SUBMITTAL TO THE FLOOD CONTROL AND WATER CONSERVATION DISTRICT BOARD OF SUPERVISORS COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

ITEM: 11.3
(ID # 11685)
MEETING DATE:
Tuesday, March 10, 2020

FROM: FLOOD CONTROL DISTRICT:

SUBJECT: FLOOD CONTROL DISTRICT: Approval of the Memorandum of Understanding for Conducting a Water Quality Improvement Monitoring and Assessment Program for Eutrophic Conditions in the Santa Margarita River Estuary and Watershed in Accordance with Investigative Order No. R9-2019-0007 Between the Commanding General, Marine Corps Installations West - Marine Corps Base, Camp Pendleton; the Riverside County Flood Control and Water Conservation District; the County of Riverside; the County of San Diego; and the Cities of Murrieta, Temecula, and Wildomar and Approval of the Commercial Service Agreement Between the Riverside County Flood Control and Water Conservation District and the United States of America, as represented by Executive Director, Naval Information Warfare Center Pacific, CEQA Exempt, Districts 1, 3 and 5. [Total $956,161 - 100% District Funds] (Companion Item to MT Item No. 11895)

RECOMMENDED MOTION: That the Board of Supervisors:

1. Find that the project is exempt from the California Environmental Quality Act ("CEQA") pursuant to State CEQA Guidelines Sections 15306 and 15061(b)(3);

ACTION:Policy

Jason Uhley, GENERAL MGR-CHF FLD CNTRL ENG 2/13/2020

MINUTES OF THE BOARD OF SUPERVISORS

On motion of Supervisor Perez, seconded by Supervisor Hewitt and duly carried by unanimous vote, IT WAS ORDERED that the above matter is approved as recommended.

Ayes:	Jeffries, Spiegel, Washington, Perez and Hewitt
Nays:	None
Absent:	None
Date:	March 10, 2020
xc:	Flood

Kecia R. Harper
Clerk of the Board
By: _____
Deputy

2. Approve the Memorandum of Understanding for Conducting a Water Quality Improvement Monitoring and Assessment Program for Eutrophic Conditions in the Santa Margarita River Estuary and Watershed in Accordance with Investigative Order No. R9-2019-0007 ("MOU") between the Commanding General, Marine Corps Installations West - Marine Corps Base, Camp Pendleton; the Riverside County Flood Control and Water Conservation District ("District"); the County of Riverside; the County of San Diego; and the Cities of Murrieta, Temecula, and Wildomar for a period of five (5) years;
3. Approve the Commercial Service Agreement ("Agreement") between the District and the United States of America, as represented by Executive Director, Naval Information Warfare Center Pacific, for a period of five (5) years;
4. Authorize the Chairwoman of the Board to execute the same on behalf of the District;
5. Authorize the General Manager-Chief Engineer or designee to take all necessary steps to implement the MOU and Agreement including, but not limited to (i) negotiating, approving and executing any non-substantive amendments, subject to approval by County Counsel, (ii) negotiating, approving and executing amendments to the Agreement to increase the total contract amount by no more than 10% of the maximum contract amount, subject to approval by County Counsel and (iii) signing subsequent essential and relevant documents, subject to approval by County Counsel; and
6. Direct the Clerk of the Board to return eight (8) signed MOUs and three (3) signed Agreements to the District.

FINANCIAL DATA	Current Fiscal Year:	Next Fiscal Year:	Total Cost:	Ongoing Cost
COST	$173,899	$222,270	$956,161	$0
NET COUNTY COST	$0	$0	$0	$0
SOURCE OF FUNDS: 25200-947580-525440 (NPDES Santa Margarita Assessment)			Budget Adjustment: No For Fiscal Year: 19/20 – 23/24	

C.E.O. RECOMMENDATION: Approve

BACKGROUND:

Summary

The Santa Margarita River Estuary ("Estuary") is located along the southern California coast in northern San Diego County on the southwestern edge of the Marine Corps Installations West - Marine Corps Base, Camp Pendleton ("Camp Pendleton"). The Estuary is one of the few remaining and largely unmodified coastal estuaries in southern California, providing 192 acres of valuable estuarine habitat including mudflats, salt pannes, salt marsh and subtidal habitats. This unique estuarine habitat includes beneficial uses of water that provide important refuge, foraging areas and breeding grounds suitable for several threatened and/or endangered species, as well as coastal marine species. These include populations of state and federally endangered or threatened species, such as the California Least Tern, Western Snowy Plover and Southern California Steelhead.

The Estuary's watershed, the Santa Margarita Watershed, drains into the Pacific Ocean and covers an area of approximately 750 square miles, encompassing portions of both the County of Riverside and the County of San Diego. Approximately 73.5 percent of the Santa Margarita Watershed land surface falls within the County of Riverside, which includes the city of Temecula, the southwest portion of unincorporated County of Riverside and portions of the cities of Menifee, Murrieta and Wildomar. The remaining 26.5 percent of the Santa Margarita Watershed is in the County of San Diego, where Camp Pendleton and the unincorporated communities of Fallbrook and Rainbow are located.

In 1986, the California Regional Water Quality Control Board, San Diego Region ("San Diego Water Board") placed the Estuary on the Clean Water Act Section 303(d) List of Water Quality Limited Segments due to eutrophic conditions, which affect the ability of the Estuary's waters to provide essential habitat for a number of rare and endangered species of fish and birds.

On May 9, 2019, the California Regional Water Quality Control Board, San Diego Region issued Investigative Order No. R9-2019-0007 to assess the condition of the Estuary and evaluate the linkage between nutrient loading trends resulting from implementation actions by MS4 owners and the restoration of the water quality and beneficial uses in the Estuary. The District, the County of Riverside, and the Cities of Murrieta, Temecula and Wildomar – the Riverside County Co-Permittees regulated by the 2015 Permit ("Riverside Co-Permittees") – together with the County of San Diego and Camp Pendleton, as owners and operators of MS4s within the Santa Margarita Watershed, are required by Investigative Order No. R9-2019-0007 to monitor the water quality condition of the Estuary for a period of four years starting in 2020 and ending after October 2023, with a final report summarizing the findings due in March 2024. The City of Menifee is not subject to Investigative Order No. R9-2019-0007 because its individual land footprint in the Santa Margarita Watershed is very small (less than one percent of the total Santa Margarita Watershed area).

The MOU documents the intentions of the Riverside Co-Permittees, Camp Pendleton and the County of San Diego ("Partners") to collaborate and share costs associated with conducting a water quality improvement monitoring and assessment program in coordination with the Naval Information Warfare Center Pacific (NIWC-PAC), formerly the Space and Naval Warfare Systems Command (SPAWAR) Systems Center Pacific, for eutrophic conditions in the Estuary as required by Investigative Order No. R9-2019-0007.

The Partners intend for NIWC-PAC, a landmark Naval research facility in San Diego, to implement the Estuary and Groundwater Monitoring within Camp Pendleton in coordination with and/or on behalf of the Partners in compliance with requirements prescribed in Investigative Order No. R9-2019-0007, Monitoring and Assessment Work Plan, and Quality Assurance Project Plan. NIWC-PAC has specialized skills in aquatic sampling, extensive knowledge of the Estuary's biology and experience with conducting chemical and biological monitoring in the Estuary over the last decade, which makes it uniquely qualified to implement the Estuary and Groundwater Monitoring within Camp Pendleton.

The Agreement with NIWC-PAC is needed to fund the Estuary and Groundwater Monitoring within Camp Pendleton and fulfill the purposes of the MOU. As the principal Riverside Co-Permittee, the District intends to enter into the Agreement with NIWC-PAC on behalf of the Riverside Co-Permittees.

Additionally, in accordance with the requirements in Investigative Order No. R9-2019-0007, the District will conduct in-stream river monitoring within its respective jurisdiction on behalf of the Riverside Co-Permittees, and the County of San Diego will conduct in-stream river monitoring within its respective jurisdiction.

County Counsel has approved the MOU and Agreement as to legal form. A companion item appears on the Riverside County's Board Agenda for approval this same date.

Environmental Findings

Pursuant to CEQA, the District has determined that the approval of the MOU and Agreement is exempt from CEQA under Section 15061(b)(3) of the State CEQA Guidelines. Section 15061(b)(3) or the "common sense exemption" applies to activities where it can be seen with certainty that there is no possibility that the activity in question may have a significant effect on the environment. The MOU and Agreement merely document the intentions of the Riverside Co-Permittees to fulfil certain permit requirements and provide funding to do so and do not include any physical changes to the environment.

Additionally, water quality monitoring required by Investigative Order No. R9-2019-0007 is exempt from CEQA pursuant to State CEQA Guidelines Section 15306 Information Collection. The District has determined that there is no possibility that the approval of the MOU and Agreement or the proposed water quality monitoring may have a significant effect on the environment.

Impact on Residents and Businesses

The MOU and Agreement will help to protect, preserve and enhance the quality of the water and the natural environment of the Santa Margarita Watershed.

Additional Fiscal Information

The approval of the MOU and the Agreement will help to meet the requirements of Investigative Order No. R9-2019-0007, including the Estuary and Groundwater Monitoring within Camp Pendleton.

Following are the estimated costs per fiscal year for the Estuary and Groundwater Monitoring within Camp Pendleton:

	FY 19/20	FY 20/21	FY 21/22	FY 22/23	FY23/24	TOTAL
Estuary and	$173,899	$222,270	$227,030	$234,549	$98,413	**$956,161**

Groundwater Monitoring within Camp Pendleton						

In addition, the District will conduct the in-stream river monitoring within its respective jurisdiction. This in-stream river monitoring, which is separate from the Agreement with NIWC-PAC, is anticipated to cost $240,000.

Sufficient funds are included in the District's Fiscal Year 2019-2020 budget and will be included in the proposed budgets for Fiscal Years 2020-2021 through 2023-2024, as appropriate.

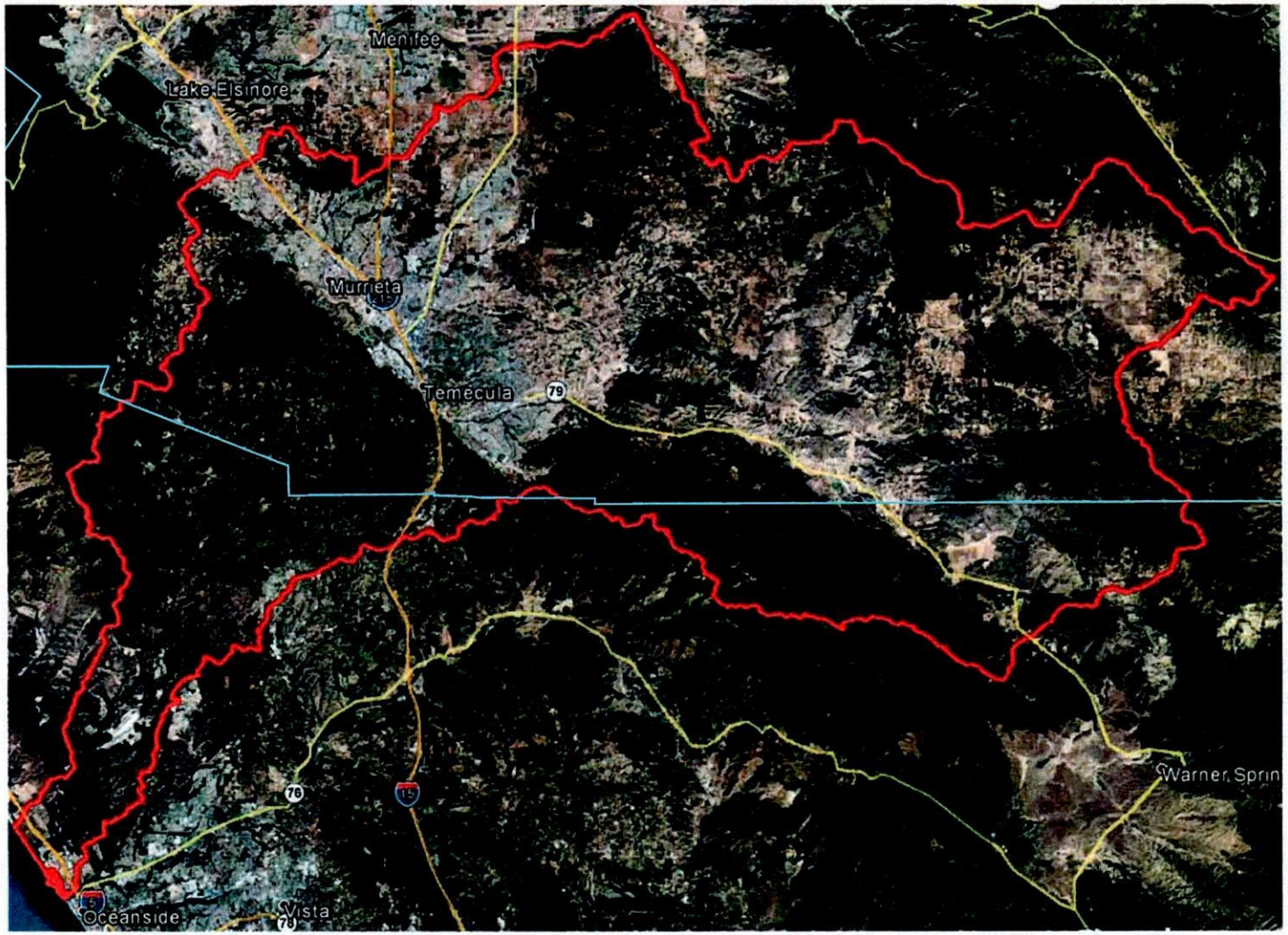
ATTACHMENTS:

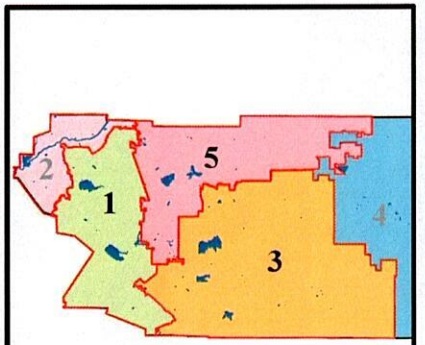
1. Vicinity Map
2. Memorandum of Understanding
3. Commercial Service Agreement

RKM:blm
P8/229676

Jason Farin, Senior Management Analyst 3/4/2020

Gregory P. Priamos, Director County Counsel 2/16/2020





Supervisor Districts

LEGEND:

- Watershed Management Area
- County Border

DESCRIPTION:

Santa Margarita Watershed Management Area

Supervisorial Districts 1, 3 & 5

N

VICINITY MAP

Riverside County Flood Control and Water Conservation District

Attachment 1

WHEN DOCUMENT IS FULLY EXECUTED RETURN
CLERK'S COPY
to Riverside County Clerk of the Board, Stop 1010
Post Office Box 1147, Riverside, Ca 92502-1147
Thank you.

Department of the Navy
Naval Information Warfare Center Pacific
(NIWC Pacific)
COMMERCIAL SERVICE AGREEMENT
(10 U.S.C. § 2539b)

1. PURCHASER:	2. AGREEMENT NUMBER:
Riverside County Flood Control and Water Conservation District, located at 1995 Market Street, Riverside CA 92501	PROJECT TITLE: SMR Investigative Order
	3. ESTIMATED COST: $956,161.00

4. INFORMATION CLASSIFICATION AND HANDLING		5. ATTACHMENTS MADE A PART OF THIS AGREEMENT:
X UNCLASSIFIED	PROPRIETARY	Final Monitoring and Assessment Workplan – Santa Margarita River Estuary and Watershed Monitoring and Assessment Program Final Quality Assurance Project Plan – Santa Margarita River Estuary and Watershed Monitoring and Assessment Program
CLASSIFIED	COMPETITION SENSITIVE	

6. STATEMENT OF SERVICES TO BE FURNISHED:

This is a request for the services of a Government laboratory pursuant to 10 U.S.C. § 2539b. The use of these services will be on a "Not-to-Interfere" basis with Department of Defense mission efforts. Provision of such services is in the interest of national defense. The specific services requested for use are outlined in Section XXII. STATEMENT OF WORK (SOW).

7. PURCHASER POINT OF CONTACT AND TELEPHONE NUMBER	8. SELLER POINT OF CONTACT AND TELEPHONE NUMBER
Matt Yeager Email: MYeager@RIVCO.ORG Phone: (951) 955-0843	Kara C. Sorensen; email: sorensek@spawar.navy.mil; (o) 619-553-1340
9. DoD/AGENCY POINT OF CONTACT AND TELEPHONE NUMBER (Where Applicable)	
10. PURCHASER (Signature of person authorized to sign) Karen S. Spiegel	11. SELLER (Signature of person authorized to sign)
12. NAME AND TITLE OF SIGNER KAREN SPIEGEL Chairwoman, Riverside County Flood Control and Water Conservation District Board of Supervisors	13. DATE 3/10/2020
14. NAME AND TITLE OF SIGNER W. R. BONWIT Executive Director NIWC Pacific	15. DATE

ATTEST:
KECIA R. HARPER, Clerk
By Kecia Harper DEPUTY

FORM APPROVED COUNTY COUNSEL
BY: Synthia M. Gunzel 2/4/2020
SYNTHIA M. GUNZEL DATE

MAR 10 2020 3.3

COMMERCIAL SERVICE AGREEMENT
TERMS AND CONDITIONS
(10 U.S.C. § 2539b)

I. AUTHORITY AND PURPOSE.

A. Pursuant to a separate agreement which has no legal bearing to this commercial service agreement, Riverside County Flood Control and Water Conservation District, located at 1995 Market Street, Riverside CA 92501 on behalf of the County of Riverside, City of Murrieta, City of Temecula, City of Wildomar, and Riverside County Flood Control and Water Conservation District, hereinafter referred to as Purchaser, and the United States of America, as represented by Executive Director (ED), Naval Information Warfare Center (NIWC) Pacific, hereinafter referred to as Seller, enter into this Commercial Service Agreement (Agreement.) This Agreement is entered into pursuant to the authority of 10 U.S.C. § 2539b. The Agreement is further limited by the estimated cost and Statement of Work (SOW) (Section XXII). The purpose of this Agreement is to provide the terms and conditions governing the tasks to be performed.

B. The Secretary of Defense promulgated Department of Defense Instruction 5535.11, implementing new guidance for work undertaken pursuant to 10 U.S.C. 2539b (Section 2539b) on March 19, 2012. This instruction states that it is Department of Defense (DoD) policy to promote research and development within the commercial sector. Efforts to improve the quality of the defense laboratories and increase their ability to perform their designated missions effectively and efficiently, while at the same time utilizing that taxpayer-funded infrastructure to support private sector activities when in the interest of national defense, shall be supported. These policies further national military and economic security by promoting the development of a national technology and industrial base from which to sustain military technology superiority while enhancing productive capabilities for the Nation overall.

C. Pursuant to this instruction, the Secretary of the Navy further delegated authority under subsections (a)(3) and (a)(4) of Section 2539b to directors or commanders of Department of the Navy (DON) laboratories, centers, ranges, or other similar facilities for testing of materials, equipment, models, computer software, and other items for any person or entity on May 9, 2012. These persons or entities include individuals, partnerships, corporations, associations, State, local, or tribunal Governments, or an agency or instrumentality of the United States other than DoD. Therefore, Seller is authorized to make available to any person or entity, at a prescribed fee, testing services for materials, equipment, models, computer software, and other items consistent with the following requirements as stated below.

D. The testing of materials and other items not owned by the Seller under this Agreement shall not cause Seller personnel or other Seller resources to be diverted from scheduled tests of Seller material or otherwise interfere with Seller mission requirements.

II. PERIOD OF PERFORMANCE.

The period of performance for this Agreement shall become effective on the date it is executed and shall remain in effect through the required date for completion by June 30, 2025 from the date of signature by both parties (Period of Performance).

III. DEFINITIONS.

A. Competition Sensitive Information – Information in any form, whether written or otherwise, that discloses, in whole or in part, information with respect to work performed, planned to be proposed, or actually proposed to be performed by either party and that can be reasonably expected to have a material effect on the competitive position of such party. This would include Seller information that is marked with any restrictive distribution statements. In addition, the information must be: 1) appropriately labeled Competition Sensitive Information, or 2) oral or visual information that is verbally designated at the time of disclosure as Competition Sensitive Information and subsequently confirmed as such within thirty (30) days after the initial oral or visual disclosure in a written document marked as Competition Sensitive Information and listing or summarizing the oral or visual information which was disclosed as Competition Sensitive Information. In addition, Competition Sensitive Information includes information that is derived by the receiving party from information designated as Competition Sensitive Information by the providing party. Notwithstanding the above, information will not be Competition Sensitive Information to the extent, if any, it: 1) is in the public domain or becomes generally available to the public in a way that does not involve a contractual breach, 2) is received by any party from a third party free to disclose such information, or 3) was independently developed by the party receiving the Competition Sensitive Information prior to that party's receipt of that information.

B. Proprietary Information - Any information, Technical Data or know-how in whatever form, including, but not limited to, documented information, machine readable or interpreted information, information contained in physical components, mask works and art work, which are clearly identified as such and marked as being proprietary. Information transmitted orally or visually shall be considered to be Proprietary Information provided such Proprietary Information is identified by the disclosing party prior to disclosure, reduced to written summary form, and marked as being proprietary by the transmitting party, and transmitted to the recipient within thirty (30) business days after such oral or visual transmission. During this thirty (30) business day period, such oral or visual information so disclosed shall be provided the same protection as provided Proprietary Information as set forth in the paragraph IV, entitled INFORMATION HANDLING. Failure to so identify, reduce to writing, mark, and deliver such verbally or visually disclosed information in the manner prescribed shall relieve the receiving party of all obligations of protection with respect to said disclosed information thereafter. Information is not Proprietary if:

(1) The information is generally known, or is available from other sources without obligation concerning its confidentiality;

(2) Has been made available by the owner to others without obligation concerning its confidentiality;

(3) It is described in an issued patent or a published copyrighted work or is otherwise available to the public without obligation concerning its confidentiality;

(4) The information is not identified as proprietary or confidential by labels or markings designating the information as such; and

(5) Information that may be necessary for the prosecution of any legal action or information subject to a valid production order by a tribunal of competent jurisdiction, provided that all related protective orders are properly respected.

IV. INFORMATION HANDLING.

A. With respect to information security, each party shall provide notice of any special information handling (classified, competition sensitive, proprietary, etc.) associated with the project, test articles, technical information, test data, specifications, etc. If no notice is provided, it will be assumed that no restrictions are required.

B. If the product or related information is classified, the product or related information will be handled in accordance with the applicable instructions (e.g., *Department of the Navy Personnel Security Program (PSP)*, SECNAVINST 5510.30B and *Department of the Navy (DON) Information Security Program (ISP) Instruction,* SECNAVINST 5510.36A) for safeguarding such articles or information against unauthorized disclosure and as stipulated herein.

C. Unless otherwise required by law, the parties to this Agreement who receive Competition Sensitive/Proprietary Information belonging to the other party shall hold such Competition Sensitive/Proprietary Information in strict confidence; shall limit its further disclosure to only personnel having a need for access to the Competition Sensitive/Proprietary Information; and shall use the Competition Sensitive/Proprietary Information only for performance of this Agreement. The parties further agree to make a good faith effort to minimize, to the extent practicable, the number of persons having access to Competition Sensitive/Proprietary Information. Competition Sensitive/Proprietary Information shall receive security protection in accordance with the receiving party's standard procedures governing the handling of such information and as agreed to in any attachments hereto.

D. Upon completion or termination of this Agreement, each party shall return or properly dispose of all classified or Proprietary Information unless otherwise agreed by the parties.

V. ESTIMATED COST AND FUNDING.

A. This is a cost reimbursable agreement. The estimated cost for accomplishing the work is $830,233 based on the Seller's stabilized rates in effect at the time of this Agreement.

B. Cost estimates and funding will be based on the SOW (Section XXII). Work under this Agreement is considered level of effort and the initial cost estimate may need to be increased after work is commenced. Purchaser shall contribute an additional ten percent (10%) of the total estimated cost to the Seller to account for minor changes and potential future variances in the

SOW such that the total purchaser cost shall not exceed a total of $956,161 (TOTAL PURCHASER COST). It is understood that, if the Purchaser makes changes to the SOW, cost will change accordingly. The costs exceeding TOTAL PURCHASER COST will require an amendment in accordance to this agreement.

Yearly Breakout	2020	2021	2022	2023	2024	Total
County of Riverside and Parties	$ 158,090	$ 202,064	$ 206,391	$ 213,226	$ 89,466	$ 869,237
10% variance	$ 15,809	$ 20,206	$ 20,639	$ 21,323	$ 8,947	$ 86,924
Grand Total	$ 173,899	$ 222,270	$ 227,030	$ 234,548	$ 98,413	$ 956,161

C. Amounts actually charged the Purchaser shall be the direct and indirect costs reasonably and necessarily incurred in the performance of the work in accordance with Chapter 1 of Volume 11A of the DoD Financial Management Regulation, DoD 7000.14-R and any applicable local instruction.

D. The Purchaser shall fund this Agreement prior to commencement of performance. The Seller will invoice Purchaser for services annually no later than (February 15th). Invoices shall be formatted such that they meet the needs of the respective finance departments of the Purchaser. Incremental funding is permitted; however, work will not be carried out without sufficient funding being provided in advance. If additional funding is required, prior to sending the invoice to the Purchaser, the Seller will provide justification for the need of additional funds including but not limited to (i) labor rates (ii) changes in SOW. The Purchaser shall provide the Seller the additional funding if the Purchaser determines the justification to be reasonable. The Purchaser shall provide funds based on the availability of funds. If funds are available, Purchaser shall provide such funds to the Seller within 45 days of the receipt of the invoice from the Seller. Failure of the Purchaser to provide funds, as required, will result in the discontinuance of performance. Upon conclusion of performance, the Seller will reconcile the Purchaser's account to determine actual charges. The Seller will refund any balance due on the Agreement to the Purchaser. Nothing in this Agreement shall give the Purchaser the right to audit the books of the Seller.

VI. METHOD OF PAYMENT.

Payment shall be made by check, bank order, or postal money order payable to "U.S. Treasury" and shall include the Agreement number. Payment shall be forwarded to:

Naval Information Warfare Center Pacific
ATTN: Code 11130
53560 Hull Street
San Diego, CA 92152-5001

VII. PURCHASER FURNISHED PROPERTY.

The resources to be provided by the Purchaser are included in the SOW (Section XXII).

VIII. RESOURCES PROVIDED BY SELLER.

The resources to be provided by the Seller are included in the SOW (Section XXII).

IX. CHANGES

A. Any changes to this Agreement will be evidenced by an amendment to this Agreement. Any changes to this Agreement must be mutually agreed upon in writing by the parties. No oral statements of any person whatsoever shall in any manner modify or otherwise affect the terms of this Agreement. Jason E. Uhley (Riverside County Flood Control and Water Conservation District), authorized representative on behalf of Purchaser; and ED, NIWC Pacific, authorized representative on behalf of the Seller; are the only persons authorized to approve changes in any of the terms of this Agreement.

B. Changes, termination notices, and other written correspondence under this Agreement should be sent to:

NIWC Pacific
Attn: Code 30000
53560 Hull Street, Bldg A-33, Rm 2053
San Diego, CA 92152-5001

X. WARRANTIES/INDEMNIFICATION/HOLD HARMLESS.

All transfers of property or services of whatever nature made pursuant to this Agreement shall be without any express or implied warranty. The Purchaser hereby agrees that the U.S. Government shall not be liable for any damage whether direct or consequential.

A. The Seller will use its best efforts in the performance of this Agreement. In addition to provision X.A. above, SELLER MAKES NO EXPRESS OR IMPLIED WARRANTY AS TO THE CONDITION OF ANY RESEARCH TEST(S), TEST RESULTS, OR ANY RESULTING PRODUCT OR PROCESS. SELLER FURTHER MAKES NO EXPRESS OR IMPLIED WARRANTY AS TO THE MERCHANTABILITY, INTELLECTUAL PROPERTY INFRINGEMENT OR NON-INFRINGEMENT, OR FITNESS FOR A PARTICULAR PURPOSE OF THE ARTICLE(S) TESTED, OR THE TEST RESULTS.

Additionally, the Seller's performance under this Agreement shall not release or diminish any obligation or duty of the Purchaser under any Government contract, or be used by the Purchaser to excuse its failure to perform under any Government contract.

XI. CANCELLATION/SUSPENSION.

A. The Seller reserves the right to cancel or suspend all or part of its performance under this Agreement in the event that such performance is deemed to interfere, for any reason, with the performance of work/mission by the Seller. The right to cancel or suspend performance hereunder shall be in addition to the right reserved by the Government to cancel or suspend performance under this Agreement for unusual and compelling circumstances when the national interest of the United States so requires or to protect public health or safety.

B. Appreciating the consequences of such a decision, the Seller will attempt to mitigate any cancellation or suspension of services. However, the Seller cannot be held liable for any cost accruing to the Purchaser as a result of any cancellation or suspension.

XII. TERMINATION/INTERRUPTION OF SERVICES.

A. The Purchaser may terminate this Agreement upon seven (7) days written notice to the Seller. If the Purchaser elects to cancel this Agreement, the Purchaser shall remain responsible for all costs incurred by the Seller up to the date of receipt by the Seller of its termination notice. The Purchaser shall also be responsible to the Seller for all costs incurred in tearing down any facility and/or restoring the facility area to the "like condition" it was in, before preparations were made to conduct these tasks, and for any other termination costs resulting directly from the termination.

B. The rights and remedies of the Seller provided by this clause are in addition to any other rights and remedies provided by law or this Agreement.

C. Seller mission requirements shall take precedence over the Purchaser's requirements under this Agreement. The Seller, at the direction of higher authority, may be required to interrupt or delay the Purchaser's tests, at any time such interruption or delay is reasonability required in support of Seller's mission. In this event, Seller shall notify the Purchaser, in writing, of the interruption or delay. Seller shall not be liable to the Purchaser, or any third party, for any costs or consequences resulting from the interruption or delay.

XIII. DISPUTES.

A. All disputes arising under this Agreement shall be resolved according to this Article. Any dispute which is not disposed of by agreement of the parties shall be decided by (Kara C. Sorensen), (Senior Research Scientist), Code 71750, NIWC Pacific, who shall reduce the decision to writing and shall furnish a copy to Jason E. Uhley, General Manager- Chief Engineer. The decision shall be final unless, within fifteen (15) calendar days from the date of receipt of the decision, the Purchaser furnishes the ED of NIWC Pacific (Reviewing Official) with a request for reconsideration. As the Reviewing Official, the ED will review the record to determine whether the initial decision was reasonable. The Purchaser shall be afforded an

opportunity to submit additional supporting documentation and rationale. The decision of the Reviewing Official shall be final.

B. During the dispute resolution process, Seller may elect not to continue testing under this Agreement until the dispute is resolved. If Seller elects to discontinue testing, Purchaser has the option to terminate Agreement with written notice to Seller, and costs not incurred by Seller will be returned to Purchaser upon written request by Purchaser.

XIV. MISHAP INVESTIGATIONS.

In the event of any mishap resulting in the loss, damage, or destruction to property and/or facilities used in the performance of this Agreement, the Purchaser agrees to provide technical support for any investigation to assess the cause. Both parties agree that the report will be held confidential to the degree allowed by applicable laws.

XV. CLEARANCE OF MATERIAL INTENDED FOR PUBLIC RELEASE.

No news release, including photographs and films, advertisement, or public announcement, regarding this Agreement or denial or confirmation of same shall be made without prior written approval of the Seller's Public Affairs Office.

XVI. EXPORT CONTROL.

Information exchanged under this Agreement may be subject to United States export control laws and regulations under the Arms Export Control Act (22 U.S.C. § 2778 et. seq.). The Purchaser is solely responsible for complying with all applicable United States export control laws and regulations for information subject to the export control laws and regulations.

XVII. DATA RIGHTS AND PATENT RIGHTS.

DATA RIGHTS.

A. The term "Technical Data" as used in this Agreement is defined in the Defense Federal Acquisition Regulation Supplement Clause 252.227-7013, Rights in Technical Data-Noncommercial Items (FEB 2014). Technical Data includes detailed manufacturing or process data, form, fit and function data, test data computer databases and computer software documentation. The term "computer software" as used in this Agreement is defined in the Defense Federal Acquisition Regulation Supplement Clause 252.227-7014, Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation (FEB 2014).

B. Notwithstanding any provision to the contrary, nothing in this Agreement shall diminish Seller's rights in any Technical Data and/or Computer Software that is not developed under this Agreement, specifically including any preexisting rights in any Technical Data and/or Computer

Software that the Government has or is entitled to, under any other Government agreements or contracts, or that the Government is otherwise entitled to as a matter of law.

C. Except where prohibited by law or regulation or otherwise provided in this Agreement, the Purchaser shall have the right to use and disclose Technical Data and/or Computer Software developed and delivered by the Seller under this Agreement. Purchaser shall retain the copyright to any Technical Data and/or Computer Software developed and delivered by Seller under this Agreement. However, Purchaser agrees to assume responsibility for placement of copyright notices on Technical Data and/or Computer Software developed under this Agreement and delivered to Purchaser, as well as for any other proprietary markings Purchaser desires to place on such Technical Data/Computer Software.

D. Except as may otherwise be stated herein, or as may be required by law, e.g., Freedom of Information Act, the Seller shall not disclose Technical Data and/or Computer Software it first creates under this Agreement outside the Federal Government, without the prior written consent of the Purchaser.

E. The provisions of this Paragraph shall survive any termination, cancellation, or suspension of this Agreement.

PATENT RIGHTS.

A. The term "invention" as used in this Agreement is defined in Federal Acquisition Regulation Clause 52.227-11, Patent Rights – Ownership by the Contractor (MAY 2014).

B. Nothing in this Agreement shall grant to or confer upon the Seller any rights, express or implied, to any invention owned by the Purchaser or to which the Purchaser is entitled to ownership, including but not limited to, any invention conceived or reduced to practice under this Agreement, or under any patent application or patent owned by the Purchaser or to which the Purchaser is entitled to ownership.

C. Nothing in this Agreement shall grant to or confer upon the Purchaser any rights, express or implied, to any invention owned by the Seller or to which the Seller is entitled to ownership, including but not limited to, any patent application or patent owned by the Government or to which the Government is entitled to ownership.

XVIII. GENERAL TERMS.

A. Governing Law. Irrespective of the place of performance or signing of this Agreement, this Agreement shall be governed by and interpreted only in accordance with U.S. Federal law and regulations.

B. Order of Precedence. The rights and obligations of the parties to this Agreement shall be subject to and governed by these Agreement clauses and the other documents incorporated by reference. Any inconsistency in this Agreement shall be resolved by giving precedence in the

following order: 1) Commercial Service Agreement provisions including clauses; and 2) Other documents incorporated by reference.

C. Safety Services. If the Seller renders service such as fire, ambulance or emergency first aid/hospitalization for the benefit of the Purchaser, the Purchaser shall pay the charges associated with those services. Purchaser shall also be responsible for following all Department of the Navy and NIWC Pacific regulations and instructions regarding safety while on board a Government installation.

D. Entire Agreement. This agreement with all attachments constitutes the entire agreement of the parties and no oral or other representations shall be binding.

E. Force Majeure. Neither party shall be in breach of this Agreement for any failure of performance caused by any event beyond its reasonable control and not caused by the fault or negligence of that party. Should a force majeure event occur, the party unable to perform shall promptly notify the other party and shall in good faith resume performance as soon as is reasonably possible.

F. Relationship of the Parties. The parties to this Agreement and their employees are independent contractors and are not agents of each other, joint ventures, or partners to any business organization. Neither party is authorized or empowered to act on behalf of the other with regard to any contract, warranty or representation as to any matter, and neither party will be bound by the acts or conduct of the other. Each party will maintain sole and exclusive control over its own personnel and operations.

G. Publicity/Use of Name Endorsement. The Purchaser, Seller, and the Seller's Public Affairs Officer shall coordinate any announcement of this Agreement. The Person or entity shall not use any name or logo attached to the United States Government, the Department of Defense, or Seller on any product, service, patent license, or assignment related directly or indirectly to this Agreement without the prior written approval of Seller. By entering into this Agreement, the United States Government, the Department of Defense, and Seller do not directly or indirectly endorse any product or service provided, or to be provided, by the Purchaser. The Purchaser shall not in any way imply that this Agreement is an endorsement of any such product or service.

H. Waiver of Rights. Any waiver shall be in writing and provided to the other party. Failure to insist upon strict performance of any of the terms and conditions hereof, or failure to delay to exercise any rights provided herein or by law, shall not be deemed a waiver of any rights of either party.

I. Severability. The illegality or invalidity of any provisions of this Agreement shall not impair, affect or invalidate the other provisions of this Agreement.

J. Assignment. No party shall assign or transfer any rights or obligations derived from this Agreement without the prior written consent of the other party.

K. Representation. Purchaser represents that Purchaser is not foreign owned or a subsidiary of a foreign-owned entity.

XIX.-XXI. RESERVED.

XXII. STATEMENT OF WORK (SOW).

a. Final Monitoring and Assessment Workplan – Santa Margarita River Estuary and Watershed Monitoring and Assessment Program
b. Final Quality Assurance Project Plan – Santa Margarita River Estuary and Watershed Monitoring and Assessment Program

JASON E. UHLEY
General Manager-Chief Engineer

1995 MARKET STREET
RIVERSIDE, CA 92501
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www.rcflood.org

RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

January 17, 2020

Via Electronic Submittal to: SanDiego@waterboards.ca.gov
Subject line: Santa Margarita River Estuary and Watershed Monitoring and Assessment Program Submission—ECM PIN CW-650655 Attn: RPPU

Mr. David Gibson, Executive Officer
CRWQCB – San Diego Region
2375 Northside Drive, Suite 100
San Diego, CA 92108

Dear Mr. Gibson:

Re: Revised Final Santa Margarita River Estuary and Watershed Monitoring and Assessment Program Workplan

Please find attached a digital copy of the final Santa Margarita River Estuary and Watershed Monitoring and Assessment Program Workplan (Workplan), submitted as required by Investigative Order No. R9-2019-0007[1] (Order), issued by the San Diego Water Board on May 9, 2019 under the authority of California Water Code Section 13267. The Workplan was previously submitted for your review on November 8, 2019. We received Regional Board staff comments on the Workplan on November 26, 2019 and have incorporated the necessary revisions into this submittal. This final submittal is made on behalf of the Cities of Murrieta, Temecula and Wildomar, the Counties of San Diego and Riverside, the Riverside County Flood Control and Water Conservation District, and the United States Marine Corps Base Camp Pendleton.

We believe the submitted Workplan addresses all the comments received and satisfies the conditions of the Order.

[1] Investigative Order No. R9-2019-0007: An Order Directing the Cities of Murrieta, Temecula and Wildomar, the Counties of San Diego and Riverside, the Riverside Flood Control and Water Conservation District, and the United States Marine Corps Base Camp Pendleton to Design and Implement a Water Quality Improvement Monitoring and Assessment Program for Eutrophic Conditions in the Santa Margarita River Estuary and Watershed, California.

CERTIFICATION

SANTA MARGARITA RIVER ESTUARY AND WATERSHED MONITORING AND ASSESSMENT PROGRAM WORKPLAN—FINAL VERSION

SAN DIEGO WATER BOARD INVESTIGATIVE ORDER NO. R9-2019-0007

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

MATT YEAGER, D. Env
Senior Flood Control Planner
Riverside County Flood Control
and Water Conservation District

1-16-20
DATE

County of San Diego

SARAH E. AGHASSI
DEPUTY CHIEF ADMINISTRATIVE OFFICER

LAND USE AND ENVIRONMENT GROUP
1600 PACIFIC HIGHWAY, ROOM 212, SAN DIEGO, CA 92101
(619) 531-6256 • Fax (619) 531-5476
www.sdcounty.ca.gov/lueg

STATEMENT OF CERTIFICATION

SANTA MARGARITA RIVER ESTUARY AND WATERSHED MONITORING AND ASSESSMENT PROGRAM WORKPLAN—FINAL VERSION
SAN DIEGO WATER BOARD INVESTIGATIVE ORDER NO. R9-2019-0007

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Sarah Aghassi

SARAH E. AGHASSI
Deputy Chief Administrative Officer
Land Use and Environment Group
County of San Diego

Date 1/6/20

CITY OF MURRIETA

CERTIFICATION

SANTA MARGARITA RIVER ESTUARY AND WATERSHED MONITORING AND ASSESSMENT PROGRAM WORKPLAN—FINAL VERSION

SAN DIEGO WATER BOARD INVESTIGATIVE ORDER NO. R9-2019-0007

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Robert K. Moehling
Public Works Director / City Engineer

1/16/2020
Date

23873 Clinton Keith Rd, Ste 201
Wildomar, CA 92595
951.677.7751 Phone
951.698.1463 Fax
www.CityofWildomar.org

CERTIFICATION

SANTA MARGARITA RIVER ESTUARY AND WATERSHED MONITORING AND ASSESSMENT PROGRAM WORKPLAN—FINAL VERSION

SAN DIEGO WATER BOARD INVESTIGATIVE ORDER NO. R9-2019-0007

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Daniel A. York, Assistant City Manager
Public Works Director/City Engineer

January 13, 2020
Date

FINAL
MONITORING AND ASSESSMENT WORKPLAN
Santa Margarita River Estuary and Watershed Monitoring and Assessment Program

Submitted to:

California Regional Water Quality Control Board, San Diego Region
2375 Northside Drive, Suite 100
San Diego, California 92108

Prepared By:

Weston Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008

On Behalf of:

County of Riverside
Riverside County Flood Control and Water Conservation District
County of San Diego
United States Marine Corps Base Camp Pendleton
City of Murrieta
City of Temecula
City of Wildomar

January 2020

P8/228135

LIST OF APPENDICES

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TKN	total Kjeldahl nitrogen
TMDL	Total Maximum Daily Load
TOC	total organic carbon
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	waste load allocation
WMA	Watershed Management Area
Workplan	Monitoring and Assessment Program Workplan
WQO	water quality objective

UNITS OF MEASURE

cm	centimeter(s)
°C	degrees Celsius
g	gram(s)
g dry weight/m^2	grams dry weight per meter squared
g wet weight/m^2	grams of wet weight per meter squared
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
m	meter(s)
m^2	meter(s) squared
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
mm	millimeter(s)
NTU	Nephelometric turbidity units
ppt	Parts per thousand
%	percent
µg	microgram(s)

Riverside County near the City of Temecula, at the confluence of Murrieta and Temecula Creeks. The main stem of the SMR flows within San Diego County through unincorporated areas, the community of Fallbrook, and MCB CamPen and ultimately drains into the Estuary. The adjacent watershed areas of the lower SMR and Estuary are largely undeveloped and support multiple habitats for populations of federally- and/or state- listed endangered species.

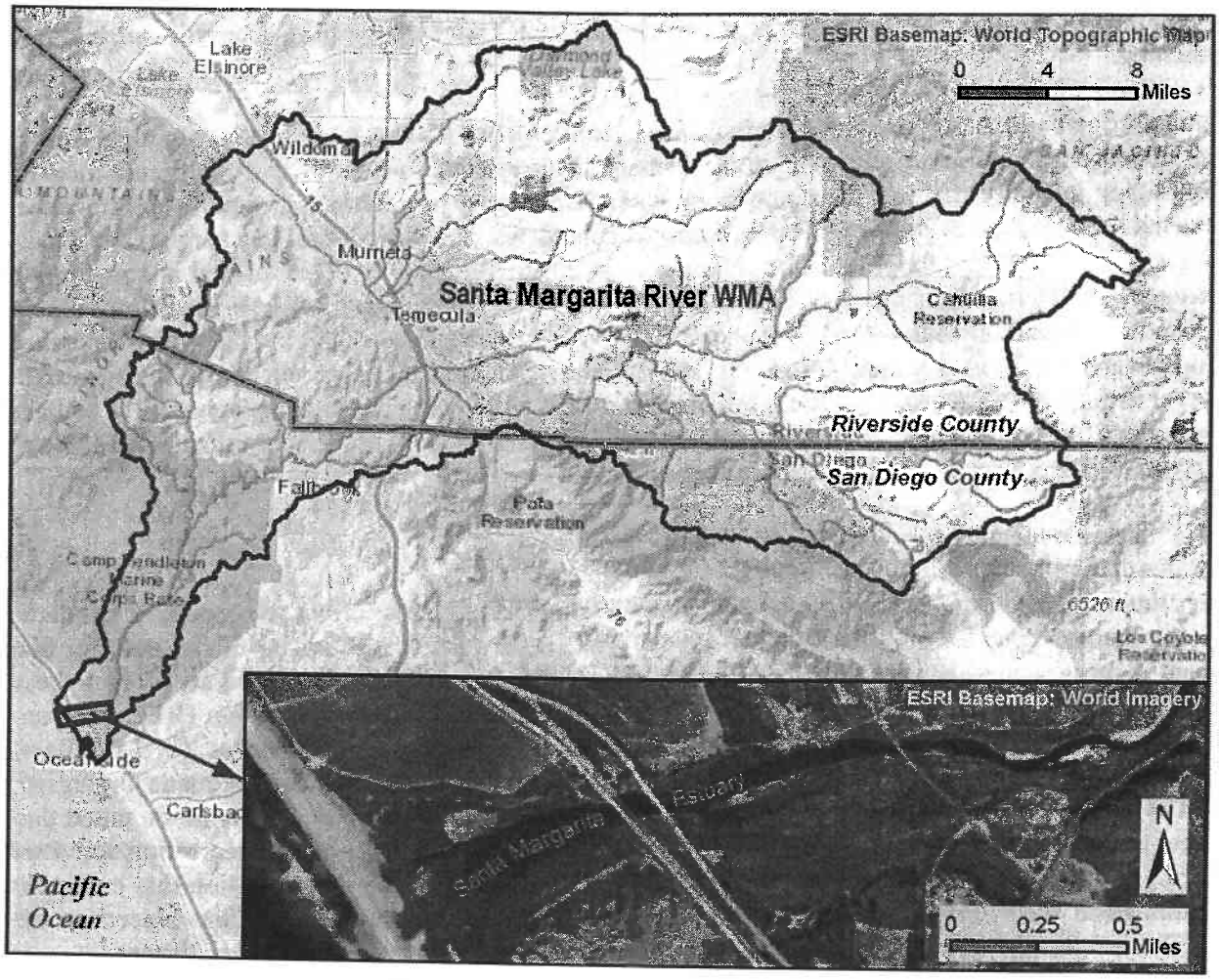

Figure 1-1. Overview of Santa Margarita River Estuary and Watershed Study Area

1.1.2 Problem Statement

The Estuary has been characterized by eutrophic conditions. Urban and agricultural land uses in the more developed portions of the watershed have resulted in hydrological modifications to the Estuary which have led to increased nutrient loading (McLaughlin et al., 2013). Throughout the year, the ocean inlet of the Estuary may be open or closed to the Pacific Ocean for extended periods depending on the amount of rainfall and flow. During periods when the inlet is open and the Estuary is connected to the Pacific Ocean, the Estuary is flushed with seawater resulting in a brackish lagoon environment. However, salinity stratification in the water column often occurs when a sand berm develops at the

Further studies of eutrophication in the Estuary were conducted between 2010 and 2018 by the Naval Information Warfare Center Pacific (NIWC Pacific).[1] While monitoring results show that overall conditions are improving as massive rafting algal mats have not been observed since 2010, these studies continue to show evidence of eutrophic conditions manifested as macroalgal blooms, with higher levels of macroalgae heavily tied to closed mouth conditions. On behalf of MCB CamPen, NWIC Pacific also conducted monitoring on resurfacing groundwater (Leather et al., 2015; Leather et al., 2016; Leather et al., 2017). Results from this monitoring indicated that ongoing discharge of nutrients into the Estuary through resurfacing groundwater from former agricultural fields on MCB CamPen was still occurring. However, data indicated that a reduction of nutrient loading by as much as one to two orders of magnitude[2] had occurred since the monitoring of resurfacing groundwater first began (San Diego Water Board, 2019).

1.1.3.2 2018 Draft Staff Report

A loading analysis was drafted in July 2018, which identified total nitrogen and total phosphorus as the causative pollutants for eutrophication in the Estuary. In *Santa Margarita River Estuary, California Nutrients Total Daily Maximum Load Project* (Draft Staff Report) (San Diego Water Board, 2018), the San Diego Water Board outlined a TMDL of 13,246 pounds of delivered total nitrogen per year and 1,528 pounds of delivered total phosphorus per year during dry weather, meaning that the Estuary is able to assimilate this amount of total nitrogen and phosphorus during that time period without impairments of beneficial uses. This assimilative capacity corresponds to a 76% load reduction from loading levels estimated by SCCWRP for the 2008 water year (San Diego Water Board, 2018).

In the Draft Staff Report (San Diego Water Board, 2018), numeric targets for the Estuary were developed using the nutrient numeric endpoint (NNE) framework approach for California estuaries developed by SCCWRP for the State Water Board. "*The NNE framework is founded on the premise that site-specific ecological response variables, such as dissolved oxygen concentrations, macroalgal biomass, and benthic community condition score combined with a weight of evidence approach provide a more direct and robust means of assessing beneficial use impairment than relying on nutrient concentrations alone*" (Draft Staff Report; San Diego Water Board, 2018). Following the NNE approach, macroalgal biomass and DO were selected as primary numeric targets for the Estuary and provide a scientifically defensible methodology for interpreting the narrative WQOs of the Basin Plan for biostimulatory substances, which states:

> *"Inland surface waters, bays and estuaries and coastal lagoon waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growths cause nuisance or adversely affect beneficial uses."*

To confirm that the Estuary beneficial uses are being supported, additional secondary numeric targets were selected for macroalgal biomass, DO concentrations, and benthic community condition.

The primary numeric targets identified in the Draft Staff Report include surface water macroalgal biomass of less than (<) 57 grams dry weight per meter squared (g dry weight/m^2) and a water column

[1] Formerly known as NAVY Space and Naval Warfare Systems Pacific (SPAWAR).
[22]Six-fold decrease (Kara Sorensen, personal communication)

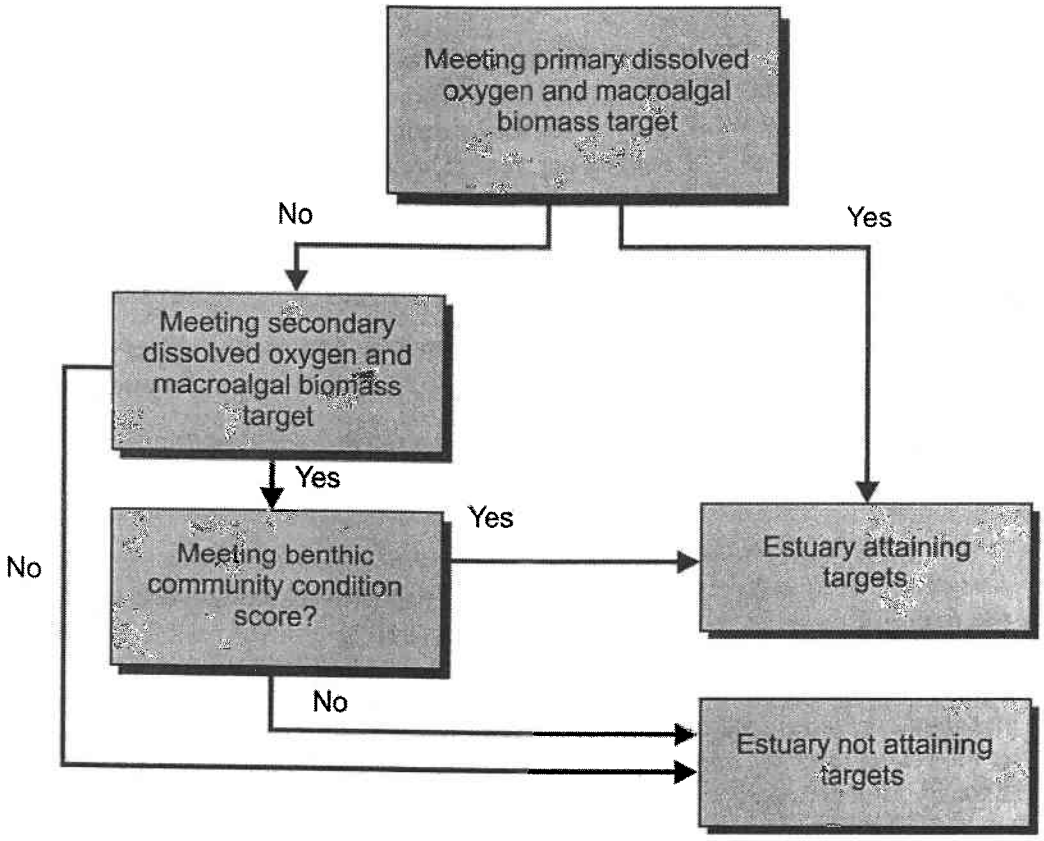

Figure 1-2. Use of Primary and Secondary Numeric Targets to Determine if the Estuary is Supporting Beneficial Uses (Modified from LWA, 2016; San Diego Water Board, 2018)

1.1.3.3 2019 Investigative Order

In May 2019, the San Diego Water Board issued the 2019 Investigative Order under the authority of California Water Code section 13267. The purpose of the 2019 Investigative Order is to "*assess the condition of the Santa Margarita River Estuary (Estuary) and to evaluate the linkage between the nutrient loading trends resulting from the implementation actions by the Cities of Murrieta, Temecula, and Wildomar, the Counties of San Diego and Riverside, the Riverside Flood Control and Water Conservation District, and the United States Marine Corps Base Camp Pendleton (collectively referred to hereafter as Dischargers) and the restoration of the water quality and beneficial uses of the Estuary*" (San Diego Water Board, 2019). The monitoring requirements were developed in collaboration with the Dischargers through the Santa Margarita River Estuary Watershed Nutrient Initiative Stakeholder Group. The 2019 Investigative Order requires the development of a Monitoring and Assessment Program Workplan (Workplan) that outlines a water quality monitoring and assessment program to track progress towards achieving the numeric targets listed in the Draft Staff Report and total nitrogen and total phosphorus loading reductions to the Estuary.

The 2019 Investigative Order outlines the primary and secondary numeric targets for the Estuary as well as the calculated capacity of the Estuary to assimilate total nitrogen and total phosphorus in pounds per year in order to still meet the numeric targets. The numeric targets are from the Draft Staff Report

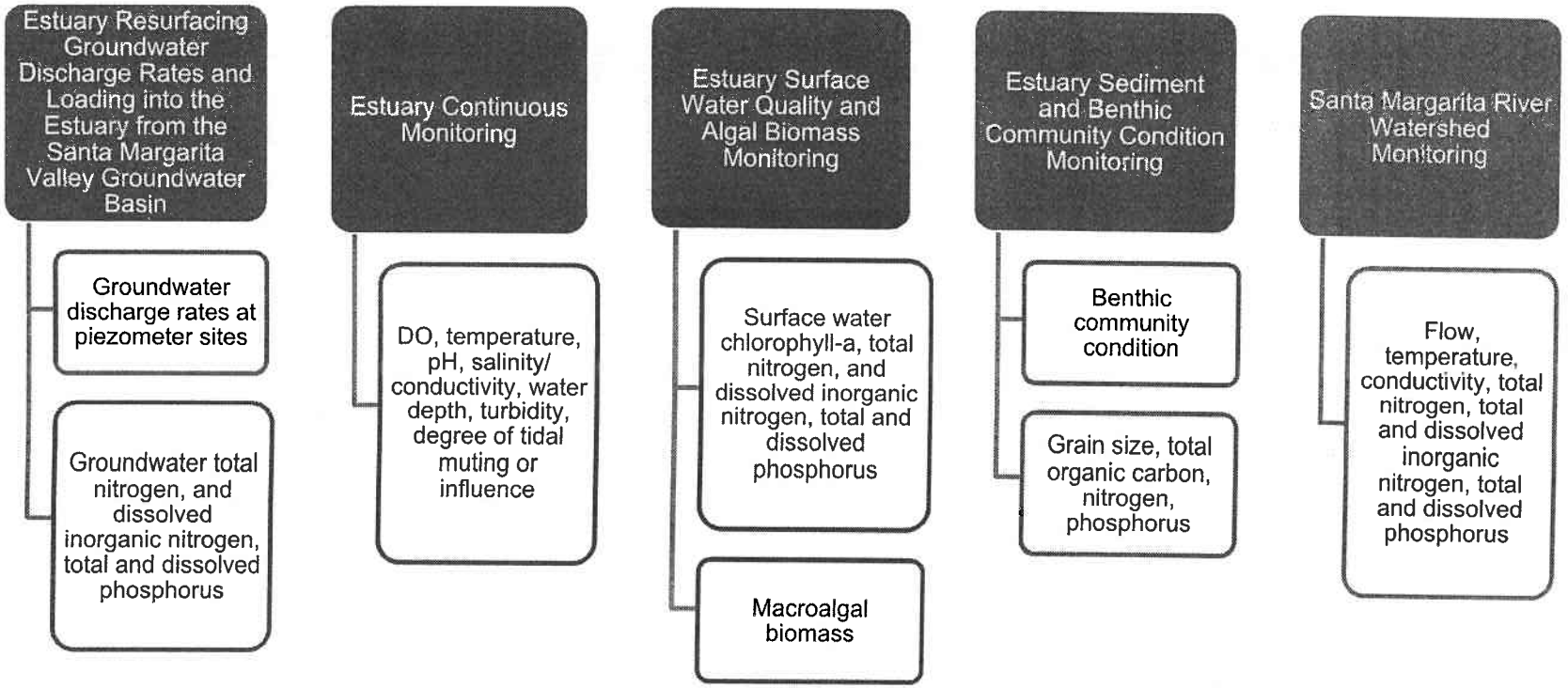

Figure 1-3. Monitoring Program Parameters

CamPen must be disinfected either through chemical treatment (generally with a dilute solution of formula 409, or equivalent) or freezing. Boat hulls and trailers should be power-washed and inspected for signs of quagga mussel, zebra mussel, and New Zealand mud snail, especially if coming from surface waters associated with the lower Colorado River. No foreign ballast or other waters shall be introduced into any surface water on MCB CamPen.

2.1.1 Estuary Resurfacing Groundwater Discharge Rates and Loading into the Estuary from the Santa Margarita Valley Groundwater Basin

Each year (biannually during winter dry and summer dry periods), resurfacing groundwater and loading to the Estuary from the Santa Margarita Valley Groundwater Basin will be monitored by sampling several piezometers and monitoring wells. Groundwater samples will be collected from three historic piezometer locations (**Table 2-1**) located near the Stuart Mesa Agricultural Fields to confirm that resurfacing groundwater is no longer a significant source of nutrient loading to the Estuary. Submarine groundwater discharge rates and nutrient concentrations will be monitored at each piezometer location. Within the Estuary, nutrients will be measured by advancing a sampling probe into the top two feet of the ground surface beneath the estuary to collect samples for laboratory analysis, as well as to perform in-field measurements of temperature and conductivity. Qualitative assessment of groundwater discharge is performed by measuring temperature and conductivity contrasts in the groundwater and surface water to determine potential areas of groundwater discharge. Measured groundwater gradients determined from existing upgradient piezometers will be quantitatively used to assess groundwater flux by relying on Darcy's flow equation. Combining nutrient analysis from the laboratory samples with quantitative measurements and qualitative assessment of groundwater flux will allow for the calculation of nutrient mass loading to the estuary. Groundwater discharge rates will be estimated using the groundwater levels observed at the piezometers and in upland piezometers located upstream of the Stuart Mesa Agricultural fields.

In addition, so as to capture loading from the Santa Margarita Valley Groundwater Basin, seven historically monitored groundwater wells in the Lower Ysidora sub-basin will be monitored for nutrients biannually (wet and dry season). The Lower Ysidora sub-basin is located just upstream of the Estuary. Groundwater monitoring wells in the Lower Ysidora were selected based on proximity to the river, i.e. their ability to monitor subflow from the groundwater to the Estuary, and consistency with previous sampling locations. **Table 2-1** lists the station locations and coordinates for groundwater monitoring.

All groundwater samples will be sent to a commercial laboratory and analyzed for analytes listed in **Table 2-7** (See **Section 2.2.1**). All groundwater methods were reviewed and approved by a State Certified Geologist[4]. All field work will be performed per state-approved Standard Methods and overseen by a State Certified Geologist per the Investigative Order.

[4] See Professional Geologist certification page in front matter of Work Plan/QAPP, following the certification pages signed by the stakeholders

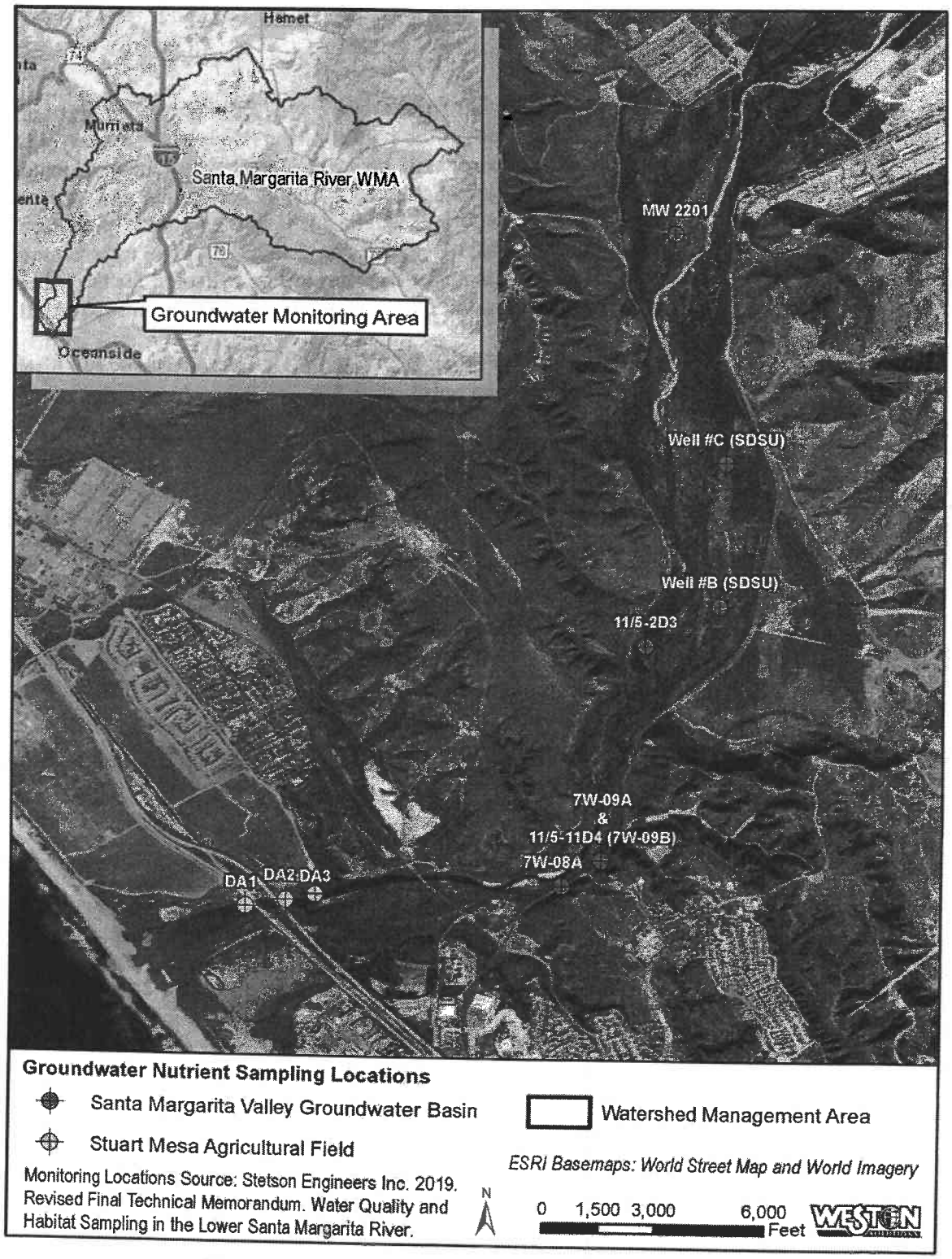

Figure 2-1. Groundwater Monitoring Station Locations

2.1.3 Estuary Algal Biomass Monitoring

Monthly algal biomass monitoring will be conducted in the Estuary from April through October. Sampling will be conducted in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[6] and between the two bridges.

During each monthly monitoring event, site conditions and sample information will be recorded on field data sheets. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented. Effort should be made to align collection location with Estuary sediment sampling described in **Section 2.1.5.**; and, where feasible, at similar sampling depths for subtidal sampling, so that relationships between the benthic community condition score and other parameters may be logically inferred.[7]

Algal biomass monitoring will be conducted in accordance with the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report 872; McLaughlin et al., 2019) (**Appendix B**). The SOP includes protocols to sample two habitat types, intertidal (mud or sand) flats and shallow subtidal (<10 m). Based on knowledge gained during previous monitoring in the Estuary, data generated by the subtidal protocol is more representative of conditions in the Estuary and is recommended. The subtidal protocol is discussed herein and detailed in Section 4 of SCCWRP Technical Report 872. The intertidal protocol can be found in Section 3 of SCCWRP Technical Report 872.

Based on several years of monitoring, NIWC Pacific has recommended sampling location options for macroalgal monitoring in the three segments of the Estuary (**Figure 2-3**). Shown in **Table 2-3** are the identifications and approximate geographic coordinates for these historical stations. A minimum of three samples will be collected from each of five sampling locations within each of the three Estuary segments, for a minimum of 15 samples per Estuary segment. The sampling approach requires that all macroalgae found within a defined surface area two meters in depth or less is comprehensively sampled from surface to bottom. As feasible, selected sites should include macroalgal sampling stations that have been sampled historically during 2008-2018, which are identified with a "✓" in **Table 2-3**. Also shown are recommended sites for Estuary Sediment and Benthic Community Condition Monitoring in order to align station sampling. While the table provides six options for macroalgae biomass monitoring per sub-segment, a list of 30 sites (10 per sub-segment) with some historical data are available from NWIC Pacific if additional location options are needed. Monitoring at historical locations will facilitate analysis of trends.[8]

Sampling locations should be the same for each sampling period, and site conditions recorded on field data sheets. Due to scouring and deposition events that may occur between monitoring periods, it may not be feasible to conduct sampling at the same locations year to year. In this case, additional sites will be selected, attempting to stay as close to the original sites as possible.

[6] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).
[7] Benthic samples must be collected in subtidal conditions in order to determine SQO benthic community scores.
[8] This targeted sampling approach based on historical monitoring information was discussed and agreed upon during the July 8, 2019 Conference Call with Cynthia Gorman of the San Diego Water Board.

limit disturbance to sampling areas and avoid walking on the shoreline and impacting birds. If water depth is too shallow to allow for deployment of the SUBS sampler (i.e., < 1 ft), the SUBS core tube will be used to collect the sample. If floating algae is present, the basket/hamper should be used to augment the SUBS sampling procedure and collect the floating algae. At each sampling point, macroalgal biomass will be collected from the surface to bottom within a defined surface area. Specific sample collection procedures for both methods are provided in Section 4.6 of SCCWRP Technical Report 872 (**Appendix B**). Examples of a mesh basket/hamper and a SUBS sampler are shown in **Figure 2-2.** Samples should be kept refrigerated at 4°C in the dark until they are processed. Laboratory processing will be completed within 48 hours. See **Section 2.2** for details on laboratory testing.

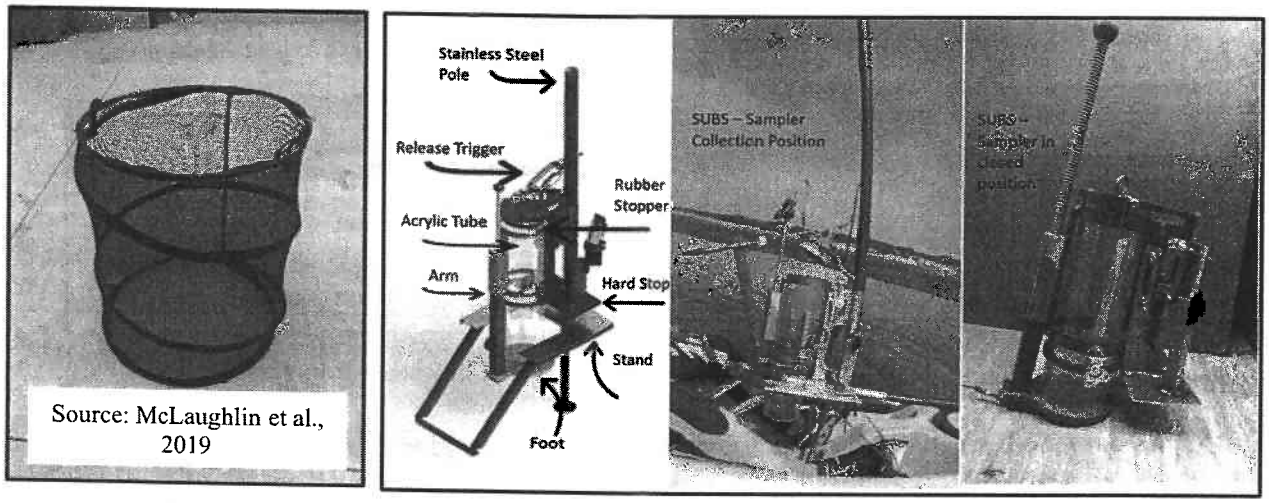

Figure 2-2. Collapsible Hamper (Left) and SUBS Sampler (Right) for Macroalgae Collection

2.1.4 Estuary Surface Water Quality Monitoring

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[9] and between the two bridges. Sampling locations are shown in **Table 2-4** and **Figure 2-3**, with station IDs consistent with historical monitoring. If algal biomass (**Section 2.1.3**) and surface water quality sampling are conducted on the same date, algal biomass sampling should occur before surface water sampling (SCCWRP, 2009).

During each monthly monitoring event, site conditions and sample information will be recorded on field data sheets. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented.

[9] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).

sediment chemistry analysis per monitoring year in order to achieve the SWAMP QA requirements outlined in the QAPP.

Table 2-5. Station Identifications and Coordinates for Estuary Sediment Monitoring

Estuary Segment	Station ID	Latitude (NAD83)	Longitude (NAD83)
Below I-5 Bridge	W1 (MA1)	33.233980	-117.413111
	W3	33.232895	-117.411361
	W8 (MA2)	33.235393	-117.408846
Between Bridges	M1	33.235302	-117.405803
	M6 (MA4)	33.236959	-117.399899
	M8	33.237211	-117.397786
Above Stuart Mesa Bridge	E3	33.237580	-117.392260
	E7 (MA5.5)	33.237630	-117.388060
	E8	33.238030	-117.387060

Benthic sediments will be collected as surface grabs for the analysis of total organic carbon (TOC), grain size, total nitrogen, total phosphorus, and benthic infaunal analysis (i.e., sorting and taxonomic evaluation of benthic macroinvertebrates). Prior to sampling, it is recommended that a salinity measurement be taken above the sediment-water interface to determine if the sampling site is located in marine ($\geq$ 27 ppt) or brackish ($<$ 27 ppt) waters. It is recommended that salinity measurements be taken as close to Mean Lower Low tide (MLLW), less than or equal to 0.5 feet on a tide chart, in order to get the most accurate measurement (SCCWRP, 2018).

A Van Veen or equivalent grab sampler with a 0.1 square meter (m^2) surface area is recommended for the collection of biology and chemistry samples in marine areas of the estuary in order to calculate the SQO benthic condition line of evidence (LOE). Equivalent grab samplers can be used with a smaller surface area as long as the sediment samples are equivalent in quality to the Van Veen grab (Bay et al., 2014). An appropriate sampler for the collection of benthic sediments will have the following characteristics:

- Constructed of a material that does not introduce contaminants.
- Causes minimal surface sediment disturbance.
- Does not leak or mix during sample retrieval.
- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least five cm below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

In brackish areas of the estuary, a 4-inch diameter plastic core tube (diameter refers to inner diameter) that is a minimum of 10 cm in length is recommended for the collection of chemistry and benthic infaunal samples (e.g., the SUBS Sampler developed by NIWC Pacific can be utilized as an alternative to constructing a core tube since the SUBS Sampler is 4-inches in diameter and 16-inches in length).

relax the collected specimens. The sample container will be inverted several times to distribute the relaxant solution. After 30 minutes, add enough sodium borate buffered formaldehyde to top off the sample container and gently invert the container several times to ensure the sample is mixed. This will make a 10% formalin solution. Laboratory processing procedures are described in **Section 2.2.2**.

2.1.5.2 Sediment Chemistry Sample Preparation and Method

Sediment samples for chemistry and grain size analysis from marine areas of the Estuary will be collected from the top 5 cm of the grab sample using a pre-cleaned stainless-steel scoop. Sediment within 1 cm of the sides of the grab will be avoided to prevent interaction of any contaminants and the sampling device. For chemistry and grain size analysis, equal portions of sediment will be aliquoted from a single grab.

In brackish areas of the Estuary, the 4-inch diameter core tubes utilized for benthic infaunal sampling can be used to collect sediment for chemistry analysis. Insert the core 5 cm into the sediment, then dump the sediment into a clean pan to remove overlying water. Scoop the sediment into the appropriate sampling container using a pre-cleaned stainless-steel scoop or spoon.

Sediment will be placed into the appropriate sample containers, preserved, and transported as described in **Section 2.1.8**. Physical and chemical laboratory analysis procedures are described in **Section 2.2.1**.

2.1.6 Santa Margarita River Monitoring

Monitoring will be conducted on the main stem of the Santa Margarita River to determine flow and ambient water quality conditions upstream of the Estuary. Methods will be consistent with relevant sections (i.e., Sections 1-3) of the *Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat* (Bioassessment SOPs) (Ode et al., 2016).

A total of three sites will be monitored; one each within the jurisdictions of San Diego County, Riverside County, and MCB CamPen (**Table 2-6**, **Figure 2-4**). The monitoring stations should be located at the most downstream feasible location above the Estuary within each of the three jurisdictions. MCB CamPen will conduct monitoring at the USGS gage at Ysidora (11046000), which is the most reliable location for measuring streamflow along that reach of the river. The Riverside County monitoring will also incorporate an existing USGS gage (11044000) on the Santa Margarita River near Temecula. Monitoring events will be conducted monthly from May through October and bi-monthly from November through April, in November, January, and March. At each location, equipment will consist of an automated flow meter and sensor, solar panel, cellular line (where coverage is available), and rain gauge. Remote Automatic Weather Station (RAWS) or ALERT system rainfall gauges will be used where available. The Lake O'Neill rain gage will be used to monitor rainfall at the sampling location at Ysidora.

2.1.6.1 Flow Monitoring

A flowmeter for continuous flow monitoring will be installed and maintained at the County of San Diego location. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000) and Riverside County monitoring will use USGS gage 11044000 near Temecula. Although monitoring events occur during nine months of the year, it is recommended that flow monitoring occur throughout the year, where equipment can remain in place, for flow volume calculations used in loading estimations. At a minimum, the equipment will be comprised of Hach (or comparable) flowmeters with a bubbler or submerged pressure transducer as the primary measuring device (level sensor). The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter, which will continually calculate flow rates by inserting the stage information into the preprogrammed discharge equation. Continual flow data will be downloaded periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. Flow data will be entered into the data management system.

Daily and monthly flow rates will be measured or estimated in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Sampling Guidance Document (EPA-833-B-92-001) (United States Environmental Protection Agency [USEPA], 1992). Flow rating curves will be developed that correlate water surface levels (or stream heights) to flow rates.[11] To quantify flow rates based on stream stage, a relationship between flow and stage will be derived using standardized stream rating protocols developed by the United States Geological Survey (USGS) (Rantz, 1982; Oberg et al., 2005) and using an applicable hydraulic calculation formula(s), such as Manning's equation. If the monitoring station is found to have a steady dry weather base flow, it may be appropriate to install a

[11] At the MCB CamPen surface monitoring site at Ysidora and the Riverside County site associated with USGS gage 11044000, discharge, rating curves, and field flow measurements from the USGS will be used in lieu of a new flow measurement site. The USGS stations have real-time telemetry and report data at 15-minute intervals.

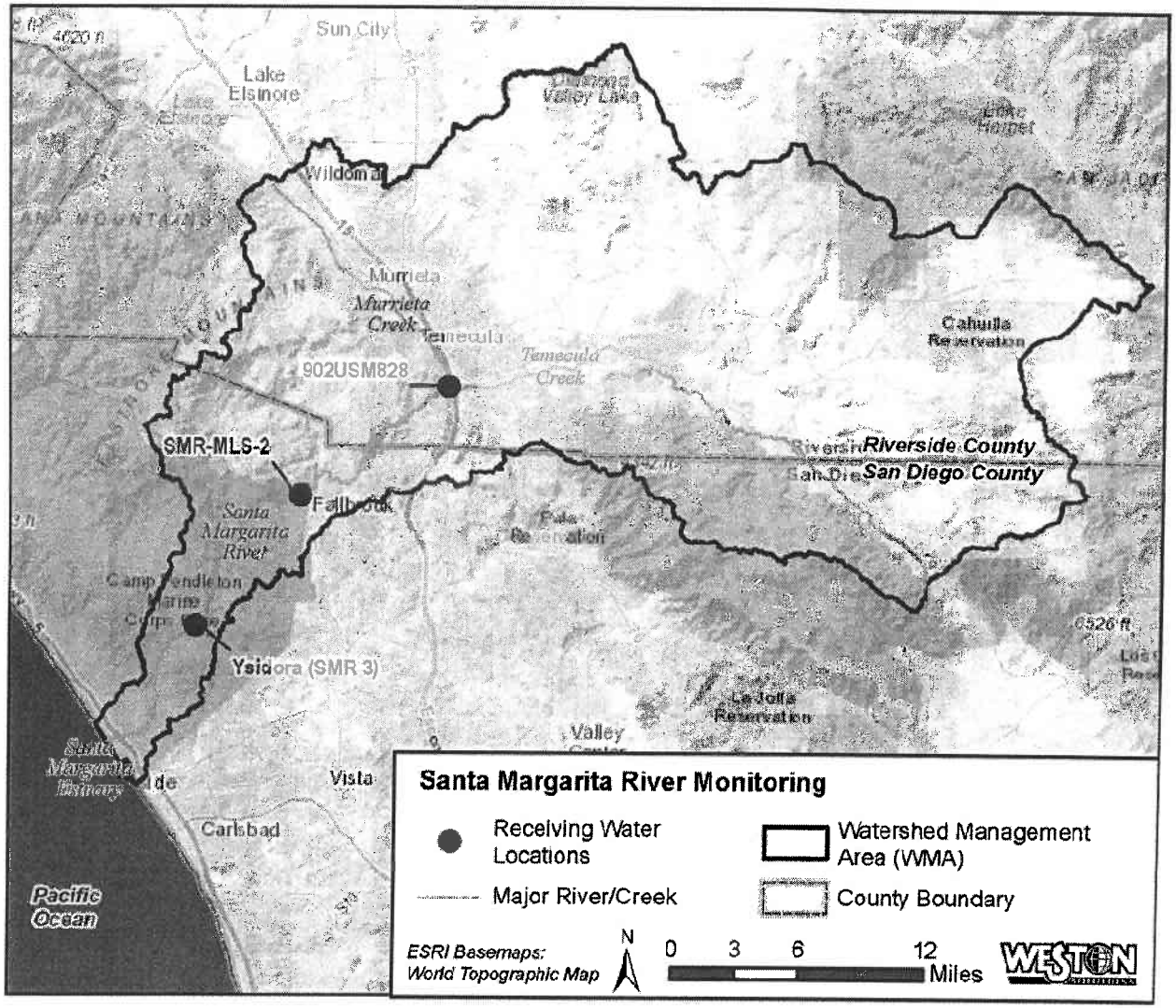

Figure 2-4. Proposed Santa Margarita River Monitoring Locations

2.2 LABORATORY TESTING

2.2.1 Physical and Chemical Analysis

Chemical measurements for this testing program were selected to comply with the requirements of Investigative Order R9-2019-0007 (San Diego Water Board, 2019) and the Draft Staff Report (San Diego Water Board, 2018). All analytical methods utilized will follow USEPA, American Society for Testing and Materials (ASTM), or Standard Methods (SM) for the Examination of Water and Wastewater (APHA, 2012). Chemical analyses of water and sediment samples will be analyzed by an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory. The specific analyses and target detection limits to be utilized for the various components of the monitoring program (**Section 2.1**) are presented in **Table 2-7**. Additional information, including holding times, preservation methods, and sampling container types and volumes, are provided in the QAPP (**Appendix A**).

In addition to the chemical analyses listed in **Table 2-7**, physical measurements of macroalgal biomass will be determined following Section 6.3 of the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report #872) (McLaughlin et al., 2019). Macroalgal biomass samples must be processed within 48 hours of collection. Biomass samples will be cleaned of all mud, bugs, and debris; weighed wet; dried in an oven at 60°C for two to three days; and weighed dry. Samples should be kept refrigerated at 4°C in the dark until they are processed. If the amount of biomass in each sub-sample (from the five sites along each transect or within each sub-segment) is small, the SOP states that they may be composited into a single sample representative of that transect/sub-segment, resulting in three biomass composites per Estuary segment. If the biomass from each sub-sample is large (i.e., enough to fill the Ziploc bag), each sub-sample will be weighed individually and added.

2.2.2 Benthic Infaunal Analysis

The benthic infaunal samples will be transported from the field to the laboratory and stored in a formalin solution for a minimum of 72 hours and no longer than 14 days. The samples will then be transferred from formalin to 70% ethanol for laboratory processing. The organisms will initially be sorted using a dissecting microscope into five major phyletic groups: polychaetes, crustaceans, mollusks, echinoderms, and miscellaneous minor phyla. While sorting, technicians will keep a count of organisms for quality control purposes, as described in **Section 2.3.3**. After initial sorting, samples will be distributed to qualified taxonomists who will identify each organism to species level or to the lowest possible taxonomic level. Data for organisms that are incidental contaminants should not be included in the data analysis and should not be counted or included in the project data. Attached parasites and other epibionts should not be recorded or submitted in annual reports but may be noted as present on bench data sheets. Nomenclature and orthography should follow the usage in the SQO species list on the *Sediment Quality Assessment Tools* page of the SCCWRP website (www.sccwrp.org) as well as Edition 5 of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) taxonomic listing (available at www.scamit.org).

2.3 QUALITY ASSURANCE/QUALITY CONTROL

All monitoring activities and laboratory analyses will comply with the requirements set forth in the QAPP (**Appendix A**).

2.3.1 Field Monitoring

All instruments used for field and laboratory analyses will be calibrated in accordance with manufacturer's specifications. Calibration of the flow monitoring and sampling equipment will be conducted immediately prior to deployment or use and will be field verified during each data download or sample event. Calibration of the sondes utilized for Estuary continuous monitoring will be conducted prior to initial deployment in the field. Calibration will be when sondes are briefly removed for maintenance (at least once a month, although summer months may require weekly maintenance). The sondes will be cleaned and the response to a suitable standard will be recorded. If the sonde is within calibration precision, then it will not be recalibrated. If the sonde is outside the required precision, then it will be recalibrated.[12]

All field personnel will have current and relevant experience in all aspects of standard field monitoring, including use of relevant field equipment such as field instruments and monitoring equipment. Field personnel will be trained and have experience in the collection, handling/storage, and COC procedures. All personnel will be responsible for complying with the QA/QC requirements that pertain to their organizational/technical function.

Field duplicates and equipment rinse blanks will be collected and analyzed at the frequency described for each monitoring program component outlined in **Section 2.1,** in accordance with SWAMP QA sample requirements. Two field duplicates and one field blank will be collected for Estuary surface water nutrient analysis and for SMR Watershed nutrient analysis during each monitoring year. One

[12] Calibration checks on DO sensors have indicated that variations in measured DO values may be greater than the instrument accuracy specification of ± 0.2 mg/L listed in the QAPP (Kara Sorensen, personal communication).

3.0 DATA REVIEW, MANAGEMENT AND ANALYSIS

3.1 DATA REVIEW AND MANAGEMENT

All laboratory data will initially be reviewed and verified by the analytical laboratory to determine whether all measurement quality objectives (MQOs) have been met, and that appropriate corrective actions have been taken, when necessary. The laboratory will supply analytical results and related QC information in both hard copy and electronic formats. The laboratory will have the responsibility of ensuring that both forms are accurate.

The Project QA Officer will be responsible for the final review of all data generated in the field and laboratory including ensuring that all of the MQOs in the QAPP have been met. All data collected under the QAPP, including laboratory and field QC results, will be formatted and submitted to CEDEN.

3.2 DATA ANALYSIS

Data analysis will consist of tabulation of results of all monitoring program data by event and annually, where applicable. Watershed loads will be estimated for total and dissolved nitrogen and total and dissolved phosphorus, DO summarized, biomass calculated, and benthic community condition determined for comparison to Draft Staff Report numeric targets (**Section 1.1.3**). This analysis over time will inform assessment of progress towards addressing eutrophication impairments. Long-term trends analysis for monitoring parameters, e.g., watershed nutrient loading and Estuary macroalgae biomass levels, should be conducted after at least three years of monitoring under this Monitoring and Assessment Workplan. An assessment of trends with projections for when the numeric targets would be achieved, or an explanation indicating why data is insufficient to do so, is required by the 2019 Investigative Order. Trend analysis may be conducted earlier where appropriate historical data are available to supplement monitoring data collected.

3.2.1 Estuary Resurfacing Groundwater Discharge Rates and Loading into the Estuary from the Santa Margarita Valley Groundwater Basin

Groundwater discharge rates and chemical identification will be conducted at each of the piezometer sites. Qualitative assessment of seepage near the Stuart Mesa Agricultural field will be performed by measuring temperature and conductivity in the upper two feet of the ground surface. Quantitative assessment of seepage will be performed by measuring hydraulic head difference in the groundwater surface. Grab samples at all piezometers will be collected for nutrient analysis so mass-loading calculations can be performed using quantitative and qualitative analysis of groundwater seepage.

Loading to the Estuary from groundwater through the Lower Ysidora sub-basin will be calculated as described in **Section 3.2.5**.

3.2.2 Macroalgal Biomass

Macroalgal biomass data, in g dry weight/m^2, will be averaged for each of the three Estuary segments separately. A two-month rolling average will be calculated for each Estuary segment. The results from

(http://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/1070_M-AMBI.pdf) or contact David Gillett at SCCWRP).

3.2.5 Nutrient Load Calculations

Dischargers must determine dry weather nutrient loading into the Santa Margarita River and Estuary from MCB CamPen, San Diego County, and Riverside County. Nutrient loading will be calculated based on data collection described in **Section 2.1**.

The load for the nine monitored months will be calculated utilizing the concentrations from each of the nine monthly sampling events, multiplied by each corresponding monthly dry weather flow volume as follows:

$$Load(pounds) = Volume\ (cubic\ feet) \times concentration\ \left(\frac{mg\ or\ \mu g}{liter}\right) \times conversion\ factors$$

A flow weighted average concentration will be calculated from the nine monthly grab samples. The observed flow at the time of collection will be used to weight each result, the sum of which will provide a weighed concentration. If monthly flow data are available for the remaining three months, this average concentration will be applied in the equation above to estimate nutrient loads from non-monitored months. If flow data were not collected, volume for the unmonitored month will be based on an average of the preceding and succeeding months (i.e., the November and January averages will be used for the December estimate). Flow data associated with storm events (> 0.2 inch of precipitation in 24 hours) should be removed from the dry weather analysis. For estimating dry weather loading, continuous flow data associated with a storm event may be excluded for the 72-hour period following the storm.

Data produced from these calculations will be used to quantify concentrations of nutrients entering the Estuary and estimate dry weather loads during each monitoring period. Loading to the Estuary will account for surface flow from the Santa Margarita River and sub-flow from the Santa Margarita Valley Groundwater Basin. Loading from groundwater will be calculated using existing tools and data for subflow out of the Lower Ysidora sub-basin and the concentration of nutrients collected at the monitoring wells. During certain times of the year, particularly late summer and early fall, there may be no surface water flow to the Estuary, in which case the loading will be based only on loads in groundwater. Periods of intermittent or zero flow in the river will be identified using the USGS gage at Ysidora (11046000).

Hydrologic conditions that occur from 2020 through 2024 will be characterized by comparing precipitation, streamflow, and groundwater levels to historical data. A hydrologic index may be used to classify years into hydrologic year types. Subflow out of the groundwater aquifer will be estimated using data from previous modeling efforts, based on periods of similar hydrology. Historical modeling data may be analyzed statistically to yield a typical mass balance of water, including subflow out, during each hydrologic year type. The exact methodology will depend on the hydrologic conditions observed in 2020 through 2024 and the relevant historical data.

4.0 REPORTING

After all results are received and all assessments are performed, draft and final reports will be prepared. These reports will include summaries of all activities associated with collecting, transporting, and chemically analyzing the samples, data analyses and assessments for each monitoring period, and cumulative assessments as more data are collected. Monitoring reports will be submitted to the Dischargers for review. After receiving comments, reports will be revised for resubmittal as final reports.

Reports will present the results of field sample collections (including DO), chemical tests, and analysis of the macroalgae and nutrient samples. Reports will include field sampling logs, station Global Positioning System (GPS) coordinates, and descriptions of field, laboratory, data management, and data analysis methodologies. Complete laboratory results, including QA/QC results, will be provided as appendices to the main report.

Monitoring reports are required to be submitted on an annual basis. Annual monitoring reports will include the following:

- Answers to the monitoring questions outlined in the Investigative Order, including:
    - Analysis and discussion of resurfacing groundwater discharge rates and nutrient loading into the Estuary.
    - Ambient water quality conditions in the River,
    - Mass loading to the River,
    - Ambient water quality conditions in the Estuary,
    - Total nitrogen and total phosphorus mass loading to the Estuary from groundwater sources, and
    - Attainment of macroalgal biomass, dissolved oxygen, and benthic community condition numeric targets in the Estuary

- Raw field data, laboratory data reports, GIS data, and associated QA/QC reports.

While data will be assessed annually, the annual report for Year 4 will also include a comprehensive assessment of all four years of monitoring.

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APPENDIX A

Quality Assurance Project Plan

Santa Margarita River Estuary and Watershed Monitoring and Assessment Program

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APPROVAL SIGNATURES

PROJECT ORGANIZATION/ RESPONSIBLE PARTIES:

Agency	Name and Title	Signature	Date
County of Riverside	Alonzo Barrera, County Executive Office Management Analyst		
Riverside County Flood Control and Water Conservation District	Richard Boon, Watershed Protection Division Chief		
County of San Diego	Jo Ann Weber, Water Quality Program Coordinator		
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage, Environmental Security Environmental Engineering Branch Head		
City of Murrieta	Mai Son, NPDES Coordinator		
City of Temecula	Stuart Kuhn, NPDES Coordinator		
City of Wildomar	Dan York, Public Works Director/City Engineer		
Contracted Consultant	**Name and Title**	**Signature**	**Date**
Naval Information Warfare Center Pacific (NIWC Pacific)	Kara Sorensen, Project Manager		
Naval Information Warfare Center Pacific (NIWC Pacific)	Ignacio Rivera QA Officer		

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD (San Diego Water Board):

Agency	Name and Title	Signature	Date
San Diego Water Board	Cynthia Gorham, Project Manager		
San Diego Water Board	Cynthia Gorham, QA Officer		

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County of Riverside	Alonzo Barrera, County Executive Office Management Analyst		
Riverside County Flood Control and Water Conservation District	Richard Boon, Watershed Protection Division Chief		
County of San Diego	Jo Ann Weber, Water Quality Program Coordinator		1/14/20
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage, Environmental Security Environmental Engineering Branch Head		
City of Murrieta	Mai Son, NPDES Coordinator		
City of Temecula	Stuart Kuhn, NPDES Coordinator		
City of Wildomar	Jason Farag, Acting NPDES Coordinator		
Contracted Consultant	**Name and Title**	**Signature**	**Date**
Naval Information Warfare Center Pacific (NIWC Pacific)	Kara Sorensen, Project Manager		
Naval Information Warfare Center Pacific (NIWC Pacific)	Ignacio Rivera QA Officer		

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD (San Diego Water Board):

Agency	Name and Title	Signature	Date
San Diego Water Board	Cynthia Gorham, Project Manager		
San Diego Water Board	Cynthia Gorham, QA Officer		

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County of San Diego	Jo Ann Weber, Water Quality Program Coordinator		
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage, Environmental Security Environmental Engineering Branch Head		
City of Murrieta	Mai Son, NPDES Coordinator		
City of Temecula	Stuart Kuhn, NPDES Coordinator		
City of Wildomar	Dan York, Public Works Director/ City Engineer		Jan 16, 2020
Contracted Consultant	**Name and Title**	**Signature**	**Date**
Naval Information Warfare Center Pacific (NIWC Pacific)	Kara Sorensen, Project Manager		
Naval Information Warfare Center Pacific (NIWC Pacific)	Ignacio Rivera QA Officer		

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD (San Diego Water Board):

Agency	Name and Title	Signature	Date
San Diego Water Board	Cynthia Gorham, Project Manager		
San Diego Water Board	Cynthia Gorham, QA Officer		

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PROJECT ORGANIZATION/ RESPONSIBLE PARTIES:

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County of Riverside	Alonzo Barrera, County Executive Office Management Analyst		
Riverside County Flood Control and Water Conservation District	Richard Boon, Watershed Protection Division Chief		
County of San Diego	Jo Ann Weber, Water Quality Program Coordinator		
U.S. Marine Corps Base Camp Pendleton	Mark Bonsavage, Environmental Security Environmental Engineering Branch Head		
City of Murrieta	Mai Son, NPDES Coordinator		
City of Temecula	Stuart Kuhn, NPDES Coordinator		
City of Wildomar	Jason Farag, Acting NPDES Coordinator		
Contracted Consultant	**Name and Title**	**Signature**	**Date**
Naval Information Warfare Center Pacific (NIWC Pacific)	Kara Sorensen, Project Manager		
Naval Information Warfare Center Pacific (NIWC Pacific)	Ignacio Rivera QA Officer		

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD (San Diego Water Board):

Agency	Name and Title	Signature	Date
San Diego Water Board	Cynthia Gorham, Project Manager	Cynthia Gorham	1-15-2020
San Diego Water Board	Cynthia Gorham, QA Officer	Cynthia Gorham	1-15-2020

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LIST OF ATTACHMENTS

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TMDL	Total Maximum Daily Load
TOC	total organic carbon
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	waste load allocation
WMA	Watershed Management Area
Workplan	Monitoring and Assessment Program Workplan
WQO	water quality objective

UNITS OF MEASURE

cm	centimeter(s)
°C	degrees Celsius
g	gram(s)
g dry weight/m^2	grams dry weight per meter squared
g wet weight/m^2	grams of wet weight per meter squared
>	greater than
≥	greater than or equal to
<	less than
≤	less than or equal to
m	meter(s)
m^2	meter squared
mg/L	milligram(s) per liter
mg/kg	milligram(s) per kilogram
mm	millimeter(s)
NTU	nephelometric turbidity units
ppt	parts per thousand
%	percent
µg	microgram(s)
µS/cm	micro Siemens per centimeter

4. PROJECT/TASK ORGANIZATION

4.1 INVOLVED PARTIES AND ROLES

This element of the QAPP describes individuals and their respective roles for this project. **Table 4-1** provides a summary of individuals, their key role, and contact information. **Figure 4-1** is an organizational chart showing the roles and lines of communication between key individuals.

San Diego Regional Water Quality Control Board (San Diego Water Board) Project Manager: Cynthia Gorham will serve as the temporary Project Manager for the San Diego Water Board until the vacancy is filled. Ms. Gorham will receive annual reports and data generated from this program.

San Diego Water Board Quality Assurance (QA) Officer: The San Diego Water Board QA Officer is Cynthia Gorham. The QA Officer will be responsible for reviewing annual reports to ensure that the monitoring plan and QAPP guidelines are being met.

County of Riverside: As the Management Analyst of the County's Executive Office, Alonzo Barrera will serve as the Contact for the County of Riverside. Mr. Barrera will be responsible for representing the County in approval of final plans, annual reports, and invoices for payment in accordance with the Memorandum of Understanding (MOU).

Riverside County Flood Control and Water Conservation District (District): As Chief of the Watershed Protection Division, Richard Boon will serve as the Contact for the District. Mr. Boon will be responsible for representing the District in approval of final plans, annual reports, and invoices for payment in accordance with the MOU. As the Water Quality Compliance Section Manager Dr. Matt Yeager will serve as the Project Manager for the District, responsible for the day-to-day contract administration with Consultant, coordination with Consultant on annual field activities and schedules; technical review of plans, reports, and ensuring that the QAPP is being implemented. As the District's Watershed Monitoring Section Manager, Rebekah Guill will serve as support for the above-mentioned roles. Ms. Guill will also be responsible for oversight of County-specific river monitoring efforts in accordance with the MOU. The District will complete the Riverside County-specific river monitoring requirements on behalf of the Riverside County Copermittees under a separate cooperative agreement. The District will be responsible for timely submittal of complete river monitoring data packages to NIWC for assessment and compliance reporting.

County of San Diego: Jo Ann Weber will serve as the Contact for the County of San Diego. Ms. Weber will be responsible for representing the County in approving final plans, annual reports, and invoices for payment in accordance with the MOU. Ms. Weber will also be responsible for oversite of County-specific river monitoring efforts in accordance with the MOU. The County of San Diego will complete the San Diego County-specific river monitoring requirements and be responsible for timely submittal of complete river monitoring data packages to NIWC for assessment and compliance reporting.

- **Consultant Quality Assurance (QA) Officer:** The Consultant QA Officer is Dr. Ignacio Rivera. The Consultant QA Officer will be responsible for guaranteeing the overall QA and QC procedures and will ensure that data reported by the Consultant have been generated in compliance with the appropriate protocols. The Consultant QA Officer will report all findings to the Consultant PM, including all requests for corrective actions. If there is evidence of significant deviations from protocols stated in this QAPP or if there is evidence of systematic failure, the Consultant QA Officer has the authority to stop all activities until corrective actions can be documented and performed.

Laboratory QA Officer: It is likely that the County of San Diego, the District, MCB CamPen and/or NIWC Pacific will utilize separate contracted laboratories for completion of the monitoring conducted within their respective jurisdictions; therefore, it is the responsibility of each agency to ensure that the contracted laboratory have a designated Laboratory QA Officer and to provide oversight to the contracted laboratory. The Laboratory QA Officer will be responsible for all analyses conducted by the laboratory and will ensure that the QAPP guidelines are being met.

Name	Organizational Affiliation	Title	Contact Information (Telephone Number and Email Address)
TBD	NIWC Pacific	Consultant Field Sampling Lead	TBD
TBD	NIWC Pacific	Laboratory QA Officer	TBD
TBD	Consultant (Riverside) - TBD	Laboratory QA Officer	TBD
TBD	Consultant (San Diego) - TBD	Laboratory QA Officer	TBD

4.2 QUALITY ASSURANCE OFFICER ROLE

The Project QA Officer will be responsible for maintaining the QAPP and ensuring that personnel listed in **Element 3** have the most recent version of the QAPP. The QA Officer will ensure that project staff understand and perform all QA/QC procedures related to field sample collection, laboratory analysis, and data analysis according to QAPP requirements throughout the duration of this project.

4.3 PERSONS RESPONSIBLE FOR QAPP UPDATE AND MAINTENANCE

Changes and updates to this QAPP may be made after a review of the evidence for change by the Santa Margarita River Nutrient Initiative Group Technical Advisory Committee (SMRNIG TAC) with the concurrence of the Riverside County Flood Control and Water Conservation District (District), County of San Diego, and MCB CamPen. The Consultant PM, with input from the Consultant QA Officer, will be responsible for making the changes, submitting drafts for review, preparing a final amended copy, and submitting the final for signature. Project work must be halted while revisions to the QAPP are made, unless authorized by the District, the County of San Diego, and MCB CamPen.

5.2 PROBLEM STATEMENT

The Santa Margarita River Estuary (Estuary) is a 192 acre coastal estuarine habitat located in northern San Diego County on the southwestern edge of the United States (U.S.) Marine Corps Base Camp Pendleton (MCB CamPen) (**Figure 5-1**). Beneficial uses for the Estuary include Contact Water Recreation (REC-1), Non-Contact Water Recreation (REC-2), Estuarine Habitat (EST), Wildlife Habitat (WILD), Rare, Threatened, or Endangered Species (RARE), Marine Habitat (MAR), Migration of Aquatic Organisms (MIGR), and Spawning, Reproduction, and/or Early Development (SPWN). The lower Santa Margarita River (SMR) and Estuary are largely undeveloped and support multiple habitats for populations of federally- and/or state- listed endangered species. The SMR begins in Riverside County near the City of Temecula, at the confluence of Murrieta and Temecula Creeks. The main stem of the SMR flows within San Diego County through unincorporated areas, the community of Fallbrook, and MCB CamPen and ultimately drains into the Estuary. Urban and agricultural land uses in the more developed portions of the Santa Margarita River Watershed (SMR Watershed) have resulted in hydrological modifications to the Estuary which have led to increased nutrient loading (McLaughlin et al., 2013).

The ocean inlet at the mouth of the Estuary is not constricted by man-made structures, but inland from the mouth, tidal influence is constrained by rock jetties from Interstate-5 and the railroad crossings. Throughout the year, the ocean inlet of the Estuary may be open or closed to the Pacific Ocean for extended periods depending on the amount of rainfall and flow (McLaughlin et al., 2013). During periods when the Estuary is connected to the Pacific Ocean, the Estuary is flushed with seawater resulting in a brackish lagoon environment. However, salinity stratification in the water column often occurs when a sand berm develops at the ocean inlet. The combination of restricted tidal flushing and watershed loading of nutrients from upstream can result in excessive algal growth in the Estuary during the summer-dry season and winter-dry season (San Diego Water Board, 2018). As the macroalgae decayed, it reduced dissolved oxygen (DO) concentrations in the Estuary resulting in eutrophic conditions, which can degrade the aquatic habitat. In addition, excessive algal mats and floating algal scum are aesthetically unpleasant, reducing the public's opportunities for enjoyment of non-contact water recreation through activities such as bird watching.

Based on the San Diego Water Board's determination that eutrophic conditions in the Estuary limit its ability to support beneficial uses, the Estuary was placed on the 1986 Clean Water Act 303(d) List of Impaired Water Bodies (303(d) List) (State Water Resources Control Board [State Water Board], 2015) for eutrophic conditions during dry weather conditions in the summer and winter months. In 2006, the San Diego Water Board issued Investigation Order No. R9-2006-0076 (2006 Investigative Order), which established monitoring requirements for dischargers to impaired lagoons, including the Estuary, and required the dischargers to develop a monitoring program and submit monitoring program reports to aid in the development of a Total Maximum Daily Load (TMDL) (San Diego Water Board, 2006). In response to the 2006 Investigative Order, the Southern California Coastal Research Project (SCCWRP) assessed the Estuary from 2008-2009, which confirmed impairment of the Estuary due to eutrophication (McLaughlin et al., 2013). Further studies of eutrophication in the Estuary were conducted between 2010 and 2018 by the Naval Information Warfare Center Pacific (NIWC Pacific).[2] While monitoring results show that overall conditions are improving as massive rafting algal mats have not been observed since 2010, these studies continue to show evidence of eutrophic conditions

[2] Formerly known as NAVY Space and Naval Warfare Systems Pacific (SPAWAR).

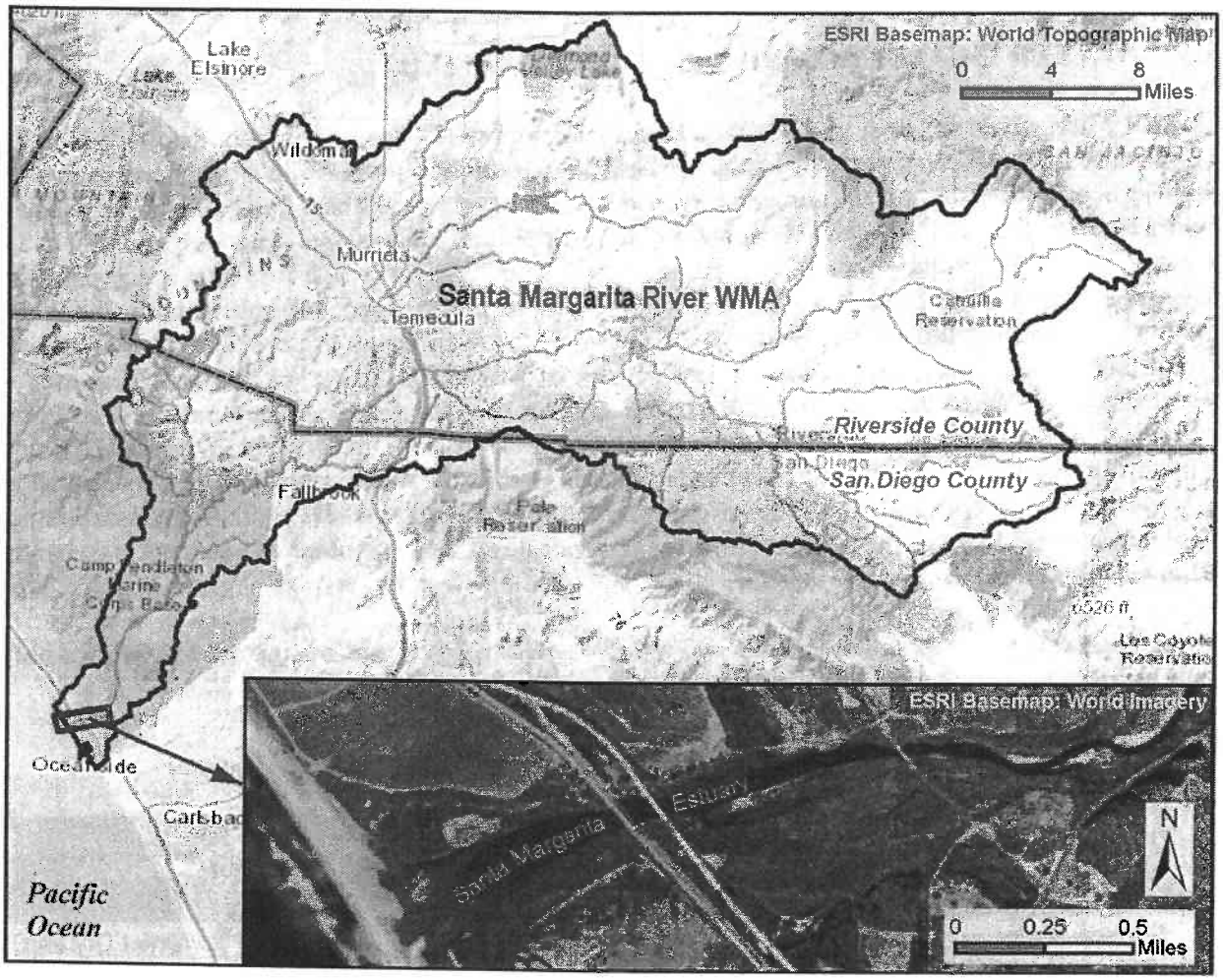

Figure 5-1. Santa Margarita River Estuary and Watershed Study Area

6. PROJECT/TASK DESCRIPTION

6.1 WORK STATEMENT AND PRODUCED PRODUCTS

Monitoring of the Estuary and SMR Watershed will be conducted during dry weather periods in both summer and winter for four years. Monitoring will begin within 60 days of receiving the Executive Officer's approval of the Workplan to be submitted November 8, 2019. The start of the monitoring program is intended to align with the beginning of the critical growth period in April. Monitoring locations are consistent with historical locations monitored between 2014 and 2018 in the Estuary and SMR Watershed and are provided in **Element 10**. Monitoring program components include the following:

- Estuary Resurfacing Groundwater Discharge Rates and Loading into the Estuary from the Santa Margarita Valley Groundwater Basin
- Estuary Continuous Monitoring
- Estuary Surface Water Quality and Algal Biomass Monitoring
- Estuary Sediment and Benthic Community Condition Monitoring
- Santa Margarita River Watershed Monitoring

Resurfacing groundwater and loading to the Estuary from the Santa Margarita Valley Groundwater Basin will be monitored biannually during winter and summer dry periods by sampling several piezometers and monitoring wells. Groundwater samples will be collected from three historic piezometer locations near the Stuart Mesa Agricultural Fields to confirm that resurfacing groundwater is no longer a significant source of nutrient loading to the Estuary. Piezometer locations were selected based on prior resurfacing groundwater work conducted between 2012 and 2017 (Chadwick et al., 2008; Leather et al., 2011; Leather et al., 2015; Stetson Engineers, 2011). In addition, seven historically monitored groundwater wells in the Lower Ysidora sub-basin will be monitored for nutrients biannually (wet and dry season). The Lower Ysidora sub-basin is located just upstream of the Estuary.

Continuous *in situ* water quality monitoring will be conducted at 15-minute intervals for seven months from April through October and during three months of the winter period (November, January, and March). Monitoring will be conducted at two locations in the Estuary, at the I-5 Bridge and Stuart Mesa Bridge. A multi-parameter data sonde with an optical sensor will be deployed at a depth of approximately 0.5 meter (m) at each location. Deployment will account for tidal range and depth such that the sonde probes remain submerged and do not contact the sediment surface. Because the sondes may need to be removed at times (e.g., due to severe weather in the winter months), data may not be collected for the entirety of each month; at least two weeks of continuous data will be collected during each monitored month. The sondes will continuously measure DO (mg/L and percent [%] saturation), water temperature (°C), pH (pH), salinity/conductivity (ppt; µS/cm), turbidity (NTU), and water depth (m). In addition, the degree of tidal muting or influence will be documented based on the current status of connectivity between the Estuary and the Pacific Ocean.

Algal biomass monitoring will be conducted monthly from April through October. During each monitoring event, sampling will be conducted in each of three Estuary regions: below the I-5 Bridge,

Annual reports will be produced to present the findings of the Estuary and SMR Watershed monitoring effort each year and address the questions presented in **Element 5.1**. The annual report for Year 4 will assess all four years of monitoring data.

6.2 CONSTITUENTS TO BE MONITORED AND MEASUREMENT TECHNIQUES

Estuary Resurfacing Groundwater and Loading from the Santa Margarita Valley Groundwater Basin

Resurfacing groundwater and loading to the Estuary from the Santa Margarita Valley Groundwater Basin will be monitored by sampling several piezometers and monitoring wells. Samples will be taken at three piezometers near the Stuart Mesa Agricultural Fields and seven groundwater wells in the Lower Ysidora sub-basin of the Santa Margarita Valley Groundwater Basin. Constituents sampled will include total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus. Total and dissolved phosphorus can be analyzed using either United States Environmental Protection Agency (USEPA) Method 365.1 or Standard Method (SM) 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation. Groundwater methods described here were approved by a State-certified Professional Geologist[6], and future groundwater sampling will be overseen by a State certified Professional Geologist to ensure procedures meet State standards.

Estuary Continuous DO Monitoring

Continuous *in situ* DO monitoring will be performed using multi-parameter data sondes with optical sensors at 15 minutes interval and 0.5 m water depth. Additional data collected by each sonde will include pH, water temperature, conductivity/salinity, turbidity, and water depth.

Estuary Algal Biomass Monitoring

Macroalgae will be collected for determination of biomass. Physical measurements of macroalgal biomass will be determined following Section 6.3 of the standard operating procedure (SOP) for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report #872, McLaughlin et al., 2019). This SOP is provided in **Appendix B** of the Workplan.

Estuary Surface Water Quality and Macroalgae Monitoring

Monthly surface water grab samples collected during macroalgae sampling will be analyzed for the following constituents: chlorophyll-a, total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus. Total and dissolved phosphorus can be analyzed using either USEPA Method 365.1 or SM 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation. Suspended chlorophyll-a will be analyzed by SM 10200.

Estuary Sediment and Benthic Community Condition Monitoring

Annual sediment grab samples will be analyzed for the following constituents: grain size, total nitrogen, total phosphorus, and TOC. Grain size can be analyzed using either ASTM D4464 (M), SM 2560 D, or ASTM D422. Total nitrogen will be determined by calculation; the calculated value is comprised of total Kjeldahl nitrogen (TKN), NO_3, and NO_2. Total phosphorus will be analyzed by SM 4500. TOC will be analyzed by EPA 9060A.

[6] See Professional Geologist certification page in front matter of Work Plan/QAPP, following the certification pages signed by the stakeholders

electromagnetic open channel velocity sensor, or equivalent may be used. To measure higher flows, the SonTek (YSI) FlowTracker Acoustic Doppler Velocimeter, or equivalent may be used.

Santa Margarita River Watershed Nutrient Water Quality Monitoring
Monthly and bi-monthly surface water grab samples will be analyzed for the following constituents: total and dissolved phosphorus and total nitrogen, total and dissolved inorganic nitrogen. Total and dissolved phosphorus can be analyzed using either EPA 365.1 or SM 4500. Total nitrogen, and total and dissolved inorganic nitrogen, will be determined by calculation.

In addition, water quality data, including temperature and specific conductivity, will be collected using a multi-parameter water quality meter or sonde.

6.3 PROJECT SCHEDULE

Table 6-1 details the project schedule for annual monitoring and reporting for the Estuary and SMR Watershed, including initiation and completion dates for major tasks, required deliverable(s), and the deliverable(s) due dates. Monitoring events will be conducted annually from 2020 through the 2022-2023 monitoring year (i.e., water years; October 1 to September 30). Initiation of data compilation, QA/QC, analysis and draft report preparation will begin prior to completion of monitoring to provide adequate time for these tasks given report deadlines. Submittal of Final Annual Reports to the San Diego Water Board will be on January 31st of the following calendar year[8] after each monitoring period. For Year 4, the Final Annual Report will be submitted by March 31, 2024.

[8] For Year 4, the report will be submitted by March 31, 2024.

6.4 GEOGRAPHICAL SETTING

The Estuary is located along the southern California coast in northern San Diego County. It is in the Ysidora Hydrologic Area (HA) (902.1) within the Santa Margarita River (SMR) Watershed Management Area (WMA), on the southwestern edge of MCB CamPen. The Estuary is one of the few remaining and largely unmodified coastal estuaries in southern California and encompasses 192 acres of valuable estuarine habitat including subtidal habitats, mudflats, salt marsh, and salt pannes. The Estuary provides important refuge, foraging areas, and breeding grounds for multiple threatened and/or endangered species, as well as coastal marine species (Staff Report; San Diego Water Board, 2018). The SMR Watershed, which drains into the Pacific Ocean, is comprised of an area of approximately 750 square miles (sq mi). Approximately 73% lies within Riverside County and includes all or portions of the Cities of Murrieta, Temecula, Wildomar, and Menifee in addition to approximately 457 sq mi of unincorporated area that also include federal, state, and tribal lands. The remaining 26.5% of the SMR Watershed land surface lies within San Diego County, which includes MCB CamPen and the unincorporated communities of Fallbrook and Rainbow.

6.5 CONSTRAINTS

Annual monitoring in the Estuary and SMR Watershed will occur during dry weather periods in both summer and winter for four years. Monitoring events will be conducted so that they are preceded by a minimum of 72 hours of dry weather (< 0.2 inch of precipitation in 24 hours). Continuous flow data and continuous DO data collected during storm events and the following 72 hours will not be included in assessment and reporting, which focus on ambient conditions. Monthly sampling will also be postponed until after a 72-hour dry period. This is consistent with the criteria used in the watershed loading model informing nutrient management in the SMR Watershed (Sutula et al., 2016).

Potential causes of equipment failure include extreme flooding, exposure to natural elements, and power failures due to the remote location.

Vandalism or theft of sampling equipment either in the Estuary itself (deployed multi-parameter data sondes) or at the receiving water stations in the watershed (flowmeters) could potentially affect the ability to collect complete data sets for the continuous monitoring portion of the program. Due to controlled access to MCB CamPen, vandalism and theft are unlikely.

7.1 Accuracy

Accuracy (bias) is a measure of how closely the analytical result or field measurement represents the true quantity found in the sample. To achieve accuracy in field measurements, the multi-parameter data sonde will be calibrated before starting the monitoring, and the sonde response will be verified to be within appropriate precision as shown in **Table 7-2**, after cleaning any biofouling, each time the sampling team visits the Estuary. Evaluation of the accuracy of laboratory samples in this study will be achieved through the preparation and analysis of standard reference materials or laboratory control samples (LCS), and matrix spike (MS) samples with each analytical batch. The accuracy of the laboratory samples is quantified as percent recovery.

7.2 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions calculated as either the range or as the standard deviation. The precision of field measurements will be controlled by measuring field duplicates or replicates. The precision of laboratory measurements will be controlled by comparison of the sample to either a laboratory duplicate or a laboratory matrix spike/matrix spike duplicate (MS/MSD). Results of the duplicate analysis are evaluated by calculating the relative percent difference (RPD) as shown in the following equation.

$$RPD = (X_1-X_2)/[(X_1+X_2)/2]*100$$

Where:

X_1= larger of two concentrations, and X_2 = smaller of two concentrations

The MQO for field and laboratory duplicate RPDs for each of the physical and chemical analytes is <25% (
Table **7-3**).

7.3 Representativeness

Representativeness is a qualitative term that describes how characteristic a sample is of the actual environmental condition from which it was collected. Determining appropriate sampling locations, sampling frequency, and use of approved/documented SOPs and analytical methods will control to the greatest extent possible that the measurement data represent the conditions at the monitoring site.

7.4 Completeness

Completeness is a measure of the percentage of sample results that are collected and analyzed and determined to be valid. Field personnel and the analytical laboratory will strive for 90% data completeness, which accounts for unexpected field conditions, equipment problems, and laboratory error.

Table 7-2. Quality Control for Field Measurements in Fresh and Marine Water

Water Quality Parameter	Recommended Device	Units	Resolution	Instrument Accuracy Specs	Points per Calibration	Pre-Sampling Calibration Check Frequency	Post-Sampling Calibration Check Frequency	Allowable Drift
Dissolved Oxygen	Polarographic or luminescence quenching probe	mg/L	0.01	±0.2*	1	Before every monitoring day or prior to long-term deployment	After every monitoring day or retrieval from long-term deployment (within 24 hours)	±0.5 or 10%
pH	Electrode	pH	0.01	±0.2	2	Per manufacturer	Per manufacturer	±0.2 units
Salinity	Refractometer of conductivity cell	ppt	0.01	±2%	Per manufacturer	Per manufacturer	Per manufacturer	Per manufacturer
Specific Conductance	Conductivity cell	µS/cm	1	±0.5%	Per manufacturer	Per manufacturer	Per manufacturer	±10%
Temperature	Thermistor or bulb	°C	0.1	±0.15%	Per manufacturer	Per manufacturer	Per manufacturer	±0.5
Turbidity	Portable turbidimeter or optical probe	NTU	0.1	±1% up to 100 NTU; ±3% from 100-400 NTU; and ±5% from 400-3000 NTU	2	Per manufacturer	Per manufacturer	Per manufacturer

Reference: State Water Board, 2017

* Calibration checks on DO sensors have indicated that variations in measured DO values may be greater than this instrument accuracy specification (Kara Sorensen, personal communication).

8. SPECIAL TRAINING NEEDS/CERTIFICATION

8.1 SPECIALIZED TRAINING OR CERTIFICATIONS

Field personnel will have current and relevant experience in the aspects of standard field monitoring, including use of relevant field instruments and monitoring equipment, experience in the collection and handling/storage of samples, and chain-of-custody (COC) procedures. Training in techniques for proper field sampling and sample-handling will be reviewed prior to each sampling event, and only those staff with proficiency will be permitted to conduct field work.

All laboratory analysts will be proficient in the use of analytical equipment, conducting analytical protocols, and other general laboratory processes. The QA Officer is responsible for distributing the most up-to-date QAPP for this monitoring project to the respective laboratory staff and ensuring that the staff understand and follow all SOPs and the QAPP for the duration of this study.

All samples must be analyzed by laboratories accredited by the Environmental Laboratory Accreditation Program (ELAP) using methods approved by the USEPA for the type of analysis to be performed.

8.2 TRAINING AND CERTIFICATION DOCUMENTATION

Personnel are responsible for complying with QA/QC requirements that pertain to their organizational/technical function. Technical staff members must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management. The analytical laboratory QA officer will ensure that all laboratory staff is proficient at analyses applicable to this project. Training and certification documents for laboratory staff will be maintained by the laboratory QA officer, or their designee.

8.3 TRAINING PERSONNEL

The Consultant PM and/or Field Task Lead will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and chain of custody (COC) procedures. The analytical laboratory QA officer will ensure that training is provided to the laboratories' personnel for implementing standard laboratory procedures and maintaining proper documentation.

Table 9-1. Summary of Document and Record Retention, Archival, and Disposition

	Type of Document	Retention	Archival	Disposition
Field Sampling Documentation	Field Notebook containing logs, data sheets, etc.	Paper or electronic	Notebook/Electronic	5 years
Sample Collection Records	Chain of Custody	Paper or electronic	Notebook/Electronic	5 years
Analytical Records	Lab notebooks, bench sheets, and sorting forms	Paper	Notebook	5 years
	Lab Results QA/QC	Paper and electronic	Notebook/Database	5 years
	Electronic data deliverables	Electronic	Database	5 years
Data Records	Data Entry	Electronic	Database	5 years
Assessment Records	QA/QC Assessment	Electronic	Database	5 years
	Final Report	Electronic	Database	5 years

At the seven monitoring wells, nutrient grab samples will be collected. The groundwater level and sampling depth in each well will be recorded on field sheets. Sampling depths at groundwater wells will be selected to best characterize subflow, corresponding to recognized coarse-grained lithologic layers within the screened intervals of the wells. Groundwater flow at monitoring wells in the Lower Ysidora sub-basin will not be directly measured, but will be estimated using existing data and tools, including prior groundwater modeling data.

Table 10-1. Station Identifications and Coordinates for Estuary Resurfacing Groundwater Monitoring

Station ID	Latitude (NAD83)	Longitude (NAD83)
Santa Margarita Valley Groundwater Basin Locations		
MW 2201	33.28539	-117.37663
Well #C (SDSU)	33.26846	-117.37276
Well #B (SDSU)	33.25792	-117.37314
11/5-2D3	33.25500	-117.37865
7W-09A	33.23914	-117.38174
11/5-11D4 (7W-09B)	33.23913	-117.38175
7W-08A	33.23728	-117.38458
Stuart Mesa Agricultural Field Piezometer Locations		
DA1	33.235497	-117.407642
DA2	33.236041	-117.404666
DA3	33.236443	-117.402449

10.2 ESTUARY CONTINUOUS MONITORING

Each year, continuous water quality monitoring will be conducted by MCB CamPen for seven months from April through October and during three months of the winter period (November, January, and March). Because the sondes may need to be removed at times (e.g., due to severe weather in the winter months), data may not be collected for the entirety of each month; at least two weeks of continuous data will be collected during each monitored month.

Data sondes will be deployed at two locations in the Estuary, I-5 Bridge and Stuart Mesa Bridge. Sampling locations are shown in **Table 10-2** and **Figure 10-2**; station IDs are consistent with historical monitoring. DO (mg/L and % saturation), water temperature (°C), salinity/conductivity (ppt; µS/cm), turbidity (NTU), and water depth (m) will be continuously monitored *in situ* at 15-minute intervals. In addition, the degree of tidal muting or influence will be documented based on the current status of connectivity between the Estuary and the Pacific Ocean.

Table 10-2. Station Identifications and Coordinates for Estuary Continuous Monitoring

Station Location	Station ID	Latitude (NAD83)	Longitude (NAD83)
I-5 Bridge	I-5 (Axial 4)	33.235317	-117.406883
Stuart Mesa Bridge	SMB	33.237620	-117.395290

10.3 ESTUARY ALGAL BIOMASS MONITORING

Monthly algal biomass monitoring will be conducted in the Estuary from April through October. During each monitoring event, sampling will be conducted in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[9] and between the two bridges (**Figure 10-2**). Algal biomass monitoring will be conducted in accordance with the SOP for Macroalgal Collection in Estuarine Environments (SCCWRP Technical Report 872; McLaughlin et al., 2019) (**Appendix B** of the Workplan).

Effort should be made to align collection location with Estuary sediment sampling described in **Element 10.5**; and, where feasible, at similar sampling depths for subtidal sampling, so that relationships between the benthic community condition score and other parameters may be logically inferred.[10]

The SOP includes protocols to sample two habitat types, intertidal (mud or sand) flats and shallow subtidal (<10 m). Based on knowledge gained during previous monitoring in the Estuary, data generated by the subtidal protocol is more representative of conditions in the Estuary and is recommended. The subtidal protocol is discussed herein and detailed in Section 4 of SCCWRP

[9] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).
[10] Benthic samples must be collected in subtidal conditions in order to determine SQO benthic community scores.

Table 10-3. Recommended Locations for Estuary Algal Biomass Monitoring

Estuary Segment	Station ID	Recommended Historical MA Site	BCA/ Sediment Site	Latitude (NAD83)	Longitude (NAD83)
Below the I-5 Bridge	W1 (MA1)	✓	✓	33.233980	-117.413111
	W8 (MA2)	✓	✓	33.235393	-117.408846
	W7 (MA3)	✓		33.234386	-117.408510
	W3	✓	✓	33.232895	-117.411361
	W4	*		33.233801	-117.409878
	W5	*		33.234402	-117.409978
Between the I-5 and Stuart Mesa Bridges	M6 (MA4)	✓	✓	33.236959	-117.399899
	M10 (MA5)	✓	*	33.237478	-117.395339
	M4	✓		33.236079	-117.402070
	M9	✓ (old MA site)		33.237657	-117.397121
	M1	*	✓	33.235302	-117.405803
	M8	*	✓	33.237211	-117.397786
Above the Stuart Mesa Bridge	E7 (MA5.5)	✓	✓	33.237630	-117.388060
	MA6	✓	*	33.238350	-117.384817
	E3	✓	✓	33.237580	-117.392260
	E5	✓		33.236980	-117.389900
	E8	✓	✓	33.238030	-117.387060
	E10	*(old ambient WQ site)		33.238600	-117.383770

10.4 ESTUARY SURFACE WATER QUALITY MONITORING

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[12] and between the two bridges. Sampling locations are shown in **Table 10-4** and **Figure 10-2**, with station IDs consistent with historical monitoring. Ambient surface water grab samples will be collected at a depth of approximately 0.5 m, and will be analyzed for chlorophyll-a, total nitrogen, and total and dissolved inorganic nitrogen and phosphorus, as described in **Element 6.2**.

[12] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).

Table 10-5. Station Identifications and Coordinates for Estuary Sediment Monitoring

Estuary Segment	Station ID	Latitude (NAD83)	Longitude (NAD83)
Below I-5 Bridge	W1 (MA1)	33.233980	-117.413111
	W3	33.232895	-117.411361
	W8 (MA2)	33.235393	-117.408846
Between Bridges	M1	33.235302	-117.405803
	M6 (MA4)	33.236959	-117.399899
	M8	33.237211	-117.397786
Above Stuart Mesa Bridge	E3	33.237580	-117.392260
	E7 (MA5.5)	33.237630	-117.388060
	E8	33.238030	-117.387060

10.6 SANTA MARGARITA RIVER MONITORING

Monitoring will be conducted on the main stem of the Santa Margarita River to determine flow and ambient water quality conditions upstream of the Estuary. Methods will be consistent with relevant sections (i.e., Sections 1-3) of the *Standard Operating Procedures for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat* (Bioassessment SOPs) (Ode et al., 2016).

A total of three sites will be monitored; one each within the jurisdictions of San Diego County, Riverside County, and MCB CamPen (**Table 10-6**, **Figure 10-3**). The monitoring stations should be located at the most downstream feasible location above the Estuary within each of the three jurisdictions. MCB CamPen will conduct monitoring at the USGS gage at Ysidora, which is the most reliable location for measuring streamflow along that reach of the river. The Riverside County monitoring will also incorporate an existing USGS gage (11044000) on the Santa Margarita River near Temecula. Monitoring events will be conducted monthly from May through October and bi-monthly from November through April, in November, January, and March. At each location, equipment will consist of an automated flow meter and sensor, solar panel, cellular line (where coverage is available), and rain gauge. Remote Automatic Weather Station (RAWS) or ALERT system rainfall gauges will be used where available. The Lake O'Neill rain gage will be used to monitor rainfall at the sampling location at Ysidora.

Flowmeters will be installed and maintained at the County of San Diego monitoring location. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000) and Riverside County river monitoring will use USGS gage 11044000 near Temecula. During each monthly monitoring event, water quality parameters (temperature and conductivity) will be measured using a multi-parameter water quality meter or sonde, and a grab sample will be collected and analyzed for total nitrogen, total and dissolved inorganic nitrogen and total and dissolved phosphorus, as described in **Element 6.2** .

Table 10-6. Station Identifications and Coordinates for Santa Margarita River Monitoring

Jurisdiction	Station ID	Latitude (NAD83)	Longitude (NAD83)
San Diego County	SMR-MLS-2	33.398142	-117.26273
Riverside County	Upper Santa Margarita River 902USM828	33.47335	-117.14344
MCB CamPen	Ysidora (SMR 3)	33.31165	-117.34570

11. SAMPLING METHODS

All equipment (waders, boots, sampling equipment, and other aquatic gear) used for monitoring described in the following sections that intentionally comes into contact with surface waters on MCB CamPen must be disinfected either through chemical treatment (generally with a dilute solution of formula 409, or equivalent) or freezing. Boat hulls and trailers should be power-washed and inspected for signs of quagga mussel, zebra mussel, and New Zealand mud snail, especially if coming from surface waters associated with the lower Colorado River. No foreign ballast or other waters shall be introduced into any surface water on MCB CamPen.

11.1 ESTUARY RESURFACING GROUNDWATER DISCHARGE RATES AND NUTRIENT LOADING

Bi-annual groundwater sampling will be conducted once during the dry season (April through October) and once during the wet season (November through March). During each monitoring event, sampling will be conducted at ten locations: three piezometers near the Stuart Mesa Agricultural Fields and seven wells in the Lower Ysidora sub-basin, as listed in **Element 10.1**. All groundwater sampling will be overseen by a State Certified Geologist.

Groundwater discharge to the estuary will be estimated based on hydraulic gradients, measured at the piezometers, and the Darcy equation. In the vicinity of the Stuart Mesa Agricultural fields, previously developed relationship between hydraulic head and groundwater seepage may be relied upon (Leather, 2016). All historic data and relationships previously developed by others will be checked and verified by a State-certified professional geologist. Nutrient grab samples will be taken at the piezometers using a peristaltic pump and sampling depth will be noted on the field sheets.

At the seven groundwater wells, nutrient samples will be taken using a peristaltic pump. The groundwater level in the well and the sampling depth will be noted on field sheets.

For nutrient grab samples at all ten sites; analytical methods, sample container requirements, and analytical holding times will be in accordance with the SCCWRP QAPP for Monitoring in Support of Nutrient Management in the Lower Santa Margarita River (SCCWRP, 2014).

Samples will be placed into appropriate bottles and preserved and transported as described in **Element 12**. Two field duplicates and one field blank will be collected for nutrient analysis per monitoring year in order to achieve the SWAMP QA sample requirements (i.e., field duplicates at a frequency of 5% of the sample count and a field blank per method).

11.2 ESTUARY CONTINUOUS MONITORING

Each year, continuous water quality monitoring will be conducted for seven months from April through October and for up to one month during each of three winter periods (November, January, and March). A multi-parameter data sonde with an optical sensor will be deployed on a stationary structure at a depth of approximately 0.5 m at two locations in the Estuary, I-5 Bridge and Stuart Mesa Bridge. Deployment will account for tidal range and depth such that the sonde probes remain submerged and

will be used to collect the sample. If floating algae is present, the basket/hamper should be used to augment the SUBS sampling procedure and collect the floating algae. At each sampling point, macroalgal biomass will be collected from the surface to bottom within a defined surface area. Specific sample collection procedures for both methods are provided in Section 4.6 of SCCWRP Technical Report 872 (**Appendix B** of the Workplan). Examples of a mesh basket/hamper and a SUBS sampler are shown in **Figure 11-1.** Samples should be kept refrigerated at 4°C in the dark until they are processed. Laboratory processing will be completed within 48 hours.

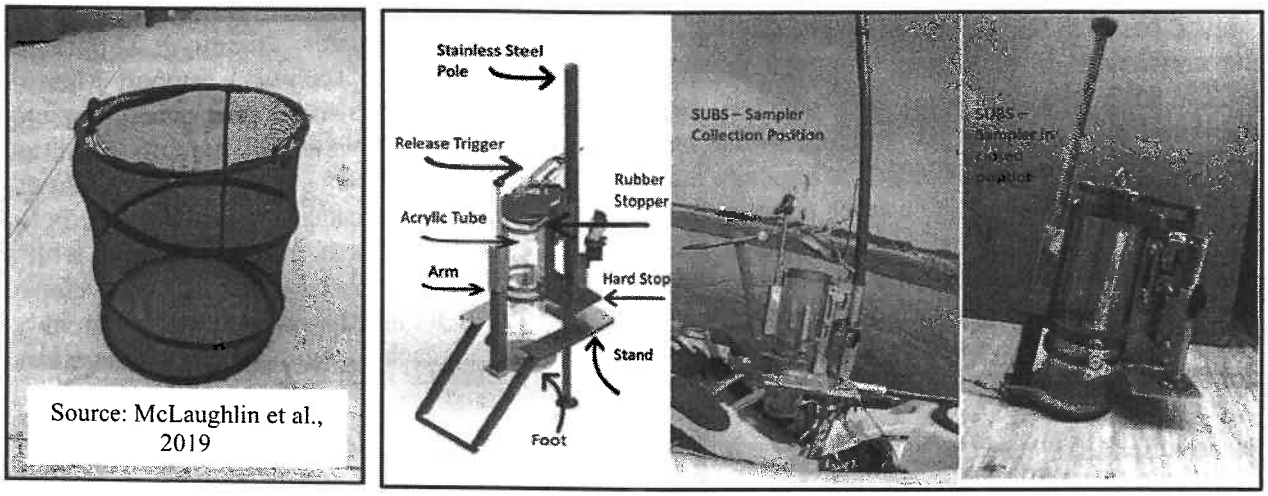

Figure 11-1. Collapsible Hamper (Left) and SUBS Sampler (Right) for Macroalgae Collection

11.4 ESTUARY SURFACE WATER QUALITY MONITORING

Monthly surface water sampling will be conducted in the Estuary from April through October and during three events from November through March. During each monitoring event, sampling will be conducted at one location in each of three Estuary regions: below the I-5 Bridge, above the Stuart Mesa Bridge to the head of the Estuary or the lower reach of the river,[17] and between the two bridges (**Figure 10-2**).

During each monthly monitoring event, site conditions and sample information will be recorded on field data sheets. Additionally, during each monitoring event, the status of connectivity between the Estuary and the Pacific Ocean will be documented.

Estuary surface water quality monitoring will be conducted in accordance with SWAMP and Standard Methods (SM) for the Examination of Water and Wastewater (American Public Health Association [APHA], 2012). Ambient surface water grab samples will be collected at a depth of approximately 0.5 m, and will be analyzed for chlorophyll-a, total nitrogen, total and dissolved inorganic nitrogen and phosphorus. Water samples will be collected using a sampling pole or peristaltic pump, and samples will be placed into appropriate bottles and preserved and transported as described in **Element 12**. Two

[17] The inner limit or upstream boundary of the Estuary should be defined by changes from estuarine to riparian vegetation, changes in salinity going from brackish to freshwater, and changes in river currents dominating over tidal action (San Diego Water Board, 2019).

- Has a design that enables safe/easy sample verification that samples meet all applicable sampling criteria (e.g., collects sediments to at least five cm below the sediment surface, has access doors allowing visual inspection and removal of undisturbed surface sediment).

In brackish areas of the estuary, a 4-inch diameter plastic core tube (diameter refers to inner diameter) that is a minimum of 10 cm in length is recommended for the collection of chemistry and benthic infaunal samples (e.g., the SUBS Sampler developed by NIWC Pacific can be utilized as an alternative to constructing a core tube since the SUBS Sampler is 4-inches in diameter and 16-inches in length). At each site, two 4-inch diameter core samples will be collected for benthic infauna. These two core samples will then be composited into a single sample. Options for sample collection at intermediate depths include the following: 1) using a SUB Sampler, 2) using core tubes attached to an extension pole, 3) inserting core tubes into the sediment grab collected with a Van Veen, or 4) inserting the core tubes by hand if collection sites are in wadeable areas. The top of each core will be sealed with a rubber cap. A vacuum will be created when the core is removed from the sediment holding the contents in place; however, the bottom should be covered if the contents are not held in place (i.e., sediment is loose). For more detailed information regarding determination of salinity at a site, sample collection protocols using the cores, or construction of the cores refer to the Bight '18 Sediment Quality Assessment Field Operations Manual (SCCWRP, 2018). For more information on using the SUB Sampler as the coring device refer to the Standard Operating Procedure for Macroalgal Collection in Estuarine Environments (McLaughlin et al., 2019).

A sample will be considered acceptable if the surface of the grab is even and there is minimal surface disturbance. For marine samples, the penetration depth of the grab sampler should be a minimum of 5 cm in compact sediments (i.e. hard packed sand). Penetration depths of 7-10+ cm should be obtained in silty sediments (fine sand to clay) and whenever possible, infaunal samples should be a minimum of 7 cm, but target 10+ cm. Benthic infaunal samples collected at brackish sites must have a minimum penetration depth of 10 cm. Rejected grabs will be discarded, and the station will be re-sampled. Acceptable sediment grabs to be utilized for chemistry and grain size will have the overlying water carefully drained from the sediment surface prior to removing the sediment to be placed in the appropriate sample containers. Overlying water will not be drained from sediment samples collected for benthic infaunal analysis.

Between sampling stations, the grab sampler will be rinsed with station water. Stainless steel scoops will be rinsed with seawater and rinsed with de-ionized water between stations. During each annual monitoring event, information to be recorded on field data sheets includes station identification, date, time of arrival, coordinates and navigation system used, water depth, weather conditions, and other pertinent observations. Information about the sediment sample will also be recorded, including the sample time, depth of penetration of sediment grab, sediment composition, sediment color, sediment odor, and presence of shell hash.

11.5.1 Benthic Community Condition Sampling

The entire contents of one grab sample (equal to 0.1 m^2 surface area) will be utilized for benthic infaunal analysis in marine areas of the Estuary (salinity $\geq$ 27 ppt) (e.g., using a Van Veen grab sampler). If using a grab sampler with a smaller surface area (e.g., SUB Sampler), then multiple benthic infaunal samples will need to be collected to be equivalent to a surface area of 0.1 m^2. Samples

11.6.1 Flow Monitoring

Flowmeters for continuous flow monitoring will be installed and maintained at each location. Flowmeters will be installed and maintained at the County of San Diego and Riverside County monitoring locations. MCB CamPen's surface monitoring site will use the Ysidora USGS gage (11046000). Although monitoring events occur during nine months of the year, it is recommended that flow monitoring occur throughout the year, where equipment can remain in place, for flow volume calculations used in loading estimations. At a minimum, the equipment will be comprised of Hach (or comparable) flowmeters with a bubbler or submerged pressure transducer as the primary measuring device (level sensor). The primary sensor will continuously measure stage (i.e., stream height) and relay that information to the flowmeter, which will continually calculate flow rates by inserting the stage information into the preprogrammed discharge equation. Continual flow data will be downloaded from each location periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. Flow data will be entered into the data management system.

Daily and monthly flow rates will be measured or estimated in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water Sampling Guidance Document (EPA-833-B-92-001) (United States Environmental Protection Agency [USEPA], 1992). Flow rating curves will be developed that correlate water surface levels (or stream heights) to flow rates.[19] To quantify flow rates based on stream stage, a relationship between flow and stage will be derived using standardized stream rating protocols developed by the USGS (Rantz, 1982; Oberg et al., 2005) and using an applicable hydraulic calculation formula(s), such as Manning's equation. If the monitoring station is found to have a steady dry weather base flow, it may be appropriate to install a flow sensor with the ability to measure instantaneous stream velocity. However, in an ephemeral stream that tends to be wet and dry out periodically, this type of sensor may not collect high quality data. A decision to use an area-velocity flow meter and/or a weir structure will be determined based on site hydraulic and flow conditions.

Instantaneous field level and flow measurements will be periodically taken to validate the rating curves. To measure instantaneous flows during low flow and base flow conditions, two types of field flow monitoring equipment may be used. To measure small flows, a handheld velocity measurement instrument, such as a Marsh-McBirney Model 2000 Portable Flowmeter connected by a cable to an electromagnetic open channel velocity sensor, or equivalent may be used. To measure higher flows, the SonTek (YSI) FlowTracker Acoustic Doppler Velocimeter, or equivalent may be used.

11.6.2 Water Quality Monitoring

During each monthly monitoring event, water quality parameters (temperature and conductivity) will be measured using a multi-parameter water quality meter or sonde. Water quality measurements and site conditions will be recorded on field data sheets. A grab sample will be collected in an appropriate container using a sampling pole or similar method. The sample will be analyzed for total nitrogen, total and dissolved inorganic nitrogen, and total and dissolved phosphorus, as described in **Element 13.2**.

[19] At the MCB CamPen surface monitoring site at Ysidora, discharge, rating curves, and field flow measurements from the USGS will be used in lieu of a new flow measurement site. The USGS station at Ysidora has real-time telemetry and reports data at 15-minute intervals.

Table 12-1. List of Analytes with Sample Volume, Container Type, Holding Time, and Preservation Method

Analyte	Recommended Container	Holding Time	Recommended Preservation
Nitrate (NO3) + Nitrite (NO2), Total	Plastic	48 hours; 28 days if acidified[4]	H_2SO_4, cool to ≤6°C
Nitrogen, Total[3] (Calculation)	NA	NA	NA
Phosphorus, Dissolved	Plastic	28 Days	Filter before adding H_2SO_4, cool to ≤6°C
Phosphorus, Total	Plastic	28 Days	H_2SO_4, cool to ≤6°C
Estuary Sediment Measurements			
Grain Size	Glass or Plastic	1 year	Wet ice to ≤6°C in the field, then refrigerate at ≤6°C
Nitrate (NO3) + Nitrite (NO2)	Glass	14 days[4]	Cool to ≤6°C
Nitrogen, Total[4] (Calculation)	NA	NA	NA
Nitrogen, Total Kjeldahl	Glass	14 days[4]	Cool to ≤6°C
Phosphorus, Total	Glass	14 days[4]	Cool to ≤6°C
Total Organic Carbon	Glass	28 Days at ≤6°C; 1 year at ≤-20°C	Cool to ≤6°C or freeze to ≤-20°C
Estuary Benthic Community Condition Measurements			
Benthic Macroinfaunal Community	Glass or Plastic	NA	Minimum of 72 hours to maximum of 2 weeks in formalin fixative, then transfer to 70% ethanol[5]

[1]Groundwater samples will include each of the analytes shown in this section except chlorophyll-a.

[2]Total and dissolved inorganic nitrogen is a calculated value comprised of NH3 and NO3 + NO2

[3]Total nitrogen in sediment is a calculated value comprised of total Kjeldahl nitrogen (TKN), NO3, and NO2

[4]Holding time may vary depending on the analytical method

[5]Start with 95% ethanol solution, not denatured ethanol. If ethanol is produced by industrial distillation rather than fermentation, buffer with marble chips (Bay et al., 2014); for preparation of 70% ethanol solution refer to Bay et al., 2014.

12.2 CHAIN-OF-CUSTODY PROCEDURES

Samples will be considered to be in custody if they are retained as follows (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be COC records, field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

13. ANALYTICAL METHODS

13.1 FIELD ANALYTICAL METHODS

In situ water quality measurements of DO (mg/L and % saturation), pH (pH), temperature (°C), conductivity/ salinity (µS/cm; ppt), and turbidity (NTU) will be determined using multi-parameter data sondes at two sites within the Estuary (I-5 Bridge and Stuart Mesa Bridge). Sondes will be set up to continuously collect data at 15-minute intervals for the duration of the monitoring period (April – October) and up to one month during each of three winter periods (November, January, March). Data sondes will need to be removed from the water to download the data and for maintenance (e.g., removal of biofouling, verification of precision, re-calibration, replacement of batteries) at least once a month. Summer months may require weekly maintenance. A telemetry system may be used to check data in real-time.

Continual flow data will be downloaded from the three sites located on the main stem of SMR periodically to verify equipment functionality and thus reduce data gaps, ensure accuracy, and identify maintenance and calibration needs. The MCB CamPen surface monitoring site at Ysidora will use the USGS station at Ysidora for flow data, which has real-time telemetry and reports data at 15-minute intervals. In situ water quality measurements of temperature and specific conductivity will be determined at these three sites using a multi-parameter water quality meter (or sonde).

Analytical methods for water quality parameters are provided in **Table 13-1**. Operation of all field equipment will be conducted as per manufacturer instructions. Calibrations will be performed and recorded to ensure accurate functionality. Maintenance will include removing biofouling to ensure the sondes are operating correctly.

Table 13-1. Analytical Methods for Water Quality Parameters

Parameter	Method	Units	Accuracy	Resolution
Dissolved oxygen	Polargraphic or luminescence quenching probe	mg/L	±0.2*	0.01
pH	Electrode	pH units	±0.2	0.01
Salinity	Refractometer of conductivity cell	ppt	±2	0.01
Specific Conductance	Conductivity cell	µS/cm	±0.5%	1
Temperature	Thermistor or bulb	°C	±0.15%	0.1
Turbidity	Portable turbidimeter or optical probe	NTU	±1% up to 100 NTU; ±3% from 100-400; and ±5% from 400-3000 NTU	0.1

Reference: State Water Board, 2017

*Calibration checks on DO sensors have indicated that variations in DO values may be greater than this instrument accuracy specification (Kara Sorenson, personal communication).

Table 13-2. Analytes, Analytical Methods, and Target Reporting Limits

Analyte	Method	Units	Target Reporting Limit[3]
Estuary Macroalgal Samples			
Macroalgal Biomass	McLaughlin et al., 2019 SOP	g dry weight/m^2	0.001
Ground Water, Estuary, and River Water Samples[1,2]			
Ammonia (as N)[4]	EPA 350.1	mg/L	0.02
Ammonia (as N)[4], Dissolved	EPA 350.1	mg/L	0.02
Chlorophyll-a, Suspended	SM 10200	mg/L	0.002
Inorganic Nitrogen, Dissolved[4]	By Calculation	mg/L	NA
Inorganic Nitrogen, Total[1,4]	By Calculation	mg/L	NA
Nitrate (NO_3) + Nitrite (NO_2) [4]	SM 4500-NO3 E/SM 4500-NO2 B	mg/L	0.01
Nitrate (NO_3) + Nitrite (NO_2), Dissolved[4]	SM 4500-NO3 E/SM 4500-NO2 B	mg/L	0.01
Nitrogen, Total[5]	By Calculation	mg/L	NA
Phosphorus, Dissolved	SM 4500 or EPA 365.1	mg/L	0.05
Phosphorus, Total	SM 4500 or EPA 365.1	mg/L	0.05
Estuary Sediment Samples[1]			
Grain Size	ASTM D4464 (M) or SM 2560 D or ASTM D422	%	NA
Nitrate (NO_3) + Nitrite (NO_2)	SM 4500 or EPA 300.0	mg/kg	0.5/1.0
Nitrogen, Total[5]	By Calculation	mg/kg	NA
Nitrogen, Total Kjeldahl	SM 4500	mg/kg	10
Phosphorus, Total	SM 4500	mg/kg	0.12
Total Organic Carbon	EPA 9060A	%	0.05

[1] Recommended analytical methods; alternative methods may be used; however, methods should follow USEPA, ASTM, or Standard Methods

[2] Groundwater Samples will include each of the analytes shown in this section except chlorophyll-a.

[3] Target reporting limits; reporting limits may vary based on the actual analytical method and method detection limits utilized by the laboratory selected to perform the analysis. Lower reporting limits may be available.

[4]Total and dissolved inorganic nitrogen in water is a calculated value comprised of NH_3 + NO_3 + NO_2. Additional water samples are identified to be collected and filtered to analyze for dissolved NH_3 + NO_3 + NO_2.

[5]Total nitrogen is a calculated value comprised of total Kjeldahl nitrogen (TKN), NO_3, and NO_2

NA = Not applicable

14. QUALITY CONTROL

14.1 FIELD MEASUREMENTS

QA/QC for sampling processes begins with proper collection of the samples to minimize the possibility of contamination. Water samples will be collected in laboratory-certified, contaminant-free bottles. Calibration of the flow monitoring and sampling equipment will be conducted immediately prior to deployment or use and will be field verified during each data download or sample event. Field instruments will be recalibrated if data quality is suspect or instruments are compromised in between downloads or sampling events, after cleaning the sensor surfaces from biofouling. All field instruments will be calibrated and deployed in accordance with manufacturer specifications.

Field measurements for DO, pH, conductivity/salinity, turbidity, and temperature will be made using a multi-parameter water quality meter or sonde according to the manufacturer's specifications. The meter or sonde will be calibrated with calibration solutions, and it will be verified that the expiration date has not been exceeded. Proper storage and maintenance procedures of field equipment will be followed.

14.2 WATER, SEDIMENT, AND MACROALGAE SAMPLING

Water, sediment, and macroalgae samples will be collected in appropriate containers, kept on wet ice at 4°C during the sampling event, and placed into coolers along with completed COC for transfer to the analytical laboratory. Sample containers for applicable constituents will be laboratory-certified. Samples requiring preservation will either be collected in pre-preserved laboratory containers or preservative will be added as soon as possible after collection. Field crews will ensure that sampling containers are being filled properly and the requirement to avoid contamination of samples at all times is met. A field log will be completed at each site for each event. The field data log sheets will include empirical observations of the site and water quality characteristics.

Field duplicates and equipment rinse blanks will be collected and analyzed at the frequency described for each monitoring program component in accordance with SWAMP QA sample requirements. Two field duplicates and one field blank will be collected for Estuary surface water nutrient analysis and for SMR Watershed nutrient analysis during each monitoring year, and one field duplicate and one equipment rinse blank will be collected for Estuary sediment chemistry analysis during each monitoring year.

14.3 LABORATORY ANALYSES

All samples must be analyzed by laboratories accredited by ELAP using methods approved by the USEPA for the type of analysis to be performed. Efforts will be made to ensure analytical techniques are consistent with those utilized in historic monitoring efforts. The laboratory quality control of all samples will be performed under the guidelines of this QAPP and the designated analytical laboratory SOPs. Quality control samples, frequency, and control limits specific to this project are discussed in **Element 7** and listed in **Table 7-2** through Error! Reference source not found.. Laboratory quality control checks will include the use of method blanks, laboratory control samples, matrix spikes, and matrix spike duplicates. These checks are performed to identify possible contamination problem(s), to facilitate the ability to duplicate results, and to assess the magnitude of matrix interference and bias

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

15.1 FIELD EQUIPMENT

Prior to conducting field sampling, field technicians will be responsible for preparing sampling kits that include field logs, COC forms, sample labels, sampling containers, and tools. Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. Equipment will be inspected prior to use and when returned from use for damage. The Consultant Field Task Lead will be responsible for implementing the field maintenance program.

Instrumentation malfunctions are immediately noted in the instrument logbook, and the Consultant PM is notified. Senior technical staff with specific in-depth knowledge of the particular instrument will then review the problem and attempt to fix the instrument. Major problems may require trained field service personnel and/or spare parts from the manufacturer to be brought in to fix the problem. If a critical measurement is found to be out of compliance during analysis, the results of that analysis will not be reported, corrective action will be taken and documented, and the analysis will be repeated. Effectiveness of the corrective action will be assessed by repeating the measurement, recording the corrected result, and documenting the chain of events and actions taken in field logs.

15.2 ANALYTICAL LABORATORY

The contract analytical laboratory is responsible for maintaining their equipment in accordance with their SOPs, which include those specified by the manufacturer and those specified by the method. Laboratory analysts are responsible for equipment testing, inspection, and maintenance. Corrective actions will be taken to repair equipment, document the issue, and reanalyze the sample if necessary.

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

It is the duty of each staff member responsible for equipment ordering to inspect equipment and materials for quality and report any equipment or materials that do not meet acceptance criteria to the appropriate Laboratory Manager and/or QA Officer. Upon receipt of materials or equipment, a designated employee will receive and sign for the materials. The items will be reviewed to ensure the shipment is complete, then they will be delivered to the proper storage location. Chemicals will be dated upon receipt. Supplies will be stored appropriately and discarded on the expiration date. The equipment and supplies purchased for use in field sampling activities will be inspected for damage as they are received.

Sample containers will be provided by the contract analytical laboratory. They will be shipped to and stored at the Consultant's facility prior to use in the field. Confirmation that sample bottles are laboratory-certified clean will be made when received from the laboratory. The Field Task Lead will oversee this element.

19. DATA MANAGEMENT

The Consultant PM will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the laboratory for analysis. The analytical laboratory will document and track the aspects of sample receipt and storage, analyses (including lab QA/QC data), and reporting pertaining to all laboratory analyses. The analytical laboratory's results will be stored in a database system at their office and will be provided to the Consultant PM both electronically and in hard copy. Further details of the analytical laboratory's data management protocols can be found in their respective quality manuals.

The Consultant's PM and QA officer will maintain and control the database of information and documents collected during this project. Data will be maintained as described in **Element 9**. Field and laboratory data will be entered into the Consultant's database based on nomenclature developed specifically for this project. Data entry oversight will be the responsibility of the Consultant's QA Officer. All data records, including field-generated data and laboratory data, will be accumulated into project-specific files that are maintained at the Consultant's office. All continuous monitoring raw data will be kept in the original files and stored in an electronic database. Data endpoints (e.g. hourly or daily averages) can be calculated and maintained in separate files or spreadsheets. Records will be maintained for at least five years or transferred according to agreement between the Consultant and the client.

All surface water data, including laboratory and field QC results, collected under the QAPP must be submitted to CEDEN. CEDEN data templates and documentation are available at: http://ceden.org.

21. REPORTS TO MANAGEMENT

The Consultant PM is responsible for preparation and submittal of all project deliverables. The analytical laboratory's QA Officer is responsible for the preparation of all data packages and laboratory reports originating from their laboratory. Draft and final reports will be provided for review. **Table 21-1** presents the proposed schedule for management reporting.

Table 21-1. Management Report Schedule

Type of Report	Frequency	Projected Delivery Dates(s)	Person(s) Responsible for Report Preparation	Report Recipients
Draft Monitoring Plan	Once	August 27, 2019	Responsible Parties Contact[3]	County of Riverside, Riverside Flood Control and Water Conservation District, County of San Diego, United States Marine Corps Base Camp Pendleton, City of Murrieta, City of Temecula, City of Wildomar, San Diego Water Board[2]
Draft QAPP	Once	August 27, 2019		
Final Monitoring Plan/QAPP to Dischargers	Once	November 6, 2019		
Final Monitoring Plan/QAPP to San Diego Water Board	Once	November 12[4], 2019		
In-Stream River Monitoring Data Submittals to NWIC Pacific	Quarterly[5]	July 31 October 31 January 31 April 30		
Draft Annual Report to Dischargers	Annually (Years 2020-2022)	November 15[6]		
Final Annual Report to Dischargers	Annually (Years 2021-2023)	January 15[1]		
Final Annual Report to San Diego Water Board	Annually (Years 2021-2023)	January 31[1]		
Draft Four-year Report to Dischargers	Once	January 15, 2024		
Final Four-year Report to Dischargers	Once	March 15, 2024		
Final Four-year Report to San Diego Water Board	Once	March 31, 2024		

1 – Following calendar year

2 –The San Diego Water Board will receive the final versions of the Monitoring Plan, QAPP, Annual Reports, and Four-year Report.

3 – The agency(s) designated to lead contract management and development of reports will be identified in the MOU.

4 – The Workplan and QAPP are due six months from May 9, 2019 when Investigative Order was issued, which is Saturday, November 9. Due to Veteran's Day holiday on November 11, the first business day is Tuesday, November 12, 2019. This date was agreed upon with the San Diego Water Board at the SMRNIG TAC meeting on October 2, 2019.

5 – Target interim data submittals to NWIC Pacific for annual assessment. Schedule may be modified as agreed upon by dischargers.

6 – Target draft report date may be modified as agreed upon by dischargers.

23. VERIFICATION AND VALIDATION METHODS

After each survey, the field data sheets will be removed from the field logbooks, and sheets will be checked for completeness and accuracy (including sample location, sample date and time, and sample type) by the Consultant's Field Task Lead or PM. Any field changes or discrepancies will be noted on the field sheets. Any changes to the COCs in the field should be indicated by a single line through the error, a revised value/change next to the original, and an initial of the field technician responsible. Copies of the COC forms with signatures from laboratory personnel showing that the laboratory has received the samples will be kept with field data sheets in a designated folder. If there are any questions, clarification from the Field Task Leader will be obtained as soon as possible. Data collected from field instruments, such as DO, will be validated and verified by the Consultant's PM or QA Officer.

Verification and validation of the laboratory data are the responsibility of the laboratory. All sample preparation and analytical activities will be documented in bound laboratory notebooks or on bench sheets. The laboratory technician generating the data has the prime responsibility for the accuracy and completeness of the data. Laboratory technicians and the laboratory QA Officer will review the analytical data to ensure that the following information is correct and complete: sample description information, analysis information, instrument calibration, analytical results, QC samples meet performance criteria, and documentation. The laboratory supervisor will maintain analytical reports and QA/QC documentation for this project in a database format. All corrective actions required during the analytical process that may affect sample results will be recorded by the laboratory's QA Officer and reported to the Consultant's PM and QA Officer.

In addition to the laboratory performing verification and validation of laboratory data, the Consultant's QA Officer will review all laboratory analytical reports and electronic data deliverables when they are received from the laboratory to ensure that the data provided are complete and MQOs in this QAPP have been met. Laboratory reports/electronic data deliverables (EDDs) that do not meet the Consultant's QC check will be returned to the laboratory with requests for correction.

The Consultant's PM will be responsible for final review of data analysis and rough drafts of annual reports prior to submission to the client for their review.

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CHAIN OF CUSTODY

Company Name: _____
Address: _____
City / State / Zip: _____
Project Manager: _____
Phone/Fax Number: _____
Client Contact: _____
Phone/Fax Number: _____

SDG Number: _____
Task Order Number: _____
Project Name: _____
Project Location: _____
Activity: _____
Lab Destination: _____
Lab Contact: _____
Lab Phone #: _____

Special Instructions:

Collection Information

LAB_SAMPLE_ID	SAMPLE_NAME	Date	Time	Matrix	Method/ SOP#:	No. of Bottles
						1

Preservation Code / Bottle Type																	
H3																	
Requesting Testing Program/ Contract Elin																	

Sampler(s) Name(s):

Turnaround Time:

Hours Sampling:

Condition upon Receipt
Cooler Temp _____ °C Received on Ice Y N Correct Container Y N
Preserved Y N

Associated Forms
BAC-T Form Y N Field Notes Y N

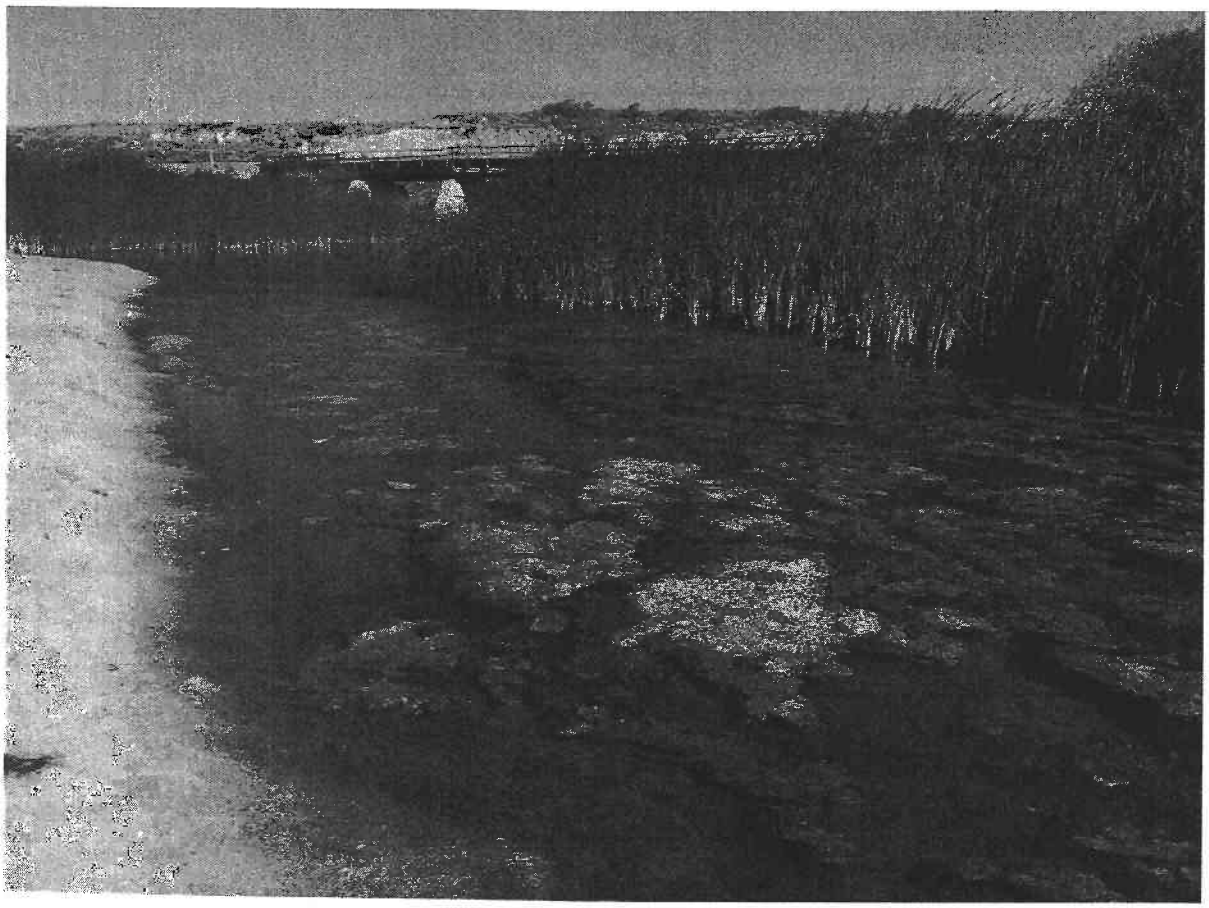
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:
Relinquished By:	Date:	Time:	Received By:	Date:	Time:

Matrices / Regulatory Programs

HAZ/GW (RCRA) WW (NPDES/CWA)
DW (SDWA) Solid (HUD) LIQ / Other

Bottle Type/Preservative Codes

1 = HCl	7 = $C_6H_8O_6$	C=50 ml
2 = $Na_2S_2O_3$	8 = $NaHSO_4*H_2O$	D=100 ml
3 = H_2SO_4	9 = HNO_3	E=250 ml
4 = NaOH	10 = Ice	F=500 ml
5 = NH_4Cl	A=Glass	G=1 Liter
6 = NaOH + ZoAC	B=HDPE	H=1L Amber



Standard Operating Procedure (SOP) for Macroalgal Collection in Estuarine Environments

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Table of Figures

1. Introduction and Purpose

Eutrophication of aquatic habitats is a global environmental issue, with demonstrated links with anthropogenic changes in watersheds. *Eutrophication*, defined as the accelerated delivery, *in situ* production, and/or accumulation of organic matter within an aquatic ecosystem (Howarth 1988, Nixon 1995, Cloern 2001), can have far-reaching ecological impacts, from headwater streams, lakes, estuaries to the coastal ocean (Valiela et al. 1992). These impacts include hypoxia, fish-kills, and lowered fishery production (Glasgow and Burkholder 2000), loss or degradation aquatic beds (Twilley 1985, Burkholder et al. 1992, McGlathery 2001), smothering of benthic macroinvertebrates, bivalves, and other organisms (Rabalais and Harper 1992), nuisance odors, impacts on aquatic life from increased frequency and extent of toxic harmful algal blooms, and poor water quality (Bates et al. 1989, Bates et al. 1991, Trainer et al. 2002). There are also a range of impacts to human health (algal toxins), drinking water (algal toxins, odors and disinfection biproducts) and recreation (nuisance blooms, loss of clarity, aesthetic impairments; Nixon 1995, Paerl et al. 2011). These impacts have significant economic and social costs (Turner et al. 1998). According to the U.S. Environmental Protection Agency (US EPA), eutrophication is one of the top three leading causes of impairments of the nation's waters (US EPA 2001). California has significant nutrient pollution and eutrophication issues. Almost 6,000 acres of estuaries and over 9,000 acres of bays and harbors have 303(d) listings for nutrient related impairments (California Integrated Report 2014/2016)[1]. In Southern California estuaries, macroalgal blooms and hypoxia have been observed at the majority of monitored segments (McLaughlin et al. 2014).

Nutrient pollution is the leading cause of eutrophication. Though in a risk prevention framework, scientific literature has demonstrated the shortcomings of using ambient nutrient concentrations alone to protect against eutrophication, e.g., in streams (Welch et al. 1989, Fevold 1998, Chetelat et al. 1999, Heiskary and Markus 2001, Dodds et al. 2002) and estuaries (Cloern 2001, Dettman et al. 2001, Kennison et al. 2003). In some cases, surface water nutrient concentrations alone are generally not effective for assessing eutrophication and the subsequent impact on beneficial use because nutrients are rapidly taken up by plants and micro-organisms and cycled through the environment. As a result, ambient concentrations are not temporally and spatially representative and do not reflect the biological processing that has already occurred. In addition, other factors can cause or significantly contribute to eutrophication. These factors include changes associated with conversion of natural landscapes to developed land uses, such as hydromodification, altered riparian and channel physical habitat, water temperature, and light availability, and grazing pressure, among others (Paerl et al. 2011). Biological response to nutrients (e.g., algal productivity) depends on a variety of mitigating factors such as basin morphology and substrate characteristics, stratification, temperature, light availability, biological community structure, and seed populations. Thus, high concentrations are not entirely predictive of eutrophication and low concentrations do not necessarily indicate absence of eutrophication.

[1] www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2014_2016.shtml

Figure 1. Examples of macroalgae in different habitat types: mats on the intertidal (upper left), rafting mats on seagrass (upper right), floating mats in closed river mouth estuary (lower left), rafting mats intercalated with Ruppia in a closed lagoon (lower right).

This document provides protocols to sample two major habitat types: 1) intertidal (mud or sand) flats and 2) shallow subtidal habitat (< 10 m). Intertidal flats are the unvegetated band of habitat found in the lower intertidal zone. Shallow subtidal habitat can be either vegetated (i.e., seagrass or other submerged aquatic vegetation) or unconsolidated sediments.

For perennially tidal or for intermittently tidal estuaries that are open to tidal exchange for most of the year, the intertidal protocol is recommended because of logistical issues and costs associated with subtidal sampling. However, if an estuary regularly features a seasonally restricted or closed inlet condition, particularly during the growing season (April-November), sampling the estuary utilizing the subtidal protocol is strongly recommended.

For regional (ambient) monitoring, it is not recommended to characterize both intertidal and subtidal habitats at the same time because of costs of sampling. However, for some site-intensive or research studies, a thorough characterization of both habitats may be desirable.

2.3. Seasonal Sampling Period, Frequency, and Recommended Time of Day to Sample

California's coastal climate is Mediterranean, with peak rainfall and freshwater flow to estuaries occurring during the winter months. Due to the freshwater input, the tidal inlets of bar-built estuaries are typically open and macroalgae that bloom during this period are often flushed from the estuary. As freshwater input slows and the tidal inlets begin to restrict, conditions for macroalgal blooms are enhanced. Therefore, typical optimum periods for blooms are during the "growing season," (i.e., April- November). However, winter blooms have been occasionally recorded, occurring during periods of peak nutrient inputs to the estuary or due to tidal inlet closure. Therefore, during the first phase of characterization of an estuary, it should be monitored throughout the year to capture seasonal variability in bloom events. Monitoring should occur on a monthly to bimonthly basis to maximize the likelihood of capturing the peak bloom event, which is not consistent from year to year. Both intertidal flats and shallow subtidal sampling should be scheduled during low tide to maximize available habitat that can be monitored and to facilitate logistics of sampling.

2.4. Additional Indicators

In addition to collecting macroalgae, other supporting indicators should be included in the assessment. Macroalgal abundance and sediment organic matter accumulation are tightly linked (Sutula et al. 2014) and, for this reason, indicators of sediment organic matter (sediment grain size, sediment % organic carbon (%OC) and % total nitrogen (%TN)) are useful supporting indicators. Additional rationale for monitoring sediment grain size, %OC, and %TN, and suggestions for their interpretation are given in the macroalgal assessment framework (Sutula et al. 2016).

Water column dissolved oxygen should also be considered for estuaries with significant sub-tidal habitat, supporting critical fish and invertebrate habitat. Changes in dissolved oxygen reflect the consumption of oxygen during organic matter respiration. Excessive photosynthesis from algal blooms and respiration from decomposition of organic matter result in changes in oxygen concentrations within the water column. These can manifest as large variability in dissolved

2.7. Measures to Avoid Transfer of Invasive Species

The transfer of invasive species and pathogens should be considered for each member of the team when moving from site to site. Protocols to prevent such transfer should be in place before sampling. See Appendix A for resources to avoid transmission of invasive species.

can be used to quantify biomass. However, if this is a persistent condition, it may be more appropriate to utilize the subtidal monitoring approach (Section 4).

Five points are randomly sampled along the transect. Random points must be selected in the office prior to departing for the field to avoid bias. Any randomized approach to sample collection is acceptable; one approach is to use a random number generator to randomly select five numbers between 1 and 60 and collect samples along the transect at distances represented by the numbers chosen. Macroalgal biomass and sediment samples are collected from these five points per transect. Biomass samples should be collected separately, not composited.

Since macroalgal blooms are spatially patchy, consideration should be given to the precision required for the assessment. For TMDL or intensive monitoring, double the number of stations to increase the precision of the estimate within each segment.

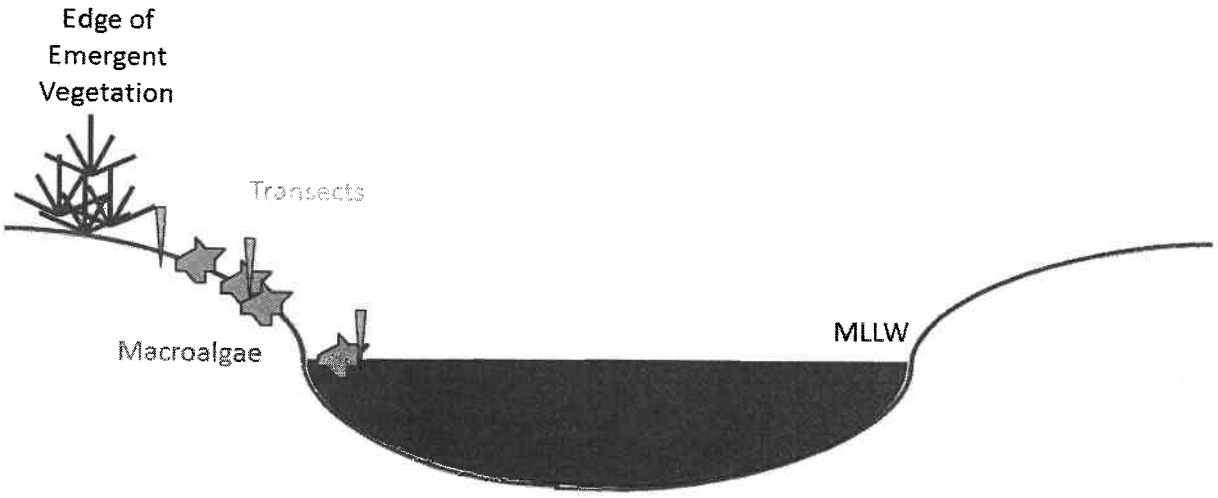

Figure 2. Cross sectional view of one station with three transects. One transect is laid out near the emergent vegetation, another between the vegetation and MLLW, and a third within the shallow subtidal.

- Breakfast table and bench paper for sample management
- Gloves (latex, nitrile, or similar)
- Cooler and ice
- Chain of Custody Form
- QA checklist

- Macroalgae biomass:
  - Buckets or dish bins (3)
  - Biomass surface area delineator (8-inch diameter plastic cylinder) and end cap
  - Spatula
  - Squirt Bottle filled with Estuary Water
  - Scissors or shears
  - Labels and Ziploc sample bags
- Sediment grain size and nutrient content:
  - Sediment syringe sampler (cut off tip of a disposable 60 ml syringe, mark 1 cm from end with black sharpie)
  - Spatula
  - Labels and Ziploc sample bags
  - Pre-weighed 50 mL centrifuge tubes with labels
  - Aluminum foil

3.5. Approaching a Station and Laying Out Transects

- When approaching a station minimize footprints within the designated sampling areas.
- At the edge of the emergent vegetation stake in a small piece of grey PVC pipe or stake to mark the start of the transect and record the GPS coordinates on the data sheet.
- Carefully lay the transect tape out to 60 m or 30 m (depending on the total length of the channel greater than 300 m or less than 300 m respectively) near the edge of the emergent vegetation parallel to the shore.
- Record the GPS coordinates of the endpoints of the transect. Record the distance in meters from the PVC pipe.
- Carefully lay out the second transect tape out to the same distance as the first (either 60 m or 30 m) between the MLLW and the emergent vegetation parallel to the shore. Stake in the landward end of the transect.
- Record the GPS coordinates of the endpoints of the transect. Record the distance in meters from the PVC pipe to the transect.
- Carefully lay the third transect tape out to 60 m or 30 m below the MLLW line and parallel to the shore. This transect should be in a very shallow area where you are able to reach your hands in to grab the samples.
- Record the GPS coordinates of the endpoints of the transect. Record the distance in meters from the PVC pipe to the transect.
- The oceanward location of each transect is designated as distance 0 m along the transect.
- Once the tapes are laid out, take a digital photograph of the station from the oceanward end.

4. Protocol for Monitoring Macroalgae in Estuarine Shallow Subtidal Habitat

4.1. Sampling Approach

Because macroalgae in subtidal habitat can be either benthic (attached) or as free floating rafting mats in water column, the subtidal sampling approach requires that all macroalgae found within a defined surface area 2 meter in depth or less be comprehensively sampled from surface to bottom. As with intertidal flat sampling, the final estimate of biomass is given in units of grams dry weight per square meter.

4.2. Number of Points Per Segment and Number of Segments Per Estuarine

For subtidal sampling, a grid-based approach or probabilistic sampling design is recommended unless the width of the estuary's channel is very small (< 5 m), in which case the point-intercept approach using transects can be used, as is done for intertidal flats.

As with intertidal flats, larger or complex estuaries should be divided into segments representing areas that are spatially homogenous with respect to habitat, morphology and/or hydrology relative to the rest of the estuary. Within each segment, assessments should generally be made in the 2nd order tidal channels or larger. Small tidal channels, pannes and pools located in the back of the marsh away from the main channel should not be assessed, as reduced tidal exchange may create natural conditions conducive to macroalgal growth. The tidal channel or open water subtidal habitat within the segment should be divided into three sub-segments and five randomly selected points should be sampled in each sub-segment for a total of 15 random sample points per segment (analogous to the transect sampling for intertidal flats). For regional (ambient) monitoring, three sub-segments are recommended and for a more intensive study such as a TMDL or permit monitoring, more sub-segments should be included and will depend on the size of the estuary segment.

4.3. Establishing the Sample Frame and Sample Location within the Grid

Any randomized approach to sampling locations on a sample grid within the estuary segment can be used to delineate sampling sites; however, random points should be selected prior to departure to avoid sampling bias. Mapping software like ArcGIS can be used to establish a sample frame, R packages like spsurvey[4] can be used for probabilistic sample draws. The grid-based approach can be used to select points to sample macroalgal biomass by laying a grid over an aerial map of the estuary (e.g. Figure 4). From the grid, delineate the estuary into 3 roughly even sub-segments and randomly select 5 points on the grid within each sub-segment (a total of 15 stations per segment), this can be done with a software package like R (as mentioned above) or using a random number generator to select numbers representing the intercepts on the grid. Make sure to record the latitude and longitude coordinates for each point. For each sampling event, samples should be collected at these same points.

[4] https://cran.r-project.org/web/packages/spsurvey/index.html

of SAV, the method be combined with the hamper method to capture both types of available biomass.

For the basket method of macroalgae sample collection, water column macroalgal mats will be collected using a dip net, bottomless mesh basket/collapsible hamper (Figure 5), or a similar device; benthic macroalgae and sediment samples will be collected using a box core. The surface area of the basket for water column sampling of macroalgal biomass should be of equal surface area as that of the box corer, such that the integrated composite from both habitats has a standardized surface area. If the surface area of the dip net or basket is different from that of the box corer, then the benthic biomass should be maintained in a separate composite bucket from the water column biomass; the combined biomass can be estimated after laboratory processing.

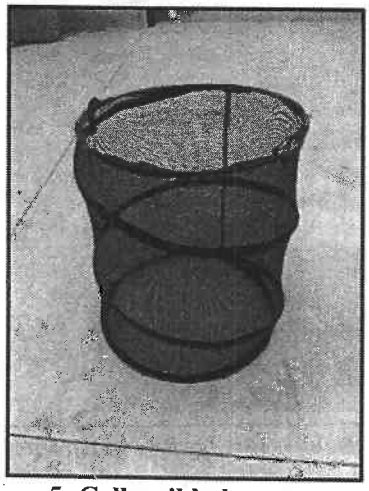

Figure 5. Collapsible hamper, used to quantitatively collect all water column macroalgae within a designated surface area and volume of water column

The SUBS sampler was developed by the Energy and Environmental Sciences Group at NIWC Pacific for quantitatively collecting macroalgal biomass in the subtidal zone (Sorensen et al., in prep) but has the capacity to collect sediment for bulk chemistry (e.g., total nutrients and organic carbon) and benthic chlorophyll-a, macroalgae in one sample. The device consists of a 4-inch ID cylindrical acrylic beveled core tube, encased in a stainless-steel collection frame that has an aluminum telescope "trigger" pole attachment and adjustable sediment hard stop (Figure 6). The entire device can be "loaded" and deployed from a small craft, such as a kayak, via the small craft sampler deployment stand (SDS). With the pole attached, the SUBS sampler can reach depths up to 3.66 meters. The adjustable sediment hard stop allows the user to increase or decrease the volume of sediment collected by the SUBS (range from 2.5 in (recommended minimum limit) to 8.5 inch (when using the long SUBS). The SUBS sampler comes in two core tube lengths, a ~12 inch (short sampler) and a 16 inch (long sampler), respectively. Total weight for each SUBS sampler (empty w/out sediment hard stop) is 7.5 to 8 lbs. respectively. To create a sufficient enough vacuum seal, we would recommend use of long SUBS when sampling in finer sediments at deeper depths (>1.5 meters), however, the long SUBS is not recommended for use in depths <0.5 m. The SUBS sampler collects samples by creating a tight vacuum seal when release cord is pulled triggering closer of foot and cap portion of collection frame. The SUBS sampler can also be used to collect sediment samples, however if a box corer is used to collect sediment samples,

- Tie downs

- Water Column Macroalgal Biomass (Basket Method):
  - Dip net
  - Collapsible mesh hamper or basket
  - Scissors or shears
  - Small oyster tongs/net
  - Labels, sample bags
  - Buckets or dish bins
  - Estuary water in squirt bottle

- Benthic Macroalgal Biomass and Sediment Sampling (Box Core Method):
  - Box core
  - Buckets
  - Sample bags with labels
  - Pre-weighed 50 mL centrifuge tubes with labels
  - Aluminum foil
  - plastic dish bin

- Benthic Macroalgal Biomass and Sediment Sampling (NIWC PAC Method):
  - Sample Device
  - Labels, sample bags
  - Buckets or dish bins
  - Estuary water in squirt bottle
  - kitchen strainers / or .750 mm sieve
  - Suction tubing

4.6. Collection

Subtidal Sampling:

- Wear gloves
- Use a kayak to access deep areas of the estuary; make sure to disturb sampling areas as little as possible
- Use GPS to find a sampling point
- Record coordinates (should be the same for each sampling period)
- Collect water column macroalgal biomass
  - If sampling by dip net, lower the dip net at an angle near the sampling point, close to the bottom but not close enough to touch the sediment. Pull up the dip net above the sampling point to grab any macroalgal biomass. Cut any mat of macroalgae that exceeds the rim of the dip net with scissors.
  - If sampling with bottomless mesh basket, lower basket into water column. Use dip net to pull out any macroalgal biomass within basket throughout the water column.
  - Using the oyster tongs or net, scoop all biomass from the net/basket, rinse any mud as necessary with squirt bottle, and carefully place biomass into pre-labeled bag.
  - Store the bag in a cooler with ice
  - If sampling by NIWC PAC method

slowly bring it up, place it in the plastic dish bin and open it so that it releases the sediment and any algae.
    - If box core surface area = surface area of dip net or basket, then pick out any algae and place it into composited pre-labeled bag with biomass from surface water.
    - If box core surface area ≠ surface area of dip net or basket, then pick out any algae and place it into a separate pre-labeled bag.
  - If sampling using SUBS sampler method load sampler and slowly lower device until it hits the benthos. Make sure a layer of sediment will be retrieved as part of the sample, to ensure a good seal. Release cap and foot plate as described above. Once cap and foot plate have been closed creating tight seal. Pull device back up to surface and place on SDS. Place collection bin under SUBS sampler. Release springs from cap screws and release pressure by slightly opening cap. Push down on frame arm spring as described above and open so that it releases sediment and algae into plastic collection bin. Repeat two additional times.
  - If using SUBS sampler to collect macroalgae then pick out any algae and place into pre-labeled collection bag.
  - Store the bag in a cooler with ice
- To collect sediment samples:
  - Insert the sediment syringe sampler into the sediment collected in the box core or SUBS sampler past 1 cm depth (marked as a hash on the side of the sampler) while pulling up on the syringe plunger.
  - Remove the sampler from the sediment.
  - Gently push in the plunger, expelling sediment until only the top 1 cm remains in the syringe.
  - Open a pre-labeled 50 mL centrifuge tube and push the plunger to expel the 1 cm of sediment.
  - Repeat the syringe process again to collect one more sediment plug. There should be a total of 2 sediment plugs collected at each sampling point.
  - Store in cooler with ice
- Repeat this process at each point