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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Vegetation and Wildlife Habitat 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
AEA	Alaska Energy Authority
APA	Alaska Power Authority
ATV	all-terrain vehicle
AVC	*Alaska Vegetation Classification*
ELS	Ecological Land Survey
FERC	Federal Energy Regulatory Commission
ft	Feet/foot
GIS	geographic information system
GPS	global positioning system
ha	hectare(s)
ILP	Integrated Licensing Process
ITU	integrated terrain unit
km	kilometer(s)
m	meter(s)
NEPA	National Environmental Policy Act
NWI	National Wetlands Inventory
PM&E	protection, mitigation, and enhancement
Project	Susitna-Watana Hydroelectric Project
RM	river mile
USACE	U.S. Amy Corps of Engineers

SUMMARY

A vegetation and wildlife habitat mapping study is being conducted to provide baseline information on existing vegetation and wildlife habitats in the Susitna-Watana Hydroelectric Project area. This information will be used to facilitate assessments of the potential impacts to vegetation and wildlife habitats from the proposed Project. The Vegetation and Wildlife Habitat 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 vegetation types in the study area (see Figure 1) were initiated in 2012.

During the 2012 field season, 36 sampling transects were surveyed for vegetation composition, physiography, geomorphic unit (landform), macrotopography, microtopography (largely surface form), and observations of wildlife use or human activity. Field data for the Vegetation and Wildlife Habitat Mapping Study were collected simultaneously with the collection of field data for the Wetland Mapping Study. Data were collected from 276 full field plots, and field verifications (a rapid assessment technique to confirm previously documented conditions) were performed at 85 field plots along the transects. Using *Alaska Vegetation Classification* (AVC) criteria, 60 Level IV AVC vegetation classes, which can be grouped into 18 general vegetation types, were documented. Field data were used in conjunction with high-resolution imagery to classify and map vegetation types within the study area. Preliminary wildlife habitats will be derived in 2013 from vegetation types, physiography, surface form (as needed), and disturbance classes after substantial mapping of those attributes has been completed.

After the field season, the original vegetation mapping for the Alaska Power Authority (APA) Project, prepared by Kreig and Associates in 1987, was obtained from the Alaska Department of Fish and Game and was assessed for current accuracy by comparison with recent aerial imagery. The 1987 vegetation mapping was found to be reasonably accurate, but only at a relatively coarse-scale (roughly equivalent to Level III AVC vegetation classes). The 1987 vegetation mapping will be used to help select field plots for this study and for other wildlife survey studies for the Project in 2013 and 2014.

As noted above, the vegetation and habitat data collected in 2012 represent only the first year of work in a multi-year mapping study of vegetation and wildlife habitats for the Project. The data from 2012 will be combined with those collected in 2013 and 2014 to prepare complete vegetation and wildlife habitat maps for the Project (see Section 11.5 in the Revised Study Plan [AEA 2012]). If warranted by the results of the 2012 work, the specific field and office methods used to identify, delineate, and map vegetation and habitat types within the study area may be refined (based on consultation with Alaska Energy Authority (AEA) and other licensing participants).

The vegetation types 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 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

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 Vegetation and Wildlife Habitat Mapping Study is a multi-year effort initiated in 2012. This report provides the results of the 2012 work, based on the 2012 Vegetation and Wildlife Habitat Mapping Study plan (AEA 2012a). This study provided data to inform the Revised Study Plan (RSP) filed with FERC in December 2012, and will be incorporated into the Exhibit E of the License Application and FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

In 2012, field ground-reference surveys to collect current data on vegetation and wildlife habitat parameters and preliminary mapping of vegetation types in the study area (see Study Area below) were conducted. Additionally, an accuracy assessment of the vegetation map prepared in the 1980s for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) was performed.

2. STUDY OBJECTIVES

The overall goals of the Vegetation and Wildlife Habitat Mapping Study are to prepare baseline maps of the existing vegetation and wildlife habitats in areas in the Upper and Middle Susitna basin (upstream of Gold Creek) that could be directly affected by Project development. This mapping information will be used in AEA's License Application to assess impacts to both vegetation and wildlife resources from the proposed Project, and to develop any necessary protection, mitigation, and enhancement (PM&E) measures (see RSP Section 11.5 in AEA 2012b). When completed, the wildlife habitat maps will be used to estimate quantitatively the impacts of habitat loss and alteration for a selected set of bird, mammal, and amphibian species evaluated during the FERC licensing process (see RSP Section 10.19 in AEA 2012b). The wildlife habitat mapping prepared in this study will be one of the primary pieces of information used to evaluate impacts to wildlife species.

The specific objectives of the Vegetation and Wildlife Habitat Mapping Study are to identify, delineate, and map vegetation and wildlife habitat types in the Upper and Middle Susitna basin to reflect current conditions as indicated on recent aerial imagery for the study area. 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 vegetation and wildlife habitats in the study area.

3. STUDY AREA

The 2012 study area for the Vegetation and Wildlife Habitat Mapping Study consisted of a 5-mile buffer surrounding those areas that would be directly altered or disturbed by development of the Project (Figure 1). Note that the buffer for the study area has since been changed to 4 miles based on subsequent agency consultation conducted during 2012 (see RSP Section 11.5 in AEA 2012b). The areas that could be affected directly or disturbed by Project development include 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, vegetation and wildlife habitats within the study area buffer will be mapped up to the boundary of the Riparian Vegetation Study area. Vegetation and wildlife habitats in riparian areas downstream of the proposed dam will be mapped in the Riparian Vegetation Study (see RSP Section 11.6 in AEA 2012b). Mapping methods in the Vegetation and Wildlife Habitat Mapping Study and Riparian Vegetation Study are compatible, and the final map products will result in vegetation and wildlife habitats being mapped consistently in the Project area above the proposed dam and in riparian areas downstream of the dam site.

High-resolution aerial imagery is required for the mapping of vegetation and wildlife habitats. Suitable high-resolution imagery (0.3- to 1-foot pixels) 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). Thus, the 2012 detailed mapping of vegetation and wildlife habitats types is currently limited 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

The procedures for the mapping of vegetation and wildlife habitats for the Project area will follow protocols developed by ABR for Ecological Land Survey (ELS) studies in Alaska (see below and RSP Section 11.5 in AEA 2012b). Vegetation and other landscape attributes important in determining the use of habitats by wildlife will be mapped by interpretation of imagery signatures on recent aerial imagery for the Vegetation and Wildlife Habitat Mapping Study area. Detailed field ground-reference data collected over three field seasons will be used to link vegetation information and other landscape data to the imagery signatures and facilitate the identification and delineation of vegetation and wildlife habitat types.

4.1. Deviations from the 2012 Study Plan

The 2012 study plan for the Vegetation and Wildlife Habitat Mapping Study (AEA 2012b) indicated that the historic vegetation mapping prepared for the APA Project (Kreig and Associates 1987) would be assessed for accuracy and updated prior to the field surveys to serve as a preliminary vegetation map for the study area. The objective of the preliminary mapping was to identify a set of characteristic vegetation 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 image signatures in each major physiographic class, which often is the first step in a multi-year vegetation and wildlife habitat mapping project. In 2013 and 2014, preliminary vegetation mapping will be available to support the selection of field plots and facilitate the field verification of that vegetation mapping. Thus, the lack of preliminary mapping prior to the 2012 field surveys will not affect the quality or accuracy of the final vegetation and wildlife habitat maps.

Additionally, no efforts were made in 2012 to prepare a preliminary set of wildlife habitat types as was indicated in the 2012 study plan for this study. Preliminary wildlife habitats could not be prepared because no preliminary vegetation mapping was available. As noted above, preliminary wildlife habitats will be derived in 2013 after substantial mapping of vegetation types, physiography, surface form, and disturbance classes have been completed. Those preliminary wildlife habitat types will be presented for review in the Initial Study Report (ISR), to be filed with FERC in February 2014.

4.2. Classification and Mapping of Vegetation and Wildlife Habitats

We are employing an integrated, multivariate approach to the classification and mapping of vegetation and wildlife habitats in the study area based on methods developed for ELS studies conducted in tundra, boreal forest, and coastal regions in Alaska (see Jorgenson et al. 2002 for an example study in Southcentral Alaska). This integrated mapping approach involves mapping terrain units such as vegetation type, physiography, surface form, and disturbance type, and then combining them into units of ecological importance (in this case wildlife habitats).

The method of combining various integrated terrain units (ITUs) allows for the preparation of a number of thematic maps, depending on specific study needs. For the Project, a vegetation map at Level IV of the *Alaska Vegetation Classification* (Viereck et al. 1992; hereafter refered to as Level IV vegetation classes) will be prepared as well as a wildlife habitat map based on combinations of ITUs that best reflect use by the wildlife species of interest in the Project area. In 2012, the mapping of vegetation types in the study area was initiated. A set of preliminary wildlife habitats will be derived in 2013 after substantial mapping of vegetation types, physiography, surface form, and disturbance classes has been completed. Those preliminary wildlife habitat types will be presented for review in the ISR, to be filed with FERC in February 2014.

In 2012, data from existing vegetation maps prepared for the APA Project (Kreig and Associates 1987) were evaluated for correspondence to the recent aerial imagery being used for mapping vegetation. Vegetation attributes in the 1987 map were coded within the "Strataveg" field using the preliminary *Alaska Vegetation Classification* scheme (Viereck and Dyrness 1980). Coding under the Strataveg field included information on major and minor vegetation components, in which the major component represented the land-cover type present in at least 75 percent of the area represented by each map polygon (Kreig and Associates 1987). ABR converted the major Strataveg components to Viereck vegetation codes (based on Level IV vegetation classes) and general vegetation codes (roughly equivalent to Viereck Level III vegetation classes) to assess map accuracy. The two new fields were evaluated for current accuracy on an individual polygon basis by comparing the vegetation codes with recent aerial imagery at several locations within the study area.

4.3. Field Survey

Field ground-reference data to link to imagery signatures were collected during summer 2012. 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 (5,000–10,000 feet) 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 vegetation and habitat types as possible (identified by differences in image signature color and texture in addition to aspect, elevation, and physiographic class). 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).

At each field plot, the vegetation and wildlife habitat mapping data for this study were collected concurrently with data on wetlands for the Wetland Mapping Study (ABR 2013). Data were collected at the pre-selected field plot locations noted above and at additional plot locations established in the field (where new, transitional, or under-sampled land cover types were encountered). As described in the 2012 study report for the Wetland Mapping Study, U.S. Army Corps of Engineers (USACE) standard data collection methods (Environmental Laboratory 1987; USACE 2007) were used for the wetland determinations. Those wetland determination methods include estimates of vascular plant species cover and soil profile descriptions, which are also standard wildlife habitat mapping variables used by ABR. A *Trimble® Nomad™* series mobile geographic information systems (GIS) unit was used to record the wetlands data, the global positioning system (GPS) coordinates of each field plot, and to provide access to the aerial imagery in the field. In addition to data on plant cover and soils, the Level IV vegetation class and data on physiography, geomorphic unit (landform), macrotopography, microtopography (largely surface form), and observations of wildlife use (e.g., trails, browse, scat) and/or human use (e.g., hunting activities, all-terrain vehicle [ATV] trails) were recorded at each plot using an *Android* tablet computer and a customized data-entry form designed to link directly to a relational database (*Microsoft Access*).

All data were recorded within a 10-meter (33-feet) radius of homogenous vegetation at each field plot, 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 each field plot was visually estimated. Soil pits were excavated to approximately 18 inches deep or to the depth of the active layer, if shallower, and the soil profile was described. Soil color was identified using the *Munsell Soil Color Charts* (2009). Digital photos of soils and vegetation were taken at each plot.

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

5. RESULTS

5.1. Historic Vegetation Map Review

The vegetation mapping prepared by Kreig and Associates (1987) encompasses 646,701.4 hectares and is centered on the upper Susitna River drainage, extending from near the confluence of the Oshetna and Susitna rivers in the east to just downstream of Devils Canyon in the west and into alpine areas in the adjacent Talkeetna Mountains.

To assess the current accuracy of the 1980s vegetation mapping, the mapped polygons were compared to current aerial imagery. No historic imagery in a digital format is currently available to evaluate the accuracy of the original mapping in a GIS. First, the attributes of the original map polygons were converted to the equivalent Level IV vegetation classes, which resulted in 59 vegetation types (Table 1). Then the mapped vegetation classes were compared to selected areas on the current high-resolution imagery for the study area and, in general, the mapped Level IV vegetation classes were quite specific and did not match the range of image signatures in the current imagery. Given this general lack of concurrence between the Level IV vegetation classes and the current imagery signatures, the accuracy of the map was assessed at a broader spatial scale. For this assessment, the 59 mapped Level IV vegetation classes were aggregated into 24 more general vegetation types, which primarily reflect vegetation structure. Based on a visual spot-check review, this process resulted in a better overall agreement between vegetation classes and the image signatures on the current imagery. Approximately 550 polygons did not have vegetation attributes assigned to them in 1987, and vegetation classes were not assigned to those polygons using the current available imagery. For the purposes of this 2012 study report, those data were considered missing.

The most common general vegetation classes in the historic vegetation mapping were Open and Closed Low Shrub types, accounting for 40.1 percent of the entire mapped area. The mapped Level IV vegetation classes indicate that the majority of the low-shrub communities were dominated by willow or shrub birch. Dry Dwarf Shrub also was a common type, accounting for 14.1 percent of the mapped area, presumably as a result of including subalpine and alpine regions, which are beyond the boundaries of the current mapping study area for the Project. Open Needleleaf Forest accounted for 10.6 percent of the 1987 map area, and was concentrated along lower slopes of the Upper Susitna River valley and in low-lying areas at the eastern end of the map area. The originally mapped Level IV vegetation classes indicate that the needleleaf forests are mixed stands of white and black spruce.

In 2013 and 2014, to the extent possible, the historic vegetation mapping data will be used to guide the current mapping of vegetation in the study area and to assist in field-planning efforts for the Vegetation and Wildlife Habitat Mapping Study. The 1980s vegetation mapping will be used at the vegetation-structure level (see Table 1), which is roughly equivalent to Viereck Level III vegetation classes.

5.2. 2012 Field Summary

During summer 2012, two teams of two scientists collected vegetation, wildlife habitat, and wetlands data during two survey periods: June 19–27 and July 30 –August 8. A total of 276 full field plots and 85 verification plots were sampled along 36 transects during the two survey periods. Sixty Level IV vegetation classes were identified and sampled in the 276 field plots (Table 2).

Field plots were located in six physiographic classes: Alpine, Subalpine, Upland, Lowland, Lacustrine, and Riverine. The Alpine, Subalpine, and Upland classes occur along a mountainside topographic gradient ranging in elevation from approximately 4,000 to 500 feet at the valley bottom. The study area generally follows the broad Susitna and Nenana River valleys and includes steep mountainsides and crests along the edges. Landforms within the mountainous regions are typically associated with mass movement (talus slopes) or periglacial processes (frost features; Dean 1980). Substrates in these areas tend to be rocky and well-drained and the physiographic classes are typically characterized by distinct differences in plant species composition (Figure 2). The valley bottoms throughout the study area are predominantly a mix of Upland (typically drumlinized features) and Lowland (intervening depressions), resulting from glaciofluvial processes during successive glaciations and de-glaciations (Dean 1980). Upland surfaces are often comprised of impermeable till material, and the intervening Lowlands are water bodies (Figure 3) or Wet Graminoid Meadow vegetation composed of obligate wetland sedges (Figure 4). These same land cover types also may occur along mountain toeslopes. Riverine physiographic classes include the active floodplains of the Nenana and Susitna rivers and major tributaries. Lacustrine physiographic classes include lakes and ponds and Fresh Sedge Marsh vegetation along lake and pond margins.

As with the historic data from the 1987 vegetation map, the 60 Level IV vegetation classes identified in 2012 were consolidated into a smaller set of 18 more general vegetation types (Table 2).

Wet Graminoid Meadow (*n*=55 field plots)—including subalpine tundra, lacustrine marsh, and lowland meadows—was the most abundant general vegetation type sampled. Wet Graminoid Meadow communities were dominated by sedges, either coarse robust sedges (e.g., *Carex aquatilis* and *C. sitchensis*) or smaller and more delicate sedges (e.g., *Tricophorum cespitosum, Carex chordorrhiza, C. limosa,* and *C. magellanica*), often with subdominant shrubs.

Low and tall shrub communities in both open and closed forms were also commonly sampled. The low shrub communities tended to be dominated by shrub birch or ericaceous species (Figure 5); willow-dominated communities were less abundant and associated primarily with rivers and streams. Closed Tall Shrub communities were primarily tall alder and alder–willow vegetation types.

Moist Dwarf Shrub (ericaceous), Needleleaf Woodland, and Open Needleleaf Forest also accounted for a significant portion of the plots sampled in 2012. The needleleaf forest types range from woodland canopy cover (10–25 percent cover) to open canopy cover (26–60 percent cover). The dominant tree species include both white and black spruce. For habitats with woodland canopies, the trees may be stunted and dwarfed with a relatively open understory or an understory composed of tall closed shrub. Needleleaf woodlands and forests occupy lower and middle slopes and raised ridges in glacially modified terrain.

5.3. 2012 Mapping Efforts

The mapping of vegetation types in the study area in 2012 was initiated after the field season and will be continued in 2013, along with the mapping of physiography, surface form, and disturbance classes. In 2013, preliminary wildlife habitats will be derived after substantial mapping of vegetation types, physiography, surface form, and disturbance classes has been completed, and after the relationships among those variables in the study area has been established. The preliminary vegetation and wildlife habitat types mapped in the study area will be presented for review in the ISR, to be filed with FERC in February 2014.

6. DISCUSSION

The vegetation and wildlife habitat data collected in 2012 represent the first year of work in a multi-year mapping study of vegetation and wildlife habitats for the Project. The data from 2012 will be combined with those collected in 2013 and 2014 to prepare comprehensive vegetation and wildlife habitat maps for the Project. The data collected in 2012 also served as a guide for planning the 2013 and 2014 field programs for this study.

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8. TABLES

Table 1. General vegetation types.

Derived in 2012 from the historic vegetation map prepared by Kreig and Associates (1987) for the APA Project.

General Vegetation Type	Area (ha)	% of Total Area
Water	15,192.5	2.3
Wet Graminoid Meadow	4,533.1	0.7
Moist Graminoid Meadow	1,479.4	0.2
Moist Dwarf Shrub (ericaceous)	4,494.2	0.7
Dry Graminoid Meadow	46.6	<0.01
Dry Forb Meadow	3.9	<0.01
Dry Dwarf Shrub	91,488.3	14.1
Open Low Shrub	138,118.4	21.4
Closed Low Shrub	121,113.6	18.7
Open Tall Shrub	17,192.2	2.7
Closed Tall Shrub	17,422.1	2.7
Dwarf Forest Woodland	3,213.7	0.5
Open Dwarf Forest	9,939.6	1.5
Closed Dwarf Forest	1,493.0	0.2
Broadleaf Woodland	546.2	0.1
Mixed Woodland	3,466.1	0.5
Needleleaf Woodland	24,584.5	3.8
Open Mixed Forest	19,918.2	3.1
Open Broadleaf Forest	1,347.9	0.2
Open Needleleaf Forest	68,838.0	10.6
Closed Mixed Forest	19,717.7	3.0
Closed Broadleaf Forest	2,989.8	0.5
Closed Needleleaf Forest	12,832.9	2.0
Barrens	44,802.7	6.9
No Attributes	21,926.9	3.4
TOTAL	646,701.4	100.0

Table 2. General vegetation types and Level IV vegetation classes.

From Viereck et al. (1992) identified in the vegetation and wildlife habitat mapping study area, Susitna-Watana Hydroelectric Project, Alaska, 2012. Level IV vegetation classes are nested below each general vegetation type. Samples sizes (*n*) are the number of field plots of each type sampled.

General Vegetation Types and Level IV Vegetation Classes	Code	*n*
Water		
Water	W	1
Wet Graminoid Meadow		
Fresh Sedge Marsh	Hgwfs	7
Subarctic Lowland Graminoid–Herb Wet Meadow	Hgwgh	1
Subarctic Lowland Sedge Bog Meadow	Hgwsb	11
Subarctic Lowland Sedge Wet Meadow	Hgwsl	16
Subarctic Lowland Sedge–Moss Bog Meadow	Hgwsmb	8
Subarctic Lowland Sedge–Shrub Wet Meadow	Hgwss	8
Wet Sedge Meadow Tundra	Hgwst	2
Wet Sedge–Willow Tundra	Hgwswt	2
Moist Graminoid Meadow		
Bluejoint Meadow	Hgmb	2
Bluejoint–Shrub	Hgmbs	3
Moist Seral Grass–Herb Meadow	Hgmgh	3
Moist Grass–Herb Meadow Tundra	Hgmght	1
Moist Sedge–Shrub Tundra	Hgmss	2
Moist Sedge–Willow Tundra	Hgmswt	3
Dry Graminoid Meadow		
Midgrass–Herb	Hgdgh	1
Moist Dwarf Shrub (ericaceous)		
Bearberry Dwarf Shrub Tundra	Sdeb	1
Cassiope Dwarf Shrub Tundra	Sdec	1
Crowberry Dwarf Shrub Tundra	Sdee	2
Ericaceous–Lichen Dwarf Shrub Tundra	Sdel	4
Ericaceous Dwarf Shrub Tundra	Sdet	4
Vaccinium Dwarf Shrub Tundra	Sdev	3
Willow Dwarf Shrub Tundra	Sdwt	1
Dry Dwarf Shrub		
Dryas–Sedge Dwarf ShrubTundra	Sdds	1
Dryas Dwarf Shrub Tundra	Sddt	4
Open Low Shrub		
Open Low Mesic Shrub Birch–Ericaceous Shrub	Slobe	32
Open Low Shrub Birch–Willow	Slobw	1
Open Low Sweetgale–Graminoid Bog	Slocg	2
Open Low Ericaceous Shrub Bog	Sloeb	7

General Vegetation Types and Level IV Vegetation Classes	Code	*n*
Open Low Willow	Slow	7
Open Low Willow–Graminoid Shrub Bog	Slowg	1
Closed Low Shrub		
Closed Low Shrub Birch–Ericaceous Shrub	Slcbe	6
Closed Low Shrub Birch–Willow	Slcbw	1
Closed Low Sweetgale Meadow	Slcm	1
Closed Low Willow	Slcw	1
Open Tall Shrub		
Open Tall Alder	Stoa	12
Open Tall Alder–Willow	Stoaw	2
Open Tall Shrub Birch	Stob	7
Open Tall Scrub, post burn or disturbance	Stod	1
Open Tall Willow	Stow	8
Closed Tall Shrub		
Closed Tall Alder	Stca	14
Closed Tall Alder–Willow	Stcaw	4
Closed Tall Willow	Stcw	9
Dwarf Forest Woodland		
Dwarf Black Spruce Woodland	Sfwbs	1
Open Dwarf Forest		
Open Dwarf Black Spruce	Sfobs	2
Open Dwarf White Spruce	Sfows	1
Open Broadleaf Forest		
Open Quaking Aspen Forest	Fboa	1
Open Paper Birch	Fbob	2
Open Paper Birch–Balsam Poplar	Fbobp	1
Open Balsam Poplar	Fbop	2
Closed Broadleaf Forest		
Closed Aspen–Balsam Poplar	Fbcap	1
Needleleaf Woodland		
Black Spruce Woodland	Fnwbs	16
White Spruce Woodland	Fnwws	14
Open Needleleaf Forest		
Open Black Spruce	Fnobs	9
Open White Spruce	Fnows	2
Open Mixed Forest		
Open Paper Birch–Balsam Poplar–Spruce	Fmobps	1
Open Spruce–Paper Birch	Fmosb	9
Open Spruce–Balsam Poplar	Fmosp	1

General Vegetation Types and Level IV Vegetation Classes	Code	*n*
Barrens		
Barren	Bbg	1
Partially Vegetated	Bpv	4
TOTAL		276

9. FIGURES

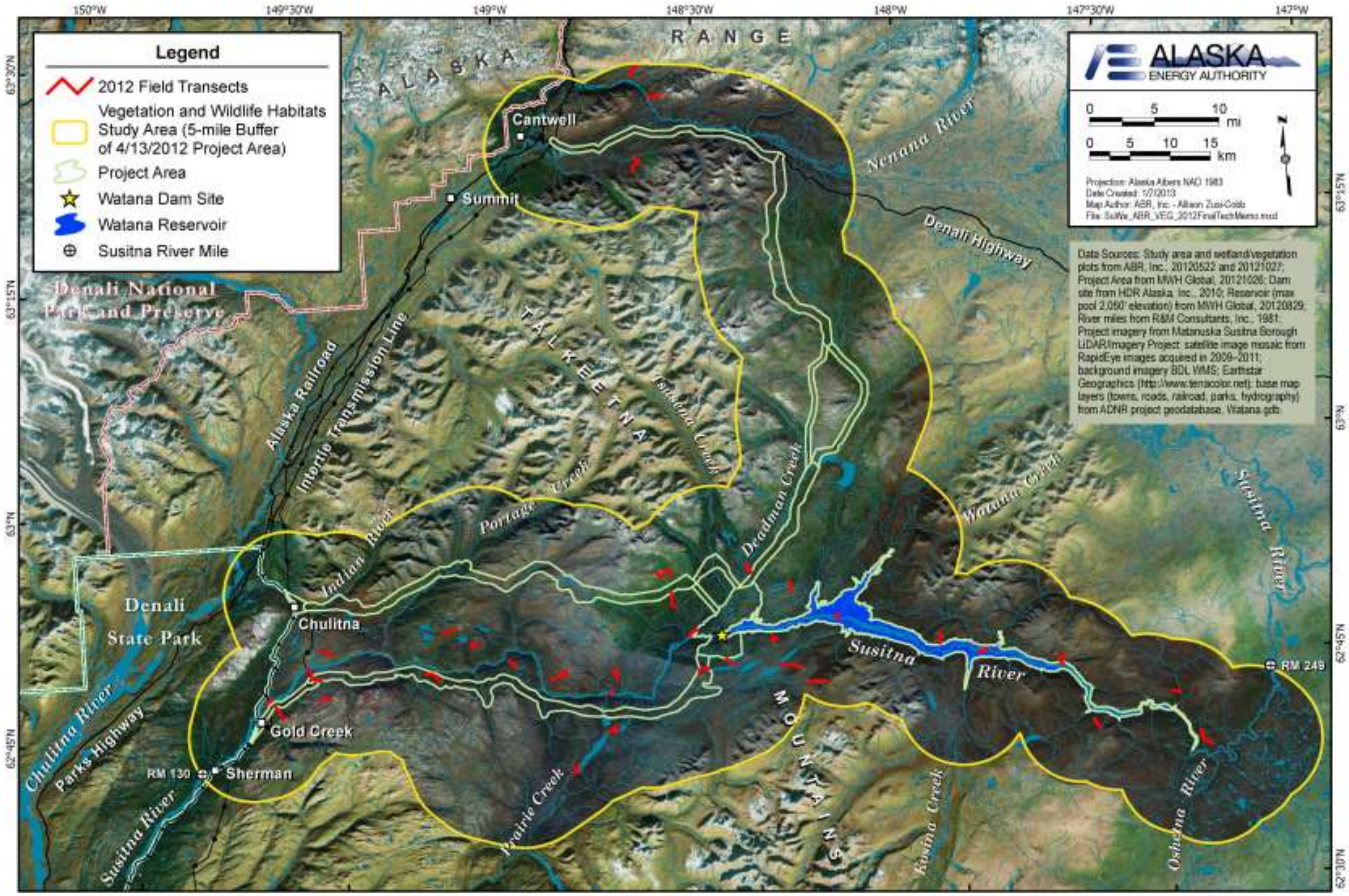

Figure 1. Study area and completed 2012 sampling transects for the Vegetation and Wildlife Habitat Mapping Study.

The Project area boundary shown is the version dated October 26, 2012, but the 5-mile buffer for the study area was drawn from the April 13, 2012 version of the Project area boundary**.** In 2013 and 2014, a smaller 4-mile buffer study area will be used as noted in RSP Section 11.5 in AEA (2012b).

Figure 2. Typical topo sequence in the Vegetation and Wildlife Habitat Mapping Study area, 2012.

Rocky, exposed, partially-vegetated areas in the Alpine physiographic class at the ridge crest, grading into the Subalpine class, which is characterized primarily by low and tall shrub plant communities.

Figure 3. View of valley floor drumlinized terrain in the Vegetation and Wildlife Habitat Mapping Study area, 2012.

The intervening troughs between raised drumlin ridges are often water bodies or wet graminoid plant communities.

Figure 4. Wet Graminoid Meadow typical of inter-drumlin troughs found within the Lowland physiography class in the Vegetation and Wildlife Habitat Mapping Study area, 2012.

Figure 5. Low deciduous shrub communities commonly found on low slopes and valley bottoms in the Vegetation and Wildlife Habitat Mapping Study area, 2012.

Willows and shrub birch are often the dominant shrub taxa.