APPENDIX I

WATER QUALITY MONITORING PLAN

Broadwater

Suspended Sediment / Water Quality Monitoring Plan

For A

Project to Construct and Operate A

Liquefied Natural Gas Receiving Terminal

In

Long Island Sound

Long Island, New York

February, 2007

BROADWATER

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1.0 Introduction

Broadwater Energy, a joint venture between TCPL USA LNG, Inc., and Shell Broadwater Holdings LLC, is filing an application with the Federal Energy Regulatory Commission (FERC) seeking all of the necessary authorizations pursuant to the Natural Gas Act to construct and operate a marine liquefied natural gas (LNG) terminal and subsea connecting pipeline for the importation, storage, regasification, and transportation of natural gas. The Broadwater LNG Project (the Project) will increase the availability of natural gas to the New York and Connecticut markets through an interconnection with the Iroquois Gas Transmission System (IGTS). The FERC application for the Project requires the submittal of 13 Resource Reports, with each report evaluating project effects on a particular aspect of the environment.

This *Suspended Sediment / Water Quality Monitoring Plan* (the Plan) provides guidance in monitoring the Project's anticipated short-term and long-term effect on water quality and provides guidance on reporting requirements during pre- and post-installation operations. The ultimate goal of the Plan is two-fold: during construction the goal is to characterize, to the extent practicable, the anticipated effect of sediment disturbance on the overlying water column; and during operation the goal is to adequately characterize, to the extent possible any affects that to water quality resulting from daily operations of the FSRU and incoming LNG Carriers.

The proposed Broadwater LNG terminal will be located in Long Island Sound (the Sound), approximately 9 miles (14.5 kilometers [km]) from the shore of Long Island in New York State waters, as shown on Figure 1-1. The LNG terminal facilitates the sea-to-land transfer of natural gas and provides short-term storage of LNG, which relies on waterborne transport. It will be designed to receive, store, and regasify LNG at an average throughput of 1.0 billion cubic feet per day (bcfd) and will be capable of delivering a peak throughput of 1.25 bcfd. The Project will deliver the regasified LNG to the existing natural gas pipeline system via an interconnection to the IGTS pipeline. Onshore facilities are discussed in a separate document.

The proposed LNG terminal will consist of a floating storage and regasification unit (FSRU) that is approximately 1,215 feet (370 meters [m]) in length, 200 feet (60 m) in width, and rising approximately 80 feet (25 m) above the water line to the trunk deck. The FSRU's draft is approximately 40 feet (12 m). The freeboard and mean draft of the FSRU will generally not vary throughout operations conditions. This is achieved by ballast control to maintain the FSRU's trim, stability, and draft. The FSRU will be designed with a net storage capacity of approximately 350,000 cubic meters [m^3] of LNG (equivalent to 8 billion cubic feet [bcf] of natural gas) with base vaporization capabilities of 1.0 bcfd using a closed-loop shell and tube vaporization (STV) system. The LNG will be delivered to the FSRU in LNG carriers with cargo capacities ranging from approximately 125,000 m^3 to 250,000 m^3 at the frequency of two to three carriers per week.

The FSRU will be connected to the send-out pipeline, which rises from the seabed and is supported by a stationary tower structure. In addition to supporting the pipeline, the stationary tower also serves the purpose of securing the FSRU in such a manner to allow it to orient in response to prevailing wind, wave, and current conditions (i.e., weathervane) around the tower. The tower, which is secured to the seabed by four legs, will house the yoke mooring system (YMS) allowing the FSRU to weathervane around the tower. The total area under the tower structure, which is of open design, will be approximately 13,180 square feet (1,225 square meters [m^2]).

A 30-inch-diameter natural gas pipeline will deliver the vaporized natural gas to the existing IGTS pipeline. It will be installed beneath the seafloor from the stationary tower structure to an interconnection location at the existing 24-inch-diameter subsea section of the IGTS pipeline, approximately 22 miles (35 km) west of the proposed FSRU site. Figure 1-1 presents the proposed pipeline route.

The water quality monitoring program will use Optical Back Scatter (OBS) sensor in combination with Acoustic Doppler Current Profiler (ADCP) technology, and grab samples from varying water column depths during pre-installation jet-plow trials and jet-plow pipeline trenching operations to monitor the project related effects on existing water quality conditions within the Project area limits. A report summarizing the results of field measurements and water column sample analysis will be provided to the NYSDEC staff after completion of the Project.

Figure 1-1
Proposed Broadwater Project
Location in Long Island Sound

Source: ESRI StreetMap, 2002.

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2.0 Establishment of Ambient Background Conditions and Project Related Suspended Sediment Concentrations.

The goal of the Plan is to characterize the effect of sediment disturbance on the overlying water column resulting from installation of the Broadwater pipeline, which will serve to verify, or truth the MIKE3 modeling that was conducted as part of the FERC application process. Results of this modeling, presented as Appendix E to Resource Report 2 in Broadwater's January 2006 application indicate that sedimentation resulting from the plow operations is not anticipated to be significant.

2.1 Monitoring Procedures

Monitoring will focus on defining the extent of the suspended sediment plume, and assessing the duration and magnitude of any resultant sediment plume that arises from installation activities. This will be accomplished using a combination of real-time instrumentation and laboratory analysis of water samples as follows:

1. Periodic turbidity profiling using in situ optical backscatter (OBS) monitoring equipment;

2. Continuous in situ acoustical backscatter monitoring for suspended sediment using an acoustic Doppler current profiler (ADCP);

3. Water column grab sample collection for laboratory analysis of TSS;

4. Periodic temperature and salinity profiling measurements using conductivity, temperature, and depth (CTD) equipment; and

5. Concurrent time and positional information using differential global positioning system (DGPS)

The OBS and ADCP data will be used in conjunction with water column TSS grab samples to determine near real-time spatial and temporal coverage of the suspended sediment plume. In addition, vertical profiling of temperature and salinity will provide data on ambient water conditions that may contribute to the sediment plume dynamics. All collected data will include time and positional information from the shipboard DGPS system.

Sampling efforts will be initiated in advance of construction activities and continue for the duration of the installation. Approximately two-weeks prior to the planned installation activities, water samples will be collected at defined intervals along the length of the proposed pipeline, and at multiple points in the tidal cycle. This will establish a baseline for variation of the suspended sediment loads along the length of the pipeline, as well as variation of sediment loads throughout the tidal cycle. Ambient conditions of TSS will

be determined through real-time field measurements using mobile OBS sensors deployed from a survey vessel within the Project area, and cross referenced with grab sample collections for laboratory analysis.

Suspended sediment monitoring will be conducted around slack and peak running tides. Each sampling location will include the collection of three-water samples for laboratory TSS analysis as follows:

1. One sample taken from 18 inches below the water surface;
2. One sample taken at mid-depth of the water column; and
3. One sample taken approximately 3 feet above the seabed.

Vertical profiles of turbidity, water temperature, and salinity will be measured at each sampling location in conjunction with the grab samples. Turbidity will be measured in *Nephelometric Turbidity Units* (NTU) using OBS instrumentation. These data can then be converted to suspended sediment concentrations on a milligram per liter (*mg/L*) basis for field calibrations. A Conductivity/Temperature/Depth (CTD) instrument will be attached to the OBS so that a single instrument cluster will be lowered through the water column at each sampling location.

In addition, real-time acoustic backscatter data will be collected concurrently with the sampling using ADCP instrumentation. These data will be compared to simultaneous TSS and turbidity measurements to determine the relationship between acoustical backscatter and suspended sediments, as well as documenting any potential error associated with this relationship. The ADCP data, having a much greater spatial relationship, will be converted to TSS or turbidity based on the relationship developed from the field measurements and laboratory analysis to create an uninterrupted profile across each section of the sediment plume traversed during water quality monitoring. Additionally, water temperature and salinity data will be used to calculate sound velocity to improve the acoustical backscatter results.

The extent of the turbidity monitoring from the construction zone will largely be determined by the measured extent of sediment plumes. Broadwater proposes that suspended sediments will be monitored to the point when levels fall below 10 mg/l above background, as these levels would largely not be visible. As such, monitoring will be limited to daylight hours, although construction activities will be conducted around the clock. Although the exact monitoring sites will vary, locations will be selected so that the monitoring transects, relative to the pipeline installation operation, will fully encompass the anticipated sediment plume. Previous experience suggests that sites up to 800 feet down-current should provide adequate monitoring coverage. The specific sites will be determined in coordination with the pipeline installation contractor to ensure safety and non-interference with construction activities and support craft (e.g. anchor handling tugs). The length of each transect will vary (primarily determined by current velocity); however, each transect will be of sufficient length to establish the spatial extent (outer boundary) of the sediment plume.

During the course of construction, monitoring will focus in the area of ongoing plow operations, and will extend out radially in all directions to the point where suspended sediment levels are consistent with background levels. Background monitoring will be performed throughout the pipeline installation operation outside the boundary of the expected sediment plume (as depicted in the sediment modeling) for comparison purposes. The number of sampling locations necessary to establish adequate background conditions will be refined during implementation of the plan; however, sampling will be conducted, at a minimum, at one location during each phase of the tide (e.g., slack, peak ebb, peak flood) during which time monitoring is performed. Monitoring frequency will typically occur at least twice per tidal cycle (12.4 hours) during pipeline installation operations, during a running tide (i.e., ebb or flood) and during a slack tide. Based on consultation with the regulatory agencies, if monitoring on a less frequent interval is determined to adequately capture the extent of the sediment plume, monitoring frequency may be decreased as the project progresses.

2.2 Sampling and Analysis Schedule

Once pipeline installation operations commence, water quality samples collected for TSS analysis will be transferred to an agency approved laboratory every 24 hours. The total turnaround time (includes gross analysis, data entry and data processing) is expected to take 4- to 6- days. It is anticipated that the in-situ sediment characteristics (i.e., sediment grain size distribution, type, etc.) will not vary substantially during trenching activities over this time period; thus, analytical results reported by the laboratory on the fourth day will immediately be used to guide the monitoring interpretation of real-time acoustical and optical backscatter data. Field monitoring activities during the first 3- to 4-days will be guided by backscatter correlations developed during the pre-installation trial. Estimates of volumetric sediment plume extent for each operational day will be provided following completion of pipeline installation activities.

2.3 Reporting

Broadwater will maintain a daily reporting log for all sediment sampling activities and results. Daily reports will include, at a minimum, the following information:

- Stations traversed;
- A catalog of data collected; and
- The correlations of optical and acoustic backscatter associated with TSS monitoring used to guide the field monitoring effort.

Weekly reports summarizing sampling efforts and laboratory results will be forwarded to FERC and appropriate permitting agencies. These reports will include the findings of the ongoing monitoring, and if suggested by data analysis, make recommendations to the frequency and distribution of sampling locations to more effectively capture the extent of the sediment plume.

Following completion of pipeline installation operations, a final monitoring report shall be prepared to include, at a minimum, the following information:

- Procedures and methodologies followed;
- Field and analytical testing results;
- Findings; and
- Limitations of the monitoring program during each phase of the Plan's implementation.

The final report shall include the actual correlations between real-time optical and acoustical backscatter equipment, and corresponding TSS measurements, comparisons of measurements with relevant water quality standards, and QA/QC data from laboratory and field monitoring activities. All analytical results and laboratory reports associated with each sampling station shall be included as appendices to the final report submitted to the appropriate agency.

3.0 Establishment of Ambient Background Conditions and Project-Related Water Quality Concentrations

The goal of the Plan is to characterize the effect of miscellaneous Broadwater discharges from the FSRU and associated LNG Carriers during the course of operation. Broadwater anticipates that regular sampling/analysis will be undertaken for the life-time of the FSRU operation as part of a compliance monitoring with New York State Department of Environmental Conservation (NYSDEC) under State Pollution Discharge Elimination System (SPDES) requirements. While the Plan below outlines the framework for the water quality monitoring, Broadwater anticipates that the list of parameters which will be monitored will be finalized following completion of design of the FSRU, and prior to the installation and start-up of the FSRU. As detailed in Resource Report 2 of Broadwater's January 2006 application, operation of the FSRU will result in up to seven point-source discharges into the Sound, including ballast water and treated wastewater among others. While the LNG carriers will not directly discharge while moored to the FSRU, the LNG Carriers will require the use of Long Island Sound for cooling water. Broadwater anticipates that all discharges from the FSRU will meet effluent limitations as developed by NYSDEC. As indicated in Resource Report 2, impacts resulting from operational discharges are not anticipated to be significant.

3.1 Monitoring Procedures

Monitoring will focus on defining and characterizing the impacts to water quality resulting from discharges associated with the FSRU and LNG Carriers, while moored to the FSRU. This will be accomplished using a combination of real-time instrumentation and laboratory analysis of water samples as follows:

1. Regular monitoring of FSRU discharges to record flow, discharge temperature, intake temperature and temperature differential.

2. Grab and composite sample collection for laboratory chemical analysis of materials present in comparison to water quality parameters;

3. Periodic temperature and salinity profiling measurements using conductivity, temperature, and depth (CTD) equipment; and

4. Concurrent time and positional information using differential global positioning system (DGPS)

Sampling will be initiated approximately one year prior to the FSRU being commissioned to establish baseline conditions within the Sound. Sampling will be conducted quarterly in the year prior to the FSRU entering into service to establish a baseline of water quality conditions.

Water quality monitoring will be conducted around slack and peak running tides. Each sampling location will include the collection of two-water samples for laboratory analysis as follows:

1. One sample taken from 18 inches below the water surface; and
2. One sample taken at mid-depth of the water column; and

Vertical profiles of turbidity, water temperature, and salinity will be measured at each sampling location in conjunction with the grab samples. Turbidity will be measured in *Nephelometric Turbidity Units* (NTU) using OBS instrumentation. These data can then be converted to suspended sediment concentrations on a milligram per liter (*mg/L*) basis for field calibrations. A Conductivity/Temperature/Depth (CTD) instrument will be attached to the OBS so that a single instrument cluster will be lowered through the water column at each sampling location.

Upon commissioning of the FSRU, Broadwater proposes to initially conduct water quality sampling quarterly. If results confirm that impacts are negligible over the course of two years of sampling, Broadwater will propose to scale back sampling and analysis to semi-annually.

Broadwater anticipates developing the specific target list of analytes through coordination with the NYSDEC in advance of commissioning. This list will be based largely on the final engineering design of the FSRU, which will identify specific processes on the FSRU and the expected discharges associated with them.

In addition to the continuous monitoring of baseline physical parameters, Broadwater anticipates that the finalized sampling plan will include many or all of the parameters identified in Table 1.

Table 1

Water Quality Monitoring for the Broadwater Project Anticipated Target Analytes	
Conventional Compounds and Metals	Biochemical Oxygen Demand (BOD)
	Chemical Oxygen Demand (COD)
	Total Suspended Solids
	Oil and Grease
	Total Residual Chlorine
	Ammonia/ammonium
	Total Coliform
	Nitrate/Nitrite Nitrogen
	Total Phosphorus (as P)
	Iron
	Manganese
Heavy Metals	Heavy Metals (copper, mercury, chromium,

Water Quality Monitoring for the Broadwater Project Anticipated Target Analytes	
	lead) – based on coordination with NYSDEC
Other Significant Pollutants	Ethylene glycol
	Others – based on coordination with NYSDEC

3.2 Sampling and Analysis Schedule

Prior to initiating any sampling effort, Broadwater will develop a specific water quality sampling protocol for submittal to and approval by NYSDEC. The protocol will identify specific sampling and analytical methods that Broadwater proposes to implement as to meet the goal of this Plan. Because the engineering design of the FSRU needs to be finalized, Broadwater believes it premature to develop and formalize a plan at the current time.

Water samples analyzed for priority pollutants will be collected quarterly. These water samples will then be transferred to a New York State Department of Health certified laboratory immediately following collection. The certified laboratory turnaround time once they receive the water sample for priority pollutants is typically expected to be 21- to 28-days.

Monitoring and analysis conducted for the Broadwater Project will be in accordance with SPDES regulations and will use test procedures promulgated pursuant to 40 CFR Part 136, unless an alternative approach is agreed to by Broadwater and NYSDEC.

3.3 Reporting

Records of all continuous monitoring on the FSRU will be maintained in a log onboard the FSRU and available for inspection if requested. Results of discreet water quality monitoring efforts will be submitted to resource agencies quarterly. The monthly reports will include

- Dates, location, and timing of sampling;
- A catalog of data collected; and
- The laboratory and analytical techniques used;
- Results of all analyses
- QA/QC documentation.

In addition to quarterly sampling Broadwater anticipates submitting a year-end summary report to identify trends and to assess the adequacy of the monitoring plan. Broadwater will actively engage the resource agencies if the results of the quarterly monitoring

identify potential deficiencies or excessiveness of the program, and work closely with agencies to modify the Plan appropriately.