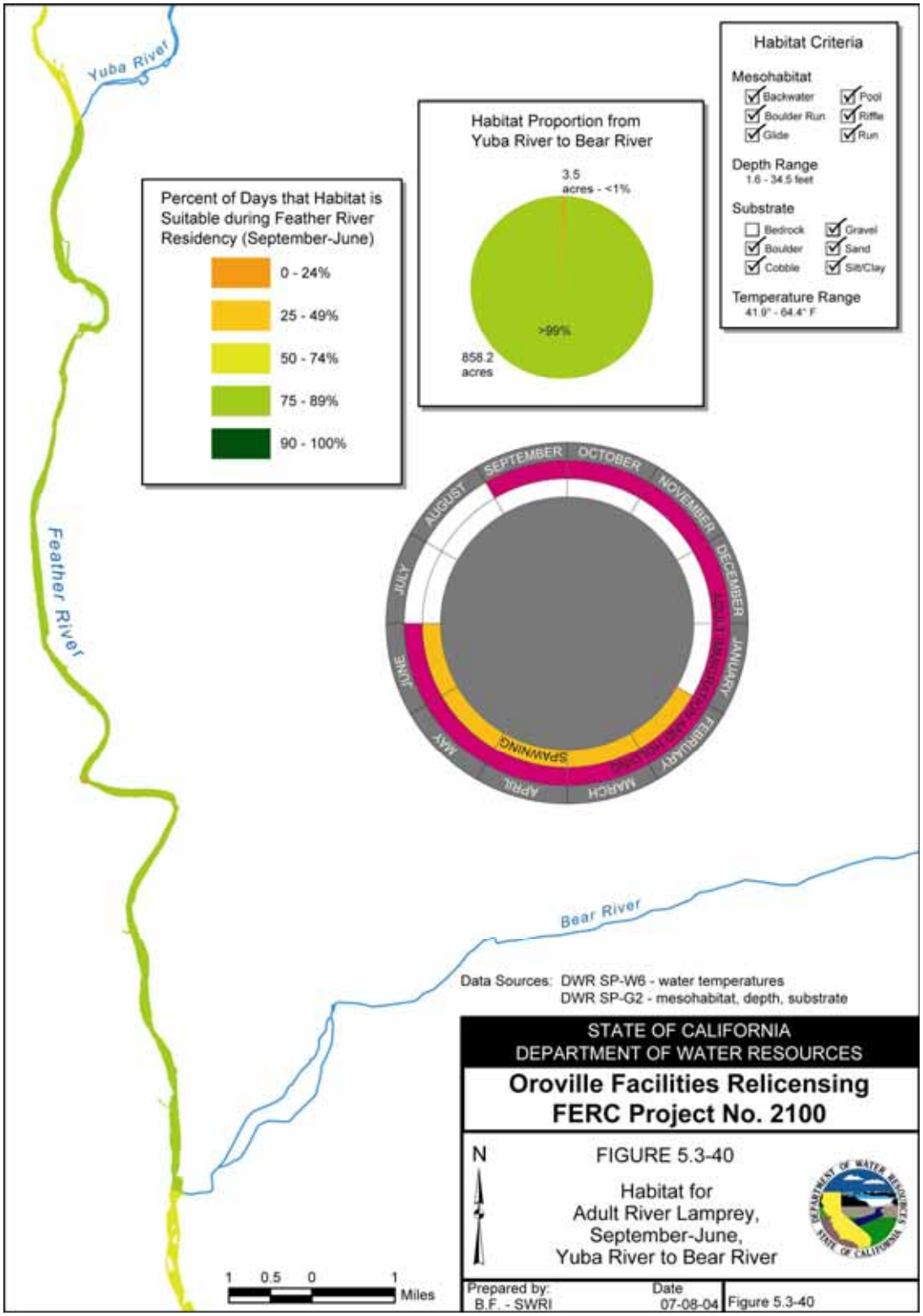

Figure 5.3-40. River lamprey habitat in the lower Feather River from the Yuba River to Bear River.

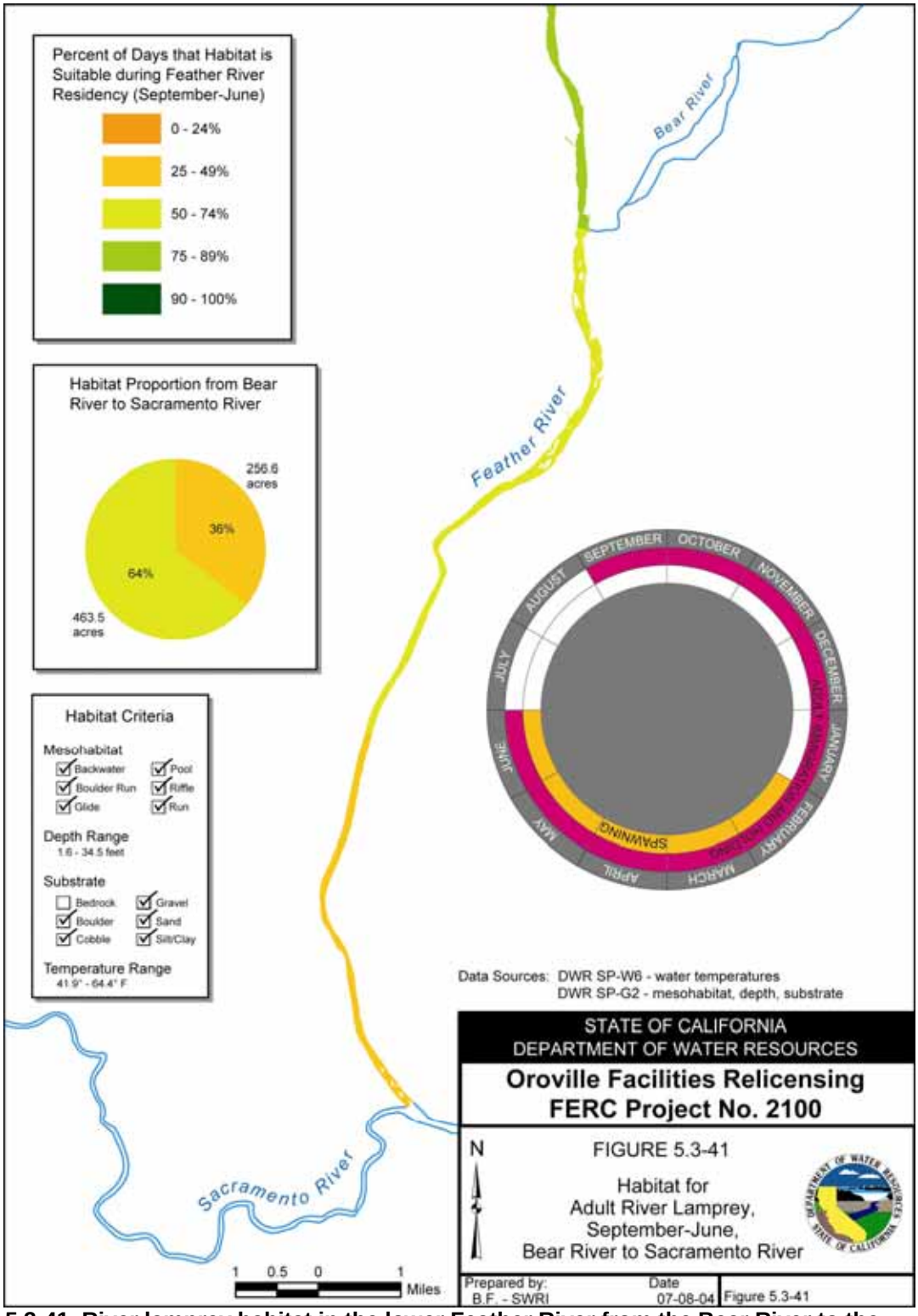

Figure 5.3-41. River lamprey habitat in the lower Feather River from the Bear River to the Sacramento River.

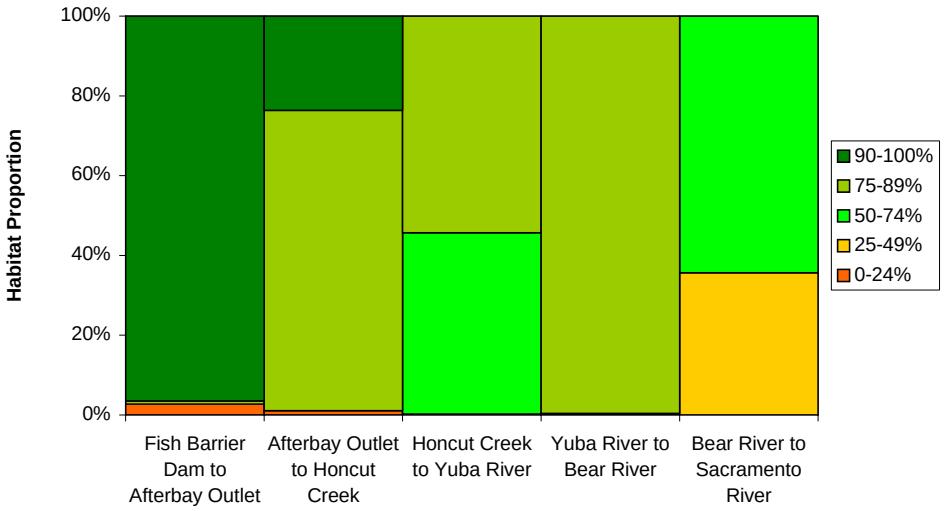

Figure 5.3-42. Proportion of River Lamprey habitat in the lower Feather River by reach.

5.3.1.8 Sacramento Splittail

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 193 acres (i.e., 70 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento splittail, and 82 acres (i.e., 30 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-43).

Between the Thermalito Afterbay Outlet and Honcut Creek, 381 acres (i.e., 69 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento splittail, and 170 acres (i.e., 31 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-44).

Between Honcut Creek and the Yuba River, 30 acres (i.e., 5 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento splittail, and 557 acres (i.e., 95 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-45).

Between the Yuba River and the Bear River, 28 acres (i.e., 3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento splittail, and 834 acres (i.e., 97 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-46).

Between the Bear River and the Feather River confluence with the Sacramento River, 257 acres (i.e., 36 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento splittail, and 464 acres (i.e., 64 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-47).

The proportion of total available habitat that fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) for Sacramento splittail generally increased with distance downstream from the Fish Barrier Dam. Specifically, the number of acres of habitat that fell into the 90 percent to 100 percent proportion of relative habitat suitability class was highest between the mouth of Honcut Creek and the mouth of the Bear River. Figure 5.3-48 shows the proportion of habitat and proportion of relative habitat suitability classes for Sacramento splittail by reach.

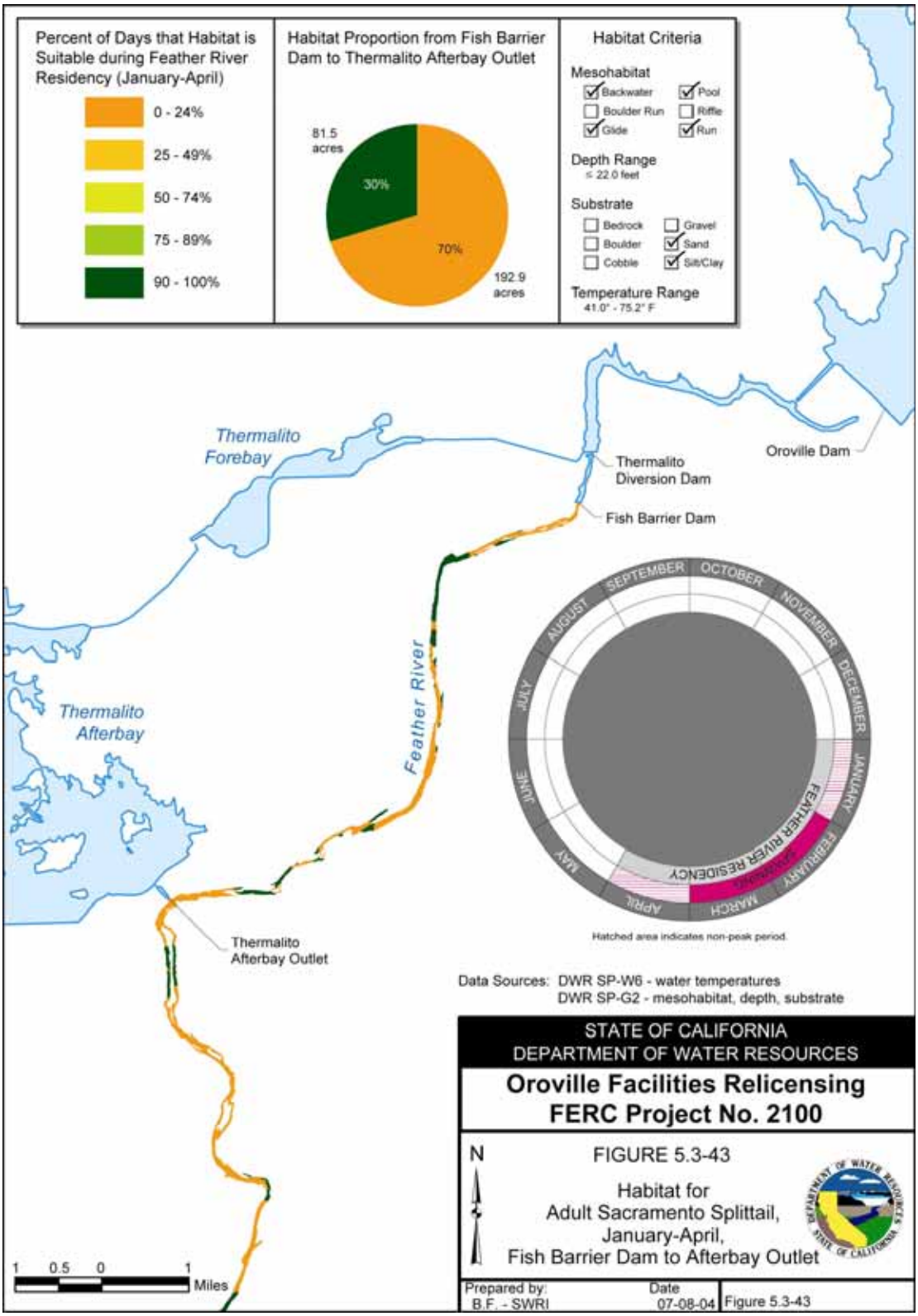

Figure 5.3-43. Sacramento Splittail habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

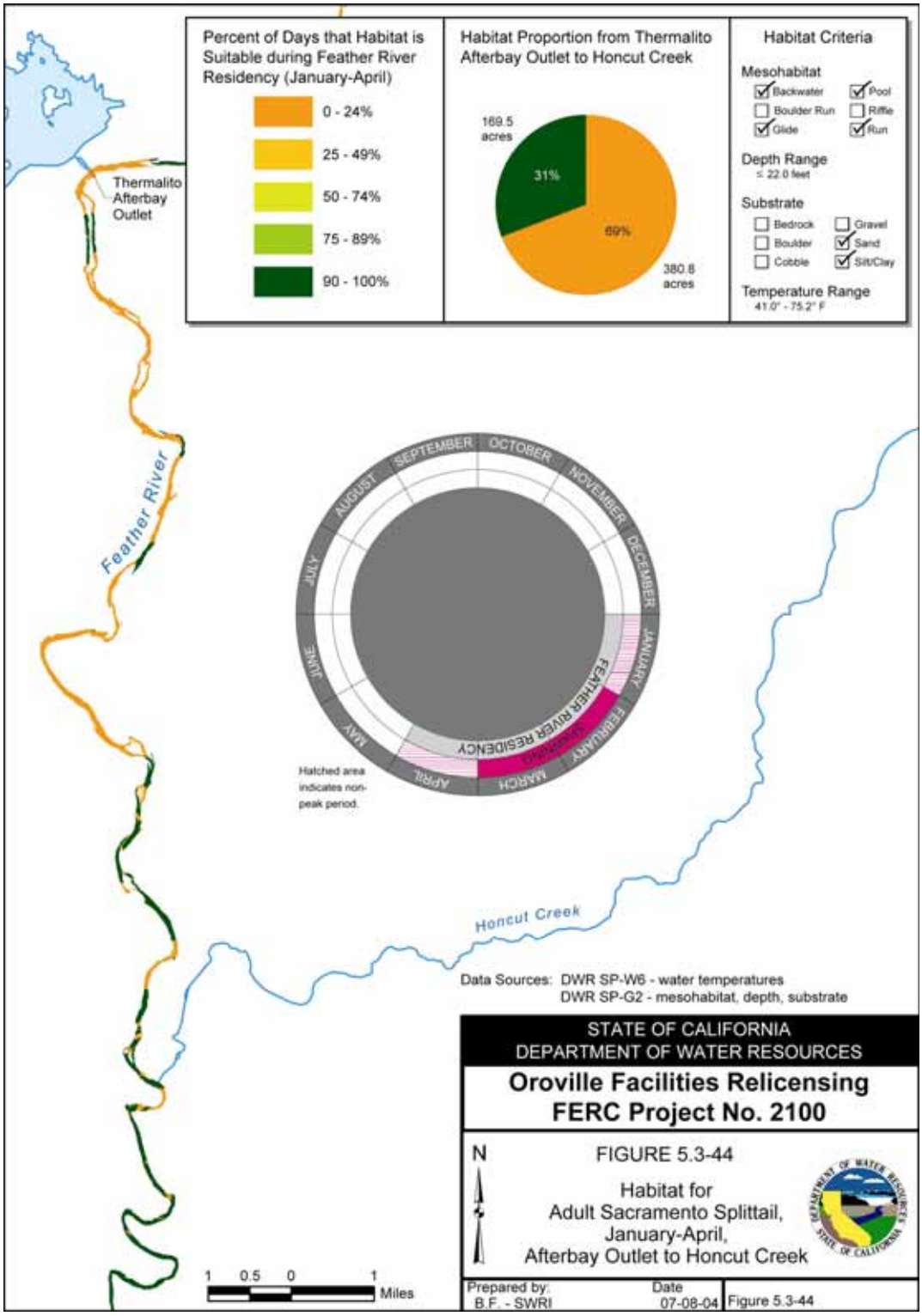

Figure 5.3-44. Sacramento Splittail habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

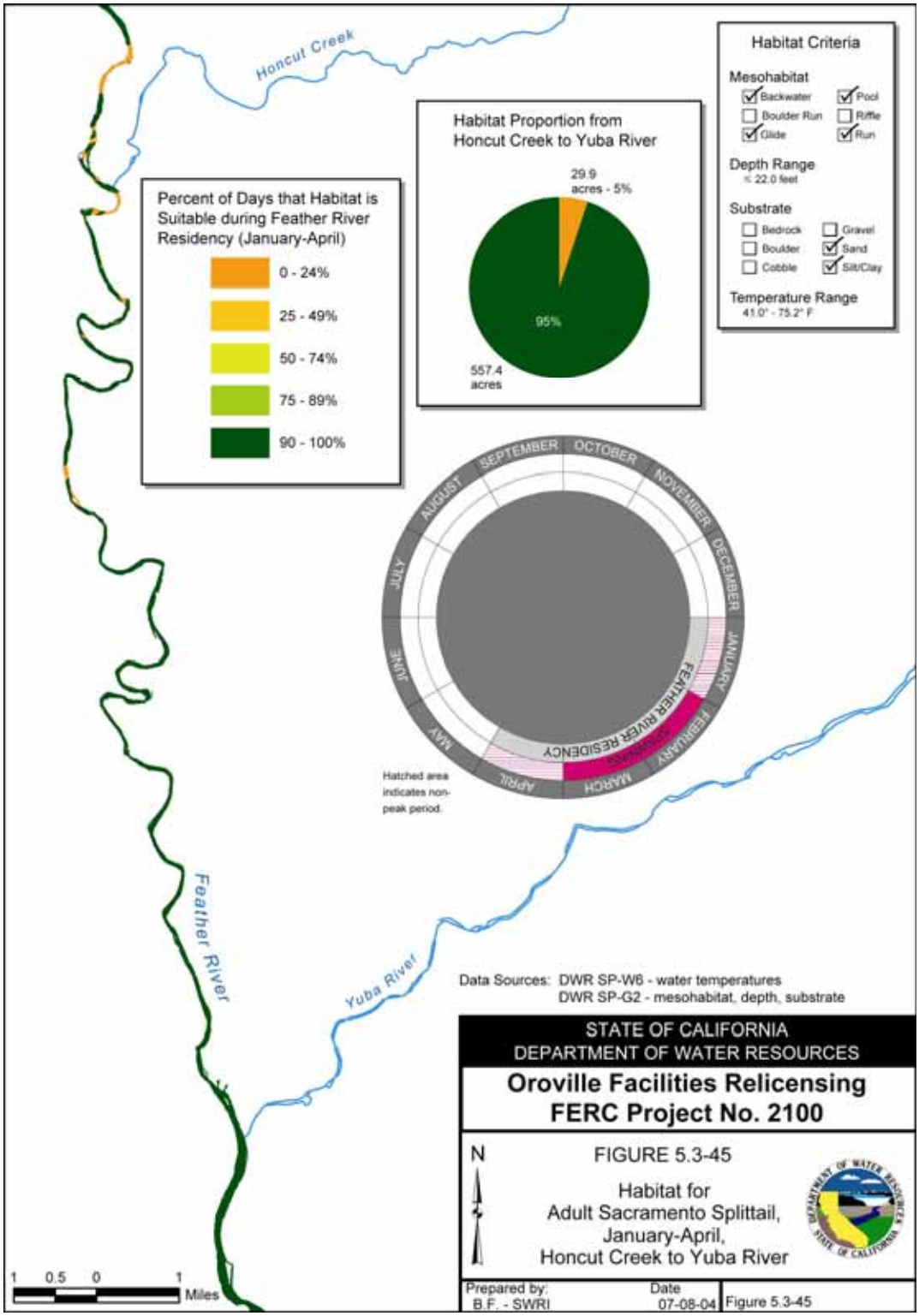

Figure 5.3-45. Sacramento Splittail habitat in the lower Feather River from Honcut Creek to the Yuba River.

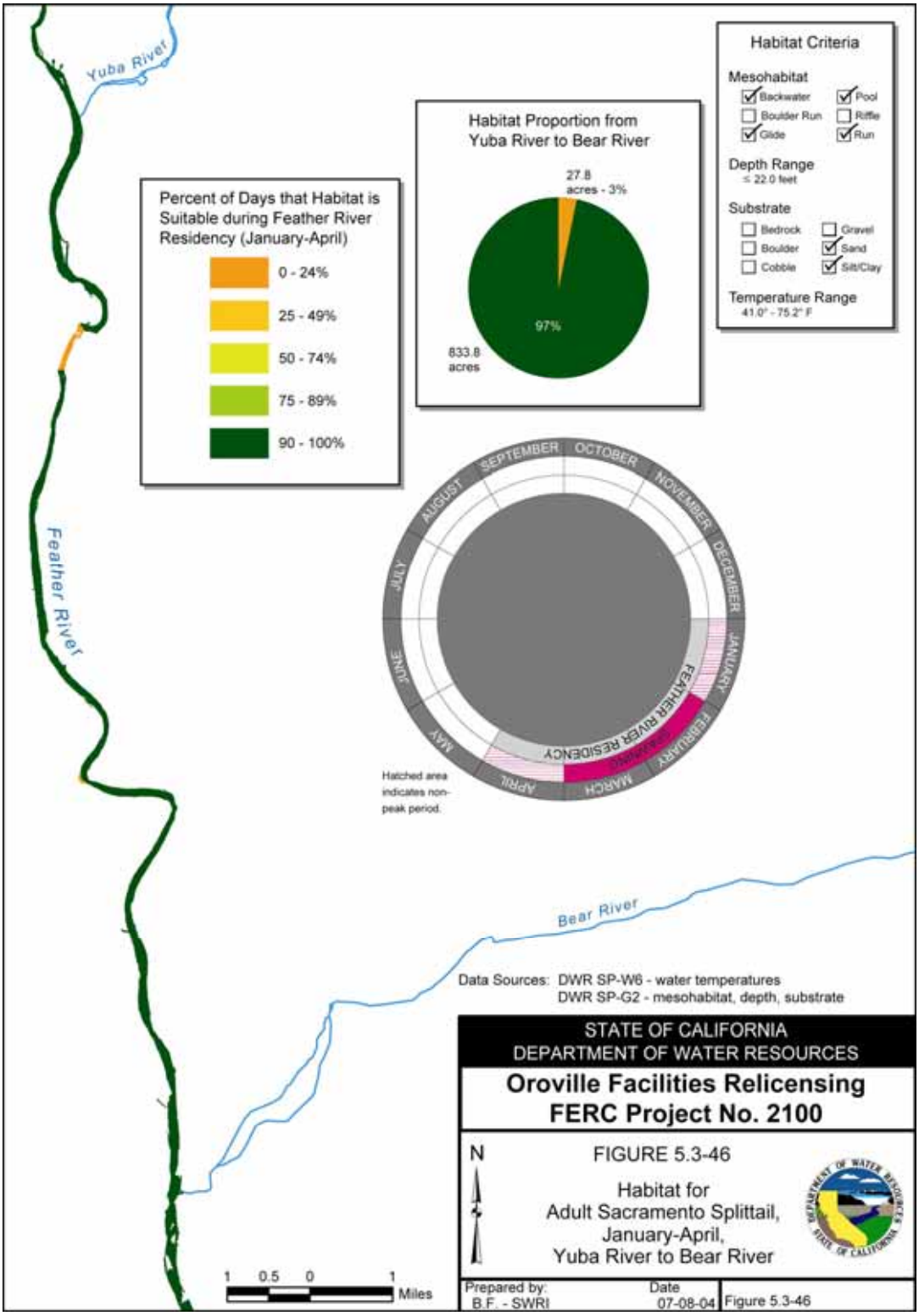

Figure 5.3-46. Sacramento Splittail habitat in the lower Feather River from the Yuba River to Bear River.

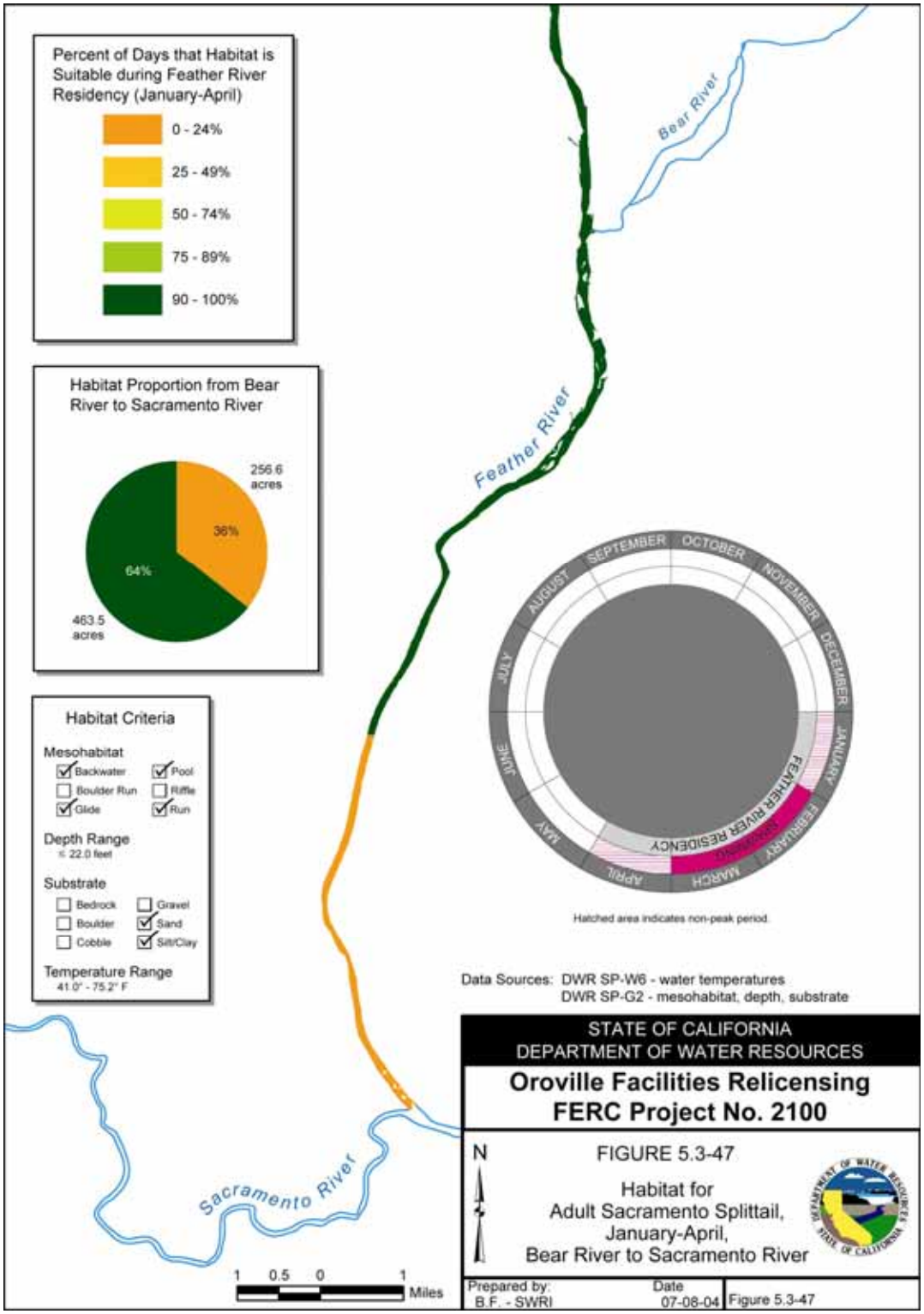

Figure 5.3-47. Sacramento Splittail habitat in the lower Feather River from the Bear River to the Sacramento River.

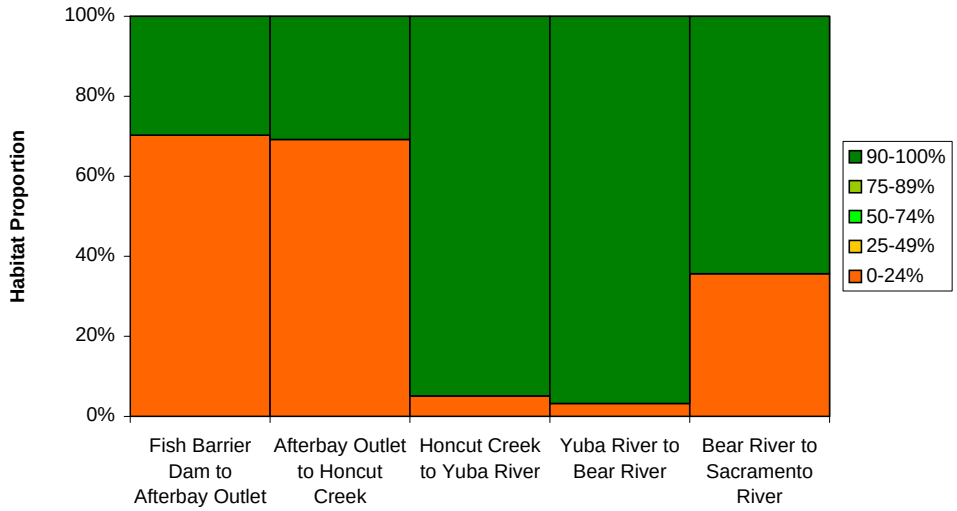

Figure 5.3-48. Proportion of Sacramento Splittail habitat in the lower Feather River by reach.

5.3.1.9 Sacramento Sucker

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 29 acres (i.e., 10 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento Sucker, and 246 acres (i.e., 90 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-49).

Between the Thermalito Afterbay Outlet and Honcut Creek, 22 acres (i.e., 4 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento Sucker, and 528 acres (i.e., 96 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-50).

Between Honcut Creek and the Yuba River, 26 acres (i.e., 4 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento Sucker, and 562 acres (i.e., 96 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-51).

Between the Yuba River and the Bear River, 4 acres (i.e., 0.4 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento Sucker, and 858 acres (i.e., 99 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-52).

Between the Bear River and the Feather River confluence with the Sacramento River, 12 acres (i.e., 2 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for Sacramento Sucker, and 708 acres (i.e., 98.3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-53).

The proportion of total available habitat that fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) for Sacramento sucker generally increased with distance downstream from the Fish Barrier Dam. However, the number of acres of habitat that fell into the 90 percent to 100 percent proportion of relative habitat suitability class was high throughout the lower Feather River. Figure 5.3-54 shows the proportion of habitat and proportion of relative habitat suitability classes for Sacramento splittail by reach.

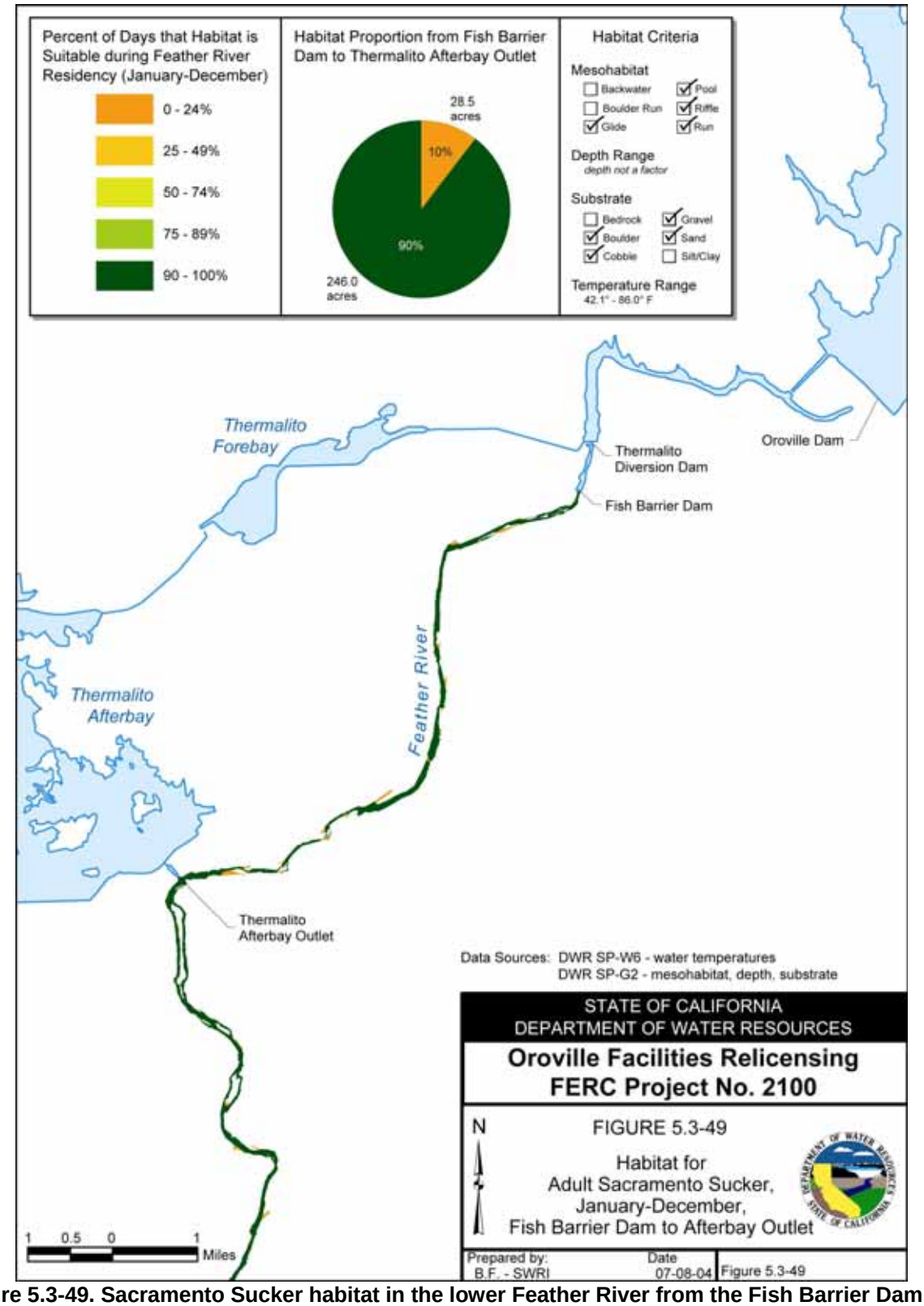

Figure 5.3-49. Sacramento Sucker habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

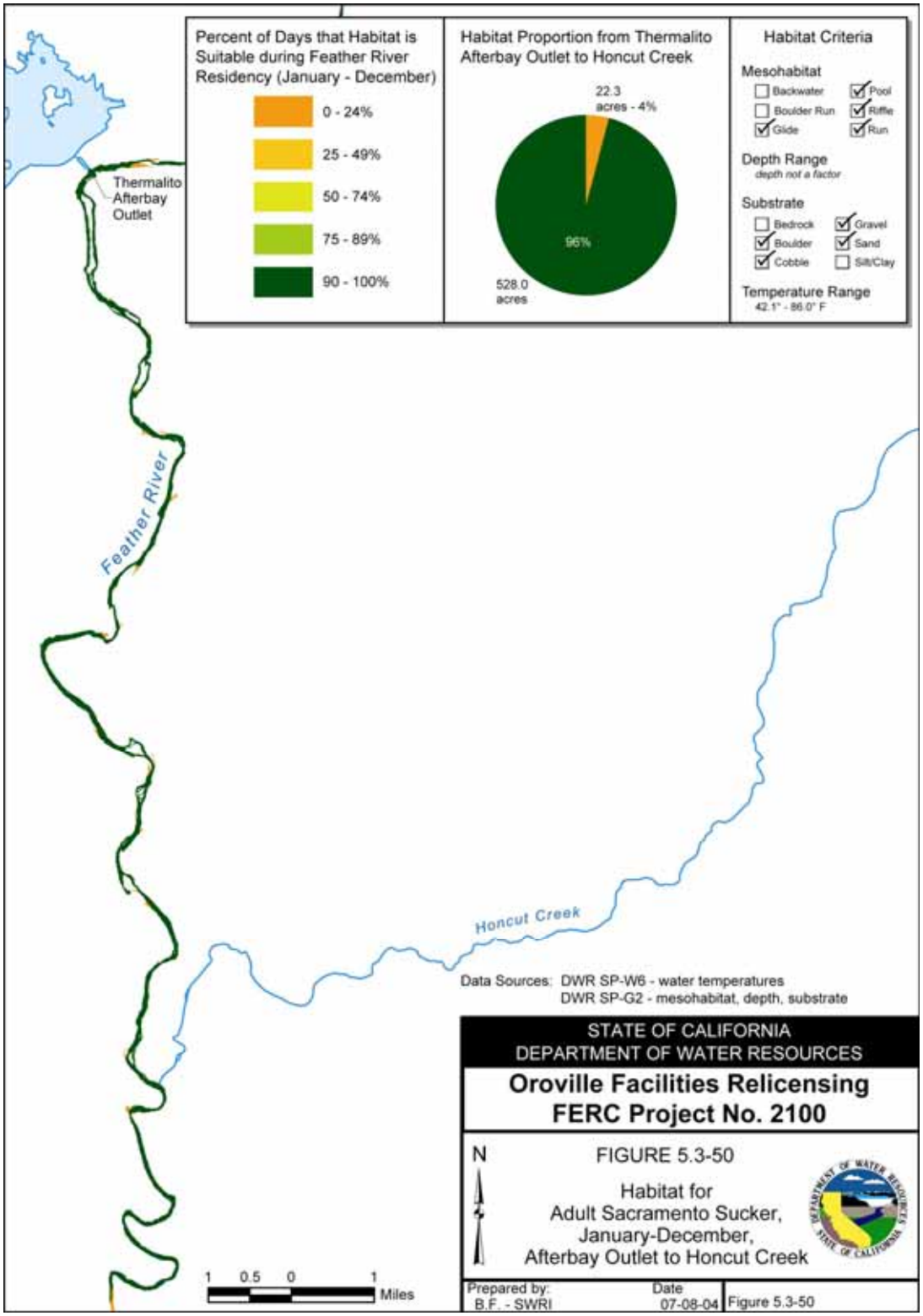

Figure 5.3-50. Sacramento Sucker habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

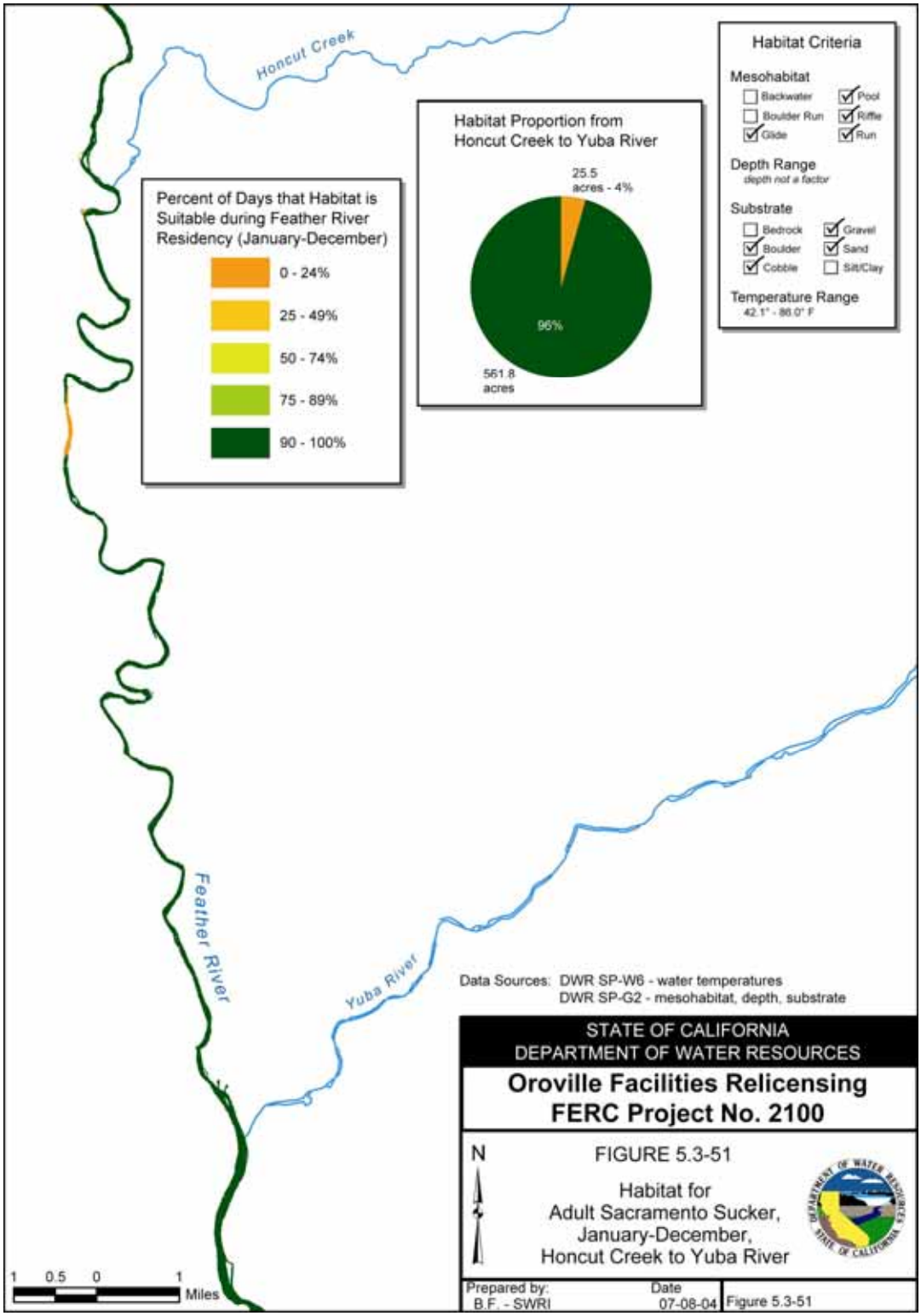

Figure 5.3-51. Sacramento Sucker habitat in the lower Feather River from Honcut Creek to the Yuba River.

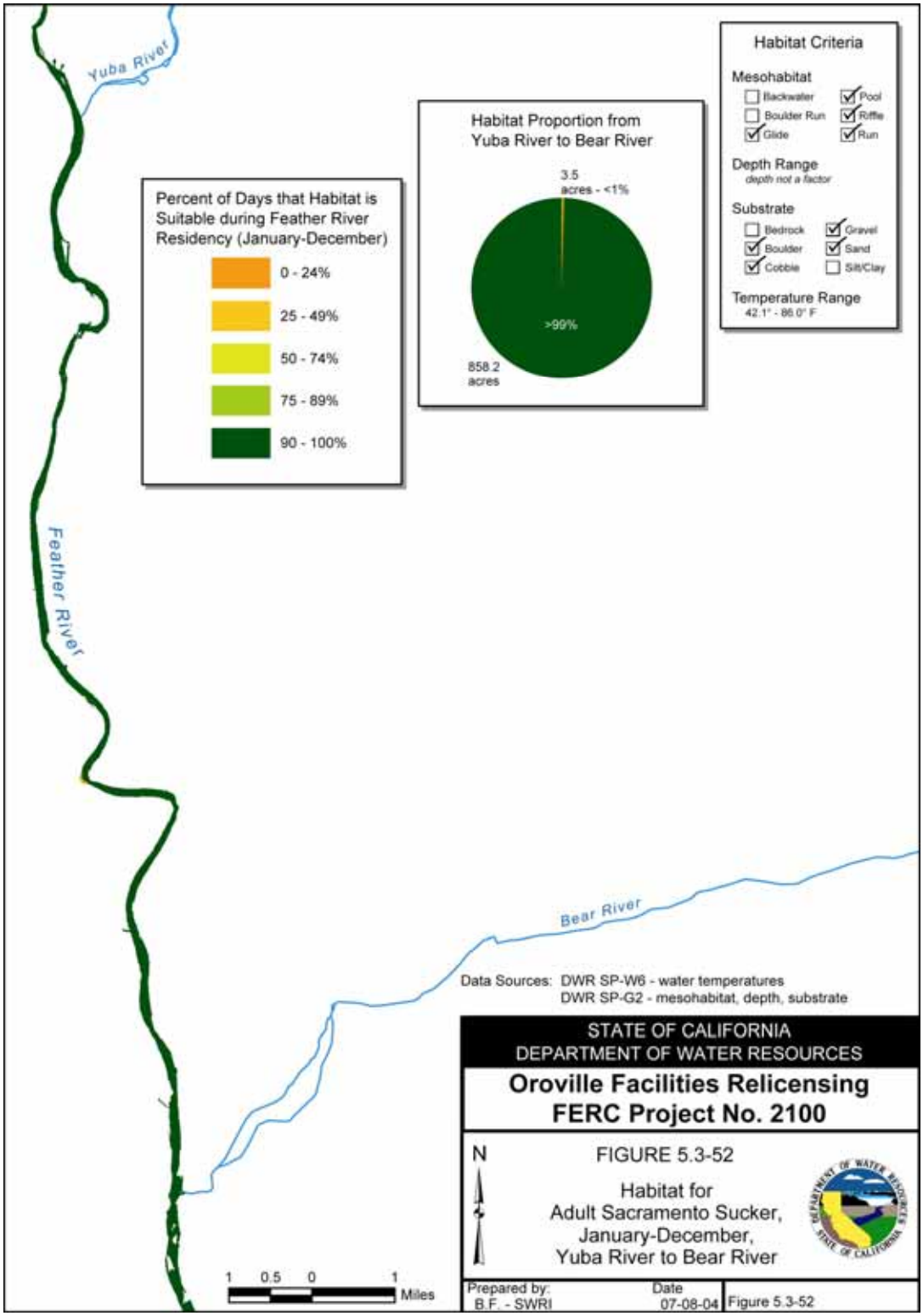

Figure 5.3-52. Sacramento Sucker habitat in the lower Feather River from the Yuba River to Bear River.

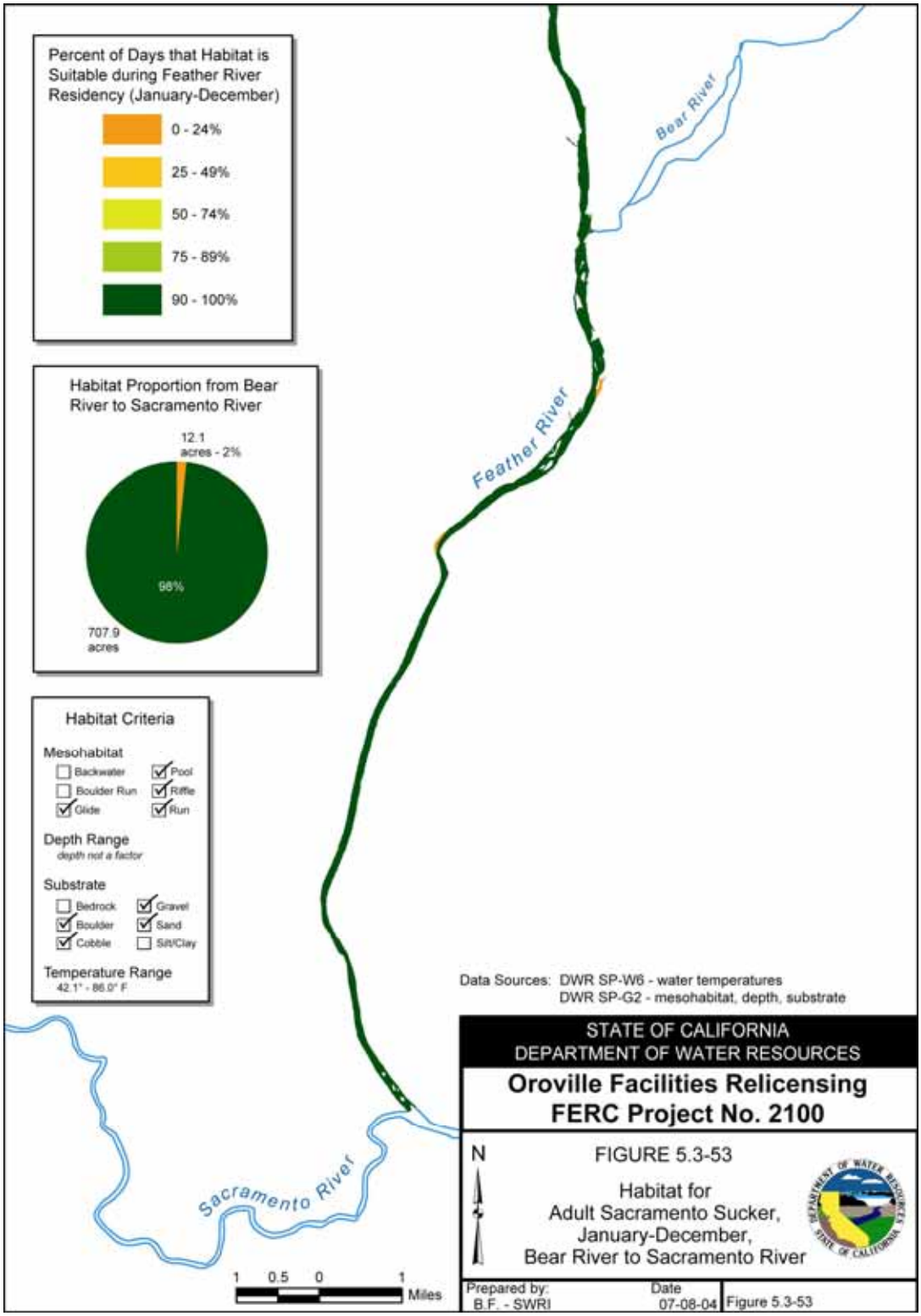

Figure 5.3-53. Sacramento Sucker habitat in the lower Feather River from the Bear River to the Sacramento River.

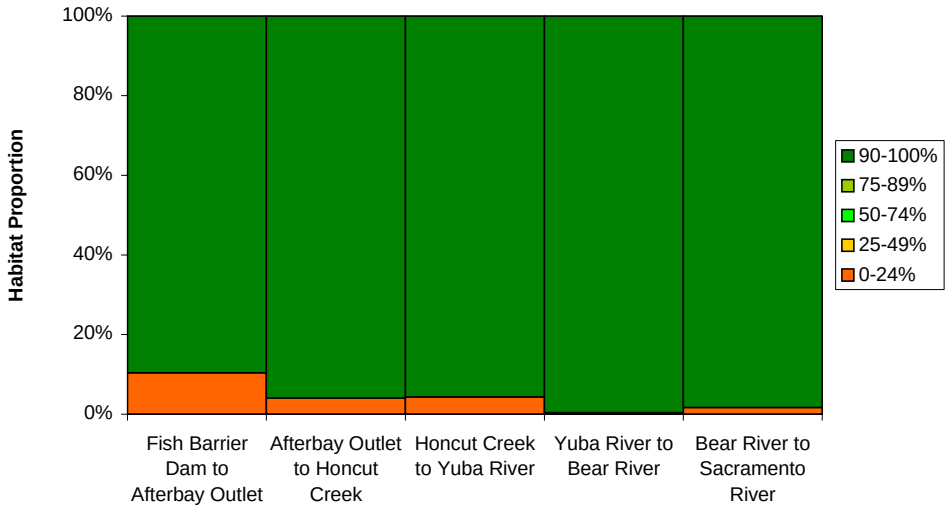

Figure 5.3-54. Proportion of Sacramento Sucker habitat in the lower Feather River by reach.

5.3.1.10 Striped Bass

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 213 acres (i.e., 78 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for striped bass, and 62 acres (i.e., 23 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-55).

Between the Thermalito Afterbay Outlet and Honcut Creek, 534 acres (i.e., 97 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class)for striped bass, and 16 acres (i.e., 3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-56).

Between Honcut Creek and the Yuba River, 564 acres (i.e., 96 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for striped bass, and 24 acres (i.e., 4 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-57).

Between the Yuba River and the Bear River, 846 acres (i.e., 98 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for striped bass, and 15 acres (i.e., 2 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-58).

Between the Bear River and the Feather River confluence with the Sacramento River, 714 acres (i.e., 99 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for striped bass, and 6 acres (i.e., 1 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-59).

The proportion of total available habitat that fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) for striped bass generally decreased with distance downstream from the Fish Barrier Dam. However, the number of acres of habitat that fell into the 90 percent to 100 percent proportion of relative habitat suitability class was low throughout the lower Feather River. The majority of available habitat in the lower Feather River fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class). Figure 5.3-60 shows the proportion of habitat and proportion of relative habitat suitability classes for Sacramento splittail by reach.

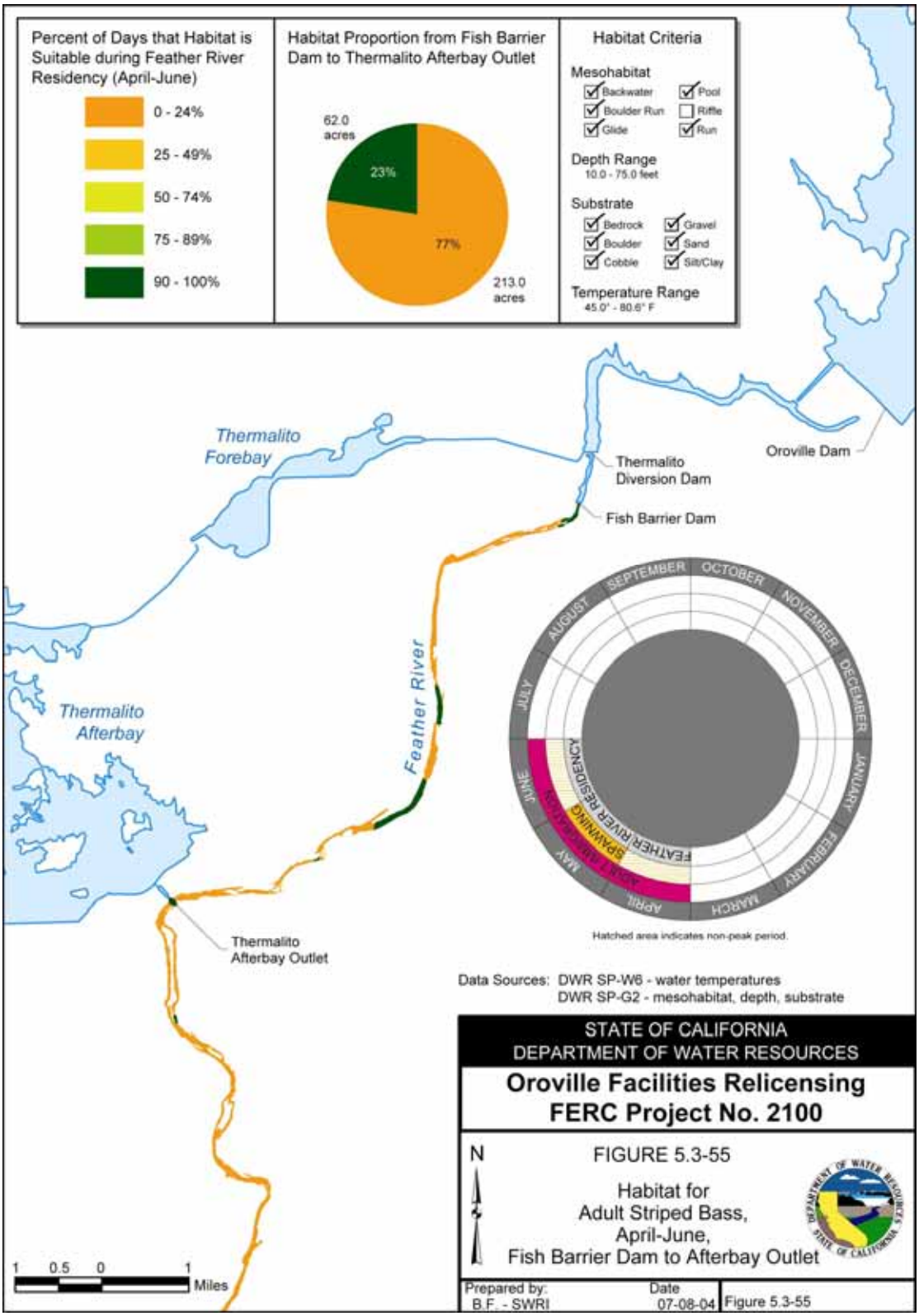

Figure 5.3-55. Striped Bass habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

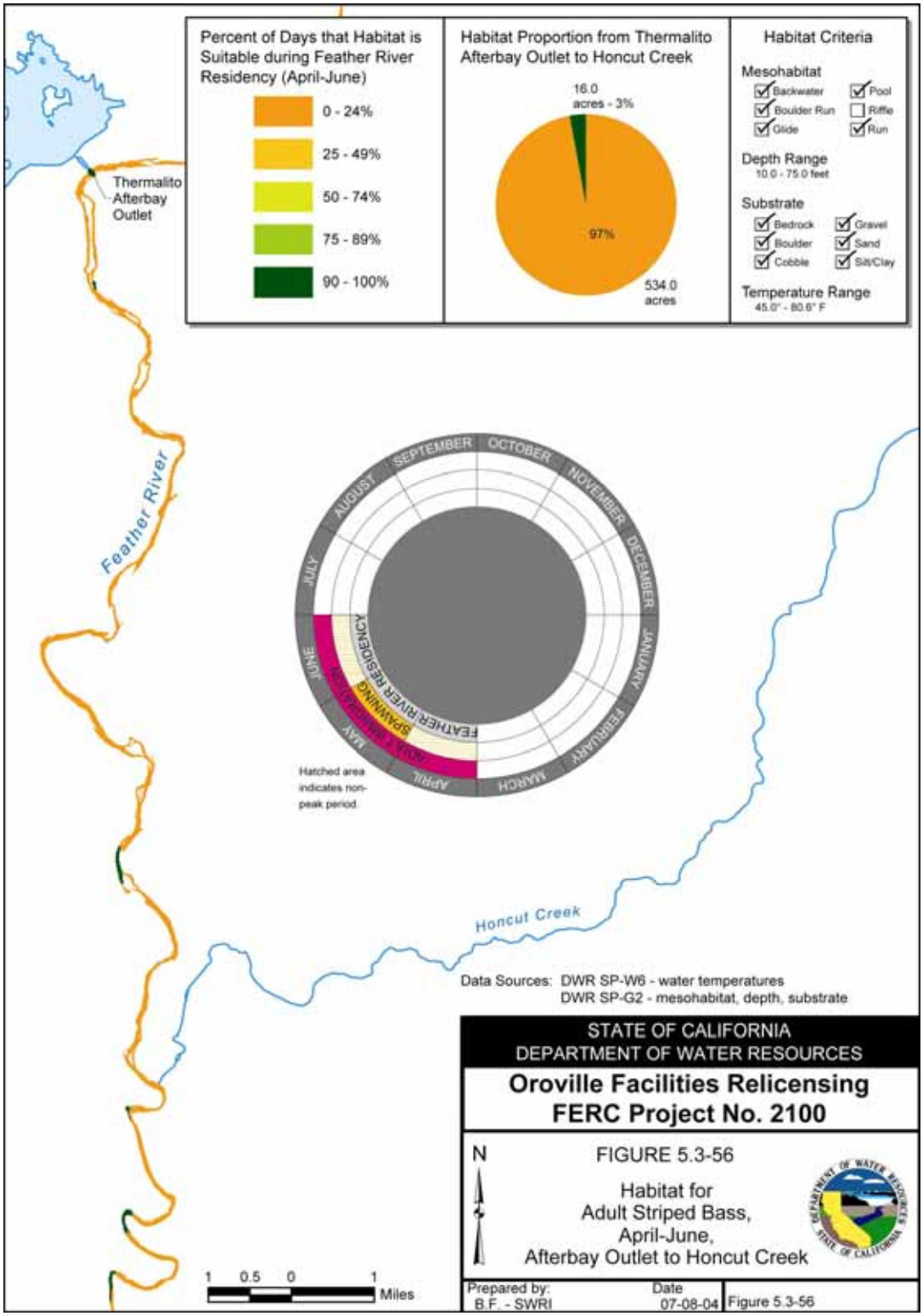

Figure 5.3-56. Striped Bass habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

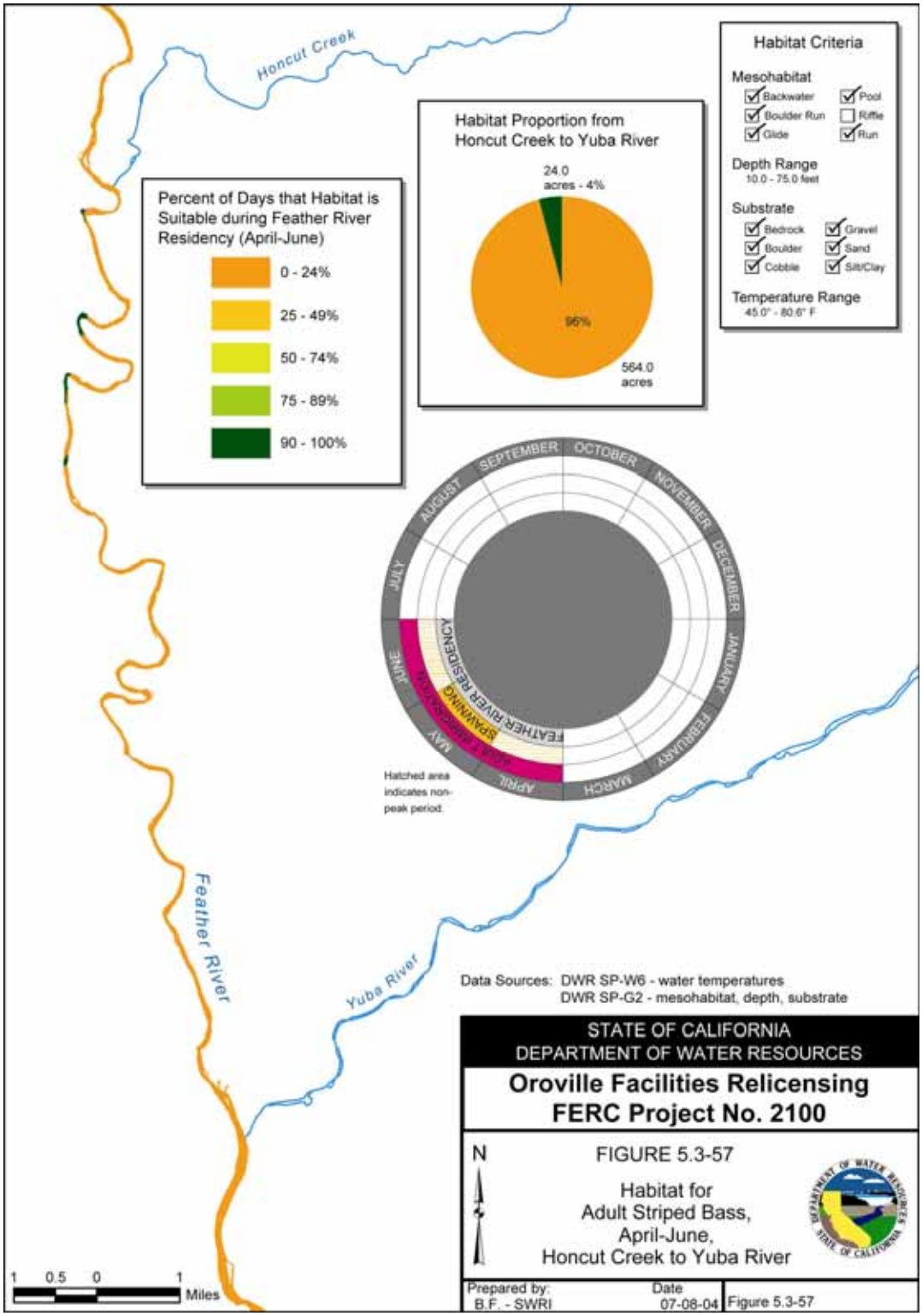

Figure 5.3-57. Striped Bass habitat in the lower Feather River from Honcut Creek to the Yuba River.

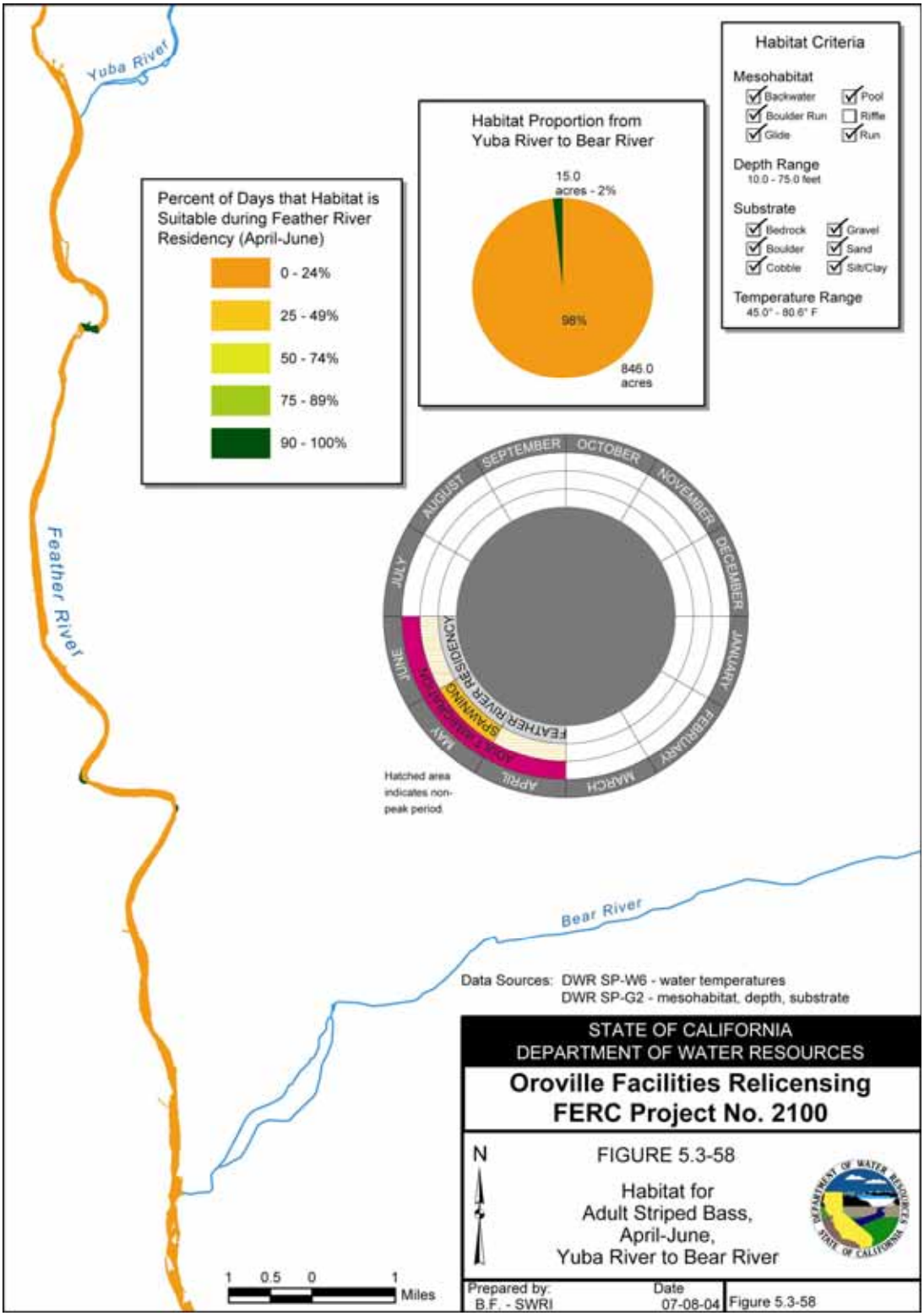

Figure 5.3-58. Striped Bass habitat in the lower Feather River from the Yuba River to Bear River.

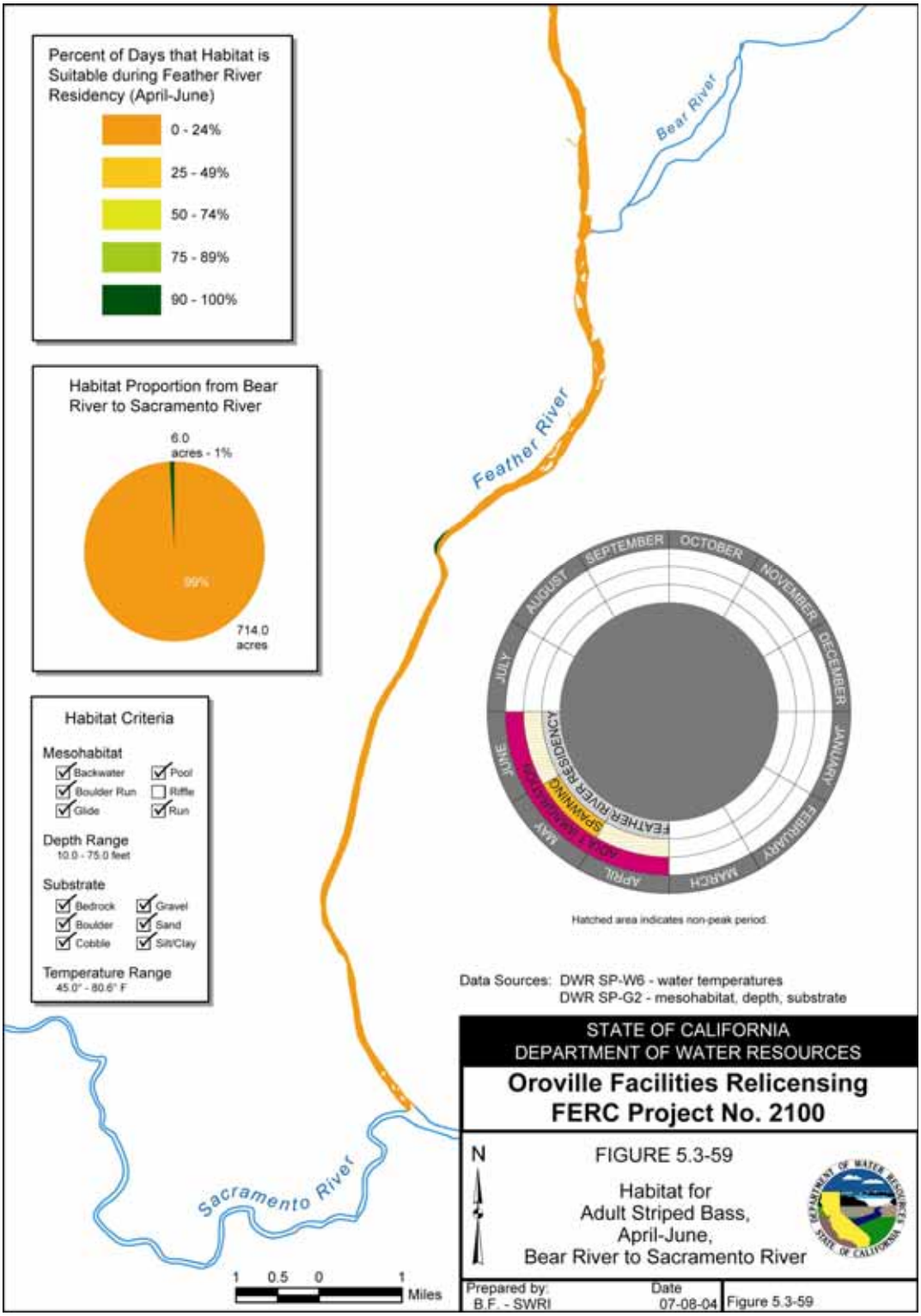

Figure 5.3-59. Striped Bass habitat in the lower Feather River from the Bear River to the Sacramento River.

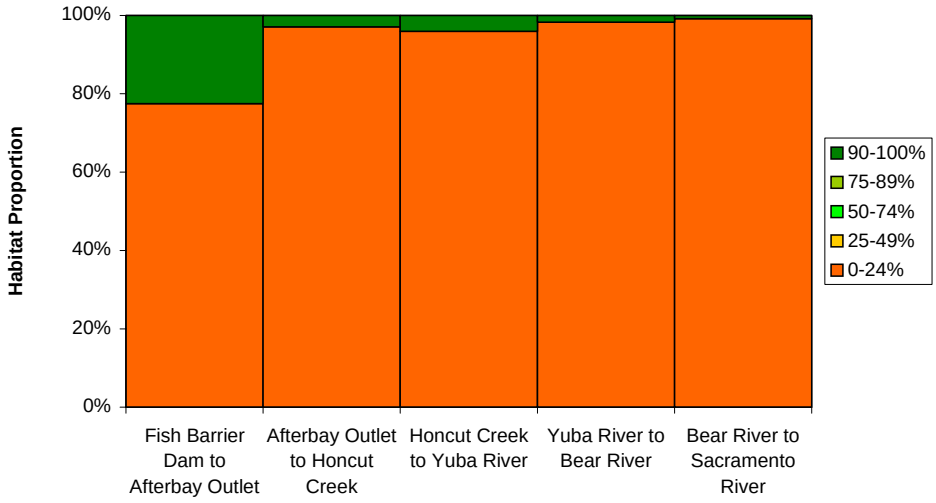

Figure 5.3-60. Proportion of striped bass habitat in the lower Feather River by reach.

5.3.1.11 Tule Perch

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 50 acres (i.e., 18 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for tule perch, and 224 acres (i.e., 82 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-61)

Between the Thermalito Afterbay Outlet and Honcut Creek, 186 acres (i.e., 34 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for tule perch, and 364 acres (i.e., 66 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-62)

Between Honcut Creek and the Yuba River, 20 acres (i.e., 3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for tule perch, and 567 acres (i.e., 97 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-63).

Between the Yuba River and the Bear River, 24 acres (i.e., 3 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for tule perch, and 837 acres (i.e., 97 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-64).

Between the Bear River and the confluence with the Sacramento River 720 acres (i.e., 100 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-65).

The proportion of total available habitat that fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) for tule perch generally increased with distance downstream from the Fish Barrier Dam. However, the number of acres of habitat that fell into the 90 percent to 100 percent proportion of relative habitat suitability class was high throughout the lower Feather River. Between the Thermalito Afterbay Outlet and Honcut creek contained the highest proportion of total available habitat that fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class). Figure 5.3.66 shows the proportion of habitat and proportion of relative habitat suitability classes for Sacramento splittail by reach.

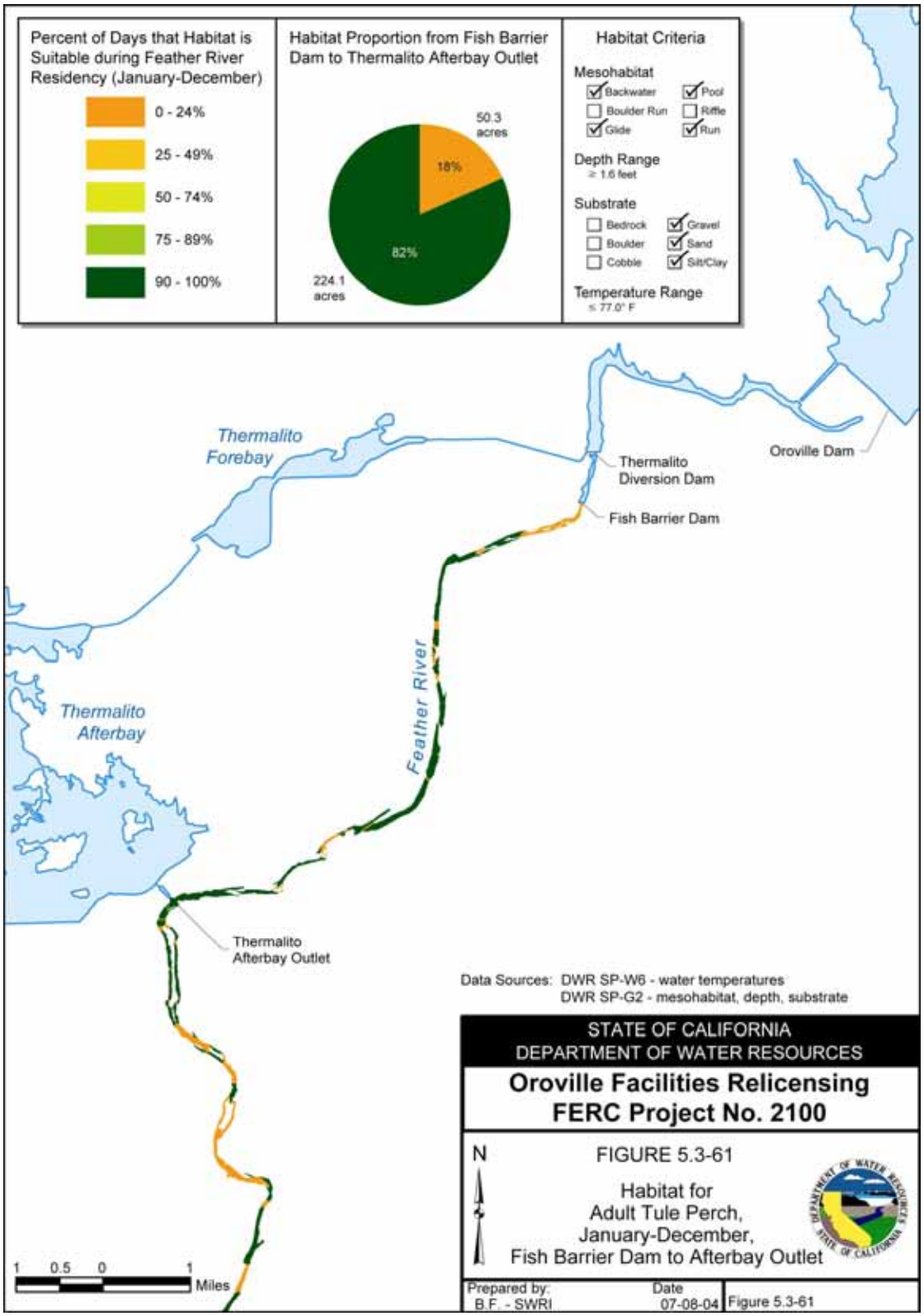

Figure 5.3-61. Tule Perch habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

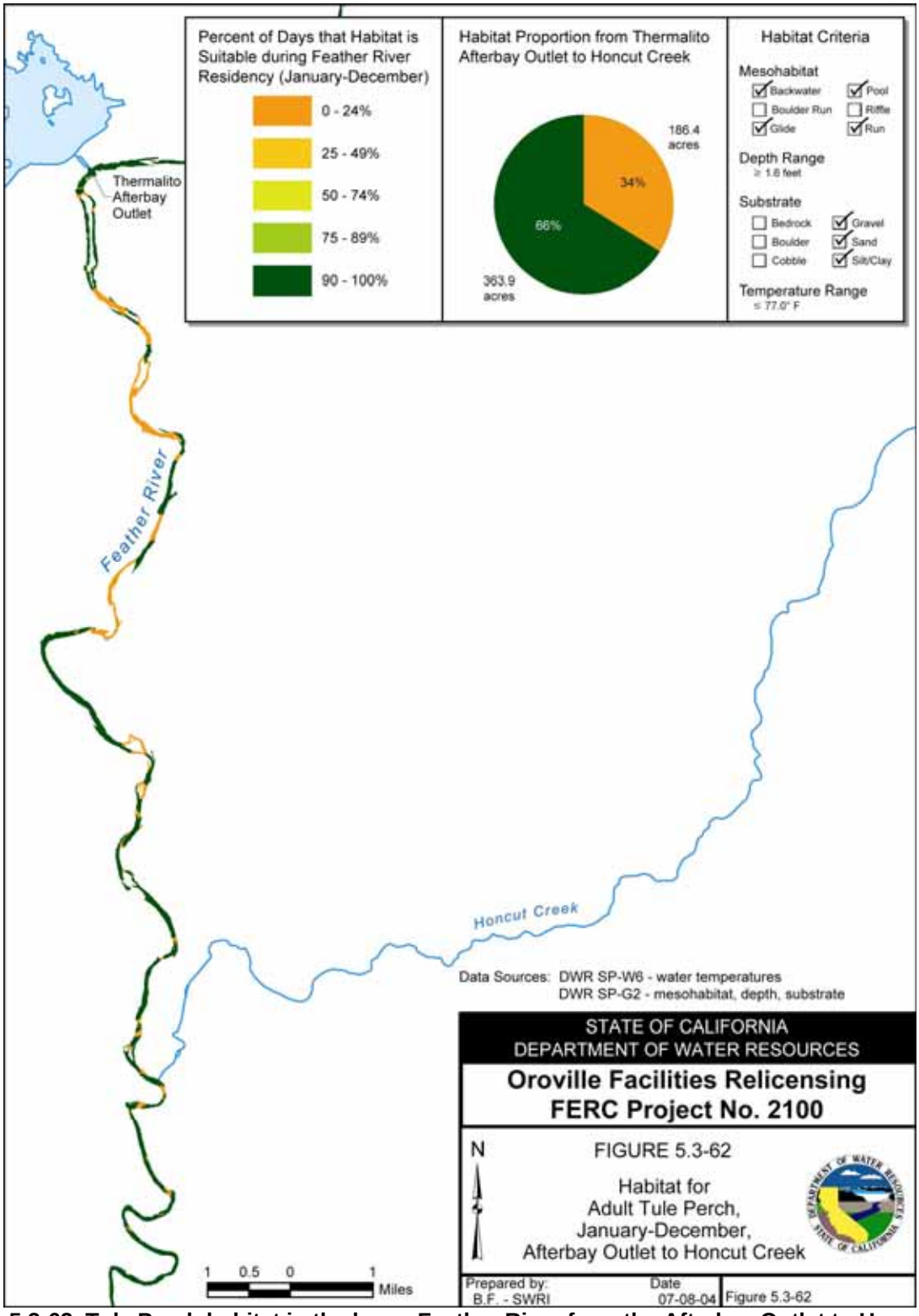

Figure 5.3-62. Tule Perch habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

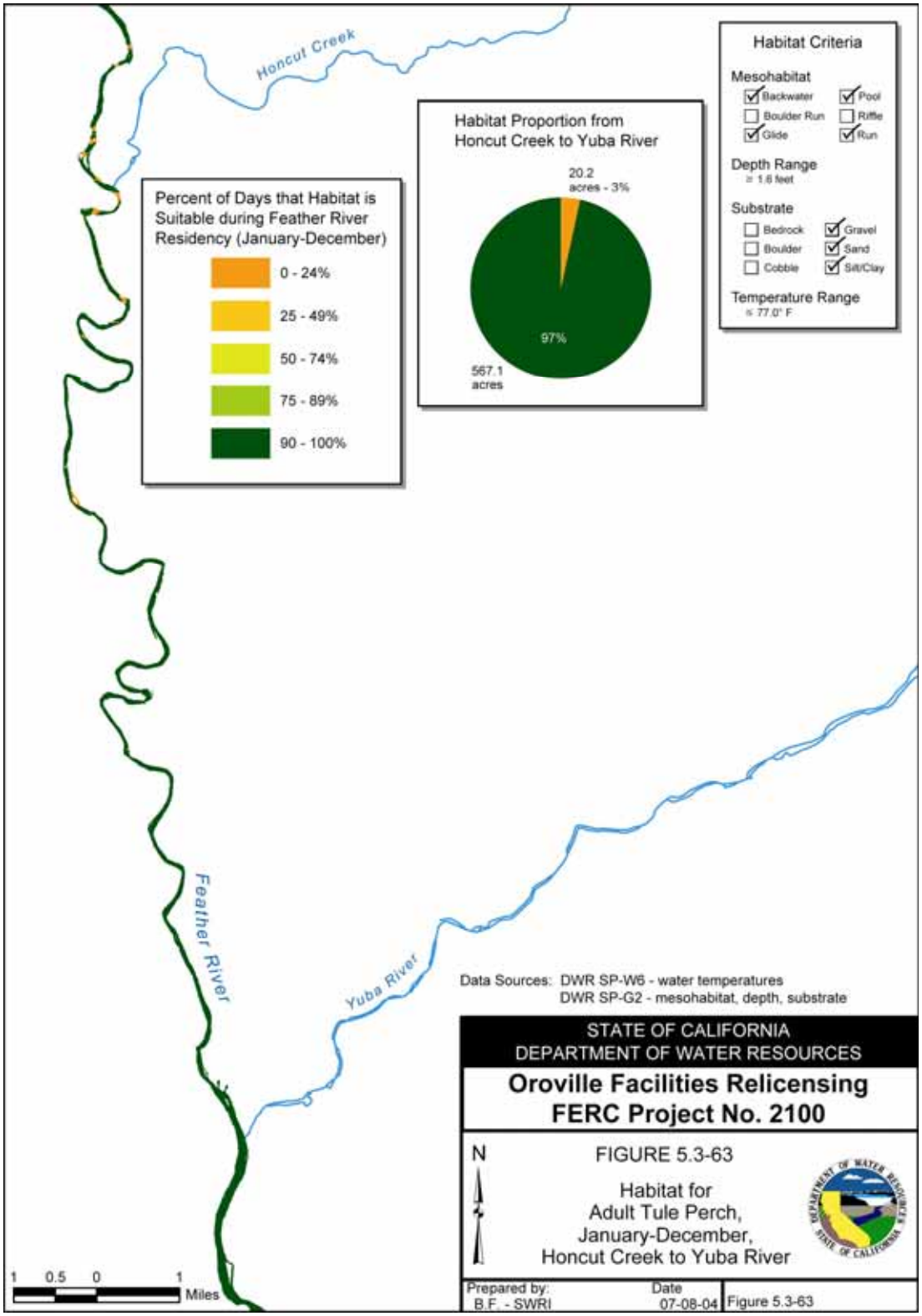

Figure 5.3-63. Tule Perch habitat in the lower Feather River from Honcut Creek to the Yuba River.

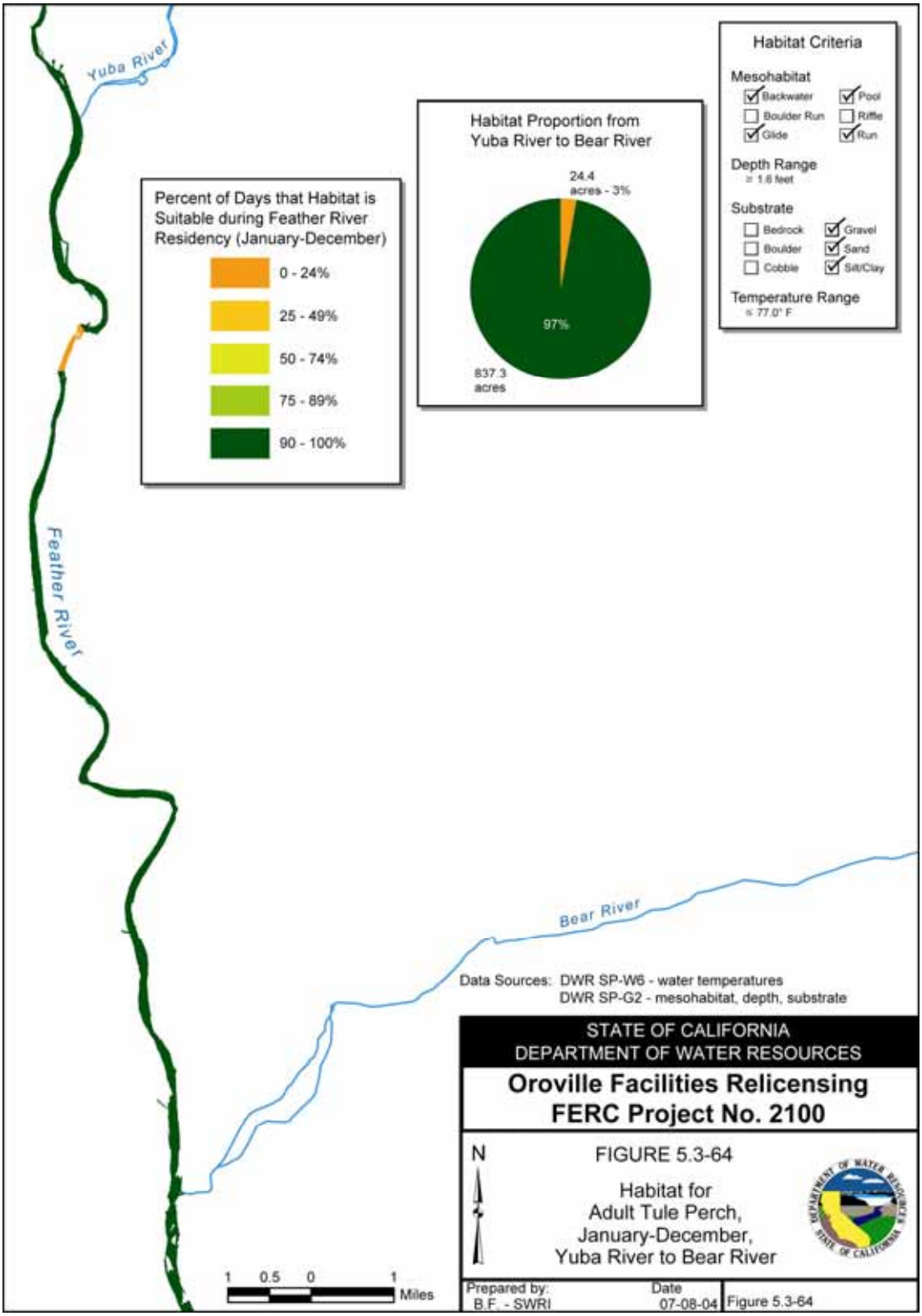

Figure 5.3-64. Tule Perch habitat in the lower Feather River from the Yuba River to Bear River.

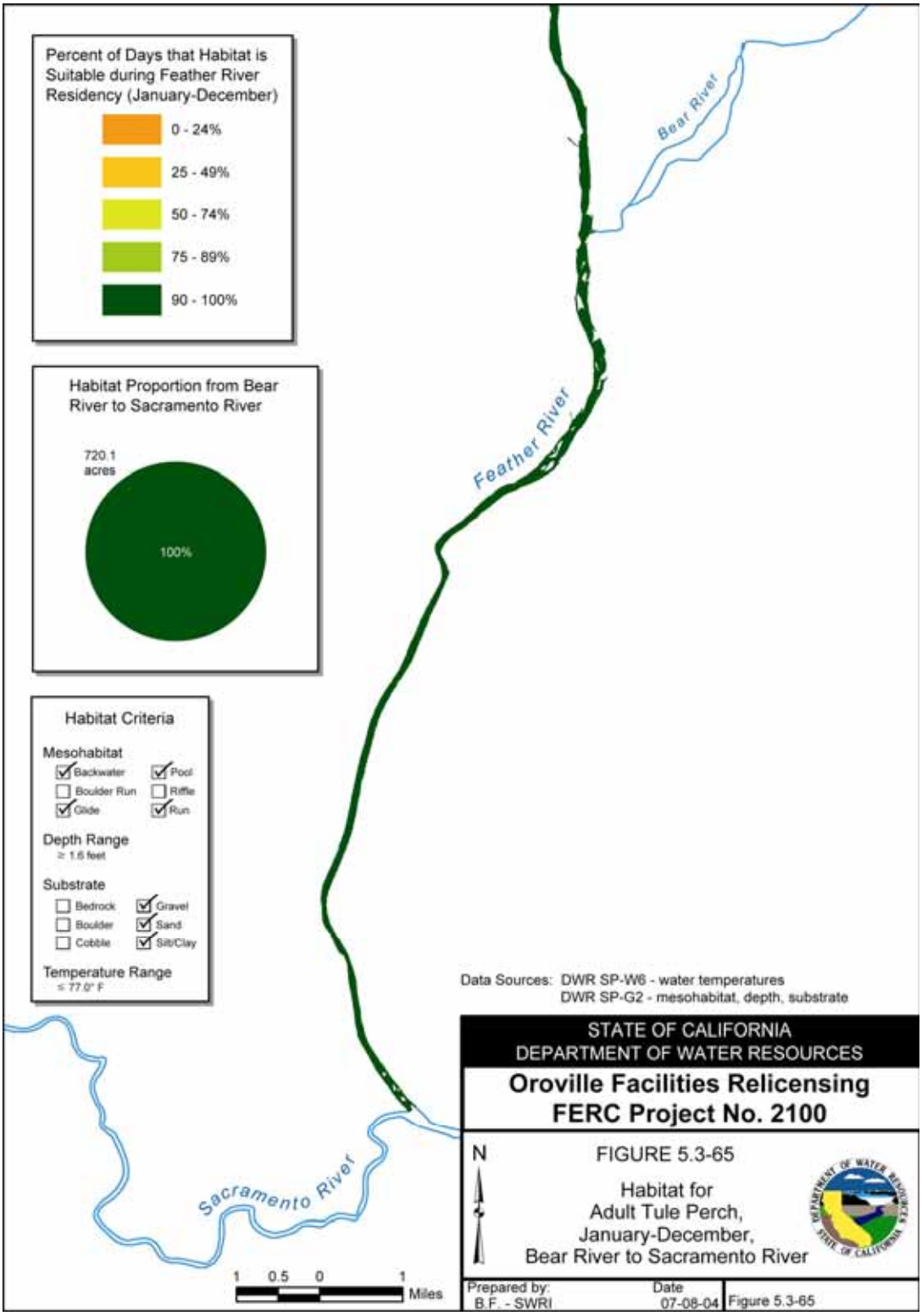

Figure 5.3-65. Tule Perch habitat in the lower Feather River from the Bear River to the Sacramento River.

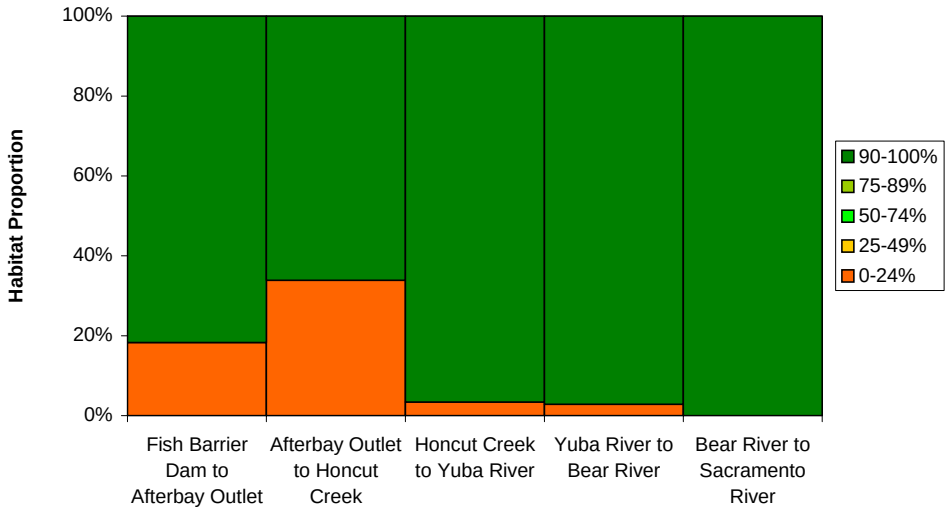

Figure 5.3-66. Proportion of Tule Perch habitat in the lower Feather River by reach.

5.3.1.12 White Sturgeon

Between the Fish Barrier Dam and the Thermalito Afterbay Outlet, 133 acres (i.e., 48 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for white sturgeon, and 142 acres (i.e., 52 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-67).

Between the Afterbay Outlet and Honcut Creek, 382 acres (i.e., 69 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for white sturgeon, and 168 acres (i.e., 31 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-68).

Between Honcut Creek and the Yuba River, 125.8 acres (i.e., 21 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for white sturgeon, and 462 acres (i.e., 79 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-69).

Between the Yuba River and the Bear River, 650 acres (i.e., 76 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for white sturgeon, and 211 acres (i.e., 25 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-70).

Between the Bear River and the confluence with the Sacramento River, 6 acres (i.e., 1 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class) for white sturgeon, and 714 acres (i.e., 99 percent) of total available habitat fell into the lowest proportion of relative habitat suitability class (90 percent to 100 percent class) (Figure 5.3-71).

The proportion of total available habitat that fell into the highest proportion of relative habitat suitability class (90 percent to 100 percent class) for white sturgeon generally increased with distance downstream from the Fish Barrier Dam. However, the reaches between the Thermalito Afterbay Outlet and Honcut Creek, and the Yuba River to the Bear River contained smaller proportions of to total available habitat within those reaches that fell into the 90 percent to 100 percent proportion of relative habitat suitability class. The reach extending from the Yuba River to the Bear River contained the highest proportion of total available habitat that fell into the lowest proportion of relative habitat suitability class (zero to 24 percent class). Figure 5.3-72 shows the proportion of habitat and proportion of relative habitat suitability classes for Sacramento splittail by reach.

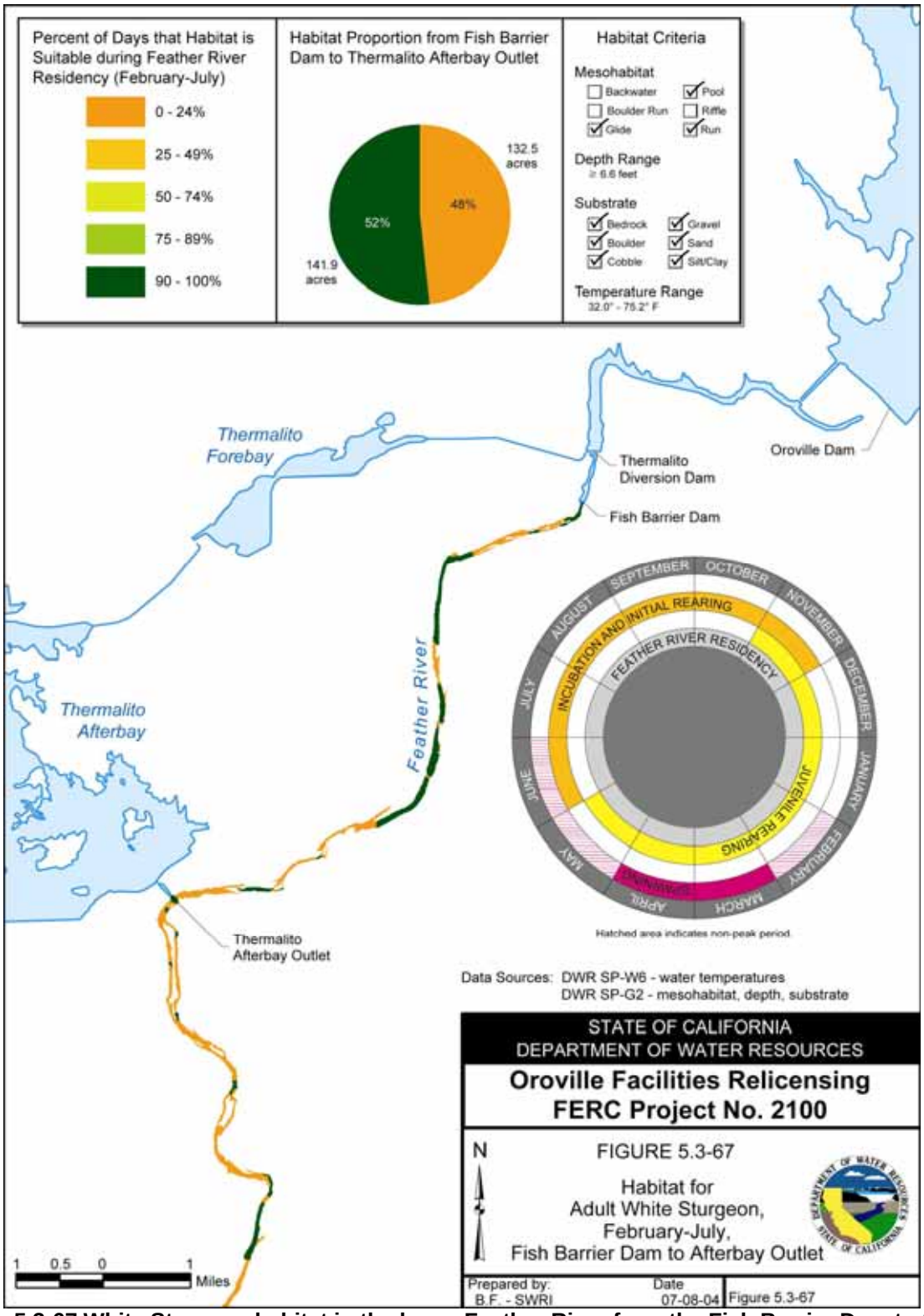

Figure 5.3-67 White Sturgeon habitat in the lower Feather River from the Fish Barrier Dam to the Afterbay Outlet.

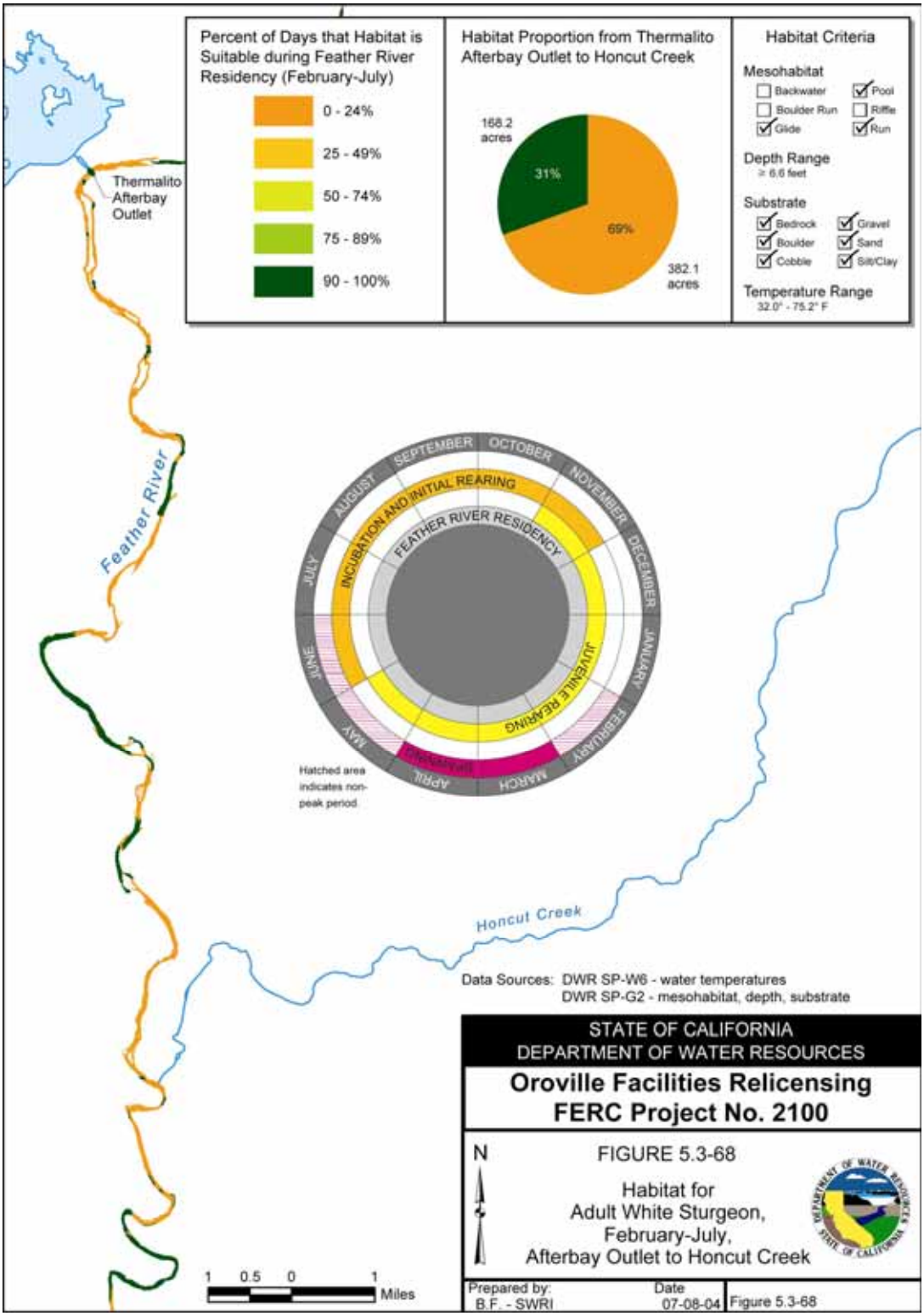

Figure 5.3-68 White Sturgeon habitat in the lower Feather River from the Afterbay Outlet to Honcut Creek.

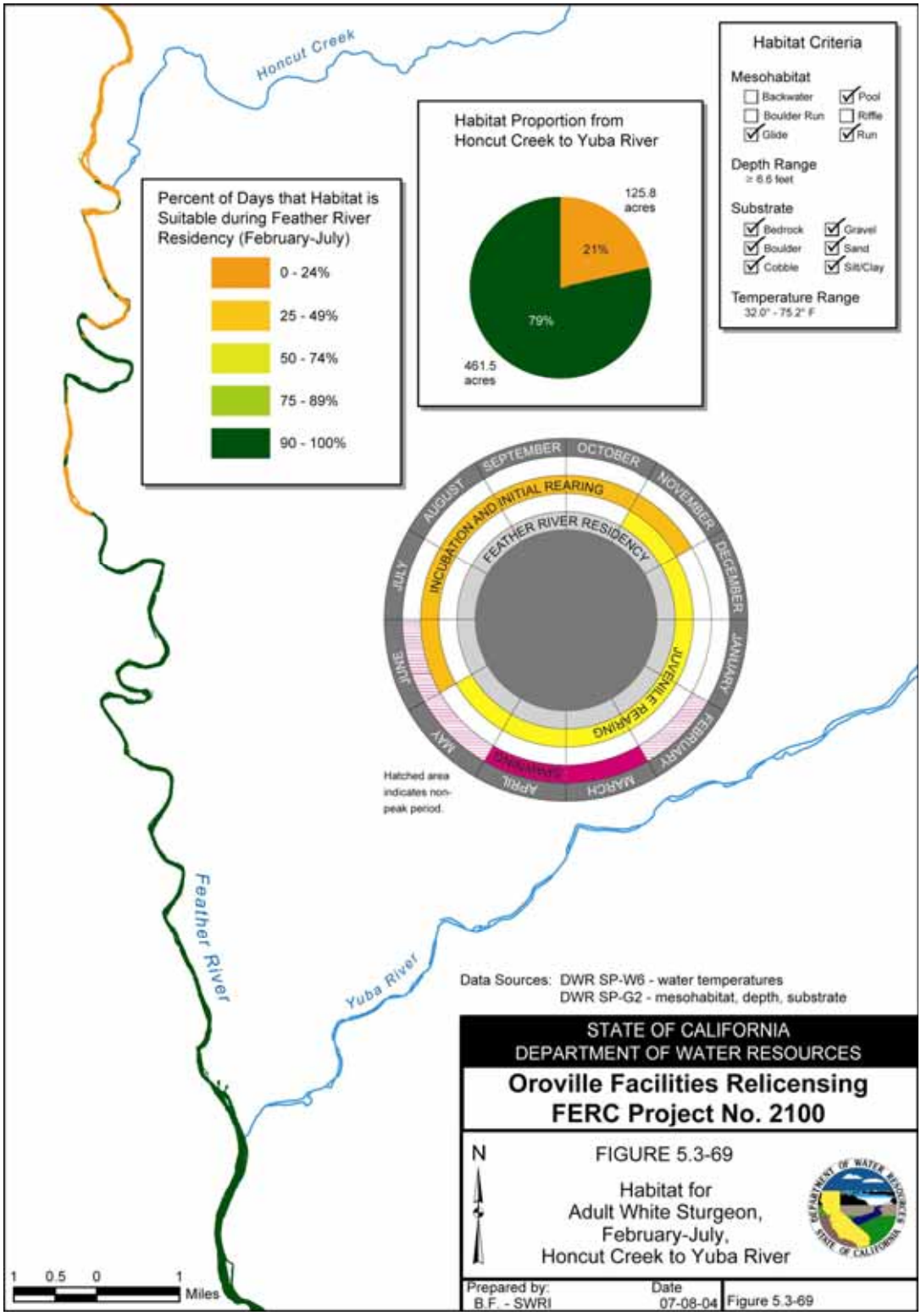

Figure 5.3-69 White Sturgeon habitat in the lower Feather River from Honcut Creek to the Yuba River.

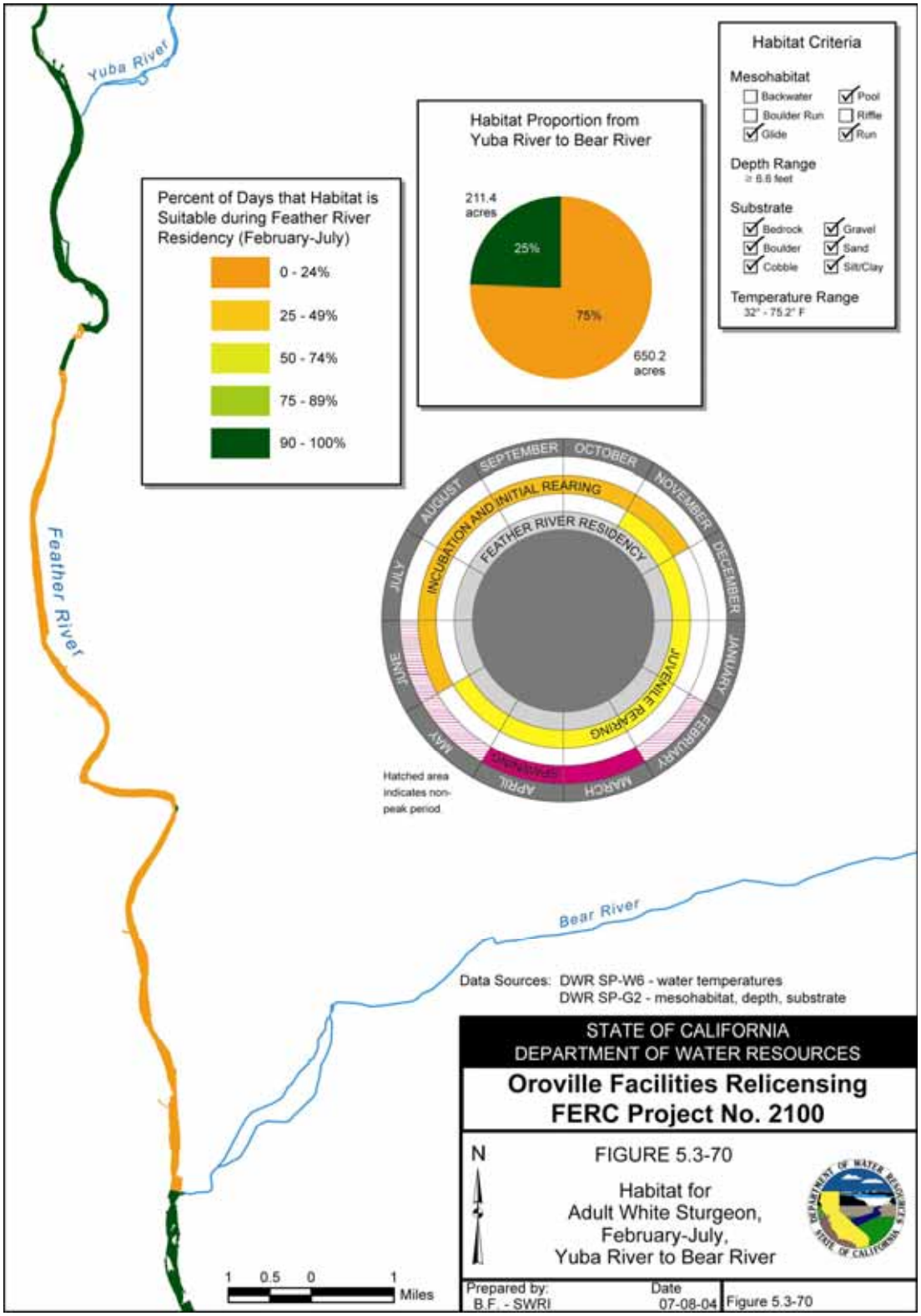

Figure 5.3-70 White Sturgeon habitat in the lower Feather River from the Yuba River to Bear River.

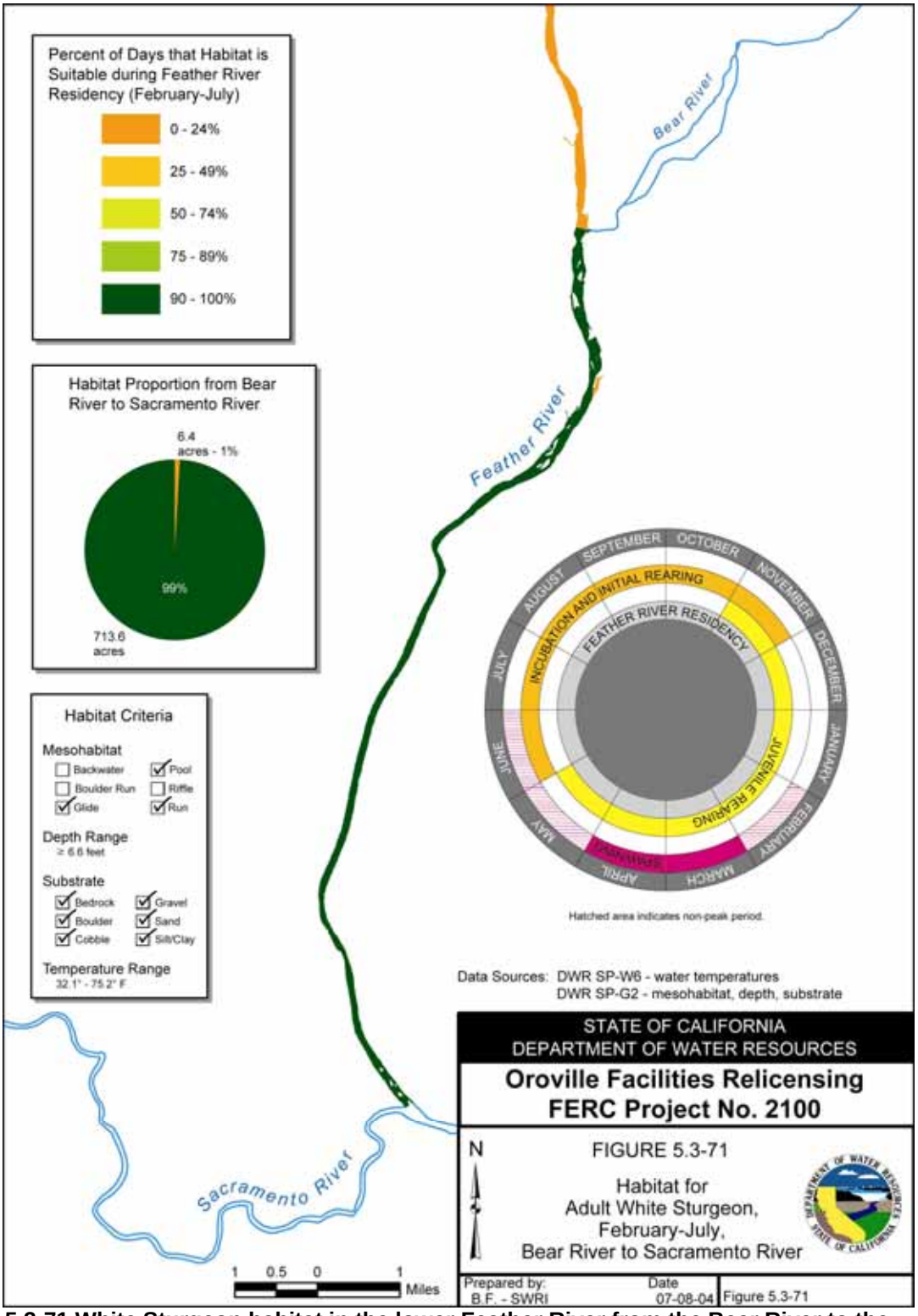

Figure 5.3-71 White Sturgeon habitat in the lower Feather River from the Bear River to the Sacramento River.

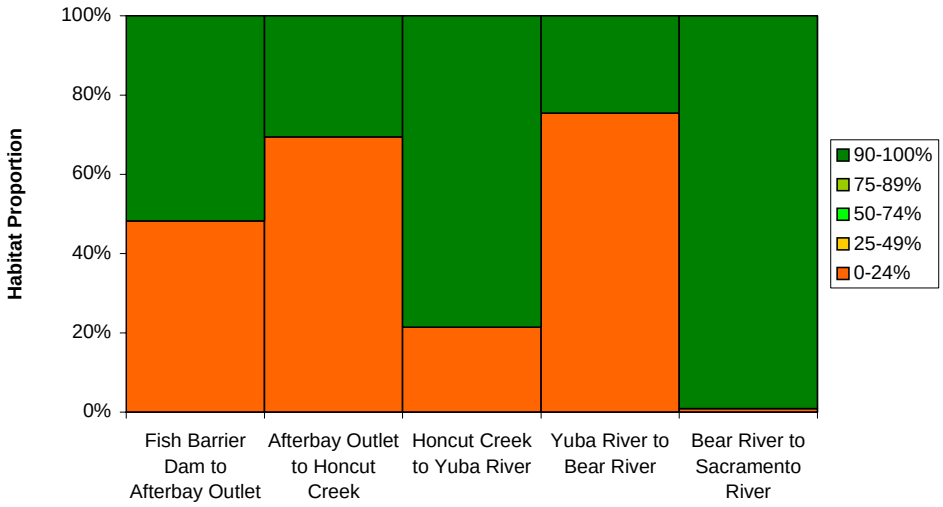

Figure 5.3.72. Proportion of white sturgeon habitat in the lower Feather River by reach.

5.3.2 Data Limitations

Due to fish habitat component data limitations and the range of types and durations of habitat use by species, the strategy employed for fish habitat classification was to use an exclusionary presence or absence approach to identifying potential fish habitat for each fish species. The zero to 24 percent proportion of relative habitat suitability class was not intended to indicate that the habitat would be entirely unsuitable for a given species, but indicates that habitat would be suitable for a short duration, infrequently, or only in portions of the area of a habitat unit. The resulting fish habitat distribution definition was potentially limited by the accuracy, representativeness, and spatial resolution of the fish habitat component data available for the classification, as well as by the accuracy of the fish habitat requirement definitions available in published literature.

5.3.3 Data Use

The fish habitat distribution information primarily was intended for use in comparison to the fish species distribution, see Section 5.4 and 6.1.2-7. The fish habitat distribution information could also be utilized to support the evaluation of potential Resource Actions. Resource Actions that could be targeted at altering habitat characteristics to benefit a particular fish species could detrimentally affect fish habitat by altering habitat components or water temperatures such that they are less suitable to other species. In either case, the habitat modification could be evaluated to identify the location and quantify the proportion of habitat that was affected.

5.4 FISH DISTRIBUTION VS. FISH HABITAT COMPARISON

Comparisons between the definitions of the range of fish species distribution to the range of fish habitat distribution could potentially lead to the identification of limitations on the accuracy of the fish species distribution or fish habitat component data, as well as identification of factors limiting habitat availability and the functional relationship to project operational effects.

5.4.1 Data Summary

The results produced in this sub-task are presented in Figures 5.4-1 through 5.4-12 showing the proportion of area by lower Feather River reach that concur for a fish species habitat and distribution definitions. The amount and proportion of disagreement by category also is reported and discussed.

5.4.1.1 American Shad

The “frequently observed” category of American shad distribution occurs in the greatest proportion in the highest proportion of relative habitat suitability class (90 to 100 percent class), and in a lower proportion for the lowest proportion of relative habitat suitability class (zero to 24 percent class) (Figure 5.4-1). Both “not observed” and “infrequently observed” categories of relative fish abundance occur in low proportions in the highest relative habitat suitability class, and in greater proportions in the lowest relative habitat suitability class. Both of these proportional relationships of relative abundance and relative habitat suitability indicate a positive concurrence in these different fish resource definitions.

The lowest proportion of relative habitat suitability class is defined primarily by the absence of an appropriate mesohabitat type or minimum water depth. Individual species distributions are general representations of the geographic distribution of each fish species. Thus, areas could exist within the general distribution of a species that fall into the lowest proportion of relative habitat suitability class. With the difference in distribution definitions eliminated from interpretation of the comparison between species and habitat, the remaining source of disagreement between the distribution definitions would be attributable to the area upstream from Steep Riffle. The area upstream from Steep Riffle fell into the highest proportion of habitat suitability class, but American shad distribution fell into the “not observed” category. The source of this potential resource distribution definition disagreement could be due to an inaccurate characterization of the extent of American shad distribution, its habitat requirements, the accuracy of the characterization of the fish habitat components, or a factor effecting fish habitat utilization that is not reflected in the fish habitat variables included in these analyses. The disagreement in the resource distribution in the area above Steep Riffle may indicate that resource decisions in this geographic area that affect this specific fish

species may need to be more closely evaluated or made with a larger degree of uncertainty of the potential affects on these resources.

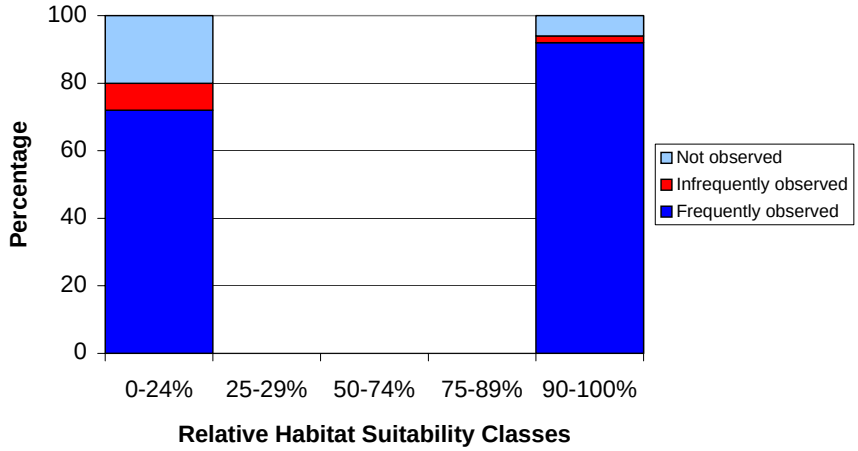

Figure 5.4-1. Relative abundance of American Shad as a function of the proportion of relative habitat suitability in the Feather River, 2002-2003.

5.4.1.2 Centrarchids

The reaches with the highest proportion of relative habitat suitability classes (75-89% and 90-100%) also had a high proportion of the "frequently observed" category of fish distribution (Figure 5.4-2). Within the 50 percent to 74 percent proportion of relative habitat suitability class, the distribution category for centrarchids was reported as "not observed." The lack of fish observations in areas that fell into the lower proportion of relative habitat suitability classes could potentially be attributable to unfavorable water temperature regimes that reduce the habitat utilization to a level not comparable to relative fish abundances found elsewhere in the river. After the sources of the binary fish habitat exclusions in the lowest proportion of relative habitat suitability class (zero to 24 percent class) and the generalizations of fish species distribution that do not take those site-specific distinctions into account have been eliminated from the interpretation, the only area of specific disagreement between these two different characterizations of fisheries resources is the area upstream from Steep Riffle and downstream from River Bend Park. The species distribution map indicates no observations in these areas, while the proportion of relative habitat suitability figure indicates that there may be some suitable habitat present at some times in this river reach. Resource management decisions that affect the areas of the river in which there is disagreement between the species distribution and habitat distribution could require additional evaluation or be made with a higher degree of uncertainty of affects on the resources.

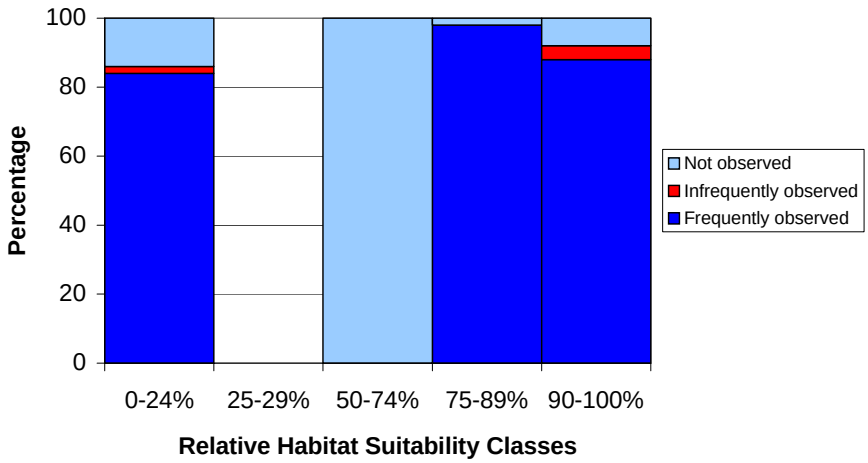

Figure 5.4-2. Relative abundance of Centrarchids as a function of the proportion of relative habitat suitability in the Feather River, 2002-2003.

5.4.1.3 Green Sturgeon

The relative abundance of green sturgeon remained relatively unchanged in areas in the lower Feather River within different proportion of relative habitat suitability classes (Figure 5.4-3). Because green sturgeon are not reported to be observed in the LFC, all of the disagreement between the "not observed" category of relative abundance and the highest and lowest proportion of relative habitat suitability classes occurred in the LFC in areas with deep pool and glide mesohabitat types. The low frequency of observations in the 75 percent to 89 percent relative habitat suitability class likely was attributable to increased water temperatures in the lower portions of the lower Feather River. However, the number of observations of sturgeon are infrequent, which may result in an underestimate of the potential distribution of the species, or there may be other factors affecting green sturgeon utilization of potentially suitable habitat that are not incorporated in the fish habitat analysis utilized in this report. In either case, there is some degree of uncertainty in the characterization of species and habitat distributions for portions of the LFC that may affect the certainty with which resource decisions could be made that would potentially affect these resources.

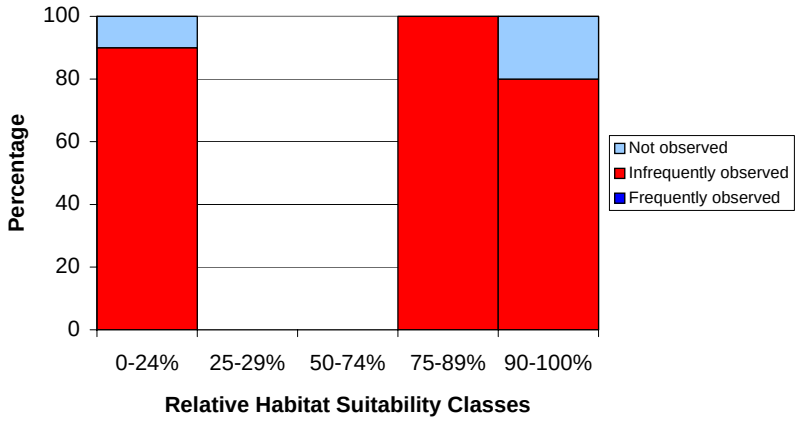

Figure 5.4-3. Relative abundance of Green Sturgeon as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.4 Hardhead-Sacramento Pikeminnow

The relative abundance of the hardhead and Sacramento pikeminnow remained unchanged through different proportion of relative habitat suitability classes in the lower Feather River (Figure 5.4-4). Although the relative abundance of the species fell into the "frequently observed" category in 100 percent of both the lowest and highest proportion of relative habitat suitability classes, the lowest proportion of relative habitat suitability class occurs only in a small amount of the total area of the river that does not have the reported appropriate substrate type for the species. Because the area in which the substrate type precluded classification in the 90 percent to 100 percent proportion of relative habitat suitability class was small, the area over which the species and habitat distributions do not agree also is small. Therefore, the fish species and habitat distribution definitions generally agree throughout the lower Feather River.

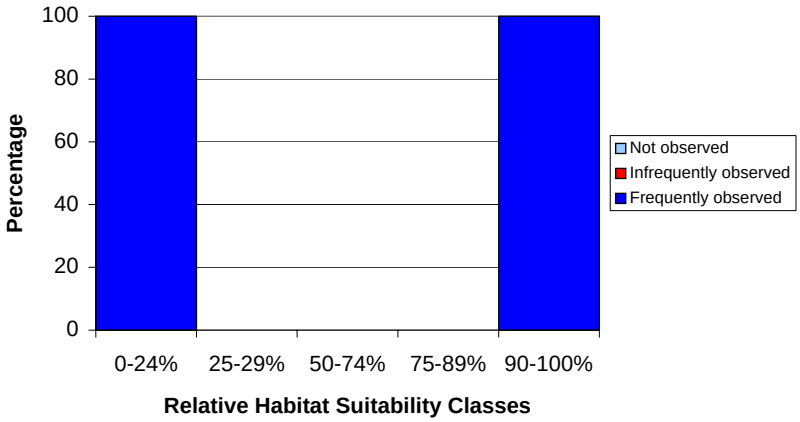

Figure 5.4-4. Relative abundance of Hardhead-Sacramento Pikeminnow as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.5 Hitch

Changes in the relative abundance of hitch were correlated with changes in relative habitat suitability. The proportion of the "frequently observed" category of relative abundance increased from 82 percent in the zero to 24 percent proportion of relative habitat suitability class to 92 percent in the 90 to 100 percent proportion of relative habitat suitability class (Figure 5.4-5). The disagreement between the species and habitat distributions in the lowest proportion of relative habitat suitability class is attributable to the lack of suitable substrate in some portions of otherwise suitable habitat. Remaining areas in which disagreement occurs between fish species and habitat distribution occurs are in the LFC, in which habitat is suitable based on current definitions while hitch were reported not to be observed.

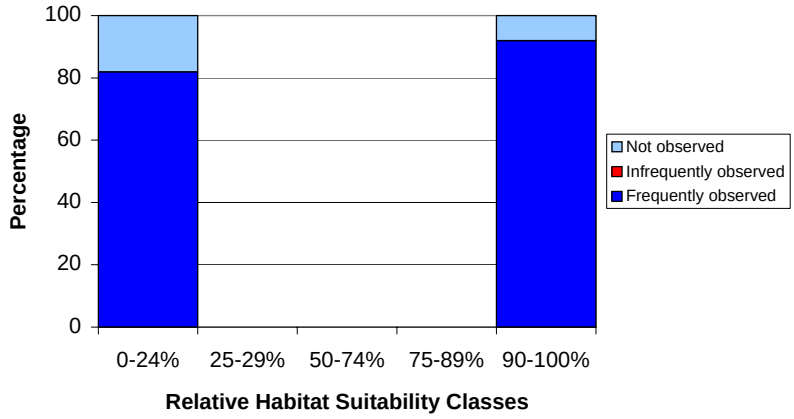

Figure 5.4-5. Relative abundance of Hitch as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.6 Pacific Lamprey

The relative abundance of Pacific lamprey remained unchanged through different proportion of relative habitat suitability classes in the lower Feather River. Survey data indicate that the species was as frequently observed in the upper and lower reaches despite differences in relative habitat suitability among habitat units (Figure 5.4-6). Relative habitat suitability downstream from the Thermalito Afterbay Outlet fell into the intermediate proportion of relative habitat suitability classes due to increased water temperatures from the Thermalito Afterbay Outlet to the Feather River confluence with the Sacramento River.

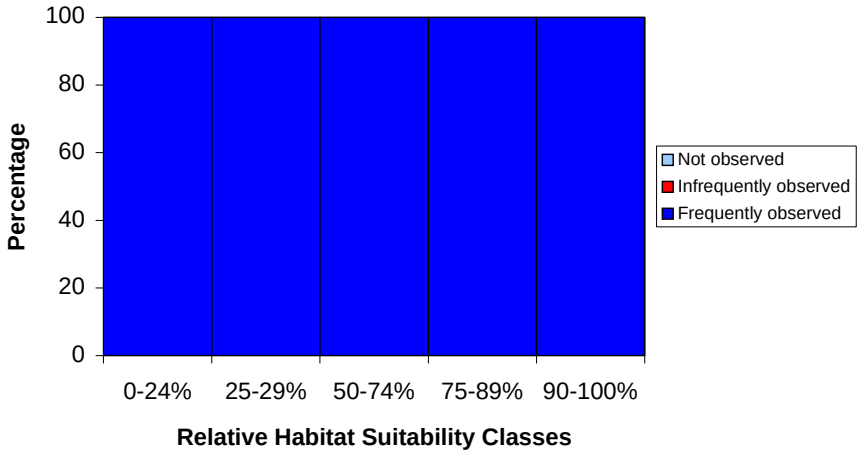

Figure 5.4-6. Relative abundance of Pacific Lamprey as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.7 River Lamprey

The relative abundance of river lamprey remained unchanged through different proportion of relative habitat suitability classes in the lower Feather River. Survey data indicate that the species was as frequently observed in the upper and lower reaches despite differences in relative habitat suitability among habitat units (Figure 5.4-7). Relative habitat suitability downstream from the Thermalito Afterbay Outlet fell into intermediate proportion of relative habitat suitability classes due to increased water temperatures from the Thermalito Afterbay Outlet to the Feather River confluence with the Sacramento River.

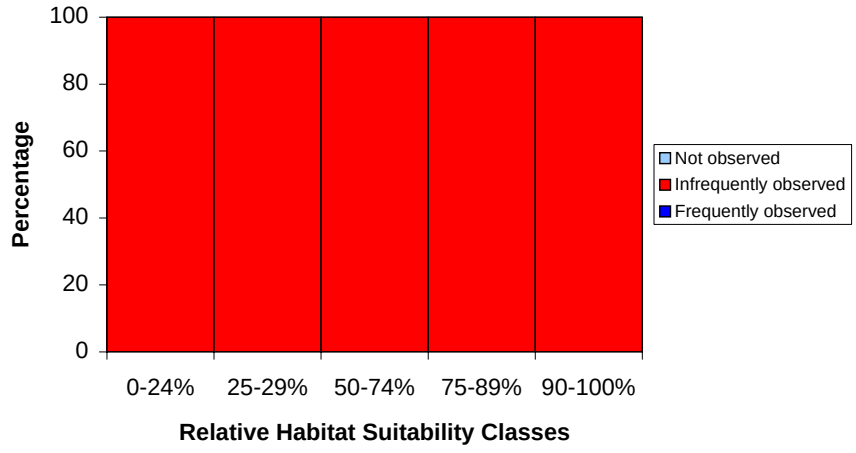

Figure 5.4-7. Relative abundance of River Lamprey as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.8 Sacramento Splittail

Splittail abundance never fell into the "frequently observed" relative abundance category. Additionally, splittail only were classified in the "infrequently observed" category downstream from Honcut Creek and only were classified as "not observed" upstream from Honcut Creek. The proportion of the "infrequently observed" category in the highest proportion of relative habitat suitability class is higher than in the lowest proportion of relative habitat suitability class. Similarly, the proportion of the "not observed" category is lower in the highest proportion of relative habitat suitability class and is greater in the lowest relative fish habitat suitability class. Both of these proportional relationships of relative fish abundance to relative habitat suitability class support a good level of concurrence between these two different resource distribution characterizations (Figure 5.4-8).

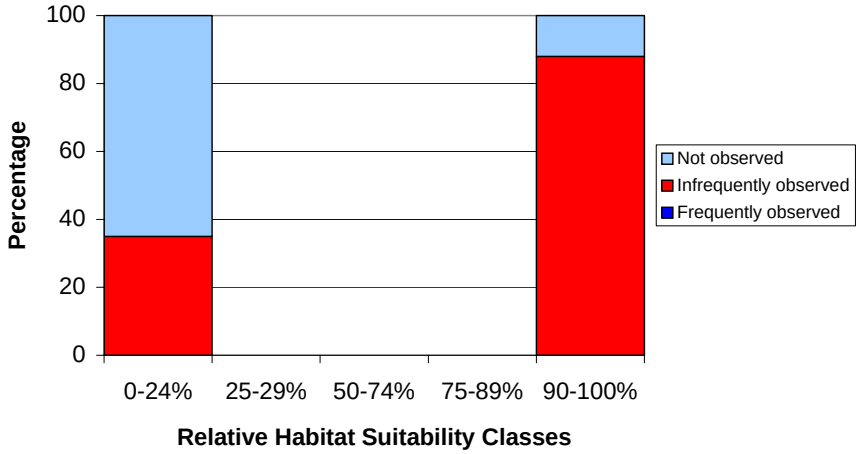

Figure 5.4-8. Relative abundance of Sacramento Splittail as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.9 Sacramento Sucker

The relative abundance of Sacramento sucker remained unchanged through different proportion of relative habitat suitability classes in the lower Feather River. The proportion of total fish habitat that was classified in the lowest relative habitat suitability class represents less than 10 percent of the total area of the lower Feather River and did not fall into the highest proportion of relative habitat suitability class due to unsuitable mesohabitat type and substrate characteristics. The comparison between species and habitat distribution indicate a high degree of concurrence that Sacramento sucker can be found in high abundance in most locations at most times anywhere in the lower Feather River (Figure 4.4-9).

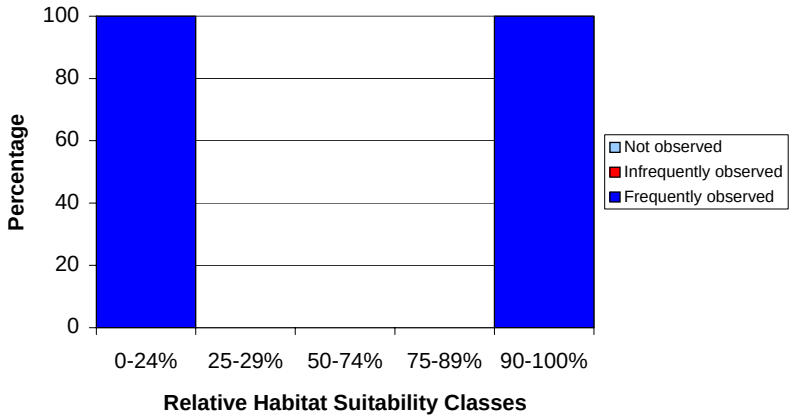

Figure 5.4-9. Relative abundance of Sacramento Sucker as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.10 Striped Bass

Changes in the relative abundance of striped bass were negatively correlated with changes in relative habitat suitability. Although the literature utilized to develop the fish habitat query criteria indicated that the minimum water depth preference for this fish species was 10' or greater, it is likely that the reported depth criterion is the source of the contradiction between the species and habitat distributions. The attributing of the "average" water depth for a habitat unit may be a factor limiting the accuracy of the definition of the distribution of the proportion of relative habitat suitability class. The majority of the high proportional suitability habitat class that striped bass were "not observed" in occur in the LFC above Steep Riffle. The fish distribution and relative abundance that is based on frequent observations of individuals is likely a more accurate representation of the distribution of this resource than the likely inaccurate representation of relative fish habitat suitability distribution (Figure 5.4-10).

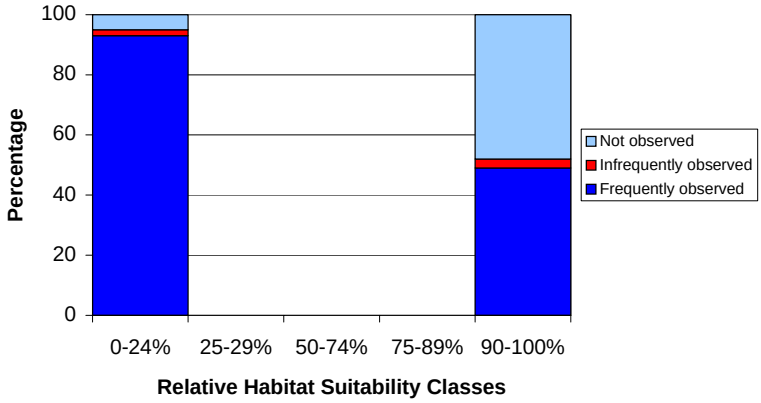

Figure 5.4-10. Relative abundance of Striped Bass as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.11 Tule Perch

Changes in the relative abundance of tule perch were correlated with changes in relative habitat suitability. The proportion of the "frequently observed" category of relative abundance increased from 82 percent in the zero to 24 percent proportion of relative habitat suitability class to 92 percent in the 90 to 100 percent proportion of relative habitat suitability class (Figure 5.4-11). Conversely the proportion of the "infrequently observed" category decreased from 18 percent in the zero to 24 percent proportion of relative habitat suitability class to eight percent in the 90 percent to 100 percent proportion of relative habitat suitability class. The majority of disagreement between the species and habitat distributions in the lowest proportion of relative habitat suitability class is attributable to the lack of suitable substrate in some portions of otherwise suitable habitat. Remaining areas in which disagreement occurs between fish species and habitat distribution occurs are in the LFC, in which habitat is suitable based on current definitions while hitch were reported not to be observed. The difference between the species and habitat distribution definitions could be due to a low number of observations of tule perch, seasonal distributional variability, limitations in the habitat component characterizations, errors in the definitions used in the habitat query, or other habitat utilization factors not included in this analysis.

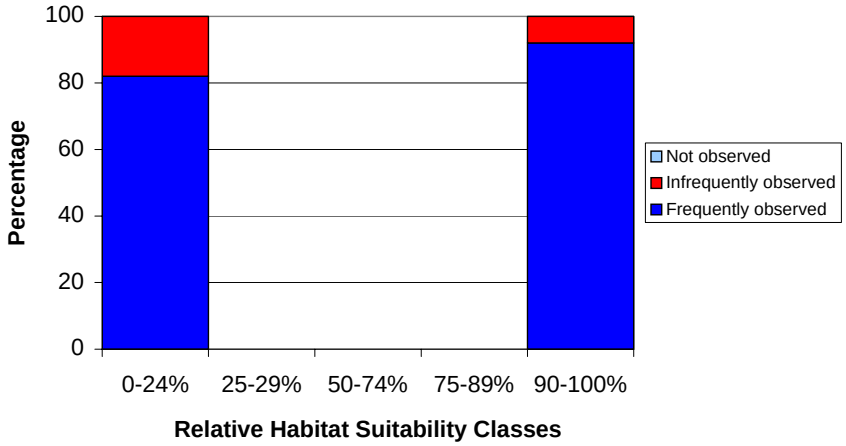

Figure 5.4-11. Relative abundance of Tule Perch as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.1.12 White Sturgeon

The relative abundance of white sturgeon remained relatively unchanged through different proportion of relative habitat suitability classes in the lower Feather River. All of the disagreement between "not observed" category of relative abundance and distribution, and the highest proportion of relative habitat suitability class occurred in the LFC in areas with deeper pool and glide mesohabitat types. The number of

observations of sturgeon are infrequent. Thus, there may be an underestimate of the potential distribution of the species or there may be other factors effecting white sturgeon habitat utilization that are not accurately reflected in the fish habitat analysis utilized in this report. In either case, there is some degree of uncertainty in the characterization of this species and habitat distribution for portions of the LFC that may affect the certainty with which resource decisions could be made that would potentially affect these resources (Figure 5.4-12).

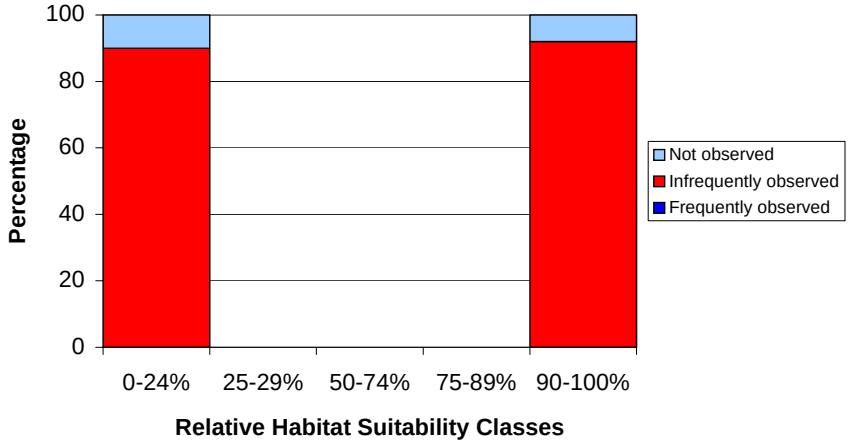

Figure 5.4-12. Relative abundance of White Sturgeon as a function of the proportion of temporal habitat suitability in the Feather River, 2002-2003.

5.4.2 Data Limitations

The comparison of fish habitat to fish distribution is limited by the differences in the accuracy and resolution of the data sets used to define each of these fisheries resource characterizations. The disagreements between the two definitions of fisheries resources in the lower Feather River are discussed in Section 5.4.1. Fish distribution represents a geographic range of extent that is generalized over portions of the river that, for example, may have an unsuitable mesohabitat unit type. The fish habitat characterization is limited by the accuracy and spatial resolution of classification of the fish habitat components that were used as the basis to define fish habitat distribution. Fish habitat distribution generalizes each habitat unit to a single characterization that generalizes the diversity of conditions that could occur within a habitat unit.

5.4.3 Data Use

After the easily understandable types of disagreements of these two different definitions of fisheries resources are eliminated from the results interpretation, potential useful insights on resource characteristics and definitions, operational effects, as well as resource conflicts can be identified. If there is a high proportion of concurrence between fish distribution and fish habitat for a species, it is likely that the degree of

understanding of the fish spatial distribution and habitat requirements as well as the habitat characterization of the river are adequate to support resource evaluations and decisions with a high degree of confidence.

If there is a low proportion of concurrence between fish distribution compared to fish habitat, there are 3 possible explanations, which could all potentially affect the usefulness of the information for use as the basis for confident resource evaluations and fisheries resource management decisions. The three potential sources of disagreement of these fisheries resource definitions (that are not easily dismissed) are, 1) the distribution or relative abundance of the fish species has not been accurately characterized, 2) the understanding of the fish habitat component requirements is not well understood or has not been accurately defined for the fish species, or 3) the quality and representativeness of the fish habitat component data sources for the lower Feather River are not adequate to support the requirements of this analyses. In the event of a low proportion of agreement in these fisheries resource definitions, it is unlikely that the limiting factor in the disagreement would be reliably identified. In the case of critical resource management decisions, the lack of concurrence in these fisheries resource definitions may identify the need for additional study or investigation in order to improve the level of resource understanding to a level that would allow confident fisheries resource management decisions to be made.

6.0 ANALYSES

6.1 EXISTING CONDITIONS/ENVIRONMENTAL SETTING

6.1.1 Fish Distribution

Fish species distributions and relative abundances included in this report did not change from the definitions and ranges defined in the interim fish distribution report (interim report). A substantial number of additional observations were added to the data set describing the distribution and relative abundance of species in the lower Feather River from on-going DWR snorkel surveys and RST data, but the overall characterization of the fish distribution was not altered by the additional information. The lack of change from the species distribution definition utilized in the interim report may be reflective of a fish distribution definition that was well characterized (even with potential interannual variabilities included) or may be illustrative of the generalized nature of the fish distribution definitions.

If individuals within a species were abundant then the frequency of observation during the surveys increased, which increased the likelihood of the accuracy of the depiction of the distribution range and relative abundance of the species. If individuals within a species were not abundant then the likelihood that a potential error could occur in the resulting characterization of the distribution of the species increased.

Intermittent habitat use or small population sizes make the accurate characterization of a species' distribution susceptible to errors in representation and could lead to variability in the accuracy of representation based on seasonal or interannual species distribution trends. Sacramento splittail are reported to utilize lower Feather River habitat intermittently interannually (Seesholtz et al. 2003; USFWS 1995a). Sturgeon are reported to be attracted to enter the Feather River at flows above approximately 5,000 cfs at the confluence with the Sacramento River (Seesholtz et al. 2003). Undocumented and undefined fish behavioral responses to combinations of environmental conditions can result in variability in fish distribution and substantially adversely effect the ability to accurately and definitively represent a fish species distribution and relative abundance.

Although substantial efforts were employed in the project studies to document sturgeon distribution through snorkel and scuba surveys, larval egg traps and radio tagging efforts, no observations of sturgeon were documented during survey efforts. The distribution of sturgeon in the lower Feather River is a compilation of anecdotally reported sightings and catches over a number of years and is based on the collective experience and professional judgment of DWR and DFG staff.

6.1.1.1 Comparison of Fish Distribution to Fish Habitat Distribution

The comparison of fish species distribution to fish habitat distribution required an evaluation of not only the sources of potential disagreements, but also of the relative magnitude of disagreement. The objective of this comparison was to determine the relative degree of concurrence or disagreement between these two types of resource distribution definitions to establish the degree of confidence with which this information could be used to make resource management decisions. Analysis of the nature and magnitude of any disagreements could potentially identify the location, type, and period of uncertainty in the current level of resource understanding, which could be used to temper the level of utilization of the information to an appropriate level, potentially identify locations, types or times for additional resource investigations; or could potentially lead to new insights on the nature of the resources and their interactions.

6.1.2 Fish Habitat Components

6.1.2.1 Mesohabitat

Mesohabitat type diversity decreased from the upstream to downstream portions of the lower Feather River. Pool, riffle, and backwater habitat types diminished in relative mesohabitat proportion with distance downstream while the proportion of glide mesohabitat type increased. Although fluvial geomorphic processes tend to move the locations of mesohabitat types in a river, if the river is in approximately dynamic equilibrium, then the relative proportions of mesohabitat by river reach should be relatively constant. The lower Feather River's dynamic equilibrium will be evaluated and reported in SP-G2.

6.1.2.2 Substrate

In general, the river reach with the highest proportion of course substrate components occurred in the upstream most portions of the lower Feather River between the Fish Barrier Dam and the Thermalito Afterbay Outlet. The increased course substrate component in this reach may be due, in part, to a lack of upstream gravel recruitment and the mobilization of smaller substrate particle sizes during flood control flow releases. Analysis of gravel composition coarsening (armoring) is presented in detail in the reports associated with SP-G2. Analysis of the effects of armoring on salmonid spawning is presented in the Final Report for SP-F10 Task 2A. Increased proportions of finer particle substrate size components in the downstream reaches of the lower Feather River potentially could be explained by the introduction of sediment loads from tributaries entering the lower Feather River. Additionally, lower water velocities could be responsible for deposition of finer sediments in the downstream reaches of the lower Feather River.

6.1.2.3 Water Depth

The greatest proportion of water in the deepest depth classification (greater than 10 feet deep) and the greatest water depth diversity occurred in the upstream most reach of the lower Feather River between the Fish Barrier Dam and the Thermalito Afterbay Outlet. Overall average depths as well as depth diversity generally decreased as distance downstream from the Thermalito Afterbay Outlet increased.

6.1.2.4 Instream Cover Complexity

The lowest proportion of instream cover complexity occurred in the upstream most reach of the lower Feather River between the Fish Barrier Dam and the Thermalito Afterbay Outlet. The relatively static flow regime and levee confinement of the channel in this reach likely reduced the fluvial geomorphic processes that typically contribute to habitat diversity and that create multiple types of instream cover (i.e., overhanging banks, diverse substrate sizes, and emergent vegetation). Dams typically also block the contribution of large woody debris (LWD) from upstream reaches, which reduces the potential contribution to instream cover complexity. The Oroville Facilities likely contribute to the reduction in instream cover complexity in the LFC due to the reduction in LWD recruitment. LWD capture and retention is also reduced by course substrates that occur in the upper portions of the LFC.

The proportion of instream cover complexity in the river generally increased with increased distance downstream. The opportunity for increased LWD recruitment to the lower Feather River increased with distance downstream due to increased quantities of riparian vegetation, the prevalence of orchards, and potential LWD contributions from tributaries such as Honcut Creek and the Bear River. It should be noted that the lowest reaches of the river are classified as having the highest proportion of high instream cover complexity even though some of these reaches have the most levee riprap, which is typically thought to reduce instream cover complexity by eliminating cut banks and reducing LWD retention and overhanging vegetation.

6.1.2.5 Water Temperature

Water temperatures tend to be coldest in the upper portions of the lower Feather River near the Fish Barrier Dam and warm progressively with distance downstream during the spring, summer, and fall. Some fish species with higher minimum water temperature tolerances may be affected by cold-water releases from the Oroville Facilities for salmonid fisheries management purposes. Increased cold-water releases could potentially result in reduced proportions of relative habitat suitability for warmwater species in the upper habitat units of the LFC. The increased proportion of habitat units that fell into lower proportion of relative habitat suitability classes for warmwater species in the LFC would be attributed to the management of the upper portions of the lower Feather River for the benefit of coldwater fish species. However, the proportion of total

habitat available for these fish species affected by the reduced water temperatures is small in comparison to the total proportion habitat that fell into the high proportion of relative habitat suitability classes throughout the lower Feather River. In the winter, at times when the temperature of water entering the LFC is above the ambient air temperatures, the warmest water temperatures in the lower Feather River occur in the upstream most portion of the lower Feather River. This phenomenon does not appear to be a common occurrence, nor an operational effect that substantially changes the water temperatures or the proportion of habitat that falls within the highest proportion of relative habitat suitability classes in the entire lower Feather River for any of the fish species evaluated.

Water temperatures in the HFC can be increased by releases from the Thermalito Afterbay in the spring, summer, and fall. The magnitude of water temperature increases in the HFC during portions of the year is affected by the ambient air temperatures, the proportion of flows released from the afterbay in comparison to the LFC, and by the effective reside time of water in the afterbay. The effective reside time of water in the afterbay can be affected by several operational factors including the total volume of releases from the afterbay including the agricultural diversions, the stage elevation of the afterbay, and the amount of pumpback and peaking that occurs. A more complete analysis of the operational effects on afterbay release water temperatures is available from the Engineering and Operations Work Group analysis of Scenario 23, as well as the Engineering and Operations Narrative Report EO1. Some fish species with lower maximum water temperature tolerances may be affected by warmer water temperatures from the afterbay releases with reduced proportions of habitat within the high proportion of relative habitat suitability classes, but the amount of habitat and the proportion of reduced relative suitability that could potentially be attributed to the incremental water temperature increase from Thermalito Afterbay Outlet releases is small in proportion to the total amount of proportional relative habitat suitability for those fish species.

6.1.2.6 Water Quality Exceedances of Aquatic Life Criteria

Only three of the analytes examined in the water quality analysis performed in support of SP-W1 exceeded any of the EPA water quality criteria (NAWQC and CTR criteria are defined in Section 4.2.6.1) for aquatic life. The aquatic life water quality criteria exceedances occurred for total aluminum, copper, and iron concentration and were reported as exceeding either the NAWQC criterion, the CTR criterion, or both. Of the three analytes exceeding the water quality criteria, total aluminum was in exceedance most often. The magnitude and time period of the exceedances was not available. Thus an evaluation of the specific effects on individual fish species was not undertaken within the scope of this report.

Aluminum is acutely toxic to fish in acidic waters (Baldigo and Murdoch 1997). The gill is the principal target organ and death is due to a combination of ion-regulatory, osmoregulatory, and respiratory malfunctions. Aluminum kills fish in at least two ways.

First, it is able to reduce the ion exchange through the gills causing salt depletion. Aluminum also precipitates in the gills and interferes with the normal transport of oxygen and other ions, so that the fish dies of a lack of oxygen. In addition, the fish will exude mucus to combat the aluminum in their gills (EPA 1988). Copper is a micronutrient that also can be highly toxic in aquatic environments. It affects fish species by bioaccumulating in many different organs (EPA 1985; EPA 1993). Additionally, copper adsorbs to organic matter, carbonates, and clay, which reduces its bioavailability. There is a moderate potential for bioaccumulation in plants, a low potential for bioconcentration by fish, and no biomagnification. Fish, invertebrates, and aquatic plants appear to be equally sensitive to chronic toxicity. Ferric ion precipitation or adsorption as ferric hydroxide (or ferric oxide) on fish gills may result in suffocation (EPA 1986).

All of the water quality sampling locations in the lower Feather River exceeded the NAWQC aquatic life standard for aluminum at least one time. Figures 4.2-1 and 4.2-2 show. the water quality sampling station locations. The proportion of water quality criteria exceedances for total aluminum was lowest in the LFC with 19% of samples exceeding the NAWQC aquatic life criterion. The highest proportion of water quality criteria exceedances sampled in the LFC was 31% of samples, which were obtained from the two upstream most locations sampled. The percentage of samples obtained Thermalito Afterbay Outlet to the Feather River confluence with the Sacramento River exceeding the water quality criteria for total aluminum were variable, but all were as high or higher than the highest observed percentage of exceedances in the LFC. Several water quality sampling station locations exceeded the water quality criteria for aquatic life for total aluminum on 100% of the samples taken.

Total copper exceeded the water quality criteria for aquatic life in 2 samples out of 111 samples taken in the LFC, and in 3 samples in 3 locations out of the 165 samples taken in the HFC.

Total iron did not exceed the water quality criteria for aquatic life in any water quality samples taken within the project boundaries in the lower Feather River.

6.1.2.7 Fish Habitat Distribution

The dominant habitat component defining habitat distribution for most species was the availability of a reportedly suitable mesohabitat type. Substrate type or water depth suitability was infrequently a factor limiting the distribution of habitat. The absence of a required habitat component for a fish species for a habitat unit resulted in a zero to 24 percent proportion of relative habitat suitability classification for the habitat unit (i.e. the unit fell into the zero to 24 percent proportion of relative habitat suitability class). The classification of a habitat unit within the zero to 24 percent proportion of relative habitat suitability class does not imply that the fish species would not utilize the habitat unit at all, but indicates that the habitat utilization would tend to be either short in duration such

as during transit or foraging activities, and acknowledges the diversity of conditions that may occur within a habitat unit, which allow some site specific locations within a habitat unit that would otherwise be characterized as having low relative suitability to provide some limited areas of potential habitat suitability. Habitat units were classified based on the presence or absence the required habitat components. Habitat units containing all of the required habitat components for a given species fell into the 90 percent to 100 percent proportion of relative habitat suitability class while units missing one or more of the required habitat components fell into the zero to 24 percent proportion of habitat suitability class. No intermediate habitat suitability classes were identified based on the presence or absence of required habitat components. Intermediate habitat suitability classes were based on the proportion of time that water temperatures were within each species reported thermal tolerance ranges. Ten of the 16 fish species habitat distributions that were characterized only using the presence or absence of required habitat components. American shad, green sturgeon, hardhead, hitch, Sacramento pikeminnow, Sacramento splittail, Sacramento sucker, striped bass, tule perch, and white sturgeon habitat fell into either the zero to 24 percent or the 90 percent to 100 percent proportion of relative habitat suitability class based on the absence of one or more required habitat components or on the presence of all the required habitat components. Water temperatures did not limit the relative habitat suitability of these fish species.

Water temperatures did limit the relative habitat suitability of six of the 16 species evaluated in this report. The influence of water temperature on the habitat suitability of fish species is identified in the proportion of relative habitat suitability by reach graphs in Section 5. If water temperature affected the relative suitability of a habitat unit, it fell into one of the intermediate proportion of relative fish habitat suitability classes (i.e., 25 percent to 49 percent, 50 percent to 74 percent, or 75 percent to 89 percent).

Only the centrarchid fish species, including smallmouth bass, largemouth bass, and spotted bass, with higher minimum water temperature tolerances than other fish species evaluated in this report habitat that fell into one of the reduced proportion of relative habitat suitability classes in the upstream most reaches of the lower Feather River due to cold water temperatures. The reduced proportion of relative habitat suitability for these fish species would be attributable to the management of Lake Oroville cold water releases into the lower Feather River for the benefit of coldwater salmonid fish species. The proportion of total habitat available for these species affected by the release of cold water from the Oroville Facilities is small in comparison to the total proportion of habitat available to these species throughout the rest of the lower Feather River.

Green sturgeon, river lamprey, and Pacific lamprey had lower maximum water temperature tolerances for their respective analysis periods than the other fish species evaluated, and had habitat that fell into the reduced proportion of relative habitat suitability classes in the downstream reaches of the lower Feather River. The reduced proportion of relative habitat suitability would be attributable to the progressive warming

of the water in the lower Feather River as it flows downstream. The habitat units that fell into the highest proportion of relative habitat suitability classes for these fish species occurred in the lower Feather River from the Fish Barrier Dam to Honcut Creek where the Oroville project has the most potential to influence coldwater temperatures.

6.2 PROJECT RELATED EFFECTS

Project operational affects on fish habitat quality, quantity, and distribution in the lower Feather River include affects on water temperatures and flows as well as upstream contributions of gravel, sediment, and LWD to the lower Feather River.

Oroville Project releases directly affect the water temperatures in the upper portions of the lower Feather River. The river currently is managed to primarily benefit coldwater fisheries management. Therefore a reduced quantity and proportional relative habitat suitability for centrarchids occurs in the upstream areas of the lower Feather River. In general, the fish species with warmer minimum water temperature tolerances have a large area of the lower Feather River that fall into the high proportion of relative habitat suitability classes. Therefore, those species also have the largest proportions of habitat that fall into the high proportion of relative habitat suitability classes. Similarly, fish species with lower maximum water temperature tolerances including green sturgeon, river lamprey, and Pacific lamprey had the majority habitat that fell into the highest proportion of relative habitat suitability classes farther upstream in the lower Feather River and potentially benefited from the project's coldwater species water release temperature management.

Oroville Project releases determine the flows in the upstream reaches of the lower Feather River and contribute proportionately to total flows below the confluences with Honcut Creek, the Yuba River, the Bear River, and locations of other flow accretions or depletions. The quantity of flows released from the project affects water velocities, mesohabitat type classifications, and geomorphic processes that affect fish habitat quality (complexity and diversity), quantity, and distribution in the lower Feather River.

Water velocities were not available, except for a portion of the lower Feather River evaluated with a physical habitat simulation (PHABSIM) model, and were not included in the fish habitat component data sets to define fish habitat distribution and proportion of relative habitat suitability classes. Water velocities within a habitat unit would represent a continuum of conditions from the highest velocities in the thalweg to zero or negative velocities on the margins or backwaters. Flows and the concomitant velocity changes may effect the lateral distribution of habitat in the channel for some fish species, but relatively small changes in flows would not be expected to substantially affect the basic characteristics of a mesohabitat unit or the overall distribution of proportion of relative habitat suitability classes for a species. In the case of extremely high flows, such as those released during flood control events, the resulting water velocities may make some habitat units entirely unsuitable for some fish species for the

duration of the event. The proportion of time during which flood control events occur compared to the total period of potential fish habitat availability is relatively small. Therefore, flood control releases would not be expected to substantially affect the overall quantity or distribution of proportion of relative habitat suitability classes for any of the fish species evaluated in this report.

High water velocities resulting from higher ranges of project releases can mobilize various size classes of substrate, which could potentially affect fish habitat substrate suitability, quality, and distribution. A complete evaluation of the effects of project operations on substrate is reported in the Final Report for SP-G2, which reports the results of the Fluvial 12 model.

Extremely high flows, such as those released during a flood control event, can potentially change the classification of some mesohabitat unit types. Extremely high flow events could potentially change riffle mesohabitat types to chute types, pools to glides or runs, glides to runs or riffles, and runs to riffles or chutes depending on the magnitude of the flow change and the local geomorphology of the river reach. The proportion of time during which flood control events occur compared to the total period of potential fish habitat availability typically is relatively small. Therefore, flood control releases would not be expected to substantially affect the overall quantity or distribution of proportion of relative habitat suitability classes for any of the fish species evaluated in this report. Extremely low flow events also could potentially alter mesohabitat types depending on the magnitude of the flow change and the local geomorphology of the river reach. Mesohabitat types in the lower Feather River were classified at moderate flows and the amount of each mesohabitat type class change due to reductions in flows would be expected to be minimal in all but extreme low flow conditions. Because many of the fish species evaluated use several similar mesohabitat types most of the proportion of the relative habitat suitability classes would not be affected by the potential mesohabitat classification change.

Increases or decreases in flow releases could result in increases or decreases to the water depth in the lower Feather River that could potentially change the water depth classification of some of the habitat units. The amount of water depth change per increment of flow release is determined by the stage discharge relationship at the location of the fish habitat unit. Based on available stage discharge data, in general, it takes large changes in flow to change any of the 2-foot depth increment water depth classifications used in the fish habitat suitability evaluations. Increases in project releases, such as those for a flood control event, could result in an increase in the amount of potentially suitable fish habitat for those fish species with minimum water depth requirements. Similarly, reductions in releases could potentially reduce the amount of potentially suitable fish habitat for those fish species with minimum water depth requirements.

Flows in the lower Feather River are regulated by Oroville Dam and other project releases. The frequency and magnitude of high flow events drives many fluvial geomorphic processes that contribute to the development and maintenance of fish habitat quality, quantity, and distribution. Some of the fluvial geomorphic processes that affect fish habitat quality, quantity, and distribution include channel shaping, river meander, bank cutting, gravel and sediment recruitment, transport, and deposition, and large woody debris recruitment and retention. Fluvial geomorphic processes are responsible for modifying mesohabitat types and locations within the river, but while the river is in a state of relative dynamic equilibrium, the proportion of mesohabitat types would be relatively constant and controlled by river gradient. Moderated flow regimes, such as those observed on a regulated river, tend to reduce these fluvial geomorphic processes and potentially reduce fish habitat quality, complexity, and diversity. The relationship of project releases to fluvial geomorphic processes is reported in the Final Report prepared for SP-G2.

The Oroville Facilities block the upstream contribution of gravel and sediment to the lower Feather River. The blockage of the replacement gravel from the upstream Feather River depletes the upstream most portions of the lower Feather River of smaller substrate particle sizes because those substrate particle sizes are mobilized by high project flow releases, which results in a gradual relative coarsening of the particle size distribution of the substrate (armoring) in the upper portions of the lower Feather River. Changes in the substrate particle size distribution can affect fish habitat suitability, quality and distribution. The changes in substrate particle size distribution in the lower Feather River are analyzed in detail in the Final Report for SP-G2. The effects of armoring on salmonid spawning habitat are analyzed in detail in the Final Report for SP-F10 Task 2A.

The Oroville Facilities also block the upstream contribution of LWD to the lower Feather River. The blockage of the replacement LWD from the upstream Feather River depletes the upstream most portions of the lower Feather River of habitat complexity because of LWD attrition and mobilization, which results in a gradual lowering of habitat complexity in the upper portions of the lower Feather River. The changes in habitat complexity as a result of decreased LWD recruitment are analyzed in detail in the Final Report for SP-G2.

Overall, operation of the Oroville Facilities in a manner consistent with current operations is unlikely to alter the distribution of species or their habitat in the lower Feather River. However, specific changes to project operations could alter the quantity, quality, and distribution of habitat for some species depending on the type of operational change implemented.

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State of California
The Resources Agency
Department of Water Resources

FINAL REPORT
COMPARISON OF FISH DISTRIBUTION TO FISH HABITAT IN THE LOWER FEATHER RIVER
SP-F3.2 TASK 2, 4, 5

Oroville Facilities Relicensing
FERC Project No. 2100

APPENDIX A
MEAN THERMOGRAPH DATA IN FEATHER RIVER POOLS
(JANUARY 2002 THROUGH DECEMBER 2003)

JULY 2004

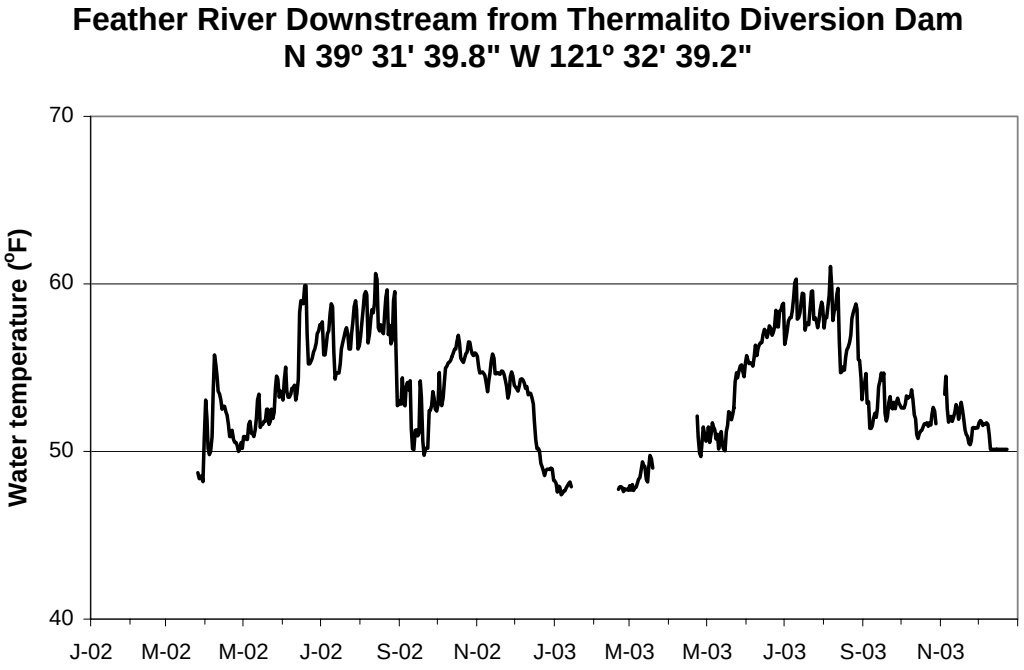

Figure A-1. Mean Thermograph Time Series at Feather River Downstream from Thermalito Diversion Dam (RM 67.4).

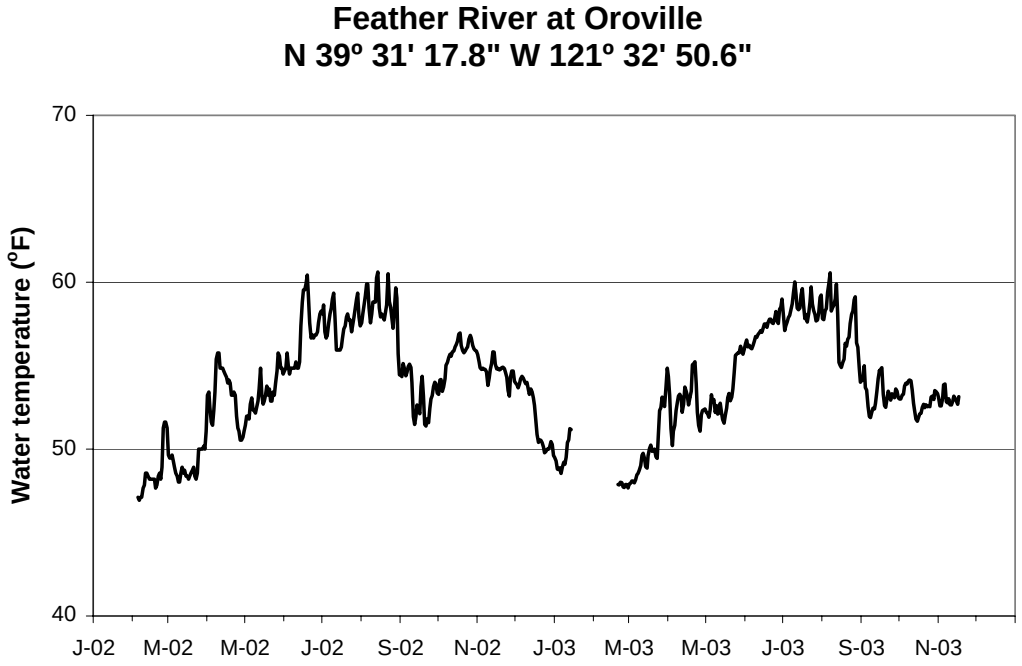

Figure A-2. Mean Thermograph Time Series at Oroville (RM 67.0).

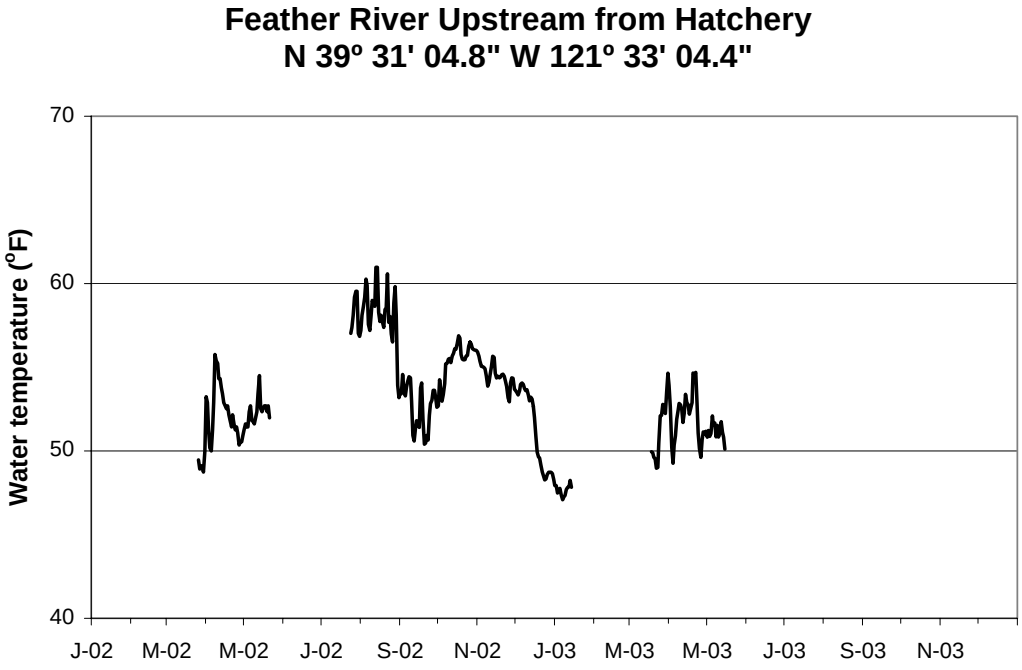

Figure A-3. Mean Thermograph Time Series at Feather River Upstream from Hatchery (RM 66.6).

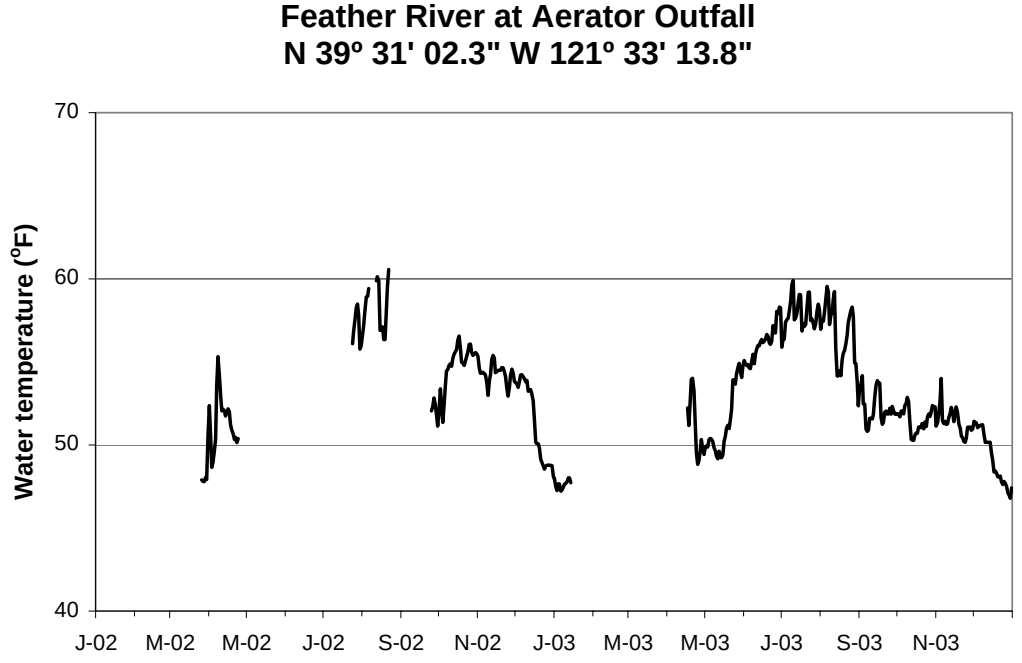

Figure A-4. Mean Thermograph Time Series at Feather River at Aerator Outfall (RM 66.4).

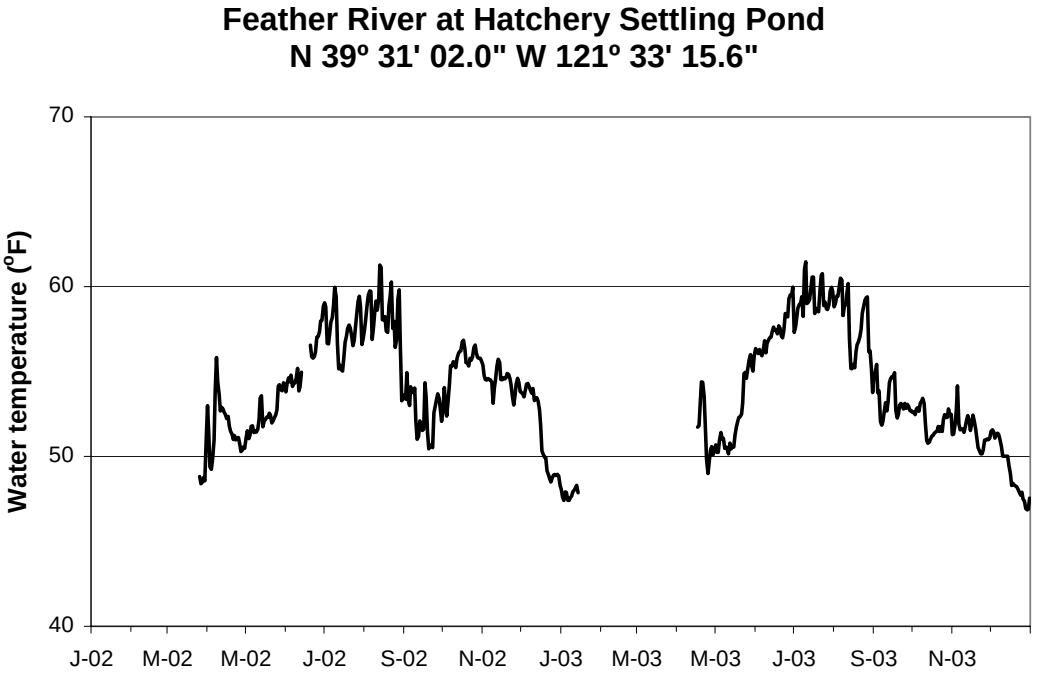

Figure A-5. Mean Thermograph Time Series at Hatchery Settling Pond (RM 66.4).

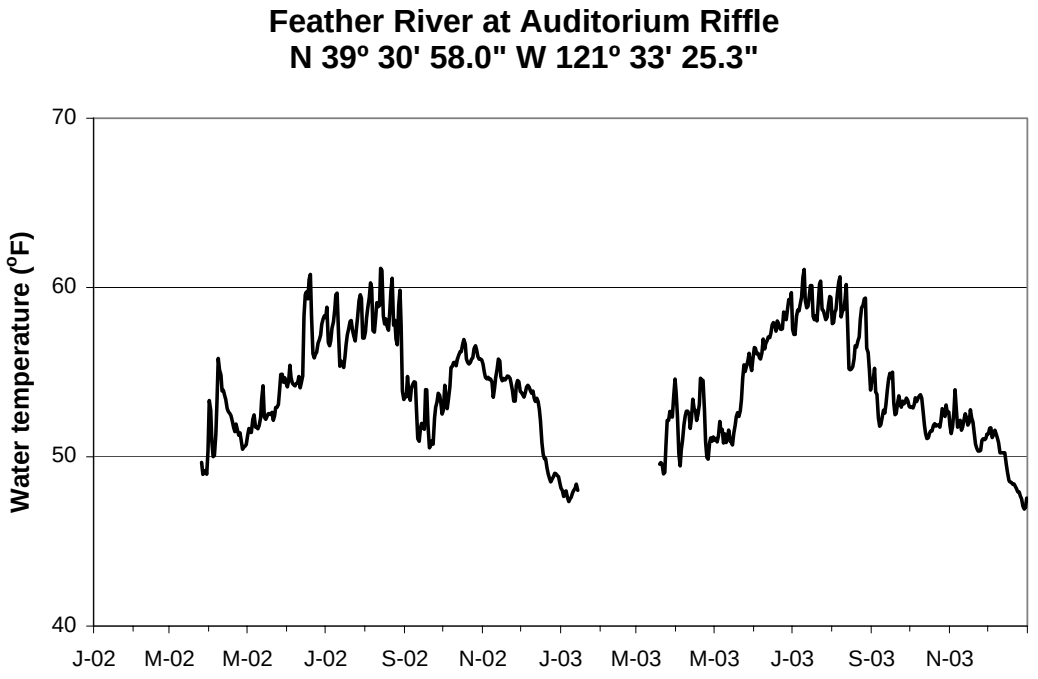

Figure A-6. Mean Thermograph Time Series at Feather River at Auditorium Riffle (RM 66.2).

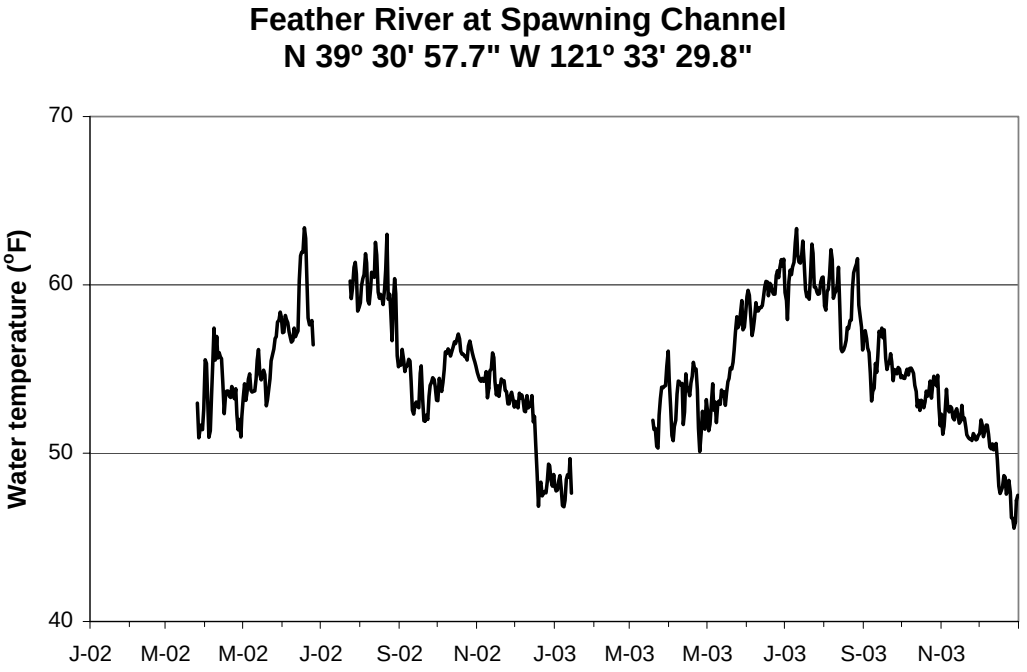

Figure A-7. Mean Thermograph Time Series at Spawning Channel (RM 66.2).

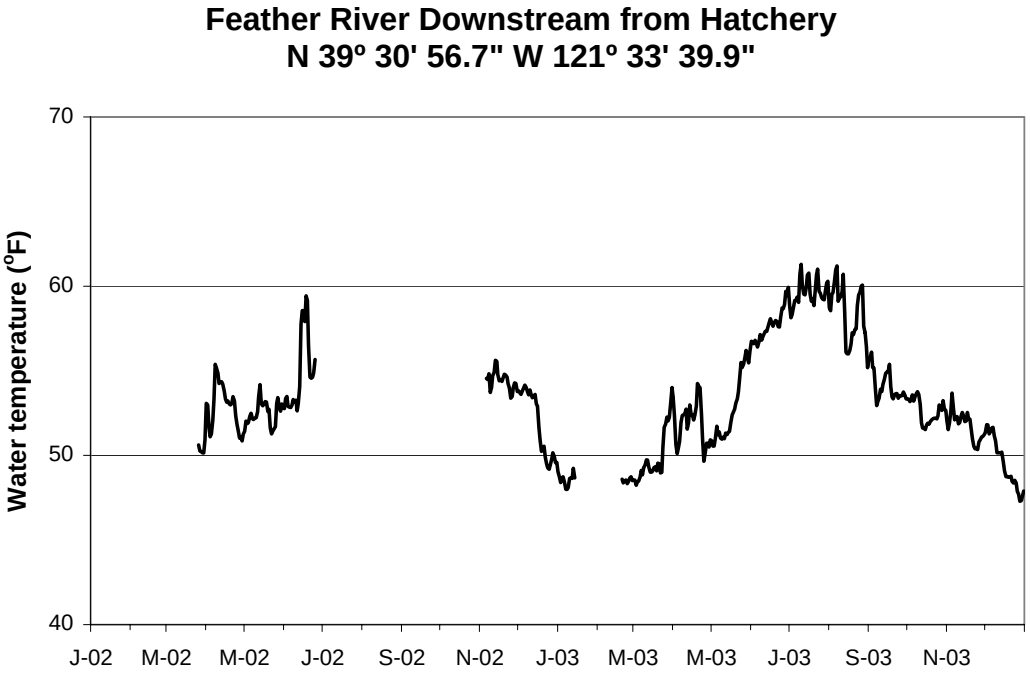

Figure A-8. Mean Thermograph Time Series at Feather River Downstream from Hatchery (RM 66.0)

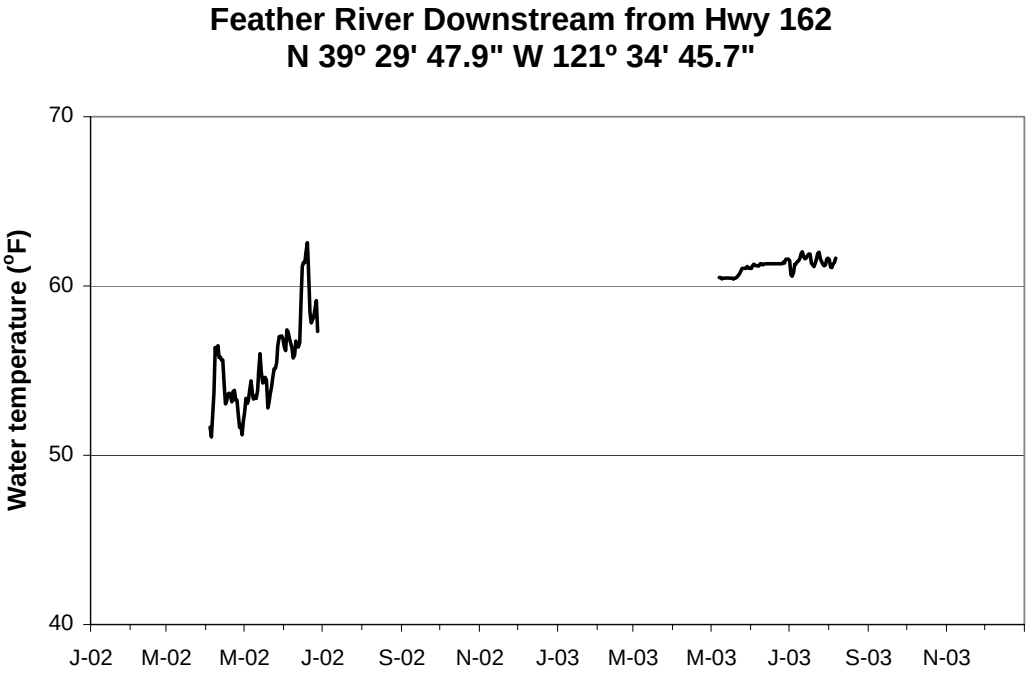

Figure A-9. Mean Thermograph Time Series at Feather River Downstream from Hwy 162 (RM 64.1).

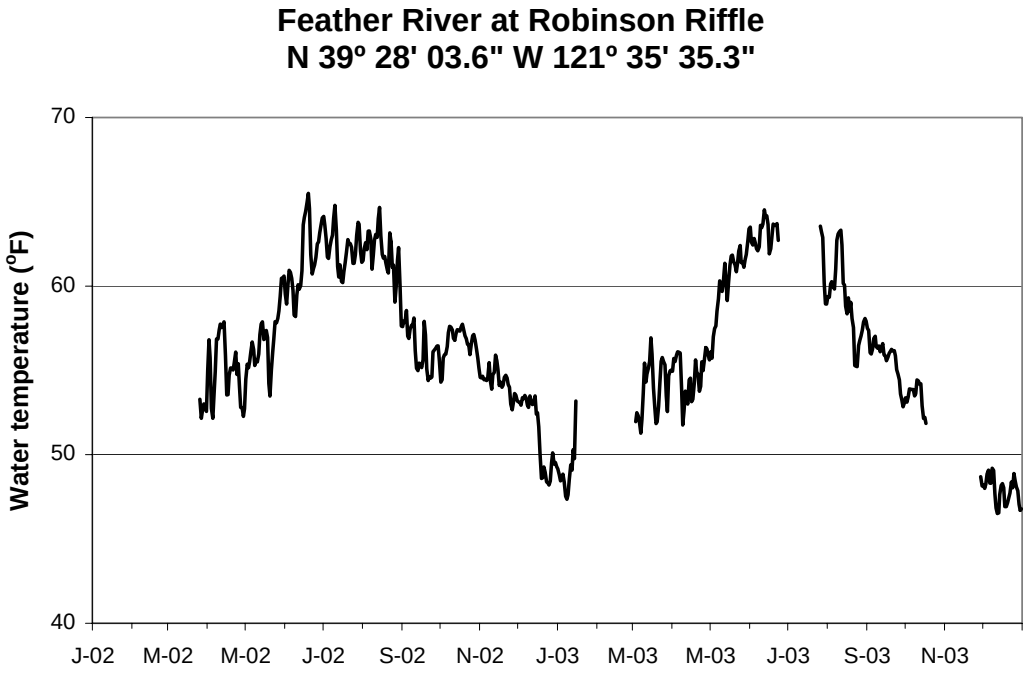

Figure A-10. Mean Thermograph Time Series at Robinson Riffle (RM 61.7).

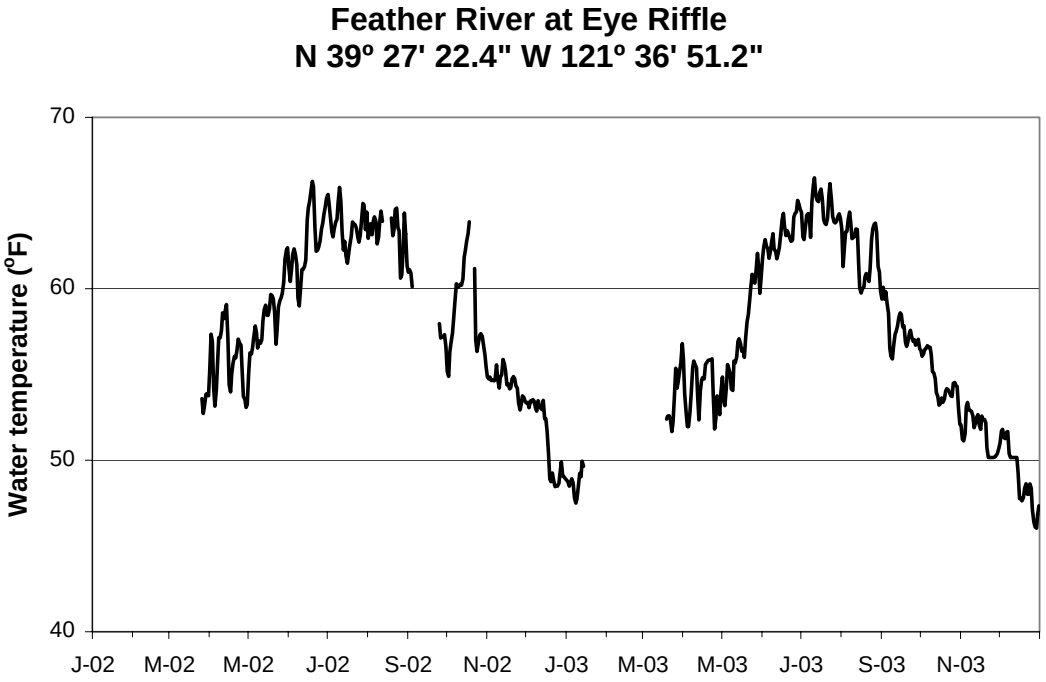

Figure A-11. Mean Thermograph Time Series at Eye Riffle (RM 60.2).

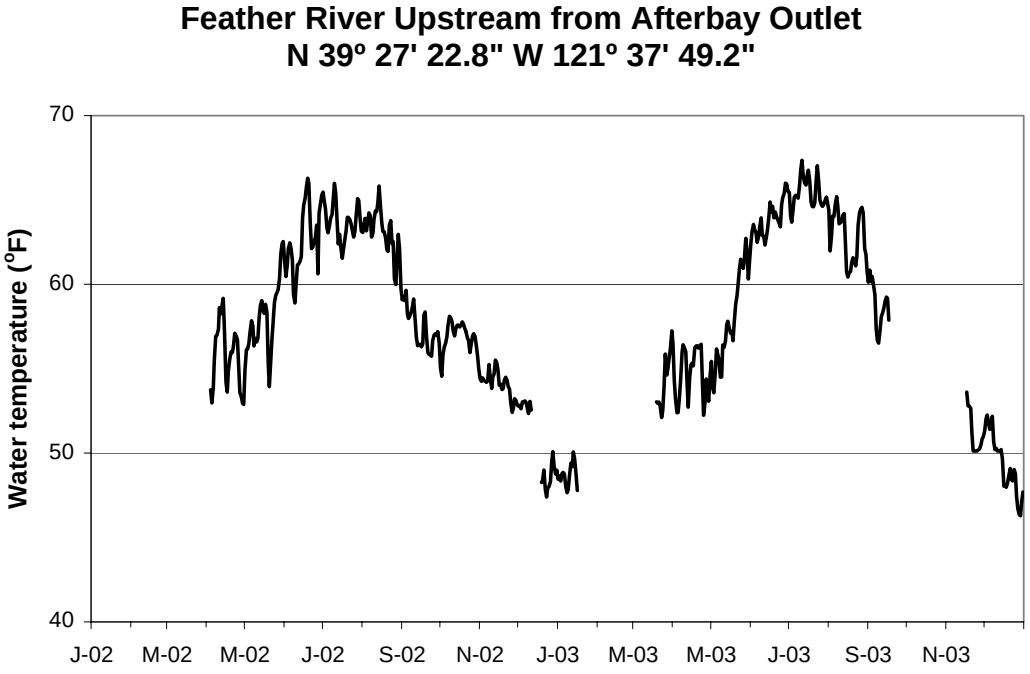

Figure A-12. Mean Thermograph Time Series at Feather River Upstream from Afterbay Outlet (RM 59.4).

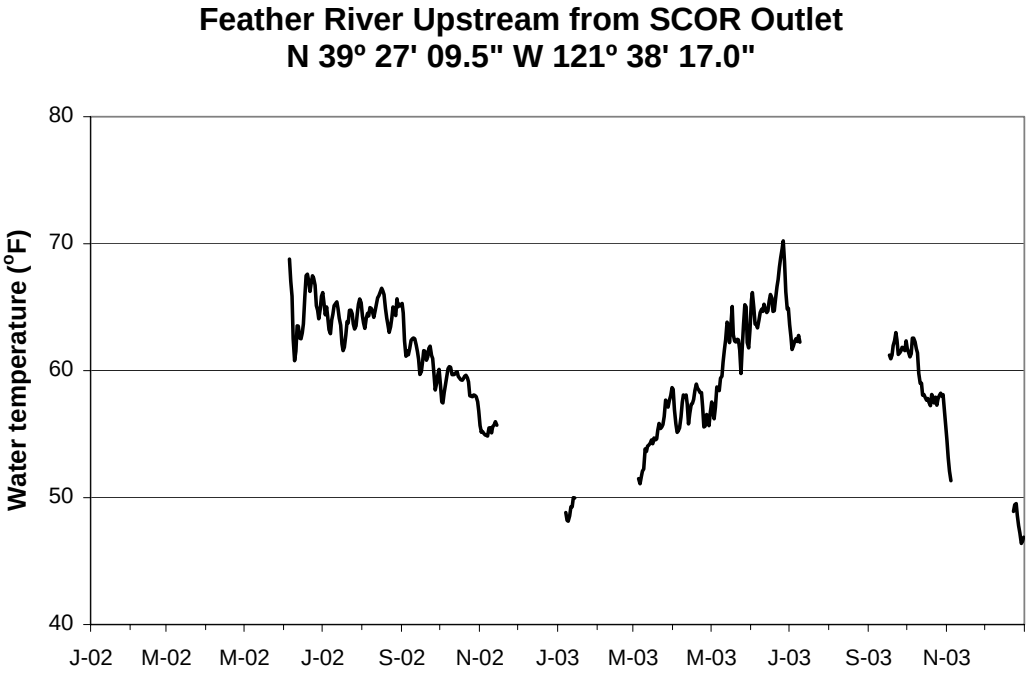

Figure A-13. Mean Thermograph Time Series at Feather River Upstream from SCOR Outlet (RM 58.8).

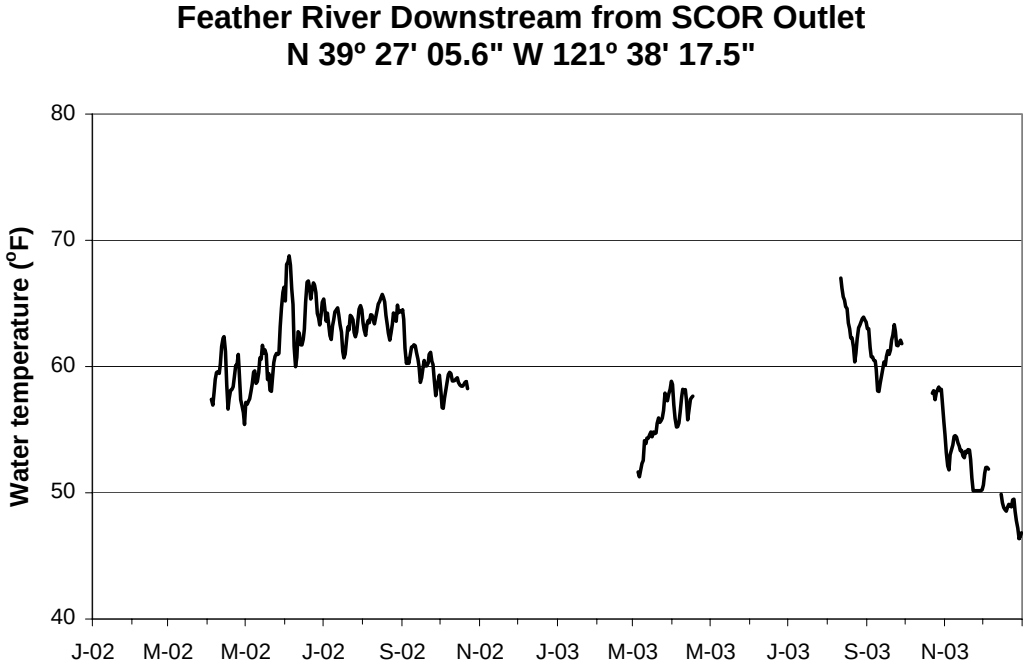

Figure A-14. Mean Thermograph Time Series at Feather River Downstream from SCOR Outlet (RM 58.7).

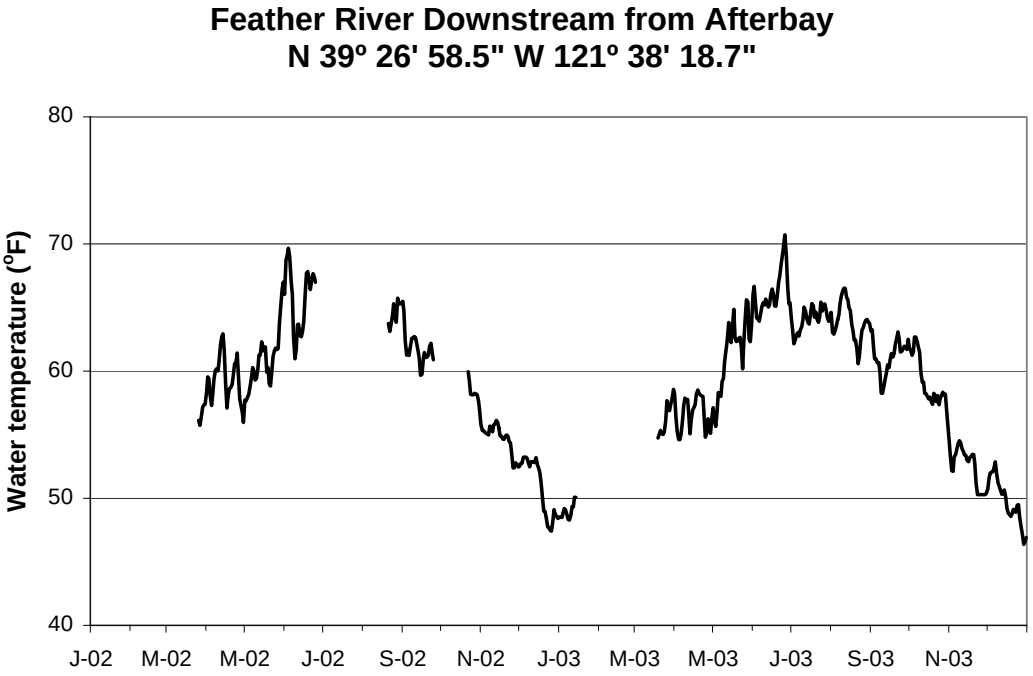

Figure A-15. Mean Thermograph Time Series at Feather River Downstream from Afterbay (RM 58.6).

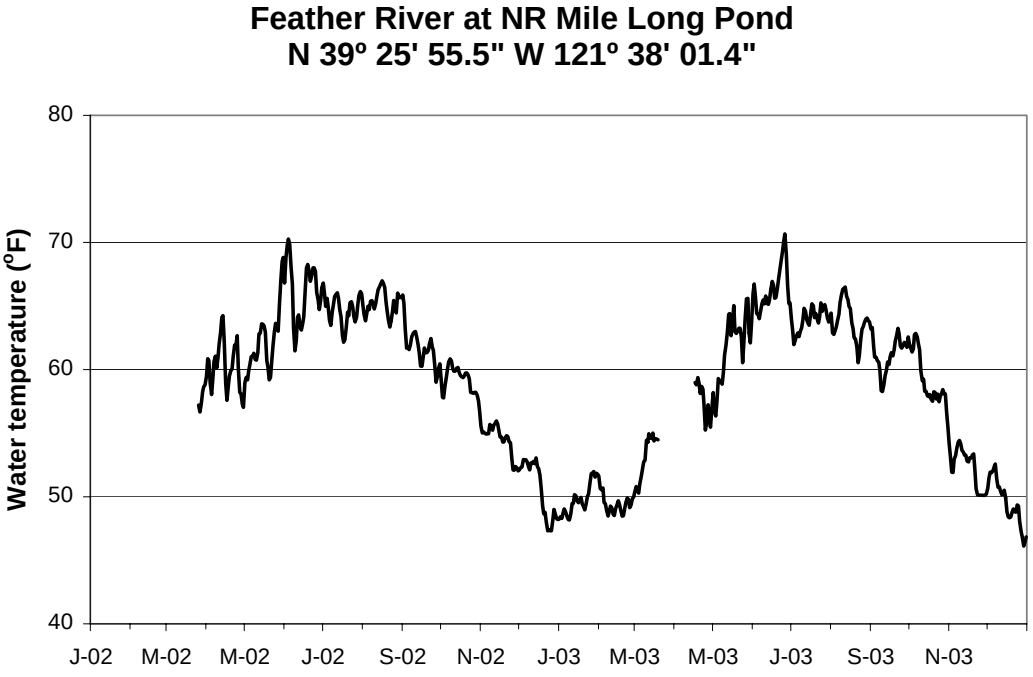

Figure A-16. Mean Thermograph Time Series at Feather River at NR Mile Long Pond (RM 57.3).

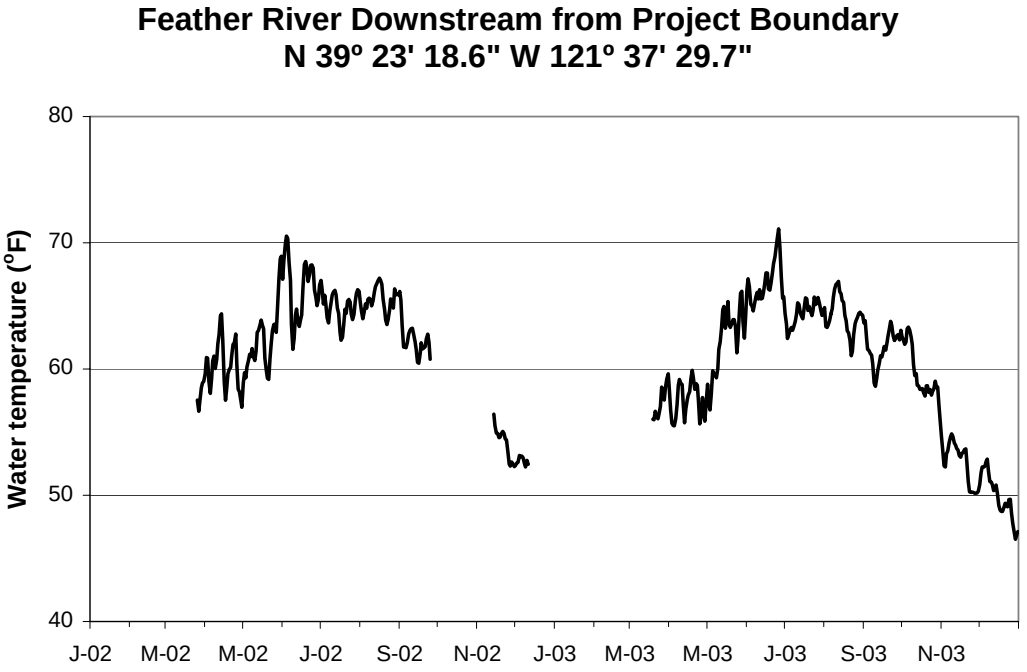

Figure A-17. Mean Thermograph Time Series at Feather River Downstream from Project Boundary (RM 53.5).

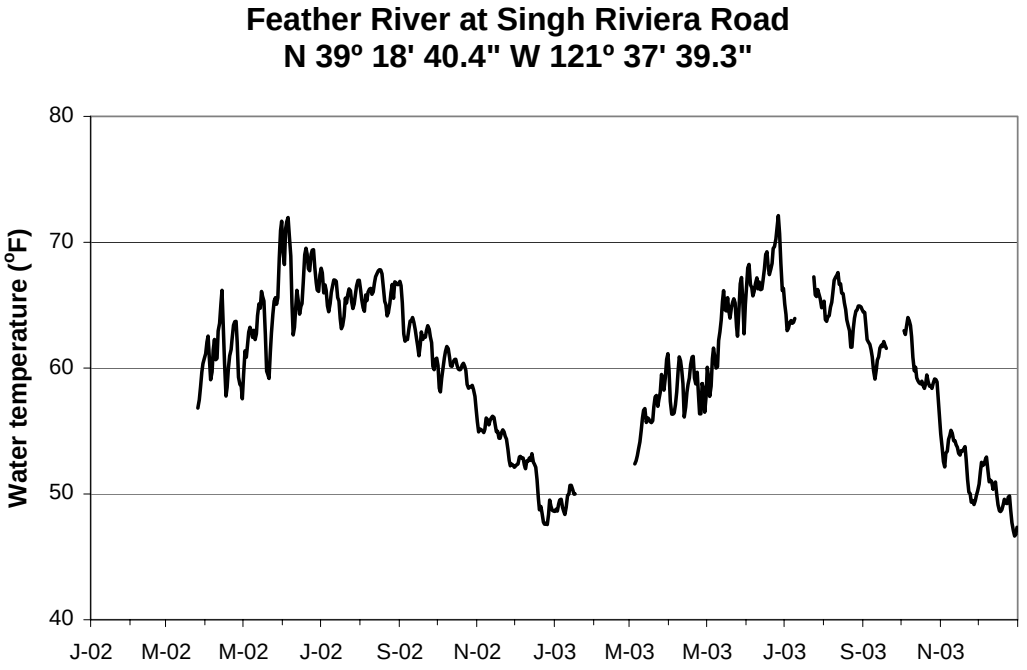

Figure A-18. Mean Thermograph Time Series at Feather River at Singh Riviera Rd. (RM 45.9).

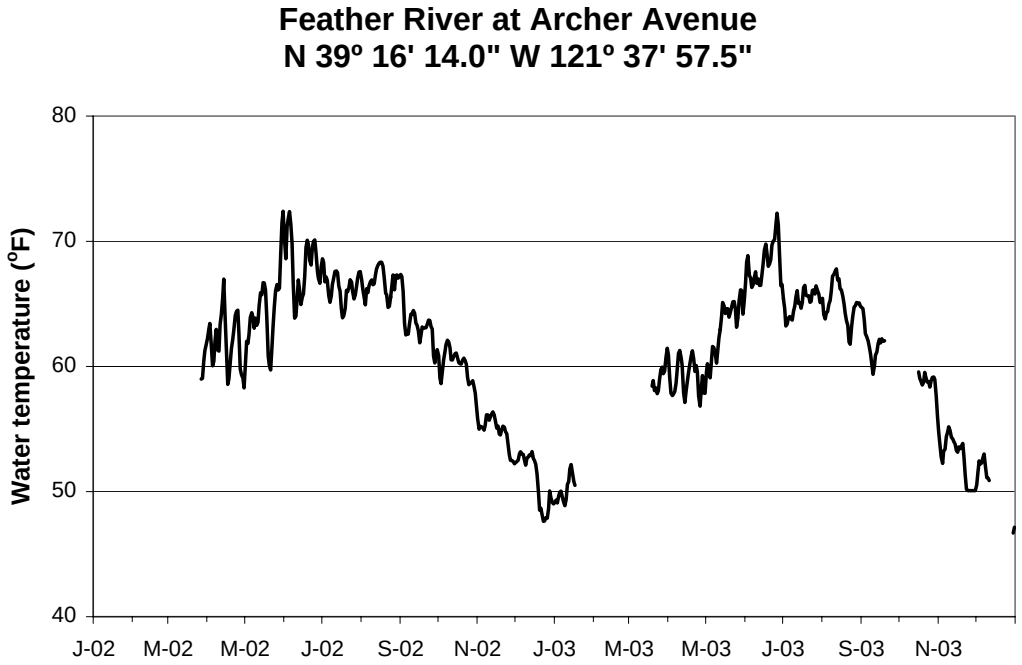

Figure A-19. Mean Thermograph Time Series at Feather River at Archer Avenue (RM 41.8)

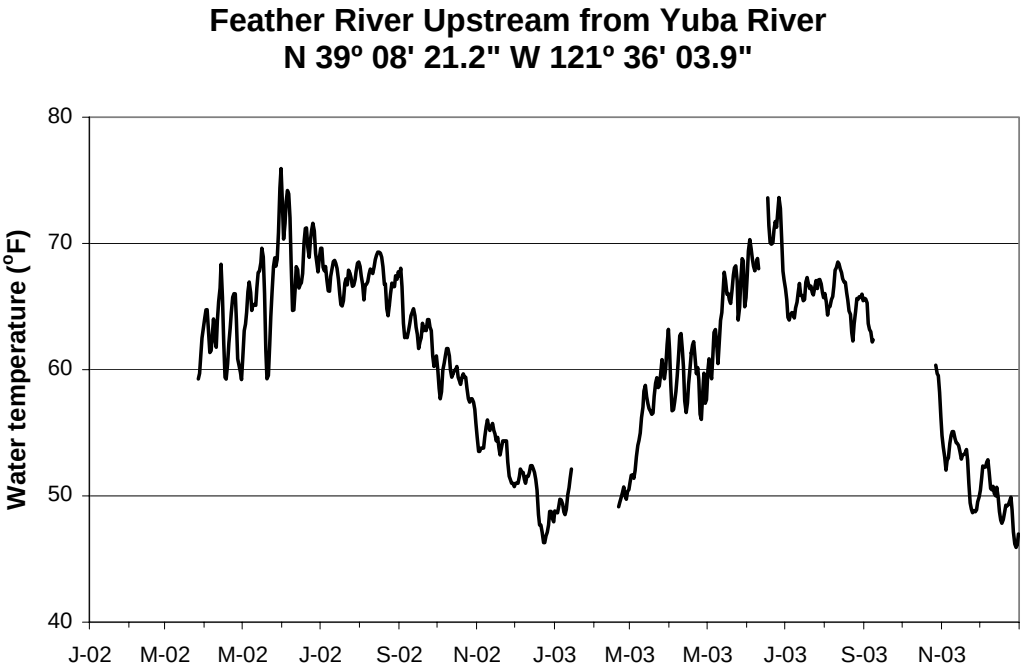

Figure A-20. Mean Thermograph Time Series at Feather River Upstream from Yuba River (RM 28.2).

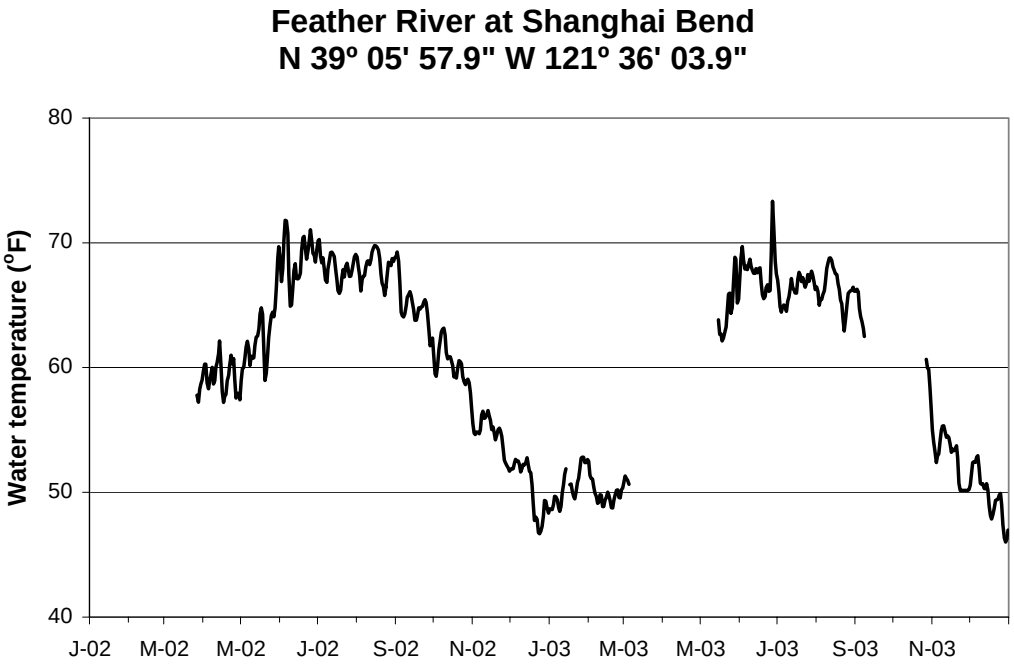

Figure A-21. Mean Thermograph Time Series at Feather River at Shanghai Bend (RM 25.2).

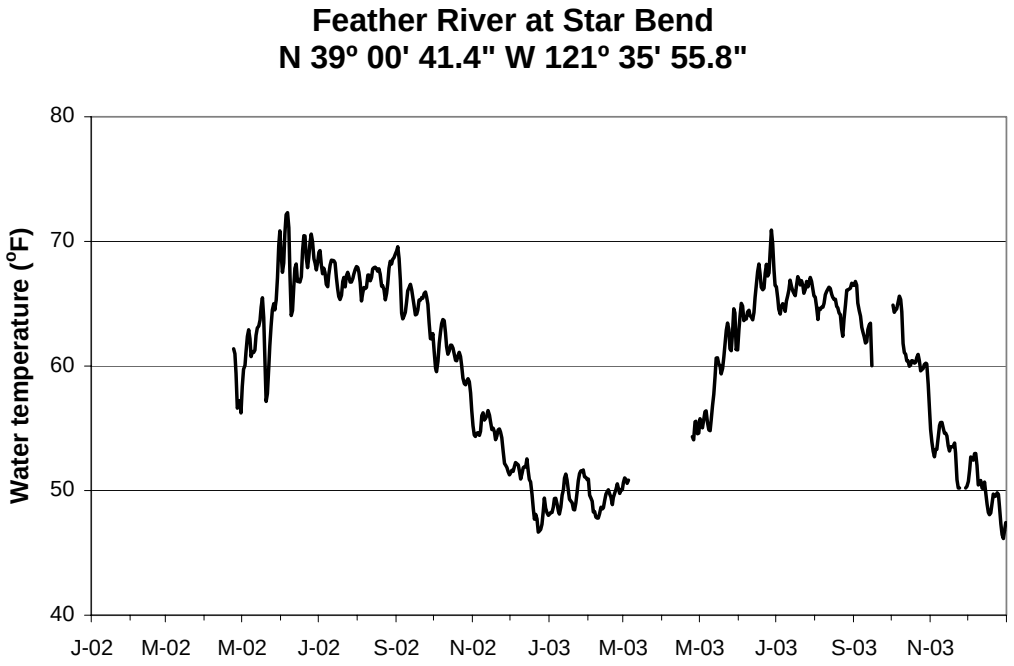

Figure A-22. Mean Thermograph Time Series at Feather River at Star Bend (RM 18.2).

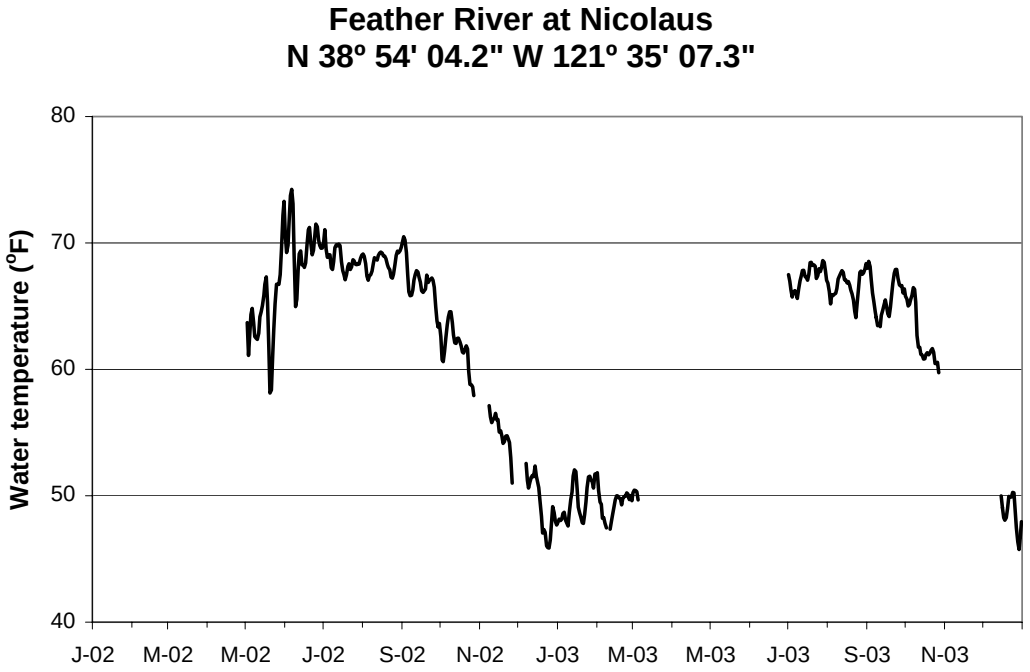

Figure A-23. Mean Thermograph Time Series at Feather River at Nicolaus (RM 9.3).

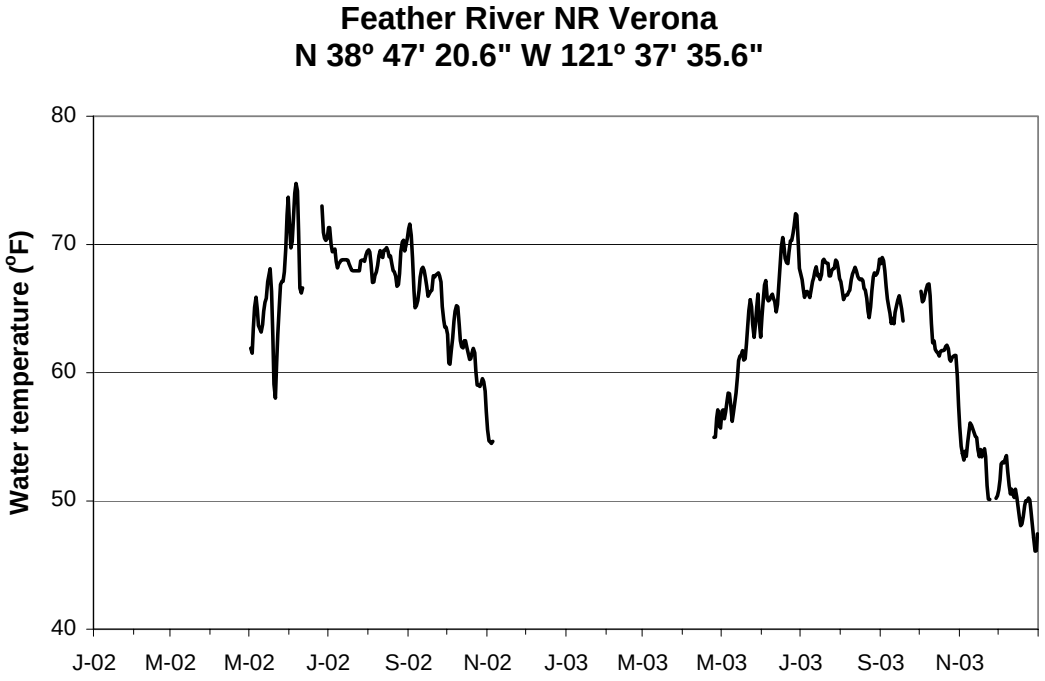

Figure A-24. Mean Thermograph Time Series at Feather River NR Verona (RM 0.3).