

22nd Conference of the MACHC “Challenges of S-101 Validation”

01 December 2021

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SevenCs Hamburg



Overview

- SevenCs / ChartWorld, a quick overview
- Involvement in IHO Standardization Activities
- Software products dealing with S-100
 - S-57 to S-101 conversion
 - S-102 optimization
- S-101 Validation with 7Cs Analyzer
- “Unveiling” S-101 Topology

“Challenges of S-101 Validation”

Friedhelm Moggert-Kägeler,
SevenCs Hamburg



SevenCs / ChartWorld

A quick overview



SevenCs / ChartWorld

A quick overview

- Founded in 1992 in Hamburg, Germany
- SevenCs belongs to ChartWorld
- International group of companies
- Digital Chart Agent, ECDIS Manufacturer, VAR, ENC and SENC distribution services
- Products and Services related to ENC / ECDIS
- Long term member of IHO Working Groups

Founded in 1992

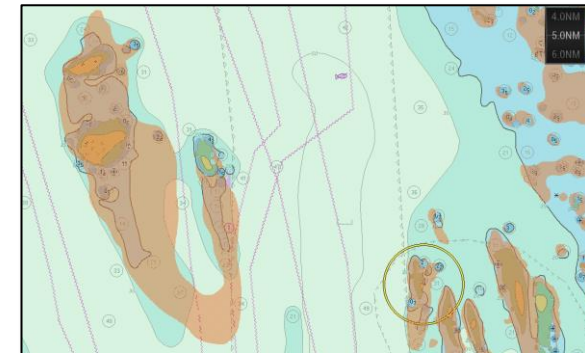
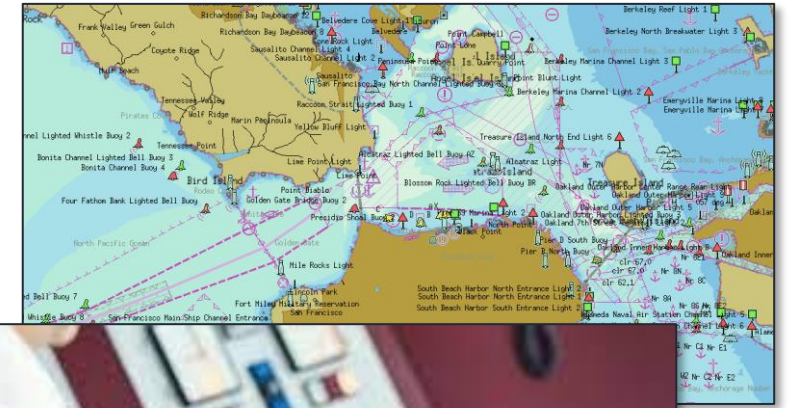
120+ Employees

4 Office locations



SevenCs / ChartWorld Products and Services

- Chart Distribution (incl. Nautical Publications)
- Solutions for Voyage Planning
- Fleet Monitoring
- ECDIS Kernel software
- Web based solutions for electronic charts
- Chart Production/Validation Software
- ECDIS and Navigation Software (ECS, PPU)
- Complementary data services (satellite derived shoals, T&P, Nav Areas)






Involvement in S-100/S-10x Standardization

Involvement in IHO Standardization Activities

- ENCWG / S-100 WG
 - Involvement and contribution to standardization processes
- Project Teams and Sub-WG
 - S-101 Project Team
 - Validation checks for S-101
 - S-57 to S-101 conversion
 - S-102 Project Team

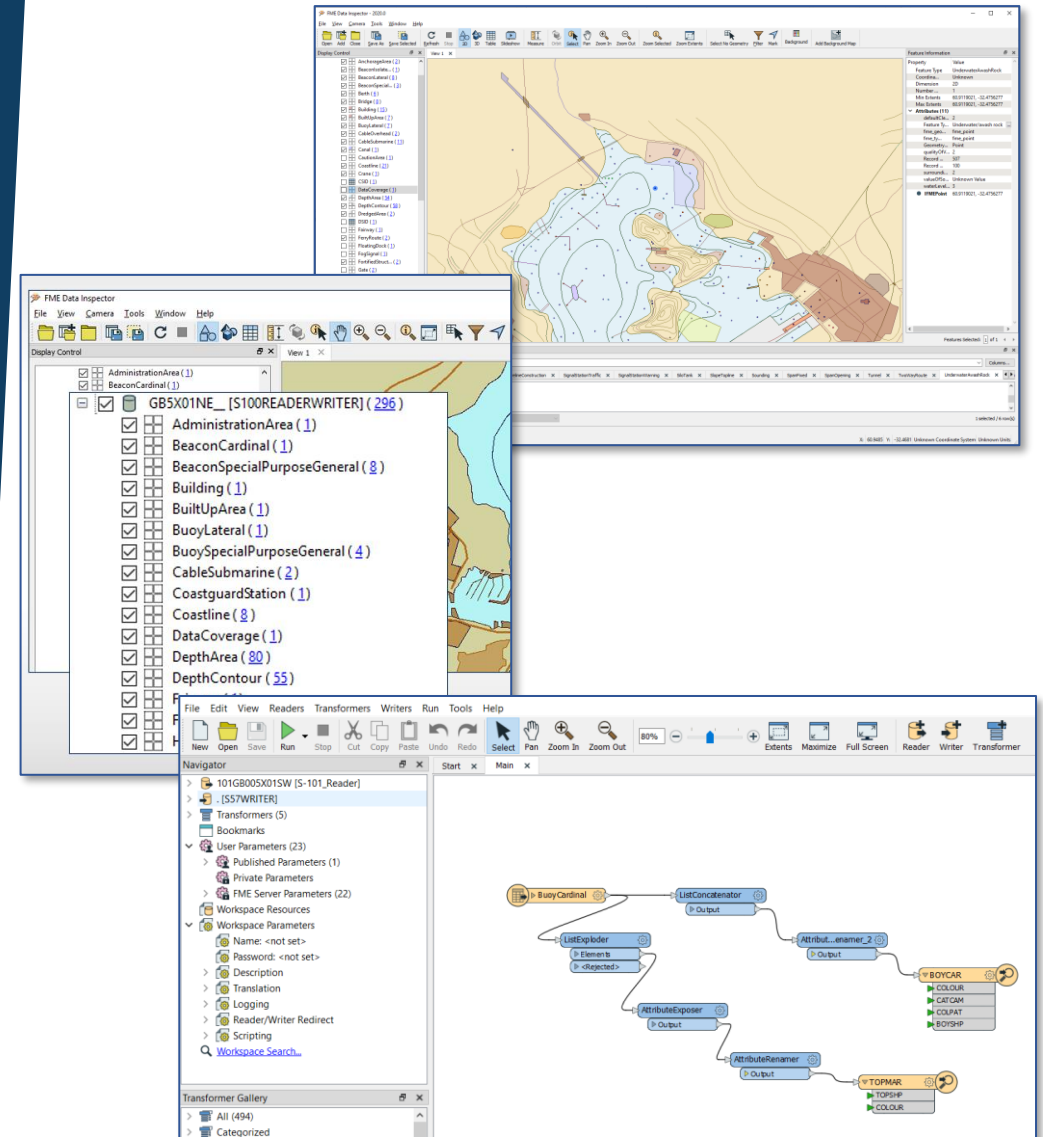




**Software products dealing
with S-100**

S-100 in FME*

- S-100 Plugins for FME
 - S-101 Reader
 - S-101 Writer
- Opens myriad data-conversion options
 - incl. S-57 to S-101 and vice versa
- Not limited to S-57 to S-101
- Users can design and adjust the translation workflow to their needs

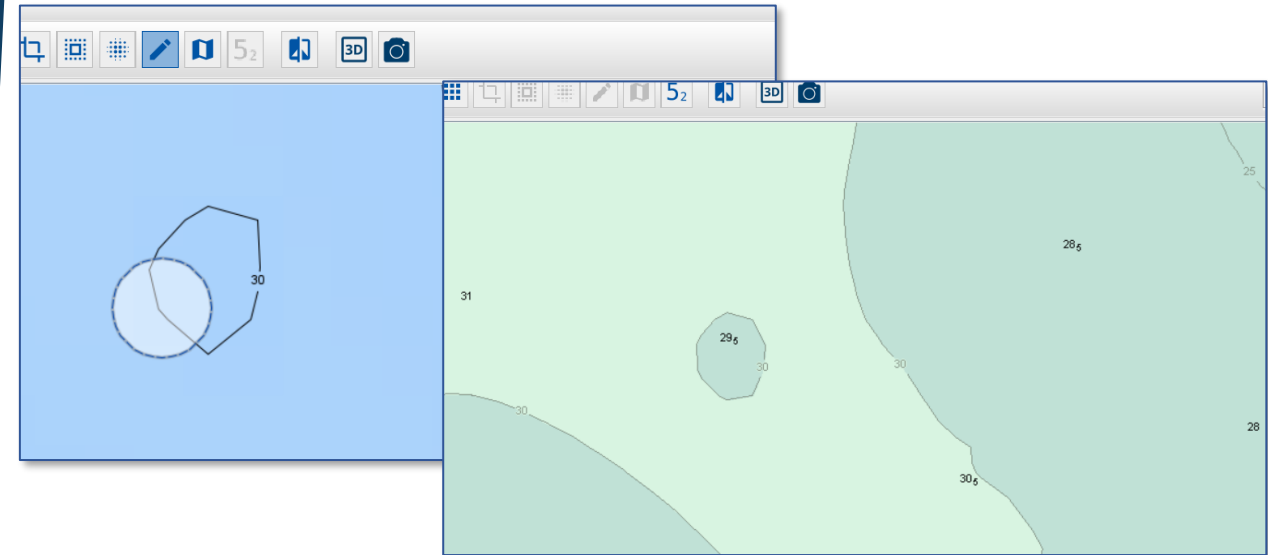
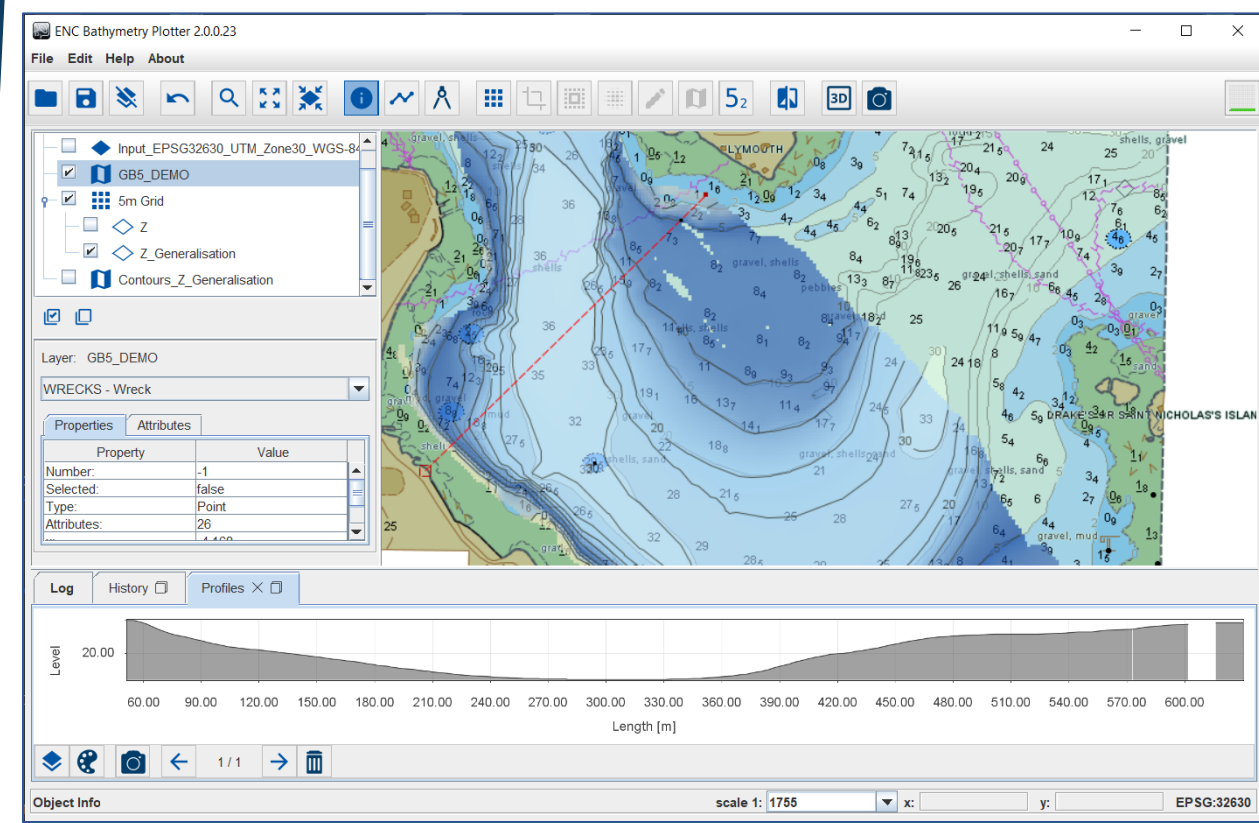


*FME by Safe Software is the data-integration platform for geo-spatial data



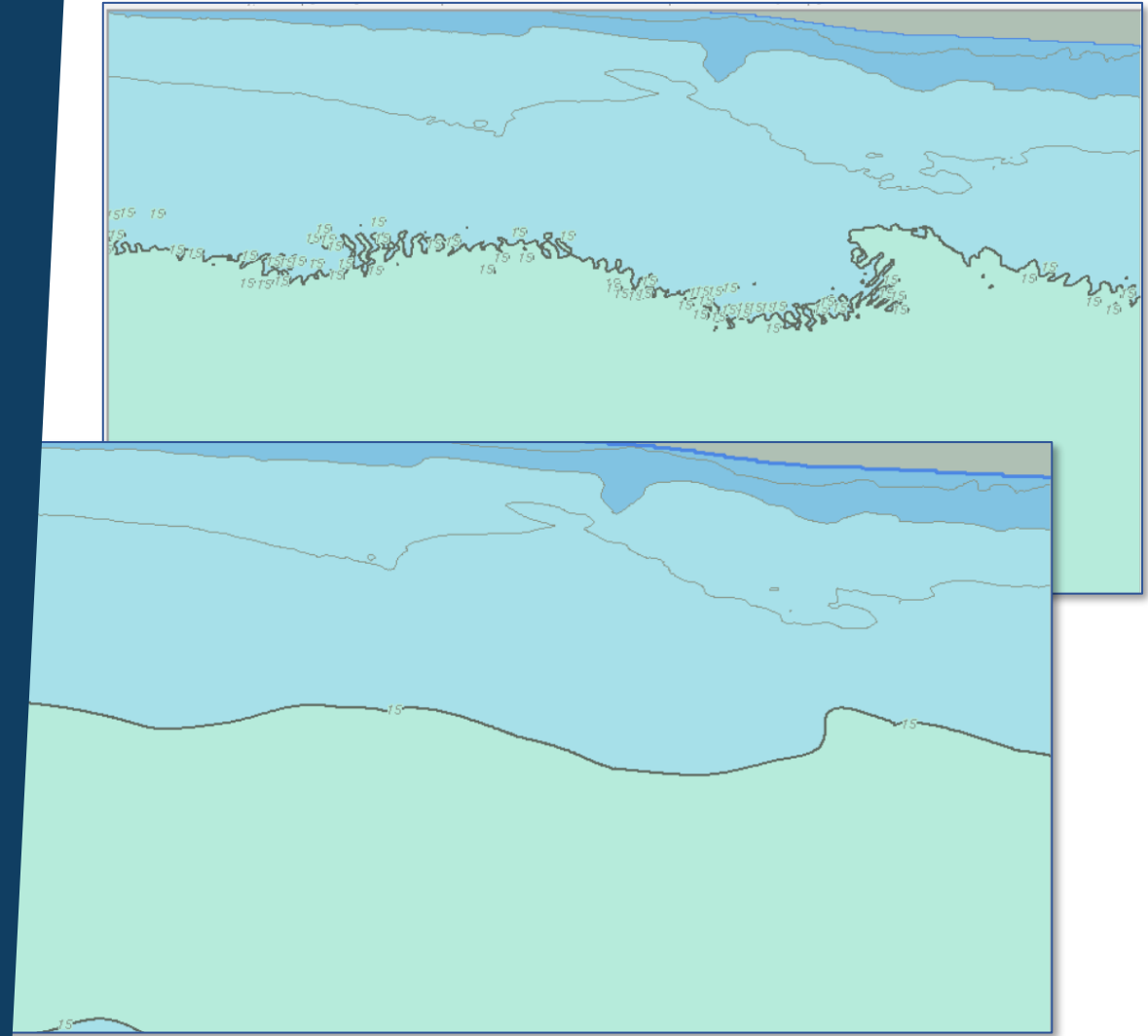
ENC Bathymetry Plotter

- Automated contour generation for nautical charts
- Advanced sounding selection
- Generalization of bathymetric surface
- Regular and High Density ENCs
- Input formats
 - xyz, ASCII Grid
 - Geo Tiff
 - BAG
 - S-102



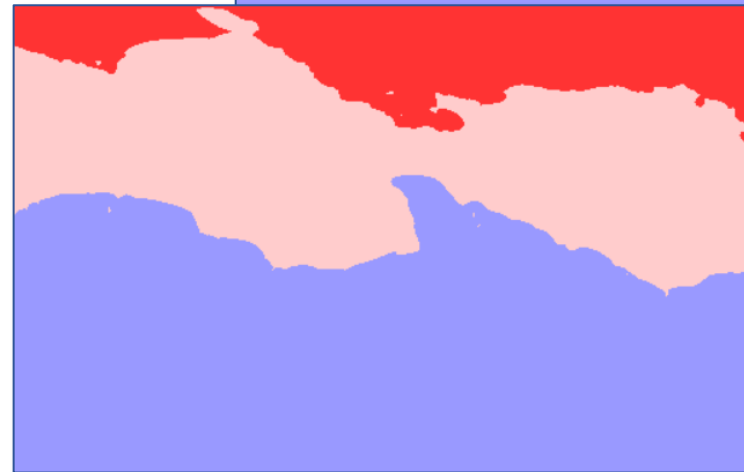
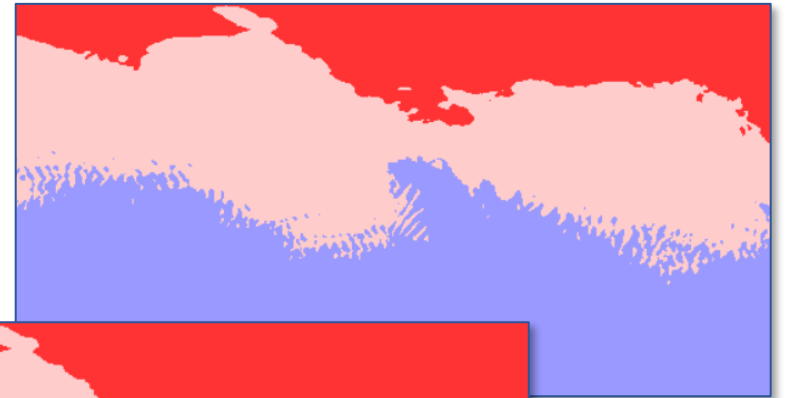
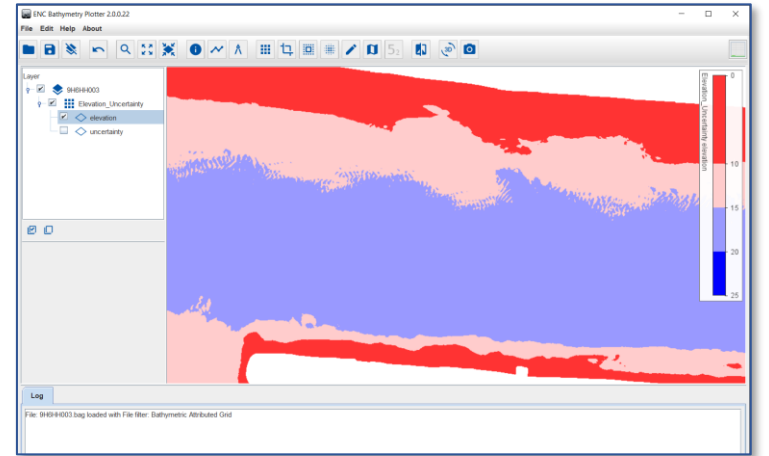
S-102 Optimization for use in Navigation Software

- Most likely navigation systems supporting S-102 could create contours on-the-fly
- S-102 high-resolution data tends to create clutter on the screen
- If these contours are not generalized properly, they will create clutter
- S-102 Optimization can help to avoid clutter in the first place



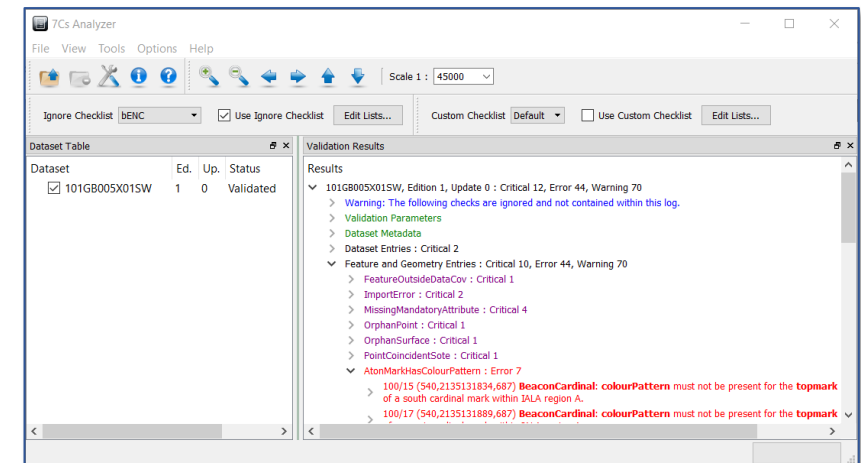
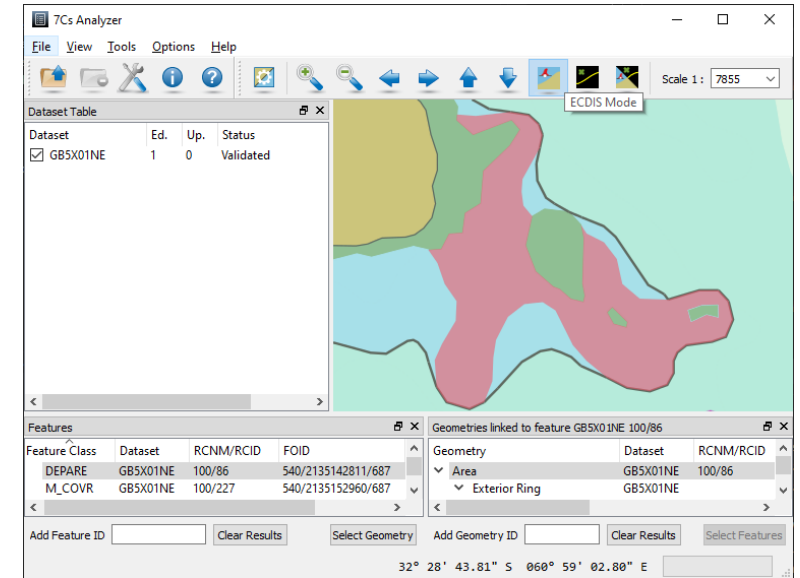
S-102 Optimization

- S-102 high-resolution data tends to create clutter on the screen
- **ENC Bathymetry Plotter** can be used to optimize S-102 bathymetry
- This will contribute to better readability without loss of resolution



S-101 Validation

- 7Cs Analyzer for S-57 and S-101 validation
- Well established for use as S-57 ENC validation tool
- Already includes checks for S-101 validation
- Implementation of new checks goes hand in hand with development of S-101 validation checks



S-101 Validation

S-101 Validation, challenges

- S-57 and S-101 differ significantly
 - New terms
 - New feature catalogue
 - New topology model
 - New feature types and new attributes
 - Multiplicity of attributes
 - Complex attributes
 - Information types
 - Associations, roles
 - etc.
- S-101 Validation standard is in the making

S-57	S-100
Objects	Features
Object catalogue	Feature catalogue
Edge	Curve
	Composite Curves
	Surface
	...

S-57ObjectClass	S-101FeatureType
BRIDGE	Bridge
BOYLAT	BuoyLateral
DEPARE	DepthArea
DEPCNT	DepthContour
LNDARE	LandArea
WRECKS	Wreck
BOYCAR	BuoyCardinal
ADMARE	AdministrationArea
AIRARE	AirportAirfield
ACHARE	AnchorageArea
ACHBRT	AnchorBerth
BCNCAR	BeaconCardinal
BCNISD	BeaconIsolatedDanger
BCNLAT	BeaconLateral
BCNSAW	BeaconSafeWater
BCNSPP	BeaconSpecialPurposeGeneral

S57Attribute	S-101Attribute
BCNSHP	beaconShape{0}
BUIHSP	buildingShape{0}
BOYSHP	buoyShape{0}
BURDEP	buriedDepth{0}
CALSGN	callSign{0}
CATAIR	categoryOfAirportAirfield{0}
CATACH	categoryOfAnchorage{0}
CATBRG	categoryOfBridge{0}
CATBUA	categoryOfBuiltUpArea{0}
CATCBL	categoryOfCable{0}
CATCAN	categoryOfCanal{0}
CATCAM	categoryOfCardinalMark{0}
CATCHP	categoryOfCheckpoint{0}
CATCOA	categoryOfCoastline{0}

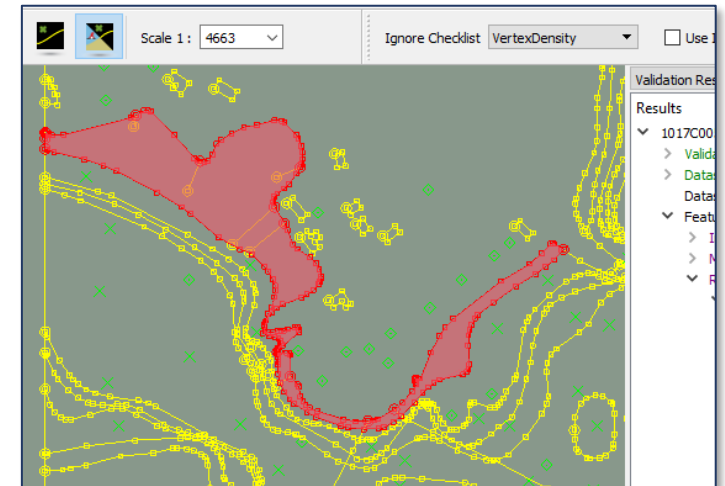
Validation of converted S-57 data

- First S-101 data will be created by means of S-57 conversion
- IHO tasked a dedicated project team, Primar is running a Conversion Task Force Project
- 7Cs Analyzer helps verifying the correctness of the conversion results
- Erroneous S-101 features and/or geometry can be highlighted
- Dedicated query functions are available for deeper analysis of errors

S-57

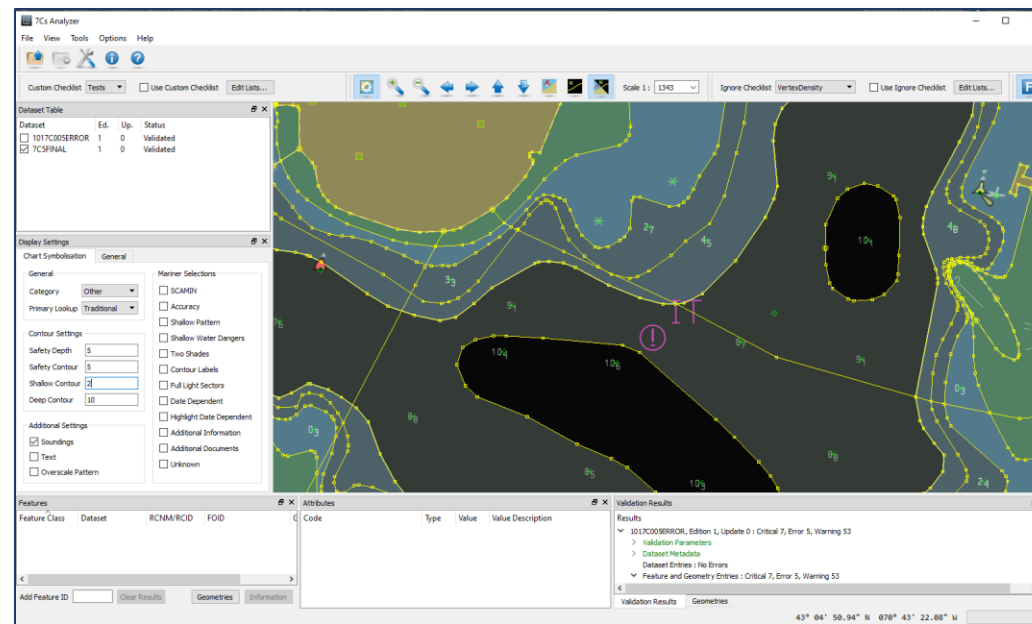


S-101



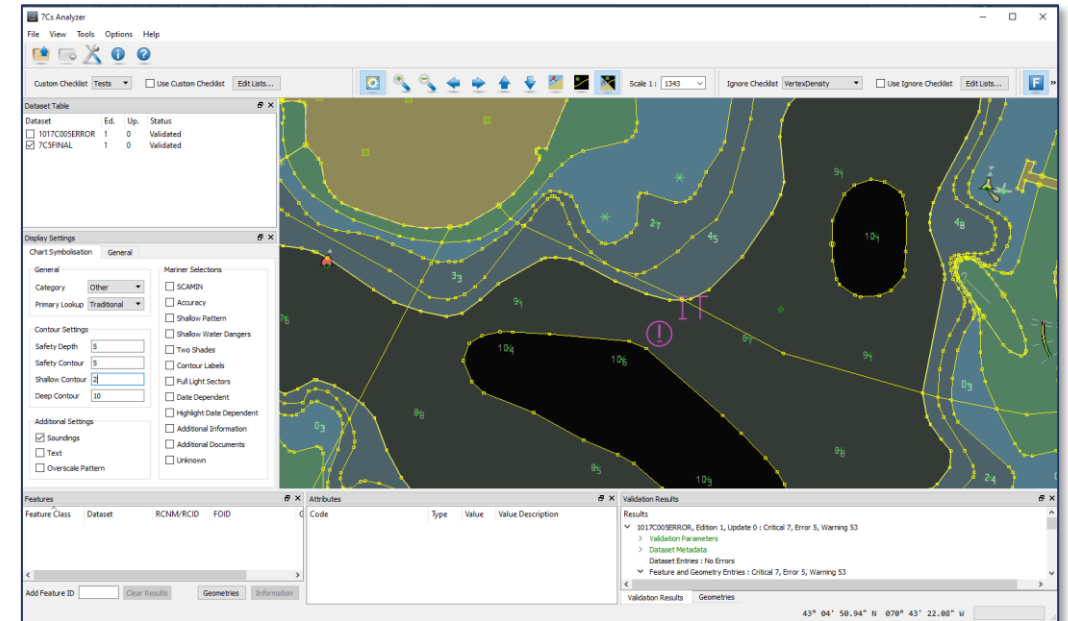
S-101 Validation with 7Cs Analyzer

- Includes dedicated module for S-101 validation checks
- Chart Display module “unveils” S-101 complex topology model (geometry mode)



S-101 Validation with 7Cs Analyzer

- Based on existing S-58 checks
- Adjusted to honor S-101 specifics:
 - Topology model
 - Feature Catalogue (Feature Types, Information Types, Complex Attributes)
- Activities in line with development of validation checks for S-101
- S-101 custom checks can be added (e.g., to test new checks before they are approved)



7Cs Analyzer S-101 Error Log

Structure of S-101 error-log entries:

- Error code / severity
- Identifier of item affected (feature code)
- Description of error
- Category of error
- Suggested solution
- (Related objects)
- (Error locations)
- S-58 reference

Drval2LessDrval1 : Error 1

100/152 (31868,1169213122,36) **DepthArea: depthRangeMaximumValue is less than depthRangeMinimumValue.**

Categories: Bathymetry and Attribute

Suggested Solution: Amend the values of **depthRangeMinimumValue** and **depthRangeMaximumValue** as required.

References:
S-58, Ed. 6.1.0, check 49

Category: Bathymetry and Attribute

SegmentsOverlap : Error 1

120/106: Curve segments partially overlap.

Categories: Topology and Redundancy

Suggested Solution: Remove duplication, add end points and edit curves as required.

Related Objects:
120/184

Error Locations:
43 04.764330 N 070 43.300110 W
43 04.765800 N 070 43.298250 W
43 04.761960 N 070 43.300710 W

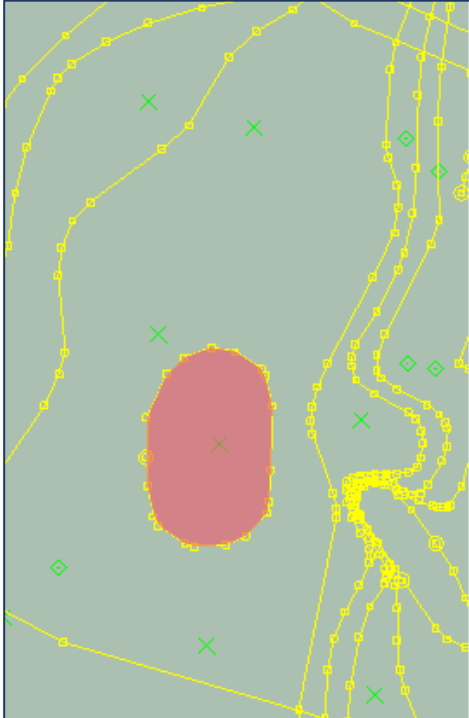
References:
S-58, Ed. 6.1.0, check 1

Category: Topology and Redundancy

Reviewing the Error Log

Analysis of feature-attribute errors:

- Select feature affected, to highlight it in chart display
- Check feature attributes



Validation Results

Results

- 1017C005ERROR, Edition 1, Update 0 : Critical 7, Error 5, Warning 53
 - Validation Parameters
 - Dataset Metadata
 - Dataset Entries : No Errors
 - Feature and Geometry Entries : Critical 7, Error 5, Warning 53
 - ImportError : Critical 2
 - MissingMandatoryAttribute : Critical 4
 - RingSelfIntersects : Critical 1
 - AtonLightCharacteristics : Error 1
 - AtonMarkHasColourPattern : Error 1
 - Drval2LessDrval1 : Error 1
 - 100/152 (31868,1169213122,36) **DepthArea: depthRangeMinimumValue, depthRangeMaximumValue.**
 - Categories:** Bathymetry and Attribute
 - Suggested Solution:** Amend the values of **depthRangeMinimumValue** and **depthRangeMaximumValue** as required.
 - References:** S-58, Ed. 6.1.0, check 49
 - SegmentsOverlap : Error 1
 - SoundgGreaterDrval2 : Error 1
 - CoincidentPoint : Warning 1

Text
 Overscale Pattern

Additional Documents
 Unknown

Features					Attributes of feature 1017C005ERROR 100/152		
Feature Class	Dataset	RCNM/RCID	FOID	Geometry	Code	Type	Value
DepthArea	1017C005ERROR	100/152	31868/1169213122/36	Area	depthRangeMinimumValue	Real	10
					depthRangeMaximumValue	Real	2

Reviewing the Error Log

Analysis of topology errors:

- Select the feature affected, to highlight it in chart display
- Select coordinates to focus on error location

Scale 1 : 4663

Ignore Checklist VertexDensity

Use Ignore Checklist Edit Lists...

F G I A

Validation Results

Results

- 1017C005ERROR, Edition 1, Update 0 : Critical 7, Error 5, Warning 53
 - Validation Parameters
 - Dataset Metadata
 - Dataset Entries : No Errors
 - Feature and Geometry Entries : Critical 7, Error 5, Warning 53
 - ImportError : Critical 2
 - MissingMandatoryAttribute : Critical 4
 - RingSelfIntersects : Critical 1
 - 100/168 (31868,1169213712,1) **DepthArea: Ring self-intersects.**
 - Categories: Topology
 - Suggested Solution: Amend ring boundary so that it doesn't self intersect.
 - Error Locations:
43 04.975543 N 070 43.401836 W

RingSelfIntersects : Critical 1

100/168 (31868,1169213712,1) **DepthArea: Ring self-intersects.**

Categories: Topology

Suggested Solution: Amend ring boundary so that it doesn't self intersect.

Error Locations:
43 04.975543 N 070 43.401836 W
43 04.971807 N 070 43.403185 W

ImportError : Critical 2

MissingMandatoryAttribute : Critical 4

RingSelfIntersects : Critical 1

- 100/168 (31868,1169213712,1) **DepthArea: Ring self-intersects.**
 - Categories: Topology
 - Suggested Solution: Amend ring boundary so that it doesn't self intersect.
 - Error Locations:
43 04.975543 N 070 43.401836 W
43 04.971807 N 070 43.403185 W
 - References:
S-58, Ed. 6.1.0, check 78

AtonLightCharacteristics : Error 1

AtonMarkHasColourPattern : Error 1

Export of validation results

- Various export formats are supported:
- xml, text
- ESRI shape format
- Exported shapefiles containing validation results can be loaded in 3rd party production software

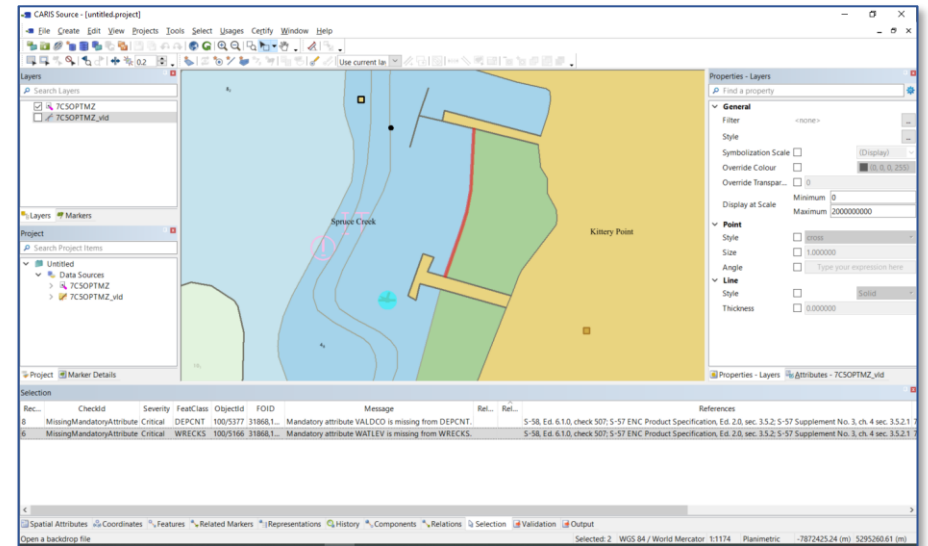


Image captured in CARIS HPD™ with permission of Teledyne CARIS™

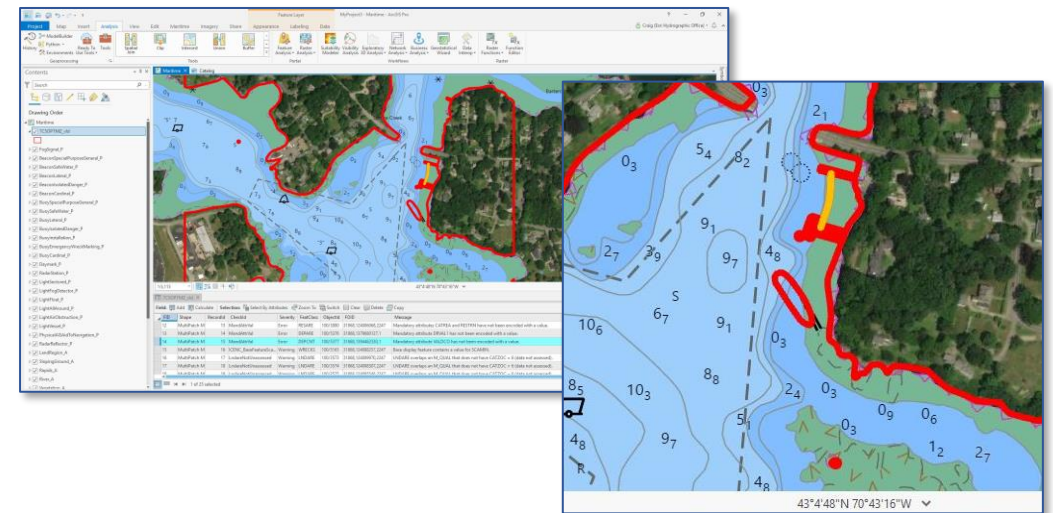


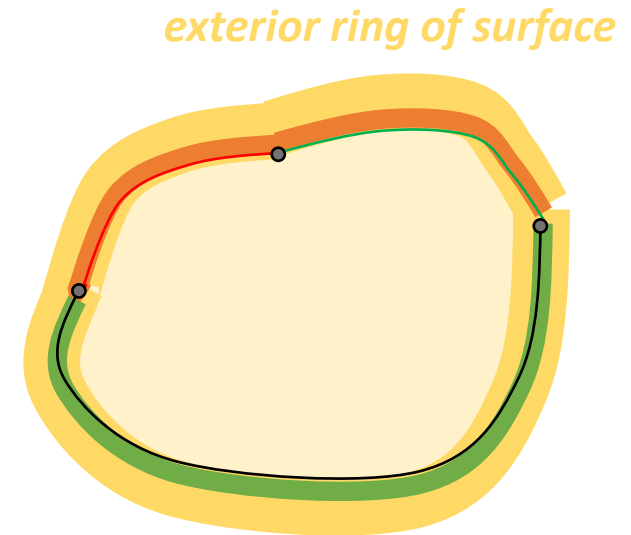
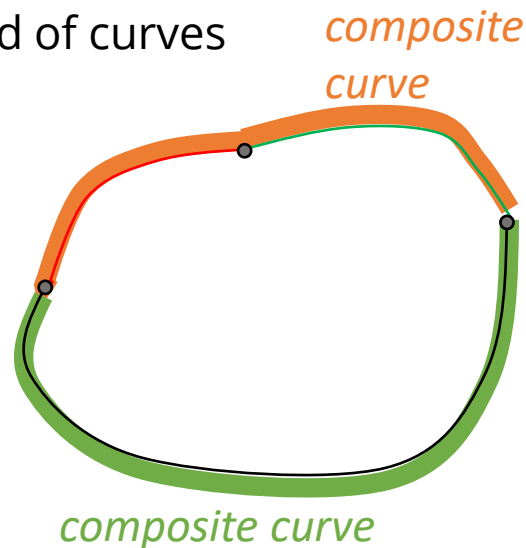
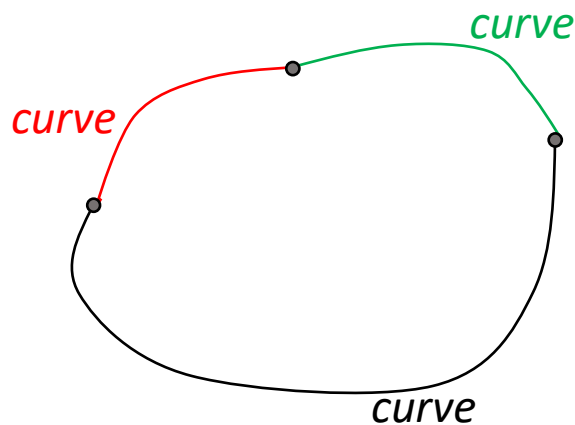
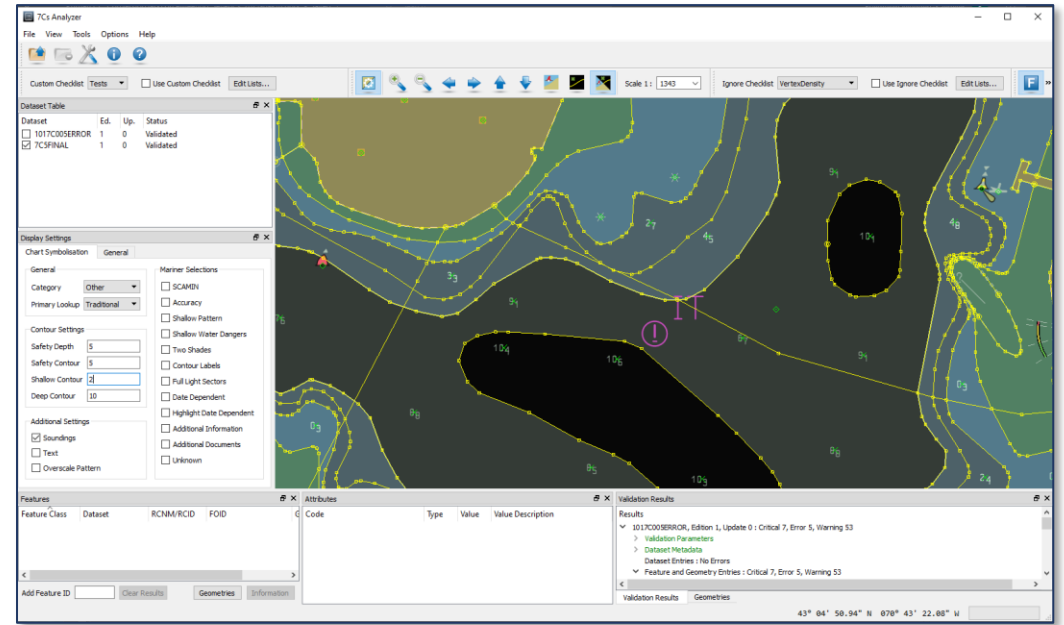
Image captured in ESRI ArcGIS Pro™ with permission of ESRI™

“Unveiling” S-101 Topology

“Unveiling” S-101 Topology

S-101 topology differs from S-57 :

- An area feature references a surface
- A surface is comprised of
 - one exterior ring
 - zero or more interior rings
- A ring is comprised of (a) composite curve(s)
- Composite curves are comprised of curves



“Unveiling” S-101 Topology

S-101 topology:

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Scale 1 : 1473

Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists...

Features

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

Add Feature ID Clear Results Geome

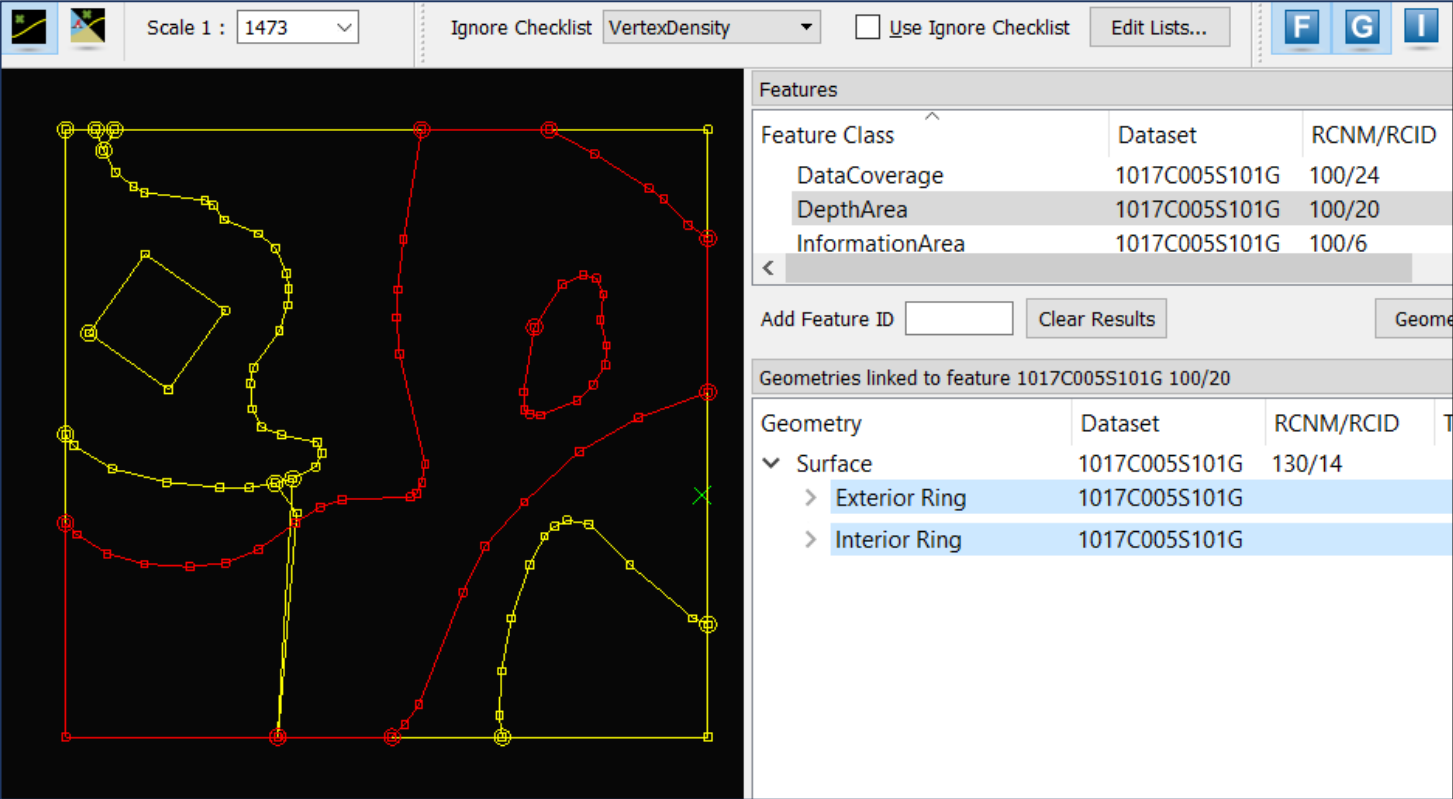
Geometries linked to feature 1017C005S101G 100/20

Geometry	Dataset	RCNM/RCID	T
Surface	1017C005S101G	130/14	
> Exterior Ring	1017C005S101G		
> Interior Ring	1017C005S101G		

“Unveiling” S-101 Topology

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- An area feature references a surface
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The screenshot shows a GIS application window. The main map area displays a yellow and red boundary on a black background. The right-hand panel contains two tables:

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

Below the first table are buttons for "Add Feature ID", "Clear Results", and "Geome".

Geometry	Dataset	RCNM/RCID
Surface	1017C005S101G	130/14
Exterior Ring	1017C005S101G	
Interior Ring	1017C005S101G	

“Unveiling” S-101 Topology

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Scale 1 : 1473

Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists...

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

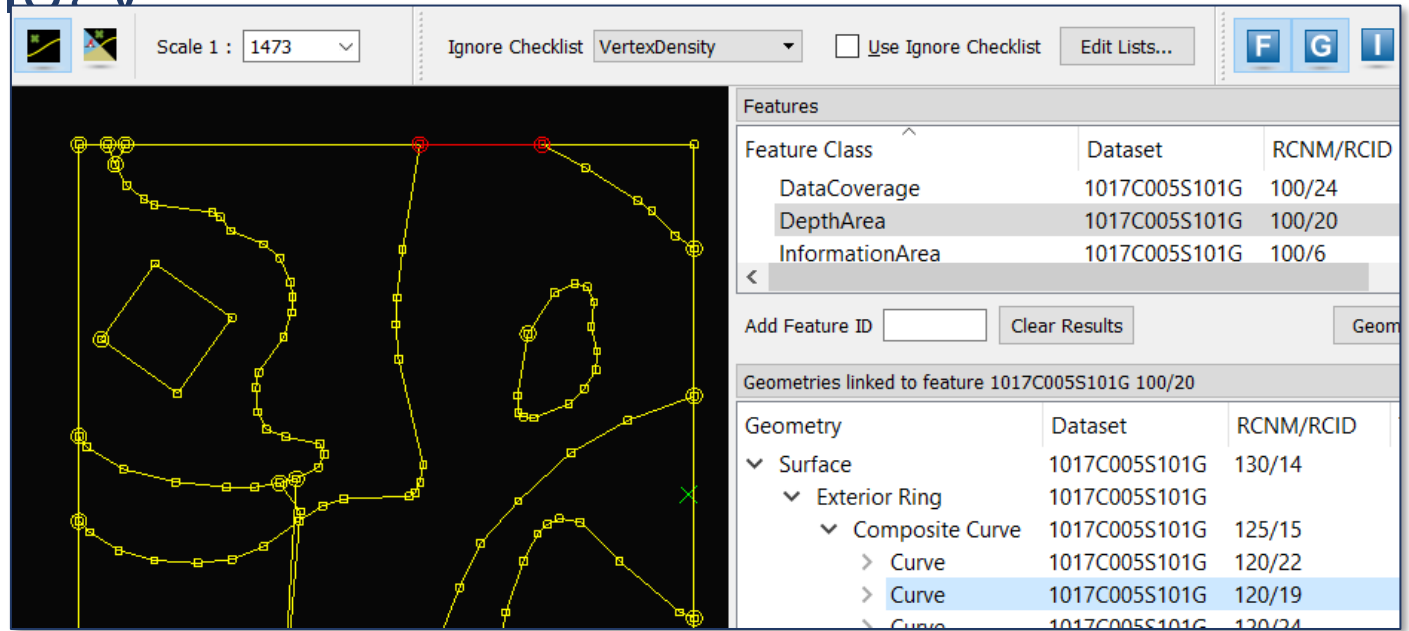
Add Feature ID Clear Results Geom

Geometry	Dataset	RCNM/RCID
Surface	1017C005S101G	130/14
Exterior Ring	1017C005S101G	
Composite Curve	1017C005S101G	125/15
Composite Curve	1017C005S101G	125/24
Interior Ring	1017C005S101G	

“Unveiling” S-101 Topology

S-101 topology:

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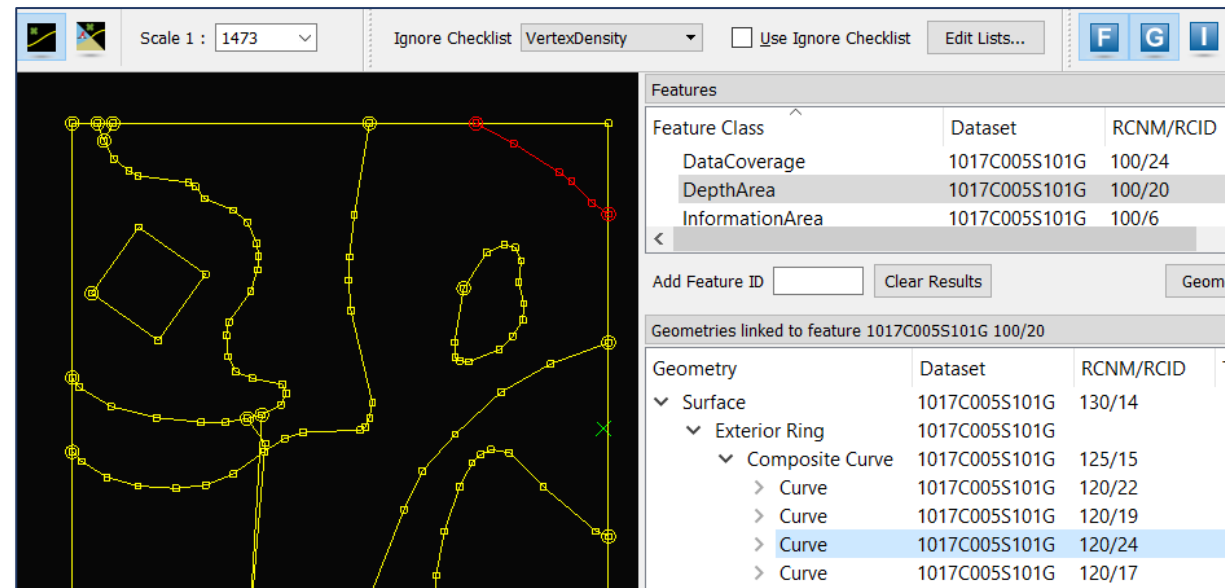
Scale 1 : 1473

Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists...

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

Add Feature ID Clear Results Geom

Geometry	Dataset	RCNM/RCID
Surface	1017C005S101G	130/14
Exterior Ring	1017C005S101G	
Composite Curve	1017C005S101G	125/15
Curve	1017C005S101G	120/22
Curve	1017C005S101G	120/19
Curve	1017C005S101G	120/24



Scale 1 : 1473

Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists...

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

Add Feature ID Clear Results Geom

Geometry	Dataset	RCNM/RCID
Surface	1017C005S101G	130/14
Exterior Ring	1017C005S101G	
Composite Curve	1017C005S101G	125/15
Curve	1017C005S101G	120/22
Curve	1017C005S101G	120/19
Curve	1017C005S101G	120/24
Curve	1017C005S101G	120/17

“Unveiling” S-101 Topology

S-101 topology differs from S-57 :

- An area feature references a surface
- A surface is comprised of
 - one exterior ring
 - zero or more interior rings
- A ring is comprised of (a) composite curve(s)
- Composite curves are comprised of curves
- Curves have a beginning and an end point

736 Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists... F G

Feature Class	Dataset	RCNM/RCID
DataCoverage	1017C005S101G	100/24
DepthArea	1017C005S101G	100/20
InformationArea	1017C005S101G	100/6

Add Feature ID Clear Results

Geometries linked to feature 1017C005S101G 100/20

Geometry	Dataset	RCNM/RCID
Surface	1017C005S101G	130/14
Exterior Ring	1017C005S101G	
Composite Curve	1017C005S101G	125/15
Curve	1017C005S101G	120/22
Curve	1017C005S101G	120/19
Curve	1017C005S101G	120/24
Curve	1017C005S101G	120/17

736 Ignore Checklist VertexDensity Use Ignore Checklist Edit Lists... F G I A

Feature Class	Dataset	RCNM/RCID	FOID
DataCoverage	1017C005S101G	100/24	31868/11692147
DepthArea	1017C005S101G	100/20	31868/11692131
InformationArea	1017C005S101G	100/6	31868/12408049

Add Feature ID Clear Results Geometries Information

Geometries linked to feature 1017C005S101G 100/20

Geometry	Dataset	RCNM/RCID	Topology Indicator
Surface	1017C005S101G	130/14	
Exterior Ring	1017C005S101G		
Composite Curve	1017C005S101G	125/15	
Curve	1017C005S101G	120/22	
Curve	1017C005S101G	120/19	
Curve	1017C005S101G	120/24	
Point	1017C005S101G	110/16	beginning point
Point	1017C005S101G	110/15	end point
Curve	1017C005S101G	120/17	

Conclusion

- We want to support current S-100/S-101 initiatives
- We are confident that 7Cs Analyzer can help to facilitate and speed up the relevant activities (standardization, S-100 testbeds)
- At the same time, we hope to receive valuable feedback from users and participants





Thank You

contact: mo@sevencs.com

