Bishop Creek Progress Report 2:
APPENDIX A - VEGETATION GUILD ANALYSIS TECHNICAL MEMO

TECHNICAL MEMORANDUM

DATE: April 14, 2020

TO: Southern California Edison

FROM: Edith Read

SUBJECT: Bishop Hydroelectric Project Riparian Guild Analysis Memorandum

1.0 Background and Purpose

Southern California Edison (SCE) owns and operates the Bishop Hydroelectric Project (Project) located west of Bishop on the eastern slope of the Sierra Nevada Mountains in Inyo County, California, under license from the Federal Energy Regulatory Commission (FERC), Project No. 1394-080. The project spans a range of elevations of nearly 1900 m (6200 ft), from Plant 6 (elev. 1380 m, 4530 ft) to Longley Lake (elev. 3260 m, 10,700 ft). Much of the project facilities are on Inyo National Forest (INF) land, while the land below Plant 4 is on private property or on land administered by the Bureau of Land Management (BLM). Although the Project has been in operation since 1913, the original 50-year operating license was not issued until 1940. The new license was issued in 1994, but anticipating that conditions of the license would require minimum flow releases as well as a long-term monitoring program, SCE began riparian studies in 1991 through 1993 prior to the flow releases (hereafter referred to as "baseline"). Subsequently, in compliance with license conditions, SCE continued monitoring at selected sites every five years after the releases began, with each year of study followed by a report of results and recommendations. The most recent monitoring season was in 2019. In February 2020, a draft report on the monitoring (Read, 2020) was submitted by SCE to agencies for review and comment.

The primary goal of the original monitoring program was to determine relationships, if any, between variations in stream flow and changes in riparian habitat attributable to the Project. In general, monitoring results have indicated that the minimum flow releases have been associated with significant growth of riparian vegetation in stream reaches that were historically dry in summer. These historically dry reaches are Bishop Creek between Plants 4 and 5, and McGee Creek below a small diversion dam. All other stream reaches studied, which had perennial flow before the releases began, have not exhibited any detectable changes in the riparian vegetation directly attributable to Project operations or variation in flow. However, at one site located in a narrow canyon upstream of Plant 3, cover of the riparian tree component dominated by black cottonwood (*Populus trichocarpa*) began declining in 2004 and this trend continued through 2019. Flow was perennial in this reach throughout monitoring so the reasons for decline are unknown. In the same year (2004), black cottonwood cover was also observed to decline at a site downstream of Plant 4 but as of 2019, cover was not significantly different from 2014 and appears to have stabilized.

As the current license is due to expire on June 30, 2024, SCE has initiated a formal relicensing process utilizing using FERC's Integrated Licensing Process. SCE has been meeting with stakeholders through of a series of Technical Working Group (TWG) meetings held in Bishop,

California, which began more than one year prior to formal initiation of the process with FERC and is still ongoing. Working with the various TWGs, Study Plans were developed and submitted to FERC. The Revised Study Plan was approved by FERC with the Study Plan Determination on November 4, 2019.

Among other studies requested by stakeholders, it was asked that the monitoring data be re-examined with a "guild" approach used by Lytle et al. (2017). This approach groups species according to commonalities in life history, rather than simple "either-or" categories of riparian vs. upland. The purpose of this report is to present methods and results of that analysis.

2.0 Methods

2.1 Field Data Collection

Figure 1 shows the six locations of the current monitoring sites for which complete datasets through 2019 were available for this analysis. Four sites 3, 4.1, 4.2, and 5 are located on Bishop Creek, with the remaining two sites on McGee Creek: lower McGee downstream of the diversion, and upper McGee upstream of the diversion. The sites on Bishop Creek were established at various times prior to 1990, and numbering of those sites was retained from previous studies for the sake of consistency in comparing results over time. Collectively for all of these sites, 28,637 records were examined in this analysis.

Methods of field data collection were described in the monitoring reports required under the existing license, the most recent of which is Read (2020). The methods relevant to the guild analysis are summarized below.

Permanent sampling locations were established in 1990, prior to the start of the baseline period. In order to provide continuity with an extensive geomorphic study conducted by Simons, Li & Associates (SLA 1990), monitoring transects were aligned with theirs as much as possible using their endpoints that were marked with reinforced bar (rebar). However, in 1990 the INF and SCE agreed that for riparian monitoring purposes, the transect endpoints should be extended inland, such that changes or expansion of the riparian vegetation zone over time could be detected. Each transect consisted of a belt five meters wide, placed perpendicular to the stream channel, and marked on one side by extending a long meter tape from the rebar on one bank to the matching rebar on the opposite bank.

Cover of all shrubs and trees within each belt transect was measured by tape reel. For estimation purposes, canopies were assumed to be elliptical in shape. Measurements of the long and short axes of the "ellipse" were recorded and cover calculated using the following standard formula for the area of an ellipse: $(\pi \times D_1 \times D_2)/4$, where D_1 and D_2 are the long and short axes of the canopy, in meters.

Herbaceous cover was measured in one-meter square quadrats nested within each belt transect. This quadrat size was selected based on previous experience with sampling

herbaceous communities, as the optimum size for representing species diversity – i.e. smaller quadrats would tend to undersample the number of species, and larger quadrats would not add significantly to the species count. Quadrat locations were established during the baseline period and used in all subsequent years. Selection of quadrat locations was based on representing the entire extent of each transect (i.e. placing a quadrat at the endpoint of each transect) as well as representing the riparian and upland zones on the left and right banks of the stream.

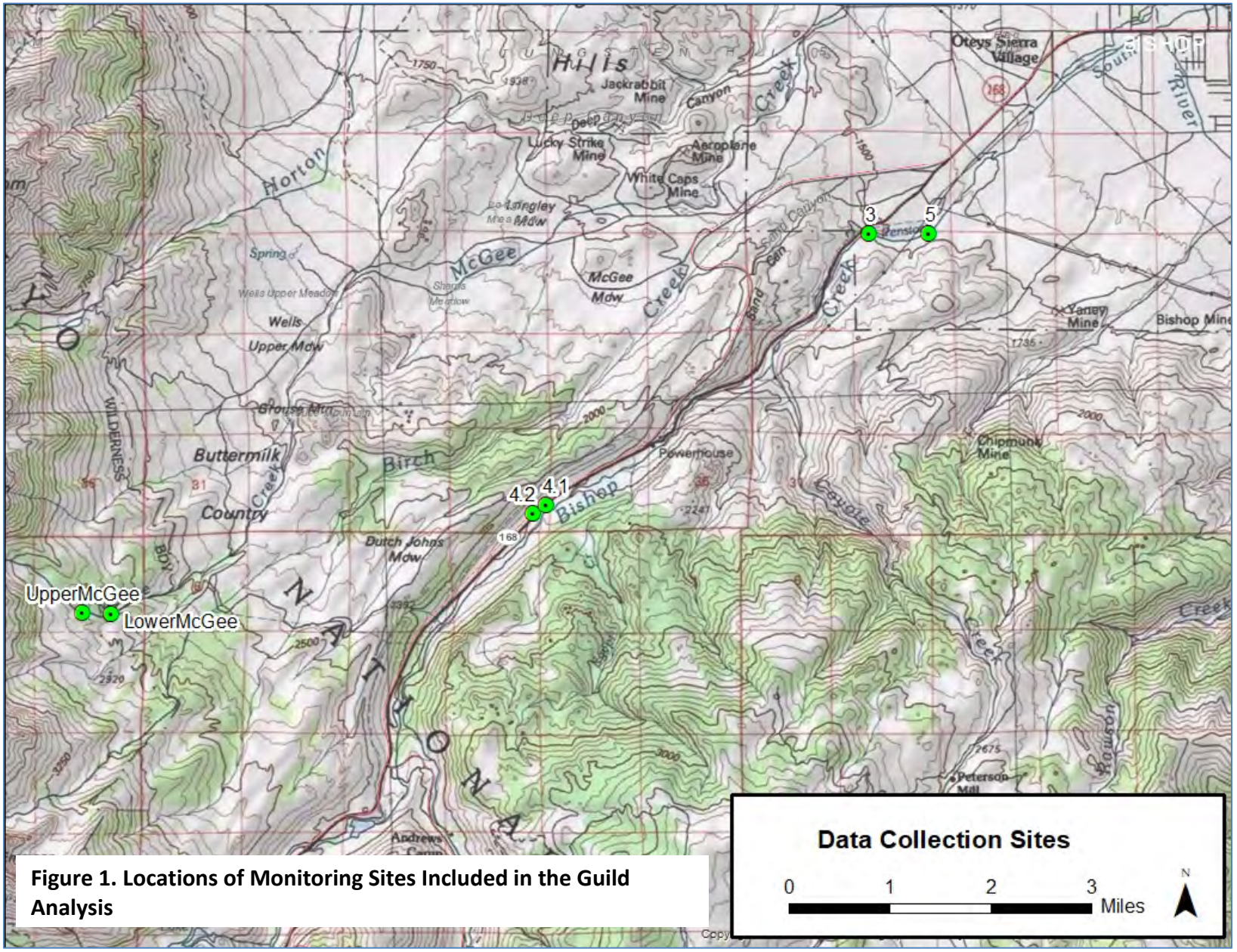


Figure 1. Locations of Monitoring Sites Included in the Guild Analysis

Only living plants rooted within transects were included in the cover calculations. Dead and dying trees and shrubs were not included in the cover calculations, but were included in mortality counts. Trees and shrubs rooted outside of transects but with canopy overlap into the transects were noted during the field work, as were plants rooted in the transect but with part of their canopy outside of the transect. These occurrences were evaluated as part of the data analysis and considered for their potential effect on the final cover value for each species. Openness of the canopy, especially for conifers, and similar deviations from the solid geometrical "ellipse" assumption were also noted and considered when comparing the relative abundance of each species within a transect.

It should be noted that assignment of water birch (*Betula occidentalis*) to the tree vs. shrub category was problematic as it is botanically classified as both. The 2019 surveys classified this species as a tree to be consistent with previous years.

2.2 Guild Definitions and Assignments

The Lytle et al. (2017) study used data collected on the Yampa River in the Colorado River Basin. The authors do not describe their study area with sufficient detail for us to assess similarities and differences from the Bishop Creek watershed. Therefore, while their guild definitions were used as a starting point, it was necessary to expand on these so that the wide range of plant species and hydrologic conditions in the Bishop Project area could be recognized in the analysis. The INF botanist provided input on the guild assignments based on a species list provided to them for this effort. It is also important to note that this analysis included only species native to California. Non-native and invasive species were not included.

Guilds used in this analysis with no change in definition from the Lytle et al. (2017) study:

> **Hydroriparian Shrub.** Active-floodplain specialist that has a high resilience to flooding. Recruits aggressively following floods, but prone to mortality in drought years. Examples from Bishop Creek: sandbar willow (*Salix exigua*), Geyer's willow (*S. geyeriana*), yellow willow (*S. lutea*). We note here that we included water birch (*Betula occidentalis*) in the hydroriparian shrub guild. While this species could also be botanically classified as a tree, field data show that its distribution in the Project area is limited to areas along stream banks immediately adjacent to flowing streams, and therefore fits the life history description of this guild.
>
> **Hydroriparian Tree**. Long-lived, flood-adapted species that depend on freshly scoured bare substrates for recruitment. Examples from Bishop Creek: black cottonwood (*Populus trichocarpa*), Fremont cottonwood (*Populus fremontii*), aspen (*Populus tremuloides*).

Guilds used in this analysis with <u>minor changes</u> in definition from the Lytle et al. (2017) study:

> **Mesoriparian Meadow**. The original definition included only perennial grasses and forbs that recruit during flood years, with mature plants moderately tolerant of flooding and drought. The authors of the study used Canada horseweed (*Conyza canadensis*) as an

example in this category, but in California this species is an annual, not a perennial. Therefore, native annual and perennial grasses and forbs were included in this category.

Additionally, for the purpose of the license-required monitoring program it was determined by the INF that the most objective method of assessing riparian classification was to use the National List of Plant Species that Occur in Wetlands as a starting point. This list has been updated several times since monitoring began, the most recent update being Lichvar et al. (2016).

Two categories of the 2016 list were used in analyzing the 2019 and previous data: the list for western valleys, mountains, and coast; and the list for the arid west. Annual and perennial grasses and forbs with a rank of Facultative Wetland or Obligate Wetland were assigned to the Mesoriparian Meadow guild. We also assigned herbs to this guild which are ranked as Facultative but field observation has indicated the species are primarily associated with riparian zones and seeps (e.g. Indian hemp, *Apocynum cannabinum*).

Upland Shrub. This category is a modification of the "desert shrub" category defined by Lytle et al. (2017) as "upland, drought-tolerant shrubs which continue to recruit and grow during drought years but suffer high mortality from floods." This was modified based on the fact that the range of shrubs such as big sagebrush (*Artemisia tridentata*) extends from the desert into most of the Project area and co-occurs with other communities such coniferous forest.

Guild not included in this analysis:

Xeroriparian shrub. The Lytle et al. (2017) study defined this guild as including species with a life history structure similar to hydroriparian trees but with deeper roots and shorter stems, and thus lower drought mortality rates, shorter age to maturity, and larger time window of fecundity. The authors' example of such a species was the non-native invasive salt cedar (*Tamarix* spp.). The only species in the Project area that comes close to fitting within this category, except for being a tree rather than a shrub, is black locust (*Robinia pseudoacacia*). It was determined that inclusion of non-native invasive species would not be meaningful for the purposes of this analysis.

Guilds added to this analysis:

Mesic Meadow. This guild includes shrubs and herbaceous species with a wetland rank of Facultative, Facultative Wetland, and Obligate that have been observed in the INF to be associated with mesic conditions within, but also outside of, the riparian zone, such as snowmelt depressions and seeps.

Upland Herbs and Upland Trees. These guilds were included as it was determined that the Upland Shrub guild alone excluded too many taxa that also benefit from years of

above-normal precipitation and (in the case of trees) higher groundwater tables and accretion flows. Two examples are Jeffrey pine (*Pinus jeffreyi*) and ponderosa pine (*Pinus ponderosa*), which have been observed to be largely restricted to stream floodplains and canyons in the Project area. If, for example, abundance of hydroriparian shrubs or trees changes over time, but abundance of upland guilds also changes in parallel, it is possible that these changes are attributable to environmental factors that are outside of the control of the Project.

3.0 Results and Discussion

Appendices 1 and 2 graphically portray results of the analysis. For consistency and to make comparisons easier, the X-axis of all graphs includes all guilds regardless of whether or not a particular guild occurs at a given site – in such a case, canopy cover will show as zero.

The graphs are divided into two sets because their hydrologic regimes differed during the baseline period when monitoring began. The first set, in Appendix 1, consists of three sites that were historically dry in summer prior to the flow releases, except in years of above-normal precipitation: Sites 3 and 5 between Plants 4 and 5, and McGee Creek below the diversion. The second set, in Appendix 2, consists of three sites that have had perennial flow, even during the baseline period of 1991 through 1993: Sites 4.1 and 4.2 upstream of Plant 3, and McGee Creek above the diversion but downstream of Longley Lake.

In all graphs, baseline data are represented by hollow columns. Post-baseline data are represented by filled columns.

Data summary for sites summer-dry in two of three baseline years, perennial flow post-baseline (Appendix 1)

The most change in native species abundance in stream reaches that were perennialized post-baseline was in the guilds of mesoriparian meadow herbs and hydroriparian shrubs. At all three sites, abundance of mesoriparian meadow herbs increased post-baseline to a range of between five and nine percent by 2014. However, the 2019 data indicate the perilous situation of this guild, which is largely confined to the stream edge, when flows are significantly above normal. Many sample plots were flooded and no herbs were observed, bringing the total cover value down below five percent. Hydroriparian shrubs, consisting of shrubby willows and water birch, increased in abundance post-baseline and their woody roots made them more resilient to flooding and scour compared to the herbs. While baseline cover by this guild never exceeded six percent at any of these three sites, post-baseline cover ranged from about eight percent at Site 5 to about 17 percent at Site 3 and 19 percent at Lower McGee.

Data summary for sites with perennial flow, baseline and post-baseline (Appendix 2)

Two of three sites in this category, namely Bishop Creek Site 4.2 and Upper McGee, were the only sites where species in the mesic meadow guild have been recorded, albeit with cover values well below five percent. However, as with species in the mesoriparian meadow herb guild, abundance declined significantly in 2019 with scouring flows. Abundance of hydroriparian

trees was generally in the range of the baseline years except at Site 4.2, where cover of black cottonwood declined in 2019 while cover by upland shrubs and trees increased.

4.0 Conclusions and Recommendations

The guild classifications provide insight into changes in diversity over time, as compared to lumping taxa into simple riparian vs. upland categories. The guild analysis also helps emphasize the fact that higher stream flows do not necessarily affect all riparian species in the same way – for example, mesoriparian meadow herbs are less resilient to flooding than hydroriparian shrubs and trees. However, results of this analysis were consistent with those from previous monitoring, insofar as perennialization of stream reaches was observed to result in increased abundance of riparian species.

5.0 Literature Cited

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin, 2016. The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30: 1-17.

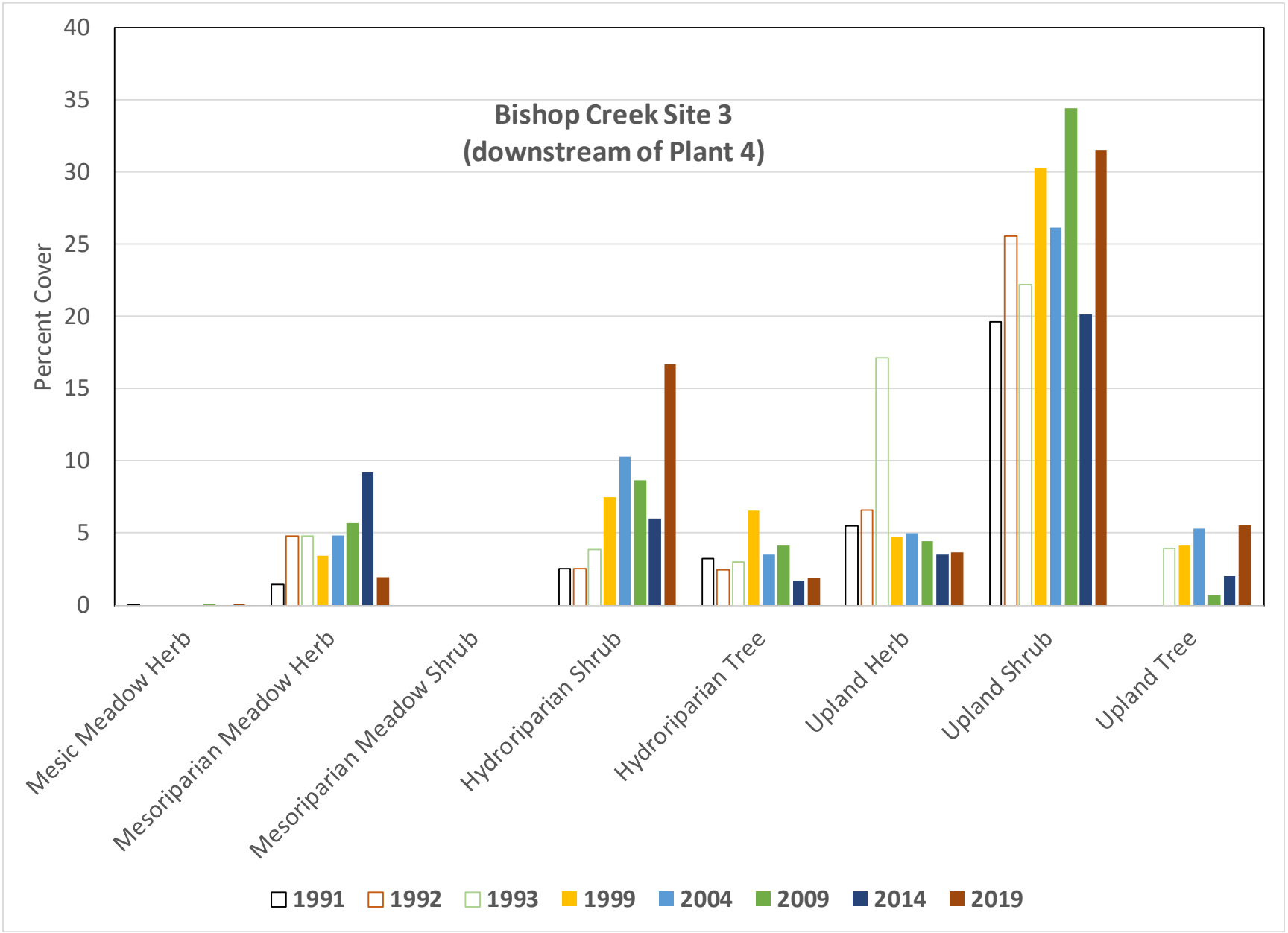
Lytle, D.A., D.M. Merritt, J.D. Tonkin, J.D. Olden, and L.V. Reynolds, 2017. Linking river flow regimes to riparian plant guilds: a community-wide modeling approach. Ecological Applications 27(4), 2017, pp. 1338-1350.

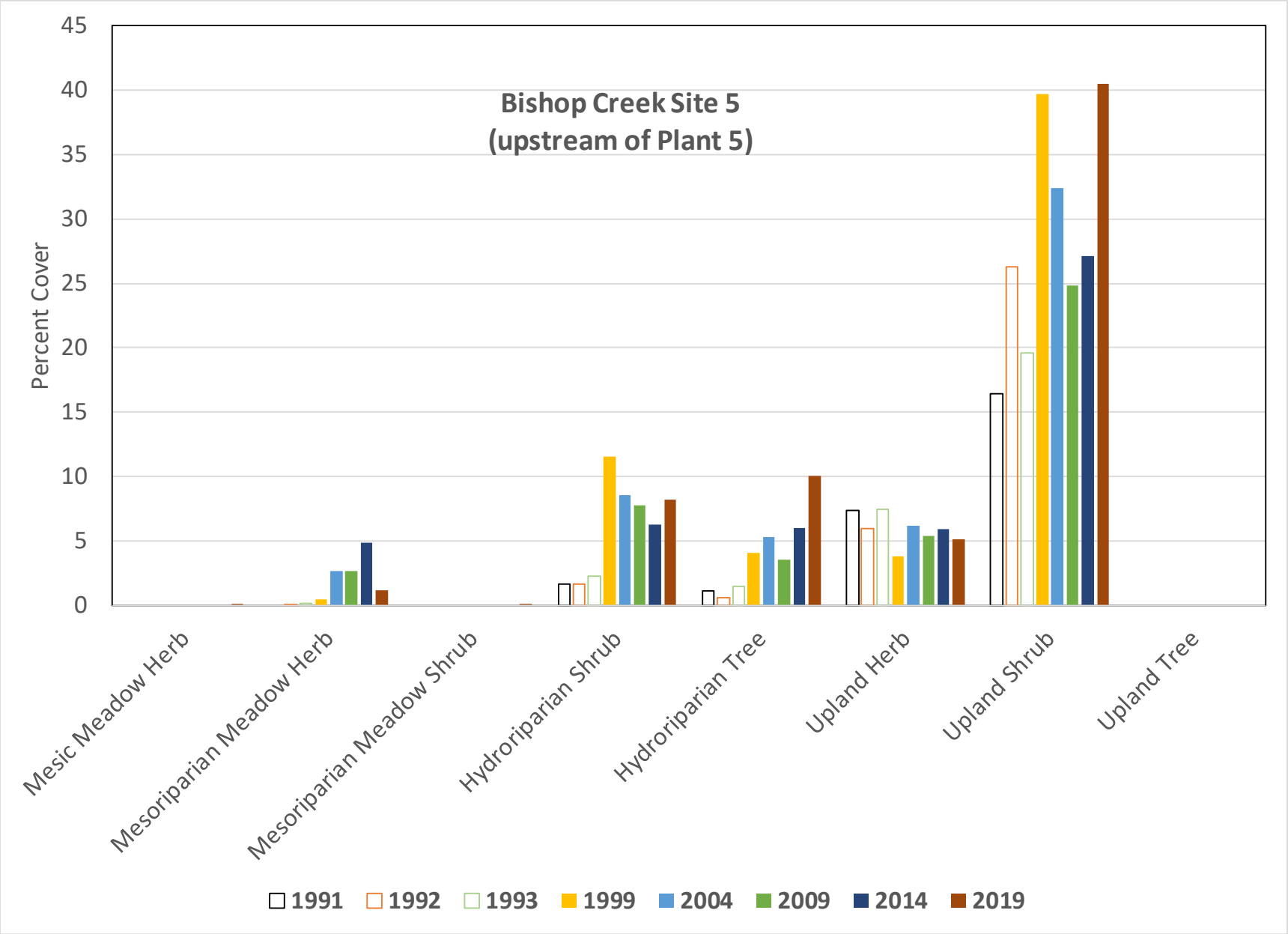
Read, E., 2020. Bishop Hydroelectric Project (FERC No. 1394): Riparian Monitoring Results for 2019 and Comparison to Previous Years. Draft dated February 20, 2020. Prepared for Southern California Edison.

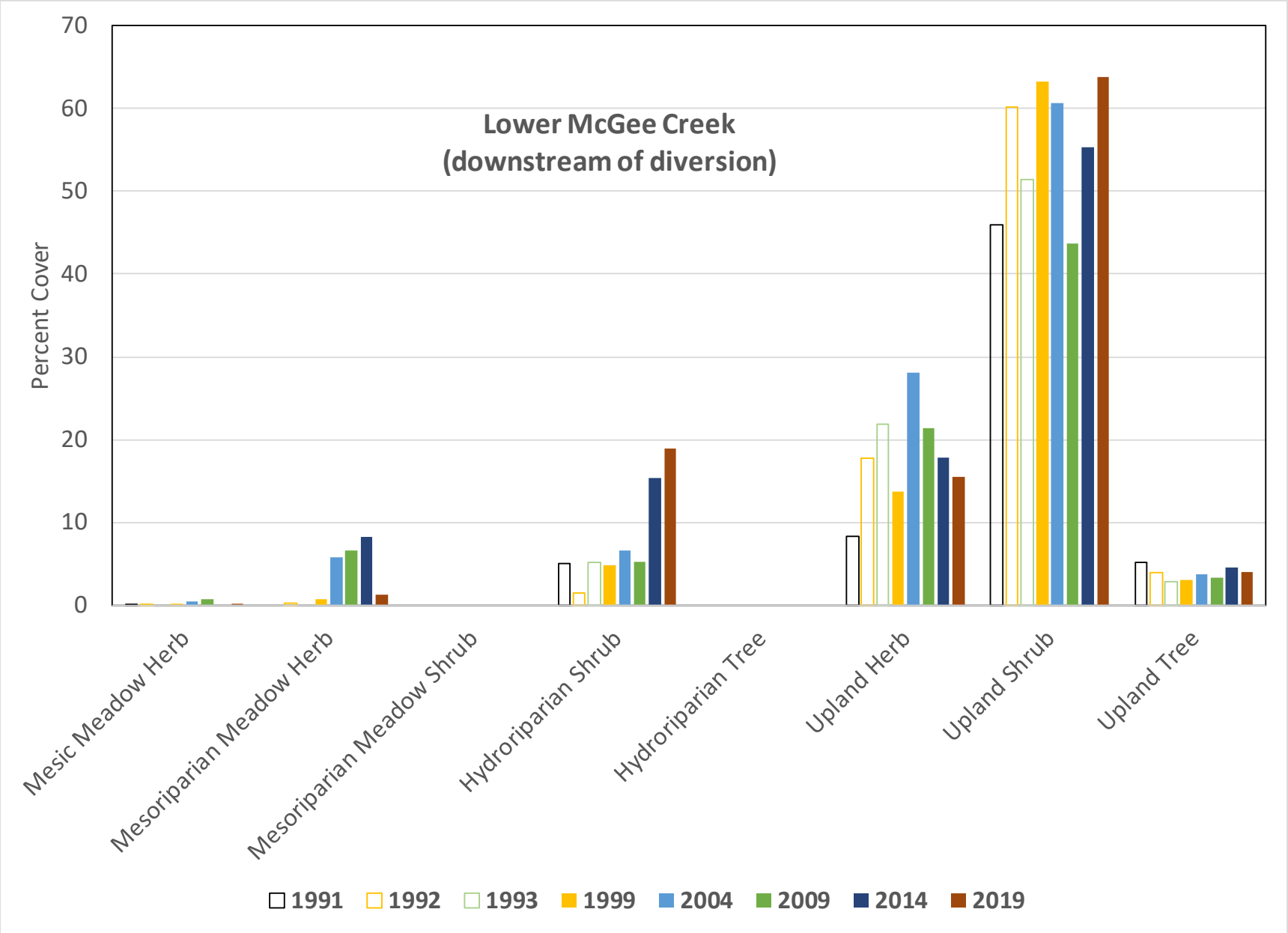
Simons, Li & Associates Inc. (SLA), 1990. Evaluation of Stream Channel Processes and the Growth of Riparian Vegetation, Bishop Creek, California. Technical report submitted to Southern California Edison.

Appendix 1

Guild Analysis Results for Historically Ephemeral Stream Reaches, Perennial Beginning in 1994

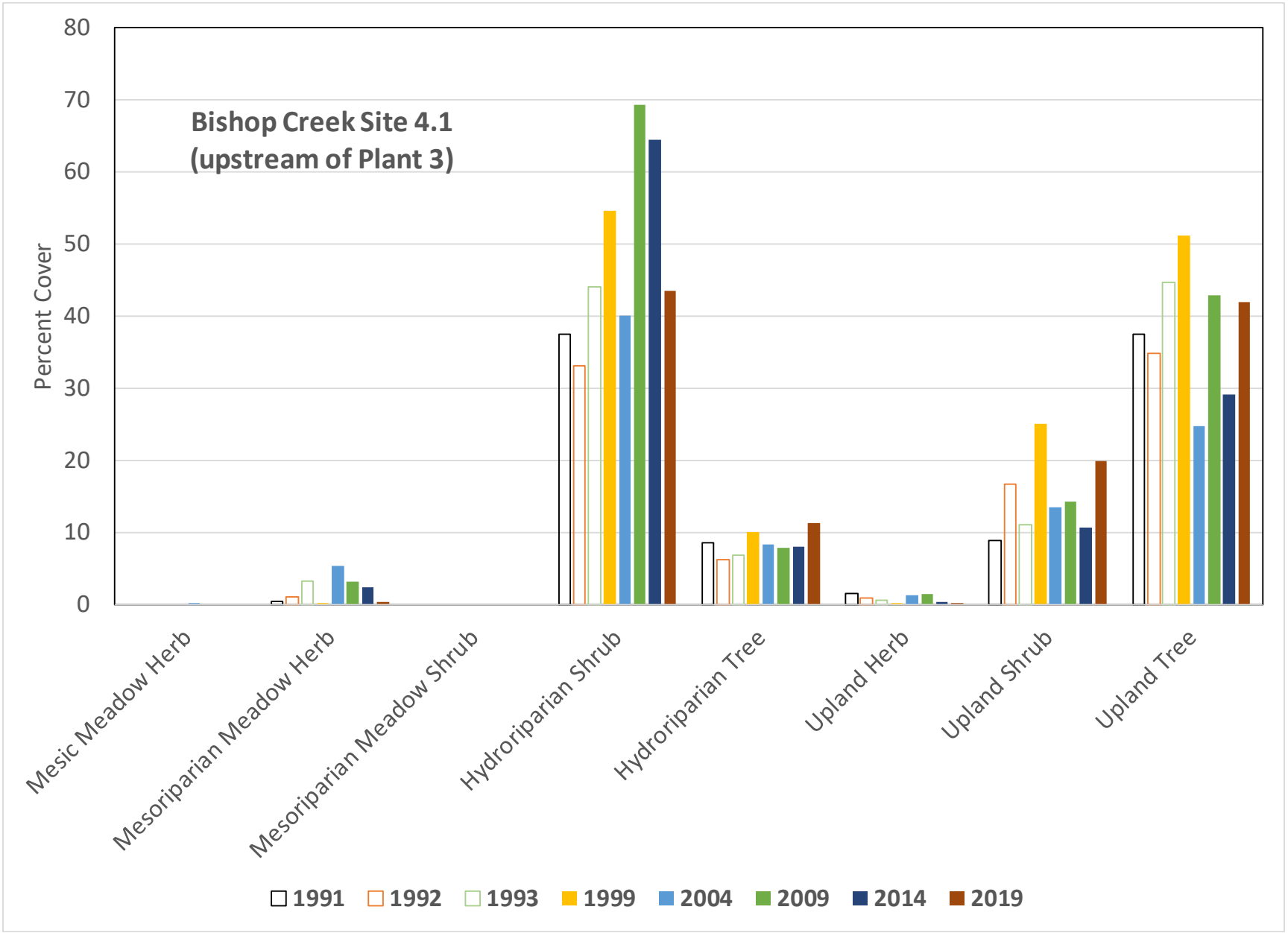

Bishop Creek Site 3
(downstream of Plant 4)
Percent Cover
40
35
30
25
20
15
10
5
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019

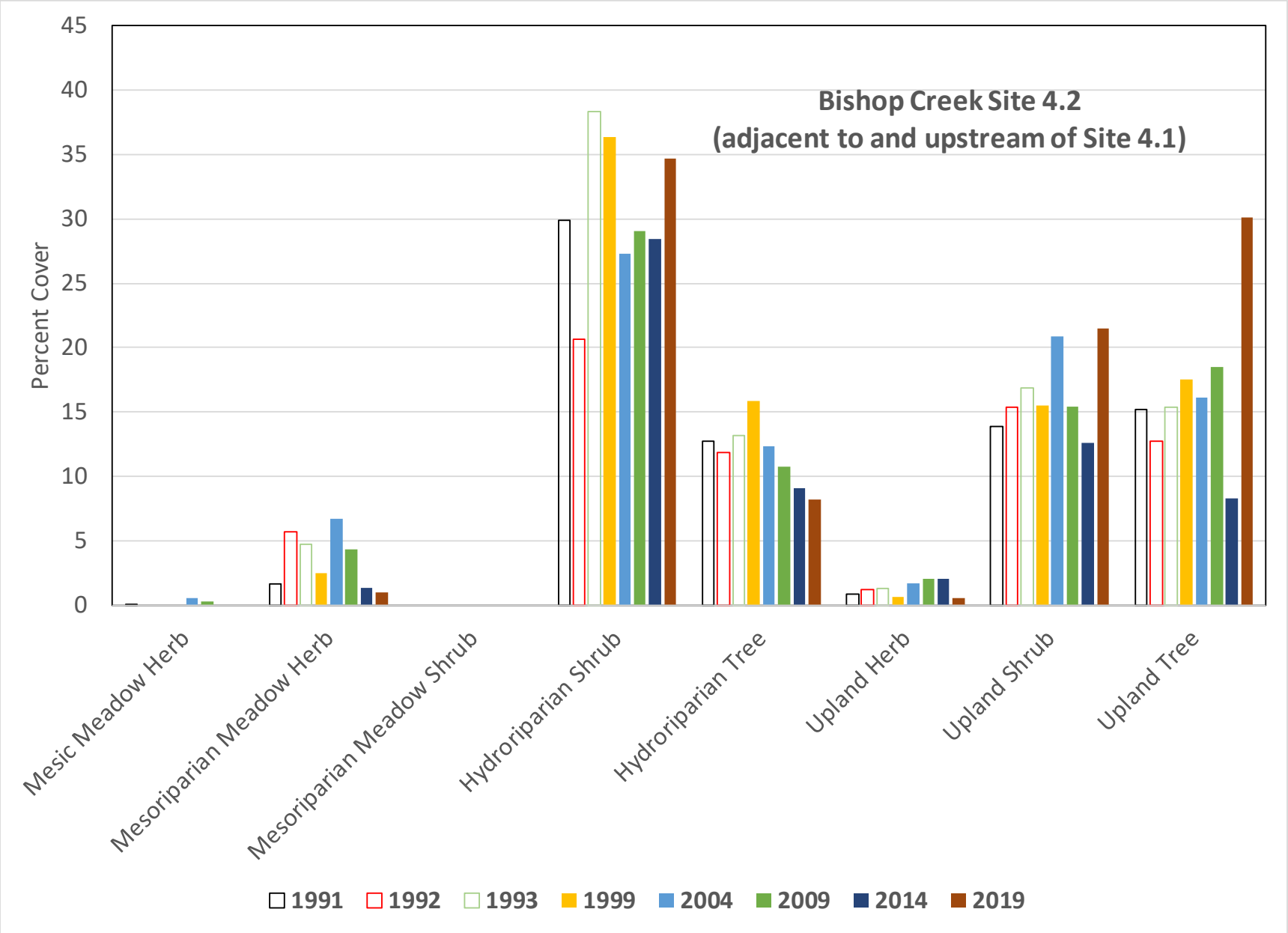

Bishop Creek Site 5
(upstream of Plant 5)
Percent Cover
45
40
35
30
25
20
15
10
5
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019

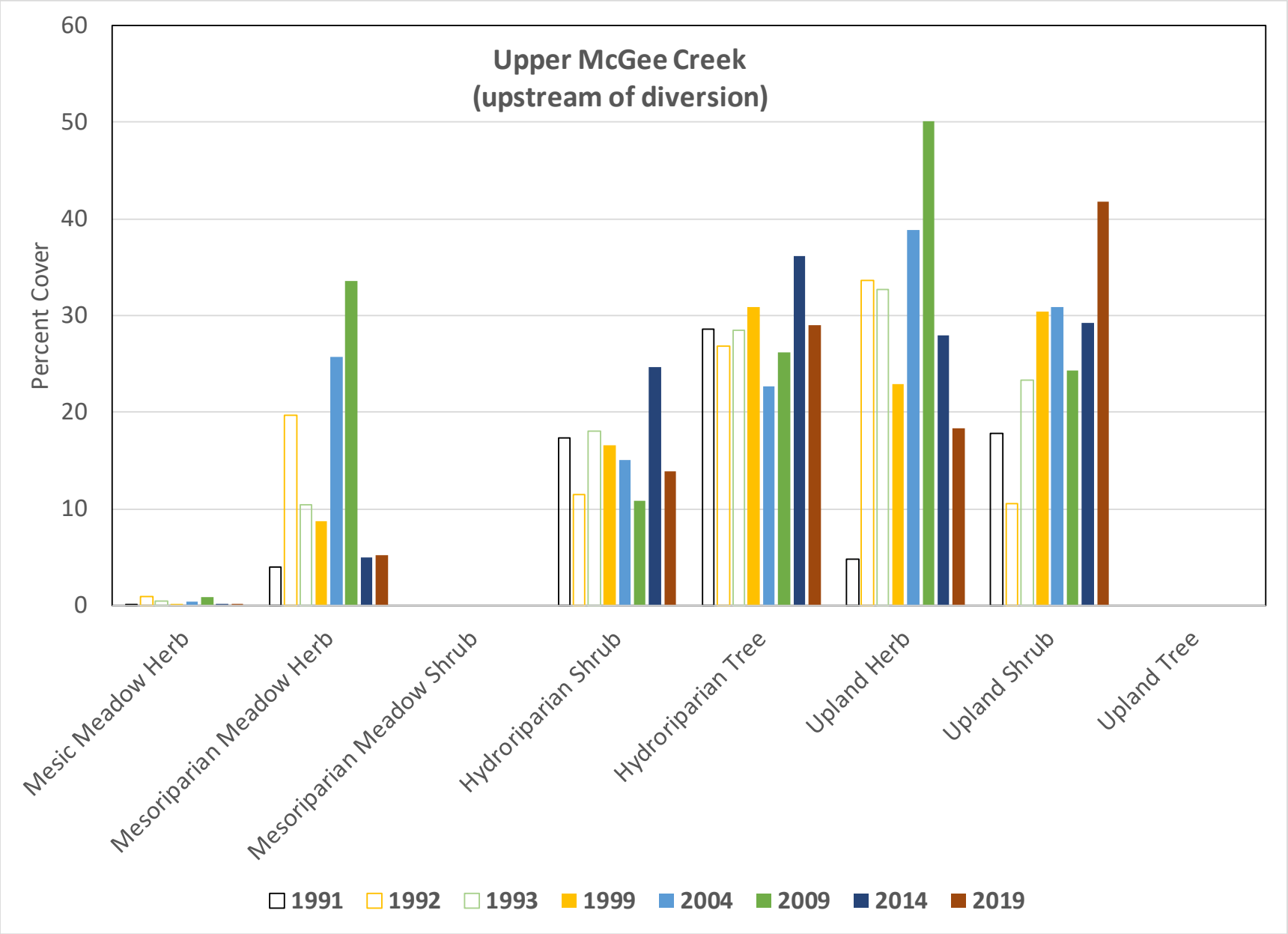

Lower McGee Creek
(downstream of diversion)
Percent Cover
70
60
50
40
30
20
10
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019

Appendix 2

Guild Analysis Results for Stream Reaches with Perennial Flow (Historical and Current)


Bishop Creek Site 4.1
(upstream of Plant 3)
Percent Cover
80
70
60
50
40
30
20
10
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019


Bishop Creek Site 4.2
(adjacent to and upstream of Site 4.1)
Percent Cover
45
40
35
30
25
20
15
10
5
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019


Upper McGee Creek
(upstream of diversion)
Percent Cover
60
50
40
30
20
10
0
Mesic Meadow Herb
Mesoriparian Meadow Herb
Mesoriparian Meadow Shrub
Hydroriparian Shrub
Hydroriparian Tree
Upland Herb
Upland Shrub
Upland Tree
1991
1992
1993
1999
2004
2009
2014
2019