Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Wetland Mapping Study in the Upper and Middle Susitna Basin
Study Plan Section 11.7

Initial Study Report
Part A: Sections 1-6, 8-10

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.—Environmental Research & Services

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Abbreviation	Definition
ADEC	Alaska Department of Environmental Conservation
AEA	Alaska Energy Authority
AVC	Alaska Vegetation Classification
CIRWG	Cook Inlet Regional Working Group
ELS	Ecological Land Survey
FCI	functional capacity index
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
HGM	hydrogeomorphic
ILP	Integrated Licensing Process
ISR	Initial Study Report
LRR	land resource regions
MLRA	major land resource areas
NWI	National Wetland Inventory
PM&E	protection, mitigation and enhancement
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project
QA/QC	quality assurance/quality control
RSP	Revised Study Plan
SPD	Study Plan Determination
TNW	Traditionally Navigable Water
USACE	United States Army Corps of Engineers
USFWS	Fish and Wildlife Service

Abbreviation	Definition
USR	Updated Study Report
WAA	wetland assessment area

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed its Revised Study Plan (RSP) for the Susitna-Watana Hydroelectric Project No. 14241 (Project) with FERC, which included 58 individual study plans (AEA 2012). Section 11.7 of the RSP described the Wetland Mapping Study in the Upper and Middle Susitna Basin. On February 1, 2013, FERC staff issued its study plan determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. RSP Section 11.7 was one of the 31 studies approved with no modifications.

In this study, wetlands in the in the Upper and Middle Susitna River Basin (where the Watana Reservoir and Project infrastructure is proposed) are being identified in the field, classified, and mapped from aerial imagery. The mapping encompasses the inundation zone of the proposed Watana Reservoir, the Watana dam site and associated infrastructure, and the three alternative corridors for the Susitna-Watana transmission lines and access corridor. RSP Section 11.7 provided goals, objectives, and proposed methods for data collection regarding wetlands.

Following the first study season, FERC's regulations for the Integrated Licensing Process (ILP) require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). This Initial Study Report (ISR) on the Wetland Mapping Study in the Upper and Middle Susitna Basin has been prepared in accordance with FERC's ILP regulations and details AEA's status in implementing the study, as set forth in the FERC-approved RSP (referred to herein as the "Study Plan").

2. STUDY OBJECTIVES

The overall goal of the wetland mapping study is to prepare a map of existing wetland habitats in the Upper and Middle Susitna River Basin (upstream of Gold Creek; see Section 3, Study Area, below). This multi-year study was initiated in 2012. The mapping information from this study eventually will be used in AEA's License Application to assess the potential impacts to wetland resources from development of the proposed Project, and to prepare protection, mitigation, and enhancement (PM&E) measures, as appropriate, to minimize impacts to wetland resources.

As described in RSP Section 11.7.1.1, the study objectives are to:

- Classify, delineate, and map wetlands in the Upper and Middle Susitna River Basin based on current aerial imagery for the study area; and
- Determine and evaluate the ecological functions of the mapped wetland types to facilitate an assessment of the relative value of each wetland type in the study area.

3. STUDY AREA

As established by RSP Section 11.7.3 and depicted in Figure 11.7-1 of the RSP, the study area comprises a 2-mile buffer surrounding those areas that would be directly altered or disturbed by development of the proposed Project (

Figure 3-1), including the three alternative corridors for the Susitna-Watana transmission lines and access road, Watana Dam, and Watana Camp sites, and maximum normal pool elevation of the Watana Reservoir (2,050 ft). The Chulitna Corridor runs east-west north of the Susitna River connecting to the Alaska Intertie and the Alaska Railroad near Chulitna station at Chulitna Pass. Another east-west alternative, the Gold Creek Corridor, runs south of the Susitna River to the Alaska Intertie and the Alaska Railroad at Gold Creek station. A third alternative, the Denali Corridor, runs north-south, and would connect the Project dam site with the Denali Highway over a distance of about 44 miles and then would run west along the existing Denali Highway to connect to the Alaska Intertie near Cantwell.

In areas paralleling the Susitna River between the Project dam site and Gold Creek station (Figure 3-1), wetlands within the 2-mile study area buffer will be mapped up to the boundary of the study area for Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6). In the riparian vegetation study, successional vegetation, wetlands, and wildlife habitats will be mapped (i.e., wetlands in riparian areas downstream of the Project dam site along the Susitna River will be mapped). Mapping methods in the wetland mapping study and riparian vegetation study are compatible, and a seamless wetlands map for the Project will be produced, which will include the areas above and below the Project dam site. The alteration of wetland habitats downstream of the Project dam site (due to changes in instream flow, groundwater/surface water interactions, ice processes, and fluvial geomorphic features in the Susitna River) will be addressed in the riparian vegetation study. No placement of fill in wetlands is expected to occur downstream from the Project dam site; thus, a wetlands map will not be needed for the Clean Water Act Section 404 wetlands permit application for the Project (this has been confirmed by the U.S. Army Corps of Engineers [USACE]; see Section 11.7 in AEA 2012).

4. METHODS AND VARIANCES IN 2013

The wetlands classification and mapping methods are set forth in RSP Section 11.7.4 and include the following components:

- Preselect field sampling locations and conduct field wetland determination and functional assessment surveys;
- Conduct wetlands mapping using data collected during field surveys in summer 2012 and 2013;
- Revise the preliminary wetlands mapping using field data collected each year; and

- Incorporate wetland functional assessment data (see below) into the classification of wetland types so that the mapped wetlands, whenever possible, represent wetland functional types.

In addition to preparing a wetlands map for the Project, a wetland functional assessment for the mapped wetland types is being conducted. As agreed to with resource management agencies (see RSP Section 11.7.4.3), the set of wetland functions to be assessed for the Project is being tailored to reflect those expected to be of most importance in remote regions of Alaska where landscape disturbances are few. The wetland functional assessment is being conducted using hydrogeomorphic (HGM) principles following the methods of Magee (1998), with modifications for the largely undisturbed wetland types in the study area and additions of spatially explicit data indicating specific wetland functions in different portions of the study area (see Section 4.3, Wetland Functional Assessment, below).

4.1. Wetlands Classification and Mapping

The wetland mapping study team implemented the methods as described in the Study Plan with no variances.

The methods for classifying and mapping wetlands and waters in the study area were implemented as described in RSP Section 11.7.4. The mapping, which is a multi-year effort to cover the entire study area, is being conducted following the protocols for preparing wetland maps that have been developed by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) program (National Wetlands Inventory Center 1995, Dahl et al. 2009). These protocols describe requirements for boundary delineation, polygon size, classification, and NWI annotation.

Additional attributes being assigned to wetland polygons include HGM (Brinson 1993) and Viereck et al. (1992) Level IV vegetation types, which involves incorporating landscape, geomorphic (physiography and surface form), disturbance, hydrological, and biological variables into the wetlands map, as well as the presence or absence of permafrost. This integrated classification approach is similar to a regional classification system developed for lowlands in the Cook Inlet basin (Gracz 2011), which improves upon Cowardin et al. (1979) by incorporating region-specific landscape, geomorphic, and wetland functions into the classification of wetlands, and thus will allow cross-referencing between the two classifications in cases where similar (lowland) wetland types are identified with the two approaches. This integrated approach to the classification of wetlands was agreed to during meetings with resource management agencies regarding the wetland mapping study in spring 2012 (see RSP Section 11.7.4.3). The Cook Inlet wetland classification system is specific to Cook Inlet lowlands, however, and many wetland types in the study area (which largely occur at higher elevations) are unlikely to be represented in the Cook Inlet classification. Developing Project-specific wetland types in this study will allow the accurate classification of higher-elevation wetlands as well as the cross-referencing of applicable lowland wetlands to similar types defined in the Cook Inlet classification system.

The wetlands mapping is being prepared by digitizing polygons on-screen using *ArcGIS* software. Map polygon boundaries are being determined by interpreting high-resolution (0.3- to 1-ft pixels) aerial image-signatures supported by ground-reference survey data collected in 2012 and 2013. Wetlands and waters are being mapped at a scale of 1:2,000. The minimum mapping polygon size for most upland and wetland habitats is 0.5 acres, with smaller polygons (0.1 acre) delineated for water bodies and other wetlands of ecological importance. Wetland and upland boundaries are being delineated based on color signature, plant canopy, and surface relief, along with hydrological indicators such as drainage patterns and surface water connections. Field parameters being used to assist the mapping effort include vegetation structure, soil organic matter content, hydrologic regime, electrical conductivity, pH, presence of a restrictive layer (lack of soil permeability), physiography, and geomorphic characteristics such as macro- and microtopography, slope, aspect, and surface form.

To assist the wetland functional assessment (see Section 4.3 below), HGM classes are being assigned to each wetland polygon based on geomorphic position and hydrologic characteristics, as defined by Brinson (1993) and modified by Smith et al. (1995). Functions and ecological services provided by wetlands vary by geomorphic position and hydrology, and HGM classification helps identify differences in both specific functions and their magnitude. For example, a depressional wetland has a much greater capacity to retain sediment than a slope wetland, due to its closed or semi-enclosed contours (a slope wetland lacks closed contours). Thus, while these systems may share a similar NWI wetland class, the difference in HGM class can be used to distinguish their functional characteristics.

The Level IV vegetation classes of the *Alaska Vegetation Classification* (AVC; Viereck et al. 1992), with additions by the botanical study team for undescribed types and nonvegetated land cover types, are defined by vegetation structure and dominant plant species (e.g., Open White Spruce Forest, Closed Tall Alder Shrub, Subarctic Lowland Sedge Wet Meadow). Physiography types represent broad, landscape-scale geomorphic features and landscape position (e.g., riverine, lacustrine, lowland, upland, subalpine, and alpine). Surface forms are finer scale geomorphic features, in this case in boreal forest environments (e.g., ridge crest, toe slope, kettle basin, point bar); the surface-form classes being used were modified from Washburn (1973) and Jorgenson et al. (2003). The disturbance types being used were modified from a list defined by the botanical study team for previous Ecological Land Survey (ELS) studies in both remote and developed areas in Alaska (see Jorgenson et al. 2003 for an example).

Because fine-scale mapping of wetland boundaries is possible only with the use of high-resolution imagery, the detailed mapping of wetland types prior to the 2013 field season was limited to two areas for which high-resolution imagery was available: (1) a corridor around the Upper Susitna River, which covers the southwestern portion of the Watana Reservoir, and portions of the Gold Creek Corridor; and (2) in the vicinity of Cantwell and adjacent portions of the Parks and Denali highways in the Denali Corridor. For the areas lacking high-resolution imagery prior to the 2013 field season, moderate-resolution RapidEye imagery (5-m [16-ft] pixels), in a false natural-color format, was used to determine preliminary NWI and HGM wetland classes and select field sampling transects for survey work in 2013. Additional high-resolution imagery, for those portions of the study area where only moderate-resolution imagery exists, was acquired by AeroMetric (now Quantum Spatial) in July–August 2013; this new digital imagery was prepared in both natural color and infrared formats.

The preliminary mapping described above is currently under revision so that it accurately reflects the field-verified occurrences of NWI and HGM wetland types, Level IV vegetation types, physiography, surface form, and disturbance types. Mapping is also being extended into portions of the study area without preliminary mapping. For this report, a preliminary set of wetland types (NWI classes only) for the study area was compiled from the mapping that was completed as of mid-November 2013.

When the wetlands map is completed, the mapping will undergo a rigorous QA/QC review process using tools developed by the botanical study team and the Wetlands Data Verification Toolset developed by the NWI program to identify digitizing anomalies (e.g., incorrect attribute codes, unattributed polygons, adjacent polygons with the same coding, digital slivers [null polygons < 0.01 acre in size]). The NWI toolset was created using the Environmental Systems Research, Incorporated (ESRI) ModelBuilder (http://www.fws.gov/wetlands/Data/Tools-Forms.html).

4.1.1. Variances

In 2013, there were no variances from the wetlands classification and mapping methods described in RSP Section 11.7.4.1.

4.2. Field Surveys

AEA implemented the methods as described in the Study Plan (RSP Section 11.7.4.2) with the exception of variances explained below (Section 4.2.1). To link aerial-image signatures with ground data, eight scientists (four teams of two each) collected wetlands, vegetation, and wildlife habitat ground-reference data in two separate field survey efforts: July 2–11, 2013 and July 30–August 8, 2013. These periods are well within the median dates of the onset of vegetation green-up in spring and vegetation senescence in fall for Southcentral Alaska, as specified in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)* (USACE 2007). The wetland field surveys were organized so as to collect data for as many wetland types as possible in a way that maximizes efficiency (numerous different wetland types were sampled in a day) and safety (topographic hazards such as traversing steep bluffs and creek crossings were avoided).

A preliminary map of wetland and upland boundaries in those areas where high-resolution imagery was available was not fully completed prior to the 2013 field season, but the portion of the mapping completed was used to define a set of characteristic wetland types that occur in the mapped areas. This information was used to guide the field survey efforts in 2013. The sampling transects (1.5–3.0 km [0.93–1.86 mi] long) focused on wetland types that were (1) less well represented in the preliminary mapping; (2) more challenging to identify from aerial image-signatures; (3) represented by a continuum of aerial image-signatures; and/or (4) under-sampled during the first year of field surveys (2012). Survey transects were designed to sample a number of different habitats during each survey day; consequently, transects typically had a number of vertices. On each transect, 6–10 wetland-determination plots were sampled depending on the length of the transect and/or the number of distinct habitat types encountered. Field plots were sampled along transects located within the major physiographic types in the study area, including riverine, lacustrine, lowland, upland, subalpine, and alpine areas. When transitional habitats or areas not readily discernible from image-signature features alone were encountered in the field, additional wetland-determination plots were surveyed.

Wetland determinations were made using the standard three-parameter approach described in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environment Laboratory 1987) and the 2007 *Regional Supplement* (USACE 2007). To be classified as a wetland, a site must be dominated by hydrophytic plants, have hydric soils, and show evidence of a wetland hydrologic regime. At each wetland-determination plot, the percent areal cover of each vascular plant species within each stratum (herb, shrub, and tree) was visually estimated, generally within a 10-m (33-ft) radius plot of relatively homogeneous vegetation as specified in Environmental Laboratory (1987). The size and shape of the wetland-determination plots were modified as needed, however, depending on the extent of the plant community being sampled (e.g., narrower plots were used in riparian fringe habitats). The presence of hydrophytic vegetation was determined using the Dominance Test (ratio of wetland versus upland dominant plants) and/or the Prevalence Index (weighted average of all species present), using the wetland indicator status for each plant species as listed in the 2013 *National Wetland Plant List* (Lichvar 2013). Additional vegetation information (percent areal cover data for structural classes of vascular and nonvascular plants [trees, saplings, tall shrubs, low shrubs, dwarf shrubs, tall herbs, low herbs, floating aquatics, submergents, mosses, and lichens]) was recorded to assist in defining wetland types and evaluating the use of wetland types by birds, mammals, and amphibians.

Hydric soils form under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper 12 in of the soil. Hydric soils often have thick organic deposits (histosols, histels, or histic epipedons) or have a low-chroma mineral soil matrix color with redoximorphic features, indicating a reducing environment. Soil pits were excavated to approximately 18 inches or to the depth of the active layer, if shallower, and the soil profile was described. Key characteristics including color (Munsell Soil Color Charts 2009) and abundance of redoximorphic features were recorded. Soil profile descriptions also were compared with hydric soil criteria in the most current version of the *Field Indicators of Hydric Soils in the United States* (USDA-NRCS 2010).

Wetland hydrology is defined as the presence of flooded or ponded surface water or saturation within the upper 12 inches of the soil profile for at least 14 consecutive days during the growing season at a minimum frequency of 5 years out of 10. Surface and subsurface, direct and indirect indicators of wetland hydrology were recorded at each site, including surface water, saturated soils, presence of and depth to water table, drift or sediment deposits, drainage patterns, and geomorphic position, as summarized in the 2007 *Regional Supplement* (USACE 2007).

A mobile *Trimble® Nomad™* series geographic information system (GIS) unit was used to record the field data for each wetland-determination plot (using the *WetForm* database), and to record global positioning system (GPS) coordinates for each plot. *WetForm* is a relational database used to record wetlands site data in the field, and it facilitates the preparation of electronic copies of the 2007 *Regional Supplement* dataform (USACE 2007) for each wetland determination plot.

Additional data recorded at each wetland-determination plot to support the wetland classification and wetland functional assessment included HGM wetland class; AVC Level IV vegetation class; physiography class; disturbance class; slope and aspect (in degrees); site, vegetation, and soil photos; and GPS coordinates. Observations of recreational use, subsistence use, and wildlife use (e.g., nests, dens, scat, tracks) and other site characteristics that reflect habitat quality and wetland function also were recorded at each plot (see Section 4.3, Wetland Functional Assessment, below). These data were recorded using a customized data-entry program on an Android tablet computer.

In addition to the formal wetland-determination plots, rapid map-verification plots were sampled to help facilitate the wetlands mapping effort. Map-verification plots were sampled in habitats for which the wetland or upland status had been previously well documented with full wetland-determination plots at other sites; the map-verification plots were used to improve map accuracy by increasing the number of documented wetland types tagged to particular aerial image-signatures. At these plots, a limited set of data was recorded, including cover estimates for the dominant vascular plant species, HGM wetland class, the Cowardin et al. (1979) water regime class, AVC Level IV vegetation class, physiography class, site photos, and GPS coordinates. No soils information was recorded at map-verification plots.

To support the survey efforts of other botanical and wildlife studies being conducted for the Project, the locations of all incidental observations of rare plants, invasive plants, wildlife species, wildlife use (e.g., browsed plants) or significant wildlife habitat features (e.g., raptor nests) were documented when encountered.

4.2.1. Variances

In 2013, there were no variances from the field sampling methods described in RSP Section 11.7.4.2. This study was designed with a multi-year data collection effort and no specific sampling locations were identified in RSP Section 11.7.4.2. The sampling of wetland determination plots in 2013 was restricted to accessible lands (state, federal, and Ahtna, Inc. lands). Consequently, thus far, some wetland types in the study area have not yet been sampled or are under-sampled, such as low-elevation slope wetlands above the Susitna River, wetlands in the Fog Lakes area, and at the northern end of Stephan Lake, all of which occur on Cook Inlet Regional Working Group (CIRWG) lands. If access to CIRWG lands is granted for the next year of study, the wetland types occurring on these lands can be adequately described and the study objectives can be achieved.

4.3. Wetland Functional Assessment

AEA implemented the wetland functional assessment methods as described in the Study Plan (RSP Section 11.7.4.3) with no variances. Based on agreements reached with resource management agencies while planning the wetland mapping study (see Section 11.7 in AEA 2012), the ecological functions of wetlands in the study area are being assessed using HGM principles (Smith et al. 1995). Several draft HGM guidebooks have been prepared for the Cook Inlet Basin (Hall et al. 2003) and Interior Alaska (ADEC and USACE 1999), but the models are confined to a small set of HGM classes (primarily slope and flat wetlands in lowland boreal forest regions) and are regionally specific. Consequently, those models do not apply to all the wetland classes in the Susitna River Basin, which lies in a transition zone between Interior Alaska and Cook Inlet, and includes montane and riverine environments in addition to boreal forest wetlands. Instead, the rapid assessment procedure developed by Magee (1998), which is based on HGM wetland classes, is being used as the basis for assessing wetland functions for this study, but the procedure and parameters measured will be modified as needed to evaluate wetland functions unique to the study area. As in formal HGM classifications, HGM wetland classes, as defined by Brinson (1993) (e.g., depressional, slope, lacustrine fringe), are being assigned to each mapped wetland type. The functional capacity of each wetland type is being assessed based on an extension of Magee's (1998) rapid-assessment procedure (hereafter referred to as the Magee model), which involves incorporating field data into HGM-specific wetland-function models. In the field, the wetland functional assessment data needed for the model were collected electronically using a customized data-entry program on an Android tablet computer.

The primary components of the Magee portion of the model are the wetland assessment area (WAA), the eight Magee wetland functions, and the functional capacity index (FCI) for each wetland type. FCI values are calculated using either direct measurement of wetland function or using field data for a suite of variables that apply to each of the eight standard Magee functions within individual WAAs (see below). In small-sized wetland projects, the WAA often represents an individual wetland type with associated ground-reference data, but for large-sized mapping projects based on aerial image-interpretation, the WAA needs to be a representative wetland type that can be reliably recognized on aerial imagery. In the analysis, FCI values are calculated for areas with ground-reference data and then extrapolated to similar mapped types in the study area. The Magee model is used initially to calculate FCI values for the eight standard Magee functions (listed below) for each plot sampled in the field, so that during the initial analysis stages the wetland assessment area (WAA) represents only one wetland type. To establish wetland functional classes (sets of wetland types that share similar wetland functions), iterative runs of the Magee model are used and wetland types are then grouped into functional classes. As model development proceeds in the next study season using the full set of mapped wetland types in the study area, the wetland functional classes, not individual wetland types, will be considered as the WAAs. At that stage, representative FCI values for each of the eight Magee functions will be assigned to each wetland functional class mapped in the study area.

Once the Magee portion of the functional assessment is complete, project-specific GIS data layers prepared by other AEA researchers working on the Project will be used to assess two additional wetland functions not included in the Magee model (consumptive uses and uniqueness), and to improve the functional assessment information for a third function (fish and wildlife habitat). Using a GIS-based approach to build on a standard wetland functional analysis has the advantage of providing spatially explicit information on wetland functions in different parts of the study area, which is quite large and covers portions of three different ecoregions of the state (see Section 6.1.1, Ecoregions, below). The full wetland functional assessment cannot be completed until after the wetlands mapping is complete and the final Project-specific data layers from other researchers are available (see below).

In the full functional assessment, the following set of 10 wetland functions will be evaluated using a combination of field data from this and other Project studies. As noted above, eight functions will be assessed following the methods of Magee (1998). Two additional functions will be assessed using spatially explicit GIS analyses of the occurrence of individual wetland functional classes mapped in the study area, and one of the 10 functions will be assessed using a combination of Magee model results and GIS analyses:

- Modification of groundwater discharge (Magee)

- Modification of groundwater recharge (Magee)
- Storm and flood-water storage (Magee)
- Modification of stream flow (Magee)
- Modification of water quality, including sediment retention and nutrient and toxicant removal (Magee)
- Export of detritus (Magee)
- Contribution to abundance and diversity of wetland vegetation (Magee)
- Fish and wildlife habitat (Magee and GIS analysis)
- Consumptive uses (GIS analysis)
- Uniqueness (GIS analysis)

At each wetland-determination plot sampled in the field, data reflecting wetland functional capacity were collected for hydrologic variables (surface water pH, electrical conductivity, wetland water regime, presence of seeps or springs, surface water fluctuations, surface water interspersion), soil variables (permeability, sedimentation), vegetation variables (dominant wetland type, areal cover of dominant vegetation, vegetation interspersion, dominant plant dispersion), and site variables (landscape-scale topographic gradient, microtopographic relief, site size, site connectivity) following Magee (1998). As described above, the collected data will be run through the Magee model to determine a base level of functional capacity (FCI value) for each mapped wetland type for 8 of the 10 functions (all except consumptive uses, and uniqueness). In this process, the data for the wetland function variables that apply to each of the eight standard Magee wetland functions are combined and summarized to derive FCI values for each mapped wetland type, as described by Magee (1998). Due to the large size of the study area, it was not feasible to deploy piezometers in each wetland type to collect direct information on two wetland functions (Modification of Groundwater Discharge and Modification of Groundwater Recharge). Instead, field observations were used to make inferences regarding groundwater discharge and recharge as described by Magee (1998), and those field variables will be used to derive FCI values for the discharge and recharge functions. Through an iterative process beginning with analyses based on field plot data for individual wetland types, the wetland function model will be adjusted to provide FCI values for each wetland functional class mapped in the study area. Then, using Project-specific GIS data, consumptive uses and uniqueness will be evaluated and the model results for the fish and wildlife habitat function will be augmented, as described below.

The fish and wildlife and habitat functions will initially be assessed using the Magee model, and then in a spatially explicit way by incorporating Project-specific fish and wildlife occurrence data to indicate which specific wetlands in the study area provide those habitat functions and to what degree. Fish-occurrence data for the study area, from the Fish Distribution And Abundance Studies (Studies 9.5 and 9.6) and the Fish Habitat Study (Study 9.9), will be used to attribute individual wetland (water body) polygons known to support fish, which will then be given higher rankings for the fish habitat function. The fish-habitat rankings will be determined based on the number of fish species and life-history stages present, so that water bodies supporting more species and a greater number of life-history stages will be ranked higher. Data from the wildlife studies, including large mammals (Studies 10.5 through 10.8), furbearers (Studies 10.9 through 10.11), small mammals (Study 10.12), bats (Study 10.13), birds (Studies 10.15 through 10.17), and amphibians (Study 10.18) will be used to identify habitat features important for particular species of birds, mammals, and amphibians, and to identify specific regions in the study area that are heavily used by wildlife. This information then will be used to evaluate the use of the mapped wetland types by wildlife; this will entail conducting habitat-use evaluations for wetland types instead of habitat-use evaluations for wildlife habitat types (as will be done in the Evaluation of Wildlife Habitat Use; Study 10.19). Wetlands known or expected to support wildlife will then be given a higher functional capacity index for wildlife habitat. As with the fish-habitat function, those wetlands that support a greater number of wildlife species and more life-history stages will be ranked higher.

Magee (1998) does not include models for consumptive uses or uniqueness. If possible, the evaluation of the consumptive uses function will be spatially explicit, using Project-specific recreational- and subsistence-use data (see Studies 12.5 and 14.5, respectively) to indicate which general regions in the study area are used currently (actual use for recreation and subsistence activities such as hunting, trapping, fishing, berry picking). The coarse spatial resolution of the recreational- and subsistence-use data, however, likely will preclude a determination of which specific wetland types are being used, so a likelihood of actual use will be assigned based on the vegetation structure and plant species composition in each wetland type and proximity to access points for recreational and subsistence users. The potential for additional consumptive use in other parts of the study area after Project construction will be assessed in GIS by identifying those wetland types that are likely to be used now, as described above, and then determining the locations of those types where they occur adjacent to the three proposed alternative transmission lines and access road alignments. Those wetland areas that could be more easily accessed via a new road will be categorized with a potential consumptive use value specific to the possible future use(s).

The specific definition of wetland uniqueness will be determined after the mapping of wetland types in the study area is completed. The uniqueness function will be used to identify those wetland types and their specific occurrences in the study area that are regionally scarce relative to other more common wetland types.

The study area lies within zones of discontinuous and sporadic permafrost (Brown et al. 2001), and permafrost is known to affect the functional capacity of wetlands (e.g., by slowing biogeochemical reaction rates due to low temperatures and reducing groundwater recharge). The presence or absence of permafrost is included in the classification of wetland types (see Section 4.1, Wetland Classification and Mapping, above), thus allowing distinctions between the functional capacities of permafrost and non-permafrost wetland types.

For review in this report, FCI values were calculated and preliminary wetland functional classes were derived for the field data for two example field transects. Plots along transects T139 and T182 were given FCI values for the eight standard Magee functions using data collected from each field plot and the plots were then grouped into preliminary wetland functional classes. The wetland functional assessment will be finalized in the USR, after additional field data are collected and the mapping of wetlands is completed for the full study area.

4.3.1. Variances

In 2013, there were no variances from the wetland functional assessment methodology described in RSP Section 11.7.4.3.

5. RESULTS

5.1. Wetlands Classification and Mapping

Mapping of wetlands in the study area was initiated in 2012 and will continue over the course of the study. As of the end of December 2013, approximately 130,000 acres had been mapped, which represents roughly 23 percent of the study area. High-resolution imagery that was not available for portions of the study area in 2012 was rectified in 2013 with the acquisition of two new sets of imagery. The first is archived satellite imagery from the QuickBird-2, WorldView-2, and Pleiades 1 satellites acquired in 2010–2012. Acquisition dates for those images were between July 7 and August 14, and the imagery was processed in both natural color and color infrared formats to create a 0.5 m (1.6 ft) orthomosaic. The remaining image gaps were filled with digital aerial imagery (0.5 m [1.6 ft] resolution) acquired by AeroMetric (now Quantum Spatial) in July 2013. This imagery also was processed in both natural color and color infrared formats.

To support the wetland mapping efforts, a total of 40 NWI wetland types were assigned to field plots sampled in the study area in 2012 and 2013 (Table 5.1-1). The NWI types were determined using plot-specific plant species cover and hydrology data. As the number of sampled plots increases, the set of NWI types documented increasingly should represent the range of variation within the image-signatures of wetland types in the study area. Given the small increase in new NWI types recorded in the 2013 field season, the current list of NWI types is likely to be a good estimate of the actual number of NWI types found in the study area. During the mapping efforts in the next year of study, close comparisons of the data for individual field plots that share similar image-signatures will eventually result in a list of those wetland types that can be reliably recognized and mapped versus those that represent features that are typically either below the minimum map size or that cannot be reliably tagged to a specific image-signature. As the mapping proceeds in the next year of study, a final list of wetland functional classes will be determined based on field data, the mapping of wetland types, and the results of the wetland functional assessment. As noted above, final wetland functional classes cannot be developed until further mapping, additional data QA/QC, and a full set of wetland functional assessment model runs are completed.

5.2. Field Survey

In 2013, a total of 914 field plots were sampled along 77 transects (Figure 3-1). Standard USACE field wetland determinations were completed at 619 wetland-determination plots and map-verification data were collected at 295 plots. Of the 619 wetland-determination plots, 379 were located in waters or wetlands and 240 were in upland areas (Table 5.1-1).

Two weather stations closest to the study area indicated that temperatures during the 2012 field season were near average (Table 5-1). Because of the unusually late, cold spring in 2013, temperatures were cooler than the 30-year mean in April and May, but then were above the long-term averages for the remainder of the field season. Precipitation was more than double the 30-year mean at the Chulitna River station in June 2012 and May 2013, and nearly double that at the Cantwell 4E station in June 2012. Precipitation for the remaining months of the 2012 and 2013 growing seasons, however, was well below the 30-year mean.

5.2.1. Waters

Waters of the U.S. were frequently sampled within the riverine, lacustrine, and palustrine systems in the study area; five riverine types, two palustrine types, and one lacustrine type were recorded in 2012 and 2013 (Table 5.1-1). Riverine waters fell into intermittent, lower perennial, and upper perennial systems. The two largest rivers in the study area (the Susitna and Nenana rivers) are classified as upper perennial (R3UBH) and accounted for the majority of field plots within that type. Permanently flooded ponds (PUBH and PUBHb) were sampled frequently throughout the study area, whereas larger lakes (L1UBH) were less commonly sampled.

5.2.2. Wetlands

Over the 2 years of field study, 32 palustrine, terrestrial, and vegetated wetland types were sampled (Table 5.1-1). The most commonly sampled NWI wetland type was saturated broadleaf deciduous shrub-scrub (PSS1B). This is in part due to the widespread distribution of this type in the study area, but is also due to the wide range of plant communities that occur in the PSS1B type and a sampling design focus on this particular wetland type in 2013. Other commonly sampled types include wet emergent meadows such as semi-permanently flooded persistent emergent (PEM1F) and seasonally flooded/saturated persistent emergent (PEM1E). In general, saturated shrub-dominated communities were sampled more often than emergent (herbaceous-dominated) wetland types. Emergent types tended to have wetter hydrology; often they were permanently flooded or semi-permanently flooded, whereas shrub-dominated communities tended to have only saturated hydrology.

5.3. Wetland Functional Assessment

Two transects (T139 and T182) that were sampled in 2013 were selected for the preliminary wetland functional assessment model run presented in this report. Transect T139 is located on a north-facing upland bench above the Susitna River near Gold Creek. The transect traverses undulating terrain with open, mixed forest non-wetlands on well-drained convex surfaces and slope wetland complexes occurring in the intervening low-lying troughs, which were formed by glacial scour. Transect T182 is located on a north-facing slope just above treeline in the subalpine zone, west of the confluence of the Susitna River and Deadman Creek. The wetland types crossed on this transect include seasonally flooded/saturated meadows and saturated, sloping shrub-dominated wetlands.

On these two transects, one HGM riverine wetland type (PSS1C) was recorded on plot T139_06, while the remaining wetlands were classified as HGM slope types (Table 5.3-1). Saturated wetland types (PFO4B and PSS4/3B) were recorded at two plots and the remaining wetland types were classified as seasonally flooded/saturated (PEM1E) or semi-permanently flooded (PEM1F).

Of the wetland functions assessed, groundwater discharge is the dominant hydrology source for HGM slope wetlands. Because groundwater discharge and recharge are mutually exclusive functions, slope wetlands are unlikely to contribute to groundwater recharge, and Magee's (1998) models do not evaluate groundwater recharge for HGM slope wetlands. Hence, the groundwater recharge function was not assessed for slope wetlands; all other functions were evaluated for each wetland type on each plot (Table 5.3-1).

Magee's (1998) models often use the characteristics of channelized features within a wetland to infer functional capacity. For example, a wetland with no channelized inlet but a perennial channelized outlet can be inferred to perform groundwater discharge; thus, this combination of inlet/outlet class would be given an FCI of 1 for groundwater discharge. The HGM riverine wetland on Transect T139 was assigned inlet and outlet classes consistent with an active channel (perennial river inlets and outlets). The wetter HGM slope wetlands (seasonally flooded/ saturated and semi-permanently flooded) that were assessed were closely associated with perennial channelized features as observed in the field. In contrast, the saturated slope wetlands (PFO4B, PSS1B, and PSS4/3B) had no inlets or outlets unless they were immediately adjacent to a broader wetland complex containing flooded wetland types. The large size of many wetland complexes within the study area and the need for efficient field data collection precluded walking the perimeter of every observed wetland to determine inlet and outlet class. Where there were no field observations of channelized features, aerial imagery was reviewed and all visible channelized features identified were assumed to be perennial. The wetter slope wetlands with no visible channelized features were assumed to have intermittent inlets and outlets based on the prevalence of small channels observed in these wetland types in the field.

A number of the broad, landscape-scale Magee variables were assessed in the office either by image interpretation in GIS, as with the inlet outlet classes discussed above, or by making reasonable assumptions that apply to the entire study area. For example, the ratio of wetland area to watershed area was assessed in GIS based on the mapping completed as of mid-November 2013, and for the wetland land use variable, it was assumed that current land use is low intensity for every sample plot in the study area, which is relatively remote and infrequently visited by humans.

Data developed in support of this study are available for download at http://gis.suhydro.org/reports/isr. The data are in two files:

- Field data, plot locations, and wetland classification data for plots in the example map areas: ISR_11_7_WET_Plot_and_Classif.gdb
- GIS polygon data for the example map areas: ISR_11_7_WET_Data_ABR.gdb

6. DISCUSSION

The wetland mapping study is currently on-going, including QA/QC of the field data, aerial imagery interpretation and mapping of wetlands, and wetland functional assessment analysis.

The field data collection and mapping efforts in 2013 were performed with no variances (see Section 4, above), and although QA/QC is ongoing, all indications are that data are of sufficient quality to meet study objectives. A discussion of the status of the specific study components, including interrelated studies, is presented below.

6.1. Wetland Occurrence and Distribution in the Study Area

6.1.1. Ecoregions

Land resource regions (LRRs) and major land resource areas (MLRAs) in Alaska were defined by the USDA-NRCS (2004) using climatic, physiographic, biological, and ecological features, properties, and relationships. LRRs represent broad regions of the state that share similar climatic conditions, patterns, and processes, and MLRAs represent subregional areas with shared physiographic and geomorphic patterns and processes. MLRAs were used as the basis for the subregions employed in the *National Wetland Plant List* (Lichvar 2013), which is being used in this study. The wetland mapping study area spans two LRRs (Southern Alaska and Interior Alaska) and three MLRAs (the Cook Inlet Mountains subregion in Southern Alaska, and the Interior Alaska Mountains and Copper River Basin subregions in Interior Alaska; USDA-NRCS 2004). The Cook Inlet Mountains subregion encompasses the vast majority of both the Chulitna and Gold Creek corridors. The easternmost extent of the Watana Reservoir extends into the Copper River Basin subregion, while the remainder of the study area (the Denali Corridor, the easternmost portions of the Chulitna and Gold Creek corridors, and the majority of the Watana Dam site and Watana Reservoir) is located within the Interior Alaska Mountains subregion.

The Cook Inlet Mountains subregion includes portions of the Talkeetna, Kenai, and Chugach mountains that drain into the Cook Inlet Lowlands MLRA and Cook Inlet, as well as portions of the Alaska and Aleutian ranges (USDA-NRCS 2004). Portions of Denali National Park and Preserve, Lake Clark National Park and Preserve, Kenai National Wildlife Refuge, and Chugach National Forest are located within the Cook Inlet Mountains subregion. Rugged mountains, deeply incised with narrow to broad, high-gradient valleys dominate the terrain in this subregion. The climate is characterized by short summers with moderate to cold winters, with an average frost-free period of 60–80 days. During the 2013 field surveys, 15 transects were sampled in the Cook Inlet Mountains subregion, within the Chulitna and Gold Creek corridors. The wetlands along those transects were dominated by saturated shrub types, intermixed with wetter emergent wetlands, lakes, and ponds.

The Copper River Basin subregion includes portions of the Talkeetna, Chugach, and Wrangell Mountains, and the Copper River Plateau (USDA-NRCS 2004). Glenallen is the largest community within the Copper River Basin MLRA, and portions of the Wrangell-St. Elias National Park and Preserve are located within this subregion. Undulating plains and rolling hills dominate the terrain, with lakes and interconnecting wetlands in shallow basins. Most of this subregion drains into the Copper River. The subarctic continental climate of this subregion is characterized by brief, warm summers and long, cold winters, with an average frost-free period of 35–90 days. The Copper River Basin MLRA is located within the discontinuous permafrost zone, and near-surface permafrost is common in fine-textured sediments on plains, stream terraces, and gentle slopes. Two survey transects were sampled in the Copper River Basin subregion in 2013; those transects were dominated by saturated shrub wetlands with scattered occurrences of seasonally flooded/saturated emergent wetland types.

The Interior Alaska Mountains subregion includes the high mountain slopes and glaciated hills and plains in the Alaska Range and in the Talkeetna, Chugach, and Wrangell mountains, the northern portions of the Aleutian Range that drain into the upper Tanana and Kuskokwim rivers, and the Copper River Plateau (USDA-NRCS 2004). This subregion is primarily undeveloped and includes portions of Denali National Park and Preserve, Wrangell St-Elias National Park and Preserve, and Tetlin National Wildlife Refuge. High rugged mountains, low rounded hills, and extended footslopes along the base of mountains dominate the terrain, with narrow to broad high-gradient valleys dissecting the mountains. This subregion drains to the Tanana River, Kuskokwim River, Copper River Basin, the Cook Inlet Lowlands, and Cook Inlet. The subarctic continental climate of this subregion is characterized by brief, warm summers and long, cold winters, with an average frost-free period of 50–80 days. The Interior Alaska Mountains MLRA is located within the discontinuous permafrost zone, with near-surface permafrost generally restricted to fine-textured sediments on stream terraces and swales on hills and footslopes. The majority (60) of the 77 survey transects sampled in 2013 were in the Interior Alaska Mountains subregion; these transects were located within the Denali Corridor, in the study area just to the north of the Watana Dam site, and in the study area surrounding the proposed Watana Reservoir. The north-south and east-west trending portions of the Denali Corridor exhibit different aspects of the Interior Alaska Mountains subregion: high-gradient valleys in the mountains and extended footslopes, respectively. The north-south trending portion of the Denali Corridor is dominated by subalpine physiography and dwarf to low shrubs typical of the broad, high-gradient valleys in this subregion. In contrast, the east-west trending portion of the Denali Corridor is dominated by a mix of upland and lowland physiography, with forested and low-shrub vegetation classes typical of extended footslopes in this subregion. In 2013, saturated HGM slope shrub wetlands were the most frequently sampled wetland types in all portions of the Denali Corridor, although seasonally flooded/saturated emergent wetlands were frequently sampled in the north-south trending portion of the corridor. Several forested wetland types were sampled at lower elevations within the Interior Alaska Mountains subregion.

The wetland types sampled in the three MLRAs in the study area in 2013 should not be interpreted as the expected distribution of classes in the final wetlands map. In particular, land-access restrictions precluded sampling at lower elevations in most of the Gold Creek Corridor, in much of the study area surrounding the Watana Dam site, and in the western portion of the Watana Reservoir (Figure 3-1). Although few PFO4B wetlands were sampled in these areas in 2013, extensive lower elevation forests are visible in the aerial imagery for these areas. Similarly, alpine physiography dominates the north-south trending portion of the Denali Corridor in the aerial imagery, but the field survey efforts were focused on the more difficult-to-distinguish subalpine saturated shrub wetland types.

6.1.2. Waters

The Susitna River is classified as a Traditionally Navigable Water (TNW) from Cook Inlet upstream to the mouth of Portage Creek (ADNR 2012). The Nenana River, located in the northern portion of the study area in the Denali Corridor (Figure 3-1), is classified as potentially navigable. Within the study area, both rivers are large, upper perennial (R3UBH) riverine systems, characterized by year-round, high-gradient, and high-velocity flows of turbid waters full of glacial silt. Neither river is tidally influenced within the study area. As expected for high-velocity river systems, substrates are dominated by coarse rock fragments (cobbles and boulders). Within the upper portions of these rivers that occur in the study area, the drainages are relatively channelized and there is little floodplain development. Some seasonally flooded gravel bars and islands in the channels of these rivers have been classified as wetland communities; these areas are characterized by plant species that can grow in both wetland and upland hydrologic regimes (R3USC and PSS1C). These communities have surface water (flooding) for brief periods during the growing season, but the groundwater table is usually well below the surface. An example of the wetlands mapping prepared for an upper perennial river system (Nenana River) is presented in Figure 6.1-1.

Additional upper perennial waters in the study area include named and unnamed clear-water tributaries of the Susitna and Nenana rivers. These waters are typically 3–6 m (10–20 ft) wide at bankfull, with gravel- to boulder-dominated substrates; cover is provided by overhanging riparian vegetation, and undercut banks and large woody debris are common. Dissolved oxygen in the water at the time of sampling (July and August) was usually at or close to saturation.

Lower perennial rivers (R2UBH) are low-gradient rivers and streams with low velocity flows, typically with sandy or silty substrates and well-developed floodplains. Due to the mountainous terrain in the study area, these waters are less common than upper perennial rivers.

Intermittent waters (R4SBC) occur regularly in the study area and may be under-represented in the mapping of water bodies because they are often too small to detect on aerial photography. Surface water is only present in the spring or during summer flood events. These small, intermittent tributaries typically originate at seeps or springs on hillsides, and alternate between surface flow and subsurface flow in less steep terrain downslope.

Freshwater ponds (PUBH) are very common in the study area and occur in a variety of terrain types. Ponds typically are characterized by shallow water and, following Cowardin et al. (1979), can be up to 20 acres in area. They may be part of a larger lowland wetland complex or isolated features within landscape depressions. Freshwater lakes (L1UBH) are lacustrine water bodies greater than 20 acres in size (see Figure 6.1-2 and Appendix A). Lakes in the study area occur in groups, notably near the south base of Deadman Mountain and within the Fog Lakes area.

6.1.3. Wetlands

As described above, saturated broadleaf deciduous shrub-scrub (PSS1B) was the most commonly sampled NWI wetland type within the study area. Saturated, sloping, shrub wetlands are probably the most common type in the study area, and the PSS1B code also includes the highest number of AVC Level IV vegetation types (Viereck et al. 1992). Level IV types within the PSS1B code include needleleaf woodlands with shrub dominated understories, both low and tall willow and alder communities, the full range of low dwarf birch-dominated communities, as well as the dwarf willow wetland types in subalpine and alpine tundra. Due to the wide diversity of plant communities within this wetland type, it is likely to be a component of a number of different wetland functional classes on the final wetlands map for the study area. PSS1B wetlands are primarily HGM slope types, but they also occur as saturated fringes on the perimeters of larger, wetter, wetland complexes (as mapped in Figure 6.1-1), or as shrub types occupying steep discharge slopes on upland or subalpine hillside (as described in Section 6.2, Wetland Functional Assessment, below).

In addition to the common PSS1B wetland type, there were a number of other shrub-dominated wetlands that have either seasonally flooded or seasonally flooded/saturated hydrologic regimes. The most commonly sampled types in this category were seasonally flooded/saturated broadleaf deciduous shrub-scrub (PSS1E, PSS1/EM1E) and seasonally flooded deciduous shrub-scrub (PSS1C, PSS1/EM1C). The seasonally flooded types most commonly occur on well-drained riverine interfluvial surfaces (e.g., gravel river bars) while seasonally flooded saturated types often occupy the edges of low-lying wetland complexes or discharge slopes on middle or lower mountain slopes. Where these wetlands occurred on wetter discharge slopes, surface water was often present throughout, in depressions and in small channelized features.

The next most commonly sampled wetland types in the study area were the seasonally flooded/saturated persistent emergent (PEM1E) and semi-permanently flooded persistent emergent (PEM1F) types. These wetter, herbaceous wetlands do not cover large portions of the study area, but they are common wetland types throughout. Seasonally flooded saturated persistent emergent meadows were commonly found in low-lying troughs on flat plateaus above the Susitna River (see Figure 6.1-1 and Appendix A). These are slope wetlands dominated by wetland-obligate plants such as *Carex aquatilis*, *Eriophorum russeolum*, *Trichophorum cespitosum*, or *T. alpinum*. Surface water was observed at all the PEM1E types sampled, and many had indicators of a strongly reducing environment, such as a hydrogen sulfide odor or iron deposits (flocculated iron and a biogenic sheen on standing water). PEM1E communities included flooded, beaver-altered meadows; reticulated fens; or abandoned river oxbows. Semi-permanently flooded persistent emergent marshes (PEM1F) are less common than PEM1E wetlands, and are usually found immediately adjacent to open water bodies (see Figure 6.1-2 and Appendix A). PEM1F wetlands often have low plant diversity; many are nearly pure stands of tall, coarse, wetland-obligated sedges.

Six wetland-determination plots were located in saturated needleleaf forest wetlands (PFO4B). All sampled PFO4B wetlands were open canopy or woodland black spruce forests, with understories frequently dominated by *Vaccinium uliginosum*, *V. vitis-idaea*, and *Equisetum* species. These forested wetlands occurred most often in toeslope areas.

Overall, the field data indicate a diversity of both wetland and upland types in the study area; 56 percent (505) of the 895 wetland-determination plots sampled in 2012 and 2013 were classified as wetlands and 44 percent (390) were classified as non-wetlands. Over half the field points in alpine, subalpine, and upland physiographic areas in the study area were classified as non-wetland. Vegetation structure in non-wetland areas ranges from mature forests to moist herbaceous and dry dwarf-shrub types. Field plots in subalpine non-wetland areas were nearly evenly divided among dwarf shrub scrub, low birch-ericaceous, and tall alder and/or willow scrub types. Field plots in non-wetland areas in riverine, upland, and lowland physiographic areas were a mix of white spruce woodlands, open canopy white spruce-paper birch forests, low birch-ericaceous scrub, and tall alder and/or tall willow scrub types.

6.2. Wetland Functional Assessment

The preliminary wetland functional assessment conducted for the 15 wetland field plots on two example transects resulted in FCI values that represent the differences in function among various HGM wetland classes (Table 5.3-1). For example, groundwater recharge does not occur or is negligible in slope wetlands and hence the Modification of Groundwater Recharge function was evaluated only for the riverine wetland plot (T139-06). Similarly, Modification for Groundwater Discharge was highest for the riverine wetland plot due to its perennial outlet; high-permeability, sub-surface geologic deposits; well-developed microrelief; and thick organic deposits. The saturated shrub and forested slope wetlands had the lowest FCI values for groundwater discharge due to the absence of perennial outlets; low-permeability, sub-surface geologic deposits; and a predominantly acidic water regime. Seasonally flooded/saturated and semi-permanently flooded slope wetlands had moderate FCI values for groundwater discharge. Their perennial outlets and thick organic deposits indicate that groundwater discharge is likely happening, while their low-permeability, sub-surface geologic deposits likely limit the amount of groundwater/surface water interaction.

The lack of a channelized outlet is a direct indicator of function (FCI = 1) for the Storm and Floodwater Storage function in HGM Slope wetlands. The majority of saturated slope, scrub and forest wetlands have no inlet and no outlet, and thus were assessed as fully functioning (FCI = 1) for Storm and Floodwater Storage (Table 5.3-1). A modification to this direct indicator of function is being considered to better represent the range of functional differences in HGM slope wetlands without an outlet, as indicated by the footnoted FCI values in Table 5.3-1. This potential change, if made, will be implemented and discussed in the USR. The remaining wetland types evaluated had moderate FCI scores for Storm and Floodwater Storage. While seasonally flooded and semi-permanently flooded wetlands have surface roughness and microrelief characteristics suitable for storage of storm and floodwater, their limited additional storage capacity for water minimizes water retention.

The lack of a channelized outlet is a direct indicator of the absence (FCI = 0) of the Modification of Stream Flow function. Consequently, saturated scrub and forested wetlands with no channelized features were considered not to provide this function (Table 5.3-1). Forest or scrub wetlands located within or adjacent to sloping wetland complexes with channelized features received highest FCI rankings for the Modification of Stream Flow function and open water bodies received the lowest rankings.

The Modification of Water Quality function was rated high for all of the 15 plots evaluated (Table 5.3-1). HGM slope, forest, and scrub wetlands score the highest for this function (FCI = 0.87–1.0; Table 5.3-1) due to their high surface roughness, lack of channelized features, and thick organic soils. The remaining seasonally flooded or semi-permanently flooded wetlands also scored highly (FCI $\geq$ 0.8) for this function due to the presence of thick organic layers, which are capable of slowing down water movement and storing particulates and dissolved elements. The model for the Modification of Water Quality function may be restructured in the next year of study to better reflect the pristine condition of the wetlands in the study area, as opposed to wetlands in more developed areas. The Magee model was developed for wetlands in proximity to human developments with significant pollutant sources, which is not the case in the study area. The primary indicator of water quality function in the Magee model, evidence of sedimentation, may be modified to better represent the natural, rather than anthropogenic, sources of sediment in the largely undisturbed study area. This change, if made, will be discussed in the USR.

The Export of Detritus function is primarily controlled by outlet class in HGM slope wetlands. The lack of an outlet is a direct indicator of no function (FCI = 0) because regardless of the quantity or quality of organic material produced, it is unlikely to be flushed on a regular basis from wetlands with no outlet. Conversely, a vegetated wetland with a perennial outlet will rank moderate to high for Export of Detritus (Table 5.3-1). Riverine wetlands typically have high potential for export of detritus, especially in very dynamic systems with frequent, seasonal, overbank flooding. The single riverine plot considered in this preliminary functional assessment, however, was rated moderate (FCI = 0.67) for Export of Detritus due to the presence organic soils (indicative of organic retention, rather than export) and a moderate (vs. high) vegetation density.

As defined by Magee (1998), the Contribution to Abundance and Diversity of Wetland Vegetation function makes no distinctions between upland and wetland-adapted species, nor does it incorporate rare or sensitive species. The derivation of FCI values for this function depends on three variables: plant diversity, vegetation density, and proximity and connections to other wetlands. Of the types evaluated in this preliminary functional assessment, the highest ranking wetlands were the saturated HGM slope wetlands that had at least two vegetation strata, such as a shrub-birch canopy and a dwarf ericaceous and herbaceous understory. One potential alteration to the model for the Contribution to Abundance and Diversity of Wetland Vegetation function would be to incorporate results from the Rare Plant Study being conducted for the Project (see ISR Study 11.8). This alteration could be another spatially explicit modification to the functional assessment methods to link rare plant population locations with wetland functional classes. This approach would be a Project-specific modification to allow the identification of those wetland functional classes most likely to support rare plant species, and to identify the specific locations of those wetland functional classes in the study area known to support rare plant populations. This change, if made, will be implemented and discussed in the USR.

As with the Contribution to Abundance and Diversity of Wetland Vegetation function, the Contribution to Abundance and Diversity of Wetland Fauna function makes no distinction between upland or wetland-adapted species, disregards fish, and considers habitat suitability only from a general perspective. The model for the Contribution to Abundance and Diversity of Wetland Fauna function is focused on degree of human disturbance, plant community structure, wetland size, and interspersion of wetland types. In this preliminary functional assessment, human disturbance was considered to be low throughout the study area, and for this initial model run, interspersion of wetland types was artificially low because only individual plots were assessed. As a result, the faunal diversity function was rated moderate for all evaluated plots (Table 5.3-1). As discussed above in Section 4.3, Wetland Functional Assessment, this function will be modified in the next year of study by incorporating Project-specific fish and wildlife data to generate spatially-explicit assessments of the use of wetlands in the study area by fish and wildlife.

In general, the preliminary run of the Magee portion of the wetland functional assessment model prepared for this report returned expected FCI values for the HGM wetland types considered, although several alterations to the models for various functions, as noted above, are being considered to improve the accuracy and applicability of the FCI values to the study area. The Magee functional assessment model allows for such flexibility (e.g., modification or removal of variables), and as more HGM classes are added to the analysis and the wetland classification and mapping of the study area advances, it is expected that more modifications to the model will be made to better represent the functions of the large, undisturbed wetland systems in the study area.

As described in RSP Section 11.7.7, data inputs from the following interrelated studies will be used to provide spatially-explicit information on wetland function in the study area: Fish Distribution and Abundance Studies (Studies 9.5 and 9.6), plus the Characterization of Aquatic Habitats in the Susitna River with Potential to be Affected by the Susitna-Watana Project (Study 9.9) as indicated above in Section 4.3; all Wildlife Resource Studies (Studies 10.5–10.18); the Subsistence Baseline Documentation Study (Study 14.5); and Recreation Resources Study (Study 12.5). The Program Lead for the fish studies reports that the clear-water tributaries upstream of the Project dam site were surveyed for fish occurrence and fish habitats in 2012 and 2013, and the tributaries along the possible Susitna-Watana transmission line/road corridors are planned to be sampled in the next year of study. The Program Lead for the wildlife studies indicates that the wildlife surveys for the Project are on track and that data have been collected on the occurrence of large mammals (Studies 10.5 through 10.8), furbearers (Studies 10.9 through 10.11), bats (Study 10.13), birds (Studies 10.15 through 10.17), and amphibians (Study 10.18). Data on the occurrence of small mammals (Study 10.12) will be collated from the scientific literature in the next year of study. The study lead for the Recreation Resources Study (Study 12.5) indicates that general use areas for hunting/trapping and fishing in the Project area have been defined, and similar information on generalized areas for subsistence use is available from the subsistence resources study. The data from each of these studies will be available to incorporate in the wetland functional assessment work in the next year of study, and no changes in these interrelated studies will affect the use of data noted above in the wetlands functional assessment.

7. COMPLETING THE STUDY

[Section 7 appears in the Part C section of this ISR.]

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9. TABLES

Table 5-1. Mean Monthly Air Temperature and Cumulative Precipitation for Two Weather Stations Within the Wetland Mapping Study Area, Susitna-Watana Hydroelectric Project, Alaska, 2013.[1]

Station	Month	Mean Air Temperature (°F)					Total Precipitation (Inches)				
		30-yr Mean	Monthly Means		Anomaly		30-yr Mean	Monthly Totals		Anomaly	
			2012	2013	2012	2013		2012	2013	2012	2013
Cantwell 4E	April	27.2	30.7	11.6	3.5	-15.6	0.71	1.14	0.00	0.43	-0.71
	May	41.4	40.3	35.7	-1.1	-5.7	0.77	0.59	0.02	-0.18	-0.75
	June	51.3	51.3	56.8	0.0	5.5	1.87	3.22	0.07	1.35	-1.80
	July	55.2	52.2	56.6	-3.0	1.4	2.53	1.29	1.00	-1.24	-1.53
	August	50.6	50.4	53.2	-0.2	2.6	3.24	1.55	0.00	-1.69	-3.24
Chulitna River	April[2]	30.6	36.0	26.0	5.4	-4.6	1.38	0.53	0.47	-0.85	-0.91
	May[2]	42.8	41.7	37.2	-1.1	-5.6	1.03	0.59	2.76	-0.44	1.73
	June	52.8	52.0	57.7	-0.8	4.9	1.65	3.74	0.69	2.09	-0.96
	July	55.5	52.3	57.9	-3.2	2.4	3.92	2.30	1.86	-1.62	-2.06
	August[2]	51.8	51.3	56.1	-0.5	4.3	5.83	4.71	0.74	-1.12	-5.09

Notes:

1 Source: NCDC 2013.

2 Data from these months are incomplete: April 2013, *n* = 20 days; May 2013, *n* = 20 days; August 2013, *n* = 17 days.

Table 5.1-1. Wetlands and Waters Sampled in the Field in 2012 and 2013 and Mapped, as of Mid-November 2013, in the Wetland Mapping Study Area, Susitna-Watana Hydroelectric Project.[1]

NWI Code[2]	Code Description[3]	No. Wetland Determination Plots		No. Map-verification Plots	
		n (2012)[4]	*n* (2013)	*n* (2012)[4]	*n* (2013)
	Waters				
R2UBH	Lower perennial river		9		5
R2USC	Seasonally flooded lower perennial shore		1	1	
R3UBH	Upper perennial river		20	8	23
R3USC	Seasonally flooded upper perennial shore	4			
R4SBC	Seasonally flooded intermittent streambed		2	4	3
L1UBH	Permanently flooded lake		3		
PUBH	Permanently flooded pond		28	1	7
PUBHb	Permanently flooded pond (beaver modified)		1		
	Wetlands				
PUSC	Seasonally flooded unconsolidated shore		3		4
PUSCb	Seasonally flooded unconsolidated shore (beaver modified)				1
PMLE	Seasonally flooded/saturated moss lichen		1		
PEM1H	Permanently flooded persistent emergent	4	4		3
PEM1F	Semi-permanently flooded persistent emergent	11	21		
PEM1Fb	Semi-permanently flooded persistent emergent (beaver modified)		1	4	12
PEM1E	Seasonally flooded/saturated persistent emergent	30	51	4	31
PEM2E	Seasonally flooded/saturated Non-persistent emergent	1	1		1
PEM1C	Seasonally flooded non-persistent emergent				2
PEM1B	Saturated persistent emergent	6	9	1	2
PEM1Bb	Saturated persistent emergent (beaver modified)		2		
PEM1/SS1F	Semi-permanently flooded persistent emergent/broadleaf deciduous shrub-scrub	1	1		
PEM1/SS1E	Seasonally flooded/saturated persistent emergent/broadleaf deciduous shrub-scrub	4	4		3
PEM1/SS1C	Seasonally flooded persistent emergent/broadleaf deciduous shrub-scrub		1		
PEM1/SS1B	Saturated persistent emergent/broadleaf deciduous shrub-scrub	3	8		2
PSS1/EM1E	Seasonally flooded/saturated broadleaf deciduous shrub-scrub/persistent emergent	5	7		1
PSS1/EM1C	Seasonally flooded broadleaf deciduous shrub-scrub/persistent emergent	1			

NWI Code[2]	Code Description[3]	No. Wetland Determination Plots		No. Map-verification Plots	
PSS1/EM1B	Saturated broadleaf deciduous shrub-scrub/persistent emergent	6	12		3
PSS3/EM1B	Saturated needleleaf deciduous shrub-scrub/persistent emergent	1	1		
PSS1E	Seasonally flooded/saturated broadleaf deciduous shrub-scrub	8	15	3	6
PSS1C	Seasonally flooded broadleaf deciduous shrub-scrub	4	16	4	2
PSS1B	Saturated broadleaf deciduous shrub-scrub	23	116	11	51
PSS1/3B	Saturated broadleaf deciduous/evergreen shrub-scrub	1	4		
PSS1/4B	Saturated broadleaf deciduous/needleleaf evergreen shrub-scrub		13		3
PSS3B	Saturated broadleaf evergreen shrub-scrub	1	1		
PSS3/1B	Saturated broadleaf evergreen/deciduous shrub-scrub	1	5		
PSS3/4B	Saturated broadleaf/needleleaf evergreen shrub-scrub	1	1		
PSS4E	Seasonally flooded/saturated needleleaf evergreen shrub-scrub	1	1		
PSS4B	Saturated needleleaf evergreen shrub-scrub	3	6		1
PSS4/1B	Saturated needleleaf evergreen/broadleaf deciduous shrub-scrub		2		
PSS4/3B	Saturated needleleaf/broadleaf evergreen shrub-scrub		3		
PFO4B	Saturated needleleaf evergreen forest	6	5		
U	Upland	150	240	44	129
	Total	276	619	85	295

<u>Notes:</u>

1 Shaded rows are sampled wetland classes that have not yet been mapped.
2 Following Cowardin et al. (1979).
3 Following Dahl et al. (2009).
4 Based on additional data review, the 2012 map classes were revised from those previously reported in ABR (2013).

Table 5.3-1. Functional Capacity Index (FCI) Values, Following Magee (1998), for Wetland-determination Plots on Two Transects (T139 and T182) in the Wetland Mapping Study Area, Susitna-Hydroelectric Project Area, 2013.

Field Plots Grouped into Preliminary Wetland Functional Classes	HGM Class	NWI Type[1]	Modification of Groundwater Discharge	Modification of Groundwater Recharge [2]	Storm and Flood Water Storage	Modification of Stream Flow	Modification of Water Quality	Export of Detritus	Abundance & Diversity of Vegetation	Abundance & Diversity of Fauna
Permanently Flooded Ponds										
SW13_T139_07	Slope	PUBH	0.53	N/A	0.33	0.22	1	0.53	0.47	0.57
SW13_T182_01	Slope	PUBH	0.33	N/A	0.38	0.22	0.67	0.53	0.47	0.53
Saturated Deciduous Shrub Scrub										
SW13_T139_13	Slope	PSS1B	0.47	N/A	1[3]	0	0.93	0	0.6	0.67
SW13_T182_03	Slope	PSS1B	0.33	N/A	1[3]	0	0.8	0	0.73	0.7
SW13_T182_05	Slope	PSS1/4B	0.33	N/A	1[3]	0	0.8	0	0.73	0.7
SW13_T182_06	Slope	PSS1B	0.47	N/A	1[3]	0	0.93	0	0.73	0.7
Saturated Evergreen Forest										
SW13_T139_12	Slope	PFO4B	0.47	N/A	1[3]	0	1	0	0.47	0.63
Saturated Evergreen Shrub Scrub										
SW13_T139_03	Slope	PSS4/3B	0.33	N/A	1[3]	0	1	0	0.73	0.57
SW13_T139_11	Slope	PSS4/3B	0.67	N/A	0.62	0.67	0.87	0.8	0.73	0.67
Seasonally Flooded Deciduous Shrub Scrub										
SW13_T139_06	Riverine	PSS1C	0.87	0.5	0.46	0.67	1	0.67	0.6	0.73
Seasonally Flooded/Saturated Deciduous Shrub Scrub										
SW13_T139_09	Slope	PSS1E	0.73	N/A	0.48	0.67	0.8	0.67	0.73	0.67
Seasonally Flooded/Saturated Emergent Meadow										
SW13_T139_01	Slope	PEM1E	0.53	N/A	0.38	0.44	0.8	0.6	0.6	0.6
SW13_T139_14	Slope	PEM1E	0.67	N/A	0.43	0.67	0.8	0.53	0.47	0.7
Seasonally Flooded/Saturated Emergent/Shrub Scrub										
SW13_T139_05	Slope	PEM1E	0.53	N/A	0.38	0.44	0.8	0.6	0.6	0.63
SW13_T182_02	Slope	PEM1/SS1E	0.47	N/A	0.48	0.44	0.8	0.4	0.47	0.67
Semi-Permanently Flooded Emergent Meadow										
SW13_T139_04	Slope	PEM1F	0.53	N/A	0.38	0.44	0.8	0.6	0.6	0.63

Notes:

1 Following Cowardin et al. (1979) and Dahl et al. (2009).

2 Groundwater recharge function not assessed for HGM slope wetlands.

3 Potential modifications to model pending, to better reflect variable wetland functional capacity (see text).

10. FIGURES

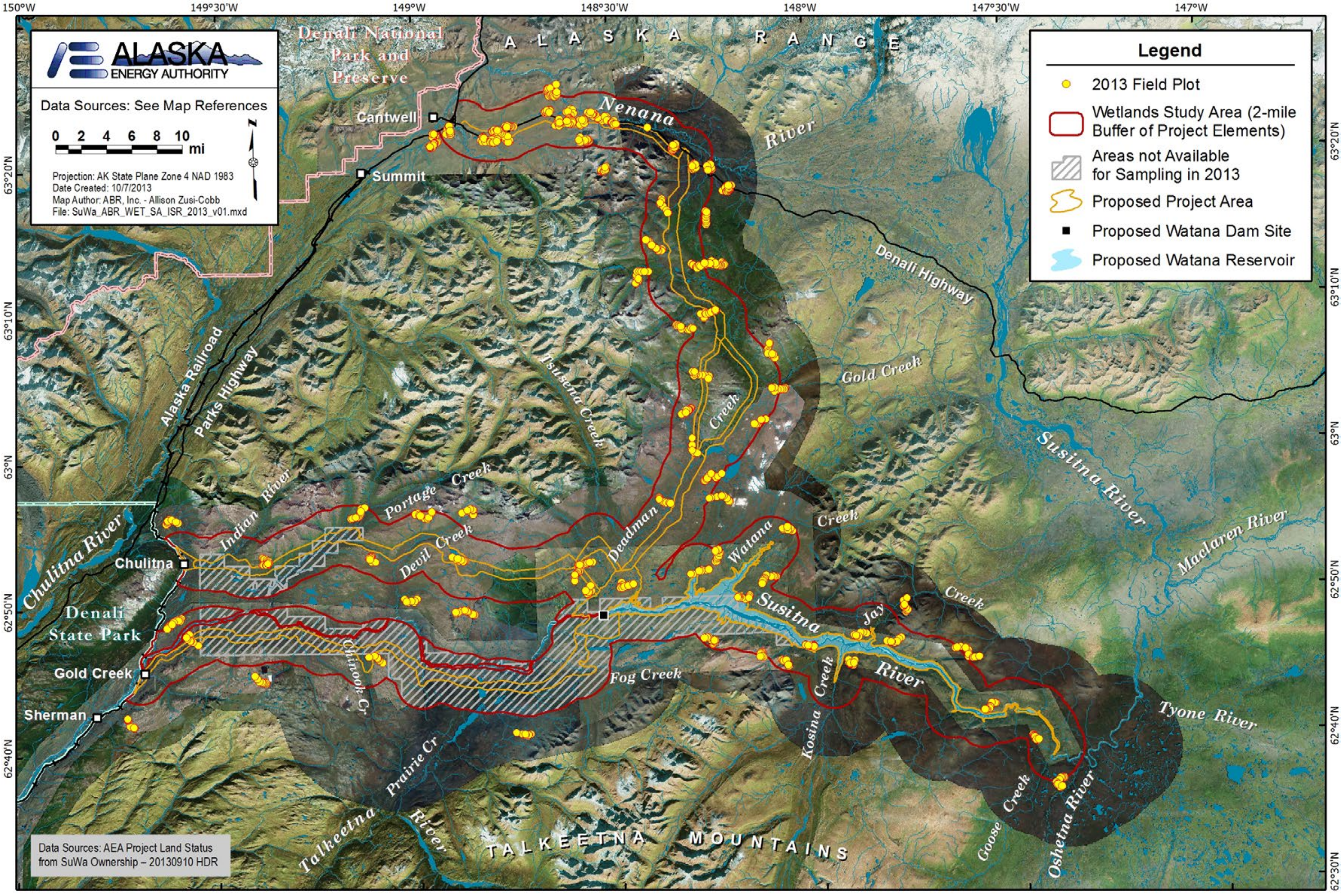


Figure 3-1. Study Area and Ground-reference Plots Sampled in 2013 for the Wetland Mapping Study, Susitna-Watana Hydroelectric Study Area.

Figure 6.1-1. Preliminary Map of Riverine Waters and Riparian Palustrine Wetlands in the Denali Corridor, Susitna-Watana Hydroelectric Project, 2013.

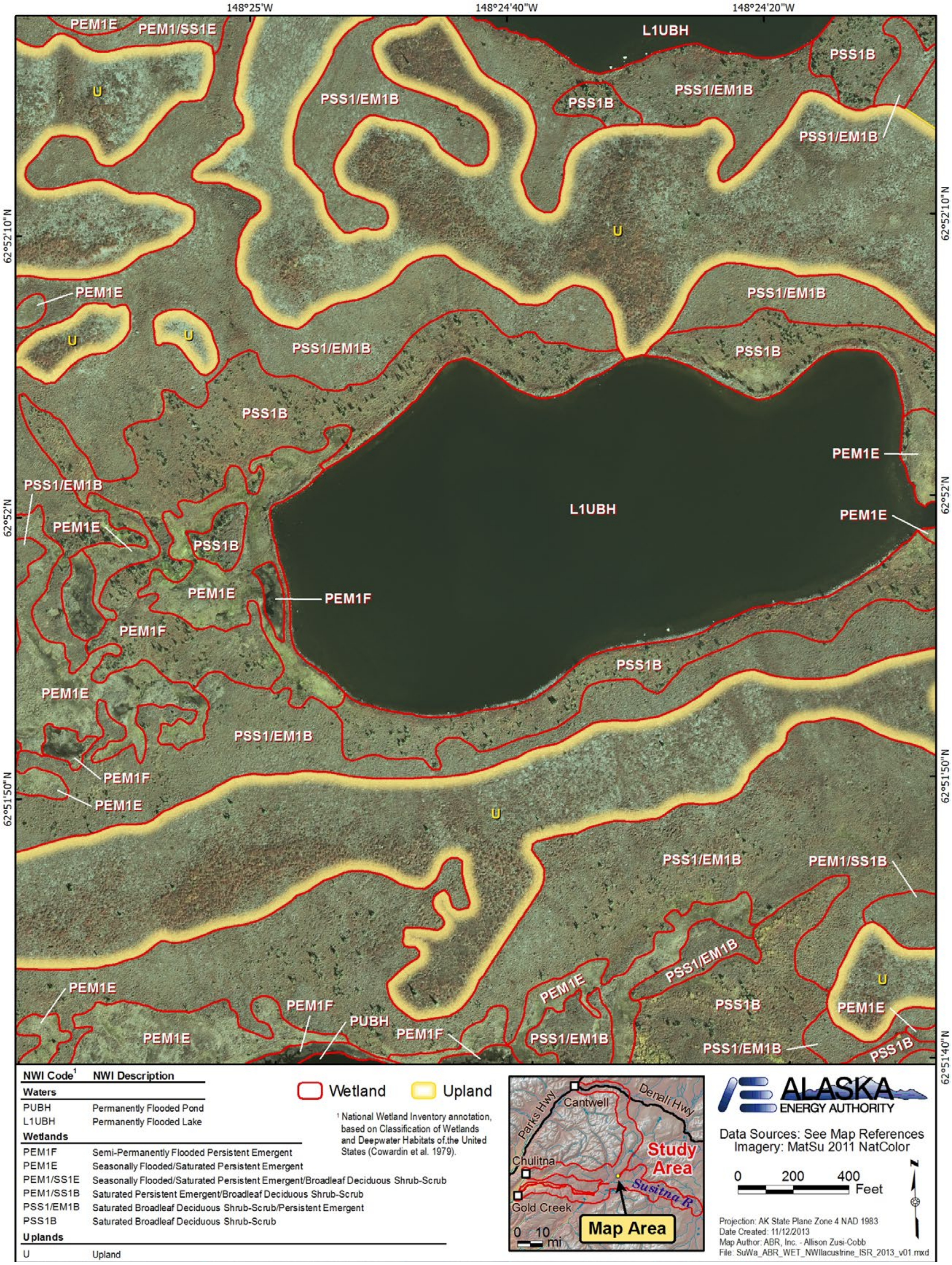


Figure 6.1-2. Preliminary Map of Lacustrine Waters and Associated Palustrine Waters and Wetlands in an Area West of the Proposed Project Dam Site, Susitna-Watana Hydroelectric Project, 2013.

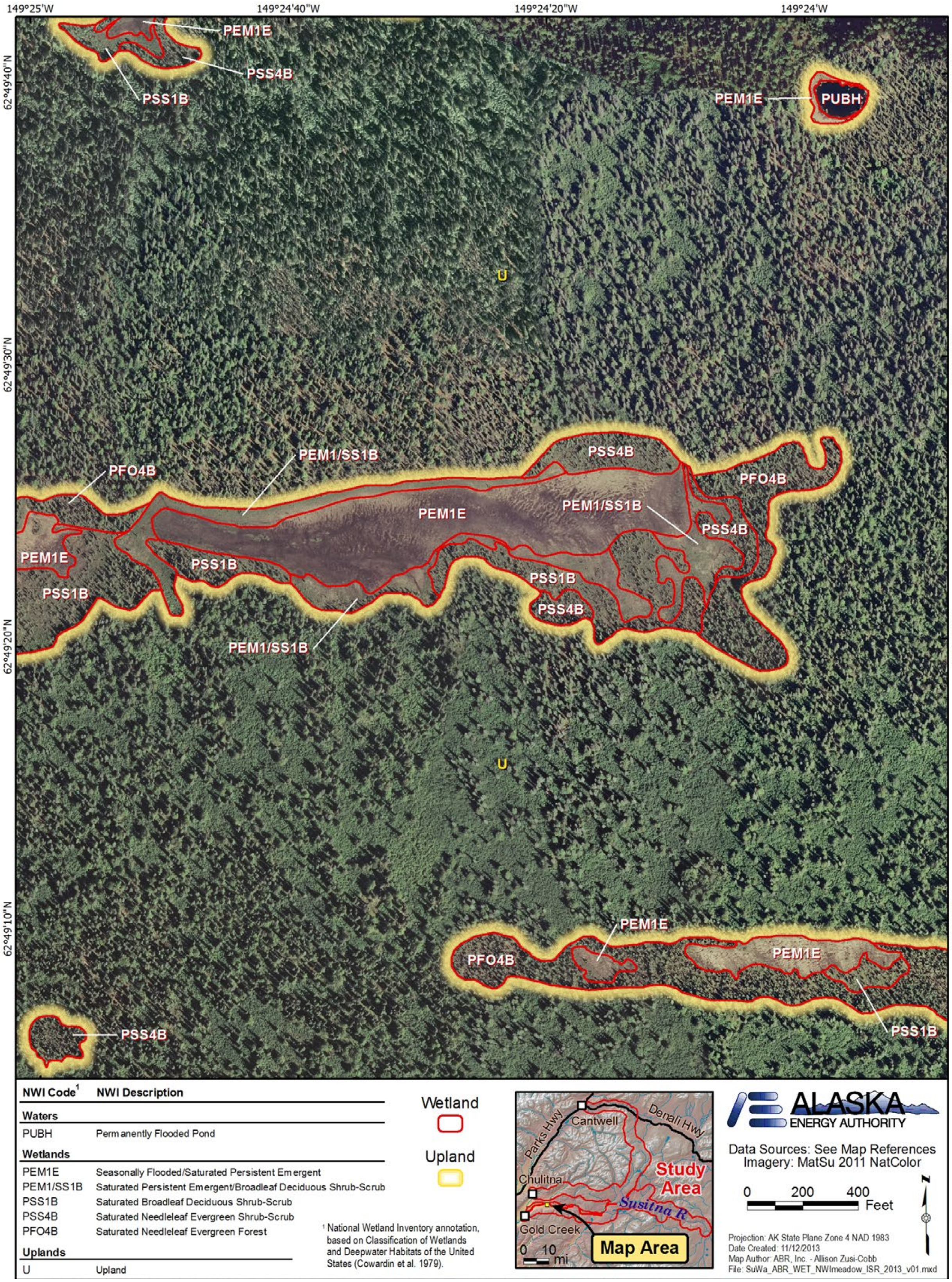


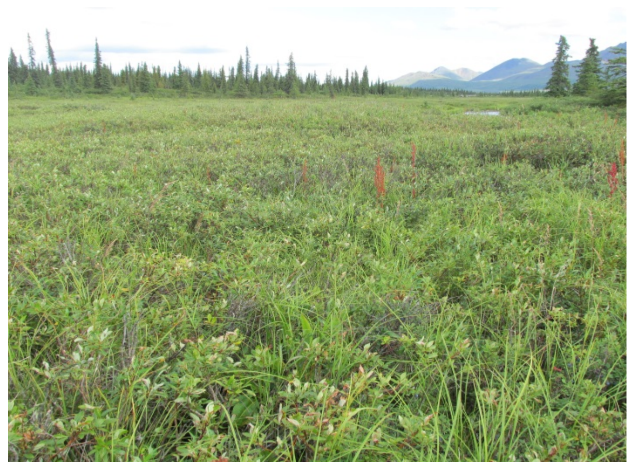
Figure 6.1-1. Preliminary Map of HGM Slope (Fen) Wetlands in the Gold Creek Corridor, Susitna-Watana Hydroelectric Project, 2013.

PART A - APPENDIX A: PHOTOGRAPHS OF REPRESENTATIVE WETLAND TYPES SAMPLED IN THE VEGETATION AND WILDLIFE HABITAT MAPPING STUDY AREA, SUSITNA-WATANA HYDROELECTRIC PROJECT, 2013.

Permanently Flooded Lake (L1UBH)

Semi-Permanently Flooded Persistent Emergent (PEM1Fb) Beaver Modified


Seasonally Flooded/Saturated Persistent Emergent (PEM1E)


Seasonally Flooded/Saturated Broadleaf Deciduous Shrub Scrub (PSS1E)

Saturated Broadleaf Deciduous Shrub-Scrub (PSS1B)

Saturated Broadleaf Deciduous Shrub-Scrub (PSS1B)