



MORRO BAY
NATIONAL ESTUARY PROGRAM

**Benthic Macroinvertebrate Bioassessment
Data Summary Memo
2025**



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Table of Contents

Introduction	2
Sites.....	2
Methods.....	5
Results.....	5
Conclusions	14
Data Availability	14
References	15
Appendix A. Bioassessment Monitoring Locations.....	16
Appendix B: CSCI Scores 1994 to 2025	17

List of Acronyms

Acronym	Definition
BMI	Benthic macroinvertebrate
CDFW	California Department of Fish and Wildlife
CCRWQCB	Central Coast Regional Water Quality Control Board
CSCI	California Stream Condition Index
EPT	Ephemeroptera, Plecoptera, and Trichoptera
Estuary Program	Morro Bay National Estuary Program
RWB	Reach-wide benthos (biotic sampling method)
MLML	Moss Landing Marine Laboratory
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SoCal B-IBI (IBI)	Southern California Coastal Index of Biotic Integrity
SWAMP	Surface Water Ambient Monitoring Program
WY	Water Year (Oct 1 to September 30; named for the year in which it ends)

Suggested Citation

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Acknowledgements

The Morro Bay National Estuary Program would like to thank the Harold J. Miozzi Charitable Trust for its continued support of our program's annual bioassessment monitoring effort. Since 2013, the Trust has contributed generous grant funds which have allowed us to contribute to a long-running creek health dataset, resulting in consistent and meaningful results. These data are critical to understanding changes in creek health over time, and help to inform restoration, conservation, and management decisions. To learn more about the Miozzi Charitable Trust, please visit www.miozzicharitabletrust.org.

We would also like to thank the many dedicated staff and volunteers who have contributed to the success of this project, as well as the many landowners who have graciously provided access to their property for this monitoring.

Introduction

The Morro Bay National Estuary Program (Estuary Program) is a nonprofit organization that brings together the community, local governments, nonprofits, agencies, and landowners to protect and restore the Morro Bay estuary and the surrounding watershed. The monitoring conducted by staff and volunteers has three main goals: 1) assess long-term ambient trends, 2) track the effectiveness of specific implementation projects, and 3) establish protection and restoration targets.

The Estuary Program conducts monitoring within the Morro Bay watershed, which is approximately 77 square miles. The watershed is largely dominated by agricultural use, with some urban land use primarily along the coast. The inland watershed drains west into the Morro Bay estuary via two primary creeks, Chorro Creek and Los Osos Creek.

This report summarizes the results of benthic macroinvertebrate sampling from 1994 to 2025¹ from Chorro Creek, Los Osos Creek, and their tributaries. Benthic macroinvertebrates (BMIs) are bottom-dwelling organisms, composed mainly of insects in their larval stage as well as other small aquatic species. These organisms are sensitive to changes in stream chemistry and substrate conditions, and therefore provide a means of assessing waterbody health over time (Barbour, 1999).

Macroinvertebrate samples are collected during annual spring bioassessment surveys. Surveys are conducted per the Surface Water Ambient Monitoring Program (SWAMP) *Standard Operating Procedures (SOP) for the Collection of Field Data for Bioassessments of California Wadeable Streams* (Ode et. al, 2016). This protocol incorporates physical, chemical, and biotic factors that can be used to measure and assess impacts to surface water ecosystems over time.

Sites

The Estuary Program conducts bioassessment surveys each spring at various locations throughout the Morro Bay watershed. Typically, ten site locations are selected for monitoring each year when adequate water is present. The site selection process is dictated by several factors, including site status ("core" or "rotating"), site access, creek conditions, and adequate staffing. There are six core sites that are

¹ Prior to 2002, data was collected by the Central Coast Regional Water Quality Control Board (CCRWQCB).

monitored every year and a number of rotating sites that are generally monitored every other or every third year. Sites not listed as either core or rotating are historic sites that are no longer monitored due to access issues or unfavorable monitoring conditions. For a map of all Estuary Program monitoring sites, please refer to Appendix A.

Between 2020 and 2024, the Estuary Program had been working to establish a reference site to represent a benchmark of biological conditions in a minimally disturbed environment. This approach was sidelined in 2025, as very few areas in the Morro Bay watershed met SWAMP’s strict screening criteria for reference condition. Instead, the Estuary Program will utilize information from SWAMP’s Reference Condition Management Program (RCMP), which has defined a network of more than 600 sites throughout California that represent reference conditions across a broad range of environmental gradients and stream types (SWAMP, 2011).

During the 2025 effort, Estuary Program staff and volunteers conducted ten bioassessment surveys, including the six core sites and four rotating sites (Table 1, Figure 1). Note that one site monitored on Upper Chorro Creek (310UCD) was reclassified from “potential reference” to “rotating” in 2025.

Table 1. Bioassessment sites codes and locations monitored in 2025.

Site Code	Location	Type
310TWB	Lower Chorro Creek	Core
310CER	Middle Chorro Creek near Chorro Creek Ecological Reserve	Rotating
310UCD*	Upper Chorro Creek above Chorro Reservoir	Rotating
310MNO	San Bernardo Creek	Core
310LSL	Lower San Luisito Creek	Core
310USL	Upper San Luisito Creek	Rotating
310UPN	Pennington Creek	Core
310DAU	Upper Dairy Creek	Core
310DAM	Middle Dairy Creek	Rotating
310CLK	Upper Los Osos Creek	Core

**This site was previously listed as a potential reference site, intended to represent unimpaired conditions in the watershed. Upper Chorro Creek (310UCD) was reclassified as a “rotating” site in 2025, as the presence of historic mines in the upstream catchment area do not meet the SWAMP’s criteria for reference site designation.*

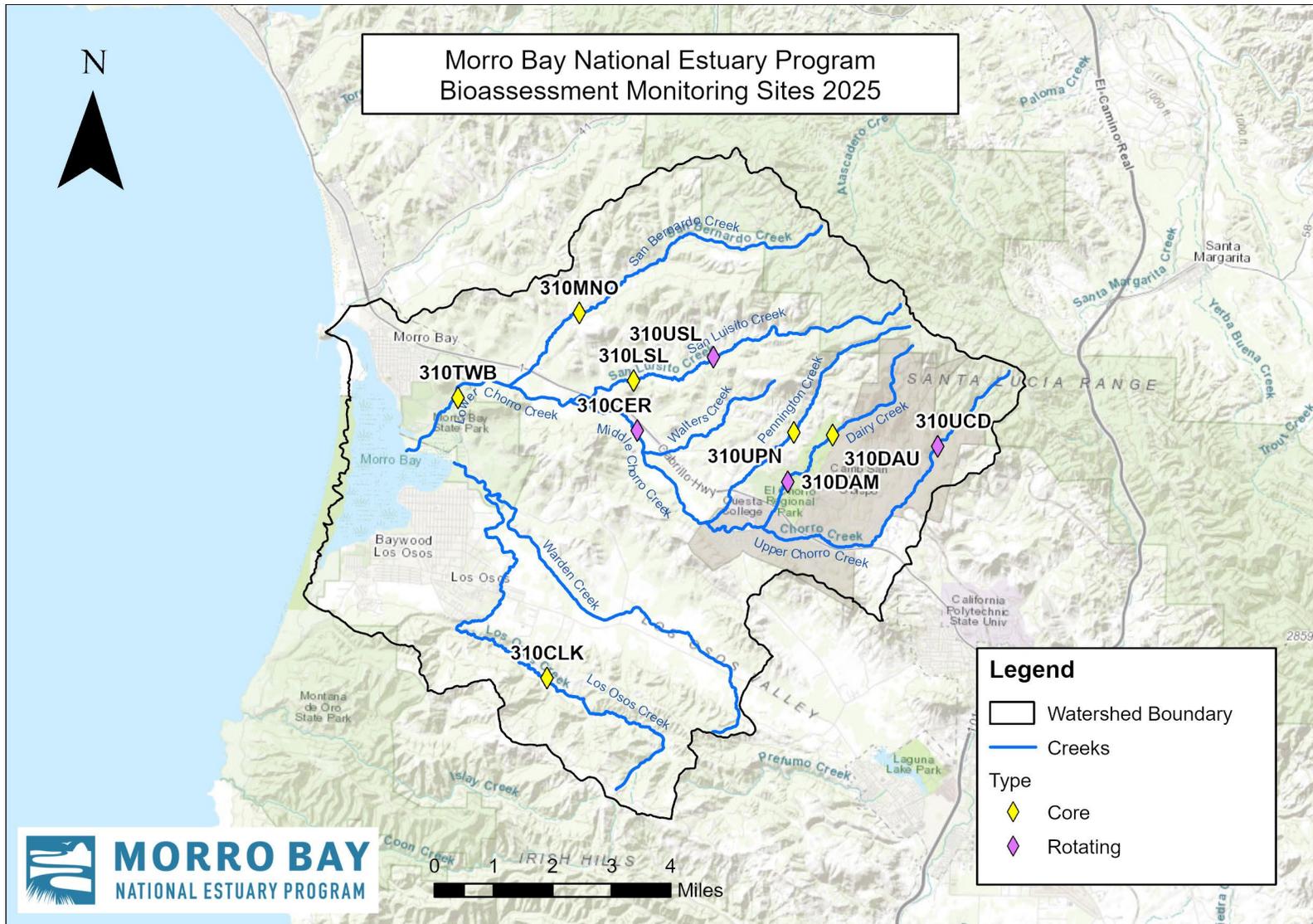


Figure 1. Bioassessment sites monitored in 2025. Core sites are monitored each year, and rotating sites are monitored approximately every other year.

Methods

The Estuary Program conducts bioassessment surveys per the SWAMP Standard Operating Procedures protocol (Ode et. al, 2025). Due to limited sampling resources, the Estuary Program does not conduct the algae collection module. All surveys are conducted under a scientific collection permit (SCP) from the California Department of Fish and Wildlife (CDFW). Sites within California State Parks property boundaries are also collected under a State Parks SCP. The Estuary Program conducts all required notifications and reporting to maintain the SCPs.

At each monitoring site, staff and trained volunteers conduct assessments along a 150-meter reach. The site is established from downstream to upstream in a consistent location over time, with only minor adjustments made as needed for field conditions. Measurements and observations are taken at 11 equidistant main transects and ten equidistant inter-transects. These measurements include wetted width, water depth, bankfull measurements, substrate size, canopy cover, slope, sinuosity, bank stability, algal observations, and anthropogenic modifications. Macroinvertebrate samples are collected from each of the 11 main transect locations using the reach-wide benthos method, rotating between the margins and center of the creek. The samples are then composited into a single sample and preserved before shipping to a certified taxonomy laboratory for analysis.

In 2025, the Estuary Program sent macroinvertebrate samples to a certified taxonomy laboratory, EcoAnalysts Inc., for analysis per Southwest Association of Freshwater Invertebrate Taxonomists Level 2 protocols. The samples were sorted, counted, and identified by certified taxonomists until 600 organisms were identified. EcoAnalysts provided a spreadsheet containing the taxa classifications and several calculated metrics and indices. The Estuary Program contracted with Moss Landing Marine Labs (MLML) to calculate index scores using the California Stream Condition Index (CSCI) analysis method. The data obtained from EcoAnalysts and MLML provide the foundation for the analysis presented in this report.

Results

The following tables, graphs, and maps summarize the results of the 2025 macroinvertebrate sampling effort and provide context for the results by comparing them to historical data. The metrics and indices presented throughout this report typically decrease in response to disturbance, so higher values generally indicate optimal conditions and lower values indicate less ideal conditions. A dashed line within any table indicates that no monitoring occurred that year. On bar graphs, an absence of a bar indicates no monitoring occurred that year.

Taxa Metrics

The calculated metrics included in this report are as follows:

- **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), which are collectively known as EPT.

- **EPT percent** is the percentage of EPT individuals within the total number of individuals in a sample.
- **Percent sensitive EPT** is the percentage of EPT individuals with associated tolerance values of 0 to 3.

Table 2. Benthic taxa metric scores from 2022 to 2025.

Site	Year	Taxa Richness	EPT Richness	% EPT	% Sensitive EPT
CER (Middle Chorro Creek)	2022	---	---	---	---
	2023	38	4	62.50	4.92
	2024	---	---	---	---
	2025	32	9	36.18	1.67
TWB (Lower Chorro Creek)	2022	44	8	13.38	2.40
	2023	40	6	10.76	1.05
	2024	46	11	17.26	2.64
	2025	45	12	14.29	7.22
UCD (Above Chorro Reservoir)	2022	81	22	21.86	11.55
	2023	40	10	31.00	9.64
	2024	66	19	28.87	14.88
	2025	55	16	18.97	8.71
CLK (Upper Los Osos Creek)	2022	---	---	---	---
	2023	39	5	4.91	1.29
	2024	47	16	39.04	8.60
	2025	54	17	64.63	16.32
MNO (San Bernado Creek)	2022	66	15	21.44	7.96
	2023	33	4	43.01	0.93
	2024	57	14	43.50	2.08
	2025	60	16	28.21	7.85
LSL (Lower San Luisito Creek)	2022	58	17	40.78	13.77
	2023	27	9	67.35	3.93
	2024	46	19	46.04	8.46
	2025	49	16	23.43	18.19
USL (Upper San Luisito Creek)	2022	64	17	49.62	33.22
	2023	---	---	---	---
	2024	47	18	74.32	25.59
	2025	56	19	45.11	36.46
UPN (Upper Pennington Creek)	2022	60	17	20.70	11.68
	2023	45	9	31.81	7.36
	2024	58	20	56.43	50.18

Site	Year	Taxa Richness	EPT Richness	% EPT	% Sensitive EPT
	2025	55	23	38.06	19.55
DAM (Middle Dairy Creek)	2022	---	---	---	---
	2023	34	6	32.69	0.37
	2024	---	---	---	---
	2025	63	17	49.69	7.62
DAU (Upper Dairy Creek)	2022	66	16	21.17	22.25
	2023	32	7	58.16	3.80
	2024	54	19	69.29	39.93
	2025	55	15	37.34	27.48

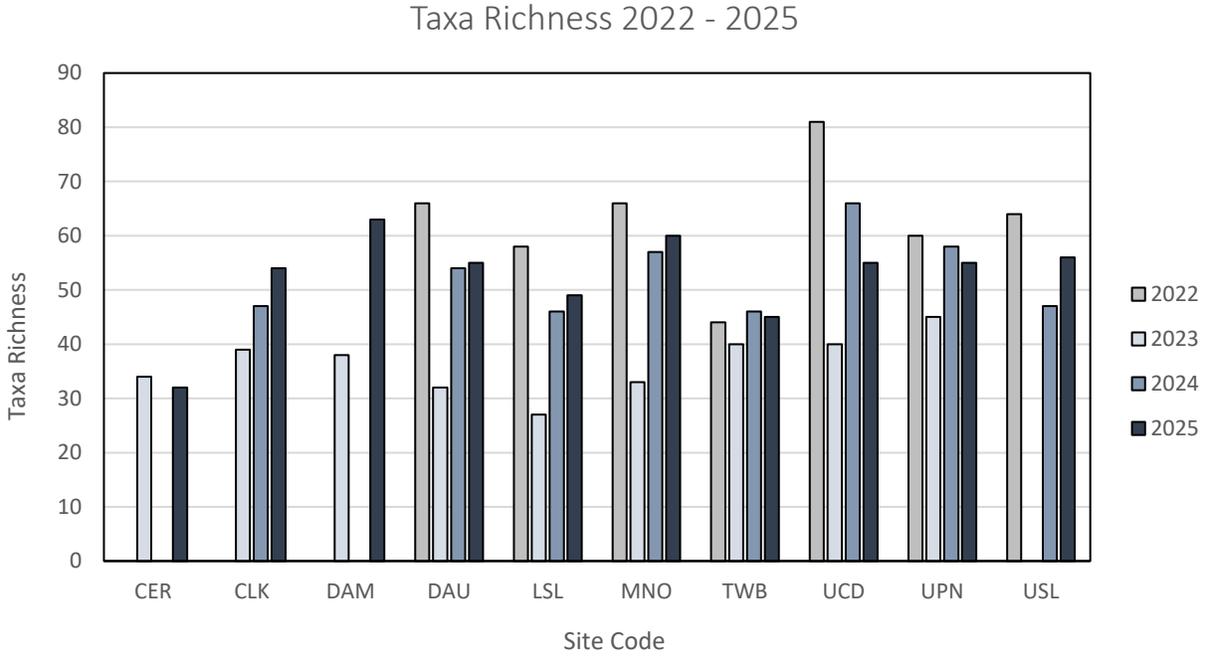


Figure 2. Taxa richness data for 2022 to 2025 macroinvertebrate sampling.

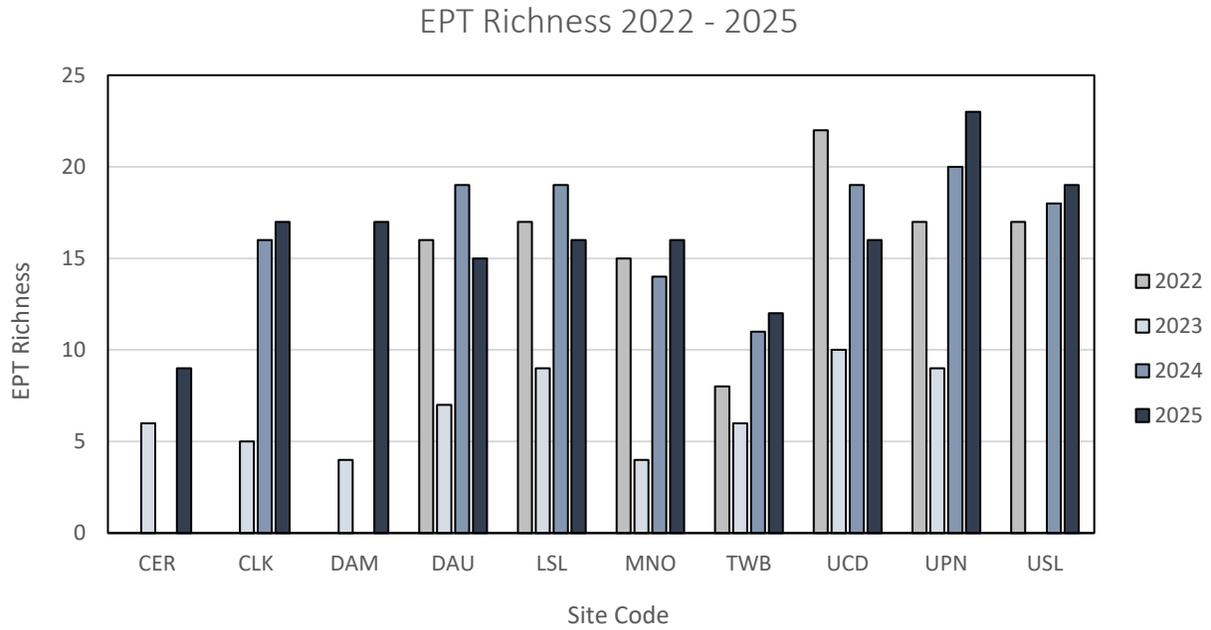


Figure 3. EPT richness data for 2022 to 2025 macroinvertebrate sampling.

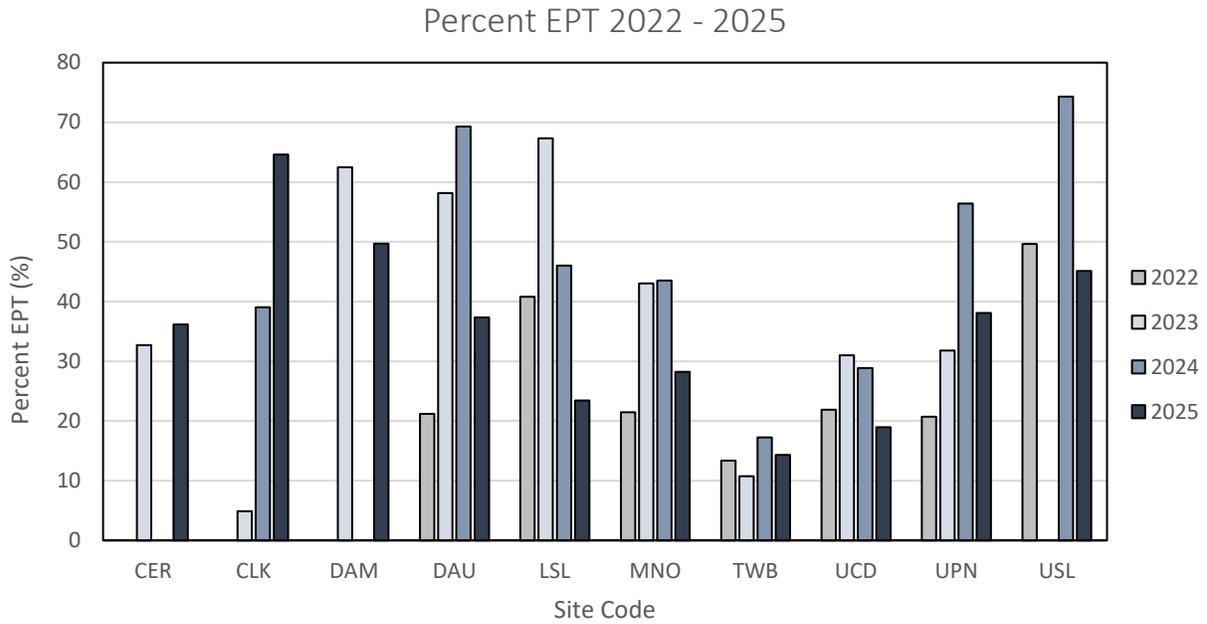


Figure 4. Percent EPT data for 2022 to 2025 macroinvertebrate sampling.

Percent Sensitive EPT 2022 - 2024

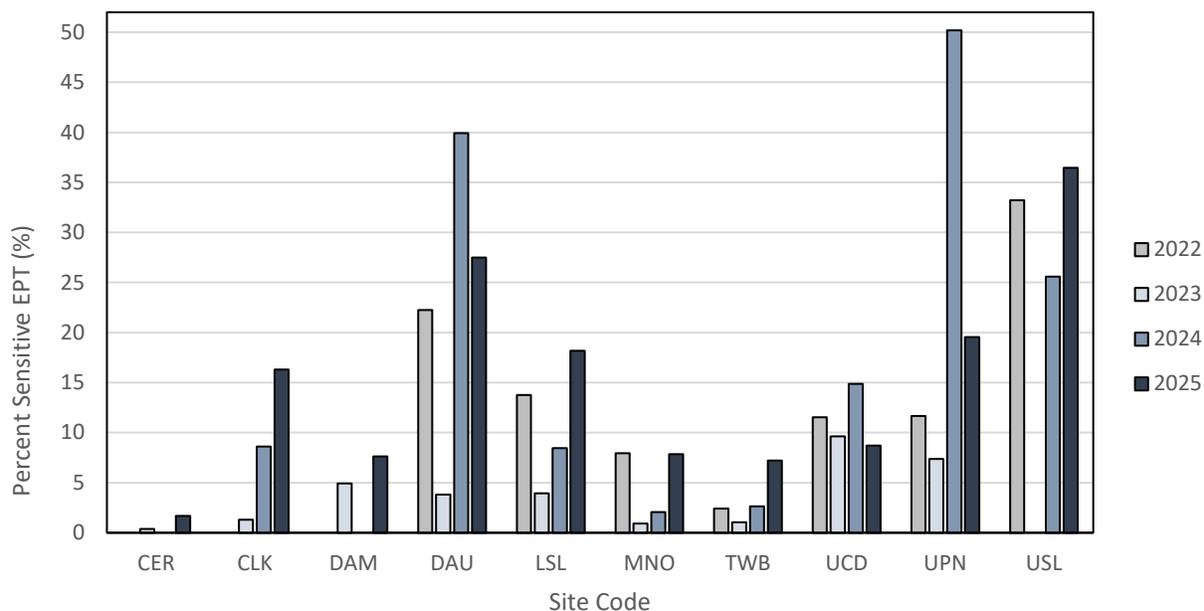


Figure 5. Percent sensitive EPT data for 2022 to 2025 macroinvertebrate sampling.

Biotic Indices

The Estuary Program uses a statewide biological scoring tool to assess overall stream health called the California Stream Condition Index (CSCI). The CSCI uses biotic and environmental data to measure how well a site’s observed condition matches its expected condition using a numeric scoring system to interpret stream degradation, as shown in Table 3 (Rehn et al., 2015).

Prior to 2021, the Estuary Program used the Southern California Coastal Index of Biotic Integrity (SoCal B-IBI, or IBI) as a primary index for classifying stream health. This metric was designed for the coastal region from Monterey to San Diego², and thus did not allow for direct comparison with results outside of this geographic area. The Estuary Program’s decision to adopt the use of the CSCI was driven in part by a shift by the State Water Resources Control Board to utilize CSCI for its own analysis of waterbody impairment.

² The SoCal IBI score is only applicable in a range from Monterey to San Diego. This region tracks closely with the jurisdictions of Regional Water Quality Control Boards 3, 4, 8, and 9.

Table 3. CSCI score ranges and associated categories, adapted from Rehn et al, 2015.

CSCI Score	CSCI Score Category
> 1.00	Better ecological and biological stream conditions than expected
≥ 0.92 up to 1.00	Likely intact stream conditions
≥ 0.79 up to 0.92	Possibly altered stream conditions
0.63 to 0.79	Likely altered stream conditions
≤ 0.62	Very likely altered stream conditions

Table 4 shows a comparison of CSCI scores between 2022 and 2025 using the classifications outlined in Table 3. A dashed line indicates that no monitoring occurred during that year. A table of all CSCI scores is available in Appendix B.

Table 4. CSCI scores from 2022 to 2025.

Site	Year	CSCI	CSCI Status
CER (Middle Chorro Creek)	2022	---	---
	2023	0.78	Possibly Altered
	2024	---	---
	2025	0.87	Possibly Altered
TWB (Lower Chorro Creek)	2022	0.85	Possibly Altered
	2023	0.90	Possibly Altered
	2024	0.96	Likely Intact
	2025	0.98	Likely Intact
UCD (Above Chorro Reservoir)	2022	1.04	Better than expected
	2023	0.91	Possibly Altered
	2024	1.09	Better than expected
	2025	1.14	Better than expected
CLK (Upper Los Osos Creek)	2022	---	---
	2023	0.72	Likely Altered
	2024	0.88	Possibly Altered
	2025	1.00	Likely Intact
MNO (San Bernardo Creek)	2022	0.94	Likely Intact
	2023	0.68	Likely Altered
	2024	1.02	Better than expected
	2025	0.99	Likely Intact
LSL (Lower San Luisito Creek)	2022	1.02	Likely Intact
	2023	0.83	Possibly Altered
	2024	1.05	Better than expected
	2025	0.98	Likely Intact
USL (Upper San Luisito Creek)	2022	1.02	Better than expected
	2023	---	---

	2024	0.99	Likely Intact
	2025	1.10	Better than expected
UPN (Upper Pennington Creek)	2022	1.13	Better than expected
	2023	0.77	Likely Altered
	2024	1.14	Better than expected
	2025	1.06	Better than expected
DAM (Middle Dairy Creek)	2022	---	---
	2023	0.69	Likely Altered
	2024	---	---
	2025	1.03	Better than expected
DAU (Upper Dairy Creek)	2022	0.94	Likely Intact
	2023	0.69	Likely Altered
	2024	1.19	Better than expected
	2025	0.96	Likely Intact

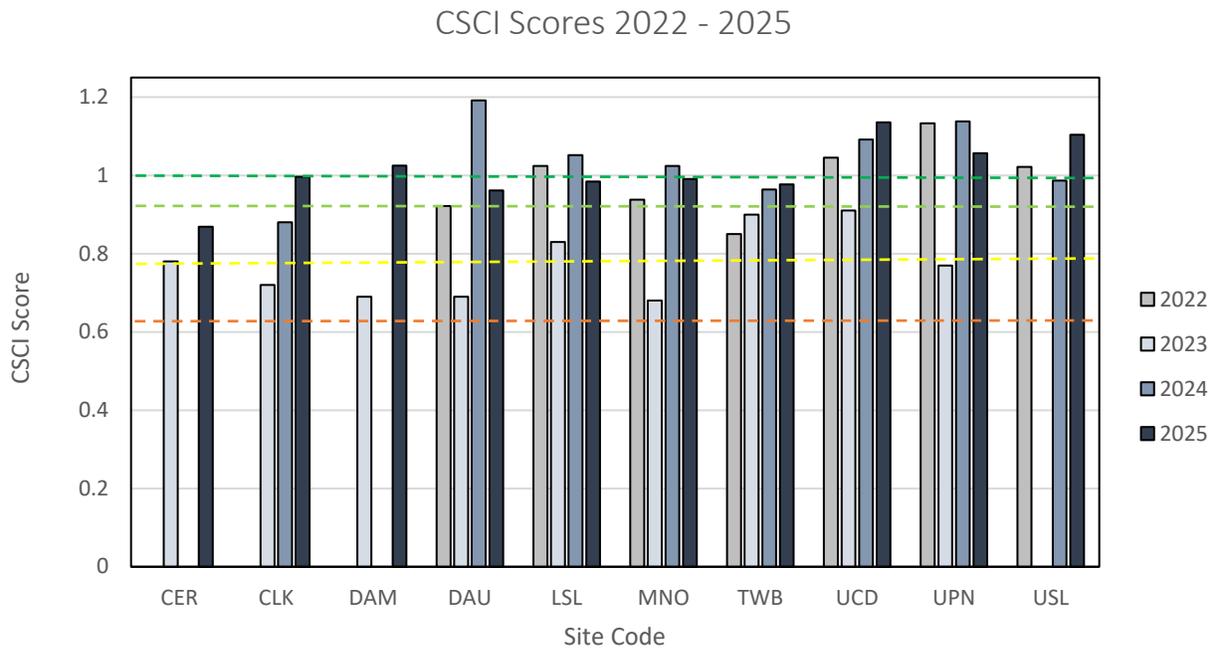


Figure 6. CSCI scores for 2022 to 2025 bioassessment monitoring.

Figures 7 and 8 show the spatial distribution of CSCI scores along creek mainstems. Figure 7 shows the 2025 scores averaged by creek segment, and Figure 8 shows the average CSCI scores by creek segment from 1994 to 2025. For CSCI score criteria, refer to Table 3.

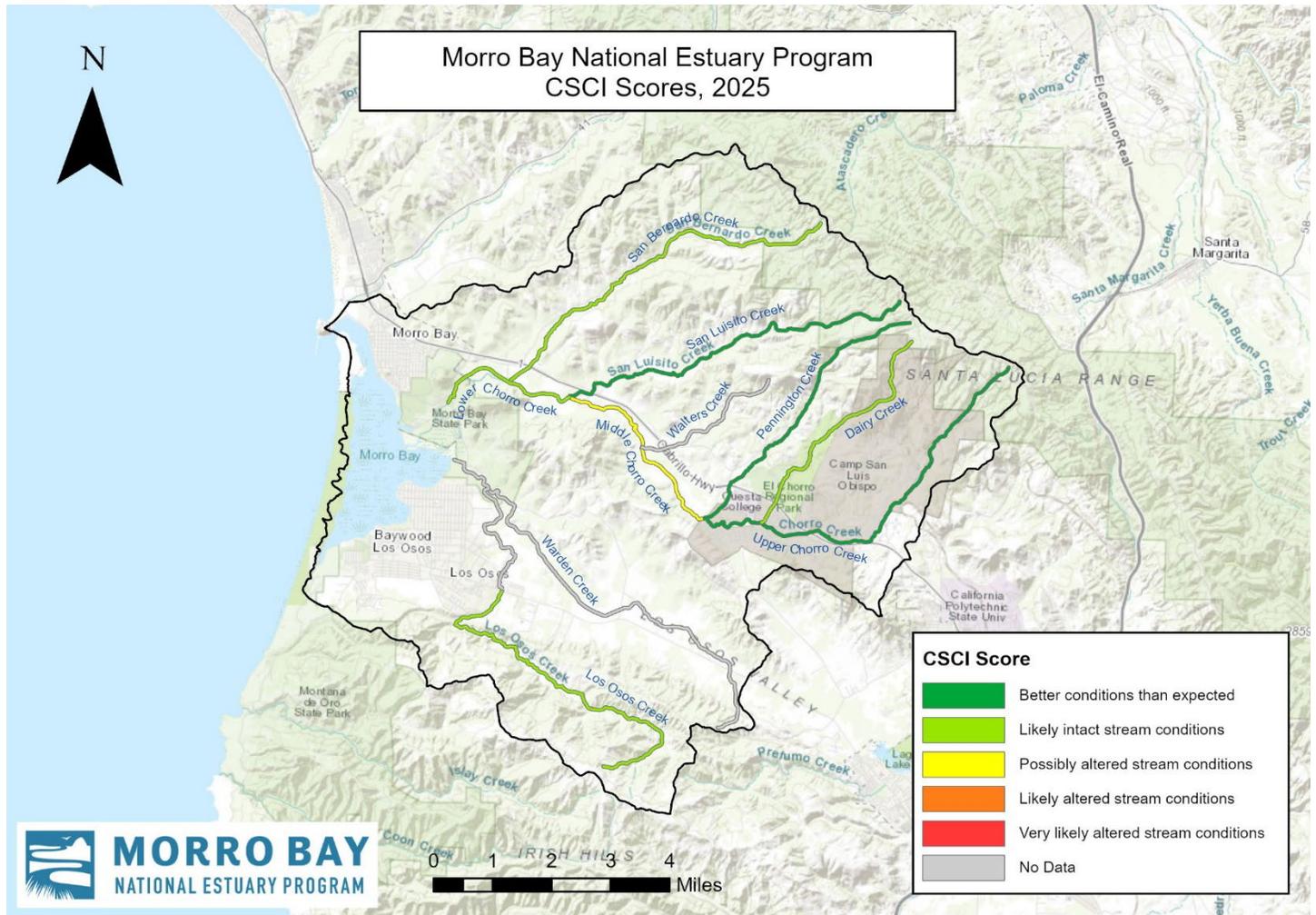


Figure 7. Mainstem stream segments and their ecological health designations based on 2025 CSCI scores averaged by creek segment.

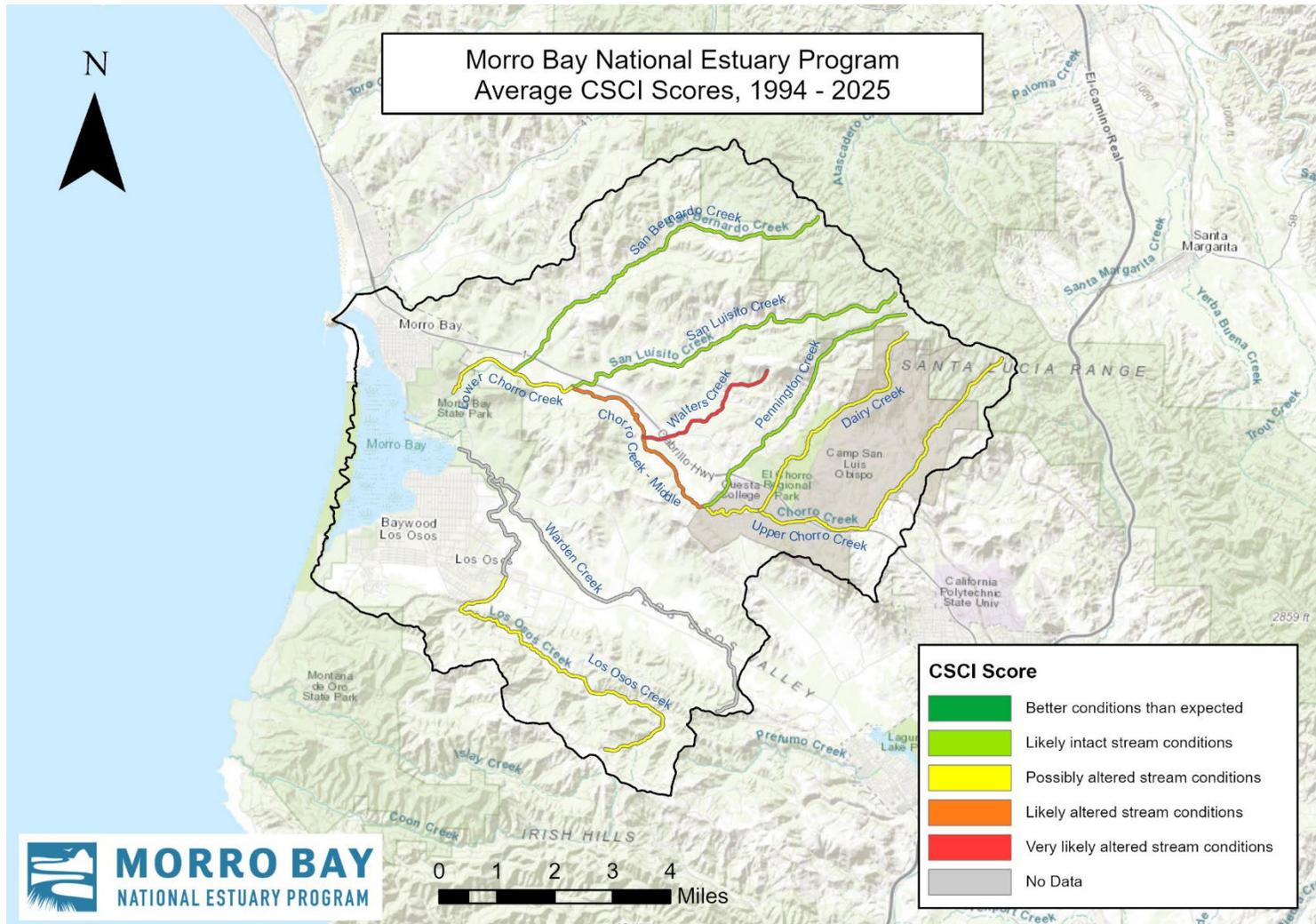


Figure 8. Mainstem stream segments and their ecological health designations based on average CSCI scores from 1994 to 2025. Refer to Appendix B for more detailed information regarding individual site scores and number of data points.

Conclusions

Results from the 2025 monitoring effort indicate macroinvertebrate community stability and resiliency throughout the Morro Bay watershed. The extreme hydrologic events of 2023 impacted macroinvertebrate communities, leading to depressed CSCI scores and taxa metrics. By 2024, results indicated significant recovery across the watershed, with the most notable improvements observed in the tributaries (MBNEP, 2025). This trend appears to have continued into 2025, with further improvement at tributary sites and stability within the mainstem of Chorro Creek.

Seven of ten sites monitored in 2025 had CSCI scores of “Likely Intact” or “Better than Expected,” indicating healthy macroinvertebrate communities that match or exceed reference condition. Taxa metrics also suggest stable or improving species diversity, particularly at Upper San Luisito Creek (USL) and Upper Pennington Creek (UPN). The highest CSCI score of 2025 occurred at Upper Chorro Creek (UCD), which has consistently scored well, even after the damaging storms of 2023. While the lowest score of the year occurred at Middle Chorro Creek (CER), the 2025 results represent the highest CSCI score at this site since 2012.

One monitoring site located on Upper Los Osos Creek (CLK) appeared to be slower to recover from the impacts of 2023, showing only modest improvements in CSCI score and taxa metrics in 2024. Results from 2025 indicate continued improvement at CLK, with its CSCI score shifting back into the “Likely Intact” category. This site also experienced a significant increase in percent EPT, nearly doubling from 2024 to 2025 (8.6% to 16.3%). The reasons for this site’s slower rebound are unknown but likely reflect unique site conditions or site-specific stressors.

Biotic data collected during bioassessment provides a comprehensive picture of creek health. This data is of value to the Estuary Program, its partners, and to the CCRWQCB who utilizes this data to assess impairment in Central Coast waterbodies. Due to the value of this data to the program and its partners, the Estuary Program plans to continue annual bioassessment monitoring for the foreseeable future.

Data Availability

Bioassessment monitoring data and CSCI scores are publicly available from the California Environmental Data Exchange Network (CEDEN), a State Water Resources Control Board data portal.

To retrieve data, visit <https://ceden.waterboards.ca.gov/>.

- Click “Start” to retrieve data.
- Select “Process” as desired.
- For taxonomy data, select “Benthic (Taxonomy)” as the Category. For habitat data, including CSCI scores, select “Habitat” as the Category.
- Select “Morro Bay National Estuary Program” as the Program.
- Under “FromDate” and “ToDate,” select the date range desired.
- Click on “Submit” to retrieve data.

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Appendix A. Bioassessment Monitoring Locations

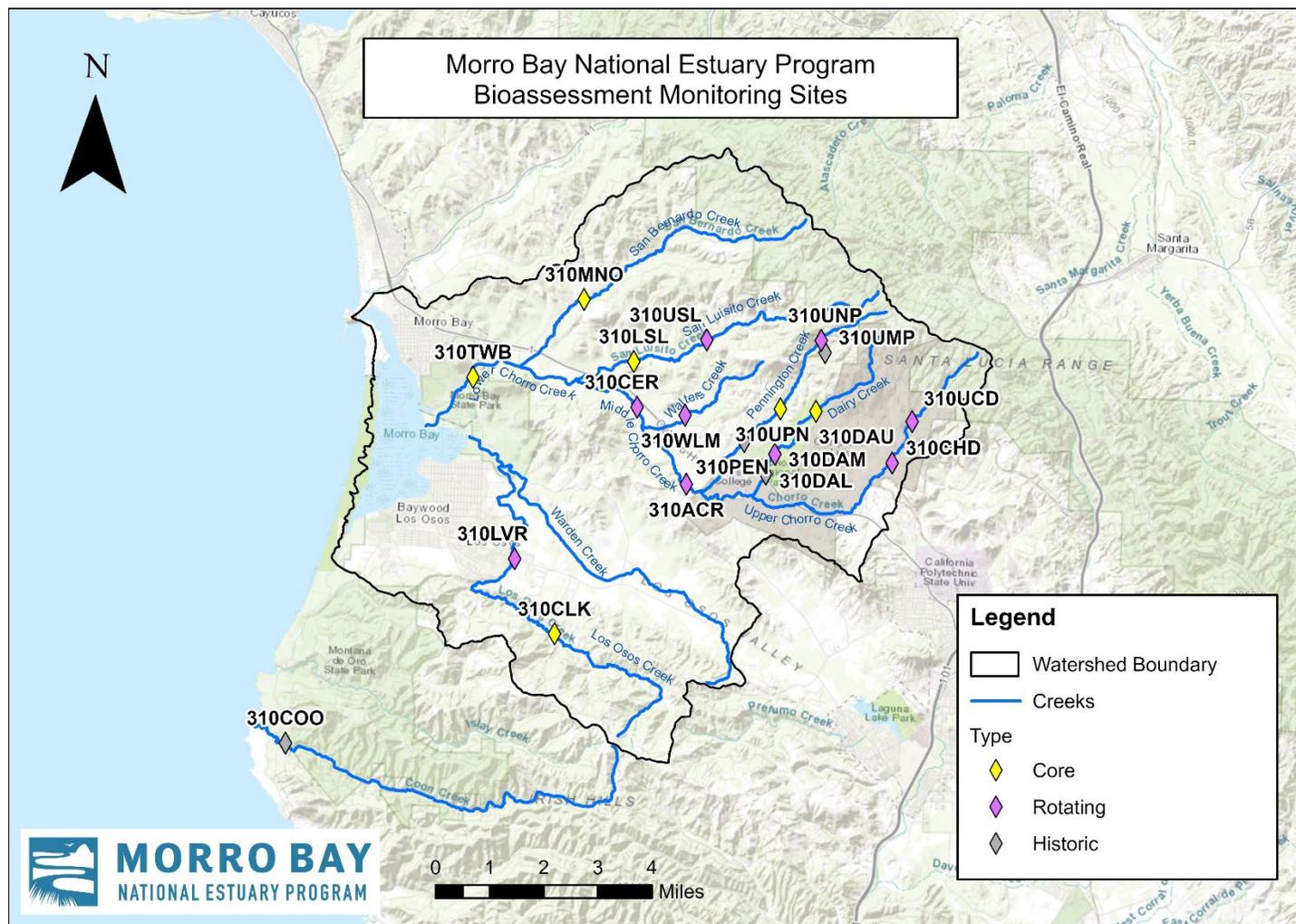


Figure 9. Core, rotating, and historic bioassessment monitoring locations.

Appendix B: CSCI Scores 1994 to 2025

Year	Chorro Creek					Dairy Creek			Pennington Creek				Walters Creek		San Luisito Creek		San Bernardo Creek	Los Osos Creek		Coon Creek	
Site Code	UCD	CHD	ACR	CER	TWB	DAU	DAM	DAL	PEN	UMP	UNP	UPN	WAL	WLM	LSL	USL	MNO	CLK	LVR	COO	
1994	*	0.70	*	*	*	0.94	0.62	*	0.94	*	*	*	*	*	*	*	*	*	*	*	*
1995	*	0.57	*	*	*	0.61	0.71	*	0.85	*	*	*	*	*	*	*	*	*	*	*	*
1996	*	0.76	*	*	*	*	1.09	*	1.17	*	*	*	0.48	*	*	*	*	1.02	1.05	*	*
1997	*	0.84	*	*	0.73	1.12	1.09	1.13	1.13	*	*	*	0.49	*	*	*	*	1.02	*	1.13	*
1998	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
1999	*	*	*	*	*	0.40	0.87	0.88	1.04	*	*	*	*	*	*	*	*	1.06	*	*	*
2000	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2001	*	0.76	*	*	*	1.07	*	1.18	0.98	*	*	*	0.75	*	*	*	*	*	*	*	*
2002	*	*	*	*	0.73	*	*	*	*	*	*	*	*	*	*	*	*	0.93	*	0.97	*
2003	*	*	*	0.82	0.74	*	*	0.87	*	*	*	*	*	*	*	*	*	0.96	*	0.98	*
2004	*	0.85	*	0.67	*	*	*	0.77	0.85	*	*	*	*	*	*	*	*	0.94	*	*	*
2005	*	*	*	0.67	*	*	*	0.75	*	*	*	*	*	*	*	*	*	0.74	*	*	*
2006	*	0.71	*	*	0.90	*	*	0.83	0.82	*	*	0.97	*	*	*	*	*	0.88	*	1.05	*
2007	*	0.82	*	0.75	0.82	*	*	*	*	*	*	1.09	*	*	*	*	*	*	*	*	1.26
2008	*	0.81	*	0.77	1.03	1.02	0.82	0.85	*	*	*	1.17	0.44	*	0.98	*	1.03	0.76	*	1.13	
2009	*	*	*	0.70	*	1.03	0.96	*	*	*	*	*	*	*	0.98	*	*	*	*	*	*
2010	*	*	*	*	*	1.08	0.70	0.74	*	*	*	*	0.56	*	1.03	1.15	1.01	0.95	0.57	*	*
2011	*	0.92	*	0.84	*	1.03	1.14	*	*	*	*	1.13	*	*	1.00	1.09	0.99	1.06	0.91	*	*
2012	*	*	*	0.87	0.79	*	*	*	*	*	*	1.04	*	*	1.06	*	1.01	0.85	*	*	*
2013	*	*	*	0.59	0.91	*	*	*	*	*	*	1.13	*	*	0.68	0.92	1.02	*	*	*	*
2014	*	*	*	0.66	0.78	*	*	*	*	*	*	1.04	*	*	0.86	0.89	0.61	*	*	*	*
2015	*	0.77	*	0.79	0.61	*	*	*	*	*	*	0.88	*	*	0.97	1.03	0.72	*	*	*	*
2016	*	0.82	*	0.81	0.71	*	*	*	0.83	*	*	1.04	*	*	1.00	1.09	0.86	*	*	*	*
2017	*	0.78	*	0.82	0.98	0.98	0.81	*	*	*	*	1.10	*	0.64	1.04	*	0.98	0.76	0.64	1.07	*
2018	*	0.92	*	0.79	0.96	1.20	*	*	*	*	*	1.06	*	*	1.10	1.17	1.06	0.75	*	0.97	*
2019	*	*	0.86	0.76	0.91	0.92	0.82	*	*	*	*	0.98	*	*	1.05	*	1.11	0.90	0.65	*	*
2020	*	*	0.83	*	0.97	*	*	*	*	*	*	0.98	*	*	0.88	0.97	0.97	0.97	*	*	*
2021	*	*	0.68	0.58	0.79	0.80	0.82	*	*	0.96	0.79	0.97	*	*	0.98	*	0.82	*	*	*	*
2022	1.04	0.88	*	*	0.85	0.92	*	*	*	0.89	0.84	1.13	*	*	1.02	1.02	0.94	*	*	*	*
2023	0.91	*	0.82	0.78	0.90	0.69	0.69	*	*	*	*	0.77	*	*	0.83	*	0.68	0.72	0.67	*	*
2024	1.09	*	0.89	*	0.96	1.19	*	*	*	*	*	1.14	*	0.63	1.05	0.99	1.02	0.88	*	*	*
2025	1.14	*	*	0.87	0.98	0.96	1.03	*	*	*	*	1.06	*	*	0.98	1.10	0.99	1.00	*	*	*
Average CSCI	1.05	0.79	0.81	0.75	0.85	0.94	0.87	0.89	0.96	0.92	0.82	1.04	0.54	0.64	0.97	1.04	0.93	0.90	0.75	1.07	*

CSCI Score	CSCI Score Category
> 1.00	Better ecological and biological stream conditions than expected
≥ 0.92 up to 1.00	Likely intact stream conditions
≥ 0.79 up to 0.92	Possibly altered stream conditions
0.63 to 0.79	Likely altered stream conditions
≤ 0.62	Very likely altered stream conditions