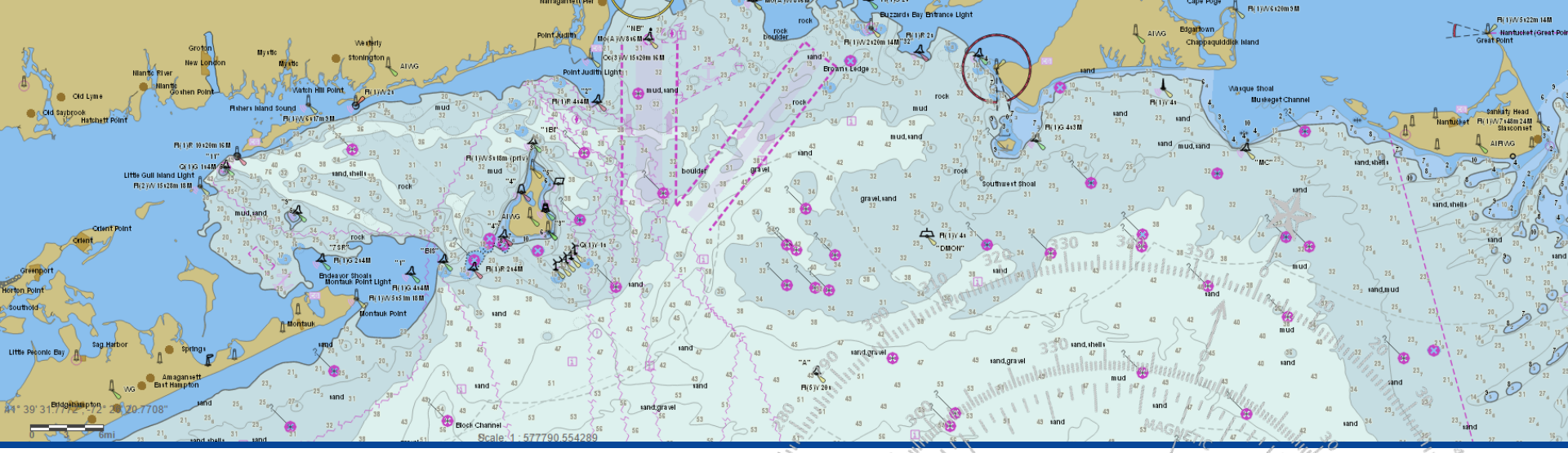


Re-scheming Plan NOAA's Electronic Navigational Chart Coverage

Shachak Pe'eri

Office of Coast Survey / Marine Chart Division / Chart Standards Group

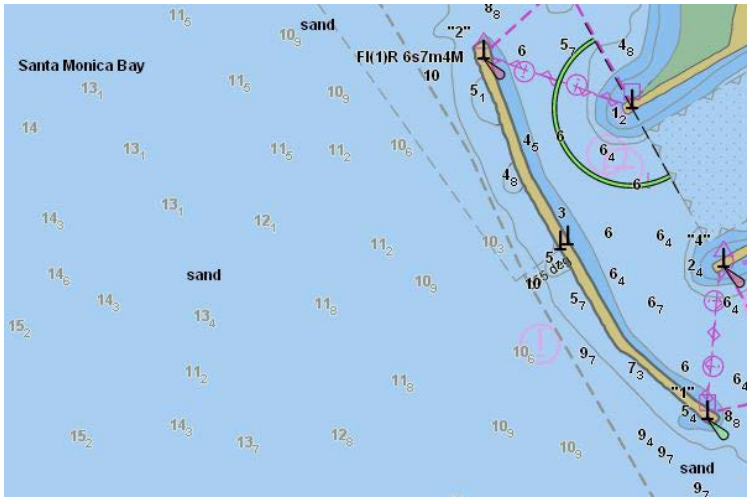
Contact info: Shachak.peeri@noaa.gov

Motivation

Feedback from the Mariners on the ENC:

- Too many alarms on caution areas
- Need more detailed depth areas in key locations
- Need accurate least depths on wrecks and obstructions- we are training our users to ignore the magenta Xs.
- ENCs are not standalone products-they are components of a seamless suite. There are too many discontinuities.
- Symbology is not good for recreational mariners

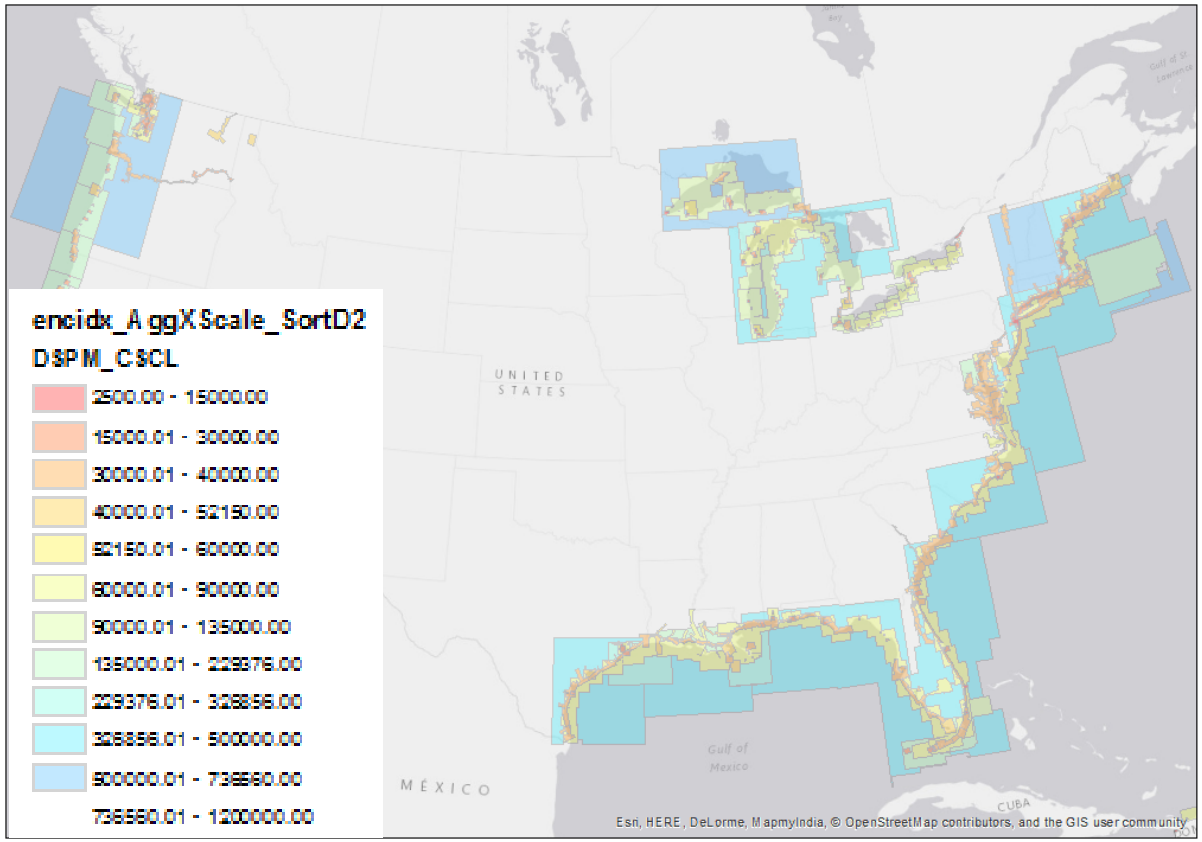
In addition – ECDIS manufacturers
(ECDIS - Electronic Chart Display and Information System)

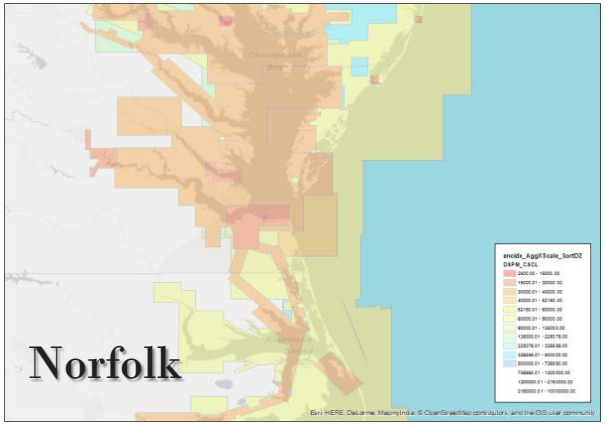


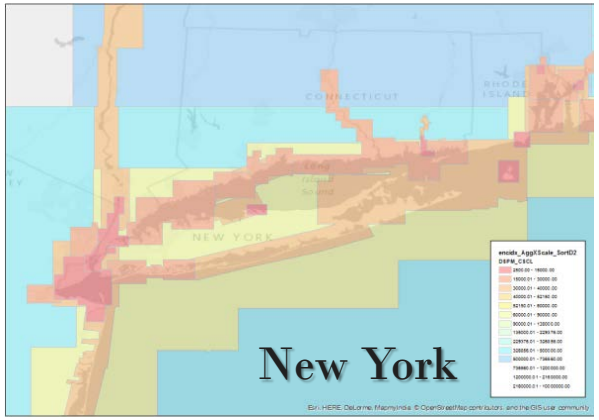
- Displays ENC's and integrates a variety of real-time information
- Meets IHO regulations and is an alternative to paper charts

- Vector database (of chart features)
- Built to IHO's S-57 standards

Current US ENC coverage





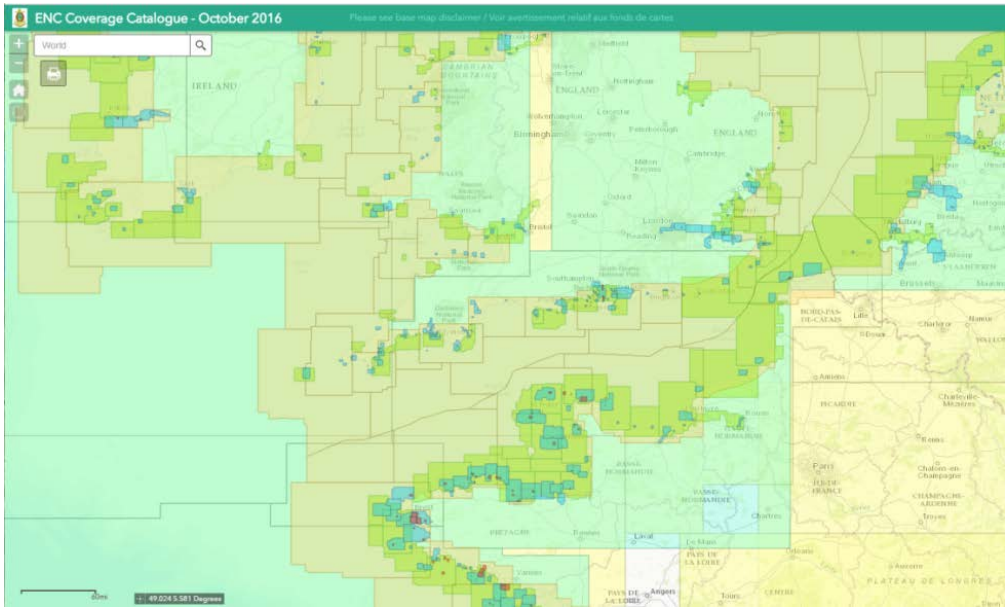


Current ENC footprints

Legacy data from raster charts (131 RNC scales and 120 ENC scales)

ENC limits copied directly from raster chart boundaries

Easy interim solution



The English channel/ UKHO & SHOM

As a result:

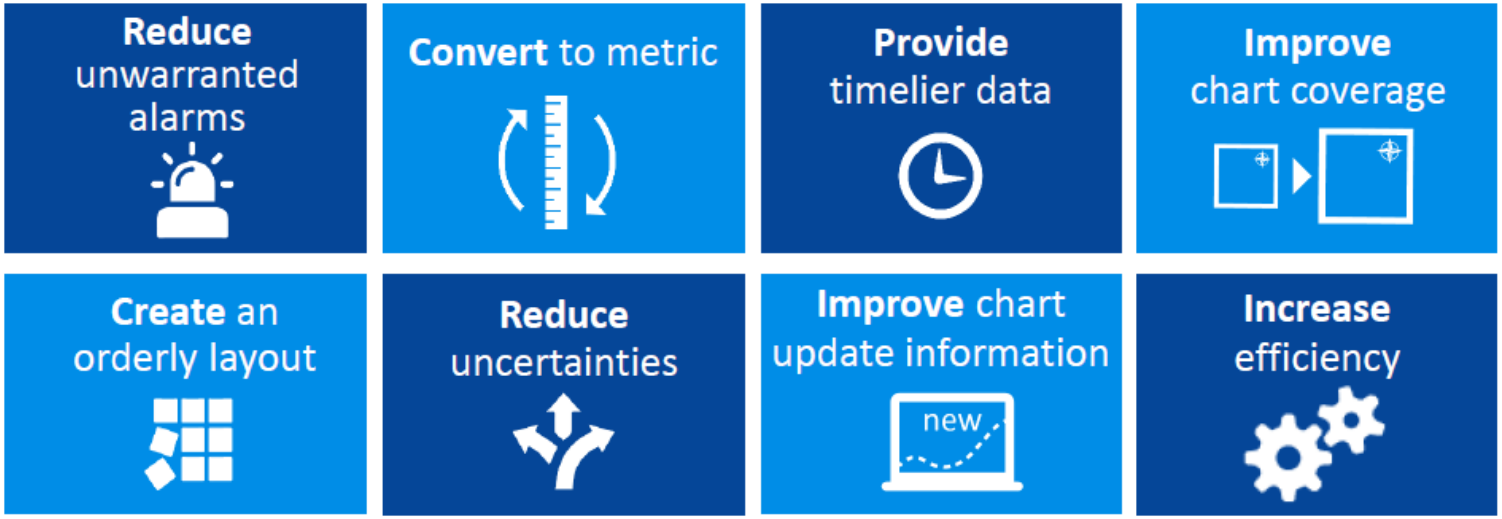
- Too many scales
- Duplication of coverage
- Lacking uniformity, consistency, and coherence

  Not a smooth transition from scale to scale while navigating on ECDIS systems

Vision for the future: Nautical Charting Plan

Purpose Improve NOAA nautical chart coverage, products, and distribution

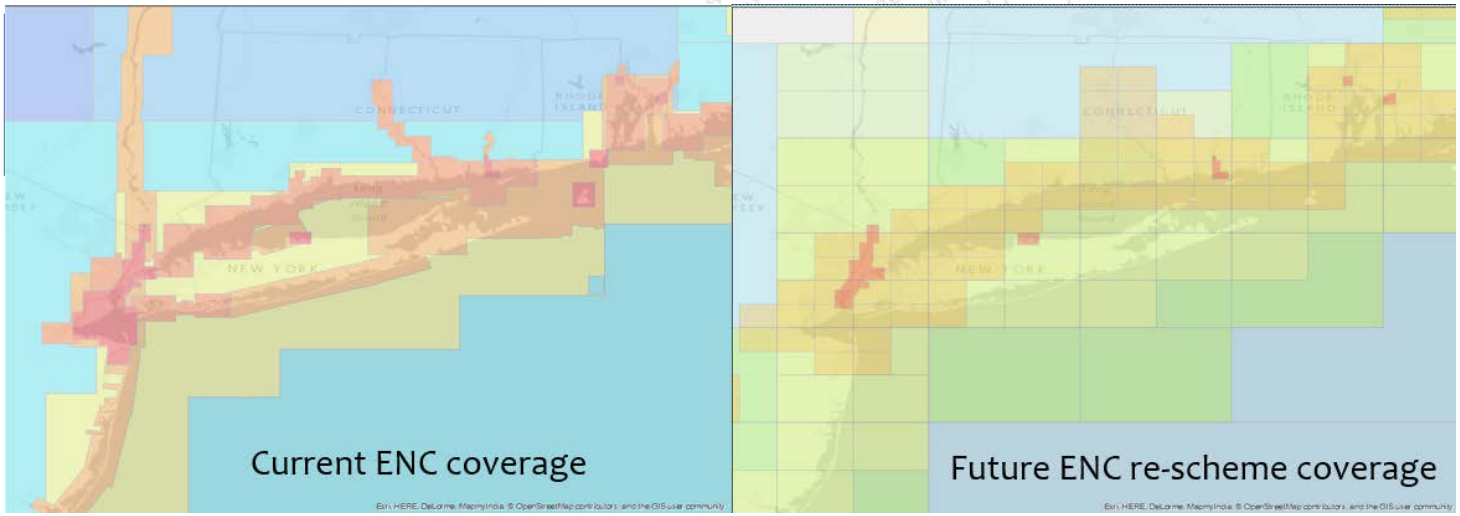
Improvements



Outcome Ease of access to more precise, higher-resolution charts that deliver the most up-to-date navigation information possible

Vision for the future: Nautical Charting Plan

Create an orderly layout for ENCs



- Reduced number of scales
- Standardized size and scope
- Boundaries/limits following lines of longitude & latitude
- Interlocking boundaries through the scales

Vision for the future: Nautical Charting Plan

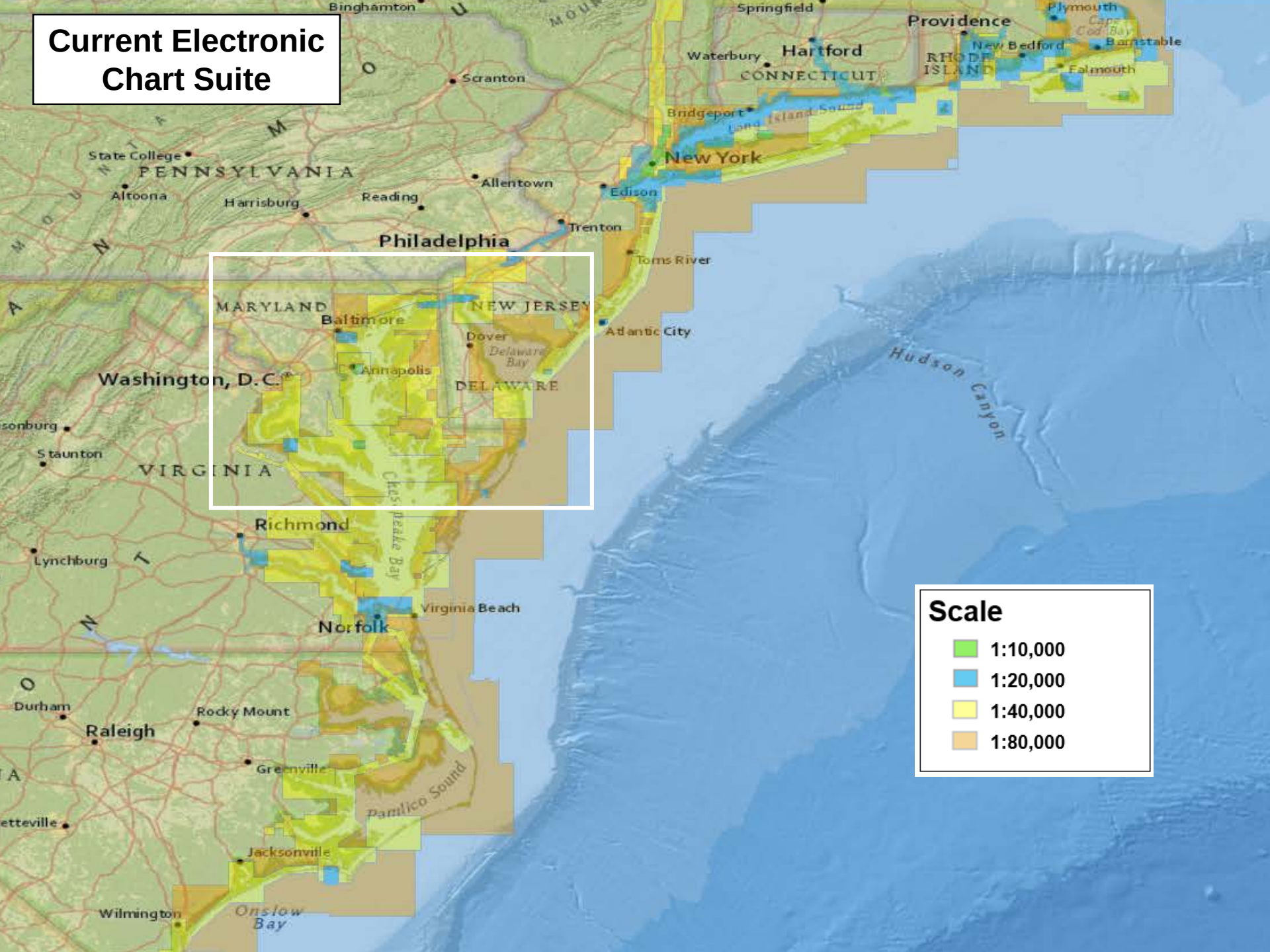
	Standard scale (rounded)
Band 1	1:3,000,000
	1:1,500,000
Band 2	1:700,000
	1:350,000
Band 3	1:180,000
	1:90,000
Band 4	1:45,000
	1:22,000
Band 5	1:12,000
	1:8,000

IHO Recommended Scales

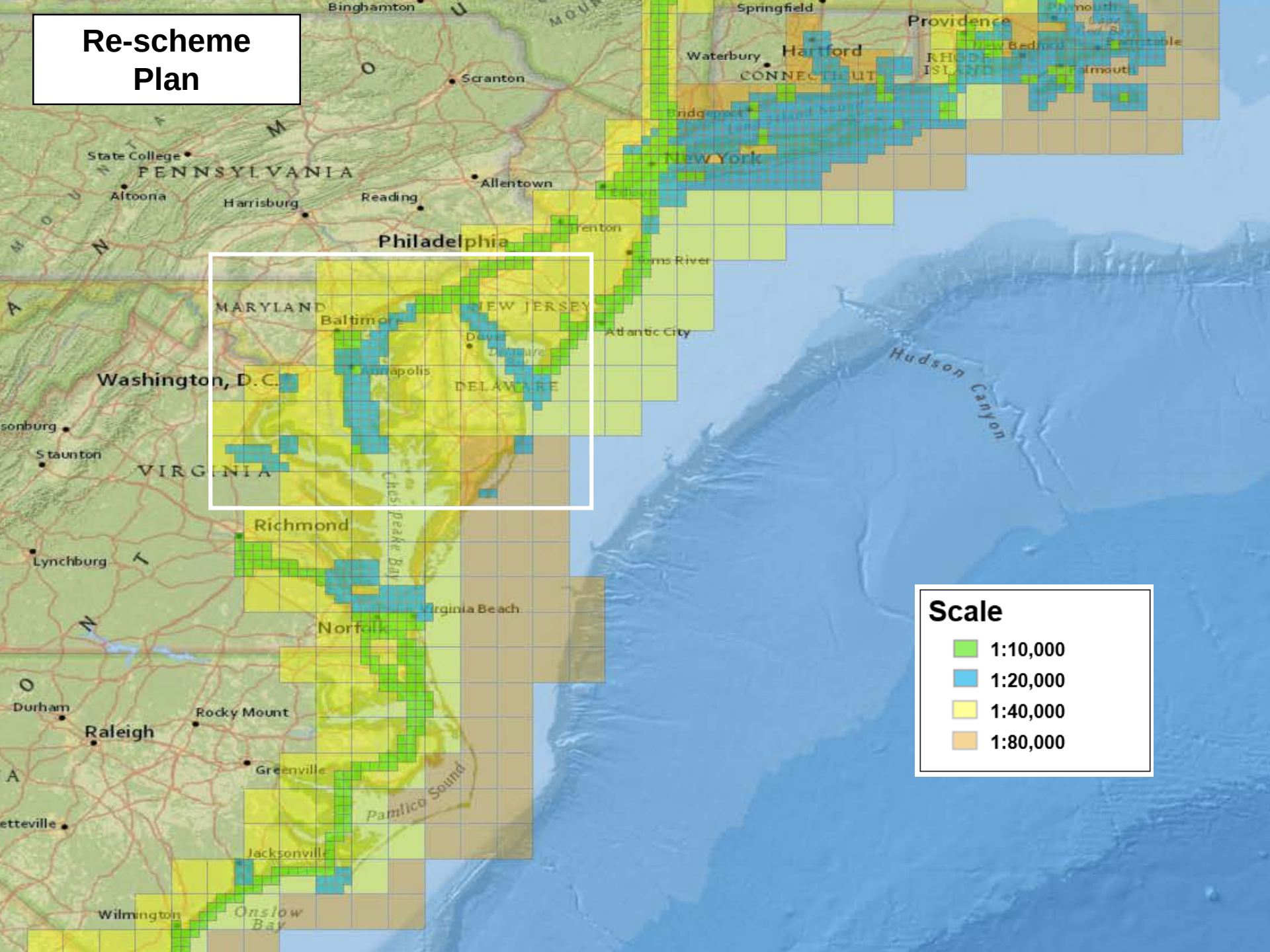
Scale band	Standard Scale (rounded)
Band 1	1:5,120,000
	1:2,560,000
Band 2	1:1,280,000
	1:640,000
Band 3	1:320,000
	1:160,000
Band 4	1:80,000
	1:40,000
Band 5	1:20,000
	1:10,000

NOAA's Reschemed Scales

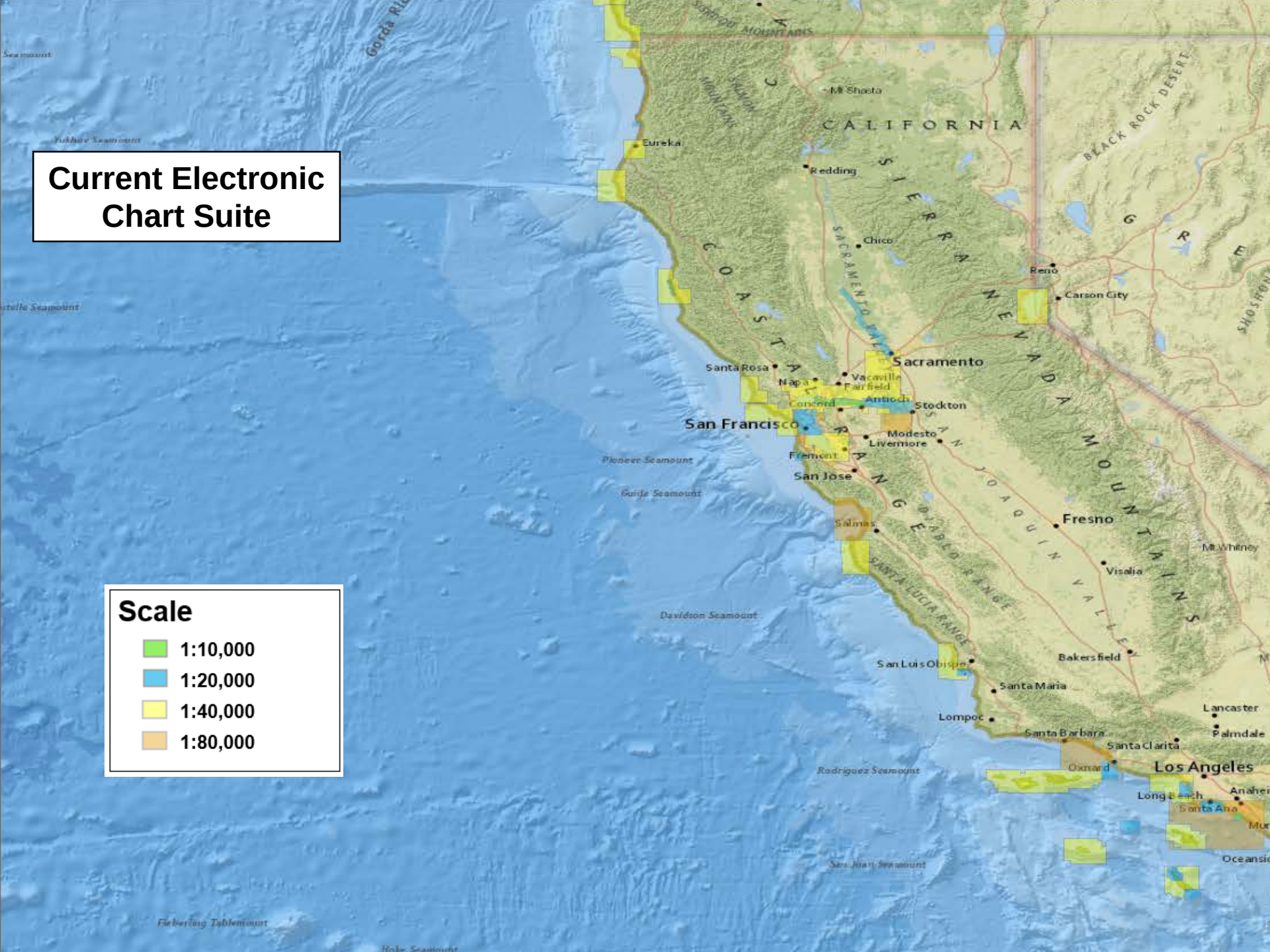
Current Electronic Chart Suite

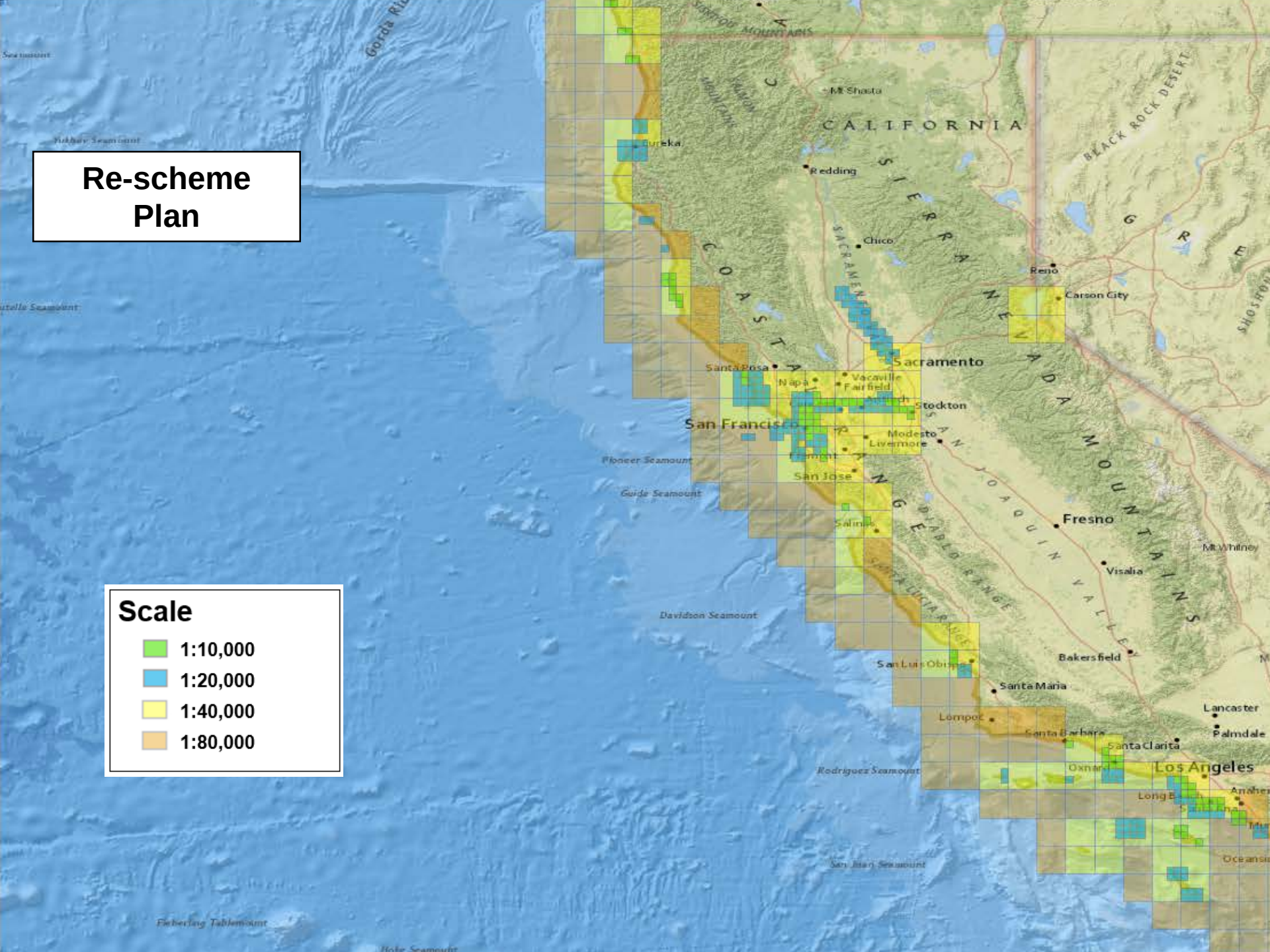


Re-scheme Plan



Current Electronic Chart Suite




Re-scheme Plan
Scale
1:10,000
1:20,000
1:40,000
1:80,000
CALIFORNIA
COAST RANGE
SIERRA NEVADA MOUNTAINS
SACRAMENTO MOUNTAINS
KLAMATH MOUNTAINS
BLACK ROCK DESERT
GREAT
SHOSHONE
SAN JOAQUIN VALLEY
DIABLO RANGE
SANTA LUCIA RANGE
Mt Shasta
Eureka
Redding
Chico
Reno
Carson City
Sacramento
Santa Rosa
Napa
Vacaville
Fairfield
Stockton
San Francisco
Modesto
Livermore
San Jose
Salinas
Fresno
Visalia
Mt Whitney
Bakersfield
San Luis Obispo
Santa Maria
Lompoc
Santa Barbara
Santa Clarita
Lancaster
Palmdale
Los Angeles
Oxnard
Long Beach
Anaheim
Pioneer Seamount
Guide Seamount
Davidson Seamount
Rodriguez Seamount
San Juan Seamount
Fieberling Tablemount
Hoke Seamount
Gorda Ridge

Added value

A. Usage bands and recommended scales

B. Cell size and Naming convention (Management tools)

C. Bathymetry (metric depth units)

D. Scale hierarchy of cartographic features

   Roads

   Topography

E. Adjustable raster products

F. More scrutiny on the quality on the chart products

Added value

A. Usage bands and recommended scales

B. Cell size and Naming convention (Management tools)

C. Bathymetry (metric depth units)

D. Scale hierarchy of cartographic features

   Roads

   Topography

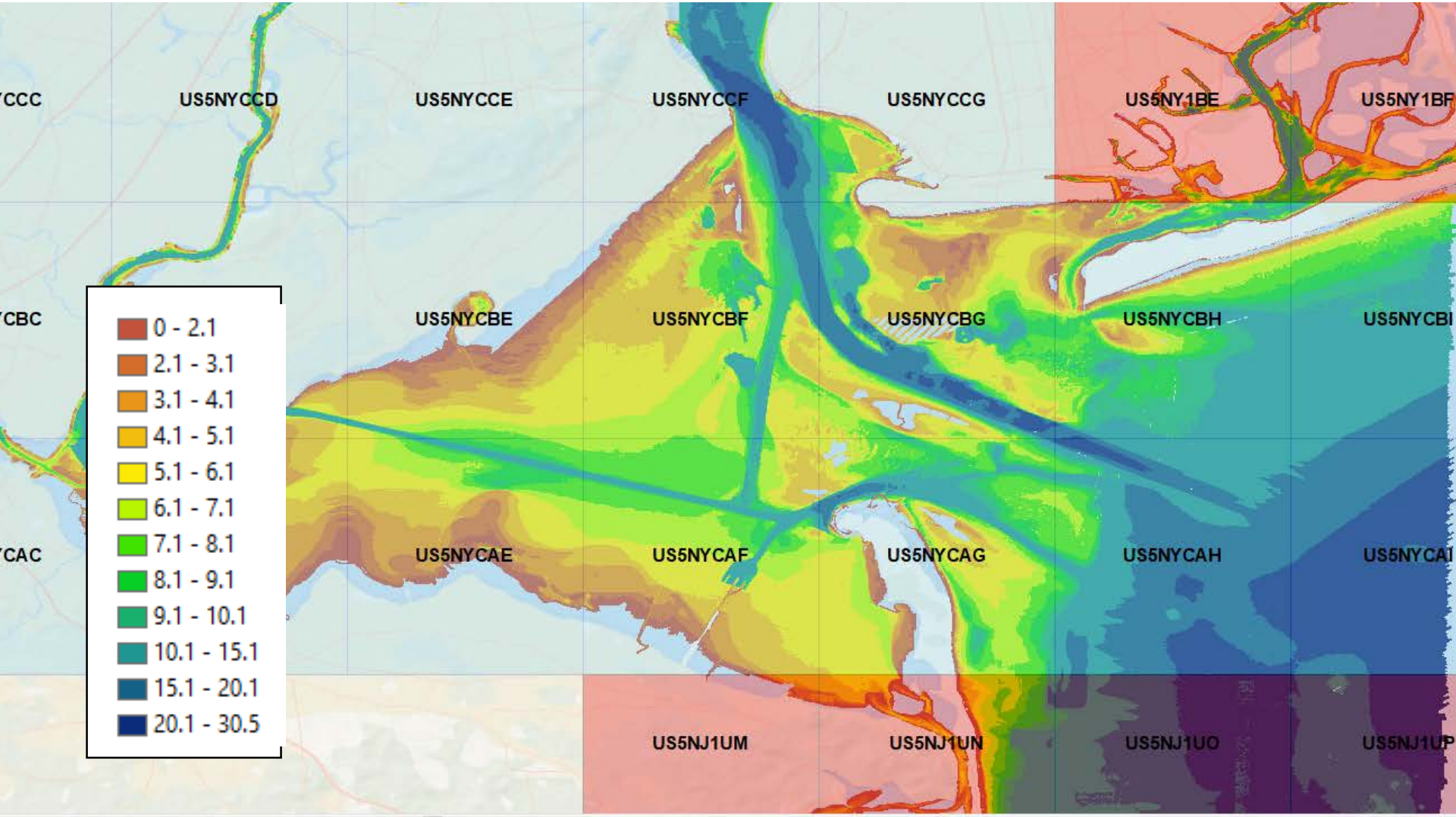
E. Adjustable raster products

F. More scrutiny on the quality on the chart products

Recommended depth contours per scale band

Scale band	Standard Scale (rounded)	Width	Height	IHO S-4 (B-411)
Band 1	1:5,120,000	38.4	38.4	100, 200,…
	1:2,560,000	19.2	19.2	50,100,150,200,…
Band 2	1:1,280,000	9.6	9.6	50,100,150,200,…
	1:640,000	4.8	4.8	20 ,50,100,150,200,…
Band 3	1:320,000	2.4	2.4	20,30,50,100,150,200,…
	1:160,000	1.2	1.2	10, ,20,30,50,100,150,200,…
Band 4	1:80,000	0.6	0.6	5, 10, ,20,30,50,100,150,200,…
	1:40,000	0.3	0.3	2, 5, 10, ,20,30,50,100,150,200,…
Band 5	1:20,000	0.15	0.15	2, 5, 8,10,15,20,30,50,100,150,200,…
	1:10,000	0.075	0.075	2,3,4,5,6,7,8,10,15,20,30,50,100,150,200,…

Although most features at similar scale can be copied, bathymetry will need to be recompiled!



Recommended depth contours per scale band

Scale band	Standard Scale (rounded)	Width	Height	Hydro S.L.	MPA	Traffic Lanes	Lights Buoys	air-gaps	Topo	Channels
Band 1	1:5,120,000	38.4	38.4							
	1:2,560,000	19.2	19.2							
Band 2	1:1,280,000	9.6	9.6							
	1:640,000	4.8	4.8							
Band 3	1:320,000	2.4	2.4							
	1:160,000	1.2	1.2							
Band 4	1:80,000	0.6	0.6							
	1:40,000	0.3	0.3							
Band 5	1:20,000	0.15	0.15							
	1:10,000	0.075	0.075							

Road

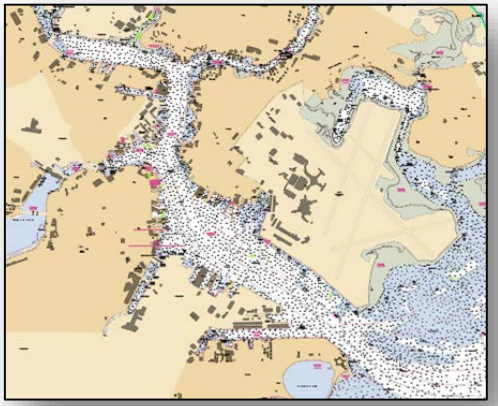

PHILADELPHIA
CAMDEN
Penns Landing
TOWER
SPIRE
STACK
USS NEW JERSEY
Camden Marine Terminal
FIREBOAT STA
REACH M TO BENJAMIN FRANKLIN BRIDGE
BENJAMIN FRANKLIN FIXED BRIDGE
Kaighn Pt
Wood-Lynne
STACK (NE OF FOUR)
Fulton St
John St
Fletcher St
Maiden Lane Slip
Depeyster St
Pine St
Wall St
Ferry
PIER 1
Poplar St
Middagh St
Cranberry St
Orange St
E 23 St
Oak St
Culyer St

Rasterization

Boston Inner Harbor (US5MA11M (1:10K)

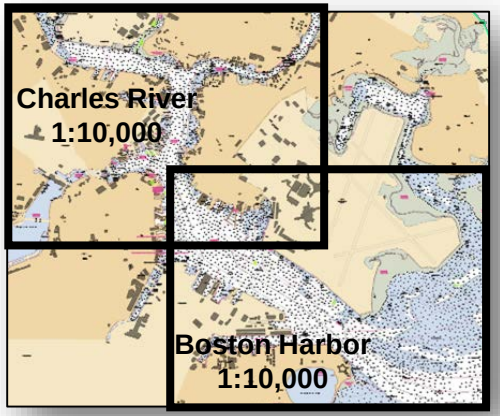
ENC

RNC-ish (tile)



No title, notes, …

PoD / Paper



With all the “cartographic furniture”

“Quality Control on ENCs”, Ence and Pe’eri
(NOAA’s Open House in Nautical Cartography - July 7, 2017)

Interfacing with other thematic layers

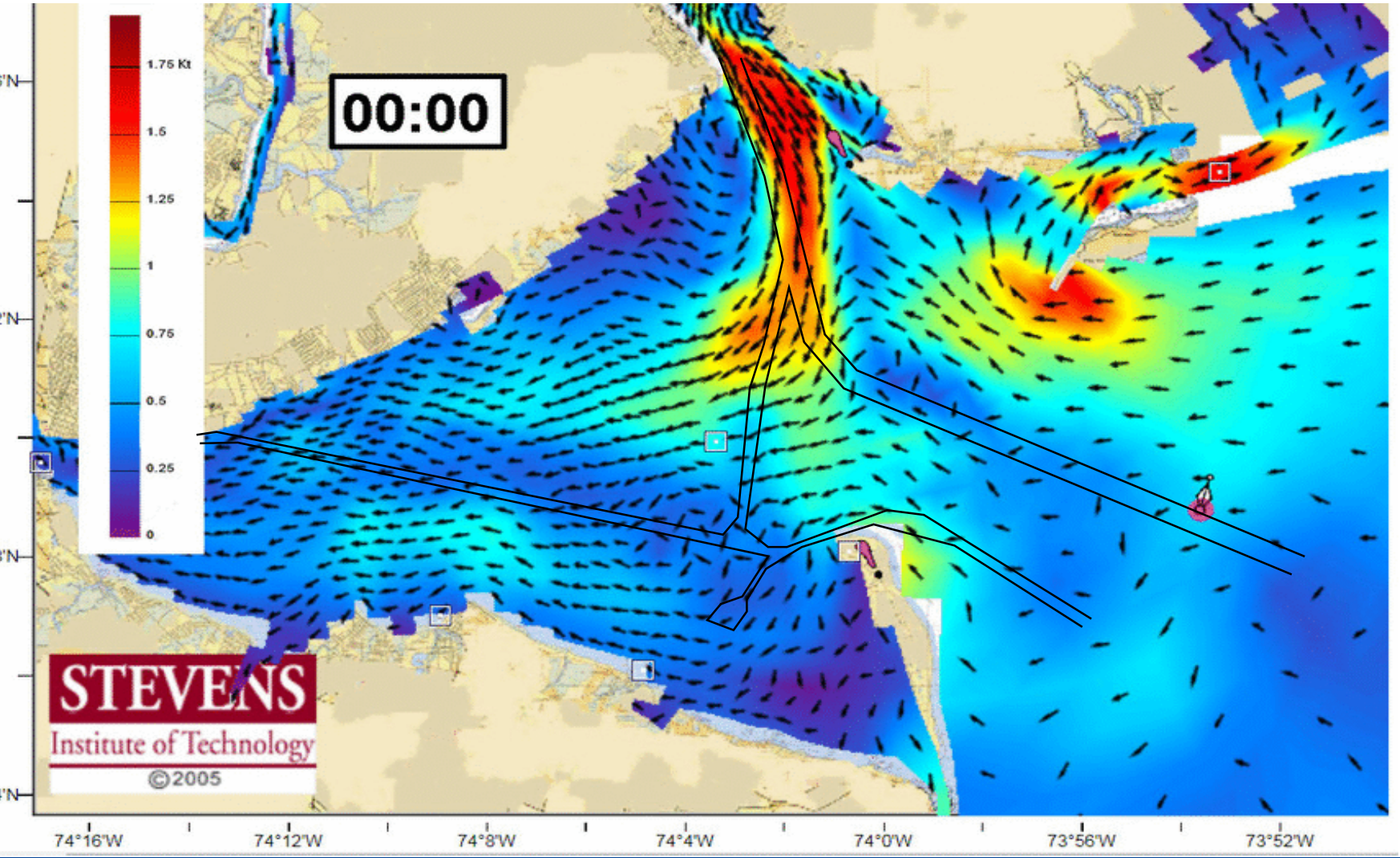
Common Portable Pilot Units (PPUs)

- Portable Pilot (ORCA PILOT G2)
- SealQ;
- QPS (Qastor)
- Transas (Pilot Pro);
- Raven Aerostar (Raven PPU)
- NavSim (NavSim PPU)
- Trelleborg (Safe Pilot)
- Rose Point (Coastal Explorer)
- Bowditch (Wheelhouse 2/3)

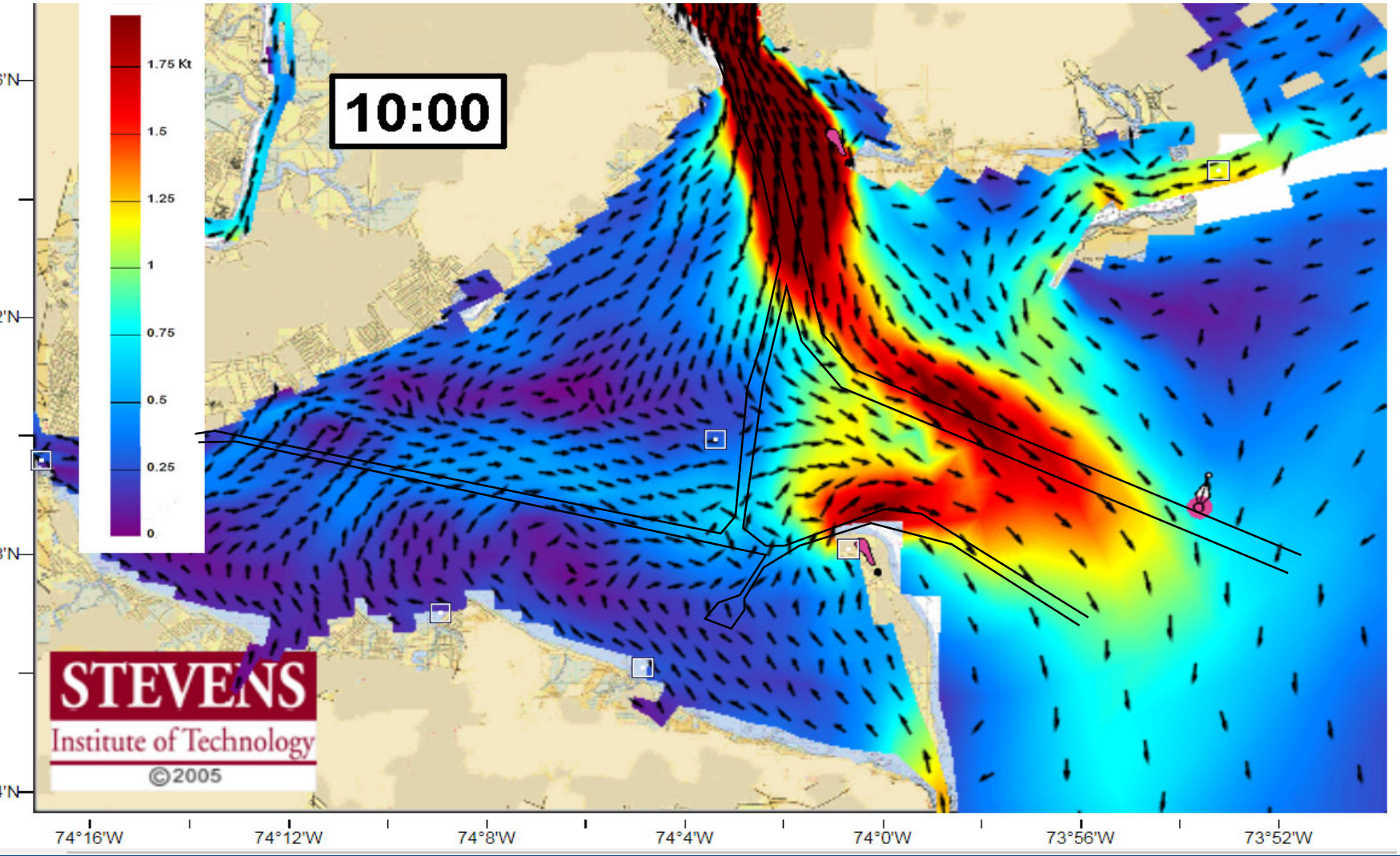
Providing products to PPUs

1. Product standards for Portable Pilot Units
2. Relevant layers (parameters to investigate)
3. Spatial resolution/Scales
4. Depth resolution for models (binning depth at a given interval)

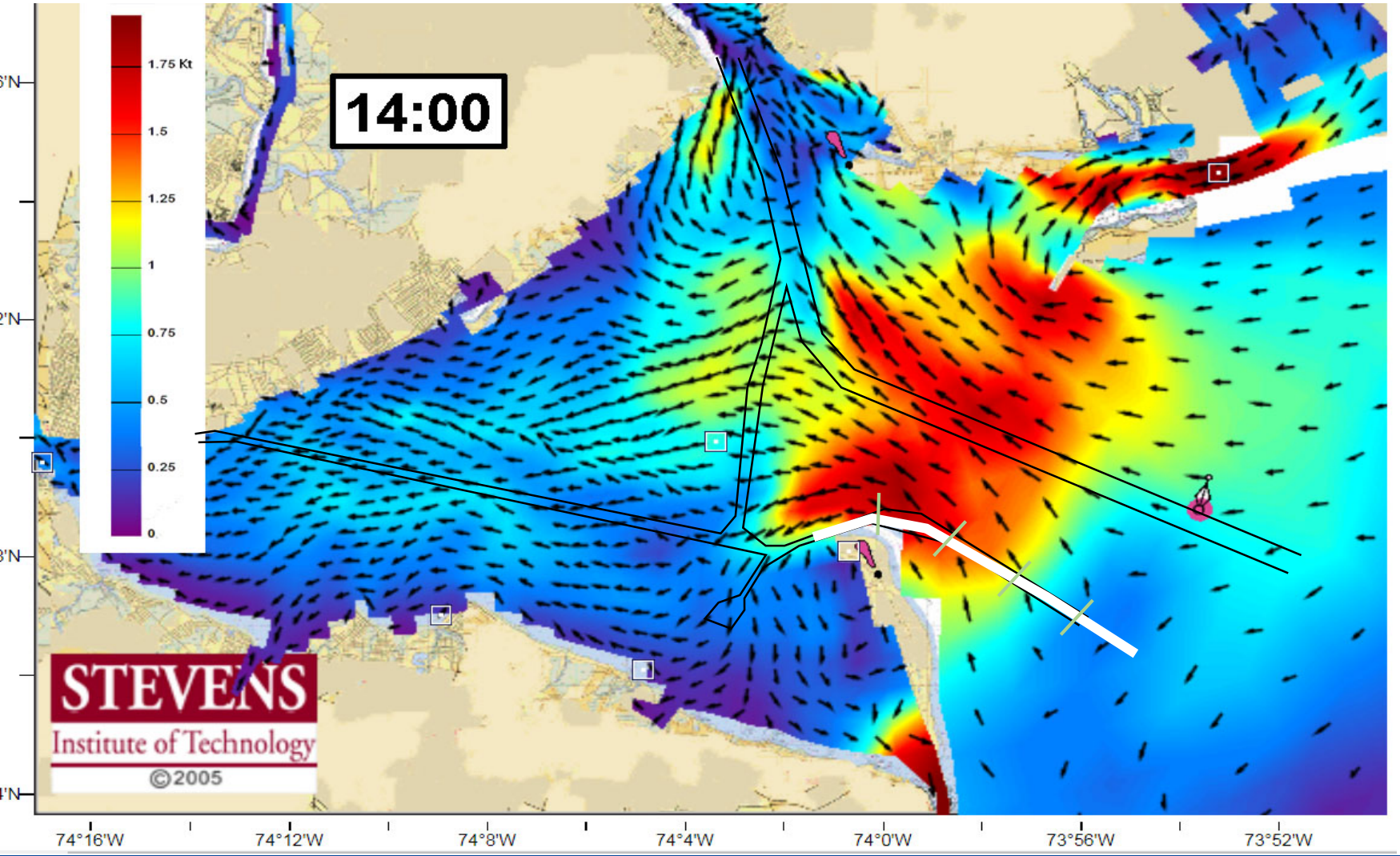
Planning a course with all available resources



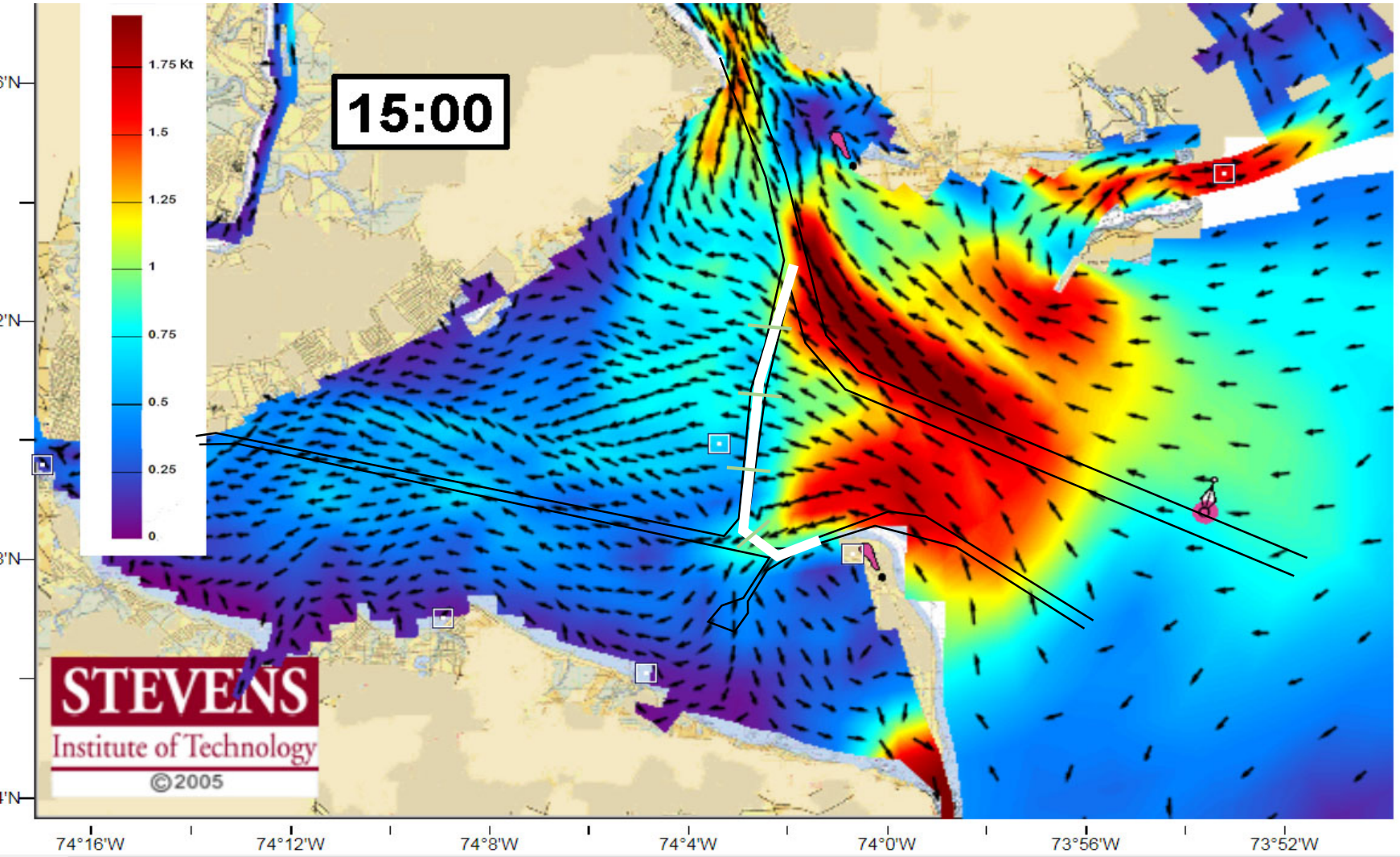
Planning a course with all available resources



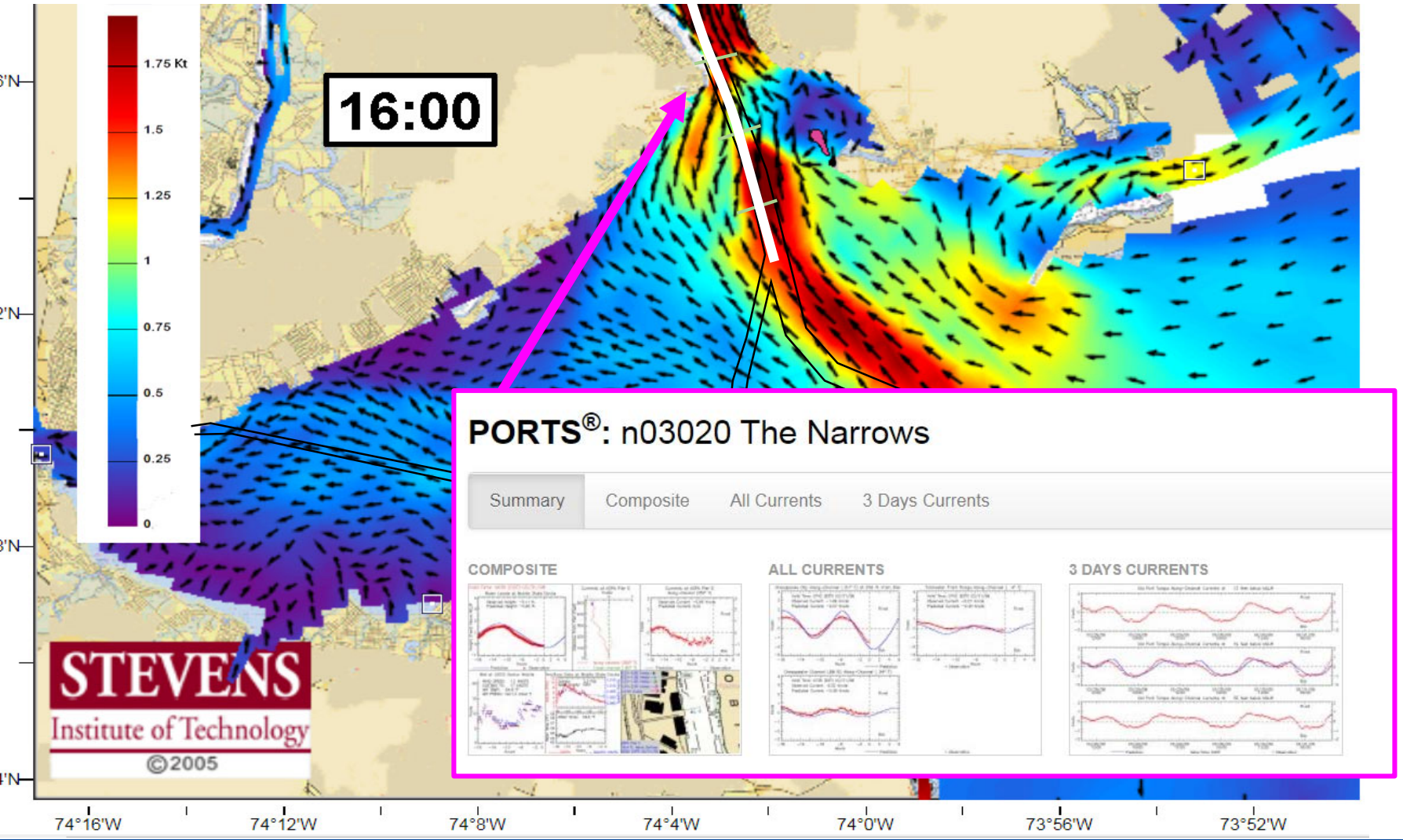
Planning a course with all available resources



Planning a course with all available resources



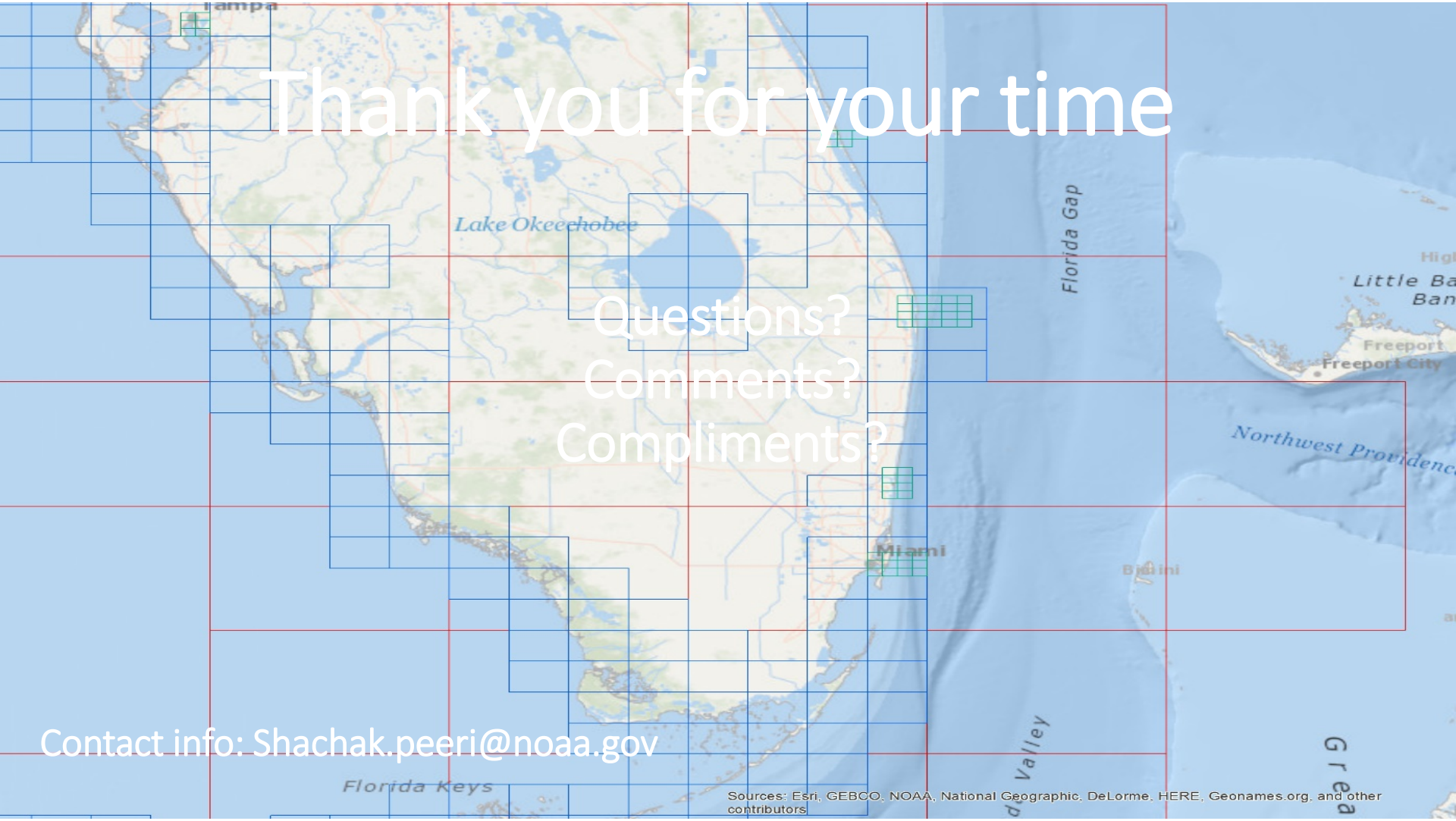
Planning a course with all available resources

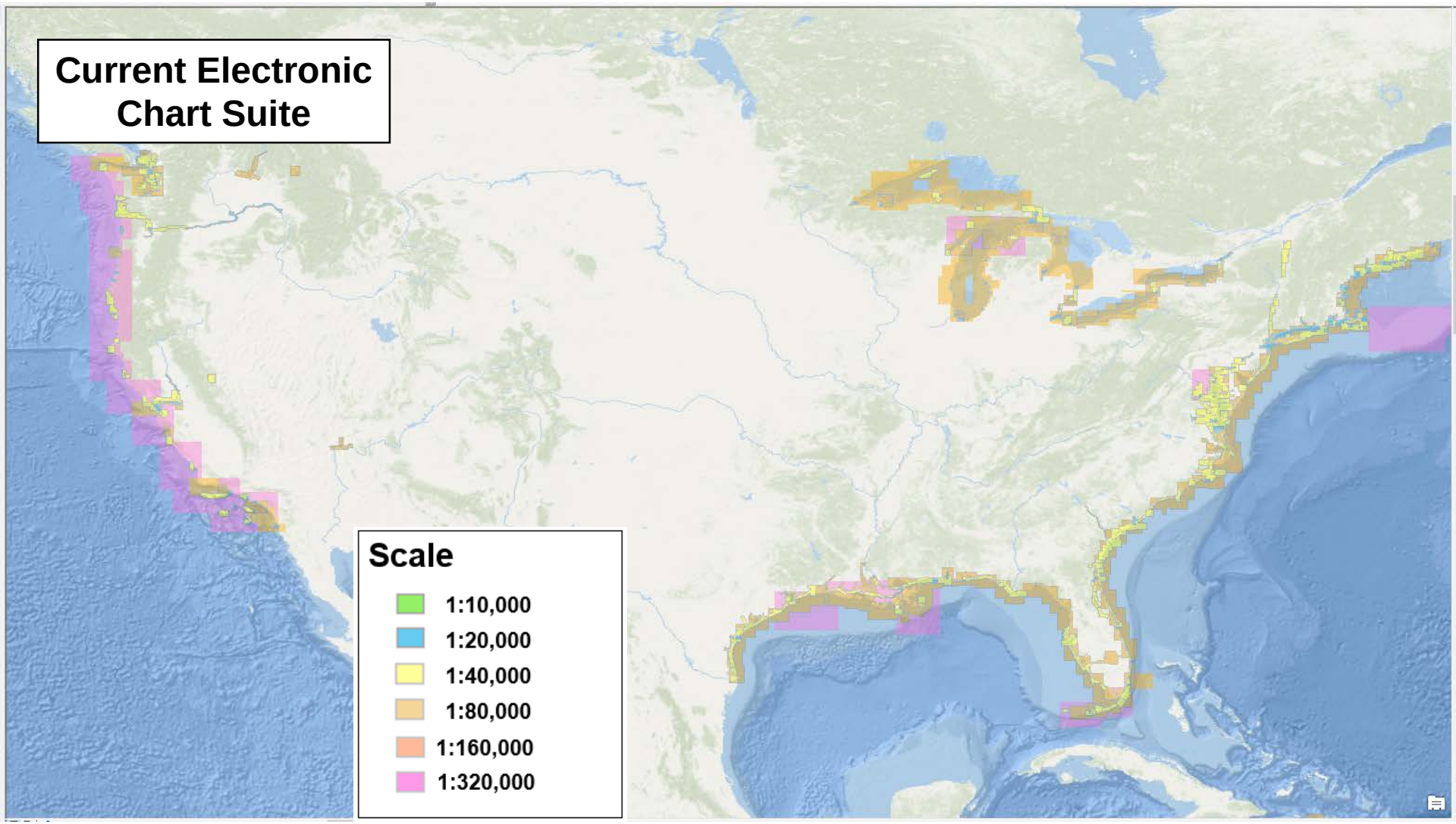


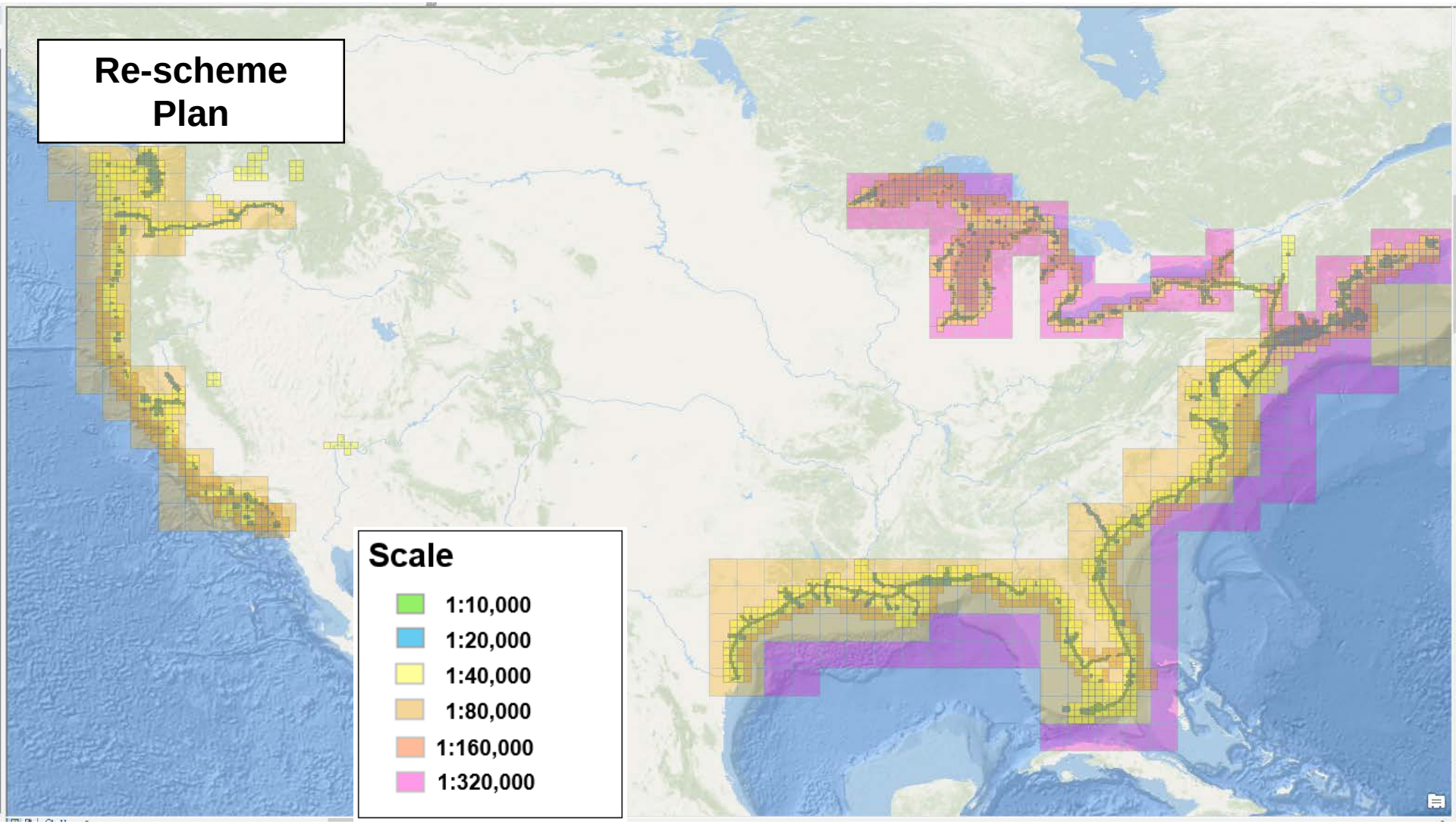
Thank you for your time

Questions?
Comments?
Compliments?

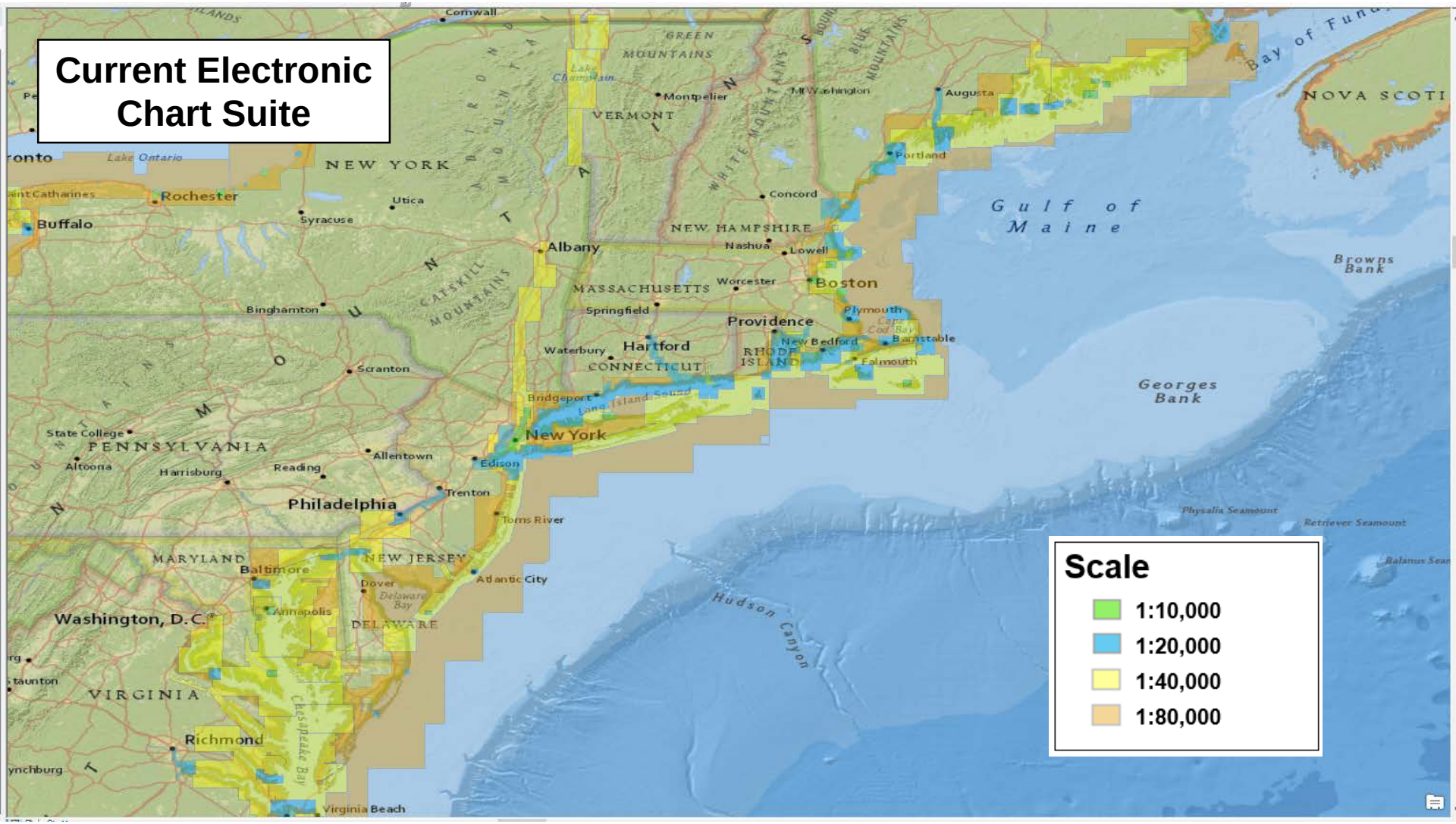
Contact info: Shachak.peeri@noaa.gov

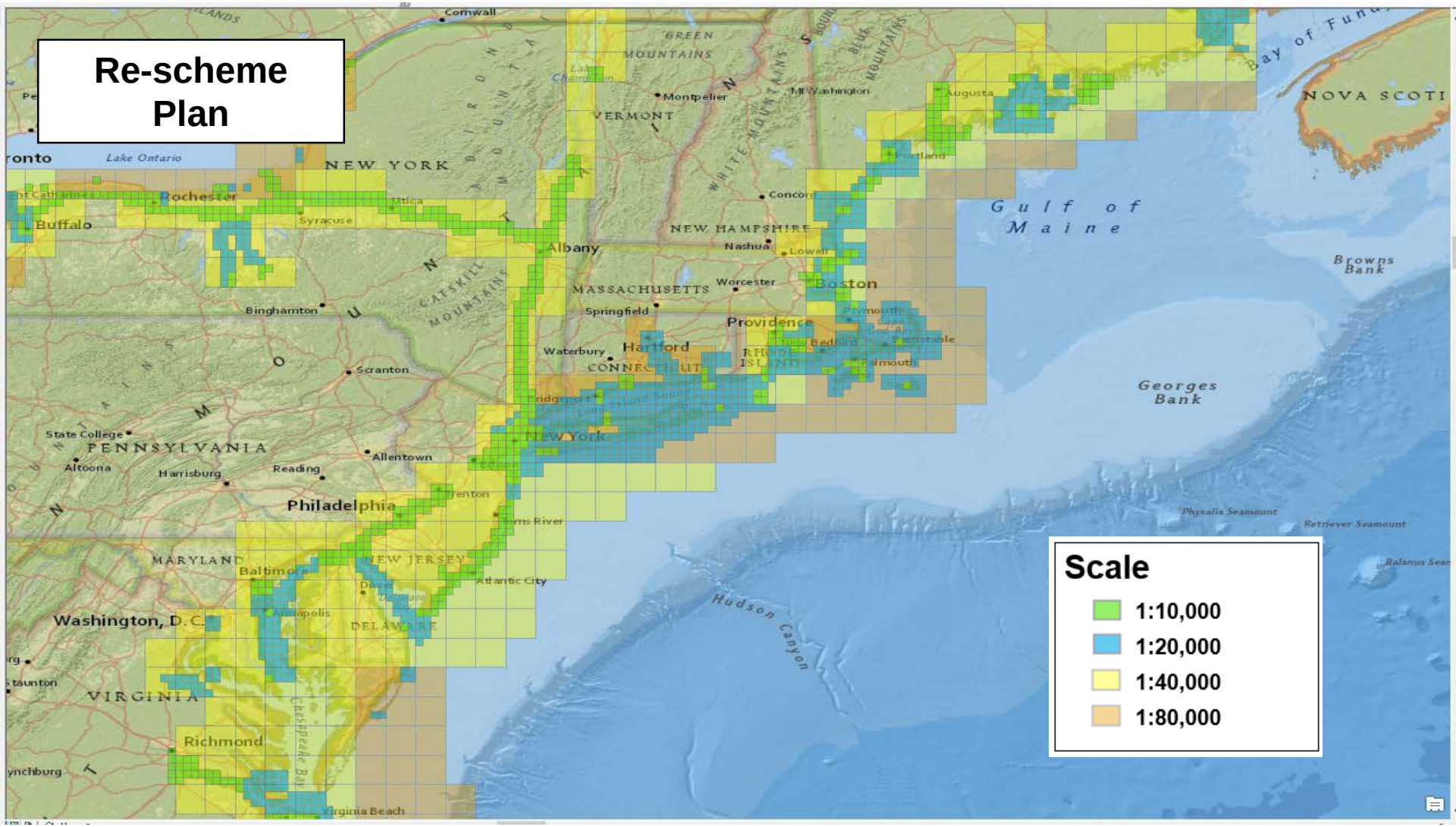

Thank you for your time
Questions?
Comments?
Compliments?
Contact info: Shachak.peeri@noaa.gov
Lake Okeechobee
Florida Gap
Miami
Florida Keys
Freeport
Freeport City
Northwest Providence
Sources: Esri, GEBCO, NOAA, National Geographic, DeLorme, HERE, Geonames.org, and other contributors

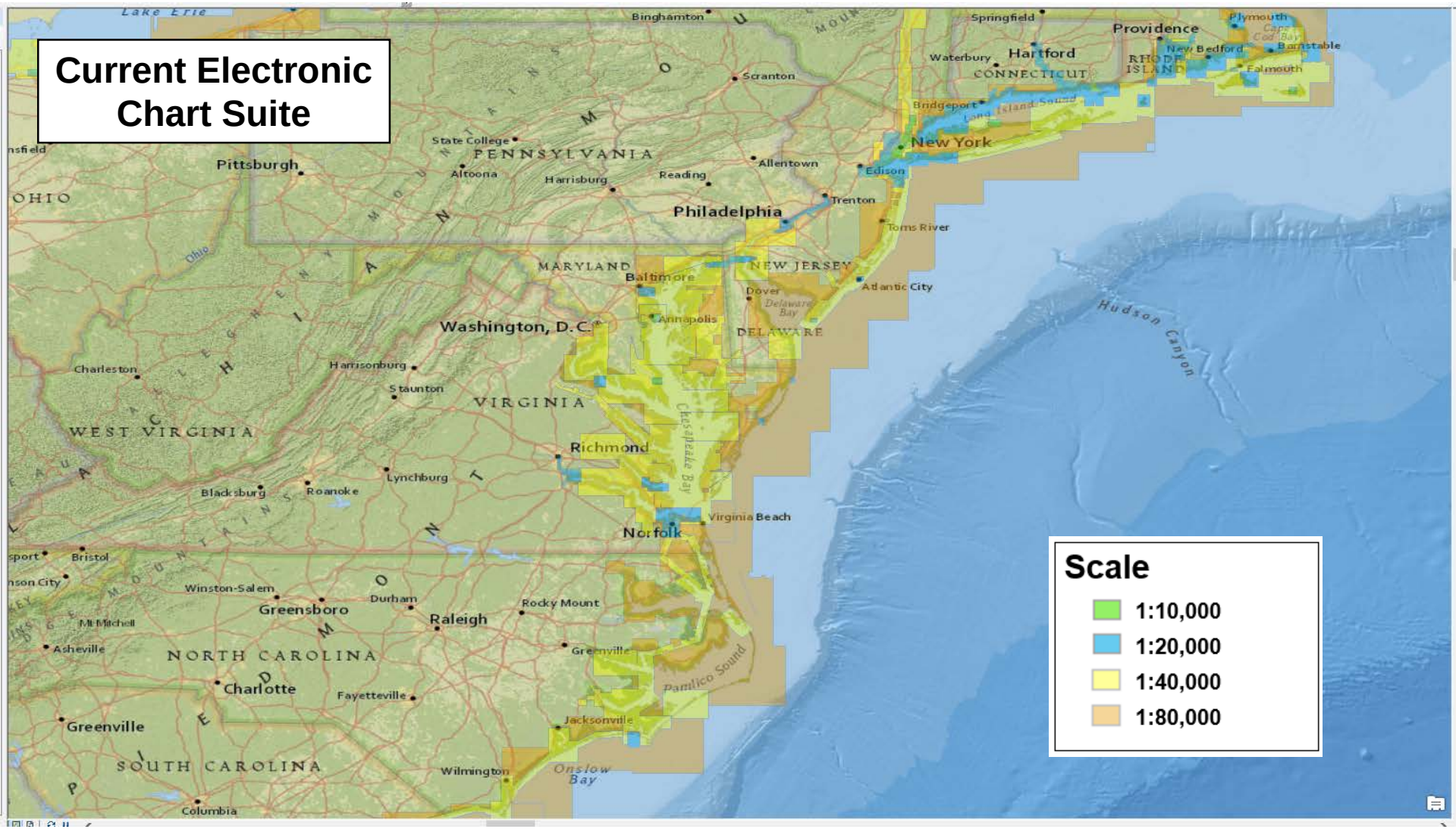

Current Electronic Chart Suite
Scale
1:10,000
1:20,000
1:40,000
1:80,000
1:160,000
1:320,000

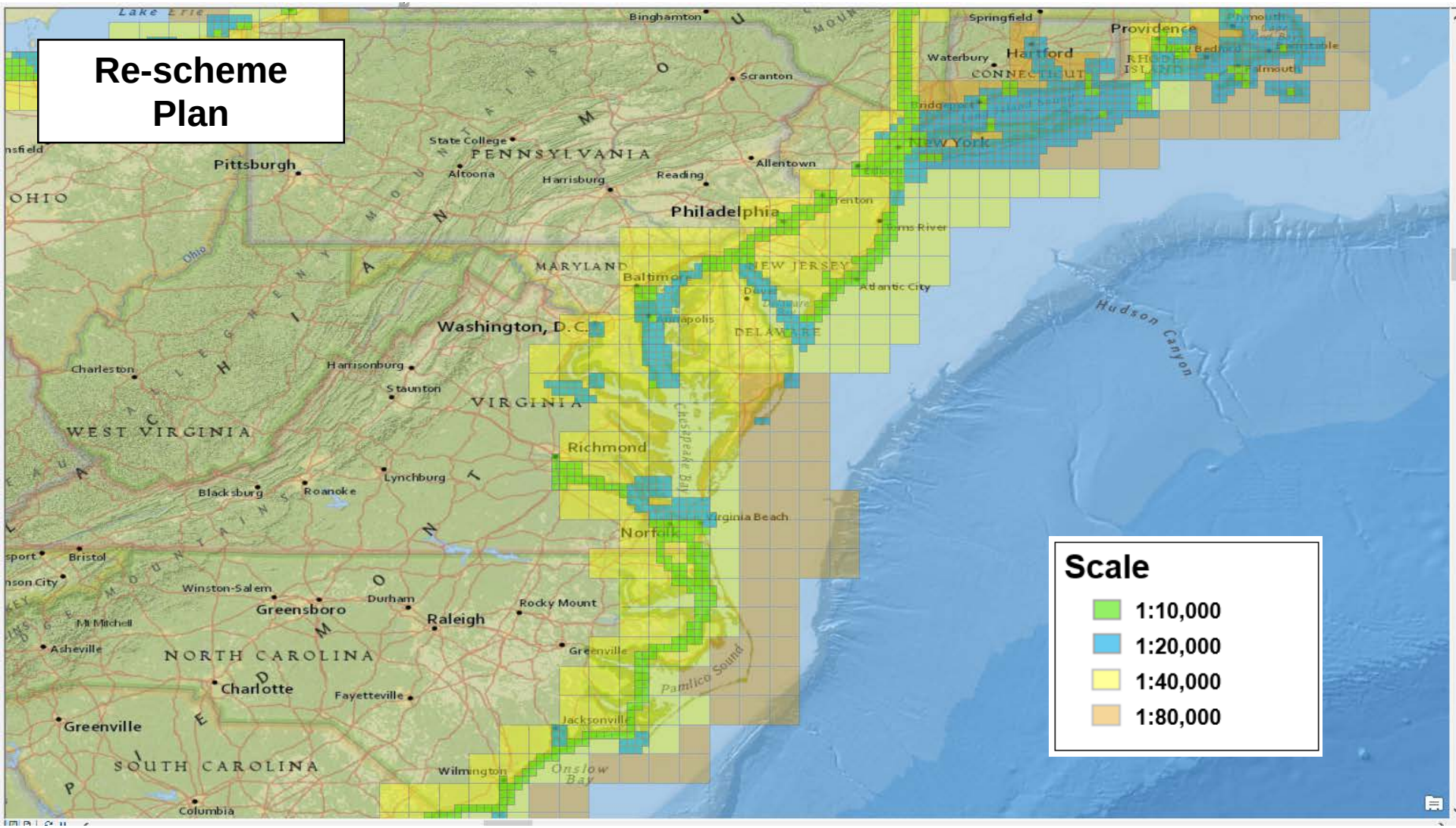

Re-scheme Plan
Scale
1:10,000
1:20,000
1:40,000
1:80,000
1:160,000
1:320,000

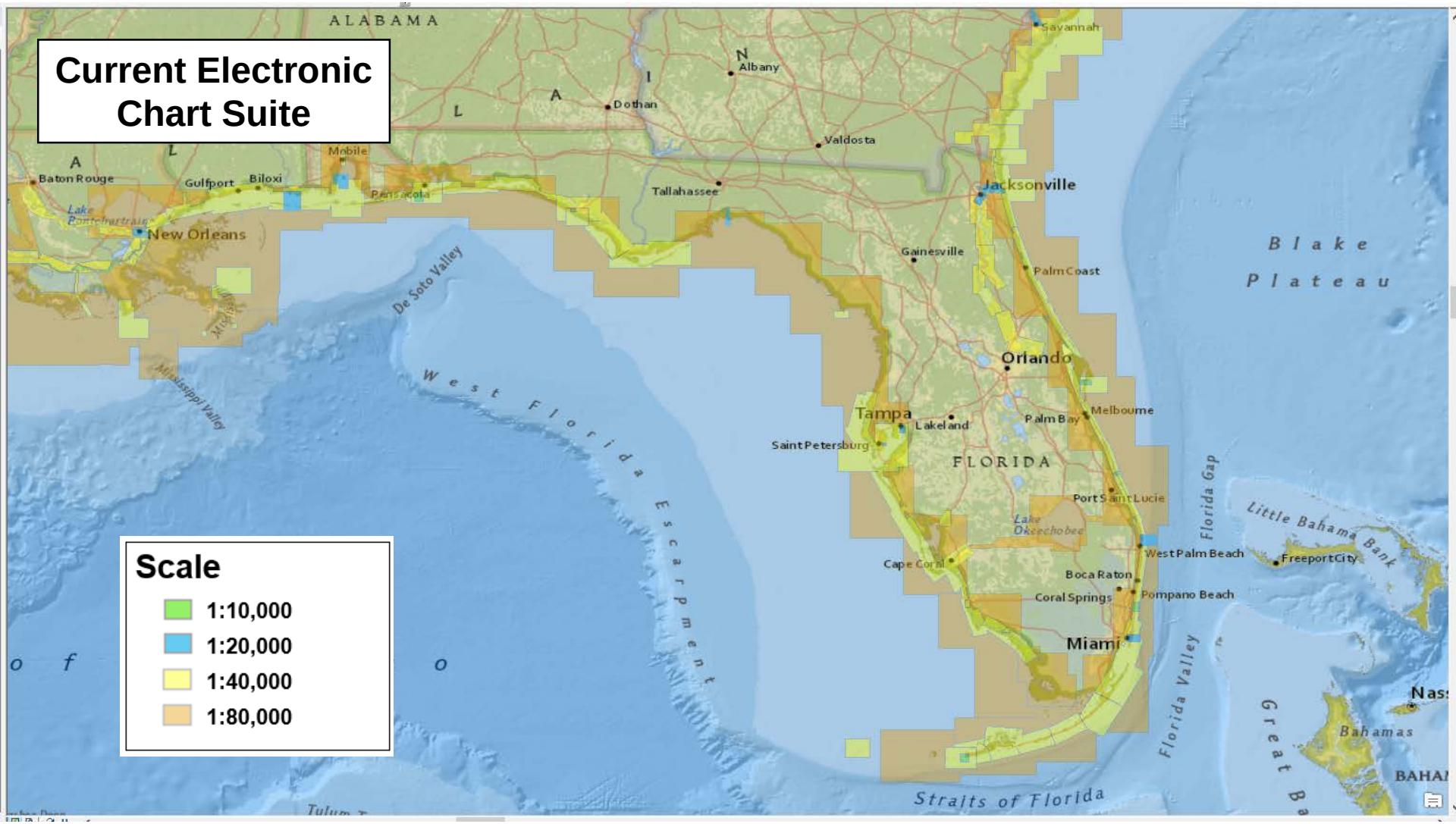
Current Electronic Chart Suite

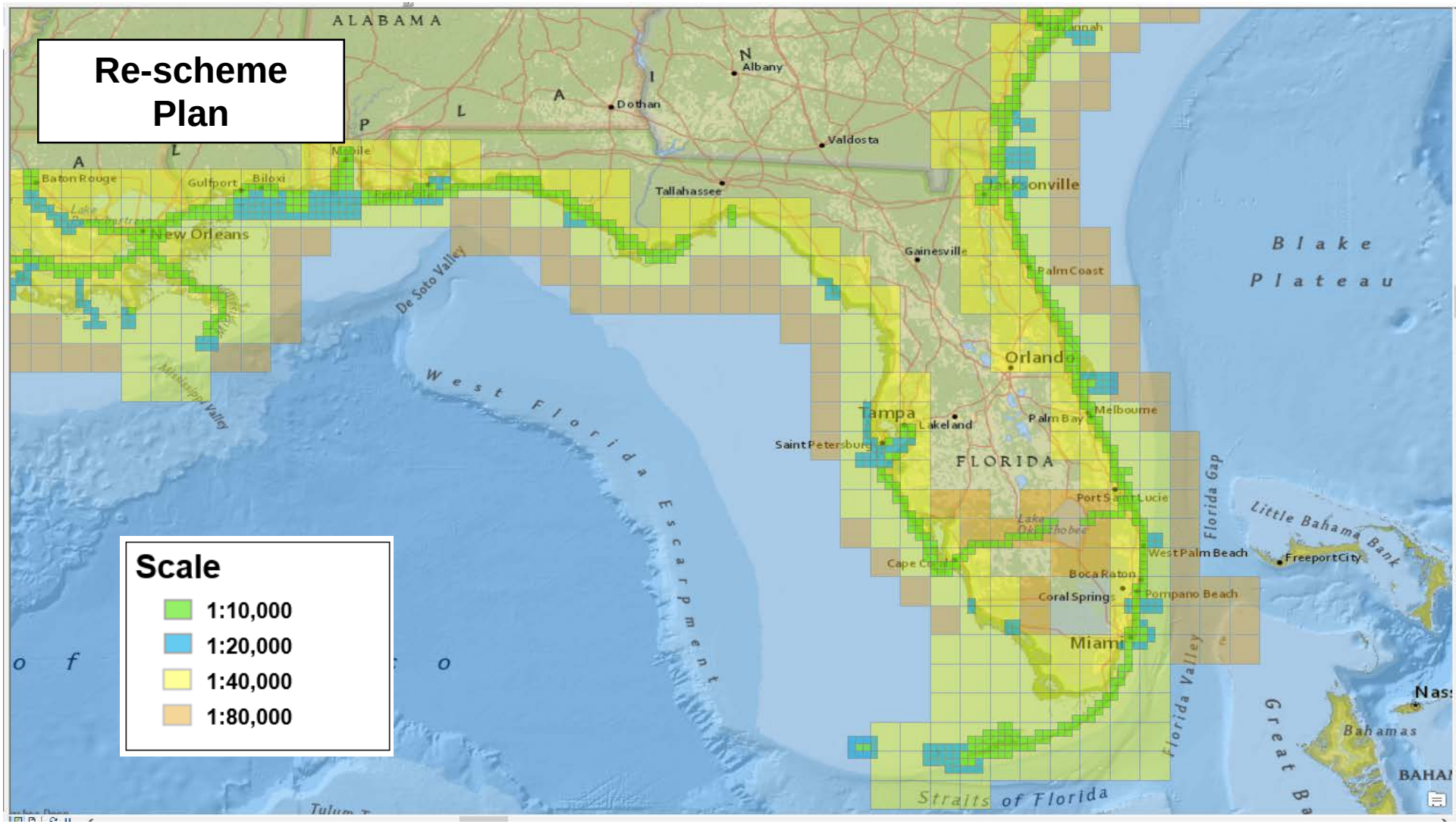


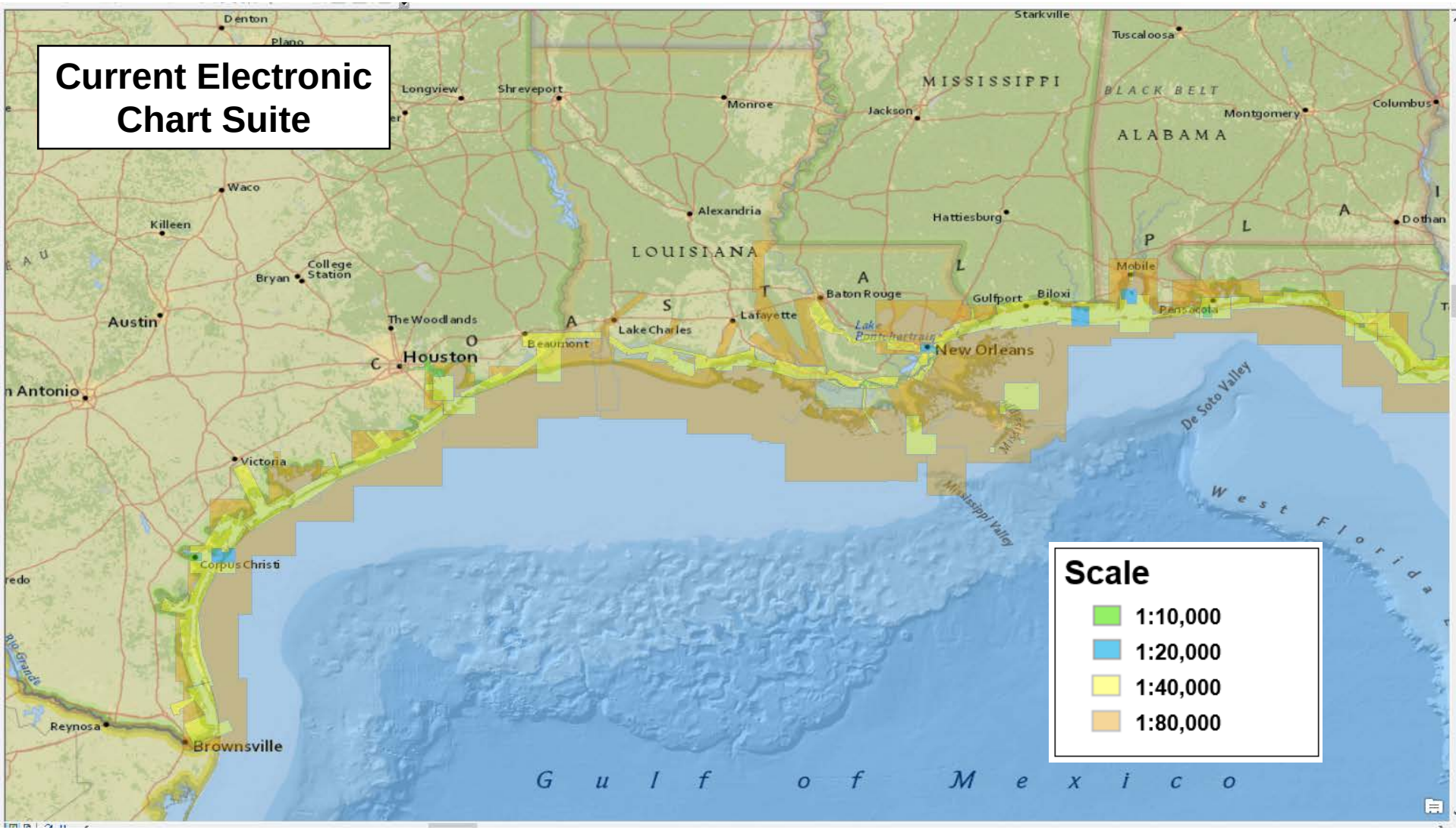

Re-scheme Plan
Scale
1:10,000
1:20,000
1:40,000
1:80,000
Cornwall
Montpelier
Washington
Augusta
Portland
Concord
Nashua
Lowell
Worcester
Boston
Springfield
Providence
Plymouth
Bedford
Falmouth
Barnstable
Hartford
Waterbury
Albany
Rochester
Syracuse
Buffalo
Binghamton
Scranton
State College
Altoona
Harrisburg
Reading
Allentown
Philadelphia
Trenton
Toms River
Atlantic City
Baltimore
Annapolis
Washington, D.C.
Richmond
Virginia Beach
Lake Ontario
NEW YORK
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
PENNSYLVANIA
MARYLAND
NEW JERSEY
DELAWARE
VIRGINIA
GREEN MOUNTAINS
WHITE MOUNTAINS
BLUE MOUNTAINS
CATSKILL MOUNTAINS
Gulf of Maine
Georges Bank
Browns Bank
Hudson Canyon
Physalia Seamount
Retriever Seamount
NOVA SCOTI
Bay of Fund
Chesapeake Bay


Current Electronic Chart Suite
Scale
1:10,000
1:20,000
1:40,000
1:80,000
Lake Erie
Binghamton
Springfield
Providence
Plymouth
Waterbury
Hartford
CONNECTICUT
RHODE ISLAND
New Bedford
Barnstable
Falmouth
Scranton
Bridgeport
Long Island Sound
New York
State College
PENNSYLVANIA
Pittsburgh
Altoona
Harrisburg
Reading
Allentown
Edison
Trenton
Philadelphia
Toms River
OHIO
Ohio
MARYLAND
Baltimore
NEW JERSEY
Atlantic City
Dover
Delaware Bay
Annapolis
DELAWARE
Washington, D.C.
Hudson Canyon
Charleston
Harrisonburg
Staunton
VIRGINIA
WEST VIRGINIA
Richmond
Chesapeake Bay
Lynchburg
Blacksburg
Roanoke
Virginia Beach
Norfolk
Bristol
Winston-Salem
Durham
Rocky Mount
Greensboro
Raleigh
Mt Mitchell
Asheville
NORTH CAROLINA
Greenville
Charlotte
Fayetteville
Pamlico Sound
Greenville
Jacksonville
SOUTH CAROLINA
Wilmington
Onslow Bay
Columbia


Re-scheme Plan
Scale
1:10,000
1:20,000
1:40,000
1:80,000
Lake Erie
Binghamton
Springfield
Providence
Waterbury
Hartford
CONNECTICUT
RHODE ISLAND
Scranton
State College
PENNSYLVANIA
Pittsburgh
Altoona
Harrisburg
Reading
Allentown
New York
OHIO
Philadelphia
Trenton
Toms River
MARYLAND
Baltimore
NEW JERSEY
Atlantic City
Washington, D.C.
Annapolis
DELAWARE
Hudson Canyon
Charleston
Harrisonburg
Staunton
VIRGINIA
WEST VIRGINIA
Richmond
Chesapeake Bay
Lynchburg
Blacksburg
Roanoke
Virginia Beach
Norfolk
Bristol
Winston-Salem
Greensboro
Durham
Raleigh
Rocky Mount
Mt Mitchell
Asheville
NORTH CAROLINA
Greenville
Charlotte
Fayetteville
Pamlico Sound
Jacksonville
Greenville
SOUTH CAROLINA
Wilmington
Onslow Bay
Columbia


Current Electronic Chart Suite
Scale
1:10,000
1:20,000
1:40,000
1:80,000
ALABAMA
Albany
Dothan
Valdosta
Savannah
Mobile
Baton Rouge
Gulfport
Biloxi
Pensacola
Tallahassee
Jacksonville
New Orleans
Gainesville
Palm Coast
Blake Plateau
De Soto Valley
Orlando
West Florida Escarpment
Tampa
Lakeland
Palm Bay
Melbourne
Saint Petersburg
FLORIDA
Port Saint Lucie
Florida Gap
Little Bahama Bank
Lake Okeechobee
West Palm Beach
Freeport City
Cape Coral
Boca Raton
Coral Springs
Pompano Beach
Miami
Florida Valley
Great Ba
Bahamas
Straits of Florida


Re-scheme Plan
Scale
1:10,000
1:20,000
1:40,000
1:80,000
ALABAMA
Albany
Dothan
Valdosta
Baton Rouge
Gulfport
Biloxi
Mobile
Tallahassee
Jacksonville
New Orleans
Gainesville
Palm Coast
De Soto Valley
Blake Plateau
Orlando
Tampa
Lakeland
Palm Bay
Melbourne
Saint Petersburg
FLORIDA
West Florida Escarpment
Port Saint Lucie
Florida Gap
Little Bahama Bank
West Palm Beach
Freeport City
Boca Raton
Coral Spring
Pompano Beach
Miami
Florida Valley
Great Ba
Bahamas
Straits of Florida


Current Electronic Chart Suite
Denton
Plano
Longview
Shreveport
Monroe
Starkville
Tuscaloosa
MISSISSIPPI
BLACK BELT
Jackson
Montgomery
Columbus
ALABAMA
Waco
Killeen
Alexandria
Hattiesburg
Dothan
LOUISIANA
College Station
Bryan
Mobile
Austin
The Woodlands
Baton Rouge
Gulfport
Biloxi
Lafayette
Lake Charles
Beaumont
Houston
New Orleans
Antonio
Victoria
De Soto Valley
Mississippi Valley
West Florida
Corpus Christi
Rio Grande
Reynosa
Brownsville
Gulf of Mexico
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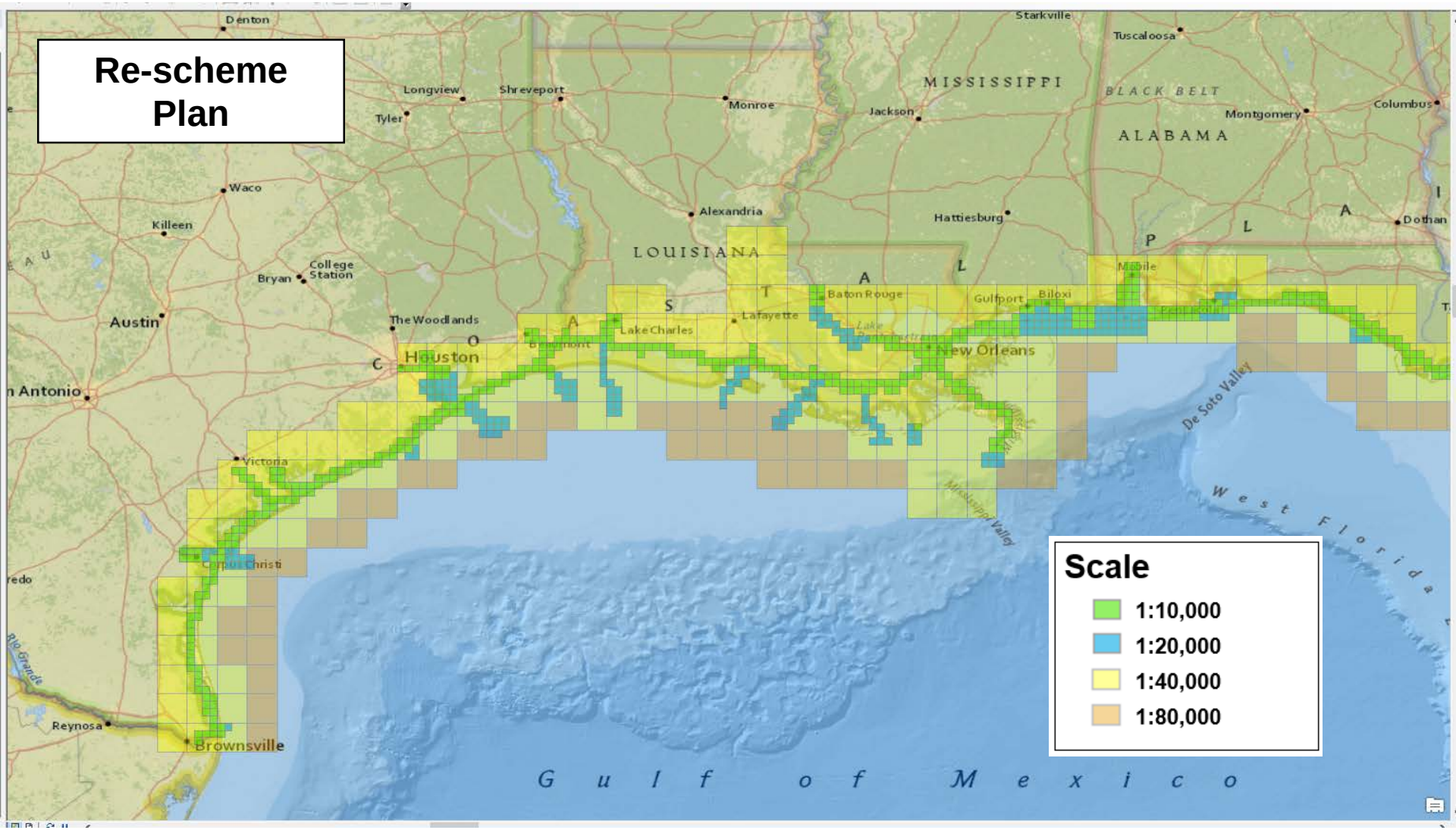
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Longview
Shreveport
Tyler
Monroe
Jackson
Starkville
Tuscaloosa
MISSISSIPPI
BLACK BELT
Montgomery
Columbus
ALABAMA
Waco
Killeen
Alexandria
Hattiesburg
Dothan
LOUISIANA
College Station
Bryan
Austin
The Woodlands
Houston
Lake Charles
Lafayette
Baton Rouge
Gulfport
Biloxi
Mobile
New Orleans
De Soto Valley
Victoria
Corpus Christi
Reynosa
Brownsville
Rio Grande
West Florida
Gulf of Mexico
Scale
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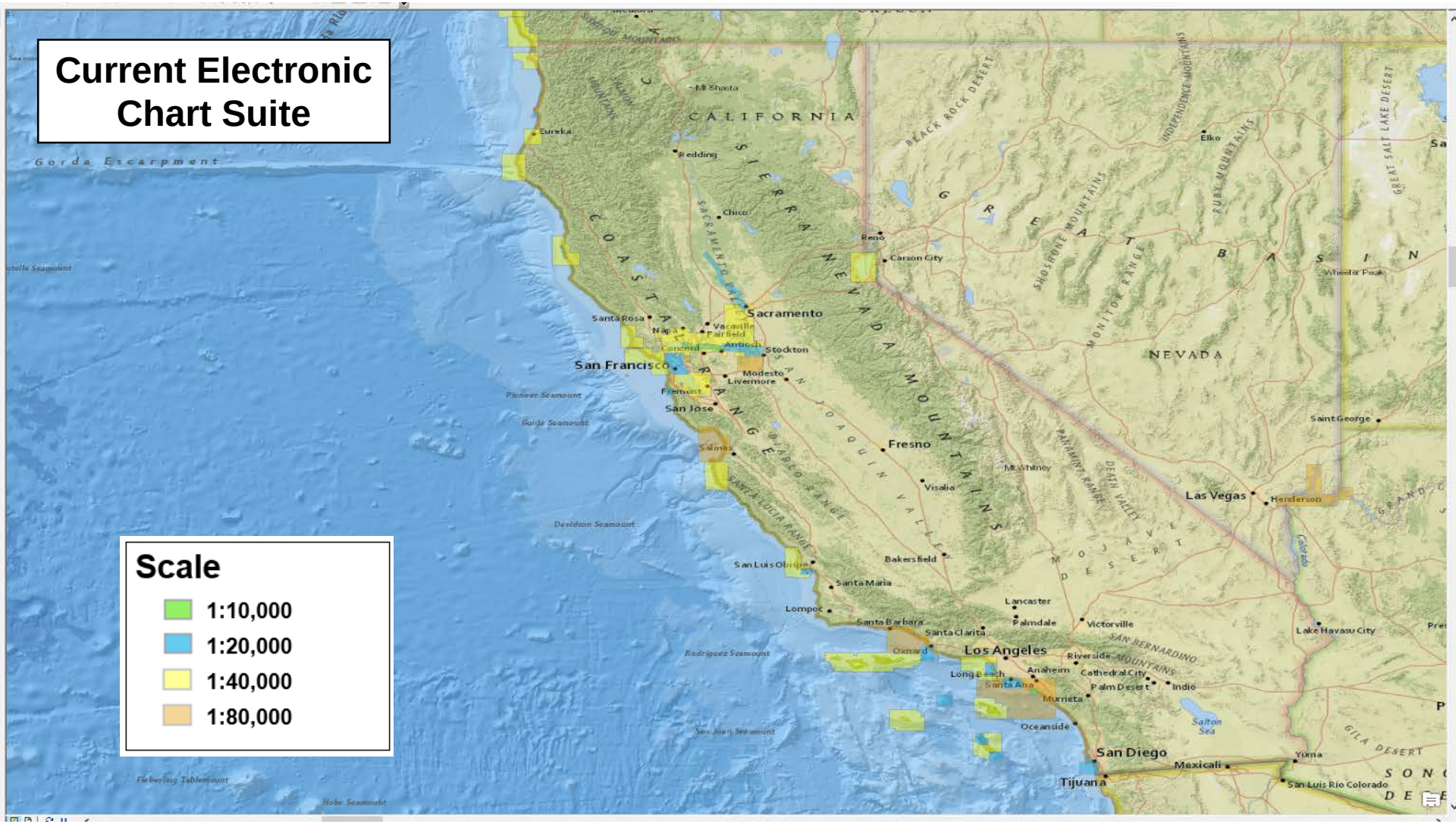
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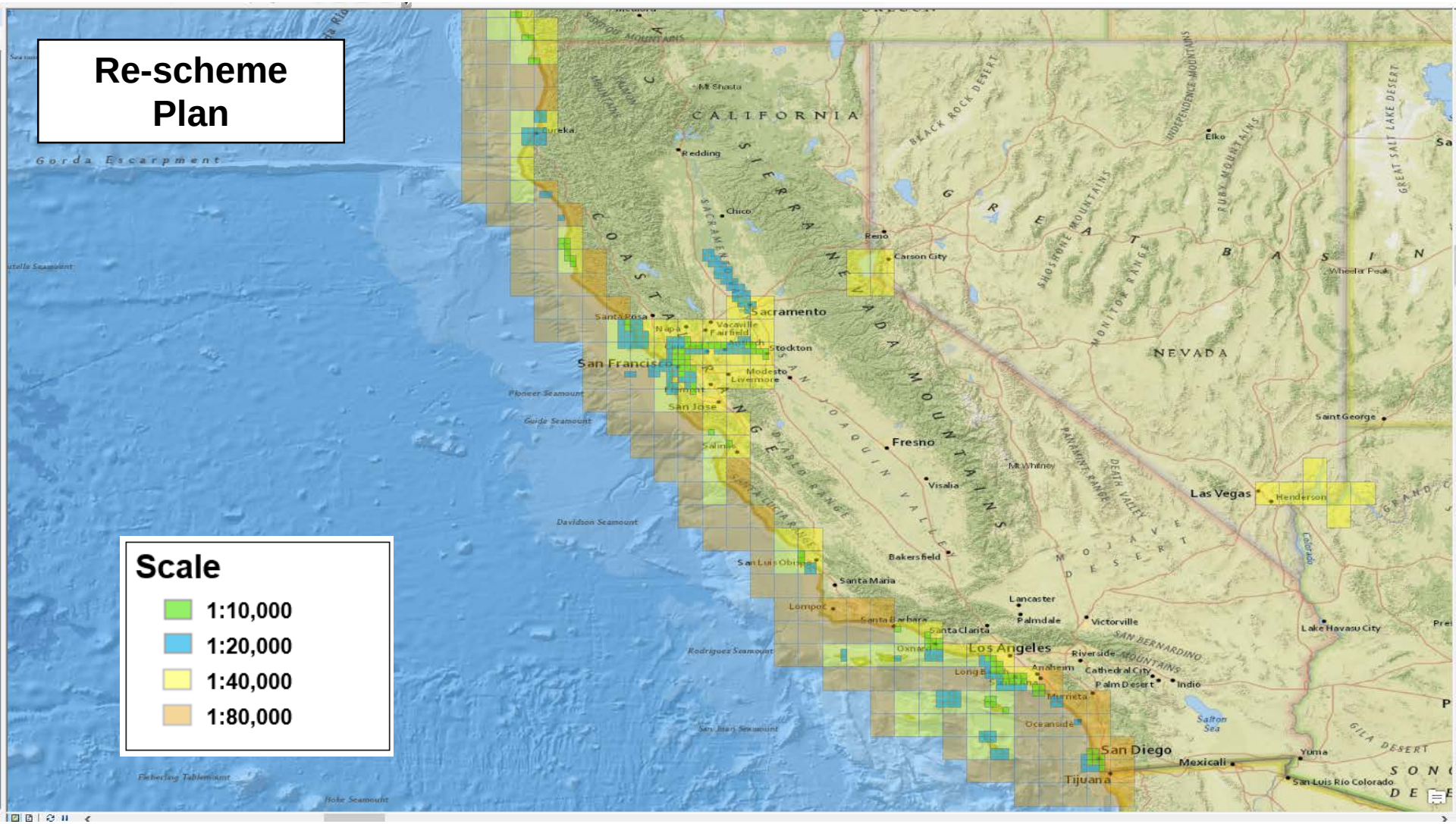
Reno
Carson City
Elko
Sacramento
Santa Rosa
Napa
Vacaville
Fairfield
Antioch
Stockton
San Francisco
Modesto
Livermore
Fremont
San Jose
Salinas
Fresno
Visalia
Bakersfield
Las Vegas
Henderson
Saint George
Mt Whitney
San Luis Obispo
Santa Maria
Lompoc
Santa Barbara
Oxnard
Santa Clarita
Lancaster
Palmdale
Victorville
Lake Havasu City
Los Angeles
Riverside
Anaheim
Long Beach
Santa Ana
Cathedral City
Palm Desert
Indio
Murrieta
Oceanside
San Diego
Tijuana
Mexicali
Yuma
San Luis Rio Colorado
Salton Sea
Gorda Escarpment
Pioneer Seamount
Guide Seamount
Davidson Seamount
Rodriguez Seamount
San Juan Seamount
Fieberling Tablemount
Hoke Seamount
SIERRA NEVADA MOUNTAINS
COAST RANGE
SAN JOAQUIN VALLEY
SANTA LUCIA RANGE
DIABLO RANGE
GREAT BASIN
MOJAVE DESERT
DEATH VALLEY
PANAMINT RANGE
SAN BERNARDINO MOUNTAINS
GILA DESERT
BLACK ROCK DESERT
SHOSHONE MOUNTAINS
MONITOR RANGE
RUBY MOUNTAINS
INDEPENDENCE MOUNTAINS
GREAT SALT LAKE DESERT
Wheeler Peak
Colorado


Re-scheme Plan
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CALIFORNIA
NEVADA
Sacramento
San Francisco
San Jose
Fresno
Bakersfield
Los Angeles
San Diego
Las Vegas
Reno
Carson City
Tijuana
Mexicali
Gorda Escarpment
Davidson Seamount
Guide Seamount
Rodriguez Seamount
Pioneer Seamount
Fieberling Tablemount
Hoke Seamount
SIERRA NEVADA MOUNTAINS
COAST RANGE
GREAT BASIN
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SAN JOAQUIN VALLEY
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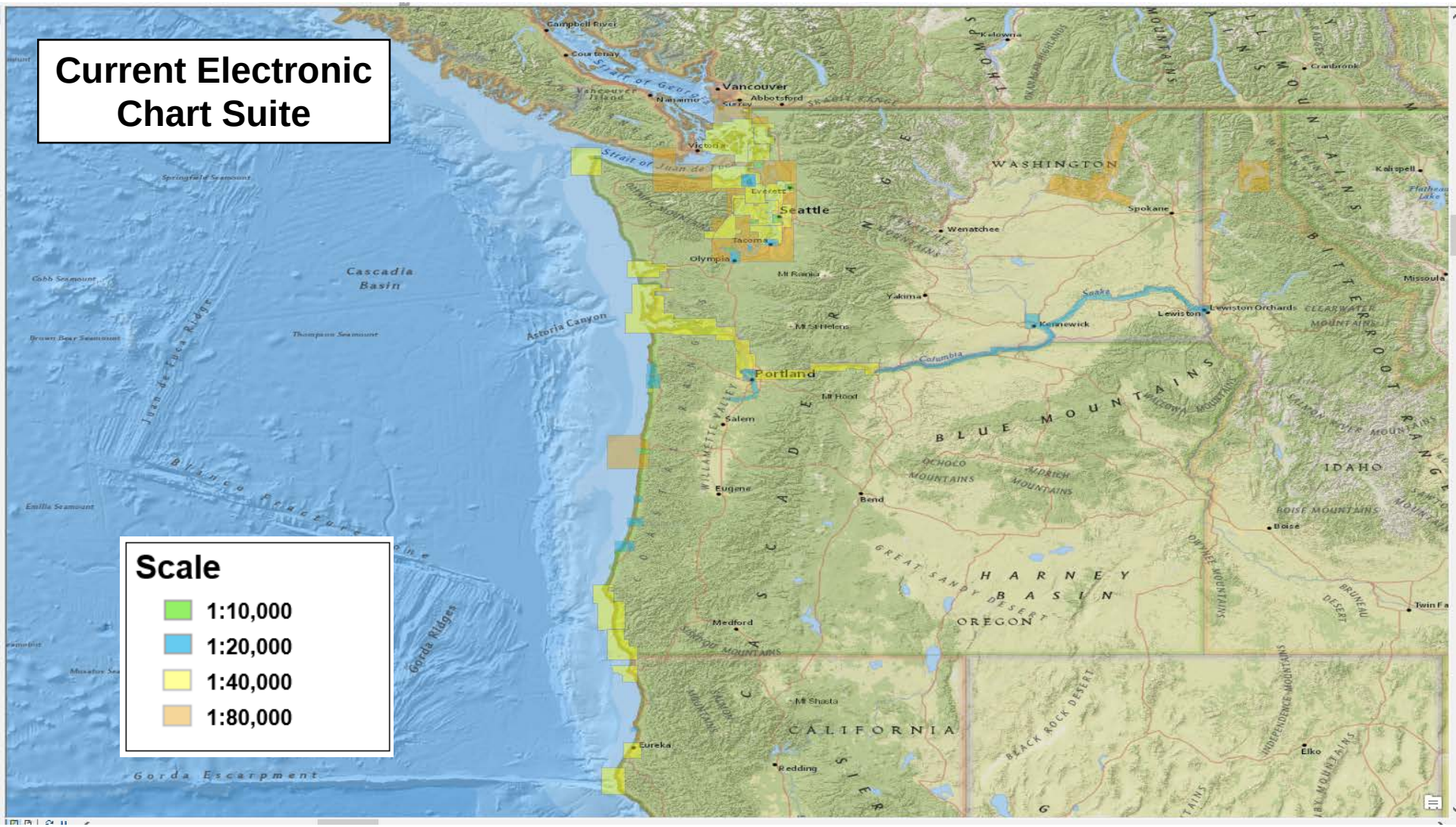
SAN BERNARDINO MOUNTAINS
DEATH VALLEY
Salton Sea
Colorado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Kalispell
Missoula
Wenatchee
Yakima
Lewiston
Lewiston Orchards
Kennewick
Olympia
Tacoma
Everett
Abbotsford
Nanaimo
Courtenay
Campbell River
Victoria
Salem
Eugene
Bend
Medford
Boise
Twin Falls
Eureka
Redding
Elko
Mt Shasta
Mt St Helens
Mt Hood
Mt Rainier
WASHINGTON
OREGON
CALIFORNIA
IDAHO
Cascadia Basin
Juan de Fuca Ridge
Astoria Canyon
Gorda Escarpment
Gorda Ridges
Springfield Seamount
Cobb Seamount
Brown Bear Seamount
Thompson Seamount
Emilia Seamount
Strait of Georgia
Strait of Juan de Fuca
Columbia
Snake
BLUE MOUNTAINS
HARNEY BASIN
GREAT SANDY DESERT
BLACK ROCK DESERT
BITTERROOT RANGE
CLEARWATER MOUNTAINS
BOISE MOUNTAINS
OCHOCO MOUNTAINS
ALDRICH MOUNTAINS
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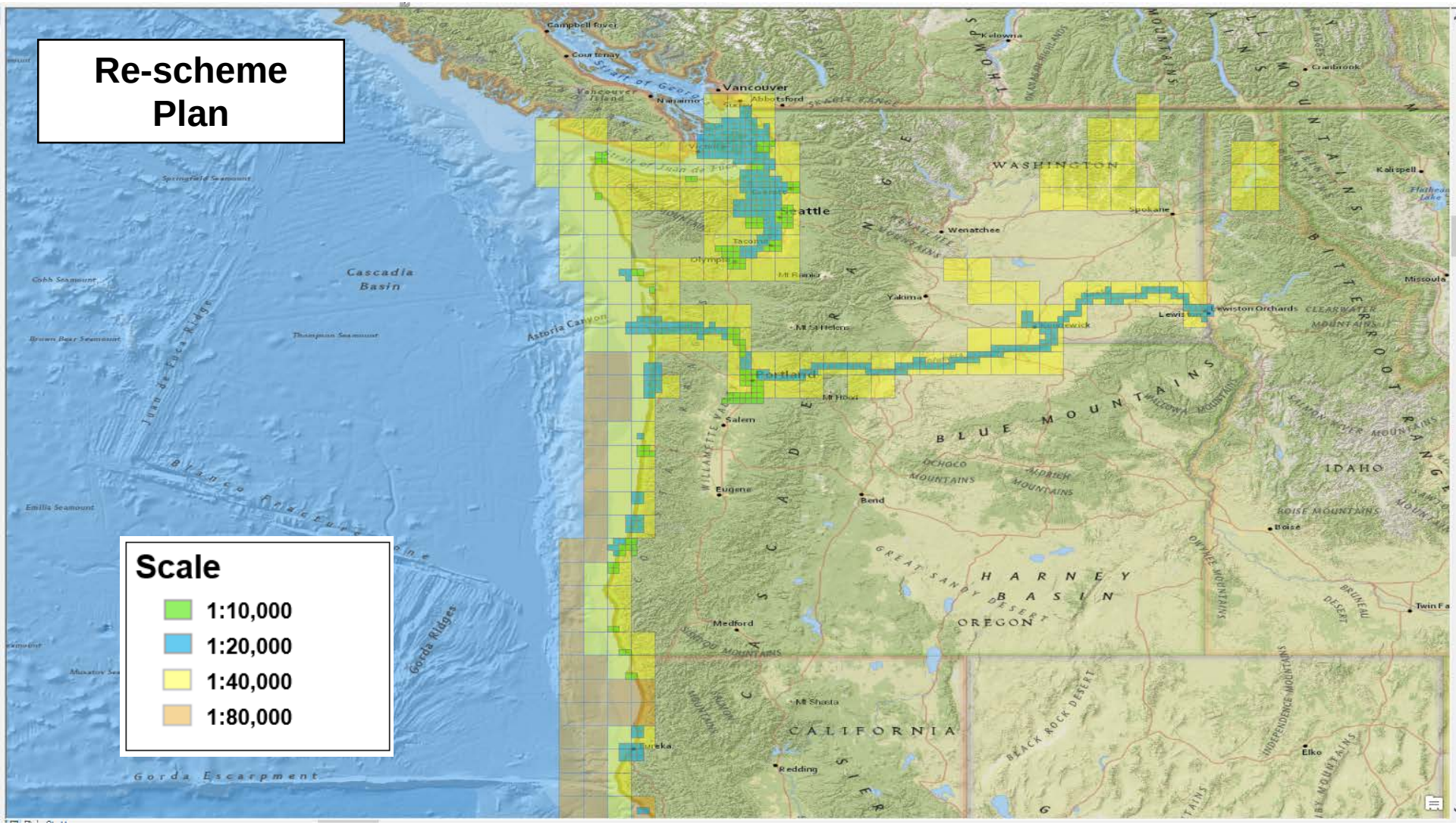
INDEPENDENCE MOUNTAINS
BRUNEAU DESERT
WILLAMETTE VALLEY
CASCADE MOUNTAINS
SIERRA


Re-scheme Plan
Scale
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Vancouver
Seattle
Portland
Salem
Eugene
Bend
Medford
Redding
Mt Shasta
Yakima
Wenatchee
Spokane
Kelowna
Boise
Elko
Missoula
Kalispell
Cascadia Basin
Gorda Escarpment
Gorda Ridges
Juan de Fuca Ridge
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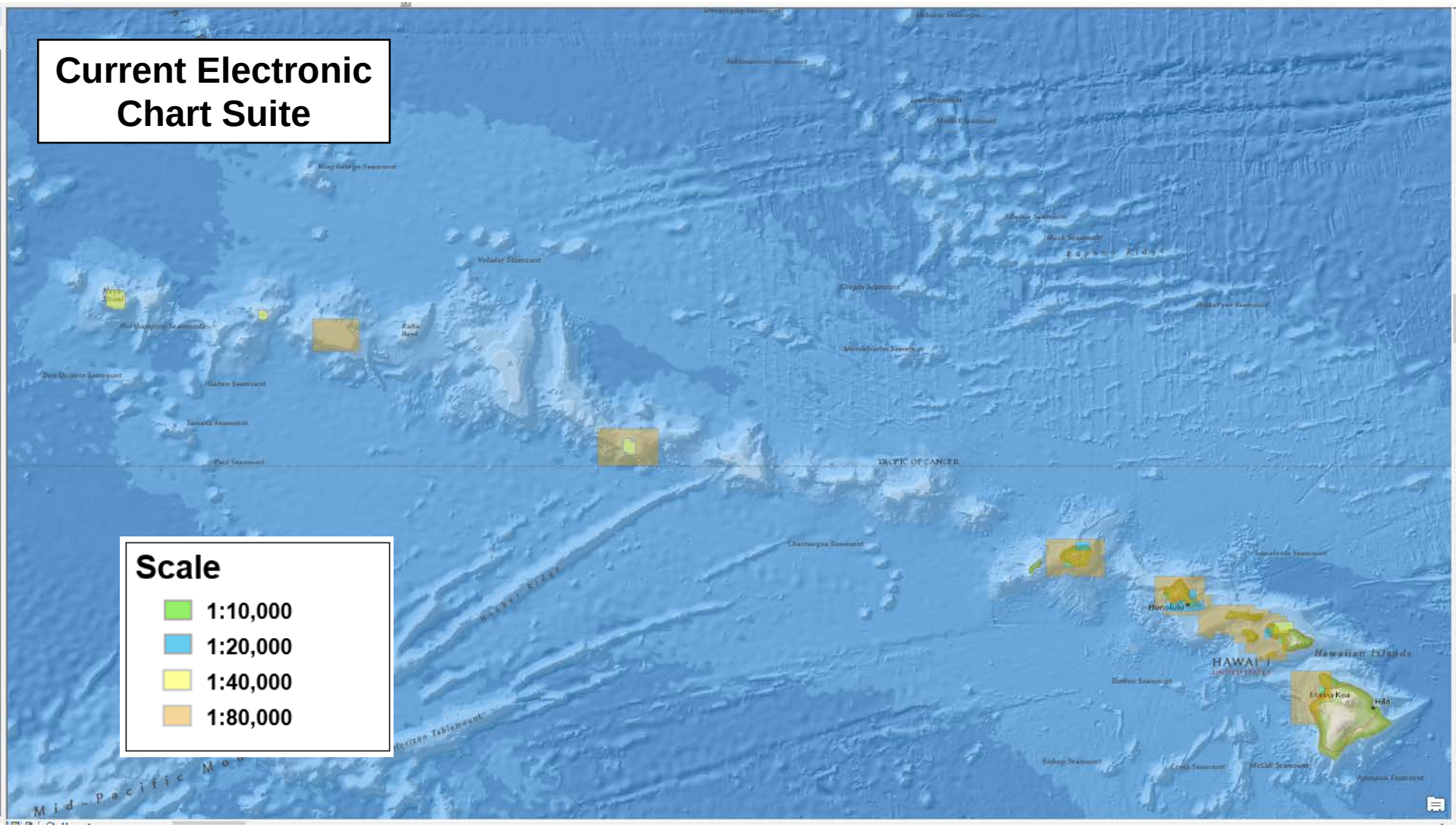
WASHINGTON
OREGON
CALIFORNIA
IDAHO
HARNEY BASIN
BLUE MOUNTAINS
CASCADE RANGE
BITTERROOT RANGE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Scale
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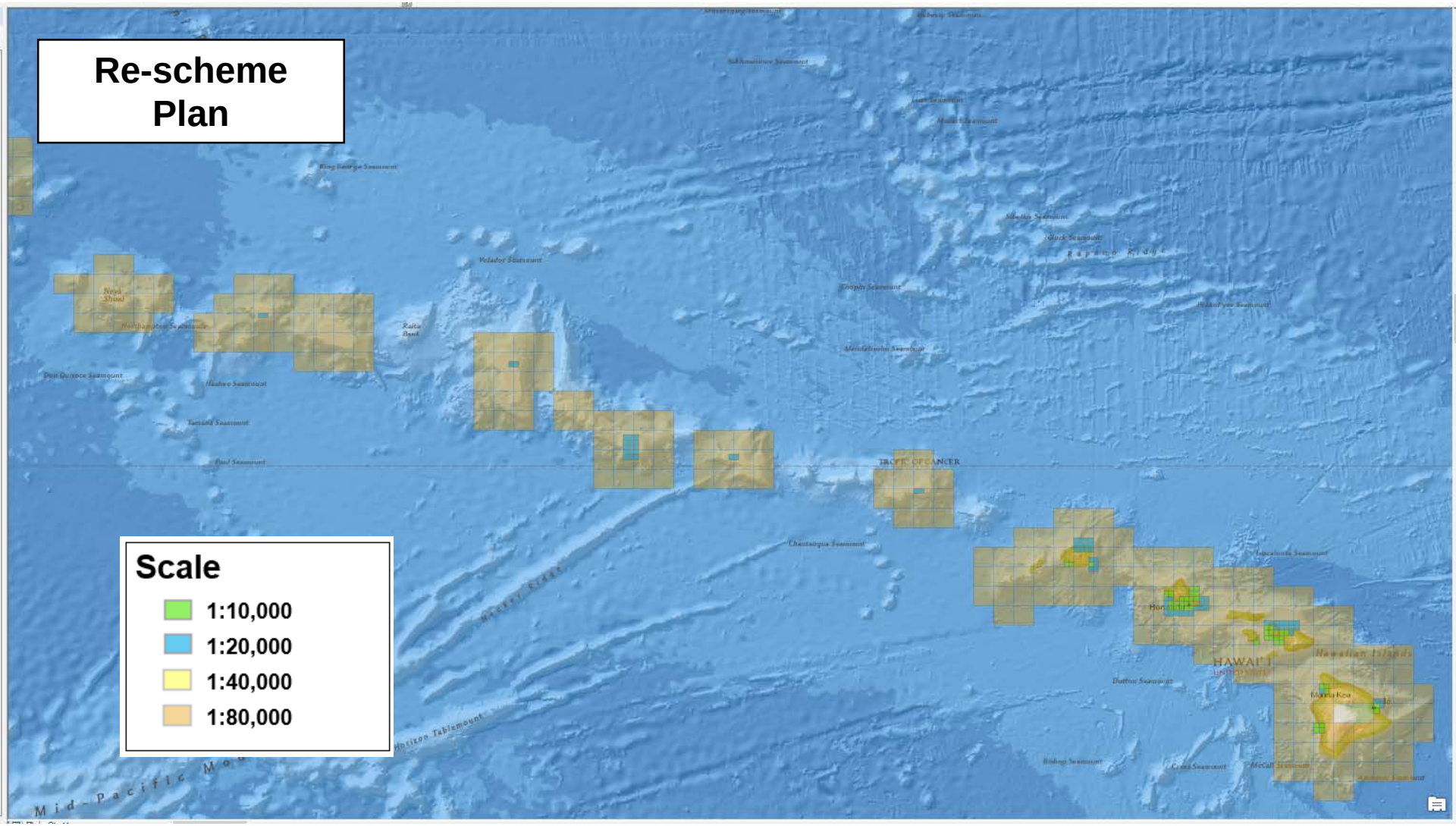
Honolulu
HAWAI'I
Hawaiian Islands
Mauna Kea
Hilo
TROPIC OF CANCER
Mid-Pacific Mo


Re-scheme Plan
Scale
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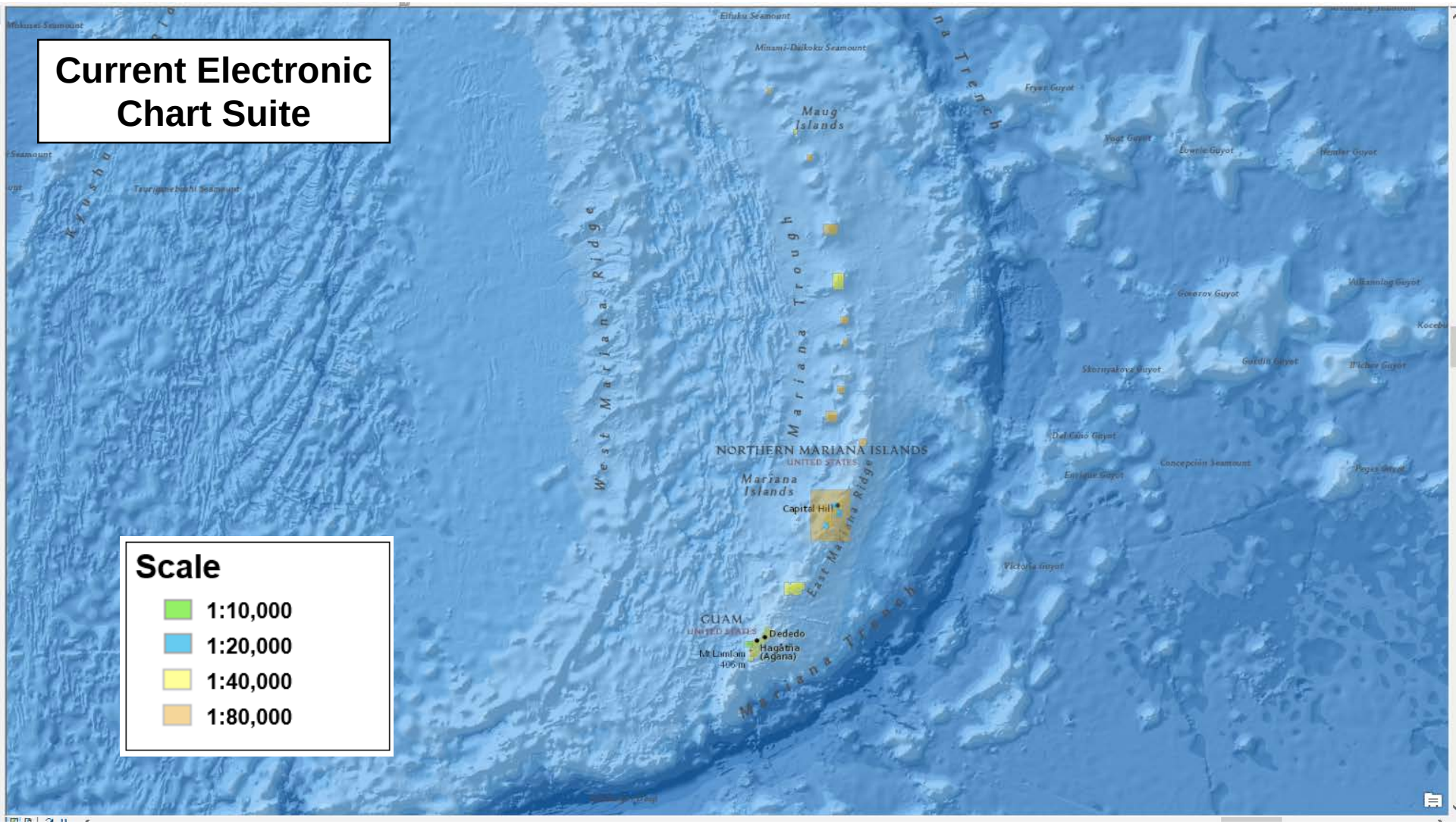
TROPIC OF CANCER
HAWAI'I
Hawaiian Islands
Mid-Pacific Mo


Current Electronic Chart Suite
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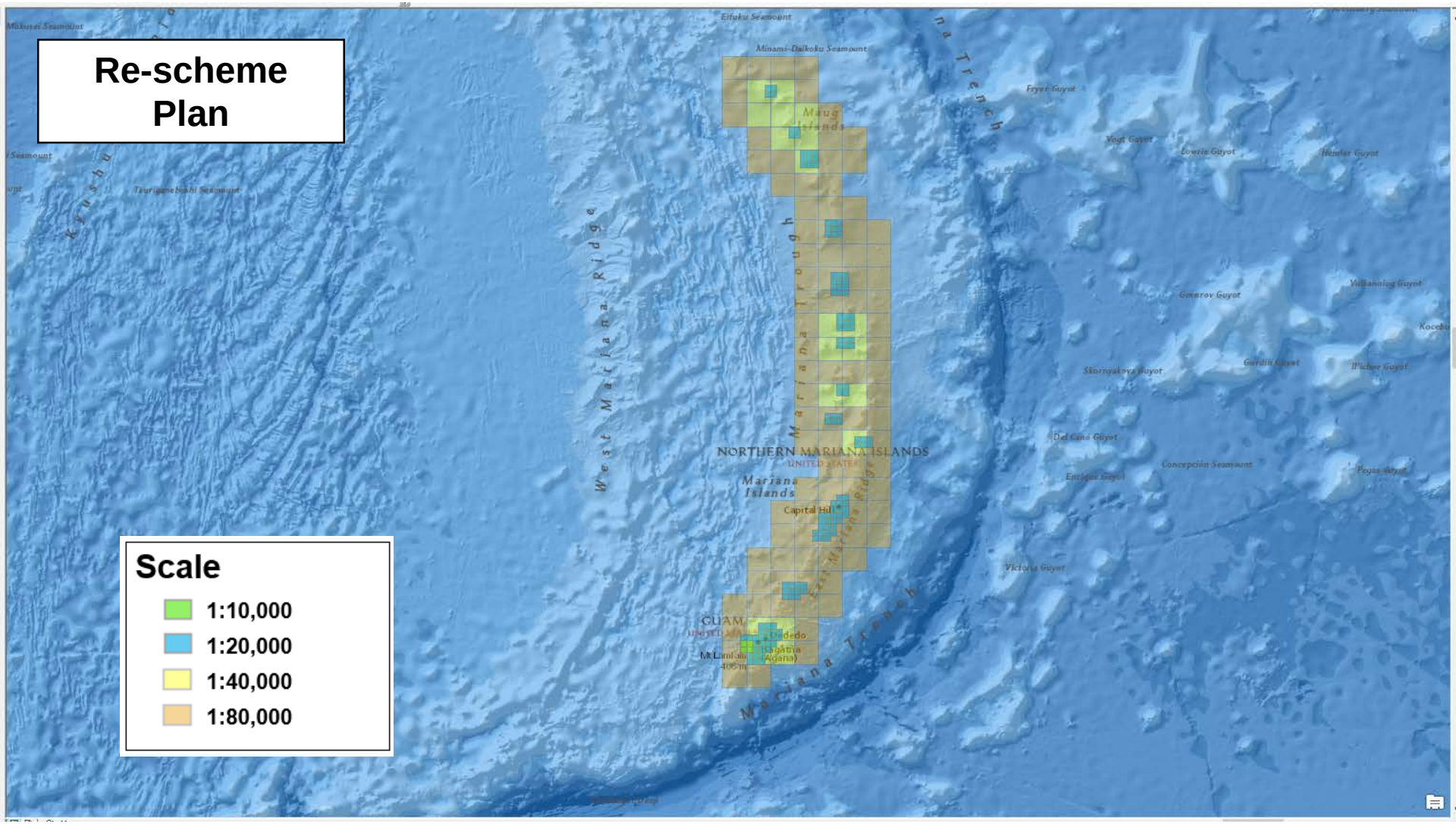
Eifuku Seamount
Minami-Daikoku Seamount
Maug Islands
Fryer Guyot
Yoat Guyot
Erwin Guyot
Hemler Guyot
Volcanologi Guyot
Goreov Guyot
Skornyakova Guyot
Gutdin Guyot
Wicher Guyot
Del Cano Guyot
Concepcion Seamount
Peyes Guyot
Victoria Guyot
West Mariana Ridge
Mariana Trough
East Mariana Ridge
Mariana Trench
NORTHERN MARIANA ISLANDS
UNITED STATES
Mariana Islands
Capital Hill
GUAM
UNITED STATES
Dededo
Hagåtña (Agana)
Mt Lamlam
406 m


Re-scheme Plan
Scale
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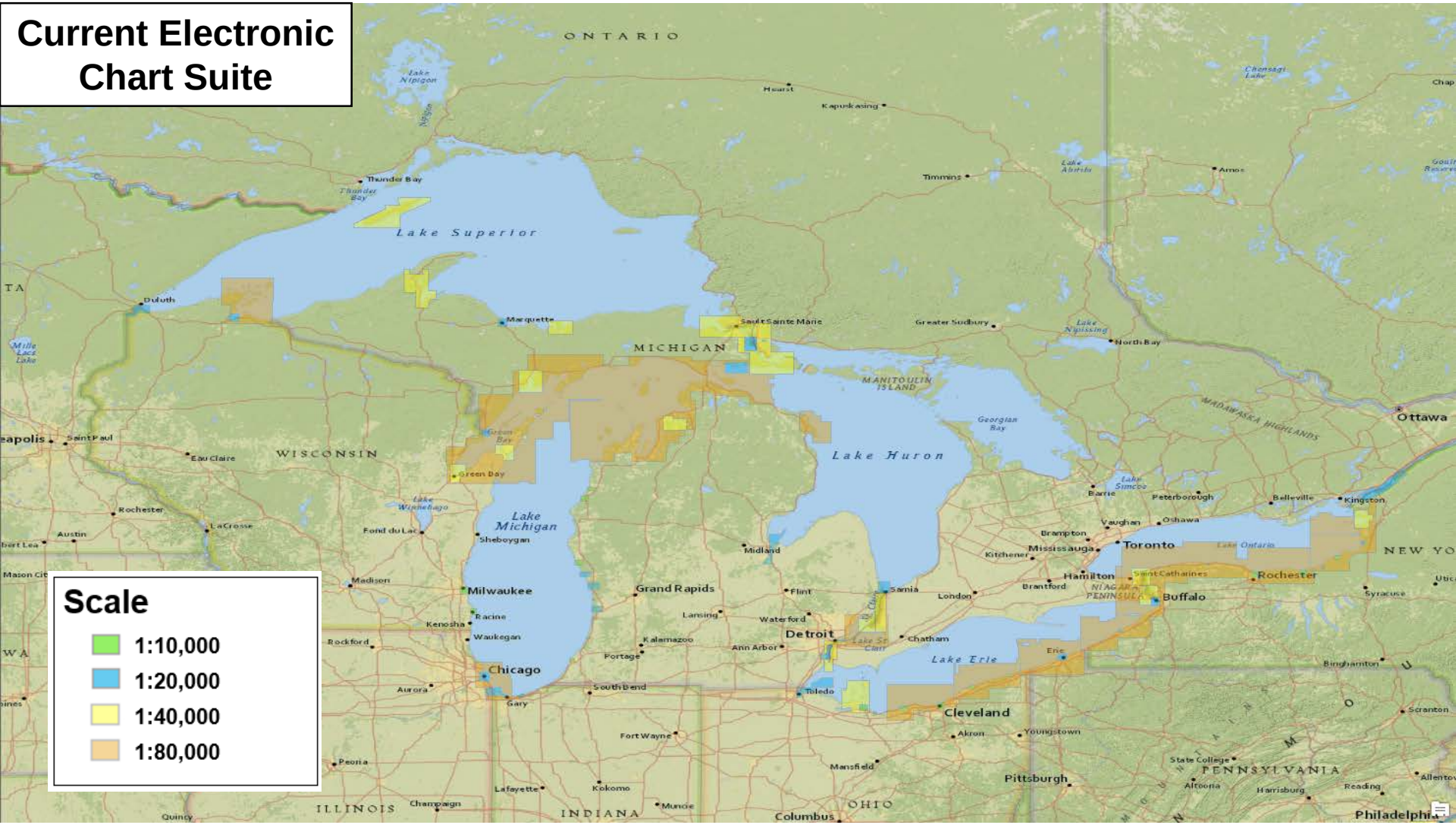
Eifuku Seamount
Minami-Daikoku Seamount
Fryer Guyot
Yogt Guyot
Lowrie Guyot
Hemler Guyot
Tauriganeboshi Seamount
Mariana Trough
West Mariana Ridge
Volcanology Guyot
Gomerov Guyot
Stormyakova Guyot
Gardiin Guyot
Del Cano Guyot
Concepcion Seamount
Victoria Guyot
NORTHERN MARIANA ISLANDS
UNITED STATES
Mariana Islands
Capital Hill
GUAM
UNITED STATES
Agana
Mariana Trench

Current Electronic Chart Suite



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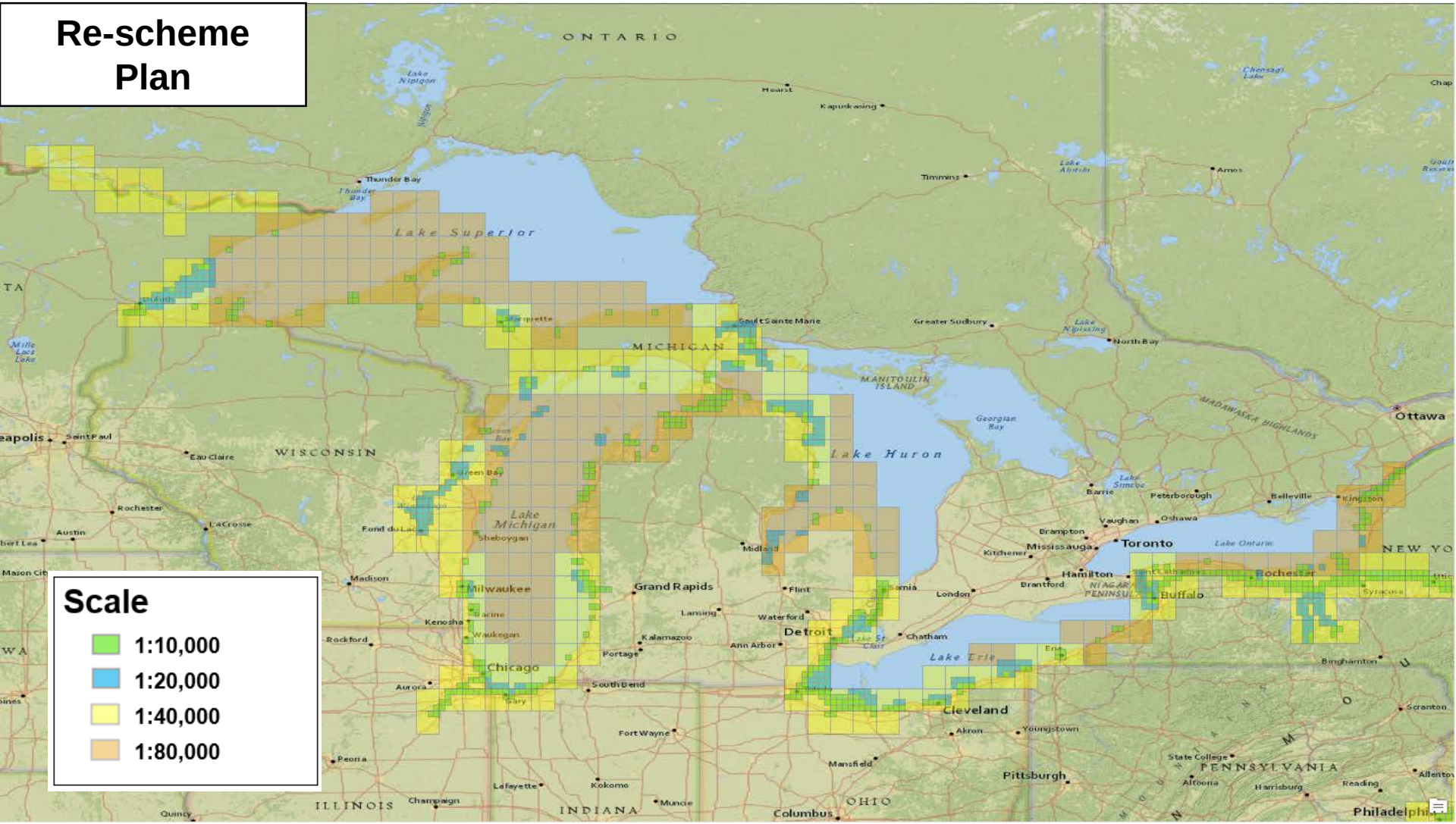
Re-scheme Plan



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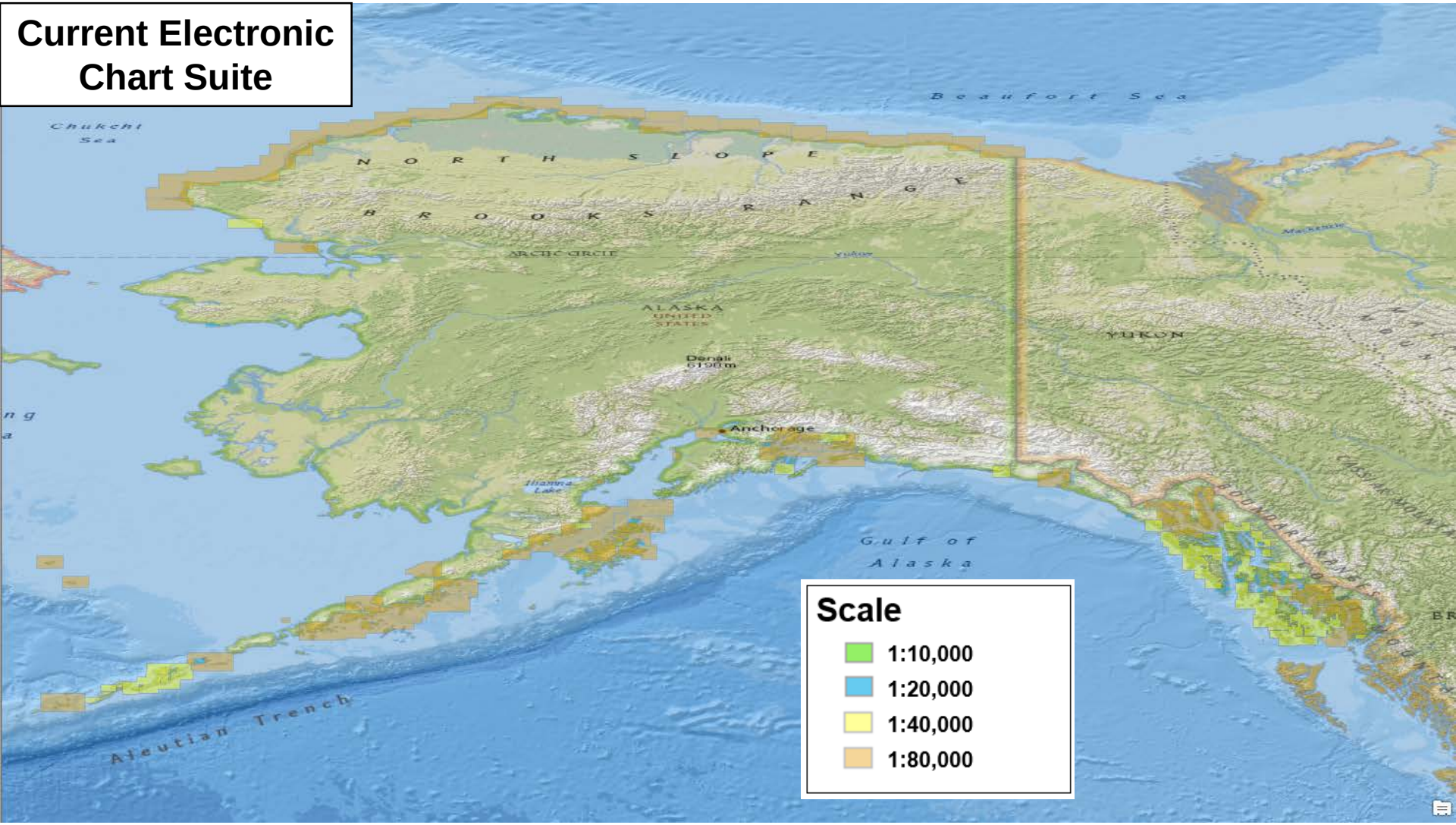

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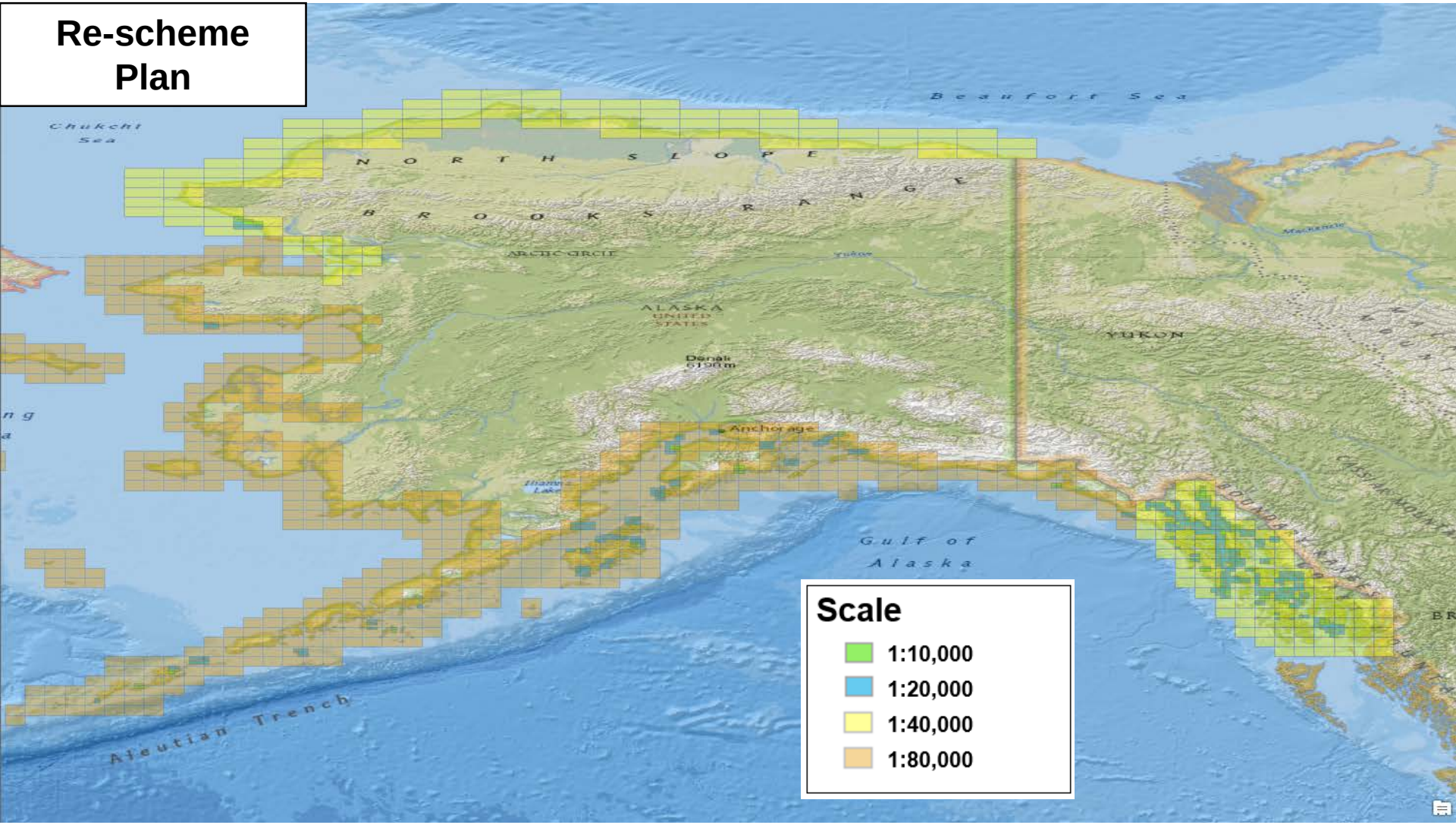

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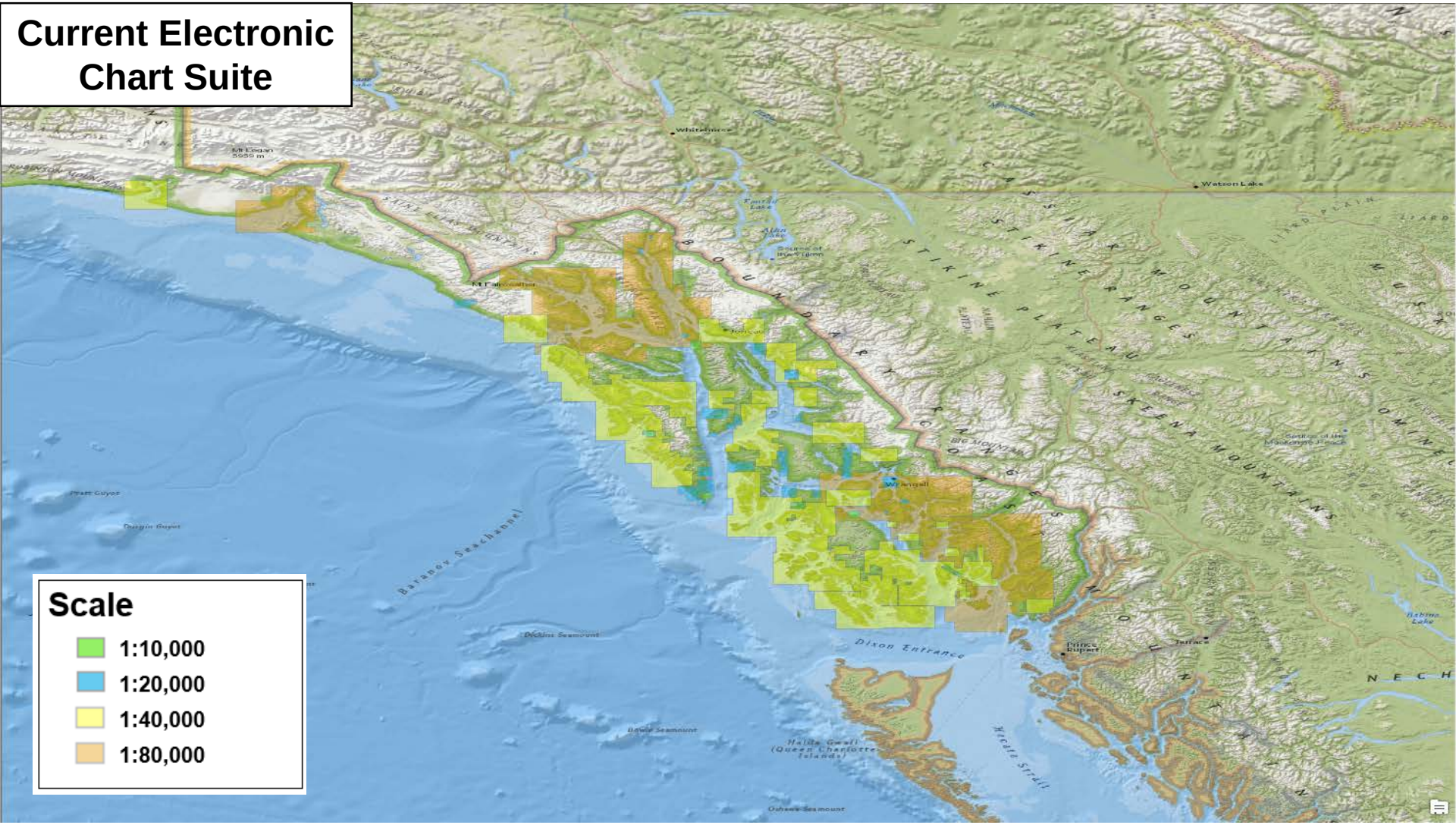
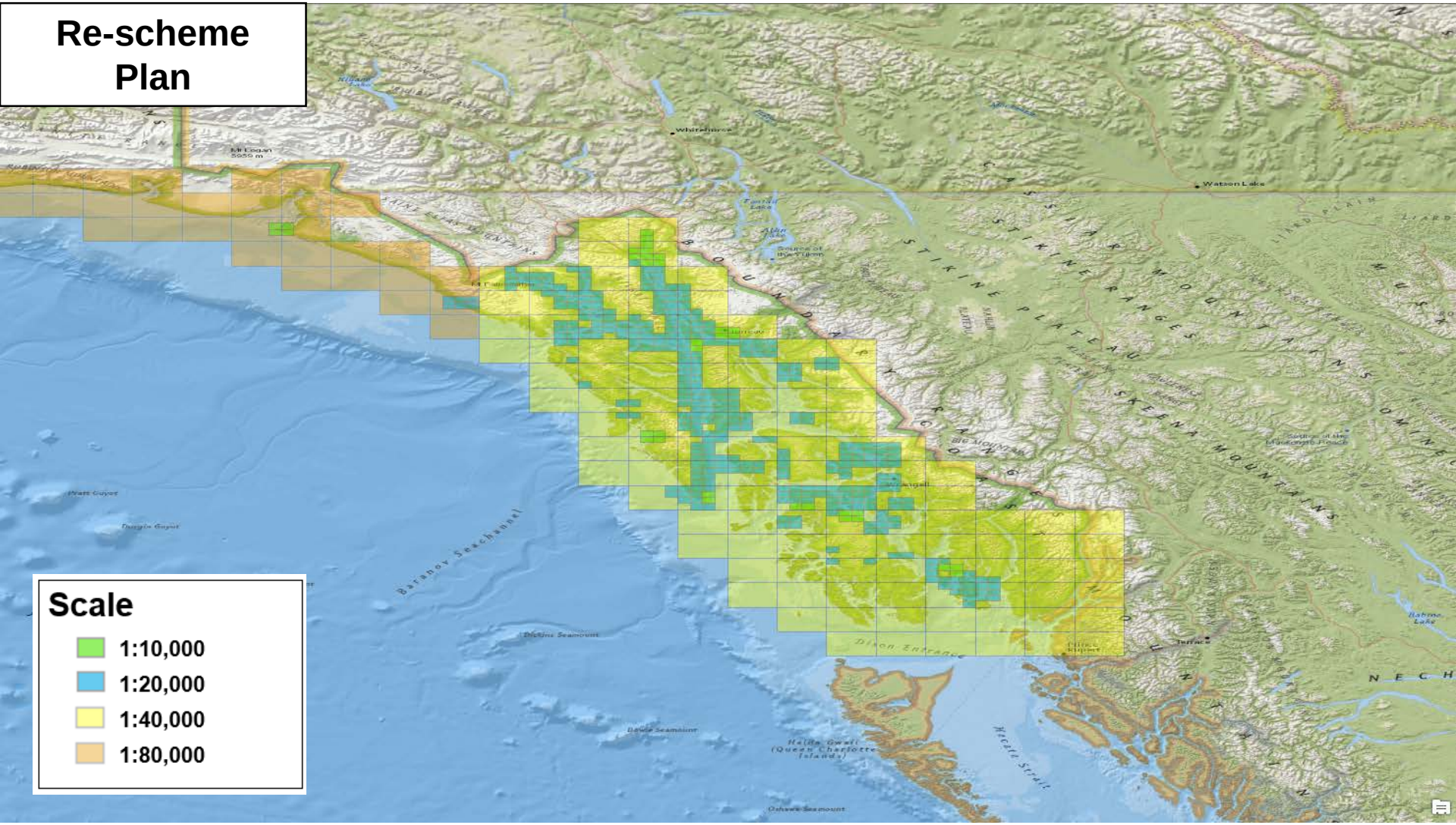


Re-scheme Plan



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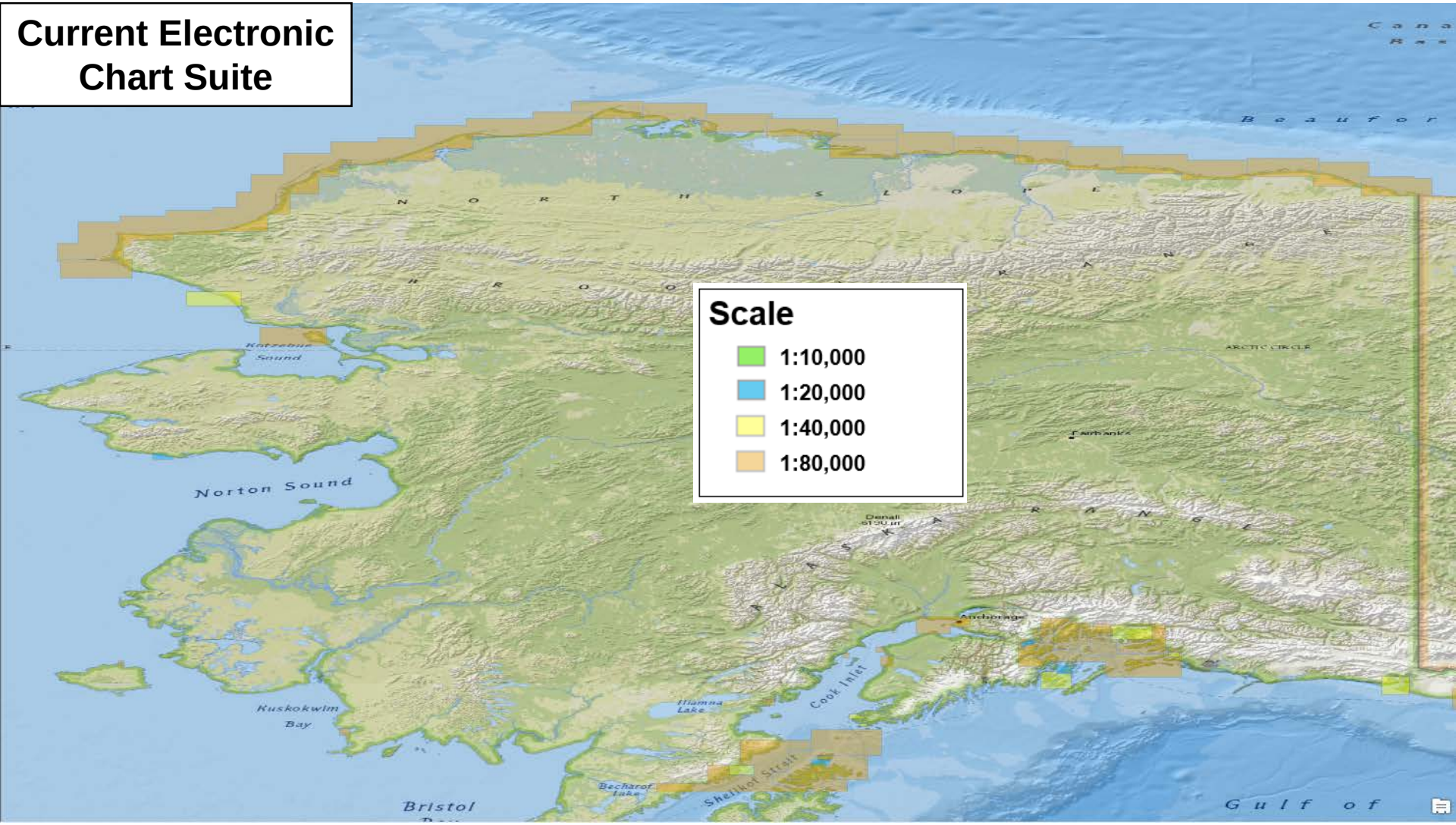

Re-scheme Plan