Benthic Macroinvertebrate Bioassessment

Data Summary Memo

2016

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List of Acronyms

Acronym	Definition
MBNEP	Morro Bay National Estuary Program
BMI	Benthic Macroinvertebrate
EPT	Ephemeroptera, Plecoptera, and Trichoptera
SoCal IBI	Southern California Coastal Index of Biotic Integrity
WY	Water Year (Oct 1st – Sep 30th, named for year in which it ends)

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Introduction

The Morro Bay National Estuary Program (MBNEP) is a nonprofit organization that brings together citizens, local governments, nonprofits, agencies, and landowners to protect and restore the Morro Bay estuary and the lands that surround it. The monitoring conducted by staff and volunteers has two main goals: 1) Assess long-term ambient trends, 2) Track the effectiveness of specific implementation projects, and 3) To establish protection and restoration targets.

This report summarizes the results of aquatic bioassessment using benthic macroinvertebrates (BMIs) during the 2016 water year (WY2016). BMIs are organisms that live in the bottoms of streams and rivers, are composed mainly of insects, and are a reliable indicator of biological health (SWAMP 2017).

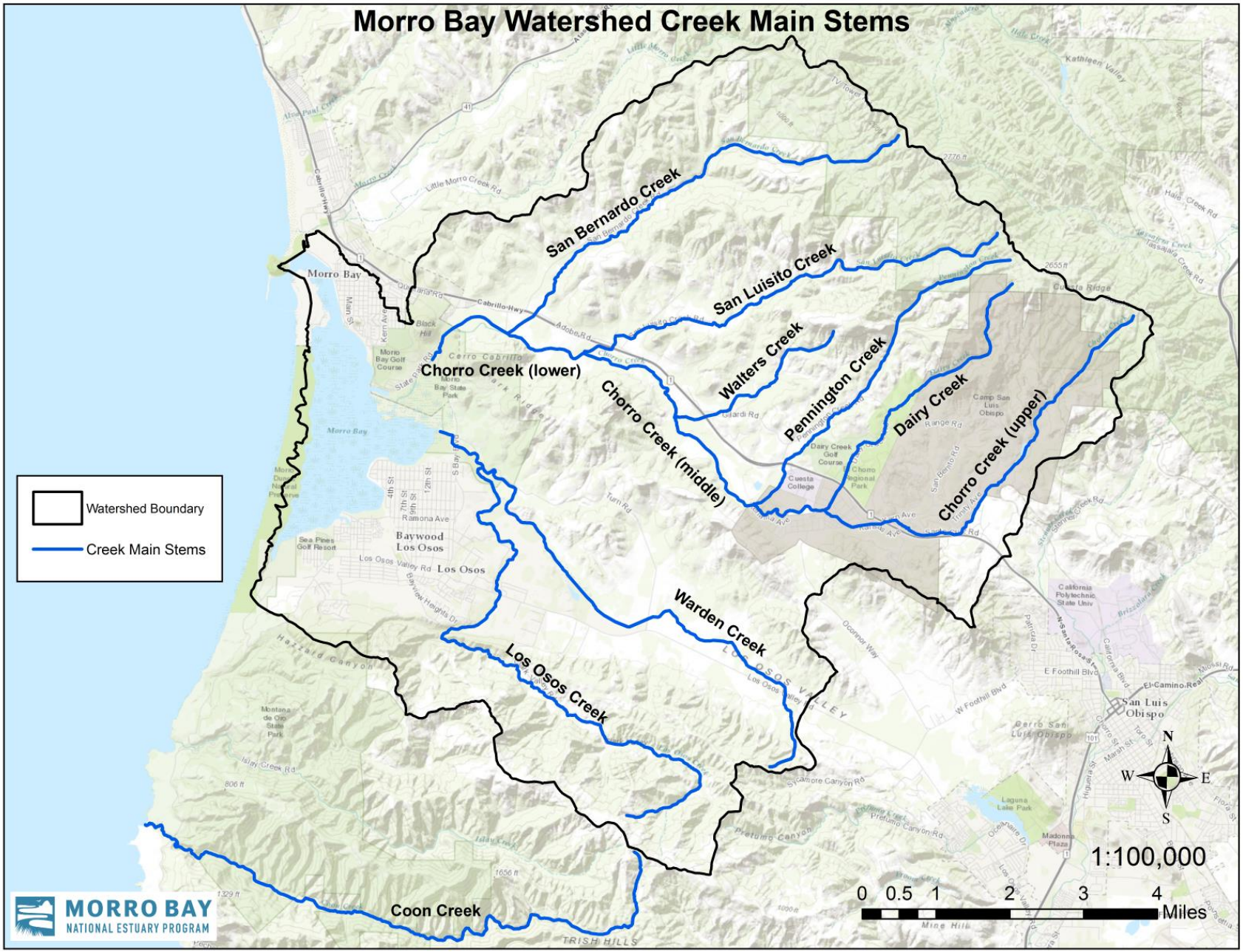
Bioassessment monitoring incorporates physical, chemical, and biotic factors into a quantitative measurement of the overall ecological health of a waterbody. The results of these surveys can be used to measure and assess impacts to surface water ecosystems over time.

This report summarizes four primary metrics used to determine waterbody health: taxa richness, EPT richness, percent EPT, and IBI Score. Bioassessment surveys were conducted by MBNEP staff and volunteers at eight locations throughout the Morro Bay watershed during WY2016. Table 1 highlights these eight sites in blue and identifies the rest of the bioassessment sites where monitoring has occurred in the past. The watershed, as shown in Figure 1, is approximately 77 square miles and is largely dominated by agricultural uses, but does have urban land use primarily along the coast. Rainfall records from the nearby university, California Polytechnic State University, San Luis Obispo, reports that the area surrounding San Luis Obispo receives an average of 21.83 inches of rain per year (Cal Poly San Luis Obispo 2017). This gauge is located approximately nine miles from the center of the Morro Bay watershed.

Table 1. MBNEP Bioassessment Sites, with WY2016 sites in blue.

Site Code	Site Description
TWB	Lower Chorro Creek
CER	Middle Chorro Creek
CHD	Upper Chorro Creek
MNO	San Bernardo Creek
USB	Upper San Bernardo Creek
LSL	Lower San Luisito Creek
USL	Upper San Luisito Creek
WAL	Walters Creek
PEN	Lower Pennington Creek
UPN	Upper Pennington Creek
DAL	Lower Dairy Creek
DAM	Middle Dairy Creek
DAU	Upper Dairy Creek
LVR	Los Osos Creek
CLK	Upper Los Osos Creek
COO	Coon Creek

Figure 1. Morro Bay Watershed boundary and the main stem creek segments.



Methods

All sampling followed the *Standard Operating Procedures (SOP) for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat* (Ode, P.R., A.E., Fetscher, and L.B. Busse. 2016) established by the Surface Water Ambient Monitoring Program (SWAMP). Due to limited sampling resources, the MBNEP does not conduct the algae collection module.

This method involves monitoring a 150-meter reach at each creek site using the reach-wide benthos procedure. Measurements and observations on substrate, water depth, canopy cover, bank stability, and other physical parameters were taken at each of 11 equidistant transects and 10 inter-transects. Macroinvertebrate samples were collected from each transect, rotating between the margins and center of the creek. The samples were composited into a single sample and sent to EcoAnalysts, Inc. for analysis according to SWAMP SAFIT Level 2 taxonomy protocols. The samples were sorted and counted until 600 organisms were identified, and a count was provided of the individual taxa as well as several calculated metrics.

These calculated metrics include taxa richness, EPT richness, EPT%, and IBI score. Taxa richness is a measure of the number of different species of organisms in the sample. EPT richness is a measure of the total number of taxa within the sensitive orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT% is the percentage of EPT individuals within the total number of individuals in the sample. The Index of Biotic Integrity (IBI) score used in this report is the Southern California Coastal IBI (SoCal IBI) developed by the Aquatic Bioassessment Laboratory of the California Department of Fish and Wildlife. Seven uncorrelated biotic measurements were selected to be included in the calculation. They include collector-gatherer and collector-filterer individuals, percent non-insect taxa, percent tolerant taxa, coleoptera richness, predator richness, percent intolerant individuals, and EPT richness. The SoCal IBI score is applicable in a range from San Diego to Monterey and closely tracks the jurisdictions of Regional Water Quality Control Boards 3, 4, 8, and 9. As shown in Table 4, IBI scores of 0–19.99 are considered to be very poor, 20–39.99 are poor, 40–59.99 are fair, 60–79.99 are good, and 80–100 are very good.

Results

The following tables, graphs, and maps summarize the results of the WY2016 bioassessment monitoring and provide context for the results by comparing them to historical bioassessment metrics.

Taxa richness, EPT richness, EPT %, and IBI scores from the most recent three-year period (2014–2016) are displayed below in Table 2. These are specific to the eight sites monitored in 2016. An "x" indicates that no monitoring occurred. Additionally, Figures 2 to 5 show trends in these four metrics over the same time frame. Typically, taxa richness and EPT richness decrease with poor water quality.

Table 2. Results of Taxa Richness, EPT Richness, EPT%, and SoCal IBI scores for 2014-2016.

Site	Year	Taxa Richness	EPT Richness	EPT %	SO CA IBI
TWB (Lower Chorro)	**2014**	41.00	4.00	6.93	41.43
	2015	31.00	0.00	0.00	24.29
	2016	42.00	2.00	2.92	30.00
CER (Middle Chorro)	**2014**	34.00	6.00	3.24	30.00
	2015	42.00	9.00	11.90	32.86
	2016	47.00	5.00	12.94	18.57
CHD (Upper Chorro)	**2014**	x	x	x	x
	2015	63.00	14.00	13.04	50.00
	2016	58.00	15.00	24.66	50.00
MNO (San Bernardo)	**2014**	46.00	3.00	3.35	44.29
	2015	57.00	5.00	4.30	48.57
	2016	70.00	16.00	23.59	71.43
LSL (Lower San Luisito)	**2014**	44.00	8.00	4.31	55.71
	2015	54.00	14.00	17.83	67.14
	2016	44.00	15.00	31.99	65.71
USL (Upper San Luisito)	**2014**	44.00	16.00	6.53	65.71
	2015	52.00	19.00	12.81	68.57
	2016	66.00	23.00	27.63	80.00
UPN (Upper Pennington)	**2014**	73.00	20.00	17.63	78.57
	2015	53.00	10.00	16.07	61.43
	2016	73.00	14.00	15.95	72.86
PEN (Lower Pennington)	**2014**	x	x	x	x
	2015	x	x	x	x
	2016	64.00	10.00	19.53	54.29

The following figures contain the taxa richness data. For Figures 2 to 5, the absence of a bar indicates that monitoring was not conducted. A score of zero is indicated by a label.

Figure 2. Taxa richness data for 2014-2016 bioassessment monitoring.

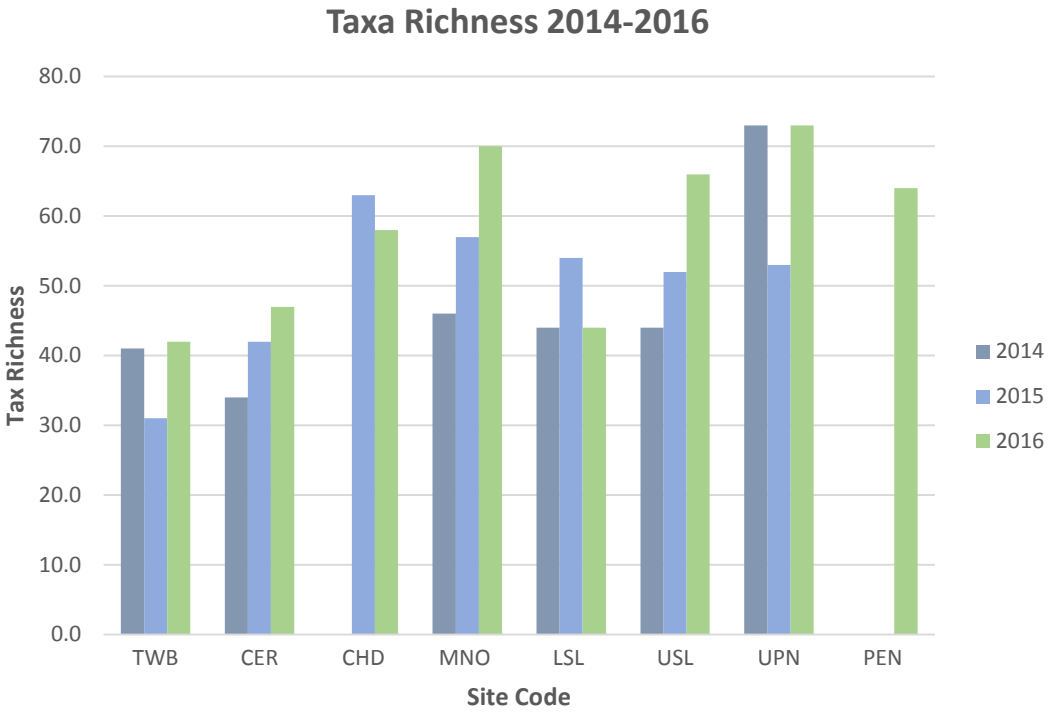


Figure 3. EPT richness data for 2014-2016 bioassessment monitoring.

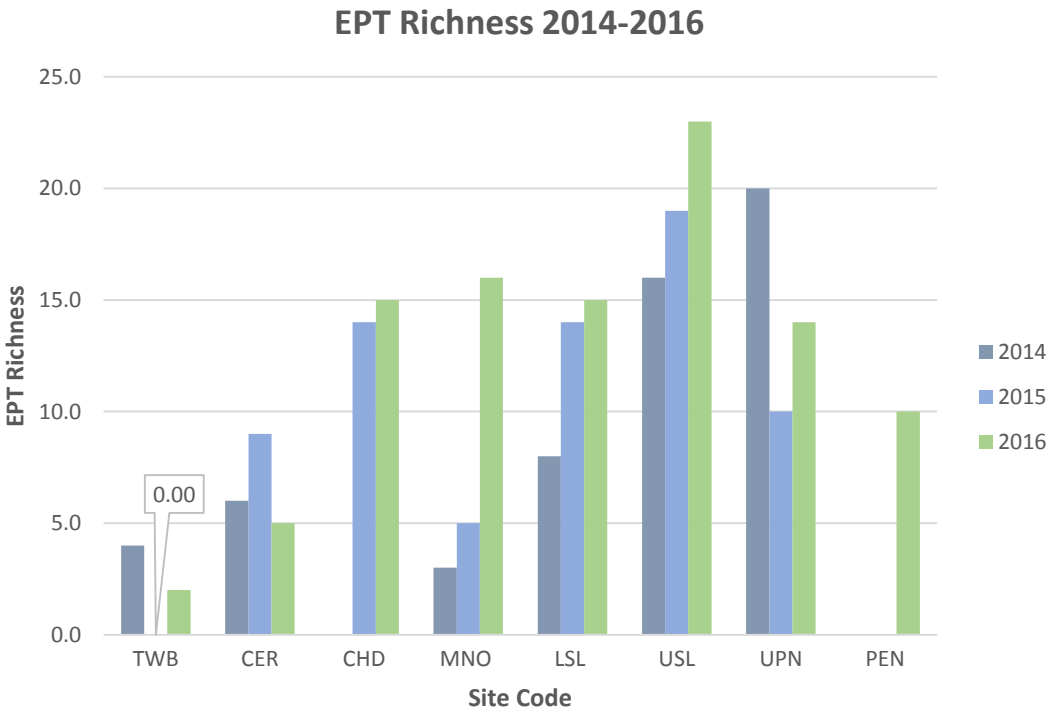


Figure 4. Percent EPT data for 2014-2016 bioassessment monitoring.

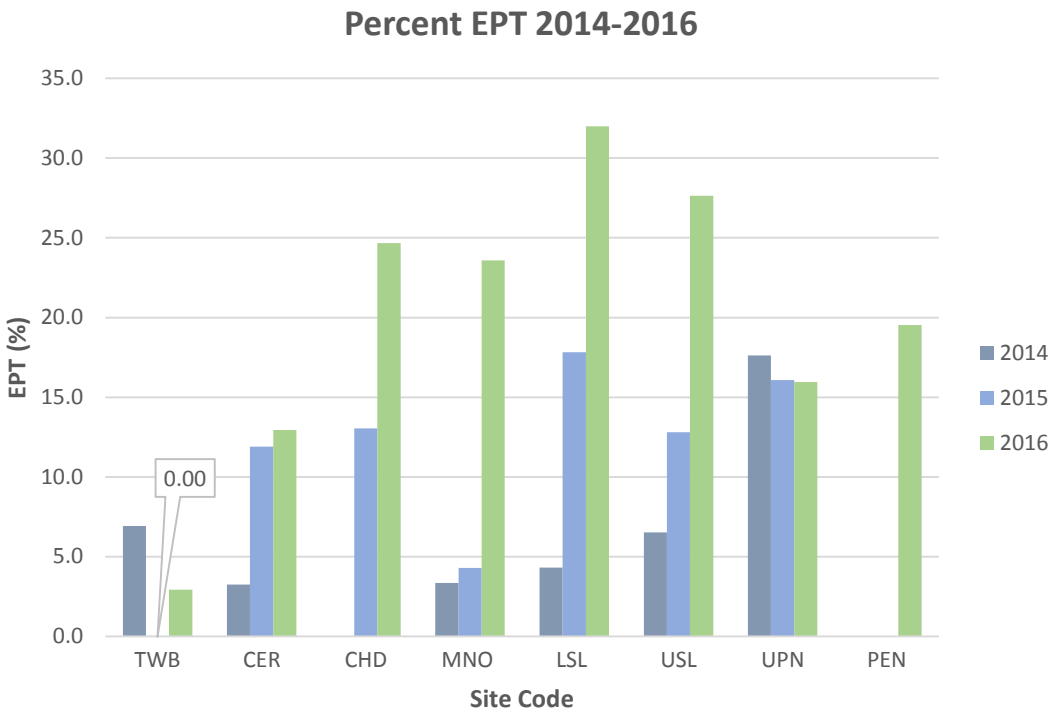


Figure 5. SoCal IBI scores for 2014-2016 bioassessment monitoring.

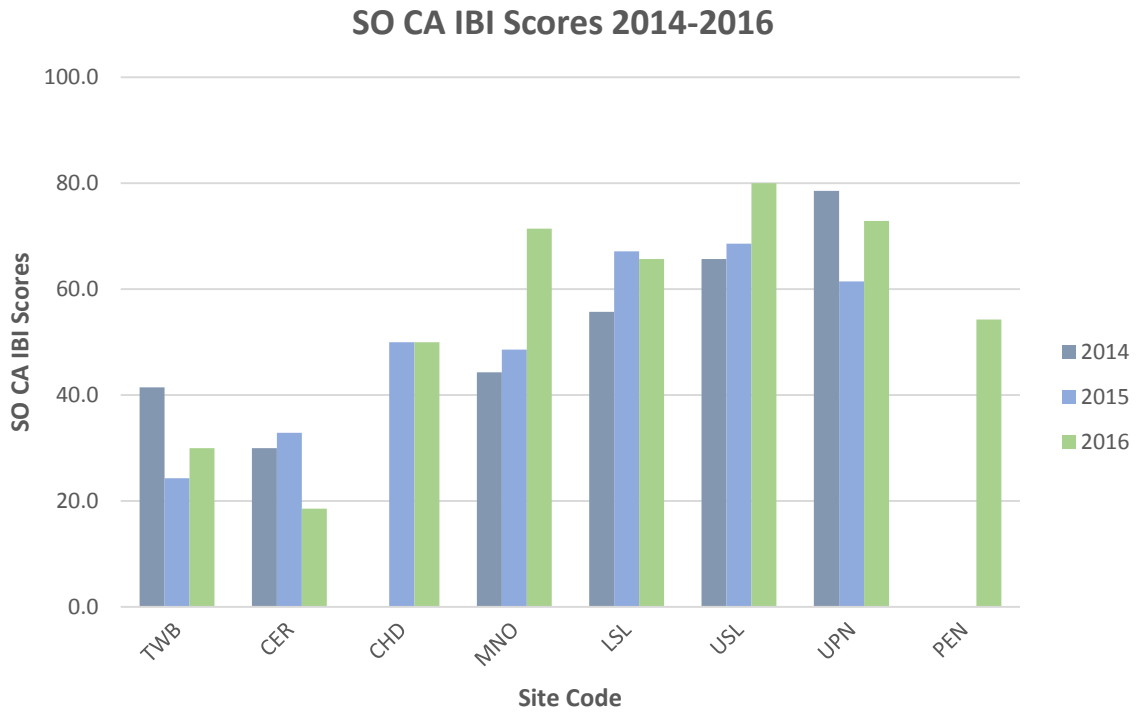


Table 3 shows IBI scores for all Morro Bay watershed creek sites, as well as the average IBI scores. Monitoring began in 1994 and has continued every year since. Monitoring prior to 2002 was conducted by the Central Coast Regional Water Quality Control Board. Every year, the number of measurable sites was determined by available resources, staffing, and surface flow conditions. As previously noted, IBI scores are grouped into categories that typically describe the ecological health of each site, shown in Table 4.

The bottom row of Table 3 shows the average of all scores for that site. Scores are highlighted based on the ecological health designations in Table 4.

Table 3. All IBI scores for all Morro Bay watershed creek sites.

	TWB	CER	CHD	MNO	USB	USL	LSL	WAL	UPN	PEN	DAU	DAM	DAL	CLK	LVR	COO
1994	*	*	44.0	*	*	*	*	*	*	*	*	*	*	*	*	*
1995	*	*	23.0	*	*	*	*	*	*	*	*	*	*	*	*	*
1996	*	*	33.0	*	*	*	*	*	*	*	*	*	*	73.0	77.0	*
1997	39.0	*	44.0	*	*	*	*	*	*	*	*	*	*	90.0	*	*
1998	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1999	*	*	*	*	*	*	*	*	*	*	*	*	*	70.0	*	*
2000	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2001	54.0	*	27.0	*	*	*	*	*	*	*	*	*	*	*	*	*
2002	36.0	*	*	*	*	*	*	*	*	*	*	*	*	70.0	*	66.0
2003	34.0	51.0	*	*	*	*	*	*	*	*	*	*	*	81.0	*	80.0
2004	32.0	41.0	50.0	*	*	*	*	*	*	66.0	*	*	*	79.0	*	*
2005	36.0	31.0	*	*	*	*	*	*	*	*	*	*	*	60.0	46.0	83.0
2006	46.0	*	46.0	*	*	*	*	*	84.0	70.0	*	*	*	51.0	*	87.0
2007	49.0	30.0	49.0	*	*	*	*	*	70.0	*	*	*	*	*	*	83.0
2008	55.8	30.0	44.3	75.8	*	*	67.2	38.6	78.7	*	80.1	50.1	50.1	58.6	*	81.5
2009	*	*	57.2	*	*	*	70.1	*	*	*	91.5	74.4	*	*	*	*
2010	*	*	*	67.2	77.2	91.5	75.8	28.6	*	*	71.5	52.9	60.1	65.8	41.5	*
2011	*	34.3	54.3	62.9	*	58.6	54.3	*	85.7	*	58.6	65.7	*	57.1	48.6	*
2012	45.7	47.1	*	74.3	*	*	72.9	*	84.3	*	*	*	*	70.0	*	*
2013	54.3	22.9	*	71.4	*	60.0	40.0	*	80.0	*	*	*	*	*	*	*
2014	41.4	30.0	*	44.3	*	65.7	55.7	*	78.6	*	*	*	*	*	*	*
2015	24.3	32.9	50.0	48.6	*	68.6	67.1	*	61.4	*	*	*	*	*	*	*
2016	30.0	18.6	50.0	71.4	*	80.0	65.7	*	72.9	54.3	*	*	*	*	*	*
Average IBI	**41.3**	**33.5**	**44.0**	**64.5**	**77.2**	**70.7**	**63.2**	**33.6**	**77.3**	**63.4**	**75.4**	**60.8**	**55.1**	**68.8**	**53.3**	**80.1**

Table 4. General Ecological Health Designations for IBI Scores.

Rating	Score Range	Color Code
Very Good	80-100	Dark Green
Good	60-79.9	Green
Fair	40-59.9	Yellow
Poor	20-39.9	Orange
Very Poor	0-19.9	Red

To provide a spatial overview of the WY2016 IBI scores as well as historical averages including WY2016, two maps were created, shown in Figures 6 and 7. Figure 6 shows main stem stream segments and their ecological health designations based on 2016 IBI scores. Figure 7 shows the same designations based on 1994–2016 averages. To protect landowner privacy, stream segments containing multiple monitoring sites used the average IBI of all sites within that segment to determine the ecological health designation. This applies to both Figure 6 and Figure 7. Coon Creek (site code COO), while not directly draining to Morro Bay, is used as a nearby reference site to demonstrate the potential conditions in the Morro Bay watershed without human disturbance.

Conclusion

Given available resources and adequate flow, eight sites were monitored by the MBNEP staff and volunteers during WY2016, including Lower Pennington (PEN) which had not been monitored since 2006. All sites except Middle Chorro (CER) were roughly equal or higher than the 2015 IBI scores. Upper Chorro (CHD), San Bernardo (MNO), Upper San Luisito (USL), and Lower San Luisito (LSL) all had higher IBI scores than the historical averages for those sites, while the remaining four had lower than average scores. It is interesting to note the significant changes since 2015 in two sites: the CER score decreased by 43% and the MNO score increased by 47%.

One factor possibly influencing the IBI scores is the historic drought in California that began in 2011 and continued until 2017. Drought can significantly affect BMI habitat conditions, especially when there is little to no flow to support aquatic organisms. Of the eight sites sampled in 2016, five (63%) had more than half of their total sample events take place during this historic drought, which could influence the interpretation of the average IBI scores. However, bioassessment data collected during a historic drought can be very informative when compared to average or above average rainfall years. Regardless of rainfall, bioassessment monitoring is critically important to understanding ecosystem-scale impacts on waterbodies. The MBNEP and its partners look forward to continuing this monitoring into the future.

Figure 6. Main stem stream segments and their ecological health designations based on 2016 IBI scores.

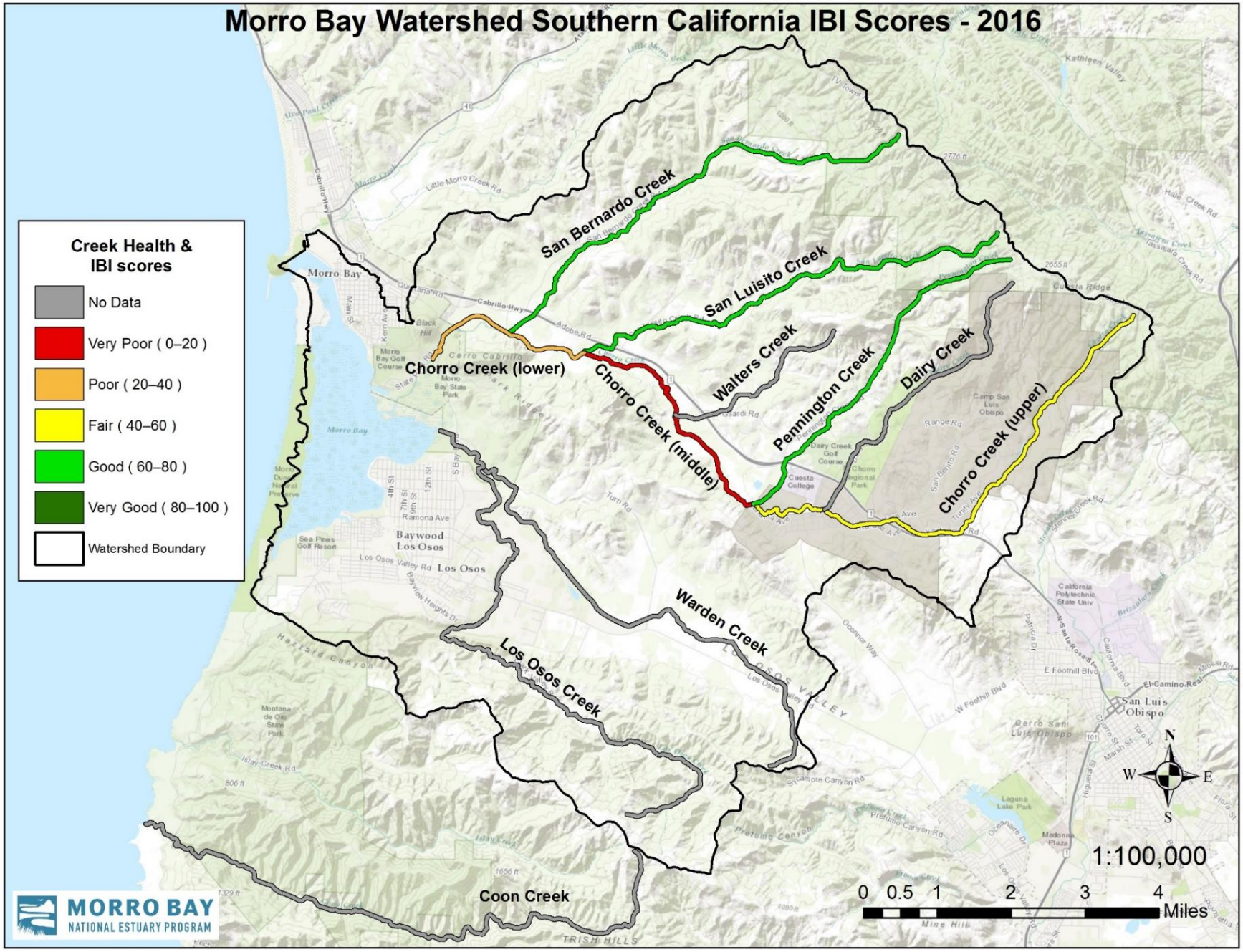
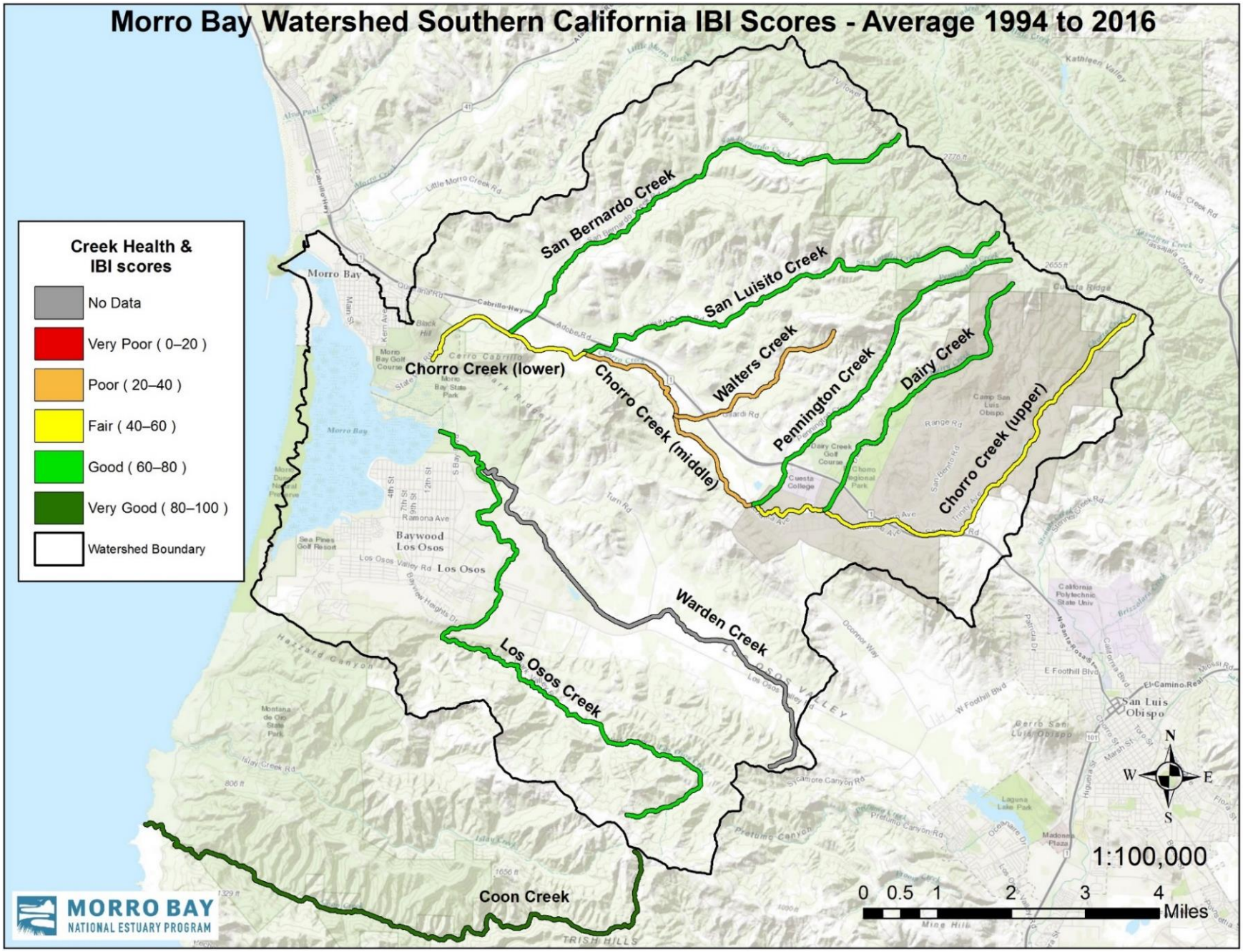


Figure 7. Main stem stream segments and their ecological health designations based on average IBI scores from 1994 to 2016.



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