FINAL

SUPPLEMENTAL ENVIRONMENTAL REPORT FOR MODIFICATIONS IN THE DESIGN, INFRASTRUCTURE, AND INSTALLATION OF THE COASTAL-SCALE NODES AND GLOBAL-SCALE NODES OF THE OCEAN OBSERVATORIES INITIATIVE (OOI)

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Acronyms and Abbreviations

approx.	approximately
AUV	autonomous underwater vehicle
CFR	Code of Federal Regulations
CSN	Coastal-Scale Nodes
CSPP	coastal surface-piercing profiler
EFH	Essential Fish Habitat
EM	electrical-mechanical
EO	electro-optical
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
ft	foot/feet
GSN	Global-Scale Nodes
LNM	Local Notice to Mariners
m	meter(s)
m^2	square meter(s)
NEPA	National Environmental Policy Act
nm	nautical mile(s)
nm^2	square nautical mile(s)
NOAA	National Oceanic and Atmospheric Administration
NOTMAR	Notice to Mariners
NSF	National Science Foundation
O&M	operations and maintenance
OOI	Ocean Observatories Initiative
PEA	Programmatic Environmental Assessment
RSN	Regional-Scale Nodes
SER	Supplemental Environmental Report
SOP	Special Operating Procedure
SSEA	Site-Specific Environmental Assessment
USCG	U.S. Coast Guard

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1.0 PURPOSE AND NEED

This Supplemental Environmental Report (SER) has been prepared to assess the potential impacts on the human and natural environment associated with proposed modifications in the design, installation, and operations and maintenance (O&M) of components of the Coastal-Scale Nodes (CSN) Endurance Array, CSN Pioneer Array, and the Global-Scale Nodes (GSN) of the Ocean Observatories Initiative (OOI) that were previously assessed in a Site-Specific Environmental Assessment (SSEA) (National Science Foundation [NSF] 2011a, b) and 2013 SER (NSF 2013). The SSEA was prepared by NSF to assess the potential impacts on the human and natural environment associated with proposed site-specific requirements in the design, installation, and operation of the OOI that were previously assessed in a Programmatic Environmental Assessment (PEA) (NSF 2008, 2009a) and a 2009 SER (NSF 2009b). The SSEA analysis concluded that installation and O&M of the proposed OOI as presented in the 2011 Final SSEA would not have a significant impact on the environment and a Finding of No Significant Impact (FONSI) was signed on January 31, 2011 (NSF 2011b) (Appendix A). In addition, an SER was prepared in 2013 to determine if proposed OOI design modifications since completion of the 2011 SSEA would result in significant impacts to the environment not previously assessed in the SSEA, including cumulative impacts. Based on the analysis in the 2013 SER, there would be no additional impacts on any resource area with implementation of the proposed OOI design modifications, and the 2013 SER concluded that the FONSI for the 2011 SSEA was still warranted (NSF 2011b), and additional National Environmental Policy Act (NEPA) documentation was not necessary.

The purpose of this SER is to determine if the proposed OOI design modifications since completion of the 2013 SER would result in significant impacts to the environment not previously assessed in the SSEA and 2013 SER, including cumulative impacts. If the proposed modifications would result in potentially significant impacts or impacts that were not addressed in the SSEA and further analysis were deemed necessary, then in accordance with NEPA (42 U.S. Code §4321 *et seq*.) and the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] §§1500-1508), a Supplemental Environmental Assessment or an Environmental Impact Statement would need to be prepared and distributed for review and comment.

1.1 BACKGROUND

The following is a brief summary and background based upon the information provided in the 2011 SSEA. For a detailed description of the purpose, goals, and design of the OOI, please refer to the 2008 PEA, 2009 SER, and 2011 SSEA (NSF 2008, 2009b, 2011a).

1.1.1 OOI Coastal, Regional, and Global Scales

To provide the U.S. ocean sciences research community with the basic sensors and infrastructure required to make sustained, long-term, and adaptive measurements in the oceans, the NSF's Ocean Sciences Division developed the OOI from community-wide, national, and international scientific planning efforts. OOI builds upon recent technological advances, experience with existing ocean observatories, and lessons learned from several successful pilot and test bed projects. The OOI would be an interactive, globally distributed and integrated network of cutting-edge technological capabilities for ocean observatories. This network of sensors would enable the next generation of complex ocean studies at the coastal, regional, and global scale.

The OOI infrastructure includes cables, buoys, deployment platforms, moorings, junction boxes, electric power generation (solar, wind, fuel cells, and undersea cabled power supplies), mobile assets (i.e., autonomous underwater vehicles [AUVs] and gliders), and two-way communications systems. This large-scale infrastructure would support sensors located at the sea surface, in the water column, and at or beneath the seafloor.

As described in detail in the PEA, the OOI design is based upon three main physical infrastructure elements across global, regional, and coastal scales. At the global and coastal scales, mooring observatories would provide locally generated power to seafloor and platform-mounted instruments and sensors and use satellite or other wireless technologies to link to shore stations and the Internet. Up to four GSN or buoy sites for ocean sensing would be installed in the Eastern Pacific and Atlantic oceans. The Regional-Scale Nodes (RSN) off the coast of Oregon would consist of seafloor and mooring observatories with various physical, chemical, biological, and geological sensors linked with submarine cables to shore that provide power and Internet connectivity. The CSN would be represented by the Endurance Array off the coast of Washington and Oregon and the Pioneer Array off the southern coast of Massachusetts. In addition, there would be an integration of mobile assets such as AUVs and gliders with the GSN and CSN observatories.

1.2 SCOPE OF THIS SER

This SER addresses the proposed:

- modifications to the mooring components for the CSN (Pioneer and Endurance arrays) and
- modifications to the mooring and glider components for the GSN.

All other components and installation and O&M activities of the OOI would remain unchanged from the description and analysis presented in the 2011 SSEA and 2013 SER. Section 2.0 describes in detail the proposed changes to the Pioneer and Endurance arrays and GSN being addressed in this SER.

2.0 DESCRIPTION OF PREVIOUSLY ASSESSED OOI COMPONENTS AND PROPOSED MODIFICATIONS

2.1 COASTAL SCALE NODES (CSN)

2.1.1 Pioneer Array

The Mid-Atlantic Bight of eastern North America is characterized by a relatively broad shelf, a persistent equator-ward current originating from the north, a well-defined shelfbreak front separating shelf and slope waters, distributed buoyancy inputs from rivers, variable wind forcing, and intermittent offshore forcing by Gulf Stream rings and meanders. The Pioneer Array would be designed to resolve transport processes and ecosystem dynamics within the shelf-slope front, which is a region of complex oceanographic dynamics, intense mesoscale variability, and enhanced biological productivity. It would collect high-resolution, multidisciplinary, synoptic measurements spanning the shelf break on horizontal scales from a few kilometers to several hundred kilometers.

The Pioneer mooring array would extend approximately (approx.) 25 nautical miles (nm) across the continental shelf, centered at the shelf-break front (refer to Figures 1 and 6 in the 2013 SER [NSF 2013]). The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor. The surface moorings would be equipped to measure surface meteorology and air-sea fluxes, fitted with power generation capability, and moored with electrical-mechanical (EM) cable to the seafloor, allowing incorporation of a benthic node for science user instrumentation.

2.1.1.1 Pioneer Array Components Previously Assessed in the PEA, SSEA and 2013 SER

The Pioneer mooring array, as described in the SSEA and 2013 SER, would consist of 2 lines of moorings running approx. north-south across the continental shelf (refer to Section 2.2.1.2 of the SSEA and Section 2.1.1.2 of the 2013 SER for details and figures depicting the Pioneer Array components and configuration). The western (downstream) line would consist of surface moorings, wire-following profiler moorings with a small surface expression, and surface-piercing profiler moorings with intermittent surface expression. The eastern (upstream) line would consist of a surface mooring, surface-piercing profiler (CSPP) mooring, and wire-following profiler moorings with a smaller surface expression. Gliders and AUVs would run missions in the vicinity of the moored array. A total of 10 moorings would be installed on the seafloor under the SSEA and 2013 SER. In addition, 3 AUVs and 6 gliders would be used to provide monitoring abilities across the entire shelf break. A summary of components and design modifications previously assessed in the SSEA and 2013 SER is provided in Table 1. Further details can be found in those respective documents (NSF 2011a, 2011b, 2013).

Based on design changes and power requirements, it has been determined that the AUV docks will require more power than can be generated or stored from wind or solar alone. As stated in the 2008 PEA, the surface moorings would be capable of being upgraded to a power system using 100% methanol (M100) in the proposed fuel cells.

Table 1. Summary of Previously Assessed (SSEA and 2013 SER) and Proposed Modifications (2015 SER) to Pioneer Array Infrastructure

Item	*SSEA, 2013 SER*	*2015 SER**
Moorings	• 3 EM surface moorings with MFN footprint of 8 m^2. • 2 CSPP moorings. • 5 wire-following profiler moorings. • Active & non-active acoustic sensors on moorings. • 2 guard buoys to mark the location of the surface piercing profilers at the Inshore and Central mooring sites. • AUV docking stations mechanically separated from the Inshore and Offshore moorings and connected by cable to the mooring base. Each docking station would have a footprint of 12.25 m^2. • Surface buoys would be upgraded to a 100% methanol fuel cell power generation system.	• 3 EM surface moorings with MFN footprint of 8 m^2. • **Option to replace the 2 CSPP moorings at the Inshore and Central mooring sites with wire-following profiler moorings.** • 5 wire-following profiler moorings. • Active & non-active acoustic sensors on moorings. • 2 guard buoys to mark the location of the surface piercing profilers at the Inshore and Central mooring sites. • AUV docking stations mechanically separated from **two of the three surface moorings (at Inshore, Offshore, or Central sites)** and connected by cable to the mooring base. Each docking station would have a footprint of 12.25 m^2. • Surface buoys would be **upgraded to a 70% methanol/30% water fuel cell system.** • **Option to deploy the AUV docking station at the Central mooring.**
AUVs & Gliders	• 3 AUVs and 6 gliders. • AUV mission box = 2,489 nm^2. • Glider mission box = 7,145 nm^2.	No changes

Note: ***Bolded** entries are proposed modifications to the Pioneer Array assessed in this SER.
Sources: NSF 2011a, 2013; Consortium for Ocean Leadership 2015.

2.1.1.2 Proposed Pioneer Array Design Modifications

The location of the proposed revisions to the Pioneer Array, inclusive of the glider mission box, is still within the area previously assessed in the SSEA. As assessed in this SER as the Proposed Action, the proposed changes in the Pioneer Array configuration would include:

- Replacement of coastal surface-piercing profiler (CSPP) moorings at the Inshore and Central mooring sites with wire-following profiler moorings.
- Upgrade power supply to a 70% methanol/30% water fuel cell on surface moorings.
- The option to deploy an AUV dock at the Central mooring site.

<u>CSPP Moorings</u>

If the CSPP moorings at the Inshore and Central mooring sites (Figure 1a) do not reliably perform, they would be replaced by wire-following profiler moorings (Figure 1b). The benthic footprint of the wire-following profilers would be the same as that of the CSPPs.

<u>Methanol Fuel Cells</u>

Based on power requirements for the surface moorings, particularly to operate the AUV docks, it has been determined that the Pioneer Array would include fuel cells consisting of 70% methanol and 30% water to supplement the power provided by wind and solar power. In addition, within the methanol fuel cell would be a sealed heat exchanger containing a 50% ethylene glycol/50% water mixture.

<u>AUV Docking Stations</u>

As assessed in the 2011 SSEA and 2013 SER, 2 AUV docks were to be incorporated into the surface mooring MFNs at the Inshore and Offshore mooring sites within the 0.5-nm radius buffer zone of each mooring site (refer to Figures 5a and 5b of the 2013 SER). Based on design changes, an amendment to the current USACE permit would be requested to allow an option to deploy the dock at the Central surface mooring. This would not be an additional AUV dock. There would still be a maximum of 2 docks deployed on the array, but deployment would be on 2 out of any of the 3 surface moorings.

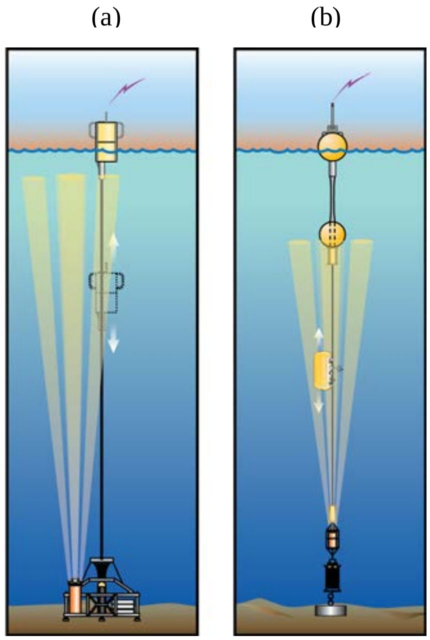


Figure 1. Schematic Diagram of the Planned Mooring Design (a) at the Inshore and Central Sites of the Pioneer Array and the Alternative Design (b) that may Replace the Planned Design as Proposed in this SER

2.1.1.3 Installation and O&M of Pioneer Array

The methods for the installation of infrastructure of the Pioneer Array and conducting routine O&M activities that were described in the 2011 SSEA (refer to Section 2.2.6 of the PEA) would be used for the proposed design modifications assessed in this SER. Installation and O&M activities use standard methods and procedures currently used by the ocean observing community, such as National Oceanic and Atmospheric Administration's (NOAA's) National Data Buoy Center and programs funded by the NOAA Integrated Ocean Observing System. There would be no changes to the installation of the Pioneer Array components as addressed in Sections 2.1.1.3 and 2.1.1.4 and Tables 2 and 3 of the 2013 SER (NSF 2013).

2.1.1.4 Special Operating Procedures (SOPs) for Installation and O&M of the Proposed Modifications to the Pioneer Array

The proposed modifications to the Pioneer Array do not require any changes or additions to the SOPs that were presented in the SSEA (Section 2.2.10, Table 2-13). The SOPs presented in Table 2 would be implemented as part of the proposed design modifications to avoid and minimize any potential impact to commercial fishing activities.

Table 2. SOPs to be Implemented under the Proposed Modifications to the Pioneer Array

1. All Pioneer Array moorings would be permitted as Private Aids to Navigation (PATONs) through the USCG. Surface buoys would be marked per U.S. Coast Guard (USCG) requirements, with all required lights and markings, with locations appearing in the Notice to Mariners (NOTMAR) and Local Notice to Mariners (LNM). Surface buoys would be marked with contact information, which will be included in the NOTMAR and LNM with suggested buffer zones* around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As Pioneer Array moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NOTMAR and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
2. Locations for all moorings and associated components of the Pioneer Array would be published on NOAA charts once moorings are listed in the USCG NOTMAR and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
3. The coordinates for Pioneer Array AUV and glider mission boxes would be published through a NOTMAR. Gliders and AUVs would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

Source: Table 2-13 from NSF (2011a).
Note: * OOI buffer zones are suggested voluntary areas to avoid.

2.1.2 Endurance Array

The coastal ocean off Oregon and Washington is characterized by a relatively narrow shelf, an energetic eastern boundary current, persistent wind-driven upwelling, a large buoyancy source (fresh water from the Columbia River), a number of distinct biogeographical regimes, mesoscale variability forced by bathymetry and fluid instabilities, and interannual variability forced by fluctuations in the tropical Pacific (e.g., El Niño Southern Oscillation), as well as variations in the large-scale circulation of the North Pacific (e.g., Pacific Decadal Oscillation). Over this shelf, water properties and biological community size and composition vary most strongly in the cross-shelf direction. A well-instrumented array spanning the continental shelf is key to sorting out ecosystem responses across this strong gradient. The proposed Endurance Array would be comprised of two lines of moorings, one located off the coast of central Oregon (Oregon Line), and a second off the coast of central Washington (Washington Line). Both lines would consist of surface and subsurface moorings and would employ gliders.

2.1.2.1 Endurance Array Components Previously Assessed in the SSEA and 2013 SER

The Endurance Array would be comprised of the Oregon Line and the Washington Line of moorings (refer to Section 2.2.1.1 of the 2008 PEA and Section 2.2.1.1 of the 2011 SSEA). Both lines would consist of surface and subsurface moorings and would employ gliders. The 80-m Shelf and 600-m Offshore moorings on the Oregon Line would be cabled and connected to the backbone cable of the RSN. As assessed in the 2011 SSEA (Section 2.2.1.1) and 2013 SER (Section 2.1.2.3), the Oregon and Washington lines would include those items listed in Table 3 below. Refer to the SSEA and 2013 SER (NSF 2011a 2013) for further details.

Table 3. Summary of Previously Assessed (SSEA, 2013 SER) and Proposed Modifications (2015 SER) to Endurance Array Infrastructure

Item	*SSEA and 2013 SER**	*2015 SER**
Oregon Line	• Active and non-active acoustic sensors on moorings & benthic nodes.	• No change.
	• 1 paired surface/subsurface mooring at the Inshore Site (approx. 25 m) with MFN footprint of 8 m^2 and anchor footprint of 0.8 m^2.	• 1 paired surface/subsurface mooring at the Inshore Site (approx. 25 m) with MFN footprint of 8 m^2 and **anchor footprint of 2.2 m^2**. • **During winter, replace Inshore CSPP mooring with up to 2 hybrid gliders; therefore total of 6-8 gliders (see below under Gliders).**
	• 1 surface mooring at approx. 80 m with a BARF footprint of 8 m^2.	• No change.
	• 1 BEP at approx. 80 m cabled to node PN1D of the RSN with a footprint of 8 m^2.	• No change.
	• 1 subsurface cabled CSPP mooring at Shelf Site (approx. 80 m) with an MFN footprint of 8 m^2.	• 1 subsurface **uncabled** CSPP mooring at Shelf Site (approx. 80 m) **anchor footprint of 2.2 m^2**.
	• 1 BEP at with a footprint of 8 m^2 at approx. 600 m cabled to node PN1C of the RSN.	• No change.
	• 1 deep profiler mooring at approx. 600 m cabled to node PN1C of the RSN with one anchor with a footprint of 0.8 m^2 each. • 1 shallow profiler mooring at approx. 600 m with two anchors with a footprint of 1.1 m^2 each.	• No change.
	• 1 surface mooring at approx. 600 m with an anchor footprint of 0.8 m^2.	• No change.
Washington Line	• 3 paired surface/subsurface moorings at approx. 25 and 80 m with MFN footprints of 8 m^2 and anchor footprint of 0.8 m^2. • Paired surface and wire-following profiler mooring at approx. 600 m with MFN footprint of 8 m^2 and anchor footprint of 0.8 m^2. • Active and non-active acoustic sensors on moorings and benthic nodes.	• 2 paired surface/subsurface moorings at approx. 25 and 80 m with MFN footprint of 8 m^2 and **anchor footprint of 2.2 m^2**. • **During winter, replace Inshore CSPP mooring with up to 2 hybrid gliders; therefore total of 6-8 gliders (see below under Gliders).** • Paired surface and wire-following profiler mooring at approx. 600 m with MFN footprint of 8 m^2 and anchor footprint of 0.8 m^2. • Active and non-active acoustic sensors on moorings and benthic nodes.
Gliders	• Mission box to 128° W. • N-S glider track along 126° W. • 5 east-west glider tracks from coast to 128° W. • 6 gliders.	• Mission box to 128° W. • N-S glider track along 126° W. • 5 east-west glider tracks from coast to 128° W. • Replace Inshore CSPP moorings with up to 2 hybrid gliders; therefore total of 6-**8 gliders**.

Notes: *BEP = Benthic Experiment Package; BARF = Benthic Anchor Recovery Frame; PN = Primary Node.
Bolded entries are proposed modifications to the Endurance Array assessed in this SER.
Sources: NSF 2011a, 2013.

2.1.2.2 Proposed Endurance Array Modifications

As assessed in this SER as the Proposed Action (Table 3), the proposed change in the Endurance Array would include:

- Revised CSPP mooring anchor frame at Oregon Inshore Site (25 m).

- Replace the subsurface, cabled CSPP mooring at Oregon Shelf Site (80 m) with an uncabled CSPP mooring.
- During winter, replace Oregon and Washington Inshore (25 m) CSPP moorings with up to 2 hybrid gliders.

Revised CSPP Mooring Anchor at Oregon and Washington Inshore Sites (25 m) and Washington Shelf Site (80 m)

The proposed Endurance CSPP anchor system would have an anchor frame offset from the profiler with a stiffened 5/8-in chain running 12 m along the seafloor to the profiler unit (Figure 2). The purpose of the chain is to dampen tension/strain on the profiler winch as the profiler bobs up and down in the energetic wave environment of coastal Oregon. The anchor frame is recoverable and trawl resistant. The mooring anchor would be placed upon sandy bottom, in an area devoid of nearby hardbottom, kelp bed, or seagrass resources. The proposed revised CSPP anchor footprint on the bottom would be 2.2 m^2 compared to the previous anchor footprint of 0.8 m^2.

Replace Cabled CSPP at Oregon Shelf Site (80 m)

The cabled CSPP mooring at the Oregon Shelf Site (80 m) may be replaced with an uncabled CSPP. This option would use an existing design and would be placed within the site radius of the Oregon Shelf Surface mooring (i.e., within the 0.5-nm radius voluntary area to avoid).

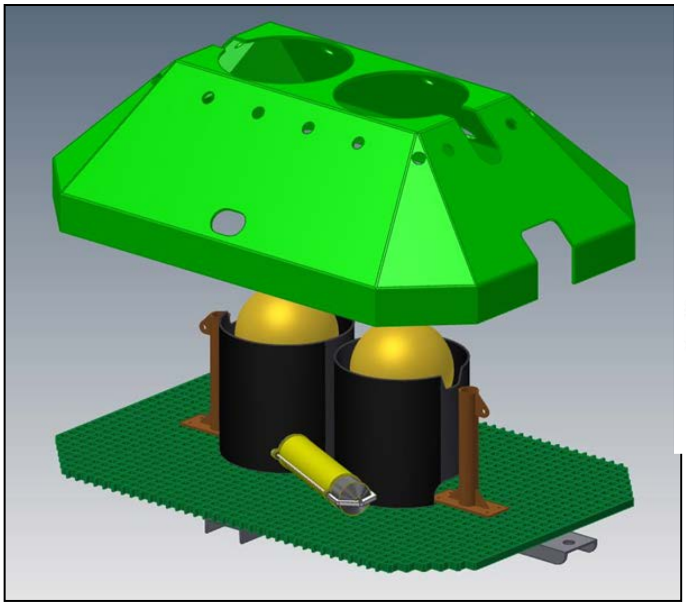
Winter Replacement of Oregon and Washington Inshore (25 m) CSPP Mooring with up to 2 Hybrid Gliders

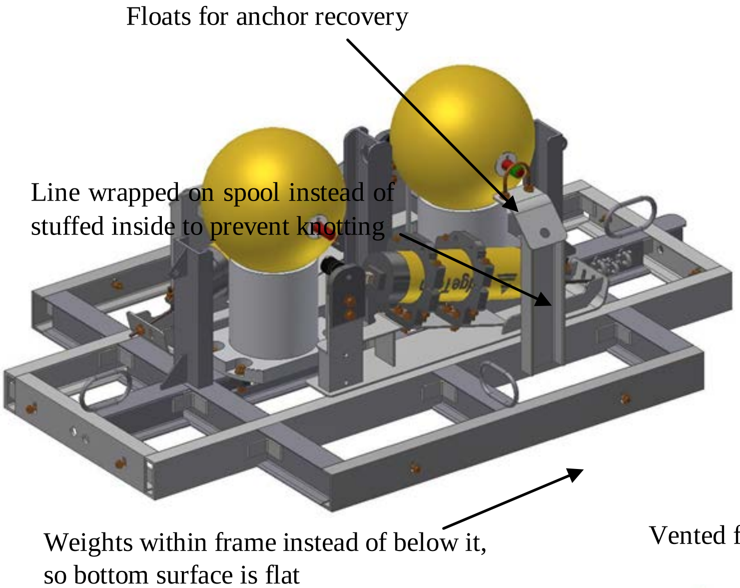
Wave modeling shows the CSPP moorings cannot withstand the winter wave action at the shallow Washington and Oregon Inshore sites (25 m). If the proposed revised CSPP mooring anchor frame (see above) does not work, there is an option to replace the CSPPs at the inshore sites with instrumented "hybrid gliders" (i.e., gliders with thruster capability to provide observations during winter). The thruster is a small collapsible propeller that would fold closed when flying in buoyancy mode. The thruster is capable of overcoming currents of up to 2 knots and would improve navigational control in strong current regimes like coastal Oregon. This would potentially increase the maximum number of gliders in the Endurance Array glider mission box from 6 gliders to up to 8 gliders during the winter season.

The addition of up to 2 gliders within the mission box extending offshore from northern Washington to southern Oregon (refer to Figure 2-1b of the SSEA) would not result in any additional impacts within the marine environment that were already assessed in the SSEA and 2013 SER. Therefore, the addition of up to 2 gliders associated with the Endurance Array does not require further environmental analysis.

2.1.2.3 Installation and O&M of Endurance Array

The methods for the installation of infrastructure of the Endurance Array and conducting routine O&M activities that were described in the 2011 SSEA (refer to Section 2.2.8.2) would be used for the proposed Endurance Array modifications assessed in this SER. Installation and O&M activities use standard methods and procedures currently used by the ocean observing community, such as NOAA's National Data Buoy Center and programs funded by the NOAA Integrated Ocean Observing System.





Dimensions of CSPP Anchor Frame

- Length = 1.78 m
- Width = 1.24 m
- Height (to frame top) = 0.53 m
- Height (to top of floats) = 0.66 m
- Footprint = 2.21 m^2

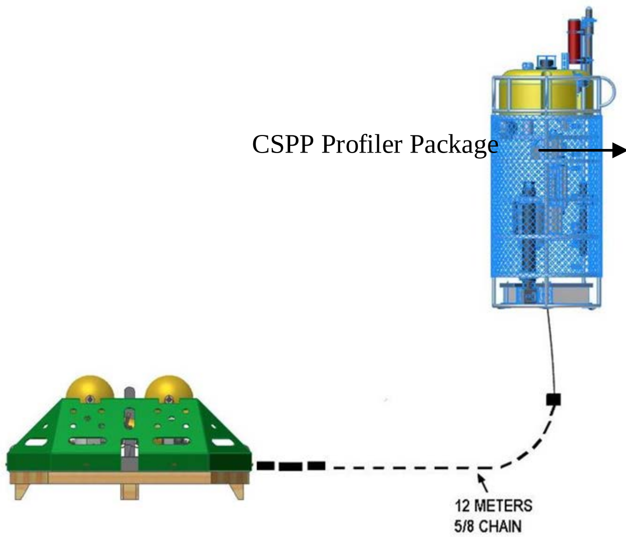


Figure 2. Revised CSPP Anchor Design for Inshore Mooring (Oregon Line) and Shelf Mooring (Washington Line) of the Endurance Array as Proposed in this SER

2.1.2.4 SOPs for Installation and O&M of the Proposed Modifications to the Endurance Array

The proposed modifications to the Endurance Array do not require any change or additions to the SOPs that were presented in the SSEA (Section 2.2.10, Table 2-13). The SOPs presented in Table 4 would be implemented as part of the proposed design modifications to avoid and minimize any potential impact to commercial fishing activities.

Table 4. SOPs to be Implemented under the Proposed Modifications to the Endurance Array

1. The Oregon Fishermen's Cable Committee (OFCC) has been notified regarding the proposed cabled moorings and sensors of the Oregon Line. In accordance with Oregon State law, the Consortium for Ocean Leadership entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and OOI activities.
2. All Endurance Array moorings would be permitted as PATONs through the USCG. Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NOTMAR and LNM. Proposed surface buoys would be marked with contact information, which will be forwarded to the USCG for inclusion in the NM and LNM with suggested buffer zones* around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NOTMAR and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
3. Locations for all moorings and associated components of the proposed Endurance Array would be published on NOAA Charts once the moorings are listed on the NOTMAR and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
4. The coordinates for proposed Endurance Array glider tracks would be published through the NOTMAR and LNM. Gliders would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

Source: Table 2-13 from NSF (2011a).
Note: * OOI buffer zones are suggested voluntary areas to avoid.

2.2 GLOBAL SCALE NODES (GSN)

The GSN would support air-sea, water-column, and seafloor sensors operating in remote, scientifically important locations and provide data and near-real time interaction to diverse communities of scientific and educational users. The scientific goals are to provide sustained atmospheric, physical, biogeochemical, ecological, and seafloor observations at high latitudes. These observations are required to understand critical influences on the global ocean-atmosphere system such as air-sea interactions and gas exchange; the global carbon cycle; ocean acidification; and global geodynamics.

Moored buoy, open-ocean observatories are well suited to address these requirements, especially in remote areas where cabled observatories are unavailable or prohibitively expensive to install. Thus, moored buoy observatories are an important complement to other components of the global ocean observing system that include satellite remote sensing, cabled ocean observatories, coastal arrays, gliders and AUVs, and research vessels.

2.2.1 GSN Mooring Array Design and Placement Previously Assessed in the PEA and 2013 SER

The design for the GSN moored arrays proposed for the high-latitude sites was described and assessed in the PEA (NSF 2008) and tiered SERs (NSF 2009a, 2013). The four sites proposed for implementation are:

- Station Papa in the southern Gulf of Alaska – 50° N, 145° W; depth = 4,250 m
- Southern Ocean off Chile – 55° S, 90° W; depth = 4,800 m
- Irminger Sea southeast of Greenland – 60° N, 39° W; depth = 2,800 m
- Argentine Basin – 43° S, 42° W; depth = 5,200 m

These high-latitude arrays consist of an acoustically linked surface discus buoy (except Station Papa), 1 subsurface hybrid profiler mooring, 2 flanking subsurface moorings, and 3 gliders.

Table 5. Summary of Previously Assessed (PEA and 2013 SER) and Proposed Modifications (2015 SER) to GSN Array Infrastructure

Item	*PEA, 2013 SER*	*2015 SER**
Surface Moorings	• Surface buoy anchoring system using 11-mm diameter steel and synthetic mooring line with 5 m of EM molded chain directly below the buoy.	• **Addition of fixed instrumentation to mitigate removal of the upper surface-piercing profiler.**
Subsurface Profiler Moorings	• Subsurface hybrid profiler moorings at Station Papa, Southern Ocean, and Argentine Basin sites would have an upper surface-piercing profiler and two lower profilers to sample within 200-250 m of the seafloor. • The subsurface hybrid profiler mooring at the Irminger Sea site would have an upper surface- piercing profiler and one lower profiler to sample within 200-250 m of the seafloor.	• Global **subsurface profiler moorings (i.e., no longer hybrid)** at Station Papa, Southern Ocean, and Argentine Basin sites would have two lower profilers to sample within 200-250 m of the seafloor. **Removal of upper surface-piercing profiler and addition of oceanographic sensors.** • The **subsurface profiler mooring (i.e., no longer hybrid)** at the Irminger Sea site would have a lower profiler to sample within 200-250 m of the seafloor. **Removal of upper surface- piercing profiler and addition of oceanographic sensors.**
Flanking Moorings	• The two flanking subsurface moorings deployed to form a triangular array with the central site (~20 to ~100 km on a side).	• **Addition of fixed instrumentation to complement the Overturning in the Subpolar North Atlantic Program (OSNAP) Array.**
Gliders	• 3 gliders at each GSN site.	• **5 gliders at each GSN site.**

Note: ***Bolded** entries are proposed modifications to the Global Arrays assessed in this SER.
Sources: NSF 2008, 2009a; Consortium for Ocean Leadership 2015.

2.2.2 GSN Mooring Array Design Assessed in this SER

The GSN array design remains essentially as described in the PEA, 2009 and 2013 SERs, and SSEA (NSF 2008, 2009b, 2011a, 2013). With maturation of the design, minor changes to the GSN design include the removal of the upper surface-penetrating profilers at each GSN site, the addition of instruments or sensors at all sites, and the addition of 2 gliders at each site (Table 5 and Figure 3).

2.2.2.1 Removal of Upper Surface-piercing Profilers

The upper surface-piercing profiler has been removed from the GSN design (Figure 3); this mooring is now referred to as the global subsurface profiling mooring. The upper subsurface float would be moved up to ~150 m depth.

2.2.2.2 Addition of Gliders

To provide profiling observations, 2 additional gilders with sensor suites comparable to the upper surface-piercing profiler (now removed) will be added to the existing 3 gliders at each GSN site. These “profiling gliders” will be designed and operated to sample the upper 200 m of the water column in proximity to the global subsurface profiling mooring. Therefore, there will be up to 5 gliders operating in the array area of each GSN site. This is the same number of gliders originally proposed and assessed in the PEA (NSF 2008).

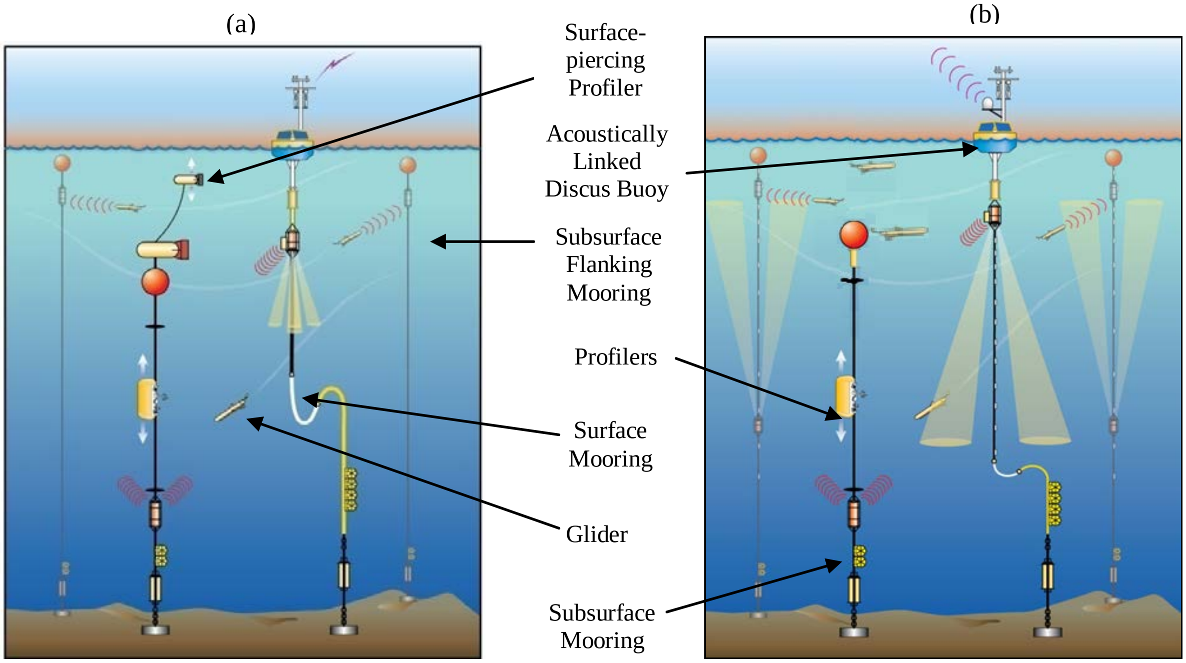


Figure 3. Representation of an Acoustically Linked Discus Buoy and Subsurface Moorings Proposed for Use at the High-Latitude GSN Sites as Assessed in the PEA (a) and this SER (b)

2.2.2.3 Additional Oceanographic Sensors

To replicate some of the sensors that were on the upper surface-piercing profiler that would be removed, additional sensors would be added to the global surface moorings of Irminger Sea, Argentine Basin, and Southern Ocean Arrays. For Station Papa, which does not have a surface mooring, instruments would be added to the subsurface mesoscale flanking moorings, and the subsurface float on those moorings would be moved up to ~20 m depth. The sensors added to the other moorings in the GSN arrays and on the global profiling gliders would be among those already part of the OOI design and previously assessed in the SSEA.

3.0 POTENTIAL IMPACTS WITH IMPLEMENTATION OF PROPOSED MODIFICATIONS

3.1 PIONEER ARRAY

The affected environment would not change under the proposed modifications to the Pioneer Array addressed in this SER. That is, the marine environment for all resource areas is the same as that previously discussed and assessed in the 2011 SSEA and 2013 SER, only changes in the placement or types of infrastructure are proposed. Those proposed changes are the scope of the analysis in this SER.

3.1.1 Installation and O&M Activities

Marine Biological Resources. The potential replacement of the CSPP moorings with wire-following profiler moorings at the Inshore and Central mooring sites would not result in any changes to the potential impacts on marine biological resources previously assessed in the SSEA and 2013 SER. The anchor footprint on the seafloor would be the same for both mooring types and the location of the moorings would not change. Although an AUV dock is proposed for the Central surface mooring, there would still be a maximum of 2 docks deployed on the array, with deployment on 2 out of any of the 3 surface moorings. Therefore, the area of Essential Fish Habitat (EFH) that would be impacted would be the same as previously assessed in the SSEA and 2013 SER, and there would be no adverse impacts to EFH.

The Pioneer Array surface moorings would be upgraded to a methanol-based fuel cell power generation system. A 70% methanol/30% water mixture would be used in the proposed fuel cells. An alcohol, methanol is a clear, odorless, volatile liquid, and mixes completely in water. Based on a review of existing information on the fate and transport of methanol in the environment (American Methanol Institute 1999), it was determined that methanol was unlikely to accumulate in surface water in the event of an accidental spill of a fuel cell. In surface water, the complete solubility of methanol would result in rapid wave-, wind-, and tide-induced dilution to low concentrations. Relative to conventional gasoline and diesel fuel, methanol is significantly less toxic to marine life than oil or gasoline and is considered a safer and more environmentally benign fuel (American Methanol Institute 1999). In addition, as part of the methanol fuel cell, a sealed heat exchanger tube in the fuel cell would contain a 50% ethylene glycol/50% water mixture. It has been found that humans and animals that ingested or inhaled ethylene glycol in concentrated quantities or were subject to long-term exposure exhibited physiological toxicity (U.S. Environmental Protection Agency 2013). However, given the very small quantity of ethylene glycol proposed for use in the fuel cells coupled with rapid wave-, wind-, and tide-induced dilution to low concentrations if a fuel cell were to rupture, the potential impacts to marine biological resources from ethylene glycol are considered discountable.

As the location of the moorings would not change, the potential for entanglement by marine mammals would not change from that previously assessed in the SSEA and 2013 SER. No new species have been listed or proposed for listing under the Endangered Species Act (ESA) that may occur within the Pioneer Array project area. Therefore, with implementation of the proposed Pioneer Array design modifications there would be no additional impacts to marine biological resources above those previously assessed in the 2011 SSEA and 2013 SER.

Water Quality. With implementation of the proposed changes to the Pioneer Array, there would not be any change in impacts to water quality beyond what was assessed in the 2008 PEA and 2011 SSEA. As stated above under Marine Biological Resources, the potential for impacts to the marine environment from the rupture of the proposed methanol-based fuel cells and the leaking of methanol and ethylene glycol into the marine environment is considered discountable. Therefore, there would be no significant impacts to water quality with implementation of the proposed Pioneer Array design modifications.

Geological Resources. The potential replacement of the CSPP moorings with wire-following profiler moorings at the Inshore and Central mooring sites and an AUV dock at the Central mooring site would not result in any changes to the potential impacts on geological resources previously assessed in the SSEA and 2013 SER. The anchor footprint on the seafloor would be the same for both mooring types and the location of the moorings would not change. Impacts due to the deployment of the anchors associated with the wire-following profilers and the AUV dock would be the same as that previously assessed for the CSPP moorings and would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing). The potential replacement of the CSPP moorings with wire-following profiler moorings at the Inshore and Central mooring sites would not result in any changes to the potential impacts on regional socioeconomic resources (fishing) previously assessed in the SSEA and 2013 SER. Discussions with the regional fishing community resulted in the proposed configuration and placement of the Pioneer Array moorings and the location of the moorings would not change. The proposed AUV dock at the Central mooring site would be placed within the 0.5-nm radius of the mooring site, which is the voluntary avoidance area. Therefore, there would be no significant impacts with the implementation of the proposed Pioneer Array design modifications.

Cultural Resources. The potential replacement of the CSPP moorings with wire-following profiler moorings at the Inshore and Central mooring sites would not result in any changes to the potential impacts on cultural resources previously assessed in the SSEA and 2013 SER. The anchor footprint on the seafloor would be the same for both mooring types, the AUV docks, and the location of the moorings would not change. The deployment plan for the Pioneer Array would continue to avoid placing infrastructure directly on any known cultural resources (including shipwrecks and sunken military craft). Therefore, there would be no impacts to cultural resources with implementation of the proposed Pioneer Array design modifications.

3.1.2 AUVs and Gliders

There are no proposed changes in the use or types of AUVs and gliders associated with the Pioneer Array that were previously assessed in SSEA and 2013 SER.

3.1.3 Active Acoustic Sources

There are no proposed changes in the use or types of active acoustic sources associated with the Pioneer Array that were previously assessed in SSEA and 2013 SER.

3.1.4 Summary

Due to the nature and extent of the proposed modifications to the Pioneer Array infrastructure, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable. In addition, the proposed modifications to the Pioneer Array would not change the cumulative effects analysis as presented in the 2011 SSEA since no additional regional cumulative projects have been proposed since the completion of the SSEA and 2013 SER, and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed Pioneer Array design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011b), and additional NEPA documentation is not necessary.

3.2 ENDURANCE ARRAY

The affected environment would not change under the proposed modifications to the Endurance Array addressed in this SER. Therefore, the affected environment for all resource areas is the same as that previously discussed in the 2011 SSEA and 2013 SER.

3.2.1 Installation and O&M Activities

Marine Biological Resources. The installation of a revised CSPP mooring anchor system at the Oregon Inshore Site and Washington Inshore and Shelf sites would impact an estimated 5.8 m^2 of additional EFH above the 58 m^2 previously assessed in the 2013 SER. However, the cabled moorings at the Oregon Shelf Site would be replaced with an uncabled CSPP, thereby impacting less seafloor and therefore less EFH. This mooring would be placed within the site radius of the Oregon Shelf Surface mooring (i.e., within the 0.5-nm radius voluntary area to avoid). In addition, the potential replacement of the Oregon and Washington Inshore CSPP moorings during winter with up to 2 hybrid gliders would eliminate the associated anchor thereby reducing the total area of seafloor impacted by 2.2 m^2 and resulting in impacts to only an estimated 4.4 m^2 of additional EFH. Therefore, this minor change would not result in adverse effects to EFH.

As the location of the moorings would not change, the potential for entanglement by marine mammals would not change from that previously assessed in the SSEA and 2013 SER. No new species have been listed or proposed for listing under the ESA that may occur within the Endurance Array project area. Therefore, with implementation of the proposed Endurance Array design modifications there would be no additional impacts to marine biological resources above those previously assessed in the 2011 SSEA and 2013 SER.

Water Quality. Impacts to water quality based on the changes to the CSPP mooring anchor systems at the Oregon Inshore Site and Washington Inshore and Shelf sites, and the replacement of a cabled CSPP at the Oregon Shelf Site would not increase beyond that assessed in the SSEA and 2013 SER.

Geological Resources. The change in dimensions of the anchor system at the Oregon Inshore Site and Washington Inshore and Shelf sites would impact 5.8 m^2 of bottom sediments above that assessed in the 2013 SER. However, the cabled CSPP mooring at the Oregon Shelf Site (80 m) would be replaced with an uncabled CSPP, thereby impacting less seafloor. In addition, as stated above under *Marine Biological Resources*, the potential replacement of the Oregon and Washington Inshore CSPP moorings during winter with up to 2 hybrid gliders would eliminate the associated anchors thereby reducing the total area of additional seafloor impacted to an estimated 4.4 m^2. Impacts due to the deployment of the revised CSPP mooring anchor system associated with the Oregon Inshore Site and Washington Inshore and Shelf sites, and the uncabled mooring at the Oregon Shelf Site would include short-term disturbance of soft sediments and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Socioeconomics (Fishing). The revision to the CSPP mooring anchor system at the Oregon Inshore Site and Washington Inshore and Shelf Sites, and the uncabled moorings at the Oregon Shelf Site would not result in any changes to the potential impacts on regional socioeconomic resources (fishing) previously assessed in the SSEA and 2013 SER. Discussions with the regional fishing community resulted in the proposed configuration and placement of the Endurance Array moorings and the location of the moorings would not change. Therefore, there would be no significant impacts with the implementation of the proposed Endurance Array design modifications.

Cultural Resources. The revision to the CSPP mooring anchor system at the Oregon Inshore Site and Washington Inshore and Shelf Sites, and uncabled moorings at the Oregon Shelf Site would not result in any changes to the potential impacts on cultural resources previously assessed in the SSEA and 2013 SER. The location of the moorings would not change. The deployment plan for the Endurance Array would continue to avoid placing infrastructure directly on any known cultural resources (including shipwrecks and sunken military craft). Therefore, there would be negligible impacts to archaeological and historic resources with implementation of the proposed Endurance Array design modifications.

3.2.2 Active Acoustic Sources

There are no proposed changes in the use or types of active acoustic sources associated with the Endurance Array that were previously assessed in SSEA and 2013 SER.

3.2.3 Summary

Due to the nature and extent of the proposed modifications to the Endurance Array infrastructure, potential impacts to marine biological resources, water quality, geological resources, socioeconomics (fishing), and cultural resources would be discountable. In addition, the proposed modifications to the Endurance Array would not change the cumulative effects analysis as presented in the 2011 SSEA since no additional regional cumulative projects have been proposed since the completion of the SSEA and 2013 SER, and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed Endurance Array design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011b), and additional NEPA documentation is not necessary.

3.3 GLOBAL-SCALE NODES (GSN)

The affected environment would not change under the proposed modifications to the GSN infrastructure addressed in this SER. Therefore, the affected environment for all resource areas is the same as that previously discussed in the 2008 PEA and 2009 SER.

3.3.1 Installation and O&M Activities

Marine Biological Resources. The change in GSN moorings and addition of gliders would not significantly increase the potential for entanglement or collision, respectively, by marine mammals. No new species have been listed or proposed for listing under the ESA that may occur within the GSN project areas. Therefore, with implementation of the proposed GSN design modifications there would be no additional impacts to marine biological resources above those previously assessed in the 2008 PEA and 2009 SER.

Water Quality and Geological Resources. With implementation of the proposed changes to the GSN moorings, there would not be any change in impacts to water quality and geological resources beyond what was assessed in the 2008 PEA, 2009 and 2013 SERs, and SSEA. Therefore, there would be no significant impacts to water quality and geological resources with implementation of the proposed GSN design modifications.

3.3.2 Active Acoustic Sources

The proposed additional sensors on the moorings in the GSN arrays and on the proposed global profiling gliders would be among those already part of the OOI design and previously assessed in the SSEA. There are no proposed changes in the use or types of active acoustic sources associated with the GSN that were previously assessed in SSEA and 2013 SER.

3.3.3 Summary

Due to the nature and extent of the proposed modifications to the GSN infrastructure, potential impacts to marine biological resources, water quality, and geological resources would be discountable. In addition, the proposed modifications to the GSN would not change the cumulative effects analysis as presented in the SSEA and 2013 SER since no additional regional cumulative projects have been proposed since the completion of the SSEA and the proposed modifications would not result in any cumulative effects not previously assessed. Therefore, there would be no additional impacts on any resource area with implementation of the proposed GSN design modifications, the FONSI for the 2011 SSEA is still warranted (NSF 2011a), and additional NEPA documentation is not necessary.

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5.0 LIST OF PREPARERS

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APPENDIX A:

FINDING OF NO SIGNIFICANT IMPACT (FONSI) – OOI SITE-SPECIFIC EA (JANUARY 2011)

FINDING OF NO SIGNIFICANT IMPACT/DECISION DOCUMENT
SITE-SPECIFIC ENVIRONMENTAL ASSESSMENT
OCEAN OBSERVATORIES INITIATIVE

Pursuant to Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1500-1508) implementing procedural provisions of the National Environmental Policy Act (NEPA) (Public Law 91-190, 42 U.S. Code [USC] 4321 et seq.), the National Science Foundation (NSF) gives notice that an environmental assessment (EA) has been prepared and an environmental impact statement (EIS) is not required for the proposed site-specific installation and operation and maintenance (O&M) of the Ocean Observatories Initiative (OOI) in the Gulf of Alaska; north and south Atlantic Ocean; southeastern Pacific Ocean; and off the coasts of Washington, Oregon, and Massachusetts.

A Site-specific Environmental Assessment (SSEA) was prepared to assess the potential impacts on the human and natural environment associated with proposed site-specific design, installation, and operation of the OOI previously assessed in a Programmatic Environmental Assessment (PEA) and a Supplemental Environmental Report (SER). This SSEA was prepared on behalf of NSF in compliance with NEPA (42 USC 4321 *et seq*.), and the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508), and NSF's NEPA implementing regulations at 45 CFR Part 640. The NEPA process ensures that environmental impacts of proposed major federal actions are considered in the decision-making process.

1.0 PREVIOUS ENVIRONMENTAL COMPLIANCE DOCUMENTATION – PEA AND SER

Because the OOI action would occur over several different locations across the Atlantic and Pacific oceans and would be phased in over time, it was determined that an initial programmatic approach would be the most efficient in terms of overall analysis and, hence, a PEA was prepared in 2008. A programmatic analysis at a conceptual level of detail provided early identification and analysis of potential impacts, methods to mitigate anticipated impacts, and a strategy to address issue areas at a tiered level if necessary.

Preparing the PEA served several purposes. First, it provided a format for a comprehensive impact analysis of the planned OOI activities as a whole. This was accomplished by assembling and analyzing the broadest range of potential direct, indirect, and cumulative impacts associated with all proposed OOI activities in the Region of Influence (ROI). The PEA also set up a framework for addressing the time- and location-specific aspects of the proposed OOI, as well as more detailed technical information (when it becomes available) through site-specific tiered EAs (e.g., this SSEA) or other environmental documentation (e.g., the SER). Tiering of environmental documents in this manner makes subsequent documents of greater use and meaning to the public as the OOI and associated research develops, without duplicating paperwork and analysis from a previous assessment.

The PEA analysis concluded that installation and operation of the proposed OOI as presented in the 2008 Final PEA would not have a significant impact on the environment and a Finding of No Significant Impact (FONSI) was signed on February 4, 2009. The SER was prepared in April 2009 to assess the potential impacts on the environment associated with proposed modifications in the design, installation, and operation of the OOI since the completion of the PEA. The SER analysis concluded that the proposed changes in the design, installation, and operation of the OOI as presented in the 2008 Final PEA would not result in additional impacts to the environment.

2.0 PROPOSED ACTION

To provide the U.S. ocean sciences research community with the basic sensors and infrastructure required to make sustained, long-term, and adaptive measurements in the oceans, the NSF's Ocean Sciences

Division developed the OOI from community-wide, national, and international scientific planning efforts. OOI builds upon recent technological advances, experience with existing ocean observatories, and lessons learned from several successful pilot and test-bed projects. The proposed OOI would be an interactive, globally distributed and integrated network of cutting-edge technological capabilities for ocean observatories.

The OOI infrastructure would include cables, buoys, deployment platforms, moorings, junction boxes, and mobile assets (i.e., autonomous underwater vehicles [AUVs] and gliders). The infrastructure would be powered by solar, wind, fuel cells, and undersea cabled power supplies. This large-scale infrastructure would support sensors located at the sea surface, in the water column, and at or beneath the seafloor.

The OOI design is based upon three main technical elements across global, regional, and coastal scales. At the global and coastal scales, mooring observatories would provide locally generated power to seafloor and platform instruments and sensors and use a satellite link to shore and the Internet. Up to four Global-scale Nodes (GSN) or buoy sites are proposed for ocean sensing in the Eastern Pacific and Atlantic oceans. The Regional-scale Nodes (RSN) off the coast of Washington and Oregon would consist of seafloor observatories with various chemical, physical, biological, and geological sensors linked with submarine cables to shore that provide power and Internet connectivity. Coastal-scale Nodes (CSN) would be represented by the Endurance Array off the coast of Washington and Oregon and the Pioneer Array off the coast of Massachusetts. In addition, there would be an integration of mobile assets such as AUVs and gliders with the GSN, RSN, and CSN observatories. Under the Proposed Action, the CSN, RSN, and GSN would consist of the following elements:

- CSN – the Endurance Array (Newport and Grays Harbor lines) off the coasts of Washington and Oregon and the Pioneer Array in the mid-Atlantic Bight south of Massachusetts;
- RSN – a configuration with 7 Primary Nodes located off the coast of Oregon and 1 shore station at Pacific City, Oregon; and
- GSN – four sites: Station Papa in the southern Gulf of Alaska; Southern Ocean off of Chile in the southeastern Pacific; Irminger Sea southeast of Greenland in the north Atlantic; and Argentine Basin in the south Atlantic..

2.1 COASTAL-SCALE NODES (CSN)

2.1.1 Endurance Array

The Endurance Array would be comprised of two lines of moorings, one located off the coast of central Oregon (Newport Line), and a second at a contrasting site in central Washington (Grays Harbor Line). The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor.

2.1.2 CSN (Pioneer Array)

The Pioneer Array would extend ~40 kilometers (km) across the continental shelf ~ 75 nautical miles (nm) south of Massachusetts. The array would employ surface moorings, subsurface profiler moorings, gliders, and AUVs to sample on multiple horizontal scales from the air-sea interface to the seafloor. In contrast to the Endurance Array, the Pioneer Array would be able to be moved to a new location approximately every 3-5 years to compare and contrast different shelf-break systems. The SSEA only addressed the proposed initial location of the Pioneer Array in the Mid-Atlantic Bight. The removal and installation of the Pioneer Array to a new location would be covered by subsequent environmental documentation.

2.2 REGIONAL-SCALE NODES (RSN)

The proposed RSN would enable oceanic plate-scale studies of water column, seafloor, and sub-seafloor processes using high-powered, high-bandwidth instrument arrays cabled to shore. Seven Primary Nodes were chosen based on their proximity to diverse tectonic features and water column settings. These nodes would be installed in the North East Pacific Ocean off the coast of Oregon at locations spatially coincident with the Juan de Fuca Plate and a suite of mesoscale oceanographic processes that operate in a 300–400-km wide swath that extends from south of Vancouver Island to southern Oregon. Under the Proposed Action, the RSN would be comprised of three components:

1. *Shore Station* – The shore station is the cable-landing site that would house the Power Feed Equipment and Network Termination Equipment for the submarine telecommunications backbone cable. The shore station provides power to the RSN and would provide network gateways between the Primary Nodes and the terrestrial data center. An existing submarine telecommunications shore station at Pacific City, Oregon has been identified for use as the RSN cable landing site.
2. *Wet Plant or Primary Infrastructure* – From the shore stations, main branches of the backbone cable span long distances to the Primary Nodes, which are located in areas of high scientific interest on the Juan de Fuca Plate. The Primary Nodes convert the high voltage from the shore stations to a lower, useable voltage for distribution to the Secondary Infrastructure. The Primary Nodes and backbone cable make up the Primary Infrastructure. The backbone infrastructure of the RSN would initially comprise 903 km of up to four types of standard submarine telecommunications electrical-optical cable; 309 km would be buried and 594 km would be on the surface of the seafloor. Each node would be enclosed in a trawl-resistant frame (TRF), which protects the electronic equipment of each node from fishing activities.
3. *Secondary Infrastructure* – The Primary Nodes distribute low voltage and data at a lower rate to Low-voltage Nodes (LVNs) positioned geographically around the Primary Nodes. The secondary infrastructure would include ~35 km of 25-millimeter (mm) diameter cable. The LVNs and the cables that connect them to the Primary Nodes make up the Secondary Infrastructure. The LVNs are connected to either a Medium-Power Junction Box (MPJbox) or a Low-Power Junction Box (LPJbox). The Jboxes then provide the correct power and data interface to small groups of scientific instruments or sensors. The tertiary infrastructure would include ~13 Jboxes.

2.3 GLOBAL-SCALE NODES (GSN)

The GSN would include moored buoy, open-ocean observatories to support air-sea, water-column, and seafloor sensors operating in remote, scientifically important locations and provide data and near-real time interaction to diverse communities of scientific and educational users. The OOI's design process has identified four strategic high-latitude sites as comprising the initial GSN under the Proposed Action:

1. Station Papa in the southern Gulf of Alaska; depth = 4,250 meters (m)
2. Southern Ocean off Chile; depth = 4,800 m
3. Irminger Sea southeast of Greenland; depth = 2,800 m
4. Argentine Basin; depth = 5,200 m

All stations, with the exception of Station Papa, would all have an acoustically linked surface buoy, 1 subsurface and 2 flanking subsurface moorings, and 3 gliders. Station Papa would have a non-acoustically linked buoy.

2.4 SENSORS

To measure changes and variability in the chemical, biological, and geological processes in the ocean, the proposed OOI would be equipped with a complex suite of sensors. These sensors would be deployed from a number of platforms including water column moorings and on the seafloor. It is important to note that the actual sensors to be deployed as part of the OOI program would be determined based on scientific objectives, costs, and the on-going discussions between engineers and investigators. It is expected that additional sensors would be added as the OOI program proceeds and the scientific objectives change based on researcher needs and priorities. Although these sensors would be largely commercial off-the-shelf sensors, some would require some modification for extended deployment and a small number would require further development to meet the scientific objectives and requirements of the proposed OOI. This would maximize the utility of the proposed OOI to the broader ocean research community. As additional sensors are proposed, they would be examined for potential environmental impacts, either during their installation or operation, and additional environmental documentation would be prepared, if necessary, that would be tiered off of the Programmatic EA.

2.4.1 Active Acoustic Sensors

The active acoustic sources proposed for use in the OOI include:

- Acoustic Doppler Velocimeter (ADV). ADVs are active sensors with an operating frequency of 1-6 megahertz (MHz), a source level of approximately 220 dB reference 1 micropascal at 1 m (re 1μPa @ 1 m), and a pulse length of 600 microseconds (μs). They would be placed on moorings or on the seafloor to investigate turbulence, boundary layers, directional waves, and sediment transport.
- ADCP. An ADCP can calculate the speed of the water current, direction of the current, and the depth in the water column of the current. This instrument can be placed on the seafloor, attached to a buoy or mooring cable, or mounted on an AUV or glider. The ADCP measures water currents with sound, using a principle of sound waves called the Doppler effect and works by transmitting high frequency (approximately 75-1,200 kilohertz [kHz]) very short pings (0.4-25 milliseconds [ms]) of sound into the water. The source level would be approximately 220 dB re 1μPa @ 1 m.
- Bio-acoustic Profilers (BAPs). BAPs monitor the presence and location of zooplankton within the water column by transmitting short (approximately 300 μs) narrow-beam (10°) signals at 38-460 kHz, which measure acoustic backscatter returns. The source level is 213 dB re 1μPa @ 1 m. Other targets detected include fish and suspended sediments. Much like a downward looking fish-finder, this tool measures the vertical distribution of plankton and fish.
- Altimeters. Altimeters would be used to assist AUVs and gliders with determining their altitude above the sea floor. They generally use generally high frequency (170 kHz) sources that emit a narrow (<5°), downward directed beam with a source level of 206 dB re 1μPa @ 1 m.
- Multibeam Echosounder (MBES). During research activities, the ocean floor would be mapped with an MBES. The MBES emits brief pulses of high-frequency (100 kHz) sound in a narrow (1-2°) fan-shaped beam at a source level of 225 dB re 1μPa @ 1 m.
- Acoustic Modems. Acoustic modems would be used for communication between mooring profilers, benthic sensors, gliders, and surface and subsurface buoys. They would operate as a omni-directional 20-30 kHz signal with a pulse duration of 1-2,000 ms.

- Tracking Pingers. These pingers would enable the tracking of AUVs and gliders once they are deployed. These pingers operate at a frequency of 10-30 kHz and emit a very brief (7 ms) pulse at source levels of 180-186 dB re 1μPa @ 1 m.
- Horizontal Electrometer-Pressure-Inverted Echosounder (HPIES). The HPIES is proposed as a core sensor on the RSN located on the seafloor near the full water column moorings. This instrument package combines a bottom pressure sensor, 12-kHz inverted (i.e., upward looking) echosounder, and a horizontal electrometer. Together these sensors allow measurement of bottom pressure, seafloor to sea surface acoustic travel time, and motionally induced electric fields. These properties provide insights into the vertical structure of current fields and water properties including temperature, salinity, and specific volume anomaly, separation of sea surface height variation and temperature, and near-bottom water currents. The echosounder would operate at a source level 172, 177, 182 dB re 1μPa @ 1 m at depths of 547, 1,094, and 1,641 fm (1, 2 and 3 km), respectively. There would be 24 narrow beamed (<5°), 6-ms pings per hour.
- Sub-bottom Profiler (SBP). The SBP is normally operated to provide information about the near-surface features and bottom topography that is simultaneously being mapped by the MBES. It operates at mid-frequencies (2-7 kHz) with a source level of 203 dB re 1μPa @ 1 m.

2.5 INSTALLATION AND OPERATION & MAINTENANCE (O&M)

2.5.1 Schedule for OOI Testing, Installation, and Operation (2010-2014) and O&M

Proposed installation and O&M activities would use standard methods and procedures currently used by the undersea telecommunications industry and oceanographic research institutions. However, methods may change based upon site-specific surveys, ship schedules, and final determination of types of equipment to be installed (e.g., sensor types, models, etc.).

Under the Proposed Action, the installation of the CSN, RSN, and GSN components of the proposed OOI Network would generally occur from spring 2011 through 2014, with all OOI components operational by 2015. However, some components (e.g., portions of RSN, Newport Line, Pioneer Array, and some GSN sites) would be operational before 2015 and associated O&M activities for those components would begin before 2015. Overall, it is expected to take approximately 100-250 days at sea (DAS), depending on the year, and involve 4 classes of vessels to install the various OOI components (Table 2-11). All OOI infrastructure would be maintained from University-National Oceanographic Laboratory System (UNOLS) vessels or vessels of opportunity (VOOs) using deployment and retrieval techniques common in oceanographic research. Average annual O&M operations after the OOI Network is fully commissioned and operational (i.e., beginning in 2015) would take an estimated 286 DAS. Note that the nominal weather window for installation and O&M activities in the Northern Hemisphere is May through October and in the Southern Hemisphere is November through April.

Prior to their installation on the backbone cable off the coast of Oregon, and depending on the device requirements, RSN components could be tested at one of 4 sites: 2 sites in Puget Sound in Shilshole Bay near UW, Seattle; the Monterey Accelerated Research System (MARS) Ocean Observatory, Monterey Bay, California; and the Victoria Experimental Network Under the Sea (VENUS) facility, British Columbia, Canada. For logistical reasons, each test event would involve the testing a group of OOI devices or components. The Puget Sound sites are the preferred test sites as they are directly accessible from UW research facilities. Each test would last less than 24 hours and a maximum of 5 tests would occur each year, starting in the spring of 2011.

2.6 Special Operating Procedures (SOPs) for Installation and O&M of the Proposed OOI

Table 1 lists the SOPs that would be implemented as part of the Proposed Action to avoid and minimize any potential impact to biological resources and commercial fishing activities.

Table 1. SOPs to be Implemented under the Proposed Action

Regional Scale Nodes (RSN)
1. Cable and equipment locations for all RSN components of the proposed OOI would be published on NOAA Charts and through a Notice to Mariners (NM) and Local Notice to Mariners (LNM), and accurate locational information would be made available to fishers to assist their avoidance of the instruments. A contact phone number would be established where fishers can report possible entanglements.
2. The Oregon Fishermen's Cable Committee (OFCC) has been notified regarding the proposed RSN submarine cable route and associated sensors. In accordance with Oregon State law, Ocean Leadership has entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and of submarine cable operations.
3. Site-specific surveys have been completed and discussions with marine users (i.e., fishers) are ongoing to address final positioning of RSN secondary infrastructure as well as associated buffer zones around them.
4. Onshore construction activities would avoid sensitive coastal dune, bluff, and wetland habitats, or scenic locations, and be sited on relatively level ground and to the maximum extent practicable on previously disturbed or developed land.
5. For onshore construction activities, appropriate best management practices (BMPs), based on the Oregon Department of Environmental Quality's (ODEQ's) Erosion and Sediment Control Manual (ODEQ 2005), would be incorporated into a Stormwater Pollution Prevention Plan (SWPPP) and submitted to the ODEQ in partial fulfillment of the CWA Section 301 National Pollutant Discharge Elimination System (NPDES) permit.
6. The shallow water exit points for horizontal directional drilling (HDD) have been sited in sandy bottom areas. Pre-installation cable route surveys have been conducted to identify bottom conditions, plan cable burial accordingly, and to minimize the crossing of rocky and/or geologically unstable areas.
7. The cables would be buried approximately 1.3 m deep where substrate conditions allow, using a combination of plow and/or remotely operated vehicle (ROV). In so far as practicable, cables would be buried to a position about 1 km seaward of the 700-fm Essential Fish Habitat (EFH) boundary. In addition to complying with any permit conditions, it is expected that the cable routes would be inspected at 5-year intervals after the installation to determine whether there are exposed sections of cable that could be snagged by fishing gear, and such areas would be reburied to the extent possible.
8. During initial installation, where it is anticipated that burial cannot be achieved, the cable would be armored and fishers notified of the location of the exposed cable.
9. The cable-laying vessel will monitor boat speed and direction to avoid marine mammals and sea turtles during the cable burial operations. To the extent practicable, the vessel will maintain speed limits of generally less than 2 knots to avoid interactions with marine mammals and sea turtles.
10. NSF will establish a 500-ft (152-m) safety zone along the proposed cable route to avoid marine mammals and sea turtles.
11. To the extent practicable, NSF will schedule cable-laying and installation activities during daylight hours when visibility allows detection of marine mammals and sea turtles within the safety zone.
12. Trained marine mammal observers (MMOs) will monitor for marine mammals and sea turtles during cable-laying activities. Any incidents will immediately be reported to the National Marine Fisheries Service (NMFS), Office of Protected Resources (OPR) by calling 301-713-2289.
13. To the extent practicable, MMOs will have the authority to call for curtailment of operations if any marine mammal or sea turtle enters the safety zone. If a marine mammal or sea turtle is sighted, operations will be delayed until the animal moves out of the area. The operations should not resume or startup until the animal is confirmed to be out of the safety zone or 15 minutes after the last sighting of the animal within the safety zone, whichever is later.

Table 1. SOPs to be Implemented under the Proposed Action

REGIONAL SCALE NODES (RSN) (cont.)
14. The MMOs will record and document the dates, times, locations, species, number, distance from vessel, and behavior of marine mammals and sea turtles sighted during monitoring activities as well as mitigation measures implemented. After completion of submarine cable installation and at subsequent submarine cable inspection/maintenance activities, these records will be combined into a summary report to be sent to the Director, NMFS OPR, 1315 East-West Highway, Silver Spring, MD 20910.
15. The RSN cable route has been submitted to the U.S. Navy.
16. Owners of all existing systems crossed by the RSN backbone cable would be contacted to coordinate crossings, if necessary. To the extent possible, all crossings would meet the recommendations of the International Cable Protection Committee (ICPC).
17. As much as possible, cables will be laid perpendicular, rather than parallel to, steep offshore slopes. Perpendicular placement is more stable and reduces the risks of damage from underwater landslides or differential slippage of cable sections down side slopes.
18. For HDD operations, an HDD Monitoring and Spill Contingency Plan would be prepared and submitted to the U.S. Army Corps of Engineers (USACE) and ODEQ as appropriate. The plan would include, but not necessarily be limited to the following: • description of surficial and bedrock geological conditions and the proposed bore profile at each HDD location; • use a forward-reaming drilling method, as planned, for the HDD; this method would result in much smaller volumes of drilling mud and drill cutting discharges than an alternative back-reaming method;. • Flush the drilling mud and cuttings from the borehole, when technically feasible, prior to the final drill out during a forward-reaming process • assessment of the likelihood of a "frac-out" involving the release of drilling fluids from the bore hole into the overlying ocean waters; • procedures to monitor drilling fluid returns, regulate drilling pressure, and add lost circulation materials as necessary to plug fractures along the bore path and minimize the possibility of a frac-out; • to minimize the release of drilling mud when the drill punches through on the seabed, operators would switch from drilling mud to water only to lubricate the bore during the last stage of the operation before the drill reaches its exit point; • procedures for monitoring the bore path between the bore entry and the planned exit point to detect a release of drilling mud; • construct a drilling mud and cuttings containment area at the HDD drill base to receive and temporarily contain the discharged materials where they could be recovered and disposed of; • a Contingency Plan for the containment and cleanup of a discharge of drilling mud onto the shore or seabed; and • reporting procedures to document the implementation of the plan and its effectiveness.

Table 1. SOPs to be Implemented under the Proposed Action

COASTAL SCALE NODES (CSN) – ENDURANCE ARRAY
1. The OFCC has been notified regarding the proposed cabled moorings and sensors of the Newport Line. In accordance with Oregon State law, Ocean Leadership entered into a formal agreement with OFCC to minimize risks to, interference with, and/or interruption of commercial trawler activities and OOI activities.
2. All Endurance Array moorings would be permitted as Private Aids to Navigation (PATONs) through the U.S. Coast Guard (USCG). Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NM and LNM. Proposed surface buoys would be marked with contact information, which will be forwarded to the USCG for inclusion in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NM and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
3. Locations for all moorings and associated components of the proposed Endurance Array would be published on NOAA Charts once the moorings are listed on the NM and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
4. The coordinates for proposed Endurance Array glider tracks would be published on NOAA Charts and through the NM and LNM. Gliders would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.
COASTAL SCALE NODES (CSN) – PIONEER ARRAY
1. All Pioneer Array moorings would be permitted as PATONs through the USCG. Surface buoys would be marked per USCG requirements, with all required lights and markings, with locations appearing in the NM and LNM. Proposed surface buoys would be marked with contact information, which will be included in the NM and LNM with suggested buffer zones around moorings. Should any vessel accidentally snag OOI moorings or equipment, they are to contact that number and/or the USCG. As OOI moorings will be considered PATONs, they are protected by USCG rules and regulations pertaining to Aids to Navigation (33 CFR 66 and 33 CFR 70). Penalties for interference, collision, and vandalism can be levied by the USCG in accordance with 33 CFR 70. So long as surface buoys are marked per regional USCG requirements, all lights and markings are operating correctly, and the infrastructure is on the marked location (i.e., as described in NM and LNM), the OOI project is not liable for snagging of or damage to any gear or vessel.
2. Locations for all moorings and associated components of the proposed Pioneer Array would be published on NOAA charts once moorings are listed in the USCG NM and LNM. In addition, accurate locational information would be made available to fishers to assist their avoidance of the instruments.
3. The coordinates for proposed Pioneer Array AUV and glider mission boxes would be published on NOAA Charts and through a NM. Gliders and AUVs would be marked with the name of the owning organization and a contact phone number that fishers can call to report potential entanglements.

3.0 PURPOSE AND NEED

The OOI would build a network of sensors that would collect ocean and seafloor data at high sampling rates over years to decades. These sensors would be linked to shore using the latest communications technologies, enabling scientists to reconfigure them from their laboratories and use the incoming data in near-real time in their models. Scientists and educators from around the country, from large and small institutions, and from fields other than ocean science, would be able to take advantage of OOI's open data policy and emerging cyberinfrastructure capabilities in distributed processing, visualization, and integrative modeling. Researchers would make simultaneous, interdisciplinary measurements to investigate a spectrum of phenomena including episodic, short-lived events (tectonic, volcanic, biological, severe storm-related), to more subtle, longer-term changes or emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, ecosystem trends). Through a unifying cyberinfrastructure, researchers would control sampling strategies of experiments deployed on one part of the infrastructure in response to remote detection of events by other parts of the infrastructure. The long-term introduction of ample power and bandwidth to remote parts of the ocean by the OOI would provide the ocean science community with unprecedented access to detailed data on multiple spatial scales, studying the coastal-, regional-, and global-scale ocean, and using mobile assets (AUVs, gliders, and vertical profilers) to complement fixed-point sensors. The discoveries, insights, and the proven new technologies of the OOI effort would continuously transfer to more operationally oriented ocean-sensing systems operated by other agencies and countries. Increased ocean coverage, the growth of technical capability, development of new and more precise predictive models, and increasing public understanding of the ocean would all be tangible measures of the OOI's contribution to transforming ocean science. In this manner, OOI would play a key role in keeping the U.S. science effort at the cutting edge of ocean knowledge.

4.0 ALTERNATIVES CONSIDERED

Numerous alternative configurations were considered for the CSN, RSN, and GSN components of the proposed OOI. As a result of extensive technical and NSF review of numerous planning and technical supporting documents, no other action alternatives to the Proposed Action emerged that would satisfy the identified purpose and need and scientific objectives and siting criteria. Consequently, only the Proposed Action and the No-Action Alternative are carried forward for analysis in the SSEA.

5.0 SUMMARY OF ENVIRONMENTAL EFFECTS

5.1 CSN (ENDURANCE ARRAY) AND RSN

5.1.1 Air Quality

The Proposed Action is located within the jurisdiction of Grays Harbor County, Washington; and Clatsop, Tillamook, and Lincoln counties, Oregon. All affected counties are in attainment of the National Ambient Air Quality Standards as well as state and regional air quality standards. Therefore, a Clean Air Act conformity determination is not required. The Proposed Action would result in minor temporary emissions from surface vessels during installation and O&M activities of the RSN and CSN. However, these vessel emissions would not represent a substantial increase above existing conditions, as only a small number would be used and for only a few weeks per year. The Proposed Action would not compromise air quality attainment status in Washington and Oregon or conflict with attainment and maintenance goals established in their State Implementation Plans. Therefore, the Proposed Action would have a negligible impact on air quality.

5.1.2 Terrestrial Biological Resources

The only terrestrial area proposed for use under the Proposed Action would be an existing shore station and beach manhole (BMH) that would be used for the landing of the RSN submarine or backbone cable at Pacific City, Oregon. Proposed HDD activities would occur in the vicinity of an existing BMH within a previously disturbed residential area with no sensitive vegetation or habitat. No sensitive terrestrial biological resources are expected to occur at or in the vicinity of the proposed HDD and BMH site. Therefore, there would be no impacts to terrestrial biological resources with implementation of the Proposed Action. The U.S. Fish and Wildlife Service (USFWS) concurs that there would be no effect to terrestrial Endangered Species Act (ESA)-listed species under their jurisdiction. The CSN does not have a terrestrial component and therefore there would be no significant impacts to terrestrial biological resources from implementation of the Grays Harbor and Newport lines of the Endurance Array.

5.1.3 Transportation

Generally only two to three vessels would be used during installation and O&M activities associated with the proposed OOI, and then only for a few weeks per year. Projected increases in vessel traffic due to implementation of the Proposed Action would constitute a negligible portion of the total existing vessel traffic in the ROI. In addition, proposed activities associated with the installation and annual O&M of the proposed OOI would not restrict or change existing vessel traffic patterns within the ROI. All mooring buoys of the Endurance Array would be marked in accordance with U.S. Coast Guard (USCG) requirements and locations of all buoys would be published in the NM, LNM, and on NOAA charts. Therefore, there would be no significant impacts to transportation within the ROI with implementation of the Proposed Action.

5.1.4 Land Use

Proposed terrestrial activities associated with the proposed cable landing Pacific City, Oregon would be sited in accordance with established land use guidelines addressing safety, functionality, and environmental protection zones where appropriate. The proposed shore station is an existing facility and no additional construction is required. With implementation of SOPs during RSN HDD activities, there would be no significant impacts to terrestrial resources. In addition, no changes to existing land use would occur with implementation of the Proposed Action.

5.1.5 Marine Biological Resources

Under the Proposed Action, there would be no significant change in the proposed CSN and RSN installation and O&M activities that were previously assessed in the PEA and SER. The installation of 1 less primary/secondary node, 510 km less of backbone cable (including the burying of 166 km less of backbone cable), 15 fewer LVNs, 7 fewer low-power junction boxes, and 8 fewer medium-power junction boxes, and associated less installation and O&M activities, would result in less potential impact to all marine species than that assessed in the PEA and SER.

The vessels and activity associated with installation of RSN cable, surface and subsurface moorings, and associated scientific sensors on the sea floor may cause marine species to temporarily avoid the immediate vicinity of the proposed CSN (Endurance Array) and RSN, but this impact would not be significant due to the small scale and temporary nature of the proposed activities. The vessel used for cable and mooring deployment would move very slowly during the activity and would not pose a collision threat to marine mammals, including ESA-listed species.

There are no documented incidents of marine mammal entanglement in a submarine cable during the past 50 years. The cables would be taut against the seafloor, without loose slack. Entanglement of marine species is not likely because the submarine cable would be buried in water depths less than 1,500 m. For water depths greater than 1,300 m, where the cable is not buried, the rigidity of the cable would cause the cable to lie extended on the sea floor and not coil thereby eliminating the potential for entanglement. Entanglement of marine species within mooring cables in the water column is considered highly unlikely because of the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. Once installed on the seabed, the proposed mooring anchors and scientific sensors would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on marine organisms.

Electromagnetic fields (EMF) are produced when electricity is transmitted through cables buried in the seafloor. The concern with EMF is the sensitivity of particular groups of the marine animals to EMF, especially the potential responses (e.g., attraction, repulsion, disorientation, or other behaviors) of fish (particularly elasmobranchs [i.e., sharks, skates, and rays]), sea turtles, and marine mammals, and the effectiveness of mitigation, primarily through burying or shielding of the cable. It is expected that due to the relatively low voltage transmitted, the smaller cable size, and the armoring and burying of the OOI cables, that potential impacts from EMF on fish, sea turtles, or marine mammals, including ESA-listed species would not be significant.

The use of up to 6 gliders within a survey area of ~16,000 nm^2 around the Endurance Array is not expected to affect marine species, as the proposed gliders would move within the water column similar to a dolphin or whale. Gliders are sealed, contain no motors, fuels, or hazardous materials; and move at very slow speeds (~0.5 knot), thereby eliminating the potential for collisions with marine fauna.

The proposed active acoustic sources associated with the Endurance Array and RSN would generally operate at frequencies much higher than those frequencies considered audible by fish and marine mammals. The ADV, BAP, and the ADCP would all operate at frequencies greater than 180 kHz, with most operating at frequencies greater than 200 kHz. For the HPIES, MBES, SBP, altimeters, acoustic modems, and tracking pingers operating at frequencies between 2 and 170 kHz, fish and marine mammals would not be disturbed by any of these proposed acoustic sources given their low duty cycles, the brief period when an individual animal would potentially be within the very narrow beam of the source, and the relatively low source levels of the HPIES, pingers, and acoustic modems. Therefore, implementation of the proposed deployment of the Endurance Array and RSN is not expected to result in significant acoustic impacts to fish and marine mammals, including ESA-listed species. NMFS concurs that there would be no adverse effects to ESA-listed species and marine mammals under their jurisdiction. No additional active acoustic sources are proposed and the analysis of potential effects of acoustic sources on marine fauna as provided in the PEA is still applicable to the current Proposed Action.

The Marine Mammal Protection Act (MMPA) Letter of Concurrence (LOC) issued by NMFS for the PEA is still applicable for the activities as proposed in this SSEA; therefore, there would be no significant impacts to marine mammals with implementation of the Proposed Action. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed revisions to the installation and O&M of the OOI are not likely to adversely affect ESA-listed species. All conservation measures or other protective measures requested by NMFS in their LOCs have been included in the SOPs for implementation of the proposed CSN (Endurance Array) and RSN components of the OOI network.

Under the provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), federal agencies must consult with NMFS prior to undertaking any actions that may adversely affect Essential Fish Habitat (EFH). Federal agencies retain the discretion to determine what actions fall within the definition of "adverse affect." Temporary or minimal impacts, as defined by NMFS regulations and below, are not considered to "adversely affect" EFH (50 CFR Part 600). "Temporary impacts" are those that are limited in duration and that allow the particular environment to recover without measurable impact. "Minimal impacts" are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions.

In considering the potential impacts of a proposed action on EFH, all designated EFH must be considered. Impacts on EFH would entail temporary mechanical disturbance of the substrate, and long-term coverage of relatively small areas of substrate by RSN cable, TRFs, mooring anchors, LVNs, junction boxes, and cabled scientific sensors. Implementation of the Proposed Action would impact an estimated 63 ha of EFH, or 36 ha less than the 99 ha previously assessed in the SER. The PEA and SER analysis concluded that implementation of the proposed actions identified in those documents would not result in adverse effects to EFH, therefore, there would not be adverse effects to EFH with implementation of the current Proposed Action.

Testing of RSN Infrastructure. The potential use of the Shilshole Bay test sites would occur no more than 5 times over a 1-year period, with each test lasting less than 24 hours and potential bottom disturbance of less than 0.8 m^2 would result in short-term, negligible impacts to marine biological resources, including ESA-listed species. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed testing of RSN infrastructure in Shilshole Bay is not likely to adversely affect currently listed threatened and endangered species or currently designated critical habitat.

5.1.6 Geological Resources

Under the Proposed Action, potential impacts to geological resources from the proposed (CSN) Endurance Array (Grays Harbor and Newport lines) would only be associated with the placement of 12, 2 m^2 mooring anchors and associated sensors on the seafloor. Impacts would include temporary mechanical disturbance of soft sediments, and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. These impacts on soft-bottom substrates are considered minor and would result in short-term insignificant impacts to geological resources.

Impacts to onshore geological resources from the installation of the RSN cable would include temporary soil disturbance by grading, excavation, and equipment operations to support HDD activities at Pacific City, Oregon. At each site, it is anticipated that HDD activities would temporarily disturb approximately 0.2 ha in close proximity to existing beach manholes for existing cables. The onshore drilling sites would be configured to avoid impacting sensitive coastal habitats that would be especially vulnerable to erosion. In accordance with CWA NPDES requirements, the OOI would obtain coverage under the State of Oregon's general permit for construction stormwater discharges. This would include the preparation and implementation of a SWPPP with BMPs to minimize erosion and sediment transport from construction sites, and to restore disturbed areas to a stable condition after construction. As a result, no significant impacts to onshore geologic resources would occur.

Impacts on offshore geology would entail temporary mechanical disturbance of the substrate, and long-term coverage of relatively small areas of substrate by TRFs, mooring anchors, LVNs, Jboxes, and cabled scientific sensors. As described previously, the substrate in the affected area offshore consists of sand, sand and mud, and mud. The cables, anchors, and instruments themselves would constitute ~3 ha of new hard substrate. Soft sediments would be excavated and dispersed a short distance around the bore exits, sites where equipment would be placed, and cable burial corridors. Use of the sea plow and/or ROV to install the cables would impact an approximately 2-m wide swath of substrate during installation, and a total area of 60 ha. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. If necessary, the placement of cables on rock substrate would cause minor physical abrasion (grooving) of the substrate. Repair activities and/or future removal of the proposed cable, moorings, and associated infrastructure would have impacts on seafloor geology similar to those of installation at the affected locations. These impacts on soft- and hard-bottom substrates are considered minor and not significant.

5.1.7 Water Quality

The onshore portion of the Proposed Action would not affect water quality. Project activities are expected to occur on level sites without surface water features or direct drainage to the ocean. A project-specific

SWPPP incorporating BMPs for erosion and sedimentation control would be prepared and implemented to prevent the discharge of sediment or pollutants or runoff from the sites.

The offshore cables consist of metallic and synthetic, essentially inert materials (glass fibers, plastic (polyethylene), copper, steel, waterproof nylon yarn). Based on observations of previously installed underwater cables, the cables would soon be covered with marine growth or buried by sand, and would not break down for a very long period of time. The available information, although limited, suggests that cable constituents (such as copper and zinc) are not normally leached into surrounding waters unless the cable is damaged, and that in any case, the amounts are small and unlikely to affect the organisms that grow on the cables. Ultimately, as cable components disintegrate, decompose, or corrode, the constituent elements would be dispersed into surrounding media, with no significant effect on sediment or water quality.

The HDD process would not directly or cumulatively introduce toxic or hazardous substances or chemicals, organic substances, or solid wastes into bodies of water or on land to cause the level of these substances to exceed regulatory standards. The bentonite clay used in the drilling process is a non-toxic, non-hazardous clay. It is possible that drilling mud could escape from the bore into the surrounding geologic formation. However, any material migrating to the surface would be rapidly dispersed by wave and current action and would not be expected to persist or accumulate in appreciable amounts. During the final stage of drilling, bentonite addition to the drilling fluid would be discontinued, and only water would be used, thus minimizing the release of the clay sediment when the bore exits the seabed. The drilling contractor would follow procedures established in a project-specific Drill Monitoring and Cleanup Plan to minimize the possibility of a release of drilling mud into the ocean, and to remove any accumulation of drilling mud on the seafloor.

The only hazardous substances that would be used in the proposed project are lubricants and fuel contained in marine vessels and equipment. Vessels would adhere to federal, state, and Implementing Organization (IO) requirements for the management of hazardous materials and hazardous waste. Vessels engaged in installation would adhere to all USCG requirements regarding the containment, cleanup, and reporting of spills, which would assure that the effects are minimized. Therefore, there would be no significant impacts to marine water quality with implementation of the Proposed Action.

Small-scale increases in turbidity would occur due to installation of the cables and instruments on the seafloor. Turbidity would be minor and temporary throughout the installation activities. Sediments would rapidly disperse and/or settle back to the seabed. Coarse sediments (sand or larger) would resettle within seconds in the immediate area, whereas fines (silt to clay) would tend to drift and remain in suspension for minutes to hours, depending on particle sizes and bottom currents. There would be no permanent or significant effect on marine water quality due to suspended sediments. The outer layers of submarine cables are insoluble and readily become encrusted with marine organisms and are not expected to break down for decades. Inner metallic components are sealed from the surrounding media. Any by-products of corrosion or dissolution of cable components in seawater would be rapidly dispersed and diluted in the water column and as such would have no significant effect on water quality.

Regular O&M operations would have impacts on marine water quality similar to those of installation at the affected locations.

Shilshole Bay Test Sites. Testing of the RSN infrastructure would occur no more than 5 times over a 1-year period, with each test lasting 24 hours or less. Depending on the test, some equipment may be placed on the seabed, including for instance the Secondary Nodes and or four 1,100 pound weights allowing the vertical mooring to remain stable. Deployment and retrieval of each device would create temporary resuspension of sediments and turbidity. However, turbidity or sediment suspension would not persist as the effects would be reversed by natural dispersive processes in the area within minutes of the equipment deployment or its removal. The temporary increase in suspended sediment concentrations and turbidity levels are expected to cause negligible effects to the surrounding water quality.

5.1.8 Cultural Resources

NSF has been conducting Government-to-Government consultations with Washington State Native American Indian Tribes and Nations since April 2010. The purpose of the consultations has been to present the Proposed Action and this site-specific phase. They also have served to initiate consultations under Section 106 of the NHPA and to inform the Native American Indian Tribes and Nations that compliance with Section 106 of the NHPA would be through the NEPA process. The Hoh Tribe, Makah Nation, Quileute Nation and Quinault Nation (listed in alphabetical order) were sent a letter discussing the proposed project. The letters were followed up with email correspondence and telephone calls. NSF also offered an opportunity to hold an in-person Government-to-Government consultation with each Tribe and Nation.

The Hoh Tribe's primary concern is access to data and data sharing and they requested written assurances that the data generated by this project be made available to Tribal Fisheries Managers. The Makah Nation responded to a telephone request indicating that further consultation was not needed. The Quileute Nation responded and indicated that they were reviewing the materials provided, including the Draft SSEA.

In addition, the USACE has also conducted government-to-government consultations with the Confederated Tribes of Grande Ronde and Confederated Tribes of Siletz Indians in Oregon as part of RSN's NWP process. Other tribes were consulted by the Oregon Department of State Lands as part of the removal fill permit process associated with the proposed RSN HDD activities. No Oregon tribes have responded with any comments or concerns (see Appendix F).

Under the Proposed Action, it is anticipated that there would be no impacts to archeological, historic, or cultural resources along the Endurance Array and RSN infrastructure. Site-specific surveys have been conducted to determine if any undiscovered resources are within the immediate vicinity of the proposed RSN cable and Endurance Array moorings. Based on these surveys, neither archeological resources, nor historic resources (e.g., historic shipwrecks, aircraft wrecks) are within the vicinity of the proposed RSN infrastructure and Endurance Array moorings. Therefore, there would be negligible impacts to archaeological and historic resources with implementation of the CSN (Endurance Array) and RSN components of the Proposed Action.

In the spring of 2010, communications were initiated between representatives of NSF and the potentially affected Washington State Tribes and Nations to discuss whether any cultural, archeological, or historic resources are present in the vicinity of the Grays Harbor Line of the Endurance Array. NSF representatives met with the Quinault Nation ("Nation") on July 7, 2010 to engage in a government-to-government consultation to address potential impacts to such resources. While the Nation has indicated that installation of the Grays Harbor Line within the area discussed in the SSEA is not likely to impact any cultural, archeological, or historic resources, the Nation and NSF have acknowledged that components of the Grays Harbor Line may, through the micro-siting process, ultimately be located within the Nation's U&A fishing areas, which were reserved by the Nation in the 1855 Treaty of Olympia. As such, NSF and the Nation are in the final stages of negotiating a Memorandum of Agreement to address such issues as the Nation's role in the micro-siting process; data sharing; opportunities for the Nation to submit proposals for services related to deployment, operations and maintenance of the Grays Harbor Line moorings and glider fleet; and efforts by NSF to develop and carry out educational experiences for the Nation's members. Therefore, implementation of the Proposed Action would result in negligible adverse effects to cultural resources. Because there are no known cultural resources within the vicinity of the RSN cable, there would be no impacts to cultural resources with installation and O&M of the RSN cable.

5.1.9 Socioeconomics (Fisheries)

The proposed installation and O&M activities of the CSN (Endurance Array) and RSN would have 2 potential impacts to commercial fisheries operations in the ROI: 1) presence of the cable installation vessel would preclude fishing activities within a limited area (approximately 1.6 km) for a temporary period (a few hours to several days), and 2) commercial fisheries that use equipment that contacts the bottom could potentially snag unburied portions of the cable or scientific sensors, causing damage to or loss of their fishing gear, or damage to the cable or scientific sensors on the seafloor.

Notice would be given to fishing vessels regarding the proposed CSN and RSN installation operations to reduce the potential for damage to fishing gear. No exclusions are proposed along the cable route, so interference would not occur between the cable installation vessel and commercial fisheries. Potential interference with commercial fishing activities could occur during cable and mooring installation operations, but these would be temporary and localized. As the cable vessel and installation operations progress, fishing activities would not be precluded along the entire proposed cable route or Endurance Array lines. Only small areas would not be available for fishing while the cable plow and cable-laying vessel are in a specific area.

The potential site-specific placement, or '*micro-siting*', of moorings within the identified study area for the Grays Harbor Line moorings and the Inshore Newport Line mooring is being coordinated with members of the public, including representatives of marine users and tribal nations. These include but are not limited to: Quinault Indian Nation, Coalition of Coastal Fisheries, Washington Dungeness Crab Fishermen's Association, Grays Harbor Marine Resources Committee, Oregon Dungeness Crab Commission, Oregon Trawl Commission, Oregon Albacore Commission, Oregon Salmon Commission, Midwater Trawlers Co-Op, FACT, Columbia River Crab Fishermen's Association, OFCC, FINE, Purse Seine Vessel Owners Association, Fishing Vessel Owners Association, and Pacific City Dorymen's Association. Coordinating with the public, including local marine users, regarding the micro-siting of each mooring will assist in addressing conflicts with regional fishing interests as well as ensuring that the mooring locations meet the scientific objectives of the CSN. Two micro-siting meetings were hosted by NSF and held in November 2010 (one in Westport, Washington and one in Newport, Oregon) to allow the public, including the fishing community, to provide input regarding potential impacts to access to fishing areas and the proposed buffer zones associated with the uncabled Endurance Array mooring sites. The meetings were well attended by the local fishing community. The public meetings allowed in-depth discussion between interested members of the public and OOI scientists to identify potential alternative siting locations for the proposed moorings based on bathymetry, known high-value fishing areas, and scientific objectives. The micro-siting process will continue through additional public meetings, if necessary, e-mail, and/or teleconferences.

Discussions have also been initiated regarding the establishment of buffer zones or 'watch circles' around OOI seabed sensors and moorings. Buffer zones would identify voluntary areas to be avoided by fishermen and other users to minimize the potential for gear entanglement or damage to OOI infrastructure. The buffer zones would be established in consultation with the USCG and the affected fishing communities. The size of these buffer zones would relate to water depths (larger buffer zones in deeper water). Currently, an approximate 0.2-nm radius buffer zone is under discussion for the two

Inshore Endurance Array sites off the coast of Washington and Oregon, and an approximate 0.5-nm radius buffer zone is under discussion for the Shelf and Offshore sites off the coast of Washington. The sites and associated buffer zones would be clearly charted on the electronic NOAA navigation charts, published in an NM and LNM, and through direct contact with user communities. There would be active radar transponders on surface buoys as well as required USCG markings; other markings are under consideration. Discussions are ongoing with members of the public, including the fishing community, regarding the proposed size and location of the proposed buffer zones and will continue as necessary to address further concerns. With the implementation of these on-going discussions with the fishing community to address potential impacts to area fisheries, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

In accordance with Oregon State law, Ocean Leadership and OFCC have entered into a formal agreement that would address concerns of the fishing industry regarding installation and operation of the RSN cable and potential impacts on fishing revenues from potential loss of gear associated with the installation and operation of the proposed RSN infrastructure off the coast of Oregon. Such agreements have been incorporated into the considerations and approvals of previous commercial fiber optic cable projects in Oregon coastal waters. They have provided a model for the preliminary discussions. With the implementation of the SOPs and the incorporation of an agreement between the OFCC and Ocean Leadership, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

5.2 MID-ATLANTIC BIGHT CSN (PIONEER ARRAY)

5.2.1 Geological Resources

Under the Proposed Action, potential impacts to geological resources from the proposed Pioneer Array would only be associated with the placement of 10 mooring anchors and associated sensors on the seafloor ~75 nm from shore. The placement of these anchors and sensors would result in short-term insignificant impacts to surface sediments in the immediate vicinity of the proposed Pioneer Array assets, and there would be no significant impacts to marine geological resources.

5.2.2 Air Quality

The Proposed Action is not located within the jurisdiction of any state and is also outside U.S. Territory. There are no emissions standards for vessels or activities operating beyond 12 nm of shore. Proposed activities would result in minor temporary emissions from surface vessels or surface buoys during installation and O&M activities of the Pioneer Array. However, these emissions would not represent a substantial increase above existing conditions as only a small number of vessels and surface buoys would be used. The proposed installation and O&M activities associated with the Pioneer Array would take place more than 75 nm from the shoreline of any state and therefore would not compromise air quality attainment status in New York, Rhode Island, Connecticut, and Massachusetts. Therefore, the Proposed Action would have a negligible impact on air quality within the ROI.

5.2.3 Water Quality

Proposed installation and O&M activities at the proposed Pioneer Array would not introduce any materials or substances into the marine environment that would adversely affect marine water quality. The only potential sources of hazardous materials would be unanticipated accidents or spills that resulted in a discharge of fuel, lubricants, or sensor components (e.g., batteries) from a project vessel or associated OOI equipment and sensors. Based on existing IO requirements and procedures for management of such materials on board vessels and the design of scientific equipment and sensors, such events are extremely unlikely to occur. If such a spill were to occur, it would be a localized occurrence, and adherence to standard containment, cleanup, and reporting requirements would assure that the effects are minimized. In addition, residual material would be dispersed by natural processes.

The project would not alter currents or circulation regimes. A minor and localized area for which the anchors, scientific sensors, and connecting cables would be placed would likely have some re-suspension of sediment, but these effects would be temporary. Therefore, there would be no impacts to water quality with implementation of the Pioneer Array component of the proposed OOI.

5.2.4 Cultural Resources

Under the Proposed Action, potential impacts to cultural resources from the proposed Pioneer Array would only be associated with the placement of 10 mooring anchors and associated sensors on the seafloor beyond 75 nm of shore. Prior to deployment of the proposed moorings and anchors, a site survey would be conducted within an approximate 1-km radius of each proposed anchor site to determine if any known or unknown cultural resources (e.g., shipwrecks) are within the vicinity. All obstructions and/or cultural resources would be avoided based on these surveys and after consulting the Automated Wreck and Obstruction Information System (AWOIS). Therefore, the placement of the proposed Pioneer Array would not result in significant impacts to cultural resources.

5.2.4 Marine Biological Resources

The vessels and activity associated with installation of 10 surface and subsurface moorings and associated scientific sensors on the sea floor may cause marine species to temporarily avoid the immediate vicinity of the proposed Pioneer Array, but this impact would not be significant due to the small scale and temporary nature of the proposed activities (estimated time to deploy a mooring with one vessel is 12-24 hours). The vessel used for mooring deployment would move very slowly (1-2 knots) during the activity and would not pose a collision threat to marine mammals. Entanglement of marine species is not likely because the rigidity of the mooring cables and the ability of marine species to detect and avoid the mooring lines. Once installed on the seabed, the proposed mooring anchors and scientific sensors would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on marine organisms.

Impacts from the placement of proposed mooring anchors or nodes, and cabled scientific sensors on the seafloor would include temporary mechanical disturbance of soft sediments, and long-term coverage of relatively small areas of substrate by the anchors and scientific sensors. Based on the expected size and number of anchors and scientific sensors on the seafloor, ~30 m^2 of EFH would potentially be impacted during installation activities. Over time, the natural movement of sediments by ocean currents and burrowing organisms would reestablish natural bottom topography. The short-term and minor increases in turbidity and sedimentation would not affect the ability of EFH to support healthy fish populations and affected areas are expected to recover quickly. Therefore, the implementation of the proposed Pioneer Array would not have an adverse effect on EFH in the area.

The use of up to 6 gliders and 3 AUVs within a survey area around the Pioneer Array is not expected to affect marine species as the proposed gliders and AUVs would move within the water column similar to a dolphin or whale. Gliders are sealed, contain no motors, fuels, or hazardous materials; and move at very slow speeds (~0.5 knot), thereby eliminating the potential for collisions with marine mammals. AUVs also move at low speeds (~3.5 knots) with little potential for collisions with marine species. AUV batteries are sealed with little potential for leakage. Therefore, the use of gliders and AUVs associated with the proposed Pioneer Array would not have an adverse effect on marine species, including ESA-listed species, in the ROI.

The proposed active acoustic sources associated with the Pioneer Array would generally operate at frequencies much higher than those frequencies considered audible by fish and marine mammals. The ADV, BAP, and the ADCP would all operate at frequencies greater than 180 kHz, with most operating at frequencies greater than 200 kHz. For the HPIES, MBES, SBP, altimeters, acoustic modems, and tracking pingers operating at frequencies between 2 and 170 kHz, fish and marine mammals would not be disturbed by any of these proposed acoustic sources given their low duty cycles, the brief period when an individual animal would potentially be within the very narrow beam of the source, and the relatively low source levels of the HPIES, pingers, and acoustic modems. Therefore, implementation of the proposed deployment of the Pioneer Array is not expected to result in significant acoustic impacts to fish and marine mammals, including ESA-listed species.

The MMPA LOC issued by NMFS for the PEA is still applicable for the activities as proposed in this SSEA. Therefore, there would be no significant impacts to marine mammals with implementation of the Proposed Action. In their 2011 LOC regarding potential effects to ESA-listed species, NMFS concurred with NSF's determination that the proposed revisions to the installation and O&M of the OOI are not likely to adversely affect ESA-listed species. All conservation measures or other protective measures requested by NMFS in their Letters of Concurrence have been included in the SOPs for implementation of the proposed CSN (Pioneer Array) component of the OOI network.

5.2.5 Socioeconomics (Fisheries)

Pioneer Array Micro-Siting Process

In response to written and oral comments to the Draft SSEA regarding the potential placement of the proposed OOI Pioneer Array moorings, NSF initiated a process whereby the public, including the fishing community, could provide input to the site selection process, or micro-siting, for final mooring placement within the study areas analyzed in this SSEA. Stakeholder input to the micro-siting process for the Pioneer Array has occurred via meetings and/or e-mail. The initial determination of candidate sites where the moorings could be placed was made by scientists (supported by NSF) to meet the science/operational requirements. Coordinating with the public, including local marine users, regarding the micro-siting of each mooring, within the study area analyzed in this SSEA will assist in addressing regional fishing interests. These discussions are on-going and will continue after issuance of this Final SSEA until site-specific placements of the Pioneer Array moorings within the study area can be determined in a manner that considers the regional fishing interests and meets the science/operational requirements of the Pioneer Array.

The micro-siting of moorings within the identified study area for the Pioneer Array is being informed through a public process during which input from the public, including representatives of marine user stakeholders, is both sought and encouraged. Representatives of marine user stakeholders include, but are not limited to:

- Massachusetts Fishermen's Partnership
- Cape Cod Commercial Hook Fishermen's Association
- Commercial Fisheries Center of Rhode Island
- Ocean State Fisheries Association
- Rhode Island Lobstermen's Association
- Rhode Island Shellfishermen's Association

- Commercial Fisheries Research Foundation
- Rhode Island Fisherman's Alliance
- American Alliance of Fishermen and their Communities
- Mataronas Lobster Company, Inc.
- Sakonnet Lobster Company
- Eastern New England Scallop Association
- Trebloc Seafood, Inc.
- Colbert Seafood, Inc.
- Manomet Seafood, Inc.
- Broadbill Fishing, Inc.
- Garden State Seafood Association
- Atlantic Offshore Lobstermen's Association
- Long Island Commercial Fishing Association
- New England FMC
- Mid-Atlantic FMC

To date, NSF and Ocean Leadership have hosted 2 micro-siting meetings dedicated to the Pioneer Array moorings:

- October 5, 2010, Coastal Institute, Narragansett Bay Campus, University of Rhode Island
- November 15, 2010, Coastal Institute, Narragansett Bay Campus, University of Rhode Island

During all micro-siting meetings, OOI representatives provided an overview of the project including, but not limited to, the OOI science goals, equipment that is proposed for deployment, and subsequent data that will be available to the public. OOI representatives also outlined the science and operational requirements for mooring siting and described how the initial candidate mooring locations were determined.

Discussions have also been initiated regarding the establishment of buffer zones or 'watch circles' around the Pioneer Array moorings. Buffer zones identifying voluntary avoidance areas around the moorings would be established in consultation with the affected fishing communities. The diameters of these buffer zones relate to water depths (larger in deeper water). Currently, a 0.5-nm radius is being proposed for each of the Pioneer Array moorings. The sites would be published in the NM and LNM, clearly charted on NOAA navigation charts, and identified through direct contact with user communities. There would be active radar transponders on surface buoys as well as required USCG markings; other markings are under consideration. Discussions with the fishing community are ongoing and will continue as necessary to address further concerns (refer to Appendix G).

NSF has stated in public meetings that the agency has no interest in seeing fishing areas closed around or near proposed OOI moorings (either on the Endurance Array on the west coast or the Pioneer Array on the east coast), and will continue to emphasize this point with its USCG contacts, state officials, and the public. Specifically, NSF contacted the USCG First District, Waterways Management, Boston, Massachusetts, to get clarification on the potential for the USCG to restrict fishing around proposed Pioneer Arrays moorings. The USCG representative stated that USCG has no statutory authority to close off areas to fishing or navigation beyond the 12-nm limit.

During the October 5 and November 15 micro-siting meetings in Rhode Island, candidate locations for the Pioneer Array within the study area analyzed in the Draft SSEA were presented and the northeast fishing community requested a detailed, quantitative socioeconomic analysis. In addition, they requested assurance that the Pioneer Array region would not be closed to fishing. During the November 15 meeting, NSF made the following statement in an effort to address concerns about fisheries closures in the area of the Pioneer Array: *NSF is stating that the agency has no interest in seeing fishing areas closed by deploying OOI, and will continue to emphasize this point with its US Coast Guard contacts, state officials, and the public.* Additional micro-siting meetings are being planned for the northeast and these meetings will occur after the Final SSEA, inclusive of the SIAR, has been published. The micro-siting process will continue through additional public meetings, e-mail, and/or teleconferences as necessary.

With the implementation of these on-going discussions with the fishing community in a manner that considers potential impacts to area fisheries, there would be short- and long-term minor impacts to commercial fisheries with implementation of the Proposed Action.

Socioeconomic Impact Analysis Report (SIAR)

In accordance with the PEA (NSF 2008) regarding the need for additional detailed assessment of the proposed OOI at the site-specific stage, to support a previous qualitative analysis, and in response to public comments on the Draft SSEA, the SIAR was prepared to provide quantitative verification of the qualitative analysis of potential impacts to socioeconomics (fisheries) from the installation and O&M of the proposed Pioneer Array as set forth in the Draft SSEA. A summary of the SIAR is presented below; the full SIAR is found in Appendix I.

The SIAR estimated the benefits and costs of the proposed installation and O&M of the proposed Pioneer Array. The Pioneer Array would be comprised of a series of 10 relocatable moorings in 7 mooring locations approximately 68 nm south of Martha's Vineyard, Massachusetts. Although gliders and AUVs would run missions in the vicinity of the moored array, they are assumed to not have an impact on fisheries. Therefore, the economic analysis within the SIAR focused on the Pioneer Array moorings only and specifically on the proposed 0.5-nm radius buffer zone around each mooring.

The SIAR concluded that the Pioneer Array would produce very modest costs and likely no costs in the future as fishermen adapt to the location of the moorings and buffer zones (Table 2). While net present value (NPV) is calculated in the summary section, the result contains many uncertainties. Over the proposed 5-year life of the Pioneer Array in this proposed location, benefits to society would have to exceed $11.3 million per year after the first year to produce a slightly positive NPV over the 5-year life of the array in this location. It is likely that benefits will exceed this value, but it may take several years for them to begin to accrue. Either way, the vast majority of the project costs are in design, installation and operation and the actual avoidance costs represent a very small portion, less than 0.01% at the upper bound level of avoidance cost, of the $47.9 million cost of the Pioneer Array over 5 years. Even under the most conservative assumptions across the most conservative additional operating cost scenario, installation and operation of the Pioneer Array does not constitute a significant impact on harvesters or shoreside businesses supported by their fishing activity in the area of the proposed buffer zones. Therefore, the SIAR did provide quantitative verification of the conclusions in the Draft SSEA's qualitative analysis of socioeconomic impacts. Accordingly, there will be no significant socioeconomic impacts as a result of implementation of the Pioneer Array.

Table 2. Summary of Potential Economic Impacts of the Proposed Pioneer Array

Sector		Potential Impact Value	Potential Impact Per Vessel Per Trip
Commercial Fishing	Revenue at risk - According to the NMFS economic analysis guidelines, revenue at risk is often used when operating cost calculations cannot be made. Therefore, this estimate is an extreme upper bound	$25,386	$1,692
	Lower bound avoidance cost – This scenario assumes that only the 15 trips estimated to occur directly in the buffer zones incur any additional avoidance costs and that those additional costs involve relocating their gear set by 1 nm to avoid the buffer zone.	$162	$11
	Upper bound avoidance cost – This scenario assumes that all 666 trips in all three 10-min squares containing buffer zones will avoid the entire 10-min square containing the buffer zone and includes the cost of moving the set of their gear by the width of the 10-min square where the effort occurred.	$40,676	$61
For-Hire Recreational	No trips will be impacted by the operation and installation of the Pioneer Array.	$0	$0
Private Recreational	No trips will be impacted by the operation and installation of the Pioneer Array.	$0	$0

5.3 GLOBAL SCALE NODES (GSN)

The Proposed Action would only involve the elimination of one GSN site (Mid-Atlantic Ridge) from proposed installation by 2015, thereby reducing the potential impacts, and would not add any infrastructure or activities that were not previously assessed in the PEA and SER. As the affected environment discussion and impact analysis were regional in nature given the large area of proposed activities and lack of site-specific data for each site, the impact analysis conducted for the GSN sites under the PEA and SER is still applicable for the proposed implementation of the Proposed Action. Therefore, additional impact analysis is not necessary within this SSEA for the proposed installation and O&M of the GSN sites. In addition, the PEA, SER, and this Final SSEA meet the requirements of Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*.

5.4 CUMULATIVE IMPACTS

CEQ regulations (40 CFR 1500 – 1508) implementing the provisions of NEPA, as amended (42 USC 4321 et seq.) provide the definition of cumulative impacts. Cumulative impacts are defined as:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7)

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. A cumulative impact results from the additive effect of all projects in the same geographical area. Generally, an impact can be considered cumulative if: a) effects of several actions occur in the same locale, b) effects on a particular resource are the same in nature, and c) effects are long-term in nature. The common factor key to cumulative assessment is identifying any potential temporally and/or spatially overlapping or successive effects that may significantly affect individual or populations of marine resources occurring in the analysis areas.

5.4.1 Resource Considerations

Certain resources do not need to be considered for cumulative impacts because either a) the effects of the proposed action would be so small and localized that the potential additive effects with other actions would be negligible; or b) the effects of the proposed action would be limited sufficiently by statutory or regulatory requirements and procedures that potential additive effects would again be negligible. These include the following:

- *Air Quality*. Emissions from the Proposed Action would be minimal in comparison with other local and regional sources and would be transitory during installation and use of the proposed systems. Local air basin jurisdictions establish emissions thresholds for significance and mitigation that help ensure that individual project emissions do not individually or cumulatively have a significant impact on air quality. Emissions from the Proposed Action would be below levels of significance and do not involve permanent stationary sources. In the offshore waters, emissions from proposed activities would involve relatively small quantities of pollutants produced by project vessels; such emissions would be transient and rapidly dispersed. Therefore, no significant cumulative impacts to air quality would occur.
- *Geology and Water Quality*. Effects of the Proposed Action are sufficiently small in magnitude and limited in extent that potential additive effects are negligible. Potential water quality impacts are also limited by CWA requirements for permitting, which would be followed for onshore and in-water construction. Therefore, no significant cumulative impacts on geological resources and water quality would occur.
- *Transportation*. Marine transportation effects would be minimized by coordination with local coastal authorities and the avoidance of heavily used vessel transit corridors, the latter by design of the system. Publication of mooring, cable, and AUV/glider assets on NM and LNM would be used to minimize the potential conflicts with other vessels, during installation, and the depiction of the structures on NOAA navigation charts would minimize conflicts thereafter. Surface buoys or other structures would be marked in accordance with USCG regulations and readily avoidable. Therefore, there would be no significant cumulative impacts on transportation.
- *Hazardous Materials*. The only potential sources of hazardous materials would be unanticipated accidents or spills that resulted in a discharge of fuel, lubricants, or sensor components (e.g., batteries) from a project vessel or associated OOI equipment and sensors. Based on existing requirements and procedures for management of such materials on board vessels and the design of scientific equipment and sensors, such events are extremely unlikely to occur. If such a spill were to occur, it would be a localized occurrence, and adherence to standard containment, cleanup, and reporting requirements would assure that the effects are minimized. In addition, residual material would be dispersed by natural processes, but the potential for additive effects with other discharges of hazardous materials in the same location(s) is considered negligible. Significant cumulative impacts would not occur.
- *Cultural Resources*. Site-specific evaluations and compliance with the requirements of the National Historic Preservation Act would ensure that the Proposed Action no significant impacts on properties listed or potentially eligible-for-listing on the National Register of Historic Places would occur. There are no additional impacts on cultural resources from other past, present, or reasonably foreseeable activities within the ROI. Therefore, no significant cumulative impacts to cultural resources would occur.
- *Terrestrial Resources at Shore Stations*. Project SOPs would ensure that any new onshore construction would have minimal or no impact on sensitive natural resources. Since the proposed

shore stations are on previously developed and disturbed sites on the immediate coast, the impacts on land are essentially contained within an existing "footprint" and there is little to no potential for cumulative effects with development or other activities onshore. Implementation of BMPs in conjunction with obtaining coverage under the NPDES general permit for construction would effectively avoid potential cumulative effects on surrounding lands and waters. Finally, the permitting for the new infrastructure onshore would address consistency with zoning requirements, local land uses, and resources of the adjacent coastal areas. Therefore, no significant cumulative impacts would occur at the proposed shore station location.

- *Marine Biology*. Marine biological resources, including the species and communities of marine benthic, water column, and surface water habitats affected by the Proposed Action, are subject to potential cumulative impacts through the incremental effects of multiple actions on habitats, species' populations, or ecological processes. Cumulative effects on habitats can result from incremental degradations and losses that ultimately diminish the capacity of the habitat to support species, communities, and ecological processes. Owing to the dispersal of populations, incremental effects on species at one location can interact with effects occurring elsewhere to affect the overall distribution and abundance of the species. Based on the analyses in the PEA, SER, and SSEA, however, there are no significant impacts on marine biological resources anticipated.
- *Socioeconomics (Fisheries)*. Potential cumulative effects on Socioeconomics (Fisheries) reflect primarily the potential for structures installed on the seabed and within the water column to interfere with commercial fishing. These potential impacts would be reduced, but not eliminated, through coordination with the public, including local fishing groups, as part of the Proposed Action. Based on the additional quantitative analysis within the SIAR, however, there are no anticipated significant socioeconomic impacts.

5.4.2 Cumulative Impacts Analysis Summary

CSN (Endurance Array) and RSN. Installation and use of the Grays Harbor and Newport lines of the Endurance Array would entail relatively small, localized areas of disturbance to the seabed during installation. The extent of disturbance to the seabed associated with the RSN is of wider extent, but still affects a very small area of the seabed in any particular location. Disturbance would be predominantly in soft-sedimentary habitats, which are subject to natural disturbances (bioturbation by fishes and invertebrates) and strong sediment deposition and transport in the dynamic cross-shelf environment. These natural phenomena ensure that alterations of the soft-bottom habitat are temporary. Once in place, the permanent structures of the RSN would either remain buried or provide hard surfaces for attachment and sheltering of fishes and invertebrates, a beneficial effect. Overall, cumulative effects on marine biological resources would be insignificant.

The CSN (Endurance Array) and RSN structures could potentially interfere with commercial fishing to varying degrees, depending on gear type, and in conjunction with restrictions imposed under the Fishery Management Plans. Coordination with the local fishing community would reduce these potential impacts, and it is possible that the presence of structures may contribute to resource sustainability by providing localized refuges from fishing. Overall, however, because of the expanding, incremental loss of access to fishing grounds due to the placement of structures on the seabed and in the water column, the potential exists for the proposed action to have cumulative effects on commercial fishing. Such impacts could be mitigated by the finalization of fishing agreements with the affected parties (i.e., OFCC) to a level of insignificance.

CSN (Pioneer Array). For the same reasons discussed above for the Endurance Array, the proposed Pioneer Array would have negligible cumulative effects on marine biological resources. Potential effects would be negligible due to the extremely small "footprints" of the array components (surface and subsurface mooring buoys). The Pioneer Array is proposed as a relocatable array that may be moved to another location 3-5 years after its initial proposed deployment as covered under the Proposed Action. The movement of the Pioneer Array, including the retrieval of assets from the proposed location south of Massachusetts, would be covered under a separate NEPA document. However, it is not expected that the retrieval or redeployment of the Pioneer Array would have any cumulative effects based on the current analysis.

GSN. Use of the proposed GSN sites would impact relatively small areas of the seabed, water column, and ocean surface of relatively remote areas. With the wide dispersion of research and other activities across these areas, no significant cumulative effects are anticipated.

6.0 CONCLUSION

The attached SSEA was prepared and evaluated pursuant to NEPA and in accordance with CEQ regulations at 40 CFR 1500-1508, and NSF's NEPA implementing regulations at 45 CFR Part 640. I have concluded that, based on the analyses contained in the PEA, SER, and SSEA, the installation and O&M of the OOI as proposed would not result in any significant direct, indirect, or cumulative impacts. Nor does not it constitute a "major Federal action significantly affecting the quality of the human environment" when considered individually or cumulatively in the context of NEPA. Therefore, no further study under NEPA is required, and a Finding of No Significant Impact is thus warranted. NSF's compliance with the National Historic Preservation Act, Marine Mammal Protection Act, Endangered Species Act, and Coastal Zone Management Act has also been completed. In addition, in light of the analyses in the PEA and SER, there are no significant impacts as a result of the installation of the GSN and, therefore, no further environmental analyses under EO 12114 are required. Accordingly, I hereby approve the installation and operation of the OOI as described in the SSEA.

David Conover
Director, Ocean Sciences Division
National Science Foundation

1/31/2011
Date