Cover Page

Project Title

Acoustic Environmental Hazard Evaluation for Riverine Hydrokinetics - (the "Project")

Best Practices for Acoustic Hazard Evaluation Technology To Date

Applicant

Benthic GeoScience Inc. (Benthic)
PO Box 556
Sutton, AK 99674
Principal Point of Contact: David Oliver – Geophysicist
Email: doliver@BenthicGeo.com
Phone: 907-715-8144

Project Partners

1. University of Alaska – Anchorage, AK (ACEP, AHERC and other researchers)
2. Igiugig Electric Company (by authority of the Village of Igiugig, AK)

Total Estimated Project Cost

Grant funds requested: **$196,205**

Previous project/application title(s) and/or number(s) for grants from the Renewable Energy Fund or Denali Commission Emerging Energy Technology Grant program (if applicable)

- No Previous application or grant.

Previous Project title(s) for abstracts submitted to the Emerging Energy Technology Fund (if applicable)

- No Previous EETF application.

1. Project Summary

To date, each riverine hydrokinetic project introduced into the Alaskan environment (specifically, the Yukon River) has met with signficant complications related to environmental hazards. The threat from environmental hazards in the Alaskan Rivers are daunting and must be overcome before extensive build out of riverine hydrokinetic power projects in many Alaskan rivers can occur. This Project is designed to empower our researchers, engineers, and other innovative minds by establishing a best practices from commercially available acousitc technologies. Our goal is to collect full water column backscatter data in phase with current velocity and river stage and make that data available to the at-large community which is working so hard to overcome the hardships specific to Alaskan environments. **The Project is not research**. This project will empower future research through the use of standard industry work practices and commerically available sensors for marine construction projects (similar to rigorous operations accomplished by the staff of Benthic GeoScience for over two decades). The project utilizes appropriate commercially avilable sensors for the purposes for which they were intended.

Benthic will make a record from commercial sensors, analyse how well they can percieve known critical hazards, and report on the success or failure in observing hazards such as frazil ice generation episodes, surface ice keel, sub-surface woody material, surface woody material keel, biomass calculations and momentum estimations, and marine mammal identification and behavior interpretation within the water column. Benthic will deploy low cost sensors in the hope that future endevors to develop "risk assessment" standards for Alaskan riverine environments can be developed.

This project is designed to define to-date technology capabilities. It has not been done before, in Alaska or else where, the Project brings these technologies to Alaska's renewable energy industry.

a. Project Description – The Project proposed is a directed initiative aimed at acquiring acoustic information for the purpose of assessing the riverine environment with the intention of generating a best formulaic practice for three typical candidate riverine hydrokinetic environments. Ulimately, it is the goal of Benthic that the sensors deployed be recognized as fundamental instruments for assessing the hazard potential for a proposed project site early in the site characterization process, which will produce comparitive standards for "risk assessment" by entities such as ACEP, AHERC, Denali Commission, and AEA prior to significant fund investment.

The development of such standards is not the goal of the Project. The Project is designed to demonstrate the usefulness and shortcomings of commercially available acoustic sensors to empower entities such as ACEP to generate meaningful standards, for AHERC to possibly generate new sensors, predictive techniques, and ulimately, hazard mitigation methodologies for diversion, encapsulation, or isolation.

Benthic will purchase and assemble the appropriate sensors and fabricate an energetic riverine mooring with high potential for survivablity specific to the three environments proposed for deployment. The sensors will be deployed for approximately 90 (ninty) days at temporal epochs with high probablily for detection of targeted hazards. The outcome of this effort will be a comprehensive operations report, sensor comparison of performance, and an evaluation of sensor function.

The data will be publicly available for researchers, engineers, and other innovative minds to propel the riverine hydrokinetic industry forward.

b. Project Eligibility - This project meets eligibility requirements because:

1. The Riverine Hydrokinetic Energy Industry is within five (5) years of producing a commercial supply of electricity into Alaskan grids (current estimates indicate within two (2) years for the Igiugig Power grid);
2. The Project will improve application methodologies and reduce the cost of hydrokinetic power site characterization projects and provide a data set to establish a baseline

methodology for "risk assessment" early in the site feasability evaluation, thus further reducing costs across the industry;

3. Riverine Hydrokinetic Energy technology expands the diversity of available energy supply sources available for the residents of Alaska. This energy resource could significantly reduce many communities' dependence upon diesel fuel for its power.
4. It is "emerging"; only the most advanced technologies have evolved beyond TRL Level 7 within the US;

c. Project Innovation – The innovative mehodologies implemented by Benthic GeoScience will signficantly reduce the cost of future hydrokinetic power conversion feasability evaluations andimprove the economics associated with hydrokinetic installations in Alaska.

The Project will improve the performance of riverine hydrokinetic energy installations in Alaska by establishing a rigorous best practice for riverine hazard assessment, ultimately leading to the institution of risk assessment early in the site characterization effort. Benthic's methodology is innovative because it couples the resource assessment with the risk assessment. In the future, Projects will be responsible for proving that the power potential at a particular site is achievable by proving that the various hazards are managable. The Project will improve the economics of performing feasibility studies, the economics of hydrokinetic projects by increasing the accuracy of economic predictions, and provide the ability to standardized a methodology for supporting entities such as the Denali Commission and AEA to rank perspective renewable energy projects. This effort will greatly enhance the likelihood of future hydrokinetic projects to be successful.

The Project is additionally innovative because it utilizes recent advances in commercially available sonar technologies which may permit a reduction in the number of sonar instruments deployed to remote Alaskan locations for hazard assessment. This has not been accomplished previously for hydrokinetic projects, nor has this combination of acousitc sensors been deployed within Alaskan rivers, and, if the sensors are proved redundant, is expected to improve the cost for future hazard evaluation moorings by 30%.

The Project couples a pre-exisiting need of hydrokinetic projects to validate their resource power by using the same mooring, and ultimately perhaps the same sonar, with the hazard assessment effort. The Project will gather data from Alaskan environments which are already candidate sites for hydrokinetic power production. The information will be directly useful for these prospective hydrokinetic projects. In addition, the sensors which are being deployed will produce a 90 (ninty) day resource assessment in phase with measuring water stage record, as well as a current directionality record (only meaningful for the Teller site). These records alone will provide essential information to the candidate project development. This effort will increase our understanding for the behavior of the current resource for previously existing projects.

The Project wastes no effort; it provides value added contribution.

d. Priority - Under AS 42.45.375(d) and RFA (sec. 4.3) this project meets priority criteria because:

i. Applicant is an domestic Alaska business holding a valid business license;
ii. The project will include the University of Alaska as a key partner;
iii. Other communities in Alaska have been identified as potentially benefitting from hydrokinetic power, these methods extend beyond the riverine hydrokinetic power conversion projects and have potiential for benifiting all hydrokinetic (Marine & Wave) practices.

2. Technology Validation and Research Methodology

a. Objective - The primary objective of this project is to establish a best hazard assessment practice for assembling the most cost-effective commercially available acoustic sensors, deploying those instruments coupled with resource assessment technology, and acquiring the best data set available

from existing technology for comparison and evaluation. The product from this effort will report that comparison and evaluation.

b. Methodology

The Project will deploy a mooring in the vicinity of the Village of Igiugig, the City of Nenana, and the City of Teller for a ninty (90) day deployment during high hazard potential periods at each respective site. All candidate sites are riverine hydrokinetic projects candidates (Benthic recognizes that the Teller location is a hybrid site with both tidal and river influence, but fits well for a multi-target evaluation site) being actively evaluated for feasability. The Project will gather information on the rigors of collecting data in remote Alaskan rivers on current velocities, Alaskan fish and marine mammal habitat, and record data that can be evaluated for hazards such as frazil ice episodes, surface ice keel, sub-surface woody material depth/elevation, surface woody material keel, biomass calculations and momentum estimations, and marine mammal identification and behavior interpretation within the water column.

The Project will evaluate the nessessary infrastructure needed to collect, interpret, and report on the quality and function of the data as an effective tool for assessing the feasibility of hydrokinetic technology to produce economical energy at the (representative) sites.

The Project will establish Best Practices for Acoustic Hazard Evaluation Technology to date; a perfect launch point as future debris and other hazard studies begin within the state. Benthic staff have prior experience in riverine power project site characterization, resource assessment, and, specifically, the interpretation of acoustic sensor data for meaningful contribution to the conception, design, and permitting of hydrokinetic projects.

3. Summary of Project Schedule, Tasks and Project Budget

Phase 1 – Sept. 2012 -Purchase sensors, fabricate framework, and assemble mooring.

Phase 2 – February, 2013 - Deploy the mooring in Igiugig late in the month of February, 2013. The mooring will be in place through breakup and will collect data on current velocity, river stage, frazil ice generation periods, and report ice keel through the breakup period. Igiugig is a clear water river, open to current flow throughout the winter. It is believed to be a fairly benign environment so represents the most favorable conditions to begin our assessment for the detection of frazil ice and the measurement of ice keel. The mooring will be recovered by the end of May.

Phase 3 – The second deployment is to be at Nenana in the Tanana River after breakup, currently targeted for the beginning of June, 2013. The mooring will collect data on current velocity, midwater and surface woody debris flows, gather information on the ambient sediment load, all in phase with river stage. Nenana is not a beneign environment so represents the least favorable conditions for our assessment. The mooring will be recovered by the end of August.

Phase 4 – The third deployment is to be at Teller, AK. The exact deployment schedule is undetermined at this time. The site potentially offers the ability to monitor current velocity, tide stage, frazil ice generation periods, and report ice keel as ice closes over the site and then opens again. Benthic will examine the data for seal activity and identify if this device can be used to identify mammal position within the water column and possible behavior.

Alternate deployments (replacing the third site) exist. Alexanna Salmon of Igiugig, has communicated that her community has concerns throughout the winter and would appreciate a mooring on site for an extended period. Also, potentially two sites at Igiugig may install hydrokinetic turbines and the third deployment may be used for this purpose as well. It is Benthic's understanding that the Teller site is not an viable candidate for hydrokinetic deployment.

"The Village of Igiugig has been pursuing a River In-Stream Energy Conversion Device (RISEC) for years. It is our highest priority alternative energy project. The device would be deployed in the Kvichak River and will most likely need to be removed during ice break-up. The Kvichak River is clear, free of debris, and ice flow is the single hazard that needs to be monitored. The community's concern is that ice-flow needs to be monitored throughout the winter because in January there was significant freeze-thaw that resulted in small ice-flows. If the resource is not properly monitored for this hazard, it will affect the performance of the RISEC device.

Thank you for your attention to this matter.

Sincerely,
AlexAnna Salmon

President, Igiugig Village Council"

Acoustic Environmental Hazard Evaluation for Riverine Hydrokinetics		
Phase	**Effort**	**Cost**
1	Mooring Fabrication & Assembly	**$88,263**
2	Deployment and Recovery - Igiugig	**$34,436**
3	Deployment and Recovery - Nenana	**$30,654**
4	Deployment and Recovery - Teller	**$42,852**
	TOTAL COST	**$196,205**

4. Project Team Qualifications

a. **Benthic GeoScience Inc (Sutton, AK) – Project Leader – David Oliver**
David Oliver has over 25 years in the geotechnical industry, and 14 years working directly with the marine geophysical industry. Having recently established Benthic GeoScience Inc after serving the renewable energy community for many years with TerraSond Ltd. David has lead the Site Characterization and Resources Assessment work on many marine and riverine hydrokinetic projects in Alaska including Ruby, Eagle, Nenana, Igiugig, and both of ORPC's tidal energy sites.
David has been an organizational member of REAP (member of the Policy and Rural Community Energy committies) for 5 years, currently serves on the AHERC Advisory Board, is a member of the AEA Hydrokinetic Working Group, and is a contributing member of the shadow committee for ANSI TC-114's Tidal Resource Assessment Project Team (PT) representing USA interests as international standards for Renewable Energy Resource Assessement are being established by the International Electrotechnical Commission.

5. Discussion of Commercialization of Funded Technology – The sonar technology is commercially available. It is its application in the marine renewable energy industry and its use in the Alaskan environment that will be being evaluated.

6. Applicant Certification

"By signature on this application, I certify that we are complying and will comply with the amount of matching funds being offered."

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David Oliver
Principle Investigator, Geophysicist
Benthic GeoScience Inc.

Proof of Eligibility

Applicant Eligibility

The applicant is an Alaska Corporation and is licensed by the State of Alaska, Division of Corporations.

Corporate Registration #: 10002684
Business License #: 969241

Project Eligibility

All three riverine hydrokinetic projects supported by the Project have a reasonable expectation of supplying electricity into their respective communities' power grid approximately within five (5) years after its projected start date of September 2102. In addition, it satisfies all three criteria outlined in section 4.2 of the Emerging Energy Technology Fund RFA:

1. The Riverine Hydrokinetic Energy Industry is within five (5) years of producing a commercial supply of electricity into Alaskan grids, current estimates indicate within two (2) years for the Igiugig Power grid;
2. The Project will improve application and reduce the cost of hydrokinetic power site characterization technology and provide a data set to establish a baseline methodology for "risk assessment" early in the site feasability evaluation further reducing costs across the industry;
3. Riverine Hydrokinetic Energy technology expands the diversity of available energy supply sources available for the residents of Alaska. This energy resource could significantly reduce many communities' dependence upon diesel fuel for its power.
4. It is "emerging"; only the most advanced technologies have evolved beyond TRL Level 7 within the US;

Statement of Project Ownership/Control and Operating/Maintenance Responsibility

Each project site partner is independent of the efforts of Benthic GeoScience regarding this topic and the existing agreements of ownership/control and operating/mainenance responsibilty will be unaffected by the accomplishment of the Project.

Statement of Prioritization

Applicant believes that this Phase 1 project satisfies all four of the criteria outlined in the RFA:

1. Applicant is an Alaska organization and an estimated 50% of the Phase 1 project budget will be spent within the borders of the state;
2. All data generated from the Project will be available to the University of Alaska as a key partner. The staff of Benthic have a long history of collaborating with University staff and accomodating changes in measurement techniques and methodologies when it would improve the accuracy and usefulness of the data;
3. At least six (6) other sites in Alaska have been identified that may benefit from the introduction of riverine hydrokinetic power into its electricity generation mix.