The Coast and Shoreline Change Analysis Program (CSCAP)

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NOAA's National Geodetic Survey
Remote Sensing Division

National Oceanic and Atmospheric Administration

Our Focus

- **NOAA**
  - **National Ocean Service**
    - **National Geodetic Survey**
      - **Remote Sensing Division**

- **Primary programs**
  - **Coastal Mapping Program**
  - **Aeronautical Survey Program**

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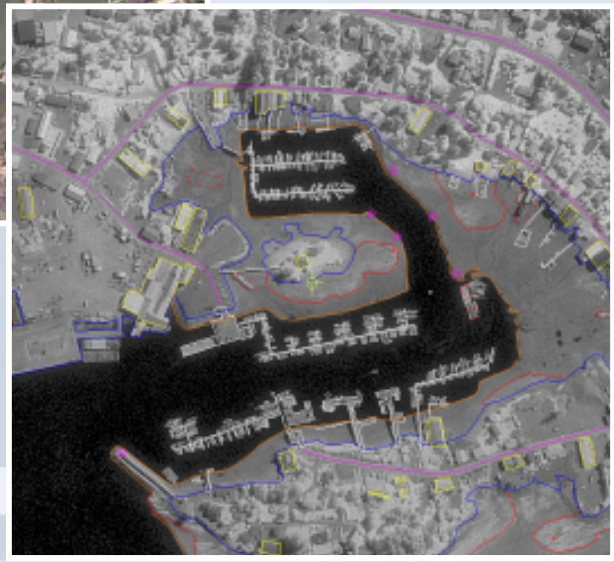
Coastal Mapping Program

- NOAA's National Geodetic Survey (NGS) has the mandate to survey coastal regions within the U.S. and territories.
- NGS delineates the shoreline through stereo photogrammetry, using tide-coordinated aerial photography controlled by kinematic Global Positioning System (GPS) techniques.
- CSCAP utilizes high resolution satellite imagery and NOAA's Electronic Navigational Charts (ENC) to look for shoreline change within major port cities.
- The Coast and Shoreline Change Analysis Program (CSCAP) is a sub-component within the CMP and is the first step in the Electronic Navigational Chart Validation Initiative.

Digital Photogrammetric Workstation used for aerotriangulation and feature extraction



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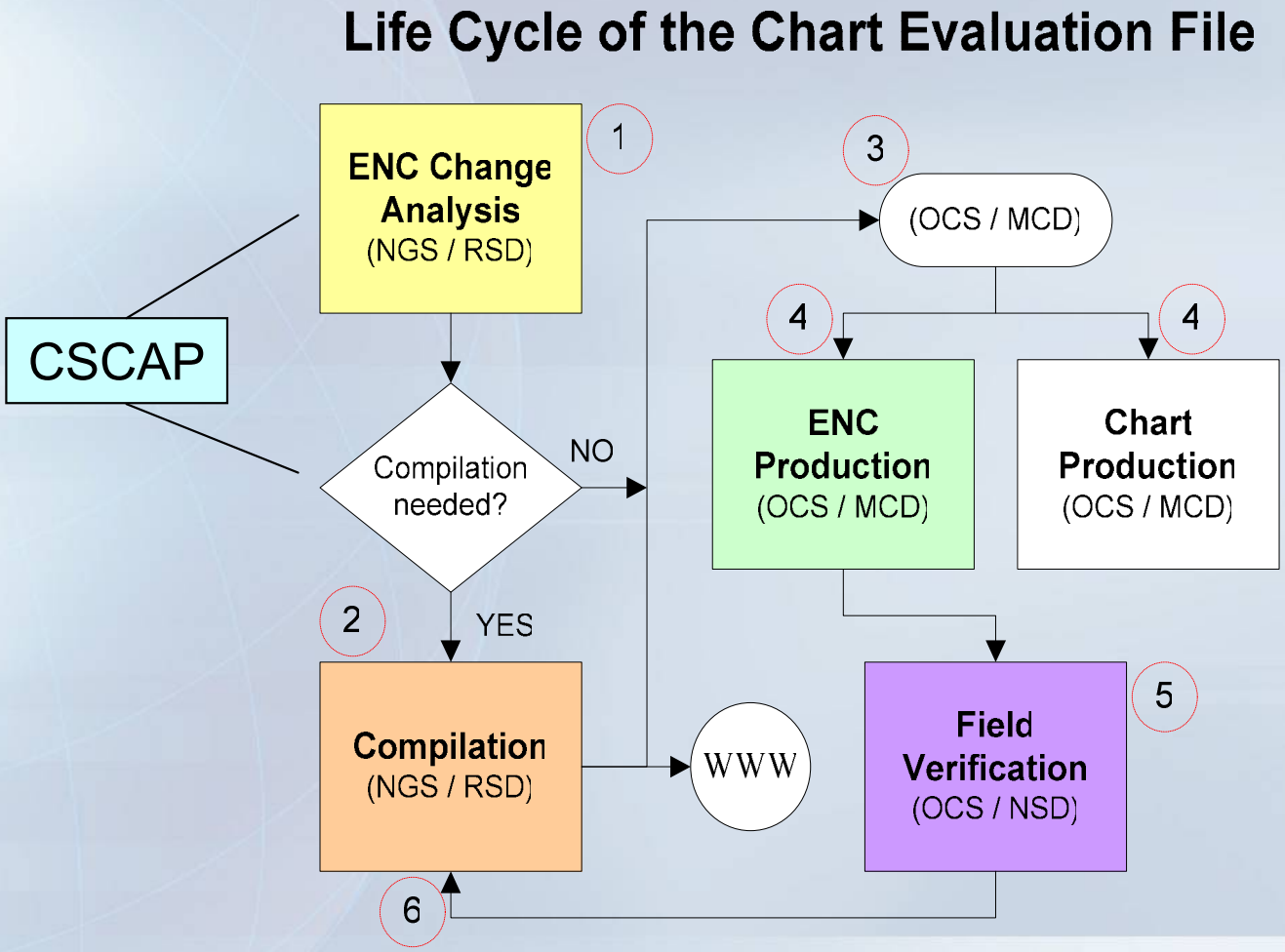
ENC VI: A Multi-Organizational Process



Evaluated Imagery

- SPOT – 10 m spatial resolution
- IRS – 5 m spatial resolution
- SPIN2 – 2 m spatial resolution
- IKONOS – 1 m spatial resolution
- Quickbird – 0.60 m spatial resolution

Charleston, SC IRS Image

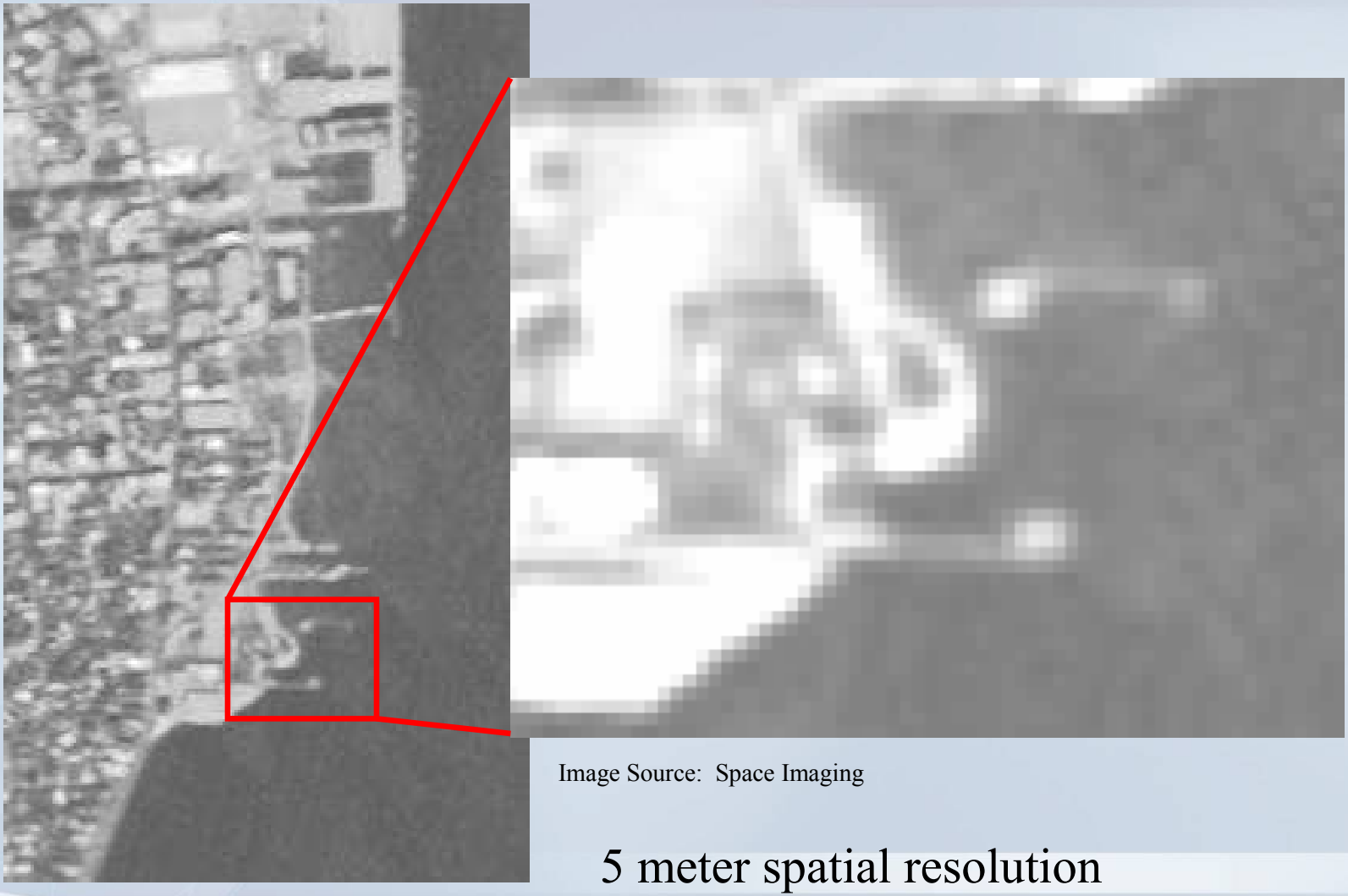


Image Source: Space Imaging

5 meter spatial resolution

Charleston, SC SPIN2 Image

Image Source:Aerial Images

2 meter spatial resolution

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Portland, OR IKONOS Image

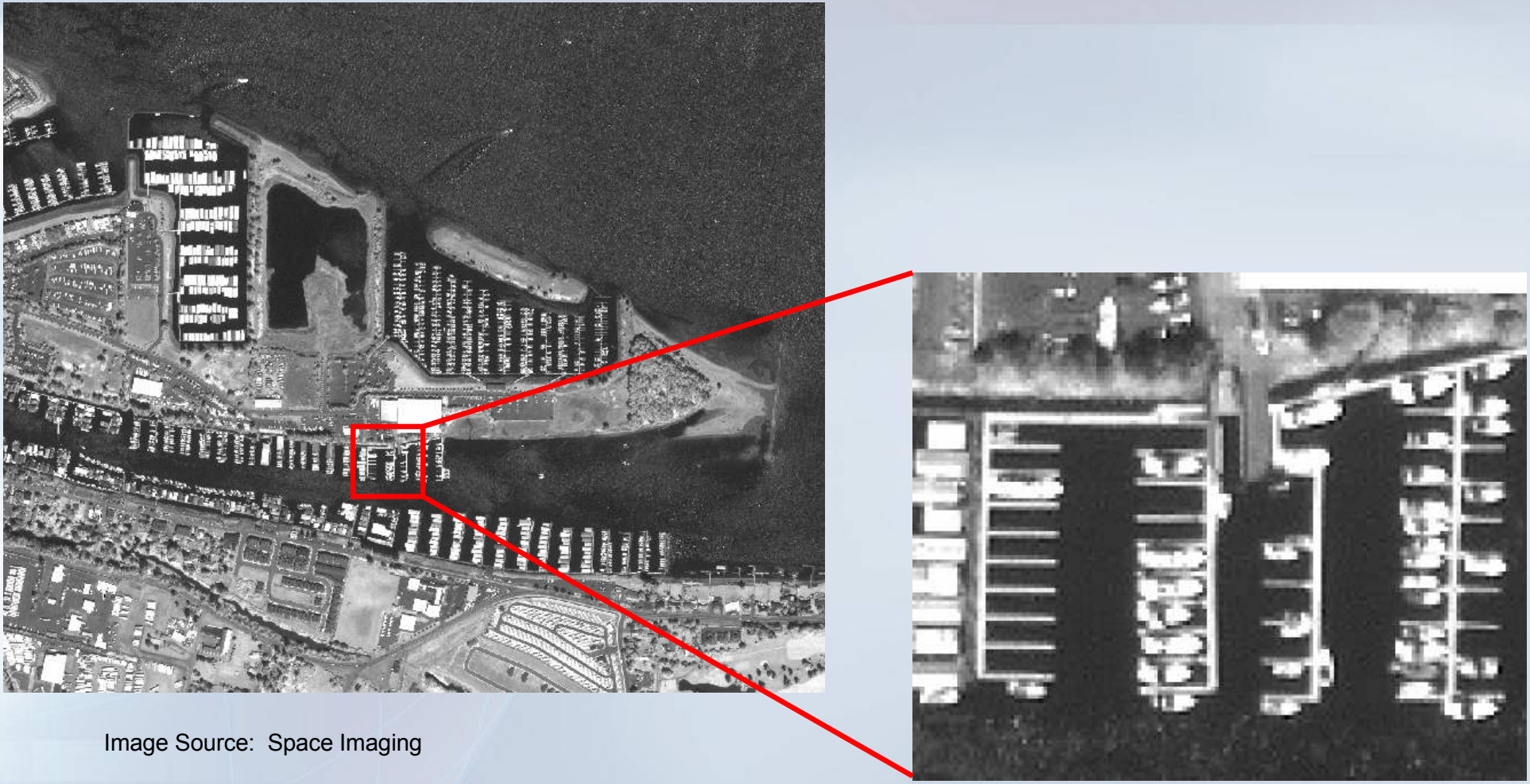

Image Source: Space Imaging

1 meter spatial resolution

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Ponce, PR Quickbird Image

Image Source: Digital Globe

60 centimeter spatial resolution

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Future Satellites

GeoEye-1 (GeoEye)

- Anticipated launch in early 2007
- 0.41 m panchromatic spatial resolution
- 1.64 m multispectral spatial resolution
- 1.2 million sq. KM of imagery/day
- 1.5 day revisit period

WorldView 1(Digital Globe)

- Anticipated launch in mid-2007
- 0.50 m panchromatic spatial resolution
- 500,000 sq. km of imagery/day
- 1.7 day average revisit time.

CSCAP Processing Steps

- Improve relative positioning
- Change Analysis
  - NOAA Electronic Navigational Chart and NOAA Raster Nautical Chart compared with High Resolution Satellite Imagery.
- Georeference Imagery using ground control
- Accuracy Assessment
- Shoreline Compilation
  - Field Verification

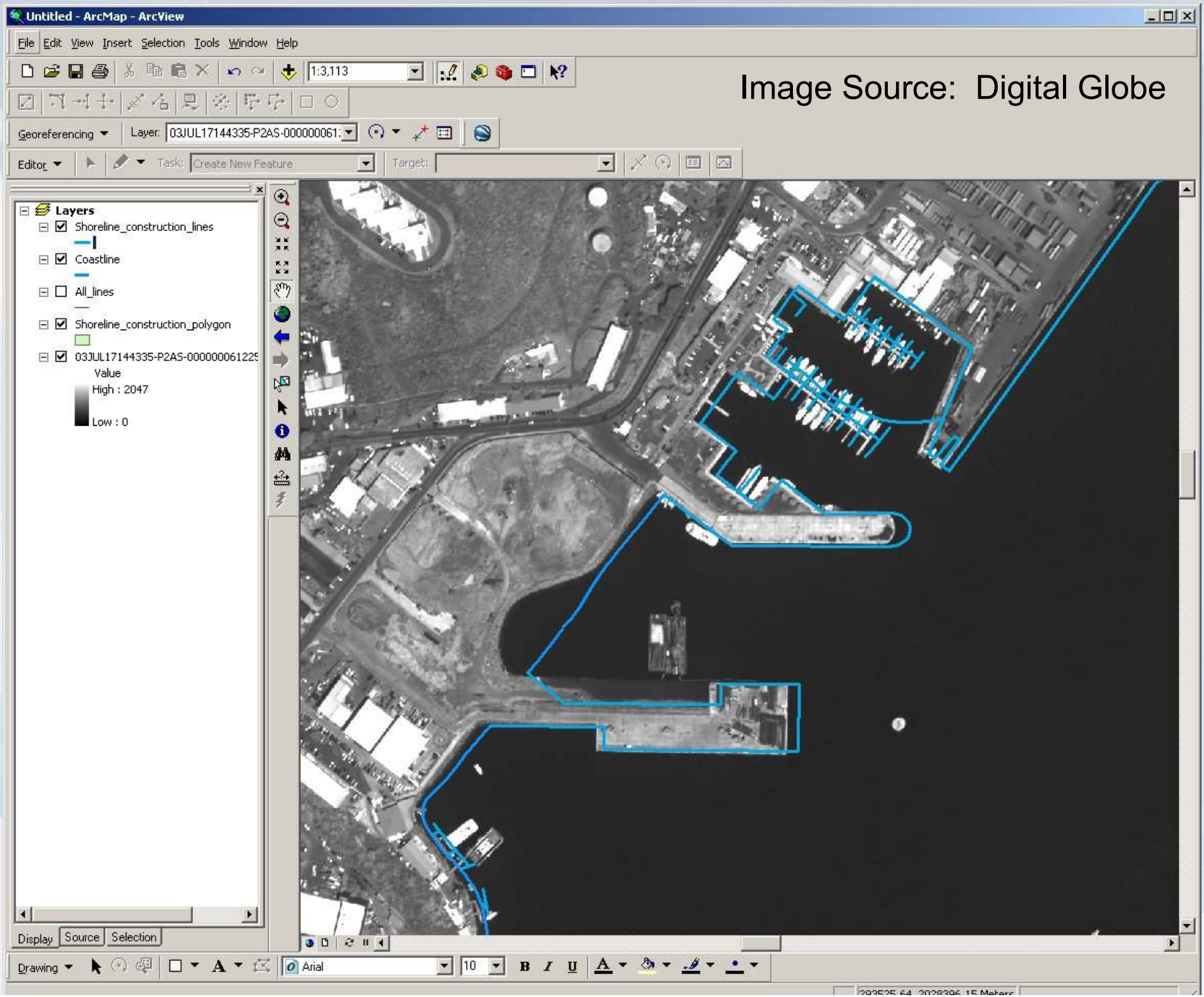
Relative vs Absolute Georeferencing

Relative

- Uses image coordinates to align shoreline with image.
- User defined links between features on image and shoreline
- Utilizes a first order polynomial transformation
- **NO ACCURACY INFORMATION**

Absolute

- Utilizes best available control
- Register imagery to reference data
- Uses a first- order polynomial transformation
- **IMAGE ACCURACY IS KNOWN**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Layers
Shoreline_construction_lines
Coastline
All_lines
Shoreline_construction_polygon
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Arial
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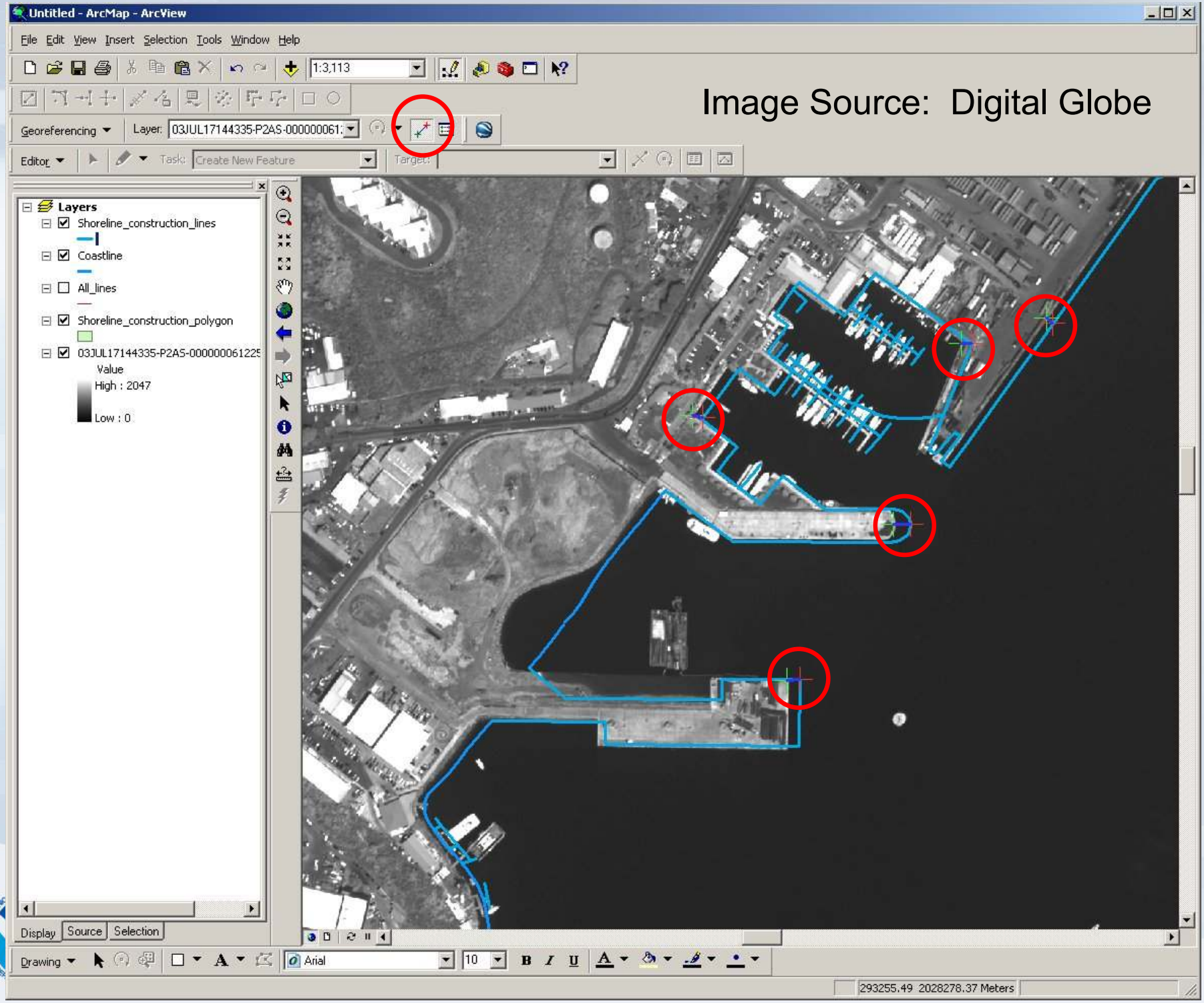
Image Source: Digital Globe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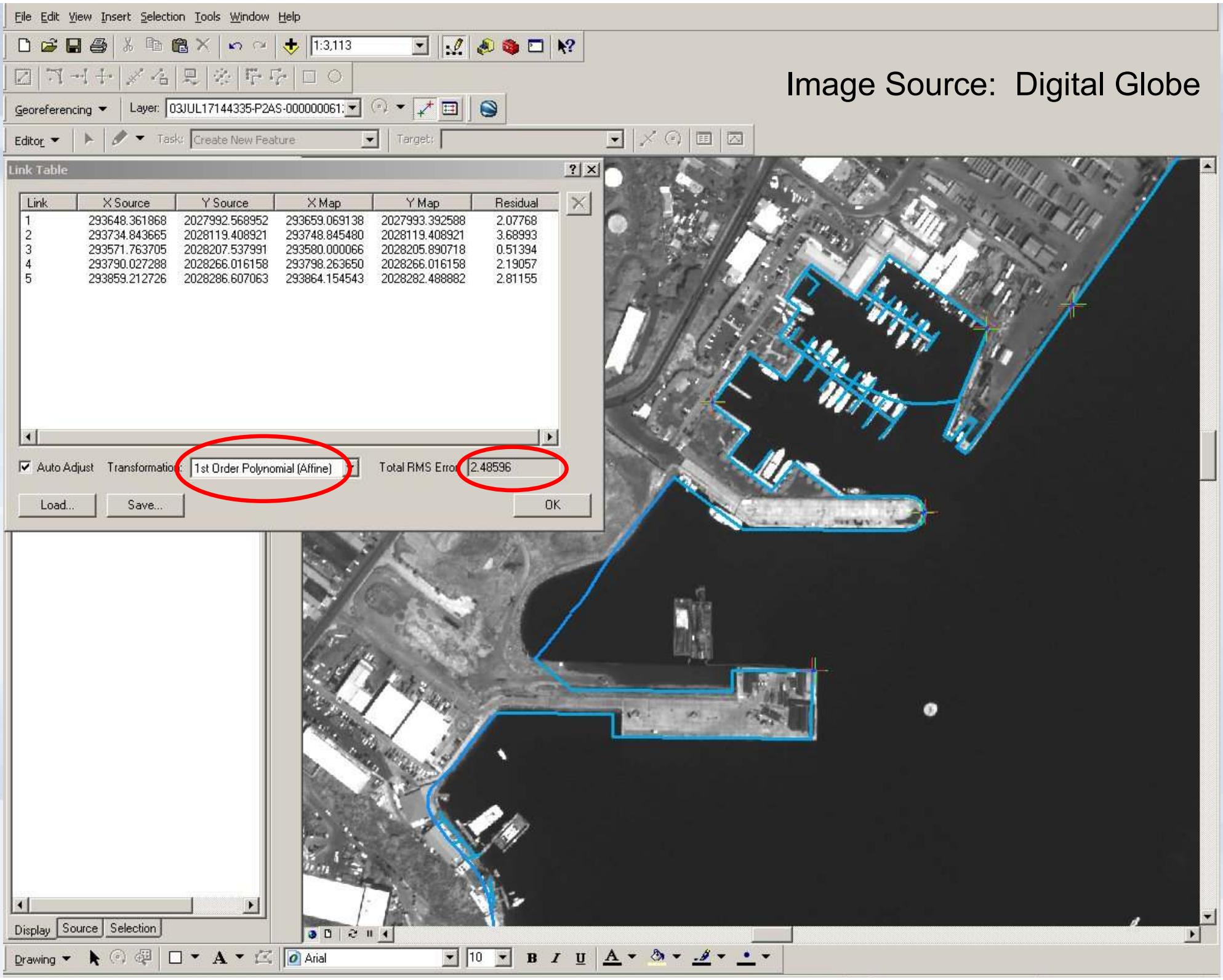
File Edit View Insert Selection Tools Window Help
1:3,113
Georeferencing
Layer: 03JUL17144335-P2AS-000000061
Editor
Task: Create New Feature
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2 | 293734.843665 | 2028119.408921 | 293748.845480 | 2028119.408921 | 3.68993
3 | 293571.763705 | 2028207.537991 | 293580.000066 | 2028205.890718 | 0.51394
4 | 293790.027288 | 2028266.016158 | 293798.263650 | 2028266.016158 | 2.19057
5 | 293859.212726 | 2028286.607063 | 293864.154543 | 2028282.488882 | 2.81155
Auto Adjust
Transformation: 1st Order Polynomial (Affine)
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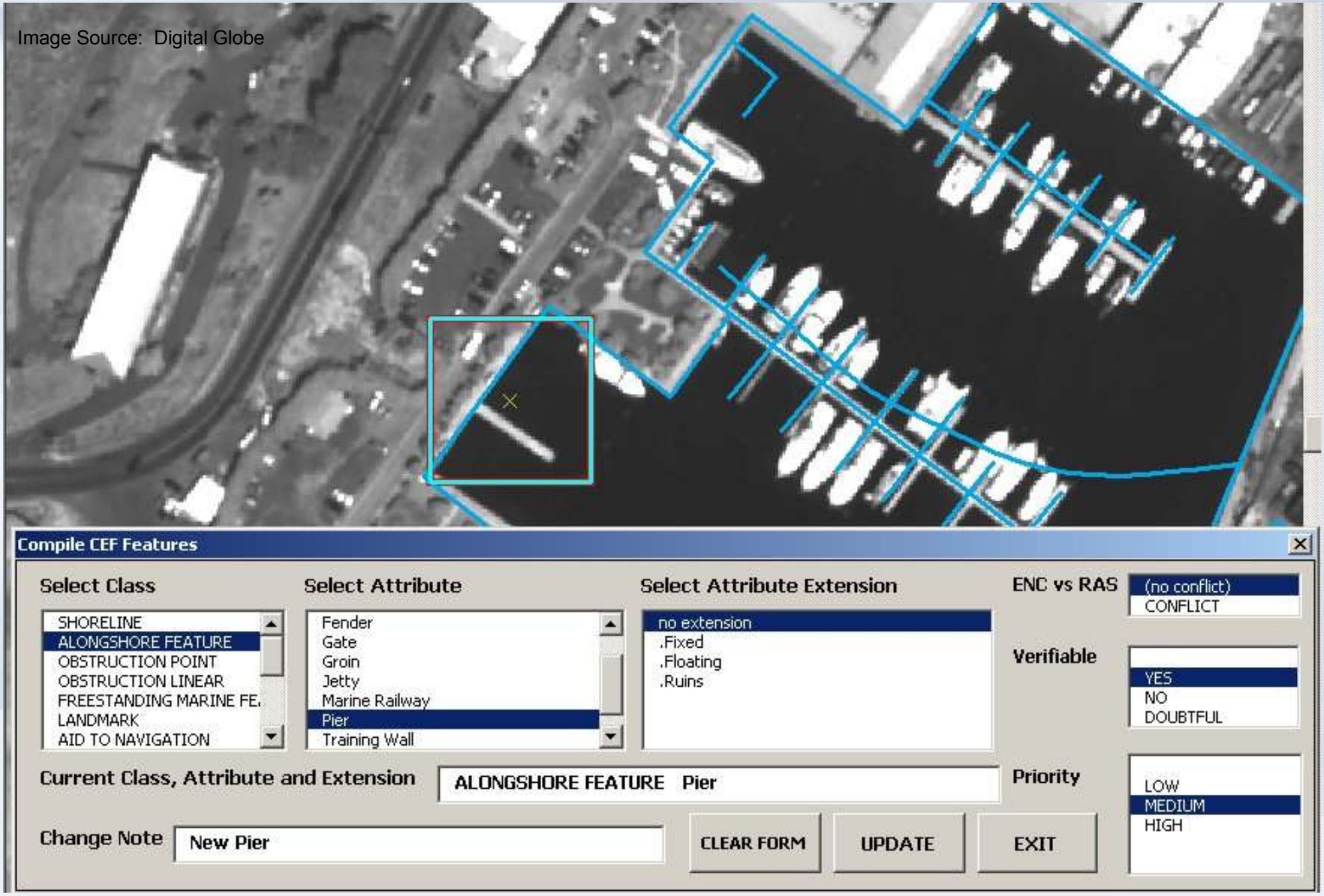
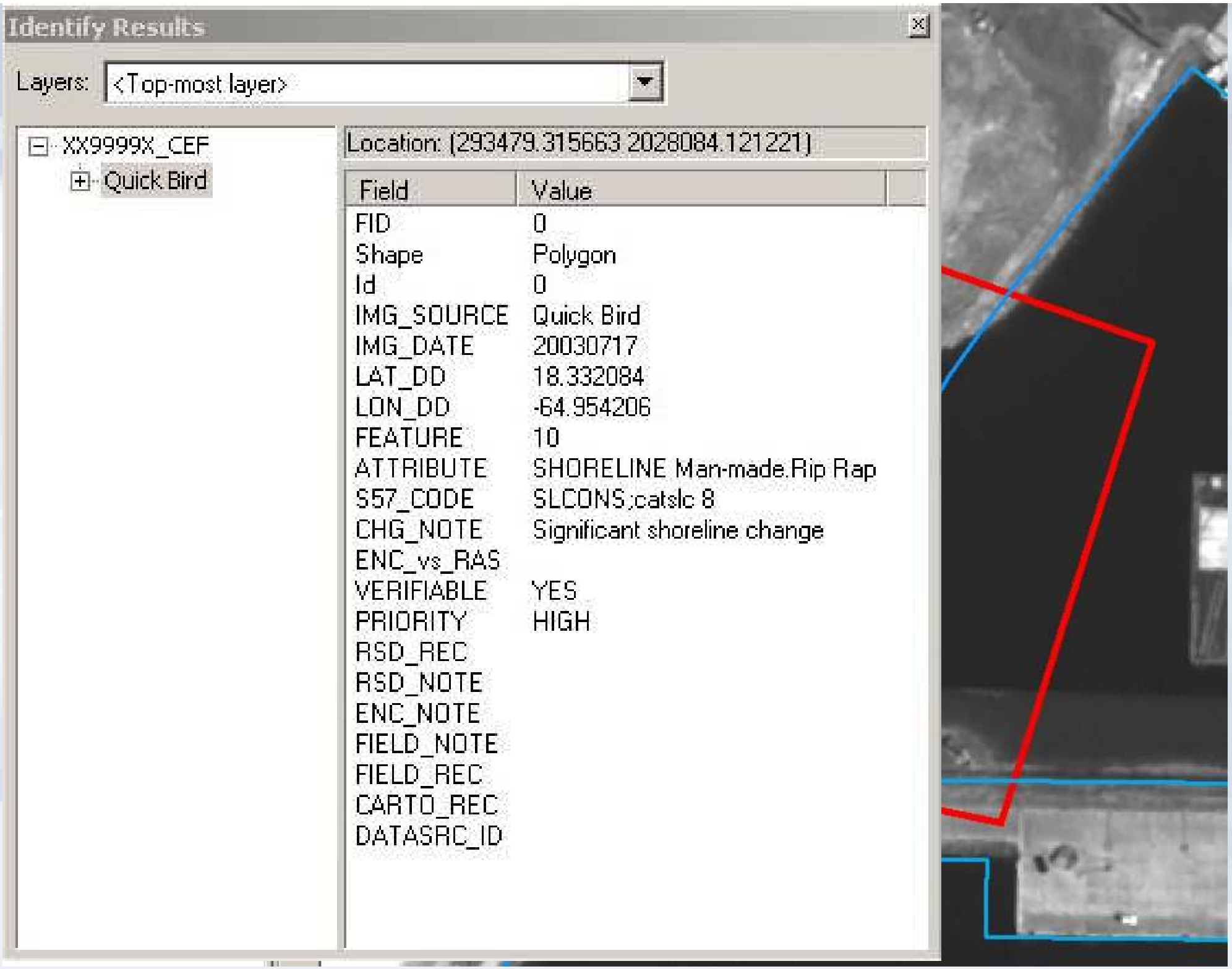
Save...
OK
Display
Source
Selection
Drawing
Arial
10
Image Source: Digital Globe

Chart Evaluation File (CEF)

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Value
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Shape Polygon
Id 0
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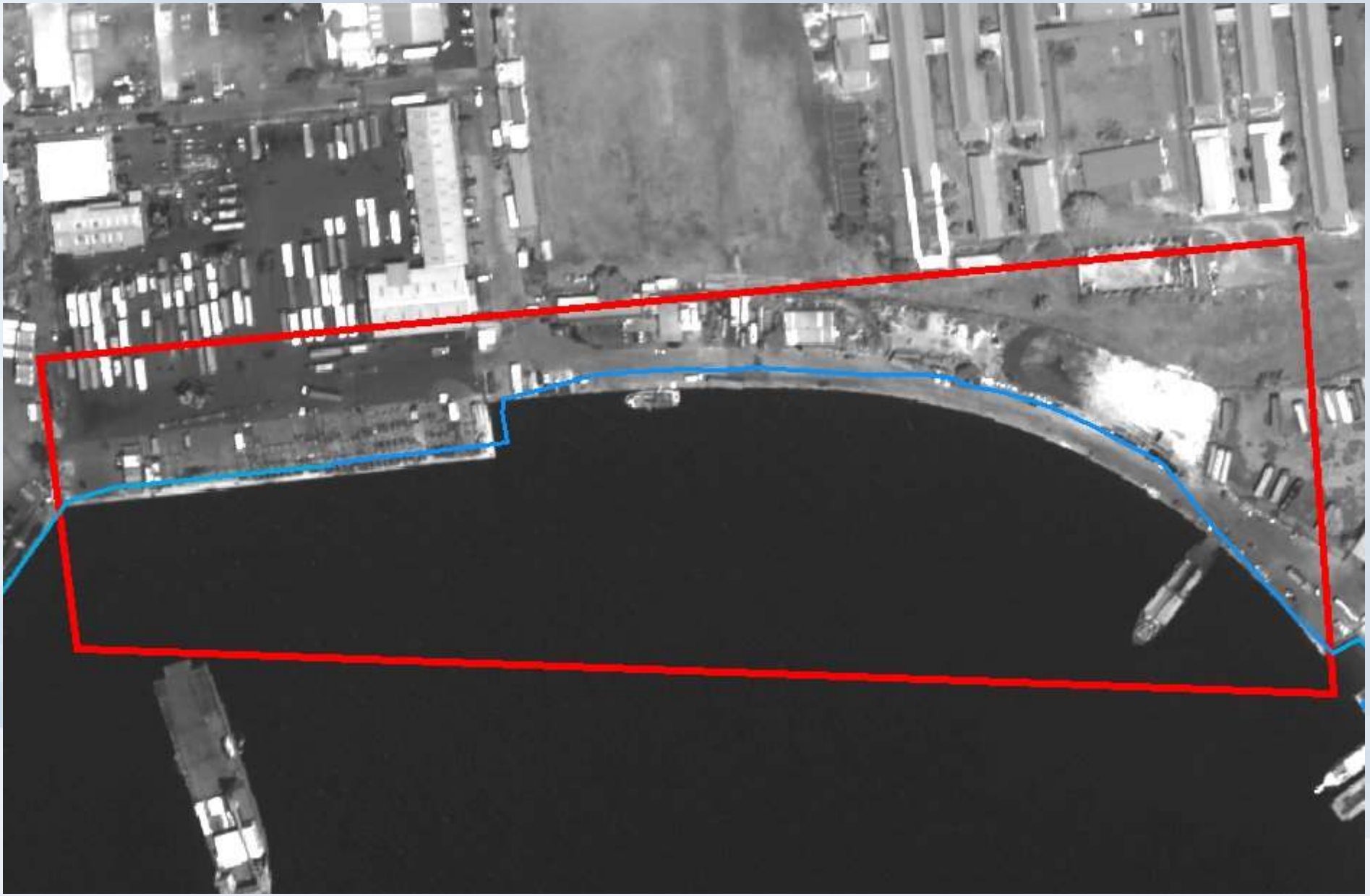
IMG_DATE 20030717
LAT_DD 18.332084
LON_DD -64.954206
FEATURE 10
ATTRIBUTE SHORELINE Man-made.Rip Rap
S57_CODE SLCONS;catslc 8
CHG_NOTE Significant shoreline change
ENC_vs_RAS
VERIFIABLE YES
PRIORITY HIGH
RSD_REC
RSD_NOTE
ENC_NOTE
FIELD_NOTE
FIELD_REC
CARTO_REC
DATASRC_ID

Charlotte Amalie 2003 Quickbird Image



Christiansted 2003 Quickbird Image

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Christiansted 2003 Quickbird Image

National Oceanic and

Absolute Georeferencing

- Obtain ~ 30 GPS ground control points
  - 10 – Re-georeferencing
  - 20 – Accuracy Assessment
- Provide approximate locations for field crew
- Use a first-order polynomial

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Accuracy Assessment Procedures

- Procedures are based on the *Geospatial Positioning Accuracy Standards Part 3: National Standard for Spatial Data Accuracy* document provided by the Federal Geographic Data Committee (FGDC)
- Root mean square error is used to estimate positional accuracy.
- An independent source of higher accuracy control must be used.
- A minimum of 20 check points shall be used.
- Check points must be distributed to reflect the geographic area of interest.

Image Georeferencing Accuracy

Location	Image georeferencing source	RMSx	RMSy	RMSr	CE at 95% confidence level
Alameda	GPS Data Points	0.57 m	0.55 m	0.79 m	1.36 m
Carquinez	GPS Data Points	0.49 m	0.47 m	0.68 m	1.17 m

Field Verification

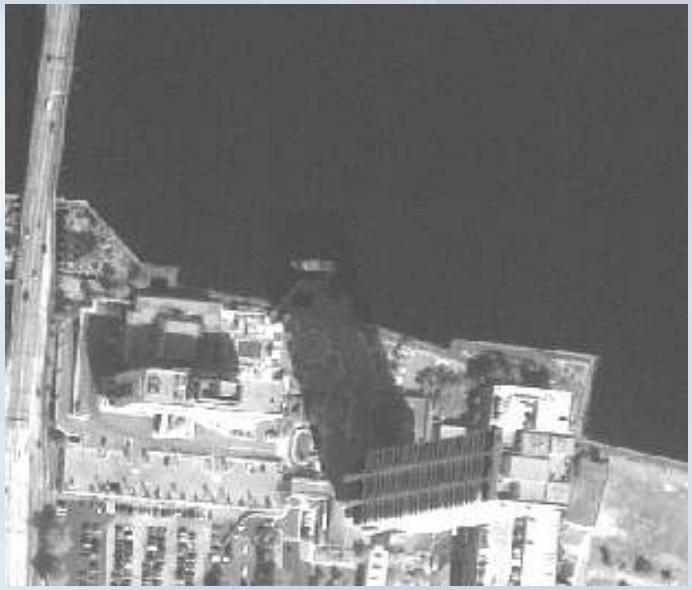


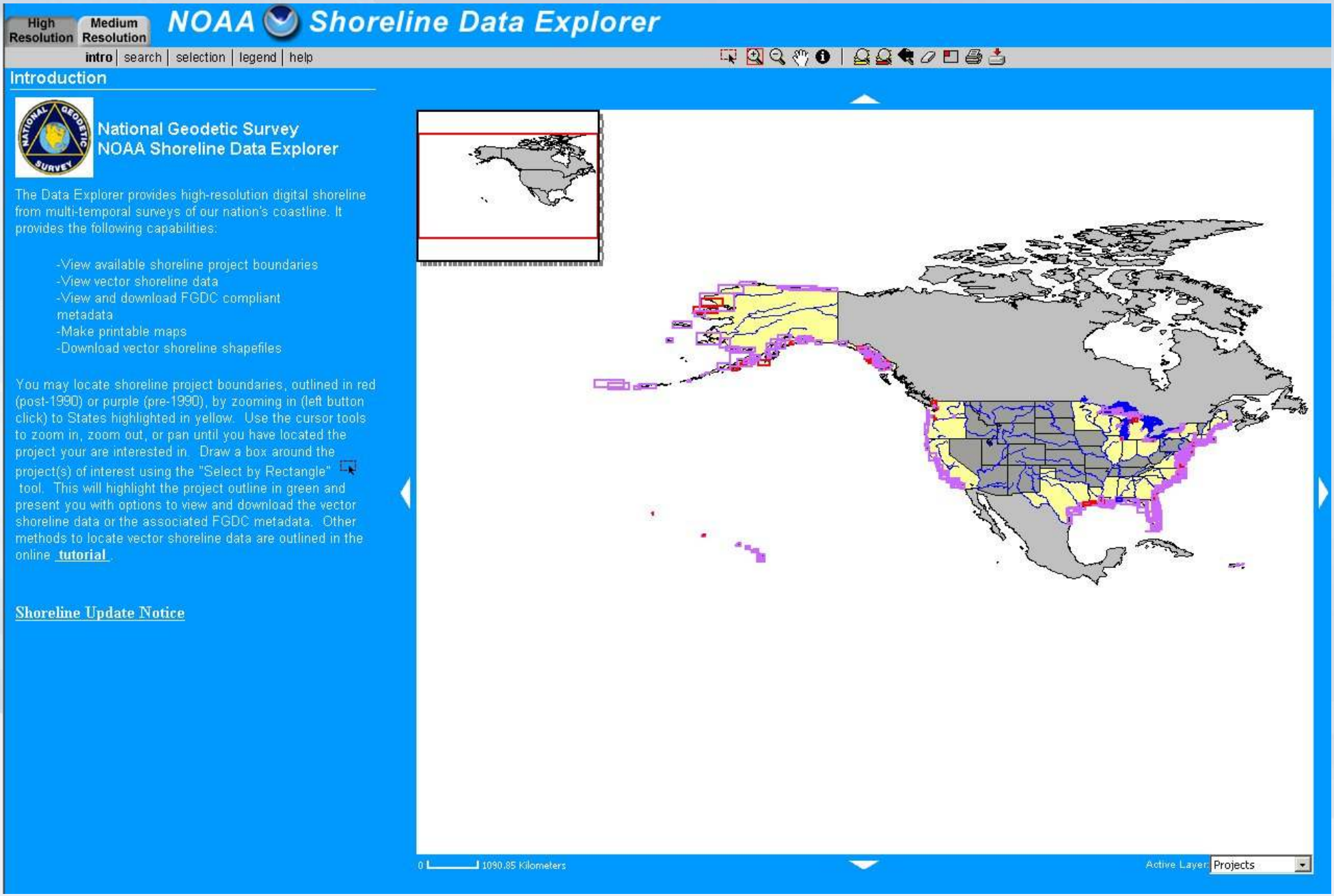
Image Source: Space Imaging, LLC

Image Source: Space Imaging, LLC

Limitations

- Ground control and check points must be collected for areas to be compiled
- Factors that limit accuracy of compiled shoreline:
  - Spatial resolution
  - Georeferencing accuracy
  - Possibility of unknown, nonsystematic geometric problems with the imagery
  - Cannot be tide coordinated
  - Attribution is difficult and varies depending on atmospheric conditions

Data Distribution



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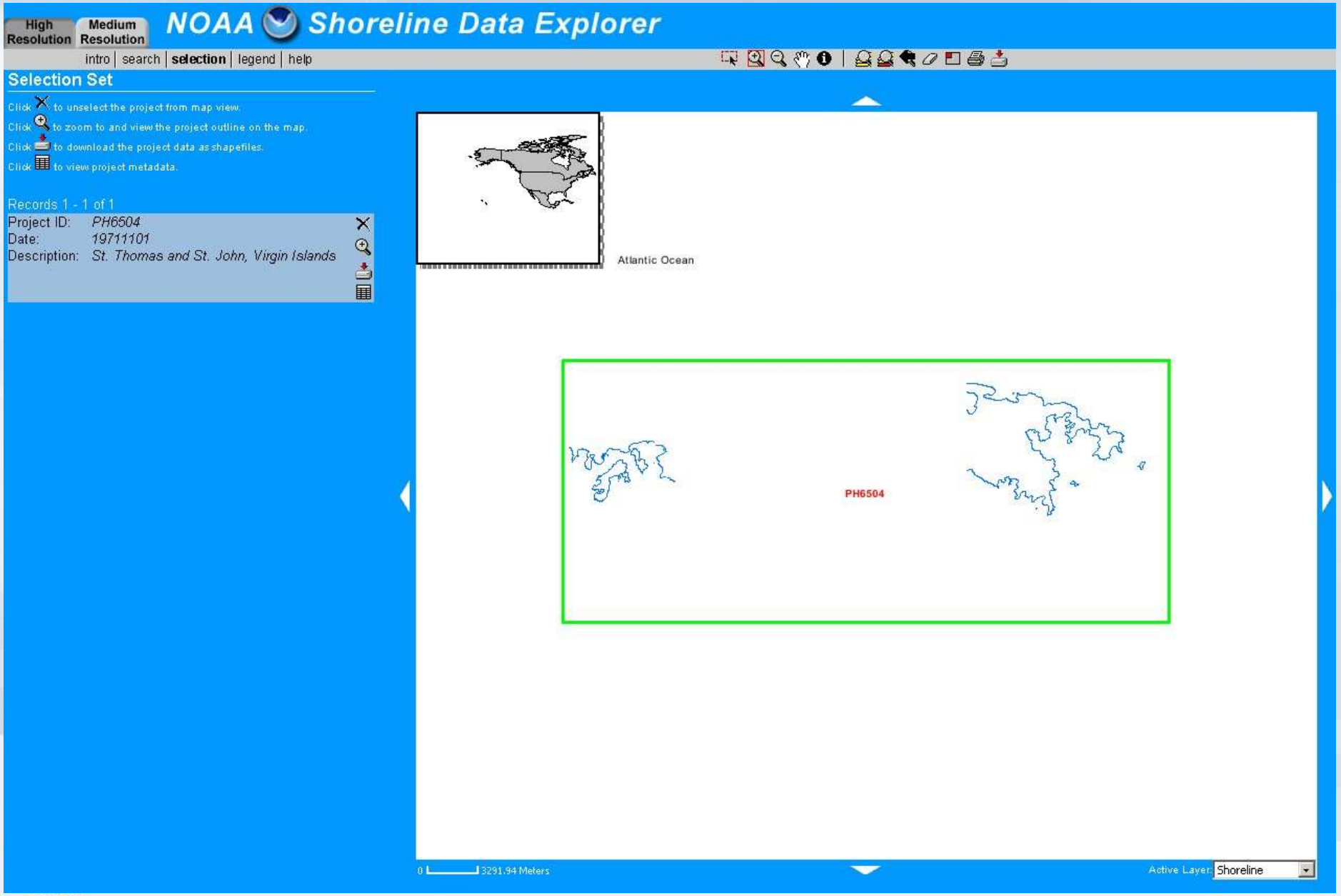

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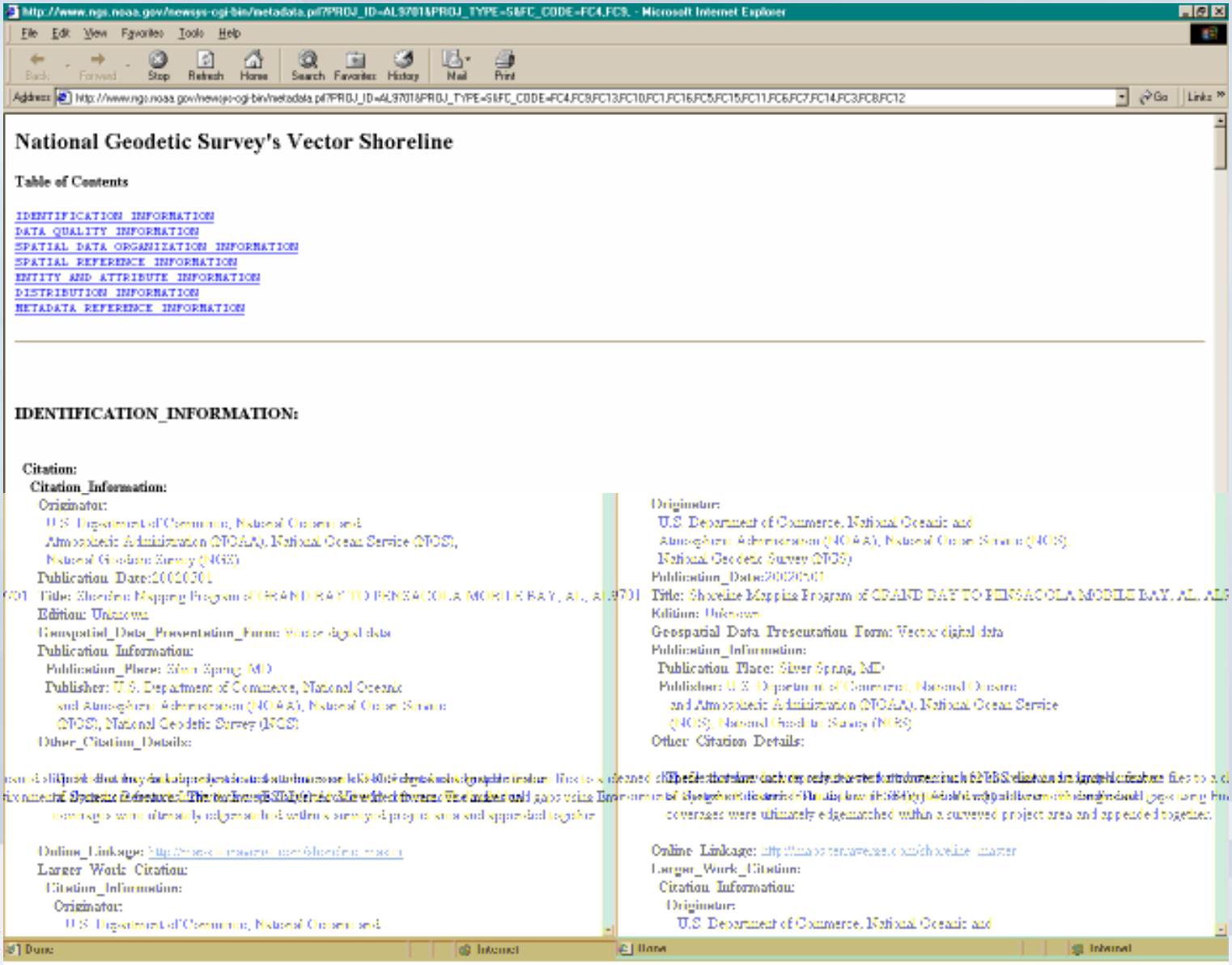

National Geodetic Survey's Vector Shoreline

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DISTRIBUTION_INFORMATION
METADATA_REFERENCE_INFORMATION

IDENTIFICATION_INFORMATION:

Citation:
Citation_Information:
Originator:
U.S. Department of Commerce, National Oceanic and
Atmospheric Administration (NOAA), National Ocean Service (NOS),
National Geodetic Survey (NGS)
Publication_Date:20020301
Title: Shoreline Mapping Program of GRAND BAY TO PENSACOLA MOBILE BAY, AL, AL9701
Edition: Unknown
Geospatial_Data_Presentation_Form: Vector digital data
Publication_Information:
Publication_Place: Silver Spring, MD
Publisher: U.S. Department of Commerce, National Oceanic
and Atmospheric Administration (NOAA), National Ocean Service
(NOS), National Geodetic Survey (NGS)
Other_Citation_Details:
Online_Linkage:
Larger_Work_Citation:
Citation_Information:
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Citation_Information:
Originator:
U.S. Department of Commerce, National Oceanic and

Shoreline Applications

NOAA's Shoreline may be used for:

- **Application to Navigational Charts**
- **Historical Shoreline Change Analysis**
- Land and marine geographic information systems (GIS) basemaps
- Property management, real estate
- Coastal disputes
- Natural resource management
- Coastal zone management
- Maritime boundaries

Shoreline Application to Nautical Charts

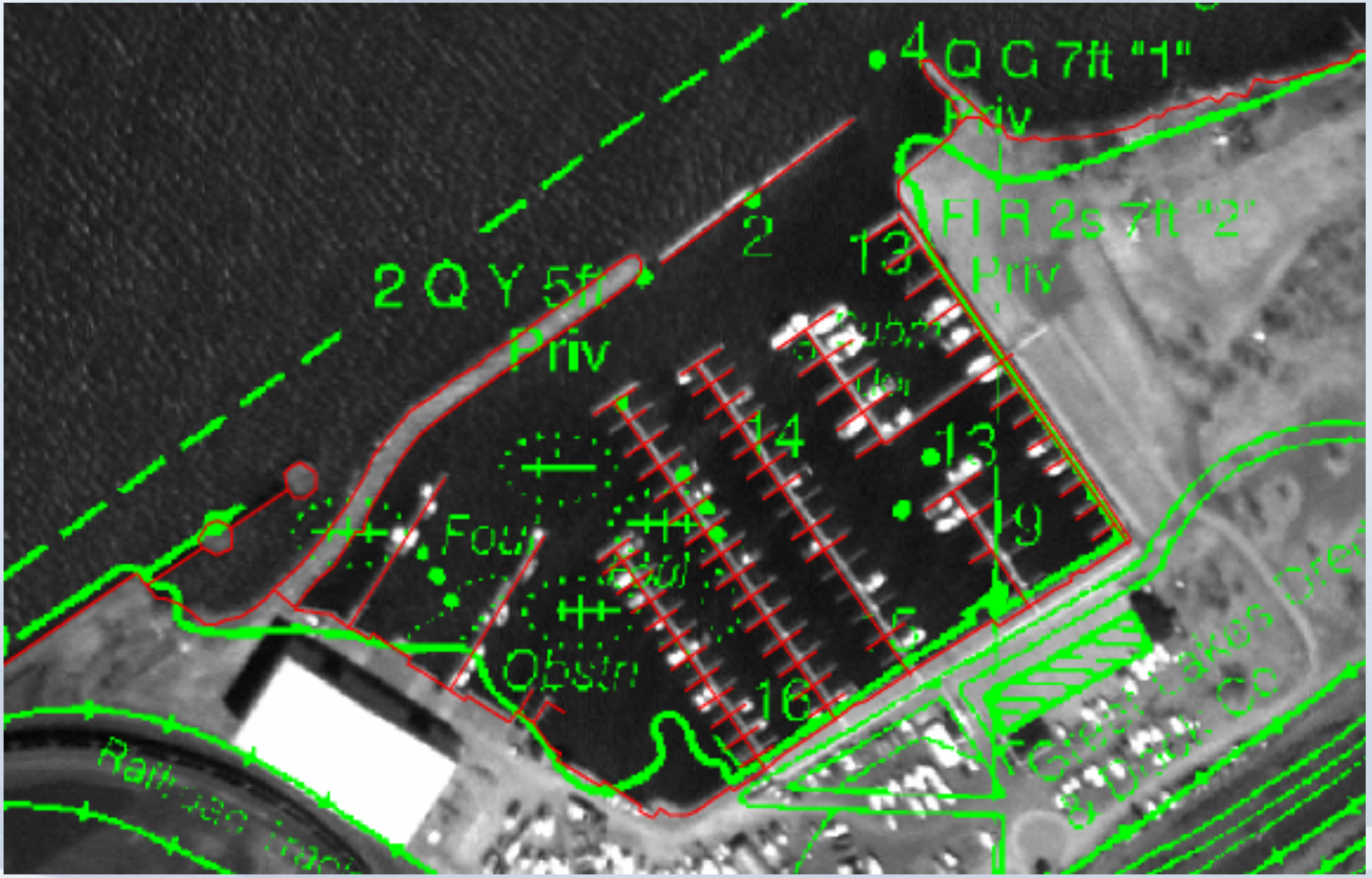

Image Source: Space Imaging, LLC

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Historical Shoreline Change

1957

1976

2004 Aerial photograph
Fort Desoto Beach, FL

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Summary

- High resolution satellite imagery can be a useful tool for shoreline feature change analysis in ports.
- Accurate georeferencing is crucial.
- The Chart Evaluation File (CEF) follows the project through the entire multi-organizational process of the ENC Validation Initiative
- Shoreline is delivered in a GIS friendly format and can be downloaded from http://www.ngs.noaa.gov/RSD/shoredata/NGS_Shoreline_Products.htm