VERDANT POWER

Before the United States of America
Federal Energy Regulatory Commission

ROOSEVELT ISLAND TIDAL ENERGY PROJECT

FERC No. 12611

Final Kinetic Hydropower
Pilot License Application

Volume 4 of 4
December 2010

Verdant Power, LLC
New York, NY

PILOT LICENSE APPLICATION

ROOSEVELT ISLAND TIDAL ENERGY PROJECT

FERC NO. 12611

VOLUME 4 OF 4

December 2010

Submitted by:

VERDANT POWER

VOLUME 4

RMEE PLANS

Roosevelt Island Tidal Energy Project (RITE)

Proposed Monitoring Plans

RITE Monitoring of Environmental Effects (RMEE)

Volume 4 – FINAL Kinetic Hydropower Pilot License Application

P-12611-003

Revision 3.2 Executive Summary

December 2010

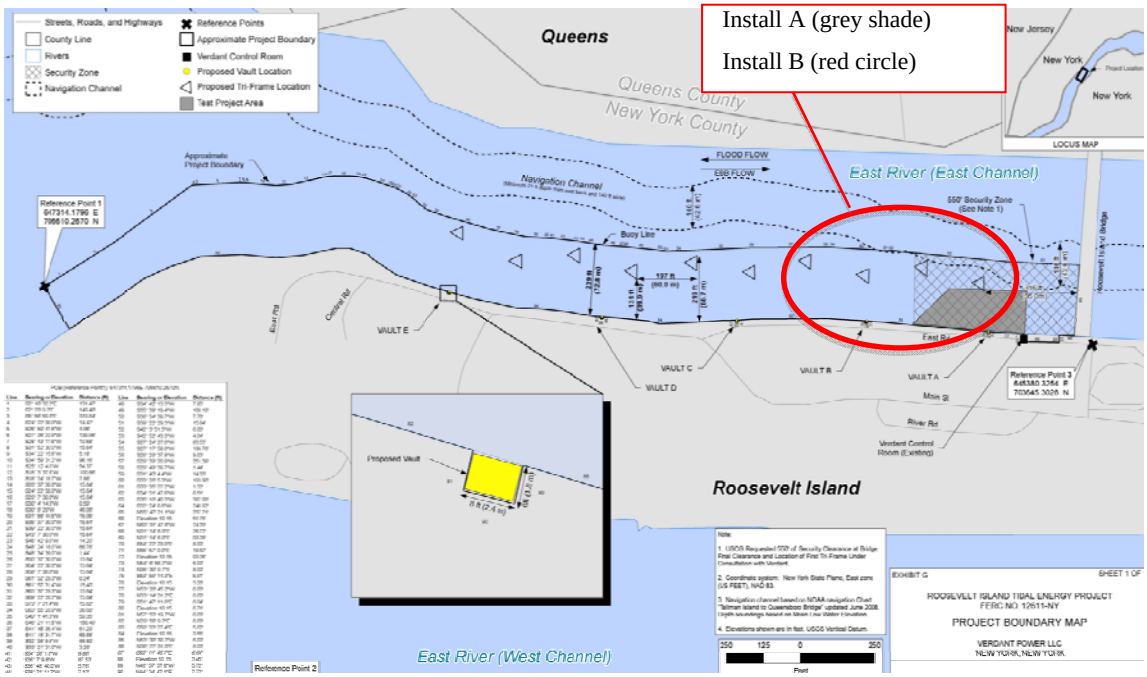
Since the filing of the Draft Pilot License Application (DLA) in November 2008, Verdant Power has made significant technological advancements on the Gen5 machine and has subsequently reconfigured the development of the proposed Pilot Project to be consistent with technology goals as well as project financing requirements. Verdant Power is now proposing a phased approach to developing the Pilot Project, as further described below. This phased development will facilitate both testing the effectiveness of the Gen5 machines and assessing potential environmental effects associated with a full build out. The RITE Monitoring of Environmental Effects (RMEE) covers all four stages of the Project including:

1. **Install A: Install Two Gen5 Turbines on Existing Monopiles**
    - Installation would be accomplished in 4Q2011 on existing foundation mountings.
    - This installation would be conducted within the boundaries of the established RITE demonstration project.
    - This effort would be conducted under a proposed modification and extension to the existing NYSDEC/USACE permit (expires May 2012) and the FERC Verdant Order and would not be under a FERC pilot License.
    - This stage of the project would last a minimum operational period of up to 180 days; and include environmental monitoring as described below.

- Verdant Power will propose an extension of the existing permit term of 1 1/2 years to November 2013 to allow for flexibility in the schedule; and incorporation of the agreed to Install A monitoring plan.

2. **Install B1: Install Three Gen 5 Turbines on a Triframe**
   - Install B1 would be governed by the terms of a FERC Pilot License, a new NYSDEC/USACE joint permit, and other requisite permits.
   - Verdant Power will apply for these permits concurrently beginning in December 2010; with expected installation in 3Q12.
   - The initial purpose would be to test the new triframe mount component of the technology and prove operation and maintenance techniques.
   - The environmental monitoring from Install A continues, adding two additional elements.
3. **Install B-2: Install up to Three Additional Triframes of Three Turbines Each**
   - Install B-2 would be done under the FERC Pilot License and additional authorizations; and expand the project to up to 12 operating KHPS in 2013.
   - This stage would include an additional element of environmental monitoring within an array of multiple Gen5 machines to increase the understanding of environmental effects.
   - The experience and lessons learned from the execution of previous RMEE elements will be incorporated into this stage.
4. **Install C: Install up to Six Additional Triframes (no more than 30 Gen5 KHPS total)**
   - Incremental buildout of the full Pilot Project, incorporating the results of technology and environmental testing in previous stages.
   - This would also be done under the FERC Pilot License and additional authorizations and likely completed in 2014.
   - Environmental monitoring in select years as shown below.

Figure 1 Project Site: The Rite Project (East River; New York)



In developing a process for monitoring marine hydrokinetic machines, Verdant Power has found it useful when discussing the studies and protocols to consider the following terminology.

- Micro scale – in and around an individual 3-rotor 5 m diameter (D) KHPS turbine; rotating at <40 rpm and only during high velocity periods > 1.0 m/s.
- Meso scale – in front/back of the KHPS. Here we are looking at the reaction around the triframe and the interdependencies and recovery distance to the next KHPS triframe in the array – generally 12D.
- Macro scale – well beyond the triframe (and the fully developed array) extending to points where organisms first sense/encounter the minor hydrodynamic presence of the KHPS array. This is a broader scale study conducted for longer-term deployments of machines.

The studies and protocols proposed in this Rite Monitoring of Environmental Effects (RMEE) Monitoring Plan for the Pilot license reflect considerations for techniques at all three of these scales. Verdant Power has performed extensive pre- and post-operation data collection and monitoring programs on and around the proposed RITE site in the East River in New York. This body of work is summarized in Appendices A and B to the RMEE and other previously delivered documents posted on the ftp site, and allows Verdant Power to propose and justify an incremental plan for each element.

Specifically our environmental monitoring plans for the RITE East Channel Pilot Project include:

RMEE-1: Seasonal Fixed Hydroacoustics
RMEE-2: Seasonal DIDSON Observation Monitoring
RMEE-3: Seasonal Species Characterization Netting
RMEE-4: Tagged Species Detection
RMEE-5: Seasonal Bird Observation
RMEE-6: Underwater Noise Monitoring and Evaluation

RMEE individual plans expand and continue the monitoring protocols established during the RITE demonstration project to understand the effects of an operational RITE East Channel field at a staged development beginning with Install A and continuing through a full build out under a Pilot License of up to 30 KHPS turbines on resident and migratory fish and bird populations. Table 1 is the current proposal for discussion.

The objectives of the individual plans are defined in the detailed plans; however the full understanding of the environmental effects of the Pilot project requires the integration of all of the plans results with the body of information developed from prior efforts. For example, species characterization netting complements the body of prior fixed hydroacoustic data and historic impingement data. Likewise seasonal DIDSON observation is informed by netting and the tagged species detection. The iterative and results based relationship between Verdant Power and the agencies that was established in the RITE Demonstration Project is key to the successful implementation of this RMEE.

As discussed in the Commission's Hydrokinetic Whitepaper, the RMEE plans adhere to the following format:

(a) detailed description of the **methods and equipment** that would be used for monitoring,

(b) a detailed description of how the **monitoring data will be analyzed**, with specific criteria by which to evaluate adverse effects,

(c) an **implementation schedule**, including the frequency and timing of data recovery and maintenance of the monitoring equipment when applicable,

(d) provisions for identifying, in consultation with the agencies, **remedial measures** if monitoring identifies any adverse changes in behavior or use of ocean habitats, and

(e) **reporting**.

Verdant Power is proposing this RMEE as a multi-year program; commencing with Install A and moving through the stages; with appropriate reporting and decision points at each stage. As part of the operational monitoring, Verdant Power will also install and record water velocity and level data with use of Acoustic Doppler Current Devices (ADCPs) that will inform the hydrodynamics of the machines and array.

The table below summarizes the frequency and timing proposed. Verdant Power will consult with agencies on the timing and execution of the fall studies and will report on the findings in an annual report to be filed with the Commission by February 15 of each year. The detailed RMEE plans have additional information on each component of the plan.

As part of the RMEE proposed plan, Verdant Power will continue to observe all species activities and migration including RTE species. In the active on-water periods of fishery seasonal mobile efforts, stationary netting, and bird observations and during the normal course of Pilot Project operation, Verdant Power will continue to record any incidental observational data that would support providing new information on known species occurrences during the pilot period. These studies should provide additional information on the potential for the turbines to impact any fish species as well as document the occurrence of any of these endangered species in the project area.

Table 1. RMEE Summary of Monitoring Plans

Plan	Name	Scale	Operational Monitoring Objectives	# of KHPS Operating Yr of FERC License Equipment	Install A 2 on Monopiles -1	Install B-1 3 on Triframe 1-3	Install B-2 3-12 on Triframes 3-5	Install C 3 on 10 Triframes 5-10
RMEE-1	Seasonal Fixed Hydroacoustics	Meso and Macro	Abundance, temporal and spatial location and size of aquatic targets	Split beam Transducers	None Proposed	None Proposed	1 year 2 SBTs for 90 days between Sept. 15th and Dec. 15th*	1 year 2 SBTs for 90 days between Sept. 15th and Dec. 15th
RMEE-2	Seasonal DIDSON Observation	Micro	KHPS fish interaction	Stationary DIDSON; with servo aimable mount	1 year 3 weeks during the window Sept. 15th to Dec. 1s*	1 year 3 weeks during the window Sept. 15th to Dec. 1st*	1 year – 2 X 3 weeks during Sept. 15th to Oct. 7th & Oct. 15th to Dec. 1st *	None; unless Install B-2 indicates effects
RMEE-3	Seasonal Species Characterization Netting	Macro	Species Characterization	Slack tide trawling	1 year Six days during window Sept. 15th – Dec. 15th *	1 year Six days during window Sept. 15th – Dec. 15th *	1 year Six days during window Sept. 15th – Dec. 15th *	1 year Six days during window Sept. 15th – Dec. 15th
RMEE-4	Tagged Species Detection	Macro	Detection of ESA and other tagged species	4 Hydrophones E/W channel	April - Nov*	April - Nov*	If study continues	If study continues
RMEE-5	Seasonal Bird Observation	Meso and Macro	Bird population interaction and reaction to KHPS	Bird observations	None Proposed	1 year Seasonal spring and fall 11 days *	2 years Seasonal spring and fall 11 days *	None proposed
RMEE-6	Underwater Noise Monitoring and Evaluation	Micro, Meso and Macro	Gen5 Noise signature Underwater noise effects on aquatic species	Underwater hydrophones in field and measurements far field	None Proposed	1 year Stationary for 1 month; 3 far-field locations (1 week)*	None proposed unless B-1 indicates effect	1 year Stationary for 1 month; 3 far-field locations (1 week)

* Indicates reporting of results and agency review of next stage.

RMEE-1

SEASONAL FIXED HYDROACOUSTICS MONITORING

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-1: SEASONAL FIXED HYDROACOUSTICS MONITORING

DECEMBER 2010

Prepared by:

VERDANT POWER

VERDANT POWER, LLC

RMEE-1: SEASONAL FIXED HYDROACOUSTICS MONITORING

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

VERDANT POWER, LLC

RMEE-1: SEASONAL FIXED HYDROACOUSTICS MONITORING

1.0 INTRODUCTION AND OBJECTIVES

This monitoring plan continues the data collection and analysis done in the RITE demonstration project, (2006-2009) and is provided in a summary in Appendix A. The fixed hydroacoustics provide a picture, albeit incomplete on species, on the meso and macro presence and abundance of fish targets in the Pilot area. Coupled with other elements of this plan, Seasonal DIDSON and Netting, the interaction and effects of operating KHPS can start to be understood. Based on the monitoring, studies, analysis and lessons learned from this data, Verdant Power proposes the following objectives for the fixed hydroacoustics monitoring plan to provide data relative to Install B-2 and C on:

1. Abundance and presence of fish at the meso scale. This includes:
    a. The estimation of total numbers and approximate size classes of fish entering and exiting the Pilot Array during a peak abundance period (fall migration) in both Install B-2 and Install C.
    b. The spatial (zonal) distribution of fish relative to the location of the installed Kinetic Hydropower System (KHPS) turbines, during the same high abundance period;
    c. The tidal (flood, slack, ebb) distribution of fish relative to the operational cycle of the installed KHPS turbines during the same high abundance period.
2. Movement of fish relative to a turbine field at the meso and macro scales at a known migration period by:
    a. Providing data on the speed and trajectory of fish entering and exiting the Pilot Array.

To advance the monitoring done previously, improved passive target tracking features will be implemented with the split beam transducer (SBT) technology used for deployment. Specifically, these tracking features should aid in examining both movement and potential reaction behavior relative to the meso- and macro-scales during a known migration period with operational KHPS. The subsequent data analysis will include spatial and zonal distribution analyses along with a comparison of fish track data (size, direction, speed) on flood, slack and ebb when multiple (nine or more) KHPS turbines are present and operating, improving the analysis of fish reaction to an array of operational KHPS.

As summarized in Appendix A, during the RITE demonstration project, the general pattern of fish presence and abundance was shown to follow yearly seasonal variations. It is generally agreed that the array of 24 SBTs with continual data collection, used previously at the RITE demonstration project, did provide a significant amount of valuable information. However, it is also generally agreed that neither an array of SBTs nor continual data collection are necessary to monitor an array of operating KHPS turbines. Instead, the targeted use of SBT technology during known periods of peak abundance (fall migration) is appropriate, for the RITE Pilot project with a focus on the meso- and macro-scale upstream conditions of a tri-frame throughout the tidal cycle.

2.0 BACKGROUND AND RATIONALE

A large volume of data on fish presence and abundance was collected and quantified during the demonstration period, June 2007 to October 2009. Appendix A contains a graphic and tabular summary of the full body of SBT data collected during the RITE demonstration project, significant analysis of the data and general conclusions. Based on the analysis of this hydroacoustic data, seen in Appendix A, Verdant Power provides this rationale for the plan provided herein.

2.1 Fish Presence and Abundance

Fish target abundance in the RITE demonstration area and the larger Pilot Project area follows a regular, seasonal variation. A relatively small number of fish populate the

area from the beginning of winter (January) through early April; with a small peak in April - May followed by a summer period of low abundance through August. A clear fall migration of fish is seen in the East Channel, with abundance rising to peak values in mid-fall (October) and declining again to winter levels. Detailed analysis of this increase in abundance confirms a variation in fish movement based on size, with smaller fish moving earlier (September – October) and larger fish moving slightly later (November – December). Additional analysis suggests that critical environmental factors, including water temperature and lunar cycle, affect the timing for these movements in a reasonably predictable way.

2.2 Spatial Distribution

Regardless of seasonal abundance variations, the spatial distribution of fish in the RITE demonstration area is similar throughout the year. The vast majority of all fish populate the near shore portion of the river, well inshore of any operational turbines or tri-frames. Additionally, the majority of fish populate the top and bottom of the water column, above and below operational turbines. As such, a very small number of the total fish are expected in the pilot project area turbine impact zones.

2.3 Temporal Distribution

The temporal distribution of fish, however, is seen to vary with seasonal abundance. In general, most fish observations occurred on or near the slack tide, when turbines are not rotating. During the periods of increased abundance, however, more fish are observed moving with the tide, travelling in the predominant tidal direction with speeds equal to or greater than the tidal speed.

3.0 PROPOSED STUDY LAYOUT

Based on this body of knowledge, seasonal monitoring of fish approaching an array of multiple operational turbines during periods of peak abundance should satisfy the objectives of this plan. For the RITE Pilot Project, it is proposed that the utilization of SBTs for up to three KHPS turbines during Install A and B-1 is not necessary. The 2-year demonstration period

provided significant data on the presence, abundance and movement of fish in the vicinity of the demonstration area with up to six operational KHPS turbines, as shown in Appendix A. However, beginning with Install B-2 (at least 9 KHPS turbines on multiple tri-frames) and advancing to Install C (30 KHPS turbines on 10 tri-frames), a targeted seasonal approach to observing presence and abundance through a fall migratory period is proposed using stationary SBT technology that can removed during periods of low abundance. It is important to note that the newer SBT transducers; with aiming capability have a recommended in-water operative period of 90-120 days at most before needed maintenance.

3.1 Methods and Equipment

During the multi tri-frame deployment phase of the RITE Pilot Project, Install B-2 and C, a stationary hydroacoustic system will be deployed before a known peak migratory period (September 15th) and retrieved afterwards (December 1). The fixed hydroacoustic system proposed uses a single BioSonics split-beam transducer (SBT) attached to a small bottom mount with remote aiming capabilities placed inshore of the tri-frames, shown with associated details in Figure 3-1. This is different than the three transducer fish frame mount used in the RITE demonstration. Two instruments will be deployed, one SBT on each to the north and south of the intended multiple tri-frame deployment, Figure 3-2 (Install B-2) and Figure 3-5 (Install C).

The SBT is a 200 kHz low side lobe narrow-beam (6 degree) transducer, similar to those used during the RITE Demonstration Project. However, the mounting and aiming capabilities are significantly improved in a side-looking orientation with intended tri-frame coverage shown in Figures 3-2 to 3-5. An appropriate multiplexing schedule will be used to capture valid data at each of the 4 stations shown in Figure 3-4. Improvements to the BioSonics SBT allow for the calculation and visualization of fish trajectories within the beam, also shown in Figure 3-4, although this capability as of 2010 is still under development. It is expected that by the time of Install B-2 significant improvements and testing of this software will be accomplished. Data will be delivered to shore via subsea cables and automatically analyzed on-shore using BioSonics proprietary algorithms. The fixed hydroacoustic time stamps are also integrated with the

water velocity and level instrumentation of the ADCPs that inform the hydrodynamic aspects of the machines and array.

The fall seasonal monitoring by the two fixed SBT units with remote aiming feature is intended to monitor the KHPS Pilot array temporal and spatial presence and abundance of fish target distributions to confirm the general patterns seen and projected for larger arrays of operating KHPS; and support other concurrent efforts of the RMEE monitoring plan – such as Seasonal DIDSON and Netting that are also providing data on the expected interaction of the migrating population of fish in the presence of operating KHPS.

For the continued successful application of the fixed SBT technology at the RITE Pilot Project, an understanding of the critical limitations of the hydroacoustic equipment is essential. Recognizing the following limitations will aid in the quality of data collection:

- Transducers are only active underwater, exposure to air while active will destroy the unit.
- Data cannot be collected past the boundaries of a substrate or the water surface.
- The transducers transmit a 6-degree angle beam. This translates to beam width of approximately 1 foot in diameter for every 10 feet of distance away from the source.
- Flow noise, including entrained air and turbulence reduce the SBT range.
- Data is post processed using proprietary software algorithms developed by BioSonics and reported to Verdant Power, who then summarizes events, size, location and trajectory as appropriate.
- The recommended limit for in water usage is 90 prior to maintenance
- The cost of a single SBT system with aimable servos and appurtenant equipment and installation and retrieval exceeds $250,000 each.

Figure 3-1. RMEE-1 Hydroacoustics – Stationary Bottom Mount with SBT

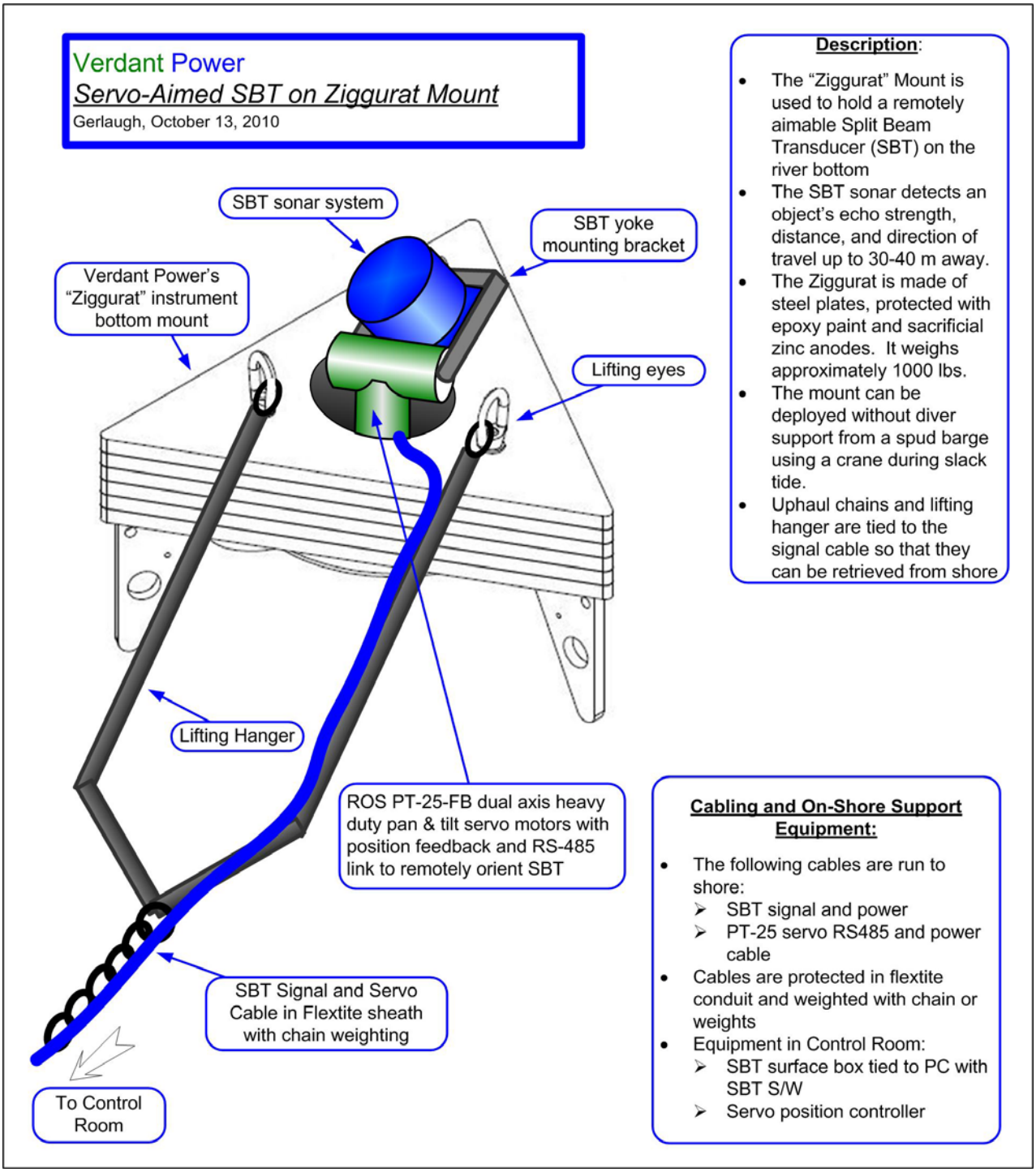


Figure 3-2. RMEE-1 Hydroacoustics – Location of Split Beam Transducers – Aerial Field View – Install B-2

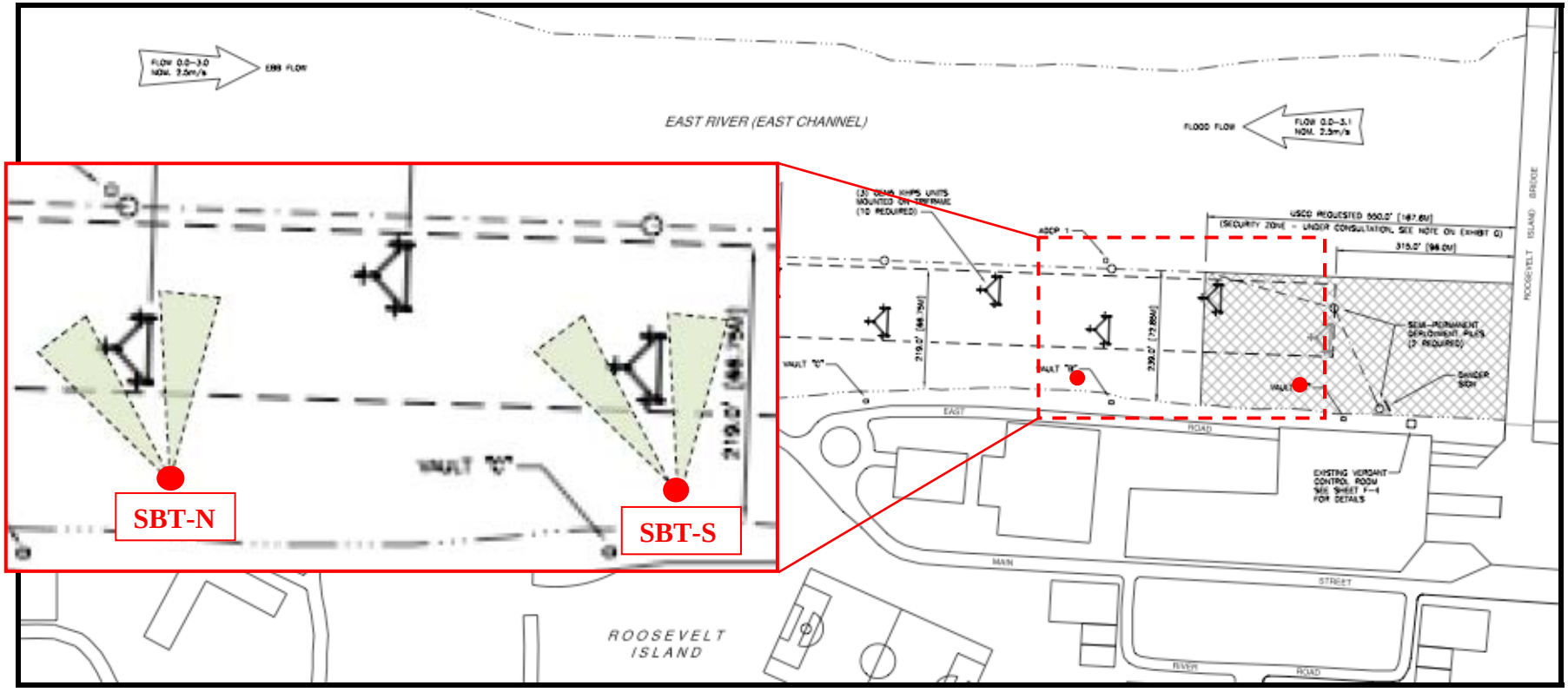
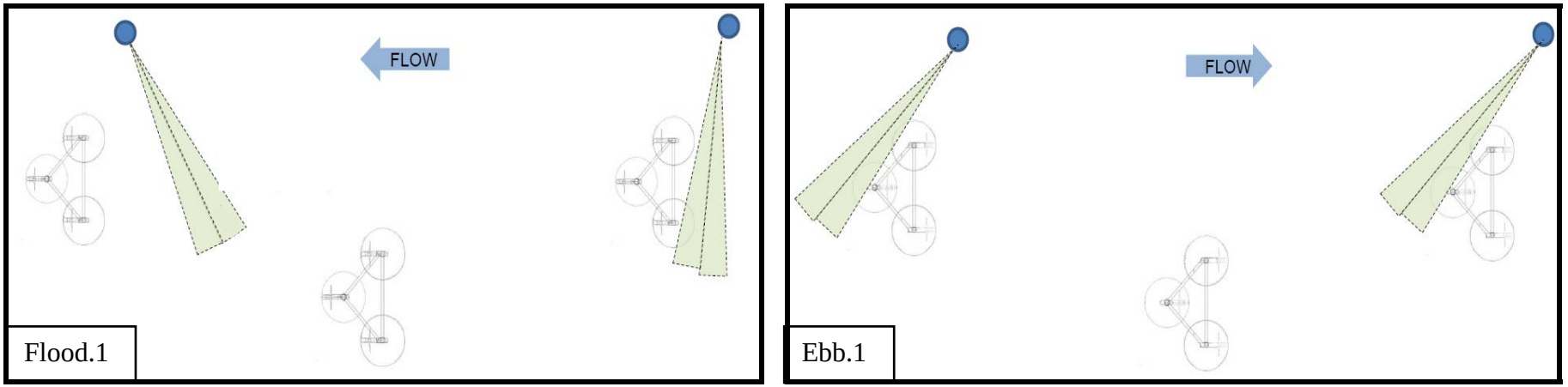
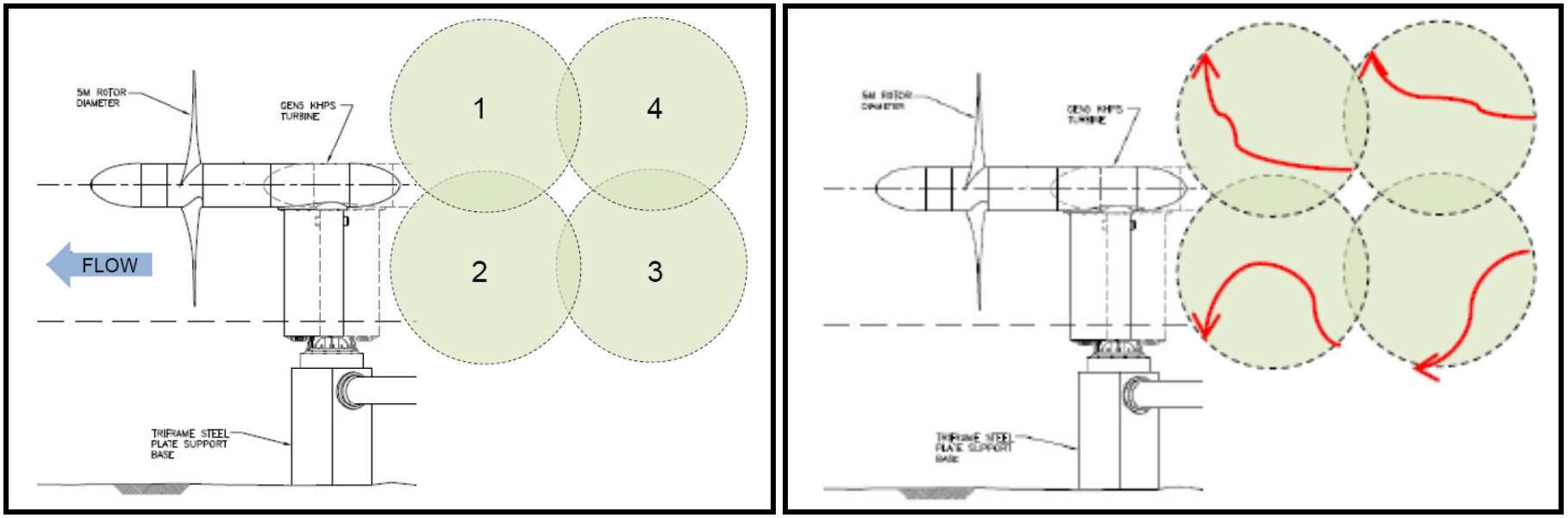


Figure 3-3. RMEE-1 Hydroacoustics – Detail of Three Tri-Frame SBT Coverage on Flood and Ebb – Install B-2



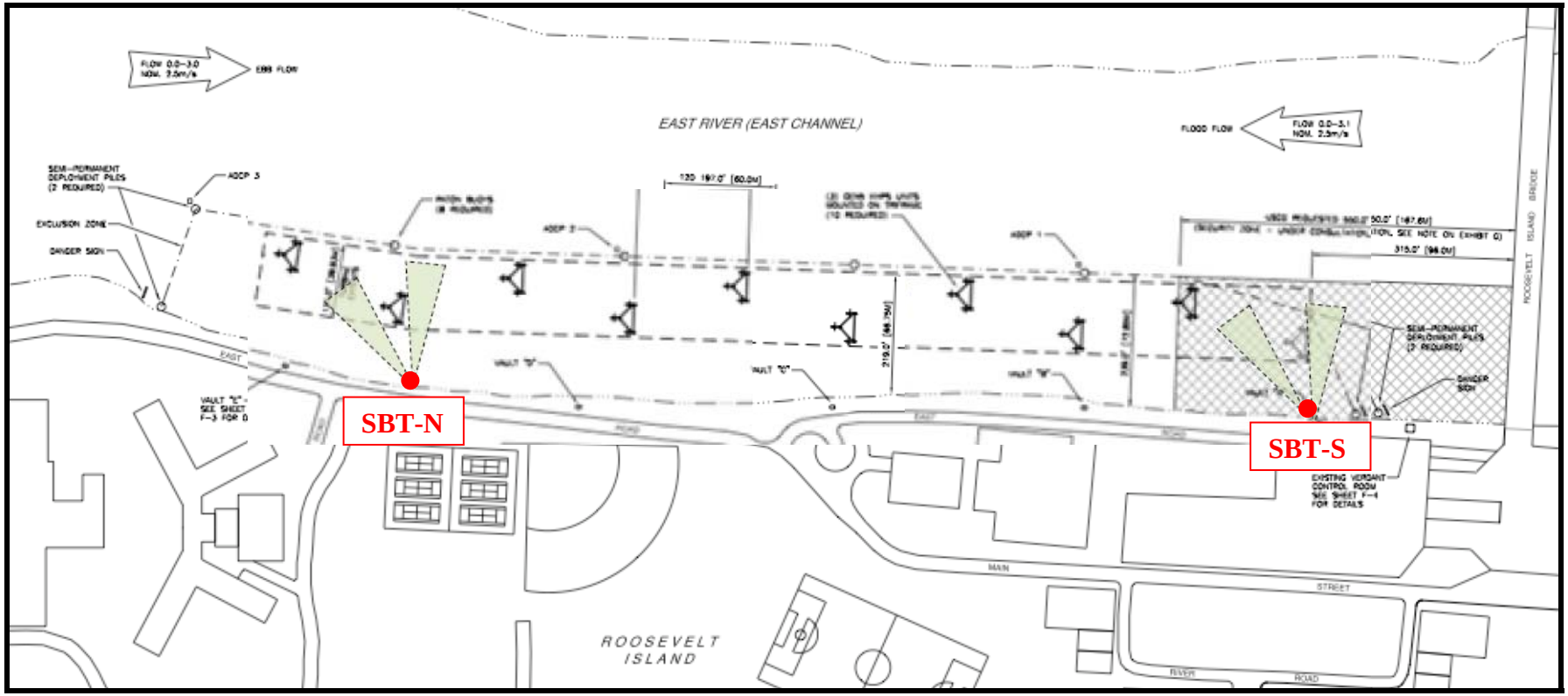
NOTE: A similar coverage scheme would be used in Install C.

Figure 3-4. RMEE-1 Hydroacoustics – Detail of Turbine and Tri-Frame Inflow SBT Coverage with Multiplexing – Install B-2



NOTE: A similar multiplexing scheme would be used in Install C.

Figure 3-5. RMEE-1 Hydroacoustics – Location of Two SBTs – Aerial Field View – Install C



NOTE: See Figures 3-2 and 3-3 for coverage and multiplexing details.

3.2 Monitoring Data Analysis

Once aimed, raw data from the BioSonics SBTs will be analyzed by proprietary algorithms to generate an automatic fish event reports; similar to the reporting during the RITE Demonstration Project. These reports will be summarized by Verdant Power based on spatial, temporal and fish target sizing, and data provided to the agencies quarterly. At the request of the NYSDEC, Verdant Power will present data sorted into 6" size class increments (6-12", 12-18" etc,) to be considered with the temporal distributions that may allow reviewers to make inferences to general fish use of the study area. Additional data on fish trajectories, including heading and speed, through each SBT beam will be presented and analyzed for possible evidence of movement and potential reaction behavior. Again, concurrent development of software and analysis by BioSonics over the intervening years should support this effort.

3.3 Schedule and Timing

Verdant Power proposes to collect the data commencing in Install-B-2, when at least 9 KHPS turbines are operating and rotating during the most important fall (September – December) migration period. Verdant Power proposes to conduct this sampling effort as shown in Table 3-1 below.

Table 3-1. RMEE-1 Hydroacoustics – Split Beam Transducer Deployment Schedule

	Install A – 2 KHPS (mono-piles)	**Install B -1 3 KHPS (1 tri-frame)**	**Install B-2 9 KHPS (3 tri-frames)**	**Install C 30 KHPS (10 tri-frames)**
Seasonal Fixed Hydroacoustics	None Proposed	None Proposed	1 year 2 SBTs for 90 days between Sept. 15th and Dec. 15th*	1 year 2 SBTs for 90 days between Sept. 15th and December 15th**

*For Install B-2 locations, see Figure 3-2.

**For Install C locations, see Figure 3-5.

3.4 Remedial Measures

Based on Verdant Power's in-water experience during the RITE demonstration project and the aquatic monitoring accomplished as a part of that project, it is highly unlikely that remedial measures will be necessary. However, Verdant Power will consult with the agencies immediately regarding remedial measures if monitoring identifies any adverse effects to fishery population changes in the East River.

3.5 Results and Reporting

Verdant Power would report the data as a technical memo quarterly and file comments and responses as part of the Annual Report filed under the RITE Environmental Effects Monitoring plan.

4.0 SUMMARY/KEY QUESTIONS

Results will be focused on answering the following questions:

1) Does the seasonal data collected on the abundance and presence in the meso-macro field correlate with the findings during the RITE Demonstration Project on:
    a. The spatial (zonal) distribution relative to the operating KHPS turbines:
        i) Do fish generally reside near shore?
    b. On the temporal tidal (flood, slack, ebb) distribution relative to the operating KHPS turbines?
        i) Are fish mainly present during slack tides?
        ii) Are fish moving with the tide when moving?
2) Does the seasonal abundance data indicate any movement or potential reaction behavior of fish populations relative to the operating Pilot Array (meso- and macro-scale) during a known migration period?
3) Do fish trajectories indicate any evidence of fish avoidance behavior approaching and/or around multiple tri-frames?

4) Does anything in the Install B-2 monitoring plan execution and subsequent data analysis indicate further understanding of the abundance and reaction of the fish community to the presence of multiple operating KHPS in the field?

5) What, if anything, should be changed in the monitoring plan for Install-C to improve the evaluation of meso- and macro-scale fish community impact do to the deployment of 10 tri-frames?

RMEE-2

SEASONAL DIDSON MONITORING

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-2: SEASONAL DIDSON MONITORING

DECEMBER 2010

Prepared by:

VERDANT POWER

VERDANT POWER, LLC

RMEE-2: SEASONAL DIDSON MONITORING

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

VERDANT POWER, LLC

RMEE-2: SEASONAL DIDSON MONITORING

1.0 INTRODUCTION AND OBJECTIVES

The objective of the seasonal DIDSON observation is to:

1. Provide real-time observation of fish behavior near operating KHPS during a seasonal period of known fish abundance. Specifically the goal is to provide imaging of any fish/KHPS interaction, both spatial and temporal, at the micro scale around a rotating turbine. Parameters that can be observed from the DIDSON will include:
    - fish swimming location and direction relative to the turbine blades
    - fish passage through or around the turbine
    - for fish passing through the turbine, it will be possible in most cases, especially for larger fish, to determine if the fish avoided the blades or was struck
    - fish size and shape with potentially some species identification, especially for larger individuals (*e.g.*, Atlantic sturgeon, turtles, marine mammals)
2. Add value to the body of collected data on fish presence, abundance, movement pattern and species in and around the operating KHPS machine by providing micro-scale details of the fish seen at the meso scale by the SBTs.

The Dual-Frequency Identification Sonar (DIDSON) is a multi-element sonar that provides video-like images of underwater objects. It was used during the RITE Demonstration project in two modes; stationary (with some limitations during December 2006 - January 2007) and mobile; in conjunction with a split beam transducer (SBT) in October 2008. Within the context of the East Channel of the East River, the video images are relatively clear, and can provide a good observation of operating KHPS, if deployed within the limitations of the technology. Appendix B provided details on prior efforts.

From prior monitoring efforts, Verdant Power proposes this plan because of three key factors:

- Location and Aimability: The DIDSON excels in providing high-resolution images at ranges less than 15 m, or within the micro scale observation of the operating Gen5KHPS. In the RITE demonstration, the stationary mount of the DIDSON was located too far from operating machines to effectively produce important imaging. The proposal here rectifies this limitation; with a bottom mount placement with aiming capability (Figures 2-1 and 2-2).
- Video Quality and Post Processing: An advantage of the DIDSON is that it can ensonify the fish target movement near an operating KHPS because it is not confused by the turbines motion. While the post-processing of data remains a significant effort, Verdant Power believes that the required time can be greatly reduced through motion detection software which can find and extract fish events from the data.
- Survivability (*i.e.*, the length of the deployment) and Timing: Verdant Power's experience at RITE (and the vendor's recommendations) are for a maximum 3 week in-water deployment to maintain quality of the signal. Moreover, based on the body of data developed by the hydroacoustics on fish presence and abundance and a hypothesis on timing of fish movement in the Pilot Area; Verdant Power believes that we can optimally time the installation of the DIDSON to coincide with an abundance of fish activity.

The combination of these factors makes the DIDSON the best technology for monitoring fish behavior, and specifically fish-KHPS interactions, with machines operating at the micro-scale.

2.0 BACKGROUND AND STUDY RATIONALE

As detailed in Appendix B, Verdant Power completed two separate DIDSON observations during the RITE demonstration.

As discussed in the DLA Volume 2 page E-96; a fixed DIDSON was deployed in December 2006 - January 2007 for a limited period observing a single operating KHPS. Limitations of the stationary DIDSON at that time precluded any meaningful results other than to verify that in the harsh conditions of the East River. The DIDSON can only be deployed for limited periods (up to 3 weeks) before anti-fouling maintenance was required (an expensive procedure). In addition, for fish monitoring, the useful range to targets was determined to be up to 15 m.

In September - October 2008, as part of the demonstration project activities under the Fish Movement and Protection Plan (FMPP), a Mobile DIDSON groundtruthing protocol was conducted (see Appendix B). Verdant Power collected imaging of fish in proximity of an operating KHPS on both slack and ebb and flood using a mobile technique (termed VAMS for Vessel-based Aimable Mount for Sonar). This monitoring technique proved much more successful than the stationary DIDSON work due to its shorter range (predominantly less than 15 m), and aimability. However, VAMS operations are limited by the boat crew's stamina to roughly 6 hours; and provided only snapshot observations from a vessel. While mobile DIDSON was proposed in the Verdant Power's Draft License Application subsequent consultations with the agencies have indicated that a stationary mount is preferred to collect a larger data set sample of the micro interaction in Install A. Mobile DIDSON is still considered a viable meso-macro tool for observing multiple operating KHPS, and may be considered again in the future.

3.0 PROPOSED STUDY PLAN

3.1 Methods and Equipment

Verdant Power has pursued design options and proposes that a new DIDSON deployment system and protocol be adopted for the Pilot monitoring plan that incorporates two design changes. By mounting the DIDSON on a small stationary bottom mount (Figure 3-1), it can be placed within 15 m of the turbines, allowing it to remain in high-resolution mode. Remotely positioning the DIDSON via a 2-axis servo controller allows the system to be setup and aimed without a diver and provides a near

360° panorama of yaw view, and horizontal to vertical pitch view. The DIDSON time stamp is also integrated with the water velocity and level instrumentation of the ADCPs that inform the hydrodynamic aspects of the machines and array.

- For Install A the servos will allow for one DIDSON to be aimed at a single Gen5KHPS on a monopile. See Figures 3-2 and 3-3 and detail below.
- For Install B-1 and B-2 sequential observation of all three turbines in a triframe configuration will likely be possible. See Figure 3-4 and 3-5 and detail below.

Deployments periods would be limited to approximately 3 weeks because biofouling of the DIDSON after that period greatly reduces its effectiveness. To capture the most fish-turbine interactions possible during the deployment, a period of known high fish abundance is chosen. The hydroacoustic data from the SBT from June 2007 to November 2009 at the RITE demonstration indicate that there are two fall peaks of fish activity corresponding with the migration of striped bass south through the East Channel. The discussion of rationale behind the timing of placement of the DIDSON is discussed in RMEE-1; thus, installing and operating the DIDSON during a 3-week window – September 15 - December 1, with a timing proposed based on the lunar cycle is proposed for Install A and B-1. Two 3-week windows are proposed for Install B-2, since the field would be larger and work could be done in conjunction with planned hydroacoustic work.

3.1.1 Install A- DIDSON Observation of a Gen5 KHPS on Monopile P1

A Servo-Aimed Bottom-Mounted DIDSON will ensonify a single KHPS for a 3-week period of predicted peak fish presence (Figure 3-2). The DIDSON will be placed between P1 and empty pile P2, approximately 8 m on the shore-side from Turbine T1 and approximately 35 m from shore. The DIDSON beam can be centered on the turbine blades (Figure 3-4 and 3-5) providing an ensonified area that contains a swath through the turbine and 1-2 m of space upstream and downstream from the blades. Because the KHPS yaws between ebb and flood

tides, the turbine changes its location by approximately 3 m in the upstream/downstream direction. To keep the DIDSON centered on the turbine blades, the servos would be programmed for two locations, an ebb position and a flood position. Software would be written to automatically switch the location to the appropriate upcoming tide sometime during slack tide. Of course, if a different beam direction is desired within +/-170° of yaw and 0 to 90° of pitch, it can be selected at any time manually via the controlling PC, or other positions can be programmed in to be sequenced automatically. After 3 weeks, the DIDSON would be retrieved.

3.1.2 Install B-1 – DIDSON Observation of Three Gen5 KHPS on a Triframe

Similarly, and dependent on the effectiveness of Install A, Verdant Power would propose a similar setup for Install B-1, wherein the 3 KHPS on the triframe would be ensonified for a 3-week period of predicted peak fish presence. One DIDSON would be placed next to Triframe 1 equidistant between the Left and Right turbine (Figure 3-5). From this position it is less than 15 m to all three turbines. The DIDSON beam can be centered on the turbine blades providing an ensonified area that contains a swath through the turbine and 1-2 m of space upstream and downstream from the blades. Because the KHPS yaws between ebb and flood tides, the turbine changes its location by approximately 3 m in the upstream/downstream direction. To keep the DIDSON centered on the turbine blades, the servos would be programmed for six locations, an ebb position and a flood position for the left, right and point turbines. Software would be written to automatically sequence through the appropriate turbine locations. Like for Install A, if a different beam direction is desired within +/-170° of yaw and 0 to 90° of pitch, it can be selected at any time manually via the controlling PC, or other positions can be programmed in to be sequenced automatically.

3.1.3 Install B-2- DIDSON Observation of Larger Field of Up to Four Triframes with Three KHPS Each, 12 KHPS Total

Similarly, and dependent on the effectiveness of Install B-1, Verdant Power would propose a similar setup for Install B-2, wherein 3 KHPS on a chosen triframe would be ensonified for a 3 week period of predicted peak fish presence. The positioning of the DIDSON on the chosen Triframe would be identical to that in B1 (Figure 3-4). It is possible that the same triframe as in B1 would be chosen so that fish abundance and behavior could be compared between deployments of one and four triframes in the field. The agencies will be consulted further on the recommended choice of a triframe for DIDSON monitoring.

Figure 3-1. RMEE-2 DIDSON on Servo-Aimable Block Mount

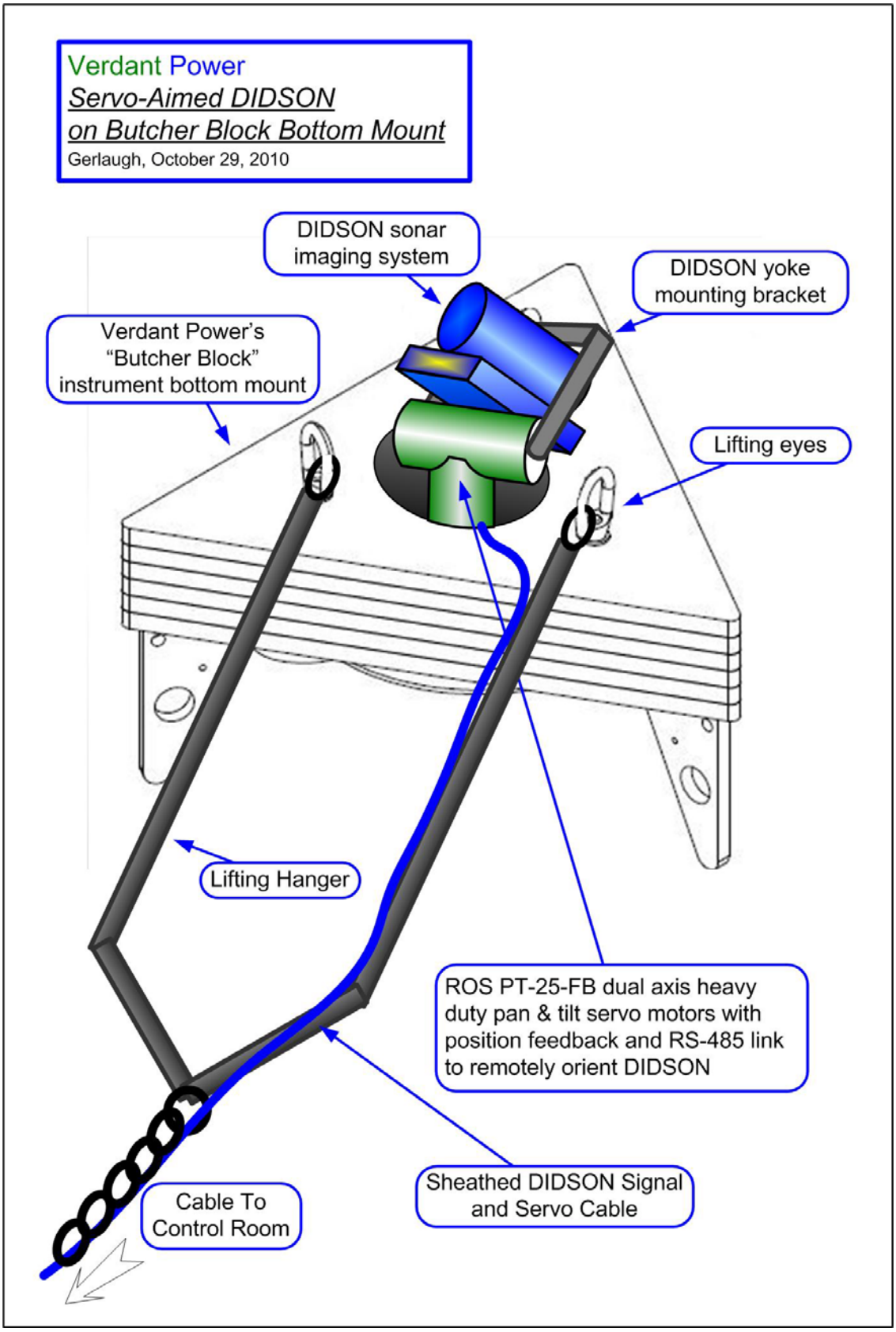


Figure 3-2. RMEE-2 DIDSON Position for Install A

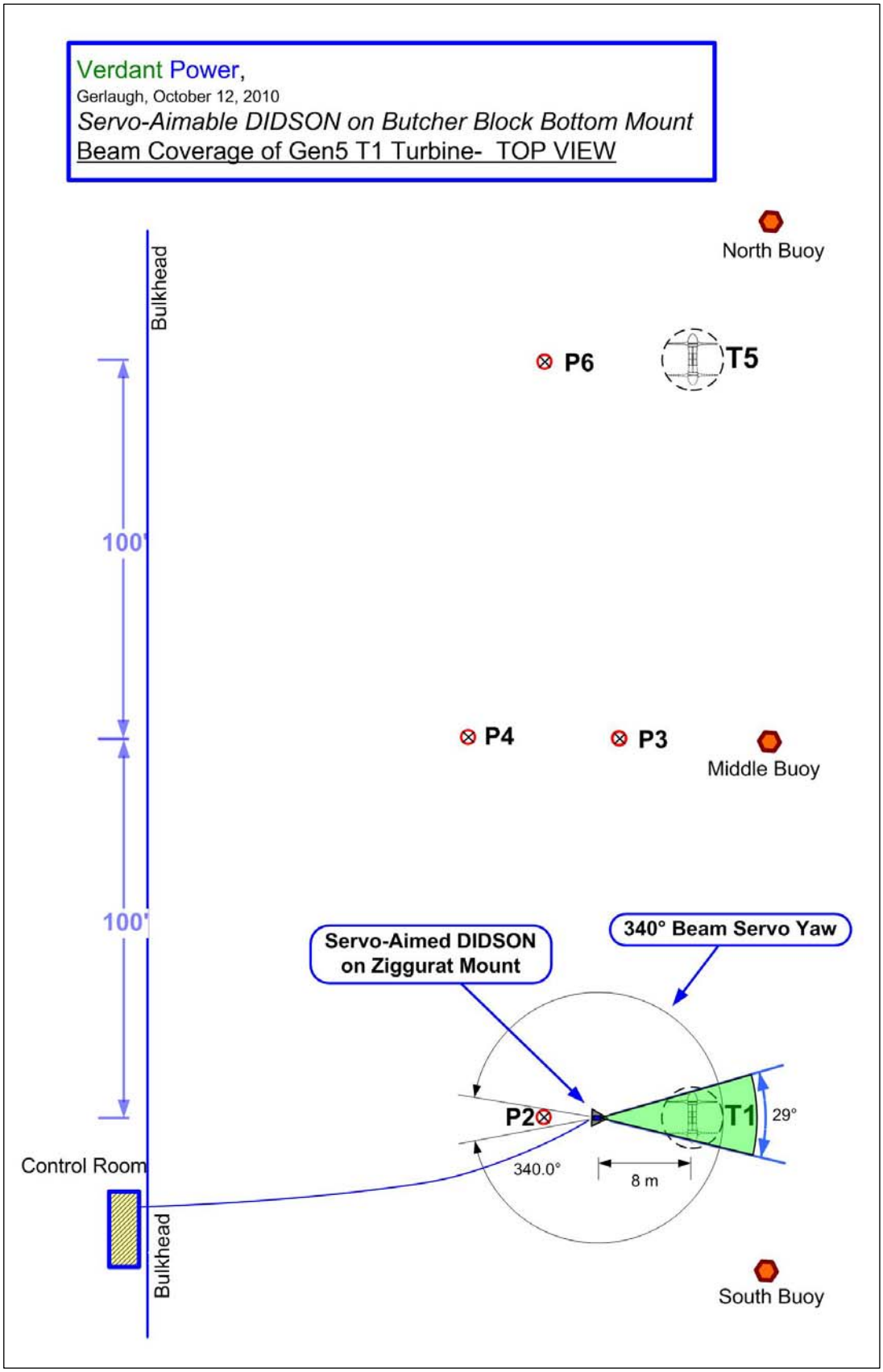


Figure 3-3. RMEE-2 DIDSON Beam Coverage for Install A - Front View

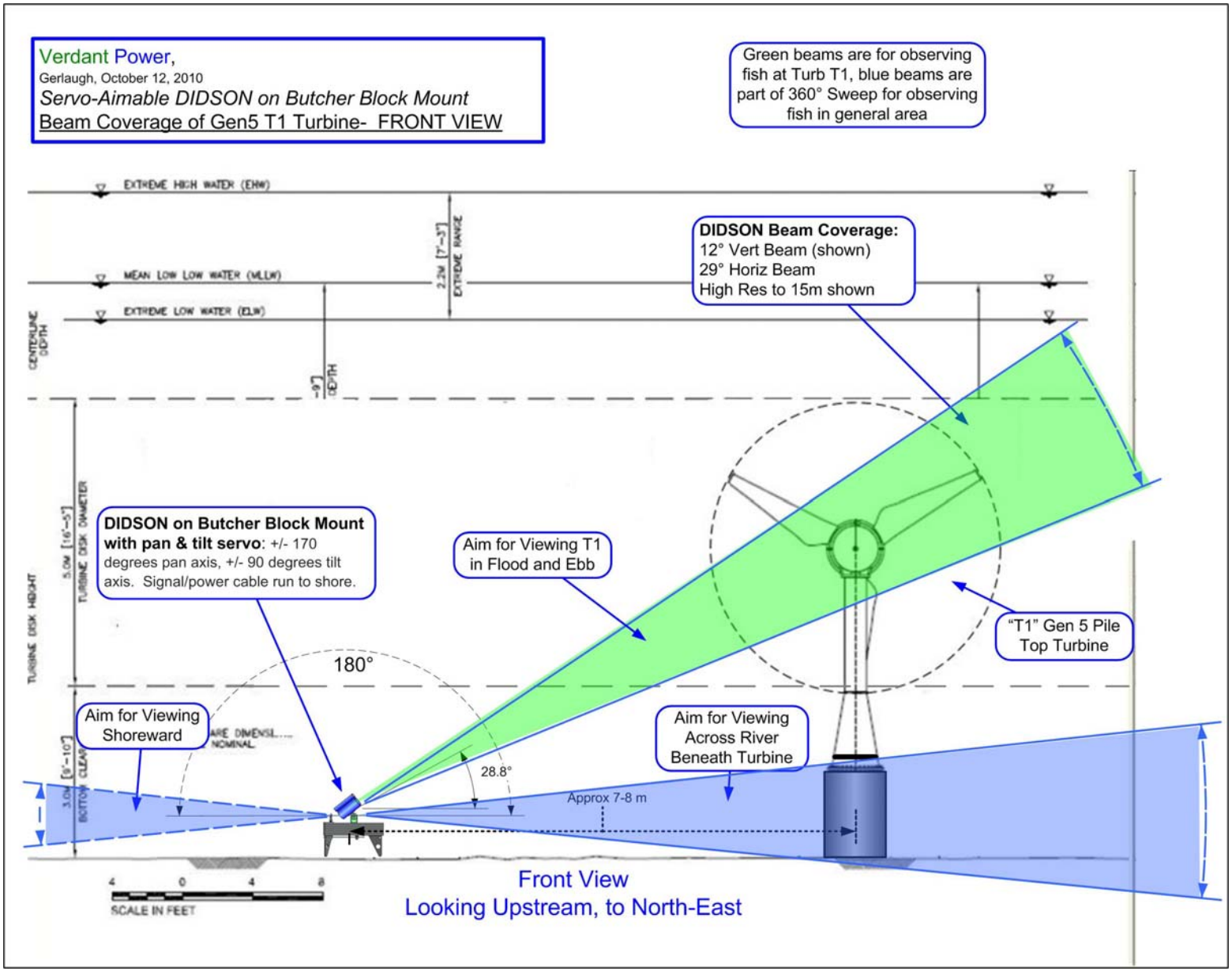


Figure 3-4. RMEE-2 DIDSON Beam Coverage for Install B1 and B2 - Profile View

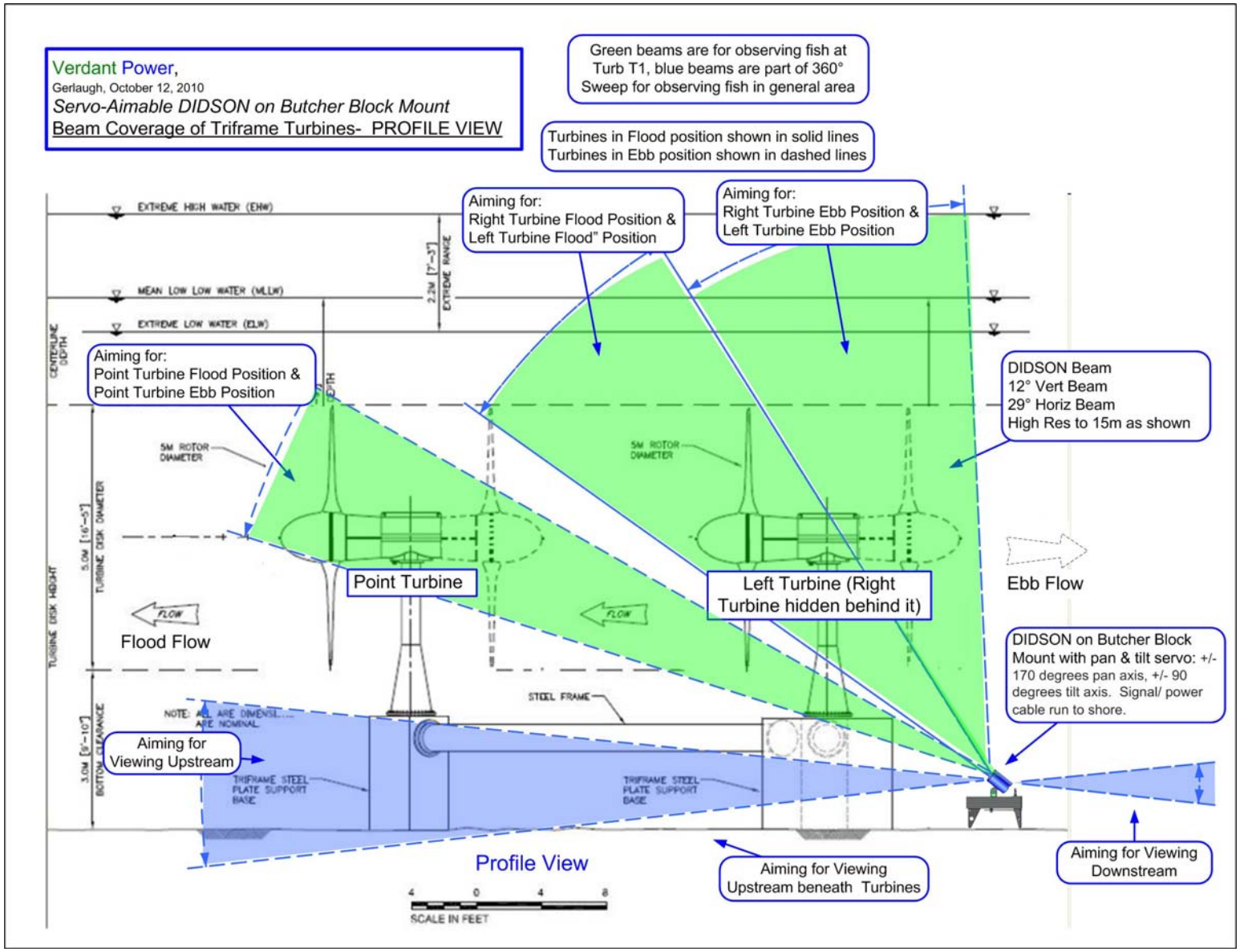
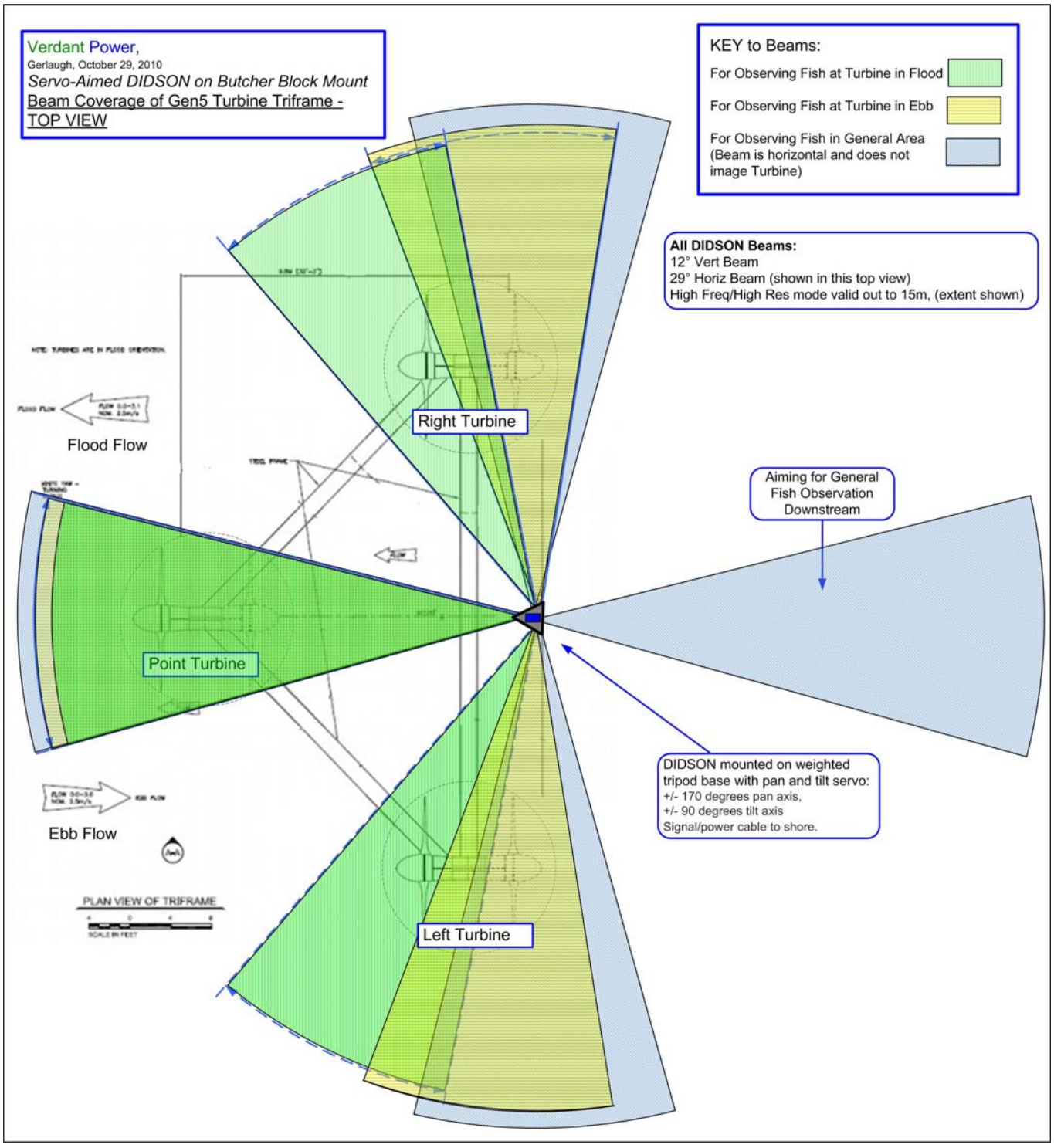


Figure 3-5. RMEE-2 DIDSON Position for Install B1 and B2



3.1.4 DIDSON

The Standard Range (SR) DIDSON made by SoundMetrics combines the signals from 96 parallel transducer elements to create a 2-D image of ensonified targets. The Field of View (FOV) is 29° in width and 12° in height. The depth (range from camera) of the ensonified area is user programmable to various window lengths, from 1.25 m to 10 m. The image can be updated at rates from approximately 4-12 fps to capture motion and provide a video-like representation of the target. The system operates at 1.8 Mhz in high frequency (HF) mode and 1.1 MHz in low frequency (LF) mode. LF mode provides further range but halves the resolution since it uses 48 transducer elements. For fish monitoring around KHPS, Verdant Power's experience is that satisfactory results can only be obtained when the DIDSON is in HF mode which is only available for target distances up to 15 m from the DIDSON. The DIDSON saves the sonar videos in a DDF file which can be viewed on the DIDSON Viewer software. The videos can also be exported as an AVI file, but the image quality is not as good as the DDF files and it is recommended that DDF files be used for review when possible. The DIDSON is equipped with a compass, pitch and roll sensor which can be used as a check of the servos feedback signal.

3.1.5 Butcher Block Mount

The "Butcher –Block" bottom mount (Figure 3-1) is a custom Verdant Power designed instrument mount made of steel plates, protected with epoxy paint and sacrificial zinc anodes. It weighs approximately 1000 lbs, but this can be adjusted by removing or adding steel plates. The mount has three steel feet and a large upward facing hole designed to normally accommodate ADCPs, but is here used to hold the bottom of the PT-25 servo controller. The mount can be deployed without diver support from a spud barge using a crane during slack tide. A lifting hanger is connected to two eyebolts on the top of the mount. The uphaul chains and cabling are tied to the lifting hanger. The lifting hanger is designed to prevent the cabling and chain from falling on the mount during deployment.

3.1.6 Remote Control Servo Controller

The DIDSON is mounted to a yoke bracket on a ROS PT-25-FB dual axis heavy duty pan & tilt servo motor with position feedback. The servo is linked to Verdant Power's control room onshore via an underwater cable. The PT-25-FB is encased in stainless steel for corrosion resistance and the servo motors provide 40 N-m (30 lb-ft) of output torque on each axis. Heavy-duty ball bearings support the output shaft allowing it to accommodate payloads up to 100 lbs. The rugged design of the gear train allows stalling of either output shaft without damage to the gears or the motor. The PT-25 is equipped with internal limit switches and position feedback potentiometers on both axes. The potentiometers sense pan and tilt orientation angles for display at the remote control station. The axial ranges are +/- 170° for the yaw axis and +/- 90° degrees for the tilt axis. The angular resolution for both axis are +/- 0.5°. The maximum rotational speed for either axis is 5.4 deg/sec. The motors are powered with 24 VDC.

3.1.7 Cabling

For all deployments a cable bundle runs from the Butcher Block mount to shore. The cable bundle contains a DIDSON signal and 24 VDC power cable, and PT-25 RS485 and 24 VDC power cable. These cables are protected in a 1" OD non-metal flextite conduit that is weighted with chain so that it remains stationary on the river bottom for its length to shore. Once on shore the cable is routed along the rip-rap until it enters the Control Room. In the Control Room the DIDSON and PT-25 cables are connected respectively to the DIDSON Surface Interface box and the PT-25 Servo Position Controller. Both boxes connect to a shared PC and monitor.

3.1.8 Interface Boxes, PCs, Software

The servo positions are read and controlled via the ROS positioner GUI (graphical user interface) and the DIDSON is configured and its image viewed through the Soundmetrics DIDSON Viewer. Both GUIs will be observable in the Control Room and also remotely via LogMeIn, a remote desktop viewing program. Raw

DIDSON data will be stored to a hard drive at the rate of 19 GB/day. The data will be backed up to an external hard drive.

Some custom software will need to be written using the ROS servo communications protocol to control the beam positions automatically. The timing of the servo beam position changes can be triggered either by programming an East River tidal cycles table for the 3-week period, or using real-time ADCP velocity data. Because this is a first time application of the DIDSON on a remotely-controlled servo mount for observing KHPS, the best procedure for operating the DIDSON and its software will require some trial and error, which will be accomplished before the required 3-week fall observational period.

3.1.9 Monitoring Procedure

The DIDSON will be programmed for monitoring in both a manual mode and an automatic mode. The vast majority of the data collection will be done in automatic mode. Shown below is the general sequence of development and implementation of the DIDSON monitoring protocol.

- 3 months prior to deployment - Pre-deployment design; software development and testing.
- 1 week before predicted 3-week period – Install and Test DIDSON; implementing the aiming protocol below, that covers both temporal timing and spatial coverage.
- 3 weeks KHPS Operation DIDSON Monitoring:
    - 24/7 data collection (with filters) follow aiming protocol programming below.
    - Allow for several days of manual operation/ observation by agencies; returning to the automatic data collection settings.
    - Daily data collection integrity checks and backup of files.
- After 3 weeks, Retrieve DIDSON and analyze data.

The positions for automatic scanning are set by trial and error during the first day of DIDSON operation. Once established, the DIDSON is placed in automatic aiming mode. The DIDSON position changes between Ebb and Flood positions at the exact center of the slack. Every hour, 75% of the time the DIDSON is aimed at the turbine(s) (shown in green and yellow shading on Figures 2.2 to 2.5), and 25% of the time it is performing a general 360° scan around the DIDSON (shown in blue shading on diagrams Figures 2.2 to 2.5). This division allows the majority of the monitoring time to be used to capture any fish-turbine interactions. The lesser balance of the time is used to observe fish in the area that are not immediately adjacent to the turbine.

Table 3.1-1. Automatic DIDSON Scanning

Parameter	Install A	Install B1	Install B2
Ebb Tide	75% of Ebb Cycle -DIDSON is automatically aimed at Turbine in Ebb position (shown in green and yellow shading on diagrams). 25% of Ebb cycle DIDSON performs 360° sweep.	75% of Ebb Cycle - DIDSON is automatically aimed at 3 Turbines of Triframe 1 in Ebb position with time equally split amongst turbines. 25% of Ebb cycle DIDSON performs 360° sweep.	Same as Install B1
Slack Tide	The DIDSON position changes between Ebb and Flood positions at exact center of slack	Same as Install A	Same as Install B1
Flood Tide	75% of Flood Cycle -DIDSON is aimed at Turbine in Flood position 25% of Flood Cycle DIDSON perform 360° sweep.	75% of Flood Cycle -DIDSON is aimed at 3 Turbines of Triframe 1 in Flood position with time equally split amongst turbines. 25% of Flood cycle DIDSON performs 360° sweep.	Same as Install B1
360° Area Sweep	6.25% or 3.75 min/hour: Aimed horizontally across river (showing bottom)	Same as Install A	Same as Install A
	6.25% or 3.75 min/hour: Aimed horizontally shoreward (showing bottom)	Same as Install A	Same as Install A
	6.25% or 3.75 min/hour: Aimed horizontally upstream (showing bottom)	Same as Install A	Same as Install A
	6.25% or 3.75 min/hour: Aimed horizontally downstream (showing bottom)	Same as Install A	Same as Install A

3.2 Data Analysis

DIDSON motion detection software is now available that should be able to detect fish motion while filtering out the zones of turbine motion. Verdant Power is currently working with the DIDSON vendor and consultants to program and test this software for application at the RITE project. Processing the video data through such software is expected to reduce the effort of searching DIDSON video, recorded continuously over 3 weeks, for fish interactions. In the automatic mode, the raw DIDSON data collected is roughly 1 TB per 3 weeks of continuous operation. It is best stored on a portable hard drive. The raw data can be viewed only with the DIDSON viewing software.

Video files will be screened for relevancy and logged as event files for review. The data will also be imported, preprocessed, and analyzed to produce relational distributions of observations. For each 3-week sampling period, the DIDSON hydroacoustic data will be presented in the following formats:

1) Complete (24/7 x 3 weeks) raw DIDSON data files on portable hard drive(s).
2) Processed video clips of all fish observed in standard video format data files (*e.g.*, MP3). To be clear, periods with no fish seen will not be contained in video clips.
3) Excel Log table that provides the following information for all video clips:
    - Time, date, ebb, flood or slack, and water velocity
    - Turbine rotation or not
    - Number of fish, approximate fish length, and if discernable, possible species identification
    - Fish behavior, including any interaction with turbine
4) A Statistical Analysis that provides the following information:
    - Fish density and Fish interactions vs. date/time by length class

- Fish density and Fish interactions vs. tidal cycle (ebb, flood or slack) and water velocity by length class
- Fish density and Fish interactions vs. Turbine rotation/non-rotation by length class

3.3 Schedule and Timing

Verdant Power proposes to conduct this sampling effort following the schedule shown in the following table.

Table 3.3-1. RMEE2 - DIDSON Monitoring Schedule

	Install A – 2 KHPS on Piletops	**Install B -1 3 KHPS/ 1 Triframe**	**Install B-2 12 KHPS/ 4 Triframes**	**Install C 30 KHPS/ 10 Triframes**
Seasonal DIDSON Observation	1 year 3 weeks: during the window September 15th to December 1st*	1 year 3 weeks: during the window September 15th to December 1st*	1 year – 2 X 3 weeks during the window September 15th to October 7th & October 15th to December 1st	None; unless Install B-2 indicates effects

* ***Timing of 3-week installation based on tidal cycle as discussed in Appendix A.***

3.4 Remedial Measures

Based on Verdant Power's in-water experience during the RITE demonstration project; and the aquatic monitoring accomplished as a part of that project; it is highly unlikely that remedial measures will be necessary. However, Verdant Power will consult with the agencies immediately regarding remedial measures if monitoring identifies any adverse effects to fishery population changes in the East River.

3.5 Results and Reporting

Verdant Power would report on the findings of the study, as a technical memo after the seasonal observations and file comments and responses as part of the Annual Report filed under the RITE Environmental Effects Monitoring plan. During the course

of the DIDSON observational studies, agencies would be invited to participate in real-time observations on-site or through the web.

4.0 SUMMARY/KEY QUESTIONS

Results will be focused on answering the following questions:

1. How do fish behave around operating KHPS and are they injured through direct contact with blades?
2. Can fish behavior be inferred by tracking a fish's swimming location and direction in the visualization and fish reaction in relation to rotating turbines?
3. Do the DIDSON observations provide some added meaning and value (correlation) to the body of collected data on fish presence, abundance, movement pattern and species in and around the operating KHPS machine?
4. What, if anything should be changed in the DIDSON operating protocol for install B-1 and B-2 to improve evaluation of the effects of operating KHPS?

RMEE-3

SEASONAL SPECIES CHARACTERIZATION – NETTING

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-3: SEASONAL SPECIES CHARACTERIZATION - NETTING

DECEMBER 2010

Prepared by:

VERDANT POWER

VERDANT POWER, LLC

RMEE-3: SEASONAL SPECIES CHARACTERIZATION - NETTING

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 OBJECTIVES

The objective of netting is to provide a set of net capture data, during May through December with more effort during the seasonal period (mid-September through mid-December) of elevated fish abundance in the project vicinity to provide:

1. Species characterization information, that combined with the 2006 RITE trawling, and the Ravenswood and other historical impingement data will provide additional understanding of the fish population in the East Channel,
2. Provide species characterization in the immediate vicinity of the turbines that can be used to support the interpretation of the past and future DIDSON monitoring and hydroacoustic evaluations, and
3. Potentially provide some observation and/or data for interpretation on potential fish injury due to turbine blade contact in a field of operating KHPS turbines.

2.0 PROPOSED SAMPLING PLAN

This plan proposes a netting program conducted north of the RITE field during late may through mid-December during Install A and repeated in Install B-2 and Install C if warranted.

2.1 Methods and Equipment

Net sampling in the East River is very difficult due to fast currents present during ebb and flood tides and was not successful in past studies for this project. Most recent sampling method discussions contemplated the use of a construction jack-up barge, similar to the barge used for turbine installation, as a work platform and structural support for net deployment. The logistical difficulties and costs of this approach were prohibitive; moreover the efficacy of this approach given the stated objectives has

resulted in a revised plan from that proposed in the Draft License Application in November 2008.

To characterize the fish assemblages that would have the most likelihood of encountering the RITE Pilot Project and KHPS turbines, Verdant Power proposes to deploy a mid-water (pelagic) research trawl. In order to be successful, sampling is proposed to occur near slack tide, which is the period of time most fish have been observed in previous studies in 2006-2008 to be present and active, hence increasing the opportunity for capture (please see Appendix A for details). Slack tide also is the safest and easiest period to trawl.

Sampling will occur near shore in the area where the hydroacoustics demonstrated most of the fish are located (Figures 2-1 and 2-2). The net depth and position will be controlled using both the speed of the boat and the length of tow rope released. The trawl is proposed to be less than 20-ft long with at least 200-ft long tow ropes. The net will include doors located on each side of the net opening to ensure the net is opened wide. The main portion of the net will consist of ½-inch mesh, with a 1/8-inch mesh cod-end collection bag. A digital echosounder (fish-finder) will be used before sampling to detect and locate the fish schools in the water column. The start and end locations of each tow will be documented using a hand held GPS unit. The tows will be standardized by length. Upon conclusion of each tow, the contents of the net will be inspected and all aquatic organisms will be sorted, identified, and enumerated. Representative catch will be documented photographically and any dead or injured fish will be frozen and archived for potential forensic examination. The data will be recorded on waterproof field data sheets and entered into a database upon return from the field.

Figure 2-1. Location of RMEE-3 Netting

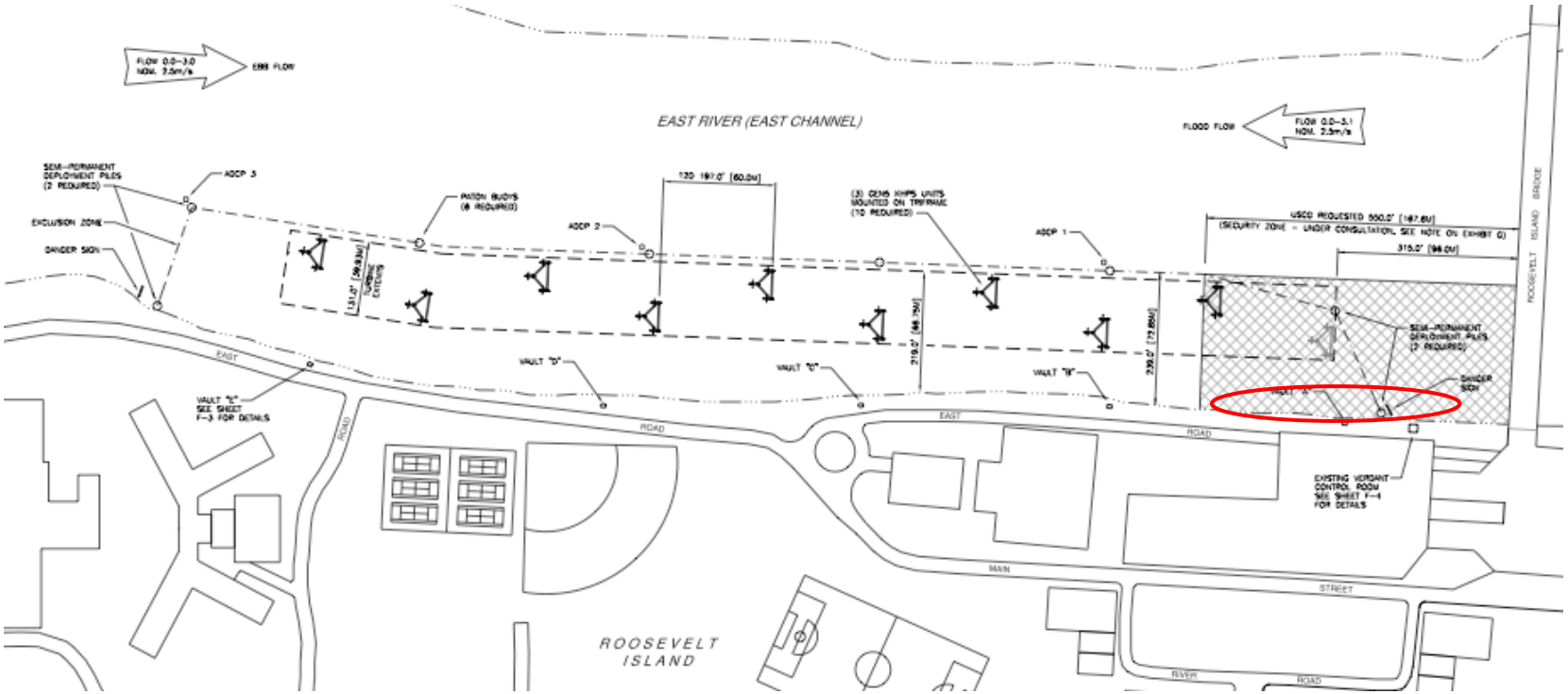
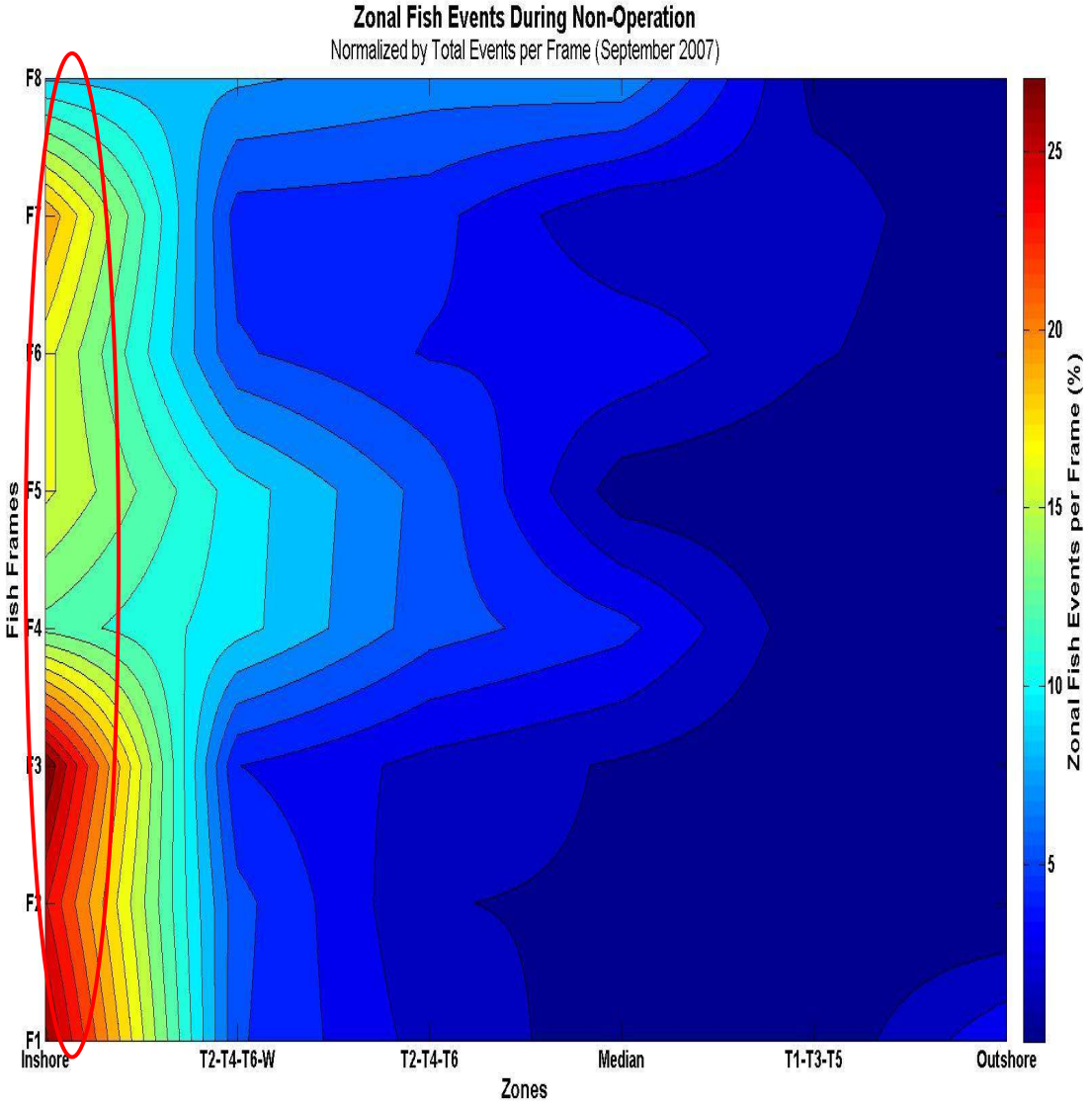


Figure 2-2. Hydroacoustic Output - the contour area above roughly matches the gray cross-hatched area in the map below.



2.2 Monitoring Data Analysis

Verdant Power proposes to sample once in during the late May-June time period, once during the July-August time period, and every other week from September 15 through December 15 during Installs A, B-2, and C.

Data to be recorded from each sample will include:

- Net deployment start and end time, (total time not to exceed 30 minutes)
- Lateral net position (left turbine, right turbine, or center) and net depth,
- Surface current velocity (or range during sample), and
- Fish data – number, species, total length, and condition.

Representative digital photos of the catch will be taken. When possible, all live and unharmed fish will be released after processing. Any suspected turbine injured fish will be retained and frozen to allow future examination and verification, if necessary.

Verdant Power will secure a biological sampling permit from NYSDEC, which includes conditions for potentially handling RT&E species. However the New York collector's permit will not cover Verdant Power for any direct or incidental collections of federally listed or managed fish or wildlife. Since federally endangered species may occur in the project area and may potentially be collected in the trawl, Verdant Power will need to obtain an Incidental Take Permit associated with a Biological Opinion produced by NMFS as a result of a formal ESA Section 7 consultation with a Federal authorizing agency before sampling can proceed.

The capture of an injured fish may suggest turbine induced injury may be occurring and may require further investigation. It must be recognized that other unavoidable sources of potential fish injury are present in the East River (sampling vessel or other boat propeller damage, trawl net, water intakes, predatory birds and fish, etc.) and can result in damage to fish that may not be distinguishable from turbine induced

injury. Therefore, the capture of an injured fish must be evaluated with appropriate perspective.

2.3 Schedule and Timing

Verdant Power proposes to conduct this sampling effort as shown on the table below.

Table 2-1. RMEE-3 Seasonal Species Characterization Netting

	Install A (2 KHPS)	**Install B -1 (3 KHPS)**	**Install B-2 (6-12 KHPS)**	**Install C (30 KHPS)**
Seasonal Species Characterization Netting	1 year, 1 day May-June, 1 day July-August, and 6 days during Sept -Dec 15th*	1 year, 1 day May-June, 1 day July-August, and 6 days during Sept - Dec 15th*	1 year, 1 day May-June, 1 day July-August, and 6 days during Sept - Dec 15th*	1 year, 1 day May-June, 1 day July-August, and 6 days during Sept -Dec 15th*

* ***Continue or modify if necessary***

Timing of the actual mobilization effort will be coordinated with NYSDEC, based on the following conditions:

- KHPS installed and operating
- Tidal conditions - best periods seem to be neap tide with moon apogee (Please see Appendix A for discussion on tidal timing with respect to fish abundance)
- Other known anecdotal observations within the watershed

2.4 Remedial Measures

Based on Verdant Power's in-water experience during the RITE Demonstration Project, and the aquatic monitoring accomplished as a part of that project, it is highly

unlikely that remedial measures will be necessary. However, Verdant Power will consult with the agencies immediately regarding remedial measures if monitoring identifies any adverse effects to fishery populations in the East River.

2.5 Results and Reporting

Verdant Power will report on the findings of the netting, in a technical memo after the seasonal events and file comments and responses as part of the Annual Report filed under the RITE Environmental Effects Monitoring plan.

3.0 SUMMARY/KEY QUESTIONS

Results will be focused on answering the following questions:

1. What is the species characterization (resident and migratory fish populations) in the East River?
2. Does the species characterization from the netting support that data seen in the 2006 RITE trawling, the Ravenswood and other historical impingement data?
3. Does this characterization support the interpretation of the past and future DIDSON monitoring and hydroacoustic evaluations?
4. What, if anything should be changed in the protocol for Installs B-2 and C to improve evaluation?

RMEE-4

TAGGED SPECIES DETECTION

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-4: TAGGED SPECIES DETECTION

DECEMBER 2010

Prepared by:

VERDANT POWER

VERDANT POWER, LLC

RMEE-4: TAGGED SPECIES DETECTION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

VERDANT POWER, LLC

RMEE-4: TAGGED SPECIES DETECTION

1.0 OBJECTIVES

The objective of this plan is to provide new and unique detections on the potential presence of the proposed ESA listed Atlantic sturgeon, ESA listed shortnose sturgeon, along with striped bass, bluefish, winter flounder and other species that have been acoustically tagged. Detection would occur in both the east and west channels of the East River, proximate to the RITE Pilot project boundary. Once that is achieved, based on collected data, revision and updated evaluation of species with respect to Installs B-1, B-2 and C will occur.

Little is known of the pattern of these species in the vicinity of the Pilot project, so it is difficult to postulate the effects of the operation of the RITE East Channel Pilot project Installs A, B and C unless and until it is know that this species is present in the project area. Once data is collected from the hydrophones proposed, these observations can be the basis for further ESA consultation and modifications for Install B and C.

Verdant Power specifically proposes to install hydrophones in the east and west channels during April to November 2011 and 2012 timeframe as discussed below. Data would be provided directly to the Connecticut Department of Environmental Protection and NYSDEC who are logging the migration pattern of tagged shortnose and Atlantic sturgeon. This data collection will overlap with Install A and B and be evaluated after each season. Continuation or modifications will likely be required for Install C and Verdant Power will conduct further consultation as directed in a FERC Pilot license article re ESA species.

2.0 METHODS AND EQUIPMENT

Verdant Power proposes to work cooperatively with area researchers from academia and state and federal agencies and proposes to purchase and install VEMCO VR2W hydrophones and place them in the Project area to detect acoustically tagged fish. Verdant Power will ensure that the hydrophones are not 180kHZ receivers as this type of receiver will not be capable of

detecting Atlantic sturgeon tagged by Stony Brook University. Currently there is over 4,800 individually tagged fish along the Atlantic Coast. These include target species shortnose and Atlantic sturgeon along with striped bass, bluefish, winter flounder and other species.

Currently, 605 Atlantic sturgeon and 350 shortnose sturgeon and about 2,000 striped bass are tagged with VEMCO tags. During the agency conference call on November 23, 2010, NMFS expressed concern that because some Atlantic sturgeon tagged by NYSDEC are tagged with LOTEK tags rather than VEMCO tags, some of the tagged sturgeon would not be detected. It was suggested that Verdant Power contact Kathy Hattala, of the NYSDEC Bureau of Marine Resources, Hudson River Fisheries Unit to obtain further information on these LOTEK tagged fish. Verdant Power initiated the teleconference and Ms. Hattala indicated that NYSDEC would prefer to use VEMCO tags to take advantage of the network of receivers along the Atlantic Coast. However they had a specific need to pinpoint locations, via mobile tracking, where Atlantic sturgeon conjugate in the Hudson River, specifically for spawning and foraging, and VEMCO does not make a mobile tracking receiver. A total of 29 Atlantic sturgeon in the Hudson River were surgically implanted with LOTEK tags for this specific objective. Tagging took place in 2008 and the tag battery life is 5 years.

Besides these 29 tagged Atlantic sturgeon, there are also 33 Atlantic sturgeon tagged in the Hudson River with satellite and pop-up tags. The batteries on these tags will function until 2013. Ms. Hattala mentioned that there are plans to tag more Atlantic sturgeon with VEMCO tags. Verdant Power has considered the information provided and have concluded that they do not have a specific need to manually track Atlantic sturgeon, and Atlantic sturgeon will be tagged in the future with VEMCO tags. Verdant Power believes it would be prudent to purchase additional VEMCO hydrophones in the future, if needed, then to invest in one LOTEK receiver at five times the cost of a VEMCO hydrophone, which may potentially detect only 5% of the Atlantic sturgeon currently tagged along the Atlantic Coast. Verdant Power will work with VEMCO and the resource agencies to make sure coverage of the channels for VEMCO tagged fish is as complete as possible.

The VEMCO VR2W hydrophones records the identification number and time stamp from acoustic transmitters as a tagged animal travels within receiver range. Data can be quickly downloaded in the field without opening the case by using a PC with Bluetooth wireless technology. The VR2W system uses new VUE software that is compatible with Windows XP SP2 operating system. The VR2W consists of a hydrophone, receiver, identification detector, data logging memory, and battery all housed in a submersible case. The VR2W receiver has a depth rating of 500 meters and is easily moored or hidden underwater by a diver.

The device has been proven successful in several studies including:

- The Pacific Ocean Shelf Tracking Project (POST) monitors the movement of marine animals through an array of listening stations set along the west coast of North America.
- Network of 250 receivers in the Bay of Fundy tracking the migratory patterns of several salmon groups.
- Ocean cod tracking off Nova Scotia using an array of 70 receivers.
- Fish passage monitoring at Tees River Barrage, UK.
- Endangered Giant Sea Bass monitoring off California.
- Lingcod site residency monitoring off Alaska.
- Monitoring of sturgeon, sharks and grouper species.

The receiver is effective at detecting acoustic tags including miniature and medium sized tags enabling a researcher to track a wide variety of fish species with the same receiver array. The low current draw will last up to 15 months on a Lithium D battery. Because non-volatile memory is used, the data remains intact even with the loss of battery power. Coded acoustic transmitters enable researchers to conduct longer term studies. Many transmitters last several years giving the researcher the benefit of collecting many years of behavioral data from the same animal. VEMCO can provide over 192,000 unique identification tags.

3.0 MONITORING DATA ANALYSIS

Data files from the VEMCO VR2W hydrophone receivers will be downloaded and sent to Tom Savoy of the Connecticut Department of Environmental Protection. Data on any fish detected from the instruments in the East River will then be will be shared with Verdant Power.

4.0 SCHEDULE AND TIMING

Verdant Power proposes three separate detection periods as shown in Table 4-1

Table 4-1. RMEE- Section 4 Atlantic Sturgeon Detections

	Install A – 2 KHPS	**Install B -1 3 KHPS = Triframe**	**Install B-2 12 KHPS**	**Install C 30 KHPS**
Hydrophones	April to November	April to November	If study continues	If study continues

No monitoring is proposed in December to April due to the limited likelihood of fish migrating passed the Project.

5.0 REMEDIAL MEASURES

Based on Verdant Power's in-water experience during the RITE demonstration project; and the aquatic and bird monitoring accomplished as a part of that project; it is highly unlikely that remedial measures will be necessary. Verdant Power shall consult with the agencies regarding remedial measures if monitoring identifies any adverse effects to Atlantic sturgeon populations in the East River.

6.0 RESULTS AND REPORTING

Verdant Power would report on the findings of the observation program as a filing with the agencies and part of an Annual Report filed under the RITE Environmental Effects Monitoring plan.

Results will be focused on answering the following questions:

1. What is the detected presence, distribution, and frequency of tagged fish in the East River during April – November 2011?
2. What can be postulated from this data as to the potential interaction of these species with operating KHPS?
3. What, if anything should be changed in the protocol for 2012 and beyond in Install B and C to improve detection and evaluation?

Figure 6-1. Location of RMEE-4 Atlantic Sturgeon Hydrophones

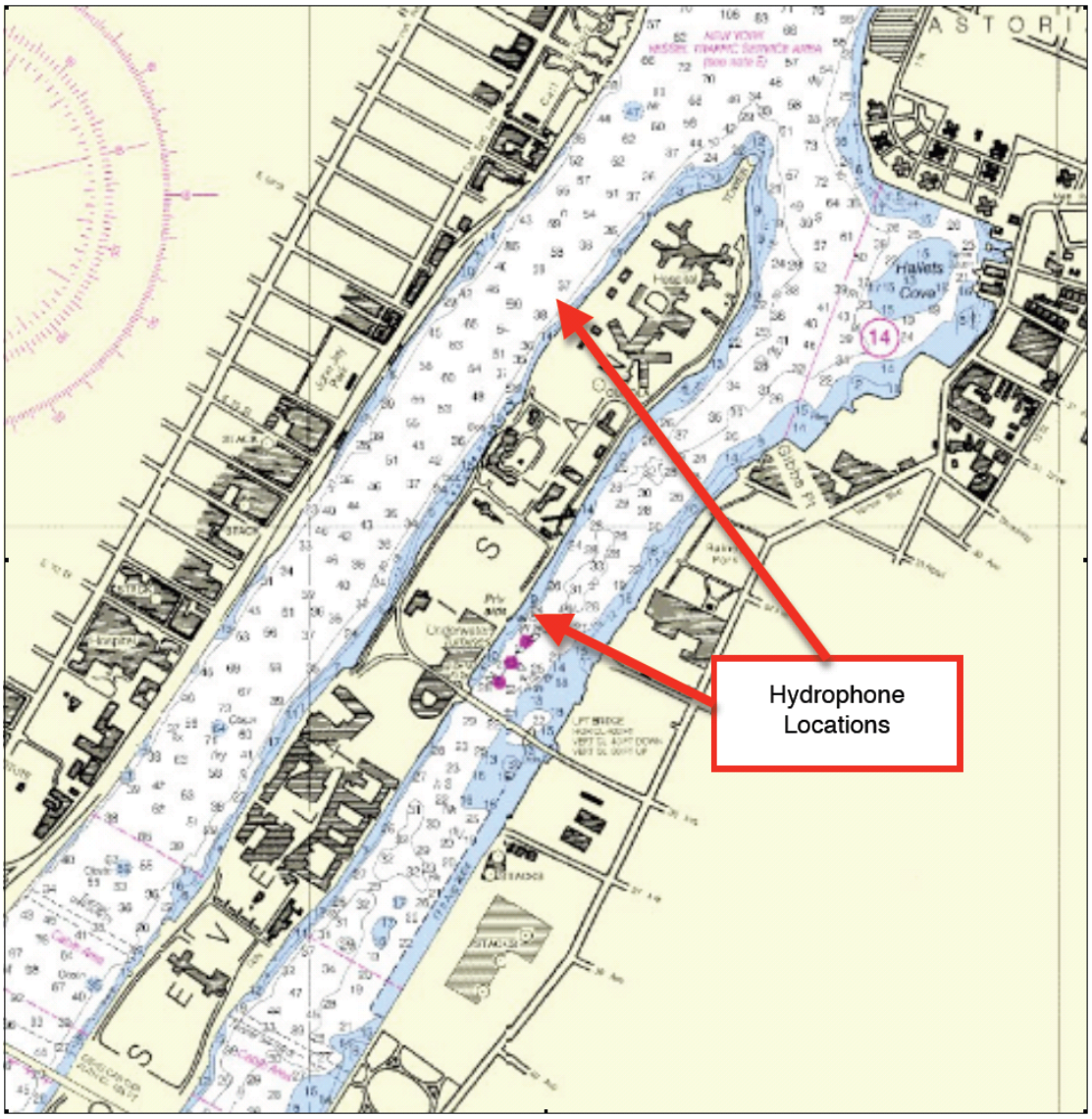


Figure 6-2. VEMCO VR2W Hydrophone Receiver

RMEE-5

RITE BIRD OBSERVATION

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-5: RITE BIRD OBSERVATION

DECEMBER 2010

Prepared by:

VERDANT POWER

VERDANT POWER, LLC

RMEE-5: RITE BIRD OBSERVATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

VERDANT POWER, LLC

RMEE-5: RITE BIRD OBSERVATION

1.0 OBJECTIVE

The objective of this plan is to observe bird presence and activity near the RITE Project boundary in order to:

1. Provide additional observations on the potential effects of the operating KHPS on diving bird populations.
2. Provide additional insights into potential effects of operating KHPS on the fish, *e.g.* increased bird activity in and around the RITE operating field could be an indication of increased injury and mortality of fish.

2.0 BACKGROUND

As discussed in the RITE Draft License Application Exhibit E, pages E129 – 141, Verdant Power conducted a Bird Observation Survey during the RITE Demonstration Project, which included bird monitoring during both pre-deployment and post-deployment of turbines.

This monitoring was conducted during all three deployments of the demonstration units. The results of these observations indicated little to no observed effects to bird populations from the presence of 2-6 KHPS during >9,000 hours of operation. The table below is extracted from the RITE DLA for information on avian species observations at RITE.

Table 2-1. Species Common to the New York Region – Observations near the RITE Demonstration Project

Species	Resident	Spring Migration	Fall Migration	Observed at RITE
Double Crested Cormorant (Phalacrocorax auritus)	Yes	No	No	Yes
Diving Ducks (Mallards)	No	March to mid May	November	2 Sightings Total – NOT DIVING
Tern species (Sterna hirundo, S. forsteri, S. nilotica)	No	Late April to early May	September	Not Observed
Brown Pelican (Pelecanus occidentalis)	No	Not Known	October	Not Observed
Loons (Gavia spp.)	No	March	November to mid December	Not Observed
Gannets (Morus bassanus),	No	March	November to mid December	Not Observed
Scaup (Aythya spp.) and ring-necked ducks (Aythya collaris)	No	March to April	November to mid December	Not Observed
Canada Geese	No	March to May	October	Yes - Flying

Since the proposed Install A and B-1 represent the installation of < 6 KHPS, which is less than the number of operating machines during the RITE demonstration, Verdant Power does not propose bird observation monitoring during these phases.

However, the agencies have commented that they are also interested in a better understanding of the use of the project area by other birds during migration (USFWS; Jan 2009). Diving ducks, cormorants, and terns migrate through the area from late March through mid-May. The fall migration of species such as the brown pelican (*pelecanus occidentalis*) or double-crested cormorant may peak in October, but species such as loons (*Gavia spp.*), gannets (*Morus bassanus*), scaup (*Aythya spp.*), and ring-necked ducks (*Aythya collaris*), may peak in November through mid-December, and many tern species (*Sterna hirundo, S. forsteri, S. nilotica*) migrate

through the area in September. They have also commented that Bald eagles (*Haliaeetus leucocephalus*) have the potential to be present in the Project Area.

To respond to these comments in specific relationship to the effects of operating KHPS on avian species, Verdant Power proposes to conduct bird observations beginning with Install B-2 when >6 KHPS are installed and operating in the East Channel of the East River.

2.1 Methods and Equipment

Consistent with protocols used in the demonstration project, Verdant Power will conduct dawn to dusk observations of bird activity, by Verdant Power personnel and other local birders and consultants. Verdant Power will focus on bird species common to the New York region – Double Crested Cormorants, Diving Ducks, Tern Species, Brown Pelicans, Loons, Gannets, Scaup, Bald Eagles, and Canada Geese. As with the demonstration project, Verdant Power will not record the activity of sparrows, seagulls and pigeons. Of the above listed species most are migrating birds, known to migrate in the fall and spring. The Double Crested Cormorant is the only resident bird. The bird observations at the RITE demonstration (2006 - 2008) site during periods of spring and fall migration, pre and post turbine deployment, did not indicate the presence of many of the common New York species listed above, except Double Crested Cormorants, Canada Geese, and two Diving Ducks.

Bird observation data will be reported in an ongoing summary study log. The log will include:

- Observation time of day
- Number of birds observed by species
- Activity – flying, dive/float, perched
- Proximity to the KHPS array and operational status of the KHPS machines
- Tidal cycle information – ebb, flood or slack

- Any notes or observations that would indicate interaction with the KHPS units

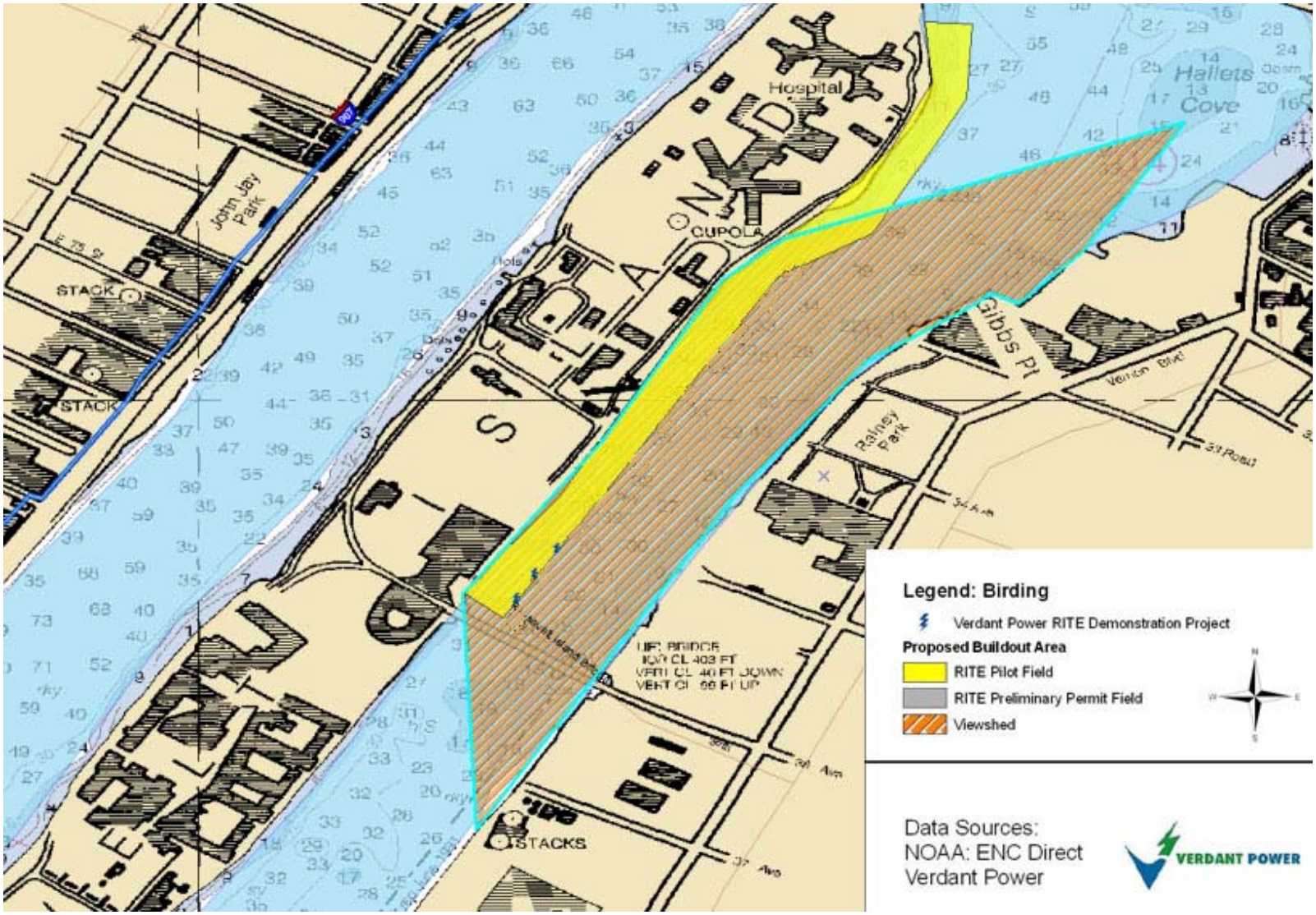
All observations will be made from the shore adjacent to the RITE East Channel KHPS field. Two birders will observe at each end of the turbine field, the exact location of the birders depending on the number of turbines deployed at the time and therefore the extent of the field. This will allow complete coverage of the project area.

Figure 2-1 shows the proposed viewshed that will be covered during bird observation Install B-2 and C of the RITE project.

Verdant Power cautions that the view north of the actual developed RITE KHPS boundary is complicated due to the influence of Hallet's Cove and presence of human bird feeding, activity due to a park and a shoreline landing, and at the confluence of the east and west channels at the northern tip of Roosevelt Island. The focus of the bird observation is to observe bird activity due to the presence of the pilot, and will have to be careful to exclude other human activities.

The observers will be equipped with binoculars, the bird book "The Sibley Field Guide to Birds in North America" and a camera. Photographs will be taken as available, however the photographs are intended to supplement the observations and the recorded data, and the observers are not responsible for photographically documenting every bird observed.

Figure 2-1. RITE View Shed for Bird Observations



2.2 Monitoring Data Analysis

The summary of bird observation data will be logged and graphically displayed for interpretation. Should increased bird activity be noted at any time during the monitoring, the agencies will be notified for consultation and evaluation of the potential for adverse effects.

2.3 Schedule and Timing

Verdant Power proposes to conduct bird observation as shown on the following table, and is predicated on collecting data for the following reason:

- observe seasonal migratory activity during March to May and September to November in three consecutive years when operating KHPS machines are present including before and after Install B-2.

Table 2-2. RMEE-5 Bird Observation

	Install A (2 KHPS)	**Install B-1 (3 KHPS)**	**Install B-2 (9-12 KHPS)**	**Install C (30 KHPS)**
Bird Observation	None proposed	1 Year Seasonal spring and fall 11 days	2 years Seasonal spring and fall 11 days	None proposed

No monitoring is proposed in December due to the limited number of birds observed in December during the RITE Demonstration Project (see Figures 5.3.4.1 and 5.3.4.1-b in Additional Information Request Response 10b, March 2009).

Due to the highly variable nature of bird migration and transit, Verdant Power does not see the value of additional observation of migration patterns – as it directly relates to the operation of a field of KHPS turbines. However, Verdant Power is open to different monitoring only if it is observed in the first observation that avian reaction to the Install B-2 (9-12 KHPS) turbine field is different than that observed during the demonstration.

2.4 Remedial Measures

Based on Verdant Power's experience during the RITE demonstration project, and the aquatic and bird monitoring accomplished as a part of that project, it is highly unlikely that remedial measures will be necessary. However, Verdant Power shall consult with the agencies regarding remedial measures if monitoring identifies any adverse effects to fishery or bird populations in the East River.

2.5 Results and Reporting

Verdant Power will report on the findings of the install B-2 pre and post turbine deployment bird monitoring study, as a filing with the agencies. Verdant Power would provide a similar summary of the fall bird monitoring observations in as part of an Annual Report filed under the RITE Environmental Effects Monitoring Plan.

3.0 SUMMARY/KEY QUESTIONS

Results will be focused on answering the following questions:

1. Prior to turbine deployment in Install B-2 - what is the seasonal presence, abundance and activity of bird populations in the East River near and around the RITE Plot Project boundary and the Verdant Power's KHPS field?
2. Post Install B-2 - what is the observed bird presence, abundance and activity of bird populations in the East River near and around the Project Boundary while up to 12 KHPS are operating?
3. Does bird activity appear to increase at the turbine field, thus potentially indicating fish injury/mortality as fish pass through a KHPS array of up to 12 turbines?
4. What, if anything, should be changed to the protocol for Install C to improve observation and evaluation?

RMEE-6

RITE UNDERWATER NOISE MONITORING AND EVALUATION

VERDANT POWER, LLC

NEW YORK, NEW YORK

RMEE-6: RITE UNDERWATER NOISE MONITORING AND EVALUATION

DECEMBER 2010

Prepared by:

VERDANT POWER, LLC

RMEE-6: RITE UNDERWATER NOISE MONITORING AND EVALUATION

TABLE OF CONTENTS

LIST OF FIGURES

1.0 OBJECTIVE

The objective of this study is to:

- Determine the noise signature from 6-30 operating Gen5 KHPS turbines and use this information to verify or refute the initial finding that the machines do not emit noise at levels that would cause harm to aquatic resources. This task will include a review of the data on representative species and the physics of sound propagation in shallow water to establish the appropriate spatial and frequency limits for monitoring.

2.0 BACKGROUND

As discussed in the Draft License application Exhibit E, pages E-109-129, Verdant Power conducted a noise evaluation survey during the RITE Demonstration Project. Verdant Power observed that noise levels from up to four operating Gen4 turbines were well below the source levels that effect fish behavior. The USACE commented (January 2009) that there were problems with the data that made it difficult to conclude that a larger field would have no impacts. Verdant Power agrees that there are unanswered concerns regarding the underwater noise signature of a field of more than six Verdant Power KHPS turbines. It should be noted that the hydrodynamic and mechanical improvements made on the Gen5 technology proposed for the Pilot would indicate a lower expected noise signature than the machines used in the RITE demonstration.

Since the proposed Install A is two machines installed on monopiles, very similar to the demonstration project, Verdant Power does not believe that this will provide adequate new data to evaluate a larger field. A more representative study will be conducted during Install B-1 with three Gen5 KHPS operating on a triframe. This study would establish three control locations for

noise evaluation in proximity to the RITE Project Boundary as outlined below and also measure the underwater noise from the three operating KHPS for comparison.

The results of the Install B-1 study will be evaluated for further recommendations regarding necessary studies in Install B-2 and C. Verdant Power proposes that a similar study be conducted in Install C with up to 30 KHPS operating.

3.0 PROPOSED STUDY PLAN

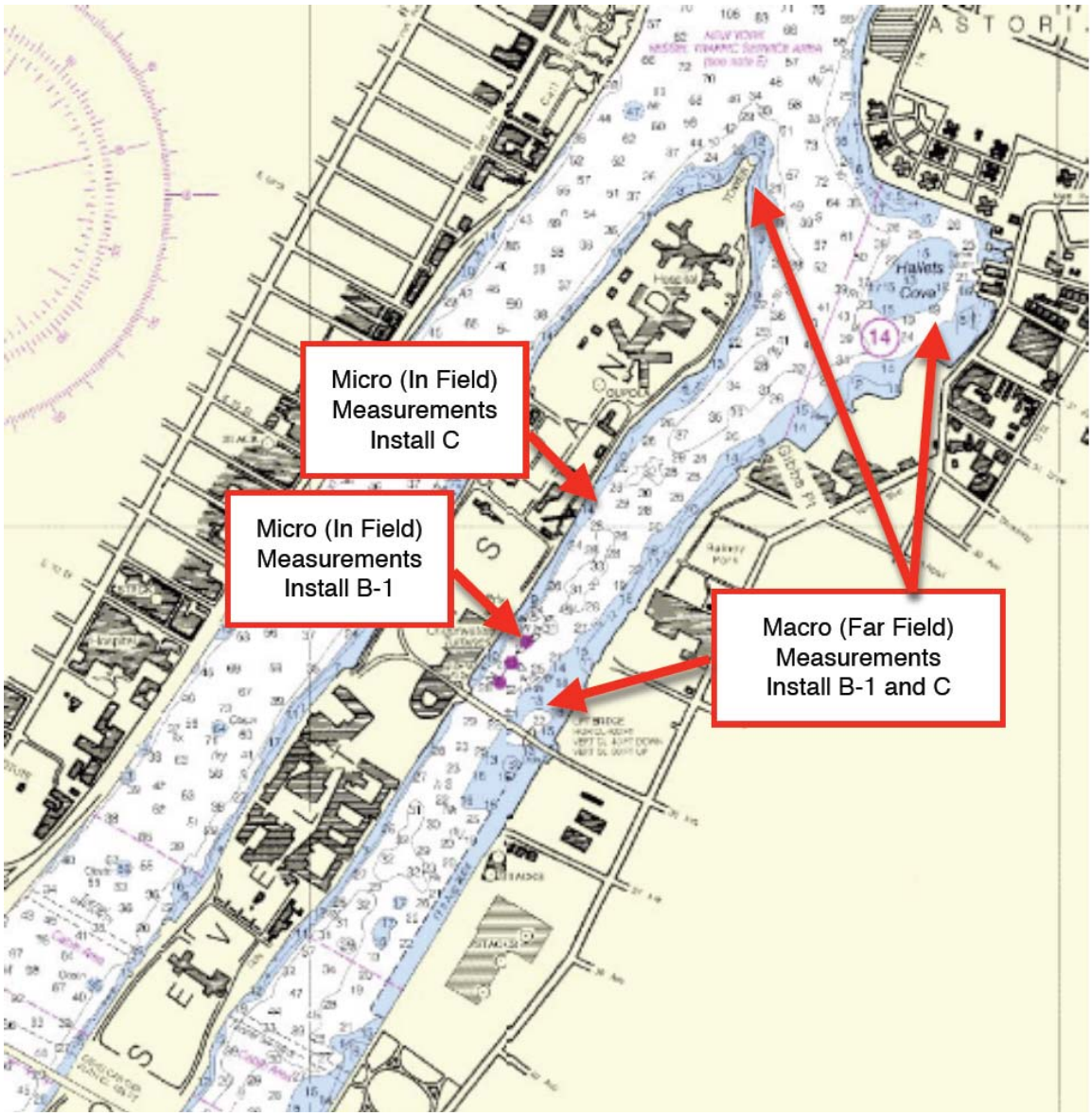
3.1 Methods and Equipment

Verdant Power, in consultation with the environmental regulatory agencies, will conduct a two-part underwater noise study consisting of:

- Micro- Meso (In-field) stationary underwater noise monitoring within the RITE East Channel Pilot Field (Proposed location of ADCP-N) near Install B-1; to capture the noise signature of three Gen5 KHPS; and
- Macro (far-field) stationary noise measurements at up to three established locations beyond the RITE Pilot Project Boundary. See Figure 3-1. The likely locations are near Hallets Cove, the northern tip of Roosevelt Island, and near Ravenswood Generating Station.

Verdant Power will attempt to compare the micro, meso, and macro field noise signatures when the Gen5 machines are operating to noise signatures during the slack condition. However due to the shallow depths and numerous variables in the acoustic environment (wind, rain, water velocities, traffic, construction, subway traffic etc.) this may be problematic.

Figure 3-1. RMEE-6 Location of Underwater Noise Monitoring



3.1.1 Micro (In-Field) Monitoring

Verdant Power will deploy a stationary mounted hydrophone instrumentation package for monitoring the RITE Pilot Project field to capture a relevant sample of sound levels of pr on slack, flood and ebb tides. Similar environmental and timing conditions will be coordinated to ensure comparable readings of both pre and post turbine deployment.

- The hydrophone instrumentation package will be deployed at the in-field location to measure direct infield source level of the turbines. The signal cables will be routed to shore. Verdant Power proposes to monitor at one depth, the bottom at the level of the ADCP mount (approximately 2-3 meters from the river bed). Based on the data collected in the demonstration project, the bottom location will present the worst-case measurements.
- The hydrophone instrumentation package will be based on the frequency.
- The stationary mount will allow Verdant Power to compare the sound levels during all stages of the tidal cycle and with different combinations of turbines coming on and off line to validate the total field array sound levels. The study is expected to take one-month after the entire installation and operation commencement of Install B-1. The operation of the turbines affects the validity of the measurements and therefore close coordination with timestamps of the noise measurements will be maintained.
- Based on the evaluation of the results of the B-1 study; the efficacy of further data collection in Install B-2 and Install C will be evaluated.

3.1.2 Macro (Far-Field) Measurements

- Far-field reference points will be established at up to three locations within shallow waters (<10m) East Channel of the East River. Likely

places may include Hallets Cove, the northern tip of Roosevelt Island and near Ravenswood Generating Station. Local environmental noise level measurements will be taken and coordinated to KHPS operation, slack, ebb and flood and noise levels from the stationary system. The similar hydrophone setup to the stationary design will be used to collect the data; however the instrumentation will only be deployed for 1 week at each site to collect measurements.

3.2 Monitoring Data Analysis

The noise data analysis will concentrate on establishing the underwater noise signature of a Verdant Power KHPS array of 6-30 operating turbines in relation to other environmental noise levels in the water channel. Results will be presented as Sound Pressure Levels (SPL) (x DB re 1uPA) and as Root Mean Squares (RMS) values for both the stationary in-field hydrophone and at three other observation locations. The monitoring data will be graphically displayed for interpretation and focused on verifying the environmental noise levels in a KHPS array during various operational modes (slack, ebb and flood tides).

3.3 Schedule and Timing

Verdant Power proposes to conduct underwater noise signature monitoring as shown below.

	Install A (2 KHPS)	**Install B-1 (3 KHPS)**	**Install B-2 (9-12 KHPS)**	**Install C (30 KHPS)**
Underwater Noise Monitoring	None proposed	1 year Stationary for 1 Month 3 far-field locations (1 week)	None proposed unless B-1 indicates effect	1 year Stationary for 1 Month* 3 far-field locations (1 week)

**** Location for B-1 at ADCP-N and at mid-field for Install C.***

3.4 Remedial Measures

Based on Verdant Power's in-water experience during the RITE Demonstration Project and the underwater noise monitoring accomplished as part of that project, it is highly unlikely that remedial measures will be necessary. Verdant Power will consult with the agencies immediately regarding remedial measures if monitoring identifies any adverse effects to fishery or bird populations in the East River.

3.5 Results and Reporting

Verdant Power will report on the draft results of the underwater noise monitoring and measurement after the conclusion of the studies during Install B-1, with consensus recommendations for Install C. A final report will be filed with FERC after consultation with the NYSDEC, USFWS, and NOAA.

4.0 SUMMARY/KEY QUESTIONS

Results will be focused on answering the following questions:

1. What is the operating noise signature of three KHPS Gen5 machines in the micro and meso field and how does this propagate and correlate to noise measurements in the macro field, near the RITE Pilot project in the greater East Channel of the East River region?
2. Does the noise signature from operating turbines during Install B-1 verify initial findings that the Pilot project is unlikely to affect the behavior (movement and migration) of wildlife in the region?
3. Are there any recommendations or changes to the underwater noise monitoring and measurement protocol to provide data during the study conducted in Install C.