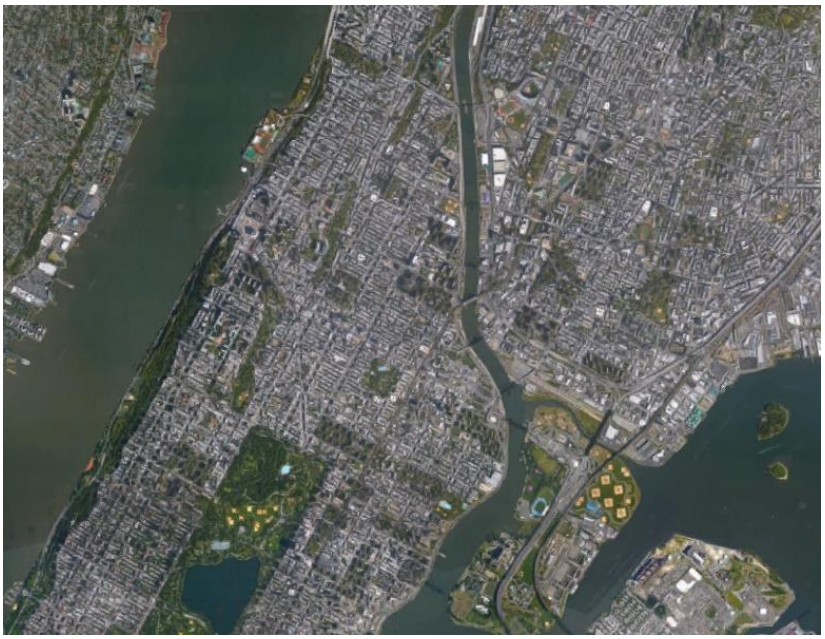
# Citizen Science Hudson-Raritan Estuary Restoration Research (Harlem/East River from 96th to 120th Streets & The Governors Island Oyster Reef)

Prepared by: Mauricio González & Maura Smotrich



Credit: Google, 2015

A NY Harbor School Harbor SEALS, CIVITAS, & NY Harbor Foundation Partnership

New York
2015

**Collaborators**

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# Title and Approval Pages

## *Title*

Citizen Science Hudson-Raritan Estuary Restoration Research (Harlem/East River from 96th to 120th Streets & The Governors Island Reef) New York Harbor School Harbor SEALs - New York Harbor Foundation - CIVITAS

**Effective Date of Plan: _____, 2015**

## *Approval Pages*

**Project Manager 01** **Melanie Smith/ Research Student**
**Urban Assembly New York Harbor School**

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**Signature/Date**

**Project Manager 02** **/ Research Student**
**Urban Assembly New York Harbor School**

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**Signature/Date**

**Operations Manager 01** **Zain Bin Khalid/Research Student**
**Urban Assembly New York Harbor School**

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**Signature/Date**

**Operations Manager 02** **/ Research Student**
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**Project Manager and Operations Advisor:** **Mauricio Gonzalez/Director, Marine Biology Research Program**
**Urban Assembly New York Harbor School**

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**Signature/Date**

**Quality Assurance Manager:** **Maura Smotrich/Urban Planner**
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**Signature/Date**

**Quality Assurance Officer:** **Susan Maresca/Scientist**
**Region 2 DEC Natural Resource Damages Coordinator**

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**Signature/Date**

**Quality Assurance Officer:** **Kate Boicourt/Scientist**
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**Signature/Date**

**Quality Assurance Officer:** **James T.B. Tripp/Senior Counsel**
**Environmental Defense Fund and CIVITAS Executive Board Member**

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**Signature/Date**

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**Signature/Date**

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**Urban Assembly New York Harbor School**

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**Signature/Date**

**Administrative Support and Liaison:** **Emma Bologna/President**
**CIVITAS**

_____
**Signature/Date**

**Administrative Support and Liaison:** **Matthew Haiken/Vice-President**
**Urban Assembly New York Harbor School**

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**Signature/Date**

**Citizen Science QAPP Template #2A**

# Project Organization Chart

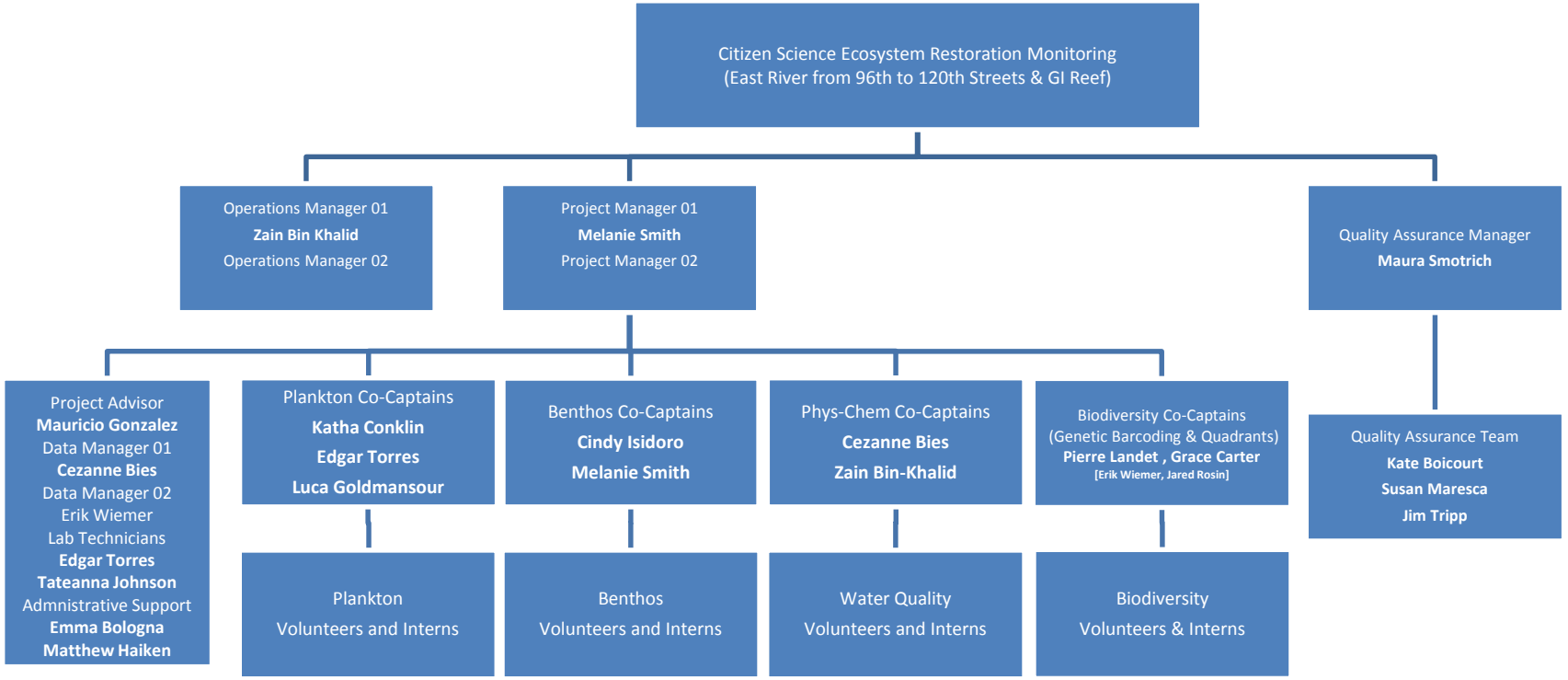


*Figure 1. Project Organization Chart of the Current Study.*

**Citizen Science QAPP Template #2B**

# Project Distribution List

*Table 1. Project Distribution Table.*

| Name/Title | Contact Information |
|---|---|
| **Melanie Smith**<br>*Project Manager 01* | *Email: m.smith3890@gmail.com*<br>*Phone: 917-589-1658* |
| *Project Manager 02* | *Email:*<br>*Phone:* |
| **Zain Khalid**<br>*Operations Manager 01* | *Email: zainb.khalid141@gmail.com*<br>*Phone: 917-246-8395* |
| *Operations Manager 02* | *Email:*<br>*Phone:* |
| **Mauricio Gonzalez**<br>*Project Advisor* | *Email: mgonzalez@newyorkharborschool.org*<br>*Phone: 646-752-2071* |
| **Maura Smotrich**<br>*Quality Assurance Manager* | *Email: maura@civitasnyc.org*<br>*Phone: 203-531-5065/203-912-1867* |
| **Kate Boicourt**<br>*Quality Assurance Officer* | *Email: kate@hudsonriver.org/kate@harborestuary.org*<br>*Phone: 212-483-7667* |
| **Susan Maresca**<br>*Quality Assurance Officer* | *Email: susan.maresca@dec.ny.gov*<br>*Phone: 718-482-6461* |
| **Jim Tripp**<br>*Quality Assurance Officer* | *Email: jtripp@edf.org*<br>*Phone: 212-616-1247w/917-553-8085c* |
| **Emma Bologna**<br>*Administrative Support and Liaison* | *Email: emma@civitasnyc.org*<br>*Phone: 212-996-0745w/516-698-2866c* |
| **Matthew Haiken**<br>*Administrative Support and Liaison* | *Email: mhaiken@nyharbor.org*<br>*Phone: 917-664-1166* |
| **Cezanne Bies**<br>*Data Manager/Researcher* | *Email: cbies16@gmail.com*<br>*Phone: 212-864-2030* |
| **Erik Wiemer**<br>*Data Manager/Researcher* | *Email: e.wiemer423@gmail.com*<br>*Phone: 347-721-2942* |
| **Katharine Conklin**<br>*Plankton Captain 02:* | *Email: kconklin600@gmail.com*<br>*Phone: 646-357-2492* |
| **Cindy Isidoro**<br>*Benthos Captain 02:* | *Email: cindyisidoro28@gmail.com*<br>*Phone: 646-498-6423* |
| **Pierre Landet**<br>*Biodiversity Captain 01:* | *Email: plandet@gmail.com*<br>*Phone: 917-843-9267* |
| **Cezanne Bies**<br>*Physical-Chemistry Captain 02:* | *Email: cbies16@gmail.com*<br>*Phone: 212-864-2030* |

**Citizen Science QAPP Template #3**

# Project Responsibilities

*Table 2. Project Responsibilities.*

| Name | Title | Organizational Affiliation | Responsibilities (specific to this project) |
|---|---|---|---|
| **Melanie Smith** | Project Managers | NY Harbor School | Oversees all aspects of project including building volunteer teams, data collection and flow, team organization and training, report writing, blogging, *etc.* |
| **Zain Bin Khalid** | Operations Managers | NY Harbor School | Team training, materials gathering, equipment maintenance and calibration logging, aiding Project Manager in all aspects of project *etc.* |
| **Cezanne Bies**<br>**Erik Wiemer** | Data Managers | NY Harbor School | Making sure data tables are being filled out correctly and completely, uploading data to on-line site, inserting blanks into samples, making sure lab technicians keep calibration log up-to-date, *etc.* |
| **Maura Smotrich** | Quality Assurance Manager | CIVITAS | Oversees data collection and processing functions and manages the incorporation of suggestions from Quality Assurance Team. |
| **Kate Boicourt** | Quality Assurance | Hudson River Foundation | Quality assurance, oversight and assessments, data verification, evaluation and usability, ensuring corrective actions are completed, *etc.* |
| **Susan Maresca** | Quality Assurance | Department of Environmental Conservation Region 2 | Quality assurance, oversight and assessments, data verification, evaluation and usability, ensuring corrective actions are completed, *etc.* |
| **Jim Tripp** | Quality Assurance | CIVITAS | Quality assurance, oversight and assessments, data verification, evaluation and usability, ensuring corrective actions are completed, *etc.* |
| **Mauricio Gonzalez** | Project Advisor | NY Harbor School | Generally oversees and advises on the execution of the project. |
| **Emma Bologna** | Administrative Support | CIVITAS | Act as a liaison between the Harbor Foundation and CIVITAS, oversee the |

| | | | |
|---|---|---|---|
| | | | terms of the project MOU, coordinate CIVITAS press releases, *etc.* |
| **Matthew Haiken** | Administrative Support | NY Harbor Foundation | Act as a liaison between the Harbor Foundation and CIVITAS, oversee the terms of the project MOU, coordinate CIVITAS press releases, *etc.* |
| **Katha Conklin** | Plankton Technicians | NY Harbor School | Use the QAPP Standard Operating Procedures to collect representative plankton data, maintain and service equipment as needed, report data to data manager, train volunteers, aide data manager in data analysis, *etc.* |
| **Cindy Isidoro** | Benthos Technicians | NY Harbor School | Use the QAPP Standard Operating Procedures to collect representative benthic data, maintain and service equipment as needed, report data to data manager, train volunteers, aide data manager in data analysis, *etc.* |
| **Cezanne Bies** | Physical-Chemical Technicians | NY Harbor School | Use the QAPP Standard Operating Procedures to collect representative water quality data, maintain and service equipment as needed, report data to data manager, train volunteers, aide data manager in data analysis, *etc.* |
| **Pierre Landet**<br>**Grace Carter**<br>**Erik Wiemer**<br>**Jared Rosin** | Biodiversity Technicians | NY Harbor School | Use the QAPP Standard Operating Procedures to collect representative biodiversity data, maintain and service equipment as needed, report data to data manager, train volunteers, aide data manager in data analysis, *etc.* |
| **Edgar Torres**<br>**Tateanna Johnson** | Lab Technicians | NY Harbor School | Use the QAPP Standard Operating Procedures to calibrate and maintain field and lab equipment, maintain and service equipment as needed, help order equipment, keep calibration log updated, communicate with equipment vendors, train volunteers, support team captains as needed, *etc.* |
| **Student Volunteers & Interns** (10) | Field/Lab Personnel | NY Harbor School | Field/lab sampling and data analysis support |
| **Adult Volunteers** (4) | Field/Lab Personnel | Various | Field/lab sampling and data analysis support |

**Citizen Science QAPP Template #4**

# Problem Definition and Project Objectives

## *Problem Definition*

The water bodies that surround the five boroughs of New York City are important resources that support economic growth and trade, as well as numerous businesses, which include travel and tourism. In fact, some of the primary reasons for the successful choice of New York as a site for European colonization were its exceptional harbor and abundance of marine wildlife. Both provided a gateway to the North American continent and a steady supply of food resources. New York's oyster and eelgrass reefs were among the largest in the world and its history is unique. Therefore, it seems intuitive that the City should still host an abundance of endogenous wildlife but New York's marine resources have actually declined in number through neglect. Its keystone species, oysters and eel grass, have all but disappeared (Muehlstein, 1989). This has not only affected the native organisms that live in and around the marine habitat, but New York citizens as well. The Reimagining the Waterfront: Manhattan's East River Esplanade initiative, and the subsequent Vision Plan, were initiated by the neighborhood not-for-profit organization, CIVITAS, that hopes to change this fact. The CIVITAS goal is to bring back New York's keystone species while also reinvigorating an ecosystem for the enjoyment of the inhabitants in the nearby neighborhoods of East Harlem.

CIVITAS initiated work on the East River Esplanade in 2011 in recognition of its badly deteriorated condition, the need for high-quality park space in the community, its vulnerability to storm surges, and its potential as a site for ecological restoration. With a couple of exceptions, the waterfront represents an enormous missed opportunity for these dense neighborhoods, as this community has a documented shortage of open space. Part of the population suffers from some of the highest rates of asthma in the country (Perez-Pena, 2003), lower IQs and high cancer rates related to exposure to air-borne particulate matter (Hoepner, Perera, & Li, 2009) (Environmental Potection Agency, 2009), as well as obesity - all of which could be reduced with more opportunity for recreation and access to healthy park spaces (Gonzalez, Turay, Vaughan, Garcia, & Pierce, 2011). The Esplanade is also simply falling apart above and below the water line. The prospect of both sea level rise and catastrophic storms has galvanized attention on the resiliency of waterfront and shoreline communities, thereby emphasizing the significance of the project. A plan for the Esplanade will need to solve multiple problems and work on many levels: open space, public health and sustainable community; social and environmental equity and restoration; and coastal resilience in a context of climate change.

The CIVITAS Vision Plan, released in 2015, presents a synopsis of the community's wish list for the various aspects of what they hope the Esplanade will become over time. Community participants have shared their desire for direct access to the waterfront for recreational and educational purposes. Comparisons were made to the direct waterfront access available on the West Side of Manhattan. With this in mind, and after a careful analysis of the physical conditions along the Esplanade, the Vision Plan recommended that the section of East Harlem north of Rheinlander Bay and up past Thomas Jefferson Park become an accessible, ecological edge or living shoreline. The bathymetry is such that the shallow water of the Harlem River in that location, coupled with the fact that it is no longer a major commercial navigation channel, makes

it an ideal location for adding physical spatial complexity to the river to widen the Esplanade and create a living shoreline that restores the estuary, creating an ecologically rich public space while addressing storm resiliency. Department of Environmental Conservation (DEC) regulations were designed to prohibit filling in the water and reducing viable marine habitat. A meeting with the DEC clarified that CIVITAS would either have to perform mitigation or predict ecological uplift to receive permission for adding physical spatial complexity to the channel to create a living shoreline. Mitigation is prohibitively expensive. As a result, CIVITAS has engaged citizen scientist students from The Urban Assembly New York Harbor School and the New York Harbor Foundation to conduct an experiment over the next 3 years to measure the baseline conditions in the Harlem/East River and, subsequently, test potential living shoreline materials and spatial complexity in an effort to predict the potential for ecological uplift with a living shoreline. The DEC is very supportive of the experiment and has expressed the desire for baseline data collection and analysis for this location, as it currently has none. CIVITAS has become a steward for the site and is also nominating the site for inclusion in the NY-NJ Harbor Estuary Program. In addition to becoming an important site for urban renewal and estuary restoration, a future ecological edge would serve to augment the storm resilient capability of the shoreline at this location.

The current proposed Project: Citizen Science Hudson-Raritan Estuary Restoration Research (East River from 96th to 120th Streets) has been designed with the hope that it will provide a baseline with which to predict ecological uplift, create an ongoing monitoring program of marine biodiversity & water quality, and determine the overall effects of using different construction materials on marine biodiversity enhancement in the study area.

The main questions that will be addressed by the project are:

01. What organisms are currently able to thrive or, at least, survive in the New York Harlem/East River Estuary?
02. What organisms of the New York Harbor are able to colonize and survive on various living and non-living materials used to both restore the estuary and build a recreational waterfront?
03. With the results of question 02 in mind, what building materials are suitable for building a living shoreline in this area?

## *Project Objectives*

01. Create a spatial-temporal baseline of physical, chemical, and biological characteristics at 3 test sites and one control site of the study area over at least a two year period,
02. Elucidate relationships, if any, between the above mentioned ecosystem characteristics,
03. Compare the community structure between traditional building composites (*i.e.* bulkheads and/or Portland cement) and novel composites that have spatial complexity built into them (i.e. Modified "Columbia" Colonizing Devices and/or "Econcrete" Experimental Sampling Units),
04. Determine ecological uplift in the marine community structure comparing the baseline data with Modified "Columbia" Colonizing Devices and /or "Econcrete" Experimental Sampling Units, and
05. Engage community stakeholders to enhance their understanding, involvement, and contribution to the restoration of their marine ecosystem and the resources it can provide.

## *Data Users*

(State who will use the data and what decisions or conclusions will be made based on the data. Include any action levels or standards to which the data will be compared.)

The data collected from this project may be used by various stakeholders (*i.e.* New York Harbor SEALs, CIVITAS, NY-NJ Harbor Estuary Program, The New York State Department of Environmental Conservation, and Hudson River Foundation) as screening level data. These stakeholders will use the collection and analysis of PHASE 01 baseline data to better understand the composition of the existing marine habitat at this location. For PHASE 02 of the project - testing materials used to implement a living shoreline and spatial complexity - may serve as the basis for a more extensive project that seeks to restore the Harlem/East River shoreline ecosystem as parkland that also serves as resilient infrastructure. The data will also be used to inform and educate the public about the existing condition of the marine aquaculture habitat and biodiversity at the selected sampling stations. Additionally, the experimental process will provide high school students with opportunities to understand and engage in scientific research in the NY-NJ Harbor Estuary while providing valuable data that doesn't currently exist.

**Citizen Science QAPP Template #5**

# Background and History

## *Background*

(In this section, state why this work needs to be done, identifying the reasons for conducting the work and/or the lack of information relating to the project.)

Although New York Harbor water quality has improved notably since the implementation of the Clean Water Act nearly 40 years ago, harbor waters continue to be of insufficient quality to sustain native flora and fauna as well as human water related activities (Table 3). As a result of excessive nutrients and pollutants from river run-off, sewage and storm water discharge from combined sewer overflows (CSOs), ground water, industrial activities, and other current and historic uses, harbor waters have been ecologically altered and are unsuitable for significant habitat restoration (*e.g.* oyster reefs and eelgrass beds), closed to shell fishing, and most are classified as appropriate only for secondary contact recreation and fishing (New York-New Jersey Harbor & Estuary Program, 1996).

*Table 3. Mean and Range of Physical-Chemical Parameters Measured in the Upper New York Bay, 2012 – 2015 (Gonzalez & Sommer, 2015).*

| | Mean (Range) | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Battery West** | **Battery East** | **Manhattan** | **Governors Island** | **Cold Months** | **Warm Months** |
| **pH** | 7.6 (6.8 – 8.19) | 7.6 (6.4 – 8.3) | 7.4 (6.2 – 8.3) | 7.5 (6.2 – 9.6) | n/a | n/a |
| **Dissolved Oxygen (ppm)** | 9.5 (6.6 – 14.0) | 8.3 (5.0 – 12.5) | 9.1 (6.6 – 12.0) | 8.6 (5.0 – 14.0) | 9.2 (5.0 – 14.0) | 7.6 (5.0 – 10.0) |
| **Temperature (°C)** | 8.7 (1.9 – 24.3) | 9.4 (1.0 – 22.8) | 7.3 (1.0 – 19.2) | 6.3 (1.8 – 19.0) | n/a | n/a |
| **Salinity (ppt)** | 18 (5 – 28) | 21 (10 – 28) | 21 (9 – 28) | 19 (10 – 27) | n/a | n/a |
| **Ammonia (ppm)** | 0.71 (0.25 – 5.00) | 0.61 (0.00 – 3.00) | 1.08 (0.00 – 3.00) | 0.39 (0.00 – 0.50) | n/a | n/a |
| **Nitrate (ppm)** | 2 (0 – 20) | 5 (0 – 20) | 2 (0 – 20) | 5 (0 – 20) | n/a | n/a |
| **Phosphate (ppm)** | 7 (5 – 30) | 8 (5 – 30) | 9 (5 – 30) | 7 (5 – 30) | n/a | n/a |

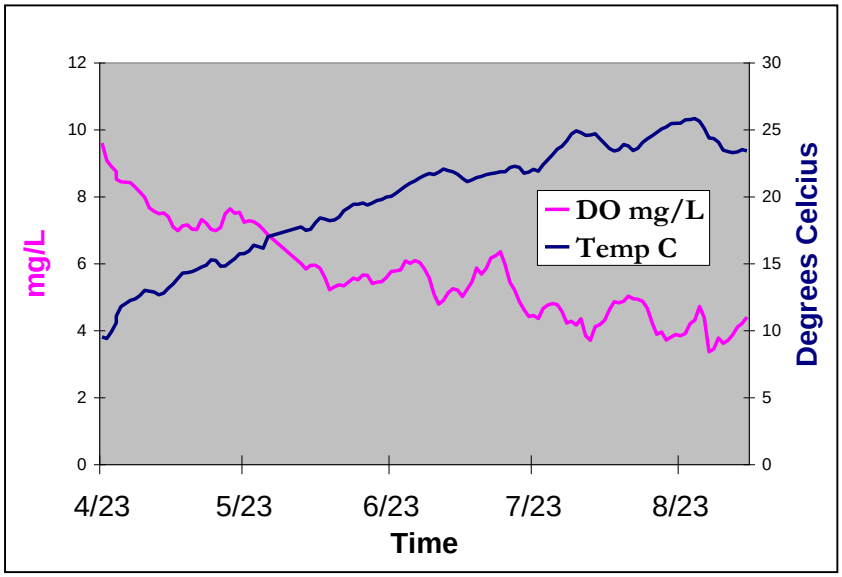


*Figure 2. Dissolved Oxygen Concentration in mg/L at the Edge of the Harlem River at a Depth of 20 feet during the Months of April to September of 2009 (Gonzalez, Turay, Vaughan, Garcia, & Pierce, 2011).*

During late summer months, dissolved oxygen levels in the harbor can reach under 4 mg/L which is well below the suitable level for fish reproduction and close to being anoxic which can cause fish kills and significant reductions in marine biodiversity (Figure 2) (Gonzalez, Turay, Vaughan, Garcia, & Pierce, 2011). During ebb tides, ammonia and enterococcus levels, products of sewage discharge, reach average toxic levels of 0.75 ppm and 23.7 MPN respectively (Table 4) (Gonzalez & Sommer, 2015). New York Harbor remains among the 20 most toxic estuaries in the country (New York City Department of Environmental Protection, 2009).

*Table 4. Mean and Range of Specific Parameters during Ebb and Flood Tide Measured in the Upper New York Bay, 2012 – 2015 (Gonzalez & Sommer, 2015).*

| | **Mean (Range)** | |
|---|---|---|
| **Parameter** | **Ebb** | **Flood** |
| Salinity (ppt) | 23 (10 – 30) | 22 (5 – 28) |
| Enterococcus (MPN) | 23.7 (0.0 – 94.5) | 8.3 (0.0 – 45.3) |
| Ammonia (ppm) | 0.75 (0.00 – 5.00) | 0.49 (0.00 – 1.00) |

These conditions have numerous negative impacts on local marine ecosystems and consequently on New Yorkers, who have very few opportunities to fish, swim, surf, or observe and interact with marine plants and animals. Arguably, this absence of opportunities to interact with a healthy marine environment disproportionately impacts New Yorkers from lower income communities who cannot afford to escape to beaches and waterfront parks outside the city. This lack of

access to clean marine waters likely exacerbates a cultural disconnect: many New York City youth and adults do not embrace the Harbor and its natural resources, and are not aware of the variety of tools and strategies that may be used to protect and restore Harbor waters. This, in turn, causes a decrease in community pride which only feeds the cycle of abandon. Additionally, poor water quality and environmental conditions translates into reduced tourist spending (Suthers & Rissik, 2009).

Along the Harlem and East River, the Esplanade bulkhead and upland recreational path are in a dire state of disrepair and continue to deteriorate while solutions to its poor condition are sought (Figure 3). Additionally, the threat of climate change and its related sea level rise are becoming real issues that are exacerbated by increasingly severe and potentially catastrophic storm activity. When these storms occur, as in the case of Sandy in 2012, extreme flooding of the upland can create damage to and temporary paralysis of a neighborhood. In the case of East Harlem, when the flooding occurs, it is happening in a neighborhood that is underserved and lacks adequate open space for healthy lifestyles. Coupled with the ensuing problems with built infrastructure, the ecosystem was destroyed by human contamination and dredging, and the majority of the wildlife was either killed or migrated to a more suitable environment.

CIVITAS, a NYC-based not-for-profit organization dedicated to preserving quality of life on the Upper East Side and in East Harlem, along with volunteer scientists and researchers from the Urban Assembly New York Harbor School and New York Harbor Foundation, New York State DEC, and the Hudson River Foundation, will be conducting an experiment with the goal of measuring the viability of a plan to restore the waterfront area along a section of East Harlem's perimeter with the implementation of an ecologically sensitive living shoreline. It is hoped that within the next twenty years, the area will be thriving with indigenous marine aquaculture, upland estuarine wildlife and vernacular plant life.

*Figure 3. Current Segment of Study Area. This image shows a dilapidated pier, an aging and vulnerable bulkhead, and an ineffective tree arrangement that will be restored to the coastal wetlands and riparian ecosystem that thrived here 150 years prior (Credit: Maura Smotrich, 2015).*

The present study will comprise two main phases over a three-year period in the Harlem/East River: PHASE 01) the generation of a physical-chemical and biological baseline and PHASE 02) the experimentation with different construction and habitat enhancing structures to determine best practices for the rehabilitation of Harlem/East River ecosystem components. Specifically, during PHASE 01, physical-chemical (*i.e.* dissolved oxygen, temperature, salinity, pH, Secchi depth, sedimentation rates, ammonia, nitrites, nitrates, silicates, total phosphorus, and chlorophyll-a) and biological (*i.e.* planktonic and benthic diversity) water quality parameters will be monitored. These parameters are key in determining marine environmental health (Eleftheriou & McIntyre, 2005) (Suthers & Rissik, 2009) (Johnson & Allen, 2012).

During a plankton monitoring study conducted in New York Harbor between 2012 and 2014, the most common groups of zooplankton found were barnacle *nauplii* and cyprids, copepods, *caprellid* amphipods, and *polychaeta* larvae (Wilson & Kalogrias, 2015). In the same study, the most common group of phytoplankton was pennate diatoms.

Existing seawall littoral biodiversity will be characterized through the use of "photoquadrants" on existing man-made structures. Genetic bar-coding will be used as an aide to species identification of organisms or colonies larger than 1 cubic centimeter and that cannot be identified through conventional methods.

During PHASE 02, settling plates of various construction materials (*i.e.* Portland cement, porcelain tiles, rock, *etc.*) will be deployed to test for the best construction materials and configurations for ecological uplift of ecosystem components (*i.e.* littoral, benthic, and planktonic). Ecological uplift will be measured as a function of biodiversity (Hill Numbers) and percent cover of sessile invertebrates and algae. "Columbia" Colonization Devices (Reid, et al., 2015) will house the various settling plates in addition to clear PVC sedimentation cylinders to measure sedimentation rates and light/temperature sensors. Eel grass, a keystone species, may also be deployed in the Units to test for its ability to survive in this environment as it most likely did over a hundred and fifty years ago before the wetlands were filled and boxed in by artificial barriers. Over 20% eelgrass coverage was maintained for the duration of a one-year pilot study in Brooklyn (Martinez, 2015). Subsurface water temperatures exceeded 24°C during the late summer of the study which is 4°C over the ideal temperature for this very delicate species.

In a previous study (Abdo, 2015), Econcrete© tiles of approximately 15x15x5cm, of different cement pH and "bioreactive" compositions, and at depths from subsurface to 3m had Shannon-Weaver Biodiversity Indices ranging from 0.8 to 1.2 with Portland cement registering just over 1.0. The textured side of the tiles registered higher levels of biodiversity. In another study (Sommer, 2015), the biodiversity (Hill N1) of standard porcelain tiles (15x15x0.5cm) hung from an ecodock ranged from 2.28 to 3.93 on the unglazed side with the higher values pertaining to the tiles closest to the surface. In Sommer (2015) the most common organism found recruiting the settlement plates were sea sponges of the genus *Halichondria* by a factor of 3. After this group, solitary tunicates, colonial ascidians, hydrozoans, tube *polychaetes*, and bivalves followed. Initially, however, Sommer (2015) found that turf algae were the predominant organism replaced by the sessile invertebrates through the process of succession. Bivalves usually take up less percent cover than colonial organisms (Hirata, 1987). It is important to consider edge effects when studying settlement plates that are small in size. Ideally they should be approximately a square meter in area (Perkol-Finkel, 2015). Schmidt (1982) used 25x25cm black perplex panels with colonial ascidians dominating the percent cover. These panels were slightly larger than those used by Sommer (2015) and Abdo (2015).

The ultimate goal is to generate an understanding of the Harlem River's existing biodiversity at this location and determine methods by which it might be enhanced to justify the creation of a living shoreline. A living shoreline would serve as the basis for a rediscovered symbiotic relationship between the public and a restored natural estuarine environment. If this were to occur, an important marine ecosystem will be strengthened, the waterfront will be more open and accessible for the public, and the overall location will become a magnet for encouraging healthier lifestyles.

## *History*

(In this section provide any relevant historical information that would help the reader understand the problem that is being addressed. Discuss any previous work or data that has been collected as they relate to this project.)

CIVITAS has been working on an East River Waterfront redevelopment initiative since 2011. At that time, CIVITAS sponsored a juried competition called Reimagining the Waterfront to inspire creative and sustainable thinking about the land water connection along the East River. In an effort to reshape this initiative into a realistic planning project with defined objectives, CIVITAS hired the consultants, Mathews Nielsen Landscape Architects, to help CIVITAS develop a Vision Plan for the 4-mile stretch of East River Waterfront, from 60$^{th}$ to 125$^{th}$ Street.

The Vision Plan identifies eight potential nodes with connective tissue to tie the Esplanade together. One potential node is an ecological edge in East Harlem. The community, the need for resiliency, and the site's characteristics are the driving forces behind proposing a living shoreline in this location running north from approximately 100$^{th}$ to 115$^{th}$ Street. Along this narrow stretch of esplanade, however, creating an ecological edge requires using fill. Further, it is inherently different from the East Harlem precedent between 139$^{th}$ and 142$^{nd}$ Street, where the ecological edge was cut back from the shoreline. Implementing this solution requires DEC approval and, therefore, mitigation or proof of ecological uplift to obtain it.

William Castro, DPR Borough Commissioner, is extremely interested in the idea of creating a living shoreline in East Harlem because, among other things, it costs half as much to build as conventional bulkhead and requires no substantial long-term maintenance. From the perspective of storm resiliency, this area of East Harlem is highly susceptible to upland flooding. It has a low elevation and suffered flooding all the way to 2nd Avenue during Super Storm Sandy in 2012. Based on EPA research, wetland plants and soils can act as natural buffers between the land and ocean, absorbing floodwaters and dissipating storm surges. CIVITAS hopes to find a way to take advantage of the multiple benefits to be enjoyed by advocating for a living shoreline in East Harlem - environmental restoration that creates a special physical environment for the community while also serving to protect the community from future storms. At a meeting in June 2014, Steve Zahn, the DEC Natural Resources Supervisor, indicated that the DEC is interested in hearing our arguments/suggestions for a living shoreline and described the regulatory process as a "dance." These perspectives convinced CIVITAS that our next step would be to partner with an academic institution with the goal of designing and conducting a study to predict ecological uplift and obtain DEC's support and approval. This led to the next step, forming a partnership with Urban Assembly New York Harbor School and New York Harbor Foundation to design and conduct the experiment.

In conclusion, an academic collaboration will provide the opportunity to validate why an ecological renewal of the shoreline will constitute an appropriate solution for rebuilding this section of the Esplanade. If experimental results predict pertinent ecological uplift, the end result would enable restoration and construction of a more resilient edge. This enhanced waterfront would provide the community with access to the water for the joint purposes of recreation and enjoyment of its marine ecology. A living shoreline will encompass the CIVITAS short, medium and long term goals for this node, and provide evidence that precious habitats come in many forms and can be the reason for implementing significant change to the current Esplanade configuration. It should also be noted that in the two meetings held with the New York State Department of Environmental Conservation up to this point, they have shared the fact that there is currently no data about the health of the marine habitat available for this site at this time, and that they are hoping that this collaborative effort will provide the missing data.

**Citizen Science QAPP Template #6**

# Project Location

(Provide a description of the site and sampling locations and how they were chosen. Provide the rationale for selecting sample locations. Provide a map showing the location and any other relevant information for the project. Tie this information back to the goals and objectives of the project.)

The three sampling location sites for the experiment are located between 103rd and 116th Streets along the East Harlem Esplanade bulkhead structure bordering the Harlem River (Figure 4). They were chosen based on characteristics of bulkhead construction type and related existing spatial complexity. It is necessary to differentiate between bulkhead construct types to determine whether that variable influences the baseline analysis or any other experimental results. Site #3 (40°47.210192'N, 73°56.301825'W) is located at approximately 103rd street along gravity wall constructed bulkhead just north of where the Harlem River opens up into Rheinlander Bay and the current speed picks up with changing water flow dynamics. Moving further north, Site #2 (40°47.490298'N, 73°56.109390'W) is located at the periphery of the 111th Street Pier; a small, closed off, dilapidated pier built off of low-level relieving platform bulkhead construction. This site offers a habitat bulkhead construction that differs from Site #3 further south, in addition to encompassing the added variable of spatial complexity contributed by a pier that has been left vulnerable to the forces of nature for many years. Site #1 (40°47.641665'N, 73°55.863572'W) is situated slightly further north between 115th to 116th Streets and is also along low-level relieving platform bulkhead construction, but without the added spatial complexity. It should be noted that the location of this waterfront edge was chosen for the experiment and potential implementation of a living shoreline because of the low elevation of the contiguous upland and the water's shallow bathymetry. The latter characteristic makes it more efficient to fill in the water to construct an ecological edge, and the former characteristic makes it a perfect location to implement a living shoreline for its value as a severe storm buffer for the upland and as an overall strategy/measure for increasing storm resiliency. As a control site, the Governors Island Oyster Reef (40.687285N, -74.013990'W) will be monitored.

These sites were chosen because they are representative of a variety of conditions that exist along the East Harlem waterfront and as proposed sites for restoration efforts (*e.g.* oyster bed and sea grass restoration).


*Figure 4. Study Site from 96th street to 120th street, Manhattan, New York City. Stars represent the 3 study sites.*

**Citizen Science QAPP Template #7**

# Project Schedule

(In the table below, list all major project activities that will be performed during the course of the project. Provide estimates of the timeframe expected for the activities to be conducted and/or completed.)

*Table 5. Project Schedule.*

| Activities | Organization/Group responsible for activity completion | Timeframe of Work |
|---|---|---|
| Preparation of QAPP | **Mauricio Gonzalez**<br>**Melanie Smith**<br>**Maura Smotrich**<br>**Zain Bin-Khlaid** | May 2015 – August 2015 |
| Project Oversight | **Maura Smotrich**<br>CIVITAS Project Officer | May 2015 - August 2018 |
| Approval of QAPP | **Kate Boicourt**<br>Hudson River Foundation Quality Assurance Officer<br>**Susan Maresca**<br>Region 2 DEC<br>**James T.B. Tripp**<br>Environmental Defense Fund | August 2015 |
| Training | **Mauricio Gonzalez**<br>**Operations Managers**<br>**Project Manager**<br>**Student Volunteers** | September – October + December – January 2015, 2016, 2017, 2018 |
| Procurement of Equipment | **Matthew Haiken**<br>NY Harbor Foundation | September - October 2015 |
| Trial Sample Collections and Training | **Field and Lab Team Captains, Volunteers, and Interns**<br>New York Harbor School, CIVITAS | May 2, 2015, May 16, 2015, July 25, August 2015 |
| Sample Collection | **Field and Lab Team Captains, Volunteers, and Interns**<br>New York Harbor School, CIVITAS | October 2015 – June 2018 |
| Sample Analysis | **Student Volunteers and interns** | October 2015 – June 2018 |

| | | |
|---|---|---|
| Blog Updates | **Project and Operation Managers** | Monthly from start to finish of Project |
| Press Releases | **Maura Smotrich**<br>**Emma Marconi Bologna** | On as needed basis |
| Data Entry on Public Site | **Data Managers** | Within **two (02) weeks** of data acquisition |
| Data Evaluation | **Project Manager**<br>**Project Advisor**<br>**Quality Assurance Officers** | October – November 2015, 2016, and 2017 |
| Data Clean-up | **Project Manager Data Managers** | October – November 2015, 2016, and 2017 |
| Data Analysis | **Project Manager Data Managers** | November 2015, 2016, 2017 |
| Annual Report 01 | **Project Manager with help from: Operations and Data Managers** | December 2015 |
| Annual Report 02 | **Project Manager with help from: Operations and Data Managers** | December 2016 |
| Annual Report 03 | **Project Manager with help from: Operations and Data Managers** | December 2017 |
| Finalization of Report | **Mauricio Gonzalez**<br>**Maura Smotrich** | June 2018 |

**Citizen Science QAPP Template #8**

# Existing Data

(For many projects it may be necessary to use data that someone else has already collected, (i.e. existing data). Just because data was collected by a reliable source, such as a peer reviewed journal article, doesn't mean it was collected in a way that your project could use. It is important to perform a check on the data to see how the data was collected and if it is acceptable for the objectives of your project. You must complete this template if your project will be using existing data.

Identify all existing data that will be used for the project, and their originating sources. Specify how the existing data will be used, and the limitations on their use.

- In the **Existing Data** section state what existing data you will use.
- In the **Data Source** section state where that data will come from.
- In the **How Data Will Be Used** section state the need for this data and/or what purpose it will be used for.
- In the **Acceptance Criteria** section state what the requirements are for the data in order for them to be used in the project. For example, if you are looking for temperature data for a water body collected in July, then temperature data collected in June would not be acceptable for the project. Data collected with a certain instrument or by a certain method are also instances where the collected data may not be acceptable for the project.)

*Table 6. Existing Data.*

| Existing Data | Data Source | How Data Will Be Used | Acceptance Criteria |
|---|---|---|---|
| Regional Precipitation (Rain) | National Weather Service - Central Park Station | To determine if there's a relationship between water quality levels and precipitation | 1. Precipitation data has to be collected from a properly calibrated rain gauge<br>2. Precipitation data was collected from within 2 km of stations<br>3. Sensitivity of the precipitation data is at least 0.01 inches |

| | | | |
|---|---|---|---|
| Air Ambient Temperature | National Weather Service - Central Park Station | To determine if there's a relationship between air and water temperature at the sites | 1. Air temperature data has to be collected from a properly calibrated thermometer<br>2. Temperature data was collected from within 2 km of stations<br>3. Sensitivity of the temperature data is at least 1.0 °F |
| Wind Direction | National Weather Service - Central Park Station | To determine if there's a relationship between wind direction and current direction | 1. Wind direction data has to be collected from a properly calibrated wind vane<br>2. Wind data was collected from within 2 km of the stations<br>3. Sensitivity of the wind direction data is at least 8 coordinate directions (N, S, E, W, NW, NE, SE, SW) |

**Citizen Science QAPP Template #9**

# Quality Objectives

(Use this template to develop the data quality objectives (DQOs) that define the type, quantity and quality of data needed to answer specific environmental questions, and support proper environmental decisions. The examples provided below are neither inclusive nor appropriate for all projects. Fill in all information appropriate for the project. Complete this template for field, existing data and laboratory activities, if your project includes these components.)

## *Precision*

(Precision is defined as the ability of a measurement to consistently be reproduced. Repeated measurements are usually used to determine precision. In the case of repeated measurements, one would see how close those measurements agree. If repeat measurements will be taken state how close those measurements need to agree by.)

Field + Lab - Duplicate samples of all physical and chemical samples will be taken in the field at all four sampling stations during each sampling event. A subset of parameters will be measured *in situ* and another subset that can't be measured *in situ* will be taken to the lab for processing. Biological samples (*i.e.* enterococcus) will not be duplicated due to the less than favorable trade-off between reproducibility and cost effectiveness of this method. The water quality and biodiversity measurements must agree within the precision intervals found in Table 7.

*Table 7. Water Quality and Biodiversity Measurement Precision Intervals.*

| PARAMETER | PRECISION | PARAMETER | PRECISION |
|---|---|---|---|
| Salinity (YSI Pro Plus, 600 OMS) | ± 0.1 ppt | Salinity (Refractometer) | ± 1.0 ppt |
| Temperature (YSI Pro Plus, 600 OMS, Hanna Combo) | ± 0.1 °C | Temperature (Thermometer) | ± 1.0 °C |
| Dissolved Oxygen (YSI Pro Plus, 600 OMS) | ± 0.5 ppm | Dissolved Oxygen (Mod. Winkler) | ± 1.0 ppm |
| pH (YSI Pro Plus, Hanna Combo) | ± 0.1 units | pH (Test strips) | ± 0.6 units |
| Ammonia (YSI 9500) | ± 0.25 ppm | Ammonia (Test strips) | ± 0.5 ppm |
| Phosphate (YSI 9500) | ± 0.25 ppm | Phosphate (Test strips) | ± 1.0 ppm |
| Nitrate (YSI 9500) | ± 0.25 ppm | Nitrate (Test strips) | ± 1.0 ppm |
| Nitrite (YSI 9500) | ± 0.25 ppm | Nitrite (Test strips) | ± 1.0 ppm |
| Silicates (YSI 9500) | ± 0.25 ppm | Silicates (Test strips) | ± 1.0 ppm |

| | | | |
|---|---|---|---|
| Chlorophyll-a (YSI 6920) | ± 0.25 μg/L | Secchi Depth (Secchi Disc) | ± 5 cm |
| Plankton Biodiversity | ± 10% Hill N1 | Benthos Biodiversity | ± 10% Hill N1 |
| Plankton Group Average Counts | ± 10% | Benthos Group Average Counts | ± 10% |
| Photoquadrant Biodiversity | ± 10% Hill N1 | Settling Plate Biodiversity | ± 10% Hill N1 |
| Sedimentation Rate (mm/day) | ± 2 mm/day | Genetic Barcoding | Highest Bit Score |
| | | | |
| | | | |

## *Bias*

(Bias is defined as any influence in the project that might sway or skew the data in a particular direction. Taking samples from one location where a problem is known to exist, instead of taking samples evenly distributed over a wide area, is one example of how data can be biased. State any biases that could potentially exist and how they will be addressed in the project.)

Field – Although the stations being sampled are located in high energy localities which mix water well, we are sampling by the edge of the seawalls at 1 m from the surface. Therefore, our data may be biased towards those waters close to the seawall edge and no deeper than 10 – 20 feet. Given that oyster reefs and eel grass beds are typically located within these characteristics due to light penetration and sedimentation, this type of sampling design is probably sufficient.

Lab – Blanks for the IDEXX method will be used to ensure that enterococcus samples are not contaminated. Positive MPN readings in the blanks will consider the other samples void. pH standards of 7.01 and 11.01 will be used to calibrate and verify pH meter readings. Discrepancies of more than 0.2 units will void the results.

Existing Data – Weather data may be biased because weather conditions vary between protected terrestrial areas and the coast or between open spaces and spaces suffering from the city canyon effect. Due to budget constraints we will be unable to install weather stations closer to the sampling stations. However, ambient air temperature and wind direction will be verified *in situ* and compared with the National Weather Service data. Temperature will be verified using the same calibrated thermometers that will be used for water temperature and wind direction will be verified with local observations of waving flags or wind cones.

## *Representativeness*

(Representativeness is how well the collected data depicts the true system. Describe how the collected data will accurately represent the population, place, time and/or situation of interest.)

There are no combined sewage outflows (CSOs) on Governors Island. Therefore, the samples taken from around GI will be representative of HRE water all around the littoral of the Island. Samples taken from the Battery Park and Pier 15 will be representative of the littoral of Manhattan that are subject to the influence of CSOs. Although efforts will be taken to minimize sampling next to CSOs, it will be difficult to avoid higher concentrations of pollutants from the Manhattan stations. Because the HRE waters in the sampling stations are high energy waters with a lot of boat traffic, we assume that the samples taken at a depth of 1m and by the seawall are representative of waters to a depth of 2 – 3 meters (Suthers & Rissik, 2009).

## *Comparability*

(Comparability is defined as the extent to which data from one data set can be compared directly to another data set. The data sets should have enough common ground, equivalence or similarity to permit a meaningful analysis. State if the data is intended to be compared to other data sets and how this will be achieved.)

Field/Lab – As far as we can tell, the only data we are collecting that will be comparable to other studies will be our dissolved oxygen data (*i.e.* both from the modified Winkler Method and the YSI Pro Plus), salinity (*i.e.* both from the refractometer and YSI) as these are approved standard methods for the examination of water and waste water and by the EPA. On year two (02) our collection of pH and temperature with the YSI ProPlus will be comparable with other studies.

Existing Data – National Weather Service data is comparable nation-wide.

## *Completeness*

(Completeness is the amount of data that must be collected in order to achieve the goals and objectives stated for the project. State how much data will need to be collected in order for the project to be considered successful. This can be stated as a total number of samples or a percentage of data collected.)

*Table 8. PHASE 01 Project Sample Completeness.*

| PHASE 01 Parameters | No. Valid Samples Events Anticipated | No. total Samples Anticipated |
|---|---|---|
| Salinity | **14 – 24** | **112-192** |
| Temperature | **14 – 24** | **112-192** |

| | | |
|---|---|---|
| Dissolved Oxygen | **14 – 24** | **112-192** |
| pH | **14 – 24** | **112-192** |
| Ammonia | **14 – 24** | **112-192** |
| Phosphate | **14 – 24** | **112-192** |
| Nitrate | **14 – 24** | **112-192** |
| Nitrite | **14 – 24** | **112-192** |
| Silicate | **14 – 24** | **112-192** |
| Secchi Depth | **14 – 24** | **112-192** |
| Plankton | **14 – 24** | **112-192** |
| Benthos | **14 – 24** | **112-192** |
| Photoquadrants | **14 – 24** | **112-192** |
| Chlorophyll-a | **14 – 24** | **112-192** |

For PHASE 01, a minimum of 14 and a maximum of 24 samples events will occur, one every month for two years (Table 8). There are 4 sampling sites and each sample will be replicated at least once. This brings the total number of samples to be collected to between 112 and 192 for each physical-chemical parameter. Sampling may be limited by the winter months. All samples will be duplicated throughout the duration of the sampling phase. A collection and processing of a minimum of 112 samples will be considered a successful project. Sampling cancelled due to winter weather will not be rescheduled. All other types of cancellations will be rescheduled.

*Table 9. PHASE 02 Project Sample Completeness.*

| **PHASE 02 Parameters** | **No. Valid Samples Events Anticipated** | **No. total Samples Anticipated** |
|---|---|---|
| "Columbia" Colonizing Units | **4** | **16** |
| Econcrete© Sampling Units | **4** | **16** |
| | | |

For PHASE 02, a minimum of 4 sampling events will be run. There are 4 sample units per site and four sites. That makes a total of 1 samples collected in total over the two years (Table 9). Sampling may be limited by the winter months. A collection and processing of a minimum of 80% of samples will be considered a successful project. Sampling cancelled due to winter weather will not be rescheduled. All other types of cancellations will be rescheduled.

## *Sensitivity*

(Sensitivity is essentially the lowest detection limit of a method, instrument or process for each of the measurement parameters of interest. State the sensitivity needed for the instruments, methods or processes used for the project in order to obtain meaningful data.)

*Table 10. Instrument Sensitivity.*

| PARAMETER | MEASUREMENT RANGE | INSTRUMENT SENSITIVITY |
|---|---|---|
| pH (Hanna Combo Sensor) | 0-14 | 0.01 |
| Temperature (Hanna Combo Sensor) | ??? | 0.01 C |
| Salinity ppt (YSI Pro Plus) | 0 – 70 | 0.01 ppt |
| Temperature C (YSI Pro Plus) | -5 – 70 | 0.1°C |
| Dissolved Oxygen ppm (YSI Pro Plus) | 0 – 50 | 0.1 or 0.01 mg/L (user selectable); 0.1% air saturation |
| pH units (YSI Pro Plus) | 0 – 14 | 0.01 units |
| Ammonia ppm (YSI 9500) | 0 – 1.0 | 0.001 AU |
| Phosphate ppm (YSI 9500) | LR 0 – 4.0 HR 0 – 100 | 0.001 AU |
| Nitrate ppm (YSI 9500) | 0 – 20 | 0.001 AU |
| Chlorophyll-a (YSI 6920) | ~ 0 – 400 µg/L | 0.1 µg/L |
| Temperature C (Thermometer) | -40 – 70 | N/A |
| Dissolved Oxygen ppm (Mod. Winkler) | 0 – 10 | 0.2 ppm |
| Salinity ppt (Refractometer) | 0 – 100 | 1.0 ppt |
| pH units (Test strips) | 0 – 14 | N/A |
| Ammonia ppm | 0 – 6 | N/A |

| | | |
|---|---|---|
| (Test strips) | | |
| Phosphate ppm (Test strips) | 0 – 50 | N/A |
| Nitrate ppm (Test strips) | 0 – 200 | N/A |
| Secchi Depth (cm) | various | 0.5 m |

Existing data- The precipitation data has a sensitivity of 0.01in. Air data has a sensitivity of 1.0°F. The sensitivity of the wind direction is not available.

**Citizen Science QAPP Template #10A**

# Data Collection Methods

## *Sampling Design*

(For this section, describe and justify the data collection activities. Include location specific information, such as GPS coordinates or landmarks, for the data collection locations. Provide information about the frequency of sampling and the collection of quality control samples. Include information about your plans for sample identification and transportation.)

Three experimental sites are located between 103rd and 116th streets along the East Harlem Esplanade bulkhead structure bordering the Harlem River. One control site is located on Pier 101 on Governors Island, NYC. The three experimental sites were chosen based on characteristics of bulkhead construction type and related existing spatial complexity. It is necessary to differentiate between bulkhead construction types to determine whether they can influence marine community structure or other experimental results. Site #3 (40°47.210192'N, 73°56.301825'W) is located at approximately 103rd street along gravity wall constructed bulkhead just north of where the Harlem River opens up into Rheinlander Bay and the current speed picks up with changing water flow dynamics. Moving further north, Site #2 (40°47.490298'N, 73°56.109390'W) is located at the periphery of the 111th Street Pier; a small, closed off, dilapidated pier built off of low-level relieving platform bulkhead construction. This site offers a habitat bulkhead construction that differs from Site #3 further south, in addition to encompassing the added variable of spatial complexity contributed by a pier that has been left vulnerable to the forces of nature for many years. Site #1 (40°47.641665'N, 73°55.863572'W) is situated slightly further north between 115th to 116th Streets and is along similar low-level relieving platform bulkhead construction. It should be noted here that this waterfront edge was chosen for the potential implementation of a living shoreline because of the low elevation of the contiguous upland and the water's shallow bathymetry. The latter characteristic makes it more efficient to fill in the water to construct an ecological edge, and the former characteristic makes it a perfect location to implement a living shoreline for its value as an upland buffer from severe storms and as an overall strategy/measure for increasing storm resiliency. The control site at Governors Island will provide a comparison reference point for any local influences the Harlem/East River study site may experience.

The study will comprise two main phases over a three year period in the Harlem/East River: PHASE 01) the generation of a physical-chemical and biological baseline and PHASE 02) the experimentation with different construction and habitat enhancing structures to determine best practices for the rehabilitation of Harlem/East River ecosystem components. Specifically, during the baseline phase, physical-chemical (*i.e.* dissolved oxygen, temperature, salinity, pH, Secchi depth, sedimentation rates, ammonia, nitrites, nitrates, total phosphorus, silicates, and chlorophyll-a) and biological (*i.e.* planktonic and benthic organisms) water quality parameters will be monitored. These parameters are key in determining marine environmental health (Eleftheriou & McIntyre, 2005) (Suthers & Rissik, 2009) (Johnson & Allen, 2012). Additionally, existing seawall littoral biodiversity will be characterized through the use of photoquadrants on existing man-made structures. Genetic barcoding will be used as an aide for species identification of organisms or colonies larger than 1 cubic centimeter and cannot be identified through conventional methods. During the second phase, settling

plates of various construction materials will be deployed in "Columbia" Experimental Sampling Units to test for the best construction materials and configurations for ecological uplift of littoral and benthic components.

**PHASE 01** - There will be three sampling Tiers that will determine the techniques used to sample the ecosystem components mentioned above for this PHASE and that depend on the resources generated to support the present study:

Tier (I) Techniques – pH and temperature will be determined using a calibrated Hanna Combo Sensor and verified using Aquacheck colorimetric test strips and a calibrated pocket thermometer; dissolved oxygen will be determined using the Lamotte Azide modified Winkler Method; salinity will be measured using a calibrated refractometer by Vital Sine; and nutrients will be determined using Aquacheck colorimetric test strips; Secchi depth will be determined with a Secchi disc; benthic sampling will be conducted with an Eckman grab and run through a 500 micrometer standard copper circular sieve; plankton biomass and populations totals will be measured using an 80µm filtration net vertical tow (depth 3m) and microscopy techniques following Suthers and Rissik (2009); preserved and chilled benthic and plankton samples will be brought to and processed in the lab using digital micro- and stereoscopes; physical-chemical samples will be taken at a depth of 2m below sea level; photoquadrants will be taken using a 1x1 meter quadrat subdivided one hundred times and a GoPro camera.

Tier (II) Techniques – pH, temperature, dissolved oxygen, and salinity will be measured with a YSI ProPlus handheld water meter; the YSI ProPlus handheld will allow for sampling the above physical-chemical parameters at multiple depths which is critical for relating the abiotic with the biotic data; horizontal plankton tows will be collected where possible following Suthers and Rissik (2009); all other components will be measured using Tier (I) techniques.

Tier (III) Techniques – Dissolved oxygen, temperature, and salinity will be continuously measured with a YSI 600 OMS at each site of the three sites at maximum depth for a period of at least a one year; nutrients will be measured with a YSI 9500 photometer; chlorophyll-a will be measured with a YSI 6920 multi-parameter sonde; benthic sampling will be conducted using a VanVeen grab; plankton will be sampled with a neuston net and manta; benthic and plankton samples will be fixed with alcohol; fish populations will be monitored with a DIDSON sonar; all other components will be measured using either Tier (I) or Tier (II) techniques.

A subset of parameters will be measured *in situ* and another subset that we can't measure *in situ* will be taken to the lab for processing.

Between 14 and 24 samples will be collected in total, one every month for two years depending on weather conditions (winter months between December and April are typically difficult to sample).

pH standards of 7.01 and 11.01 will be used to calibrate and verify pH meter readings. Discrepancies of more than 0.2 units will void the results.

A Beta bottle will be used in the field to collect the water sample at a depth of 1m below the water's surface. The first sample will be discarded to wash out the vessel. The second sample will then be emptied into three graduated (50ml) polypropylene (PP) vials. These vials will have been previously marked with a unique code. Immediately after sample retrieval, the vials will be placed in a 28 Qt. Igloo cooler with four Rubbermaid ice packs measuring 7"x6"x2". A sample of water will be taken directly from the beta bottle for the Winkler Method by allowing the sample to overflow for at least 2

seconds over the glass sampling container. For Tier (II) YSI instruments, the probe will be lowered into the water at 0.5m intervals below the surface until the bottom is hit or the cable runs out.

YSI 600 OMS will be enclosed in a 20' long 4" PVC pipe and tagged. The data will be retrieved on a monthly basis by connecting the vendor supplied cable to an RS232 port on a lap top and using YSI Ecowatch software. A copper mesh will be applied around the probe section to avoid bio-fouling. Any fouling that does occur will be removed on a semester basis.

The samples will travel by the team leaders and the Project Manager to Governors Island where they will be processed for nutrients. Used vials will be disposed of. Volunteers will consist of NY Harbor School students, NYHS teachers, CIVITS Staff, NY Harbor Foundation Staff, and other adult volunteers.

*Table 11. Sampling Parameters/Techniques Employed by Tiers Depending on Level of Resources Available.*

| Parameter/Technique | Tier I | Tier II | Tier III |
|---|---|---|---|
| Manual physical chemistry (pH, Temp., DO, Sal) | X | | |
| Test strips for nutrients (nitrites, nitrates, phosphates, ammonia) | X | X | |
| Secchi depth | X | X | X |
| Benthic with Eckman grab for type totals | X | X | |
| Vertical plankton tow for biomass & type totals | X | X | |
| Photoquadrants for Intertidal percent cover and Hill biodiversity | X | X | X |
| YSI Proplus physical chemistry (pH, temp., DO, sal.) | X | X | |
| Horizontal plankton tow | | X | |
| YSI 600 OMS physical chemistry (DO, temp., sal.) or YSI 6920 (DO, temp., sal., chlorophyll-a) | | | X |
| YSI 9500 photometer nutrients (Silica, nitrites, nitrates, phosphates, ammonia) | | X | X |
| Benthic Grab with Vanveen for type totals | | | X |
| Neuston tow for plastic vs. plankton biomass ratio | | | X |
| DIDSON fish population quantification | | | X |

**Phase 02** – "Columbia" Colonization Devices (Reid, et al., 2015) (Figure 5) will be used for determining colonization potential on various construction materials built into settling plates (*e.g.* Portland cement, porcelain tiles, oyster shells, rock, *etc.*). The settling plates will be modified to be larger than the original set up in Reid *et. al.* in order to try and avoid edge effects and distortions caused by over growth of dominant quick-colonizing species. The Devices will test for Ecological uplift as a function of biodiversity (Hill Numbers) and percent cover of sessile invertebrates and algae. Ecological uplift will further be tested by the total number and identification of sessile and motile organisms counted and identified in the middle chamber that will house oyster shell and rock of the same origin as the rip rap used throughout edge water reconstruction. This is also a modification of the original Reid *et.al.* design. In the top compartment, instead of bricks, a ceramic pot filled with local sediment (and sand brought in from Brooklyn Piers Park) and planted with eel grass. Blade length average and new shoots will be monitored. Clear PVC sedimentation cylinders will be attached to the Devices to measure sedimentation rates. A light/temperature data logger will be deployed at the top of the Site 02 Device.

Four "Columbia" Colonization Devices will be deployed at each of the three experimental sites and at the control site on Governors Island for a total of twelve Devices. Devices will be deployed to be at 1.0m below Neap Tide. One device from each site will be sampled semi-annually (April 2016, 2017 & October 2016, 2017) for a total of four Devices per sampling event. This will allow for two years' worth of succession and colonization data. A temperature and light data logger will be maintained during every PHASE 01 sampling event for associated growth.

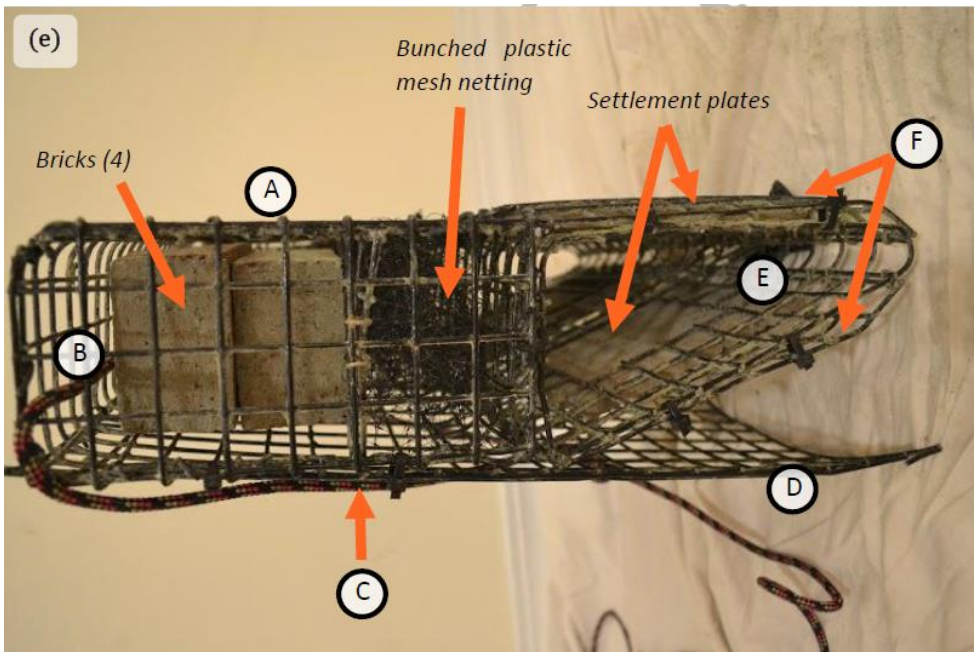


*Figure 5. "Columbia" Colonizing Device.*

## *Sampling Design Matrix*

(Complete all required information in the table below, using additional rows/columns, if necessary. Only a short reference back to the project objective is necessary in the table.

- In the **Matrix** section, state what kind of matrix (air, water, soil, animal/organism) is being sampled during the project.
- In the **# of Sampling Location(s)** section, provide the number of sampling locations.
- In the **# of Samples per Location** section, state if multiple efforts will be made at one location, such as sampling at different depths or taking repeated measurements over a given amount of time (i.e. once/quarter).
- In the **Parameter** section, state what substance will be measured/sampled.
- In the **Field QC Samples** section, state how many and what type of quality control samples will be collected.
- In the **Total Number of Samples** section, state the total number of samples that will be collected for each sampling event or total project including field QC samples.
- In the **Sampling SOP Reference** section, state what specific methods will be used for the sample/monitoring data collection. Attach any SOPs as necessary.
- In the **Project Objective for Sampling and Analysis or Monitoring** section, state why the data will be collected at the particular location, frequency and time.)

*Table 12. Sampling Design Matrix.*

| Matrix | # of Sampling Locations | # of Samples per Location | Parameter | Field QC Samples | Total Number of Samples/ Measurements | Sampling SOP Reference | Project Objective for Sampling and Analysis or Monitoring |
|---|---|---|---|---|---|---|---|
| Water | 4 | 2 | Salinity (Refractometer, YSI Pro Plus) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4 | 2 | Temperature (Calibrated Thermometer, Hanna Combo Meter) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | Atlantic oyster reefs and eel grass beds. |
| | | | Temperature (Onset) | | | | |
| Water | 4?????? | 2 | Temperature (YSI ProPlus) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4 | 2 | Dissolved Oxygen (Winkler Method) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4????????/ | 2 | Dissolved Oxygen (YSI ProPlus) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4???????????? | 2 | Dissolved Oxygen (YSI 600 OMS) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4 | 2 | pH (Aquacheck Test Strips, Hanna Combo Meter) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Water | 4???????? | 2 | pH (YSI Pro Plus) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| Water | 4 | 2 | Ammonia, Nitrite, Nitrate, Phosphorus, Silicates (Aquacheck Test Strips, YSI 9500) | 1 | 8 per sampling event | See attached SOP | Collect water quality parameters at four stations off of Governors Island and Lower Manhattan to determine their suitability to sustain Atlantic oyster reefs and eel grass beds. |
| | | | Secchi Depth | | | | |
| | | | Sedimentation Rate | | | | |
| | | | Light (Onset) | | | | |
| | | | | | | | |
| | | | | | | | |

## *Project Limitations*

I) Water Quality –

01) Unless we can use the Tier II or III equipment, it'll be difficult to get data at every 0.5 meters of depth which is standard for water quality monitoring schemes.

02) If permanent sondes are deployed they may run the risk of being vandalized or stolen. Make sure to build enclosures that can be pad locked.

II) Plankton –

01) There will be no pristine controls with which to compare our results to discern anthropogenic impacts just local impacts.

02) Plankton nets may not be heavy enough to withstand the current for vertical sampling. Try adding extra SCUBA lead weights to increase mass.

III) Benthos –

01) Unless we use the Tier III equipment we cannot compare our results with previous benthic studies in the region.
02) Eckman grabs may not be heavy enough to withstand the current for sampling. Try adding extra SCUBA lead weights to increase mass.

IV) "Columbia" Colonizing Devices

01) Tampering with devices by the public may be an issue.

V) Boats –

01) Availability of New York Harbor School boats is uncertain.

**Citizen Science QAPP Template #10B**

# Equipment List and Instrument Calibration

## *Equipment List*

(Generate a list of all field equipment that will be used for the project.)

*Table 13. Equipment List*

| *Item* | *Tier* | *Catalog Co.* | *Cat. #/ISBN* | *Price* | *Qty.* | *Total amt.* |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Consumables** | | | | | | |
| Dissolved oxygen test kit | 1 | http://www.aquaticeco.com/subcategories/523/LaMotte-Test-Kits-Dissolved-Oxygen | LM7414 | 45.95 | 6 | 275.70 |
| Ethyl alcohol (95%) Case of 6 | 1 | http://www.fishersci.com/ecomm/servlet/fsproductdetail?storeId=10652&productId=6662334&catalogId=29104&matchedCatNo=S73985&endecaSearchQuery=%23store%3DScientific%23N%3D0%23rpp%3D15&fromSearch=1&searchKey=AJS73985&highlightProductsItemsFlag=Y | S93231 | 53.40 | 1 | 53.40 |
| Lugol's solution (1L – lab grade) | 1 | http://www.carolina.com/specialty-chemicals-d-l/lugol-solution-laboratory-grade-1-l/872797.pr?question=lugol%27s+solution | 872797 | 23.50 | 5 | 117.50 |
| Nitrile gloves (small) – dozen reuseable. | 1 | http://www.aquaticeco.com/subcategories/2953/Gloves-Thick-Nitrile | Crg1 | 39.43 | 2 | 80.00 |
| Nitrile gloves (medium) – dozen reuseable. | 1 | http://www.aquaticeco.com/subcategories/2953/Gloves-Thick-Nitrile | Crg2 | 33.28 | 2 | 67.00 |
| Nitrile gloves (large) – dozen reuseable. | 1 | http://www.aquaticeco.com/subcategories/2953/Gloves-Thick-Nitrile | Crg3 | 33.85 | 2 | 68.00 |
| Nitrile Gloves – Large disposeable | 1 | http://www.aquaticeco.com/subcategories/4764/Gloves-Nitrile | GL702 | 15.76 | 4 | 63.04 |
| Nitrile Gloves – medium disposeable | 1 | http://www.aquaticeco.com/subcategories/4764/Gloves-Nitrile | Gl701 | 15.76 | 4 | 63.04 |
| Nitrile Gloves – X-Large disposeable | 1 | http://www.aquaticeco.com/subcategories/4764/Gloves-Nitrile | GL703 | 15.76 | 4 | 63.04 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rubber gloves | 1 | http://www.aquaticeco.com/subcategories/2451/Gloves-Rubber | GL502 | 13.67 | 5 | 68.35 |
| Multi-test strips for pH, Alkalinity, nitrites, and nitrates | 1 | http://www.aquaticeco.com/subcategories/502/AquaChek-Pond-Test-Strips | 11252 | 15.65 | 10 | 156.50 |
| Ammonia test strips | 1 | http://www.aquaticeco.com/subcategories/502/AquaChek-Pond-Test-Strips | 11253 | 13.68 | 10 | 136.80 |
| Phosphate test strips | 1 | http://www.aquaticeco.com/subcategories/1822/Hach-Water-Quality-Test-Strips | H27571 | 19.09 | 10 | 190.90 |
| Silica Palintest Reagents LR & HR (YSI 9500) | 1 | https://www.ysi.com/Accessory/id-YPM290/Silica-HR-Reagent-Starter-Kit | YPM290 | 68.00 | 1 | 68.00 |
| YSI 9500 Photometer reagents (ammonia, nitrite, nitrate, phosphorus, Silicates | 0 | https://www.ysi.com/Accessory/id-YPM290/ | | | Var | 300.00 |
| Transfer pipettes (500pk, 5 ml) | 1 | https://www.fishersci.com/ecomm/servlet/itemdetail?catalogId=29104&productId=2701152&distype=0&highlightProductsItemsFlag=Y&fromSearch=1&storeId=10652&langId=-1 | LP5 | 54.46 | 1 | 54.46 |
| Lab Wipes | 1 | http://www.aquaticeco.com/subcategories/4233/Lab-Wipes | KW242 | 6.46 | 5 | 32.30 |
| Pipette tips 2 – 10 mL | 3 | http://www.coleparmer.com/catalog/product_view.asp?sku=2501062&pfx=LM | LM – 25010 - 62 | 25.25 | 2 | 50.50 |
| pH calibration solution pellets: PH4, PH7, PH10 | 1 | http://www.aquaticeco.com/subcategories/544/pH-Calibration-Capsules | PH4, PH7, PH10 | 6.92 | 3 | 20.76 |
| Probe cleaning solution | 1 | http://www.aquaticeco.com/subcategories/1863/Electrode-Care-Accessories | CS | 7.73 | 1 | 7.73 |
| Probe storage solution | 1 | http://www.aquaticeco.com/subcategories/4807/Electrode-Care-Accessories | SS | 11.86 | 1 | 11.86 |
| Petri Dishes (100x20mm) 12pk | 1 | http://www.carolina.com/lab-dishes/corning-petri-dishes-100-20-mm-pack-12/721135.pr?question=petri+glas | 721135 | 60.70 | 2 | 121.40 |
| Ziploc bags (Quart) 54pk | 1 | http://www.amazon.com/dp/B003GVGZTU/ref=sr_ph?ie=UTF8&qid=1449864639&sr=1&keywords=ziploc+bags | Amazon.com | 7.79 | 5 | 38.95 |
| Glass sample bottles for plankton (Pyrex 250mL) | 1 | http://www.carolina.com/lab-bottles/pyrex-bottle-square-glass-250-ml/716221.pr?question=pyrex+250ml+glass+orange | 716221 | 13.65 | 20 | 273.00 |
| Sampling bottles 1000mL | 1 | http://pentairaes.com/sample-bottles.html | LSB1 | 5.18 | 25 | 129.50 |
| Sampling bottles 250mL | 1 | http://pentairaes.com/sample-bottles.html | LSB250 | 2.52 | 25 | 63.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sampling vials | 1 | http://www.coleparmer.com/Product/50_mL_PP_vial_with_graduations_500_pack/EW-06120-68?SearchTerm=EW-06120-68 | EW-06120-68 | 195.00 | 1 | 195.00 |
| Hole Saws 4” | 3 | http://www.amazon.com/DEWALT-D180064-4-Inch-Standard-Bi-Metal/dp/B00005LEZR/ref=sr_1_1?ie=UTF8&qid=1449931797&sr=8-1&keywords=4+inch+hole+saw | Amazon.com | 14.76 | 2 | 29.52 |
| Plastic Shoe boxes case/20 | 1 | http://www.containerstore.com/shop?productId=10001753&N=&Ntt=shoe+boxes | 10007943 | 39.00 | 2 | 78.00 |
| AA Batteries (rechargeable) | 1 | http://www.amazon.com/Duracell-Rechargeable-Batteries-Count-Packaging/dp/B00007ISWA/ref=sr_1_8?s=hpc&ie=UTF8&qid=1449869462&sr=1-8&keywords=aa+rechargeable+batteries | Amazon.com | 12.78 | 3 | 38.34 |
| AA recharging station | 1 | http://www.amazon.com/Ni-MH-Ni-Cd-Rechargeable-Battery-Charger/dp/B00EB7812C/ref=pd_sim_121_1?ie=UTF8&dpID=41afgpXztDL&dpSrc=sims&preST=_AC_UL160_SR160%2C160_&refRID=1N89NQT4JMMSG69CX1DJ | Amazon.com | 9.99 | 1 | 9.99 |
| C Batteries (rechargeable) | 1 | http://www.amazon.com/Pack-5000mAh-Capacity-Rechargeable-Batteries/dp/B00ZA7PYE0/ref=sr_1_1?s=electronics&ie=UTF8&qid=1449869612&sr=1-1-spons&keywords=c+batteries&psc=1 | Amazon.com | 8.99 | 2 | 17.98 |
| C recharging station | 1 | http://www.amazon.com/Universal-Rechargeable-Batteries-Discharge-Functions/dp/B00IHT2AUE/ref=sr_1_2?s=electronics&ie=UTF8&qid=1449869612&sr=1-2-spons&keywords=c+batteries&psc=1 | Amazon.com | 21.99 | 1 | 21.99 |
| D Batteries (rechargeable) | 1 | http://www.amazon.com/FlePow-Rechargeable-Batteries-Pre-charged-Self-discharge/dp/B00N9Y2XIG/ref=sr_1_2?s=electronics&ie=UTF8&qid=1449869745&sr=1-2-spons&keywords=d+batteries&psc=1 | Amazon.com | 52.99 | 1 | 52.99 |
| 9V Batteries (rechargeable) with charger | 1 | http://www.amazon.com/Battery-Charger-Lithium-ion-Rechargeable-Batteries/dp/B00ER10DZ0/ref=sr_1_1?s=electronics&ie=UTF8&qid=1449869841&sr=1-1-spons&keywords=9v+batteries&psc=1 | Amazon.com | 18.99 | 1 | 18.99 |
| LR1130 AG10 Pack of 10 Batteries | 1 | http://www.amazon.com/gp/product/B000W75GAK?psc=1&redirect=true&ref_=oh_aui_detailpage_o08_s00 | Amazon.com | 5.89 | 2 | 5.89 |
| Fishing line heavy (30lb) for small quadrats | 1 | http://www.amazon.com/Stren-Monofilament-Fishing-400-Yard-30-Pound/dp/B00NWD4JNQ/ref=sr_1_14?s=hunting-fishing&ie=UTF8&qid=1449861499&sr=1-14&keywords=fishing+line | Amazon.com | 8.49 | 1 | 8.49 |
| Fishing line medium (15lb) for small quadrats | 1 | http://www.amazon.com/Stren-Monofilament-Fishing-400-Yard-30-Pound/dp/B00NWD4JNQ/ref=sr_1_14?s=hunting- | Amazon.com | 8.49 | 1 | 8.49 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | fishing&ie=UTF8&qid=1449861499&sr=1-14&keywords=fishing+line | | | | |
| Fishing line light (10lb) for small quadrats | 1 | http://www.amazon.com/Stren-Monofilament-Fishing-400-Yard-30-Pound/dp/B00NWD4JNQ/ref=sr_1_14?s=hunting-fishing&ie=UTF8&qid=1449861499&sr=1-14&keywords=fishing+line | Amazon.com | 8.49 | 1 | 8.49 |
| Wood glue for small quadrats | 1 | http://www.amazon.com/Franklin-International-1414-Titebond-3-Ultimate/dp/B0002YQ3KA/ref=sr_1_6?s=hi&ie=UTF8&qid=1449861652&sr=1-6&keywords=wood+glue | Amazon.com | 6.48 | 3 | 19.44 |
| Popsicle sticks for small quadrats (6”) | 1 | http://www.amazon.com/Chenille-Kraft-Natural-Sticks-3776-01/dp/B001GXD6BU/ref=sr_1_8?s=arts-crafts&ie=UTF8&qid=1449932262&sr=1-8&keywords=popsicle+sticks | Amazon.com | 9.34 | 1 | 9.34 |
| Erasable marker (Multi Pack) | 1 | http://www.amazon.com/Sanford-Corporation-Dry-Erase-Marker-Expo/dp/B0141M6LFK/ref=sr_1_20_sit?s=hpc&ie=UTF8&qid=1449951549&sr=1-20&keywords=Erasable+marker | Amazon.com | 53.12 | 1 | 53.12 |
| | | | | | | |
| | | | | | | |
| **Non-consumables** | | | | | | |
| Jars, Clear glass (125mL, case of 24) | 1 | http://www.aquaticeco.com/subcategories/2370/Clear-Glass-Jars | 13004C | 59.85 | 1 | 59.85 |
| Chemical Aprons | 1 | http://www.aquaticeco.com/subcategories/3301/Lab-Apron-Green-PVC | 05-157GR | 7.65 | 20 | 153.00 |
| Igloo Roller Cooler 28Qt | 0 | http://www.amazon.com/Igloo-Island-Breeze-Roller-Cooler/dp/B002SU97BI/ref=sr_1_11?ie=UTF8&qid=1310179899&sr=8-11 | Amazon.com | 29.88 | 5 | 149.00 |
| Ice packs 7"x6"x2" | 0 | http://www.amazon.com/Rubbermaid-Blue-Brand-Weekender-Pack/dp/B000VPBIZA/ref=sr_1_2?s=sporting-goods&ie=UTF8&qid=1310180124&sr=1-2 | Amazon.com | 6.68 | 20 | 134.00 |
| Pipette 1 – 10 mL | 3 | http://www.coleparmer.com/catalog/product_view.asp?sku=2501424&pfx=LM | LM – 25014 - 24 | 320.00 | 2 | 640.00 |
| Dive weights (3lbs) | 1 | http://www.amazon.com/Sea-Pearls-Uncoated-Weights-3Pounds/dp/B0034ZKGWA/ref=sr_1_3?ie=UTF8&qid=1449862267&sr=8-3&keywords=dive+weights | Amazon.com | 13.70 | 10 | 137.00 |
| Dropper bottles (12 pk, 30 ml) | 1 | http://www.aquaticeco.com/subcategories/2377/Narrow-Mouth-Dropper-Bottles | 17625 | 38.00 | 2 | 76.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Beta bottles w/ case, acrylic, for phytoplankton | 1 | http://www.wildco.com/search.php?mode=search&page=1 | 1920-G62 | 469.00 | 2 | 938.00 |
| Stainless Steel Utility Tray 13.5 x 9.75inches | 1 | http://www.coleparmer.com/Product/Stainless_steel_utility_tray_13_1_2_L_x_9_3_4_W/WU-07277-13 | WU-07277-13 | 62.00 | 4 | 248.00 |
| Vital Sine Refractometer | 1 | http://www.aquaticeco.com/subcategories/552/Vital-Sine-Salinity-Refractometer | SR6 | 130.32 | 6 | 790.00 |
| Pocket thermometer (plastic case) | 1 | http://www.aquaticeco.com/subcategories/572/Pocket-Thermometer | TH27 | 5.25 | 10 | 52.50 |
| Hanna Combo Sensor | 1 | http://pentairaes.com/combo-meter.html | HI98129 | 153.00 | 3 | 459.00 |
| DIDSON (weekly rental) | 3 | http://www.soundmetrics.com/Products/DIDSON-Sonars | | 2500.00 | 1 | 2,500.00 |
| VanVeen Grab | 3 | http://shop.sciencefirst.com/wildco/search?controller=search&orderby=position&orderway=desc&search_query=van+veen | 3-1775-A10 | 2,999.00 | 1 | 2,999.00 |
| VanVeen sieve box | 3 | http://www.amazon.com/All-Purpose-Wash-Frame-complet/dp/B0096DK2KA/ref=sr_1_2?s=industrial&ie=UTF8&qid=1449935808&sr=1-2&keywords=van+veen+grab | Amazon.com | 454.80 | 1 | 454.80 |
| Ekman Grab | 1 | http://shop.sciencefirst.com/wildco/standard-ekman-grab/5998-ekman-grab-kit-standard-6x6x6-includes-carry-case-ss.html | 3-196-B12 | 495.00 | 2 | 918.00 |
| Ekman Jaw Springs | 1 | http://shop.sciencefirst.com/wildco/standard-ekman-grab/5988-replacement-springs-for-standard-and-tall-ekman-grabs-pack-of-two-stainless-steel.html | 3-197-B15 | 35.00 | 2 | 70.00 |
| Ekman replacement cables | 1 | http://shop.sciencefirst.com/wildco/551-standard-ekman-grab | 3-196-F35 | 42.00 | 2 | 84.00 |
| Eckman weights | 1 | http://shop.sciencefirst.com/wildco/standard-ekman-grab/5990-extra-weights-for-standard-or-tall-ekman-pack-of-two-lead-3lbs-each.html | 3-196-F75 | 199.95 | 2 | 400.00 |
| Eckman messenger | 1 | http://shop.sciencefirst.com/wildco/messengers/6650-stainless-steel-split-messenger-pack-of-three-ss-11-ounce.html | 3-45-B12 | 139.00 | 1 | 139.00 |
| Sieves 355um | 1 | https://www.fishersci.com/shop/products/fisherbrand-u-s-standard-stainless-steel-test-sieves-12-in-dia-3-1-4-in-d/048841aq | 04-884-1AQ | 211.12 | 2 | 422.24 |
| Buckets | 1 | http://pentairaes.com/5-gallon-pail-1-doz.html | BK5 | 123.08 | 1 | 123.08 |
| Lab Stereoscopes (digital) | 0 | http://www.amscope.com/Articulating.html | SM-6TZ-FRL-9M | 1028.02 | 2 | 2056.04 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Portable digital stereoscopes (with SD) | 1 | http://www.amazon.com/Celestron-InfiniView-LCD-Digital-Microscope/dp/B00B4DBVKU/ref=sr_1_13?s=industrial&ie=UTF8&qid=1449936248&sr=1-13&keywords=digital+microscopes | Amazon.com | 189.99 | 5 | 949.95 |
| Gooseneck Illumnators (30W) | 1 | http://www.amscope.com/accessories/illuminator/30w-led-fiber-optic-dual-gooseneck-lights-microscope-illuminator.html | LED-30WY | 349.98 | 1 | 349.98 |
| Lab Microscopes (digital) | 1 | http://www.amscope.com/compound-microscopes/laboratory-compound-microscopes/40x-2500x-infinity-trinocular-compound-microscope-10mp-camera-for-windows-mac-os.html | T690C-10MA | 999.75 | 3 | 2999.25 |
| Micro SD cards (32Gb) | 1 | http://www.amazon.com/SanDisk-Memory-Adapter--SDSDQUAN-032G-G4A-Version/dp/B00M55C0NS/ref=sr_1_3?s=electronics&ie=UTF8&qid=1449938389&sr=1-3&keywords=micro+sd | Amazon.com | 16.99 | 5 | 84.95 |
| Zooplankton net (80um) | 1 | http://shop.sciencefirst.com/wildco/wisconsin-sampler/6435-wisconsin-sampler-includes-carry-case-nitex-80m.html | 3-40-A50 | 319.00 | 2 | 638.00 |
| Sedgewick-Rafter cell (glass with grid) | 1 | http://pentairaes.com/counting-cell-sedgewick-rafter.html | M414 | 247.00 | 1 | 247.00 |
| Sedgewick-Rafter cell (plastic with grid) | 1 | http://pentairaes.com/counting-cell-sedgewick-rafter.html | M415 | 55.00 | 6 | 330.00 |
| Bogorov Chamber (nondisposeable) 2pk | 1 | http://shop.sciencefirst.com/wildco/plankton-samplers-and-processing/6332-bogorov-modified-counting-chamber-pk-of-2-disposable-acrylic.html | 3-1810-B20 | 59.95 | 1 | 59.95 |
| Bogorov Chamber (disposeable) 2pk | 1 | http://shop.sciencefirst.com/wildco/plankton-samplers-and-processing/6333-bogorov-original-counting-chamber-pk-of-2-disposable-acrylic.html | 3-1810-B10 | 39.95 | 5 | 199.75 |
| Deluxe Dissecting kits | 1 | http://pentairaes.com/deluxe-dissecting-kit.html | 10GS | 20.95 | 10 | 209.95 |
| Clipboards | 1 | http://www.amazon.com/gp/product/B00U9RPAWM?keywords=clipboard&qid=1449863044&ref_=sr_1_2&s=office-products&sr=1-2 | Amazon.com | 4.45 | 10 | 44.50 |
| GoPro – camera & waterproof case | 1 | http://www.amazon.com/GoPro-CHDHA-301-HERO/dp/B00NIYNUXO/ref=lp_2529502011_1_1?srs=2529502011&ie=UTF8&qid=1449863682&sr=8-1 | Amazon.com | 129.99 | 1 | 129.99 |
| Gopro - extra batteries & charger | 1 | http://www.amazon.com/Wasabi-Power-Original-AHDBT-001-AHDBT-002/dp/B005NC8BF6/ref=pd_sim_421_63?ie=UTF8&dpID=51eZYNWoGPL&dpSrc=sims&preST=_AC_UL160_SR160%2C160_&refRID=0AM4B9RN0PKM87W1YFRP | Amazon.com | 19.99 | 1 | 19.99 |
| 4” PVC pipes (10’) | 3 | http://www.mcmaster.com/#48925k18/=107l2vx | 48925K18 | 40.92 | 6 | 245.52 |

| | | | | | | |
|---|---|---|---|---|---|---|
| PVC water mounting hardware | 3 | HomeDepot | | 200 | | 200 |
| Cordless Drill with 2 rechargeable batteries and charging cradle | 1 | http://www.homedepot.com/p/DEWALT-20-Volt-Max-Lithium-Ion-1-2-in-Cordless-Drill-Driver-Kit-DCD771C2/204279858 | 1000014677 | 99.00 | 1 | 99.00 |
| Depth Sonde | 1 | http://shop.sciencefirst.com/wildco/secchi-disks-and-accessories/6697-depth-sounder.html | 3-126-D15 | 239.00 | 1 | 239.00 |
| Garmin GPS | 1 | http://www.amazon.com/Garmin-GPSMAP-High-Sensitivity-GLONASS-Receiver/dp/B00HWL9BQ4/ref=sr_12?s=gps&ie=UTF8&qid=1449953467&sr=1-2&keywords=garmin+gps | Amazon.com | 279.99 | 1 | 279.99 |
| Secchi Discs | 1 | http://shop.sciencefirst.com/wildco/secchi-disks-and-accessories/6702-limnological-secchi-disk-acrylic-300mm.html | 3-58-B20 | 79.00 | 2 | 158.00 |
| Zooplankton Net (100um) | 2 | http://pentairaes.com/catalog/product/view/id/31373?green=EE3CB14F-F93B-5A36-A22F-BE7A7AE42D01 | PKN4 | 354.00 | 1 | 354.00 |
| Neuston net (335um) | 0 | http://oceaninstruments.com/products/net-systems/manta-net-system/ | | | | 2000.00 |
| Manta for Neuston | 0 | http://oceaninstruments.com/products/net-systems/manta-net-system/ | | | | 1000.00 |
| Manta Hardware | 0 | HomeDepot | | | | 100.00 |
| Flow meter | 0 | http://shop.sciencefirst.com/wildco/current-meters-wading-rods-and-accessories/6217-mechanical-flow-meter-6-digit-counter.html | 3-39-B10 | 499.95 | 1 | 499.95 |
| Manual Centrifuge/ test tubes | 1 | http://www.amazon.com/HETTICH-INSTRUMENTS-1011-Benchtop-Centrifuge/dp/B00BTMHSEO/ref=sr_1_1?s=industrial&ie=UTF8&qid=1449953921&sr=1-1&keywords=manual+centrifuge | Amazon.com | 186.84 | 1 | 186.84 |
| Digital Cameras | 1 | http://www.amazon.com/Canon-PowerShot-Digital-Wide-Angle-Optical/dp/B005OA265I/ref=sr_1_1?s=photo&ie=UTF8&qid=1449954116&sr=1-1&keywords=canon+powershot | Amazon.com | 84.00 | 3 | 252.00 |
| Panasonic Toughbook | 1 | http://www.ebay.com/itm/231097849903?_trksid=p2055119.m1438.l2649&ssPageName=STRK%3AMEBIDX%3AIT | E-Bay | 599.00 | 2 | 1198.00 |
| 25mL glass pipette | 1 | http://www.coleparmer.com/Product/KIMAX_Class_A_Glass_Volumetric_Pipette_25_0_mL_12_Cs/EW-16600-22 | EW-16600-22 | 253.50 | 1 | 253.50 |
| Pipette pumps 25ml | 1 | http://www.coleparmer.com/Product/Pipette_Pumps_with_Rapid_Release_Lever_25_mL_Red_Each/EW-06221-34 | EW-06221-34 | 37.00 | 5 | 185.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Pipette pumps 10ml | 1 | http://www.coleparmer.com/Product/Pipette_Pumps_with_Rapid_Release_Lever_10_mL_Green_Each/EW-06221-33 | EW-06221-33 | 29.00 | 5 | 145.00 |
| Pipette pumps 2ml | 1 | http://www.coleparmer.com/Product/Scienceware_Pipette_Pump_2_0_mL_Blue_Each/EW-06221-02 | EW-06221-02 | 25.00 | 5 | 125.00 |
| Graduated Cylinder 100ml | 1 | http://www.coleparmer.com/Product/PyrexBrand_3026_Cylinder_Class_A_To_Deliver_100_ml/EW-34592-03 | EW-34592-03 | 36.00 | 10 | 360.00 |
| Squirt Bottles (500ml) | 1 | http://www.amazon.com/ACM-Economy-Bottle-Squeeze-Medical/dp/B00WTHLR2M/ref=sr_1_2?ie=UTF8&qid=1449941447&sr=8-2&keywords=wash+bottles | Amazon.com | 6.99 | 20 | 139.80 |
| Stop Watch | 1 | http://www.amazon.com/MARATHON-Adanac-3000-Digital-Stopwatch/dp/B00BLM6I7K/ref=sr_1_5?ie=UTF8&qid=1449951758&sr=8-5&keywords=stop+watch | Amazon.com | 7.95 | 5 | 39.75 |
| Pool vacuum | 1 | http://pentairaes.com/muck-vac.html | MV25 | 85.45 | 2 | 170.90 |
| Aqua Vu replacement camera | 1 | http://www.aquavu.com/Products/AV-Micro-Plus-Micro-Plus-DVR-R/AV-Micro-Plus-DVR-Replacement-Camera-and-Spool_2?whence= | 120-012 AV | 69.99 | 1 | 69.99 |
| Aqua Vu camera Microfins | 2 | http://www.aquavu.com/Products/Original-Micro/AV-Micro-Fins-qty-2 | 120-Kit-13 AV | 9.99 | 1 | 9.99 |
| Aqua Vu Claw | 2 | http://www.aquavu.com/Products/AV-Claw/Aqua-Vu-Claw-Discover | 400-7120 | 999.99 | 1 | 999.99 |
| | | | | | | |
| | | | | | | |
| **Photoquadrant 1m^2** | | | | | | |
| 45 Elbow 1” | 1 | http://www.mcmaster.com/mv14497 79469/#catalog/121/82/=107itth | 4880K33 | 0.94 | 8 | 7.52 |
| Tee 1” | 1 | http://www.mcmaster.com/mv14497 79469/#catalog/121/82/=107iv9e | 4880K43 | 0.81 | 4 | 3.24 |
| Side outlet Elbow 3 female | 1 | http://www.mcmaster.com/mv14497 79469/#catalog/121/82/=107iv9y | 4880K633 | 2.88 | 4 | 11.52 |
| PVC 1” (5’ length) | 1 | http://www.mcmaster.com/mv14497 79469/#catalog/121/84/=107iwoo | 48925K93 | 5.27 | 6 | 31.62 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Fiberglass rod (1/8" x 48") | 1 | http://www.amazon.com/gp/product/B001TO338C?psc=1&redirect=true&ref_=oh_aui_detailpage_o00_s00 | Amazon.com | 5.00 | 30 | 150.00 |
| Drill bit 1/8" | 1 | http://www.amazon.com/gp/product/B00Q1EXT2K?keywords=1%2F8%26%2334%3B%20drill%20bit&qid=1449943030&ref_=sr_1_6&sr=8-6 | Amazon.com | 16.34 | 1 | 16.34 |
| PVC Primer & Glue | 1 | http://www.amazon.com/Oatey-30246-Regular-Cement-4-Ounce/dp/B0002YU23O/ref=sr_1_2?ie=UTF8&qid=1449943097&sr=8-2&keywords=pvc+glue | Amazon.com | 9.87 | 1 | 9.87 |
| Boat Hook | 1 | http://www.amazon.com/gp/product/B0000AXOMS?psc=1&redirect=true&ref_=oh_aui_detailpage_o03_s00 | Amazon.com | 50.95 | 1 | 50.95 |
| | | | | | | |
| **"Columbia" Colonization Devices** | | | | | | |
| Line 3/8" hemp line (1220 feet) | 1 | http://www.amazon.com/T-W-Evans-Cordage-23-430-1220-Feet/dp/B00DKA3OEG/ref=sr_1_1?s=hi&ie=UTF8&qid=1449943840&sr=1-1&keywords=3%2F8+hemp+line | Amazon.com | 123.74 | 1 | 123.74 |
| Vinyl Coated Steel Mesh | 1 | http://www.amazon.com/Forney-70452-Aircraft-250-Feet--16-Inch/dp/B003YDK49M/ref=sr_1_1?s=hi&ie=UTF8&qid=1449943999&sr=1-1&keywords=vinyl+coated+cable | Amazon.com | 32.26 | 1 | 32.26 |
| Cable Clip 1/8" | 1 | http://www.amazon.com/The-Hillman-Group-4839-10-Pack/dp/B00III7IP6/ref=pd_bxgy_469_2?ie=UTF8&refRID=07WZZ83V13RHZ28H7WNP | Amazon.com | 8.27 | 20 | 165.40 |
| Cable splitter | 1 | http://www.amazon.com/dp/B003UWOID0?psc=1 | Amazon.com | 25.20 | 2 | 50.40 |
| Cable Thimble | 1 | http://www.amazon.com/Loos-Cableware-AN100-C4-Stainless-Diameter/dp/B0038YY3LW/ref=pd_bxgy_469_3?ie=UTF8&refRID=07WZZ83V13RHZ28H7WNP | Amazon.com | 7.73 | 20 | 154.60 |
| Plier Set (thin, thick, cutting) | 1 | http://www.amazon.com/Stanley-84-056-3-Piece-Bi-Material-Pliers/dp/B000M2GHUS/ref=sr_1_1?s=hi&ie=UTF8&qid=1449943661&sr=1-1&keywords=pliers | Amazon.com | 11.96 | 3 | 35.88 |
| Rubber mallet | 1 | http://www.amazon.com/Steel-Grip-Mallet-16-Hardwood/dp/B015X6J6PU/ref=sr_1_1?s=hi&ie=UTF8&qid=1449943616&sr=1-1&keywords=rubber+mallet | Amazon.com | 6.37 | 2 | 12.74 |
| Stainless Steel hog rings | 1 | http://www.amazon.com/meite-15GA-Diameter-Crown-Galvanzied/dp/B015O6RBPG/ref=sr_1_18?ie=UTF8&qid=1449943192&sr=8-18-spons&keywords=hog++rings&psc=1 | Amazon.com | 40.99 | 2 | 81.98 |
| Hog ring staple gun | 1 | http://www.amazon.com/meite-SC7E-Plier-Closure-Pneumatic/dp/B016BBUIPI/ref=pd_sim_sbs_469_4?ie=UTF8&dpID=41eDF | Amazon.com | 325.00 | 1 | 325.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ezcirL&dpSrc=sims&preST=_AC_UL160_SR160%2C160_&refRID=0QNN7RJ66XSWR5CJNXGG | | | | |
| 8" cable ties UV resistant | 1 | http://www.amazon.com/1000-Pack-Lot-Pcs-Resistant/dp/B010EARXWS/ref=sr_11?s=hi&ie=UTF8&qid=1449944480&sr=1-1&keywords=8+cable+ties+uv | Amazon.com | 32.95 | 1 | 32.95 |
| Hard substrate (ceramic, stone, hardwood, acrylic, porcelain | 1 | Homedepot | | | various | 300.00 |
| 2"x4"x4' hardwood lumber | 1 | http://www.homedepot.com/p/Unbranded-2-in-x-4-in-x-96-in-Premium-Kiln-Dried-Whitewood-Stud-161640/202091220 | 161640 | 3.05 | 5 | 15.25 |
| Measuring Tape (100ft vinyl) | 1 | http://www.amazon.com/Stanley-34-790-100-Foot-Open-Fiberglass/dp/B000037X0H/ref=sr_122?s=hi&ie=UTF8&qid=1449944722&sr=1-22&keywords=measuring+tape | Amazon.com | 11.83 | 2 | 23.66 |
| Scissors Heavy Duty | 1 | http://www.amazon.com/Wiss-W20-8-Inch-Inlaid-Industrial/dp/B005LBMFCY/ref=sr_12?s=hi&ie=UTF8&qid=1449945052&sr=1-2&keywords=scissors+heavy+duty | Amazon.com | 24.73 | 3 | 74.19 |
| Permanent marker (King Felt) pk3 | 1 | http://www.amazon.com/SanFord-15101-Black-King-Marker/dp/B00JOLNQFW/ref=sr_1_7?s=hi&ie=UTF8&qid=1449944818&sr=1-7&keywords=permanent+marker | Amazon.com | 7.79 | 2 | 15.58 |
| Plastic mesh netting (4x4mm bird) | 1 | http://www.amazon.com/Welded-Wire-Gauge-Vinyl-Coated/dp/B008CJ0FGA/ref=sr_1_12?s=hi&ie=UTF8&qid=1449944894&sr=1-12&keywords=vinyl+coated+wire+mesh | Amazon.com | 350.00 | 1 | 350.00 |
| Ceramic small pots (3.5") 10pk | 1 | http://www.amazon.com/10-Clay-Great-Plants-Crafts/dp/B004L0DU7U/ref=sr_1_1?s=lawn-garden&ie=UTF8&qid=1449945189&sr=1-1&keywords=clay+pot+small | Amazon.com | 9.99 | 10 | 99.90 |
| | | | | | | |
| ***ECONCRETE*** | | | | | | |
| 30x30cm Econcrete Slabs | 1 | | | | | 10,000.00 |
| | | | | | | |
| ***Cylindrical Sediment Trap*** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Test Plastic Funnel 01 | 1 | http://www.mcmaster.com/#plastic-funnels/=107kfb4 | 40775T47 | 5.37 | 10 | 53.70 |
| Test Plastic Funnel 02 | 1 | http://www.mcmaster.com/#funnels/=107kig3 | 4144T3 | 3.87 | 10 | 38.70 |
| Test Plastic Funnel 03 | 1 | http://www.mcmaster.com/#funnels/=107kizs | 4144T4 | 6.80 | 10 | 68.00 |
| Clear PVC | 1 | McMaster-Carr | | | Var | 200.00 |
| PVC Couplings | 1 | McMaster-Carr | | | Var | 100.00 |
| Bushing | 1 | McMaster-Carr | | | Var | 100.00 |
| PVC End Caps | 1 | McMaster-Carr | | | Var | 100.00 |
| Hose Clamps | 1 | McMaster-Carr | | | Var | 100.00 |
| Copper Mesh | 1 | McMaster-Carr | | | Var | 200.00 |
| | | | | | | |
| ***Deployment*** | | | | | | |
| HOBO Light/Temp Data loggers | 1 | http://www.onsetcomp.com/products/data-loggers/ua-002-64 | UA-002-64 | 64 | 6 | 384.00 |
| Laminated tags | 1 | See Sam Janis | | | | 200.00 |
| ***Retrieval*** | | | | | | |
| Snap Shackles (2-3/4"L Small Swivel Bail Shackle, 5/8" Snap, 7/16" Bail, 2112lb. MWL) | 1 | http://www.westmarine.com/buy/wichard--forged-snap-shackles--P002_060_001_003 | 583908 | 72.99 | 5 | 364.95 |
| Large tubs for plate analysis | 1 | http://www.amazon.com/gp/product/B001AQ0CDI?psc=1&redirect=true&ref_=oh_aui_detailpage_o02_s00 | | 17.81 | 6 | 106.86 |
| Squirt bottles | 1 | http://shop.sciencefirst.com/wildco/plastic-bottles-and-dippers/6664-one-piece-polyethylene-wash-bottle-polyethylene-500ml.html | 3-7900-D57 | 9.95 | 20 | 199.00 |
| Test tube cleaning brush (1" dia) 12pk | 1 | http://www.coleparmer.com/Product/Nylon_Radial_Tube_Brush_10_Handle_3_L_x_1_Dia_Brush_12_Pk/EW-84551-51 | EW-84551-51 | 31.25 | 1 | 31.25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 500 um sieve | 1 | https://www.fishersci.com/shop/products/fisherbrand-u-s-standard-stainless-steel-test-sieves-12-in-dia-3-1-4-in-d/048841an | 04-884-1AN | 216.00 | 3 | 648.00 |
| Rose Bengal Solution (4pk) | 1 | https://www.fishersci.com/shop/products/rose-bengal-solution/s25789 | S25789 | 72.00 | 2 | 144.00 |
| | | | | | | |
| **YSI Multi-parameter Probe** | | | | | | |
| YSI ProPlus Instrument | 0 | http://www.aquaticeco.com/subcategories/4500/YSI-Professional-Plus-Multiparameter-Instrument | Y60500 | 1095 | 2 | 2,200 |
| pH sensor | 1 | http://www.aquaticeco.com/subcategories/4500/YSI-Professional-Plus-Multiparameter-Instrument | Y6101 | 165 | 2 | 340 |
| Galvanic DO sensor | 0 | http://www.aquaticeco.com/subcategories/4500/YSI-Professional-Plus-Multiparameter-Instrument | Y6202 | 170 | 2 | 340 |
| Galvanic Blue Cap membrane kit (6 pack) | 1 | http://www.aquaticeco.com/subcategories/4500/YSI-Professional-Plus-Multiparameter-Instrument | Y5914 | 57 | 1 | 57 |
| Quattro cable | 0 | http://www.aquaticeco.com/subcategories/4501/YSI-Professional-Plus-Multiparameter-Instrument-Cables | Y579010 | 1390 | 2 | 2800 |
| Membrane kit Y5561 (black) | 1 | https://www.ysi.com/Accessory/id-059880/Cap-Membrane-Kit-1-00-Mil-Teflon | 059880 | 60.00 | 2 | 120.00 |
| Membrane kit Y5561 (blue) | 1 | https://www.ysi.com/Accessory/id-605307/Cap-Membrane-Kit-2-00-Mil-PE | 605307 | 60.00 | 2 | 120.00 |
| Membrane kit YSI ProPlus (yellow) | 1 | https://www.ysi.com/Accessory/id-605306/Cap-Membrane-Kit-1-25-Mil-PE | 605306 | 60.00 | 2 | 120.00 |
| YSI 556 | 0 | https://www.ysi.com/556 | 556-01 | 1920.00 | 1 | 1920.00 |
| YSI 556 Cable | 0 | https://www.ysi.com/Accessory/id-5563/556-DOTempConductivity-Field-Cable | 5563-10 | 1150.00 | 1 | 1150.00 |
| YSI 556 pH replacement probe | 1 | https://www.ysi.com/Accessory/id-655564/5564A-Amplified-pH-Sensor | 655564 | 290.00 | 1 | 290.00 |
| YSI 600 OMS V2 (Quote required; amt. estimate) | 0 | https://www.ysi.com/600OMS-V2 | 600-01 | 2000.00 | 3 | 6000.00 |
| YSI 600 OMS V2 ROX (Quote required; amt. estimate) | 0 | https://www.ysi.com/rox | 606150 | 500.00 | 1 | 500.00 |
| YSI 9500 Photometer | 2 | https://www.ysi.com/9500 | YPT950 | 1355.00 | 2 | 2710.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| YSI 5200 pH | 3 | https://www.ysi.com/Accessory/id-005564/pH-Kit | 005564 | 270.00 | 2 | 540.00 |
| | | | | | | |
| **Stationary** | | | | | | |
| Weather proof copy paper | 1 | | | | | 100.00 |
| Printer | 1 | | | | | 500.00 |
| Sheet protectors | 1 | | | | | 50.00 |
| Weatherproof pads | 1 | | | | | 50.00 |
| Pencils (30ct 2pk) | 1 | http://www.amazon.com/Dixon-Ticonderoga-Pre-Sharpened-Pencil-Barrel-30/dp/B015RYHCC2/ref=sr_1_6?s=hpc&ie=UTF8&qid=1449951428&sr=1-6&keywords=pencils+ticonderoga | Amazon.com | 159.25 | 1 | 159.25 |
| Printer ink | 1 | | | | | 300.00 |
| | | | | | | |
| | | | | | | |
| **Outreach** | | | | | | |
| Host site maintenance Total<br>.ORG Domain Name Registration - 2 Years (recurring)<br>Term: 2<br>Name: HARBORSEALS.ORG<br>Item number: 12102-1<br>Quantity: 1<br>34.66<br>Protected Registration<br>Term: 2 year(s)<br>Name: HARBORSEALS.ORG<br>Item number: 766001-1<br>Quantity: 1<br>65.94 | 1 | www.godaddy.com | | 100.60 | 1 | 100.60 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Website maintenance (Wordpress) | 1 | | | 100.00 | 1 | 100.00 |
| Banners | 1 | http://www.vistaprint.com/custom-banners.aspx?couponAutoload=1&GP=12%2f11%2f2015+2%3a51%3a55+PM&GPS=3700095501&GNF=0 | | 41.00 | 5 | 205.00 |
| | | | | | | |
| **Software** | | | | | | |
| Nobeltec Tides and Currents 3.7 software | 0 | http://www.landfallnavigation.com/-enso1.html?cmp=amazon-ppc&am=ensew&utm_source=ensew&utm_medium=shopping%2Bengine&utm_campaign=amazon-ppc | | 170.00 | 1 | 170.00 |
| Trimble GPS | 0 | | | | | 300.00 |
| ArcGIS | 0 | | | | | 1500.00 |
| ArcPAD | 0 | | | | | 150.00 |
| EcoWatch | 0 | http://ecowatch.software.informer.com/3.1/download/ | | 0.00 | 1 | 0.00 |
| PRIMER (10 licenses) | 0 | www.primer-e.com | | 1050.00 | 10 | 1050.00 |
| PERMANOVA | 0 | www.primer-e.com | | 750.00 | 10 | 750.00 |
| | | | | | | |
| **Gear Maintenance** | | | | | | |
| YSI 600 OMS, YSI 6920 repair | 3 | https://www.ysi.com/proplus | | | | 2176.00 |
| YSI handheld | 1 | https://www.ysi.com/proplus | | | | 1500.00 |
| | | | | | | |
| | | | | | | |

## *Instrument Calibration and Maintenance*

*Table 14. Instrument Calibration and Maintenance.*

| Equipment Type | Calibration Frequency | Standard or Calibration Instrument Used |
|---|---|---|
| YSI Pro Plus (pH, salinity, temperature, DO) | DO and pH before each use | According to manufacturer's instructions and standards; salinity and temperature are calibrated by manufacturer |
| YSI 600 OMS (salinity, temperature, and DO) | DO before each use | According to manufacturer's instructions and standards; salinity and temperature are calibrated by manufacturer |
| YSI 9500 (ammonia, phosphate, nitrate) | Before each use | According to manufacturer's instructions and standards |
| Thermometer | None | NIST Traceable calibration from vendor |
| Mod. Winkler | None | None |
| Refractometer | Quarterly | According to manufacturer's instructions and standards |
| OnSET temperature and light sensor | None | None |
| Test strips (pH, ammonia, phosphate, nitrite, nitrate, silicate) | None | None |

All calibrations for this project will be documented. Calibration records will be kept on calibration data sheets specific to each piece of equipment. Calibration records will include date, time, name of individual doing calibration, and the calibration results themselves. Acceptance criteria for calibration checks will also be included on the data sheets.

**Citizen Science QAPP Template #11**

# Analytical Methods*

**********NONE**********

Identify all laboratory organization(s) that will provide analytical services for the project. Group by matrix, analytical group/parameter, reporting limit, detection limit, analytical/preparation method SOP, sample volume, containers, preservation requirements, maximum holding time and the laboratory contact information.

***This table only needs to be completed when sample analysis by a laboratory is applicable to the project.**

| Matrix | Analytical Group/Parameter | Reporting Limit | Detection Limit | Analytical & Preparation Method/ SOP Reference | Sample Volume | Containers (*number, size, type*) | Preservation Requirements (*chemical, temperature, light protected)* | Maximum Holding Time (*preparation / analysis)* | Laboratory used for Analysis |
|---|---|---|---|---|---|---|---|---|---|
| *Water* | *Algae (chlorophyll a)* | *.2 ug/L* | *0.05 ug/L* | *EPA Method 445.0* | *1.0L* | *56 1.0 L HPDE sample containers* | *Store in dark place on ice. Filter as soon as possible. Filters should be stored in -20 °C freezer* | *3.5 weeks once filtered* | *XYZ University Ecology Lab 12 College Dr. Edison, NJ* |

**Citizen Science QAPP Template #12**

# Field Data Sheets

## *Physical Chemistry Parameters Tier (I)*

**Project name** _Citizen Science Water Quality Monitoring of Harlem/East River_ **page** ____ **of** _____

**Initial date** _____ **Final Date** _____ **Location/GPS Coordinates** _____

**Sampler's Name(s)** _____**Station** _____ **Sample #**_____

| Sampling Day # | Date (mmddyy) | Time | Sample Vial # (optional) | T °C | D.O. ppm | pH units | $PO_3$ ppm | $NO_2$ ppm | $NO_3$ ppm | $NH_3$ ppm | $SiO_3$ ppm | Sal ppt | Secchi Depth (cm) | Total Rain (1-5 days prior) | Air T °C | Wind-speed | Waves/tide/current | % cloud coverage | Depth | Moon phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY ___ | | | | | | | | | | | | | | | | | | | | |
| | Initials | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | Initials | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | Initials | | | | | | | | | | | | | | | | | | | |

**Use pencil only please. Make sure all required cells are completed including time + initials.** ***Measured with Hanna Combo Sensor** ****Measured with YSI**

*****Measured with Dewy Winkler Method, Hach Test Strips, or other instrument**

**General Comments:**

_____

_____

_____

_____

**Ask your group leader if you have any questions.**

## *Physical Chemistry: Continuous Sampling with YSI Sondes (0.5m) Tier (II & III)*

**Project name** _Citizen Science Water Quality Monitoring of Harlem/East River_ **page** ____ **of** _____

**Initial date** _____ **Final Date** _____

| **Sonde Deployment Field Data Sheet** | | | | | | |
|---|---|---|---|---|---|---|
| Date | | Personnel | | | | |
| | | | | | | |
| Instrument Model/ID | Site ID | Location | | Time In | Time Out | Initials/Comments |
| | | Lat | Lon | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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## *Columbia Colonizing Device (Eel grass growth, general growth on oysters and rocks, & plate cover)*

See (Reid, et al., 2015).

## *Photoquadrant Biodiversity*

| **Photo Quadrant Survey Field Data Sheet** | | | | | | |
|---|---|---|---|---|---|---|
| Date | | Personnel | | | | |
| | | | | | | |
| Photo Number | Site ID | Location | | Time In | Time Out | Above/Under Water |
| | | Lat | Lon | | | |
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| Photo Quadrant Survey Lab Data Sheet | | | |
|---|---|---|---|
| Date | | Personnel | |

| Photo Number | Site ID | Percent cover | | Comments |
|---|---|---|---|---|
| | | Species | % | |
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## *Plankton Field Data*

Team:_____ Latitude:_____
Date:_____ Longitude:_____
Location:_____ Time:_____
Station:_____ Depth:_____

---

**Weather:**
Wind speed/direction:_____ Waves/tide/current:_____
Air temp:_____ % cloud:_____
Moon phase:_____

---

**Water @ start:**
Temperature/Salinity:_____ ˚C:_____ Secchi Depth:_____
pH:_____ DO:_____
Comments:

---

Sampling gear:_____
a) Sample #:_____ Time:_____ Flowmeter:_____
b) Sample #:_____ Time:_____ Flowmeter:_____
c) Sample #:_____ Time:_____ Flowmeter:_____
d) Sample #:_____ Time:_____ Flowmeter:_____

---

**Water @ end:**
Temperature/Salinity:_____ ˚C:_____ Secchi Depth:_____
pH:_____ DO:_____
Comments:

## *Zooplankton Laboratory Data*

LOCATION:_____ STATION:_____
Sorter's name: _____ Date:_____
Sample 01 #:_____ Sample 02 #:_____
Location:_____
Gear and Mesh:_____ Tow duration/speed:_____

| Organisms | Sample 01 Tally | Comments: | Sample 02 Tally | Comments: |
|---|---|---|---|---|
| **Biomass (Volume Displacement)** | *Sample 01:* | | *Sample 02:* | |
| *Copepods:*<br>*Calanoid*<br>*Cyclopoid*<br>*Harpacticoid* | | | | |
| *Bivalved Crustaceans:*<br>*Ostracod*<br>*Cladoceran* | | | | |
| *Crab Larvae* | | | | |
| *Amphipod Isopod* | | | | |
| *Nauplii* | | | | |
| *Elongate Crustaceans:*<br>*Krill*<br>*Mysids*<br>*Penaeids*<br>*Jaxea* | | | | |
| *Polychaetes* | | | | |
| *Chaetognaths* | | | | |
| *Pelagic Snails* | | | | |
| *Bivalve Molluscs* | | | | |
| *Cnidaria Obelia* | | | | |
| *Larvaceans* | | | | |
| *Salps* | | | | |
| *Other Gelatinous* | | | | |
| *Fish Eggs* | | | | |
| *Fish Larvae* | | | | |
| *Large Jellies, Ctenos, Algae* | | | | |
| *Other:* | | | | |

## *Phytoplankton Laboratory Data*

LOCATION:_____ STATION:_____
Sorter's name: _____ Date:_____
Sample 01 #:_____ Sample 02 #:_____
Location:_____
Gear and Mesh:_____ Tow duration/speed:_____

| Organisms | Sample 01 Tally | Comments: | Sample 02 Tally | Comments: |
|---|---|---|---|---|
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| **# of Squares Counted in Sedgewick-Rafter** | *Sample 01:* | *Additional squares:* | *Sample 02:* | *Additional squares:* |
| **Units of Colonies:** | *Sample 01:* | *Additional units:* | *Sample 02:* | *Additional units:* |
| **Units of Filament:** | *Sample 01:* | *Additional units:* | *Sample 02:* | *Additional units:* |
| **Units of Unicelular Algal Cells:** | *Sample 01:* | *Additional units:* | *Sample 02:* | *Additional units:* |
| "If counting 30 grid squares or two traverses does not yield a sufficient number of units (that is more than 23), then additional grid squares or traverses will need to be counted" – Suthers and Rissik (2009) | | | | |

## *Benthic Field Data*

Team: _____ Sample number: _____
Date: _____ Time: _____
Location:_____
Station:_____ Depth:_____
---
**Weather:**
Wind speed/direction:_____ _ Waves/tide/current:_____
Air temp: _____ % cloud:_____
Moon phase: _____
---
**Water @ start:**
Temperature/Salinity:_____ ˚C:_____ Secchi Depth:_____
pH:_____ DO:_____
Comments:
---
Sampling gear:_____
a) Sample #:_____ Time: _____ Mass: _____
b) Sample #:_____ Time: _____ Mass: _____
c) Sample #:_____ Time: _____ __ Mass: _____
d) Sample #:_____ Time:_____ __ Mass: _____
---
**Water @ end:**
Temperature/Salinity:_____ ˚C:_____ Secchi Depth:_____
pH:_____ DO:_____
Comments:

## *Benthic Laboratory Data*

Location:_____ Station:_____
Sorter's name: _____ Date: _____
Location/GPS: _____ Gear:_____
Sample 01 #: _____ Sample 02 #: _____

| Organisms | Sample 01 Tally | Comments: | Sample 02 Tally | Comments: |
|---|---|---|---|---|
| Eastern Mud snail | | | | |
| Threeline Mud snail | | | | |
| Lunar Dove snail | | | | |
| Atlantic Dog Winkle Snail | | | | |
| Eastern Melampus snail | | | | |
| Streblospio Benedicti Polychaeta | | | | |
| Brania Spp Polychaeta | | | | |
| Opal worm Polychaeta | | | | |
| Aquatic Earthworm Oligochaeta | | | | |
| Typical Oligochaete Worm | | | | |
| Typical Tubificid Oligochaete | | | | |
| Northern Horsemussel Bivalvia | | | | |
| Blue Mussel Bivalvia | | | | |
| Sea Grapes /Squirt Ascidiacea | | | | |
| Pagurus ssp Crustacea (hermit crab) | | | | |

| Organisms | Sample 01 Tally | Comments: | Sample 02 Tally | Comments: |
|---|---|---|---|---|
| Other: | | | | |
| Other: | | | | |
| Other: | | | | |
| Other: | | | | |
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| Other: | | | | |
| Other: | | | | |

**Citizen Science QAPP Template #13**

# Training and Specialized Experience

## *Training*

*Table 15. Volunteer Training.*

| Personnel/Group to be Trained | Description of Training | Frequency of Training |
|---|---|---|
| High school and adult volunteers | Field and lab safety protocols; preparation of technical sampling materials before events; protocols of collecting samples in accordance with the QAPP; protocols for obtaining physical-chemical parameter water quality data using technical equipment; use of data tables and data collection management; use of the on-line Webpage for data entry; processes required to conduct the study; and maintenance and storage of technical sampling materials after events | Session at the beginning of the sampling season and each semester after that. (*i.e.* September - October 2015, 2016, 2017; January -February 2015, 2016, 2017 |

## *Specialized Experience*

(Individuals with specialized experience utilized by the project.)

*Table 16. Specialized Experience.*

| Person | Specialized Experience | # of Years of Experience |
|---|---|---|
| Kate Boicourt | Marine Ecologist | ??????? |
| Susan Maresca | ????????? | ?????????? |
| James Tripp | ??????????? | ?????????? |
| Mauricio Gonzalez | Marine Ecologist | 15 |

**Citizen Science QAPP Template #14**

# Assessments and Oversight

(Assessments and project oversight include various reviews to identify shortcomings or deviations from the project. For each type of assessment, describe procedures for handling QAPP and project deviations encountered during the planned project assessments. Fill in all necessary information.)

*Table 17. Assessment and Oversight.*

| Assessment Type | Frequency of Assessment | What is Being Assessed | Who will Conduct the Assessment | How Issues or Deviations will be Addressed |
|---|---|---|---|---|
| Data Checks and Assessments | October – November 2015, 2016, and 2017 | Field data entries into spreadsheet and database | Maura Smotrich and Quality Assurance Officers | Verify with sampling team |
| On-Site Field Inspection | 1/month | Adult and high school volunteers against QAPP/SOP | Mauricio Gonzalez, Maura Smotrich, and Quality Assurance Officers | Re-train if necessary |

**Citizen Science QAPP Template #15**

# Data Management

(Describe the data management processes used throughout the life of the project. Data management includes: recording and transcribing field notes, logging and retrieval of instrument data, transmittal of automated field and laboratory results, data transformation and reduction procedures, compilation of survey results, and data storage, retrieval and security uses throughout the project. Describe the way data handling errors will be controlled (i.e. spot checks for transcription and calculation errors.)

## *Field Datasheets and Field Data*

All data from the field will be recorded on pre-printed datasheets (see template #12). Data will be transcribed from datasheets to an online database **no later than two (02) weeks** after it has been processed by the Data Manager. 100% of the data will be checked for accuracy and transcription errors by the Project Manager and Quality Assurance Officer. If there are any discrepancies in data entries, the Project Manager and Quality Assurance Manager will check the field datasheets and discuss them with the field sampling team. Original datasheets will be stored in a dedicated data binder in the New York Harbor School's marine Science laboratory for at least 5 years after the completion of the project. Existing weather data will be obtained from existing database, reviewed and added to an electronic database. The electronic database is located at www.harborseals.org.

## *Laboratory Analytical Results*

The processing of nutrients will be performed at the New York Harbor School's Marine Science laboratory on Governors Island if it cannot be done on-site. Lab results will be transcribed on to the same field data sheet and delivered to the Data Manager. Any data that does not meet the quality control requirements of the laboratory will be flagged. Once received by the Data manager, the laboratory data will also be entered into the electronic database **no later than two (02) weeks** after processing. The electronic database is located at www.harborseals.org.

**Citizen Science QAPP Template #16**

# Data Review and Usability Determination

(Include in this section the types of checks that will be performed at the end of the project to determine if the data collected is usable for achieving the goals of the project. Examples of data checks are provided in the table below.)

## *Data Checks*

*Table 18. Data Checks.*

| Field/Lab | Data Management |
|---|---|
| Monitoring performed per SOPs or QAPP | Data entry and transcription errors |
| Field QC samples performed correctly | Calculation/reduction errors |
| Measurements performed correctly | Proper data and document storage |
| Calibrations performed correctly | Missing data documented |
| Data meets acceptance criteria | |
| Holding times | |
| Evaluate any deviations from QAPP or SOPs to determine the impact to the data and project objectives | |

## *Data Usability*

(Describe the process used to determine the usability of your project data. If your data review, based on the table above, does not uncover any issues and all of your QC criteria are satisfied, then your data will be assumed to be usable for the intended project objective. However, this is not always the case and so you will need to lay out a process for determining data usability in the event that all QC criteria are not met.)

All data issues identified will be discussed with the QAO to determine data usability on a case by case basis. All decisions to allow data that did not fully comply with QC criteria or QAPP requirements will be explained, and any resultant limitations on data use fully discussed in the final project report.

**Citizen Science QAPP Template #17**

# Reporting

## *Reports*

(Specify the frequency of all reports, the names of the originators and to whom they will be issued. Itemize what information and records must be included in the report(s). This might include but is not limited to the following:

- Sample collection records
- QC sample records
- Equipment calibration records
- Assessment reports
- Data reconciliation results and associated recommendations/limitations
- Final report of results

**Note:** If your project will include posting data to a website for public access, state in your description information about how data limitations will be conveyed.)

The Project Manager is responsible for submitting quarterly project reports to the Quality Assurance Officer and Project Advisor. The quarterly reports will provide a status update for the project and will include a summary of the quality assurance data checks conducted and the results of those checks. The final project report will summarize the quality assurance data check results for the entire project along with the data usability determinations made by the Project Quality Assurance Officer. The rationale for the use of any data that does not fully comply with the quality criteria requirements of the approved QAPP will be fully explained in the final report and on the program web page.

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# APPENDIX: STANDARD OPERATING PROCEDURES (SOPs)

## *Labeling Samples (Tier I)*

All samples will be labeled with a unique nine (9) digit alphanumeric code. The first digit will be a letter starting with "A" as the first sample event and moving up one letter for each subsequent sampling event. The next 6 digits will be the date in yymmdd format. The eighth digit will be a code for the type of test being run. The next digit will be a number expressing the replicate number of the sample. The last pair of digits will be the sample site (*i.e.* S1, S2, S3, S4, or S?) Use the table below for test codes. An example of a label is A150725P2S1 which is broken down as the first sampling event "A" of the project, followed by the date July, 25 2015, the test "P" which stands for plankton, the two for the second replicate of that sampling event, and, finally, the S1 for the sampling site. An Asterisk in the stead of the first letter stands for a training day. A question mark after the sample station S stands for station outside of the four CIVITAS stations.

| Code | Test |
|---|---|
| P | Plankton |
| B | Benthos |
| N | Neuston |
| C | Columbia Colonizing Device |
| F | Physical-Chemistry |
| Q | Photoquadrant |

## *Labeling Pictures Taken of Benthic, Plankton, Photoquadrant, and Other Samples (Tier I)*

Picture labels will include the format for labeling samples with the addition of a unique label as defined by the person taking the picture (processing the sample) and the number of picture in the sequence. The personal identifier will be the initials of the person's first and last name. The picture number will be in double digit form. Thus, if John Smith were labeling the first picture of a sample he's processing and the organism was found in the sample labeled A150725P2S1 the resultant picture label would be A150725P2S1-JS01. In sum, the label is comprised of the sample label followed by a dash, the initials of the sampler, and the number of the picture as a double digit. Note that all numbers between one (01) and nine (09) will be preceded by a zero.

## *Preserving Samples (Tier I)*

**Preserving Phytoplankton in Lugol's Iodine Solution**

"Samples are best preserved using Lugol's iodine solution for both freshwater and marine samples (although it may damage some of the smaller flagellates). Some laboratories will not analyze samples preserved with substances such as formaldehyde, as these are carcinogenic and represent an occupational health and safety hazard. Samples collected from a dense algal bloom can be analyzed directly, but they usually need to be concentrated prior to analysis." – Suthers and Rissik (2009).

*Preparation*

*Application*

01. Apply drop by drop until sample turns a dark tea color

**Preserving Zooplankton in 70% Alcohol**

**Preserving Benthic fauna in 70% Alcohol**

## *Calculating the Tow Volume with a General Oceanics Flow Meter (Tier II)*

(Adapted from Suthers & Rissik, 2009)

The formulae for calculation of volume are as follows:

01. Distance (m) = (difference between start and end # x Rotor Constant)/999,999
02. Speed (cm/s) = (Distance (m) x 100)/Duration of tow (s)
03. Volume ($m^3$) = (3.14 x $r^2$) x Distance (m)

The rotor constant is 26,873 for a new standard rotor

Plankton and Neuston horizontal tows will run for 10 minutes

## *Salinity (ppt) with Vital Sine Refractometer (Tier I)*

### VITALSINE Calibration

1. Calibration of ATC refractometers should only be conducted when the previous calibration setting has shifted and is noticeably affecting measurements. **DO NOT PERFORM CALIBRATIONS IN THE FIELD!** Calibration must take place in a controlled environment of 20°C (68°F) using distilled water of the same temperature. It's recommended to allow the refractometer and the distilled water to reach temperature equilibrium with the controlled environment before calibration takes place.
2. Open the daylight plate and apply one or two drops of distilled water on to the surface of the prism. Hold the prism at an angle close to parallel with the floor so the distilled water will not run off of the prism.
3. Gently close the daylight plate over the prism. The distilled water should spread as a thin, even layer in between the daylight plate and the prism. By looking through the daylight plate, ensure that the distilled water covers the ENTIRE surface of the prism. If there are bubbles and gaps or if the distilled water is only on one portion of the prism, the distilled water must be reapplied (Figure 1). Inaccurate calibrations will result if the prism is not covered correctly.
4. Looking through the eyepiece, hold the refractometer and direct the daylight plate upwards towards light. If the scale is not in focus, adjust it by gently turning the eyepiece (rubber hood) either clockwise or counterclockwise. Be careful not to overturn the focusing mechanism.
5. When the refractometer scale is viewed through the eyepiece, the upper field of view will be seen as blue and the lower field will be seen as white (Figure 2). Confirm that the boundary line crosses the scale at "0" (Figure 3).
6. If the boundary line falls above or below zero, gently loosen the set screw on the calibration ring with the supplied screwdriver. While looking through the eyepiece, gently turn the calibration ring clockwise or counterclockwise until the boundary line is at zero. Once this is achieved gently tighten down the set screw with the supplied screwdriver. (NOTE: Do not over-tighten. If the set screw is over-tightened, the boundary line may shift slightly).
7. When calibration is complete, gently wipe the prism using tissue paper.

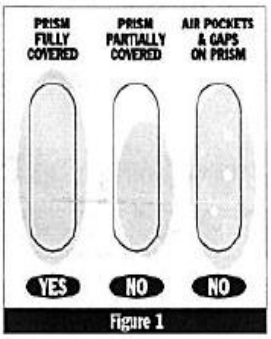


Figure 1

Figure 2

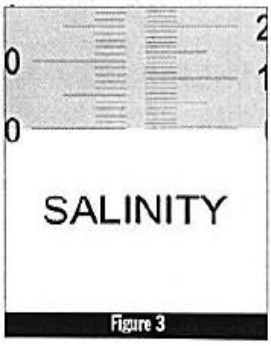


Figure 3

3

***Continued***

## VITALSINE General Use

1. Open the daylight plate and apply one or two drops of the sample solution to the surface of the prism. Hold the prism at an angle close to parallel with the floor so the sample will not run off of the prism.
2. Gently close the daylight plate over the prism. The sample solution should spread as a thin, even layer in between the daylight plate and the prism. By looking through the daylight plate, ensure that the sample solution covers the ENTIRE surface of the prism. If there are bubbles and gaps or if the sample is only on one portion of the prism, the sample solution must be reapplied (Figure 1). Inaccurate readings will result if the prism is not covered correctly.
3. Looking through the eyepiece, hold the refractometer and direct the daylight plate upwards towards light. If the scale is not in focus, adjust it by gently turning the eyepiece (rubber hood) either clockwise or counterclockwise. Be careful not to overturn the focusing mechanism.
4. When the refractometer scale is viewed through the eyepiece, the upper field of view will be seen as blue and the lower field will be seen as white (Figure 4). The reading is taken at the point where the boundary line of the blue and white fields crosses the scale (Figure 5). The value (either permillage or specific gravity) is the salinity level of water.
5. When each measurement is complete, the sample must be cleaned from the prism using tissue paper and water.

Figure 4


Figure 5

## VITALSINE Conversion Table

| Salinity (‰) | NaCl (w/w) | $MgCl_2$ (w/w) | $MgSO_4$ (w/w) | $K_2SO_4$ (w/w) | $CaCl_2$ (w/w) | Brix% |
|---|---|---|---|---|---|---|
| 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 1.0 | 0.7 | 0.9 | 1.4 | 0.8 | 1.3 |
| 20 | 2.1 | 1.4 | 1.8 | 2.9 | 1.5 | 2.5 |
| 30 | 3.1 | 2.1 | 2.7 | 4.3 | 2.3 | 3.7 |
| 40 | 4.1 | 2.8 | 3.6 | 5.8 | 3.0 | 4.9 |
| 50 | 5.1 | 3.5 | 4.5 | 7.3 | 3.8 | 6.2 |
| 60 | 6.2 | 4.2 | 5.4 | 8.8 | 4.5 | 7.4 |
| 70 | 7.2 | 5.0 | 6.3 | 10.3 | 5.3 | 8.6 |
| 80 | 8.3 | 5.7 | 7.2 | 11.8 | 6.0 | 9.8 |
| 90 | 9.4 | 6.4 | 8.2 | 13.4 | 6.8 | 11.0 |
| 100 | 10.5 | 7.2 | 9.1 | 15.0 | 7.6 | 12.3 |

## VITALSINE Specifications

| | |
|---|---|
| **Range:** | 0-100‰ / 1.000-1.070 Specific Gravity |
| **Resolution:** | 1.0‰ / 0.001 Specific Gravity |
| **Accuracy:** | ±1.0‰ / ±0.001 Specific Gravity |
| **ATC Range:** | 10-30°C |
| **Dimensions:** | 40 x 40 x 185mm (1.6 x 1.6 x 7.3") |
| **Weight:** | 285g (10.0 oz.) |
| **Supplied With:** | Vinyl Carrying Case (1), Plastic Transfer Pipet (1), Calibration Screwdriver (1) |

## *Temperature (C) with Calibrated Thermometer (Tier I)*

01. Using a calibrated thermometer, temperature in Degrees Celsius will be measured.
02. Once the sample is brought up, unscrew protective casing from thermometer
03. Place thermometer in bucket, fully submersing the glass in water
04. Wait approximately 1 minute before taking the thermometer out of the water.
05. Read thermometer where the red line stops approximately
06. Add data to data table.
07. Rinse off the thermometer completely with RO/DI water and fasten the protective casing back onto the thermometer

## *Dissolved Oxygen (ppm) with the Modified Winkler Method (Tier I)*

01. Acquire Water Sample by lowering either a 7 gallon (26.4979 Liter) Beta Bottle or a 5 gallon (18.9271 Liter) bucket with an attached rope.
02. Fill Sampling Bottle by submerging bottle fully in water
03. Empty and refill bottle for accuracy
04. Once filled, cap while underwater and set aside on a flat surface
05. Uncap and add 8 drops of Maganous Sulfate Solution (Note: all chemical dropper bottles should be held at a 90 °angle directly facing the Sample bottle)
06. Add 8 drops of Alkaline Potassium Idodide Azide
07. Cap and invert bottle vigorously 3 times
08. Set aside and let precipitate settle to the neck of the sample bottle
09. Add 8 drops of Sulfuric Acid to Sample Bottle
10. Cap and invert bottle vigorously 3 times
11. Set aside and let precipitate settle to the bottom of the sample bottle
12. Fill Test Tube with the mixture from the Sample Bottle to the 20 mL line. Cap and set aside
13. Depress plunger of the Titrator
14. Insert the Titrator into the opening of the Sodium Thiosulfate
15. Invert the bottle of Sodium Thiosulfate and slowly withdraw the plunger until slightly over zero (for next step)
16. If any air bubbles have occurred, flick Titrator lightly with finger and push plunger up to the zero line
17. With the Titrator, add Sodium Thiosulfate to the Test Tube until the mixture turns a pale yellow (Note: Slowly swirling Test Tube in clockwise directions while adding Sodium Thiosulfate is recommended) Set aside Titrator
18. Add 8 drops of Starch indicator to Test Tube; shake slightly until mixture turns black or purple
19. With the Titrator, add Sodium Thiosulfate drops until clear
20. Read result by measuring how much Sodium Thiosulfate is remaining in Titrator in ppm
21. For accuracy, preform sampling test twice

## KIT CONTENTS

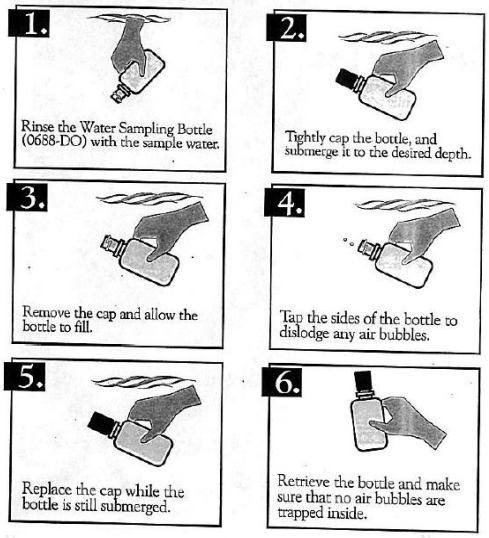
| QUANTITY | CONTENTS | CODE |
|---|---|---|
| 30 mL | *Manganous Sulfate Solution | *4167-G |
| 30 mL | *Alkaline Potassium Iodide Azide | *7166-G |
| 50 g | *Sulfamic Acid Powder (7414 Kit) | *6286-H |
| 30 mL | *Sulfuric Acid, 1:1 (5860 Kit) | *6141WT-G |
| 60 mL | *Sodium Thiosulfate, 0.025N | *4169-H |
| 30 mL | Starch Indicator Solution | 4170WT-G |
| 1 | Spoon, 1.0 g, plastic (7414 Kit) | 0697 |
| 1 | Direct Reading Titrator | 0377 |
| 1 | Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap | 0608 |
| 1 | Water Sampling Bottle, 60 mL, glass | 0688-DO |

*WARNING: Reagents marked with a * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents go to www.lamotte.com. To obtain a printed copy, contact LaMotte by email, phone or fax.

To order individual reagents or test kit components, use the specified code numbers.

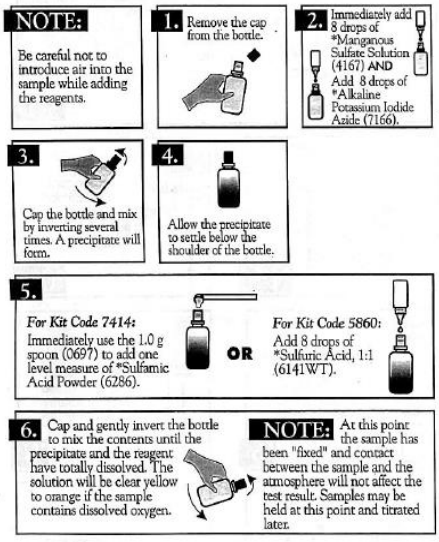
## TEST PROCEDURE

### PART 1 - COLLECTING THE WATER SAMPLE



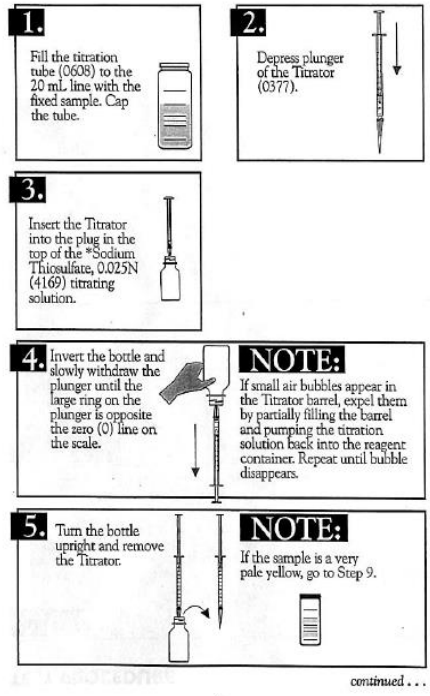

## TEST PROCEDURE

### PART 2 - ADDING THE REAGENTS




## TEST PROCEDURE

### PART 3 - THE TITRATION




continued . . .

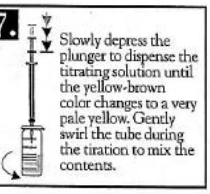
5

6

***Continued***

**TEST PROCEDURE**

**6.** Insert the tip of the Titrator into the opening of the titration tube cap.



**7.** Slowly depress the plunger to dispense the titrating solution until the yellow-brown color changes to a very pale yellow. Gently swirl the tube during the titration to mix the contents.



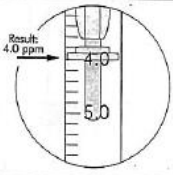
**8.** Carefully remove the Titrator and cap. Do not to disturb the Titrator plunger.

**9.** Add 8 drops of Starch Indicator Solution (4170WT). The sample should turn blue.

**10.** Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.

**11.** Continue titrating until the blue color disappears and the solution becomes colorless.

**12.** Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Dissolved Oxygen. Each minor division on the Titrator scale equals 0.2 ppm.




**TEST PROCEDURE**

**NOTE:**

If the plunger ring reaches the bottom line on the scale (10 ppm) before the endpoint color change occurs, refill the Titrator and continue the titration. Include the value of the original amount of reagent dispensed (10 ppm) when recording the test result.

**NOTE:**

When testing is complete, discard titrating solution in Titrator. Rinse Titrator and titration tube thoroughly. DO NOT remove plunger or adapter tip.

# *Dissolved Oxygen (ppm), pH, Salinity (ppt), Temperature (C) with the YSI ProPlus Galvanic Probe Method (Tier II)*

## Professional Plus Quick-Start Guide

This Quick-Start Guide is meant to serve as a quick reference in operating the Professional Plus. It is not intended to replace the information found in the Operations Manual. For your convenience, this quick start guide will enable you to unpack your instrument and get to the field quickly.

### GETTING STARTED

Unpack the instrument and install (2) C size batteries in the back of the instrument. Tighten the four screws of the battery plate on to the back of the instrument.

If necessary, install the sensors into the cable assembly by inserting the sensors into the ports and then hand tightening them. Do not use a tool and do not over tighten.

If using a 1010 cable, a sensor must be installed in port 1 for correct operation. If installing a pH/ORP combo sensor into a 1010 cable, ORP will not be measured. If using a 1020 cable, install a pH, ORP, pH/ORP, or an ISE sensor in port 1 and a DO sensor in port 2.

If using a Quatro cable, install a pH, ORP, or ISE sensor in ports label 1 and 2. A sensor must be installed in port 1 for port 2 to operate correctly. If you install a pH/ORP combo sensor into port 1 or port 2, ORP will not be measure. Install the Dissolved Oxygen sensor in the port labeled DO. Install the Conductivity/Temperature sensor in the port labeled CT following the instructions included with the sensor. For ease of installation, YSI recommends that you install a sensor into port 1 first; followed by DO installation, then port 2, and lastly C/T.

Please refer to the Getting Started Setup section of the Manual for a complete list of sensor/cable port configurations.

Install a port plug into any port that does not have an installed sensor. Attach the cable assembly to your instrument.

### INSTALLING THE DO MEMBRANE

Note: The DO sensor is shipped with a red protective cap to protect the electrode. A new membrane cap must be installed before the first use.

1. Prepare the $O_2$ probe solution according to the instructions on the bottle. After mixing, allow the solution to sit for 1 hour. This will help prevent air bubbles from later developing under the membrane.
2. Remove, and discard or save the red protective cap.
3. Thoroughly rinse the sensor tip with distilled or deionized water.
4. Fill a new membrane cap with probe solution. Avoid touching the membrane portion of the cap.
5. Thread the membrane cap onto the sensor, moderately tight. A small amount of electrolyte will overflow.
6. Screw the probe sensor guard on moderately tight.

### MENU FUNCTIONS

The Professional Plus has a menu-based interface. Press the "hot keys" to access the System, Sensor, Calibration, and File menus (from left to right at the top of the keypad). To navigate through the menus, use the up and down arrow keys to highlight a desired menu option with a highlight bar, and press the Enter key to activate the selection. Use the left arrow key to go back one screen. Press the Esc key to return to the run screen or to exit an alpha/numeric entry screen. The Pro Plus will automatically power on to the Run screen.

### SETTING THE DATE AND TIME

1. Press the System key.
2. Highlight **Date/Time** and press Enter.
3. Highlight **Date Format** and press Enter. Highlight the correct format and press Enter.
4. Highlight **Date** and press Enter. Use the keypad to enter the correct date, then highlight ↵on the display keypad, and press Enter.
5. Highlight **Time Format** and press Enter. Highlight the correct format and press Enter.
6. Highlight **Time** and press Enter. Use the keypad to enter the correct time, then highlight ↵on the display keypad, and press Enter.
7. Press Esc to return to the Run screen.

### SETTING UP SENSORS & REPORTING UNITS

A sensor must be enabled in the **Sensor** menu for it to operate. Once a sensor is enabled, the desired units for that sensor must be selected in the **Display** menu to determine what will be displayed.

1. Press the Sensor key.
2. Highlight **Setup** and press enter. Highlight the parameter of interest and press enter. Highlight **Enabled** and press enter to ensure a checkmark in the box. When enabling the ISE1 and ISE2 ports, you must select the correct sensor after enabling the port.
3. When Dissolved Oxygen is enabled, a submenu allows the user to select the sensor type (Polarographic or Galvanic) and membrane type being used. Highlight **Sensor Type** or **Membrane** and press **Enter** to modify these settings.
4. Press the left arrow key to return to the previous screen or press Esc to return to the Run screen.

Once changes to the Sensor menu have been completed, you must determine which units will be reported (i.e. %, mg/L, °C, °F, etc.).

1. Select the Sensor hot key on the keypad, highlight **Display**, and press enter.
2. Highlight the parameter you want to access and press the Enter.
3. A submenu will open allowing you to select the reporting units. Some parameters can be reported in multiple units. For example, DO can be reported in DO%, DO mg/L, and DO ppm. Other parameters, for example temperature, can only be reported in one unit. Make selections from the submenu, and then press the left arrow key to return to the Display menu or press Esc to return to the Run screen.

### BAROMETER CALIBRATION

1. Determine your local barometric pressure (BP) in mmHg from a mercury barometer, an independent laboratory, or from a local weather service. If the

***Continued***

BP reading has been corrected to sea level, use the following equation to determine the true BP in mmHg for your altitude:

True BP = (Corrected BP in mmHG) – {2.5 * (Local Altitude in feet/100)}

2. Press the Cal key.
3. Highlight **Barometer** and press Enter. Use the arrow keys to highlight the desired units and press Enter to confirm.
4. Highlight **Calibration Value** and press enter to adjust.
5. Use the Alpha/Numeric screen to enter your True BP, then highlight <<<ENTER>>> and press enter.
6. Highlight **Accept Calibration** and press enter to finish the calibration.

## CONDUCTIVITY, PH, AND ORP CALIBRATION

1. Press the Cal key.
2. Highlight the parameter you wish to calibrate and press enter. For Conductivity, a second menu will offer the option of calibrating **Specific Conductance**, **Conductivity**, or **Salinity**. Calibrating one automatically calibrates the other two. An additional sub-menu will require you to select the calibration units. For pH, auto-buffer recognition will determine which buffer the sensor is in and it will allow you to calibrate up to 6 points.
3. Place the correct amount of calibration standard into a clean, dry or pre-rinsed container.
4. Immerse the probe into the solution, making sure the sensor and thermistor are adequately immersed. Allow at least one minute for temperature to stabilize.
5. For any of parameters, enter the calibration solution value by highlighting **Calibration Value**, pressing enter, and then using the alpha/numeric keypad to enter the known value. Once you have entered the value of the calibration standard, highlight <<<ENTER>>> and press enter.
6. Wait for the readings to stabilize, highlight **Accept Calibration** and press enter to calibrate.
7. For pH, continue with the next point by placing the probe in a second buffer and following the on-screen instructions or press Cal to complete the calibration.

## DO CALIBRATION

The Pro Plus offers four options for calibrating dissolved oxygen. The first is an air calibration method in % saturation. The second and third calibrates in mg/L or ppm to a solution with a known DO concentration (usually determined by a Winkler Titration). Calibration of any option (% or mg/L and ppm) will automatically calibrate the other. The fourth option is a zero calibration. If performing a zero calibration, you must perform a % or mg/L calibration following the zero calibration. For both ease of use and accuracy, YSI recommends performing the following 1-point DO % calibration:

1. Moisten the sponge in the cal/transport sleeve with a small amount of water and install it on the probe. The cal/transport sleeve ensures venting to the atmosphere. For dual port and Quatro cables, place a small amount of water (1/8 inch) in the calibration/transport cup and screw it on the probe. Disengage a thread or two to ensure atmospheric venting. **Make sure the DO and temperature sensors are not immersed in the water.**
2. Turn the instrument on. If using a polarographic sensor, wait 10 minutes for the DO sensor to stabilize. Galvanic sensors do not require a warm up time.
3. Press the Cal key, highlight DO and press enter.
4. Highlight DO%, then press Enter.
5. Verify the barometric pressure and salinity displayed are accurate. Once DO and temperature are stable, highlight **Accept Calibration** and press enter.

## TAKING MEASUREMENTS AND STORING DATA

1. The instrument will be in Run mode when powered on.
2. To take readings, insert the probe into the sample. Move the probe in the sample until the readings stabilize. This releases any air bubbles and provides movement if measuring DO.
3. **Log One Sample** is already highlighted in Run mode. Press enter to open a submenu. Highlight **Sites** or **Folders** and press enter to select the site or folder to log the sample to.
4. If necessary, use the keypad to create a new Site or Folder name. If Site List and Folder List are disabled in the System menu, you will not see these options when logging a sample.
5. Once the Site and/or Folder name is selected, highlight **Log Now** and press enter. The instrument will confirm that the data point was logged successfully.
6. If you would like to log at a specific interval vs. logging one sample at a time, press the **System** key. Use the arrow keys to highlight **Logging** and press enter. Enable **Continuous Mode** and adjust the time **Interval** if necessary. On the Run screen, the option to log will change from **Log One Sample** to **Start Logging** based on the time interval entered.
7. During a continuous log, the **Start Logging** dialog box on the Run screen will change to **Stop Logging**.

## UPLOADING DATA TO A PC WITH DATA MANAGER

1. Make sure Data Manager and the USB drivers are installed on the PC. The USB drivers will be installed during the Data Manager installation.
2. Connect the Communications Saddle to the back of the Pro Plus instrument and use the USB cable to connect the saddle to the USB port on the PC.
3. If connecting for the first time, Windows® may prompt you through two 'New Hardware Found' Wizard in order to complete the USB driver installation.
4. Open Data Manager on the PC and turn on the Pro Plus.
5. Click on the correct instrument in Data Manager under the **Select Instrument** heading. Once you've highlighted the correct instrument, click the **Retrieve Instrument Data** tab and check **Data, GLP, Site List, Configuration** or **Select All** options to retrieve data. Click **Start**.
6. After the file transfer is complete, the data is available for viewing, printing, and exporting from Data Manger and the data can be deleted from the Pro Plus if desired.
7. Press the File key and choose **Delete Data** if you no longer need the data on the Pro Plus.

## CONTACT INFORMATION

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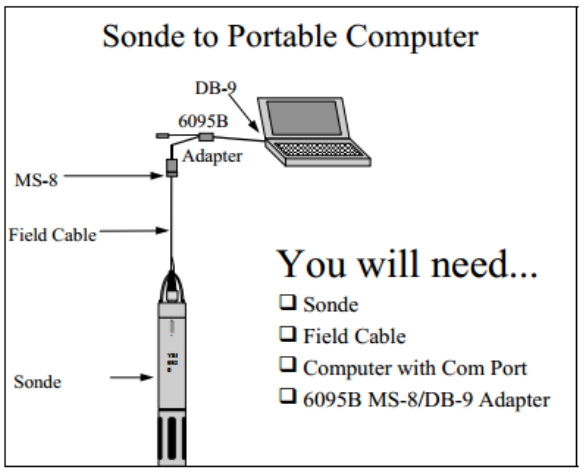
Item # 605595
Drawing # A605595
Revision B
February 2009

# *Dissolved Oxygen (ppm), pH, Salinity (ppt), Temperature (C), and Chlorophyll-a with the YSI 6920 Multi-Probe System and 600 OMS (Tier III)*

Figure 3

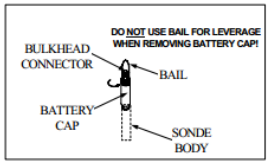



INSTALLING BATTERIES INTO THE YSI 600XLM OR 600 OMS V2-1 SONDES

To install 4 AA-size alkaline batteries into the sonde, refer to the following directions and Figure 33.

Grasp the cylindrical battery cover and unscrew by hand. Then slide the battery lid up and over the bulkhead connector. Insert batteries, paying special attention to polarity. Labeling on the battery compartment posts describes the orientation. It is usually easiest to insert the negative end of battery first and then "pop" the positive terminal into place.

Figure 33



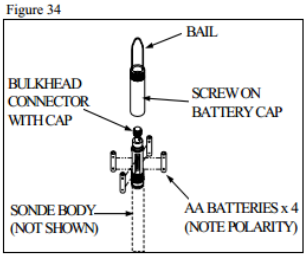

Check the O-ring and sealing surfaces for any contaminants that could interfere with the O-ring seal of the battery chamber.

***CAUTION:* Make sure that there are NO contaminants between the O-ring and the sonde. Contaminants that are present under the O-ring may cause the O-ring to leak when the sonde is deployed.**

Lightly lubricate the o-ring on the outside of the battery cover. DO NOT lubricate the internal o-ring.

Return the battery lid and tighten by hand. *DO NOT OVER-TIGHTEN.*

Figure 34



## 2.5 SONDE SOFTWARE SETUP

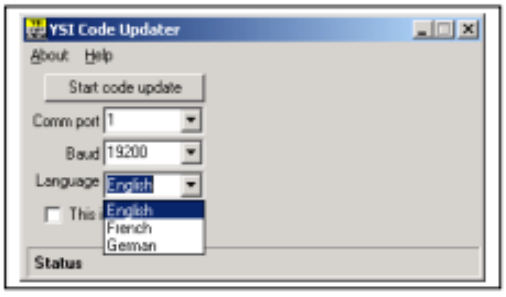
There are two sets of software at work in any YSI environmental monitoring system. One is resident in your PC and is called EcoWatch for Windows. The other software is resident in the sonde itself. In this section, you will first make sure that the language associated with your sonde software is appropriate to your application and change it if necessary. You will set up the sonde software using EcoWatch for Windows as the interface device between the sonde and your PC.

### SETTING UP THE SONDE SOFTWARE LANGUAGE

The menus in the sonde software can be viewed in English, German, or French. However, the choice of language CANNOT be made from the sonde software itself. Rather the choice must be selected via a complete update of the software itself from the YSI Website as described below. Note that the menus in your sonde will be shown in English when you receive the instrument and, if this is your language of choice, no further action is required and you should skip to the next section. If you wish to change the language of your menus to German or French, use the following instructions.

Follow the step-by-step instructions below to change the language for the menus in your 6-series sonde:

- Connect your sonde to the serial port of a PC with access to the Internet using the proper cable as described in the previous section of this manual.
- Make sure that the sonde is powered with either internal batteries or a suitable power supply.
- Access the YSI Environmental Software Downloads page at www.ysi.com/edownloads or go to main page at www.ysi.com and click on Support button in green bar.
- Log in, or if a first time user, fill out the registration form and wait for a login password via return E-mail.
- Click on the **Software** folder under the Software Downloads section.
- Inside the folder, click on the file *6-Series & 556MPS Code Updater, M-DD-YYYY* and save the file to a temporary directory on your computer.
- After the download is complete, run the file that you just downloaded and follow the on-screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI Technical Support for advice.
- Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:



- Set the Comm port number to match the port to which you connected the sonde cable and make sure that the "This is an ADV6600" selection is NOT checked.
- **NEXT, SELECT THE LANGUAGE (ENGLISH, FRENCH, OR GERMAN) WHICH WILL BE USED IN YOUR SONDE MENUS.**
- Then click on the Start Code Update button. An indicator bar will show the progress of the upgrade as shown below.


- When the update is finished (indicated on the PC screen as shown below), close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

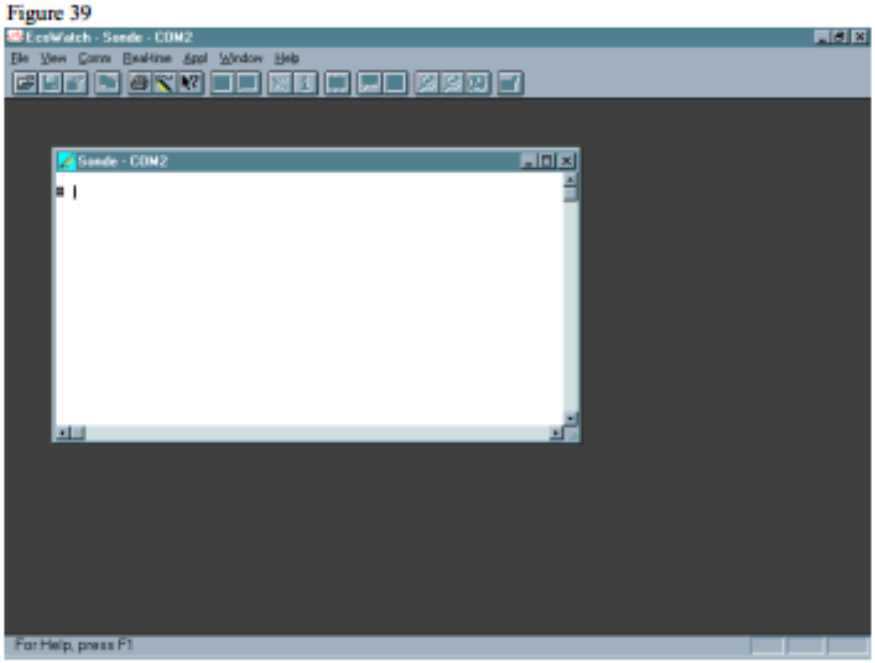

**Your sonde menus will now appear in the language which you selected prior to running the updater. If you want to change the language associated with your sonde menu, you MUST rerun the YSI Code Updater and select the new language via this mechanism.**

## INTERFACING TO THE SONDE WITH ECOWATCH FOR WINDOWS

When you select **Sonde** from the EcoWatch for Windows menus, the PC-based software begins direct communication with the sonde-based software via standard VT100 terminal emulation.

In EcoWatch for Windows, select the sonde icon,  Then select the proper Com port and confirm by clicking **OK**. A window similar to that shown below will appear indicating connection to the sonde as shown in Figure 39. Type "**Menu**" after the **#** sign, press **Enter**, and the sonde Main menu will be displayed.

Figure 39




If your sonde has previously been used, the **Main menu** (rather than the # sign) may appear when communication is established. In this case simply proceed as described below. You will not be required to type "**Menu**".

If you are unable to establish interaction with the sonde, make sure that the cable is properly connected. If you are using external power, make certain that the YSI 6651 or 6038 power supply or other 12 vdc source is properly working. Recheck the setup of the Com port and other software parameters. Also refer to **Section 6, Troubleshooting.**

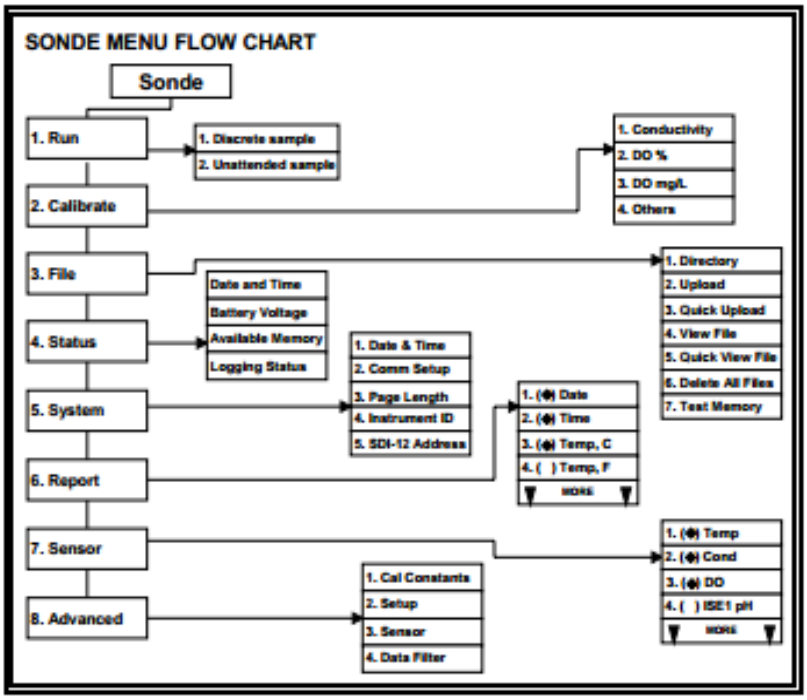
The sonde software is menu-driven. You select functions by typing their corresponding numbers. You do not need to press **Enter** after choosing a selection. Type the **0 or Esc** key to return to the previous menu.

Sonde Main Menu

```
-----------------Main----------------
1-Run                5-System
2-Calibrate          6-Report
3-File               7-Sensor
4-Status             8-Advanced

Select option (0 for previous menu):
```

Figure 40 • Sonde Menu Flow Chart




## SYSTEM SETUP

At the Main menu, select **System**. The System Setup menu will be displayed.

System Setup Menu

```
1-Date & time
2-Comm setup
3-Page length=25
4-Instrument ID=YSI Sonde
5-Circuit board SN:00003001
6-GLP filename=00003001
7-SDI-12 address=0

Select option (0 for previous menu):
```

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Select **1-Date & time**. An asterisk will appear next to each selection to confirm the entry. Press 4 and 5 to activate the date and time functions. Pay particular attention to the date format that you have chosen when entering date. You must use the 24-hour clock format for entering time. Option **4- ( ) 4 digit year** may be used so that the date will appear with either a two or four digit year display. If you do not enter the correct year format (8/30/**98** for 2-digit, 8/30/**1998** for 4 digit) your entry will be rejected.

```
-----------Date & time setup-----------
1-(*)m/d/y           4-( )4 digit year
2-( )d/m/y           5-Date=08/30/98
3-( )y/m/d           6-Time=11:12:30

Select option (0 for previous menu):
```

Select **4-Instrument ID** from the System setup menu to record the instrument ID number (usually the instrument serial number), and press **Enter**. A prompt will appear which will allow you to type in the serial number of your sonde. This will make sure that any data that is collected is associated with a particular sonde. Note that the selection **5-Circuit Board SN** shows the serial number of the PCB that is resident in your sonde (not the entire system as for Instrument ID). Unlike the **Instrument ID**, the user cannot change the **Circuit Board SN**. The **6-GLP filename** and **7-SDI-12 address** selections will be explained in Section 2.9.5

Press **Esc** or **0** to return to the **System setup** menu.

Then press **Esc** or **0** again to return to the **Main menu**.

```
------------------Main-----------------
1-Run                5-System
2-Calibrate          6-Report
3-File               7-Sensor
4-Status             8-Advanced

Select option (0 for previous menu):
```

## ENABLING SENSORS

To activate the sensors that are in your sonde, select **Sensor** from the Sonde Main menu.

```
------------Sensors enabled------------
1-(*)Time
2-(*)Temperature
3-(*)Conductivity
4-(*)Dissolved Oxy
5-(*)ISE1 pH
6-(*)ISE2 Orp
7-(*)ISE3 NH4+
8-(*)ISE4 NO3-
9-( )ISE5 NONE
A-(*)Optic T Turbidity - 6136
B-(*)Optic C Chlorophyll

Select option (0 for previous menu):
```

Note that the exact appearance of this menu will vary depending upon the sensors that are available on your sonde. Enter the corresponding number to enable the sensors that are installed on your sonde. An asterisk indicates that the sensor is enabled.

When selecting any of the ISE or Optical ports, a submenu will appear. When this occurs, make a selection so that the sensor corresponds to the port in which the sensor is physically installed. Only ORP can be enabled as ISE2. Optic T, Optic C, Optic B, and Optic O generate a submenu on selection. Each optical port can have one of six probes (6136 Turbidity, 6025 Chlorophyll, 6130 Rhodamine WT, 6131 BGA-PC, 6132 BGA-PE, or 6150 ROX Optical DO) installed as indicated by the submenus.

**NOTE CAREFULLY:** It is NOT possible to simultaneously activate BOTH the 6562 Rapid Pulse polarographic dissolved oxygen sensor and the 6150 ROX Optical dissolved oxygen sensor. Activation of either sensor will automatically deactivate the other selection. Thus, users of 6600V2-2, 6600EDS V2-2, 6820V2-1, and 6920V2-1 sondes CANNOT measure oxygen with both types of sensors.

After all installed sensors have been enabled, press **Esc or 0** to return to the Main Menu.

## ENABLING PARAMETERS

In order for a specific parameter to be displayed:

1. The sensor must first be enabled as described above.
2. That parameter must be activated in the Report Setup menu described below.

Select **Report** from the Main menu. A Report Setup menu similar to the one shown below will be displayed.

```
--------------Report setup-------------
1-(*)Date m/d/y      E-(*)Orp mV
2-(*)Time hh:mm:ss   F-(*)NH4+ N mg/L
3-(*)Temp C          G-( )NH4+ N mV
4-(*)SpCond mS/cm    H-( )NH3 N mg/L
5-( )Cond            I-(*)NO3- N mg/L
6-( )Resist          J-( )NO3- N mV
7-( )TDS             K-(*)Cl- mg/L
8-( )Sal ppt         L-( )Cl- mV
9-(*)DOsat %         M-(*)Turbid+ NTU
A-(*)DO mg/L         N-(*)Chl ug/L
B-( )DOchrg          O-(*)Chl RFU
C-(*)pH              P-(*)Battery volts
D-( )pH mV

Select option (0 for previous menu):
```

Note that the exact appearance of this menu will vary depending upon the sensors that are available and enabled on your sonde. The asterisks (*) that follow the numbers or letters indicate that the parameter will appear on all outputs and reports. To turn a parameter on or off, type the number or letter that corresponds to the parameter.

Note also that since a 6136 turbidity probe was selected in the Sensor menu above, the units of turbidity are presented as "turbid+ NTU". If a 6026 turbidity probe (which was offered by YSI up until 2002) had been selected, the units of turbidity would be presented as "turbid NTU". This designation is designed to differentiate the data from the two sensor types in later analysis.

For parameters with multiple unit options such as temperature, conductivity, specific conductance, resistivity and TDS, a submenu will appear as shown below for temperature, allowing selection of desired units for this parameter.

```
--------------Select units-------------
1-(*)NONE
2-( )Temp C
3-( )Temp F
4-( )Temp K

Select option (0 for previous menu): 2
```

After configuring your display with the desired parameters, press **Esc or 0** to return to the Main menu.

# 2.6 GETTING READY TO CALIBRATE

## 2.6.1 INTRODUCTION

### HEALTH AND SAFETY

Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review health and safety information in Appendix A of this manual. Some calibration standard solutions may require special handling.

### CONTAINERS NEEDED TO CALIBRATE A SONDE

The calibration cup that comes with your sonde serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Although not recommended except in unusual circumstances, instead of the calibration cup, you may use laboratory glassware to perform some of the calibrations. If you do not use a calibration cup that is designed for the sonde, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Guard installed. This protects the probes from possible physical damage.
- ✓ Use a ring stand and clamp to secure the sonde body to prevent the sonde from falling over. Much laboratory glassware has convex bottoms.
- ✓ Insure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other probes (e.g., temperature probe). The top vent hole of the conductivity sensor must also be immersed during calibrations.

### CALIBRATION TIPS

1. If you use the Calibration Cup for calibration of either the Rapid Pulse Polarographic or ROX Optical DO sensors in water-saturated air, make certain to loosen the seal to allow pressure equilibration before calibration.
2. If you choose to calibrate your Rapid Pulse Polarographic or ROX Optical DO sensor in air-saturated water in a separate vessel, be sure to sparge the water with an aquarium pump and air-stone for at least 1 hour to assure that the water is truly saturated with air.
3. The key to successful calibration is to insure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.
4. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the sonde. You may wish to save old calibration standards for this purpose.
5. Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions or perform the calibration near a sink where the probes can be rinsed from the tap.

6. Have several clean, absorbent paper towels or cotton cloths available to dry the sonde between rinses and calibration solutions. Shake the excess rinse water off of the sonde, especially when the probe guard is installed. Dry off the outside of the sonde and probe guard. Making sure that the sonde is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.

7. Make certain that port plugs are installed in all ports where probes are not installed. It is extremely important to keep these electrical connectors dry.

## USING THE CALIBRATION CUP

Follow these instructions to use the calibration cup for calibration procedures with all of the instruments except the 600R, 600QS, and 600 OMS V2-1. For these sondes, the over-the-guard bottle that comes with your sonde, must be used.

- ✓ Ensure that a gasket is installed in the gasket groove of the calibration cup bottom cap, and that the bottom cap is securely tightened. Note: Do not over-tighten as this could cause damage to the threaded portions of the bottom cap and tube.
- ✓ Remove the probe guard, if it is installed.
- ✓ Inspect the installed gasket on the sonde for obvious defects and if necessary, replace it with the extra gasket supplied.
- ✓ Screw the cup assembly into place on the threaded end of sonde and securely tighten. Note: Do not over tighten as this could cause damage to the threaded portions of the bottom cap and tube.
- ✓ Sonde calibration can be accomplished with the sonde upright– i.e. the cable connector end of the sonde is oriented above the probe end, or inverted where the orientation is reversed. A separate clamp and stand, such as a ring stand, is required to support the sonde in the inverted position.
- ✓ When using the Calibration Cup for dissolved oxygen calibration in water-saturated air, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly, depending on orientation, and that approximately 1/8" of water is present in the cup.

**NOTE CAREFULLY:** If you are calibrating a 6136 turbidity sensor for use with a 6820V2-1, 6920V2-1, 6600V2-2, or 6600EDS V2-2, you can use either the calibration cup supplied with your sonde or an optional extended length cup for the calibration. Please see the section below which describes the special calibration recommendations for this sensor.

## 2.6.2 CALIBRATION PROCEDURES

The following calibration procedures are the most commonly used methods for the 6-series sensors. For detailed information on all calibration procedures, refer to Section 2.9.2, Calibrate.

To ensure more accurate results, you can rinse the calibration cup with water, and then rinse with a small amount of the calibration solution for the sensor that you are going to calibrate. Discard the rinse solution and add fresh calibrator solution. Use tables 1-8 to find the correct amount of calibrator solution.

1. Carefully immerse the probes into the solution and rotate the calibration cup to engage several threads. YSI recommends supporting the sonde with a ring stand and clamp to prevent the sonde from falling over.

2. With the proper cable, connect the sonde to a PC, access EcoWatch for Windows and proceed to the Main menu (for information on how to run EcoWatch for Windows software, see Section 2.4.2, Running EcoWatch Software). From the sonde Main menu, select 2-Calibrate.

```
---------------Calibrate---------------
1-Conductivity        6-ISE3 NH4+
2-Dissolved Oxy       7-ISE4 NO3-
3-Pressure-Abs        8-Optic T-Turbidity-6026
4-ISE1 pH             9-Optic C-Chlorophyll
5-ISE2 ORP

Select option (0 for previous menu):
```





3. Note that the exact appearance of this menu will vary depending upon the sensors that are available and enabled on your sonde. To select any of the parameters from the Calibrate menu, input the number that is next to the parameter. Once you have chosen a parameter, some of the parameters will have a number that appears in parentheses. These are the default values and will be used during calibration if you press Enter without inputting another value. Be sure not to accept default values unless you have assured that they are correct. If no default value appears, you must type a numerical value and press Enter.

4. After you input the calibration value, or accept the default, press Enter. A real-time display will appear on the screen. Carefully observe the stabilization of the readings of the parameter that is being calibrated. When the readings have been stable for approximately 30 seconds, press Enter to accept the calibration. The calibrated value is bolded on the example screen on the following page.

5. Press Enter to return to the Calibrate menu, and proceed to the next calibration.

## ROX OPTICAL DISSOLVED OXYGEN

Place the sensor either (a) into a calibration cup containing about 1/8 inch of water which is vented by loosening the threads or (b) into a container of water which is being continuously sparged with an aquarium pump and air stone. Wait approximately 10 minutes before proceeding to allow the temperature and oxygen pressure to equilibrate.

Select ODOsat % and then 1-Point to access the DO calibration procedure. Calibration of your Optical dissolved oxygen sensor in the DO % procedure also results in calibration of the DO mg/L mode and vice versa.

Enter the current barometric pressure in mm of Hg. (Inches of Hg x 25.4 = mm Hg).

*Note:* Laboratory barometer readings are usually "true" (uncorrected) values of air pressure and can be used "as is" for oxygen calibration. Weather service readings are usually not "true", i.e., they are corrected to sea level, and therefore cannot be used until they are "uncorrected". An approximate formula for this "uncorrection" (where the BP readings MUST be in mm Hg) is:

True BP = [Corrected BP] – [2.5 * (Local Altitude in ft above sea level/100)]

Press Enter and the current values of all enabled sensors will appear on the screen and change with time as they stabilize. Observe the readings under ODOsat %. When they show no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted and prompt you to press Enter again to return to the Calibrate menu.

The minor advantages and disadvantages of calibration in air-saturated water versus water-saturated air are outlined in **Appendix M, ROX Optical DO Sensor**

NOTE CAREFULLY: As opposed to the 6562 Rapid Pulse Polarographic DO sensor described above, there is no difference between the calibration routine for sensors which will be used for sampling or monitoring applications. Usually the Autosleep RS-232 feature in the Advanced|Setup menu will be activated for ROX calibrations, but there is no problem if it is not active.

Rinse the sonde in water and dry the sonde.





## DEPTH AND LEVEL

For the depth and level calibration, make certain that the depth sensor module is in air and not immersed in any solution.

From the Calibrate menu, select Pressure-Abs (or Pressure-Gage if you have a vented level sensor) to access the depth calibration procedure. Input 0.00 or some known sensor offset in feet. Press Enter and monitor the stabilization of the depth readings with time. When no significant change occurs for approximately 30 seconds, press Enter to confirm the calibration. This zeros the sensor with regard to current barometric pressure. Then press Enter again to return to the Calibrate menu.

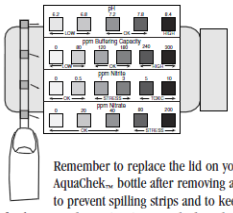
For best performance of depth measurements, users should ensure that the sonde's orientation remains constant while taking readings. This is especially important for vented level measurements and for sondes with side mounted pressure sensors.

## *pH, Nitrite, and Nitrate with Aquacheck Colorimetry (Tier I)*

1851 R11-98.Pond-4way.ps - 1/27/2006 11:19 AM

**AquaChek™ POND TEST STRIPS**

AquaChek™ is a test for pH, Buffering Capacity, Nitrite and Nitrate levels in your pond. The test pads on the strip will change color to indicate the levels in your pond.



Remember to replace the lid on your AquaChek™ bottle after removing a strip to prevent spilling strips and to keep them fresh. **Keep the strips in a cool, dry place**, and leave the packet of drying agent in the bottle — it will help keep the test strips at their best.

**Follow these easy, step-by-step instructions**

**Step 1**

Remove an AquaChek™ Pond Test Strip from the bottle and replace the cap tightly. Dip test strip into your pond water for 1 second and remove. Do not shake excess water from strip.

**Step 2**

Hold strip level for 30 seconds.


**Step 3**

pH

Compare the end pad of the strip to the pH color chart on the label. The pH pad should turn a shade of red-orange, between 7.2 and 7.8.

Buffering Capacity

Compare the second pad from the end of the strip to the Buffering Capacity color chart on the label. The Buffering Capacity pad should turn a shade of green. The correct range is 120 ppm (parts per million) to 180 ppm.

Nitrite

Compare the third pad from the end of the strip to the Nitrite color chart on the label. The Nitrite pad should remain white or turn a shade of pink. The safe range is between 0 ppm and 0.5 ppm.

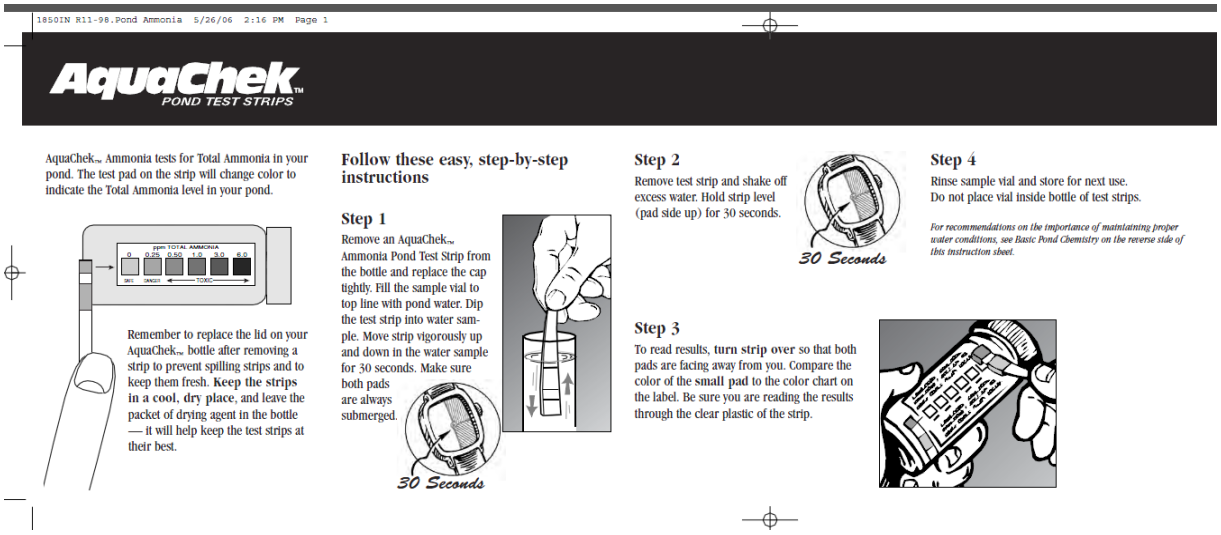
**Step 4**

Nitrate

At 60 seconds after dipping strip, compare the pad nearest the handle to the Nitrate color chart on the label. The pad should remain tan or turn a shade of pink. The safe range is between 0 ppm and 40 ppm.


*For recommendations on the importance of maintaining proper water conditions, see the reverse side of this instruction sheet.*

## *Ammonia with Aquacheck Colorimetry (Tier I)*



1850IN R11-98.Pond Ammonia 5/26/06 2:16 PM Page 1

AquaChek™ POND TEST STRIPS

AquaChek™ Ammonia tests for Total Ammonia in your pond. The test pad on the strip will change color to indicate the Total Ammonia level in your pond.

ppm TOTAL AMMONIA 0 0.25 0.50 1.0 3.0 6.0 SAFE DANGER TOXIC

Remember to replace the lid on your AquaChek™ bottle after removing a strip to prevent spilling strips and to keep them fresh. **Keep the strips in a cool, dry place**, and leave the packet of drying agent in the bottle — it will help keep the test strips at their best.

**Follow these easy, step-by-step instructions**

**Step 1**
Remove an AquaChek™ Ammonia Pond Test Strip from the bottle and replace the cap tightly. Fill the sample vial to top line with pond water. Dip the test strip into water sample. Move strip vigorously up and down in the water sample for 30 seconds. Make sure both pads are always submerged.

30 Seconds

**Step 2**
Remove test strip and shake off excess water. Hold strip level (pad side up) for 30 seconds.

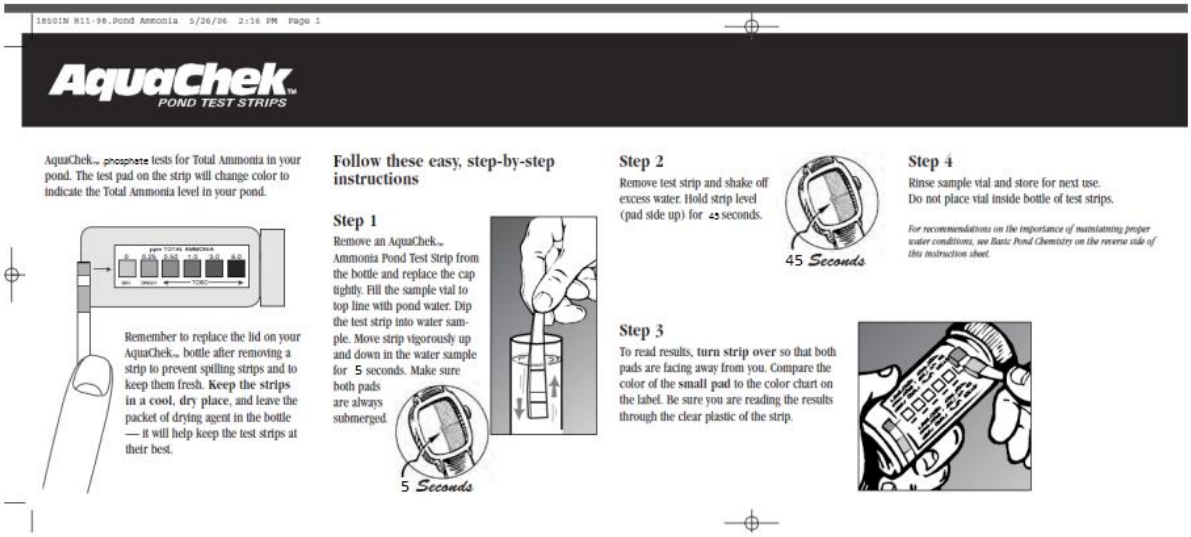
30 Seconds

**Step 3**
To read results, **turn strip over** so that both pads are facing away from you. Compare the color of the **small pad** to the color chart on the label. Be sure you are reading the results through the clear plastic of the strip.

**Step 4**
Rinse sample vial and store for next use.
Do not place vial inside bottle of test strips.

*For recommendations on the importance of maintaining proper water conditions, see Basic Pond Chemistry on the reverse side of this instruction sheet.*

## *Phosphate with Aquacheck Colorimetry (Tier I)*



1850IN R11-98.Pond Ammonia 5/26/06 2:16 PM Page 1

AquaChek™ POND TEST STRIPS

AquaChek™ phosphate tests for Total Ammonia in your pond. The test pad on the strip will change color to indicate the Total Ammonia level in your pond.

ppm TOTAL AMMONIA 0 0.25 0.50 1.0 3.0 6.0 SAFE DANGER TOXIC

Remember to replace the lid on your AquaChek™ bottle after removing a strip to prevent spilling strips and to keep them fresh. **Keep the strips in a cool, dry place**, and leave the packet of drying agent in the bottle — it will help keep the test strips at their best.

**Follow these easy, step-by-step instructions**

**Step 1**
Remove an AquaChek™ Ammonia Pond Test Strip from the bottle and replace the cap tightly. Fill the sample vial to top line with pond water. Dip the test strip into water sample. Move strip vigorously up and down in the water sample for 5 seconds. Make sure both pads are always submerged.

5 Seconds

**Step 2**
Remove test strip and shake off excess water. Hold strip level (pad side up) for 45 seconds.

45 Seconds

**Step 3**
To read results, **turn strip over** so that both pads are facing away from you. Compare the color of the **small pad** to the color chart on the label. Be sure you are reading the results through the clear plastic of the strip.

**Step 4**
Rinse sample vial and store for next use.
Do not place vial inside bottle of test strips.

*For recommendations on the importance of maintaining proper water conditions, see Basic Pond Chemistry on the reverse side of this instruction sheet.*

# *Ammonia (ppm) with Palintest Colorimetry Based on the Indophenol Method (Tier II)*

**Test Instructions**

1 Fill test tube with sample to the 10 ml mark.
2 Add one Ammonia No 1 tablet and one Ammonia No 2 tablet, crush and mix to dissolve.
3 Stand for ten minutes to allow colour development.
4 Select Phot 4 on Photometer to measure Ammonia mg/l N or select Phot 62 on Photometer to measure Ammonium mg/l $NH_4$.
5 Take Photometer reading in usual manner (see Photometer instructions).

**Sea Water Samples**

Palintest Ammonia Conditioning Reagent is required when testing sea water or brackish water samples to prevent precipitation of salts. The reagent is supplied in a special 'spoon pack' to aid measuring out the powder.

Fill the test tube with sample to the 10 ml mark, and add one level spoonful of conditioning reagent. Mix to dissolve reagent then continue the test as described in the above test instructions. If turbidity still forms in the test, repeat using two level spoonfuls of conditioning reagent.

**Notes**

1 At low temperatures the rate of colour development in the test may be slower. If the sample temperature is below 20°C allow 15 minutes for the colour to develop.
2 Ammonia concentrations can be expressed in a number of different ways. The following factors may be used for the conversion of readings :-

To convert from N to $NH_4$ multiply by 1.3.
To convert from N to $NH_3$ multiply by 1.2.

---

Palintest®
**TEST INSTRUCTIONS**

**PHOT.4.AUTO**

**Photometer Method**

# AMMONIA

**TEST FOR AMMONIA IN NATURAL, DRINKING AND WASTE WATERS**

**AUTOMATIC WAVELENGTH SELECTION**

**0 – 1.0 mg/l N**

Ammonia occurs as a breakdown product of nitrogenous material in natural waters. It is also found in domestic effluents and certain industrial waste waters. Ammonia is harmful to fish and other forms of aquatic life, and the ammonia level must be carefully controlled in water used for fish farms and aquariums. Ammonia tests are routinely applied for pollution control on effluents and waste waters, and for the monitoring of drinking water supplies.

The Palintest Ammonia Test provides a simple method of measuring ammonia (ammoniacal nitrogen) over the range 0 - 1.0 mg/l N.

**Method**

The Palintest Ammonia test is based on an indophenol method. Ammonia reacts with alkaline salicylate in the presence of chlorine to form a green-blue indophenol complex. Catalysts are incorporated to ensure complete and rapid colour development. The reagents are provided in the form of two tablets for maximum convenience. The test is simply carried out by adding one of each tablet to a sample of the water.

The intensity of the colour produced in the test is proportional to the ammonia concentration and is measured using a Palintest Photometer.

**Reagents and Equipment**

Palintest Ammonia No 1 Tablets
Palintest Ammonia No 2 Tablets
Palintest Automatic Wavelength Selection Photometer
Round Test Tubes, 10 ml glass (PT 595)

## *Phosphate (ppm) with Palintest Colorimetry Based on Vanadomolybdate Method (Tier II)*

114

**Palintest®**

# PHOSPHATE HR

**PHOSPHATE PHOSPHAT FOSFAAT FOSFAT FOSFATOS FOSFATI**

**Reagents/Réactifs/Reagenzien/Reactivos:**

Palintest Phosphate HR
Palintest Phosphate SR

| mg/l $PO_4$ | PHOSPHATE PHOSPHAT FOSFAAT FOSFAT FOSFATOS | | | | | | | | | 490 nm |
|---|---|---|---|---|---|---|---|---|---|---|
| %T | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 90 | - | - | - | 0.0 | 0.7 | 1.8 | 2.9 | 4.1 | 5.2 | 6.4 |
| 80 | 7.5 | 8.7 | 9.9 | 11 | 12 | 14 | 15 | 16 | 18 | 19 |
| 70 | 20 | 21 | 23 | 24 | 26 | 27 | 28 | 30 | 31 | 33 |
| 60 | 34 | 36 | 38 | 39 | 41 | 42 | 44 | 46 | 47 | 49 |
| 50 | 51 | 53 | 55 | 56 | 58 | 60 | 62 | 64 | 65 | 68 |
| 40 | 71 | 73 | 75 | 77 | 80 | 82 | 84 | 87 | 89 | 92 |
| 30 | 95 | 97 | 100 | - | - | - | - | - | - | - |

**Test Instructions** **ENGLISH**

These instructions apply with the following test equipment. Use correct grade of tablets for test equipment in use - see packet.

Comparator - Disc CD 114
Pocket Kit - TestCard CC 114
Direct-reading Photometer
- select Program Phot 29
Transmittance-display Photometer (490 nm)
- use Calibration Chart

1 Fill test tube to 10 ml mark.

2 ONLY FOR SILICA CONTAINING SAMPLES (>20 mg/l):
Add one Phosphate SR tablet, crush and mix to dissolve.

3 Add one Phosphate HR, crush and mix to dissolve.

4 Stand for 10 minutes.

5 Take the test reading (see instrument instructions).

**Instructions de Test** **FRANÇAIS**

Les instructions s'appliquent aux équipment suivants: (Utiliser les pastilles adéquates au type de matérial - voir emballage).

Comparateur - Disque CD 114
Kit de Poche - TestCard CC 114
Photomètre à lecture directe
- sélectionner le programme Phot 29
Photometre en % de transmission (490 nm)
- utiliser la table de calibration

1 Remplir le tube jusqu'au 10 ml.

2 UNIQUEMENT POUR LES ECHANTILLONS CONTENANT DU SILICE (>20 mg/l):
Ajouter une pastille 'Phosphate SR', écraser et remuer pour dissoudre.

3 Ajouter une pastille 'Phosphate HR', écraser et remuer pour dissoudre.

4 Attendre 10 minutes.

5 Lire le résultat (voir mode d'emploi de l'instrument).

## *Nitrate (ppm) with the Palintest Nitratest Colorimetry Method (Tier II)*

**Test Procedure**

1 Fill the Nitratest Tube with sample to the 20 ml mark.
2 Add one level spoonful of Nitratest Powder and one Nitratest tablet. Do not crush the tablet. Replace screw cap and shake tube well for one minute.
3 Allow tube to stand for about one minute then gently invert three or four times to aid flocculation. Allow tube to stand for two minutes or longer to ensure complete settlement.
4 Remove screw cap and wipe around the top of the tube with a clean tissue. Carefully decant the clear solution into a round test tube, filling to the 10 ml mark.
5 Add one Nitricol tablet, crush and mix to dissolve.
6 Stand for 10 minutes to allow full colour development.
7 Select Phot 23 on Photometer for result as mg/l N, or Phot 63 for result as mg/l $NO_3$.
8 Take Photometer reading in usual manner (see Photometer instructions).

**Note**

*To convert mg/l N to mg/l $NO_3$ multiply result by 4.4.*

Concentrations of nitrate greater than 1.0 mg/l may be determined by diluting the original sample with deionised water. The test can be conveniently carried out over a range 0 - 20 mg/l N as follows :-

Take a clean Nitratest Tube. Add 1 ml of sample using a pipette or graduated dropper. Fill the Nitratest Tube to the 20 ml mark with deionised water. Continue the test procedure as given in steps 2 to 9 above. Multiply the chart reading obtained by 20 to obtain the nitrate concentration in the original sample.

**Nitrite Correction**

The Nitratest method will also respond to any nitrite present in the sample. In most natural and drinking waters the amount of nitrite will be small in comparison to the nitrate concentration. If it is desired to correct for nitrite, determine nitrite concentration (as mg/l N) in the prescribed manner (see PHOT.24.) and deduct from the nitrate concentration (as mg/l N) obtained from the Nitratest procedure.

V1-10/05

Palintest®

**TEST INSTRUCTIONS**

**PHOT.23.AUTO**

**Photometer Method**

# NITRATE (NITRATEST)

**AUTOMATIC WAVELENGTH SELECTION**

**TEST FOR NITRATE IN NATURAL, DRINKING AND WASTE WATERS**

**0 – 1 mg/l N**
**0 – 20 mg/l N**

Nitrates are normally present in natural, drinking and waste waters. Nitrates enter water supplies from the breakdown of natural vegetation, the use of chemical fertilisers in modern agriculture and from the oxidation of nitrogen compounds in sewage effluents and industrial wastes.

Nitrate is an important control test for water supplies. Drinking waters containing excessive amounts of nitrates can cause methaemoglobinaemia in bottle-fed infants (blue babies). The EEC has set a recommended maximum of 5.7 mg/l N (25 mg/l $NO_3$) and an absolute maximum of 11.3 mg/l N (50 mg/l $NO_3$) for nitrate in drinking water.

The Palintest Nitratest method provides a simple test for nitrate nitrogen over the range 0 - 1 mg/l N. The test can however be extended to cover the range 0 - 20 mg/l by a simple dilution technique.

**Method**

In the Palintest Nitratest method nitrate is first reduced to nitrite, the resulting nitrite is then determined by a diazonium reaction to form a reddish dye.

The reduction stage is carried out using the unique zinc-based Nitratest Powder, and Nitratest Tablet which aids rapid flocculation after the one minute contact period. The test is conducted in a special Nitratest Tube - a graduated sample container with hopper bottom to facilitate settlement and decanting of the sample.

The nitrite resulting from the reduction stage, is determined by reaction with sulphanilic acid in the presence of N-(1-naphthyl)-ethylene diamine to form a reddish dye. The reagents are provided in a single Nitricol tablet which is simply added to the test solution.

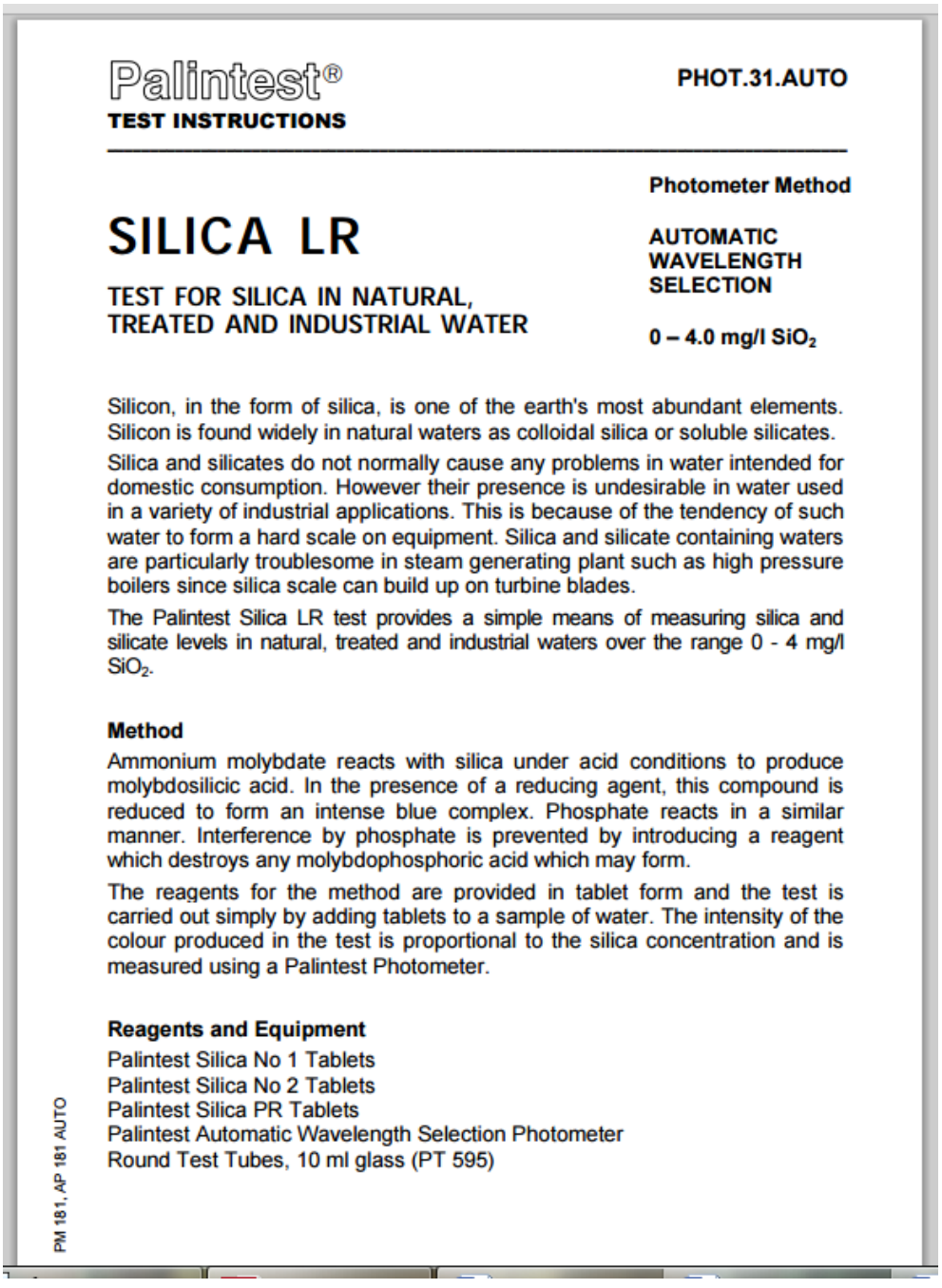
The intensity of the colour produced in the test is proportional to the nitrate concentration and is measured using a Palintest Photometer.

**Reagents and Equipment**

Palintest Nitratest Powder (Spoon Pack)
Palintest Nitratest Tablets
Palintest Nitricol Tablets
Palintest Nitratest Tube, 20 ml (PT 526)
Palintest Automatic Wavelength Selection Photometer
Round Test Tubes, 10 ml (PT 595)

PM 163 AUTO

## *Silicate (ppm) with the Palintest Colorimetry Method (Tier II)*



Palintest®
**TEST INSTRUCTIONS**

**PHOT.31.AUTO**

**Photometer Method**

# SILICA LR

**TEST FOR SILICA IN NATURAL, TREATED AND INDUSTRIAL WATER**

**AUTOMATIC WAVELENGTH SELECTION**

**0 – 4.0 mg/l $SiO_2$**

Silicon, in the form of silica, is one of the earth's most abundant elements. Silicon is found widely in natural waters as colloidal silica or soluble silicates.

Silica and silicates do not normally cause any problems in water intended for domestic consumption. However their presence is undesirable in water used in a variety of industrial applications. This is because of the tendency of such water to form a hard scale on equipment. Silica and silicate containing waters are particularly troublesome in steam generating plant such as high pressure boilers since silica scale can build up on turbine blades.

The Palintest Silica LR test provides a simple means of measuring silica and silicate levels in natural, treated and industrial waters over the range 0 - 4 mg/l $SiO_2$.

**Method**

Ammonium molybdate reacts with silica under acid conditions to produce molybdosilicic acid. In the presence of a reducing agent, this compound is reduced to form an intense blue complex. Phosphate reacts in a similar manner. Interference by phosphate is prevented by introducing a reagent which destroys any molybdophosphoric acid which may form.

The reagents for the method are provided in tablet form and the test is carried out simply by adding tablets to a sample of water. The intensity of the colour produced in the test is proportional to the silica concentration and is measured using a Palintest Photometer.

**Reagents and Equipment**

Palintest Silica No 1 Tablets
Palintest Silica No 2 Tablets
Palintest Silica PR Tablets
Palintest Automatic Wavelength Selection Photometer
Round Test Tubes, 10 ml glass (PT 595)

PM 181, AP 181 AUTO

**Test Instructions**

1 Fill test tube with sample to the 10 ml mark

2 Add one Silica No 1 tablet, crush and mix to dissolve. Stand for five minutes to allow the silica to react.

3 Add one Silica PR tablet, crush and mix to dissolve. (This stage may be omitted if the sample is known to be completely free of phosphate).

4 Add one Silica No 2 tablet, crush and mix to dissolve. Stand for one minute to allow full colour development.

5 Select Phot 31 on Photometer.

6 Take Photometer reading in usual manner (see Photometer instructions).

7 The result is displayed as mg/l $SiO_2$.

**Note**

For testing high levels of Silica the Palintest Silica HR test should be used. The range of this test is 0 - 100 mg/l (see Test Instruction Phot 56).

Palintest®

**PHOT.56.AUTO**

**TEST INSTRUCTIONS**

# SILICA HR

**Photometer Method**

**AUTOMATIC WAVELENGTH SELECTION**

## TEST FOR SILICA IN NATURAL AND INDUSTRIAL WATERS

**0 – 150 mg/l $SiO_2$**

Silicon, in the form of silica, is one of the earth's most abundant elements. Silicon is found widely in natural waters as colloidal silica or soluble silicates.

Silica and silicates do not normally cause any problems in water intended for domestic consumption. However, their presence is undesirable in water used in a variety of industrial applications. This is because of the tendency of such water to form a hard scale on equipment. Silica and silicate containing waters are particularly troublesome in steam generating plant such as high pressure boilers since silica scale can build up on turbine blades.

Formulations containing silicate are used in industrial water treatment, as it is necessary to control the silicate within specified levels.

The Palintest Silica test provides a simple means of measuring silica and silicate levels in natural, treated, industrial and cooling waters over the range 0 - 150 mg/l $SiO_2$.

### Method

Sodium molybdate reacts with silica under acid conditions to produce molybdosilicic acid. Phosphate reacts in a similar manner. Interference by phosphate is prevented by introducing a reagent that destroys any molybdo-phosphoric acid which may form.

The reagents for the method are provided in tablet form and the test is carried out simply by adding tablets to a sample of water. The intensity of the colour produced in the test is proportional to the silica concentration and is measured using a Palintest Photometer.

PM 290, AP 290 AUTO

### Reagents and Equipment

Palintest Silica HR No 1 Tablets
Palintest Silica HR No 2 Tablets
Palintest Silica PR Tablets
Palintest Automatic Wavelength Selection Photometer
Round Test Tubes, 10 ml glass (PT 595)

**Test Procedure**

1 Fill the test tube with sample to the 10 ml mark.

2 Add one Silica No 1 tablet, crush and mix to dissolve.

3 Add one Silica No 2 tablet, crush and mix to dissolve. Stand for 10 minutes to allow full colour development.

4 Add one Silica PR tablet, crush and mix to dissolve. Stand for two minutes. (This stage may be omitted if the sample is known to be completely free of phosphate and chlorine).

5 Select Phot 56 on Photometer.

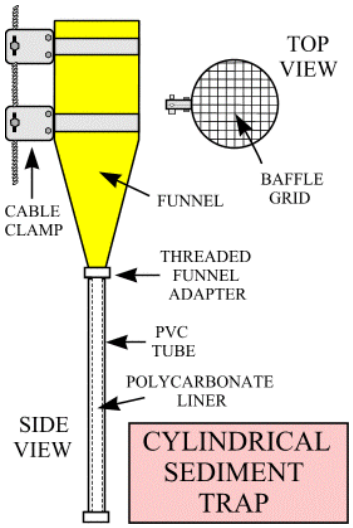
6 Take Photometer reading in usual manner (see Photometer instructions).

7 The result is displayed as mg/l $SiO_2$.

## *Sedimentation Rate (Tier III)*

(From USGS: http://pubs.usgs.gov/of/2000/of00-358/text/chapter1.htm in Reid, *et. al.* 2015),

01. Continuous water movement makes measuring sediment movement across the benthos particularly difficult. A trap to measure sedimentation within a oyster and invertebrate colonization device placed on the benthos will incorporate features of both a bedload sediment trap (e.g. Emerson 1991) and a suspended sediment trap (*e.g.* USGS http://pubs.usgs.gov/of/2000/of00-358/text/chapter1.htm), diagram below. However, no attempt should be made to separate sediment into grain sizes; a sum total will be ok for the purposes of the protocol (bearing in mind also that detritus and possibly organisms will form part of the sediment mass).
02. Data will be in the form of a single mass of sediment per trap (which could be scaled against the time that the trap had been deployed)



# *Benthic Grabs: Procedures for the Collection and Analysis of Benthic Organism Populations (Tier I)*

**Materials list**

| *Item* | *Catalog Co.* | *Cat. #/ISBN* | *Qty.* | *Purpose* |
|---|---|---|---|---|
| Bucket | | | 2 | To obtain water so that samples may be sieved through |
| Eckman Benthic Grabber | | | 1 | To obtain our sample |
| Metal Trays | | | 2 | To hold any found samples |
| Digital Microscope | | | 2 | Used to get a better visual of sample for identification |
| Dissection Kit | | | 2 | Move around and observe samples |
| Petri Dish | | | 5 | Used to hold specific samples |
| Rodi Water | | | 3 | To rinse of the equipment |
| Permanent Marker | | | 2 | To mark zip lock bags |
| Zip lock bags | | | 9 | Will hold various samples from multiple test sites |
| Sieve (500um) | | | 2 | To go through the benthic samples |
| Identification Key | | | - | To keep track of data being uploaded |
| Digital weighing scale | | | 1 | To weigh the total mass of every sample we get |
| Weights | | | - | To fight against currents when sampling |

**Field Sample Collection**

01. Fill one bucket with water. Using an empty 5 gallon bucket weigh its weight with a digital weighing scale.
02. Tare the weight until the scale reads 0.00 .
03. Position jaw springs so that they are placed on top of the circular metal pieces on the side, to ensure that the grab will close properly.
04. Adjust the benthic grab cables so that they are held upward and hold the jaws open.
05. Make sure the sampler has enough slack in the line to lower the benthic grab when it's ready to be lowered.
06. Slowly lower the benthic grab. Wait, until it reaches the bottom of the water body.
07. Place messenger to the line. Hold line straight and throw the messenger down the line fast and with force.
08. Bring messenger up to the surface. Let water drain out before putting into the bucket.
09. Place the ENTIRE sample into the bucket. Use a plastic spoon or your finger if you have gloves on.
10. Weigh the bucket and record onto data sheet.
11. Fill the sieve an approximate ¾ of the way with the mud sample. Have the water bucket under when sample is being place into the sieve.
12. Pour water from a separate water bucket over the mud until sediments are watered down and organisms can be easily picked out and seen.
13. Label a Ziploc bag with a sharpie and place the macro organisms into the Ziploc bag using forceps.
14. Record the date and sample location, along with the original sample weight in the samplers research journal, and on the bag.
15. When done placing the macro organisms found in the sample, close the Ziploc bag and place it into the cooler.
16. Duplicate sampling at each site about two (2) or three (3) times.
17. Rinse out buckets for use at the next site.

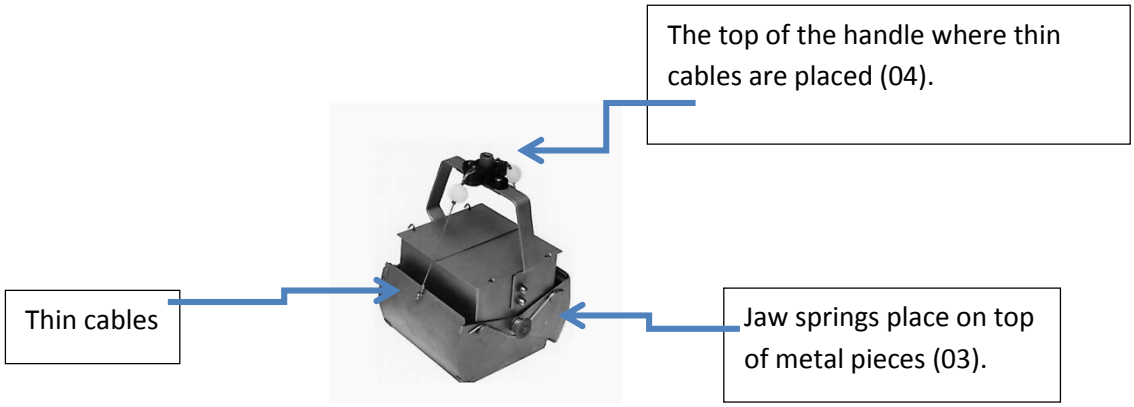



Figure. Benthic Sampler (Eckman Grab) (Source www.hoskin.ca)

**Lab Sample Processing**

01. Fill an empty bucket with warm water.
02. Set up microscopes in the lab and the light lamp correctly.
03. Take the Ziploc bag samples out of the freezer and place samples into bucket.
04. Allow the bag to defrost in the water before analyzing the samples, (Approximately 10-12 minutes).
05. Remove organism from bags, and place on Petri dish.
06. Turn the microscope light on, if necessary.
07. Use dissecting kit tools to move the organism across the petri dish surface.
08. Use *Marine Animals of Southern New England and New York* to identify any organisms you may find.
09. Record any identified organisms found into data sheet.
10. Place processed sample back into Ziploc bag, and label with the "process" symbol and the date with a permanent marker. Do the same in your research journal.

## *Phytoplankton Chlorophyll-a Sampling*

See YSI 6920 sampling above which describes chlorophyll-a measures.

# *Phytoplankton Beta Bottle Sampling*

(From Suthers and Rissik, 2009)

**Materials list**

| Materials | Purpose | Quantity |
|---|---|---|
| Beta Bottle (1.7L) | Capture sample | 1 |
| Bucket (5 gallon) | Hold sample | 2 |
| Glass Sample Jars (100mL) labeled | Contain plankton samples | 7 |
| Lugol's Iodine Solution (200mL bottle) | Preserve samples | 1 |
| Cooler | Store plankton samples | 1 |
| Ice Packs (Large) | Preserve samples | 3 |
| Sink | Thaw plankton samples | 1 |
| Pipette (20mL) and Pear | Drawing volume to concentrate subsample | 1 |
| Plastic Pipette (1mL) | A) Add Lugol's Iodine Solution to sample &<br>B) Apply plankton samples on Sedgwick-Rafter Counting Cell | 2 |
| Plankton Field Data Table | Record sample obtaining | 1 |
| Plankton Lab Data Table | Record sample processing | 1 |
| Graduated Cylinder (100mL) | Allow subsample to settle | 7 |
| Sedgwick-Rafter Counting Cell and slip | Process phytoplankton samples | 3-6 |
| Digital Microscope | Observe and take pictures of plankton samples | 1 |
| Dichotomous Key | Identify species in plankton samples | 1 |

**Field Sample Collection**

01. Populate field data table
02. Lower set Beta bottle to 1.0m below the surface
03. Replicate x 2
04. Pour replicate contents into 2 separate buckets
05. Mix contents of each bucket
06. Take a 100mL subsample from the well mixed bucket
07. Preserve with Lugol's Iodine preservative solution (sample settles quicker with preservative for lab steps)
08. Take an additional 100 mL subsample without preserving and add to cooler for live organism i.d.
09. Populate field data table

**Lab Sample Processing**

01. Take plankton sample vials out of cooler/storage
02. Place sample in a 100mL graduated cylinder and let rest for 24 hours (more if nanoplankton are present) in order for plankton to settle
03. Draw off the top exactly 90mL from the cylinder with a large (*e.g.* 20ml) pipette and pear or suction pipette (use care not to disturb cells at bottom of cylinder)
04. This gives a 10x concentration
05. Mix 10mL subsample thoroughly by swirling
06. Add Sedgwick-Rafter* counting cell to the microscope stage
07. Place cover slip** obliquely on chamber with just one corner open
08. Decant 1mL subsample carefully into the one corner with a Pasteur pipette until slip just begins to float
09. Rotate slip completely to cover chamber (this avoids introducing air bubbles into subsample)
10. Let sample stand in chamber for 15min to allow plankton to settle to the bottom
11. Count at 100x magnification and use high power if there is a need to ID small sized algal cells
12. Identify and count each taxon (that is, each species or 'type') using the steps that continue:
13. A. Count a required minimum of 30 squares by determining the squares randomly using the special plankton die (there are 50 squares across and 20 squares down) OR
    B. To avoid differential settling (plankton concentrate towards the edges), as an alternative to random box counting, count a row across (traverse) of 40 boxes
14. On the lab data table record the number of grid squares counted as well as the number of algal species or 'types' counted
15. If an algal species or 'type' lies across the line engraved in the base of the counting cell so that if falls between two squares, the simple **RULE**: is that if it lies on the right side of the square grid include it in the count, but if it lies on the left side, exclude it. Similarly, if it falls across the top line of the square, include it, but exclude any algal units falling across the bottom. Algal units are often smaller than the width of the lines engraved, so the same applies for any units lying within the grid lines delineating the squares
16. The number of algal units present per 1mL within the actual water body is calculated as:

$$\text{No. of units/mL} = \frac{(\text{Units counted } \mathbf{x}\ 1000\text{mm}^3)}{\text{---------------------------------------------------------------------------------}}$$

(No. grid squares counted **x** concentration factor - typically 10)

17. For filamentous and colonial units, it's necessary to convert units/mL to cells/mL. To do this, figure out how many cells in the typical colony of filament and multiply by that number. However, cyanobacteria don't have a uniform number of cells. For cyanobacteria:
    a. Find 30 random filaments
    b. Count the number of cells in each
    c. Average the amount
    d. Multiply by Units to convert top cell/mL
18. If samples contain large colonies or tangled aggregations of filaments containing thousands of cells making it impossible to count take discard the sample. If the second is the same as the first, estimate a portion of the colony or aggregation – say 5% or 10% of the total colony size – and count or estimate the number of within that portion. Remember that the colonies or aggregations are three dimensional and cells will fall out of the plane of focus. Once you have an estimate of the number of cells of 5% or 10% of the colony, multiply this by 20 or 10, respectively, to obtain an estimate of the total cells per colony. This procedure can introduce large error and are indicative of a possible algal bloom and thus is only acceptable for sampling during blooms. This must be stated in results. Sonification or homogenization by chemicals is unacceptable.

*[Sedgwick-Rafter Cell – is a four sided counting chamber that is 50mm long by 20mm wide by 1mm deep, giving a bottom area of 1000mm$^2$, and an internal volume of 1mL; they have a grid engraved on the bottom, with lines 1mm apart; if correctly calibrated and filled, the volume of sample covering each grid square is 1mm$^2$; used on the stage of a compound microscope]

** Cover the Sedgwick-Rafter counting chamber with a thin (No. 01 thickness) cover slip

## *Vertical Zooplankton Tows (Tier I)*

(Adapted from Suthers and Rissik, 2009)

According to Suthers and Rissik (2009), "vertical hauls provide a depth-integrated plankton sample, and are useful for broad-scale spatial surveys of microplankton (less than 200um, small plankton and phytoplankton)."

**Materials list**

| Materials | Purpose | Quantity |
|---|---|---|
| Plankton Net (80 µm) with line (Suthers and Rissik, 2009, suggest the use of a 100um net for estuaries, p. 91) | Capture sample | 1 |
| Sample Vial | Contain plankton samples | 3-6 |
| Cooler | Store plankton samples | 1 |
| Ice pack | Keep samples cold | 2-3 |
| Sink | Thaw plankton samples | 1 |
| Pipette | Apply plankton samples on microscope slide | 1 |
| Plankton Data Sheet | Record observations on plankton samples | 1 |
| Microscope Slide and Coverslip | Facilitate microscope observation of plankton samples | 3-6 |
| Digital Microscope | Observe and take pictures of plankton samples | 1 |
| Dichotomous Key | Identify species in plankton samples | 1 |

**Field Sample Collection**

01. Populate field data table
02. Check to see that plankton (80µm) net hose valve is completely closed

03. Find a safe area of operation on the perimeter of the vessel or dock, vessel must be stationary and slack tide is preferable
04. Lower the net into water until the marked part of the rope (3m or estuary bottom) is in water (try to calculate the depth if less than 3m)
05. Slowly and at a constant rate pull net back up
06. Try and keep the net as vertical as possible to prevent sample from spilling out
07. Once the net is out of the water, position the nozzle right above the sample vial (you must have a partner to hold the vial and perform the washing as explained in step 08 below)
08. Push the stopper out of place and let the sample pour into the vial
09. Using filtered water, wash off mesh netting of plankton net so all samples stuck to the netting are obtained
10. If there is some water still in the nozzle, squeeze the nozzle to cause the remaining water to pour
11. Make sure the sample vial is capped tightly as well as properly marked in sharpie with the site, sample vial number, date, street, *etc.*
12. Repeat procedure for replicate sample
13. Place with the all sample vials in one zip-lock bag that is properly labeled (as above)
14. Place zip-lock bag in a cooler

**Lab Sample Processing – Tier I**

01. Take plankton sample vials out of cooler
02. Run under hot water to thaw
03. Uncap sample vial once fully thawed
04. Use pipette to collect sample from vial for observation
05. Place two or three drops on a microscope slide and cover with plastic coverslip
06. Place slide on digital microscope stage and turn microscope on
07. Adjust fine and coarse adjustment as well as magnification to get best possible view of sample
08. Take picture using digital microscope
09. Examine photos to identify species in sample using a dichotomous key
10. Record on plankton data sheet

**Lab Sample Processing – Tier II**

01. Take plankton sample

## *Horizontal Zooplankton Tows (Tier II)*

(From Suthers and Rissik, 2009)

**Materials list**

| Materials | Purpose | Quantity |
|---|---|---|
| Plankton Net (200 µm, 3m long, 42cm diameter) with line | Capture sample | 1 |
| Sample Jar (1L) | Contain plankton samples | 3-6 |
| Alcohol (70%) (3L) | Preserve sample | 1 |
| Cooler | Store plankton samples | 1 |
| Sink | Thaw plankton samples | 1 |
| Pipette | Apply plankton samples on microscope slide | 1 |
| Plankton Data Sheet | Record observations on plankton samples | 1 |
| Pipette deliverer (2mL) | Transfer sub-sample to counting chamber | 1 |
| Microscope Slide and Coverslip | Facilitate microscope observation of plankton samples | 3-6 |
| Digital Microscope | Observe and take pictures of plankton samples | 1 |
| Dichotomous Key | Identify species in plankton samples | 1 |

**Field Sample Collection**

(Adapted from Suthers and Rissik, 2009) The net must have enough surface area to avoid pressure waves that'll render the tow useless. That is why at least a 3m long net is suggested. The shape and area of the net should be determined from the mouth area of the net, multiplied by a factor of 7 to 10 to account for the percentage free surface area. A typical 40cm diameter net with 200µm mesh should be about 3m long (see p. 96 & 97 in Suthers & Rissik, 2009).

01. *Follow neuston procedure found below wherever procedures are lacking.
02. Tow for 10 minutes (suggested time is between 3 and 10 minute tows)

03. Tow at about 1-2 m/s or 2-4 knots ("Any faster will increase the extent of extrusion and any slower may increase the incidence of avoidance")
04. The tow is done from behind the vessel turning in a slight circle so that net is not in propeller wash
05. The sample jar will be brim full of plankton, so before unscrewing and spilling it, tip the excess water back out through the mesh, and splash water back up onto the mesh as a quick rinse down
06. Empty half of sample into 1L properly labeled jar and preserve with 70% alcohol (1/2 volume jar = alcohol)
07. Empty other half into another jar without preservative to view live organisms
08. Add Lugol's solution to preserve one of the sample jars until solution is a deep amber color (Live plankton cannot tolerate any trace of formalin or preservative or the heat of a lamp)
09. Add sample without preservative to cooler for live analysis.
10. With gentle tows plankton is easily rinsed off with fresh water but detritus jammed in the mesh must be dislodged with a good blast and even a little detergent
11. Let equipment ventilate and dry properly

*Need to purchase 100µm, 3m long, 42cm diameter net

**Lab Sample Processing**

*Live Plankton Observation*

01. Take plankton sample jars out of cooler
02. Prepare anesthetic
    a. MgCl2 solution,
    b. Soda water,
    c. Clove oil, or
    d. Ice water
03. Again, live plankton cannot tolerate any trace of formalin or preservative or the heat of a lamp
04. For large living plankton
    a. Use wide mouth pipette to place a small volume of sample into a clean petri dish
    b. It's best to observe large copepods and cladocerans under the dissecting microscope at low magnification (less than 40x)
    c. Add a few drops of anesthetic to slow the activity of larger zooplankton
    d. Make observations on microscope drawing paper and take digital images with a phone camera
05. For smaller living plankton
    a. Prepare a counting chamber
        i. Place two glass cover slips 3-10mm apart on top of a slide
        ii. Place a few drops in the gap
        iii. Place another intact cover slip over the sample, resting on the two beneath
        iv. This will prevent the plankton from being crushed between a simple slide and a cover slip
    b. Use a pipette to place a small volume of sample into clean counting chamber

c. Make observations on microscope drawing paper and take digital images with a phone camera

*Analytical Plankton Observation*

01. Take plankton sample jars out of cooler or storage
02. Rinse sample with cold fresh water in sieve of the same or smaller mesh of the net ~ < 200um to remove preservative, grass, and sticks
03. Gelatinous zooplankton should be counted and removed at this stage and recorded on data sheet
04. Option 01
    a. With another rinse, consolidate the plankton onto one end of the sieve cylinder ready to pour out
    b. Add 100 mL of freshwater to a 100mL graduated cylinder
    c. Carefully add plankton from sieve into the 100mL graduated cylinder
        i. If necessary make up the volume to 100mL
        ii. With bulky samples, especially with detritus, 200 or 500mL cylinder may be necessary
    d. Read off the approximate displacement volume in milliliters of plankton for biomass
    e. If this doesn't work, return plankton to sieve (edge) and try Option 02 below
05. Option 02
    a. Add 100mL of fresh water to a 100mL
    b. Carefully rinse plankton with the 100mL fresh water into an empty 100mL graduated cylinder
    c. Allow 1 hr. to settle plankton
    d. Read off the approximate displacement volume in milliliters of plankton for biomass (that is, the approximate milliliters that the plankton is occupying at the bottom of the cylinder. Adjust for substrate, detritus, plastic *etc.*)
06. After calculating the approximate biomass thoroughly mix the contents of the cylinder by swirling
07. While still swirling remove an accurate 2 or 4 mL sub-sample with a pipette
    a. The fine tip should be cut off of the pipette
    b. Thus 2 or 4% of the total sample has been removed
    c. The volume of the subsample should be determined by density of zooplankton and the time it takes to sort. Start off with 2 mL with students
    d. It's better to take two or three 1mL subsamples than to take one 3mL subsample as variance due to sub-sampling error can be incorporated into analysis
    e. Remember that the second sub-sample will not be the same proportion of the total as the first
        i. If 2ml are removed from 100mL = 2.00 %
        ii. If 2mL are removed from 98mL = 2.04% Thus for the second sub-sample, instead of multiplying the counts by 50 you would multiply by 49.02 to get the total number in the sample
08. Add sub-sample to a Bogorov chamber or Ward counting wheel
    a. Top off volume with fresh water
09. Use a dissecting microscope to count the plankton from one end of the chamber to the end
10. Use a probe to turn individuals around for identification
11. Populate the data table

12. Multiply counts by 50 for the first sub-sample and 49.02 for the second sub-sample to get an estimated total number
13. The remaining sample can be scanned for large or interesting plankton before storing in preservative (70% alcohol) or discarding sample
14. If freezing, samples will only last 1-2 days!
15. Data should be standardized as numbers per unit volume filtered as indicated by the flow meter
    a. See above for calculating total volume of sample tow using the flow meter
    b. Generally, the standard unit of volume should be similar to the actual volume filtered
    c. For example, for a tow of 200-300$m^3$, results should be reported per 100$m^3$
    d.

# *Plankton Bloom Sample (Tier II)*

(From Suthers and Rissik, 2009)

**Materials list**

| Materials | Purpose | Quantity |
|---|---|---|
| Beta Bottle (1.7L) | | |
| Bucket | | |
| Sedgwick-Rafter Cell | | |
| Compound Microscope | | |
| Graduated Cylinder (100mL) | | |
| Pipettes (1 & 10mL) | | |
| Pear for pipette | | |
| | | |
| | | |

**Field Sample Collection**

01. Lower Beta bottle to 0.5 and 1.5m below the surface
02. Replicate x 2 for each depth
03. Pour different depth contents into 2 separate buckets
04. Mix contents of each bucket
05. Take a 100mL subsample from the well mixed bucket
06. Preserve with Lugol's Iodine preservative solution (sample settles quicker with preservative; below step)
07. Take an additional 100 mL subsample without preserving and add to cooler for live organism i.d.

**Lab Sample Processing**

01. Take plankton sample vials out of cooler
02. Place sample in a 100mL graduated cylinder and let rest for 24 hours (more if nanoplankton are present) in order for plankton to settle

03. Draw off the top exactly 90mL from the cylinder with a large (*e.g.* 20ml) pipette and pear or suction pipette (use care not to disturb cells at bottom of cylinder)
04. This gives a 10x concentration
05. Mix 10mL subsample thoroughly by swirling
06. Add Sedgwick-Rafter* counting cell to the microscope stage
07. Place cover slip** obliquely on chamber with just one corner open
08. Decant 1mL subsample carefully into the one corner with a Pasteur pipette until slip just begins to float
09. Rotate slip completely to cover chamber (this avoids introducing air bubbles into subsample)
10. Let sample stand in chamber for 15min to allow plankton to settle to the bottom
11. Count at 100x magnification and use high power if there is a need to ID small sized algal cells
12. A. Count a required minimum of 30 squares by determining the squares randomly using the special plankton die (there are 50 squares across and 20 squares down) OR
    B. To avoid differential settling (plankton concentrate towards the edges), as an alternative to random box counting, count a row across (traverse) of 40 boxes
13. Another counting requirement is to count a minimum of 23 of each unit type (units = **unicellular, filamentous, and colonial**) which provides a counting precision of +/– 30%
14. If counting 30 grid boxes or two traverses does not yield a sufficient number of units (that is, more than 23), then additional grid boxes or traverses will need to be counted
15. On the lab data table record the number of grid squares counted as well as the number of algal units counted
16. If an algal unit lies across the line engraved in the base of the counting cell so that if falls between two squares, the simple **RULE**: is that if it lies on the right side of the square grid include it in the count, but if it lies on the left side, exclude it. Similarly, if it falls across the top line of the square, include it, but exclude any algal units falling across the bottom. Algal units are often smaller than the width of the lines engraved, so the same applies for any units lying within the grid lines delineating the squares
17. The number of algal units present per 1mL within the actual water body is calculated as:

$$\text{No. of units/mL} = \frac{(\text{Units counted } \mathbf{x}\ 1000\text{mm}^3)}{(\text{No. grid squares counted } \mathbf{x} \text{ concentration factor - typically 10})}$$

18. For filamentous and colonial units, it's necessary to convert units/mL to cells/mL. To do this, figure out how many cells in the typical colony of filament and multiply by that number. However, cyanobacteria don't have a uniform number of cells. For cyanobacteria:
    a. Find 30 random filaments
    b. Count the number of cells in each
    c. Average the amount
    d. Multiply by Units to convert top cell/mL
19. If samples contain large colonies or tangled aggregations of filaments containing thousands of cells making it impossible to count, estimate a portion of the colony or aggregation – say 5% or 10% of the total colony size – and count or estimate the number of within that portion. Remember that the colonies or aggregations are three

dimensional and cells will fall out of the plane of focus. Once you have an estimate of the number of cells of 5% or 10% of the colony, multiply this by 20 or 10, respectively, to obtain an estimate of the total cells per colony. This procedure can introduce large error and are only needed for sampling during blooms. Sonification or homogenization by chemicals is unacceptable.

*[Sedgwick-Rafter Cell – is a four sided counting chamber that is 50mm long by 20mm wide by 1mm deep, giving a bottom area of 1000$mm^2$, and an internal volume of 1mL; they have a grid engraved on the bottom, with lines 1mm apart; if correctly calibrated and filled, the volume of sample covering each grid square is 1$mm^2$; used on the stage of a compound microscope]

** Cover the Sedgwick-Rafter counting chamber with a thin (No. 01 thickness) cover slip

## *Neuston Manta Tow – Plankton vs. Plastic (Tier II)*

Between 14 and 24 tow events will be realized along the Study Site throughout the duration of the Project. The tows will be replicated twice within each event. Samples will be obtained with a 4 meter long manta trawl. The rectangular opening is approximately 1m x 0.5m. The mesh size is approximately 333µm and the cod end has a capacity of 1L. The net will be towed at the surface outside the effects of port wake (from the stern of the vessel) at a nominal speed of 1m/s (approximately 2 knots). The duration of the tow will be 10 minutes. According to Suthers and Rissik (2009) the manta opening should be 90% submerged.

| Materials | Purpose | Quantity |
|---|---|---|
| Manta | Keep Neuston net 90% above water line | 1 |
| Neuston net (333µm, 4m, rectangular mouth ?? x ??) | Collect Neuston sample | 1 |
| Bridles | Attach eye bolts on manta to tow line | 4 |
| Eye bolts | Attach Bridles to manta | 4 |
| Snap shackle | Attach bridles to tow line carabiner | 1 |
| Flow meter | To measure volume of water flowing into | 1 |
| Tap water (100ml) | To fill up flow meter | 1 |
| Syringe | To fill up flow meter with tap | 1 |
| Bucket (5 gallon) | Hold sample | 2 |
| Sample Vial (100mL) labeled | Contain plankton samples | 7 |
| Lugol's Iodine Solution (200mL bottle) | Preserve samples | 1 |
| Cooler | Store plankton samples | 1 |
| Ice Packs (Large) | Preserve samples | 3 |
| Sink | Thaw plankton samples | 1 |
| Pipette (20mL) and Pear | Drawing volume to concentrate subsample | 1 |
| Plastic Pipette (1mL) | A) Add Lugol's Iodine Solution to sample & | 2 |

| | | |
|---|---|---|
| | B) Apply plankton samples on Sedgwick-Rafter Counting Cell | |
| Plankton Field Data Table | Record sample obtaining | 1 |
| Plankton Lab Data Table | Record sample processing | 1 |
| Graduated Cylinder (100mL) | Allow subsample to settle | 7 |
| | | |
| Sedgwick-Rafter Counting Cell and slip | Process phytoplankton samples | 3-6 |
| Digital Microscope | Observe and take pictures of plankton samples | 1 |
| Dichotomous Key | Identify species in plankton samples | 1 |

**Set-up Vessel**

01. Attach manta to net
02. 5/16 inch stainless eye bolts with eye inside (*i.e.* nut – washer – frame – manta – washer – nut).
03. Check net for holes
04. Correctly attach cod and verify
05. Use ½ inch torque wrench for bolt fastening
06. Add guideline to starboard wing support
07. Lower spinnaker pole (tow pole) to horizontal position
08. Attach fore guy and after guy to outboard end of pole
09. Attach snatch block to loop on one of the guys (guys have loop spliced to end)
10. To get tow pole horizontal, ease the popping lift
11. Attach bridles to stainless steel eye bolts on manta using carabiners
12. Attach bridles together with a snap shackle swivel
13. Attach towline to snap shackle with a carabiner
14. Attach snatch block to port bow cleat
15. Attach tow line (1/2” nylon line) to bridle and run it through the snatch blocks
16. Attach flow meter
17. Set up flow stick for spring meter (optional)
18. Label sample bottles

**Launching Manta Tow**

01. Read the flow meter and take note of the value on the data sheet
02. Take in the topping lift in order to raise up the outboard end of the tow pole
03. Take in on tow line such that net is 10’ away from tow pole

04. Someone should take charge of the end of the net so it doesn't spin by using the guideline
05. Lower tow pole and slowly release tow line until the bottom of the manta is in water but not the mouth
06. Drop the tow pole slightly below horizon plunging mouth into water
07. TAKE NOTE OF TIME on data sheet
08. Maintain tension on steadying guideline (guy) to starboard wing
09. Ease the tow line to allow tow to drift of the port stern
10. Adjust as necessary
    a. tow line
    b. guy lines
    c. steadying lines
11. Tow for 10 minutes

**Vessel Position**

01. Steam into ebbing Hudson current at 1 m/s or approx 2 knots
02. 2 hrs after slack

**Retrieving Sample**

01. Unscrew cod end
02. Add cod contents by sieving with a 350 micron sieve to a 1000mL labeled sample bottle or bucket if needed
03. Add 5% formalin to cover sample
04. Sieve again to another sample bottle
05. Rinse with salt water
06. Sieve back to original bottle
07. Add 50% Isopropyl Alcohol to fix

**Lab Sample Processing**

01. Separate Plastic and plankton by draining and adding sea water (plastics float, living matter sinks)
02. Inspect top and bottom portions with stereoscope
03. Remove intermixed plastic from tissue fraction and vice versa onto separate and labeled Petri dishes
04. Count plankton and identify to class
05. Sort plastic using sieves (*i.e.* 4.76, 2.80, 1.00, 0.71, 0.50, 0.35mm) and place in labeled glass Petri or hour glasses
06. Oven dry plastic and plankton @ 65°C for 24h
07. Weigh plastic and plankton using digital scale
08. Categorize individual plastic pieces (*i.e.* fragment, Styrofoam fragment, pellet/nurdle, polypropylene/monofilament line fragment, thin plastic film)
09. Keep count for each size and category on lab data table

**Data Tables**

01. Field data table
    a. Metadata:
        i. Crew
        ii. Sample ID code (use sample nomenclature from SOP)
        iii. Date
        iv. Time
        v. GPS coordinates
        vi. Station name
        vii. Depth
    b. Weather:
        i. Gather rainfall data from: http://w1.weather.gov/obhistory/KNYC.html
        ii. Wind speed/direction
        iii. Waves/tide/current
        iv. Air temperature
        v. % cloud cover
        vi. Moon phase
        vii. INCLUDE 3 FIELDS FOR EACH IN CASE WEATHER CONDITIONS CHANGE WITH TIME
    c. Water @ Start:
        i. Temperature (°C)
        ii. Salinity (ppt)
        iii. Secchi Depth (cm)
        iv. pH
        v. Dissolved Oxygen (ppm)
        vi. Comments
    d. Data:
        i. sample gear
        ii. Sample #
        iii. time
            1. start – mouth in water
            2. stop – mouth out of water
        iv. Bearing
        v. Speed
            1. average over ground
            2. on water
        vi. Flow meter
            1. start value
            2. stop value
        vii. comments
    e. Water @ End:
        i. Temperature (°C)

ii. Salinity (ppt)
iii. Secchi Depth (cm)
iv. pH
v. Dissolved Oxygen (ppm)
vi. Comments

02. Lab Data
    a. Metadata:
        i. Crew
        ii. Sample ID code (use sample nomenclature from SOP)
        iii. Date
        iv. Time
        v. Station name
    b. Data:
        i. Mass
            1. Station name
            2. Replicate #
            3. Plankton mass
            4. Plastic mass
        ii. Plankton identification
            1. Station name
            2. Replicate #
            3. Plankton class list
        iii. Plastic size & category counts
            1. Station name
            2. Replicate #
            3. Size (row) & Category (column) chart
                a. Size: (*i.e.* 4.76, 2.80, 1.00, 0.71, 0.50, 0.35mm)
                b. Category (*i.e.* fragment, Styrofoam fragment, pellet/nurdle, polypropylene/monofilament line fragment, thin plastic film)
                c. Counts found in each size class and category
        iv. Comments

**Troubleshooting**

01. Difficulty pointing into current – Harlem/East River Ebb
02. Time and flow meter readings need to be taken by independent person
03. When taking unit out of water:
    a. Avoid striking into vessel
    b. There should be at least two personnel pulling up net
    c. Need 2 personnel, a hook, and a large/secured tub to place manta/net inside
    d. Use gloves to avoid lesions
04. Need labeled sample bottles (1000ml) and multiple cod ends
05. May need buckets if sample exceeds cod capacity (*i.e.* jellyfish or ctenophore bloom)

06. Read depth with handheld sonde
07. Depending on movement, may need additional poles to guide manta out of water and onto vessel
08. Boom may not be raised sufficiently when hauling in net. In order to avoid this, vocabulary needs to be standardized and memorized by crew to as to give orders accordingly.

**Vocabulary**

01. Forestay
02. Jib sheet
03. Port jib sheet
04. Dogging – closing or securing a lid, hatch, door, *etc.*
05. Bow rail
06. Cleat
07. Port
08. Starboard
09. Stern
10. Bow
11. Stern line
12. Bow line
13. Holding tank
14. Hatch
15. Boom / Spinnaker
16. Turning block
17. Winch
18. Up haul
19. Down haul
20. Shackle
21. Snap shackle
22. Eye splice
23. Shrouds
24. Life line
25. Bitter end
26. Topping lift
27. Easing

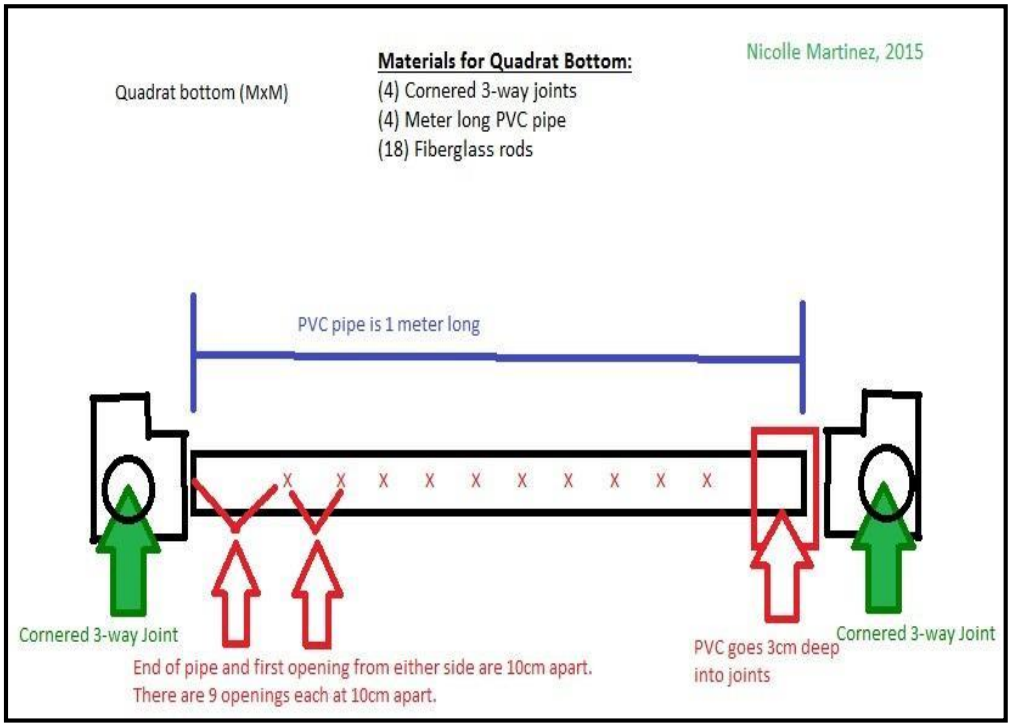
## *Characterizing the Sea Wall using Photoquadrants (Tier I)*

**Materials list**

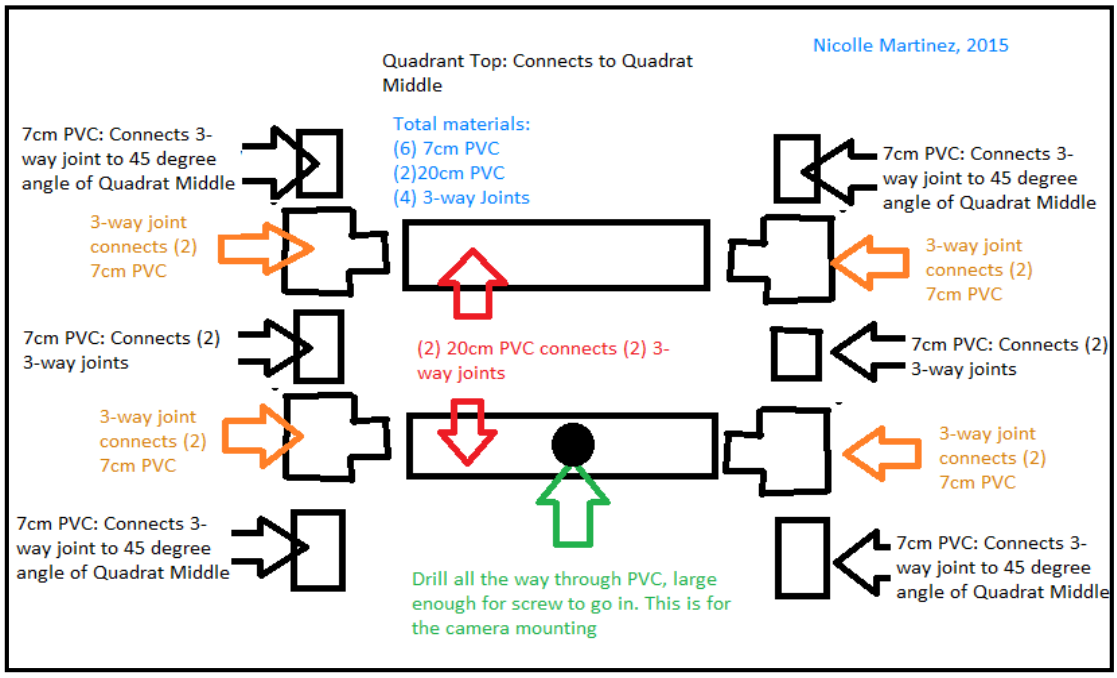
| **Biodiversity Photoquadrant Sampling Materials** | | |
|---|---|---|
| **Item** | **Quantity** | **Function** |
| GoPro HERO3+ | 1 | Take pictures of quadrat, Document steps |
| Zip ties, Various sizes | >20 | Attachments, Emergency repair |
| Photo Quadrat | 1 | Apply grid to surface, Steady/hold camera |
| ¼ inch Braided Nylon Line | 40-100 ft | Control photo quadrat, Safety for camera |
| Micro SD Card | 1 | Photo storage |
| Laptop | 1-2 | Photo analysis |
| Personal Floatation Devices | 1 per person | Safety, Coast Guard compliance |
| Boat Hook | 1 | Maneuvering Photo Quadrat |
| ****Optional**** | | |
| Wifi Smart Remote for GoPro/ GoPro app on Smartphone | 1 | Simplify super-surface photos |
| **Photo Quadrat** | | |
| ½ inch PVC pipe | ~8 m | Structure |
| Fiberglass rods | 18 m | Quadrat Lines |
| 45 degree joints | 8 | Structure |
| flat 3-way joints | 4 | Structure |
| 90 degree 3-way joints | 4 | Structure |

**Field Sample Collection**

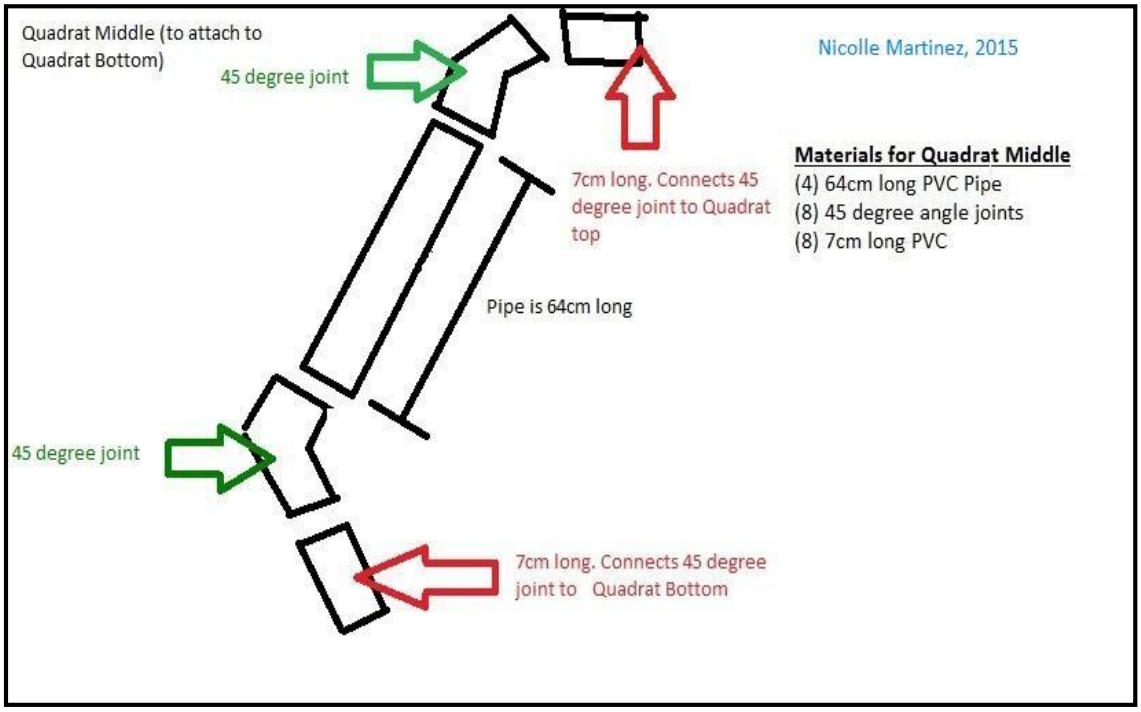
01. Prepare photo-quadrant (built following appendix A) for sampling (fig 1) by attaching your preferred camera (this study used a HERO 3+ with LCD touch BacPac $^{tm}$ and waterproof case (fig 2)).
02. Attach control line(s) to the photo quadrat using clove hitches on two adjacent camera support pipes and a trucker's hitch on the lines leading out of those two knots (fig. 3). This study used ~20 feet of ¼ inch braided nylon line.
03. Attach safety/control line to camera mounting and camera support bracket (fig…)
04. Using control lines, one or more persons lower the photo quadrat down the seawall until it hangs just above the current water level, and maneuver it until it is parallel with the seawall and level (fig …).
05. Trigger camera:
    a. In time lapse mode (Preferred method, can work with many waterproof cameras): set the interval between photos (This study used 5 or 10 second intervals) and trigger either before lowering or, if using a GoPro, using a GoPro Smart Remote, or with the GoPro app on a smartphone (fig 5-8).
    b. In single shot mode: Use a GoPro Smart Remote or the GoPro app on a smartphone to trigger the camera (fig. 4.1-4.3)
06. Trigger camera in time lapse mode.
07. Using the control lines lower the photo quadrat to a level just below the waterline, once again maneuver the photo quadrat until it is parallel to the sea wall and level (fig…).
    Note: If using a GoPro, the wireless control feature will not work while the camera is submerged.
08. Hold photo quadrat in this position for the time it takes for two pictures to be taken (differs based on time lapse settings).
09. Retrieve photo quadrat, stop recording and shut it down. Coil control lines and move to next sampling location.




Figure…




Figure…




Figure…

**Lab Sample Processing**

# *Modified "Columbia" Colonizing Device (Tier I)*

(Adapted from Reid *et. al.* 2015)

**Components and rationale**

| Trap components | Purpose | Rationale |
|---|---|---|
| Vinyl-coated steel mesh box with separate compartments | Houses oysters in one compartment (others hold mesh netting and tiles) | Allows oysters to be in close proximity, mimicking the arrangement found in a natural reef and maximizing reproductive success. The vinyl coated mesh is a durable housing for the oysters, which also provide weight to secure the trap to the bottom. |
| 6 x 6" tiles (ceramic, hardwood, stone or acrylic) | Provide settlement surface in varying orientations for algae and invertebrates that are sessile (stationary) in their adult phase. | Sessile invertebrates make up major components of benthic (bottom-dwelling) organisms and are key oyster associates as oyster reefs provide hard surfaces for these communities. |
| Mesh netting (4x4mm mesh insect netting) | Collects detritus and other organic matter, providing both food and micro-habitat for mobile invertebrates. | Mobile invertebrates such as crabs, annelid worms and amphipods are key associative species to oyster reefs |
| Datalogger (e.g. HOBO Pendant®) | Depending on the type, measures salinity, temperature, light | Water conditions are important factors governing the survival and growth of invertebrate communities |
| ***Additional measures*** | | |
| Minnow traps (set alongside colonization device) | Samples small fish communities | Catch records can be used to provide qualitative data about the broad types of fish present in the area |
| Sediment trap (*to be developed and tested*) | Measures sediment movement and loads in proximity to oyster trap; based in part on bedload sampling protocol developed by Emerson (1991) | Sedimentation is a key threat to oyster survival and a limiting factor in determining the types of associate organisms found near reefs |
| Plankton sampling (*to be developed and tested*) | Sample in-water plankton using nets | Provides students with observations of zooplankton and larval stages of sessile, as well as excellent opportunities for understanding sampling |

**Device construction procedures**

| | |
|---|---|
| *Time required* | 1.5 hrs per device |
| *Equipment* | Vinyl-coated steel mesh, wire cutters, wooden plank (e.g. 2" x 4" x 4' hardwood lumber), rubber mallet, pliers, stainless steel hog rings and hog ring staple gun, 8 inch cable ties, settlement plates (e.g. 4.5" x 4.5" tiles made from ceramic, stone, hardwood or acrylic), plastic mesh netting (e.g. 4 mm x 4 mm mesh bird netting), bricks, ruler or measuring tape, scissors |
| *Rationale* | Devices are designed to both house oysters and provide different microhabitats that are suitable for colonization by the suite of invertebrate biota likely to associate with both oyster populations and hard shorelines. The components |

| | |
|---|---|
| | intended for colonization by sessile and mobile communities can be separated to facilitate efficient processing of both sample types when devices are retrieved. |

01. Cut vinyl-coated steel mesh into panels, as shown in
02.
03. Figure: Plan of the components needed for construction of the vinyl-coated steel mesh caging of each colonization device. The dashed lines indicate where bends occur for construction of the main box and settlement plate triangular prism.. Do not cut the gaps in panels A and E until after bending (see step 2, below). Leave exposed 'fingers' on one of the shorter edges of the main body of the box (panel A), all edges of the box sides (panel B) and one of the shorter ends of the settlement plate triangular prism (panel E). Note that the material cut out to leave a gap in panel A can be used as one of the box sides (panel B).
04. Using a solid wooden plank and rubber mallet, bend panels A and E at the positions shown in
05.
06. Figure: Plan of the components needed for construction of the vinyl-coated steel mesh caging of each colonization device. The dashed lines indicate where bends occur for construction of the main box and settlement plate triangular prism. and approximate angles shown in **Error! Reference source not found.** to form the main body of the box and settlement plate triangular prism, respectively. For each panel, use pliers to twist the exposed fingers around the adjoining mesh to secure the short edges to each other. Cut gaps in the mesh of panels A and E, at locations shown in
07.
08. Figure: Plan of the components needed for construction of the vinyl-coated steel mesh caging of each colonization device. The dashed lines indicate where bends occur for construction of the main box and settlement plate triangular prism., after securing the edges to each other using the fingers.
09. Using hog rings and a hog ring staple gun, secure the box divider (panel C) inside the main body of the box, leaving 3 inches on one side of the box and 5 inches on the other (see **Error! Reference source not found.**). B ricks will be inserted on the 5 inch side and plastic mesh netting on the 3 inch side.
10. Add both sides to the box, securing them by twisting the exposed fingers on all of their edges to the main body of the box, using pliers.
11. Use hog rings to create hinges for the settlement plate covers: secure one long edge of each of the settlement plate covers to the long edge of the settlement plate triangular prism that will be at the bottom of the colonization device, such that the gaps in the settlement plat covers and triangular prism are aligned. The other long edge of the settlement plate covers will be secured by plastic cable ties, which are less durable than steel hog rings, so this edge should be in the less exposed middle part of the device (where the main box and settlement plate triangular prism are joined).
12. Insert settlement plates between the triangular prism and hinged settlement plate covers, aligning plates so that they completely fill the 4" x 4" gaps cut from prism and covers. Secure plates by using plastic cable ties to tightly attach the settlement plate covers to the triangular prism. Use at least two cable ties on each of the shorter edges, four cable ties along the long edge and additional cable ties directly abutting the edges of the settlement plates to prevent them being moved when deployed.
13. Using scissors, cut sheets of plastic mesh netting to standard dimensions (e.g. 2' 6" x 7').

**STOP!** *Devices are more easily transported before completing the construction steps listed below, which can be done in the field just prior to deployment.*

14. Attach the main box and triangular prism using cable ties (at least six on the top and bottom edges of the two components), such that the smallest compartment of the main box is in contact with the triangular prism and the hole in the main box is on the 'bottom' of the device (see **Error! Reference source not found.**).
15. To the main box, add bunched sheets of plastic mesh netting (evenly distributed across the smaller compartment) and four bricks (larger compartment). Secure these inside the caging by attaching the base plate to the main frame of the colonization device with cable ties. Use at least four cable ties along each edge of the base plate and pass some cable ties through the mesh netting to prevent it being washed from the device.

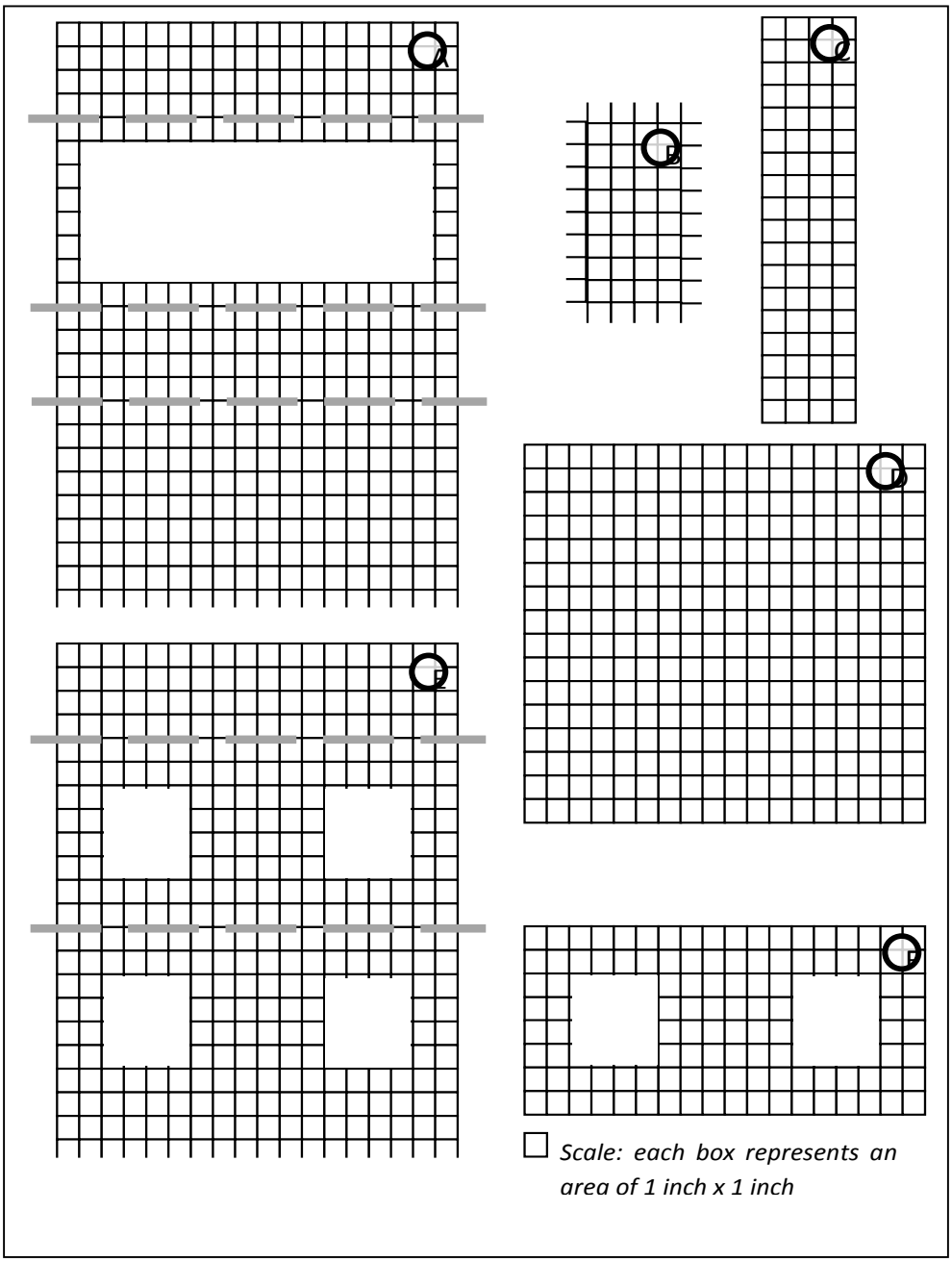



Figure: Plan of the components needed for construction of the vinyl-coated steel mesh caging of each colonization device. The dashed lines indicate where bends occur for construction of the main box and settlement plate triangular prism.

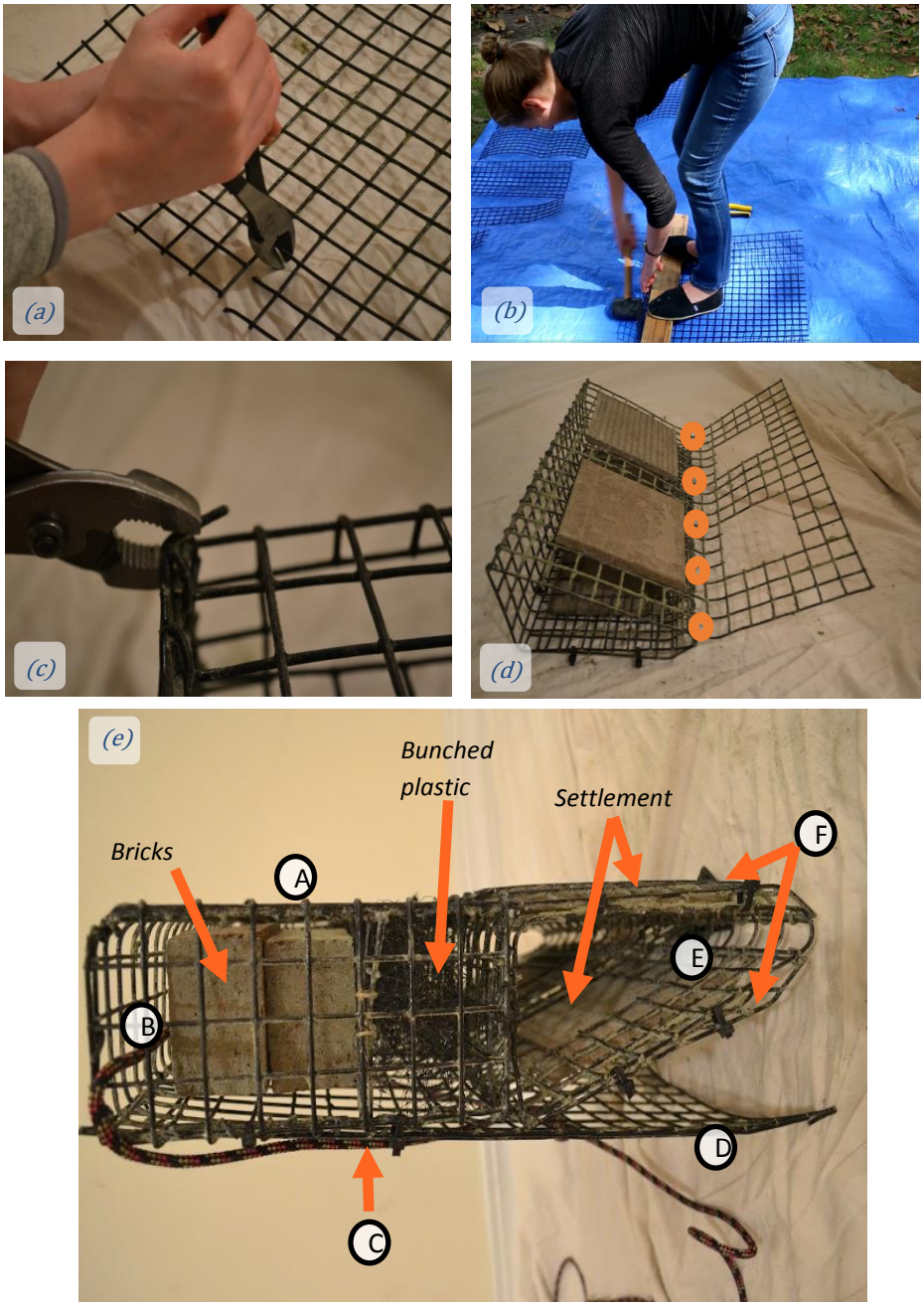



*Figure 2: Steps in construction of the outer caging for colonization devices: a) cutting vinyl-coated steel mesh, with exposed 'fingers' left on the mesh on the right-hand side; b) bending mesh to construct main box, using a wooden plank and rubber mallet; c) twisting exposed 'fingers' to secure edges, using pliers; and, d) hog rings (represented by orange ovals) used to create hinges for settlement plate covers. e) A fully constructed colonization device, with different components labelled. The capital letters indicate the location of (A) body of the main box, with hole cut in mesh covered by the base plate at the bottom of the device, (B) side of the main box, (C) box*

**Deployment of colonization devices**

| | |
|---|---|
| *Equipment* | All components of colonization devices (see section 4.2), chest-high waders, telescoping boat pole, data loggers for continuous measurement of light and temperature (e.g. HOBO Pendant®), magnet, 8" cable ties, ~25' of rope per device (depending on location of attachment points above high tide water level), laminated tags, ribbon or spray paint |
| *Rationale* | Deployment should occur during a low spring tide, to ensure that colonization devices remain submerged over the full tidal cycle. Each device should be placed approximately 1 meter below the water level at low spring tide. At sites where the shoreline is vertical, devices can be lowered into place without entry into the water, whereas at lower-gradient shorelines devices can be submerged by personnel entering the water in waders. Deploying devices for a suggested duration of eight weeks allows adequate time for larvae of animals that are sessile as adults to colonize settlement plates and grow into identifiable forms, plus ample time for colonization by mobile taxa. |

***Procedure***

01. Colonization devices will provide the most information if deployed from late spring through to fall, when temperate waters support relatively high biotic productivity. If sites are surveyed over multiple years, colonization devices should be deployed in the same season during each year, to minimize the influence of seasonal variability in recruitment patterns to hard substrata on community structure. This allows meaningful comparisons of the community structure between years, although inter-annual variability will still influence results and it is preferable to survey all shorelines at the same time for any given study.
02. Deploy devices during a low spring tide. If required, entry into the water is safest during a low tide. In addition, placing the devices below the low spring tide water depth ensures that if they are not moved they will remain submerged through all tidal phases.
03. Ensure that stable attachment points for ropes are available above the mid tide water level on the landward side. Devices should be submerged on firm substrate, at least one meter below the low spring tide water level and five meters apart from each other. Determining whether there is adequate firm substrate on which to place devices can be done by feel with a telescoping pole lowered below the water surface at vertical shorelines, but may require entry into the water at lower gradient shorelines with low visibility through the water column.
04. Data loggers can be used to continuously measure temperature and light at the same depth as colonization devices. Activate and attach a data logger to the top of one of the colonization devices using cable ties (HOBO

Pendant® data loggers require a magnet for activation). Secure so that the light reader will remain pointed towards the surface of the water when the device is submerged.

05. Tie rope to the end of the device farthest away from the settlement plates. Secure the other end of the rope to a stable attachment point on the shoreline, leaving enough rope to allow the device to be at least one meter below low spring tide water level. Securing each rope above mid tide height facilitates retrieval, which may coincide with a low spring tide which is not as low as that during deployment. Securing ropes above high tide facilitates locating devices during any tidal phase, but requires additional rope and along shorelines with high density of human use leaves the devices more susceptible to tampering.
06. Devices may be lowered into the water from the top of vertical shorelines, whereas entry into the water is required to deploy devices on lower-gradient shorelines. Submerge device so that the base plate is in contact with the shoreline and no settlement plates are touching the shoreline.
07. Tampering of devices may occur, particularly in densely populated areas. Tampering is often not malicious: maintenance staff or others working for the property manager, unaware of the study, may remove or destroy devices. To identify the colonization devices as a scientific experiment attach tags to ropes above the high tide water level. Tags should have a brief description of the purpose of devices and contact details. It may also be useful to state that those animals captured in the device will not be economically valuable or suitable for eating. Tags should be laminated to make them waterproof. Identification tags will reduce the risk of removal by maintenance staff and (hopefully) reduce the motivation for vandalism,
08. To assist with finding devices when wishing to retrieve them, mark the location of each with a marker at the top of the shoreline (e.g. ribbon tied around a stable object or spraypaint). Marking the location of each device is also beneficial for confirming that a device has been removed, as searching for the device need only cover the narrow area of shoreline near the marker, as opposed to searching across the whole site for any missing device/s.
09. Leave devices submerged for a standard duration. Mobile communities colonize devices relatively soon after deployment, but approximately eight weeks is required to allow communities of taxa that are sessile as adults to colonize and grow into identifiable forms.

## *Processing % Cover Data with Digital Image Software (Tier III)*

## *Uploading Data to On-Line Database (Tier I)*

**Hard Copy Data Storage Folder Protocol**

01. Pages are in chronological order and stored in sheet protectors
02. Sticky labels are as followed: Title, Date (Δ, SD, or neither) Name of person who collected the data
03. Δ=Processed Day
04. SD= Sample day
05. Most sheet protectors will have an overall collection of a day's work
06. Folder Protocol, Rationale, Location, and Background information should always stay in the front of the folder (Note: Color of Sticky notes does not matter towards the organization of the data collected)

**Soft Copy Data Storage Protocol**

01. All soft copy data collected should be sent directly to the current Data Manager (Cézanne Bies, as of 2015-2016; at cbies16@gmail.com) or the current Project Manager (Melanie Smith, as of 2015-2017; m.smith3890@gmail.com)
02. The Data manager will proceed to upload the soft copy data to: http://harborseals.org according to the category of data collected

## *Identifying Marine Organisms using Genetic Barcoding Techniques (Tier I)*

Add pdf to final document