MOBILE TREATMENT

for

Emergency Response and

Alternative Ballast Management

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OVERVIEW

Mobile Testing at Golden Bear Facility

Testing and Efficacy

CSLC Results

Ongoing Testing Efforts

Great Lakes Planning

Puget Sound Voyages

Emergency Response

Deployment Readiness

Response Network

PARTICIPANTS

California State Lands Commission

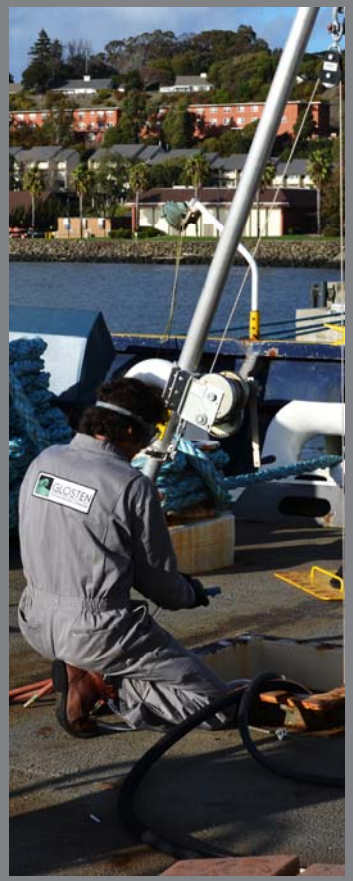
Golden Bear Facility

Moss Landing Marine Laboratories

National Park Service

Grand Portage Tribe

Global Diving & Salvage



MOBILE TESTING AT GBF

BALLAST TANKS

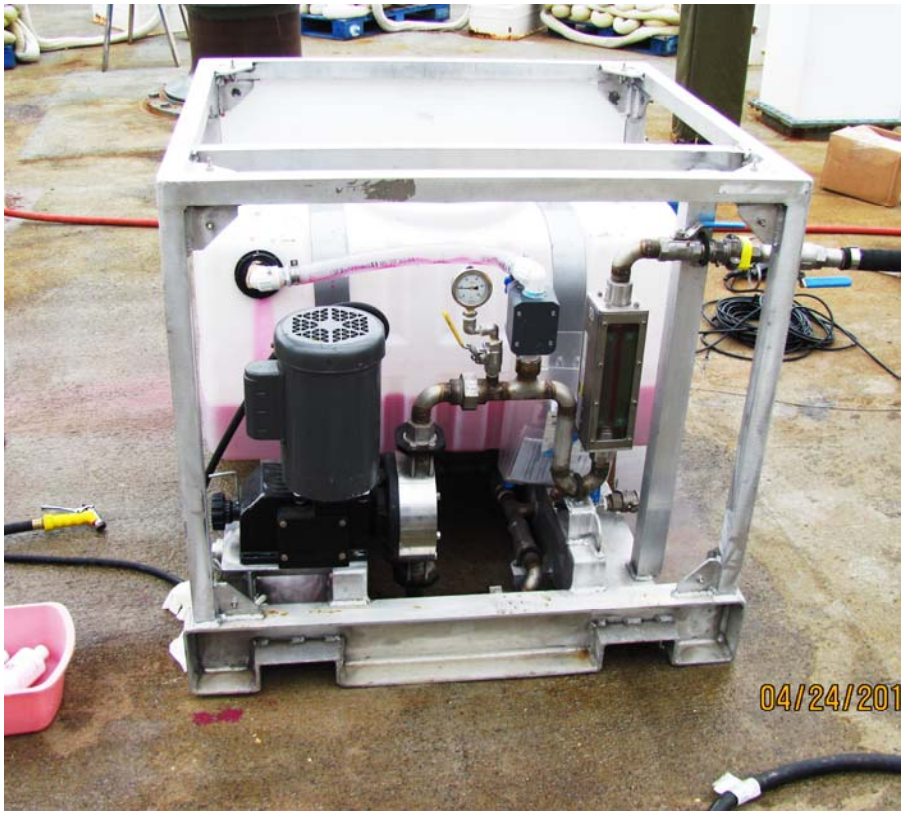
METERING SKID

Portable design

Chemical prep tank

Metering pump

Flow meter



MIXING PUMP

Submersible

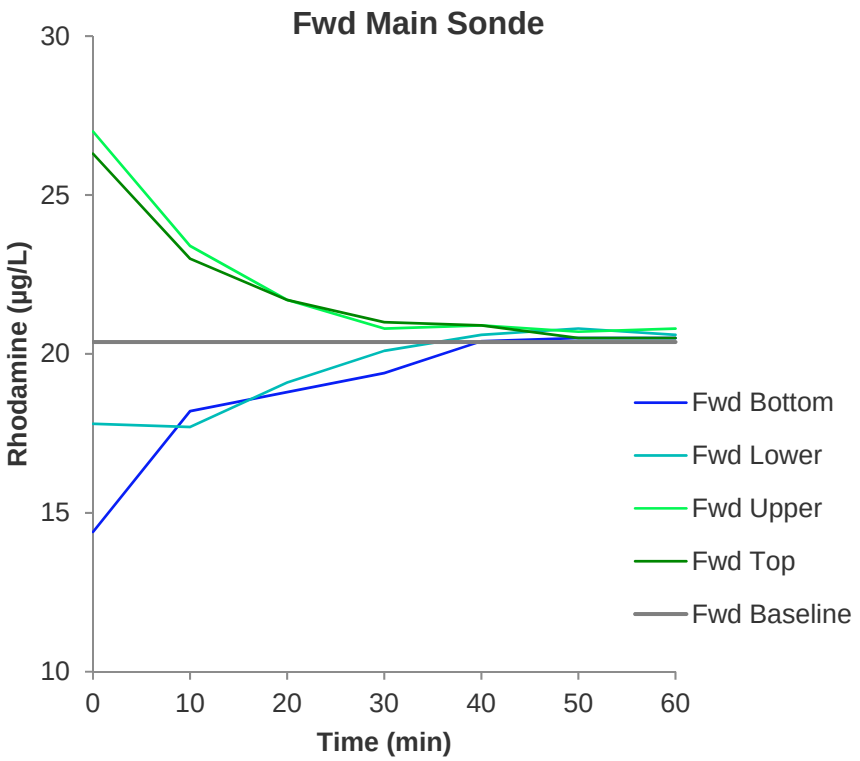
300 GPM flow rate

Chemical sparger

3-way nozzle outlet

Tripod mount

DYE MIXING STUDY



PROCESS

BIOLOGY RESULTS

Parameters	USCG Criteria & Standards		I48A-TD1	I48A-TD2	I24A-TD1	I24A-TD2	I24B-TD1	I24B-TD2	I8A-TD1	I8A-TD2	I18A-TD1	I18A-TD2	I18B-TD1	I18B-TD2
Full Tank Treatment Discharge (dd-mm-yy)			12-11-14	12-11-14	14-11-14	14-11-14	2-12-14	2-12-14	3-12-14	3-12-14	4-12-14	4-12-14	7-12-14	7-12-14
≥50 µm (organisms/m^3)[b]	Mean	<10	2.14 (0.38)	5.50 (0.58)	6.86 (1.1)	14.6 (1.58)	8.8 (1.2)	113.3 (4.3)	9.2 (1.3)	21.5 (1.9)	13.2 (1.5)	11.3 (1.4)	1.2 (0.5)	0.34 (0.24)
<50 µm & ≥10 µm, Flow Cytometry (organisms/mL)[b]	Mean (S.D.)	<10	1.70 (1.2)	1.70 (1.2)	3.29 (1.7)	2.44 (1.9)	2.99 (1.7)	6.7 (2.8)	1.1 (1.4)	2.9 (1.2)	0.36 (0.85)	1.2 (1.2)	1.4 (1.2)	1.3 (1.2)
<50 µm & ≥10 µm, ATP[a] (ng/L)[a,c]	Mean (S.D.)	n/r	0.56 (0.08)	0.57 (0.31)	7.26 (11.1)	14.9 (23.1)	12.8 (18.9)	7.4 (5.8)	10.4 (14.7)	2.4 (3.5)	2.7 (1.9)	23.3 (28.4)	0.61 (0.34)	7.3 (10.4
Indicator Microbes, *E. coli* (CFU/100 mL)[c]	Mean (S.D.)	<250	3.0 (1.0)	3.7 (3.8)	<1 (n/a)	2.26 (1.4)	1.28 (3.1)	<1 (n/a)	<1 (n/a)	2.24 (1.98)	<1 (n/a)	0.46 (0.96)	<1 (n/a)	<1 (n/a)
Indicator Microbes, *Enterococci* (CFU/100 mL)[c]	Mean (S.D.)	<100	0.7 (0.6)	11.0 (5.0)	0.86 (1.1)	3.56 (7.4)	1.6 (1.5)	1.1 (1.95)	<1 (n/a)	0.5 (0.95)	<1 (n/a)	10.4 (21.6)	2.2 (1.3)	17.6 (19.5)
Indicator Microbes, *Vibrio cholerae* (01/0139) (CFU/100 mL)[c]	Mean (S.D.)	<1	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)
Indicator Microbes, Heterotrophic Plate Counts (CFU/mL)[a,c]	Mean (S.D.)	n/r	50.0 (66.1)	187.5 (45.1)	222.5 (442.2)	201.0 (521.1)	170.3 (441.4)	304.2 (249.6)	62.6 (149.7)	137.5 (242.9)	15.0 (27.4)	1003.1 (2074.5)	21.5 (194.9)	222.2 (645.1)
Parameters	**USCG Criteria & Standards**		**I48A-TD1**	**I48A-TD2**	**I24A-TD1**	**I24A-TD2**	**I24B-TD1**	**I24B-TD2**	**I8A-TD1**	**I8A-TD2**	**I18A-TD1**	**I18A-TD2**	**I18B-TD1**	**I18B-TD2**
Partial Tank Treatment Discharge (dd-mm-yy)			12-11-14	12-11-14	14-11-14	14-11-14	2-12-14	2-12-14	3-12-14	3-12-14	4-12-14	4-12-14	7-12-14	7-12-14
≥50 µm (organisms/m^3)[b]	Mean	<10	n/a	n/a	8.2 (1.3)	6.3 (1.1)	6.8 (1.2)	95.8 (4.4)	4.7 (0.97)	5.4 (1.04)	4.1 (0.91)	6.1 (1.1)	0.18 (0.18)	0.26 (0.25)
<50 µm & ≥10 µm, Flow Cytometry (organisms/mL)[b]	Mean (S.D.)	<10	n/a	n/a	1.9 (1.4)	0.64 (1.4)	1.9 (1.4)	1,9 (4.3)	0.64 (1.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.4 (1.3)	1.1 (1.3)
Indicator Microbes, *E. coli* (CFU/100 mL)[c]	Mean (S.D.)	<250	n/a	n/a	<1 (n/a)	2.3 (1.4)	1.6 (2.9)	<1 (n/a)	<1 (n/a)	1.00 (0.0)	<1 (n/a)	<1 (n/a)	<1 (n/a)	<1 (n/a)
Indicator Microbes, *Enterococci* (CFU/100 mL)[c]	Mean (S.D.)	<100	n/a	n/a	0.5 (0.9)	0.8 (0.5)	1.0 (0.0)	<1 (n/a)	<1 (n/a)	<1 (n/a)	<1 (n/a)	<1 (n/a)	2.2 (0.86)	12.5 (10.7)
Indicator Microbes, *Vibrio cholerae* (01/0139) (CFU/100 mL)[c]	Mean (S.D.)	<1	n/a	n/a	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)	<1/<1 (n/a)
Indicator Microbes, Heterotrophic Plate Counts (CFU/mL)[a]	Mean (S.D.)	n/r	n/a	n/a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	165.6 (28.4)	77.5 (140.8)	10.0 (0.0)	7.5 (4.5)	5.0 (9.1)	11.1 (8.2)	24.4 (4.1)

TAKEAWAYS

Residence Time (RT)

- ***Target dose to allow 24-hr dose & neutralize window***

Target Sustained Dose (SD)

- ***Minimize bulk chemical required***
- ***Prevent coating damage***

Mixing/Dosing Coordination

- ***Maximize mixing, re-dose frequently***

Applied Dose Margin

- ***+50% dose to offset initial demand***

ONGOING SYSTEM TESTING

OTHER SHIPS AND WATERS

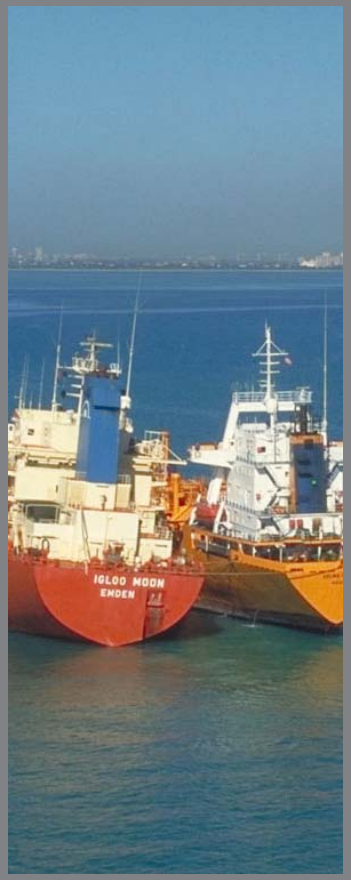
GREAT LAKES

VESSEL SURVEY

FRESHWATER TREATMENT

FRESHWATER TREATMENT

Analysis		Control	Treatment	Standard
Stereo Microscopy (>50 um)	*Live per cubic meter*	3,903 (SD 552, CV 37.8)	0 No live found	Less than 10
Flow Cytometry (10 – 50 um)	*Live per milliliter*	112 (SD 33, CV 29.8)	0.69 (Poisson SD 0.49, CV 70.71%)	Less than 10
Epifluorescent Microscopy (10 – 50 um)	*Live per milliliter*	73 (SD 19.61)	1.0 (SD 1.4)	Less than 10
Heterotrophic Plate Counts	*MPN cell per milliliter*	103.57 (SD 38.72)	<2 (zero) (SD <2)	Not required
E. Coli	*MPN cell per 100 milliliter*	165.7 (SD 80.52)	0 (SD 0)	Less than 250
Enterococcus	*MPN cell per 100 millilter*	0.57 (SD 1.51)	0 (SD 0)	Less than 100



EMERGENCY RESPONSE

DEPLOYMENT READINESS & RESPONSE NETWORK

EMERGENCY RESPONSE

System ready for immediate deployment

Incorporation with standard salver services

Operator awareness: contingency solution for vessel planning

GLOBAL
Diving & Salvage, Inc.

ALTERNATIVE BALLAST MANAGEMENT

STEP Application and Testing

Target Vessels

Glosten

MOBILE TREATMENT

for

Emergency Response and
Alternative Ballast Management

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