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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Wetland Mapping Study
in the Upper and Middle Susitna Basin

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

ABR, Inc.–Environmental Research & Services

February 2013

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LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
ADNR	Alaska Department of Natural Resources
AEA	Alaska Energy Authority
APA	Alaska Power Authority
ATV	all-terrain vehicle
FERC	Federal Energy Regulatory Commission
ºF	degrees Farhenheit
ft	feet, foot
GIS	Geographic Information System
GPS	global positioning system
HGM	hydrogeomorphic
ILP	Integrated Licensing Process
km	kilometer
LiDAR	Light Detection and Ranging
m	meter(s)
NEPA	National Environmental Policy Act
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
Project	Susitna-Watana Hydroelectric Project
PM&E	protection, mitigation, and enhancement
PSP	Proposed Study Plan
RM	The distance of a point on a river measured in miles from the river's mouth along the low-water channel, referencing those of the 1980s APA Project.
RSP	Revised Study Plan
TNW	Traditionally Navigable Water
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

SUMMARY

A wetland mapping and functional assessment study is being conducted for the Susitna-Watana Hydroelectric Project to provide baseline information on existing wetlands and their functions in the Project area. The information on existing wetlands and their functions derived from this study will be necessary for assessing potential Project impacts to wetland resources and supporting wetland permitting under Section 404 of the Clean Water Act. The Wetland Mapping Study is designed as a multi-year study, with work to be conducted in 2012 through 2014. The collection of field ground-reference data and the classification and mapping of wetlands in the study area (see Figure 1) were initiated in 2012.

Thirty-six sampling transects were completed during the 2012 field season. Standard wetland field determinations, as defined by the U.S. Army Corps of Engineers (USACE; 2007 Regional Supplement criteria) were completed at 276 field plots, and field verifications (a rapid assessment technique to confirm previously documented conditions) were performed at 85 field plots along the transects. Additional data collected included physiography, geomorphic unit, macrotopography, and microtopography; selected wetland function parameters to support the wetland functional assessment; and observations of wildlife use or human activity. Field data for the Wetland Mapping Study were collected simultaneously with the collection of data for the Vegetation and Wildlife Habitat Mapping Study. Field data were used in conjunction with high-resolution imagery to classify and map wetlands and waters within the study area according to the methodology defined in the Revised Study Plan (RSP; see Section 11.7 in RSP; AEA 2012b).

As the mapping proceeds in 2013, wetland types will be classified based on a number of landscape, geomorphic, hydrological, and biological variables, and will incorporate elements of two wetland classification systems: National Wetlands Inventory (NWI) and hydrogeomorphic (HGM). Information on vegetation types (Level IV classes of the *Alaska Vegetation Classification*) also will be used in classifying wetlands. This integrated classification approach is similar to a regional classification system developed for lowlands in the Cook Inlet Basin, and will allow wetland classes developed for the Project to be cross-referenced with wetlands identified in the Cook Inlet Basin. This approach was agreed upon during meetings with resource management agencies regarding the wetland mapping study in spring 2012 (see Section 9.7 in the Proposed Study Plan [PSP]; AEA 2012a).

As noted above, the wetlands data collected in 2012 represent only the first year of work in a multi-year mapping study of wetlands for the Project. The data from 2012 will be combined with those collected in 2013 and 2014 to prepare a complete wetlands map for the Project (see Section 11.7 in RSP). If warranted by the results of the 2012 work, the specific field and office methods used to identify, delineate, and map wetlands within the study area may be refined (based on consultation with AEA and other licensing participants).

The wetlands identified in the study area to-date typify this region of Alaska. Because of the large size of the Project and study area, a number of different wetland and vegetation types have been encountered, ranging from those comparable to the coastal Cook Inlet area (in the west near Gold Creek) to those more typical of interior areas of Alaska (in the east near the Oshetna River and the north near Cantwell).

1. INTRODUCTION

This report provides the results of the 2012 Wetland Mapping Study, based on work outlined in the 2012 Wetland Mapping Study in the Upper and Middle Susitna Basin Study plan (AEA 2012c).

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300-mile-long river in Southcentral Alaska. The Project's dam site would be located at river mile (RM) 184.

The Wetland Mapping Study is a multi-year study initiated in 2012. Two primary tasks were started during 2012: (1) field ground-reference surveys were conducted to collect current data on wetland occurrence and wetland functions, and (2) preliminary mapping of wetlands in the study area (see Study Area below). This study provided data to inform the 2013–2014 licensing study program, Exhibit E of the License Application, and FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

2. STUDY OBJECTIVES

The overall goals of the Wetland Mapping Study are to prepare a baseline map of existing wetland habitats in the Upper and Middle Susitna basin (upstream of Gold Creek) that could be directly affected by Project development, and to determine the functions that each mapped wetland type performs. This mapping information will be used in AEA's License Application to assess impacts to wetland resources from the proposed Project, and to develop protection, mitigation, and enhancement (PM&E) measures, as appropriate. Additionally, the Wetland Mapping Study will provide the baseline information necessary for preparing a wetland permit application for the Project under Section 404 of the Clean Water Act.

The specific objectives of the Wetland Mapping Study are to identify, delineate, and map wetlands in the Upper and Middle Susitna basin to reflect current conditions as indicated on recent aerial imagery for the study area, and to determine and describe the functional values for each of the mapped wetland types. The multi-year study was initiated in 2012 and will be continued in 2013 and 2014. Results from the 2012 work will be used to fine-tune the field investigations and the mapping of current wetland types in the study area.

3. STUDY AREA

The study area for the Wetland Mapping Study consists of a 2-mile buffer surrounding those areas that would be directly altered or disturbed by development of the Project (Figure 1), including three possible alternatives for road and transmission lines (Chulitna, Gold Creek, and Denali), the proposed reservoir inundation area, dam site, and supporting infrastructure surrounding the dam site. The Chulitna Corridor would include transmission lines and a road running north of the Susitna River toward the west to connect to the Alaska Intertie and the

Alaska Railroad near the Chulitna station. Another east–west corridor configuration, the Gold Creek Corridor, would follow a route south of the Susitna River running west to Gold Creek station. A third corridor, the Denali Corridor, runs north and would connect the dam site to the Denali Highway by road over a distance of about 44 miles. If transmission lines are run along the Denali Corridor, they would also need to run west along the existing Denali Highway to connect to the Alaska Intertie near the community of Cantwell. In areas paralleling the Susitna River between the dam site and Gold Creek, wetlands within the 2-mile study area buffer will be mapped up to the boundary of the Riparian Vegetation Study area. Wetlands in riparian areas downstream of the proposed dam will be mapped in the Riparian Vegetation Study. Mapping methods in the Wetland Mapping Study and Riparian Vegetation Study (see RSP Section 11.6 in AEA 2012b) are compatible, and the final mapping will result in a seamless wetlands map for the Project area, both above the proposed dam site and in riparian areas downstream of the dam site.

High-resolution aerial imagery is required for wetland mapping, because wetlands can be differentiated both from uplands and from other wetland types by subtle differences in color, texture, and plant canopy, as well as hydrological indicators such as drainage patterns and surface water connections. Suitable high-resolution imagery (0.3-meter to 1.0-meter [1-foot to 3.3-foot] pixel resolution) is not yet available for the entire study area, but it is anticipated that additional imagery will be acquired during the 2013 field season (the new imagery will include both natural color and infrared formats) (see RSP Section 11.7 in AEA 2012b). Thus, the detailed mapping of wetlands conducted in 2012 is limited currently to those areas with high-resolution imagery, which includes a section surrounding the Upper Susitna River (covers the southwestern part of the reservoir inundation zone and small portions of the Gold Creek corridor), and another section in the vicinity of Cantwell at the northern end of the Denali corridor.

4. METHODS

In general, the wetlands mapping for the Project area will follow protocols developed by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) program (National Wetlands Inventory Center 1995, Dahl et al. 2009). Wetland types will be classified based on a number of landscape, geomorphic, hydrological, and biological variables, and will incorporate elements of two wetland classification systems: NWI (Cowardin et al. 1979) and hydrogeomorphic (HGM) (Brinson 1993). Information on vegetation types (Level IV classes of the *Alaska Vegetation Classification*; Viereck et al. 1992) will also be used in classifying wetlands. This integrated classification approach is similar to a regional classification system developed for lowlands in the Cook Inlet basin (Gracz 2011), and will allow wetland classes developed for the Project to be cross-referenced with wetlands identified in the Cook Inlet basin. This approach was agreed to during meetings with resource management agencies regarding the Wetland Mapping Study in spring 2012 (see RSP Section 9.7 in AEA 2012a).

4.1. Deviations from the 2012 Study Plan

The 2012 study plan for the Wetland Mapping Study (AEA 2012c) indicated that preliminary wetlands mapping would be conducted prior to field surveys in areas where NWI mapping was lacking but high-resolution imagery was available. The objective of the preliminary mapping was to identify a set of characteristic wetland types within the study area to guide field survey plot locations, and to allow field verification of the preliminary mapping. Instead, in 2012, field plots were located within the prominent imagery signatures in each major physiographic type, which often is the first step in a multi-year wetlands mapping project. In 2013 and 2014, preliminary wetland mapping will be available to support the selection of field plots and facilitate the field verification of the wetlands mapping. Thus, the lack of preliminary mapping prior to the 2012 field surveys will not affect the quality or accuracy of the final wetlands map.

Additionally, no efforts were made to relocate the 1980s sampling locations during the 2012 field season as indicated in the 2012 study plan. Given the poor spatial quality of 1980s (pre-global positioning system [GPS]) sampling locations and the logistical constraints associated with the 2012 field activities, the 2012 field efforts were focused on acquiring current wetlands data. Because the primary goal of this study is to develop a wetlands map based on current conditions and because revisiting historic sampling locations will not increase the accuracy of the new map, no future efforts will be made to revisit historic sampling locations (see RSP Section 11.7 in AEA 2012b).

4.2. Field Survey

Field data were collected along transects designed to access the primary physiographic classes (Alpine, Subalpine, Upland, Lowland, Lacustrine, and Riverine) in the study area, while maximizing safety and efficiency. Transect length ranged from approximately 1.5 – 3.0 kilometers (0.93 – 1.86 miles) and 8–12 pre-selected field plot locations were allocated along each transect. Transects were not always straight lines because they were designed specifically to allow the sampling of different land cover types within the physiographic classes noted above. Transect length and complexity were designed to allow a field team to complete data collection along one transect per day. Field plots were pre-selected to facilitate the collection of ground-reference data from as many wetland types as possible, identified by differences in imagery signature color and texture, plant canopy, and surface relief, along with hydrological indicators such as drainage patterns and surface water connections. Data were collected at the pre-selected field plot locations and at additional plot locations established in the field (where new, transitional, or under-sampled land cover types were encountered). Transects were located (Figure 1) in those portions of the study area for which there currently is high-resolution aerial imagery (see Study Area above). Six transects were located outside the Wetland Mapping Study area, but within the Vegetation and Wildlife Habitat Mapping Study area (data for the two studies were collected concurrently at each field plot to maximize the efficiency of the field effort). Although six transects were located outside the Wetland Mapping Study area, those transects include imagery signatures of wetland types that occur within the Wetland Mapping Study area, so the field data collected can still be used to assist in the wetlands mapping effort.

Routine wetland determinations were performed following the U.S. Army Corps of Engineers (USACE) three-parameter approach (Environmental Laboratory 1987; USACE 2007) at each field plot location. 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. A *Trimble® Nomad™* series mobile Geographic Information System (GIS) unit was used to record the wetlands data (using the *WetForm* database) and the GPS coordinates of each field plot, and to provide access to the aerial imagery in the field. *WetForm* is a proprietary relational database used to record standard wetland determination data in the field, and facilitates the preparation of an electronic version of the USACE-required dataform for each wetland determination plot (USACE 2007).

At each field plot, all wetland-determination data were recorded within a 10-meter (33-foot) radius of homogenous vegetation, as specified by the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), although the size and dimensions of the field plots were modified where necessary to accurately characterize the plant community (e.g., narrow plots were used in some riverine habitats). The absolute cover of each vascular plant species within the plot was visually estimated and 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 per the *2012 National Wetland Plant List: Alaska* (Lichvar and Kartesz 2012).

Hydric soils form under conditions of saturation, flooding, or ponding, which occur long enough during the growing season to develop anaerobic conditions in the upper 12 inches of the soil. Hydric soils often have thick organic deposits (histosols, histels, or histic epipedons; Figure 2) or have a low-chroma mineral soil matrix color with redoximorphic features, indicating a reducing environment. To assess the presence or absence of hydric soils, 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, and at a minimum frequency of 5 out of 10 years. To assess the presence or absence of wetland hydrology, surface and subsurface, direct and indirect indicators were recorded at each site, including surface water, saturated soils, presence of and depth to the water table (Figure 3), drift or sediment deposits, drainage patterns, and geomorphic position, as summarized in the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual* (USACE 2007).

Documentary photos of soils and vegetation were taken at each wetland determination plot. Additional data collected at each plot included physiography, geomorphic unit, macrotopography and microtopography; selected wetland function parameters to support the wetland functional assessment; observations of wildlife use (e.g., trails, browse, scat) or human use (e.g., hunting activities, all-terrain vehicle [ATV] trails); and the Level IV vegetation class of the *Alaska Vegetation Classification* (Viereck et al. 1992; hereafter refered to as the Level IV vegetation class).

In some cases, verification plots (a rapid assessment technique to provide replication for previously documented conditions) were also sampled to collect additional data to support the wetland mapping efforts. At verification plots, data on dominant vascular plant species, NWI wetland classes, and Level IV vegetation classes, in addition to site photographs and GPS coordinates, were recorded. Verification plots were typically conducted in areas where the wetland or upland status had been documented in the data from formal wetland determination plots. Data from the verification plots will be used to improve map accuracy by increasing the number of documented wetland data elements tagged to particular aerial imagery signatures.

4.3. Wetland Classification and Mapping

Two high-resolution (0.3-meter to 1.0-meter [1-foot to 3.3-foot] pixel resolution) imagery products suitable for mapping are currently available for the study area. The Matanuska-Susitna Borough LiDAR (hereafter referred to as Mat-Su LiDAR) project imagery is a near-infrared, color orthomosaic at 0.3-meter (1-foot) pixel resolution based on aerial photography obtained between July and October 2010; it covers portions of the study area from Gold Creek through the southwestern section of the inundation zone surrounding the Susitna River. The Denali Census (hereafter referred to as Denali) orthorectified aerial imagery acquired in May through September 2006 at a 1-meter (3.3-foot) pixel resolution is a true-color image product publicly available, and is suitable for mapping the northern portions of the study area near Cantwell.

Where high-resolution imagery was available, the delineation of wetland boundaries was initiated in 2012 using on-screen digitizing and *ArcGIS* software, which is the predominant approach employed by the USFWS NWI program (Dahl et al. 2009). The minimum mapping polygon size for wetlands, waters, and most upland areas is 0.5 acres (see RSP Section 11.7 in AEA 2012b), although smaller polygons (0.1 acre) are being delineated for water bodies and other wetlands of ecological importance, such as marsh habitats with standing water and emergent vegetation. Wetland and upland boundaries are being delineated based on imagery signature color and texture, plant canopy, and surface relief, along with hydrological indicators such as drainage patterns and surface water connections.

Wetlands and waters are being categorized first following Cowardin et al. (1979) using annotation developed by the NWI program, which describes the dominant vegetation and hydrological regime. The Cowardin classification is a comprehensive system for the classification of wetlands and deepwater habitats developed for the USFWS NWI program in which wetlands are classified based on vegetation structure and hydrology, and on other characteristics that are generally identifiable from aerial imagery. In addition to assigning an NWI class, each wetland polygon was assigned a physiography class, a Level IV vegetation class, and an HGM class. In Level IV vegetation classes, dominant plant species and vegetation structure are used to categorize common vegetation types in Alaska. In the HGM system, wetlands are classified into seven different categories based on geomorphic position and hydrologic characteristics, as defined by Brinson (1993) and modified by Smith et al. (1995) for functional assessments. Functions and ecological services provided by wetlands vary by geomorphic position and hydrology, and the HGM classification helps identify differences in both wetland 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, which a slope wetland lacks. Thus, while some wetlands may share a similar NWI class, differences in HGM classes can be used to distinguish them by their functional characteristics.

The four attributes (NWI, physiography, Level IV vegetation, and HGM class) assigned to each map polygon will be combined to produce a set of unique wetland types, which will then be aggregated into broader, ecologically related categories for functional assessment purposes. Additional features, such as the presence or absence of permafrost, will be included in this aggregation to allow greater distinctions between wetlands in terms of their functional capacity.

4.4 Wetland Functional Assessment

Based on discussions with resource management agencies while preparing the Wetland Mapping Study Plan (see RSP Section 11.7 in AEA 2012b), wetland functions in the study area will be assessed using HGM principles (Smith et al. 1995). Similar to formal HGM methodologies, HGM classes as defined by Brinson (1993) (e.g., depressional, slope, lacustrine fringe) will be used. The functional capacity of each wetland type will be assessed following Magee's (1998) rapid-assessment procedure, which involves incorporating field data into HGM-specific models. The Magee (1998) rapid-assessment procedure provides a means for collecting field data relevant to HGM assessments within a time frame compatible with the schedule for the Project.

After reviewing wetland functional assessments conducted elsewhere in Alaska (Figure 2) and consulting with resource management agencies, the following set of 10 wetland functions were selected for evaluation:

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

These functions will be evaluated using a combination of field data from this and other Project studies (AEA 2012b), as well as GIS analysis of the spatial occurrence of the wetland types identified in the study area. As part of the 2012 field survey effort, data reflecting wetland functional capacity were collected at each wetland determination plot for hydrologic (e.g., pH, water regime, presence of seeps or springs), soil (e.g., organic or mineral), and vegetation (e.g., dominant wetland type, vegetation interspersion) variables following Magee (1998). These data (combined with data collected in 2013 and 2014) will be run through HGM-class-specific models (Magee 1998) to determine a base level of functional capacity for each mapped wetland type for 7 of the 10 functions (all except fish and wildlife habitat, consumptive uses, and uniqueness). Magee (1998) does not include models for consumptive uses or uniqueness. If possible, consumptive uses will be evaluated using spatially explicit, Project-specific recreational- and subsistence-use data (see Sections 12.5 and 14, AEA 2012b) to indicate which general regions in the study area are used currently (actual use for recreation and subsistence activities). Wetland uniqueness will be evaluated after wetland mapping is complete and will be based on the frequency of occurrence, relative to other wetland types and the extent to which the "rare" wetland types are also regionally scarce. The fish and wildlife and habitat function will be assessed by incorporating Project-specific fish and wildlife occurrence data to derive spatially explicit functional capacity indices indicating which specific wetlands in the study area provide those habitat functions and to what degree. The presence or absence of permafrost also will be included in the classification of wetland types, thus allowing distinctions between the functional capacities of permafrost and non-permafrost wetlands.

5. RESULTS

During summer 2012, two teams of two scientists collected wetlands, vegetation, and wildlife habitat field data during two survey periods: June 19–27 and July 30–August 8. Survey dates were selected to be well within the median dates of the onset of vegetation green-up in spring and vegetation senescence in fall, as specified in the USACE manual (2007). Two weather stations closest to the Project area indicated that temperatures during the 2012 field season were near average (Table 1). Precipitation in June was more than double the 30-year mean at the Chulitna River station and nearly double that at the Cantwell 4E station. Precipitation for the remaining months of the growing season, however, was well below the 30-year mean.

5.1. Field Survey

Thirty-six transects were sampled during the 2012 field season. Standard USACE field wetland determinations were completed at 276 sites and verification plots at 85 sites along the 36 transects. Of the 276 standard wetland determinations, 152 were uplands (non-wetland) and 124 were wetlands or waters. The 124 wetland or water determination plots were categorized into 24 NWI (Table 2) and 4 HGM (Table 3) wetland classes. The 85 verification plots provided replicate sampling for the imagery signatures of 44 upland sites and 41 wetlands or water bodies.

5.1.1. Waters

The Susitna River is classified as a Traditionally Navigable Water (TNW) from Cook Inlet to the confluence with Portage Creek. The Nenana River, located in the northern portion of the study area, is classified as potentially navigable (ADNR 2012). Both rivers are upper perennial (R3) riverine systems, characterized by year-round, high-gradient, and high-velocity flow. Neither river is tidally influenced within the study area. As expected for high-velocity systems, there is little floodplain development and substrates are generally coarse (cobbles to boulders). Gravel bars and islands are frequently flooded wetland communities, dominated by vegetation that can grow in both wetland or upland settings. These communities have surface water (flooding) for brief periods during the growing season, but the groundwater table is usually well below the surface.

Additional Waters of the U.S. within the study area include named and unnamed tributaries of the Susitna and Nenana rivers. Upper perennial waters (R3UBH) were documented with eight verification plots and one wetland determination plot. These waters were typically 3–6 meters (10–20 feet) wide at bankfull, with gravel to boulder substrates, and cover provided by overhanging vegetation, undercut banks, and large woody debris (Figure 4).

Intermittent waters (R4SBC) were documented with four verification plots. These small intermittent tributaries were typically observed flowing from seeps or springs on hillsides, with surface flow present for short stretches along less steep terrain.

Freshwater ponds (PUBH) were documented with one verification plot. The documented pond was small (<1 acre), and was unvegetated with fine substrates.

5.1.2. Wetlands

The most commonly sampled NWI wetland class was palustrine seasonally flooded/saturated persistent emergent marsh (PEM1E; *n*=29 wetland determination plots; Figure 5). PEM1E communities were frequently dominated by *Carex aquatilis*, *Eriophorum russeolum*, *Trichophorum cespitosum*, or *T. alpinum*. Surface water was observed at all PEM1E communities, and many had indicators reflecting 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; floating *Sphagnum* mats adjacent to kettle ponds; or vegetated mid-channel interfluves in braided stream systems.

The next most commonly sampled NWI class was palustrine saturated broadleaf deciduous scrub-shrub (PSS1B; *n*=23 wetland determination plots; Figure 6). PSS1B communities were frequently dominated by *Salix pulchra*, *S. barclayi*, *S. commutata*, *Alnus crispa*, *Betula nana*, and *Vaccinium uliginosum*. Saturated soils were observed at most PSS1B wetlands, with a few showing oxidized rhizospheres around living roots or the presence of reduced iron. PSS1B sites included toeslope wetlands, discharge slopes, and riparian corridors. Seasonally flooded/saturated broadleaf deciduous scrub-shrub wetlands (PSS1E; *n*=8) were also found throughout the study area, and were distinguished from PSS1B wetlands by the presence of surface water or indications of previous flooding. These seasonally flooded/saturated wetland types were dominated by a variety of *Salix* species and occurred on interfluves in low-lying braided stream drainages and in toeslope areas.

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

Over half of the field plots sampled within the study area were uplands (non-wetlands). Dwarf-shrub communities were the predominant alpine non-wetland community sampled. Field plots in subalpine non-wetland communities were nearly evenly divided among dwarf shrub, low birch–ericaceous, and tall alder and/or willow communities. Field plots in riverine, upland, and lowland physiographic non-wetlands were a mix of *Picea glauca* woodlands, open canopy *Picea glauca*–*Betula neoalaskana* forests, low birch–ericaceous shrub, and tall alder and/or tall willow communities.

5.1.3. HGM Classes

Four HGM wetland classes (slope, depressional, riverine, and lacustrine fringe) were sampled during 2012 (Table 3). Slope wetlands were the most commonly sampled HGM class (*n*=72 wetland determination plots), and preliminary mapping indicates that it is the most common HGM class in the study area. Many wetlands in the study area occur on gently sloping terrain or toeslopes where groundwater discharges. HGM slope wetlands comprised a variety of NWI classes, from palustrine permanently flooded persistent emergent marsh (PEM1H) to palustrine saturated needleleaf forest wetlands (PFO4B).

Wetlands that fell under the Riverine HGM class (*n*=18 wetland determination plots) were sampled within the Susitna River floodplain, as well as smaller tributaries to the Susitna and

Nenana rivers, and included upper perennial rivers (R3UBH and R3USC), and both emergent (PEM) and scrub-shrub (PSS) palustrine NWI codes.

Field plots in lacustrine-fringe wetlands were associated with lakes and ponds, and were typically seasonally to permanently flooded persistent emergent palustrine NWI classes. Depressional wetlands include a variety of NWI classes, from permanently flooded persistent emergent marsh (PEM1H) to palustrine saturated broadleaf scrub-shrub wetlands (PSS1B).

5.2. Wetland Classification and Mapping

After the 2012 field season, all field ground-reference data were used in conjunction with the Mat-Su LiDAR imagery to initiate the mapping of wetlands and waters within the study area. The mapping of wetlands and waters (and vegetation and wildlife habitats) will continue through the winter and spring of 2013 using the imagery described in RSP sections 11.5 and 11.7 in AEA 2012b. Additional high-resolution imagery acquired in 2013 will be used to continue the mapping process in fall and early winter 2013. The preliminary wetland types classified and mapped in the study area will be presented for review in the Initial Study Report, to be filed with FERC February 2014.

6. DISCUSSION

In 2012, 24 NWI wetland classes were documented in the study area, with PSS1B and PEM1E being the most commonly sampled. Through the continued wetland mapping efforts in 2013, the full range of wetland types within the study area will be determined, and pre-selected field plot locations will be allocated for the 2013–2014 field programs to ensure that any unsampled or undersampled NWI classes are documented with wetland determination plots.

Upper perennial and intermittent rivers and streams (R3UBH and R4SBC, respectively) were documented with field data in 2012. Initial mapping efforts and review of aerial imagery indicate that these are the most common riverine systems within the study area. However, review of aerial imagery also indicates that lower perennial waters (R2UBH) are present within the study area, meandering through low-lying scrub wetlands. R2UBH systems comprise low-gradient, low-velocity waters with fine substrates (typically mud or sand). While no field plots were sampled to document R2UBH waters in 2012, pre-selected plots will be allocated for the 2013–2014 field programs to adequately characterize these systems in the study area.

In the Cowardin classification, lacustrine (lake) systems are distinguished from palustrine (pond) systems based on size and depth, with lacustrine systems being >20 acres in size and/or >2 meters (6.6 feet) deep in the deepest part of the basin at low water. A review of the aerial imagery indicates that the majority of water bodies within the study area are freshwater ponds (PUBH), with a few scattered large lakes (L1UBH), none of which were designated as navigable (ADNR 2012). Pre-selected field plots will be established for the 2013–2014 field programs to adequately characterize ponds and lakes within the study area.

Four HGM wetland classes (slope, depressional, riverine, and lacustrine fringe) were sampled in 2012. While there were many level to nearly level wetlands sampled during the 2012 field program, no wetlands were assigned to the flat HGM class. The flat HGM class is reserved for precipitation-driven wetlands with primarily vertical hydrodynamics. Such wetlands are commonly located in large relict lake bottoms or old floodplain terraces; the extensive peatlands on the western Kenai Peninsula in Alaska are an example of HGM flat wetlands. The level to nearly level wetlands sampled in the study area in 2012 were classified as HGM slope wetlands, located in toeslope areas where hydrology is dominated by groundwater discharge. Typical vegetation in these areas included numerous fen indicators or plant species such as *Eriophorum angustifolium*, *Tricophorum cespitosum*, and *Betula nana* that require more mineral-rich conditions, which are indicative of a strong groundwater component to the wetland hydrology.

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8. TABLES

Table 1. Mean monthly air temperature and cumulative precipitation for two weather stations nearest to the wetland mapping study area, Susitna-Watana Hydroelectric Project, Alaska, 2012.

		Mean Air Temperature (° F)				Precipitation (inches)		
Station [1]	**Month**	**30-yr Mean**	**2012**	**Anomaly**		**30-yr Mean**	**2012**	**Anomaly**
Cantwell 4E	April	27.2	30.7	3.5		0.71	1.14	0.43
	May	41.4	40.3	–1.1		0.77	0.59	–0.18
	June	51.3	51.3	0.0		1.87	3.22	1.35
	July	55.2	52.2	–3.0		2.53	1.29	–1.24
	August	50.6	50.4	–0.2		3.24	1.55	–1.69
Chulitna River	April	30.6	36.0	5.4		1.38	0.53	–0.85
	May	42.8	41.7	–1.1		1.03	0.59	–0.44
	June	52.8	52.0	–0.8		1.65	3.74	2.09
	July	55.5	52.3	–3.2		3.92	2.30	–1.62
	August	51.8	51.3	–0.5		5.83	4.71	–1.12

Notes:
1 Source: National Climatic Data Center (NCDC) U.S. Department of Commerce. 2012. Climate Data Online http://www.ncdc.noaa.gov/cdo-web/

Table 2. Wetland classes following Cowardin et al. (1979) sampled within the wetland mapping study area, Susitna-Watana Hydroelectric Project, Alaska, 2012.

Cowardin Wetland Class	Code	*n*
Palustrine		
Persistent emergent		
Saturated	PEM1B	8
Seasonally flooded/saturated	PEM1E	29
Semipermanently flooded	PEM1F	11
Permanently flooded	PEM1H	4
Nonpersistent emergent		
Seasonally flooded/saturated	PEM2E	1
Persistent emergent/broadleaf deciduous scrub-shrub		
Saturated	PEM1/SS1B	5
Seasonally flooded/saturated	PEM1/SS1E	4
Permanently flooded	PEM1/SS1H	1
Broadleaf deciduous/broadleaf evergreen scrub-shrub		
Saturated	PSS1/3B	1
Broadleaf deciduous scrub-shrub/persistent emergent		
Saturated	PSS1/EM1B	3
Seasonally flooded	PSS1/EM1C	1
Seasonally flooded/saturated	PSS1/EM1E	5
Broadleaf evergreen scrub-shrub/persistent emergent		
Saturated	PSS3/EM1B	1
Broadleaf deciduous scrub-shrub		
Saturated	PSS1B	23
Seasonally flooded	PSS1C	2
Seasonally flooded/saturated	PSS1E	8
Broadleaf evergreen/broadleaf deciduous scrub-shrub		
Saturated	PSS3/1B	1
Broadleaf evergreen/needleleaf evergreen scrub-shrub		
Saturated	PSS3/4B	1
Broadleaf evergreen scrub-shrub		
Saturated	PSS3B	1
Needleleaf evergreen scrub-shrub		
Saturated	PSS4B	3
Seasonally flooded/saturated	PSS4E	1
Needleleaf evergreen forest		
Saturated	PFO4B	6
Riverine		

Cowardin Wetland Class	**Code**	***n***
Upper perennial unconsolidated bottom	R3UBH	1
Upper perennial unconsolidated shore	R3USC	3
Upland (non-wetland)	U	152
Total		276

Table 3. Hydrogeomorphic (HGM) wetland classes sampled within the wetland mapping study area, Susitna-Watana Hydroelectric Project, Alaska, 2012.

HGM Class	Geomorphology	Hydrology	Example
Slope	Steep hillsides to moderate slopes, lacking closed contours	Groundwater discharge. Flow is unidirectional with horizontal hydrodynamics.	Toeslope discharge wetland
Depressional	Topographic depressions, which may have any combination of inlets and outlets.	Groundwater discharge, interflow and overland flow from adjacent uplands. Direction of flow is generally from the surrounding uplands to the center of the depression. Vertical hydrodynamics.	Kettle wetland
Riverine	Flood plains and riparian corridors. Replaced by *Slope* or *Depressional* wetlands where channel morphology disappears.	Overbank flow from a channel. Flow is generally unidirectional, horizontal hydrodynamics.	Relict oxbow wetland
Lacustrine Fringe	Adjacent to a lake.	Water elevation of lake maintains water table in wetland. Flow is bidirectional with horizontal hydrodynamics.	Floating *Sphagnum* mat at lake fringe

9. FIGURES

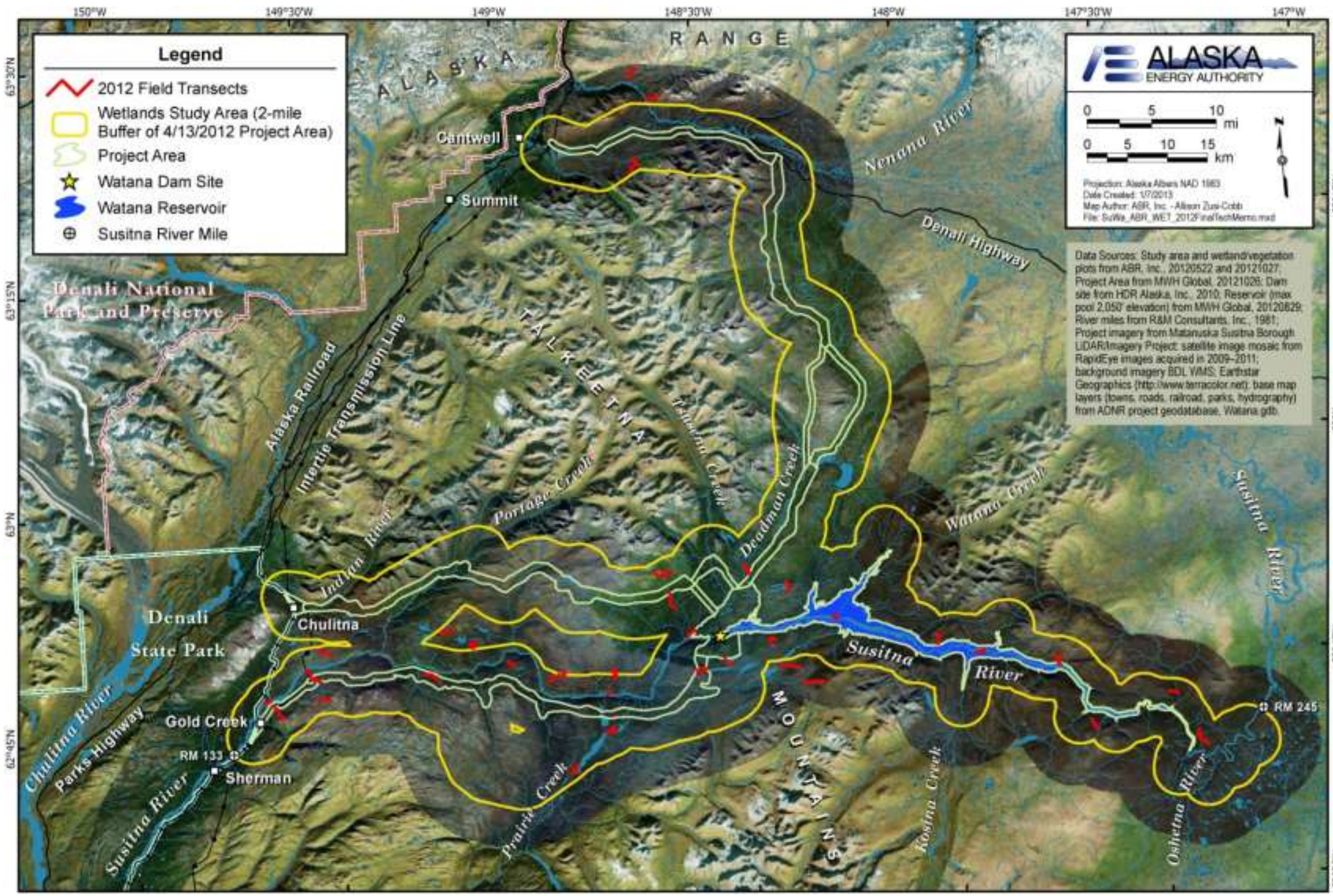

Figure 1. Study area and completed 2012 sampling transects for the Wetland Mapping Study, Susitna-Watana Hydroelectric Project, Alaska. The Project area boundary shown is the version dated October 26, 2012, but the 2-mile buffer for the study area was drawn from the April 13, 2012 version of the Project area boundary.

Wetland Functional Assessment Methods

HGM (Slope/Flat Wetlands)

- Discharge of water to downgradient systems
- Surface and shallow subsurface water storage
- Particulate retention
- Organic carbon export
- Cycling of elements and compounds
- Maintenance of characteristic plant communities
- Maintenance of characteristic habitat structures
- Interspersion and connectivity

Interior Alaska

- Soil Profile Integrity
- Characteristic Soil Thermal Regime
- Surface and Near Surface Water Storage
- Cycling of elements and compounds
- Organic carbon export
- Plant Community
- Faunal Habitat Components
- Interspersion and connectivity

Mat-Su Wetlands Functions and Values

- Contribution to groundwater
- Transmission of groundwater
- Streamflow moderation
- Floodflow alteration
- Sediment/Toxicant/Pathogen retention
- Sediment shoreline stabilization
- Nutrient removal/Retention/Transformation
- Foodchain support
- Anadromous fish habitat
- Habitat and maintenance of biodiversity
- Habitat for species of interest
- Recreation
- Consumptive uses
- Education
- Visual quality/Aesthetics
- Cultural and historical significance
- Uniqueness

Susitna-Watana Functions and Values

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

Figure 2. Selection of wetland functional parameters to be used for the Susitna-Watana Hydroelectric Project in relation to parameters used for other functional assessments in Alaska.

Figure 3. Hydric soil indicator: A1 (Histosol) in the wetland mapping study area, 2012.

Figure 4. Wetland hydrology indicators: A1 (High Water Table) and A2 (Saturation) in the wetland mapping study area, 2012.

Figure 5. Typical R3UBH wetland (upper perennial stream) in the wetland mapping study area, 2012.

Figure 6. Typical PEM1E wetland (wet sedge meadow) in the wetland mapping study area, 2012.

Figure 7. Typical PSS1B wetland (willow scrub) in the wetland mapping study area, 2012.