Fish and Wildlife Service

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National Wetland Inventory

Joint Base Elmendorf Richardson, Alaska - Wetland Mapping

2022 Final Report

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ON THE COVER, Black spruce wetland on JBER,
Image by Charlotte Weiss, 2022

Alaska - Wetland Mapping on Joint Base Elmendorf Richardson

2022 Final Report

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NWI program

This report was prepared by Charlie Weiss working under a SCA Internship for United States Fish and Wildlife Service, Region 7.

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Abstract

The National Wetlands Inventory (NWI) is the most comprehensive database storing the location and type of wetlands across the United States. The NWI is used by the Department of Defense, including the U.S. Air Force (USAF), to support planning and habitat management decisions on their installations. This includes not only infrastructure development, but also Natural Resource Management Plans (NRMPs). This project used a variety of data inputs including previous inventories, jurisdictional wetland determinations and extensive field work to produce a wetland inventory across Joint Base Elmendorf Richardson (JBER) at a .25 acre Target Mapping Unit (TMU). The final product will be integrated into the GEOBASE wetlands layer as well as the NWI master geodatabase.

The project will resolve inconsistencies between the existing wetland map products using newly available imagery and lidar data. This report documents the methodology and tools used to update the wetland inventory, including a signature library and field report in the appendices.

List of Acronyms

CIR – Color Infrared

DEM – Digital Elevation Model

JBER – Joint Base Elmendorf Richardson

LiDAR-Light Detection and Ranging

NWI – National Wetland Inventory

QA/QC – Quality Assessment/Quality Control

RGB – Red, Green, Blue

USFWS – United States Fish and Wildlife Service

PI – Photo interpreter

RWC – Regional Wetlands Coordinator

TA – Training Area

TMU – Target Mapping Unit

Introduction

Joint Base Elmendorf-Richardson (JBER) is a 321,667 acre military installation in Anchorage, Alaska. The installation spans multiple ecozones ranging from the tidal waters of Cook Inlet to the alpine environment of the Chugach Mountains. The average annual temperature is 37.6 degrees F, and the average annual precipitation is 16.42 inches. The average annual snowfall is 77.9 inches. The geomorphology of the area is a glacial driven system and evidence of the last glacial period is readily observed in the field in the form of eskers, glacial till and erratic boulders. Water plays a significant role in the landscape as the numerous small streams and rivers move water from the alpine to the ocean, and expansive wetland complexes store water in the soil and vegetation. See Figure 1for a project area map.

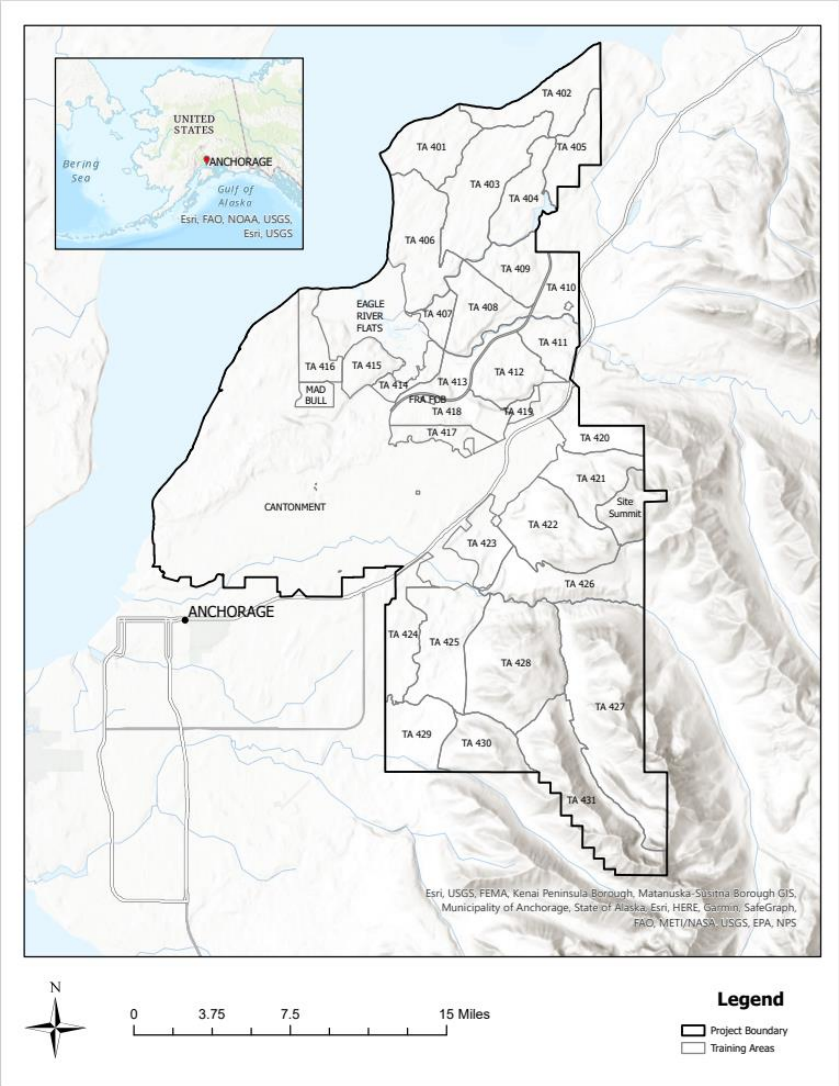

Figure 1: Project area map with labeled training areas

The United States Air Force (USAF) initiated this project to update JBER's wetland database using the National Wetland Inventory (NWI) standards. The NWI is the National Geospatial Data Asset for wetlands maintained by the U.S. Fish and Wildlife Service (USFWS). The NWI is completed in accordance with Federal Geographic Data Committee (FGDC) standards for classification and mapping. The USAF uses the NWI as the technical reference during early project planning to determine whether the project area is upland, or if further field investigation is required if wetlands are likely. The primary objective of this project was to align the JBER base-wide wetlands data layer with the NWI. Once the project is complete, the data will be coincident in both systems.

The FGDC classification and mapping standards (FGDC 2009, FGDC 2013) characterize three indicators to determine wetland status of an area: Vegetation, soils, and hydrology. Common references to support field identification of soil, hydrology, and vegetation included *Field Indicators of Hydric Soils in the United States* (USDA NRCS 2018), *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)* (USACE 2007), *Plants of the Pacific Northwest Coast* (Pojar 2004), *Alaska Trees and Shrubs* (Viereck 2007), and *The National Wetland Plant List: 2018*.

Vegetation is a very important component of field evaluation. Across JBER, vegetative cover often reaches or exceeds 100% and therefore image signatures were tied directly to the vegetation that is visible in the imagery. Wetland plants are categorized using indicator ratings of OBL, FACW, FAC, or FACU. These are defined by the US Army Corps of Engineers (Lichvar 2012) as follows:

- OBL (Obligate Wetland Plants)—Almost always occur in wetlands.
- FACW (Facultative Wetland Plants)—Usually occur in wetlands, but may occur in non-wetlands.
- FAC (Facultative Plants)—Occur in wetlands and non-wetlands.
- FACU (Facultative Upland Plants)—Usually occur in non-wetlands, but may occur in wetlands.

Data and Methods

The NWI is considered a photo interpreted product that is supported by ancillary data such as LiDAR and field information. Wetlands in this project area were mapped for use at a 1:6,000 scale. Methodologies for mapping the wetlands were based on an adjustment to the national standards used in the Lower 48 states.

Wetland Mapping

Wetlands and deepwater habitats were delineated and classified through scale appropriate adaptation of the Federal Geographic Data Committee's Wetlands Mapping Standard. Data were developed using heads-up digitizing in the ArcGIS Pro 2.9.5 software. Mapping occurred after field work was completed, with a .25 acre Target Mapping Unit (TMU).

Datasets used for wetlands mapping were

- 448 field points collected with USACE methods spanning 1995-2019
- 15 cm resolution multi-spectral imagery collected in 2021 and 2019
    - Imagery signatures vary between the images
- .15 m resolution LiDAR imagery collected in 2021
- Legacy NWI data
- Existing JBER Wetlands Inventory
- New field data collected in summer 2022
- Google Earth Pro (All years, May 2021 especially)

Photointerpretation involved assessing vegetative type, cover, and health in CIR imagery, and landscape position in LiDAR. Wetlands typically had dense magenta (shrubs and trees) or tan (grassland) foliage. Saturation was evident from darker blue patches or tone overall, which is the signature of standing water and saturation. Some areas did not show an obvious water signature and generally fell into the "B" water regime. Landscape position was essential in evaluating these; for example, some PEM1B areas were added because they occurred in isolated depressions, despite lacking a saturated signature. Conversely, some PFO4B areas were removed because they extended over hills, which did not accurately reflect field conditions (see Figure 2)

Another essential signature was dead spruce, which appears teal rather than bright magenta. White spruce trees are more susceptible to death by spruce beetles, so high presence of a dead spruce signature indicated high presence of white spruce on the ground. High amounts of white spruce occur more often in upland areas, so areas with this signature were removed (see Figure 2).

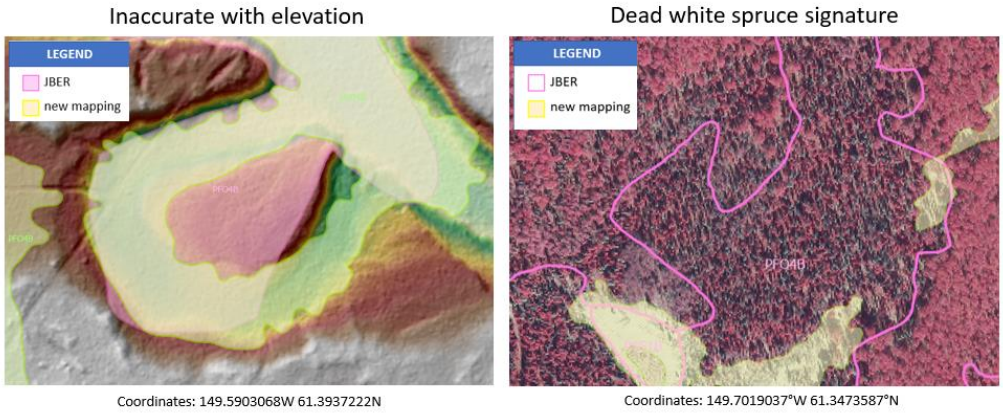

Figure 2: PFO4B wetlands modified to exclude hill (left) and dead spruce signature (right)

Some areas on base were directly copied in from the existing JBER wetlands layer with some minor edits, rather than redrawn completely. This occurred where the prior mapping was below the TMU and/or field data did not confidently support new mapping. The areas include tidal watercourses in

the Eagle River Flats (which was mapped at 1:5000 rather than 1:3000), alpine wetlands, and a riverine area at 149.6750326°W 61.1904530°N.

Wetland mapping was completed in an iterative process. Initial mapping was conducted by a trained photo-interpreter (PI) supported by the USFWS Regional Wetlands Coordinator (RWC). The PI and RWC coordinated on map production to ensure consistent mapping and classification. The final product received a 100% Quality Control review by the RWC. Finally, the data received a 10% Quality Assurance review by the FWS Quality Assurance lead.

Field Verification

Field verification was necessary to create a signature library that correlates wetland or upland appearance in imagery to their NWI code. Field sites were selected based on a variety of characteristics including validating expected wetland characteristics, unclear or complicated photo signatures, and redundancy. With multiple field points per wetland type (assessed by vegetation and water regime), field data could be compared to imagery and elevation data to pick a representative example signature for each NWI code. These have been compiled into a signature library in Appendix A. Imagery in the southeast arm of JBER was taken in a different season and did not align with signatures on the rest of the base, so it is not included. Prior mapping and Google Earth (May 2021) were the primary references for this area (see Figure 3).

Figure 3: (from left to right) Comparison of PEM1B wetland in 2021 CIR, 2019 CIR, and Google Earth (May 2021)

Field Procedures

JBER is made up of many training areas (TAs) that require special advanced permission to access, and one "Cantonment Area" that does not require advanced authorization. TAs are used for military exercises which are restricted from civilians, so they must be reserved at least 30 days in advance for

field work. Due to safety concerns, some areas were never accessible, including the Eagle River Flats and TAs 420, 421, 422 and 426. See Figure 1for a project area map with labeled training areas.

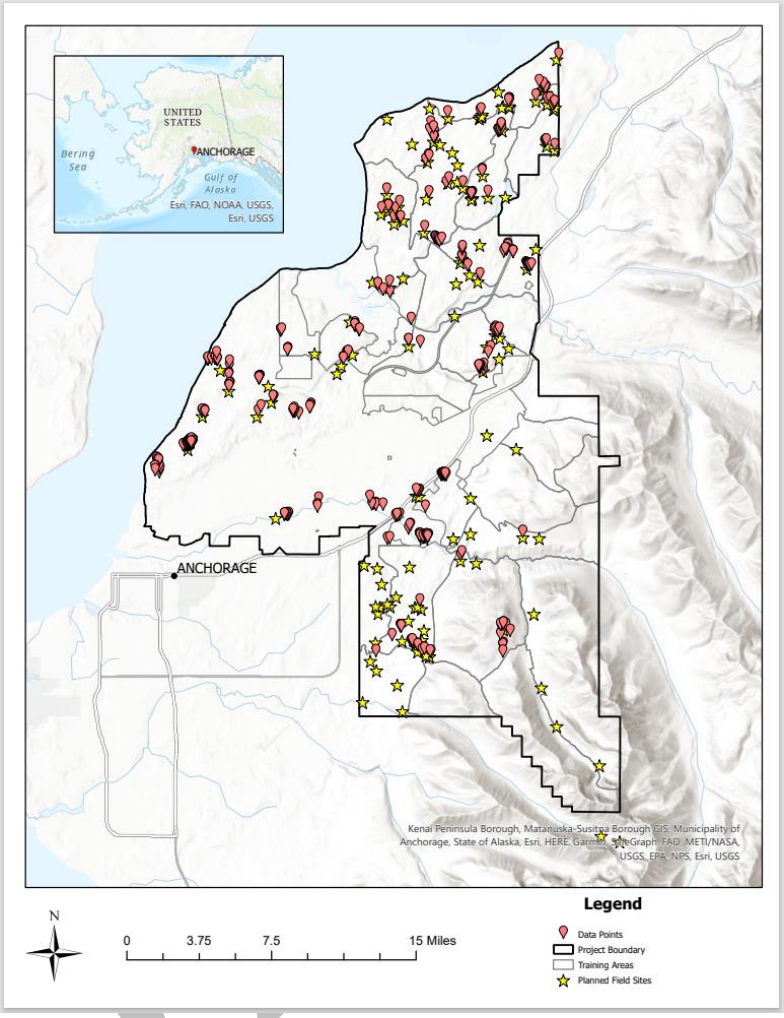

Figure 4: Project area map with data points and field sites

There were 383 data points collected over the field season making up 78 distinct sites across JBER (See Figure 4). Field work began on June 6, 2022 and ended on September 13, 2022. The team generally completed two days of field work each week. At each site, the team observed dominant vegetation, hydrology, and surface soil conditions. Complex or unknown vegetation and soils were sometimes further investigated using references or a soil probe to evaluate conditions in the top 10-20 inches of the soil profile.

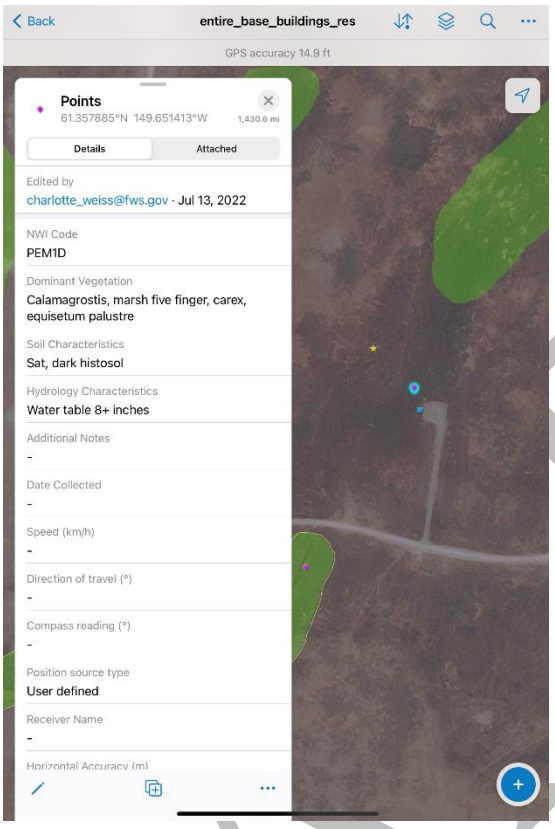

Figure 5: Screenshot of setup in ArcGIS Field Maps

Data were collected at 78 distinct sites. For most sites, data was successfully entered into the field maps application (ArcGIS Field Maps), which contained fields for NWI code, Dominant Vegetation, Soil Characteristics, and Hydrology (see Figure 5). The NWI code was taken as preliminary assessment that would be reviewed and revised later during mapping and quality control. Dominant Vegetation recorded species present in larger than trace amounts, with some comments on general presence of wetland or upland vegetation based on wetland indicator status and professional judgement, in cases of morphological adaptation. Soil Characteristics recorded the organic depth of the soils and other hydric soil indicators such as black histic or presence of redox in the profile. Test hydric soil indicators for Alaska were considered in this assessment. Hydrology recorded hydrology indicators such as tussocking, waterways, presence of a water table and water-stained leaves.

For additional information about field procedures, please see the field report in Appendix B.

Discussion and Deliverables

Wetlands

This wetlands inventory mapped 7178 acres of wetland habitats across the JBER installation. This acreage includes 3413 unique wetland polygons, as opposed to the 1147 mapped previously; about three times more. Digitizing wetlands with a smaller TMU allowed large wetland complexes to be split into many smaller polygons. The result is much more accuracy overall and complexity in wetland complexes, which more accurately reflects wetland functions and habitat across JBER (see Figure 6).

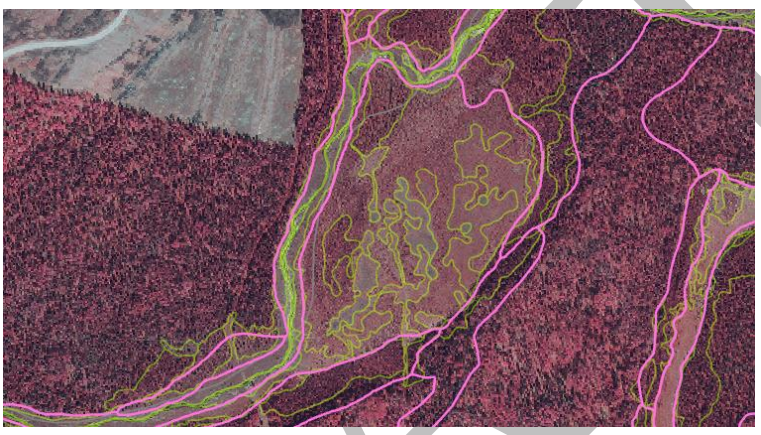

Figure 6: Demonstration of more unique wetland polygons in new mapping (yellow) than prior mapping (pink)

There are a wide diversity of wetlands throughout the project area with the most common wetland type by occurrence being PEM1D and the second most common being PFO4B. By area, the most common wetland types are E2EM1N and PFO4B. Table 1 summarizes the types by acres and occurrence.

Table 1: Summary of wetland types on JBER

ATTRIBUTE	ACRES	COUNT
E2ABM	195.7254651	11
E2EM1N	1178.17933	27
E2EM1P	158.759086	1
E2SS1P	67.78191176	12
E2USM	217.130849	80
E2USN	485.6570707	51
L1UBH	248.3388334	3
L2UBH	195.6878555	3
PABH	24.19573242	6
PEM1/FO1A	0.99767549	1

PEM1/FO1D	8.282702048	6
PEM1/FO4B	0.391223235	1
PEM1/FO4D	5.021370348	3
PEM1/SS1B	9.464611553	5
PEM1/SS1D	19.6151555	20
PEM1/SS1F	30.38710622	10
PEM1/SS4D	0.226922862	1
PEM1A	16.81207755	15
PEM1B	213.4500959	360
PEM1C	23.73280406	98
PEM1D	313.0410878	422
PEM1Dx	1.025493884	1
PEM1F	173.2572658	284
PFO1/4B	29.94795127	16
PFO1/4D	10.63486639	1
PFO1/EM1B	15.20997509	9
PFO1/EM1D	26.61391954	11
PFO1/SS1D	6.423171014	2
PFO1A	14.33769927	17
PFO1B	63.14474483	58
PFO1C	4.147953174	4
PFO1D	25.10839437	24
PFO4/EM1B	2.702573241	6
PFO4/EM1D	7.893233168	4
PFO4/SS1B	0.939145557	3
PFO4/SS1D	12.47066868	10
PFO4A	1.537804244	2
PFO4B	1132.108537	384
PFO4D	293.1339453	182
PRB1H	0.869172658	1
PSS1/4D	64.62794059	59
PSS1/EM1B	0.322093744	1
PSS1/EM1D	21.87638866	17
PSS1/EM1F	12.16444458	15
PSS1/FO1B	1.473032432	1
PSS1/FO1D	0.330860065	1
PSS1A	96.0335449	87
PSS1B	193.6789758	110
PSS1Bx	0.712404174	2
PSS1C	28.33477144	12
PSS1D	627.6669697	372
PSS1F	2.504125669	2
PSS3B	10.19451891	6
PSS3C	16.91199028	15

PSS4/EM1B	3.061692254	3
PSS4/EM1D	6.640958097	5
PSS4B	8.834450596	4
PSS4C	1.576052383	1
PSS4D	478.7781176	292
PUBF	7.610948901	43
PUBFx	1.234754435	1
PUBH	162.8811591	114
PUBHb	3.805683049	1
PUBHx	0.192977319	2
PUSC	0.56640903	3
R2UBH	0.196452317	1
R3UBH	167.1259415	16
R3USC	23.78646141	72

The updated mapping includes roughly 7100 acres of wetlands, which is about 300 acres less than JBER previously mapped (see Table 2 for exact numbers). A main reason for this reduction is the removal of about 600 acres of PFO4B wetlands (see Figure 2 for reasoning and Table 3 for exact acreage). However, some new wetlands were added to the database, including 137 acres of PFO4B wetlands that were not previously captured and 130 new acres of PEM1D wetland.

Table 4 shows the total acreage of newly mapped wetland types, and Figure 7 shows the new wetlands on a map.

Table 2: Total wetland acreage by GIS layer

Wetlands Layer	Number of Wetlands	Acreage
JBER	1147	7420.85
Previous NWI	1046	7375.23
Updated NWI	3413	7177.51

Table 3: Total PFO4B acreage by GIS layer

Wetlands Layer	PFO4B Acreage
JBER	1738.12
Previous NWI	1352.72
Updated NWI	1132.11

Table 4: New wetlands in descending order of total acres

ATTRIBUTE	ACRES
L1UBH	235.82
L2UBH	179.89
E2USN	169.78
R3UBH	149.84
PFO4B	137.36
PEM1D	130.14
PEM1B	70.96
PSS1A	58.62
PSS1D	44.45
E2USM	30.96
PFO1B	22.30
R3USC	20.61
PSS1B	20.35
PFO1D	18.91
PFO1/EM1D	18.02
PFO4D	14.83
PEM1F	12.10
PFO1/EM1B	11.99
PUBH	10.91
PSS1/EM1D	9.63
PSS4D	9.11
E2SS1P	8.95
PFO1A	8.79
E2EM1N	7.82
PEM1C	7.74
PFO4/EM1D	6.87
PFO1/SS1D	6.25
PEM1/FO1D	4.73
PFO1/4B	4.69
PSS1C	4.64
E2EM1P	4.57
PUBF	4.36
PUBHb	3.81
PEM1A	3.73
PEM1/SS1D	1.86
PSS1/4D	1.65
PSS4C	1.34
PSS4/EM1B	1.18
PEM1/SS1F	1.16
PFO1C	1.10
PEM1/FO4D	1.04

PEM1Dx	1.03
PEM1/SS1B	1.01
PEM1/FO1A	1.00
PABH	0.88
PSS1Bx	0.71
PSS1/EM1F	0.62
PUSC	0.57
PSS3C	0.41
PSS3B	0.40
E2ABM	0.39
PEM1/FO4B	0.38
PFO4/EM1B	0.36
PSS4B	0.31
PSS1F	0.29
PRB1H	0.25
PUBHx	0.19
PFO4A	0.13
PSS1/FO1B	0.11
R2UBH	0.08
PUBFx	0.06
PSS4/EM1D	0.05

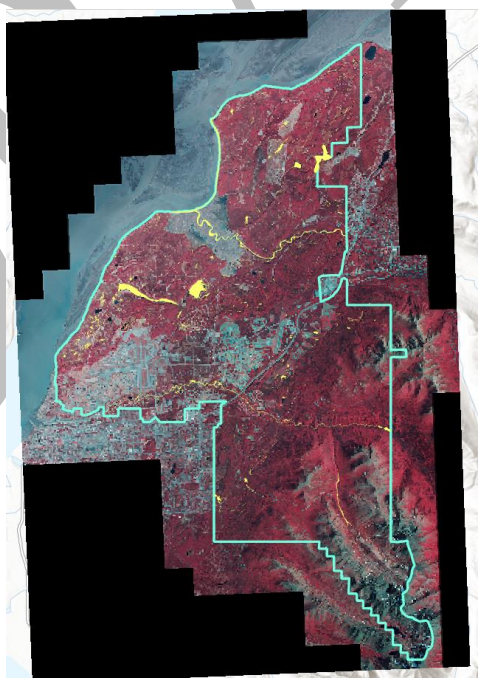

Figure 7: New wetlands shown in yellow on JBER imagery. Most small dots are slivers of wetland that extend beyond previous wetland boundaries.

Deliverables

The National Wetlands Inventory product will be publicly available through the online USFWS Wetlands Mapper. A separate wetlands product will be delivered to USAF for integration into the internal system. At the time of delivery, the geometry and NWI coding of the USFWS and USAF datasets will be identical. All data inputs for this product including field photos and notes will be archived in the FWS data repository.

This report has two appendices: A field report, produced at the end of the 2023 field season as well as a signature library to assist the public and/or future data producers with understanding the relationship between on the ground wetland conditions and aerial imagery signatures.

Future Work

There are many ecosystems across the JBER installation that exhibit soils, vegetation and hydrology that can be difficult to tie directly to a wetland indicator. These complicated sites include black spruce (*Picea mariana* [FCW]) wetlands and woodlands, areas with gradual elevation changes, complex upland-wetland mosaics, alpine swales, and fields of bluejoint grass (*Calamagrostis canadensis* [FAC]). In each of these instances, the association of the plant community with a photo signature is not conclusive enough for remote methodologies to have high confidence regarding the determination of whether a site is upland or wetland. This inventory has defaulted to assigning areas that meet certain photo interpretive characteristics as wetlands. Therefore, it is likely on the ground wetland determinations will find areas of uplands within this inventory, especially within the B water regimes. More conclusive or high-resolution mapping of these areas will require much more intensive on the ground sampling and delineation methodologies outside the scope of the NWI.

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