

Liquid Robotics, Inc.
Field Operations

MBARI SV3 Engineering Test
Mission Plan



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1 EXECUTIVE SUMMARY

Client: MBARI

Mission Date Range: 3/13/14 – 3/19/14

LR Project Manager: Thom Maughan

Wave Glider Info: 1 SV3 (Tiny)

Theater(s) of Operations: Monterey Bay near-shore.

Mission Description:

This mission will be a 1 week engineering test and sea trial to verify sensor integration into their new SV3 vehicle “Tiny” and to familiarize MBARI with SV3 operations. Experiment designed to detect and track progress of a harmful algal bloom (HAB) from start to finish. Two specific toxins targeted and genomically identified in-situ by ESP moorings. It is theorized that HAB activity in this area is driven by local upwelling of nutrient rich water which “fertilizes” a bloom. Once fertilized, the bloom can turn toxic. Some laboratory studies point towards re-suspended sediments contributing to a target (like pseudo-nitzschia) becoming toxic (with a toxin like domoic acid - think amnesic shellfish poisoning).

These blooms can be sub surface and detected using a variety of methods including AUVs. Once a bloom is found, water samples will be taken from ships and AUVs and analyzed in-situ by the ESP moorings. AUV chlorophyll data is essential in providing scientists with a better picture of the scale and intensity of a given bloom. It informs them on decision making for other assets including ships, and ESP sample times. A high resolution version of this data will be transferred to shore from an LRAUV via the WaveGlider.

Special Operational Considerations:

Client will enter desired waypoints (3/13-14) with guidance and safety assessment of location performed by Liquid Robotics Wave Glider Operations Center (WGOC). Over the weekend (3/15-16), WGOC will pilot vehicle per MBARI instruction. Co-piloting (MBARI and WGOC) may ensue for the duration of the mission as coordinated in advance (evidenced in WGMS by a PICCHANGE comment). Anticipate real-time course change requests as per MBARI’s request.

Environmental Risk Assessment Summary:

Operating within the 60 fathom isobaths poses a higher risk to encounter kelp beds which may entangle the glider or thruster (floating kelp paddies may also entangle the float with a lower likelihood). Crab pots and fishing gear also pose a risk in shallower water. Power margin is not fully understood (power draw characterizations on client integrated devices unknown). WGOC will monitor power utilization for safe operating conditions.

	Monterey Bay	Mitigation
• Navigational Authority	●	
• Power Margin	●	<u>power management protocol</u>
• Bathymetry	●	
• Vessel Traffic	●	
• Hazards to Navigation	●	<u>navigation protocol</u>
• Political Interests	●	

Link to Environmental Risk Assessment: [see Appendix](#)

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Local Authorities & Permitting:

Request for publication in Local Notice to Mariners submitted by LRI

- Covered under USCG-D11 02 Feb – 31 Mar

* Evidence of communications and or authorizations required: [see Appendix](#)

2 KEY STAKEHOLDERS

2.1 Points-Of-Contact			
Client POC:	Thom Maughan tm@mbari.org +1 805 245 4890 (cell) +1 831 775 1865 (office) Brian Kieft +1 831 334 7658 bkieft@mbari.org	LR Project Mgr.:	Ryan Carlon Ryan.carlon@liquidr.com +1 530 520 0816
LR Sensor Eng.:	Mike Cookson mike.cookson@liquidr.com +1 408 636 4233 Viet Tran viet.tran@liquidr.com +1 408 636 4253	LR Field Ops Mgr.:	Keith Kreider VP Operations, Wave Glider keith.kreider@liquidr.com +1 408 636 4277
LR Field Ops Eng./Tech:	NA	LR WGOC Mgr.:	John Appelgren Dir, Customer Support Operations john.appelgren@liquidr.com +1 408 636 4260
LR Acct Rep, or Channel Partner:	Jamie Griffith jamie.griffith@liquidr.com (509) 993-8216	LR WGOC:	Pilot-in-Charge Mission Support Specialists opscenter@liquidr.com +1 408 636 4205

2.2 Roles and Responsibilities

Client Point-of-Contact: If deployment is on behalf of an external client, Client POC is the primary liaison to the Project Manager to coordinate mission objectives, and communicate deviations should they become required during fulfillment of mission objectives.

Project Manager: Is the primary liaison to the client. If deployment is in support of an internally managed project, or supporting an external client, Project Manager coordinates all communications and personnel required to support the field deployment in conjunction with Field and Customer Support Operations.

Sensor Engineer: Ensures sensors and Wave Glider are properly integrated and operating consistent with mission objectives (prior to, and during field deployment).

Field Operations Manager: Coordinates and plans logistics of people, equipment, and vessels (responsibility may be fulfilled by Project Manager).

Field Operations Engineer/Technician: Personnel assigned to perform on-location work.

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Wave Glider Operations Center Manager: Coordinates mission planning logistics, mission administration, and piloting operations of Wave Glider activities.

Account Representative/Channel Partner: Provides project oversight ensuring mission plan aligns with client's operational immediate and future business needs.

Wave Glider Operations/Customer Support Call Center: Personnel assigned to perform shore-side piloting operations.

3 MISSION PLAN

3.1 Client Deliverables

Specific to Client PO:

- **Sortie 1:** Client conducting engineering tests on Comm HotSpot, Ocean Acidification (OA) sensor, and Ecopuck Fluorometer.

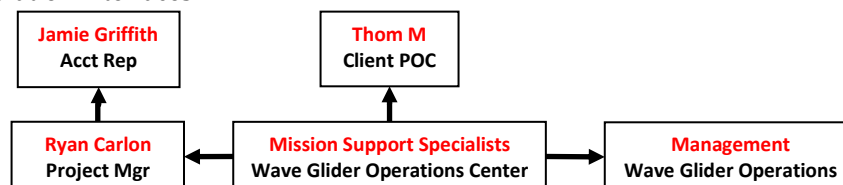
Professional Service: LRI mission planning logistics and piloting services.

Sea Acceptance Tests (SAT): The mission itself is a sea trial to verify sensor integration into the SV3.

Data: Client requires weather station and EcoPuck data from shore using LRI hosted Fetch.

Communications:

- Non-emergency:
 - Drift or evasive navigation causing breach of, and return to a defined survey area to be communicated to LR Project Manager and Client POC immediately.
 - Device duty-cycling in compliance with power management criteria to be authorized by LR Project Manager and Client POC.
- Emergency:
 - Core system and or device malfunctions to be communicated to LR Project Manager and Client POC.
- Escalation Interfaces:



3.2 Operations Logistics

Project Code:	563000	LR Field Ops Eng/Tech Req.:	Total days on location: NA days Total days underway: NA days
Deployment Type:	Single launch and single recovery from client chartered vessel.	Schedule (dates):	140313 - Mobilization 140313 - Vessel Underway 140320 - Demobilization
Vessel:	M/V Paragon MBARI	Client/	Credentials required: TWIC and valid

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Port: Moss Landing, CA MBARI	Vessel Physical
	Required Certs:
LR Field Operations Accommodations: NA Field Replaceable Units (FRUs/Spares) and Special Tools: NA Freight Forwarding Logistics: NA Pre-Launch Validation: Core systems and sensor calibration (pre-launch checklist) distributed to WGOC (mission/case record). Operations and HSSE review preceding each voyage: see Appendix Launch/Recovery Reports: Authored by field resource following task; distributed to WGOC (mission/case record) and Field Operations; expanded distribution to affect quality improvement initiatives. Post-Recovery: SL1 inspection/servicing (client to perform; LRI services available); stage for next mission. Vessel & Equipment Specifications: Client contracted vessel.	

3.3 Vehicle Configuration & Operating System			
Wave Glider Info:	Vehicle & tracker name(s): Tiny (SV3-011), Tracker SV3-011 Detailed Vehicle Parameters: see Appendix	WGMS Org: mbari.wgms.com	
		Org, WG, Dashboard Prep:	Ready date: 140312
Float Devices:	Comm HotSpot (S1), EcoPuck (S3), Ocean Acidification (OA) sensor, Acoustic Modem mounted to custom skeg (controlled by HotSpot PL)	WGMS Access:	Submit request to opscenter@liquidr.com User name, email, phone# (LR Account Representative authorization required)
Sub Devices:	None		

3.4 Navigational Tasking
Mission Description and Theater of Operations: <i>Executive Summary</i> Sortie 1: Tiny will be deployed offshore of Moss Landing in Monterey bay for a weeklong sea trial for client to familiarize themselves with sensor integration into the SV3 platform and piloting techniques. <i>* Thruster use requires Brian Kieft's authorization</i> Task 1: Safely deploy in vicinity of 36.79675, -121.86712 (WP2) followed by core system and device validation. Following systems validation, begin mission by holding station at WP2-5 until directed otherwise: WP2 36.79675, -121.86712 Wp3 36.79450, -121.86432 WP4 36.79226, -121.86712 WP5 36.79450, -121.86993 [yymmdd, hhmmz, lat/lon – task start] [yymmdd, hhmmz, lat/lon – unplanned events: challenges; special discoveries; etc...]
Task 2: Begin transit to northwest to 'Outer shelf' location located at 36.839 -121.925 and/or to "Mid Shelf"

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location 36.8625 -121.9068 (initiate a 120m hold station box courses at each). Client will direct on preferred location.

[yyymmdd, hhmmz, lat/lon – task start]

[yyymmdd, hhmmz, lat/lon – unplanned events: challenges; special discoveries; etc...]

[yyymmdd, hhmmz, lat/lon – task end]

Task 3: Safely recover in vicinity of 36° 47.8050N, 121° 52.0272W, secure vehicle for transit to shore, and end mission.

[yyymmdd, hhmmz, lat/lon – unplanned events: challenges; special discoveries; etc...]

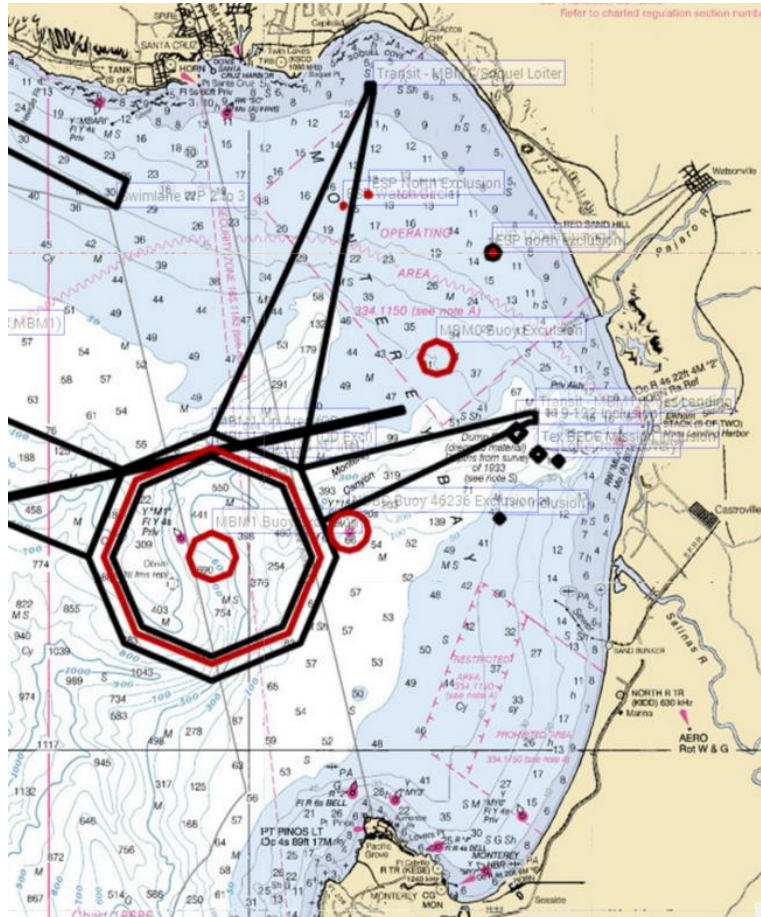
[yyymmdd, hhmmz, lat/lon – task end]

3.5 Piloting Tasks

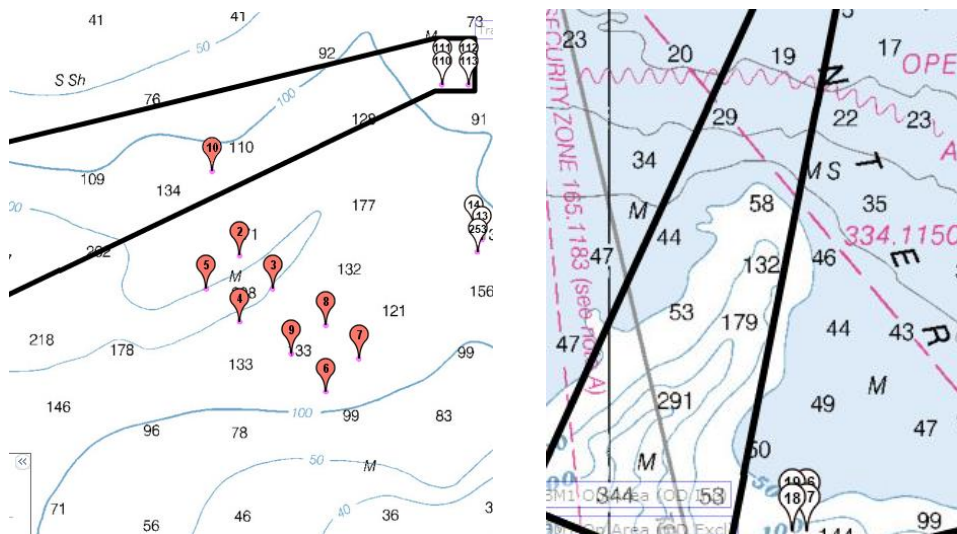
Observations:	Probable Response:	When to Escalate:
Event Notifications	• Navigate (manage drift; evade threats) • Take corrective action	• Unsafe operation conditions • Mission deviation
Power Management	• Light: Launch/recover/emergency use ◦ <i>Night use requires local authority authorization</i> • Thruster: Client authorized use only • Telemetry: 10min (250wh); 15min (200wh auto-adj); 20min (150wh); 30min (100wh) ◦ <i>Consider glider position (AIS notification diminished at TRR >5min)</i> • Water Speed Sensor: Off at 250wh • Payloads: Adj sample rate, or off at <200wh • Weather Station: Off at 150wh • AIS and Radar Target Enhancer: Off at 100wh ◦ <i>Consider glider position (no vessel awareness aides, and risk of power loss)</i> • Move to Safe Harbor: At 50wh • Power Restoration: In reverse order +25wh ◦ <i>Increase thresholds by 100Wh when entering periods of deteriorating weather forecasts)</i>	• Notify Project Manager at 300Wh, and upon device duty-cycling thresholds
Device Operation Notes:	• Fluorometer activation: write console script "EcoPuck --run" to board address 12306 • Cell Modem: Near-shore use considerations ◦ <i>Set WGMS default coms channel to VR/Cell</i> ◦ <i>Cell Range Edge Option - command cue mitigation (requires client authorization)</i> ▪ <i>Set WGMS default coms channel to Iridium</i> – <i>Benefit:</i> Mitigate risk of "out-of-cell-range" VR/Cell commands getting cued in relay. Low coms volume, low Iridium costs. Operator can override coms channel. ▪ <i>Clear default channel from vehicle</i> – <i>Benefit:</i> Vehicle coms default to VR/Cell 1st... Iridium 2nd. High coms volume, essentially no Iridium costs (if in cell range).	• Notify Project Manager If VR/Cell commands do not ACKed. Decision required: ◦ <i>Acknowledge risk of aged/cued commands</i> ◦ <i>Disabling VR/Cell to prevent aged/cued commands from being executed upon return to cell range</i>

3.6 Course Architecture

Overall Operating Area:



Course Details:



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3.7 Emergency Equipment Retrieval

If escalation warrants emergency retrieval of a Wave Glider, local authorities are notified and Marine Operations is engaged to coordinate search and recovery operations. Logistics include: last known disposition for shipping crates; WG cart/stand/saddle; Ops kit (specifically recovery tool, bundling/release straps, sea-catch, and tagline carabineers); and vessel/crew of opportunity contracting/vetting.

3.8 Authorizations

Client POC: Thom Maughan

LR Project Manager: Ryan Carlon

LR Account Representative: Jamie Griffith

Dir., WGOC: John Appelgren

VP, Field Operations: Keith Kreider

Sr. VP Product Management: Graham Hine

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4 APPENDIX

4.1 [Environmental Risk Assessment](#)

4.2 [Evidence of Communications with Local Authorities & Permitting](#)

4.3 [Detailed Vehicle Parameters](#)