



Terramar Environmental Services, Inc.  
1241 Crane Boulevard  
Sugarloaf Key, Florida 33042  
(305) 393-4200 [terramar@bellsouth.net](mailto:terramar@bellsouth.net)

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## MEMORANDUM

Date: February 14, 2018

To: Dan Sabino  
Director of Engineering  
Keys Energy Services (KEYS)

From: Philip A. Frank, Senior Biologist

RE: KEYS Hurricane Irma Emergency Repairs, Line 4 Damage Assessment

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We completed a resource damage assessment on poles on Line 4 that were repaired following Hurricane Irma. This assessment was stipulated by the Florida Keys National Marine Sanctuary (FKNMS) per the October 24, 2017 Letter of Authorization (FKNMS-2017-098) provided to the U.S. Army Corps of Engineers, Jacksonville District. Required Condition 32 states:

*A post-construction benthic survey shall be submitted to FKNMS within 30 days of construction completion at each line. The survey shall include a qualitative assessment of all work areas traversed by the pontoon excavators and Flexi Float barges where this equipment came in contact with the sea floor. The qualitative assessment shall provide a description of adjacent, un-impacted areas for comparison purposes. Photos shall be included to document the impacted and un-impacted area at each pole.*

Hurricane repairs were completed on six in-water poles at Line 4: 75, 76, 77, 78, 80 and 81. Work on Line 4 started on October 9, 2017 and was substantially complete on November 12, 2017. The only remaining in-water work remaining on Line 4 is to remove the remnants of the abandoned poles. The work was completed by Michels Power working under contract to KEYS. Methods utilized to remove damaged poles and power lines, and install replacement poles, were adaptive and utilized a combination of Flexi-Float sectional barges, amphibious pontoon excavators, and traditional utility equipment. The work was complicated by the shallow waters surrounding the poles, typically between 1-3' in depth.

The methods for the damage assessment at Line 4 utilized a survey drone to capture an accurate georeferenced image of the site. ArcGIS mapping software was then used to digitize areas of obvious damage. Aerial base maps were taken to the field to ground-truth damage vs undamaged areas by experienced marine biologists. A small portion of the survey area was inaccessible to the

survey drone due to closed airspace associated with the Naval Air Station. In those areas, traditional mapping methods using a handheld GPS was used to complete the mapping.

Aerial mapping of damaged areas was conducted over the drone maps using heads-up digitizing. The accuracy of the imagery was such that accurate mapping of damaged areas was possible and was a far more accurate method for this site as compared to traditional transect or swim-thru mapping methods. Ground-truthing the maps further increased resolution, and matched marine habitat conditions to aerial imagery.

To determine the extent of damage in marine habitats, reference habitats well outside of the area impacted were assessed to establish the baseline condition of intact habitat. Habitats are described qualitatively based on the following criteria:

Habitat Type	Cover Type	Cover Description	Cover Class
Seagrass	Note dominant species	Sparse	5-25%
Seagrass	Note dominant species	Moderate	25-75%
Seagrass	Note dominant species	Dense	75-100%
Hardbottom	Note dominant taxa	Sparse	5-25%
Hardbottom	Note dominant taxa	Moderate	25-75%
Hardbottom	Note dominant taxa	Dense	75-100%

## Marine Habitats

There were two primary marine habitats in the survey area; seagrass and hardbottom (Attachment 1 – Maps, Attachment 2 – Reference Photographs). These habitats form a mosaic with seagrass and hardbottom interspersed throughout much of the area.

Seagrass habitats in the project vicinity are healthy and well-developed. Seagrass was prevalent in areas with deep sediments and were composed of moderate to dense Turtle grass (*Thalassia testudinum*) rooted in deep, soft sediments. Shoal grass (*Halodule wrightii*) was also well represented, but turtle grass was the dominant species observed. Seagrass density was highly variable, ranging from sparse to dense depending on water depth and sediment development. Of interest is the high density of sediment mounds created by marine worms in the seagrass habitat. These mounds can be seen clearly in the drone imagery and comprised significant cover in areas of well-developed seagrass.

Hardbottom habitats occurred in shallow areas where exposed limerock substrate was present, limiting the ability for seagrass to colonize. Due to the shallow water in the hardbottom areas, hardbottom supported a limited benthic community composed of sparse algae (*Laurencia*, *Halimeda*, *Caulerpa*) and scattered small sponges. No hard or soft corals were observed anywhere in the survey area, likely due to the shallow waters allowing habitats to be periodically exposed during low tide events.

### **Damage Assessment**

In general, substrate and water depth were primary factors in observed damage. Areas of adequate water depth capable of supporting the barges, especially depending on the tide, did not sustain measurable damage. Areas of deep, soft sediments supported well-developed seagrass habitats, and these habitats were most vulnerable to damage from equipment and sustained extensive damage in many areas. Topographic alteration of the seafloor resulting from equipment use was evident in areas of shallow seagrass habitat, consisting of trenches, berms and scarification.

Shallow hardbottom habitats with a limited benthos were more resilient to damage, and in many areas, it was difficult to discern if equipment had traversed the site. The only evidence of impact in many shallow hardbottom areas was damaged sponges and algae, but the underlying substrate was intact.

Damage to marine habitats was highly variable, ranging from dense scarification over large areas to single excavator tracks in intact habitats. Qualitatively, the majority of observed damage was dense to moderate in cover. Trenches resulting from excavator tracks ranged in depth from very shallow to 18” in some areas. Berms composed of seagrass sods and associated sediment were present in those areas with well-developed seagrass and deep, soft sediments.

The estimated area traversed by equipment conducting repairs is 9.8 acres. Of the 9.8 acres mapped as potentially impacted, an area of approximately 1.6 acres located between pole 77 and the bridge over the channel was obviously traversed by equipment but exhibited little observable benthic damage. This was likely the result of the exposed rock substrate with minimal benthic cover supporting the low-pressure tracks of the pontoon excavators without sustaining damage.

Observable damage to benthic habitats was estimated to be 10.5 acres, with the majority of that in seagrass habitats where deep, soft sediments made the habitat susceptible to equipment damage (Attachment 1 – Maps). Benthic damage was observed in two main locations; poles 75-77 and poles 80-81. Benthic damage at 78 was accomplished by placing a barge across the dredged channel and then working from the barge, limiting the need for the excavators to maneuver in this area. In addition, the area surrounding pole 78 was hardbottom which exhibited less damage than seagrass habitats.

The observed damage consisted of trenches, berms and scarification on seagrass habitats. Qualitatively, observed damage in mapped impacted areas ranged from severe damage consisting of areas of consolidated scarification to moderate to minimal impacts consisting of individual trenches in otherwise un-impacted habitats. Trenches resulting from excavator tracks ranged in depth from very shallow to 18” in some areas. Berms composed of seagrass sods and associated sediment were present in those areas with well-developed seagrass and deep, soft sediments.

## **Summary**

As a result of damage caused by Hurricane Irma, KEYS was required to initiate emergency repairs on six in-water poles at Line 4: 75, 76, 77, 78, 80 and 81. Work on Line 4 started on October 9, 2017 and was substantially complete on November 12, 2017. Construction methods were complicated by shallow water at the site, requiring amphibious pontoon excavators and shallow-draft Flexi-float barges.

Unavoidable impacts to seagrass and hardbottom habitats occurred as a result of the project. An estimated 10.5 acres of seagrass and hardbottom habitats were impacted from the emergency work, with damage classified as moderate to severe in most areas.

Damage was most severe in seagrass habitats characterized by deep, soft sediments. Damage resulted in topographic alterations to the seafloor consisting of trenches, berms and scarification.

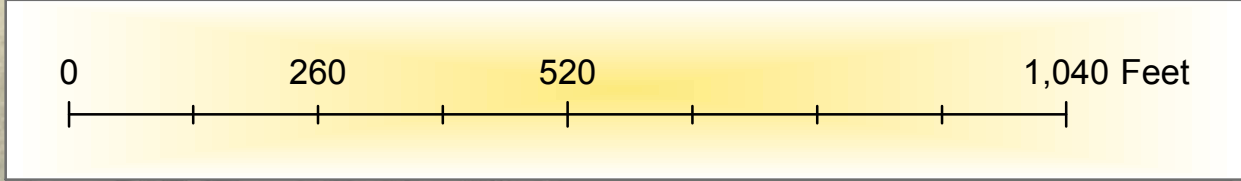
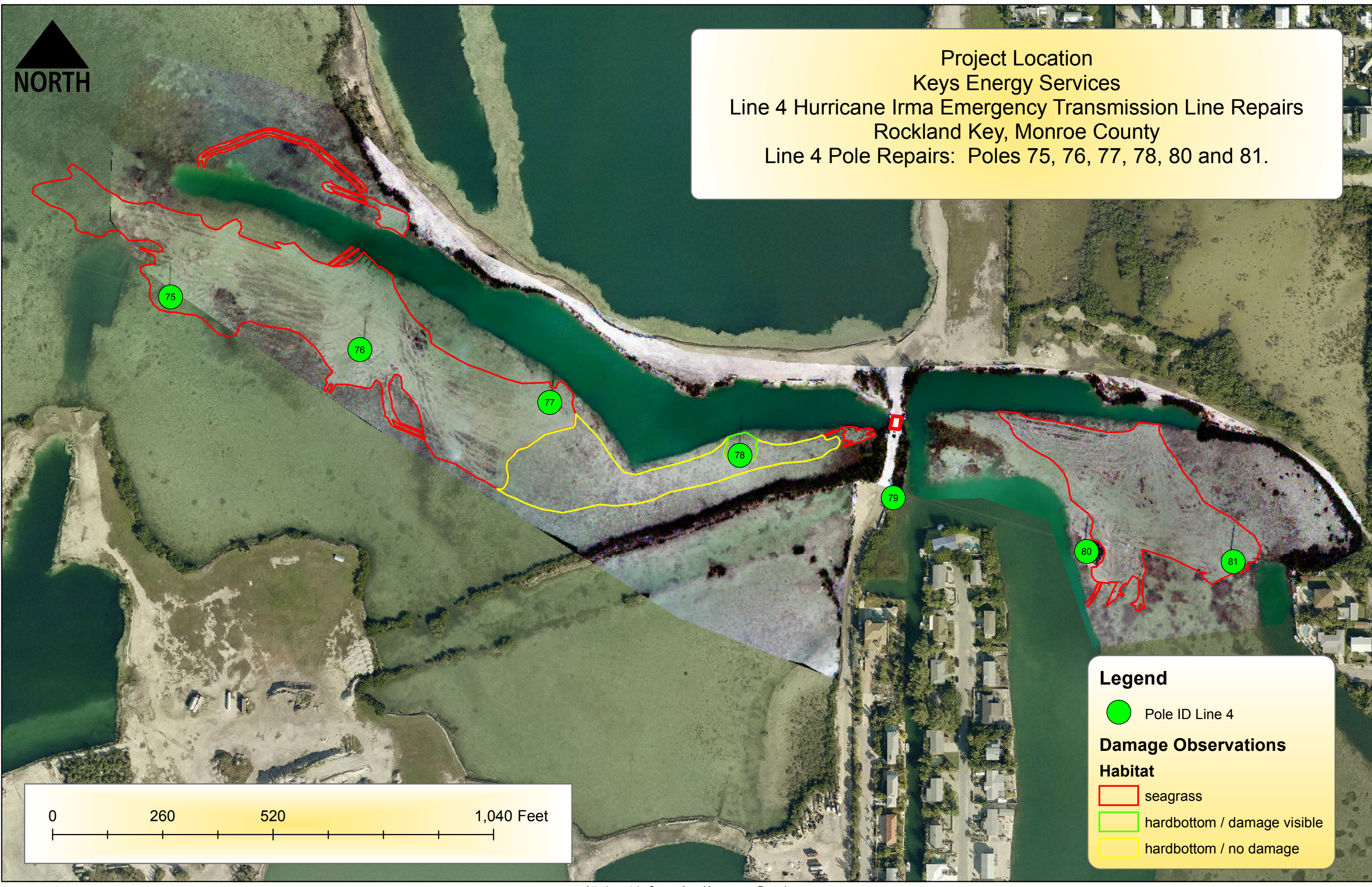
Damage to hardbottom areas was less observable. An area of approximately 1.6 acres between pole 77 and the bridge was traversed by equipment but exhibited little observable damage. This was likely the result of exposed rock with little to no substrate or benthic cover supporting the low-pressure tracks of the pontoon excavators.

Coral resources were not observed in the project area; therefore, it is unlikely that any coral resources were impacted by the emergency repair work.






Project Location  
Keys Energy Services  
Line 4 Hurricane Irma Emergency Transmission Line Repairs  
Rockland Key, Monroe County  
Line 4 Pole Repairs: Poles 75, 76, 77, 78, 80 and 81.





**Legend**


 Pole ID Line 4

**Damage Observations**

**Habitat**

 seagrass

 hardbottom / damage visible


 hardbottom / no damage






Map 1 - Poles 75 - 77  
Pre-Irma Habitats  
Keys Energy Services  
Line 4 Hurricane Irma Emergency Transmission Line Repairs  
Rockland Key, Monroe County


**Legend**


 Pole ID Line 4

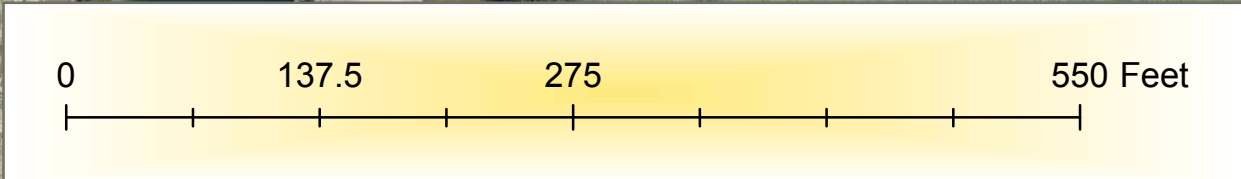
**Damage Observations**

**Habitat**

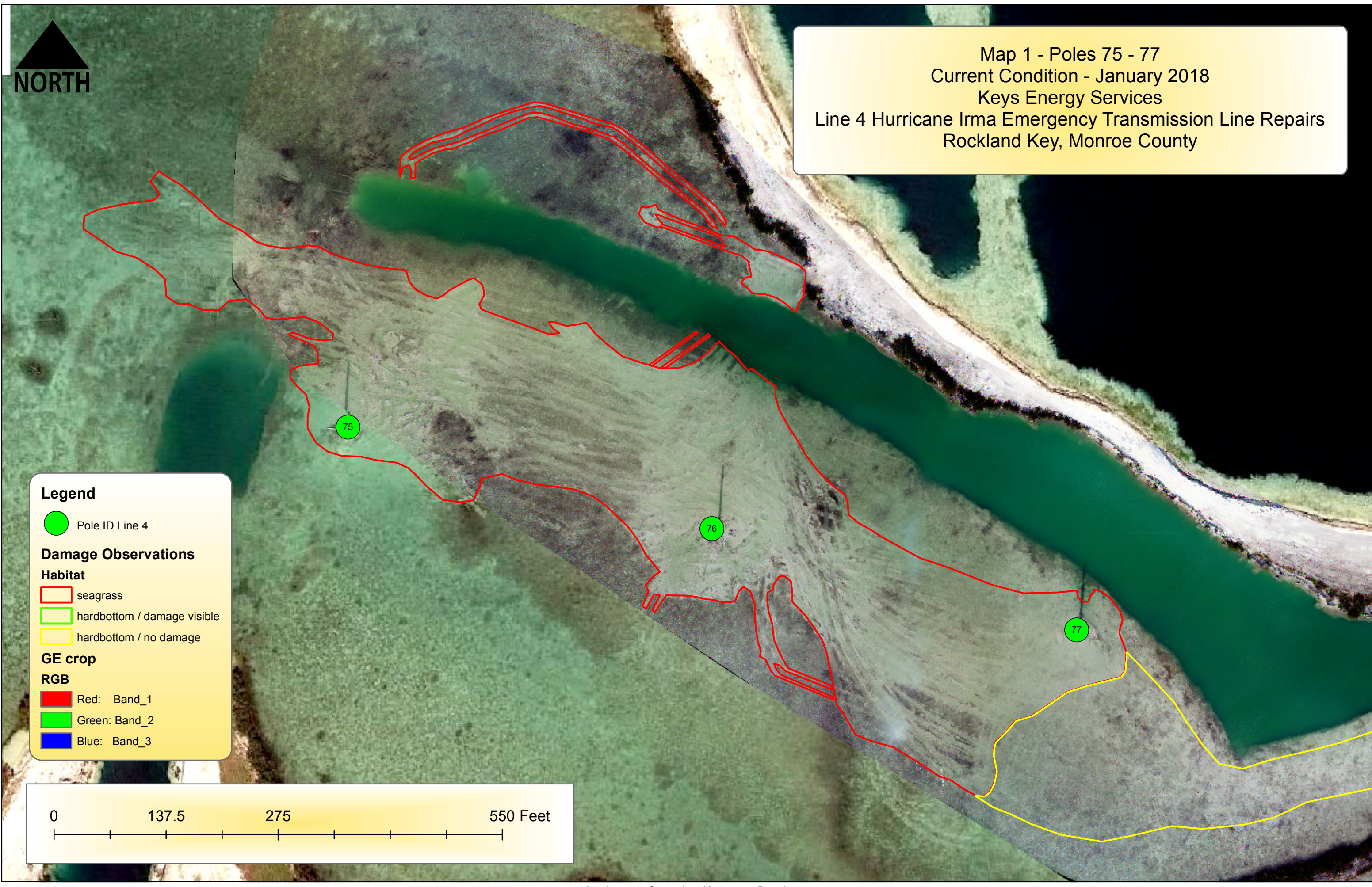
 seagrass

 hardbottom / damage visible

 hardbottom / no damage









Map 1 - Poles 75 - 77  
Current Condition - January 2018  
Keys Energy Services  
Line 4 Hurricane Irma Emergency Transmission Line Repairs  
Rockland Key, Monroe County


**Legend**


 Pole ID Line 4

**Damage Observations**

**Habitat**


 seagrass


 hardbottom / damage visible


 hardbottom / no damage

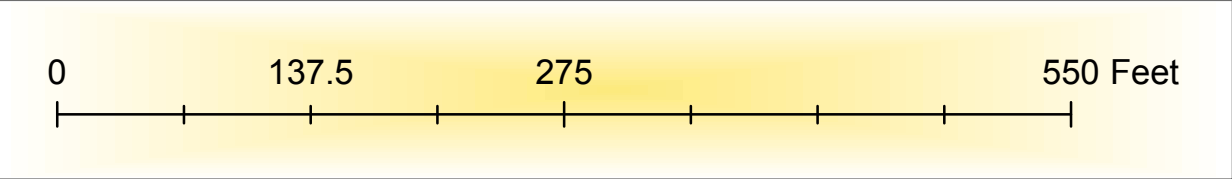
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**RGB**

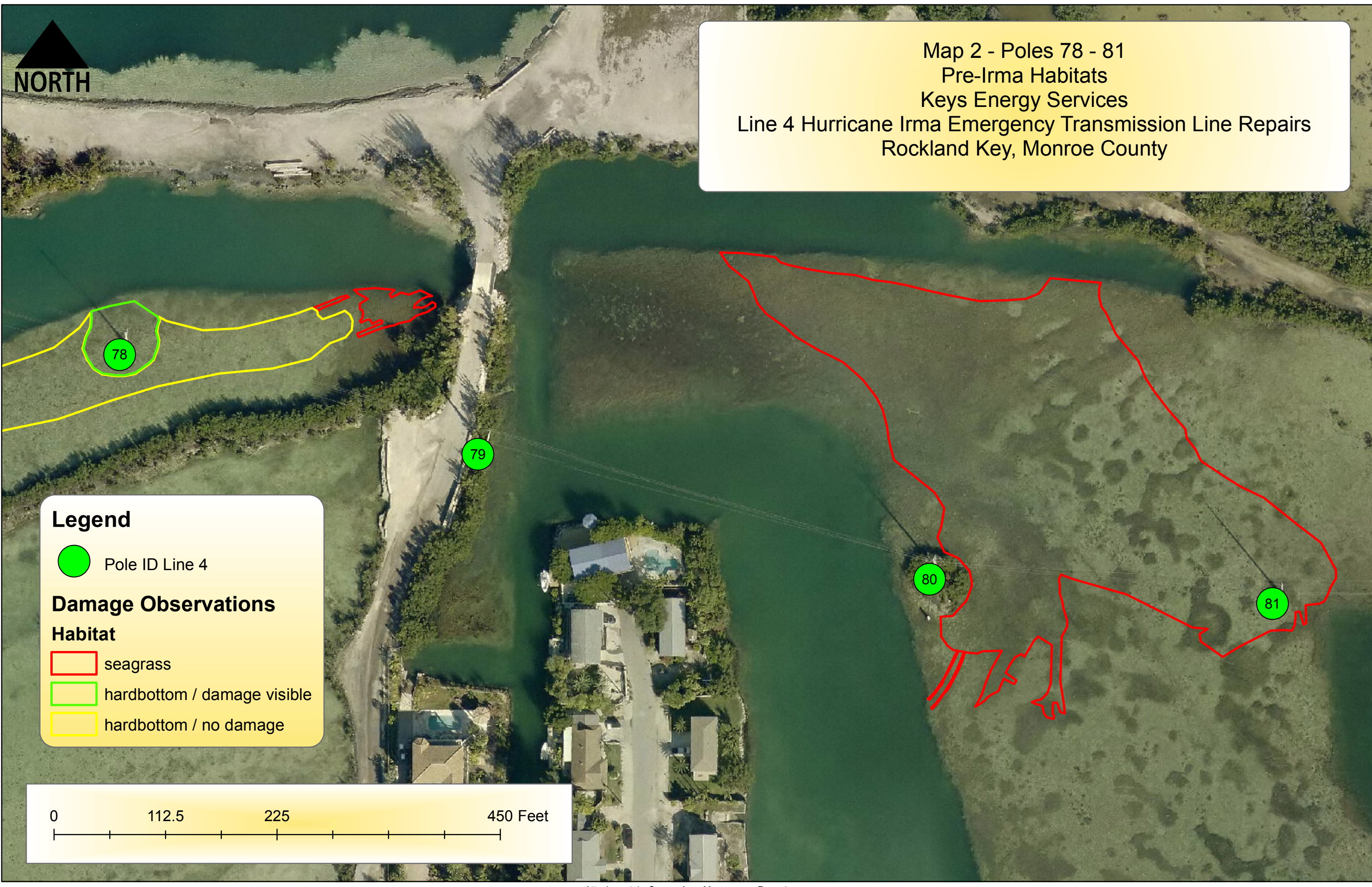
 Red: Band\_1

 Green: Band\_2

 Blue: Band\_3









Map 2 - Poles 78 - 81  
Pre-Irma Habitats  
Keys Energy Services  
Line 4 Hurricane Irma Emergency Transmission Line Repairs  
Rockland Key, Monroe County


**Legend**


 Pole ID Line 4

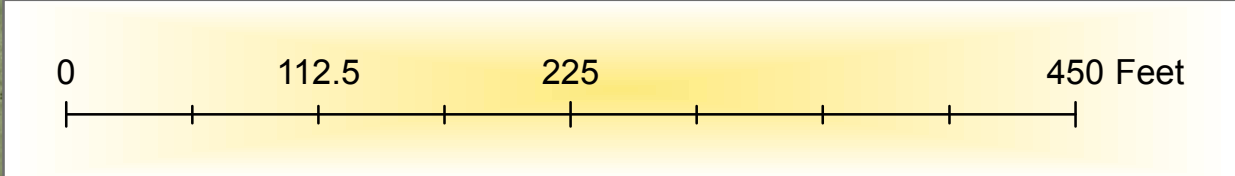
**Damage Observations**

**Habitat**

 seagrass

 hardbottom / damage visible

 hardbottom / no damage









Map 2 - Poles 78 - 81  
Current Condition - January 2018  
Keys Energy Services  
Line 4 Hurricane Irma Emergency Transmission Line Repairs  
Rockland Key, Monroe County

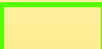
**Legend**


 Pole ID Line 4

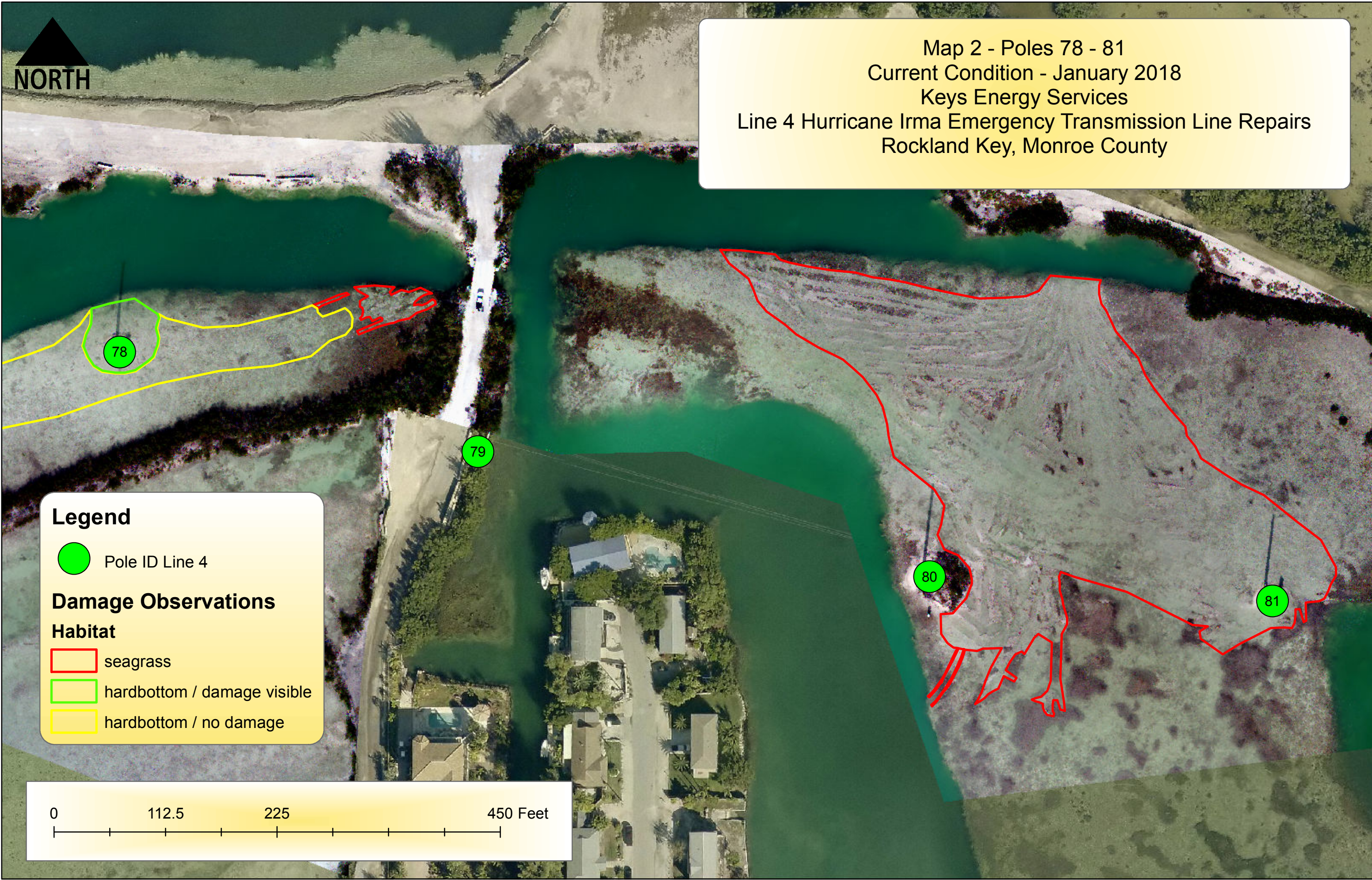
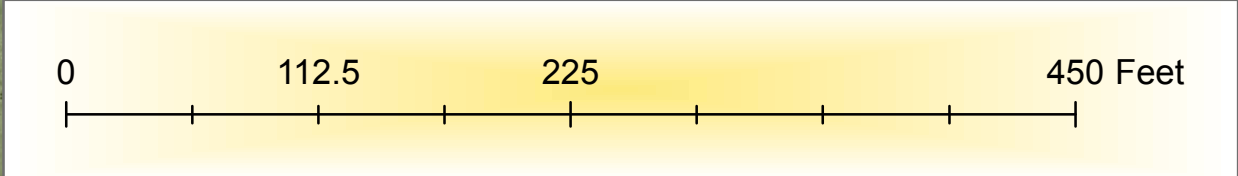
**Damage Observations**

**Habitat**

 seagrass

 hardbottom / damage visible

 hardbottom / no damage







Flexi-float barge being deployed across channel to access pole 78. October 2017.



Pontoon excavators working in shallow water at pole 78. October 2017.





Flexi-float barge and pontoon excavators working on pole 78. October 2017.



Replacement pole showing casing installation and stub at Pole 78. January 2018.





Typical dense seagrass habitat in un-impacted area. Turtle grass was the dominant species observed throughout the survey area. January 2018.



Typical hardbottom habitat in un-impacted area. These habitats are characterized by shallow sediment and exposed rock with sparse macroalgae and limited seagrass present. January 2018.





Damaged seagrass habitat with trenches and berms visible. January 2018.



Damaged dense seagrass habitat with trenches and berms visible. January 2018.





Damaged dense seagrass habitat with trenches visible. January 2018.



Damaged dense seagrass habitat with trenches visible. January 2018.





Damaged hardbottom habitat with surface scarification evident. January 2018.



Damaged hardbottom habitat with surface scarification evident. January 2018.