

Boater Waste Education Campaign

GLO Contract # 14-079-000-7947

FINAL REPORT

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Table of Contents

Project Description	2
Task 1. Maintain Active Workgroup and BWEC Marketing	3
BWEC Workgroup	3
Clean Vessel Committee	5
Technical Advisory Committee	6
Marketing/Outreach Materials	7
Task 2. Public Outreach and Distribution Plan	8
Print Media, Education Booths, and Presentations	9
Clean Water Partnerships (CWPs)	14
Task 3. Boat Sewage Discharge Reporting and Enforcement	15
Galveston Bay Action Network (GBAN)	15
Illegal Discharge Fine/Reporting Signs	17
Enforcement-Related Meetings/Presentations	17
Enforcement Efforts Carried Out	18
Task 4. Facilitate Volunteer Programs	18
GBF Dockwalkers (DW)	19
GBF Water Monitoring Team (WMT)	21
Water Quality Research Internship (WQRI)	25
Marina Service Learning Days	26
Task 5. Track Behavior Change and Resulting Environmental Improvements and Quantify Boater Waste Impacts	27
Galveston Bay Action Network (GBAN)	27
GBF Dockwalkers (DW)	27
GBF Water Monitoring Team (WMT)	31
Water Monitoring Team Photos	32
Water Quality Research Internship (WQRI)	35
Pump-Out Facilities	35
Conclusions and Lessons Learned	37
References	38
Appendices (download from link)	39
I – Task 1 attachments	
II – Task 4 attachments	
III – Task 5 attachments	

Project Description

Approximately 50% of Galveston Bay oyster waters are impaired for bacteria, based on the Texas Commission on Environmental Quality's Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast. The primary sources addressed in the Implementation Plan include insufficient treatment by wastewater treatment facilities and septic systems, sanitary sewer overflows, boat sewage dumping, and stormwater runoff. These impairments result in negative impacts to environmental and public health, as well as the economy.

Water and sediments are often degraded in and around marinas from boat sewage and introduction of dockside wastes and other non-point sources. It has been demonstrated that the combination of poor circulation and discharge from boaters and boat maintenance operations can create serious localized water quality and potential public health concerns (Jeong et al., 2005). The purpose of the Boater Waste Education Campaign (BWEC) is to decrease the incidences of illegal discharge of boater sewage waste in the Galveston Bay Estuary, particularly Clear Lake since it has the third highest concentration of privately owned marinas in the U.S. Due in large part to a lack of local data and communication of these potential environmental and public health impacts, and lack of enforcement of the existing No Discharge Zone in Clear Lake, behavior change through outreach alone is difficult and improvements are hard to track. GBF has continued to work toward overcoming these barriers to success and

Throughout the BWEC, GBF communicated the campaign message directly to boaters and marinas. This was achieved by contacting marinas to arrange special events, presentations, and/or exhibits where boaters were exposed to the campaign message, in addition to distributing education packets to new tenants. The campaign emphasizes 1) negative environmental and public health impacts caused by sewage and 2) how boaters can properly dispose of their waste, and 3) the existing laws and fines associated with illegal boat discharges. As part of the initiative, boaters and marinas have been encouraged to join the Clean Texas Marina and Clean Boater Programs. Marinas have also been encouraged to seek funding through the Clean Vessel Act Program to construct, renovate, or replace pump-out stations. Outreach programs have proved to be effective in the past, but there is a need for a strong campaign in the Clear Lake area to reach new boaters and reawaken awareness of the issue. GBF has directed the development and distribution of the message with the input of a workgroup comprised of stakeholders representing 14 different boating and environmental groups, as well as members of the recreational boating community.

Funding from the Texas Coastal Management Program has played a key role in the distribution of the BWEC messages by covering costs associated with marketing, advertisement, outreach, illegal discharge reporting, marina partnerships, and volunteer water monitoring. The BWEC has been well received in the Clear Lake/Galveston Bay community and GBF plans to continue carrying out and enhancing this project indefinitely.

Task 1: Maintain Active Workgroup and Marketing/Outreach Materials

BWEC Workgroup

A campaign workgroup continued to guide BWEC activities, and consisted of representatives from the Galveston Bay Estuary Program, Clean Marina Program, Clear Lake Marina Association, Texas Parks and Wildlife, and other relevant, bay-area groups. The workgroup was originally formed under a Galveston Bay Estuary Program grant beginning in 2007. The committee members were solicited in the fall of 2007; the original invitation sent to bay area entities predated the beginning of this grant cycle. The workgroup was formed to develop and execute the campaign. The current workgroup consists of several original members, but GBF continually recruits new members in order to keep the BWEC ideas fresh. Participation in the workgroup is open to any interested parties. **Table 1** includes a list of the participating individuals during this grant cycle. The meeting schedule is included in **Table 2**.

The workgroup members contributed to the project in different ways. The Clear Lake Marina Association provides the business perspective to BWEC efforts and acts as an effective means to disseminate information and build networks in the local boating community. The Clean Texas Marina Program offers Clean Boating Tip cards, Clean Boater Pledge cards, Scoop on Poop brochures showing pump-out locations throughout Texas, as well as technical information on the Clean Marina Program. Both of these organizations are associated with the Marina Association of Texas and aid in getting the BWEC efforts publicized state-wide. Redfish Island Marine and Maritime Sanitation are the two mobile pump-out companies currently in operation in Clear Lake and Galveston Bay. They provide in-kind donations for marina outreach events, as well as technical information on pump-out equipment. Additionally, Maritime Sanitation has been a long-time partner in donating pump-out services for the annual Redfish Raft Up event and assistance to marinas interested in applying for Clean Vessel Act grants to install pump-out facilities. Texas Parks and Wildlife Department, Texas Commission on Environmental Quality, and Galveston Bay Estuary Program assist the workgroup with questions relating to environmental regulations, access to data, and aid in the workgroup's efforts to get Galveston Bay designated as a No Discharge Zone. Several members of the workgroup are solely recreational boaters, or in addition to their involvement in the boating industry. Their knowledge and experience in the community is invaluable to the BWEC efforts.

The most valuable result of continuing this workgroup has been the fact that GBF has a group of committed stakeholders from the boating industry that are always available to bounce ideas off of and to give feedback on BWEC efforts. In addition, their input led to the creation of a second stakeholder group (described below) to focus on compliance and enforcement. During this funding cycle, **organizational representation at the workgroup meetings was about 50%**, which is good considering the group's size. In addition, **100% of the organizations were directly involved in assisting with campaign tasks**, such as assembling and distributing education packets, connecting GBF to audiences for giving presentations, implementing the campaign at their marina, providing technical assistance for the Water Monitoring Team, etc. The performance indicators used during this funding cycle were approved by the workgroup, and can be downloaded and saved from **Appendix I**. The measured results corresponding to these indicators are addressed throughout this final report in the appropriate sections.

Table 1. Boater Waste Education Campaign Workgroup

Last	First	Organization
Tuma	Scott	City of League City/Clear Lake Racing Association
Hollin	Dewayne	Clean Texas Marina Program
Marshall	Lisa	Galveston Bay Estuary Program
Bartsch	Trey	Galveston Bay Foundation
Bohanon	Charlene	Galveston Bay Foundation
Stiles	Alexandra	Galveston Bay Foundation
McCann	Katie	Galveston Bay Foundation
Rhea	Neally	Galveston Bay Foundation
Fitz Simmons-Evans	Lori	Galveston County Health District
Johnston	Steven	Houston-Galveston Area Council
Wright	Jean	Houston-Galveston Area Council
Paige	Helen	Marina Bay Harbor/ Clear Lake Marina Association
Fannin	Paul	Marine Surveyor/Recreational Boater
Walker	Sterling	Onward/Maritime Sanitation, Inc.
Christopher	Jonathon	Onward/Maritime Sanitation, Inc.
Hutchinson	Ken	Onward/Maritime Sanitation, Inc.
Jackson	Nikki	Onward/Maritime Sanitation, Inc.
Frakes	Dick	Recreational Boater
Broach	Linda	Texas Commission on Environmental Quality
Derrick	Cassandra	Texas Commission on Environmental Quality
Morris	Chip	Texas Commission on Environmental Quality
Kropf	Philip	Texas Mariners Cruising Association
Carrier	Mary	Texas Parks and Wildlife Department
Guillen	George	University of Houston – Clear Lake

Table 2. Workgroup meeting schedule

CMP Cycle	Date	Location	Time	Attendance
17/18	12/11/2013	GBF Office	3:00pm	7
17/18	6/26/2014	GBF Office	3:00pm	4 (break-out)
18	7/22/2014	Kemah Community Center	2:00pm	15 current members and potential recruits
18/19	3/19/15	GBF Office	1:00pm	10

Clean Vessel Committee

During this grant cycle, a new stakeholder group was formed to provide focused attention and collaboration on increasing compliance and enforcement of boat sewage discharge codes. Over the years, the BWEC Workgroup has met with various authorities individually to address the lack of enforcement, but a more collaborative approach was needed for several reasons: 1.) Many authorities shared that they receive very few reports of illegal discharges, 2.) When authorities do receive reports, they do not get all of the key details needed or by the time they arrive to the scene the sewage has dissipated, 3.) Jurisdiction, training, and emphasis of the safety concerns from illegal discharges varies widely amongst enforcement entities. The Clean Vessel Committee is made up of the members listed in **Table 3** and the meeting schedule is in **Table 4**.

Table 3. Clean Vessel Committee

Last	First	Organization
Brand	Bryan	City of Seabrook Police Department
Hollin	Dewayne	Clean Texas Marina Program/Marina Association of Texas
Bohanon	Charlene	Galveston Bay Foundation
Jones	Scott	Galveston Bay Foundation
McCann	Katie	Galveston Bay Foundation
Rhea	Neally	Galveston Bay Foundation
Stokes	Bob	Galveston Bay Foundation
FitzSimmons-Evans	Lori	Galveston County Health District
Bower	Justin	Houston Galveston Area Council
Johnston	Steve	Houston Galveston Area Council
Stevenson	Bob	Houston Sail and Power Squadron
Hall	Lynda	Lakewood Yacht Club/Clear Lake Marina Association/MAT
Paige	Helen	Marina Bay Harbor/Marina Association of Texas
Faubion	Amber	Marina Del Sol
Fannin	Paul	Marine Surveyor
Derrick	Cassandra	TCEQ Clean Water Certification Program
Morris	Chip	Texas Commission on Environmental Quality
Sears	Beth	Texas Commission on Environmental Quality
Wiles	Kirk	Texas Department of State Health Services
Carrier	Mary	Texas Parks and Wildlife – Boater Education
Moses	Dale	Texas Parks and Wildlife - Law Enforcement
Sidman	Ross	Texas Parks and Wildlife - Law Enforcement
Pelland	Jeff	U.S. Coast Guard - Houston
Franklin	Kim	U.S. Coast Guard - MSU Texas City

Naker	Keith	U.S. Coast Guard - MSU Texas City
White	Christina	U.S. Coast Guard - MSU Texas City
Muraglia	Frank	U.S. Coast Guard Auxiliary

Table 4. Clean Vessel Committee meeting schedule*

CMP Cycle	Date	Location	Time	Attendance
17/18	12/3/2013	GBF Office	1:00pm	24
18	7/22/2014	Kemah Community Center	2:00pm	17 current members and other potential recruits

*Several phone/email/individual meetings held in addition to this large group meeting

Technical Advisory Committee

GBF maintained communication with the newly formed Technical Advisory Committee (TAC) for the Boater Waste Impact Study, consisting of academic and environmental professionals from local universities, TCEQ and the workgroup chair. The TAC makes recommendations to GBF on strategies for collecting key data to quantify the potential impact of boat sewage on bacteria levels in the bay. They gave advice and comments on the Boater Waste Impact Studies conducted by the Water Quality Research Interns, the Dockwalker Team surveys, and the background research being conducted for the No Discharge Zone application.

Table 5. Technical Advisory Committee

Last	First	Organization
Dobberstine	Jim	Lee College Environmental Science
Feiveson	Alan	NASA Statistician
Hall	Lynda	Lakewood Yacht Club/Clear Lake Marina Association
Henderson	Andrew	University of Texas School of Public Health
Lane	Helen	GBF Board Member/Retired NASA Chemist
Paige	Helen	Marina Bay Harbor/Clear Lake Marina Association

Table 6. Technical Advisory Committee meeting schedule*

CMP Cycle	Date	Location	Time	Attendance
18	N/A	N/A	N/A	N/A

*To date, communication has been via phone/email/individual meetings due to their busy schedules.

Marketing/Outreach Materials

Marketing and outreach materials were maintained or newly developed, as needed, for all of the various programs within the BWEC, including Pump Don't Dump, GBAN, GBF Water Monitoring Team, Clean Water Partnerships, Water Quality Research Internship, and Dockwalker Team.

Pump Don't Dump education packets and campaign giveaways were reprinted for distribution during this cycle. Items included Pump Don't Dump paper bags, Pump-Out Guide postcards, GBAN plastic cards, and Pump Don't Dump koozies and floating key chains (Figure 2). Per the workgroup's request, GBF designed a new Pump-Out Postcard that included applicable marine sanitation codes on one side and the map on the other (Figure 3). In addition, TCEQ's brochure on the Clean



Figure 2. BWEC campaign materials

Water Certification program, and Texas Sea Grant's Clean Boater Tip cards and Clean Boater Pledge brochures were donated to us for distribution. The overarching goal was to use these items as a conversation starter so we can more easily share the campaign message, to keep directing the boating community to the campaign website, to provide them with tools to help improve water quality, and to create ambassadors that will help spread the message as well. In addition, GBF wrote Facebook posts, newsletter articles, and press releases to advertise BWEC campaign messages, as well as to share our campaign work with GBF followers and supporters. PowerPoint presentations and hands-on activities were developed for various audiences such as the Houston Safe Boating Council's W.A.D.E. summer program, GBF's Bay Day event, and the Texas Mariners Cruising Association.

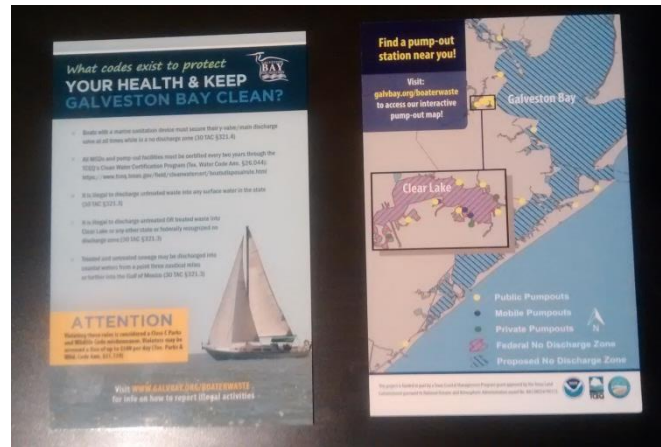


Figure 3. New pump-out postcard

GBF continued to manage the infrastructure for running the GBF Water Monitoring Team and Bacteria Monitoring Lab including renewing our EPA-approved Quality Assurance Project Plan and Quality Management Plan, improving training materials, ordering and maintaining equipment, and maintaining our status as Certified Texas Stream Team Trainers. GBF updated the Water Monitoring Team webpage on the GBF website and maintained the Google map of all of our current and potential monitoring sites in order to make it easier to communicate with volunteers when they are trying to choose a site, as well as with the public to let them know where we monitor. We also created a new Citizen Science Data webpage where all of the data products and instructions will be housed to make them more accessible

to the public. All of this information can be found at www.galvbay.org.

One major enhancement carried out during this cycle was that GBF contracted with The Hatcher Group, in collaboration with the Workgroup, on a social and digital media project to increase the visibility of the interactive pump-out map in the boating community. Preliminary Dockwalker data showed that boaters were unaware of how many facilities are truly available around the bay, so re-focusing the campaign message on this was needed. This project included purchasing a unique URL for the campaign (www.pumpdontdump.org) which will improve the campaign's brand image and simply redirect to the campaign page on GBF's website. The Hatcher Group also identified a unique Twitter hashtag (#pumpdontdump), popular hashtags related to the campaign, and social media influencers to help spread our messages. Finally, they developed a social media toolkit of sample social media messages and graphics (Figure 4) designed to drive traffic to the campaign webpage, created a Facebook advertising campaign to promote the Pump Don't Dump campaign, and updated the campaign logo (as seen in Figure 4 graphics) to help draw fresh attention to the campaign. Now that GBF has received all of these materials and strategy documents, we will execute the new social media campaign and track its progress. All of the deliverables for this project can be viewed in **Appendix I**.

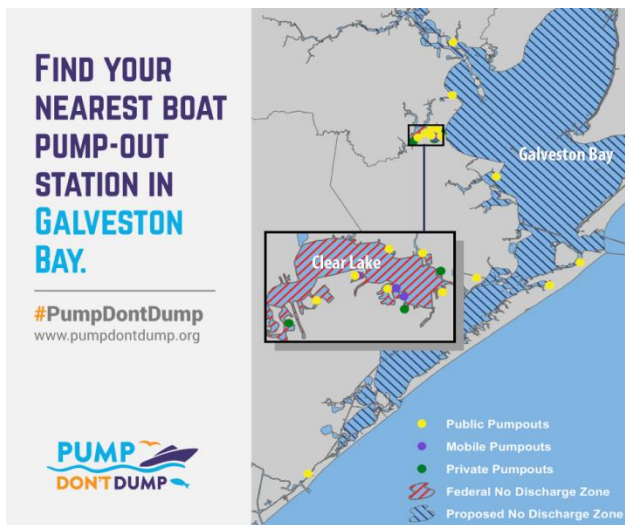


Figure 4. New social media graphics by The Hatcher Group

Overall, the marketing materials developed through this project will add significant depth to the BWEC by being able to connect with boaters on multiple levels. GBF is now able to engage boaters through social media using professionally-developed best management practices. This additional branch of the campaign will continue to allow GBF to reach a broader audience by giving boaters the opportunity to take action and empower them to spread the campaign message to their fellow boaters.

Task 2. Develop Outreach Schedule and Distribution Plan

During this project period, outreach was carried out through print media and education booths/presentations, as well as through Clean Water Partnerships and several BWEC volunteer

programs including the Galveston Bay Action Network, Dockwalker Team, GBF Water Monitoring Team, Water Quality Research Internship, Water Quality Policy and Outreach Internship (new for this cycle), and Marina Service Learning Days. BWEC outreach and distribution is detailed below for print media, booths, presentations and Clean Water Partnerships, and details on the reach of BWEC volunteer programs are found under Task 3. Total impressions achieved through the BWEC will be discussed under Task 5.

Print Media, Education Booths, and Presentations

GBF contacted marinas and popular boating events to schedule outreach presentations and booth displays, and to offer printed materials for inclusion in tenant packets and event goodie bags. **Table 7** shows the list of marinas that were contacted during this grant cycle and **Table 8** shows the yacht brokers that were contacted.

Workgroup members and campaign partners frequently help with directly promoting the BWEC through donating banner space at events, inviting us to speak or host education booths, and even distributing campaign materials at their booths. GBF staff and volunteers have hosted many education exhibits throughout the project area to ensure one-on-one interaction with boaters.

In addition to these outreach booths, several group presentations were made throughout the BWEC project period. GBF continues to have quality interactions with the boating community through giving live presentations due to the fact that it facilitates better discussions and the opportunity to disseminate more detailed information than can be done with a passive booth audience. Please see **Table 9** for a schedule of both types of education events carried out during this grant cycle. **Through these activities, GBF reached over 177,000 people at 52 live events.**

In terms of advertising, GBF has promoted the campaign through magazines, websites, social media, and local print and online news sources (extensive press release list managed by GBF’s Marketing Coordinator). Some of the space was paid for, but much of it was donated because of the publication’s support for the BWEC. Numbers of impressions for the various BWEC advertisements, posts, and articles GBF was able to track are found in **Table 10. Through print and digital media, GBF was able to reach over 404,000 people with the various BWEC messages through 13 different media outlets.**

Table 7. Marinas contacted about the BWEC

Marina Name and Location			
Clear Lake			
Bal Harbor Marina	123 Lakeside Lane	Houston	(281) 333-5168
Blue Dolphin Yachting Center, Inc.	P.O. Box 123	Seabrook	(281) 474-4450
Clear Lake Marine Center, Inc.	P.O. Box 716	Seabrook	(281) 326-4426
Constellation Point and Marina	451 Constellation	League City	(281) 334-2527
Endeavour Marina	3101 NASA Parkway	Seabrook	(832) 864-4000
Kemah Boardwalk Marina	555 Bradford St.	Kemah	(281) 334-2284
Lakeside Yachting Center, Inc.	2511- B Nasa Rd. 1, Ste. 101	Seabrook	(281) 326-5547
Lakewood Yacht Club	2425 Nasa Parkway	Seabrook	(281) 474-2511

Legend Point	1300 Marina Bay Drive	Clear Lake Shores	(281) 334-3811
Marina Bay Harbor Yacht Club	P.O. Box 478	Kemah	(281) 535-2222
Marina Del Sol	1203 Twin Oaks Blvd.	Kemah	(281) 334-3909
Nassau Bay Homes and Marina Assoc., Inc.	1120 Nasa Pkwy, Ste. 109	Nassau Bay	(281) 333-2570
Nassau Bay Yacht Club	1120 Nasa Pkwy, Ste. 109	Nassau Bay	(281) 333-2570
Portofino Harbour	One Portofino Plaza	Clear Lake Shores	(281) 334-6007
Seabrook Shipyard & Marina Inc.	1900 Shipyard Dr.	Seabrook	(281) 474-2586
South Shore Harbour	2551 South Shore Blvd., Ste B	League City	(281) 334-0515
Waterford Harbor Marina	800 Mariners Drive	Kemah	(281) 334-4400
Watergate Yachting Center	1500 Marina Bay Drive	Clear Lake Shores	(281) 334-1511
Wharf at Clear Lake	P.O. Box 1208	League City	(281) 334-5976

Galveston Bay

Bayland Marina	2651 S. Highway 146	Baytown	(281) 422-8900
Eagle Point Fishing Camp, Inc.	Route 1 Box 1718	San Leon	(281) 339-1131
Galveston Yacht Basin	715 North Holiday Dr.	Galveston	(409) 762-9689
Harborwalk Marina	P.O. Box 2328	Hitchcock	(409) 935-3737
Houston Yacht Club	3260 Miramar Drive	Shoreacres	(281) 471-1255
Payco, Inc.	501 Blume Dr.	Galveston	(409) 744-7428
Pelican Rest Marina	7819 Broadway	Galveston	(409) 744-2618
Pirates Beach Bait & Tackle	14302 Steward Rd.	Galveston	(409) 737-3635
Ray's Marina	6310 Herds Lane	Galveston	(409) 744-2111
San Leon Marina	100 6 th St.	Dickinson	(281) 339-1515
Waterman's Harbor, Inc	16426 Clearcrest	Houston	(281) 339-1416

Table 8. Yacht brokers and other boating businesses that received BWEC materials

Yacht Broker	Location	Address	Phone Number
Lauderdale Yacht Sales	League City	2551 South Shore Harbour Blvd Suite B	281-535-0900
Galati Yacht Sales	Seabrook	1902 Seabrook Shipyards	281-474-1470
United Yacht Sales	Kemah	1115 Marina Bay Drive	281-538-6231
Sea Lake Yacht Sales	Kemah	1500 FM 2094 rd	281-334-1993
Jay Bettis & Co Yacht Sales	Seabrook	2509 Nasa Parkway	281-326-3333
Flagship Yachts	Seabrook	2511 Nasa Parkwat #107	281-532-3200
Nautic Yacht Sales	Kemah	585 Bradford St	281-334-2628
J M Yachts	Clear Lake	1500 Marina Bay Dr #1570	281-538-0761
Texas Marine & Brokerage Inc	Seabrook	2700 Nasa Parkway	281-326-9595
HSH Yacht Sales	Kemah	1500 Marina Bay Drive #132b	832-864-2030
Lone Star Yachts Sales	Kemah	1500 Marina Bay Drive #3380	281-334-3500
Texas Sport Fishing Yachts Sales	Seabrook	802 Hardesty Ave	281-474-9600
Discovery Yachts Inc	Seabrook	2101 Todville Road	281-291-9109
Texas Coast Yachts	Kemah	1500 Marina Bay Drive Suite 122-A	281-957-9046

Gibson Weaver Yacht Sales	Seabrook	2511B Nasa Parkway	281-326-1574
Kent Little @ Little Yacht Sales	Kemah	Waterford Harbor, 800 Mariners Drive	713-817-7216
Southern Cross Yacht Sales	Kemah	585 Bradford Ave	281-334-7411
Seawinds International Inc	Kemah	703 Bay Ave	281-334-5296
Marine Max Inc.	Seabrook	3001 Nasa Parkway	281-326-4224
Maritime Sanitation	Clear Lake Shores	1500 Marina Bay Drive	281-334-5978
Maximum Marine Services	Kemah	1203 Twin Oaks Blvd.	317-698-5063
Redfish Island Marine	Clear Lake Shores	1500 Marina Bay Drive, Suite 112	832-282-8202
Kevin E. Severance Insurance Agency	League City	3027 Marina Bay Drive, Suite 309	281-333-3100
Ron Hoover RV and Marine	La Marque	1903 Gulf Frwy	409-935-7101

Table 9. Distribution schedule of education booths and presentations

Audience	Date	Impressions	Description
Cedar Bayou stakeholders	10/3/13	25	Presentation about activities in Cedar Bayou watershed and possibilities for partnering
Boaters and general public	10/24/13-10/27/13	500	Pump Don't Dump campaign materials distributed at Boatoberfest through several partner booths
GBF Executive Board	10/28/13	20	Presentation on water quality programs and results
GCOOS Education and Outreach Committee	11/12/13	25	Presentation about CWP and Water Monitoring Team activities
General public	11/16/13	500	Water quality education booth at Anahuac Wildlife Expo
Boat enforcement and outreach stakeholders	12/3/13	21	Hosted initial Clean Vessel Committee meeting in order to combine efforts and address problem of limited enforcement of boat sewage discharge laws
Boaters and general public	1/3/14-1/12/14	75,000	Pump Don't Dump campaign materials distributed at Houston Boat Show through several partner booths
Aquatic Science students	1/10/14	40	Back the Bay Watershed Tour for Ball High School, including BWEC messaging and stop at Bayland Marina
Biology students	1/23/14	8	Presentation about our CWP and general water quality introduction for College of the Mainland
Environmental professionals	2/26/14	20	EPA Urban Waters Learning Network - Clean Water Partnership AquaKids Family Program
Boaters and general public	3/5/14-3/9/14	70	Houston Fishing Show education booth
Boaters	3/21/14	75	Texas Mariners Cruising Association presentation
Biology students	3/24/14	16	GBF WQ intro/College Watershed Survey at Bayland Marina
Environmental students	3/24/14	17	Student Service Learning Day-Lee College @ Bayland Marina and Houston Yacht Club
Boaters and general public	3/27/14-3/30/14	10,000	Southwest International Boat Show materials at partner booths

GLO Contract Number 14-079-000-7947
Boater Waste Education Campaign Final Report
Page 12

General public	3/29/14	250	Land and Sand Run outreach booth
General public	3/29/14	40	Trash Bash outreach booth
General public	4/3/14	20	Give 5% Kick-Off outreach booth
General public	4/12/14	30	Exploration Green groundbreaking ceremony
University students	4/22/14	100	U of H Earth Day booth
General public	4/22/14	100	Dow Chemical Earth Day booth
General public	4/26/14	2,500	Bay Day - WQ booth
Elementary students	4/28/14-5/2/14	250	Waterworks Education Center Water Week
General public	5/2/14	100	UTMB Earth Day outreach booth
General public	5/9/14	10	Kiwanis Club of Kingwood - Texas City Y Oil Spill and Water Quality
Boater and fishermen	5/20/14	30	Coastal Conservation Association Annual Meeting-Brazoria County presentation
Teen boaters	6/18/14	30	Water Activities Day Event (WADE) - Houston Safe Boating Council
Teen boaters	7/16/14	35	Water Activities Day Event (WADE) - Houston Safe Boating Council
Boaters, enforcement agencies, municipalities	7/22/14	35	Boater Waste Compliance and Enforcement meeting
General public	7/26/14	60	KPRC Parenting Expo outreach booth
Boaters	8/1/14	30	Galveston Bay - Sail and Power Squadron Dockwalker presentation
General public	8/8/14	200	Accenture Eco Team Fair outreach booth
General public	8/16/14	5	Creation Care Fest outreach booth
General public	8/31/14	20	Redfish Raft-Up outreach booth and material distribution via boat
Boaters and fishermen	9/2/14	10	Coastal Conservation Association - Report Card and Boater Waste
General public	9/6/14	120	POHA Centennial Family Fest outreach booth
General public	9/13/14-9/14/14	280	GatorFest outreach booth
Environmental professionals	9/26/14	20	Galveston Nature Council - Managing/Coordinating Volunteers Panel
Teachers	9/27/14	20	Marsh Mania/Professional Development water quality class
General public	10/4/14	30	Buffalo Bayou Shrimp Festival booth
General public	10/8/14	680	National Night Out booth in Nassau Bay
University students	12/3/14	100	U of H Sustainability Fest booth
Boaters	1/2/14 – 1/11/14	75,000	Pump Don't Dump campaign materials distributed at Houston Boat Show through GBF and partner booths
GBF Development Team	2/17/15	6	GBF Water Quality Program overview
H-GAC Clean Water Initiative Workshop	2/25/15	35	Galveston Bay Action Network: Citizen Pollution Reporting Made Easy

Environmental student	3/3/15	1	GBF Water Quality Program overview
Marina staff	3/13/15	6	WQRI results/GBAN/Dockwalkers - Clear Lake Marina Association
Boaters	3/26/15 – 3/29/15	10,000	Southwest International Boat Show partner outreach booths (GB Sail and Power Squadron and The Yacht Sales Company)
Boaters	3/28/15	2	Marine Sanitation Codes and GB No Discharge Zone – Southwest International Boat Show
General public	3/28/15	1,000	GBF Trash Bash site @ Bay Area Park – GBAN outreach at lunch tables
Boaters	3/29/15	1	Dockwalker and GBAN volunteer spotlight – Southwest International Boat Show
Environmental students	3/31/15	1	WMT and GBAN overview – GBF Intern
TOTAL:		177,493	

Table 10. Media outlets and impressions for outreach distribution

Media Outlet	Distribution Period	Impressions
Dock Line Magazine (ad)	2013: Oct, Nov 2014: December 2015: February	30,000 (7,500/month)
GBAN on GBF Main Page (post)	Oct 2013 – March 2015	54,000 (3,000/month)
GBF Boater Waste Webpage	Oct 2013 – March 2015	535
GBF Water Monitoring Team Webpage	Oct 2013 – March 2015	1,034
Old GBAN Webpage	Oct 2013 – December 2015	354
New GBAN Webpage (with mobile optimized application)	January 2015 – March 2015	495
GBF E-Newsletter (post)	2013: Feb, Mar, Jun, Aug, Nov, Dec 2014: Feb, Aug 2015: Jan, Mar	84,540 (8,454/month)
GBF Facebook Page (post)	2013: Dec 2014: Jan (2 posts), Feb (2 posts), Mar (2 posts), Aug (3 posts), Dec (1 post) 2015: Jan (2 posts), Feb (1 post), Mar (6 posts)	109,120 (5,456/post)
GBF Gazette (article)	2013: Fall 2014: Spring, Winter	11,946 (3,982/issue)
GBF YouTube Videos (Pump Don't Dump: Maritime Sanitation, Marina Del Sol, South Shore Harbour, How To Pump Out Your Boat, Pump Don't Dump – Message to Boaters)	Oct 2013 – March 2015	6,964
The Boater's Directory (ad)	2012-2013 issue 2013-2014 issue	100,000 (50,000/issue)
City of Nassau Bay newsletter	2013: Oct 2014: July 2015: March	6,000 (2,000/issue)
* Total Impressions:		404,988

* Total impressions are likely higher due to press releases picked up by online and print media that were not easily traceable.

Clean Water Partnerships (CWPs)

GBF began piloting Clean Water Partnerships (CWPs) with marinas during Cycle 16 and has continued to refine the partnership model so that it creates value for the partners and results in increased environmental improvements. The program was designed to form partnerships with diverse organizations, from cities, to schools, to marinas. Through the BWEC, the program aims to develop relationships with marinas through long-term action projects instead of only utilizing them to distribute printed campaign materials. In order to increase the value of these partnerships, GBF is in the process of finalizing new partnership requirements and benefits, as listed below:

CWP Drafted Requirements

- 1.) Play an active role in at least two of GBF's water quality programs
- 2.) Have made a contribution to the Galveston Bay Foundation in the past 12 months
- 3.) Submit a short application (under development) describing why your organization should be recognized as a Clean Water Partner

CWP Drafted Benefits

- 1.) Play an active role in improving water quality in Galveston Bay
- 2.) Clean Water Partner Certificate and decal to display at your organization
- 3.) Photo opportunity to be displayed in regional press release and social media posts
- 4.) Logo and website linked on the GBF Clean Water Partnership map and website
- 5.) Activity highlights in GBF Gazette and E-News
- 6.) Partnership recognition in all GBF water quality outreach presentations
- 7.) Qualify as candidate for GBF's annual Guardian of the Bay Award

These program improvements dramatically change our metrics for CWPs in the BWEC and purposely build exclusivity compared to the previous inclusive model. The new application requirement will allow GBF to tease out marinas that do not go above and beyond basic code requirements (i.e. don't have a pump-out station) and require them to invest in their partnership instead of GBF bringing everything to the table. Those that commit to this will receive exclusive benefits and all of these changes will lead to more sustainable partnerships.

Table 11 shows which programs each marina plays and active role in on their way toward becoming a Clean Water Partner. One of the biggest improvements GBF hopes to achieve is in regards to participation in the Pump Don't Dump campaign. We will collaborate with the Workgroup to outline baby steps for marinas to actively adopt the campaign versus just receiving printed materials to pass out in tenant packets or sitting on a table at the marina. We are borrowing lessons learned from our Cycle 19 Cease the Grease campaign workgroup, as well as from our social media project with The Hatcher Group. Over time, these improvements will help broaden our reach in each marina with the campaign messages if we can gain their buy-in to the changes.

Table 11. Cycle 18 marina participation

Clean Water Partner	Partnership Activities
Bal Harbor Marina	GBF Water Monitoring Team
Bayland Marina	Marina Service Learning Program
Blue Dolphin Yachting Center	GBF Water Monitoring Team
Endeavour Marina	GBF Water Monitoring Team
Galveston Yacht Basin	Dockwalkers
Harborwalk Marina	Dockwalkers
Houston Yacht Club	GBF Water Monitoring Team; Marina Service Learning Program
Lakeside Yachting Center	Dockwalkers
Lakewood Yacht Club	GBF Water Monitoring Team; Water Quality Research Internship
Marina Bay Harbor Yacht Club	Pump Don't Dump; Boater Waste Workgroup
Marina Del Sol	Pump Don't Dump; Clean Vessel Committee; GBF Water Monitoring Team; Water Quality Research Internship; Dockwalkers
Maritime Sanitation	Pump Don't Dump; Boater Waste Workgroup; Dockwalkers
Nassau Bay Yacht Club	GBF Water Monitoring Team
Pelican Rest Marina	GBF Water Monitoring Team
Portofino Harbour Marina & Yacht Club	GBF Water Monitoring Team
Redfish Island Marine	Pump Don't Dump
South Shore Harbour Marina	GBF Water Monitoring Team
Star Fleet Yachts	GBF Water Monitoring Team (training site)
Topwater Grill	GBF Water Monitoring Team
Waterford Harbor Yacht Club & Marina	GBF Water Monitoring Team; Dockwalkers; Marina Service Learning Program
Watergate Yachting Center	Pump Don't Dump; GBF Water Monitoring Team ; Dockwalkers

Task 3. Boat Sewage Discharge Reporting and Enforcement

Galveston Bay Action Network (GBAN)

The major focus for this task during Cycle 18 was to work with a developer to create a mobile-optimized reporting site (**Figure 5**) for the Galveston Bay Action Network (GBAN), which can also be used on desktop computers (**Figure 6**). GBF originally created a free, beta version of the desktop application in Cycle 17 through Crowdmap in order to test out its functionality and determine what we needed in a custom program. During this cycle, GBF worked with Vertices, LLC to develop the current version of GBAN (www.galvbay.org/GBAN) and integrate it into GBF's new mobile-friendly website. It launched in December 2014 and the tracking results will be discussed in Task 5.



Figure 5. GBAN web application

GBAN aims to educate citizens on how and where to report boat sewage discharges and other common water pollution incidents. The BWEC workgroup's theory is that more citizens reporting illegal discharges will open the eyes of marina owners, boaters, and enforcement agencies to the reality of the boater waste issue instead of GBF and workgroup members just receiving the reports via word of mouth. Having a central location for citizens to submit reports makes it easier on them and provides regulatory agencies with quicker reports. With the new site, citizens fill out a simple form with critical details of the pollution incident and the report is automatically emailed to the appropriate authority based on the type of pollution and municipality that they select. On the back-end, regulatory agencies at the state, county, and city levels are tied into the app to receive reports and have generally been very excited about the technology! Our ultimate goal with GBAN is to keep our water fishable and swimmable through the transparent exchange of information. This transparency should be similar to a neighborhood crime watch program and result in safer and more desirable marinas.

Partnering with enforcement agencies was the key to this site's success. The following partners are currently tied into the application: National Response Center, U.S. Army Corp of Engineers, Texas Commission on Environmental Quality – Region 12, Texas General Land Office Oil Spill Prevention and Response, Texas Parks and Wildlife, Harris County Pollution Control, Galveston County Health District, and City of Pasadena. Several of these entities are part of the Clean Vessel Committee, so this reporting tool will allow us to continue bridging relationships with them in hopes of increasing attention on boater waste enforcement.

GBF developed a presentation focused on recruiting new agencies and a second presentation tailored to recruiting citizens to use the reporting site. In Cycle 19, we will be working with The Hatcher Group to develop a social media campaign for GBAN, which will launch in time for the busy boating season.

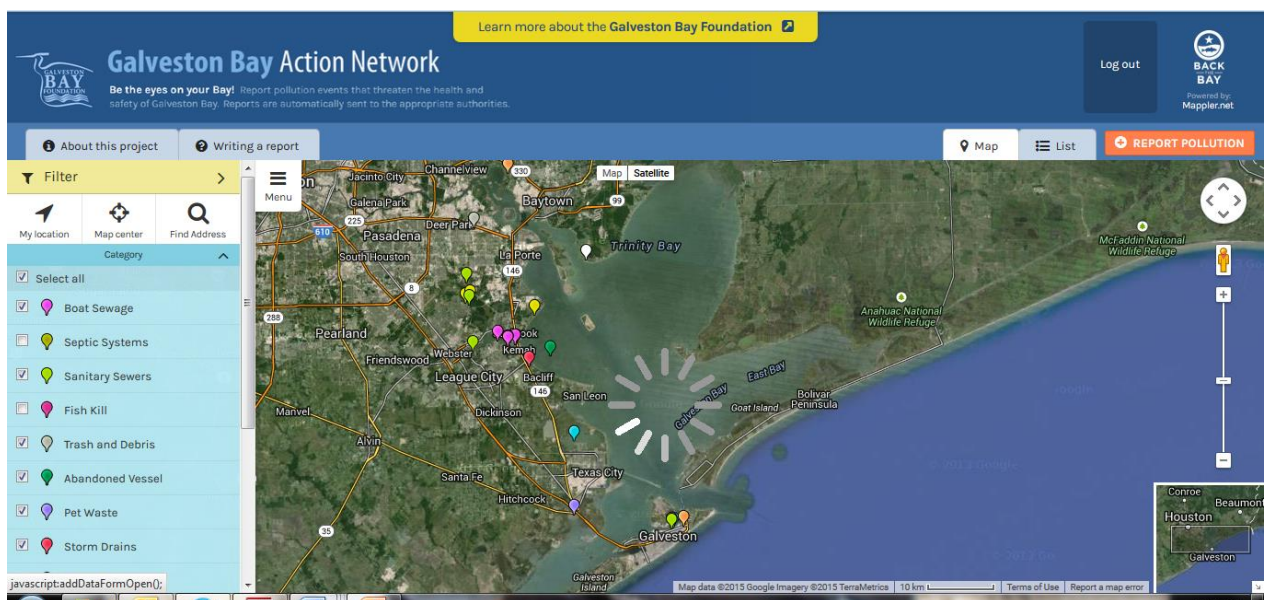


Figure 6. GBAN desktop reporting site

Illegal Discharge Fine/Reporting Signs

- Endeavour Marina, Kemah Boardwalk Marina, Lakewood Yacht Club, Marina Bay Harbor Yacht Club, Marina Del Sol, Maritime Sanitation
- These signs are small, with simple graphics, and include bracketed holes for easy installation on pilings. They were updated by GBF from a past sign used by the Clean Texas Marina Program and were purchased with their grant funding. GBF, Maritime Sanitation and the Clean Texas Marina Program have all made efforts to get these signs distributed and posted over the past year, but unfortunately, we haven't had luck getting marinas interested in posting them. Due to this barrier, GBF is working with local municipalities to approve a new municipal code that requires marinas to post illegal boat sewage dumping codes and reporting information in visible areas within the marinas. So far, the Cities of Seabrook and Kemah have expressed interest in working with GBF on this.

Enforcement-Related Meetings/Presentations

Table 12. Enforcement meetings and presentations

Date	Location	Time	Attendance	Details
12/3/2013	GBF Office	10:00am	24	GBF carried out a boat sewage enforcement roundtable meeting where we asked everyone to introduce themselves and explain their role in enforcement or outreach related to the boater waste issue, gave the group background on the history of the BWEC and documented need for more cohesive enforcement, and discussed strategies for better collaboration and communication. This group will be called the Clean Vessel Committee and agreed to meet again in 6 months. In the meantime, GBF met with committee members individually to follow up on items from the meeting. As a result of this meeting, a plan of action was created for how to engage marina managers, the TCEQ Clean Water Certification program, and the Coast Guard and Coast Guard Auxiliary in collaborative efforts with GBF's BWEC program. The next step from this meeting was to facilitate a Galveston Bay/Clear Lake-wide meeting to engage a more diverse audience of this group's work.
7/22/2014	Kemah Community Center	2:00pm	35	GBF held a combined workgroup/public meeting to combine efforts of the BW Workgroup, Clean Vessel Committee and Jarbo Bayou TMDL Marina/Boater Workgroup. Presenters included representatives from GBF, the Houston-Galveston Area Council, Gulf Coast Yacht Brokers Association, U.S. Coast Guard, and U.S. Coast Guard Auxiliary. Participants represented diverse stakeholder interests and overall the conversations that resulted were very productive in moving forward on collaborative efforts. GBF had participants fill out "action surveys" so we could capture information on how each representative would like to get plugged in to the BWEC efforts if they weren't already and continues to follow up with groups on these items.
3/28/2015	Southwest International Boat Show	2:15pm	2	GBF developed and delivered a boat show seminar specifically to address the status of marine sanitation enforcement and the pending application for a No Discharge Zone for Galveston Bay. Although attendance was low, the conversation had depth and was very helpful for a first go around with this presentation. The

				attendees were most interested in discussing the NDZ since one of them has a boat with a treatment system on board with no holding tank.
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Enforcement Efforts Carried Out

One of the most valuable things that resulted from the two enforcement meetings (**Table 12**) is the fact that GBF now has an open line of communication with the Houston and Texas City U.S. Coast Guard stations. They provide us with updates on enforcement efforts that they carry out and quickly respond to any questions that we have on boater waste enforcement. In 2014, the Houston station conducted 235 boardings with no MSD violations, but the majority were on smaller outboards with no head. They do inspect some of the bay shrimpers and oyster boats in the bay and had one significant case with a vessel discharging bilge oil into the bay. They also conducted around 25 – 30 informal inspections by walking marina docks, which their Officer in Charge described as being partially due to our Clean Vessel Committee activities. He shared that we inspired them to take a closer look when they have the time and opportunity. The Texas City station boarded 288 vessels in 2013; 18 were vessels >25 feet long and there were no MDS violations. In 2014, they boarded 250 vessels; 15 were vessels >25 feet long and there were no MDS violations.

The other major enforcement authorities are TPWD Game Wardens, but GBF has not seen much of an improvement in their willingness to engage in this issue. They have sent representatives to each meeting, but those representatives are not in a position to know what they specifically do to enforce illegal discharges or have the authority to make any changes in their efforts. GBF has made a request for their boarding and MSD inspection information and will update this in the final grant report.

During the December 2013 meeting, the enforcement agencies (U.S. Coast Guard and TPWD) and those that can receive reports to pass along to enforcement (TCEQ, Harris County Pollution Control Services and Galveston County Health District) expressed that their experience hasn't indicated that illegal boat sewage discharges are a widespread problem. However, less than 1% of boats > 25 feet are being boarded each year, so the chance of seeing discharge valves open is not likely. GBF will open this as a topic for discussion at the next Clean Vessel Committee meeting. Additionally, reporting to any agency has historically been confusing for citizens and not always proven to be effective, for various reasons. GBF is addressing this with the new GBAN reporting app and subsequent public outreach of the mobile web app to teach citizens how to create useful and timely reports. The new app will be demonstrated at the next Clean Vessel Committee meeting.

In terms of outreach that can prevent the need for enforcement, the Coast Guard Auxiliary is distributing Pump Don't Dump campaign materials during their vessel safety checks and the Houston Sail and Power Squadron has agreed to allow their vessel safety examiners to be on the Dockwalker Team and conduct Dockwalker surveys during their voluntary inspections.

Task 4. Facilitate Volunteer Programs

Volunteer programs can be a very cost effective way to increase the visibility of a campaign and spread your message further. When the BWEC began in 2007, the only volunteer components were the BWEC Workgroup and occasional volunteers to assist with education booths and assembling outreach

materials. There are now five additional volunteer programs, Galveston Bay Action Network, Dockwalkers, GBF Water Monitoring Team, College Research Experience, and Marina Service Learning Days, three of which were launched during this funding cycle. **BWEC volunteer programs generated a total of over 2,400 volunteer hours during this funding cycle and engaged about 150 volunteers through five programs and two stakeholder workgroups.** Each of them is described below.

GBF Dockwalkers

Dockwalkers is a volunteer program for boaters to educate other boaters on environmentally sound practices through positive “pier” pressure, to provide them with physical tools to keep the bay fishable and swimmable, and to collect local statistics to aid in environmental planning. GBF’s program is based off of a very successful program in California, but has been personalized to focus on the immediate water

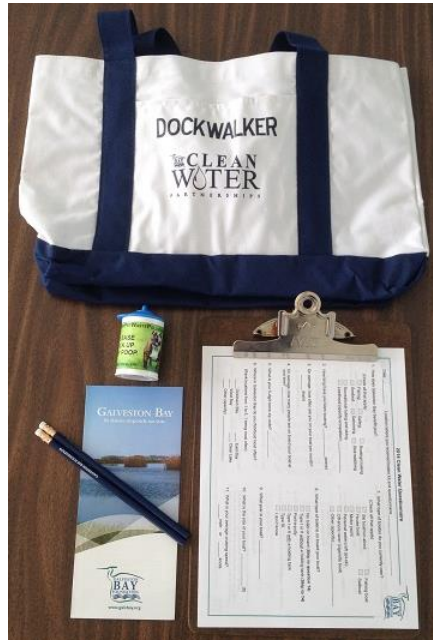


Figure 7. Dockwalker volunteer kit



Figure 8. Clean Boater Kits

quality needs in the Galveston Bay area. GBF trains volunteers, particularly from boating organizations or companies, to take quality controlled surveys. The survey contains questions that helps us obtain data to improve the Pump Don’t Dump campaign, provide marinas with data on pump-out usage and functionality, as well as statistics to be considered in the process of applying for a Galveston Bay No Discharge Zone. Dockwalkers ask boaters to take a few minutes to fill out the educational survey (**Figure 7 and Appendix II**) and the boaters receive a Clean Boater Kit (BWEC education materials, Pump Don’t Dump zip tie for discharge valve, dye tablet, and bilge oil absorbent pad) (**Figure 8**) in exchange for their participation. Dockwalkers are also trained to submit water pollution reports through GBAN. Details on the survey sampling design can be reviewed in the Dockwalker Plan found in **Appendix II**.

Table 13 shows the Dockwalker volunteers and survey plan and **Table 14** shows the Dockwalker training and survey schedule. GBF’s summer 2014 Water Quality Policy and Outreach Intern surveyed and compiled her results and lessons learned. This information was used to tweak and improve the program and we have since held Dockwalker Volunteer training classes and took on a spring 2015 Water Quality Policy and Outreach Intern to continue surveying and collecting background research. Preliminary results from the Summer 2014 Dockwalker pilot test are summarized under Task 5.

Table 13. Dockwalker volunteers and survey plan

Name	Organization	Survey Schedule	Target Locations
Neally Rhea	Galveston Bay Foundation (staff)	As needed	GBF random sampling plan
Charlene Bohanon	Galveston Bay Foundation (staff)	As needed	GBF random sampling plan
Sarah Cunningham	Galveston Bay Foundation (intern)	Summer 2014 pilot test	GBF random sampling plan
Amber Faubion	Individual (former Marina Del Sol marina manager)	Unknown	Marina Del Sol
Bill Haddock	Houston Sail and Power Squadron	10/month during boating season	Wherever conducting Vessel Safety Checks
Caitlyn Suttle	Onward/Maritime	10/month during boating season as a group	Wherever conducting vessel pump-outs
Chris Machol	Onward/Maritime		Wherever conducting vessel pump-outs
James Carlton	Onward/Maritime		Wherever conducting vessel pump-outs
Jonathan Christopher	Onward/Maritime		Wherever conducting vessel pump-outs
Matthew McLemore	Onward/Maritime		Wherever conducting vessel pump-outs
Sean Fitzgerald	Onward/Maritime		Wherever conducting vessel pump-outs
Sterling Walker	Onward/Maritime		Wherever conducting vessel pump-outs
Danny Parker	Galveston Bay Foundation (intern)		Spring 2015
Candy Capuano Day	Galveston Bay Sail and Power Squadron	Whenever conducting Vessel Safety Checks or at boat shows	Wherever conducting Vessel Safety Checks or at boat shows

Table 14. Dockwalker trainings and survey schedule

Date	Event	Site	Dockwalkers	# Volunteer Interactions	# Surveys
3/12/2014	Training and pilot testing	Marina Del Sol	Alternative Spring Break college students from University of North Texas and University of Texas – Dallas	18	3
6/3/2014	Training	GBF Office	Sarah Cunningham – GBF intern	0	0
6/27/14	Pilot testing	Harborwalk Yacht Club	Sarah Cunningham – GBF intern	0	11
6/28/14	Pilot testing	Harborwalk Yacht Club	Charlene Bohanon (GBF staff); Jamie Bohanon (volunteer); Sarah Cunningham (GBF intern)	1	10
7/4/2014	Pilot testing	Galveston Yacht Basin	Neally Rhea – GBF staff	0	0
7/5/2014	Pilot testing	Galveston Yacht Basin	Neally Rhea – GBF staff	1	14
7/11/2014	Pilot testing	Watergate Yachting Center	Neally Rhea – GBF staff/Sarah Cunningham – GBF intern	0	6

7/12/2014	Pilot testing	Watergate Yachting Center	Neally Rhea – GBF staff/Sarah Cunningham – GBF intern	0	12
7/18/2014	Pilot testing	Waterford Harbor Marina	Sarah Cunningham – GBF intern	0	21
7/19/2014	Pilot testing	Waterford Harbor Marina	Sarah Cunningham – GBF intern	0	11
7/19/2014	Pilot testing	Lakeside Yachting Center	Neally Rhea – GBF staff	0	1
9/5/2014	Training	GBF Office	Houston Sail and Power Squadron	1	0
9/6/2014	Training	GBF Office	Maritime Sanitation-Onward Shipyard Supply	7	0
9/13/2014	Surveying	Seabrook public boat ramp	Bill Haddock	1	1
3/24/2015	Training	GBF Office	Danny Parker – Water Quality Policy/Outreach Intern and Candy Capuano Day - GB Sail and Power Squadron	2	0
3/26/2015 – 3/29/2015	Surveying	Southwest International Boat Show	Candy Capuano Day – GB Sail and Power Squadron	1	62
TOTAL				31	152

GBF Water Monitoring Team

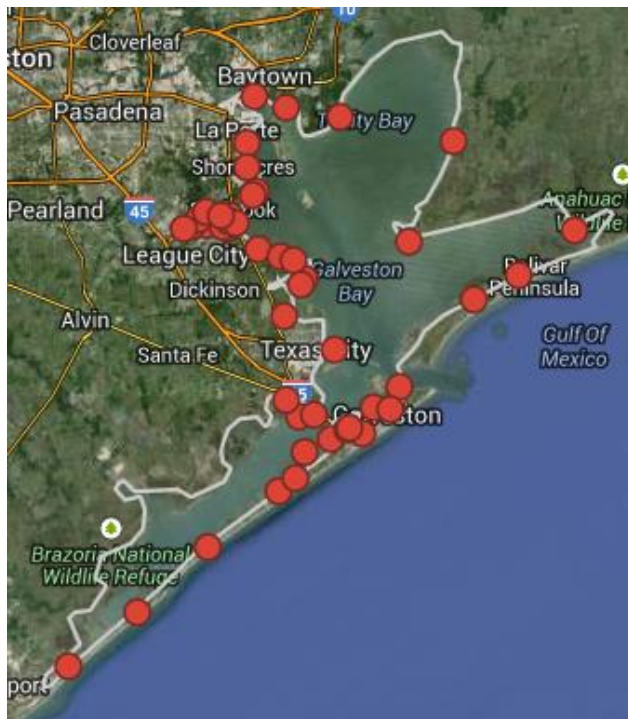


Figure 9. GBF Water Monitoring Team sampling site Google map

The GBF Water Monitoring Team (a group within the Texas Stream Team) launched in February 2012 and the Bacteria Sampling Program in January 2013. There are four main goals for collecting water quality data through these programs for the BWEC:

- 1.) To engage citizens in a hands-on program that empowers them to be Bay Ambassadors
- 2.) To create a line of communication between GBF, boaters, and marinas on a regular basis
- 3.) To establish baseline data trends at marinas and other near-shore recreational sites in Clear Lake and Galveston Bay
- 4.) To detect potential bacteria impairments associated with boat sewage discharges

GBF Water Monitoring Team volunteers are certified to sample at sites around the bay and Clear Lake for core parameters (temperature, pH, dissolved oxygen, salinity, transparency, and field observations), as well as Enterococci bacteria. They

commit to sample their site(s) on at least a monthly basis. GBF's team is part of the Texas Stream Team by being a group within the Houston Galveston Area Council's region, in addition to having our own Volunteer Bacteria Sampling Program. **The monitoring team currently has 50 volunteers sampling from 49 locations, 20 of whom have advanced certification to collect bacteria samples (Figure 9 and Table 16).** Monitoring locations are shown below and the full map can be accessed at <http://www.galvbay.org/watermonitors>. The entire monitoring program is conducted under an EPA-approved Quality Assurance Project Plan and Quality Management Plan. **Table 15** shows the history of active monitors from the establishment of the team in 2012 to present. The **WMT has increased from 40% active to 80% active volunteers**, which we believe is due to setting up reliable systems and standard operating procedures, as well as taking time to build relationships with the volunteers.

The WMT has allowed GBF to develop a strong relationship with the local chapter of Master Naturalists, who are also interested in preserving, protecting, and enhancing Galveston Bay. Implementation of the WMT has allowed GBF to better connect with many marina and waterfront restaurant owners around Galveston Bay to provide sampling sites and promote clean water. **Table 17** shows the group and quality control training events that GBF held during this cycle. In addition, each volunteer that decided to complete their certification received a one-on-one Phase III certification session at their site with a GBF staff member to ensure that they were able to carry out the procedures accurately. GBF continued to make improvements to the management and processes within the WMT. GBF plans to continue training new volunteers to fill in some of the gaps around the Galveston Bay coastline and marinas that are not yet monitored, as well as to refill sites if volunteers decide to stop monitoring. Results from WMT activities will be discussed under Task 5.

Table 15. GBF Water Monitoring Team active monitor data

Reporting Period	# Phase I and II's completed this period	# Phase III's completed this period	Total # Bacteria Samplers	Total # GBF Monitoring Sites	Total # GBF Certified Monitors	Total # Active Monitors**	% Active
Before CWP*	0	10	0	9	10	4	40%
11/31/12	36	17	0	23	24	8	33%
5/31/13	16	14	11	27	28	21	75%
1/31/14	21	15	13	39	38	32	84%
12/8/14	26	19	20	49	50	40	80%

*These monitors were previously trained by other Texas Stream Team trainers and adopted onto GBF's team upon formation

**Active monitors are those who submit data on at least a monthly basis with very few missed months

Table 16. GBF Water Monitoring Team volunteers, sites and monitoring schedule

Site ID	Site description	Name	Monitoring Schedule
81035	Christmas Bay @ 257s County Boat Ramp	Annasheril Santos	2 nd Saturday
80955	Clear Lake @ Bal Harbor Marina (End of Pier A)	Brenda Hesse	3rd Thursday
80956	Clear Lake @ Blue Dolphin Yachting Center	Tricia Lestarjette	1st Monday

GLO Contract Number 14-079-000-7947
Boater Waste Education Campaign Final Report
Page 23

15105	Clear Lake @ Clear Lake Park Pier	Diane Humes	Last Monday
80759	Clear Lake @ Clear Lake Shores (near 1010 North Shore Drive)	Arline Laughter	2nd Tuesday
80758	Clear Lake @ Jarboe Bayou Park	Helle Brown	2nd Tuesday
81045	Clear Lake @ Kemah Boardwalk Aquarium	LeAnn Kincaid	1st Wednesday @ 9am
80467	Clear Lake @ Lakewood Yacht Club	Tricia Lestarjette	1st Monday
30012	Clear Lake @ Marina Del Sol	Amber Faubion, Glen Graves, Yulenty Deal	Middle of month
81040	Clear Lake @ Nassau Bay Yacht Club	Helen Lane	1st Tuesday @ 9am
30010	Clear Lake @ Nassau Bay, Upper Bay Road	Ray Rottmann	Tuesday closest to 15th
81037	Clear Lake @ South Shore Harbor	Kevin Priest	4th Monday
30014	Clear Lake @ Watergate Yachting Center	Cindy Liening	3rd Thursdays
81039	East Bay @ Bluewater	Dennis Peterson	19th of each month
80961	East Bay @ Frozen Point, Anahuac NWR	Mark Danna	2nd Wednesday
30008	Galveston Bay @ 1109 6th St. San Leon	Mark Niles	15th and 30th
80952	Galveston Bay @ 3903 Bayshore Bacliff	Dianne Forthmann and Joe Cavallaro	1st Tuesday, 6pm
30009	Galveston Bay @ Bayland Park	Sara Halpin	The last Sunday
80951	Galveston Bay @ Bayshore Park	Brenda Gonzales	30th
80960	Galveston Bay @ Candy Abshier WMA	Mark Danna	2nd Wednesday, first
81036	Galveston Bay @ Carroll Rd	Bob Lanser	14th of each month
81047	Galveston Bay @ Galveston Bay RV Resort	Raul Rogel	2nd weekend of month
	Galveston Bay @ Houston Yacht Club	Priscilla Blankenship	1st Tuesday @ 1pm
80589	Galveston Bay @ Jetty off Starboard Lane	Gary Russell	1st Sunday
81042	Galveston Bay @ Pier 21	Julie Birsinger	3rd Thursday 1-3pm
80463	Galveston Bay @ Pine Gully Park	Madeleine Barnes	2nd and 4th Monday
80418	Galveston Bay @ Seascapes Pier	Gary Bell	Middle of month
81044	Galveston Bay @ Shoreacres Pier	Kay and Kendall Pickett	2nd Wednesday
80949	Galveston Bay @ Stingaree Restaurant	Ange Busceme	1st and 3rd Wednesdays
80950	Galveston Bay @ Sylvan Beach Park	Brenda Gonzales	30th
81053	Galveston Bay @ TAMUG	Clifford Pabon	beginning of month
30013	Galveston Bay @ Texas City Dike	Cindy Liening	2nd Thursdays
81051	Galveston Bay @ Topwater Grill	Ray Rottmann	Tuesday closest to 1st
	Jones Bay @ Bayou Vista	Chris Roper	2nd Wednesday @ 9am
80957	Jones Bay @ Isles End Tiki Island	John (and Lynn) Wright	3rd Saturday
80958	Jones Bay @ Tiki Tom's RV Park	Carol French	3rd Thursday
80719	Moses Lake @ Texas City Prairie Preserve	Scott Buckel	Every Other Tuesday
30007	Offatt's Bayou @ Sandbar Grill	Heather Brasher	1st Tuesday
81034	Offatt's Bayou @ Sea Scout Base Galveston Dock #2	Abigail Hils	Mondays and Fridays
81041	Swan Lake @ 257J Boat Ramp	Jody Ainbinder	3rd Saturday

81050	Trinity Bay @ Oak Island Lodge	Sandra Moreno	2nd Monday @ 4pm
81038	West Bay @ Eckert Bayou	Christi and Marcos Torres	Every other Sunday
81048	West Bay @ Oak Bayou	Skyler Carey	2nd Wednesday @ 8am
80954	West Bay @ Sportsman Road	Kristi Fluker	3rd Thursday
81046	West Bay @ Sweetwater Preserve	Neally Rhea	Every other Sunday @ noon
81043	West Bay @ Terramar	Jo Monday	3rd Sunday @ 8-10am

Table 17. GBF Water Monitoring Team events

Date	Presenters	Event / Organization - Topic	Location	Impressions
10/17/2013	Ryan Bare (WQRI Intern) and Charlene Bohanon	WQRI research poster presentation	Texas Association of Environmental Professionals - Houston, TX	150
12/10/2013	Katie McCann	QC training class	Marina Del Sol	6
12/20/2013	Katie McCann	Phase I and II training class	College of the Mainland	2
1/8/2014	Katie M	Texas Stream Team Quality Control training for Water Monitoring Team members	Marina Del Sol	2
1/13/2014	Katie M	Texas Stream Team Quality Control training for Water Monitoring Team members	Portofino Harbor	1
1/16/2014	Katie M	Texas Stream Team Quality Control training for Water Monitoring Team members	Bayou Vista home	1
1/31/2014	Katie M	Texas Stream Team Phase 3 training	Yes	1
2/13/2014	Katie M	Texas Stream Team Phase 3 training	Pier 19 on Harborside Dr	1
2/22/2014	Katie M	WMT Bacteria Sampler Certification Training	GBF Conference Room	4
3/6/2014	Katie M / Charlene B	Texas Stream Team Houston Regional Meeting - How GBF/WMT uses TST program	H-GAC	40
3/7/2014	Katie M	Texas Stream Team Quality Control training for Water Monitoring Team members	Bayshore Park	1
3/12/2014	Neally R / Charlene B / Katie M	Alternative Spring Break for college students	Marina Del Sol, Waterford Marina, City of Kemah	18
3/18/2014	Katie M	Texas Stream Team Phase 3 training - WMT member	Seawolf Park	1
3/25/2014	Katie M	Texas Stream Team Quality Control training for Water Monitoring Team members	Marina Del Sol	1
3/31/2014	Katie M / Neally R	Texas Stream Team Quality Control training for Water Monitoring Team members	Marina Del Sol	11
4/1/2014	Katie M	Texas Stream Team Phase 3 training	Boudreaux's on the Bayou (Galveston Island)	1
4/5/2014	Katie M / Neally R	Texas Stream Team Quality Control training for Water Monitoring Team members	Marina Del Sol	5
4/11/2014	Katie M / Neally R	Texas Stream Team Phase 1 and 2 group training	Star Fleet Yachts	23
4/23/2014	Katie M	Texas Stream Team Phase 3 training	Swan Lake, Freeport	1

4/24/2014	Katie M	Texas Stream Team Phase 3 training	TAMUG boat basin	1
4/25/2014	Katie M	Texas Stream Team Phase 3 training	Sea Scouts Base Galveston	1
5/10/2014	Katie M	Texas Stream Team Quality Control Training	Tiki Island	2
5/10/2014	Katie M	Texas Stream Team Phase 3 training	Eckert Bayou/Settegast Rd. Galveston Island	2
5/14/2014	Katie M	Texas Stream Team Phase 3 training	Shoreacres, TX	2
5/14/2014	Katie M	Texas Stream Team Phase 3 training	Beach City, Tx	1
6/2/2014	Katie M	TST Phase 1 and 2 training	GBF conference room, nassau bay/upper bay road	2
6/3/2014	Katie M	TST Phase 3 training	Marina Del Sol	2
6/5/2014	Katie M	TST Phase 3 training	Christmas Bay	1
6/7/2014	Katie M	TST Phase 3 training	Baytown RV Resort	1
6/19/2014	Katie M	TST Phase 3 training	Crystal Beach	1
6/28/2014	Katie M	Bacteria Sampler Training	GBF conference room	2
8/18/2014	Katie M / Tanu U / Winston L / Charlene B / Neally R	WQRI Intern Presentations	Lakewood Yacht Club	25
8/21/2014	Katie M	Texas Stream Team Partners Meeting	TSU - San Marcos, Texas Stream Team	15
9/16/2014	Katie M	Phase 3 Training - water monitoring team	Houston Yacht Club	1
9/23/2014	Katie M	Phase 3 Training - water monitoring team	South Shore Harbor	1
9/26/2014	Katie M	Galveston Nature Council - Managing/Coordinating Volunteers Panel	Moody Gardens	20
11/1/2014 - 11/6/2014	Emily Seldomridge	Water Quality Research Intern poster session	Restore America's Estuaries conference - Washington D.C.	1,100
12/3/2014	Katie M	Phase 1 and 2 Training	GBF and Nassau Bay Park	1
12/4/2014	Katie M	Bacteria Sampler Training	GBF	1
12/5/2014	Katie M	Phase 3 Training - water monitoring team	Clear Lake Park	1
12/17/2014	Alexandra S	TST Training	Jessie H. Jones Park	10
1/19/2015	Alexandra S	Phase 3 Training-Water Monitoring Team	Sunset Cove, Galveston	1
			TOTAL	1,464

Water Quality Research Internship (WQRI)

(Formerly called College Research Experience)

GBF's Water Quality Research Internship (WQRI) was started because there is very little existing water quality data for marinas in the Galveston Bay area. To our knowledge, the only study conducted took place over 20 years ago (Guillen et al., 1993). That study was conducted over a 3 month period, looking at various water quality parameters in comparison to flow rates, in order to make recommendations for marina designs.



Figure 10. Summer 2014 Interns

WQRIs provide university students the opportunity to develop and execute a short-term water quality research project from start to finish including planning, design, sampling, data analysis and creating a final research product. This program was started in order to provide the many university students in the Clear Lake/Galveston Bay area an opportunity to participate in a hands-on, professional internship experience. Students are introduced to the Upper Gulf Coast Oyster Water TMDL Implementation Plan and the BWEC, certified to sample under GBF's QAPP, and carry out a project to help answer research questions related to the BWEC. This intern program helps provide the BWEC Workgroup and Clean Vessel Committee with focused data to help guide campaign activities, as well as track potential improvements in marina water quality over time in a more focused way than is possible with monthly ambient monitoring at just one site per marina.

During summer 2014, two interns (**Figure 10**) were selected – an undergraduate civil engineering student from the University of Texas – Austin and a graduate student from the University of Texas, School of Public Health – Houston. They conducted a second year of sampling in Marina Del Sol, as well as a new study at Lakewood Yacht Club. The marina manager at Lakewood Yacht Club was very interested in learning more about the water quality in their marina after seeing the 2013 research poster and results, so invited GBF to use their marina as a study site.

Marina Service Learning Days



Figure 11. College students testing water at Waterford Harbor Marina

Data collection is often limited by either monetary or human resources, making citizen monitoring a beneficial option for non-regulatory purposes. However, collecting quality data requires a significant amount of dedication from both staff and volunteers in terms of training and quality control. GBF wanted to create a protocol that would allow for local college classes to receive streamlined training and collect a substantial amount of data in one day, while still upholding a high level of quality control (**Figure 11**). Thanks to the Houston-Galveston Area Council (BWEC Workgroup member) loaning us YSI meters, we were able create Marina Service Learning Days in order to augment our monthly ambient sampling and intense CRE studies because it significantly cuts down on the sampling time for dissolved oxygen, salinity, and water temperature. The same methods for pH, transparency, air temperature, field observations, and bacteria sampling are used as for the WMT. Quality control is maintained by having a GBF staff member or advanced trained WMT volunteer accompany and oversee all of the sampling procedures. This program allows us to give more students the

opportunity to participate in hands-on citizen science and increase outreach and presence in local marinas. **Table 18** shows the first two pilot events for this program and the next one will be held in April 2015. Due to funding limitations, this program not being widely offered for the time being. GBF sees great value in this model, however, so will continue to offer it to Lee College on an annual basis until additional funding becomes available.

Table 18. Marina Service Learning Day schedule, sites, and volunteers

Date	Event	Site	Representatives	# Volunteers
3/12/2014	Marina Service Learning Day pilot test	Marina Del Sol and Waterford Harbor Marina	Alternative Spring Break college students from U of North Texas and UT Dallas; Charlene Bohanon, Katie McCann and Neally Rhea	18
4/25/2014	Lee College Marina Service Learning Day	Bayland Marina; Houston Yacht Club	Neally Rhea and Charlene Bohanon	18

Task 5. Track Behavior Change and Resulting Environmental Improvements

GBF is continuously looking for ways to improve our tracking methods in order to better demonstrate behavior change and environmental improvements resulting from the BWEC. Due to the nonpoint source, transient nature of boater waste pollution, it can be difficult to attribute changes in water quality specifically to this one source. This is compounded by the fact that data in marinas was lacking. During this funding cycle, GBF continued to carry out several volunteer programs that began in Cycle 17, which will help increase the amount of water quality and supporting data that is able to be collected in marinas. The following sections will detail results for this funding cycle and will address opportunities for improvement in future cycles.

Galveston Bay Action Network (GBAN)

Since the custom app launched in December 2014, GBAN has received 495 page views compared to 394 between October 2013 and December 2014. This number is still lower than we would like, but we haven't done a major push yet because we are still working out some backend bugs and preparing for a social media project with The Hatcher Group in April for Cycle 19. To date, the new GBAN app has received 7 reports, which all made it to the proper authority and ranged from construction site sediment fencing not being installed, to a small oil leak, to a sanitary sewer overflow. Since the boating season hasn't started yet, we are not surprised that most of the reports are land-based thus far. GBF looks forward to future results of boating community usage once marketing picks up in April!

GBF Dockwalkers

To date, we have a total of 10 trained volunteers and 152 surveys have been conducted, but 62 of those were just recently taken at a boat show, so our preliminary analysis below is including 90 surveys. This represents 1.0% of the boating population with boats > 25 feet and covers five diverse marinas. **Figures 12 – 15** summarize a few key findings. The data in **Figures 12 and 13** informed us that we needed to take a new approach to our Pump Don't Dump messaging and distribution since so many people were unaware of how many pump-out stations there really are around the Bay and the consequences for not

securing the y-valve/main discharge valve. As a result, GBF created the new Pump-Out Postcard with an updated pump-out map and simplified list of marine sanitation codes. **Figure 14** will help us determine how many boats will be impacted by a No Discharge by determining the percentage that doesn't have holding tanks. The data in Figure 15, along with other data collected on the survey, will assist GBF in calculating the waste production on the average boat on Galveston Bay and multiply that by the total number of registered boats to get a basic idea of the amount of waste that boaters produce per year. Based on these and future results, GBF will be able to tailor campaign messaging and strategy to improve knowledge and behavior change, determine priority areas for new pump-out facilities, share valuable market information with mobile pump-out companies, etc.

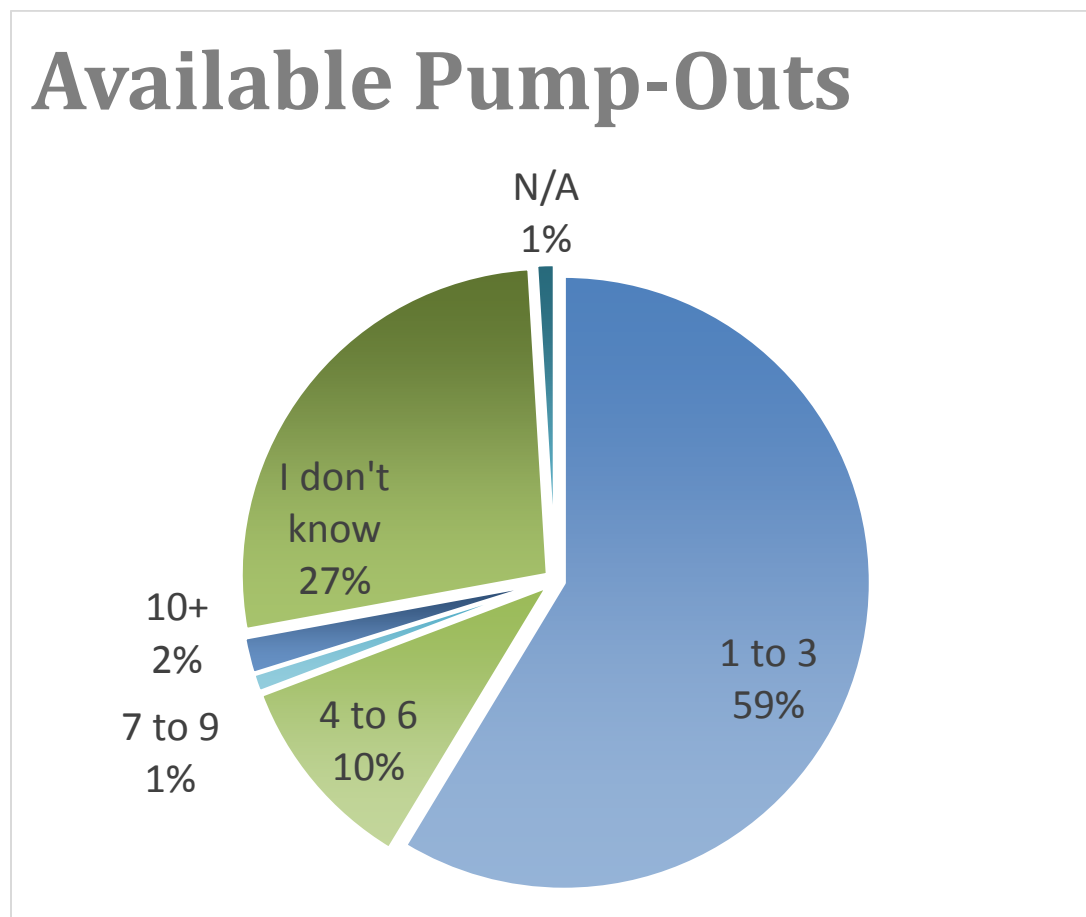


Figure 12. Perception of number of pump-out facilities available on Clear Lake and Galveston Bay

Code Enforcement

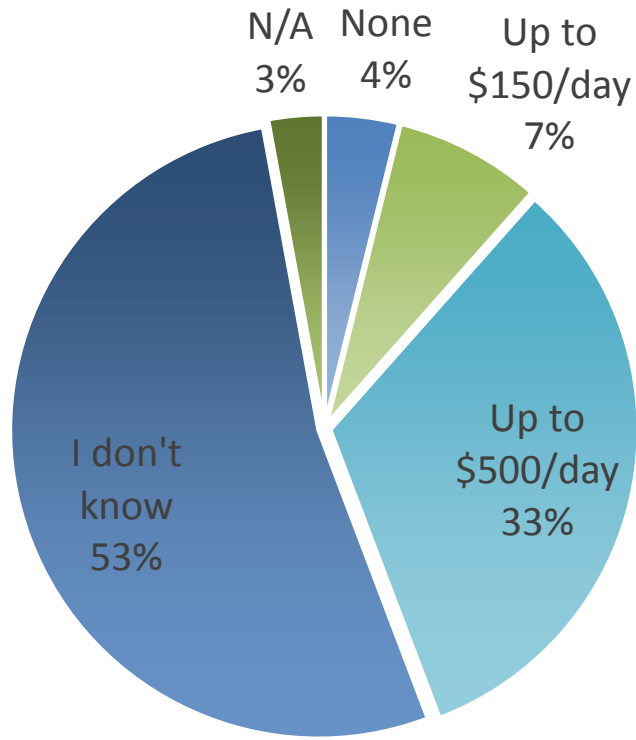


Figure 13. Perception of level of fine for not following marine sanitation codes

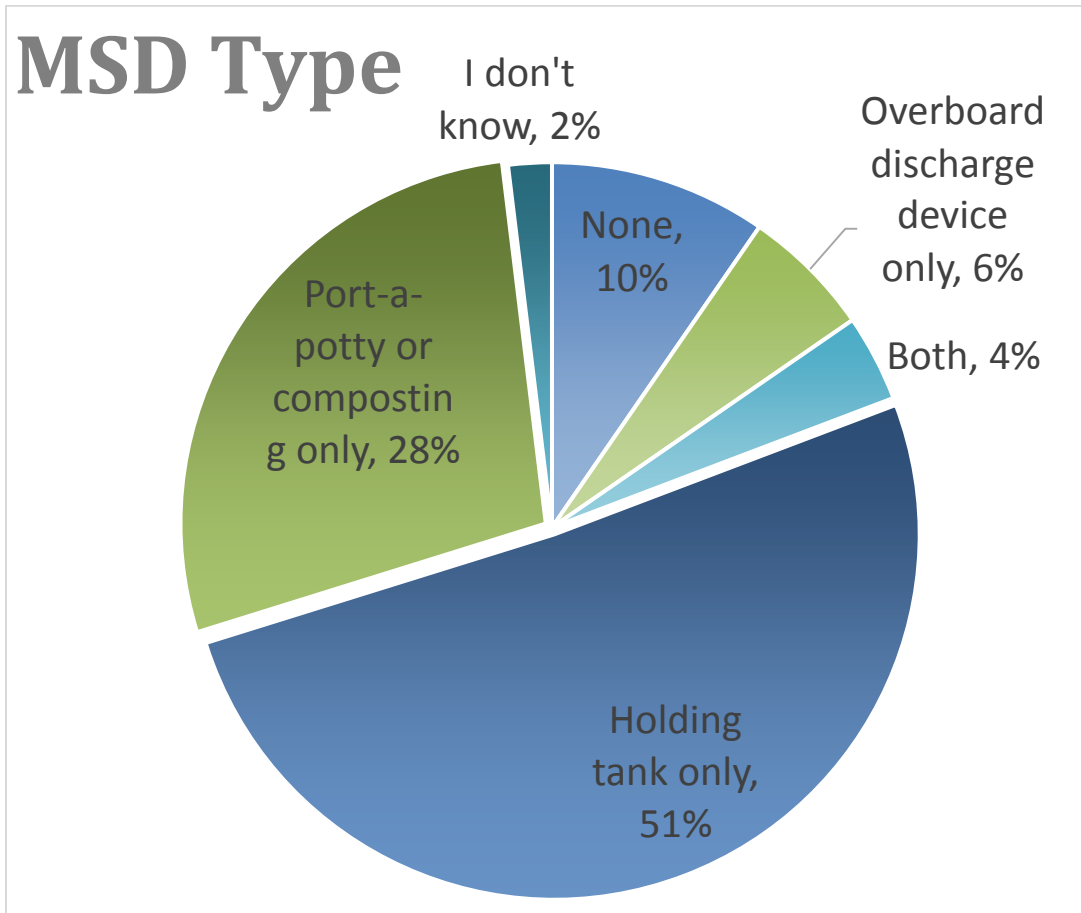


Figure 14. Type of MSD onboard survey participants' boats

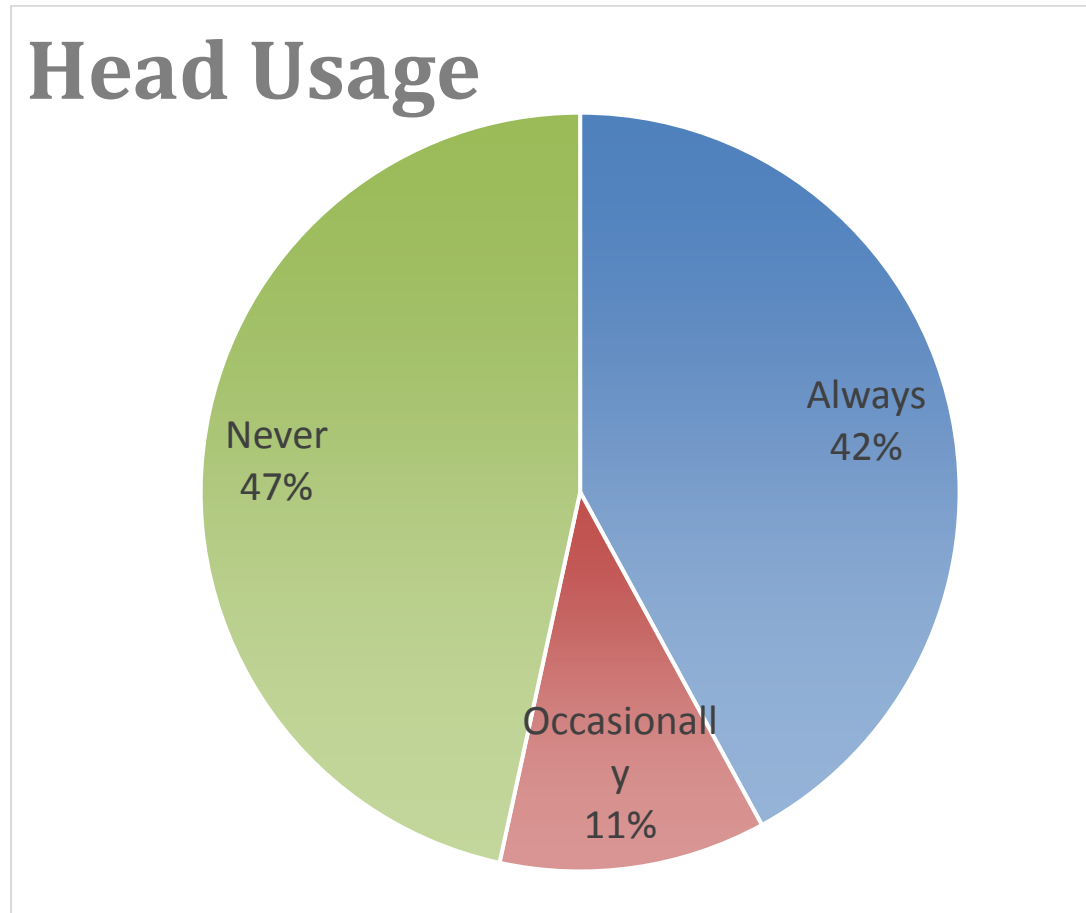


Figure 15. Frequency of head usage on survey participants' boats

GBF Water Monitoring Team (WMT)

GBF continued to collect ambient water quality data at marina and near-shore sites around Clear Lake and Galveston Bay throughout this funding cycle. Please see **Appendix III** for the Water Quality Data Analysis. The following article highlights the value of this component of the BWEC: <http://bit.ly/1wig8A9>.

Water Monitoring Team Photos







Water Quality Research Internship (WQRI)

As a result of the WQRIs for this cycle, GBF completed three Boater Waste Impact Studies to guide the work of the BWEC and continue building relationships with the boating community. Results of these studies can be downloaded and saved from the following link:

<https://www.dropbox.com/sh/x564qi5988ks103/AAA-YWTuKYs67Dih7K8QcFiDa?dl=0>.

GBF will continue these studies in Marina Del Sol and Lakewood Yacht Club in 2015, if we are able. We already have permission for Lakewood Yacht Club and are waiting to hear of Marina Del Sol's plans to rebuild some of their finger piers that were destroyed by Hurricane Ike. This might impede on our sampling design so we will be assessing this situation soon to determine if we need to select a new marina.

Last summer, the interns considered how the number of birds, boat activity, rainfall, water transparency, flow, and marina design affect bacteria concentrations. They made comparisons within Marina Del Sol from last summer to this summer, as well as between Marina Del Sol and Lakewood Yacht Club. If possible, GBF and the interns will partner with either Texas A&M Galveston or the University of Texas, School of Public Health to carry out microbial source tracking on some of the samples. We are also exploring the option of partnering with the Houston Advanced Research Center to make this a joint internship since they have so much expertise in data analysis.

Pump-Out Facilities

The number of pump-out stations/carts and mobile pump-out companies remained the same this year (**Figures 16 and 17**). This is likely due to the fact that the Clean Vessel Act funding has been on hold as Texas Parks and Wildlife tries to fill the position for the person who is in charge of that program since he retired. The former TPWD employee is now working as a consultant for the Marina Association of Texas, of which GBF's Water Quality Program Manager is a board member, so we will be staying in the loop on when this funding will become available again and continue to promote it.

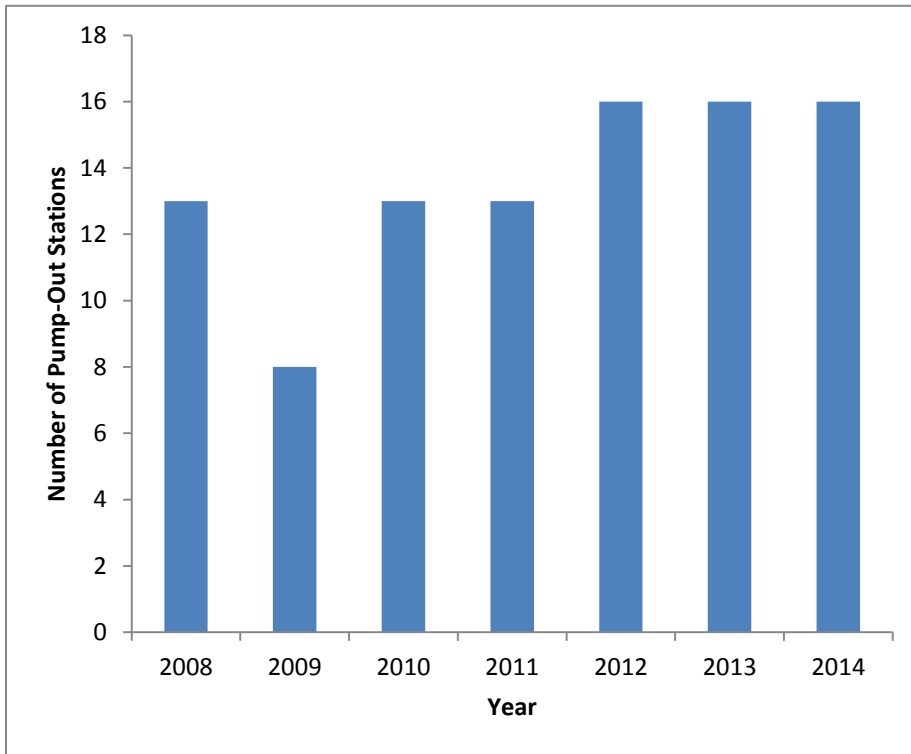


Figure 16. Number of pump-out stations on Clear Lake and Galveston Bay

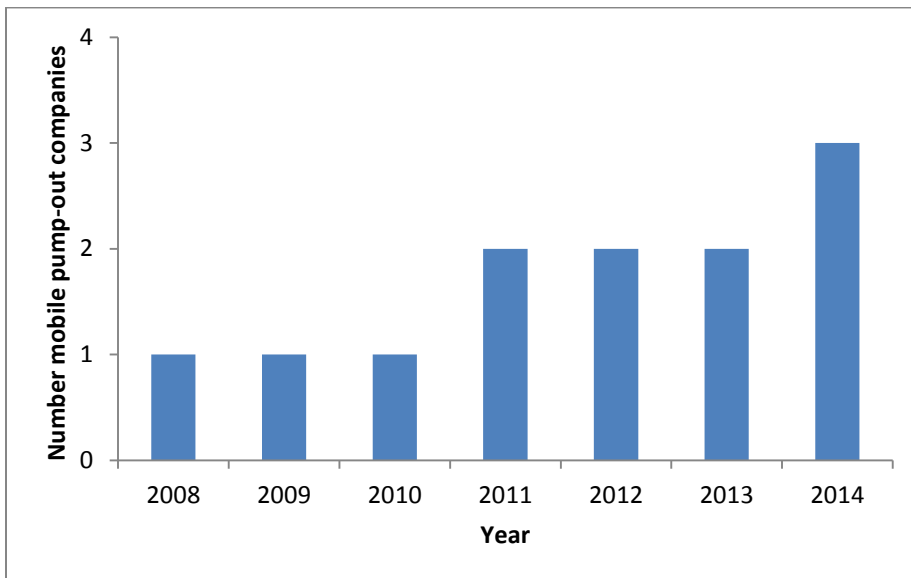


Figure 48. Number of mobile pump-out companies on Clear Lake and Galveston Bay

Conclusions and Lessons Learned

The Boater Waste Education Campaign saw many rewarding enhancements during this funding cycle. The Clean Vessel Committee continued to give a much needed push to some efforts that the BWEC Workgroup has been trying to accomplish for several years. Volunteer programs including the Water Quality Research Internship, Dockwalker Team, and GBAN have and will continue to grow and provide the campaign with much needed data. And finally, teen and elementary-aged boaters were engaged in the campaign through hands-on activities at the WADE camp with the Houston Safe Boating Council, in the classroom, and at outreach booths.

To summarize our major findings, 50% of the organizations on the BWEC workgroup attended meetings and 100% directly contributed to campaign activities, such as certifying Clean Texas Marinas, distributing BWEC education packets, and helping us build relationships with and gain access to marinas for the various volunteer programs. Through education booths, presentations, and workshops, the BWEC reached over 177,000 people at 52 live events. Through print and digital media outlets, GBF was able to reach over 404,000 people with the Pump Don't Dump campaign message through 13 media outlets. These numbers will continue to grow through the social media strategy and graphics that resulted from our project with The Hatcher Group. A custom GBAN reporting tool was developed based on lessons learned and has already received 495 page views and 7 pollution reports with very little marketing. Since the last funding cycle, the GBF Water Monitoring Team remained strong at 50 certified volunteer monitors at 49 sites around Clear Lake and Galveston Bay and 20 of them have their advanced certification to sample for bacteria. GBF's Volunteer Lab Assistant helped us run the lab by analyzing hundreds of bacteria samples, and we hosted two Water Quality Research Interns to conduct sampling at two marinas, which doubles what we did last cycle.

Overall, GBF and the workgroup are pleased with the advances that have been made to the campaign. The information collected during this cycle will assist us as we continue to strive for authorities to more proactively enforce existing boater waste laws. GBF recognizes that the BWEC is a complex balance of education and advocacy efforts and we look forward to continuing work on this project. Thank you to the Coastal Management Program and NOAA for your ongoing support of this important environmental, economic, and public health issue.

References:

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- Galveston Bay Estuary Program (GBEP) and Houston Advanced Research Center (HARC). (2011). *The State of the Bay: A Characterization of the Galveston Bay Ecosystem*, Third Edition. Chapter 6.
- Jeong, Y., Grant, S. B., Ritter, S., Pednekar, A., Candelaria, L., & Winant, C. (2005). Identifying pollutant sources in tidally mixed systems: Case study of fecal indicator bacteria from marinas in Newport Bay, Southern California. *Environmental Science & Technology*, 39, 9083-9093.
- Texas Commission on Environmental Quality (TCEQ). (2008). *Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast: Segments 2421, 2422, 2423, 2424, 2432, and 2439*. Chief Engineer's Office, Water Programs, TMDL Section. Austin, Texas. 1-46.

Appendices:

Appendix I, II, and III can be downloaded and saved via this link:

https://www.dropbox.com/sh/k6kwgk8q18q7c6z/AAA7q5yzZlgFQ4_Mlz9_atACa?dl=0



GBF Water Monitoring Team: 2014 QC Session



Water Monitoring Team Data Analysis

GBF collected ambient water quality data at near-shore sites around Clear Lake and Galveston Bay throughout this Boater Waste Education Campaign (BWEC) project period. The overarching goals for this data collection were:

- 1.) To engage citizens in a hands-on program that empowers them to be Bay Ambassadors
- 2.) To create a line of communication between GBF, boaters, and marinas on a regular basis
- 3.) To establish baseline data trends at marinas and other near-shore recreational sites in Clear Lake and Galveston Bay
- 4.) To detect potential bacteria impairments associated with boat sewage discharges

Long-term monitoring is extremely valuable because the identified trends and hotspots can result in targeted outreach, help foster stewardship in those communities, as well as aid in watershed planning activities. Due to budget constraints, professional monitoring is conducted at a limited number of sites and generally on a quarterly basis, so GBF's Water Monitoring Team is a cost-effective way to augment this professional data. Through the BWEC, GBF continues to carry out citizen-based bacteria sampling and increase the number of volunteers and sites being sampled. When setting up this program, GBF selected Enterococci because it is the recommended indicator bacteria for tidal waters and is widely used for measuring contact recreation use-attainment. The downside to using Enterococci is that oyster water use-attainment is assessed using fecal coliform. However, the use-attainment concentrations set by the U.S. EPA for **Table 1. Summary of water quality standards in the United States.**

Enterococci and fecal coliform have the same relative ratios for each use, so general discussions can be had regarding GBF's citizen science Enterococci results in relation to oyster waters (see **Table 1**). Our data was not intended to be used for regulatory purposes, so this indicator was a better fit due to it being a straight-forward method for citizen scientists to carry out and relate to.

	Enterococcus (CFU/100mL)	Fecal Coliform (CFU/100mL)	Indicators used to detect fecal waste/pathogens for various uses:
Drinking water	*	0	Drinking
Oyster Waters	* (no standard – equiv. to 7.5 geomean)	43	Oyster harvesting for consumption
Primary Contact Recreation	35 (geometric mean)	200	Swimming, tubing, skiing, jet skiing
	104 (single sample)		
Secondary Contact Recreation	175	1000	Canoeing, fishing, power boating
Non-Contact Recreation	350	2000	Birding, hiking, biking

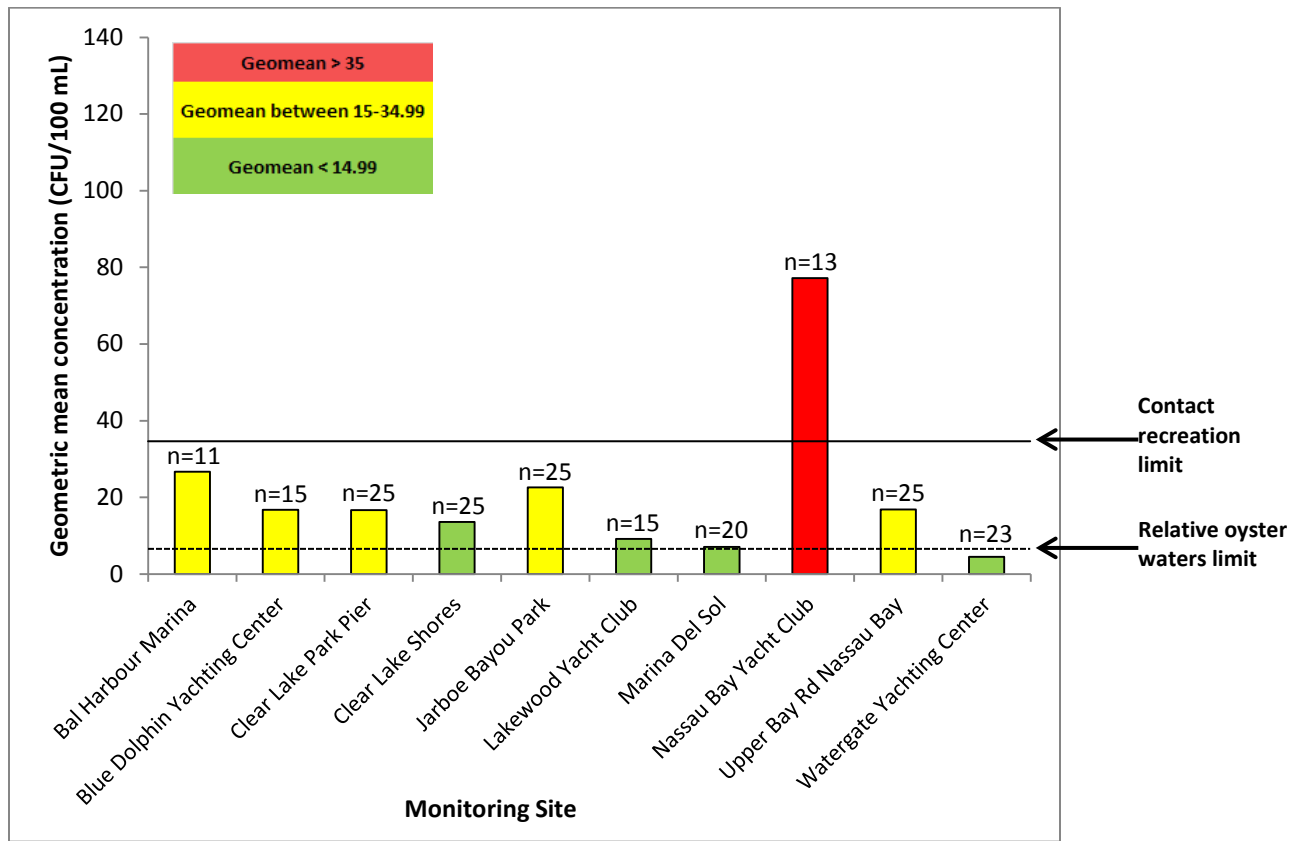


Figure 2. Enterococci geometric means at Clear Lake monitoring sites between January 2013 – February 2015

Results are described below for sites on Clear Lake and Galveston Bay. Geometric mean Enterococci concentrations by monitoring site from January 2013 through February 2015 at Clear Lake sites are plotted in **Figure 2** and at Galveston Bay sites in **Figure 3**. The bars are color coded based on low (green = geomean < 14.99 CFU/100 mL), medium (yellow = geomean between 15 - 34.99 CFU/100 mL), and high (red = geomean > 35 CFU/100 mL) ranges. The geometric mean limit for contact recreation is indicated by a solid line and the relative limit for oyster waters is indicated by a dashed line.

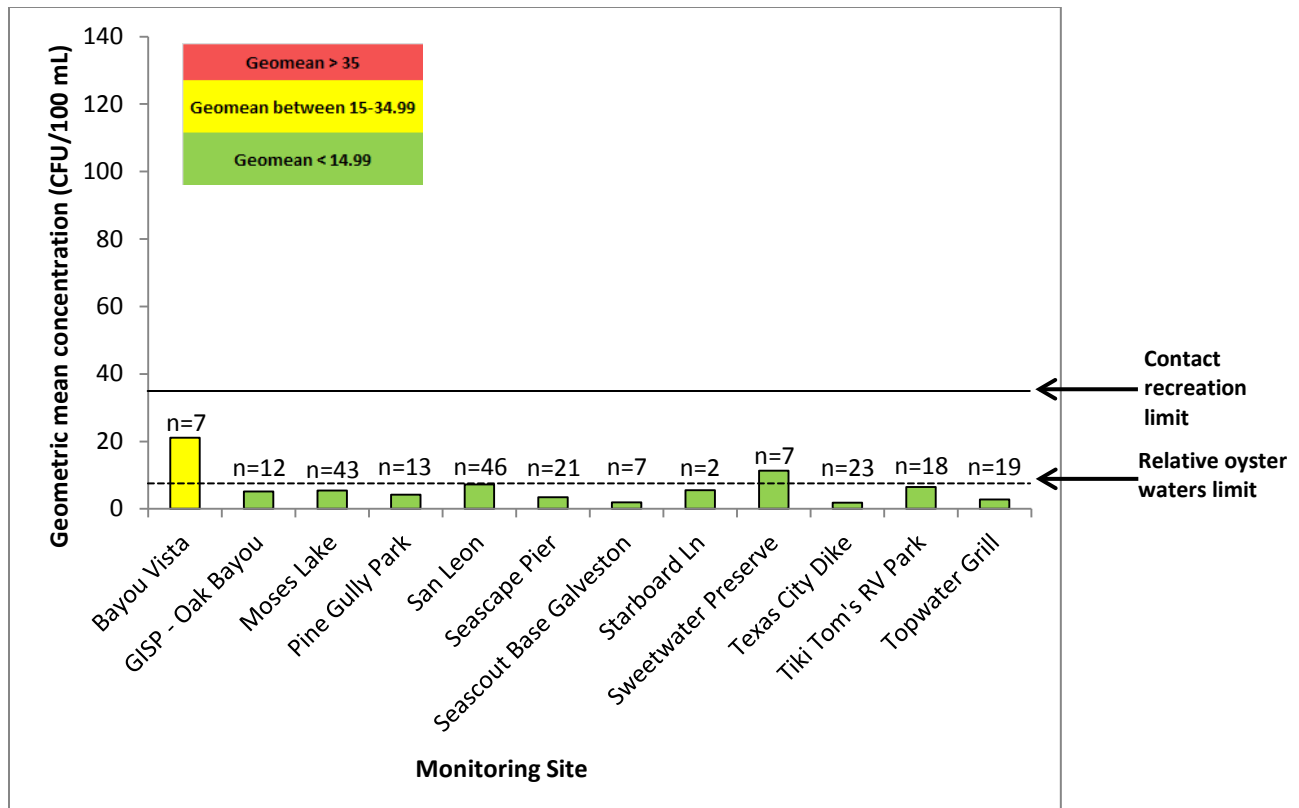


Figure 3. Enterococci geometric means at Galveston Bay monitoring sites between January 2013 – February 2015

Nassau Bay Yacht Club, which is upstream from Clear Lake on the tidal portion of Clear Creek, had the highest geometric mean concentration (77.23 CFU/100 mL) out of all of the sites. Due to the fact that the geometric mean still remains high after 12 months of consecutive data (n=13), GBF will be notifying the city and TCEQ of this continued exceedance. We have been in communication with the marina manager and will work with them to raise awareness amongst their members. Clear Creek already has a Total Maximum Daily Load for contact recreation so this corroborates professional monitoring results and will be communicated in order to aid in watershed planning efforts. GBF will also keep an eye on the sites that are in the medium range, such as Jarboe Bayou at Jarboe Bayou Park and Clear Lake at Nassau Bay – Upper Bay Road, because they have several single-grab samples that exceed the contact recreation limit (104 CFU/100 mL) and have been monitored for over a year. All of the Enterococci geometric means for the Galveston Bay sites were in the low range, aside from Jones Bay at Bayou Vista. However, localized, high single-grab concentrations can and have occurred at many of these sites, so we will continue monitoring their trends. The site at Bayou Vista has been monitored for less than a year, but concerns from residents regarding potential dumping of boat sewage, landscape and pet waste into the canals, along with the fact that the canals receives very little flushing due to poor circulation, make this a prime candidate for increased outreach.

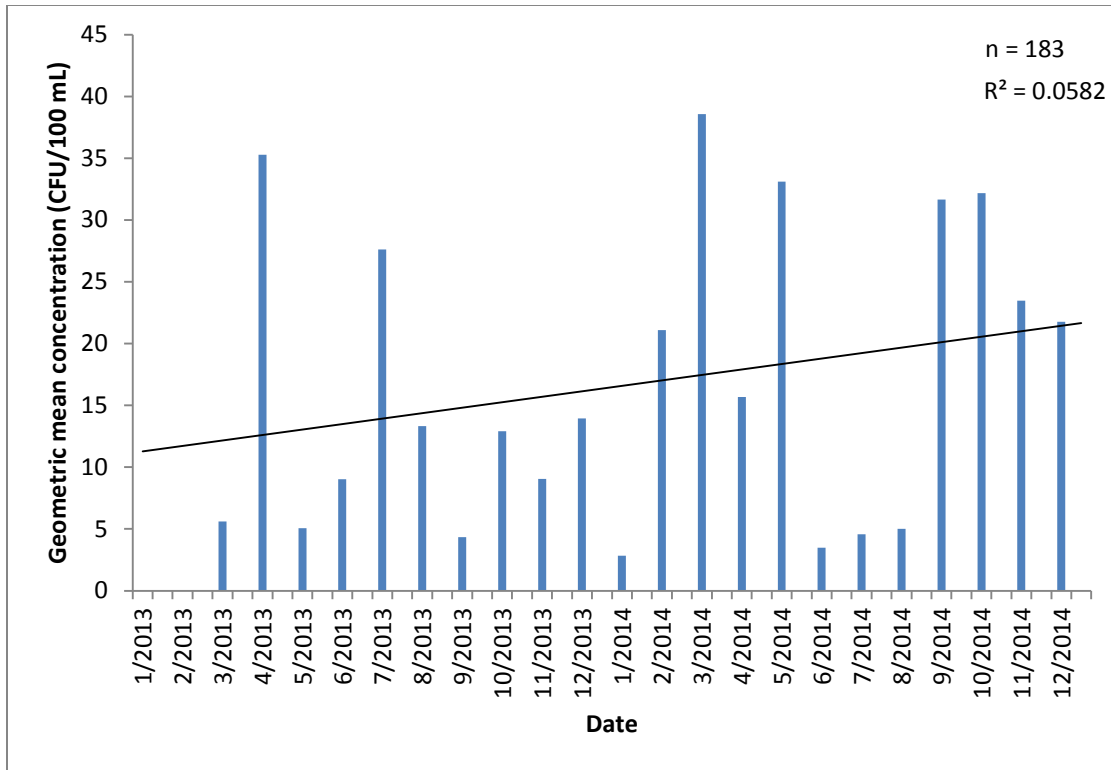


Figure 4. Enterococci geometric means at GBF Water Monitoring Team Clear Lake sites

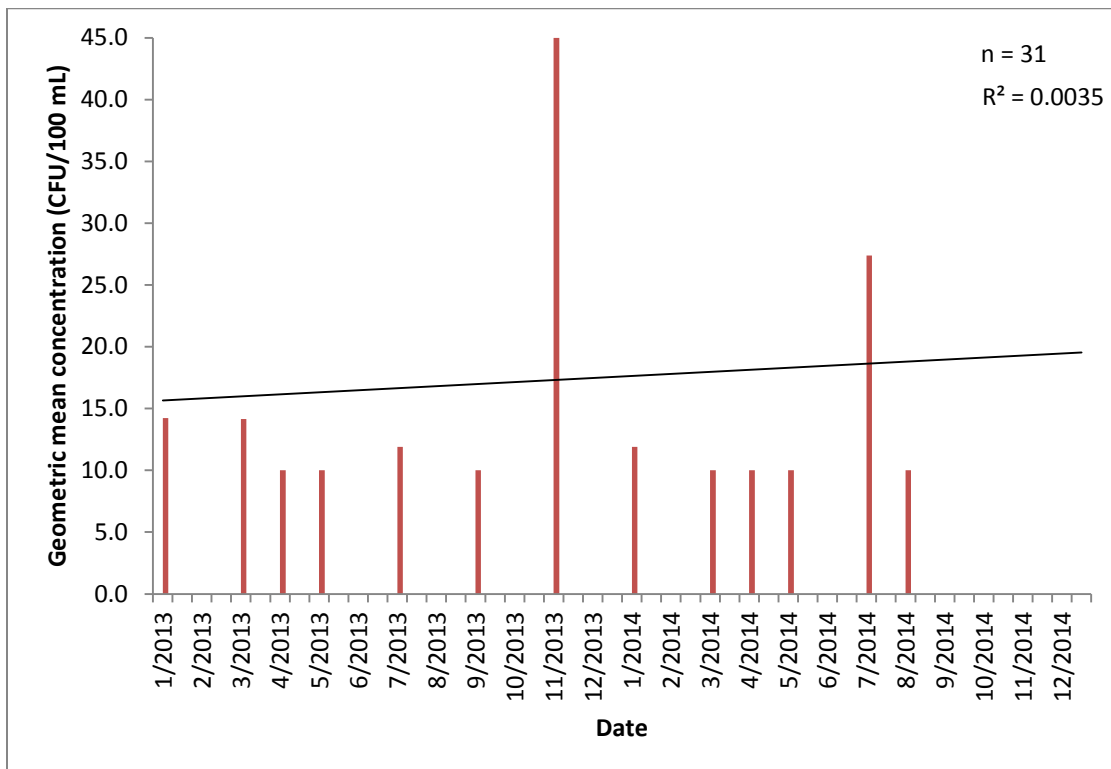


Figure 5. Enterococci geometric means at TCEQ Clear Lake sites

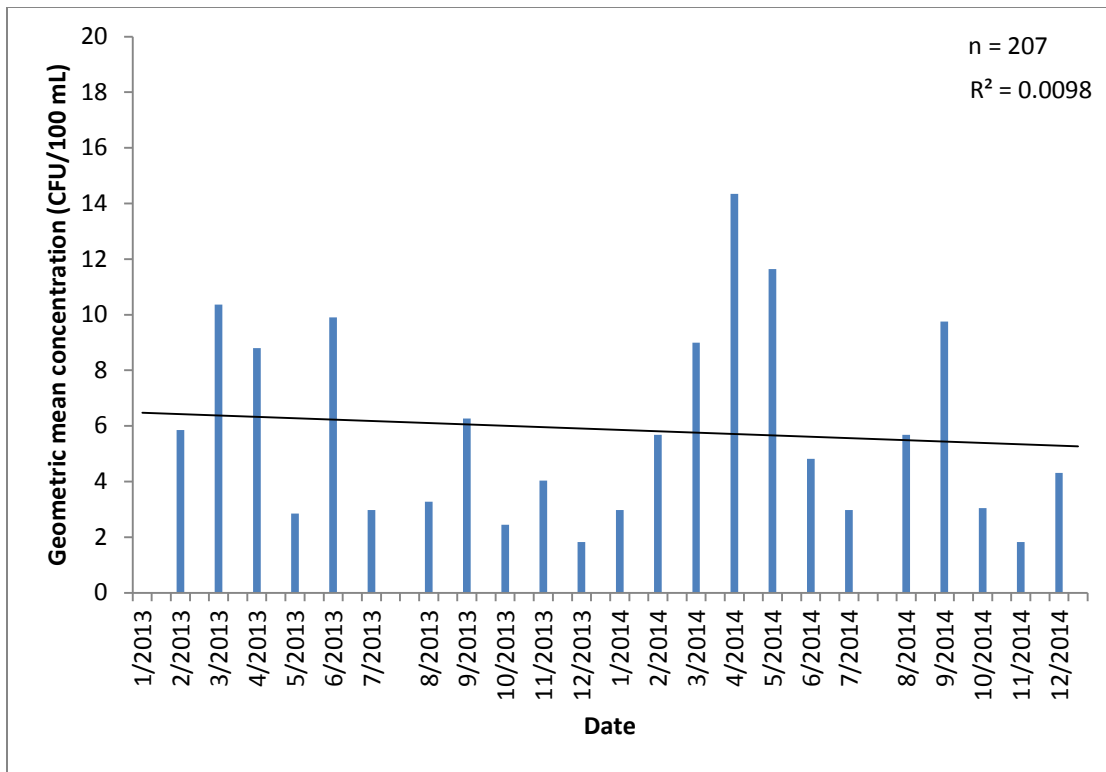


Figure 6. Enterococci geometric means at GBF Water Monitoring Team Galveston Bay sites

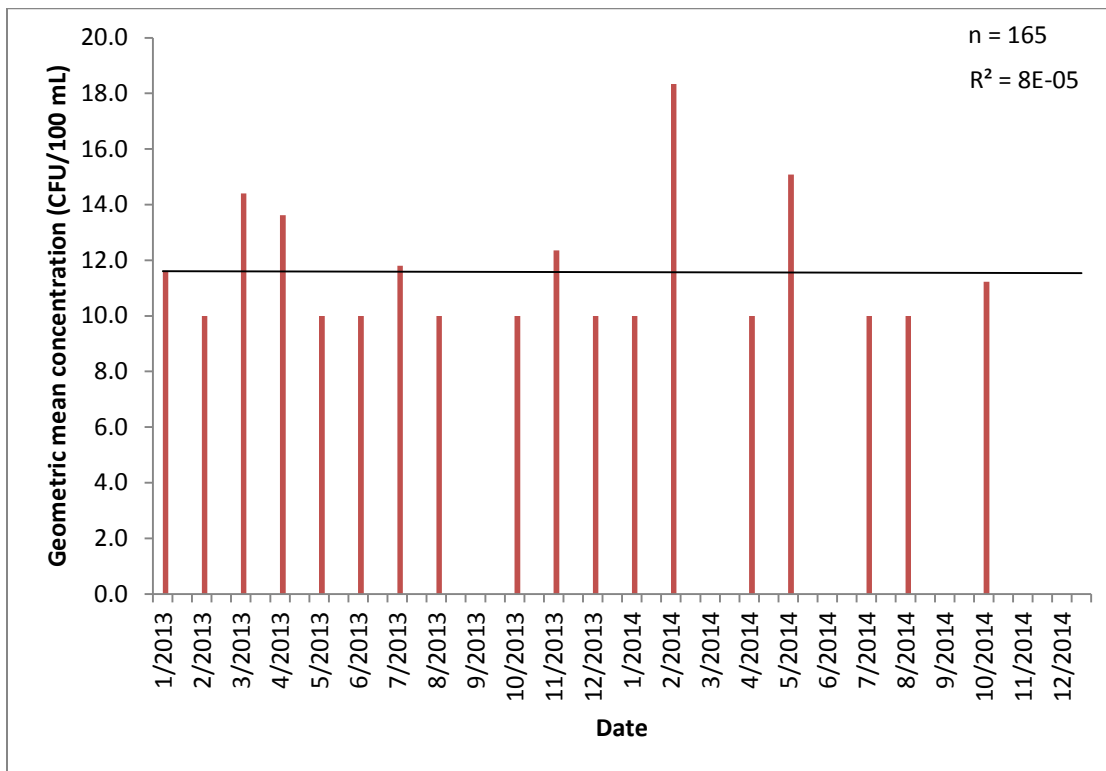


Figure 7. Enterococci geometric means at TCEQ Galveston Bay sites

Figure 4 and 5 show the geometric mean concentrations for Enterococci samples taken on Clear Lake in 2013 and 2014 by the GBF Water Monitoring Team volunteers and the Texas Commission on Environmental Quality professional monitors, respectively. **Figure 6 and 7** show the geometric mean concentrations for Enterococci samples taken on Upper, Lower, and West Galveston Bay in 2013 and 2014 by the GBF Water Monitoring Team volunteers and the Texas Commission on Environmental Quality professional monitors, respectively. In general, more samples were taken through the BWEC on both waterbodies (Clear Lake, n= 183; Galveston Bay, n= 207) compared to TCEQ sampling (Clear Lake, n= 31; Galveston Bay, n= 165). The citizen science data showed an increasing trend in bacteria concentrations on Clear Lake (**Figure 4 and 5**) and a slight decreasing trend on Galveston Bay (**Figure 6 and 7**). Several months exceeded the geometric mean contact recreation standard (35 CFU/100 mL) on Clear Lake and there were no months exceeding that limit on Galveston Bay, however the relative oyster waters limit (7.5 CFU/100 mL) was exceeded over many months on both water bodies. These preliminary results are a small snapshot of the water quality in Clear Lake and Galveston Bay. Clear Lake water quality has significant pressure put on it due to it being densely populated, which may explain the increasing trend in bacteria concentrations. GBF believes that the newly launched Cease the Grease Campaign and Galveston Bay Action Network mobile pollution reporting site will play a major role in reducing pollution inputs to Clear Lake so these trends will continue to be monitored. The slight decreasing trend in bacteria concentrations on Galveston Bay throughout this project period were encouraging to see and GBF is excited to see these numbers go down as the BWEC continues to become more established around the bay.

GBF will continue to look for new opportunities to utilize citizen science data to monitor and support the BWEC and look forward to strengthening trends as increased data is collected over the long-term.