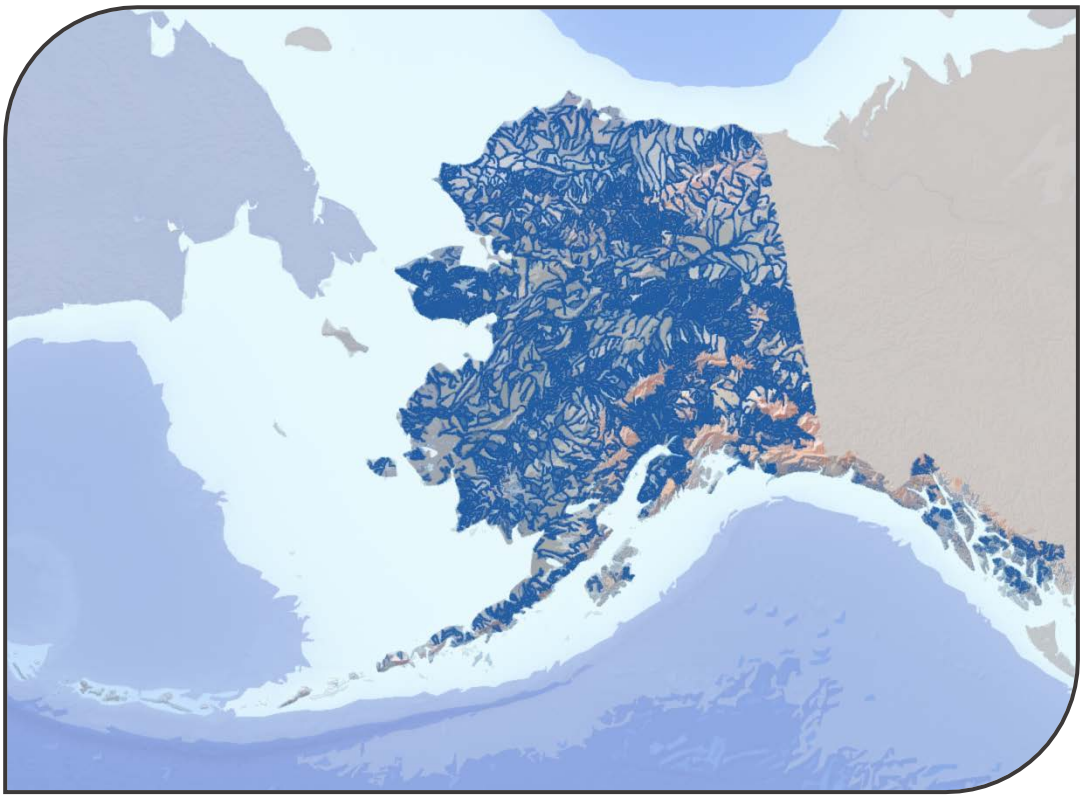
Impaired Waters Assessment Unit Identification (AU ID) Naming Methods



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FUNDING

This project was funded through a Reimbursable Services Agreement from the Alaska Department of Environmental Conservation.

NOTES

This report is accompanied by a collection of digital files which include the final assessment unit base layers for rivers, lakes, and marine features. Other supplemental materials included with this report include interim presentations to ADEC staff exploring other potential approaches for AU identification as well as preliminary efforts to develop the final, preferred methodology for designating waterbody assessment unit identifiers.

Contents

INTRODUCTION

The Clean Water Act administered by the US Environmental Protection Agency requires that the waters of the United States be evaluated every two years via an integrated water quality monitoring and assessment report. Implementation of this action has been delegated to individual states necessitating a system to assign a unique identifier to each separate waterbody within a particular state. This alphanumeric code is referred to as an assessment unit identifier (AU ID).

GOAL

This report and accompanying datasets aim to update the existing, historic AU IDs for Alaskan waters as well as assign new AU IDs for a vast inventory of previously undesignated waters including: flowing and still freshwater waters, and nearshore marine waters.

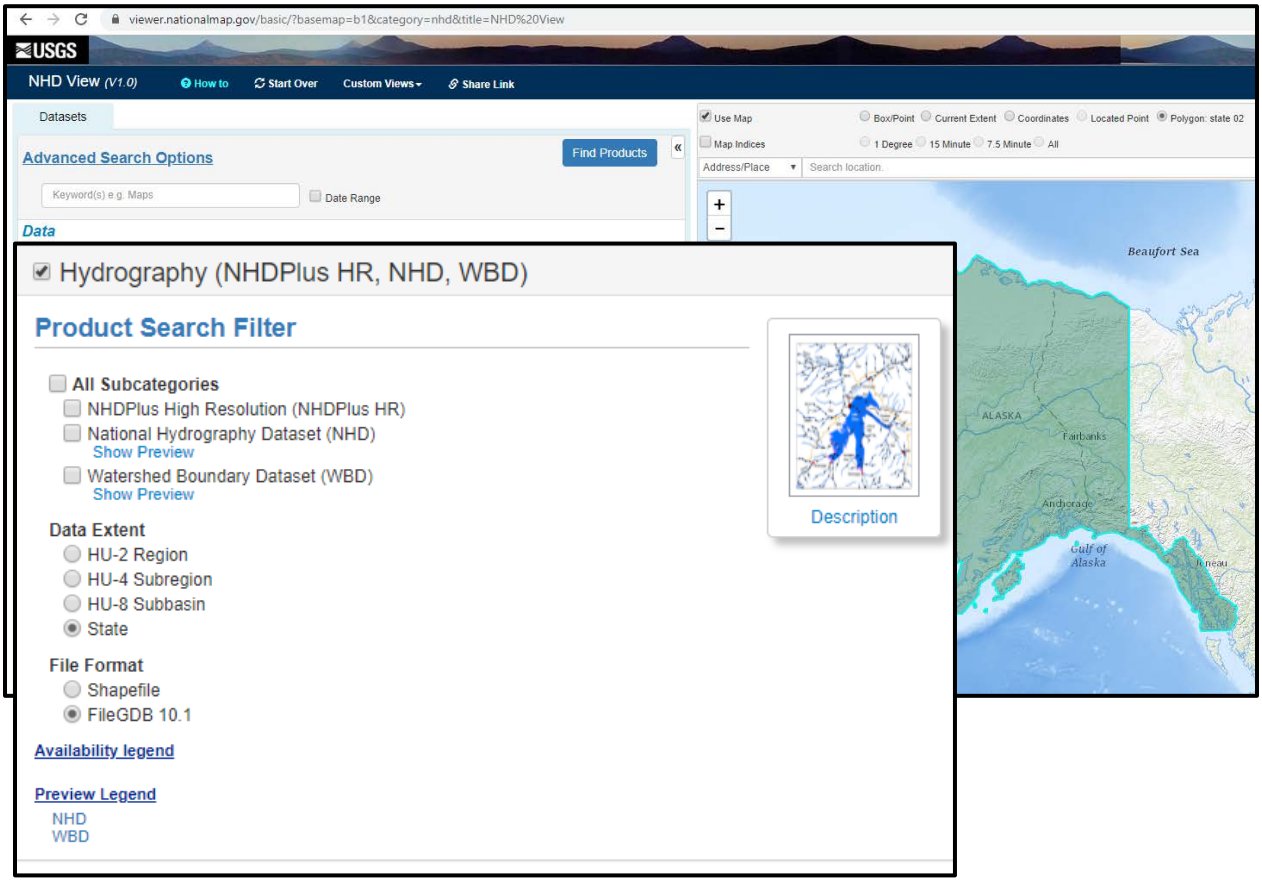
By using current, digital data along with a detailed set of methods and explanatory graphics, this document establishes a format for AU ID assignments that shall be accurate, durable, consistent, and simple as Alaska's digital hydrographic data are continuously improved. Finally, the report provides a template for Alaska Department of Environmental Conservation staff to assign AU IDs to additional waters or to further subdivide waters into more discrete units in the future. The methods outlined in this report are intended to be sufficiently flexible to allow AU ID updates as Alaska's digital hydrographic data are improved.

METHODS for assigning Assessment Unit Identification codes (AU IDs)

FLOWING WATERS (Rivers and Streams)

DATA ACQUISITION

Download current NHD National Hydrographic Dataset from USGS – choose download by state (Alaska) source data https://viewer.nationalmap.gov/basic/



SPATIAL DATA PREPARATION

Open Feature Class NHD Flowline in ArcGIS

1) STEP – Select lines that represent streams and rivers and are part of named features

Select FType = 558 ‘Artificial Path’ or FType = 390 ‘StreamRiver’ (streams, rivers, paths through lakes and ponds)

Select GNIS Name IS NOT NULL (selects only features that are named)

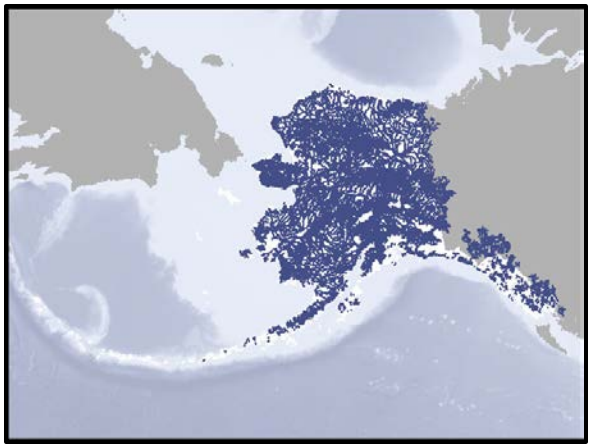
ArcGIS selection syntax GNIS_Name IS NOT NULL AND (FType = 460 OR FType = 558)

(2,665,529 records as of October 2019)

Before: All Flowlines

(296,280 records)

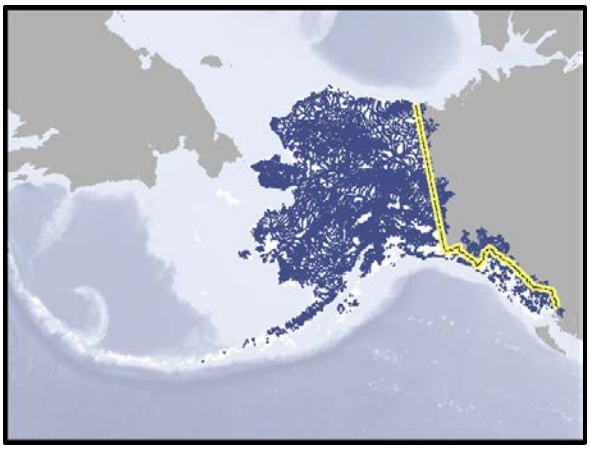
After: named StreamRiver & Artificial Paths



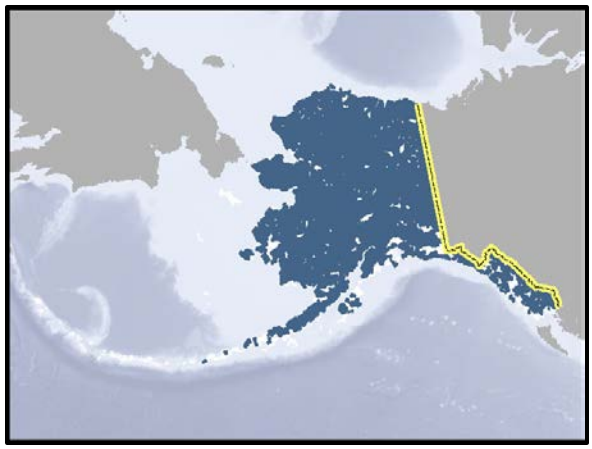
2) STEP – Clip the named streams to eliminate stream segments in Canada.

Clip File with AK polygon AK_63k.shp (Source Alaska Geospatial Data Clearinghouse http://www.asgdc.state.ak.us/#56)

Before: Named Streams



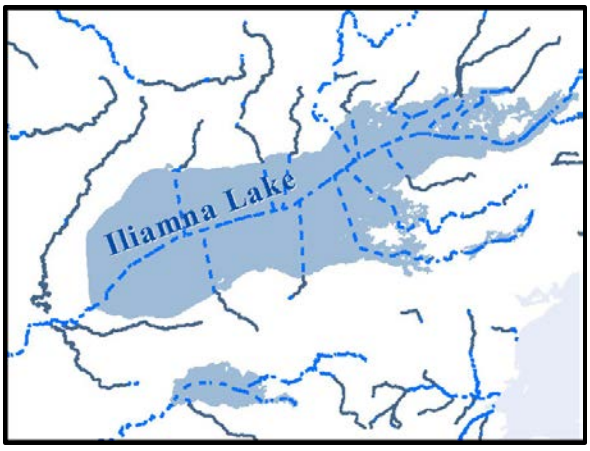
After: Named Streams clipped to Alaska



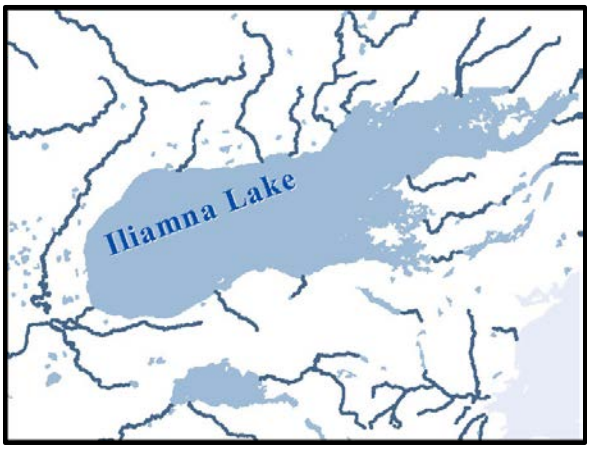
3) STEP – Erase the stream segments in the NHD which are artificial flow paths crossing lakes to maintain network connectivity in the NHD dataset.

Erase with NHD Waterbody (eliminate artificial path stream segments traversing lakes)

Before (with artificial paths through lakes)



After (artificial lake paths removed)



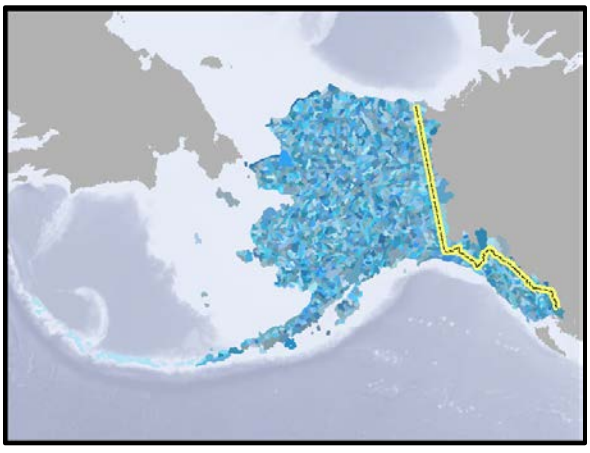
4) STEP – Add the parent watershed information at the ten-digit Hydrologic Unit Code (HUC10) level by intersecting (Intersect GIS tool) each stream segment with the watershed in which it is located.

Download WBD – watershed boundary dataset

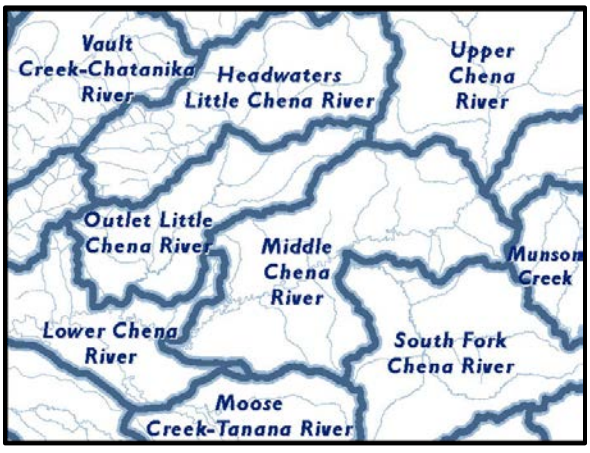
Open HUC10 – 10-digit Hydrologic Unit Code watersheds

Intersect the HUC10 polygons with the named streams layer

2,448 HUC10 watersheds



example of HUC10 intersecting streams

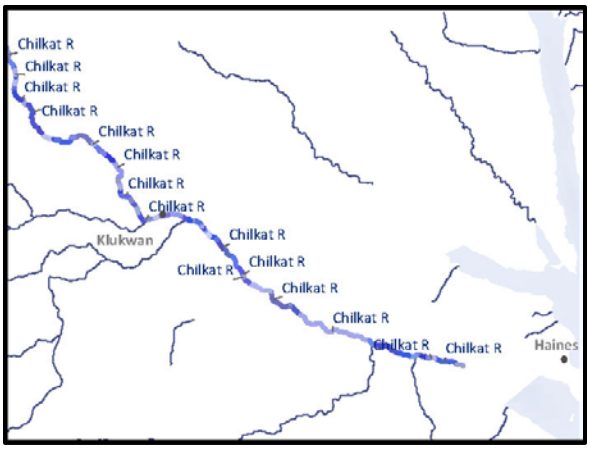


RESULT: 250,033 separate stream segments with HUC10 attributes

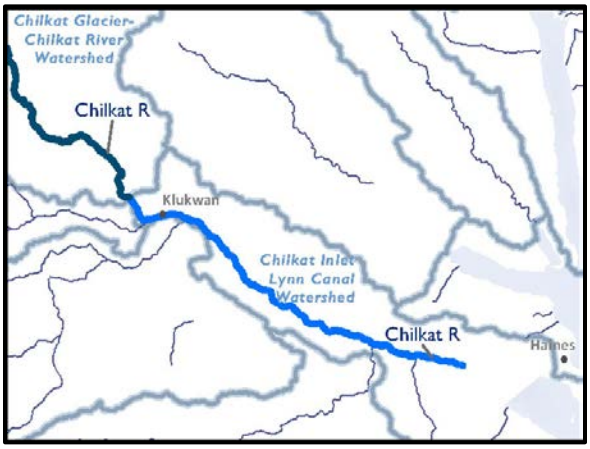
5) STEP – Combine all of the common stream segments within each separate HUC10 watershed based upon features sharing a common name. Use ArcGIS Geoprocessing tool (*Dissolve)* combine segments with common attributes GNIS_Name (stream name), HUC10 (watershed code), and Name (HUC10 watershed name)

   EXAMPLE of dissolve tool combining 214 separate segments of Chilkat River

Before: multiple (>100) segments in HUC10



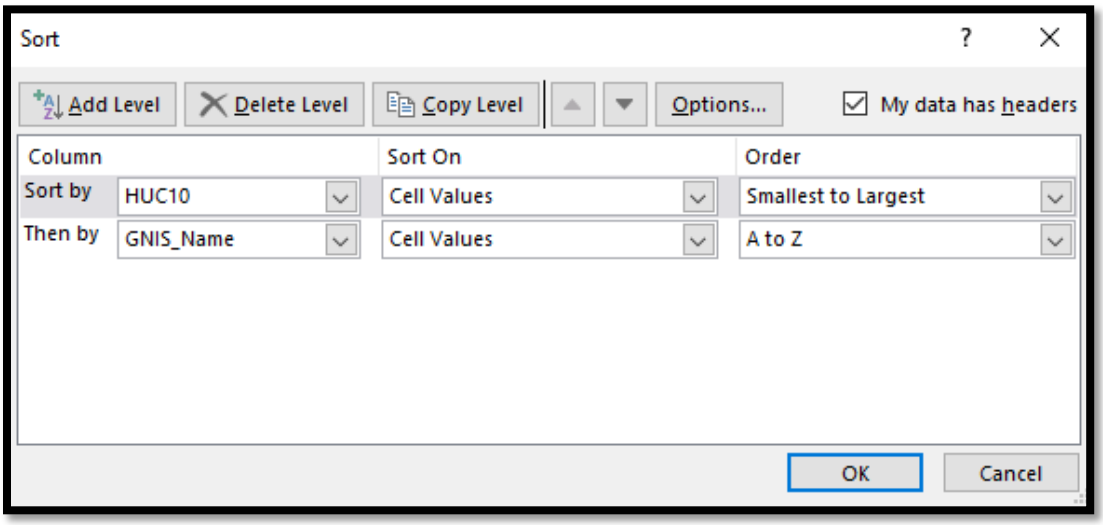
After: segments dissolved into 2 features



RESULT: Output is a dataset with 10,274 unique stream or river features

TABULAR DATA PREPARATION

1) STEP In ArcGIS, export the feature table as a .txt file
2) STEP Open in MS-Excel, sort by the HUC10 number (ascending order: smallest to largest) and then by the Stream Name (GNIS_Name) in descending alphabetical order (A to Z).



Rivers, streams, and creeks can now be assigned sequential numbers within each HUC10 watershed. Since each stream in a row is unique and not repeated in a given HUC10 watershed, an Excel formula can be used to check each row's HUC10 numeric code against the preceding row's HUC10 code. If the HUC10 numbers match, then the sequential number grows by one. If the HUC10 codes do not match, then the sequential count begins again at the number one.

3) STEP Apply formulas to assign sequential numbers and combine into the ATTAINS AUID

The following MS-Excel extract graphically shows how the Assessment Unit identification method will be applied. The Excel export file includes Excel formulas to calculate the AU ID.

Sort 2nd A to Z	Sort 1st Ascending		HUC10 and sequential #	Seque-ntial #'s	
GNIS_Name (stream/river)	**HUC10 (numeric code)**	**Name (watershed)**	**ATTAINS_AUID**	**AUID_ Seq**	**AUD_ suffix**
Ella Creek	1901010201	Princess Bay-Frontal Behm Canal	AK_R_1010201_001	1	001
Fromholz Creek	1901010201	Princess Bay-Frontal Behm Canal	AK_ R_1010201_002	2	002
Grace Creek	1901010201	Princess Bay-Frontal Behm Canal	AK_ R_1010201_003	3	003
Beaver Creek	1901010202	Neets Bay-Frontal Behm Canal	AK_ R_1010202_001	1	001

First, **AK** prefix for Alaska; second, add a "R" for River; next add **last 7 digits** of the HUC10 code; finally add a **sequential number** determined by alphabetical order of each stream or river sorted within each watershed

Sequential numbering restarts at 1 at each new HUC10

Sequential numbering modified to 3-digit format (e.g. 1 = 001)

4) STEP an additional, second suffix could be added to further specify distinct impaired segments along each stream. This would yield an ATTAIN AU ID that would be 20 characters long.

Final Data Layer The final AU ID dataset for flowing waters contains 10,274 separate base assessment units for rivers and streams (mean length = 12.95 miles, total cumulative length = 133,000 miles). Filename is: AU_Streams.shp

WATERBODIES (Lakes and Ponds)

DATA ACQUISITION

Can use same NHD data acquired in the Flowing Waters section.

SPATIAL DATA PREPARATION

1) STEP in ArcGIS Open Feature Class NHD Waterbody, select FType = 390 'LakePond'
2) STEP Select GNIS Name IS NOT NULL (selects only features that are named)

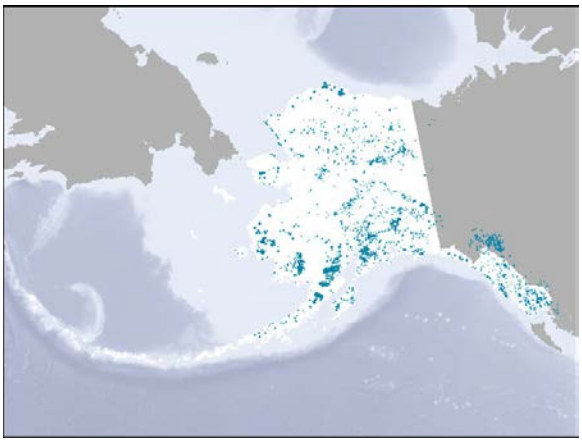
ArcGIS selection syntax GNIS_Name IS NOT NULL AND (FType = 390)

(1,040,139 records as of October 2019)

All Lakes and Ponds

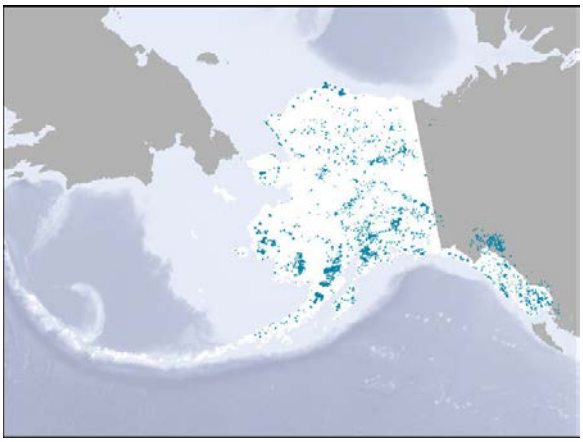
(3,555 lakes or ponds)

Named Lakes and Ponds

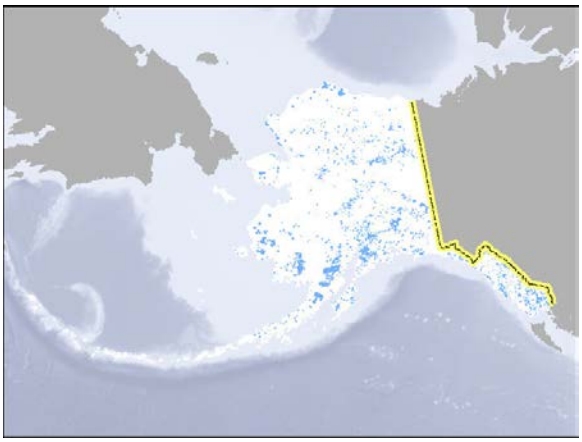


3) STEP Clip File with AK polygon AK_63k.shp (Source Alaska Geospatial Data Clearinghouse http://www.asgdc.state.ak.us/#56)

Named Lakes and Ponds

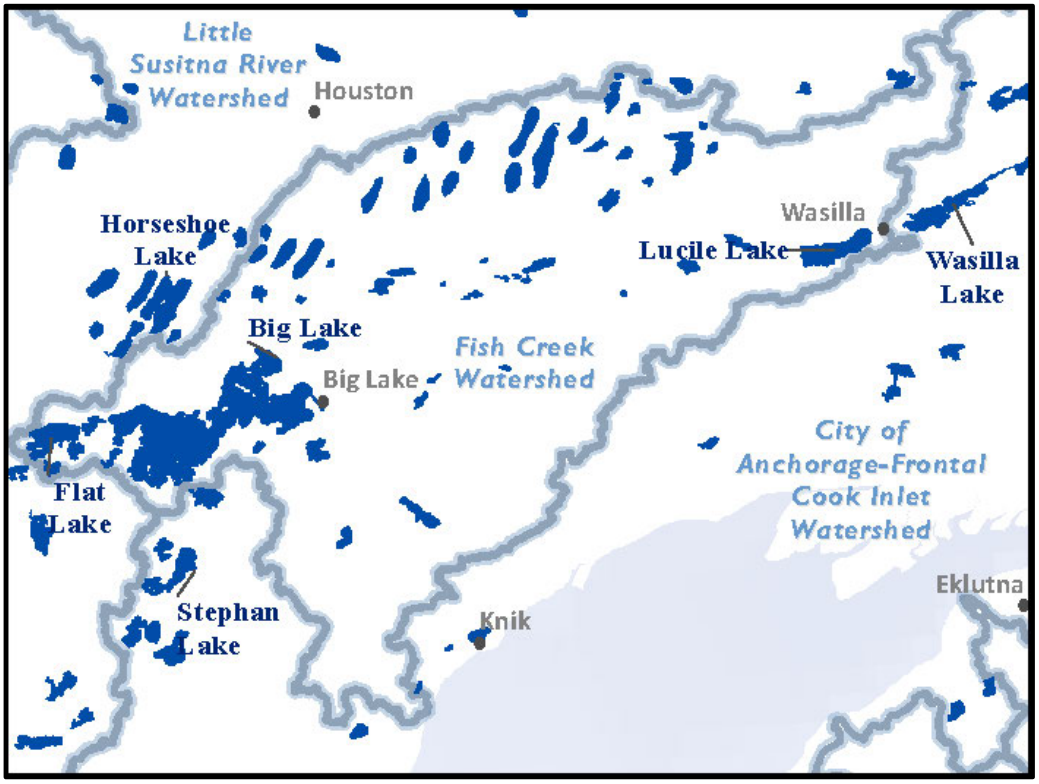


Named lakes and ponds clipped to Alaska



4) STEP Intersect lakes and ponds with HUC10 watershed boundaries

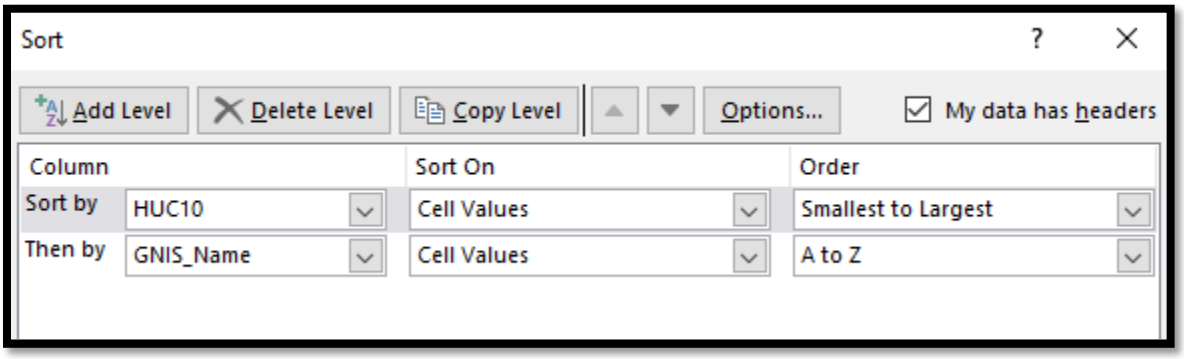
Example of named lakes and ponds (dark blue) with HUC10 watersheds (light blue-gray outline).



2932 total named lakes and pond features within Alaska's HUC10 watersheds.

TABULAR DATA PREPARATION

1) STEP In ArcGIS, export the feature table as a .txt file
2) STEP Open in MS-Excel, sort by the HUC10 number (ascending order: smallest to largest) and then by the Stream Name (GNIS_Name) in descending alphabetical order (A to Z).



Lakes and ponds can now be assigned sequential numbers within each HUC10 watershed. Since each waterbody in a row is unique and not repeated in a given HUC10 watershed, an Excel formula to check each row's HUC10 numeric code against the preceding row's HUC10 code. If the HUC10 numbers match, then the sequential number grows by one. If the HUC10 codes do not match, then the sequential count begins again at the number one.

3) STEP Apply formulas to assign sequential numbers and combine into the ATTAINS AUID

The following MS-Excel extract graphically shows how the Assessment Unit identification method will be applied. The Excel export file includes Excel formulas to calculate the AU ID.

Sort 2nd	Sort 1st		Calculate from HUC10 and sequential #	Seque-ntial #'s	
GNIS_Name (lake/pond)	**HUC10 (numeric code)**	**Name (watershed)**	**ATTAINS_AUID**	**AUID_ Seq**	**AUD_ suffix**
Lake Galea	1901010301	Logjam Creek	AK_L_1010301_001	1	001
Sweetwater Lake	1901010301	Logjam Creek	AK_L_1010301_002	2	002
Angel Lake	1901010302	Thorne River	AK_L_1010302_001	1	001
Control Lake	1901010302	Thorne River	AK_L_1010302_002	2	002

First, **AK** prefix for Alaska; second, add a "L" for Lake; next add **last 7 digits** of the HUC10 code; finally add a **sequential number** determined by alphabetical order of each waterbody sorted within each watershed

Sequential numbering restarts at 1 at each new HUC10

Sequential numbering modified to 3-digit format (e.g. 1 = 001)

4) STEP an additional, second suffix could be added to further specify distinct impaired areas within a lake. This would yield an ATTAIN AU ID that would be 20 characters long.

Final Data Layer

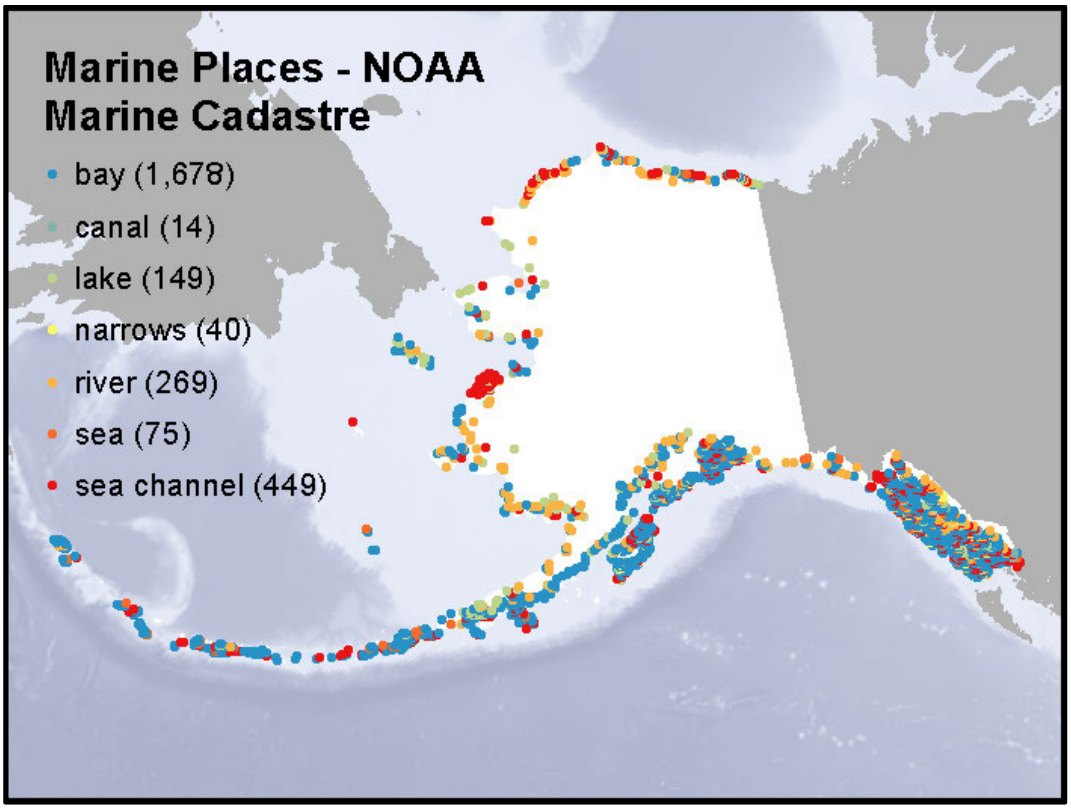
The final AU ID dataset for lakes and ponds contains 2932 separate base assessment units (mean area = 1344 acres). Filename is: AU_Lakes.shp

MARINE FEATURES (Bays, Coves, Harbors, Inlets)

DATA ACQUISITION and CONSIDERATION

Dataset: Marine Place Names (NOAA Marine Cadastre): marine place name points from this dataset has been determined as the preferred alternative for assigning simple, consistent and durable marine AU IDs with the intent to hand delineate the polygons representing the actual impaired water.

This dataset has nearly 2700 unique, named marine features in Alaskan waters and it available as a **GIS point** dataset. This layer displays coastal and offshore marine place names. These are general names for areas of the sea as published on the NOAA Nautical Charts. While the points do not provide any detailed geometry delineating marine waters, they are simple, easy to use, and provide a consistent dataset covering the entire Alaskan coastline from north to south and east to west.



NOAA Source data: https://marinecadastre.gov/data/

SPATIAL DATA PREPARATION

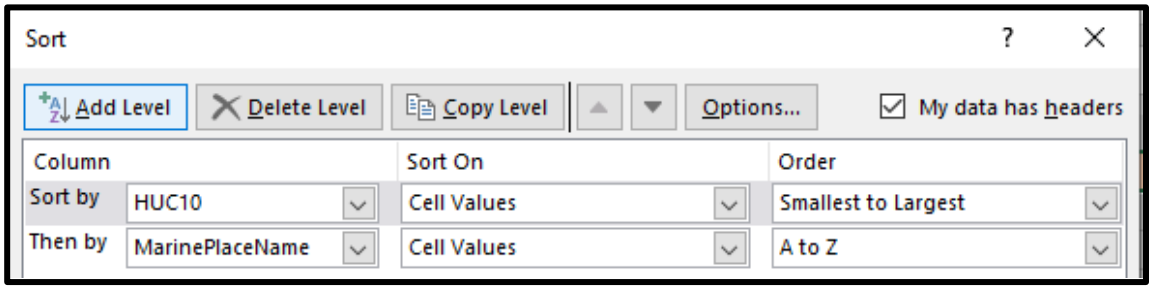
Using the Marine Place Names point layer

The dataset was distilled to just water features via an ArcGIS query of the “type” attribute to eliminate nautical hazard features such as shoals, and reefs.

1) STEP In ArcGIS: Query: *"type" = 'lake' OR "type" = 'sea channel' OR "type" = 'sea' OR "type" = 'bay' OR type = 'canal' OR type = 'narrows' OR type = 'river'*

TABULAR DATA PREPARATION

1) STEP In ArcGIS, Using the Marine points names layer - export the table as a .txt file
2) STEP Open in MS-Excel, sort by the HUC10 number (ascending order: smallest to largest)



and then by the Marine Place Name in descending alphabetical order (A to Z).

Marine waters can now be assigned sequential numbers within each HUC10 watershed. Since each waterbody in a row is unique and not repeated in a given HUC10 watershed, an Excel formula can be used to check each row’s HUC10 numeric code against the preceding row’s HUC10 code. If the HUC10 numbers match, then the sequential number grows by one. If the HUC10 codes do not match, then the sequential count begins again at the number one.

3) STEP Apply formulas to assign sequential numbers and combine into the ATTAINS AUID

The following MS-Excel extract graphically shows how the Assessment Unit identification method will be applied. The Excel export file includes Excel formulas to calculate the AU ID.

Sort 2nd	Sort 1st		HUC10 and sequential #		
GNIS_Name Marine Waters	**HUC10 (code)**	**Name (watershed)**	**ATTAINS_AUID**	**AUID _Seq**	**AUD_ suffix**
Dry Cove	1901021002	Portage Bay-Frontal Frederick Sound	AK_M_1021002_001	1	001
Big John Bay	1901021003	Irish Creek-Frontal Rocky Pass	AK_M_1021003_001	1	001
Big John Creek	1901021003	Irish Creek-Frontal Rocky Pass	AK_M_1021003_002	2	002

First, **AK** prefix for Alaska; second, add a "M" for Marine; next add **last 7 digits** of the HUC10 code; finally add a **sequential number** determined by alphabetical order of each waterbody sorted within each watershed

Sequential numbering restarts at 1 at each new HUC10

Sequential numbering modified to 3-digit format (e.g. 1 = 001)

4) STEP an additional, second suffix could be added to further specify distinct impaired portions within a single marine waterbody.

Final Data Layer

The final AU ID dataset for marine waters contains 2674 separate marine features with HUC10 attributes. Filename is : AU_Marine.shp

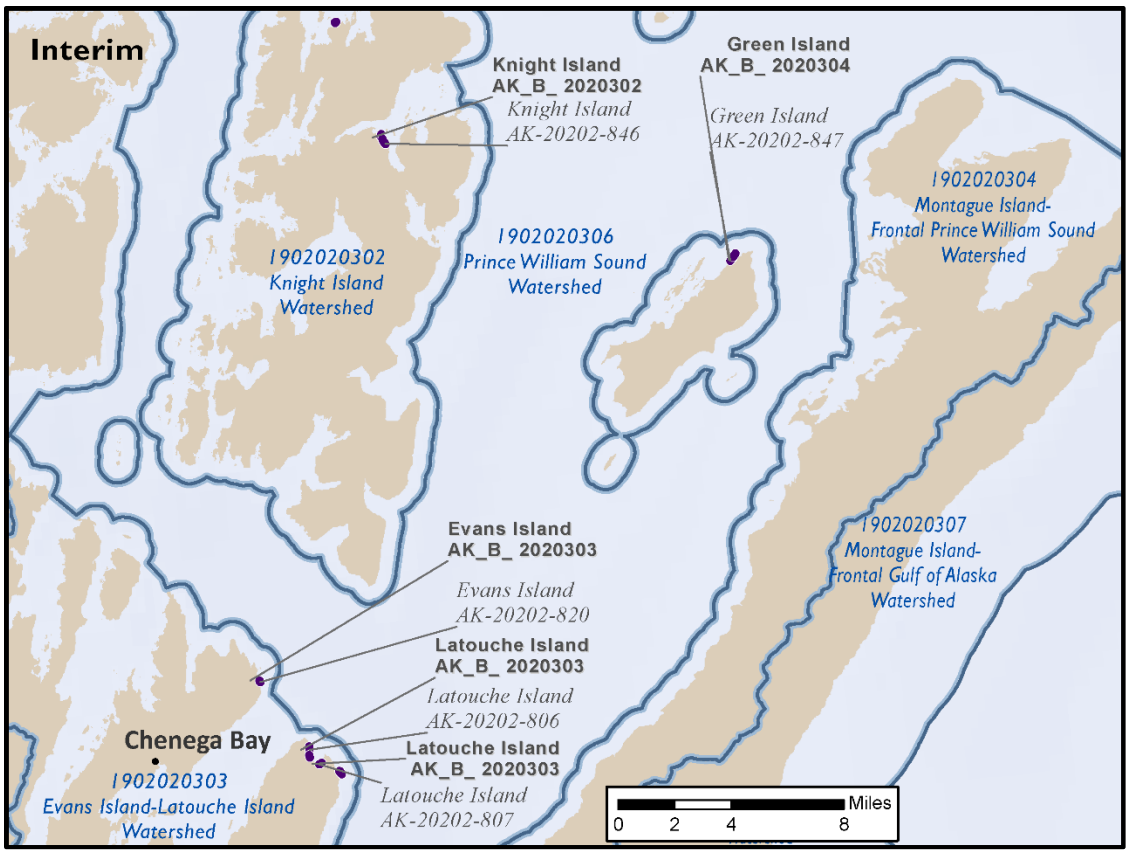
SPECIAL CASES – Beaches and Shorelines

Prior report sections have outlined methods to assign assessment unit identifiers to rivers, streams, lakes, ponds, and marine waters such as bays and harbors. Another feature type to be assigned assessment unit identifiers is beaches. Historically, some Prince William Sound island beaches had been designated impaired by the 1989 Exxon Valdez oil spill. This section outlines methods to reassign AUIDs for those beaches as well as a procedure to delineate any future beach impairments.

EXISTING BEACHES

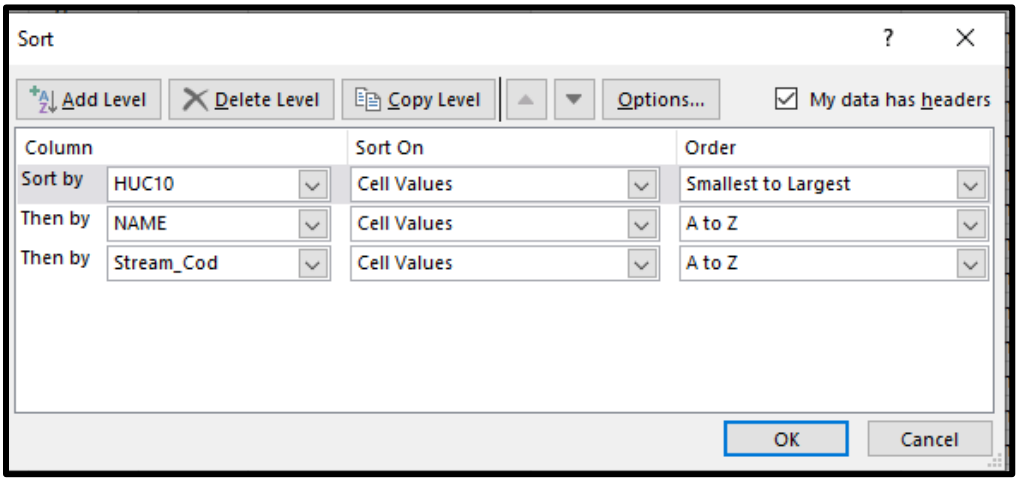
The previously identified beach segments with AU IDs can be updated through a simple sequence of steps.

1) STEP in ArcGIS, open existing beach impairments coded with an AUID, open HUC10 polygon features from the Watershed Boundary Dataset (WBD)
2) STEP perform a spatial join on the beach segments adding the host HUC10 watershed's attributes (current HUC10 name and numeric code) to each beach



This figure shows existing beach AUIDs (italics) and interim values (bold text labels) from HUC10 (blue lines).

3) STEP In ArcGIS, export the feature table as a .txt file
4) STEP in MS-Excel, sort by newly attributed HUC10 number, then alphabetically by impairment name (e.g. Green Island, Ingot Island), then finally by existing AU ID code



5) STEP Apply formulas to assign sequential numbers and combine into the ATTAINS AUID

The following MS-Excel extract graphically shows how the Assessment Unit identification method will be applied. The Excel export file includes Excel formulas to calculate the AU ID.

Sort 2nd	Sort 1st	Sort 3rd	Calculate from HUC10 and sequential #		
AU NAME	**HUC10**	**existing AUID**	**ATTAINS_AUID**	**AUID_ Seq**	**AUID_ suffix**
Evans Island	1902020303	AK-20202-820	AK_B_2020303_001	1	001
Latouche Island	1902020303	AK-20202-803	AK_B_2020303_002	2	002
Latouche Island	1902020303	AK-20202-806	AK_B_2020303_003	3	003
Latouche Island	1902020303	AK-20202-807	AK_B_2020303_004	4	004
Latouche Island	1902020303	AK-20202-823	AK_B_2020303_005	5	005
Green Island	1902020304	AK-20202-847	AK_B_2020304_001	1	001
Green Island	1902020304	AK-20202-848	AK_B_2020304_002	2	002

First, **AK** prefix for Alaska; second, add a "B" for Beach; next add **last 7 digits** of the HUC10 code; finally add a **sequential number** determined by alphabetical order of each waterbody and previous AUID sorted within each watershed

Sequential numbering restarts at 1 at each new HUC10

Sequential numbering modified to 3-digit format (e.g. 1 = 001)

NEW BEACHES

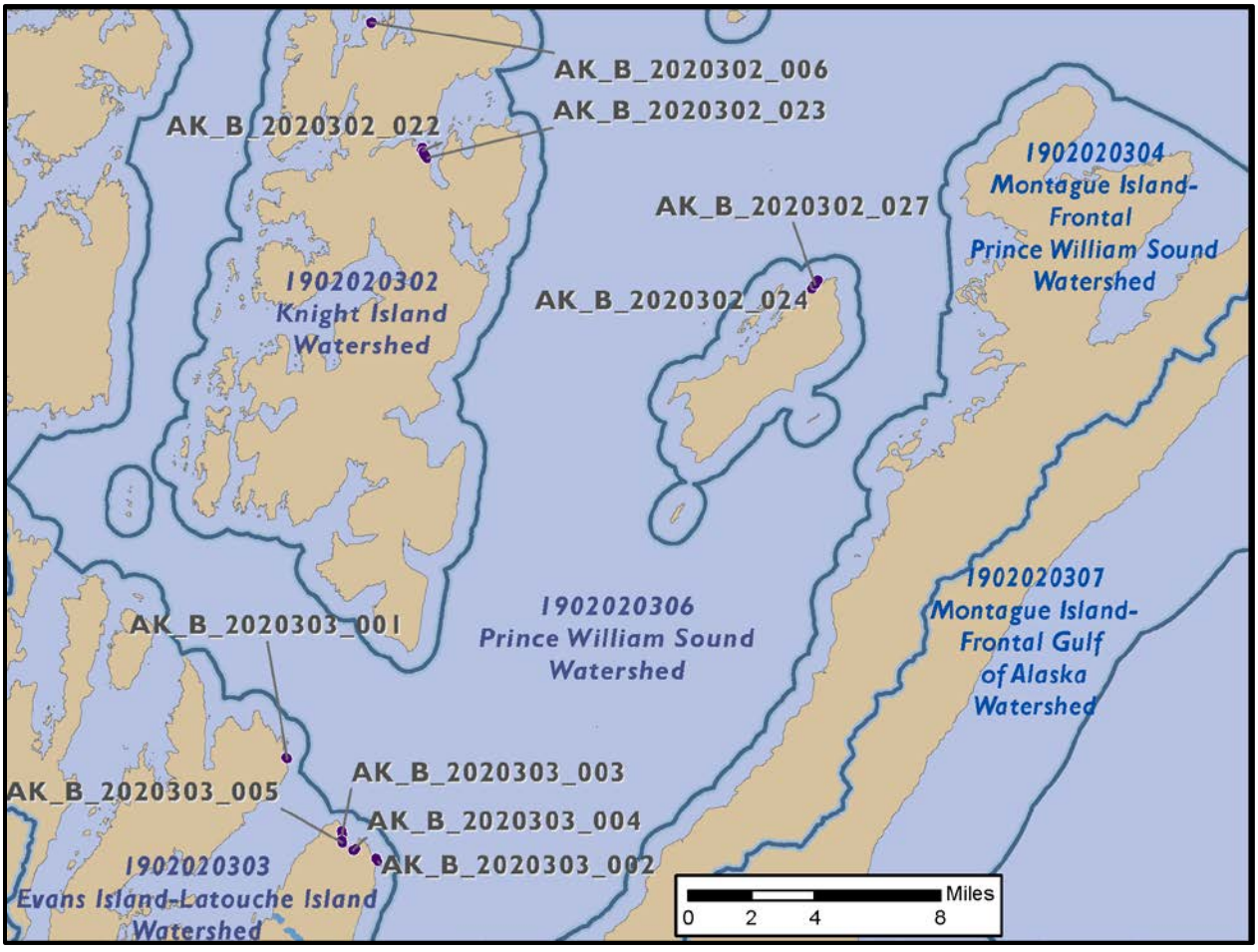
DATA ACQUISITION

Can use same NHD data acquired in the Flowing Waters section.

SPATIAL DATA PREPARATION

1) STEP In ArcGIS Open Feature Class NHD Flowline, select FType = 566 'Coastline'
2) STEP Add HUC10 Watershed polygons from Watershed Boundary Dataset
3) STEP Select Coastline segments that encompass the map
4) STEP Spatial Join to add HUC10 attributes
5) STEP Follow STEPS 3, 4, and 5 in the previous section assigning beach AUIDs

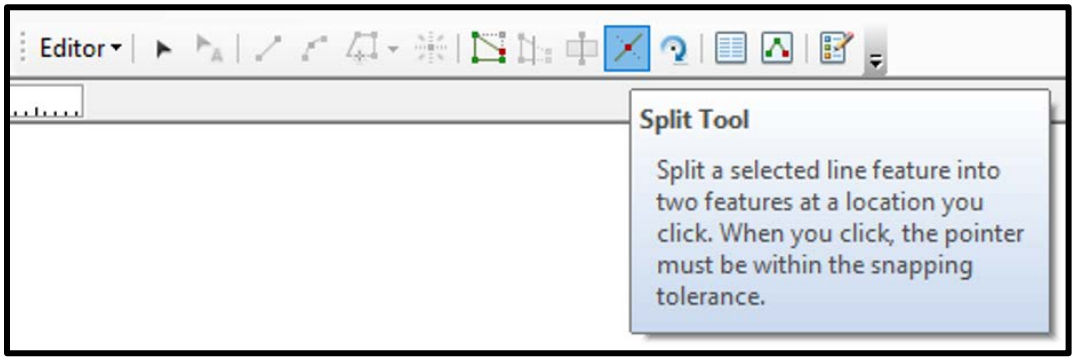
The following figure showing a finalized set of revised AU IDs for beaches on Prince William Sound islands using current HUC10 watershed boundaries and the naming schema presented in this report.

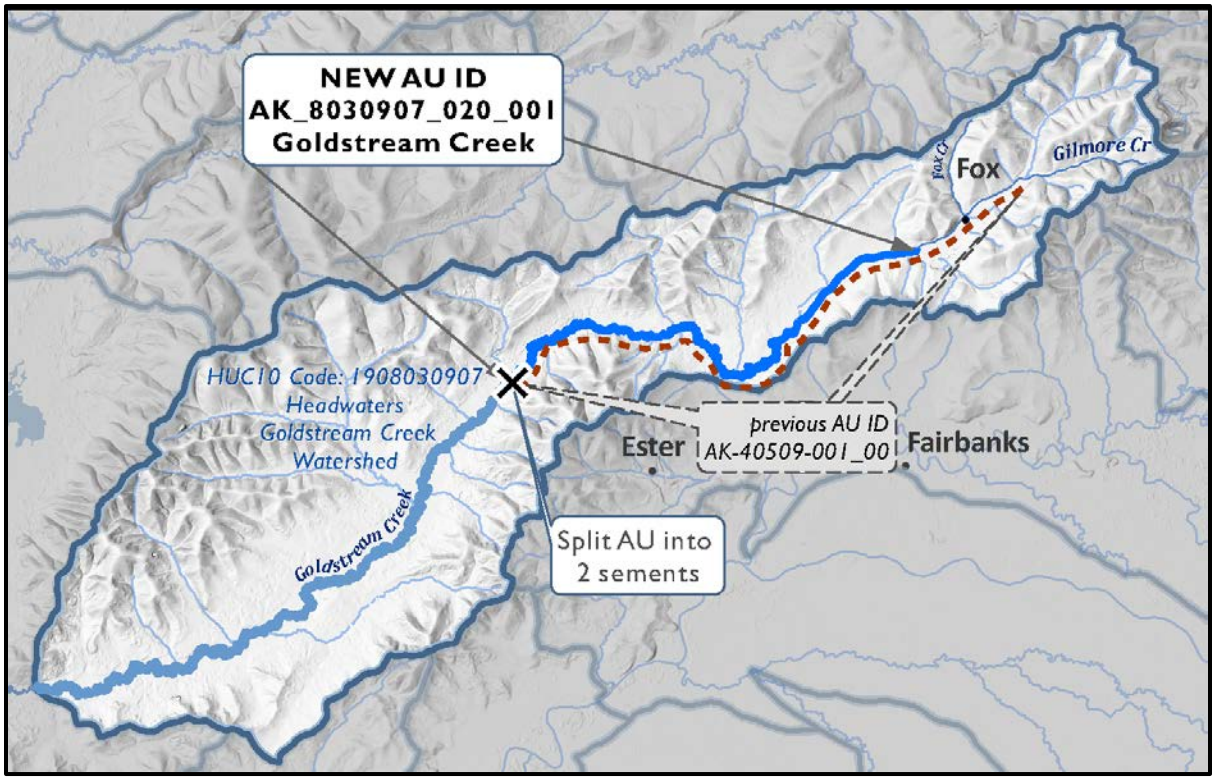


MODIFY an existing Assessment Unit

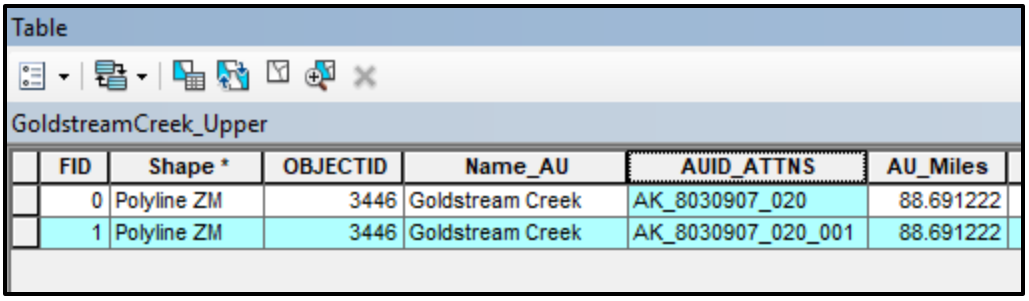
Instructions for segmenting an existing AU into smaller units.

1) STEP In ArcGIS, *Edit Features* using AU ID dataset (e.g. AUID_Streams.shp)
2) STEP In ArcGIS, select stream to be segmented
3) STEP In ArcGIS, enable Editor toolbar and use Split tool to break feature line into two separate segments. The following figures show the ArcGIS Split tool and graphic example of splitting a stream feature into two separate parts to match the desired beginning and endpoints of the delineated impairment.
4)



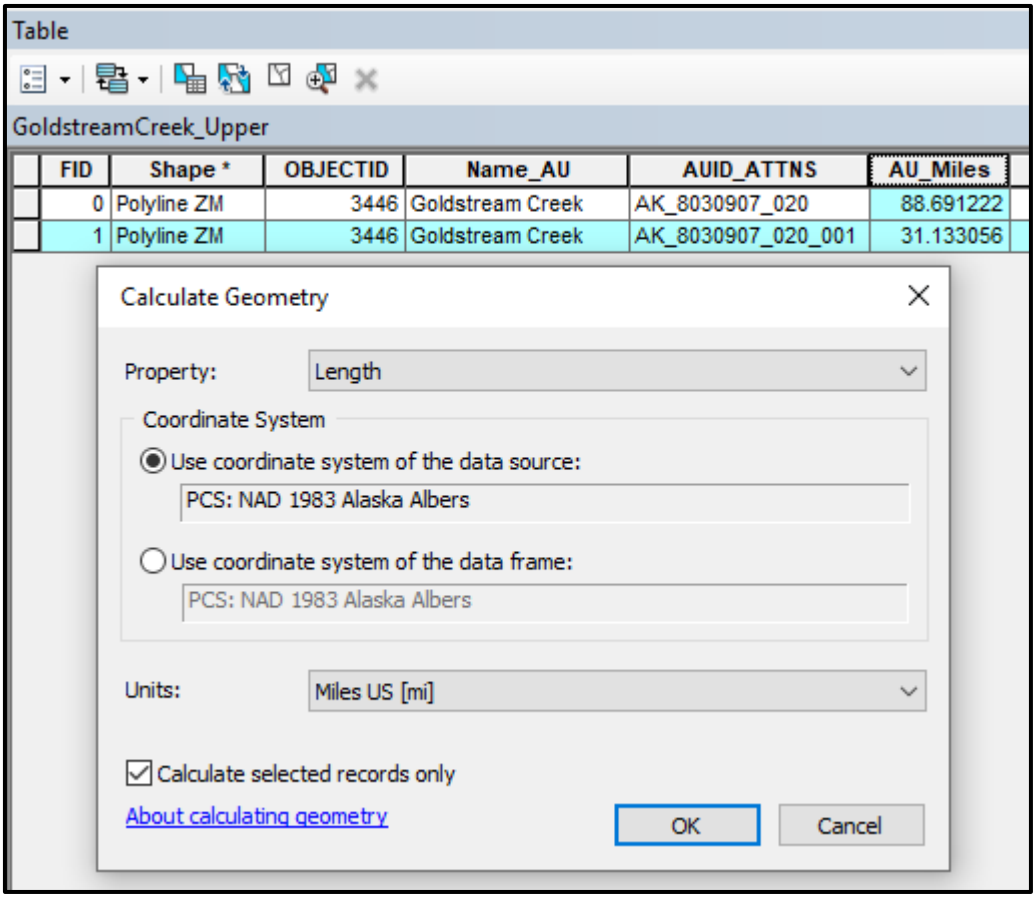


5) STEP In the feature attribute table, modify the AUID_ATTNS field by adding the appropriate suffix to the existing AUID value (e.g. adding "_001" for the first segment)



FID	Shape *	OBJECTID	Name_AU	AUID_ATTNS	AU_Miles
0	Polyline ZM	3446	Goldstream Creek	AK_8030907_020	88.691222
1	Polyline ZM	3446	Goldstream Creek	AK_8030907_020_001	88.691222

6) STEP In the feature attribute table, select the AU_Miles field, use the Calculate Geometry tool and recalculate the feature lengths in miles (note is necessary as ArcGIS doesn't not automatically update this field to reflect the new segments lengths)

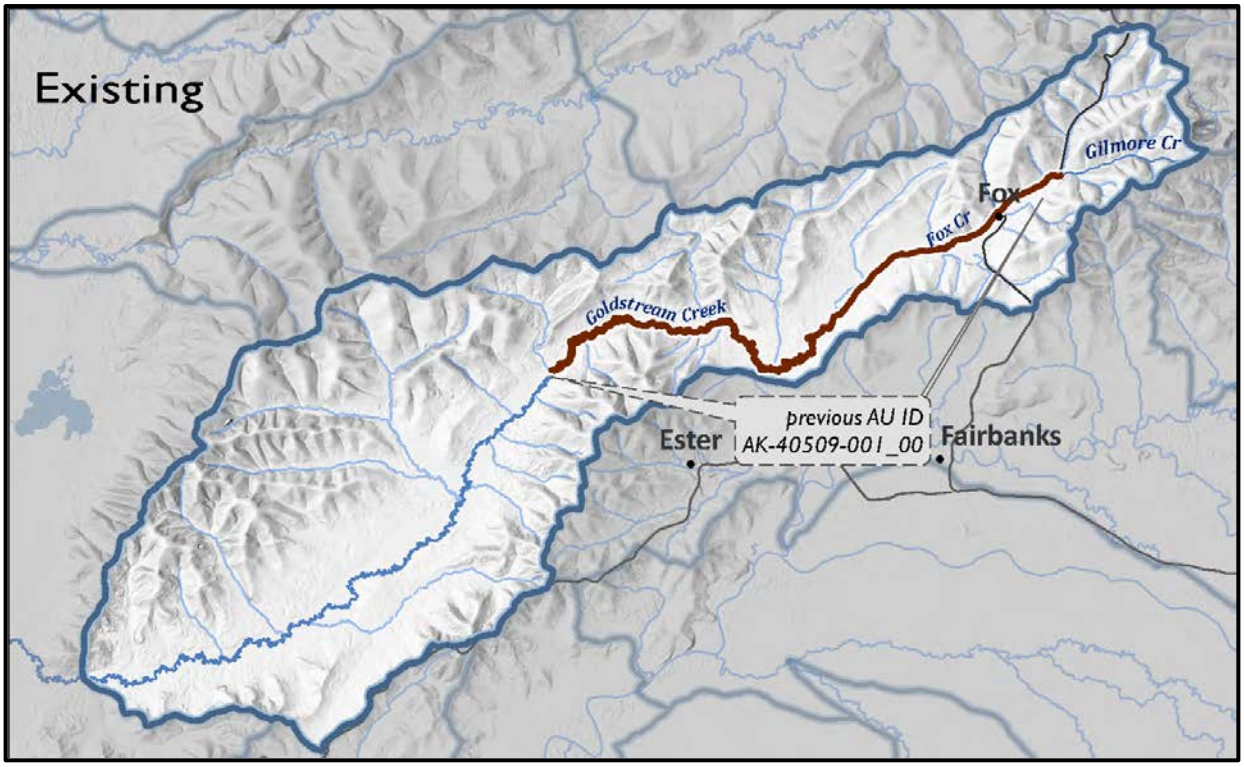


FID	Shape *	OBJECTID	Name_AU	AUID_ATTNS	AU_Miles
0	Polyline ZM	3446	Goldstream Creek	AK_8030907_020	88.691222
1	Polyline ZM	3446	Goldstream Creek	AK_8030907_020_001	31.133056

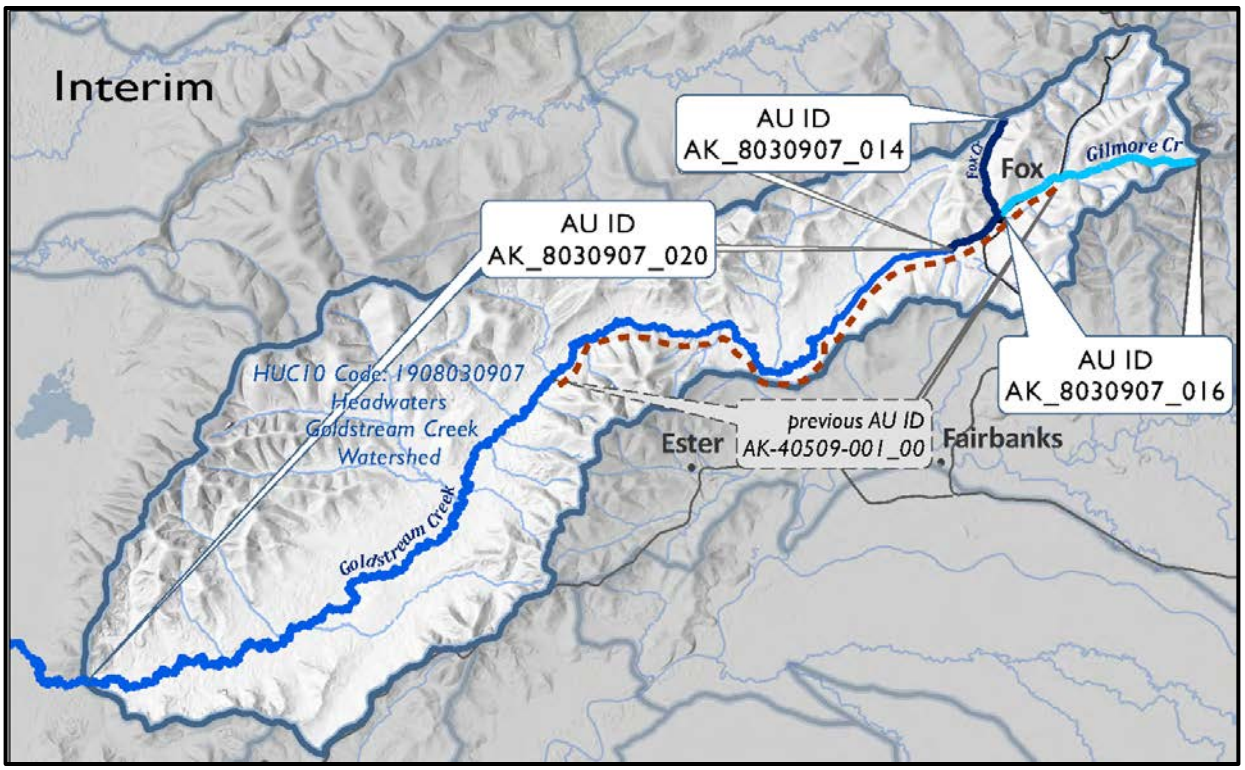
REASSIGN existing AUs with new AU IDs

In some cases, existing AUs may span multiple newly defined Assessment Units which were generated using the methods presented in this report. The following graphics highlight how the new AUs can be applied to reassign an existing assessment unit.

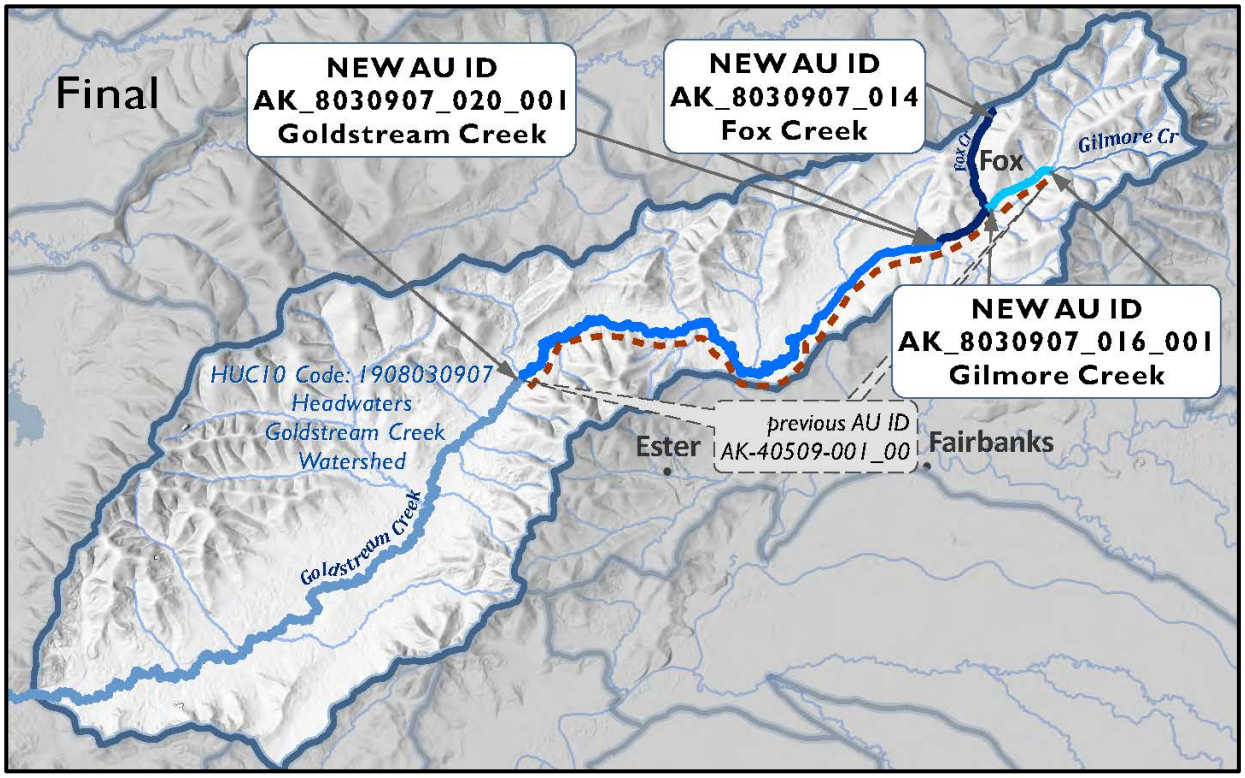
1) STEP Start with existing AU feature to be reassigned (example is AK-40509-001 which is Goldstream Creek north of Fairbanks)



2) STEP Add newly defined AUs and determine if existing AU spans an entire new AU or only a portion (necessitating the segmentation presented in the previous set of instructions or if the existing AU spans multiple new AU (requiring existing AU to be attributed to multiple features) The Goldstream Creek example AUID reassignment actually involves both a segmentation of Goldstream Creek into two parts and it entails including two additional new assessment units the original impairment extends upstream to include the Goldstream Creek tributaries of Fox Creek and Gilmore Creek. The graphic labeled "Interim" shows both of these situations with the existing AU shown as an offset dotted line. Another item of note is the change in the Tolovana River subbasin's eight-digit base hydrographic unit code (HUC8) from the original AU ID (19040509) to the current HUC8 designation (19080309).



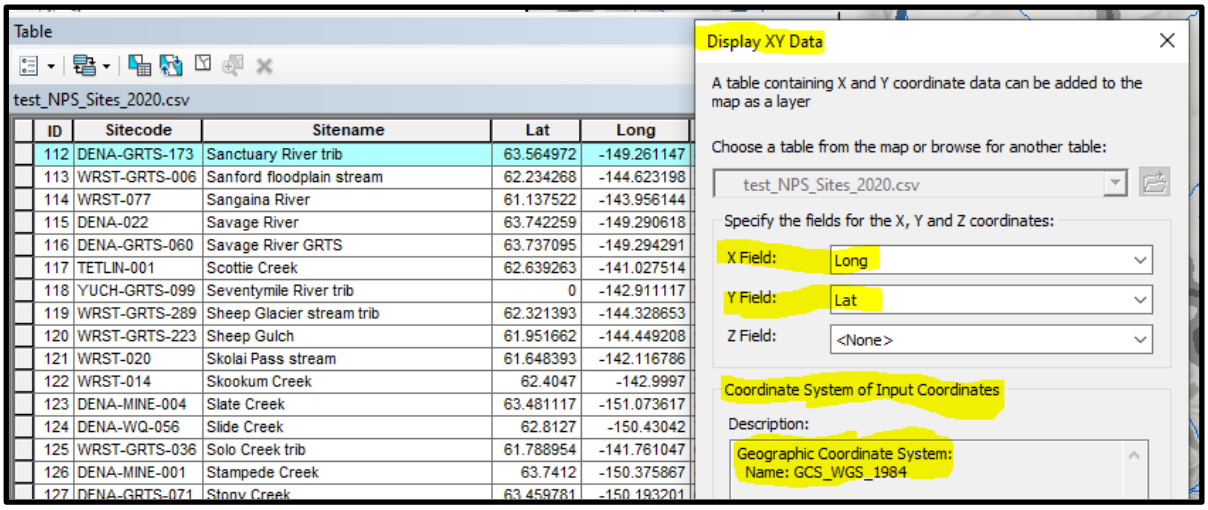
3) STEP The final graphic shows the newly segmented Goldstream Creek as well as two additional AUs to represent the previous impaired assessment unit.



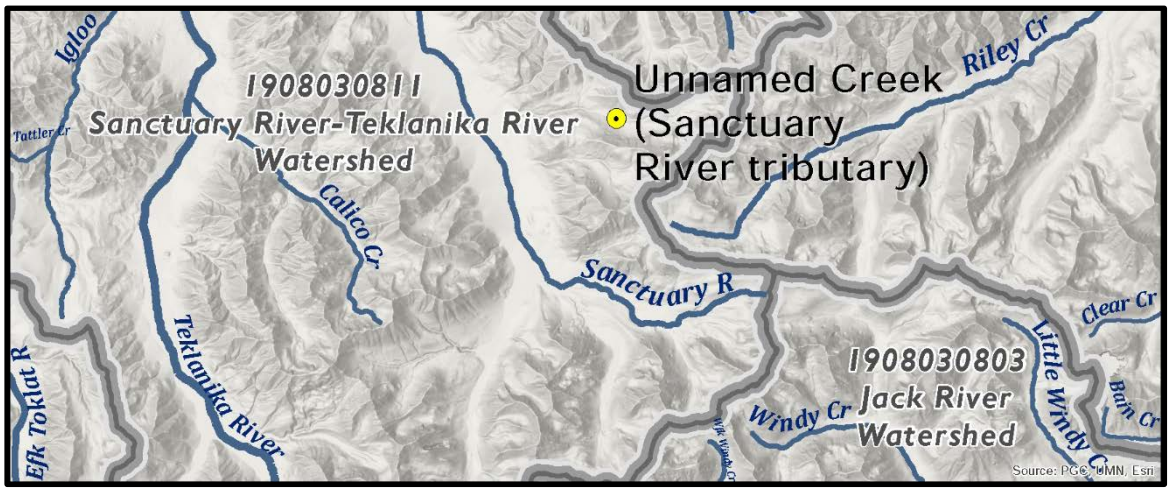
ADD AU ID for an Unnamed Stream

In the future, an unnamed stream not included in the inventory will need to be added to the statewide catalog of assessed waters. The following instructions highlight how the new AUs can be applied to an unnamed stream. Example: Sanctuary River tributary in Denali National Park.

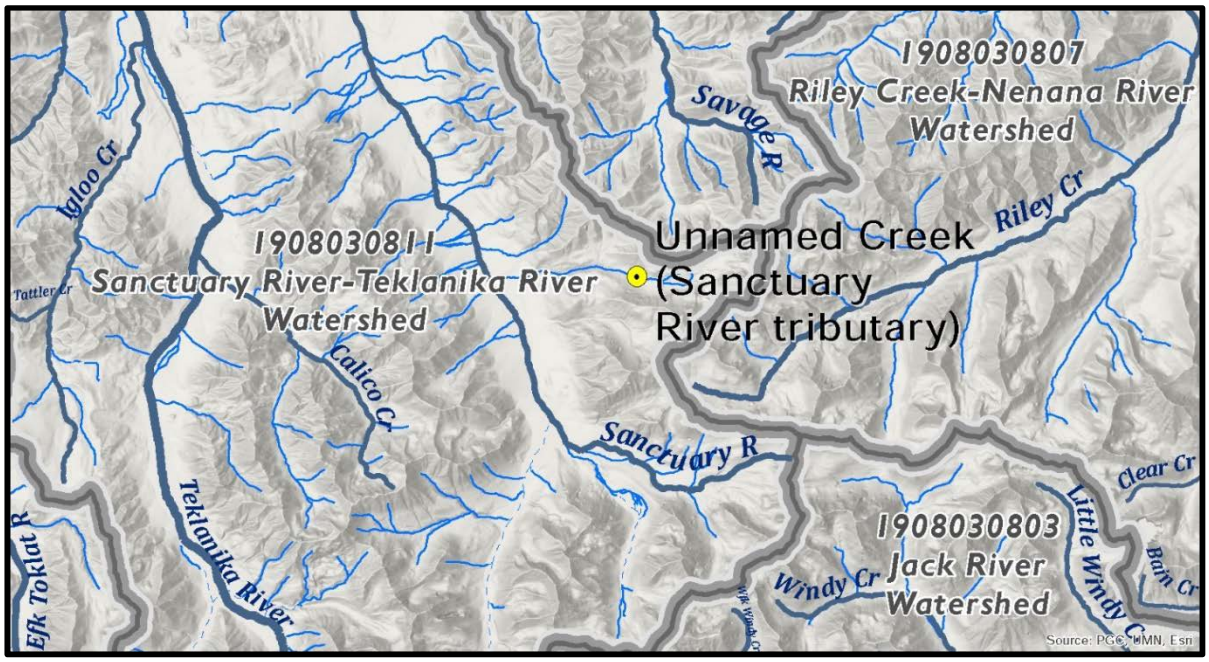
1) STEP Start with new unnamed stream location plotted in ArcGIS. If the data are not in a GIS format and only in tabular form such as MS-Excel then:
   - Format the Latitude and Longitude columns as numbers in Decimal Degree format,
   - Import the table into ArcGIS and
   - Use the "Display XY" tool to convert the table into GIS points



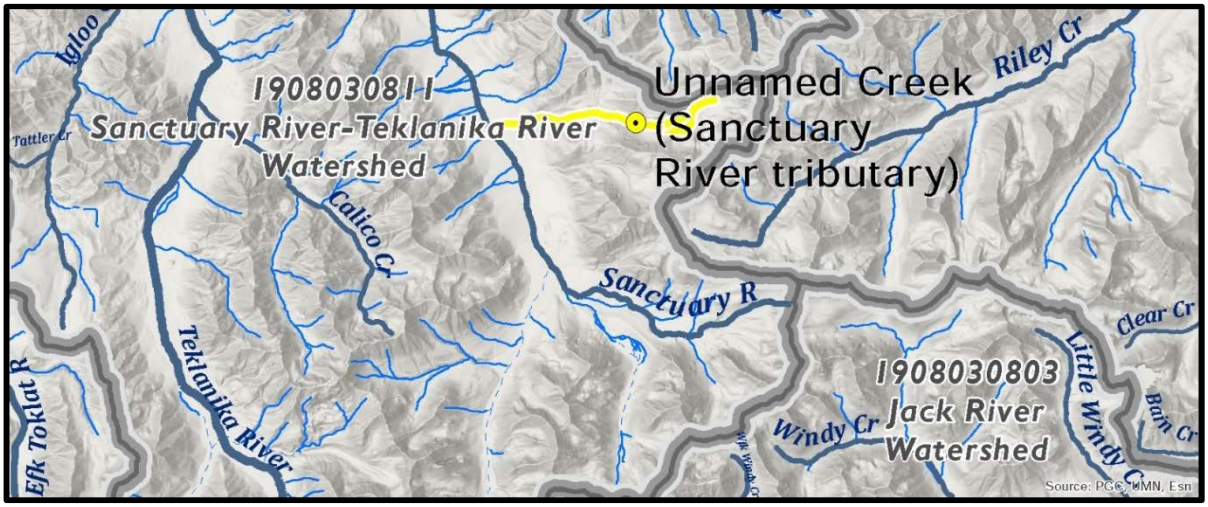
2) STEP In this step the Assessment Unit's 10-digit HUC code will be added. In ArcGIS Intersect the new Assessment Unit point dataset (yellow dot) with the Watershed Boundary Dataset HUC10 layer (WBD_HUC10_HUC8_attrib) gray boundary and label.



3) STEP Add the NHD – National Hydrographic Dataset "Flowline" feature dataset polylines to the map, see "DATA ACQUISITION" section for Flowing Waters earlier in this document. These are the GIS lines (light blue on the map) representing all currently mapped Alaskan streams. They will serve as the inventory from which the new AU segments will be selected.



4) STEP Select the NHD segments that represent the monitored Assessment Unit stream (shown in yellow).



5) STEP Use ArcGIS "Dissolve" tool to combine multiple segments into a single line feature.
6) STEP Create a numeric attribute AU_Miles – use "Calculate Geometry" tool to determine new Assessment Unit's length in miles

7) STEP Use the “Spatial Join” tool to attach the attributes of the AU point to the newly created line feature from STEP 5
8) In Excel, open the existing inventory of AU IDs for rivers and streams (AU_Streams.xlsx) and then filter the HUC10 column to the HUC10 number of the new AU (highlighted in yellow in table) to be added and then insert new AU by adding to the existing list of sequential numbers. Example shown: HUC 1908030811 Sanctuary River-Teklanika River

Filter by HUC10, select the HUC10 host of new AU

Name	HUC10	HUC10_Name	AUID
Big Creek	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_001
Calico Creek	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_002
Igloo Creek	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_003
Sanctuary River	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_004
Savage River	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_005
Tattler Creek	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_006
Teklanika River	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_007
Sanctuary River Trib	1908030811	Sanctuary River-Teklanika River	AK_R_8030811_008

Add to sequential numbering within host HUC10: 006, 007, 008, ….

9) STEP in ArcGIS, use the “Append” tool to add the newly created Assessment Unit feature to the existing AU dataset

APPENDICES

Data Deliverables

1) Streams and Rivers: AU_Streams.shp, AU_Streams.xlsx
2) Lakes and Ponds: AU_Lakes.shp, AU_Lakes.xlsx
3) Marine Features: AU_Marine.shp, AU_Marine.xlsx
4) Beaches: AU_Beaches.shp, AU_Beaches.xlsx
5) Crosswalk Table – old AUs to new AU IDs: AU_Old_New_Table.xlsx

Data Sources - Hyperlinks

National Hydrographic Dataset, (NHD); United States Geological Survey (USGS)

https://www.usgs.gov/core-science-systems/ngp/national-hydrography/access-national-hydrography-products

https://viewer.nationalmap.gov/basic/?basemap=b1&category=nhd&title=NHD%20View

Watershed Boundary Dataset, (WBD); United States Geological Survey (USGS) or Natural Resource Conservation Service (NRCS)

https://datagateway.nrcs.usda.gov/GDGOrder.aspx?order=QuickState

Marine Place Names; National Oceanographic and Atmospheric Administration (NOAA)

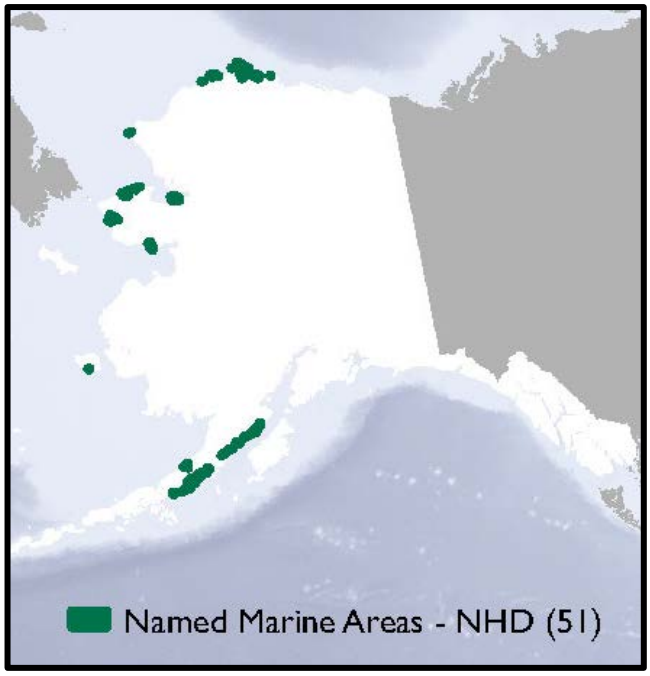
https://marinecadastre.gov/data/

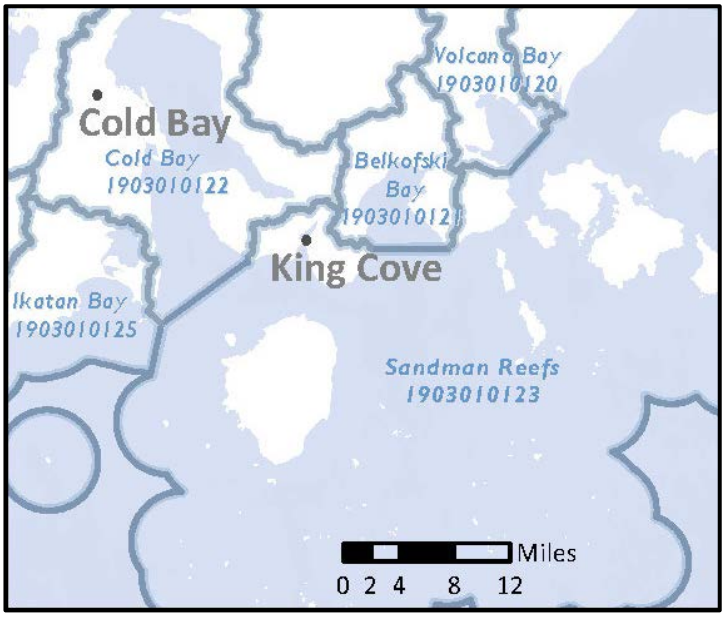
Interim Presentations – Testing Methods

1) April 30 2019 Update: ACCS_ADEC_AU_ID_Update_April_30_2019.pdf
2) July 8, 2019 Update: ACCS_ADEC_AU_ID_Update_July_8_2019.pdf

Marine Feature development – methods

The National Hydrographic Dataset (NHD) does not have a comprehensive inventory of coastal features with only 51 named marine features in the AK NHD. This a very limited dataset and not appropriate for the Assessment Unit identification effort. (see figure to the right ->)



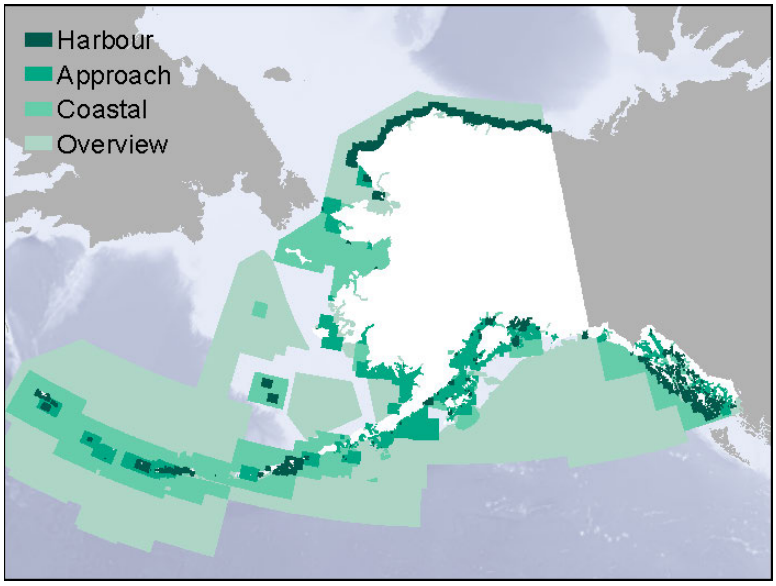


The Watershed Boundary Dataset (WBD) which delineates the HUC10 watersheds does extend offshore into the marine environment and can be attributed to individual, nearshore marine waterbodies. The ten-digit HUC watershed can still be used as a base layer to provide AU identifiers with a durable, simple, and practical index.

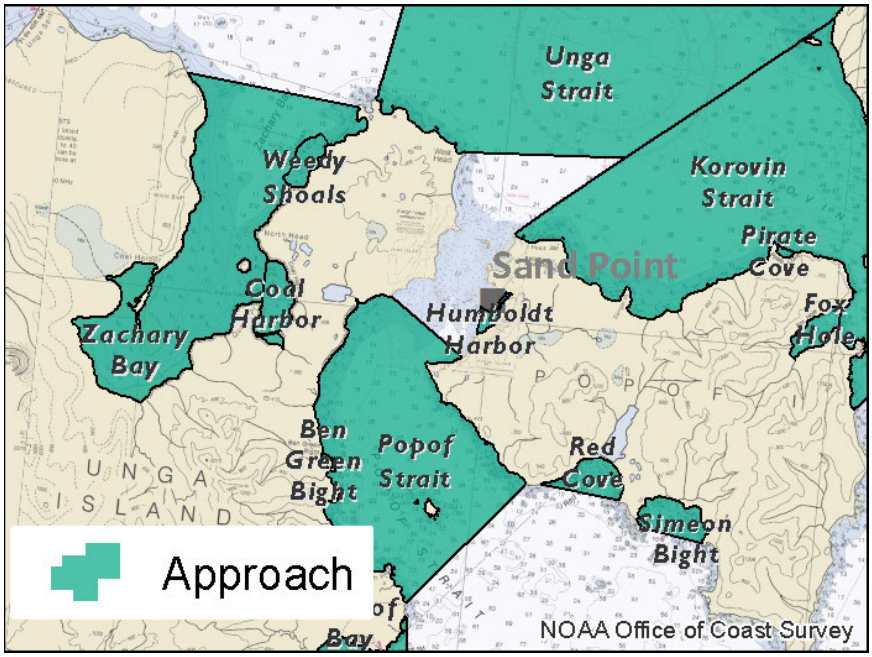
see example (right) of HUC10 off-shore extent in the Cold Bay / King Cove area of the Alaska Peninsula extending multiple miles from land.

Two primary marine geospatial data sources were investigated:

A) NOAA ENC (Electronic Navigation Charts).



Point, line, and polygon features depicted on NOAA navigation charts are downloadable as GIS files via a NOAA tool. The **polygonal** features of interest such as bay and coves are contained in the Natural Features, Sea Area Named Water Areas layer. NOAA does not map Alaska's coast at a consistent scale and therefore some areas have a very fine scale delineation of nearshore features marking the coastline in great detail while other areas are charted at much more coarse resolution. An additional complication is that these datasets can overlap. This requires significant manual effort to sort best available geometry for each feature. This map depicts NOAA's chart scales from most detail (Harbour: scale e.g. 1:20,000) to least detail (Overview: scale 1:3,500,000). SOURCE: https://enc.charts.noaa.gov

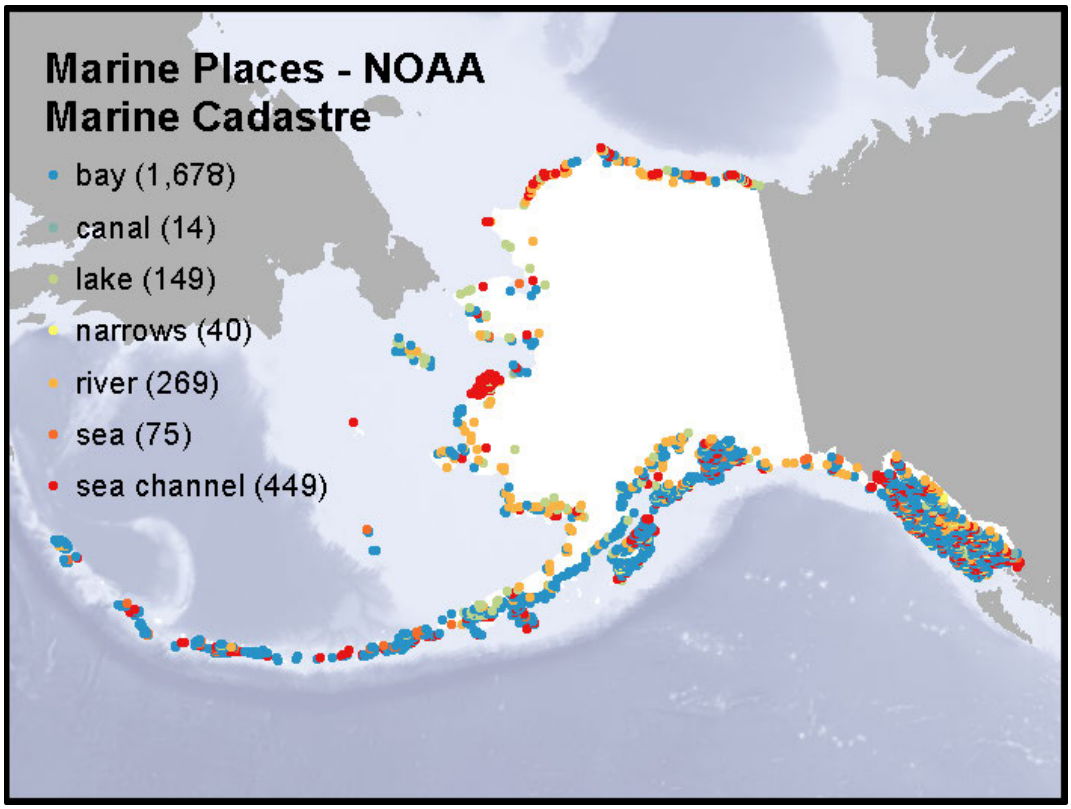


Although some of the NOAA ENC polygons represent marine features quite well with a high-level detail, these data are mapped at inconsistent scales with gaps in coverage. (see graphic at right, showing NOAA ENC mapped marine features at the Approach Chart scale near Sand Point, Alaska in green; note that some features like Unga and Popof Straits end abruptly, while

other features like the coves are mapped quite well). These shortcomings coupled with the pragmatic need to ultimately delineate precise impairments based upon monitoring locations and results suggest a simpler approach to assigning marine assessment unit geography and identifiers.

B) Marine Place Names (NOAA Marine Cadastre)

This dataset has nearly 2700 unique, named marine features in Alaskan waters and it available as a **GIS point** dataset. This layer displays coastal and offshore marine place names. These are general names for areas of the sea as published on the NOAA Nautical Charts. While the points do not provide any detailed geometry delineating marine waters, they are simple, easy to use, and provide a consistent dataset covering the entire Alaskan coastline from north to south and east to west.

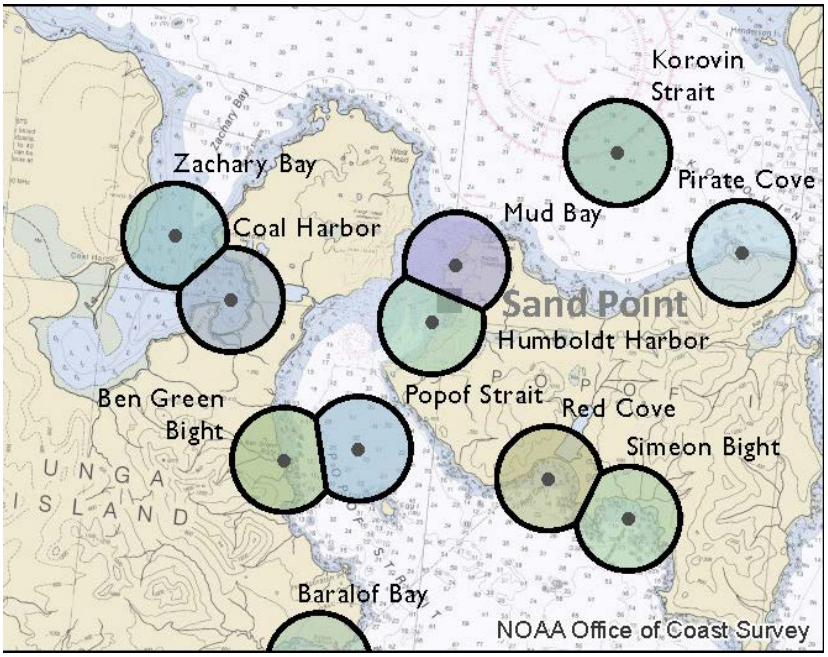


NOAA Source data: https://marinecadastre.gov/data/

Using the Marine Place Names point layer

The dataset was distilled to just water features via an ArcGIS query of the "type" attribute to eliminate nautical hazard features such as shoals, and reefs.

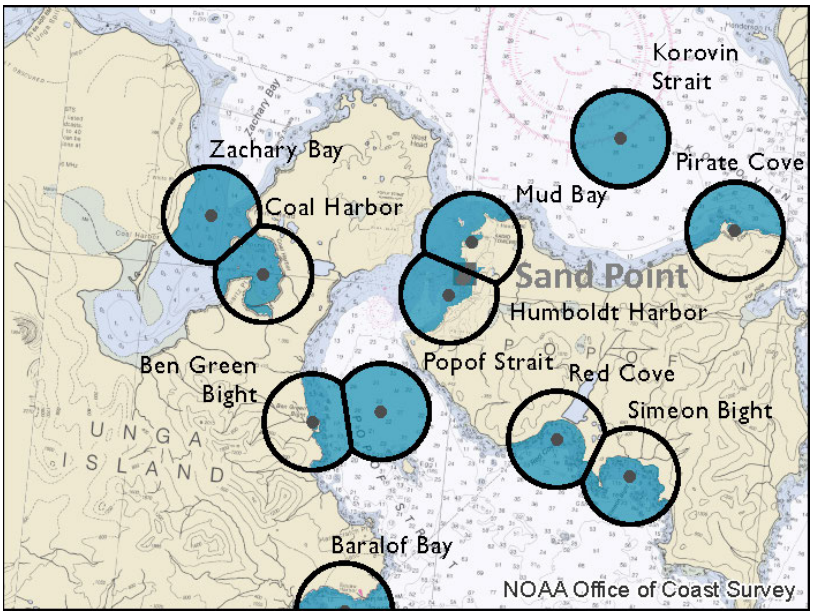
2) STEP In ArcGIS: Query: *"type" = 'lake' OR "type" = 'sea channel' OR "type" = 'sea' OR "type" = 'bay' OR type = 'canal' OR type = 'narrows' OR type = 'river'*



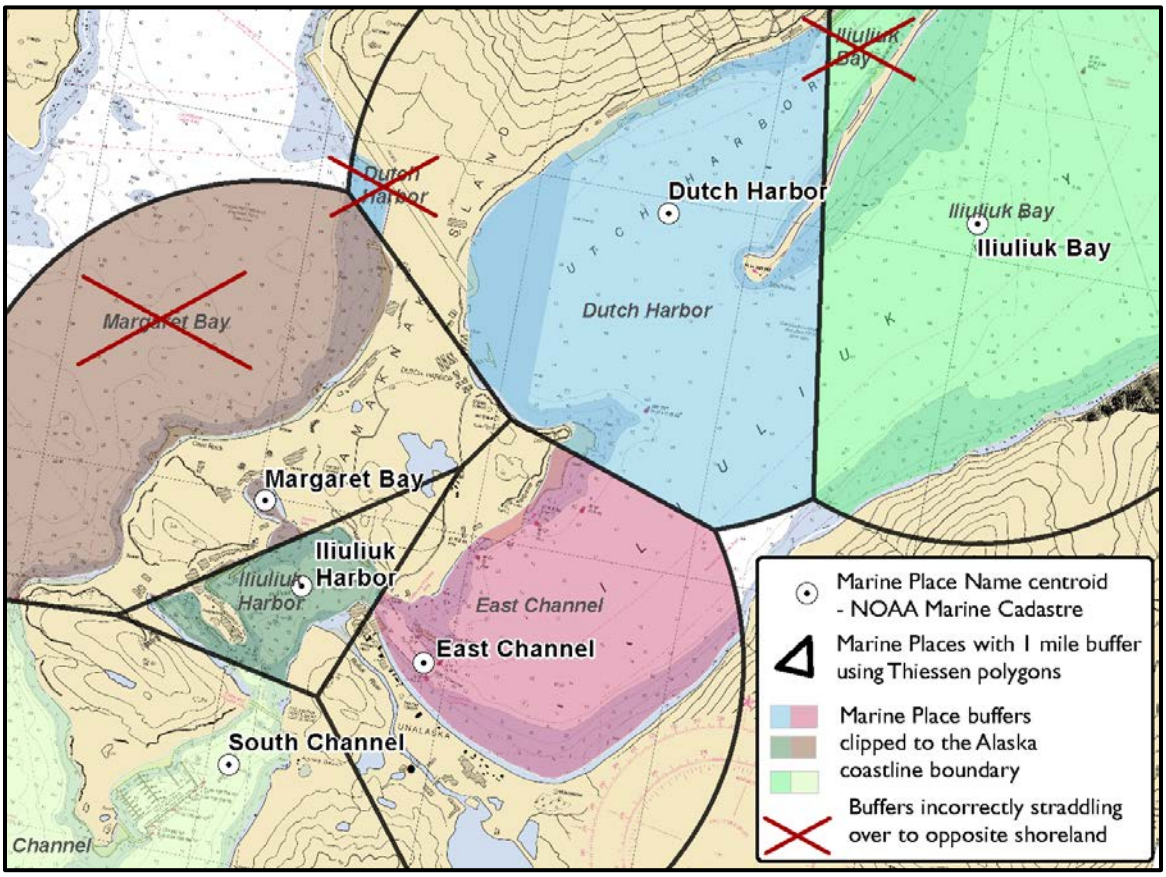
Experimental steps, considered but not ultimately used:

Creating 1-mile buffers around each feature yields simple polygons that can serve as a base layer for future marine impaired water delineations (see figure to the left). Overlapping buffers were separated using a Thiessen polygon technique so that buffers terminate along an equidistant line from each neighboring marine place center-point.

Additional refinement was attempted by using the 1:63,360 scale Alaska coastline polygon from ADNR to erase the land portions of each 1-mile buffer yielding the blue remainders shown in the figure to the right.



Due to the imprecise coastline boundary and the circular buffers, portions of marine areas were eliminated or marine buffer remainders straddled narrow sections of land leaving buffered waters on either side of a peninsula (see examples marked with red X's in the figure below)



Dataset B, marine place name points from the NOAA Marine Cadastre dataset has been determined as the preferred alternative for assigning simple, consistent and durable marine AU IDs with the intent to hand delineate the polygons representing the actual impaired water.