Boundary Hydroelectric Project (FERC No. 2144)

Study No. 15

Waterfowl/Waterbird Study

Final Report

Prepared for
Seattle City Light

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Study No. 15: Waterfowl/Waterbird Study
Final Report
Boundary Hydroelectric Project (FERC No. 2144)

1 INTRODUCTION

Study No. 15, the Waterfowl/Waterbird Study, was conducted in support of the relicensing of the Boundary Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 2144, as identified in the Revised Study Plan (RSP; SCL 2007) submitted by Seattle City Light (SCL) on February 14, 2007, and approved by the FERC in its Study Plan Determination letter dated March 15, 2007. This is the final report describing the field efforts, analyses, and determination of Project effects and represents the completion of the study.

2 STUDY OBJECTIVES

The primary goal of the Waterfowl/Waterbird Study was to provide information on suitable habitat in the Project area for ground-nesting waterfowl and use of this habitat, and to characterize any effects of Project operations on this habitat. An additional goal was to provide information on populations of piscivorous waterbirds in the Project area, particularly cormorants.

Specific objectives of the study were to:

- Document the extent of existing nesting by ground-nesting waterfowl in wetland, riparian, and shoreline habitats along Boundary Reservoir upstream of Metaline Falls.
- Estimate the amount of waterfowl ground-nesting habitat that could potentially occur in the reservoir fluctuation zone upstream of Metaline Falls.
- Determine the elevation range utilized by ground-nesting waterfowl and evaluate the impact of reservoir water levels on the availability of suitable nesting habitat and on the degree of nest failure due to flooding.
- Estimate the number of piscivorous waterbirds using the Project area and locate their nest sites, if possible, with an emphasis on double-crested cormorants.
- Document levels of use of the Project area by waterfowl and waterbirds during the fall migration and winter time periods.

3 STUDY AREA

The study area for Tasks 1 (Map and Estimate Existing Habitat) and 2 (Estimate Potential Habitat) of the Waterfowl/Waterbird Study was focused primarily on the reservoir, shorelines, and adjacent wetland and riparian habitat along Boundary Reservoir upstream of Metaline Falls (Figure 3.0-1). This upper reservoir area extends approximately 8 miles along the Pend Oreille River from the Box Canyon tailrace downstream to Metaline Falls and encompasses the reservoir, the reservoir fluctuation zone (approximately 1,986–2,020 feet NAVD 88 [1,982–

2,016 feet NGVD 29[1]], based on hourly records from 1987 through 2005 at the U.S. Geological Survey [USGS] gage below Box Canyon Dam), and all suitable waterfowl nesting habitat within 200 feet of the high water level (approximately 2,020 feet NAVD 88 [2,016 feet NGVD 29]) and within the SCL-owned Boundary Wildlife Preserve (BWP).[2]

The study area for Task 3 (Waterfowl Nest Searches) focused on the upper reservoir as well (where the majority of ground-nesting waterfowl nesting habitat occurs), but also included potentially suitable ground-nesting waterfowl habitat occurring on the islands between Boundary Dam and Metaline Falls (the lower reservoir). The study area for Tasks 4 (Piscivorous Waterbird Surveys) and 5 (Fall Migration and Winter Surveys) included both the upper and lower portions of the reservoir.

The range of water surface elevations recorded during the survey periods for this study is presented below and represents typical operating conditions for the period in which data were collected. Existing conditions at the time of surveys were considered adequate to acquire all data required for this study:

- From Box Canyon Dam to Metaline Falls—Elevation 1,991–1,999 feet NAVD 88 (1,987–1,995 feet NGVD 29), as measured at the USGS gage 12396500 (Box Canyon gage), with one exception: waterfowl surveys were conducted along the upper reservoir on June 18, 2008, when the elevation at the Box Canyon gage was approximately 2,009 feet NAVD 88 (2,005 feet NGVD 29).
- From Metaline Falls to Boundary Dam—Elevation 1,983–1,993 feet NAVD 88 (1,979–1,989 feet NGVD 29), as measured at the SCL gage located in the Boundary forebay.

[1] SCL is in the process of converting all Project information from an older elevation datum (National Geodetic Vertical Datum of 1929 [NGVD 29]) to a more recent elevation datum (North American Vertical Datum of 1988 [NAVD 88]). As such, elevations are provided relative to both data throughout this document. The conversion factor between the old and new data is approximately 4 feet (e.g., the crest of the dam is 2,000 feet NGVD 29 and 2,004 feet NAVD 88).

[2] As indicated in this and other study reports in the Updated Study Report, SCL agreed it is appropriate to study the existing fluctuation range of the reservoir; however, for development of the Preliminary Licensing Proposal (PLP) and License Application, SCL will base its assessment of potential protection, mitigation, and enhancement measures on that portion of the fluctuation zone that is determined to be under the influence of Boundary Project operations, versus the effects of inflows and Metaline Falls that are beyond the control of the Project.

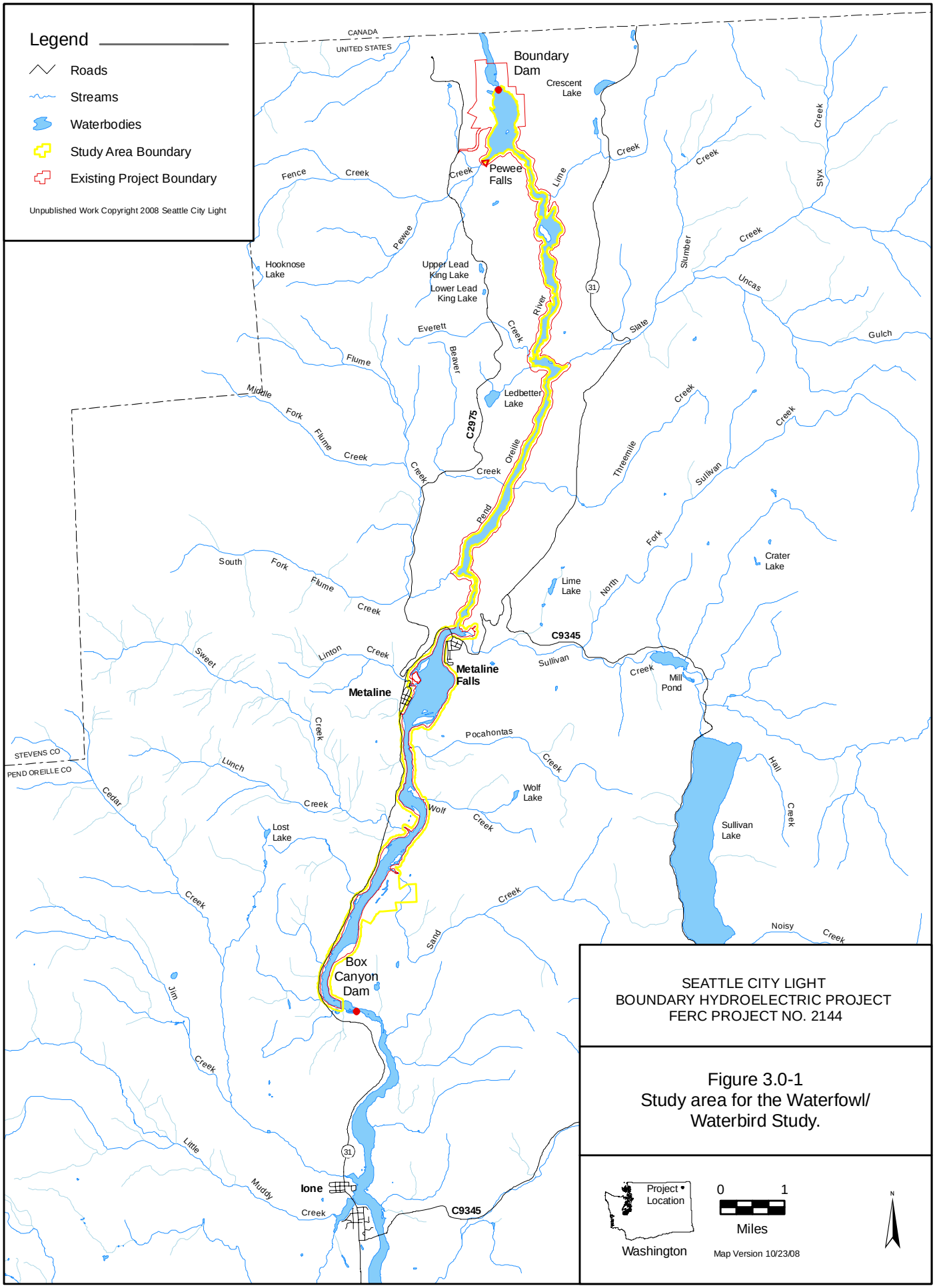

Figure 3.0-1
Study area for the Waterfowl/ Waterbird Study.

4 METHODS

Six tasks were identified for this study:

- Task 1: Map and estimate habitat for ground-nesting waterfowl
- Task 2: Estimate potential habitat for ground-nesting waterfowl in the reservoir fluctuation zone
- Task 3: Waterfowl nest searches
- Task 4: Piscivorous waterbird surveys
- Task 5: Fall migration and winter surveys
- Task 6: Documentation and effects assessment

The methodologies for the tasks are described below.

4.1. Map and Estimate Existing Habitat for Ground-nesting Waterfowl

The RSP described a process of mapping and estimating suitable waterfowl nesting habitat based on vegetation associations, bathymetry, and water surface elevations. During early reconnaissance trips to the study area, it became apparent that there were no backwater areas around the reservoir that typify waterfowl nesting and brooding habitat. Based on these early observations and coordination with the relicensing participants, the existing habitat assessment portion of the study was modified to concentrate on those habitat parameters selected by nesting Canada geese and mallards (scientific names of waterfowl and waterbird species observed during this study are found in Table 5.0-1), the only two species of ground-nesting waterfowl that were observed to nest in the study area.

A key element in estimating habitat is to understand breeding habitat requirements for local ground-nesting waterfowl. Nesting habitat characteristics for Canada geese and mallards were determined from a literature review and the field results of the waterfowl nest surveys (Task 3). Based on the literature review and field surveys, working definitions of suitable nesting habitat for these two species were developed and presented to the relicensing participants for approval on March 4, 2008.

Because most of the reservoir shoreline represents potential ground-nesting waterfowl nesting habitat, seasonal and annual variation in flow can affect the amount of available habitat. The effects of varying water surface elevations on goose and mallard nesting habitat were investigated using existing data on hydrology, topography, and vegetation coupled with the Hydraulic Routing Model (HRM; see Study 7, Mainstem Aquatic Habitat Modeling Study Final Report [SCL 2009a]). The HRM predicts pool elevations at specific locations under various flow scenarios, and was used to identify existing nesting habitat for Canada geese and mallards under current operations.

4.1.1. Canada Geese

Data from the 2007 surveys and previous observations indicate that Canada geese in the study area nest almost exclusively on grass covered islands from mid-March through mid-May.

Assessing the amount of suitable island habitat under existing conditions required the following steps:

- Calculate island area—The median water surface elevation and flow at Boundary Dam for the mid-March to mid-May Canada goose nesting season were determined from the hydrologic record (1987–2005). The median water surface elevation (approximately 1,990 feet NAVD 88 [1,986 feet NGVD 29]) and flow (26,026 cubic feet per second) at the dam (determined as described above) were input into the HRM to estimate median water surface elevations at each of the upper reservoir islands. The water surface elevations defined the perimeter of each island under current operations, which was used to calculate the existing acreage for each island.

- Determine how often islands are connected to the mainland under low water conditions (land-bridged)—For each island, recent topography and bathymetry were used to determine the water surface elevation that resulted in land-bridging. Hydrologic data from 1987 to 2005 were then analyzed to calculate how often the islands land-bridged during representative wet, dry, and normal precipitation years. These steps provided an estimate of when island nests would be at greatest risk to mammalian predators.

- Determine how often inundation associated with flooding occurred—For purposes of estimating how often water surface elevations (under current operating conditions) are high enough to inundate nests during the breeding period, it was assumed that the distribution (and elevational range) of goose nests in 2007 was generally representative of all years. This approach was used instead of a habitat area-based approach because the 2007 survey results strongly indicated that goose nests on the islands are neither randomly distributed nor evenly spaced across the island, but were clustered at the higher elevations. The elevation of each nest was standardized to the Box Canyon gage by adding the elevational difference between the gage and each nest location to the nest elevation. This provided the basis for calculating the water surface elevation at the Box Canyon gage at which each nest would flood (flood elevations). These flood elevations were plotted onto the results from the HRM for the 19-year hydrologic record (1987–2005, during the March 15 to May 15 nesting period) to estimate how often goose nests would flood. The hypothetical loss of nests due to flooding was calculated for each year.

4.1.2. Mallards

Because mallards are often not very selective in their choice of nesting habitat (Drilling et al. 2002), a working definition of mallard nesting habitat was needed to identify the most suitable habitat available in the study area. For this study, mallard nesting habitat was defined, in consultation with relicensing participants (March 4, 2008), as the woody riparian habitats identified and mapped in Study 16, Inventory of Riparian Trees and Shrubs Final Report (SCL 2009b). The mapping results from Study 16 were used to estimate the amount and location of existing mallard nesting habitat.

4.2. Estimate Potential Habitat for Ground-nesting Waterfowl in the Reservoir Fluctuation Zone

The objective of this task was to estimate the amount of nesting habitat for mallards and Canada geese that would likely develop in the fluctuation zone (of the upper reservoir) if the Boundary Project were operated at lower water surface elevations.

4.2.1. Canada Geese

Canada geese in the study area are dependent on grass-covered islands for nesting, so estimates of potential habitat focused on net changes in island acreage resulting from lower water surface elevations during the goose nesting season. Calculating the net change in nesting habitat for Canada geese at lower water surface elevations involved the following process:

- The median water surface elevation and flow at Boundary Dam for the mid-March to mid-May Canada goose nesting season were determined from the hydrologic record (1987–2005). This elevation, approximately 1,990 feet NAVD 88 (1,986 NGVD 29), represented the line between existing habitat and the habitat that could potentially develop in the fluctuation zone.

- Using elevation 1,990 feet NAVD 88 (1,986 NGVD 29) to represent the lower limit of existing vegetation, the HRM was run with the water surface elevation at the dam held at 1,985 and 1,980 feet NAVD 88 (1,981 and 1,976 feet NGVD 29, respectively), which are 5 and 10 feet lower than the median water surface elevation. Island acreage was calculated for each of these increments, and the net change in island acreage between increments determined, recognizing that lower water surface elevations would result in the complete loss of some islands due to land-bridging, while new islands would also develop. Because of the hydraulic influence of Metaline Falls, a 5-foot change in elevation at Boundary Dam does not equate to the same elevational change in the upper reservoir. Depending on the location in the upper reservoir, lowering the water surface elevation from 1,990 feet NAVD 88 (1,986 feet NGVD 29) to 1,985 feet NAVD 88 (1,981 feet NGVD 29) at the dam translates to an approximately 1.1- to 2.3-foot decrease in the upper reservoir; lowering the elevation at the dam to 1,980 feet NAVD 88 (1,976 feet NGVD 29) equates to only an additional 0.6- to 1.1-foot elevation decrease in the upper reservoir. Below 1,980 feet NAVD 88 (1,976 feet NGVD 29), Boundary Dam no longer influences water surface elevations above Metaline Falls; thus, the last two increments (1,975 and 1,970 foot NAVD 88 [1,971 and 1,966 foot NGVD 29] at the dam) were not evaluated.

4.2.2. Mallards

As discussed in Section 4.1.2, potential mallard nesting habitat occurring along the upper reservoir was defined as the woody riparian habitats identified in Study 16. Because Study 16 (Task 3) estimated the amount of woody riparian habitat that could potentially develop in the

fluctuation zone, these same results were used to estimate the amount of potential mallard nesting habitat that could develop in the fluctuation zone (only for the upper reservoir).

4.3. Waterfowl Nest Searches

Nest searches were conducted to determine waterfowl use of the existing breeding habitat in the study area. Riparian, wetland, and shoreline habitats were searched four times between April and June 2007, and twice during April and May 2008, to document waterfowl ground nests. Suitable nesting habitat was surveyed by systematically walking through accessible areas (Figure 4.3-1) and recording all nests observed. Global Positioning System (GPS) units were used to document locations of nests. Nest searches were conducted in a way that minimized disturbance to nesting waterfowl to the greatest extent possible (e.g., some detailed nest measurements were not made until after nesting was complete).

Data were recorded on standard datasheets and consisted of the following for each nest:

- Date and time of visit
- Visit number
- Species
- Species identification method (flushed hen, nest characteristics, etc.)
- Nest location
- Nest type
- Nest elevation
- Horizontal distance from water's edge
- Habitat type
- Concealment vegetation
- Evidence of human disturbance

Maps showing the surveyed area and locations of nests were generated using Geographic Information System software. In 2007, nest elevations were measured using a survey rod and inclinometer and recorded relative to the existing water level at the time. By noting the exact time of day, the elevation of each nest was calculated relative to the known water level at the Box Canyon USGS gage or the Boundary forebay gage. The elevation data allowed for an assessment of the effects of fluctuating water surface elevations on nest sites from 2007 (e.g., flooding or land-bridging). By the 2008 nesting season, bathymetric and topographic data were available, allowing nest elevations to be measured directly from the GPS data collected in the field. Flood conditions in May 2008 also limited follow-up visits to most of the nest sites.

Because the 2007 survey resulted in the identification of only one mallard nest, the 2008 nest searches focused on geese. However, surveys were conducted in May, June, and July 2008 for duck broods, an indirect measure of breeding success in the study area; the decision to change the focus of the 2008 nest surveys was made in consultation with relicensing participants (March 4, 2008).

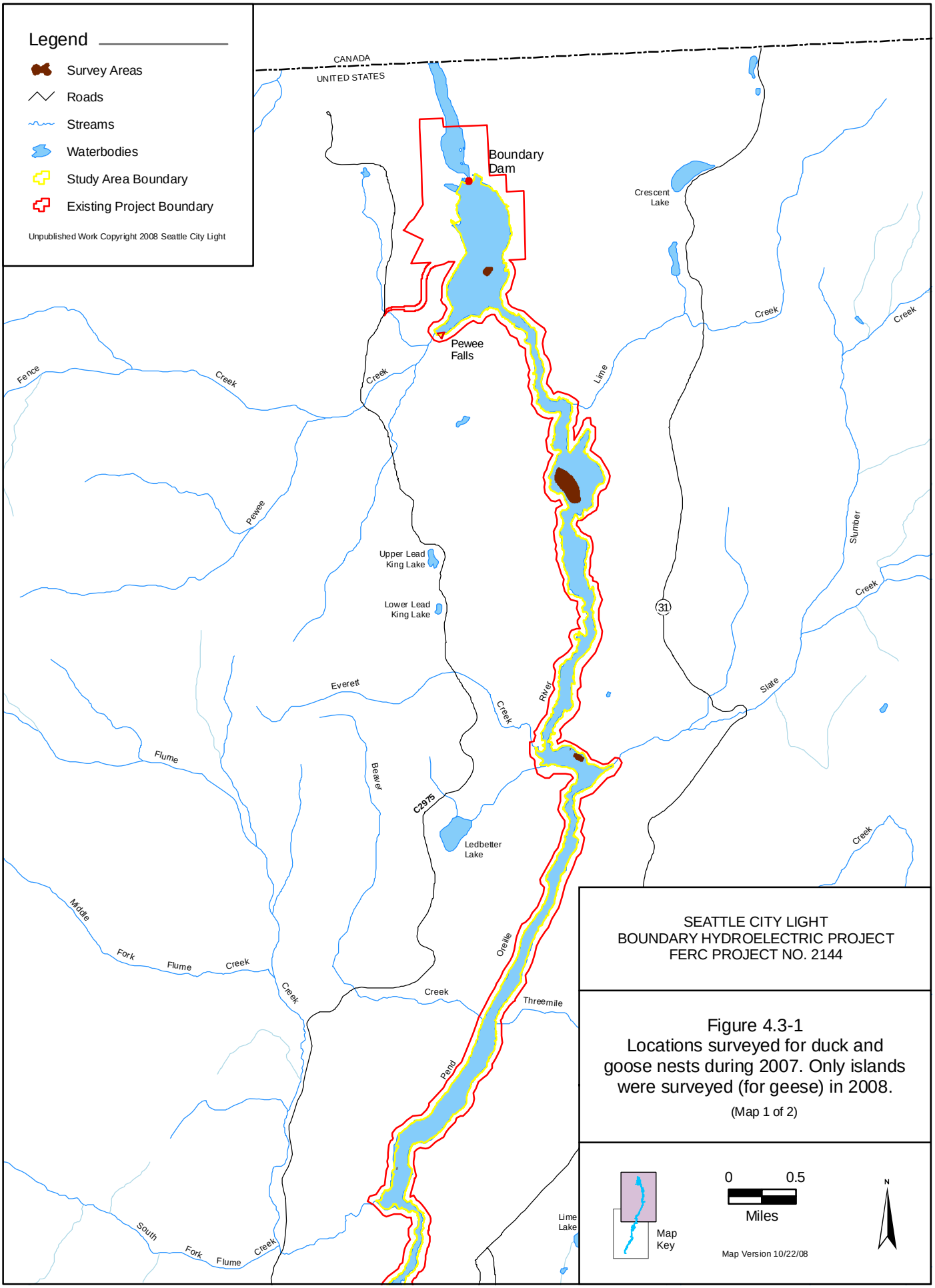

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Figure 4.3-1
Locations surveyed for duck and goose nests during 2007. Only islands were surveyed (for geese) in 2008.

(Map 1 of 2)

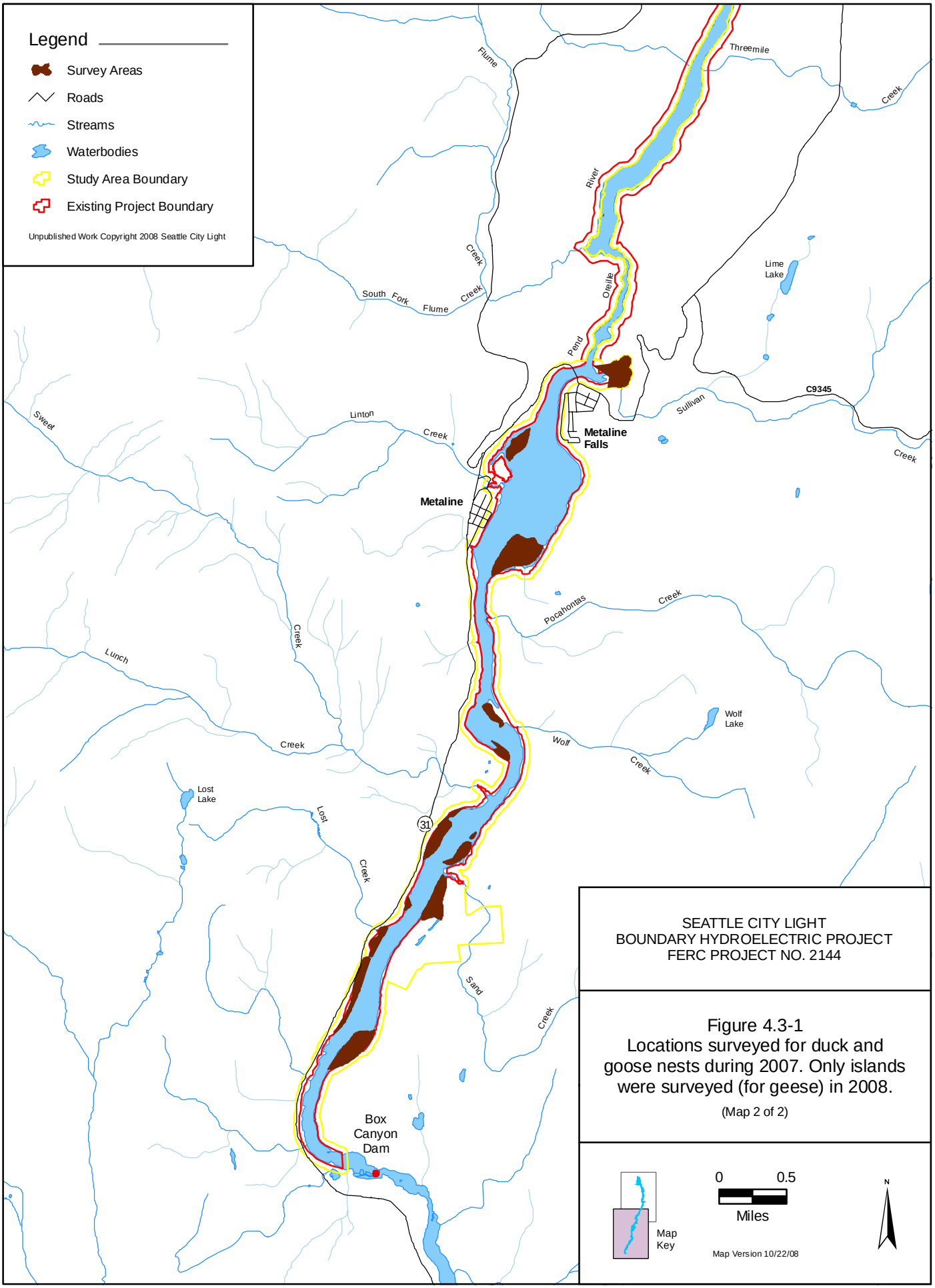

Figure 4.3-1
Locations surveyed for duck and goose nests during 2007. Only islands were surveyed (for geese) in 2008.
(Map 2 of 2)

4.4. Piscivorous Waterbird Surveys

The number and locations of piscivorous waterbirds (and all other waterfowl and waterbirds) observed on the reservoir were recorded concurrently with waterfowl nest searches (Task 3); fall migration and winter waterfowl surveys (Task 5); rare, threatened, and endangered (RTE) wildlife species surveys (Study 18, Rare, Threatened, and Endangered [RTE] Wildlife Species Study [see SCL 2009c]); and big game surveys (Study 19, Big Game Study [see SCL 2009d]). Twenty-one surveys of the reservoir were conducted between April 2007 and September 2008 in which piscivorous waterbirds, waterfowl, and other waterbirds were recorded. These surveys were conducted by slowly traversing the entire length of the reservoir in a small, open boat. The sighting locations were recorded using GPS units. Although the RSP placed an emphasis on double-crested cormorants and great blue herons, sightings of all piscivorous waterbirds were recorded. Common merganser was added as a target species based on recent work by Wiese et al. (2008) showing that this piscivorous duck is a major predator of juvenile salmonids in the mid-Columbia River.

4.5. Fall Migration and Winter Surveys

Surveys to assess migration and wintering use of the reservoir by waterfowl began in September 2007 and ended in March 2008 (nine surveys total). As with all other wildlife surveys, waterfowl were recorded to location using GPS and locations were plotted onto maps.

4.6. Documentation and Effects Assessment

The effects assessment describes observed and potential Project and non-Project effects on waterfowl/waterbird populations and waterfowl nesting habitat in the study area. The results of Task 2 (see Section 4.2) served as the basis for determining the effects of Project operations on nesting habitat. Information on the effects of seasonal flooding and potential disturbance from recreational activities was obtained from the Study 16 Final Report (SCL 2009b) and Study 21, Recreation Resource Study Final Report (SCL 2009e), respectively.

5 RESULTS

Surveys for this study documented 20 waterfowl species and 20 waterbird species on or near the reservoir between April 2007 and September 2008 (Table 5.0-1; Figures 5.0-1 and 5.0-2). More detail on waterfowl and piscivorous waterbirds is summarized in the following sections.

Table 5.0-1. Waterfowl and waterbirds seen in the study area, April 2007–September 2008.

Common Name	Scientific Name
Waterfowl	
tundra swan	*Cygnus columbianus*
snow goose	*Chen caerulescens*
Canada goose	*Branta canadensis*
wood duck	*Aix sponsa*
mallard	*Anas platyrhynchos*

Table 5.0-1, continued…

Common Name	Scientific Name
gadwall	*Anas strepera*
green-winged teal	*Anas crecca*
American wigeon	*Anas americana*
northern pintail	*Anas acuta*
northern shoveler	*Anas clypeata*
blue-winged teal	*Anas discors*
cinnamon teal	*Anas cyanoptera*
ring-necked duck	*Aythya collaris*
lesser scaup	*Aythya affinis*
Barrow's goldeneye	*Bucephala islandica*
common goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
common merganser	*Mergus merganser*
hooded merganser	*Lophodytes cucullatus*
American coot	*Fucila americana*
Waterbirds	
common loon	*Gavia immer*
eared grebe	*Podiceps nigricollis*
red-necked grebe	*Podiceps grisegena*
western grebe	*Aechmophorus occidentalis*
double-crested cormorant	*Phalacrocorax auritus*
American bittern	*Botaurus lentiginosus*
great blue heron	*Ardea herodias*
killdeer	*Charadrius vociferous*
lesser yellowlegs	*Tringa flavipes*
spotted sandpiper	*Actitis macularia*
California gull	*Larus californicus*
Forster's tern	*Sterna forsteri*
belted kingfisher	*Ceryle alcyon*
bank swallow	*Riparia riparia*
barn swallow	*Hirundo rustica*
cliff swallow	*Petrochelidon pyrrhonota*
northern rough-winged swallow	*Stelgidopteryx serripennis*
tree swallow	*Tachycineta bicolor*
violet-green swallow	*Tachycineta thalassina*
American dipper	*Cinclus mexicanus*

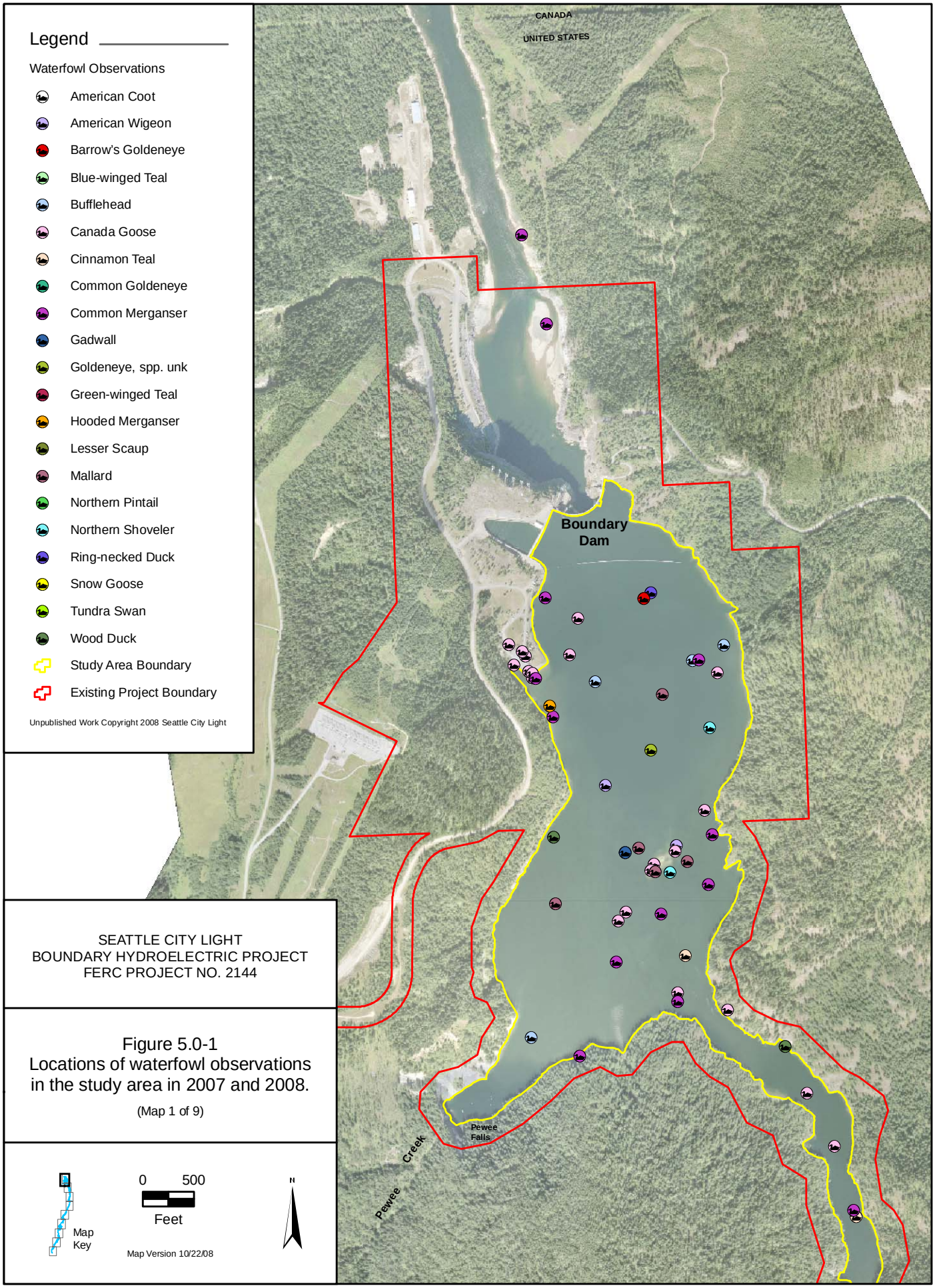

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Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 1 of 9)

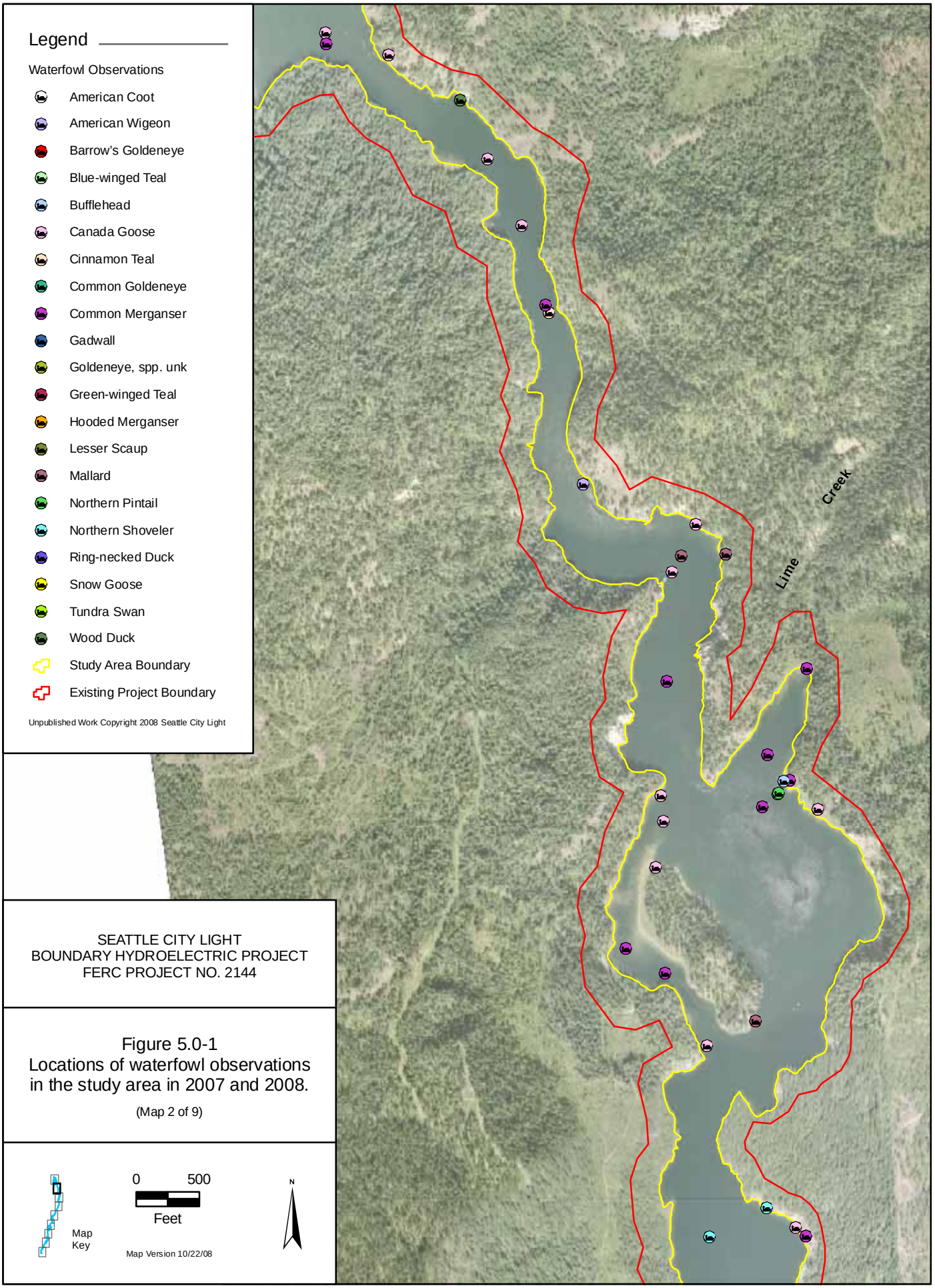

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Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 2 of 9)

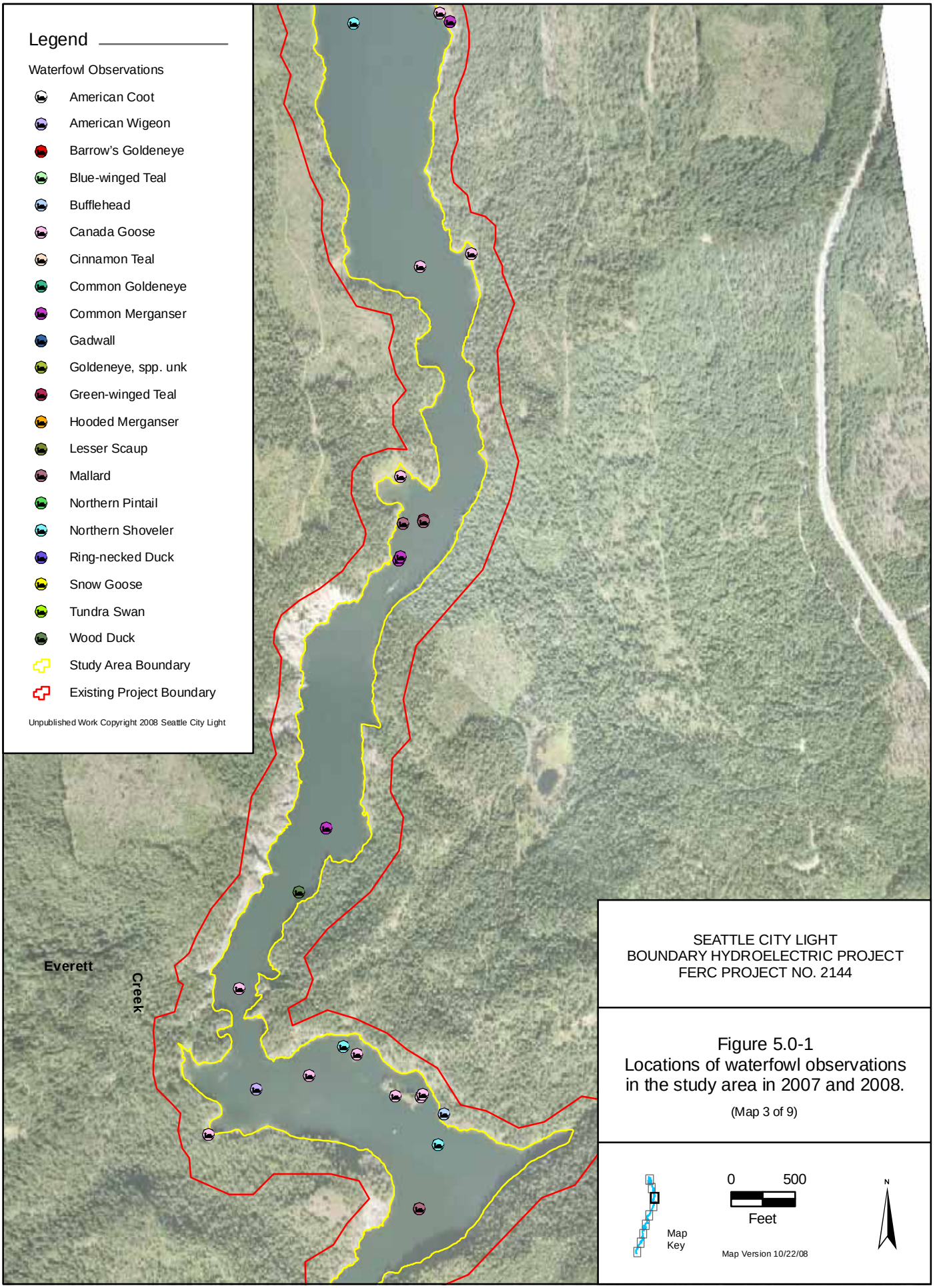
Legend
Waterfowl Observations
American Coot
American Wigeon
Barrow's Goldeneye
Blue-winged Teal
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Goldeneye, spp. unk
Green-winged Teal
Hooded Merganser
Lesser Scaup
Mallard
Northern Pintail
Northern Shoveler
Ring-necked Duck
Snow Goose
Tundra Swan
Wood Duck
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
Everett
Creek
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Figure 5.0-1
Locations of waterfowl observations
in the study area in 2007 and 2008.
(Map 3 of 9)
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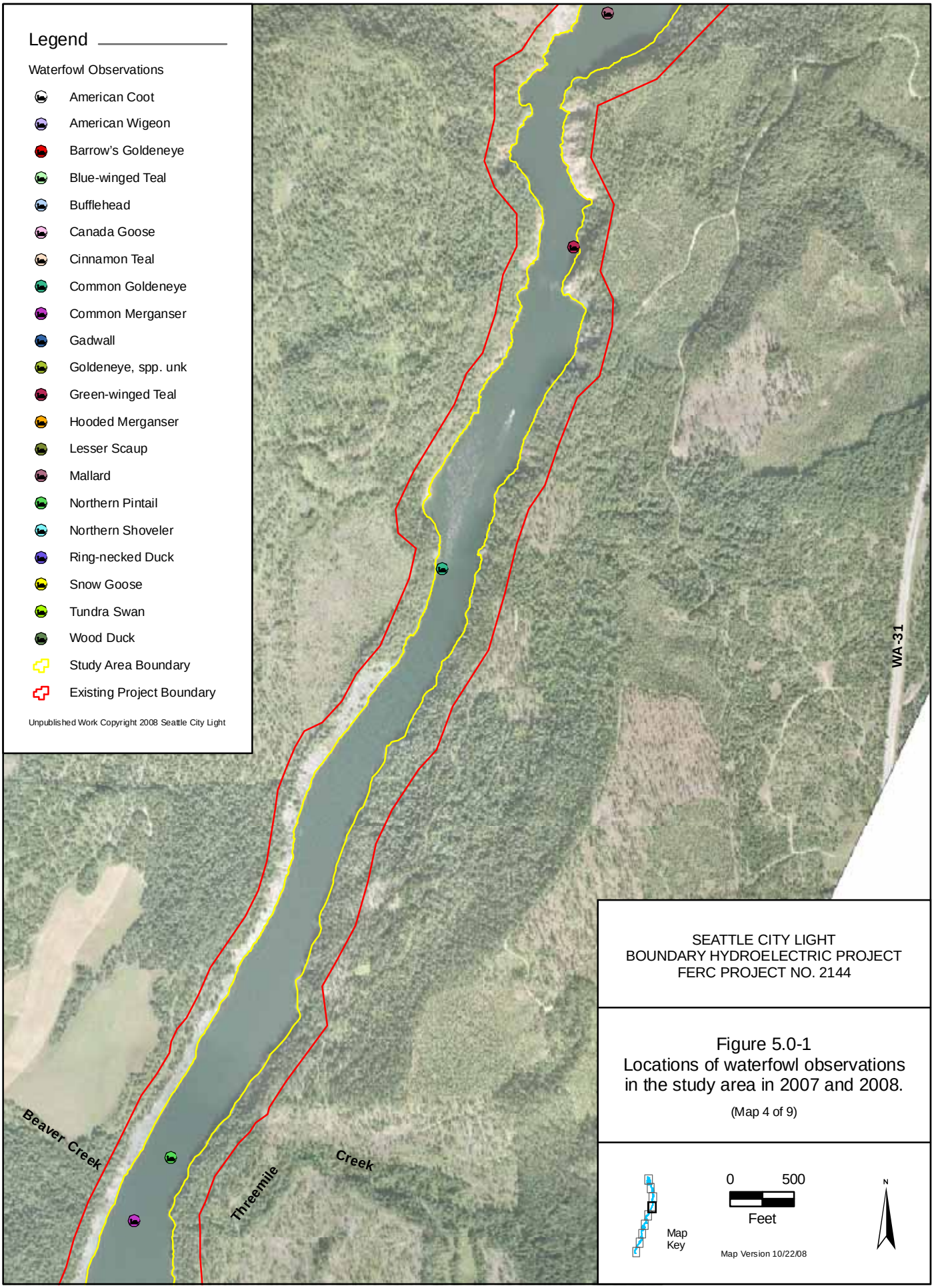

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Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 4 of 9)

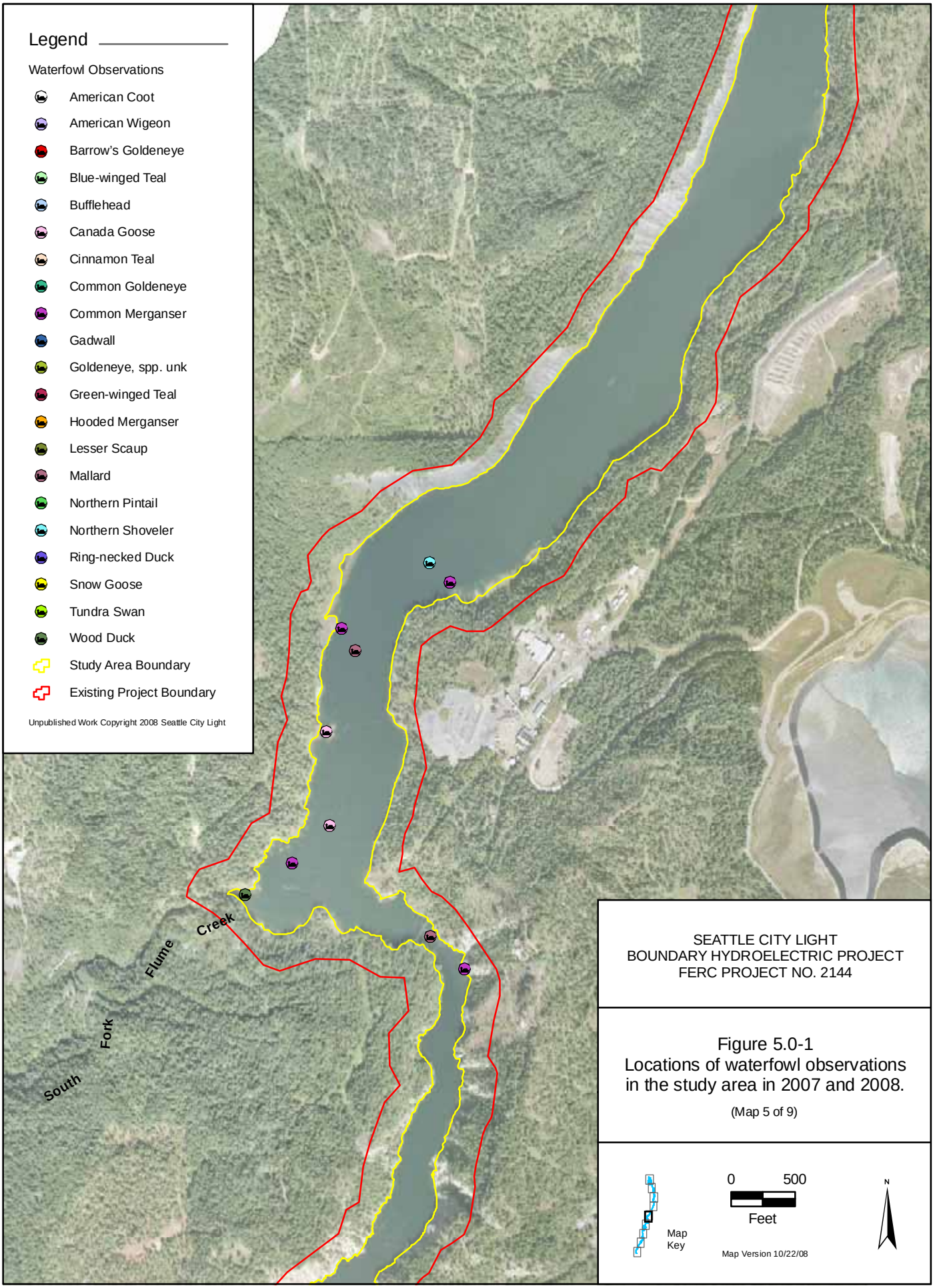

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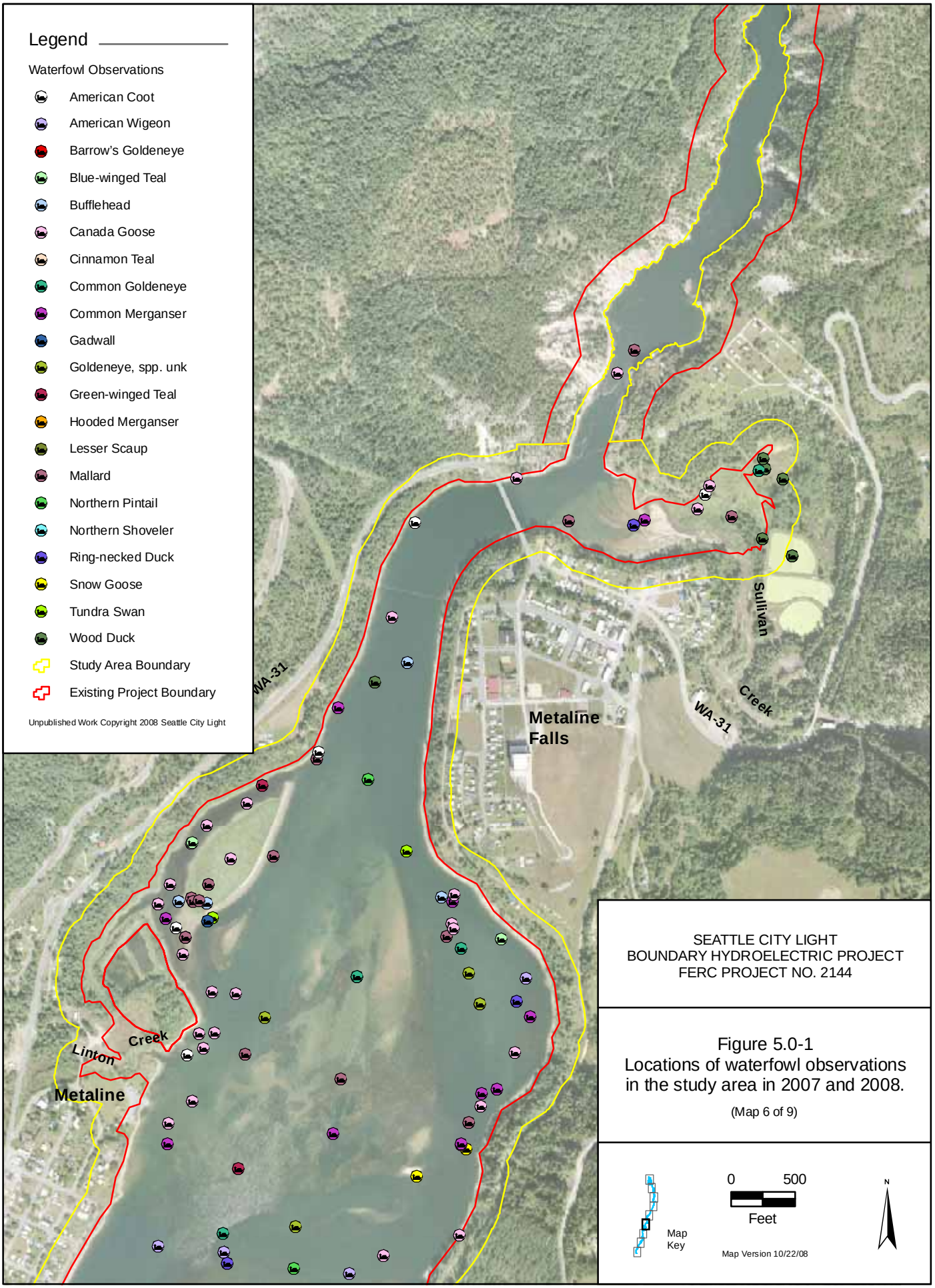
Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 5 of 9)


Legend
Waterfowl Observations
American Coot
American Wigeon
Barrow's Goldeneye
Blue-winged Teal
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Goldeneye, spp. unk
Green-winged Teal
Hooded Merganser
Lesser Scaup
Mallard
Northern Pintail
Northern Shoveler
Ring-necked Duck
Snow Goose
Tundra Swan
Wood Duck
Study Area Boundary
Existing Project Boundary
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Metaline Falls
Sullivan
Creek
WA-31
Linton
Creek
Metaline
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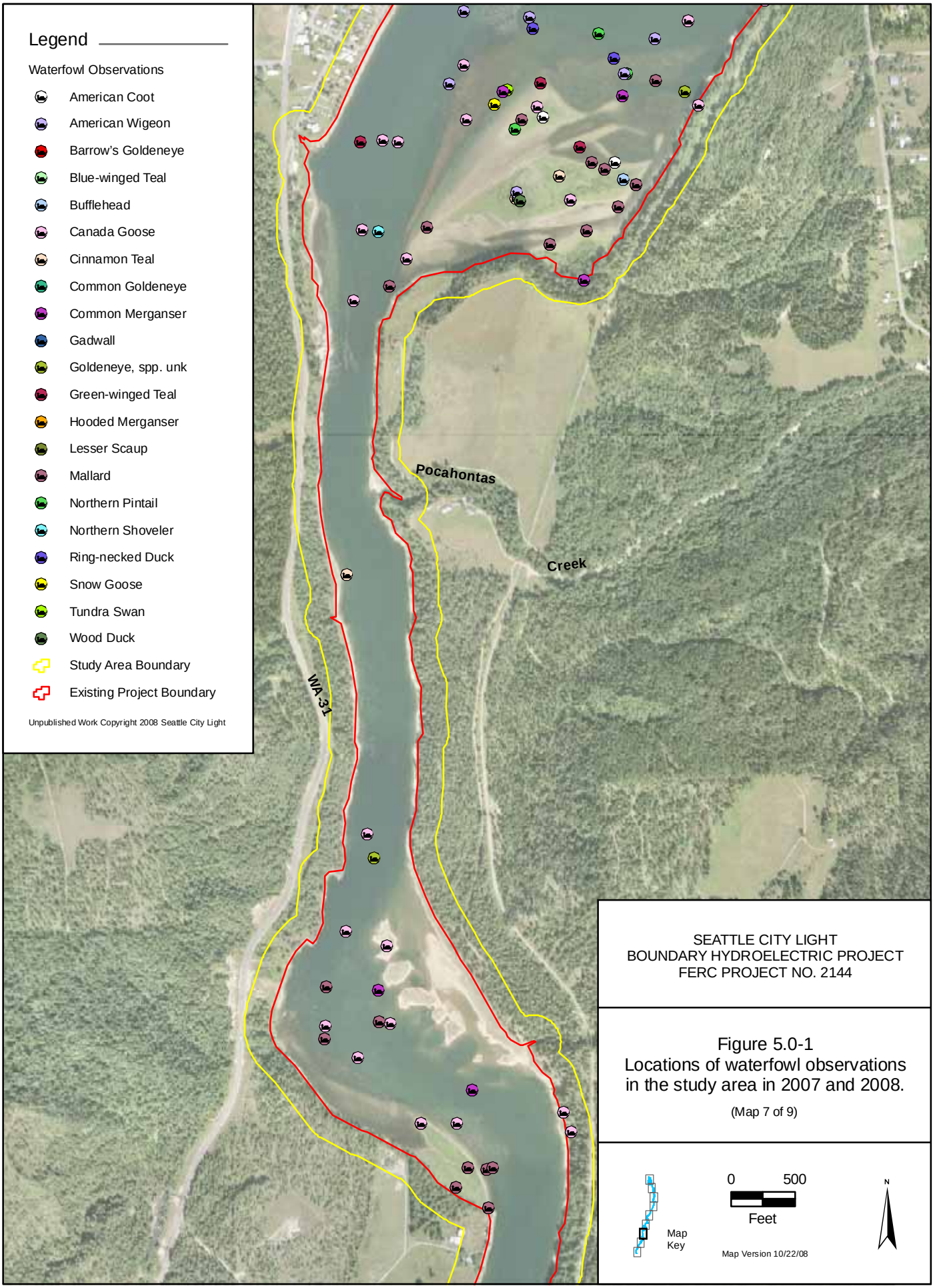
Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.
(Map 6 of 9)
Map Key
0
500
Feet
Map Version 10/22/08
N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Waterfowl Observations
American Coot
American Wigeon
Barrow's Goldeneye
Blue-winged Teal
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Goldeneye, spp. unk
Green-winged Teal
Hooded Merganser
Lesser Scaup
Mallard
Northern Pintail
Northern Shoveler
Ring-necked Duck
Snow Goose
Tundra Swan
Wood Duck
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
Pocahontas
Creek
WA-31
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-1
Locations of waterfowl observations
in the study area in 2007 and 2008.
(Map 7 of 9)
Map
Key
0
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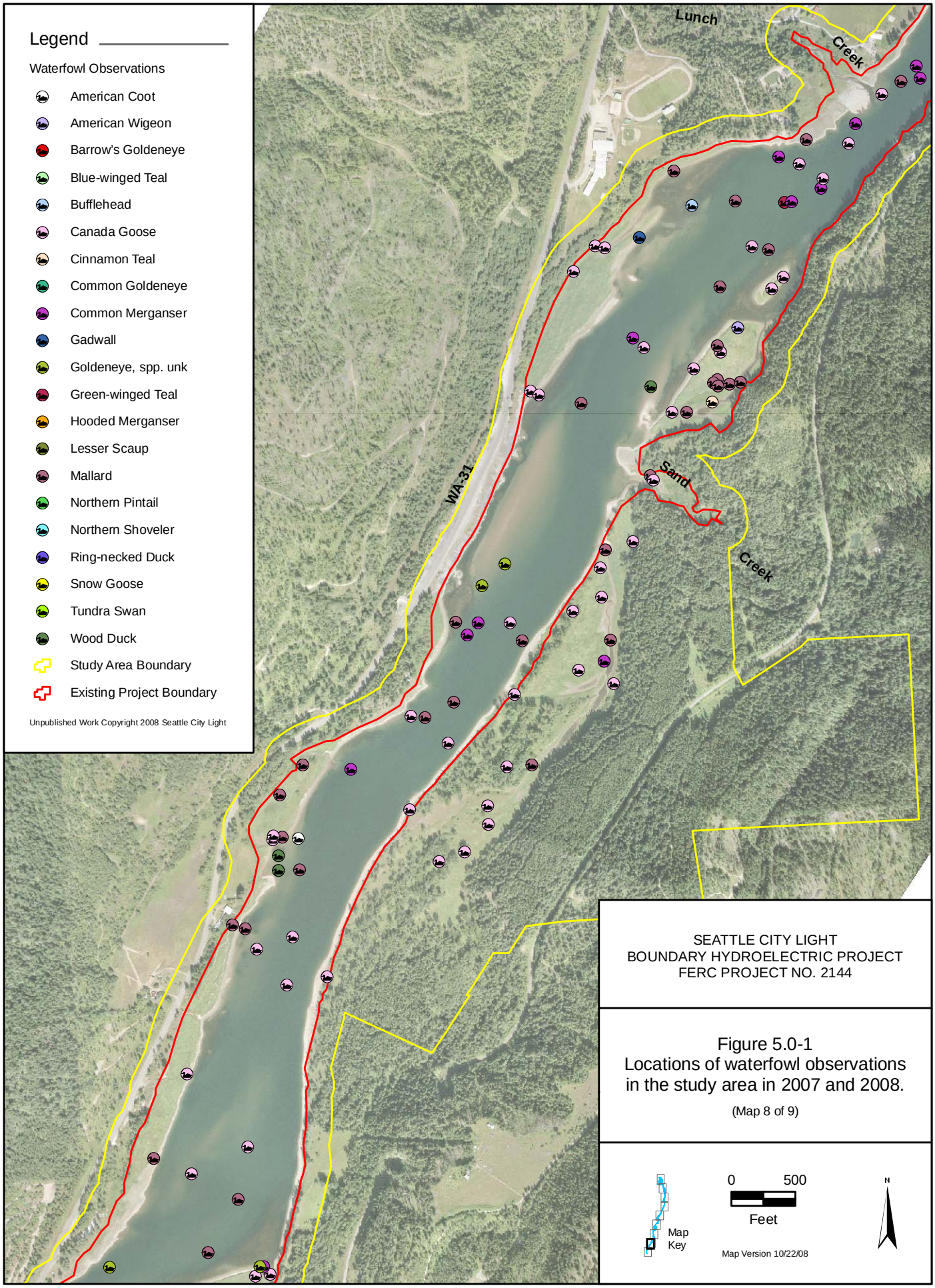
Feet
Map Version 10/22/08
N



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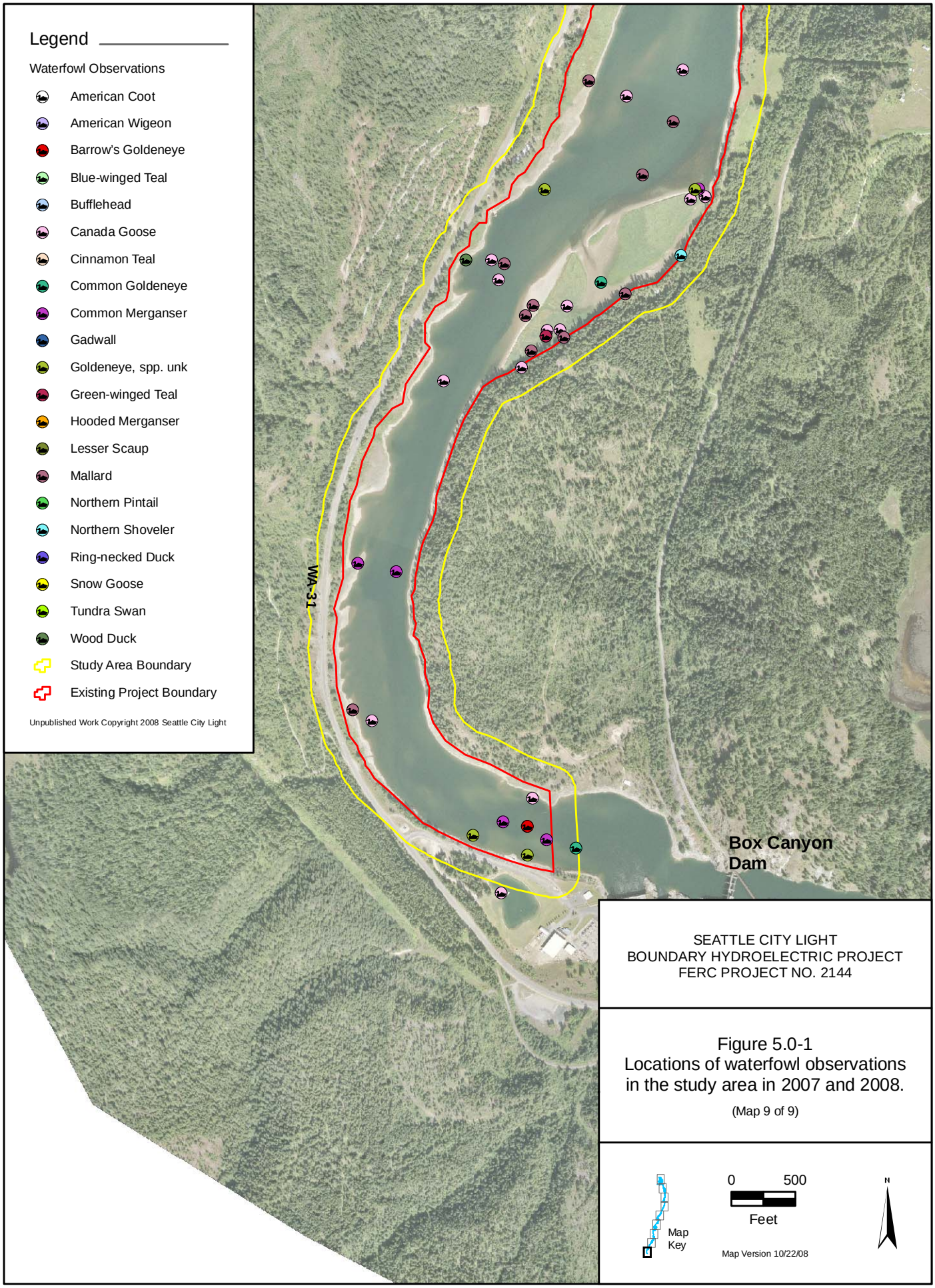
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 8 of 9)



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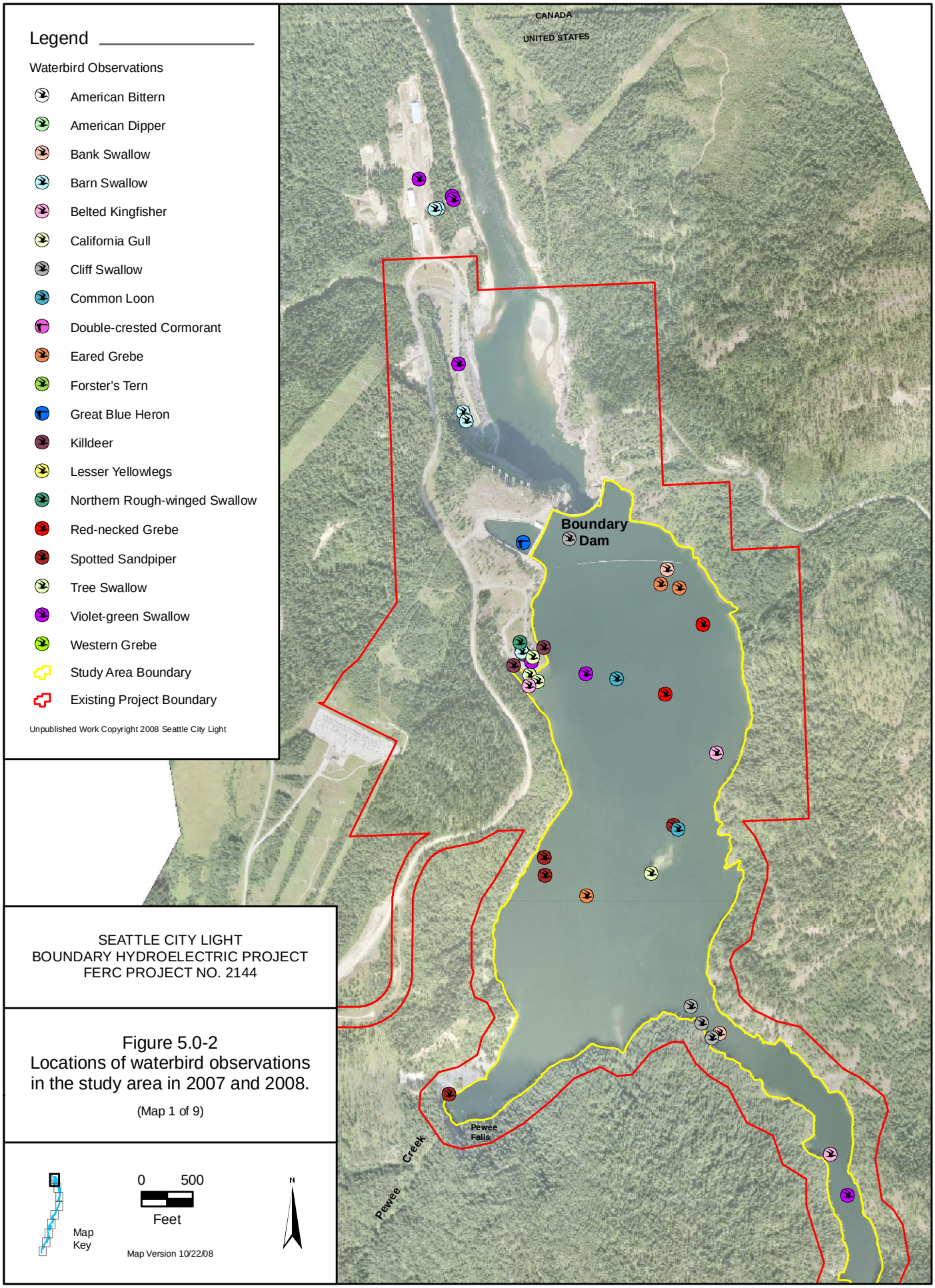
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 5.0-1
Locations of waterfowl observations in the study area in 2007 and 2008.

(Map 9 of 9)



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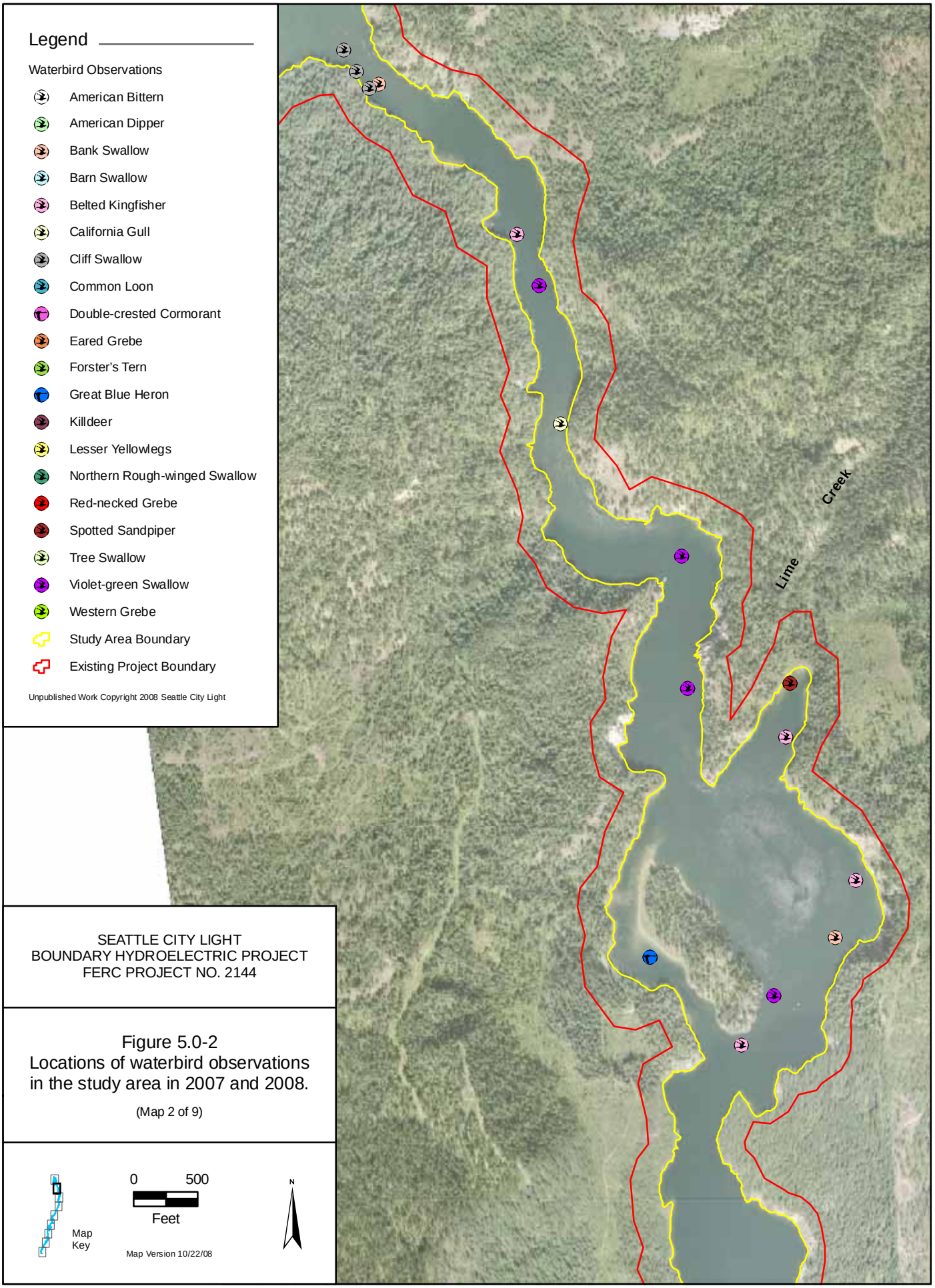
FERC PROJECT NO. 2144

Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 1 of 9)



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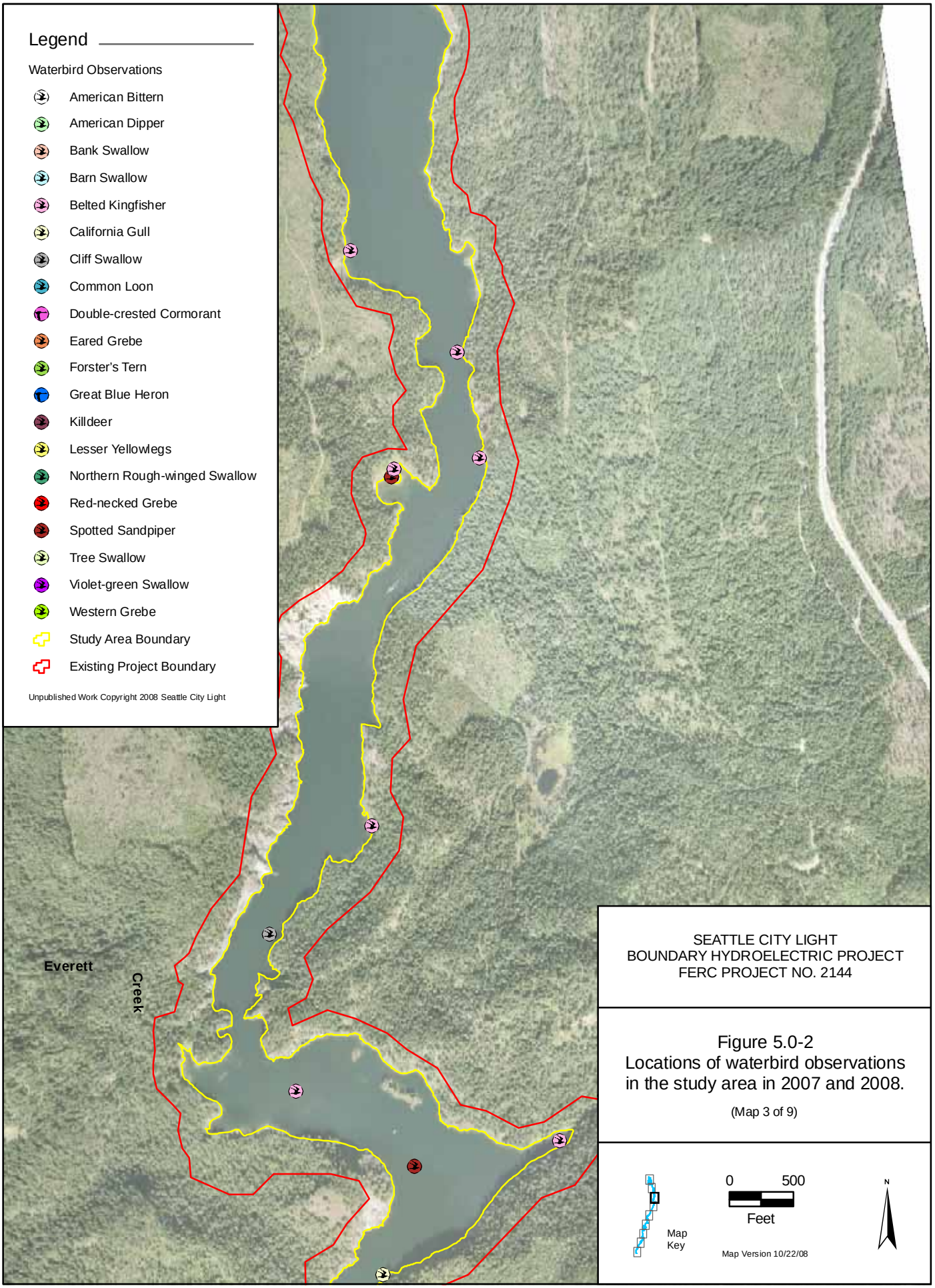
FERC PROJECT NO. 2144

Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 2 of 9)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American Bittern
American Dipper
Bank Swallow
Barn Swallow
Belted Kingfisher
California Gull
Cliff Swallow
Common Loon
Double-crested Cormorant
Eared Grebe
Forster's Tern
Great Blue Heron
Killdeer
Lesser Yellowlegs
Northern Rough-winged Swallow
Red-necked Grebe
Spotted Sandpiper
Tree Swallow
Violet-green Swallow
Western Grebe
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
Everett
Creek
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-2
Locations of waterbird observations
in the study area in 2007 and 2008.
(Map 3 of 9)
Map
Key
0
500
Feet
Map Version 10/22/08
N

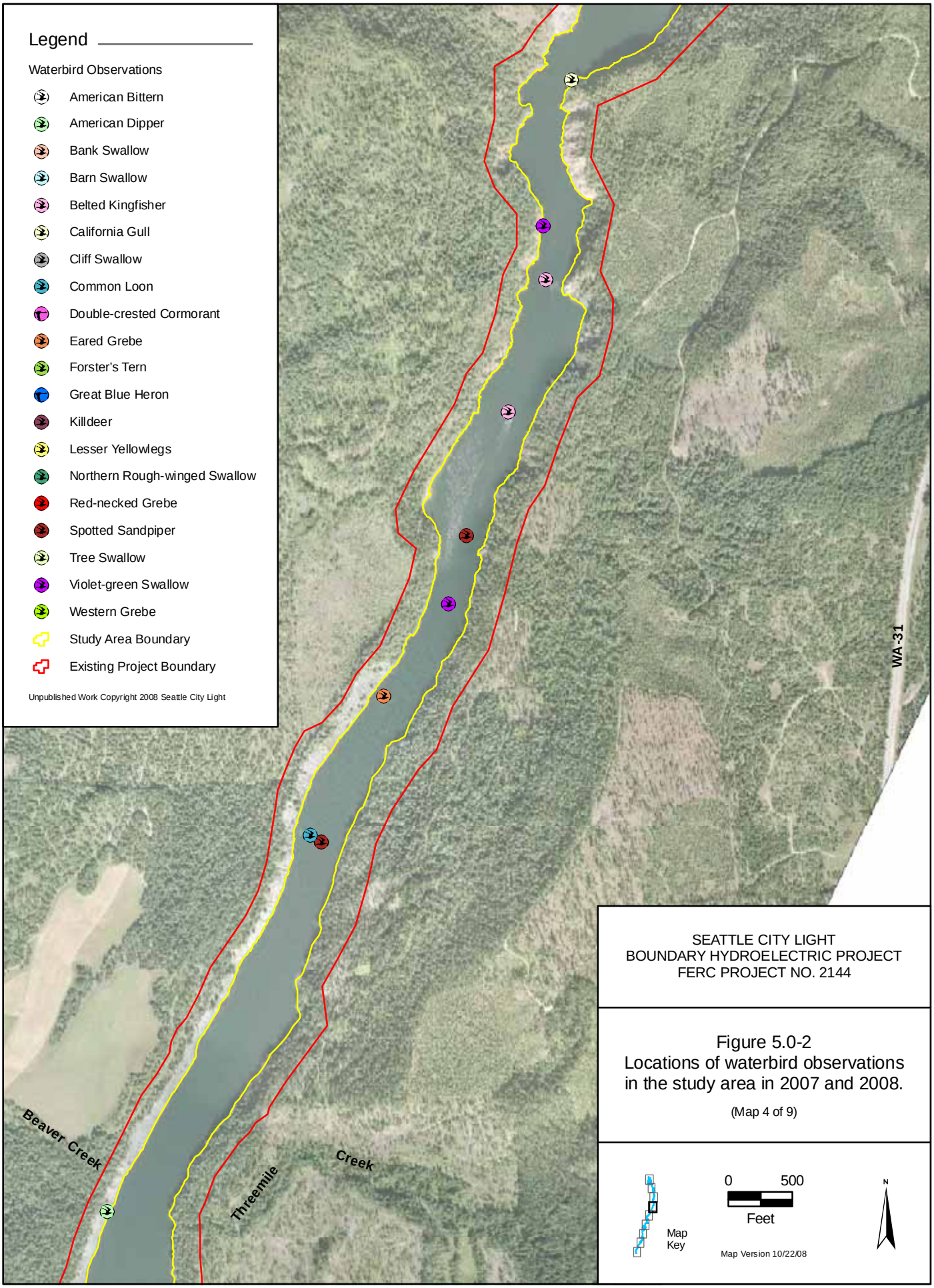

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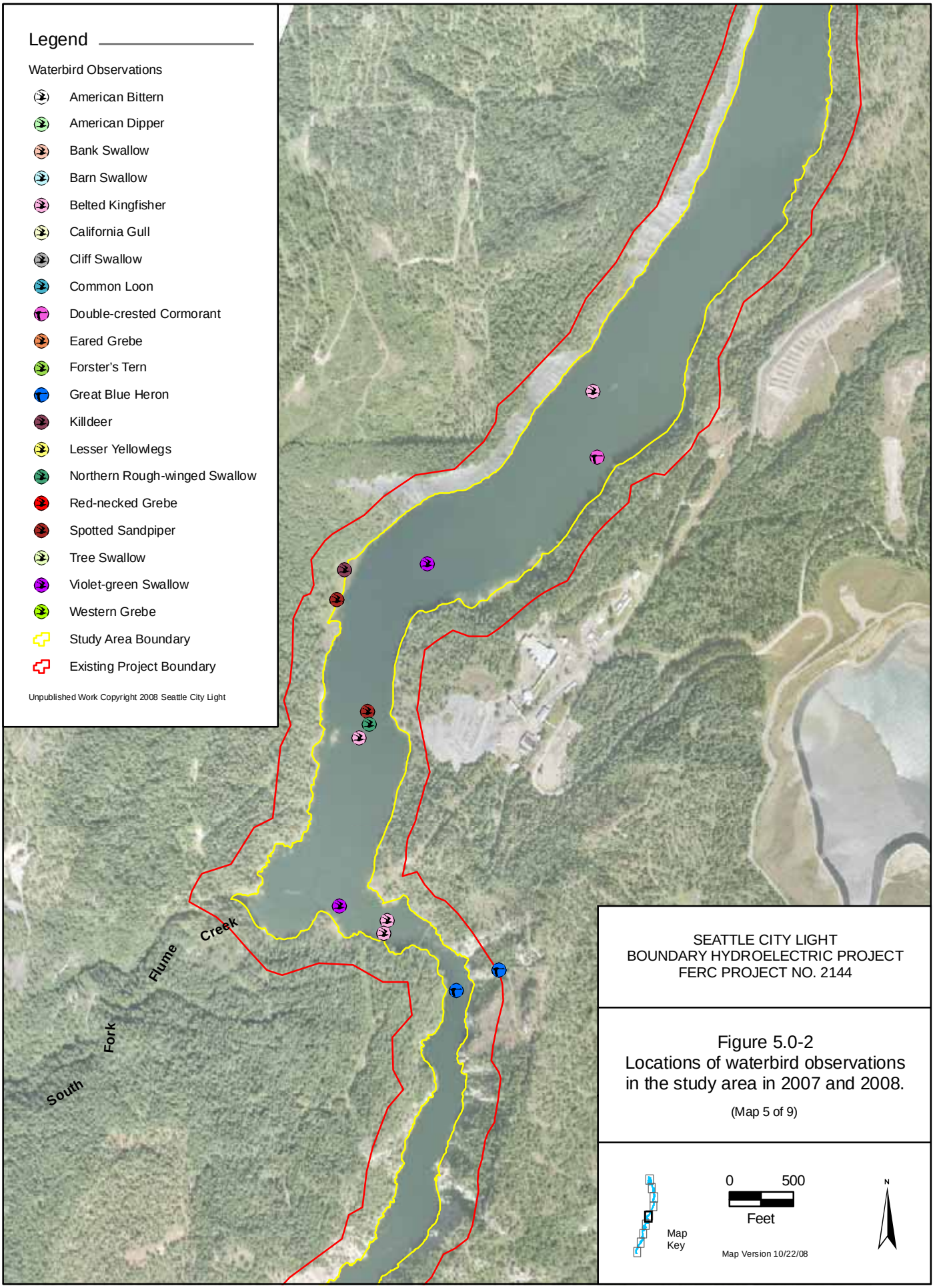
Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 4 of 9)


Legend
Waterbird Observations
American Bittern
American Dipper
Bank Swallow
Barn Swallow
Belted Kingfisher
California Gull
Cliff Swallow
Common Loon
Double-crested Cormorant
Eared Grebe
Forster's Tern
Great Blue Heron
Killdeer
Lesser Yellowlegs
Northern Rough-winged Swallow
Red-necked Grebe
Spotted Sandpiper
Tree Swallow
Violet-green Swallow
Western Grebe
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
South Fork Flume Creek
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.
(Map 5 of 9)
Map Key
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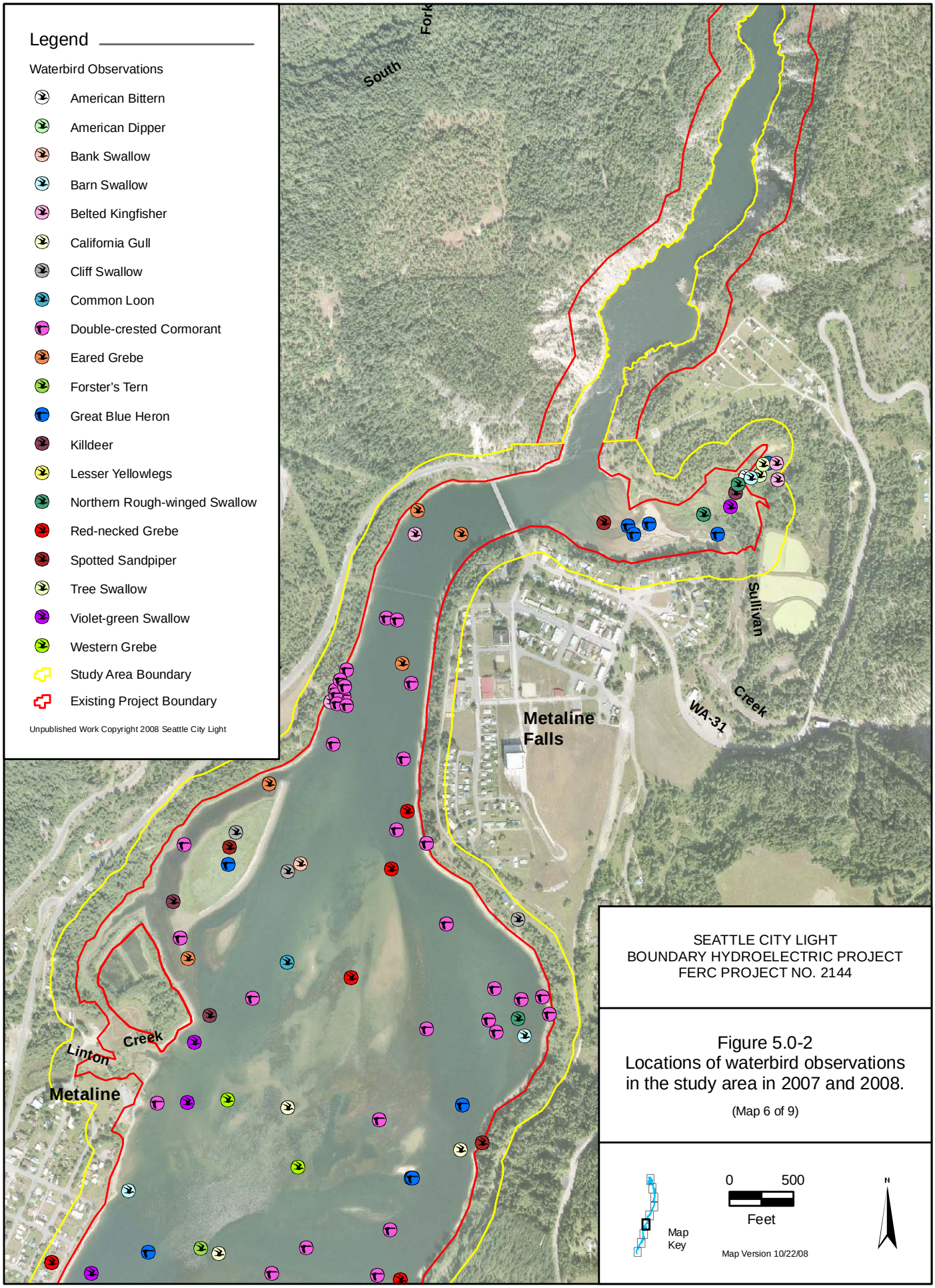
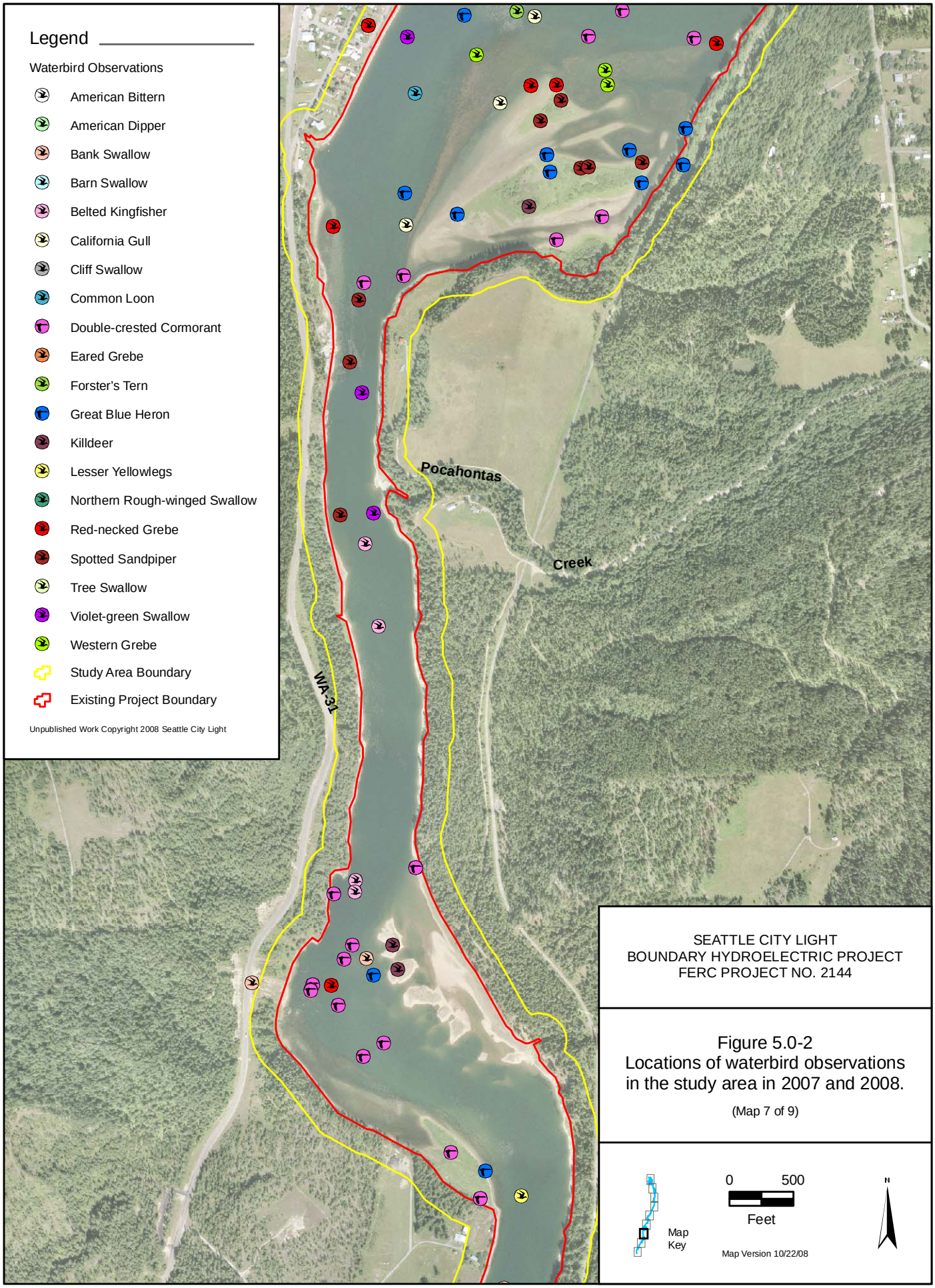
Feet
Map Version 10/22/08
N



SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 6 of 9)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Waterbird Observations
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American Dipper
Bank Swallow
Barn Swallow
Belted Kingfisher
California Gull
Cliff Swallow
Common Loon
Double-crested Cormorant
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Spotted Sandpiper
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Violet-green Swallow
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Pocahontas
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SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-2
Locations of waterbird observations
in the study area in 2007 and 2008.
(Map 7 of 9)
Map
Key
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Map Version 10/22/08
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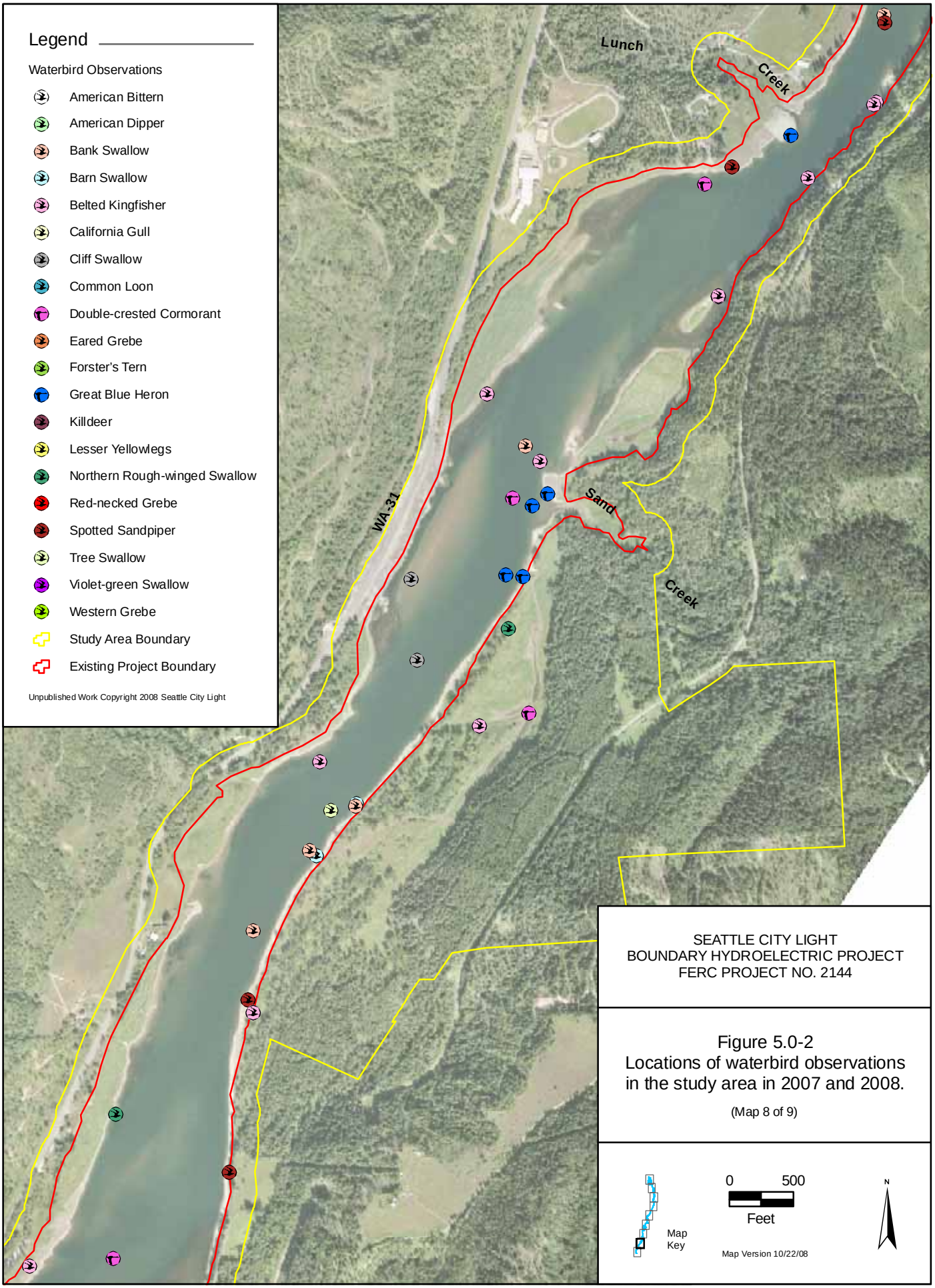
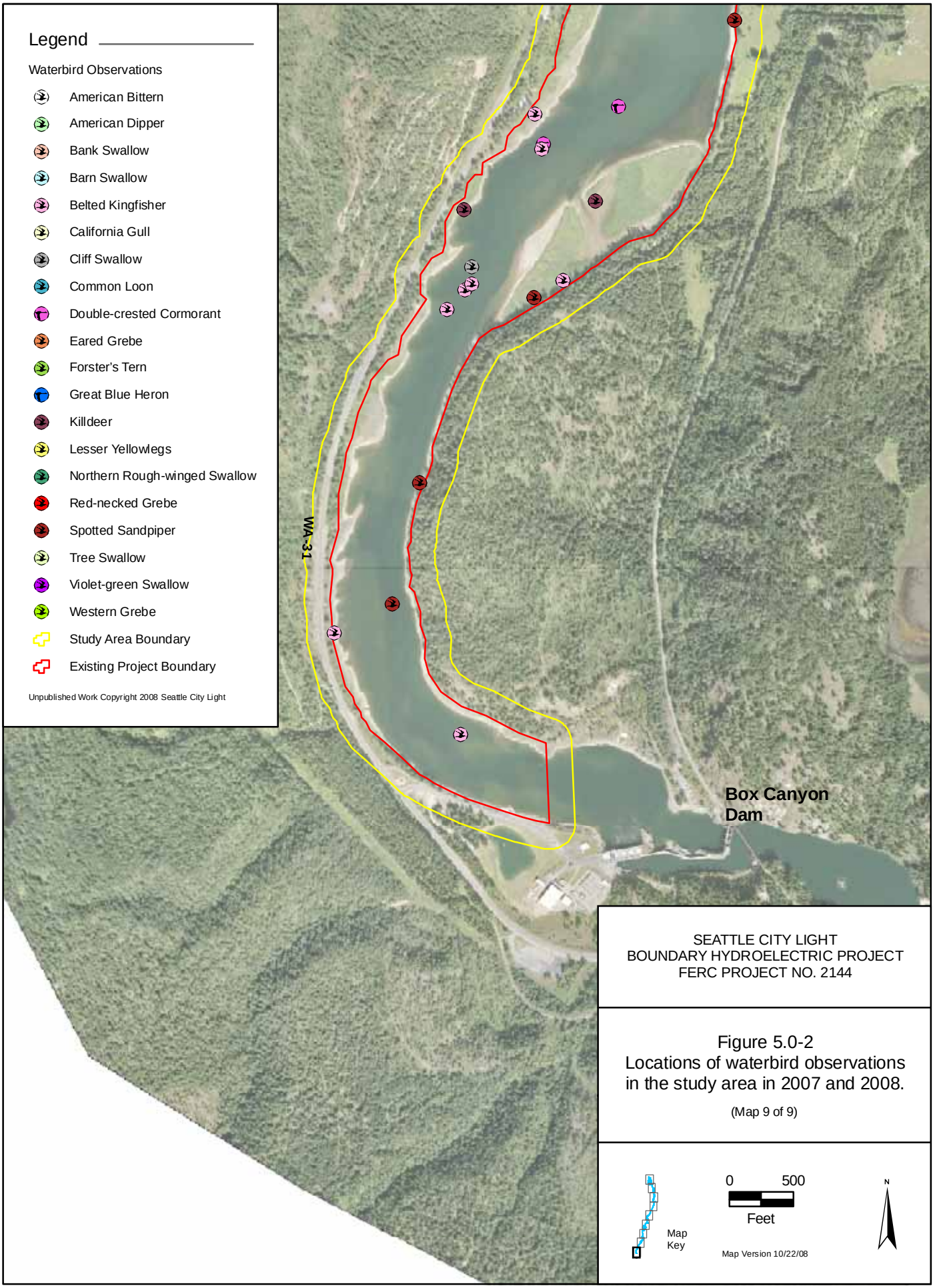


SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 8 of 9)



SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144

Figure 5.0-2
Locations of waterbird observations in the study area in 2007 and 2008.

(Map 9 of 9)

5.1. Map and Estimate Existing Habitat for Ground-nesting Waterfowl

Based on the findings of the spring and early summer surveys of 2007 and 2008, only two species of ground-nesting waterfowl—Canada goose and mallard—are known to nest within the study area. Results of the existing habitat mapping for these two species are presented below.

5.1.1. Canada Geese

Great Basin Canada geese nest in a variety of habitats including cliff-faces, abandoned eagle and osprey nests, on muskrat and beaver houses, on artificial platforms, and on mainland shorelines, but mostly on islands (Fitzner et al. 1994). The peak goose nesting season generally runs from the third week in March to the first of May, although early and late nesting pairs can expand the season from mid-March to mid-May (McCabe 1979). Forty-one of the 44 (93 percent) goose nests recorded in 2007 were found on islands, and 41 of the 45 (91 percent) nests found in 2008 were on islands. Given that two of the non-island nestings were in an abandoned eagle nest on the BWP (in the same nest, once in 2007 and again in 2008), only 6 percent of the nests were mainland ground-nests, and only one of these, a cliff nest, was verified as successful. Consequently, only islands with appropriate vegetation (low, herbaceous species providing protection from the wind without impeding visibility) were considered effective nesting habitat for local Canada geese.

Islands provide ideal nesting habitat largely because they provide protection from terrestrial predators, especially coyotes (*Canis latrans*). Dramatic declines in Canada goose nesting success have been recorded where coyotes have gained access to islands, because of 1) land-bridging, 2) a shortened distance between the island and the mainland due to lowered water levels; or 3) shallower water between the mainland and island (Fitzner et al. 1994; Zoellick et al. 2004). Land-bridging is a concern to nesting geese where it allows mammalian predators, especially coyotes, access to nesting islands (Craighead and Craighead 1949; Geis 1956; Hanson and Eberhardt 1971; Zoellick et al. 2004). Zoellick et al. (2004) investigated the impacts of land-bridging on goose nesting islands in the Snake River and concluded that coyotes could access islands when water depth was less than 1.5 feet. Thus, for this study, an island was considered land-bridged when water depth in the adjoining channel was less than 1.5 feet.

5.1.1.1. Upper Reservoir

There are five islands (or island complexes) in the upper reservoir between Metaline Falls and Box Canyon Dam (Figure 5.1-1). One set of the islands, the cobble islands at Project river mile (PRM) 30.2, is devoid of cover and does not provide suitable waterfowl nesting habitat. Collectively, the remaining four sets of islands provide approximately 35.2 acres of potential nesting habitat for Canada geese (when the water surface elevation at Boundary forebay is at a median 1,990 feet NAVD 88 [1,986 feet NGVD 29] during the nesting season):

1. The large island immediately north of the town of Metaline (8.2 acres) is covered mainly by reed canarygrass and is separated from the mainland by a 4- to 5-foot channel (located at PRM 27.7).

2. A large complex of islands (PRM 28.9) dominated by stands of red-osier dogwood (*Cornus sericea*) occurs across the river from the town of Metaline. Depending on water surface elevations, this complex can become a single island or separate into four islands. At the median water surface elevation during the nesting season, there are approximately 14.5 acres of exposed nesting habitat. This island complex is occasionally connected to the mainland via a land-bridge and is within the Metaline bald eagle territory.

3. A large island near Sand Creek (5.9 acres, PRM 31.5) is located adjacent to a much smaller island (0.3 acre, PRM 31.3). Both are covered by reed canarygrass and separated from the mainland by a narrow channel, although the smaller island is isolated from the mainland by a much deeper (approximately 5- to 6-foot) channel. The larger island often land-bridges, and both are in close proximity to the Sand Creek bald eagle nest site.

4. The last island complex is located just below the Box Canyon Dam tailrace (at PRM 33.2). It is covered with reed canarygrass and separates into two and three islands during high water. At the median pool elevation during the goose nesting season, there are 6.3 acres of island habitat (although slightly higher water levels can separate additional portions of the complex from the mainland doubling the total island acreage). It is separated from the mainland by a very narrow channel and often land-bridges. The island is in close proximity to the Box Canyon bald eagle nest site.

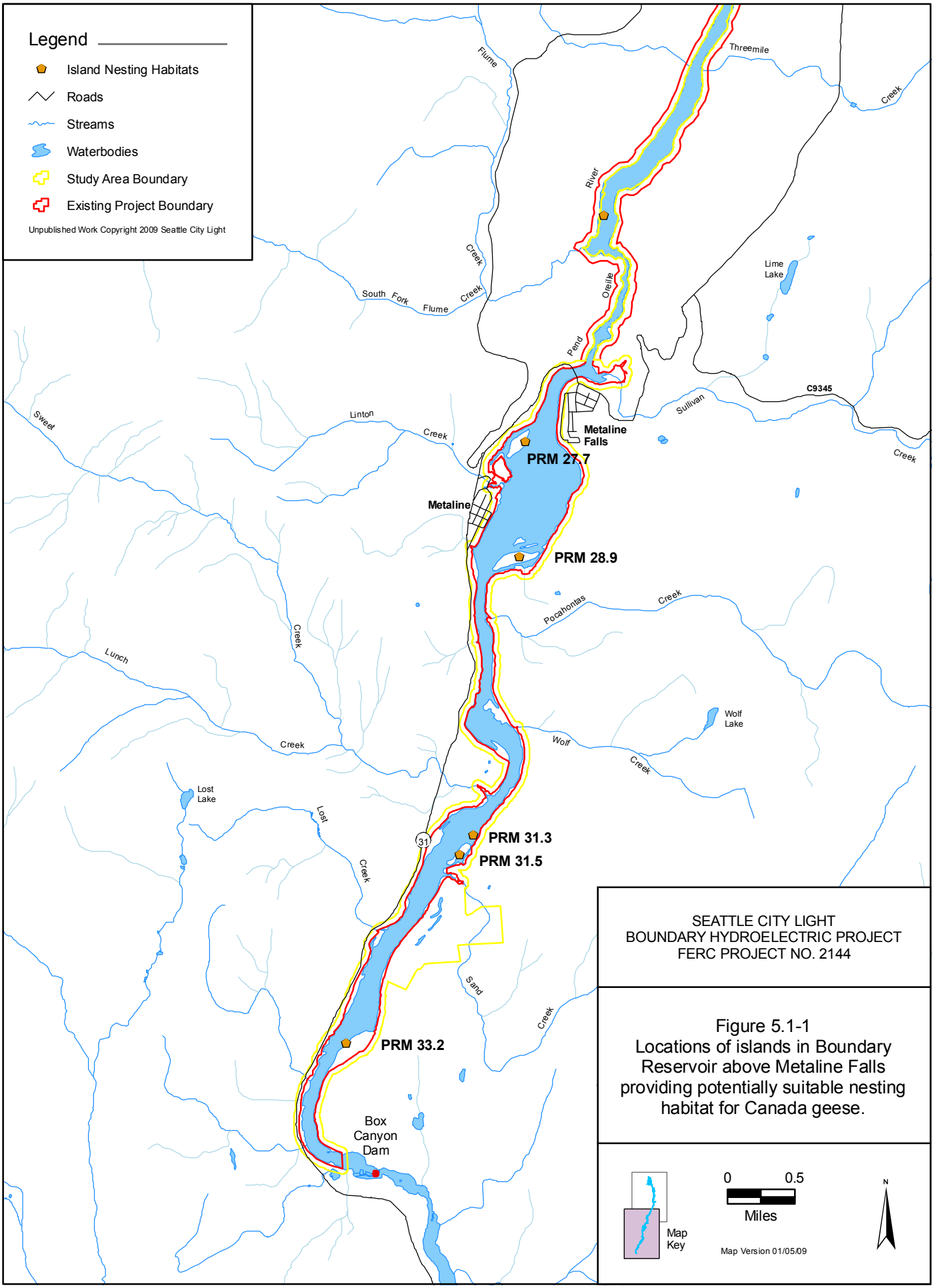


Figure 5.1-1
Locations of islands in Boundary Reservoir above Metaline Falls providing potentially suitable nesting habitat for Canada geese.

The analysis revealed that land-bridging occurred during the 2007 nesting season (March 15 to May 15) on the island complexes at PRMs 28.9, 31.5, and 33.2 (26.7 total acres). No land-bridging occurred during the goose nesting season at the islands at PRM 27.7 or PRM 31.3 (8.5 total acres). The historical hydrologic record confirms this pattern; water depths were less than 1.5 feet 17.7 to 76.8 percent of the time during the goose nesting season at the island complexes at PRMs 28.9, 31.5, and 33.2 during dry years, and 14.0 to 44.6 percent of the time during average years (Table 5.1-1). The hydrologic record also confirms that the islands at PRMs 27.7 and 31.3 rarely land-bridge during the goose nesting season, never during wet years. Possible effects of land-bridging on nesting success are addressed in Section 5.3.

Table 5.1-1. Percent of time from March 15 to May 15 that islands in the upper reservoir land-bridge (less than 1.5 feet of water depth between the island and the mainland at any point) in a representative dry year (2001), average year (2002), and wet year (1997).

Island Location	Island Acreage	Land-bridge Surface Elevation (feet NAVD 88)	Percent of Time Land-bridged March 15–May 15		
			2001 (dry)	2002 (average)	1997 (wet)
PRM 33.2	6.3	1,993.2	76.8	42.7	6.3
PRM 31.5	5.9	1,992.9	73.4	44.6	6.4
PRM 31.3	0.3	1,985.9	0.4	0.2	0.0
PRM 28.9	14.5	1,989.5	17.7	14.0	1.0
PRM 27.7	8.2	1,986.7	2.6	2.0	0.0

Note:
PRM – Project river mile

Changes in water surface elevations in the reservoir due to operations and flood events have the potential to inundate goose nests (Rocklage et al. 2003). None of the nest sites established in the study area during the primary nesting season in 2007 was flooded. Two late nests (hens still on eggs on May 11, 2007) established near the water's edge at the south end of island at PRM 27.7 were flooded by high water, but apparently only briefly because both nests were successful. In 2008, snow delayed the start of nesting, and predation from ravens further resulted in re-nesting later in the breeding season. Some of these late nests may have been lost during the high spring runoff in 2008 (see Section 5.3).

Examination of the hydrologic record (1987–2005) indicated that high water events during the March 15 to May 15 nesting season had the potential to flood at least one goose nests in 10 of the 19 years (Figure 5.1-2). Assuming that the 2007 distribution and number of goose nests on islands in the upper reservoir was representative of the years included in the hydrologic record, no nests would have been inundated in 9 of these years because water surface elevations never reached the elevation (2,000.6 feet NAVD 88 [1,996.6 feet NGVD 29] at the Box Canyon gage) where the lowest goose nest would have flooded (Figure 5.1-2). In 1997, the year with the highest flows on record, water surface elevations were high enough (greater than 2,009 feet NAVD 88 [2,005 feet NGVD 29] as measured at the Box Canyon gage) on April 28 (well before expected hatch dates) to flood all of the islands used for nesting by Canada geese.

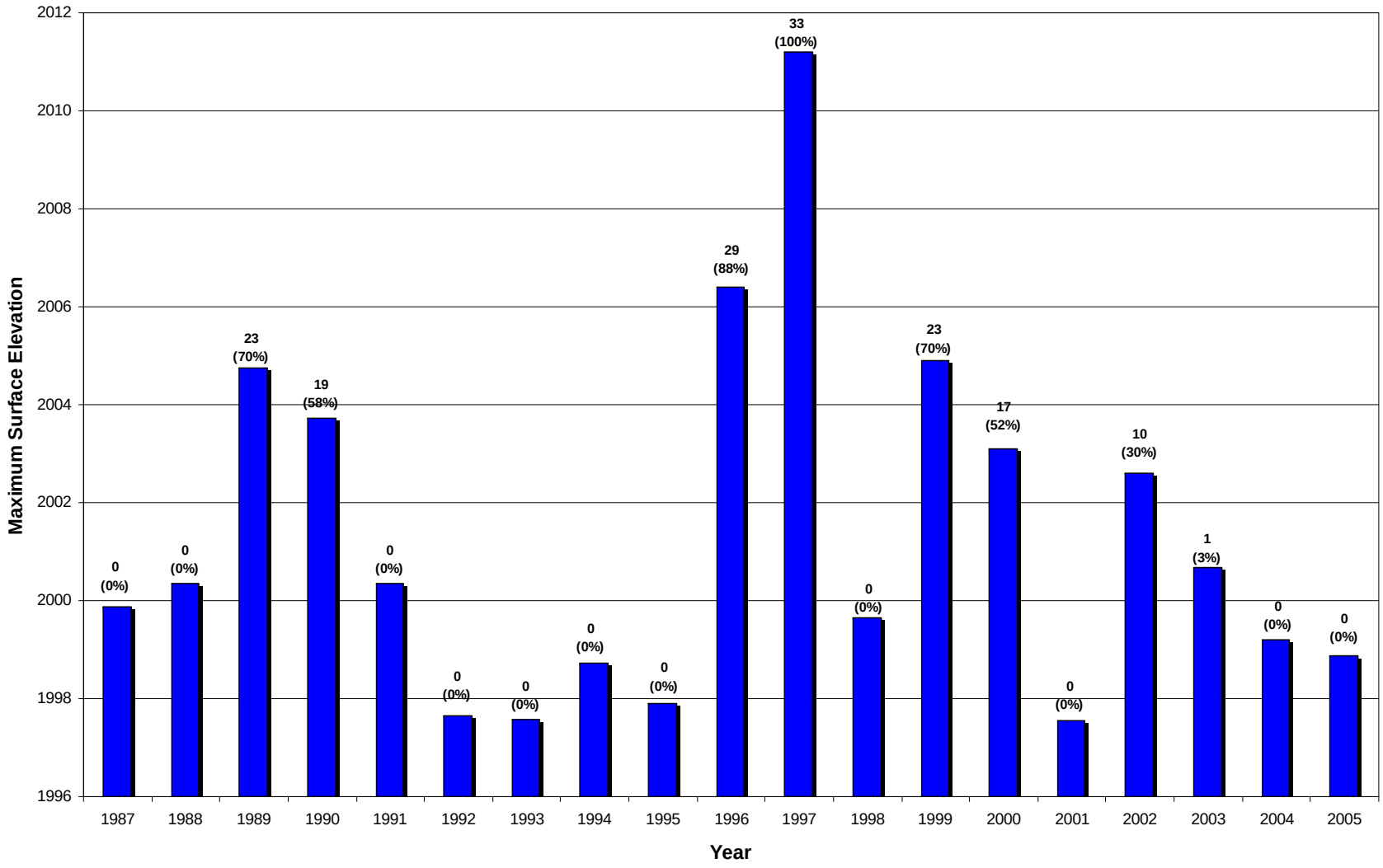


Figure 5.1-2. Theoretical number of goose nests lost to flooding by year, showing number of nests lost (percentage of nests lost shown in parentheses). Maximum surface elevation is the water surface elevation, as measured at the Box Canyon gage, at which goose nests flood.

5.1.1.2. Lower Reservoir

There are four small islands in the lower reservoir downstream of Metaline Falls, each of which was used by at least one nesting pair in 2007, and three of which were used in 2008 (Figure 5.1-3). These islands include Rat Island (PRM 17.7) located in the Boundary forebay, and three small islands located at PRMs 22.0, 22.1, and 25.6; collectively, these islands total 0.74 acre, and none land-bridge during normal Project operations. A fifth island, Everett Island (PRM 19.6), is large (approximately 13 acres), wooded, and separated from the mainland by a shallow channel (and frequently land-bridges). The land-bridging and an established bald eagle nesting territory may preclude goose nesting on this island.

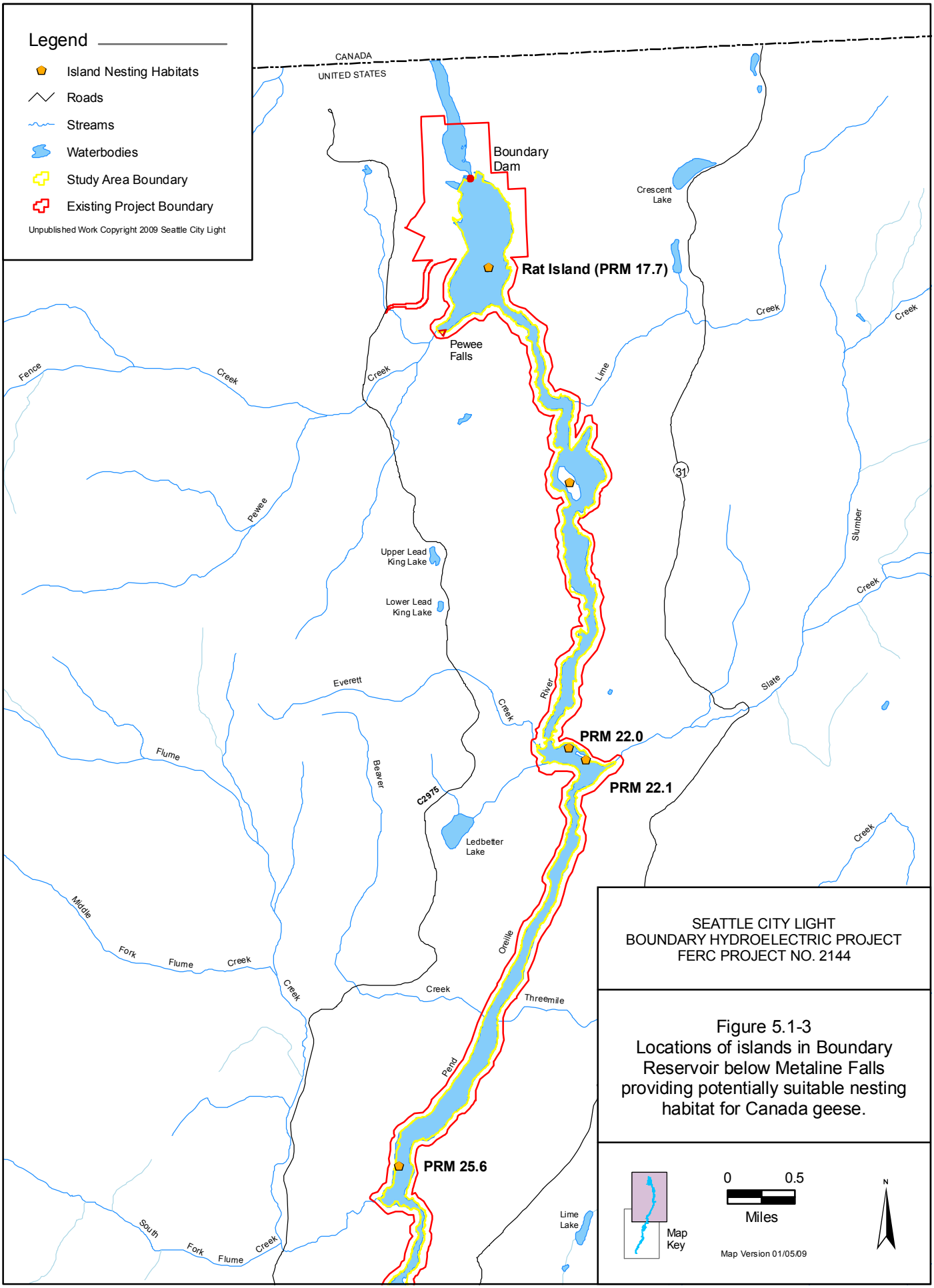


Figure 5.1-3
Locations of islands in Boundary Reservoir below Metaline Falls providing potentially suitable nesting habitat for Canada geese.

5.1.2. Mallards

Although mallards nest in a wide variety of habitats (Drilling et al. 2002), some of which are available along Boundary Reservoir, the study area does not appear to support an abundance of breeding mallards (see Section 5.3). It is unclear whether nesting habitat is limited, if another habitat component (such as brooding habitat) is lacking, or if some other factor is responsible for low mallard production in the study area. Further, defining suitable mallard breeding habitat is difficult because this species nests in a wide variety of habitats, including conditions with marginal cover values. For example, mallards have been found nesting in conifer forest communities (Drilling et al. 2002). In general, the most important component of mallard nesting habitat appears to be overhead cover capable of concealing nests (Drilling et al. 2002), such as dense aquatic or riparian vegetation or terrestrial vegetation dominated by shrubs (e.g., common snowberry [*Symphoricarpos albus*]).

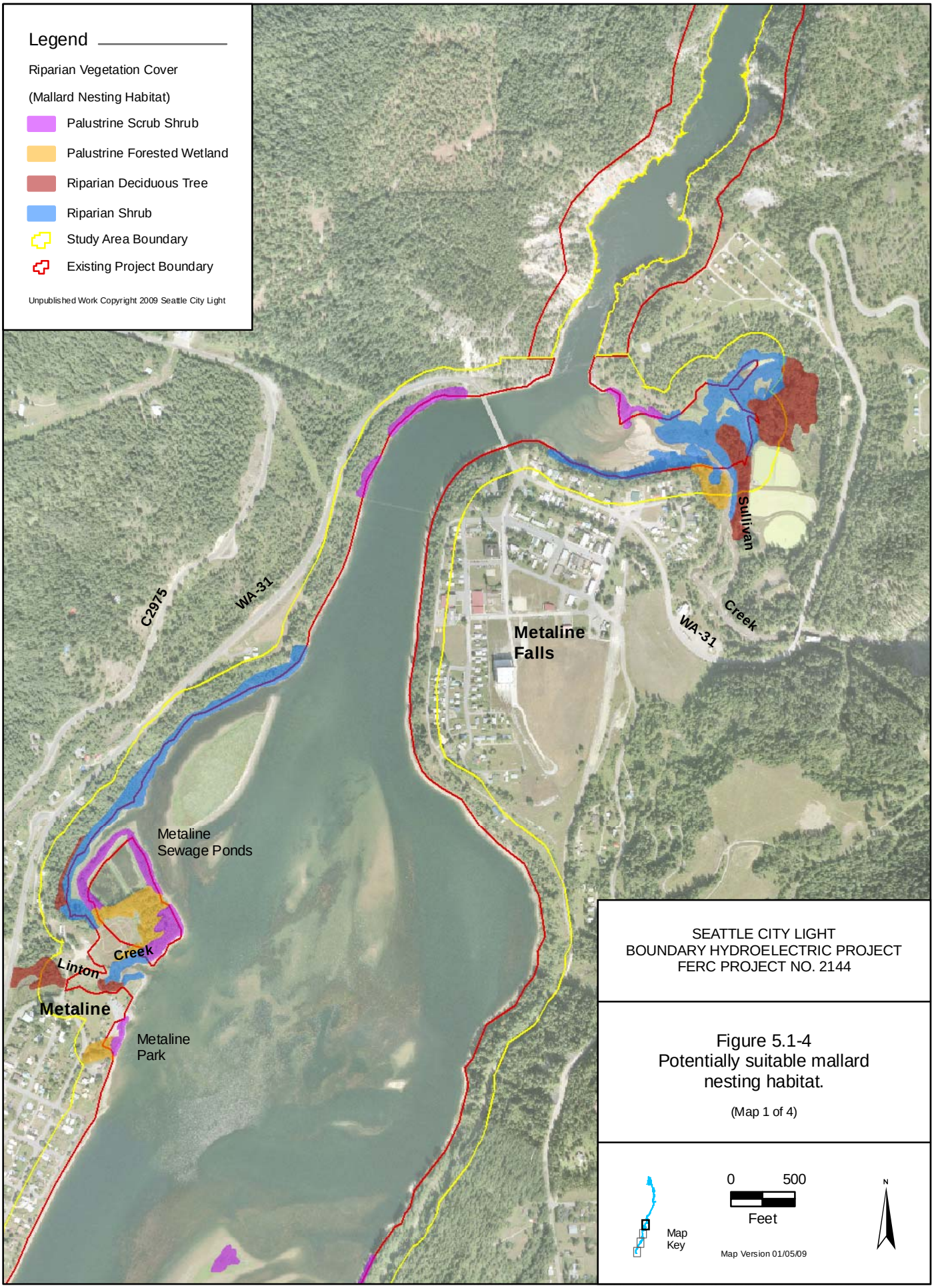
As identified in Study 16 (SCL 2009b), woody riparian habitats in the study area appear to be suitably dense to conceal mallard nests. A total of 93.6 acres, including riparian shrubs (16.5 acres), palustrine scrub-shrub wetlands (29.7 acres), palustrine forested wetlands (43.4), and riparian deciduous trees (with dense shrub understories; 38.9 acres), were classified as potential mallard nesting habitat along the upper reservoir (Figure 5.1-4). Riparian areas dominated by reed canarygrass (*Phalaris arundinacea*) were not considered suitable nesting habitat for mallards. This invasive species forms such dense swards during the duck peak nesting season (April 15 to June 15) that it provides little value to nesting ducks (Maia 1994).

The amount of potential mallard habitat that would have been inundated during wet, dry, and average years was estimated to assess the potential impact on mallard nesting success. The maximum water surface elevations in the upper reservoir, as measured at the Box Canyon gage (USGS gage 12396500), were 2,019 feet NAVD 88 (2,015 feet NGVD 29) for the representative wet year (1997), 1,997.5 feet NAVD 88 (1,993.5 feet NGVD 29) for the dry year (2001), and 2,011.5 feet NAVD 88 (2,007.5 feet NGVD 29) for the average year (2002). The year 2002 represents the average annual conditions from 1913 to 2006 (R2 Resource Consultants, Inc. 2008) but average conditions have been much drier since 1987. Therefore, the maximum water surface elevation during the mallard nesting season for 1989 was also evaluated because this year represents average conditions for the April 15 to June 15 mallard (peak) nesting period (Drilling et al. 2002) for the 19-years since 1987 (1987–2005) (R2 Resource Consultants, Inc. 2008). In 1989, the maximum water surface elevation was approximately 2,005 feet NAVD 88 (2,001 feet NGVD 29) at the Box Canyon gage.

The wet year of 1997 would have flooded over 90 percent of the potential mallard nesting habitat including the higher elevation palustrine forested wetlands and riparian deciduous tree habitats dominated by black cottonwoods (*Populus balsimifera* var. *trichocarpa*). The dry year of 2001 would have flooded less than 10 percent of the palustrine scrub-shrub and riparian shrub habitats occurring along the reservoir fringe. Much of this affected habitat would be the coyote willow (*Salix exigua*) stands that do not represent high quality nesting habitat.

In 1989, approximately 50 percent of the palustrine scrub-shrub and riparian shrub habitats, and 10 percent of the palustrine forested wetlands and riparian deciduous tree habitats would have flooded. In 2002, greater than 75 percent of the palustrine scrub-shrub and riparian shrub

habitats, and about 50 percent of the palustrine forested wetlands and riparian deciduous tree habitats would have flooded. In general, high flows associated with the annual spring runoff, even during average hydrologic conditions, have the potential to flood significant amounts of potential mallard nesting habitat during the early portion of the nesting season. Still, large amounts of nesting habitat would remain available in all but the most extreme flood years. Mallards often nest at locations greater than 500 feet from water and are often known to re-nest after initial nest loss (Drilling et al. 2002).


Legend
Riparian Vegetation Cover
(Mallard Nesting Habitat)
Palustrine Scrub Shrub
Palustrine Forested Wetland
Riparian Deciduous Tree
Riparian Shrub
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2009 Seattle City Light
C2975
WA-31
Metaline Falls
Sullivan
Creek
WA-31
Metaline Sewage Ponds
Linton
Creek
Metaline
Metaline Park
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.1-4
Potentially suitable mallard nesting habitat.
(Map 1 of 4)
Map Key
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500
Feet
Map Version 01/05/09
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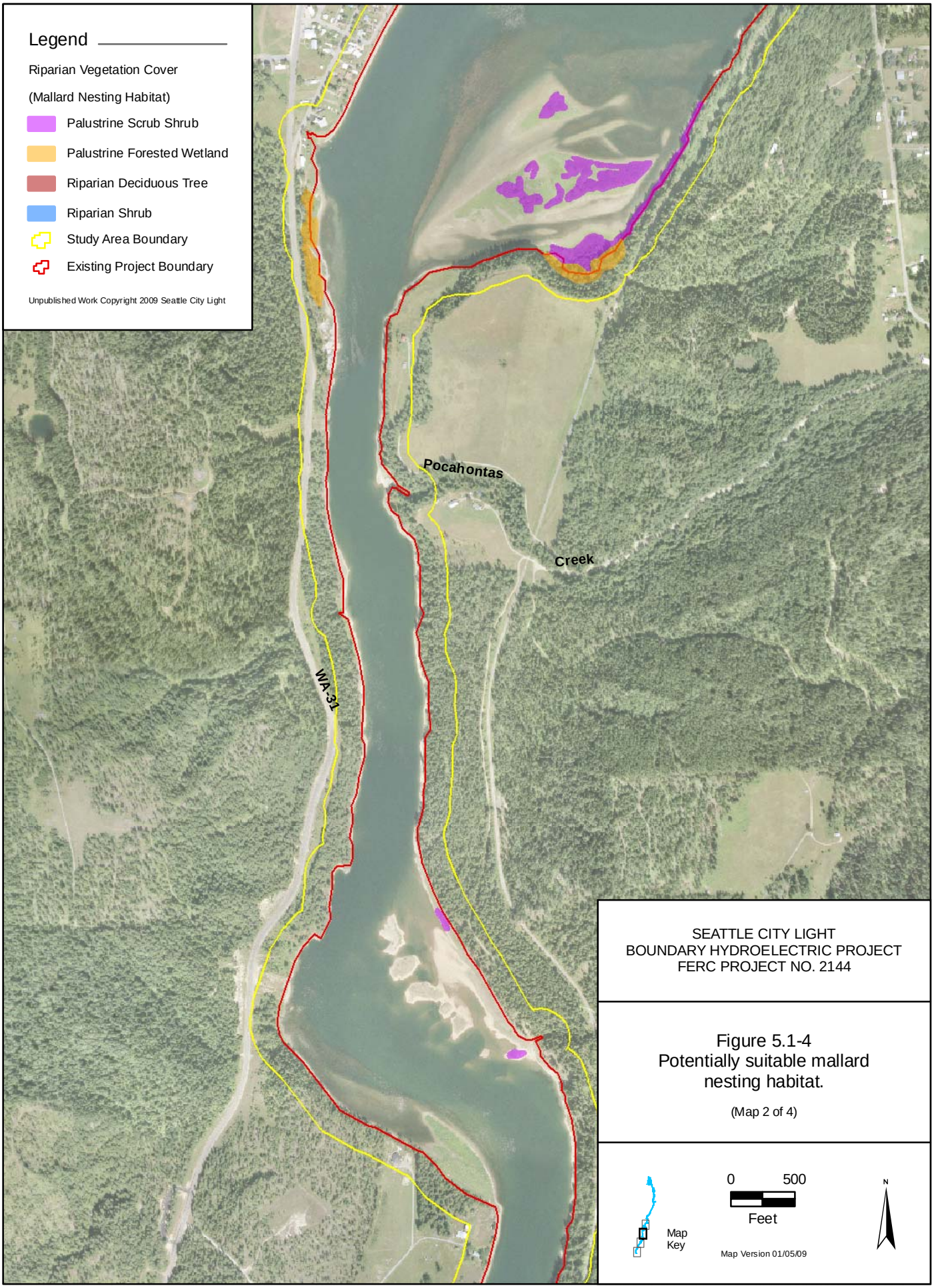
Legend
Riparian Vegetation Cover
(Mallard Nesting Habitat)
Palustrine Scrub Shrub
Palustrine Forested Wetland
Riparian Deciduous Tree
Riparian Shrub
Study Area Boundary
Existing Project Boundary
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Pocahontas
Creek
WA-31
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.1-4
Potentially suitable mallard nesting habitat.
(Map 2 of 4)
Map Key
0
500
Feet
Map Version 01/05/09
N

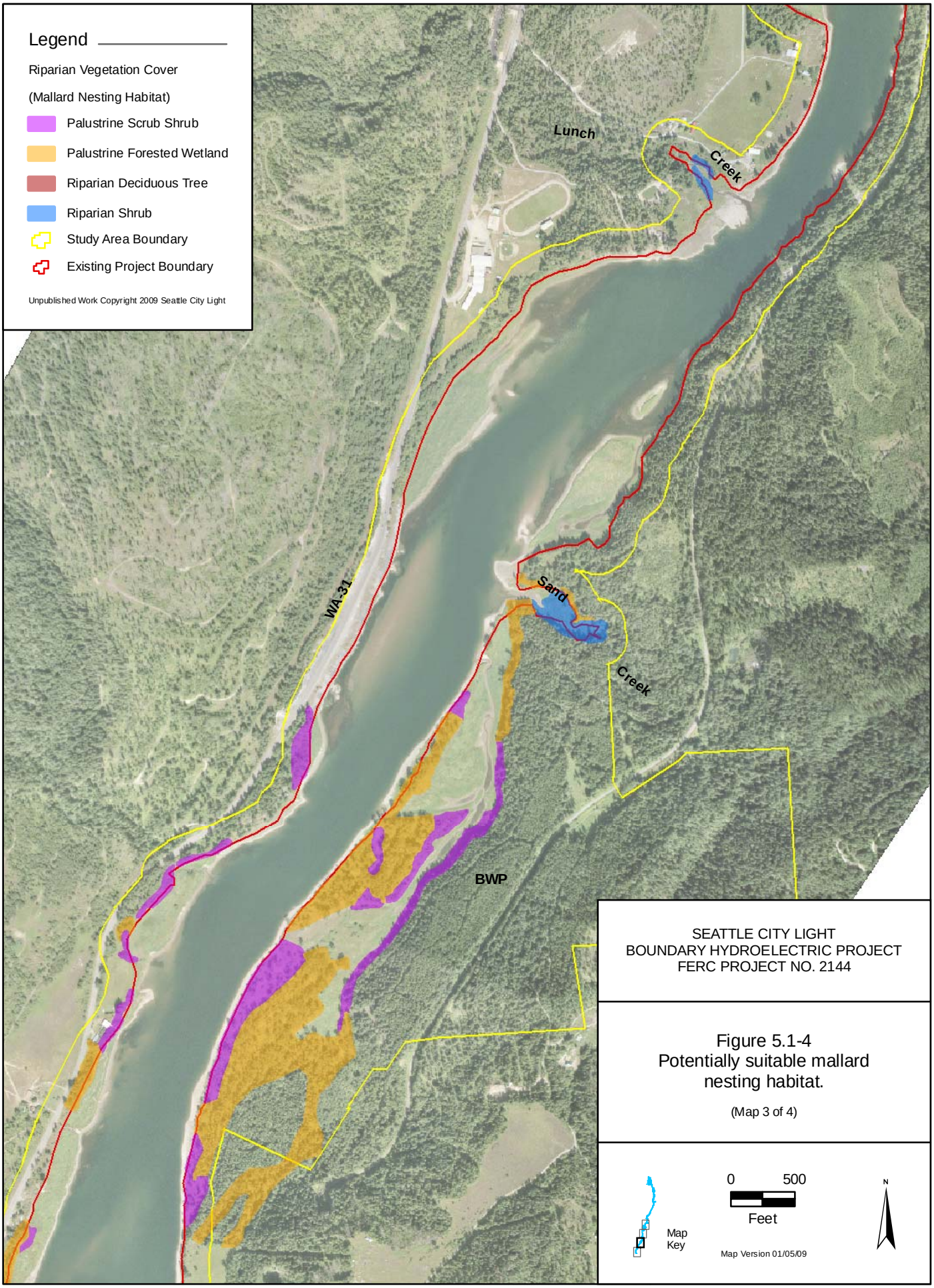

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Figure 5.1-4
Potentially suitable mallard nesting habitat.

(Map 3 of 4)

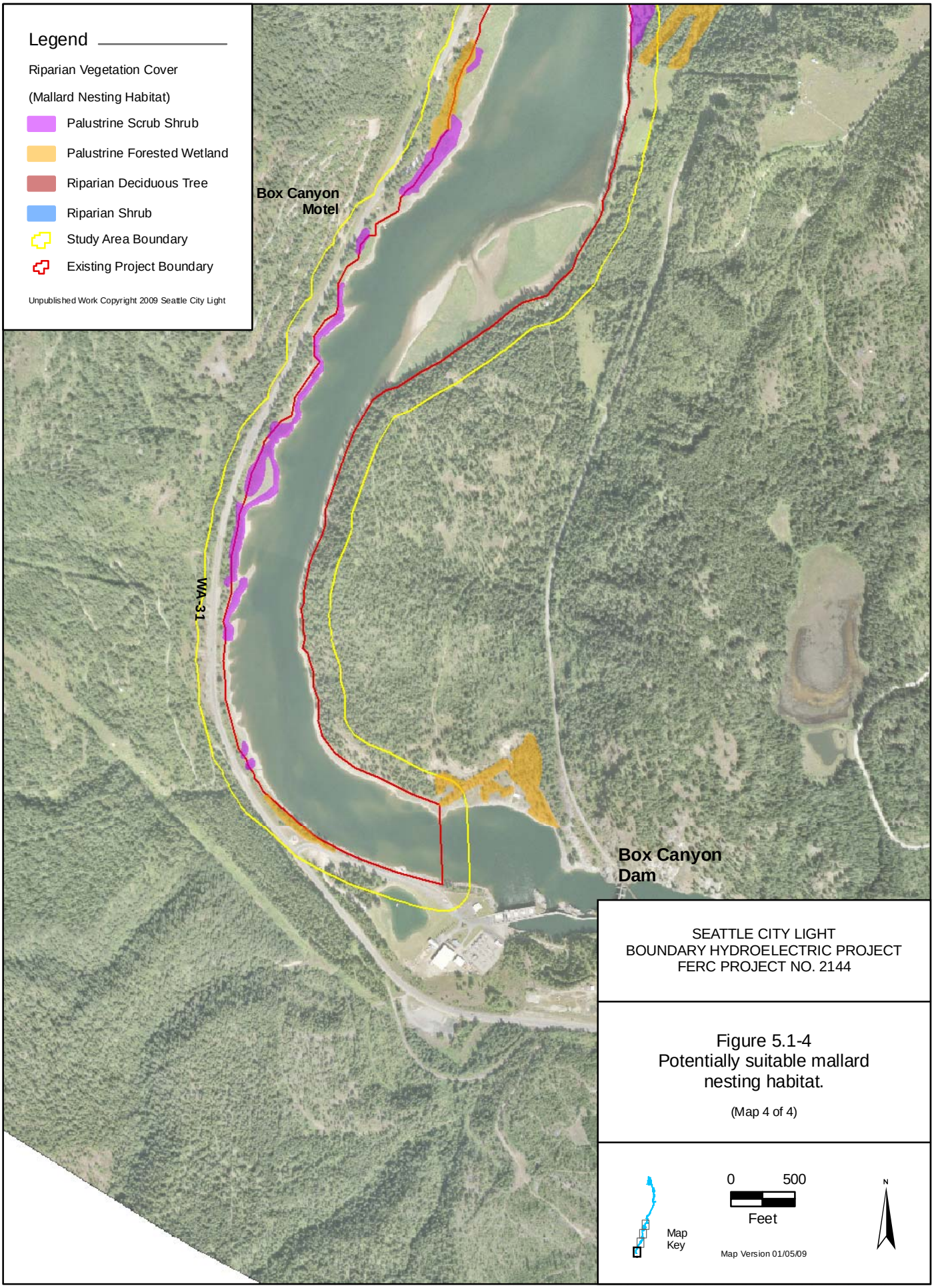

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Figure 5.1-4
Potentially suitable mallard nesting habitat.

(Map 4 of 4)

5.2. Estimate Potential Habitat for Ground-nesting Waterfowl in the Reservoir Fluctuation Zone

5.2.1. Canada Geese

Operating Boundary Reservoir at lower water surface elevations would likely change the distribution and extent of Canada goose nesting in the study area. Although some islands upstream of Metaline Falls would expand and new islands would emerge, several existing islands would disappear, becoming connected to the mainland.

Operating the reservoir at a median pool elevation at Boundary Dam of 1,985 feet NAVD 88 (1,981 feet NGVD 29), as measured at the Boundary Dam forebay, or 5 feet lower than current conditions during the goose nesting season, would result in a net increase of only 0.15 acre of potential nesting habitat. This is due to an expected loss of the islands at PRMs 31.5 and 33.2 because of land-bridging (in this case, land-bridging is defined as no water between the island and the mainland because this discussion concerns island acreage, not predation threat), offsetting the expansion of islands at PRM 27.7 and 28.9 (Table 5.2-1; Figure 5.2-1).

Operating the reservoir at a median pool elevation at Boundary Dam of 1,980 feet NAVD 88 (1,976 feet NGVD 29) would result in the creation of approximately 2.2 acres of new island habitat with fine sediment substrate that could potentially support vegetation suitable as nesting habitat. Notwithstanding this small gain, there would be an expected loss of over 24 acres of habitat by the land-bridging of the island at PRM 28.9, for a total net loss of about 21.5 acres. At the 1,980 foot increment, approximately 2 acres of additional island area would emerge but would be composed of cobble substrate and would therefore be unlikely to develop the vegetation communities important to nesting geese.

Table 5.2-1. Net change, in 5-foot increments, in Canada goose island-nesting habitat in the upper reservoir if the Boundary Dam forebay was operated at lower elevations.

Island Location	Island Size (ac) by Increment (feet below 1,990 NAVD 88)		
	0	**–5**	**–10**
PRM 33.2	6.3	0	0
PRM 31.7	0	0	1.8
PRM 31.5	5.9	0	0
PRM 31.3	0.3	0.7	0.8
PRM 28.9	14.5	24.3	0
PRM 27.8	0	0.2	0.4
PRM 27.7	8.2	10.1	10.8
Total Acreage	**35.2**	**35.3**	**13.8**
Percent Net Change	**N/A**	**+0.4**	**–61**

Note:
PRM – Project river mile

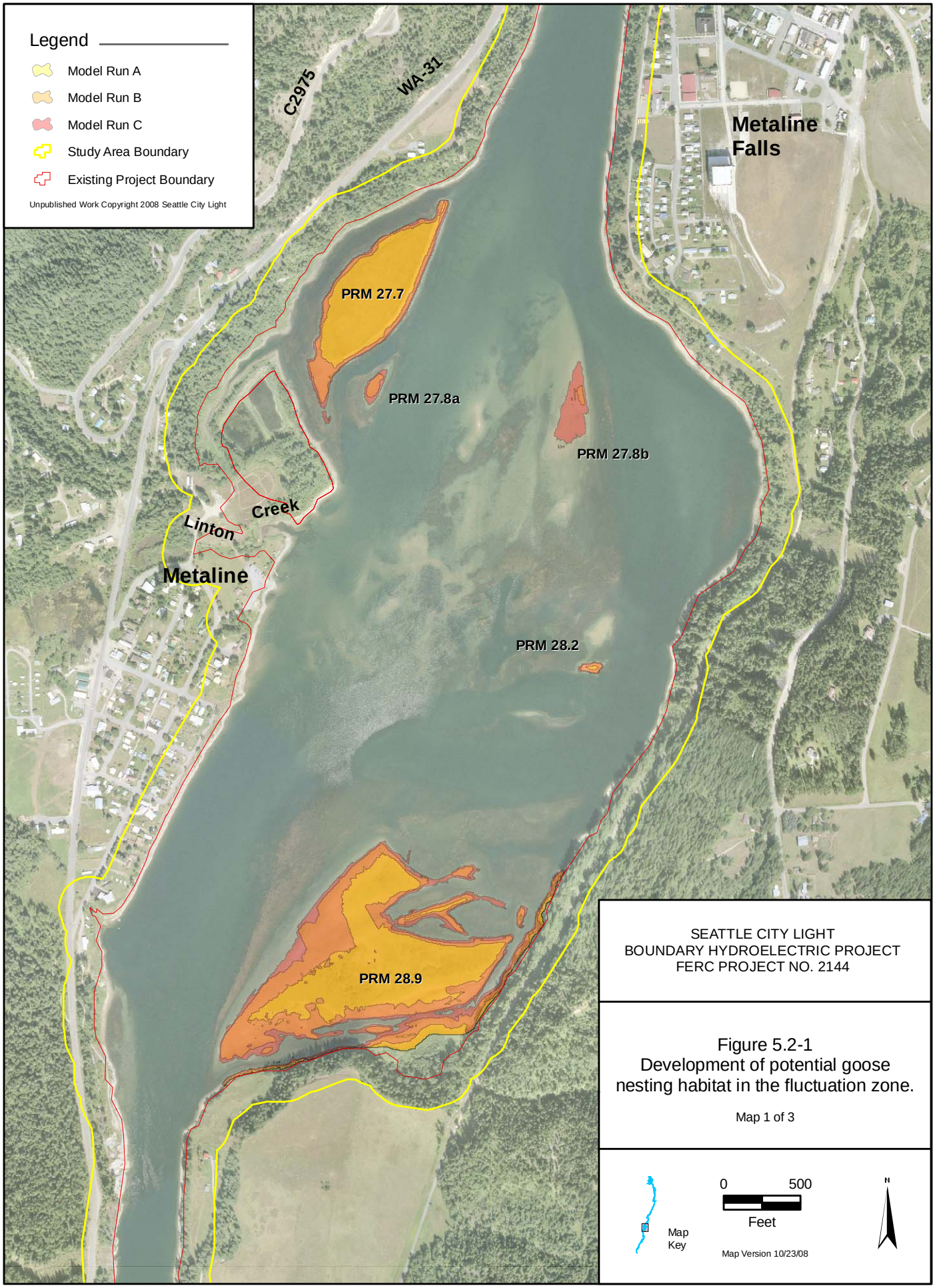

Figure 5.2-1
Development of potential goose nesting habitat in the fluctuation zone.

Map 1 of 3

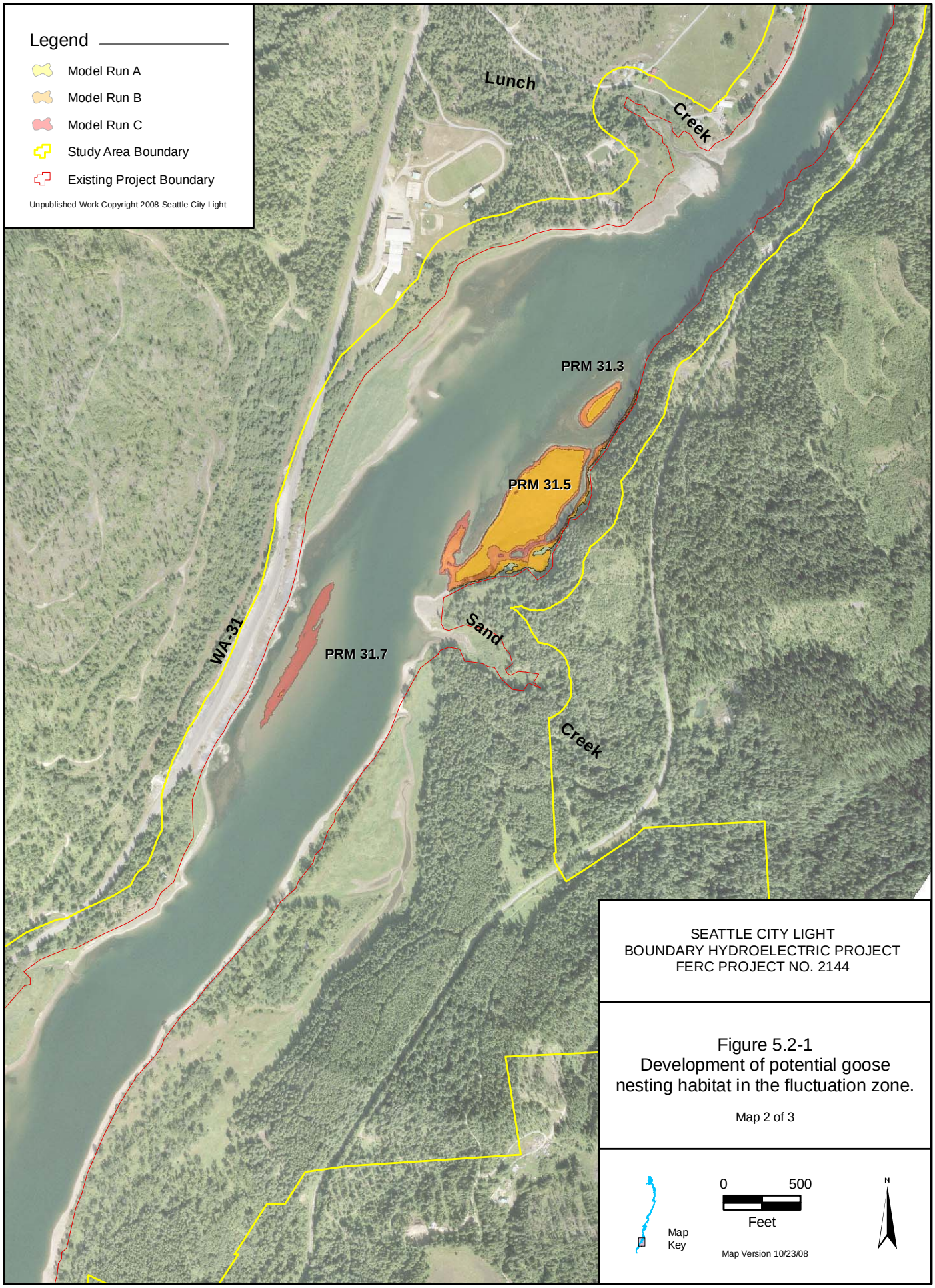

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Figure 5.2-1
Development of potential goose nesting habitat in the fluctuation zone.

Map 2 of 3

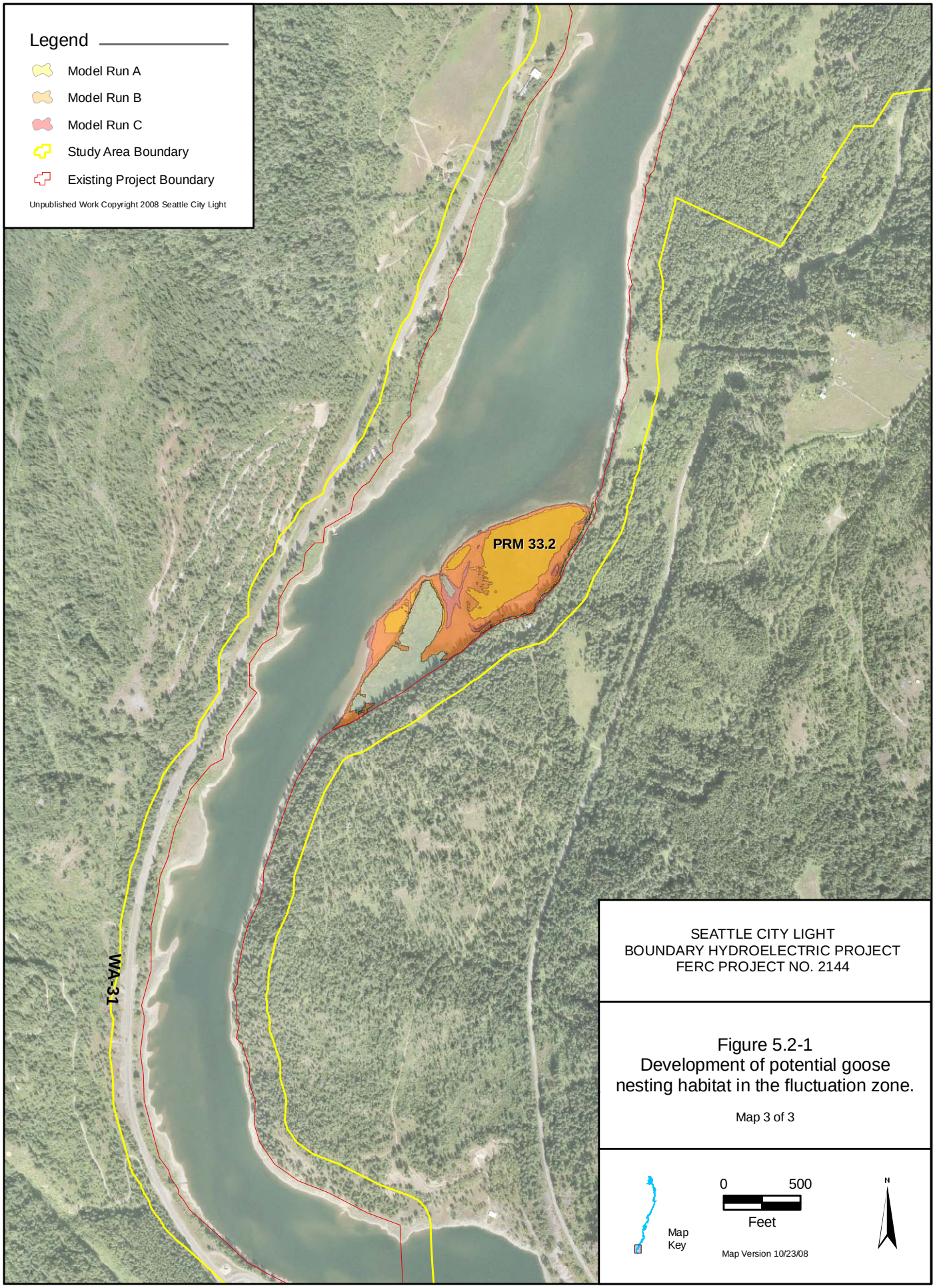
Legend
Model Run A
Model Run B
Model Run C
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
PRM 33.2
WA-31
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Figure 5.2-1
Development of potential goose nesting habitat in the fluctuation zone.
Map 3 of 3
Map Key
0
500
Feet
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N

5.2.2. Mallards

The Study 16 Final Report SCL 2009b) concluded that operating the reservoir at lower water surface elevations would result in a small net increase in riparian habitat. None of the palustrine forested wetland or riparian deciduous tree habitats, both dominated by black cottonwoods, would expand due to a lack of suitable substrates and effects from seasonal flooding in the upper reservoir. However, a net increase of approximately 5.8 acres (6.2 percent gain) and of 8.1 acres (8.7 percent gain) of riparian shrub and palustrine scrub-shrub wetland habitats would likely develop if the Project were operated with a median pool elevation at Boundary Dam of 1,985 feet NAVD 88 (1,981 feet at NGVD 29) and 1,980 feet NAVD (1,876 feet at NGVD 29), respectively. Nearly all of the calculated increase (95 percent or more) would be red-osier dogwood stands at the PRM 28.9 island complex where several acres of shallow water would become exposed. No change in the black cottonwood, black hawthorn (*Crataegus douglasii*), or common snowberry habitats is expected, while a slight loss in some willow species habitats would be offset by a slight increase in other willow species. Overall, as much as 8.1 acres of new mallard nesting habitat could develop along the upper reservoir if Boundary Dam were operated at a lower water surface elevation.

5.3. Waterfowl Nest Searches

Nest searches in 2007 and 2008 documented breeding in the study area by only two species of ground-nesting waterfowl—Canada goose and mallard.

5.3.1. Canada Geese

5.3.1.1. 2007 Surveys

Ground-nesting waterfowl nest searches in 2007 (see Figure 4.3-1) documented 44 active Canada goose nests along both the upper and lower reservoirs (see Table 5.3-1). Of these, 41 were on islands (Figures 5.3-1 to 5.3-7); the remaining 3 were found along the reservoir shoreline at the following locations:

1. On a point of land on the west bank of the reservoir, just south of Lost Creek (at PRM 32.4)
2. On a steep slope above the mouth of Sullivan Creek
3. In an abandoned bald eagle nest at the BWP

Twenty-eight (64 percent) of the nests successfully hatched goslings, 10 (23 percent) were lost to predation, 2 (4 percent) were abandoned, and 4 (9 percent) had an unknown fate. Coyote and raccoon (*Procyon lotor*) tracks were found on all the islands where nests were lost to predation, and the odor of a striped skunk (*Mephitis mephitis*) was detected at the PRM 28.9 island complex. Additionally, a dead striped skunk was found at the BWP, confirming the presence of this species in the study area. All three mammals are potential predators of goose eggs, goslings, and nesting adults.

Table 5.3-1. Nest fate and other measurements of Canada goose nests found during wildlife surveys, spring and summer 2007.

Location	Number of Nests	Nest Fate				Average Clutch Size[1]
		Successful	Predated	Abandoned	Unknown	
PRM 33.2 Island[2]	1	0	0	0	1	7
PRM 31.5 Island[2]	3	0	1	1	1	6
PRM 31.3 Island	1	1	0	0	0	7
PRM 28.9 Island[2]	7	1	5	1	0	6
PRM 27.7 Island	23	23	0	0	0	3.7
PRM 25.6 Island[3]	1	0	1	0	0	N/A
PRM 22.1 Island[3]	2	0	1	0	1	6.5
PRM 22.0 Island[3]	1	1	0	0	0	N/A
PRM 17.7 Island[3]	2	2	0	0	0	5
Non-islands[4]	3	0	2	0	1	N/A
All nests	**44**	**28 (64%)**	**10 (23%)**	**2 (4%)**	**4 (9%)**	**5.7**

Notes:
1 Maximum number of eggs observed in nest, with no sign of predation present (e.g., egg shells); the Mayfield method (Johnson 1979) was *not* employed to account for egg loss.
2 Islands that land-bridged at least occasionally during the 2007 goose nesting season.
3 Lower reservoir.
4 All upper reservoir.
N/A – not available
PRM – Project river mile

Six nests were found in the lower reservoir, all on islands. The remaining 38 were found in the upper reservoir, 23 on the large island (PRM 27.7) near Metaline. All of the nests on this island appeared to have been successful. Other successful nests were found at: 1) Rat Island (PRM 17.7) in the Boundary forebay (2 nests); 2) the two small islands in the lower reservoir at PRMs 22.0 and 22.1; 3) the easternmost island at the PRM 28.9 island complex across from Metaline; and 4) the smaller island (PRM 31.3) near Sand Creek. None of these islands land-bridged during the nesting season. In contrast, none of the three nests recorded on the mainland were known to be successful; the fate of the goose nest in the BWP bald eagle nest could not be determined (Table 5.3-1).

The distance of goose nest location relative to the water's edge averaged 34.4 feet and ranged between 3.9 and 123.0 feet. There was no evidence to suggest that any of the goose nests were lost to flooding during the 2007 nesting season, although two late nests (both established on a mudflat below the vegetation line) may have briefly flooded. However, both nests were successful, suggesting that the inundation was for a short duration and not significant enough to carry the eggs away or interrupt brooding by adults.

Backdating suggests that most Canada geese nesting in the study area in 2007 initiated egg-laying during the last week of March. Seventeen nests, many with full clutches, were recorded on the large island near Metaline (PRM 27.7) on April 6. The island was not resurveyed during the late April waterfowl surveys to avoid disturbing the large number of nesting geese nesting.

The island was surveyed again on May 11, when three successful nests not discovered during the April 6 survey were found, in addition to three other nests with incubating/laying hens. The three late nests had only three or four eggs, suggesting that egg-laying was still in progress (although re-nesting birds often lay smaller clutches [Mowbray et al. 2002]). Further, these late nests were found on the south end of the island at the edge or within the upper limits of the fluctuation zone. Geese may have been avoiding nesting in the dense stands of reed canarygrass that by May 11 were already a few feet high.

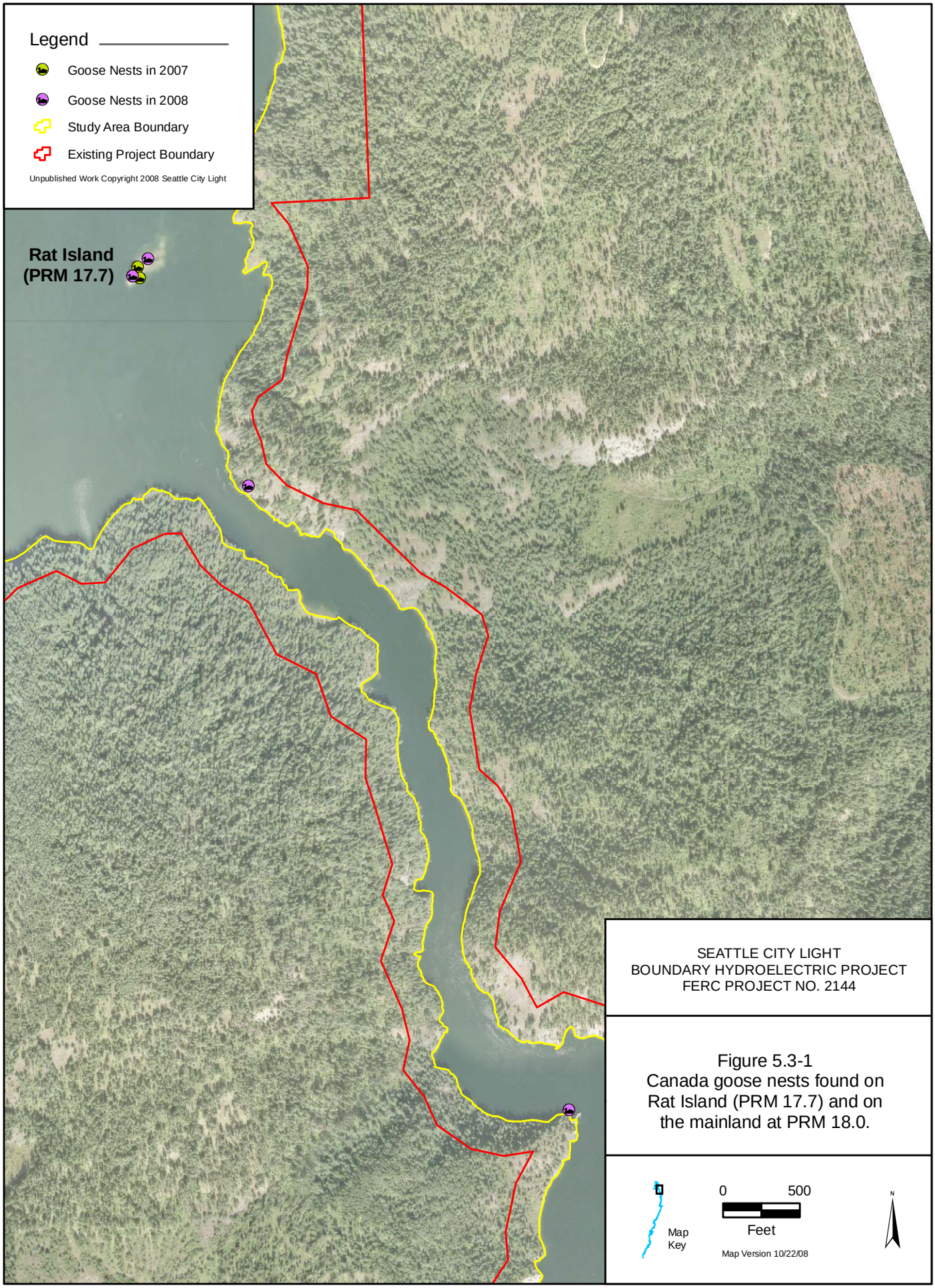

Figure 5.3-1
Canada goose nests found on Rat Island (PRM 17.7) and on the mainland at PRM 18.0.

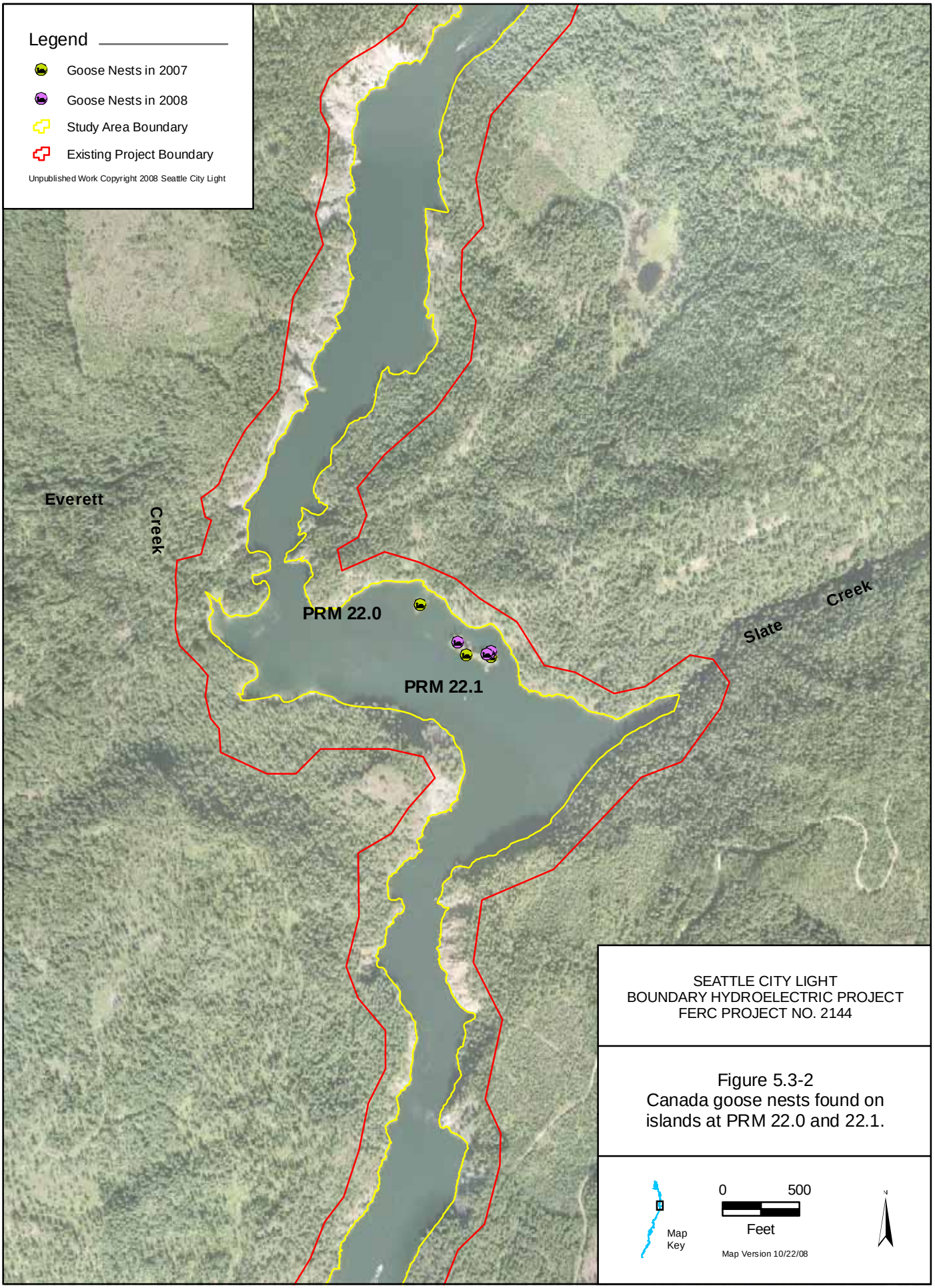

Figure 5.3-2
Canada goose nests found on islands at PRM 22.0 and 22.1.

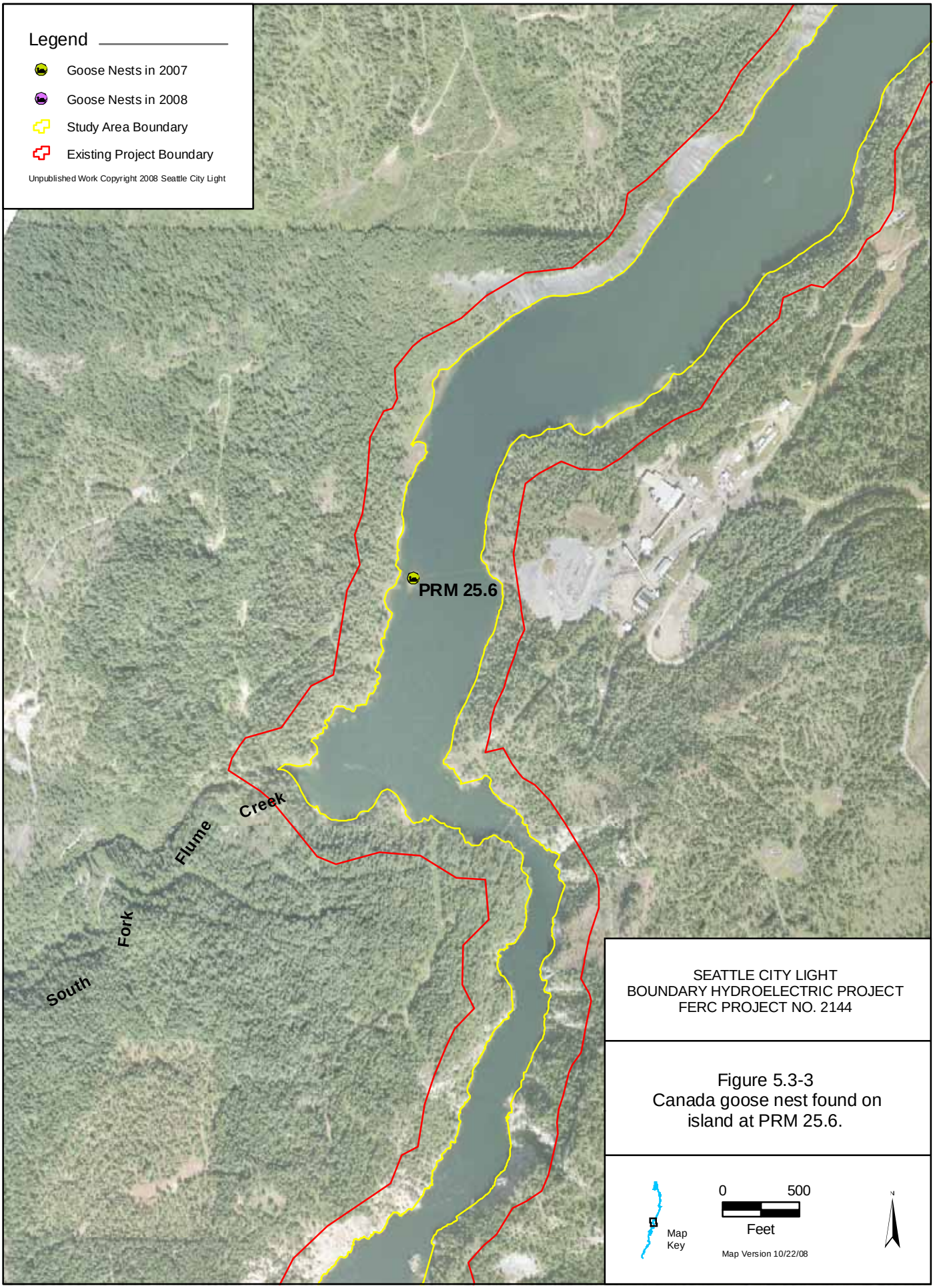

Figure 5.3-3
Canada goose nest found on island at PRM 25.6.

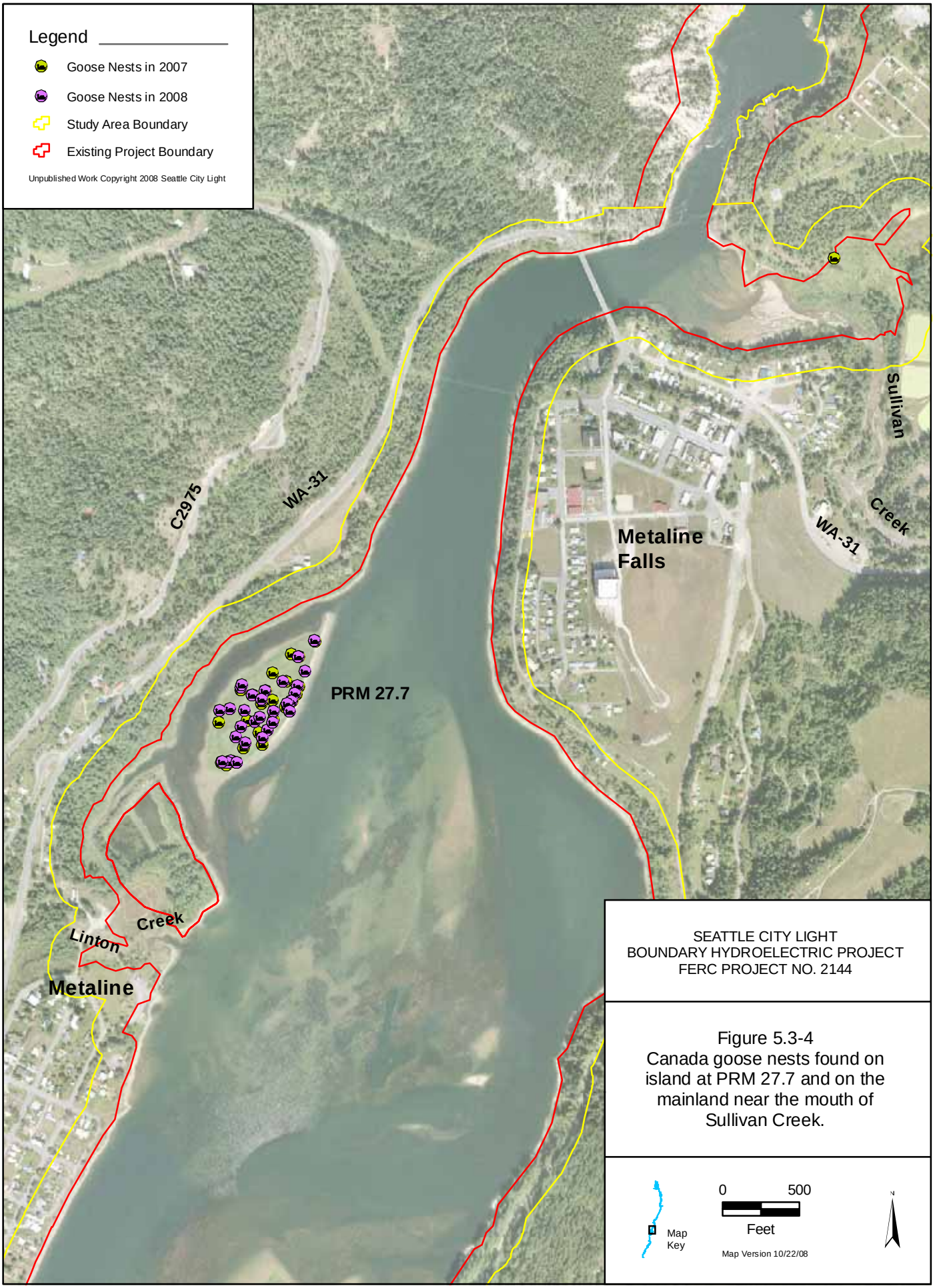

Figure 5.3-4
Canada goose nests found on island at PRM 27.7 and on the mainland near the mouth of Sullivan Creek.

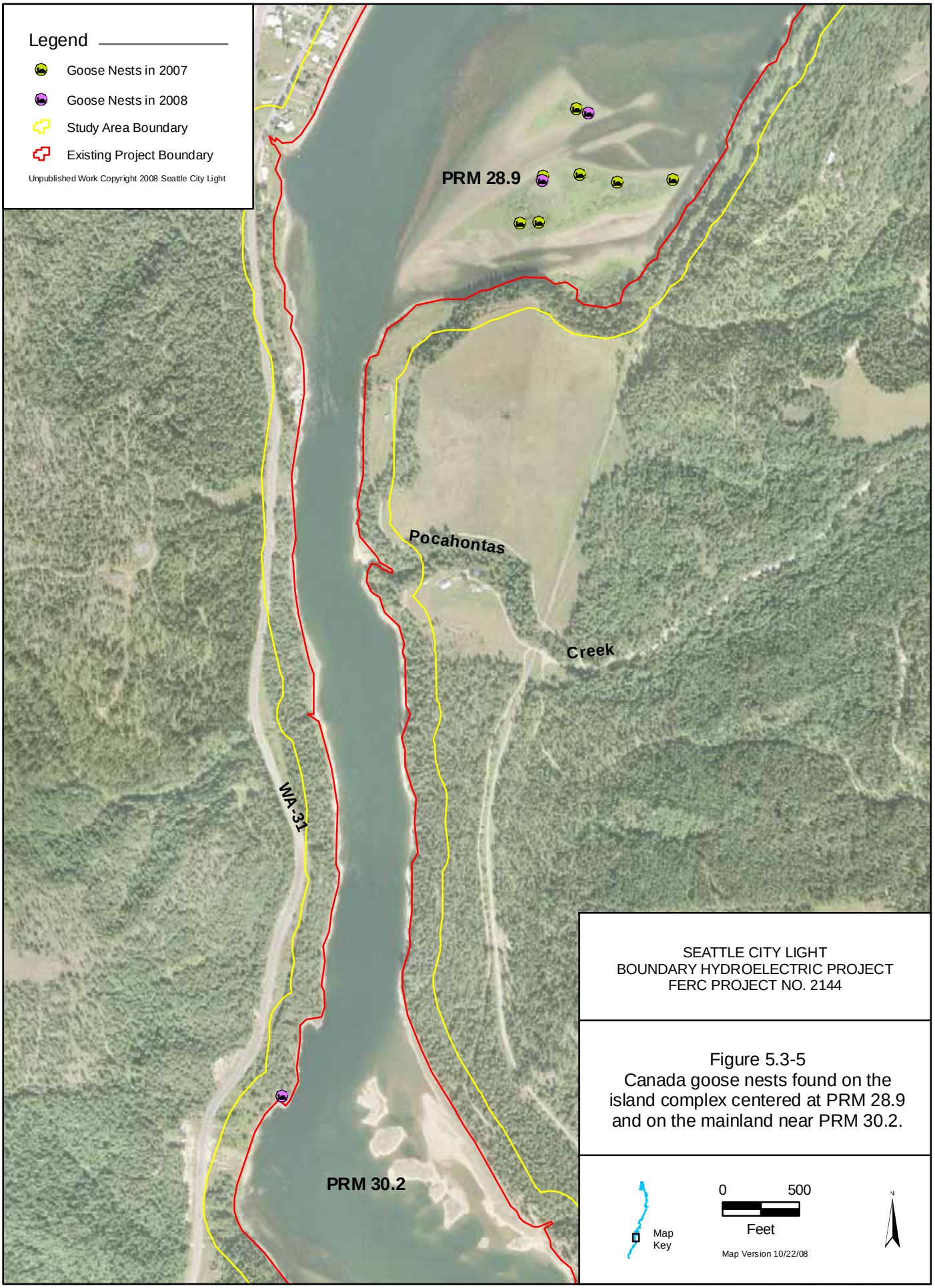

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Figure 5.3-5
Canada goose nests found on the island complex centered at PRM 28.9 and on the mainland near PRM 30.2.

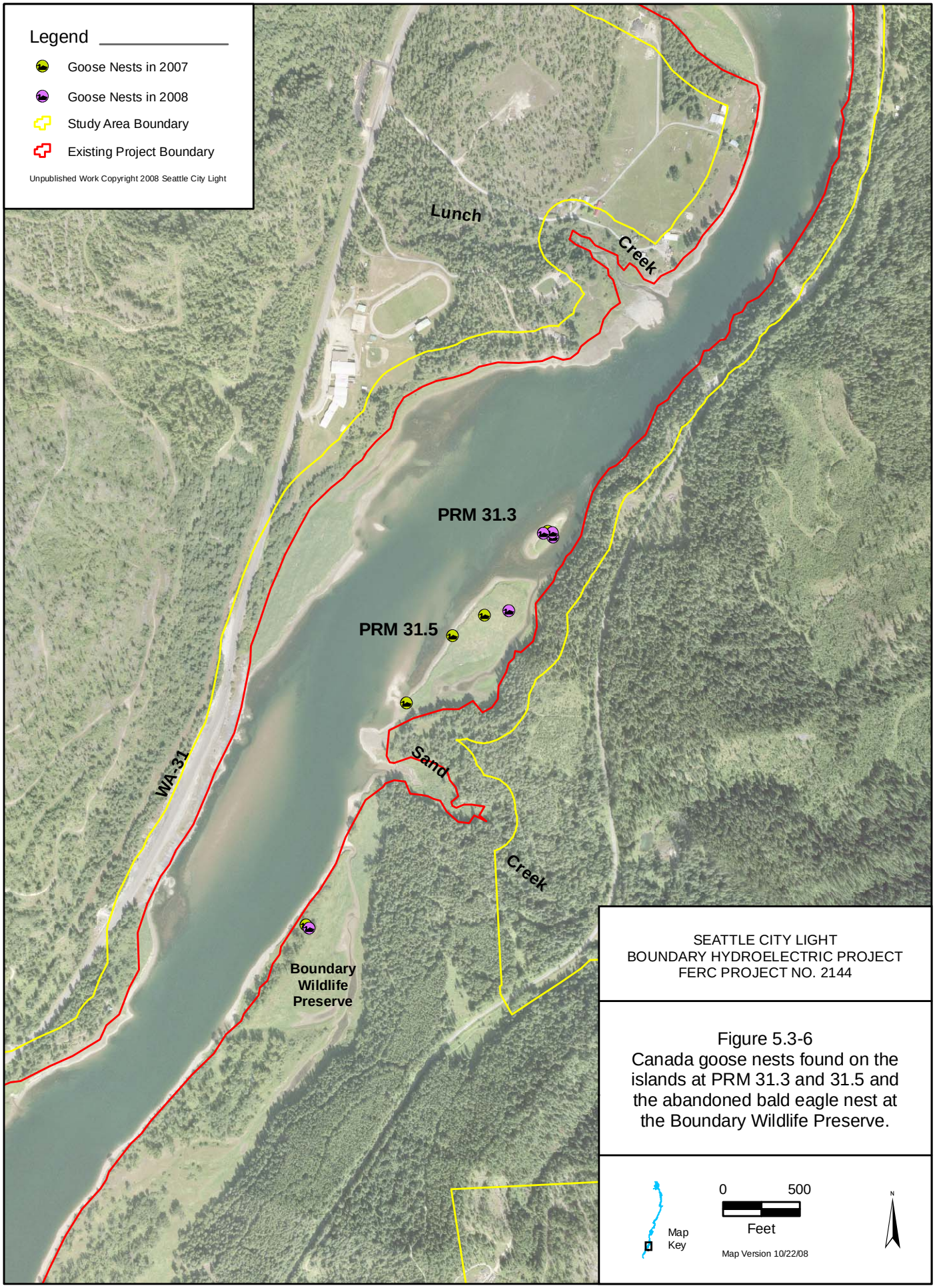

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Figure 5.3-6
Canada goose nests found on the islands at PRM 31.3 and 31.5 and the abandoned bald eagle nest at the Boundary Wildlife Preserve.

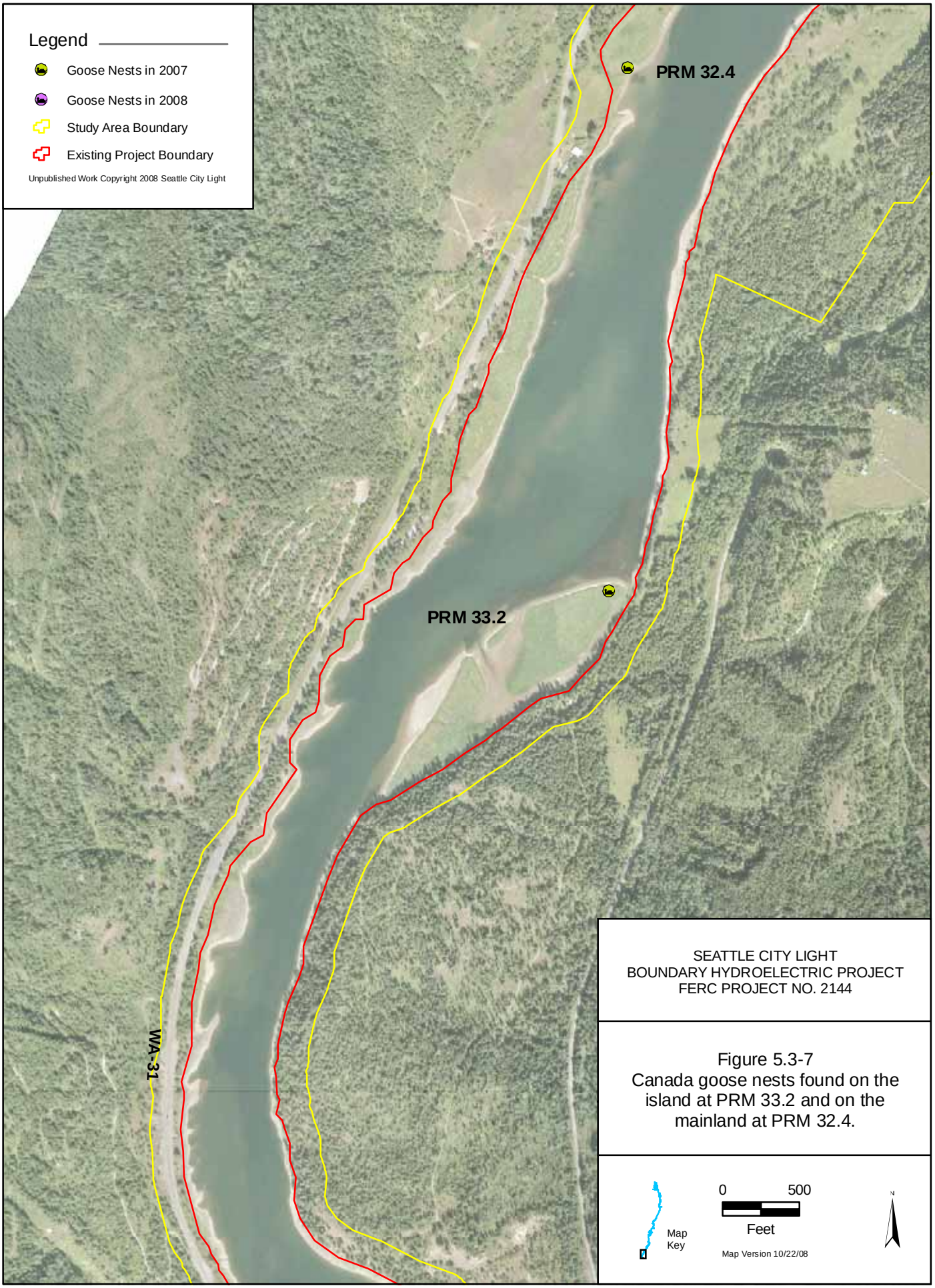


Figure 5.3-7
Canada goose nests found on the island at PRM 33.2 and on the mainland at PRM 32.4.

5.3.1.2. 2008 Surveys

In 2008, 45 goose nests were recorded along the upper and lower reservoir, with 41 of the nests on islands (Table 5.3-2; Figures 5.3-1 to 5.3-7). The four non-island locations included the abandoned bald eagle nest at the BWP, as well as cliff nests at PRMs 18.0, 19.0, and 30.0. Canada goose nesting in 2008 was influenced by poor weather conditions early in the nesting season (e.g., the island at PRM 27.7 was still blanketed with snow on March 25, the normal beginning of the nesting season), high raven predation (especially at the island at PRM 27.7), and extensive flooding later in the season. Because high water late in the nesting season flooded some nests before they could be revisited, the fate of 18 of the 38 nests located in the upper reservoir could not be confirmed. Of the 20 that were revisited, 11 were successful and 9 were lost to predation. For a number of nests on the island at PRM 27.7 it was not possible to determine if predation had reduced the original clutch size or caused re-nesting at the same site. It is possible that an additional 5 re-nestings occurred based on changes in clutch size and timing. The loss of the entire clutch was attributed to ravens for at least 3 nests. At the island at PRM 31.3, two nests were lost to predation, the geese re-nested, and then the second nests were likely lost to flooding (although the latter could not be confirmed). Again, the fate of the nest in the abandoned bald eagle nest at the BWP was unknown, but may have been successful.

Table 5.3-2. Nest fate and other measurements of Canada goose nests found during wildlife surveys, spring and summer 2008.

Location	Number of Nests	Nest Fate			Average Clutch Size[1]
		Successful	Predation	Unknown	
PRM 31.5 Island	1	0	1	0	N/A
PRM 31.3 Island	4	0	2	2	5.8
PRM 28.9 Island	2	0	2	0	N/A
PRM 27.7 Island	29	10	3	16	4.9
PRM 22.1 Island[2]	3	2	1	0	6
PRM 17.7 Island[2]	2	2	0	0	5
Non-islands, lower reservoir	2	1	0	1	N/A
Non-islands, upper reservoir	2	0	1	1	N/A
All Nests	**45**	**15 (33%)**	**10 (22%)**	**20 (44%)**	**5.1**

Notes:
1 Maximum number of eggs observed in nest, with no sign of predation present (e.g., egg shells); the Mayfield method (Johnson 1979) was *not* employed to account for egg loss.
2 Lower reservoir.
N/A – not available
PRM – Project river mile

Of the 45 Canada goose nests located during 2008, 7 were recorded in the lower reservoir. These included 2 nests on Rat Island (PRM 17.7), 3 nests on the island at PRM 22.1, and 2 nests on bluffs (at PRM 18.0 and PRM 19.0). One of the bluff nests, the 2 nests on Rat Island, and 2 of the nests on the island at PRM 22.1 were confirmed as successful. The third nest at the island

at PRM 22.1 was lost to predation. The fate of the remaining bluff nest could not be determined because of access problems.

Poor weather conditions in early spring 2008 probably resulted in a slightly later start to the Canada goose nesting season compared to 2007. On March 24, 2008, the island at PRM 27.7 was mostly covered in snow; 21 pairs of geese were recorded but no nests were evident. Nesting must have begun soon after because 23 goslings one to two weeks of age were recorded at the island on May 13, suggesting egg-laying for some pairs began the last few days of March. The presence of four clutches (one in the process of hatching) on May 13 suggested some geese did not initiate egg-laying until well into April. On May 13, rising waters (from spring runoff) were beginning to flood the nests located at lower elevations on the island, but survey results indicate that these nests had either already successfully fledged young or were lost to predation before the flooding occurred.

Despite high water conditions late in the nesting season, the presence of broods, 15–20 days old on June 18, at three locations in the upper reservoir confirmed that a number of late-nesters in 2008 were successful (although broods were very small, only one or two goslings). However, two clutches on island PRM 31.3 were within inches of the rising water during the May 13 survey and were likely lost if they did not hatch within a day or two. Because both appeared to be re-nesting attempts, it is suspected there was insufficient time to complete incubation before the nests flooded.

5.3.1.3. Nest Density, Clutch Size, and Brood Survival

For both 2007 and 2008, overall nest density (approximately one nest per acre) was higher than other Columbia Basin Canada goose populations (e.g., Buss and Wing [1966] found 0.75 nest per acre on Snake River islands). This is especially evident at the island at PRM 27.7 where the 2008 density was 3.5 nests per acre.

Observed clutch size averaged 5.7 in 2007 (Table 5-3.1) and 5.1 in 2008 (Table 5.3-2). Some nests may not have had full clutches at the time of survey so the true averages may be higher. Regardless, the 2007 average is similar to the average clutch sizes of 5.5 and 6.05 (Hanson and Eberhardt 1971 and Fitzner et al. 1994, respectively) recorded for Columbia River populations of this subspecies. The smaller clutches in 2008 might be attributed to partial egg predation by ravens and/or fewer eggs in late nests (Mowbray et al. 2002).

Although fledgling goose success was not evaluated as part of this study, 13 broods (totaling 60 goslings) in the upper reservoir and 2 broods (6 goslings) in the lower reservoir were counted on June 14–15, 2007, representing a brood survival rate of 54 percent (15 of 28). This rate is similar to the 56 percent survival (15 of 27) (Eberhardt et al. 1989) found on the Hanford Reach of the Columbia River. On July 10, 2007, nearly 150 geese were observed near Metaline. Brood survival rates were not estimated for 2008, but over 150 geese, including several broods, were observed on the upper reservoir on July 17, 2008. Evidently, significant goose production occurred in 2008 despite snow, avian predation, and flooding.

5.3.2. Mallards

An active mallard nest was incidentally found during a June 17, 2007, RTE wildlife survey on Rat Island (PRM 17.7) in the Boundary forebay. A follow-up visit on July 11 found that the eggs had successfully hatched. Three mallard broods were observed on the reservoir in 2007: a brood with five ducklings at the Boundary forebay boat launch on May 31, and two broods (eight ducklings and seven ducklings) near the BWP on June 15. Pairs or single drakes (suggesting nesting hens nearby) were observed earlier at or near all of these locations but nests could not be found (in one case, near PRM 32.5, the nest was suspected to occur on private land that the survey crew did not have permission to access).

In 2008, single mallard pairs (three total) were observed on the upper reservoir on May 13 on the islands at PRM 28.9 and 31.5, and across from the BWP at PRM 32.2. On June 16, a single pair was seen (again across from the BWP), although a group of three hens and a single drake were also observed. On July 17, only a single brood, a hen with six ducklings, was recorded (in the backwater of the island at PRM 33.2). These observations suggest that although one to three mallard nesting attempts were made in the upper reservoir study area in 2008, only one was successful. However, a duck nest was again found on Rat Island, tucked up under a juniper tree (*Juniperus occidentalis*), on May 12, 2008. While the presence of broken eggshells in the bottom of the nest indicated that the nest had been successful, the species of duck could not be determined (the nest was smaller than a typical mallard nest). The nests found on Rat Island in both 2007 and 2008 represent the only duck nests found during this study.

The small number of mallard broods observed in the Boundary study area contrasts with the results of the brood study conducted along Box Canyon Reservoir. Reese and Hall (1991) recorded 32 broods of ground-nesting waterfowl, including mallards (13), American wigeons, gadwalls, and green-winged teal, as well as 11 broods of unidentified ducks (some of which might have been cavity-nesting ducks). The Box Canyon Reservoir study area supports a variety of habitats, including many miles of sloughs and other backwater areas, where most of the duck broods were found. However, the Box Canyon study area was nearly 10 times larger than the entire Boundary study area (including both the upper and lower reservoirs). Thus, while the availability of backwater slough habitat along Box Canyon Reservoir supported a greater diversity of nesting waterfowl species, the total of number of waterfowl nests per reservoir area was similar between Box Canyon and Boundary reservoirs.

5.4. Piscivorous Waterbird Survey Results

Thirteen piscivorous bird species were recorded in the study area during the 2007 and 2008 surveys (Table 5.4-1). Five of the species—common loon, western grebe, bald eagle, osprey, and great blue heron—are discussed in the Study 18 Final Report (SCL 2009c); the great blue heron is also discussed in this report because it was called out in the RSP as a piscivorous species of concern (along with double-crested cormorants). Single common loons were observed in April and May; paired western grebes were observed in April, June, July, and October (although no evidence of nesting was found); and bald eagles and osprey are breeding residents. A few juvenile California gulls appeared near Metaline in late July and a few adults were observed in August and September. A single Forster's tern was photographed near Metaline in September 2008. Other grebes recorded included eared (which is only slightly piscivorous) and red-necked

grebes (pied-billed grebes were recorded during the 2005 reconnaissance survey but not in 2007 or 2008). All eared grebes were recorded during April and early May, and were believed to be migrant groups. Red-necked grebes were also recorded, mostly in April and May, but one to two individuals also appeared in July, August, September, and October. Belted kingfishers were recorded during nearly all surveys and at least three breeding territories were documented along the reservoir.

The three piscivorous species with the greatest potential to impact native salmonids—double-crested cormorant, great blue heron, and common merganser—are addressed in detail below.

5.4.1. Double-crested Cormorant

Double-crested cormorants are primarily a coastal bird in Washington with a population estimate of about 20,000 birds in 1997 (Wahl et al. 2005). Nesting in eastern Washington was first reported in 1941 (Benton Co.; Jewett et al. 1953), with some birds found year-round along the Columbia River system. Additional nesting colonies appeared at Umatilla National Wildlife Refuge in the 1970s, at the Potholes in the 1980s, and on the Pend Oreille River in the 1990s (Wahl et al. 2005). Approximately 35 to 40 cormorant nests were found on river pilings near Usk in 1996, and then increased to 128 nests by 1999 (Duke 2001). The Usk colony is likely the source of cormorants found in the Project study area.

Increased nesting by double-crested cormorants in eastern Washington in the mid-1900s coincided with the decline of predators and egg collecting, and the increase in warm-water fish and hatchery-raised salmonids (Vermeer and Rankin 1984; Wahl et al. 2005). Concern over Columbia River salmon recovery efforts led federal, state, and tribal agencies to remove over 800 cormorants annually from the mid-Columbia River between 1997 and 2001 (USDA 2003). Recent studies by the Columbia Bird Research Team revealed that 10 to 20 percent of the diet of the cormorant nesting population on Foundation Island (near the Tri-Cities) was composed of salmonids (mostly steelhead smolts), whereas the Potholes Reservoir population ate almost no salmonids. Results from Box Canyon relicensing studies suggest that the development of the Box Canyon impoundment, plus the availability of pilings near the Usk Bridge, partially account for the establishment the cormorant colony at Usk. In addition to concerns related to fisheries, piscivorous birds were monitored along the Box Canyon Reservoir to determine whether cormorants are competing significantly with osprey, herons, and eagles for prey, and with osprey for nesting platforms (Duke 2001; status of current efforts is not known).

During this study, double-crested cormorants first began to appear in the upper reservoir in late April (the earliest sighting was of three birds on April 25, 2008), staying until mid-October (the latest sighting was 10 birds on October 11, 2007 (Table 5.4-1); cormorants were rarely observed in the lower reservoir (Figures 5.0-2 and 5.4-1). In both years, cormorant numbers began building in mid-May (approximately 20 birds), then peaking in September (27 in 2007 and 47 in 2008). Cormorants were observed perching on logs, snags, and overhangs at two general locations near Metaline, and one opposite the islands at PRM 30.2 (Figure 5.4-1). No evidence of breeding was observed (most of the observed cormorants were juveniles). Birds found in the study area may represent non-breeders supplemented by post-breeders and fledglings in September.

Table 5.4-1. Piscivorous waterbird species observed during wildlife surveys conducted during 2007 and 2008.

Species	Wildlife Survey Number[1]																						Total
	1	**2**	**3**	**4**	**5[2]**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	
common loon	1		1															3					**5**
eared grebe[3]	61	2																67					**130**
red-necked grebe	7	1				1		2	1	2								3	6		1		**24**
western grebe	3									2										4	2	2	**13**
d-c cormorant		4	18	20		17	18	10	27	10								3	21	23	10	47	**228**
great blue heron			3			7	1		9	3				1					2		2	5	**33**
common merganser	8	25	4	5		18	18	3	17	17			19	10	25	26	15	7	4	3	7	10	**241**
hooded merganser																	2						**2**
California gull							6	5	2														**13**
Forster's tern																						1	**1**
belted kingfisher	3	7	2	3		1	1	8	5	5			1		2		2	5	1	1		2	**49**
osprey	9	6	2	10		8	4	2	1									13	7	6	17	1	**86**
bald eagle	7	5	3	10		5	11	15	2	2	1	2		5	5	5	6	18	8	12	16	3	**141**

Notes:

1 Survey dates: **2007** 1—April 20–21; 2—May 9–10; 3—May 30–31; 4—June 14–15; 5—June 25–29; 6—July 10–11; 7—July 25–26; 8—Aug 13 and 16; 9—Sep 7–8; 10—Oct 11–12; 11—Nov 13; 12—Nov 28; 13—Dec 27; **2008** 14—Jan 17; 15—Feb 27; 16—Mar 11; 17—Mar 25–26; 18—April 22–26, 19—May 12–13; 20—June 18; 21—July 16–17; 22—Sep 16.

2 No reservoir surveys were conducted during Wildlife Survey 5.

3 Eats mainly invertebrates, fish only infrequently.

d-c – double-crested

Although double-crested cormorants could be feeding on salmonids in Boundary Reservoir, preferred prey, such as smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), cyprinids (e.g., northern pikeminnow [*Ptychocheilus oregonensis*] and tench [*Tinca tinca*]) are common in the upper reservoir where cormorants are found.

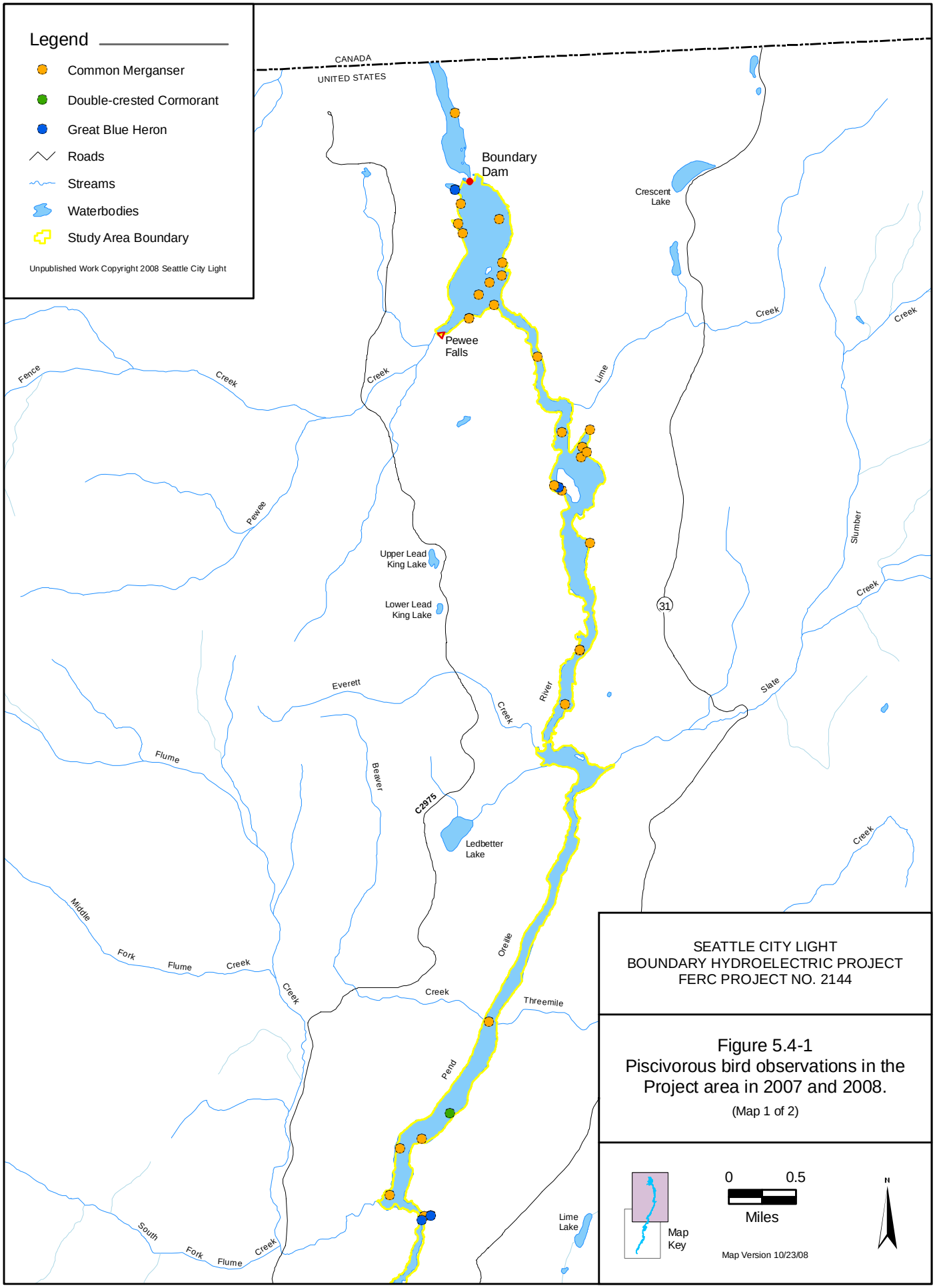
5.4.2. Great Blue Heron

Great blue herons are year-round residents in Washington, although birds in eastern Washington will move out of the region to avoid extended freezing conditions. Approximately 1,600 pairs of great blue herons breed in eastern Washington (Wahl et al. 2005), including 75 to 160 pairs at a nesting colony near Usk (Duke 2001). State population trends are unclear, although an average of 169 herons were killed annually between 1997 and 2001 as part of a mid-Columbia River salmonid protection program (USDA 2003), indicating a concern that this bird poses a threat to local fisheries.

Great blue herons were largely absent from the study area from February to mid-May, which coincides with their breeding season in the Pacific Northwest (Thomas 2003), and most common from July to September (when they disperse from breeding rookeries) (Table 5.4-1). The highest daily count was seven birds on July 10 and September 7, 2007; most of the birds observed were juveniles (probably hatch-year birds from upriver rookeries). Overall, great blue heron use of the study area was low and confined largely to the upper reservoir (Figures 5.0-2 and 5.4-1) with no evidence of breeding.

5.4.3. Common Merganser

Common mergansers are an uncommon breeder in eastern Washington, although numbers appear to be increasing, especially in association with reservoirs (Wahl et al. 2005). The Washington Department of Fish and Wildlife (*in* Wahl et al. 2005) recently estimated that between 1,200 and 3,800 common mergansers winter annually in eastern Washington. Because common mergansers prey on salmonids, an average of 268 common (and hooded) mergansers were annually killed between 1997 and 2001 as part of a mid-Columbia River salmonid protection program (USDA 2003). Recent research by the University of Washington on the mid-Columbia River revealed that although common mergansers individually take few salmonids compared to other piscivorous birds, their high numbers, especially during critical smolt passage periods, rank them as the greatest predatory threat to Columbia River salmonids (Wiese et al. 2008).


Legend
Common Merganser
Double-crested Cormorant
Great Blue Heron
Roads
Streams
Waterbodies
Study Area Boundary
Unpublished Work Copyright 2008 Seattle City Light
CANADA
UNITED STATES
Boundary Dam
Crescent Lake
Pewee Falls
Fence Creek
Creek
Lime Creek
Creek
Pewee
Slumber Creek
Upper Lead King Lake
Lower Lead King Lake
31
Everett Creek
River
Slate Creek
Flume
Beaver
C2975
Ledbetter Lake
Creek
Middle Fork Flume Creek
Creek
Creek
Threemile
Pend Oreille
South Fork Flume Creek
Lime Lake
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.4-1
Piscivorous bird observations in the Project area in 2007 and 2008.
(Map 1 of 2)
Map Key
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0.5
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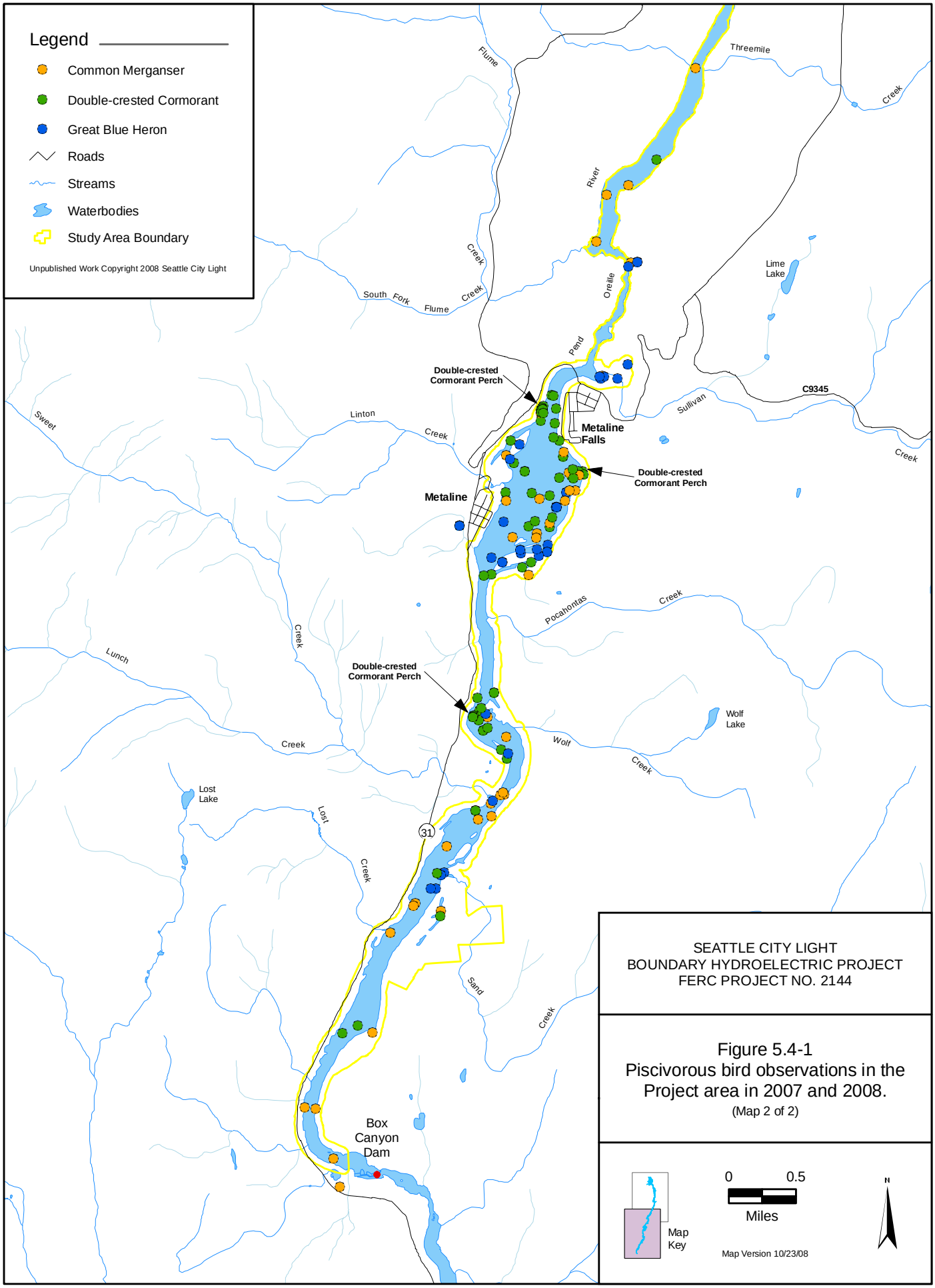
Legend
Common Merganser
Double-crested Cormorant
Great Blue Heron
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Waterbodies
Study Area Boundary
Unpublished Work Copyright 2008 Seattle City Light
Threemile
Creek
Flume
River
Creek
Lime Lake
South Fork
Flume
Creek
Oreille
Pend
Double-crested Cormorant Perch
C9345
Sullivan
Sweet
Linton
Creek
Metaline Falls
Creek
Double-crested Cormorant Perch
Metaline
Pocahontas
Creek
Creek
Lunch
Double-crested Cormorant Perch
Wolf Lake
Creek
Wolf
Creek
Lost Lake
Lost
31
Creek
Sand
Creek
Box Canyon Dam
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.4-1
Piscivorous bird observations in the Project area in 2007 and 2008.
(Map 2 of 2)
Map Key
0
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Miles
Map Version 10/23/08
N

In the study area, common mergansers are year-round residents in both the upper and lower reservoirs (Figures 5.0-1 and 5.4-1) but were most commonly observed in the upper reservoir. Numbers were lowest during April when mergansers were nesting, with numbers building in the summer with the appearance of broods. As the summer and fall progressed, hatch-year birds lost to predation were replaced by fall and winter visitors. The highest counts were recorded in May (25 birds) of 2007, and February (25 birds) and March (26 birds) of 2008, with numbers in July through December relatively consistent between 14 and 18 birds (Table 5.4-1). The earliest brood was recorded near the BWP on May 30, 2007. Observations suggest that three broods (at one point at least 17 ducklings) were produced on the upper reservoir in 2007 (there is incidental evidence that the broods were reduced by bald eagle predation). In the Boundary Dam tailrace, 4 common mergansers, presumed to be a brood, were recorded on July 9, 2007, and again on July 11. In 2008, only one brood (6 ducklings) was observed (in the upper reservoir on July 17).

Results from this study suggest that between 14 and 26 mergansers used the study area year-round in 2007 and 2008, with winter visitors and spring migrants being replaced by summer broods as the season progressed. In 2007, three broods were produced in the upper reservoir and possibly a fourth in the Boundary Dam tailrace area. Compared to information on this species from British Columbia and northern California (Foreman 1979; Wood 1985, 1986), densities were low with a maximum of approximately 2 mergansers per river mile.

5.5. Fall Migration and Winter Survey Results

Nine fall migration and winter surveys for waterfowl and waterbirds were conducted between September 2007 and March 2008. During these surveys, 7 waterbird species and 16 waterfowl species were recorded (Table 5.5-1). Six of the 7 waterbird species (belted kingfisher, California gull, double-crested cormorant, great blue heron, red-necked grebe, and western grebe) are piscivorous birds; these species were addressed in Section 5.4. The other waterbird species, killdeer, was recorded near Metaline Park on March 25, 2008 (3 birds). The 16 waterfowl species are discussed below.

Most observations of fall and winter waterfowl use were recorded in the large reservoir pool opposite the town of Metaline, including the island complex at PRM 28.9. Canada geese, mallards, and common mergansers were the most consistently observed waterfowl species throughout the fall and winter (Table 5.5-1). A high count of 181 Canada geese was recorded on March 11, 2008; 86 mallards on November 13, 2007; and 44 common mergansers on March 11, 2008. Fall migrants included American coots, American wigeons, gadwalls, northern shovelers, and ring-necked ducks, while spring migrants included American wigeons, buffleheads, hooded mergansers, northern pintails, ring-necked ducks, and tundra swans. The coots, wigeons, and pintails generally appeared in large single flocks. On October 11, 2007, single flocks of approximately 138 coots and 75 wigeons were recorded; on March 11, 2008, a single flock of 57 pintails was observed, all near Metaline.

Table 5.5-1. Observations of waterfowl and waterbirds during fall and winter, 2007–2008, by wildlife survey.

Species	Wildlife Survey Number[1]								
	9	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Waterfowl									
American coot	1	138							
American wigeon	3	75					2	20	18
Barrow's goldeneye						9			
blue-winged teal									
bufflehead									2
Canada goose	53	84	34			26	103	181	93
cinnamon teal									
common goldeneye			2			1	4		
common merganser	17	17			19	10	25	44	15
gadwall	2								
green-winged teal		6	2		6				
hooded merganser									2
lesser scaup									
mallard	78	59	86				22	4	51
northern pintail							7	57	3
northern shoveler	12								
ring-necked duck	2	3							16
snow goose									
tundra swan								3	
wood duck									7
Waterbirds									
American bittern									
American dipper									
bank swallow									
barn swallow									
belted kingfisher	5	5			1		2		2
California gull	2								
cliff swallow									
common loon									
double-crested cormorant	27	10							
eared grebe									
Forster's tern									
great blue heron	9	3				1			
killdeer									3
lesser yellowlegs									
northern rough-winged swallow									

Table 5.5-1, continued…

Species	Wildlife Survey Number[1]								
	9	10	11	12	13	14	15	16	17
red-necked grebe	1	2							
spotted sandpiper									
tree swallow									
violet-green swallow									
western grebe		2							

Note:

1 Survey dates: **2007** 9—Sep 7–8; 10–Oct 11–12; 11—Nov 13; 12—Nov 28; 13—Dec 27; **2008** 14—Jan 17; 15—Feb 27; 16—Mar 11; 17—Mar 25–26.

Additionally, 4 species of waterfowl and 13 species of waterbirds were recorded in the study area outside the fall and winter period, and are listed in Table 5.5-1. Other than eared grebes, spotted sandpipers, bank swallows, and violet-green swallows, none of these species were recorded in large numbers.

5.6. Effects Assessment

5.6.1. Project Effects

Project-related fluctuations in water surface elevations have the potential to affect waterfowl production. These potential effects are related to loss of or change in riparian or emergent vegetation, flooding of nests, and formation of land-bridges (potentially resulting in increased predation) (Rocklage et al. 2003). Further, Project-related recreation also has the potential to affect waterfowl production.

5.6.1.1. Daily Reservoir Fluctuation

Canada geese nesting in the study area generally use islands that support herbaceous vegetation, primarily reed canarygrass, and construct nests above the water levels typically observed in March and April (R2 Resource Consultants, Inc. 2008). Daily changes in water surface elevations do not directly affect individual nest sites and may actually favor the establishment of ruderal weed species like reed canarygrass that are tolerant of daily wet/dry cycles (Hill et al. 1998). Daily reservoir fluctuations do influence goose nesting habitat in some locations by land-bridging, which can result in higher nest predation rates. Three of the islands (at PRM 28.9, 31.5, and 33.2) in the upper reservoir land-bridge during normal reservoir fluctuations, especially during drier years (Table 5.1-1). However, the island with the highest goose nest production (at PRM 27.7) is separated from the mainland by a deep channel and rarely land-bridges (defined as a channel depth 1.5 feet or less) during the goose nesting season relative to the historical (1987–2005) hydrologic record (Table 5.1-1). Fluctuating water surface elevations from current Project operations may therefore reduce overall goose nesting success in the study area by creating land bridges that provide access to some island habitats by mammalian predators, although less than 20 percent of the nesting occurred on the three aforementioned islands in the upper reservoir most vulnerable to land-bridging.

Based on the results of Study 16 (SCL 2009b), daily reservoir fluctuations appear to have little or no effect on existing woody riparian stands (suitable mallard nesting habitat), except during seasonal high water (flooding), but may be limiting establishment of new stands at some locations (due to past removal of fine soils), particularly along the lower reservoir. The development of new stands of woody riparian vegetation in the fluctuation zone is unlikely except in sheltered areas, such as coves or creek inlets, where fine sediment substrates exist.

5.6.1.2. Flooding

As recorded in this study, Canada geese generally nest at the upper elevations of islands in Boundary Reservoir, well above the area affected by normal water surface elevation fluctuations. However, as observed in 2008, high water during spring runoff can flood nest sites in the upper reservoir. The results of Study 2, Analysis of Peak Flood Flow Conditions Above Metaline Falls Final Report (SCL 2009f), showed that during the peak flood events of 1972, 1974, and 1997 Project operations resulted in water surface elevations that were +1.6 feet above the level that would have flooded without the Project at the downstream end of the upper reservoir (near Metaline Falls). The influence of Project operations during these events on water surface elevations at the upstream end of the upper reservoir (near Box Canyon Dam) was +1.1 feet.

Depending on timing, an additional 1.1 to 1.6 feet in water surface elevations could flood more goose nests than would be otherwise affected without the influence of the Project. The flood elevations (as measured at the Box Canyon gage) for the 35 goose nests considered in the flooding impacts analysis (see Figure 5.1-2) were distributed from 2,000.6 to 2,007.4 feet NAVD 88 (1,996.6 to 2,003.4 feet NGVD 29). Between 1987 and 2005, the addition of 1.5 feet to the maximum flood level in the upper reservoir would have increased the number of years with nest losses from 7 to 10. With or without the Project, all nests would have flooded during the peak event in 1997 (Figure 5.6-1). In 6 of the 7 years where some goose nests would have flooded regardless of Project influence; the higher maximum water surface elevations from the Project would have resulted in the loss of additional nests. For example, in 1990, 2000, and 2002, 10 to 12 more nests would have been lost due to increased water surface elevations associated with Project operations (Figure 5.6-1).

Overall, Project operations would not have contributed to goose nest losses from flooding when the maximum water surface elevation during the nesting season was less than 2,002 feet NAVD 88 (1,998 feet NGVD 29). When maximum water surface elevations were greater than 2,004 feet NAVD 88 (2,000 feet NGVD 29), there would have been a moderate (less than 26 percent) increase in nest loss, and at water surface elevations greater than 2,009 feet NAVD 88, all nests would have flooded regardless of Project operations. The potential contribution of Project operations to nest loss from flooding was greatest (accounting for over half the loss) during years when the maximum water surface elevations were between 2,002 and 2,004 feet NAVD 88 (1,998 and 2,000 feet NGVD 29).

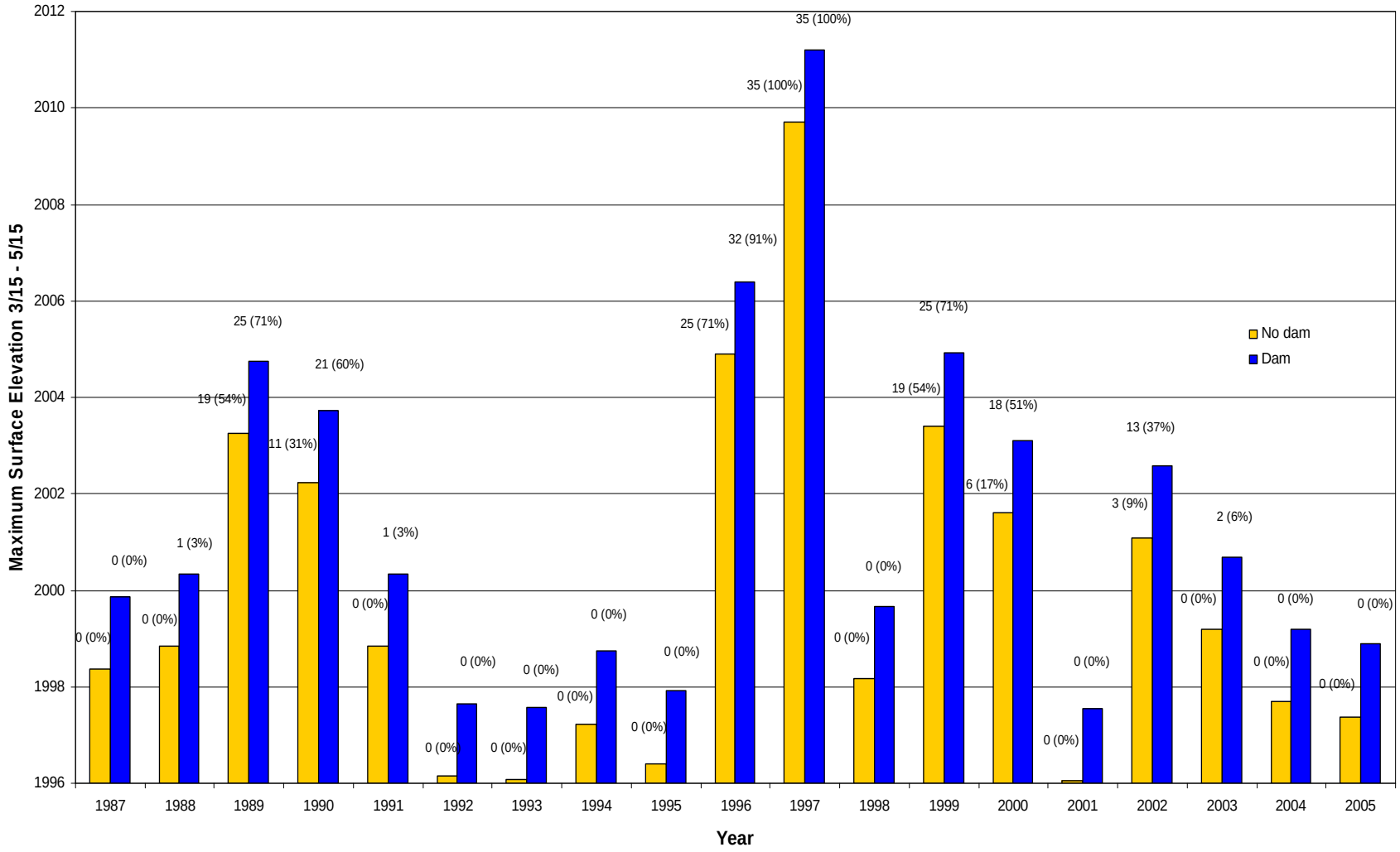

Figure 5.6-1. Maximum water surface elevations in the absence (orange) and presence (blue) of Project operations and the number of Canada goose nests lost (percentage of nests lost is in parentheses).

5.6.1.3. Project-related Recreation

Depending on the timing, reservoir-based recreation also has the potential to affect goose production. Fitzner et al. (1994) attributed a marked increase in goose nest abandonment on the Columbia River in one year of a 10-year study to a single visit to a nesting island by a fisherman and his dog, early in the nesting season. In this study, ravens took advantage of unattended nests (from researcher disturbance) on the island at PRM 27.7 following a May 13, 2008, survey by stealing a hatchling and attempting to steal an egg, highlighting the possible indirect effects of human presence during the nesting season. While this potential exists, recreational activity on and along Boundary Reservoir is low during the nesting season (see Study 21 Final Report [SCL 2009e]) and the nest islands are not expected to be at great risk from humans. It should be noted that, although the likelihood of human use may be low during the nesting season, the potential for a single visit on the island at PRM 27.7 to greatly affect annual goose production is high. Mallards are far more secretive and usually nest in shrub stands or other vegetation that provide concealment from avian predators and are difficult to traverse by humans or mammalian predators. Thus, risks to mallard nesting from Project-related recreational activities are likely very low.

5.6.2. Non-Project Effects

Potential non-Project effects to nesting ducks and geese include nest and habitat loss from seasonal flooding that would occur without any contributing influence of the Project. No impacts are anticipated from grazing, timber harvest, mining, or non-Project-related recreation because they do not typically occur in habitats where ducks and geese nest.

As discussed in Section 5.1, seasonal flooding can have a significant effect on Canada goose nesting because most geese nest on low-elevation islands in the upper reservoir. Flooding due to seasonal high flows caused the loss of goose nests in 7 of the 19 years of hydrologic data examined, potentially affecting over 50 percent of the nest sites in 6 of the years. The 1997 flood inundated all the islands in the study area, potentially affecting the entire island nesting population of geese. Geese can breed at 2 years of age, are long-lived birds (up to 24 years), and have relatively large clutches, so nest failure every few years is unlikely to reduce the local productivity for more than a year or two.

Potential loss of mallard nests from seasonal flooding is unknown because no nests for this species were found in the upper reservoir. Reese and Hall (1991) conducted research on nesting ducks along Box Canyon Reservoir and suggested that the late broods they observed may have resulted from forced re-nesting after a spring flood event (there was no evidence that duck production was reduced, only delayed). A mallard brood observed in July 2008 at the island at PRM 33.2 indicated that at least one duck nest survived the 2008 high water season. Thus, although flooding has the potential to flood duck nests, there is no evidence that this occurred in the study area in 2007 or 2008.

There is no evidence of erosion on the goose nesting islands leading to the loss of nesting habitat (see Study 1, Erosion Study Final Report [SCL 2009g)]. Most of the nesting islands are somewhat shielded from the erosive effects of high flows because of their location downstream of points of land. They are also protected by grass and shrubs, the roots of which limit soil

erosion. Study 16 (SCL 2009b) investigated potential riparian habitat (potential mallard nesting habitat) loss along the upper reservoir. Although a few riparian sites were identified where active erosion was occurring, the sites have steep slopes and are unlikely to provide typical duck nesting habitat.

6 CONCLUSIONS

Key findings of this study are summarized as follows:

- Between April 2007 and September 2008, 20 species of waterfowl and 20 species of waterbirds were recorded in the study area.

- Only two species of ground-nesting waterfowl—Canada geese and mallards—were documented nesting in the study area.

- Ninety-two percent of the 87 Canada goose nests (and nearly all the successful nests) were located on islands. A few geese nested on four rocky islands (with shrub coverage) in the lower reservoir, but most nested on the five grass and shrub-covered islands in the upper reservoir. The island at PRM 27.7 (near Metaline) alone supported 60 percent of all goose nests.

- Three islands in the upper reservoir are susceptible to land-bridging, potentially exposing nests to mammalian predation, especially from coyotes. However, the most productive islands in the study area did not land-bridge during the nesting season.

- In general, geese in 2007 nested at elevations well above the normal range of daily water surface fluctuations, but these nests are theoretically at risk from early spring flood events. It was calculated that greater than 50 percent of the island nests could be lost in 6 of the 19 years of the hydrologic record.

- Existing mallard nesting habitat was defined as the 93.6 acres of riparian tree and shrub stands identified along the upper reservoir (SCL 2009b). There was no indication in either year of the study that mallard nests would be affected by or lost to flooding.

- It was determined that if the reservoir were operated during the goose nesting season at a median elevation of 1,985 feet NAVD 88 (1,981 feet NGVD 29) (as measured at the Boundary forebay), instead of the current median of 1,990 feet NAVD 88 (1,986 feet NGVD 29), two of the islands would be connected to the mainland and no longer be suitable as goose nesting habitat. This loss would be offset by a 10-acre expansion of the island at PRM 28.9 (net change of 0.4 percent). However, lowering the reservoir median to 1,980 feet NAVD 88 (1,976 feet NGVD 29) would result in land-bridging of the island at PRM 28.9 and a net loss of 61 percent of goose nesting habitat.

- Operating the reservoir at 1,980 feet NAVD 88 (1,976 feet NGVD 29) would produce a net increase in mallard nesting habitat along the upper reservoir of 8.1 acres (8.7 percent), due mostly to a large increase in riparian habitat at the island at PRM 28.9. Nearly all other riparian stands would either decline or be unaffected.

- Forty-four goose nests were recorded in 2007 and 45 were recorded in 2008. Known success rates for the nests were 64 percent in 2007 (28 nests) and 33 percent (15 nests) in 2008. Flooding in 2008 limited the study teams' ability to determine the fate of nearly half (44 percent) of the goose nests, although available evidence suggested that some were successful while others were lost to predation and flooding.

- One mallard nest was found in the lower reservoir and none were found along the upper reservoir in 2007. A second ground-nesting duck nest was found in the lower reservoir in 2008, but the species could not be determined. During the two-year study season, only four mallard broods were confirmed. Mallards were the only ground-nesting duck observed in the study area during the June and July nesting season.

- Double-crested cormorants, mostly juveniles, used the upper reservoir late April to mid-October, with an annual peak (up to 47) in September. Cormorants concentrated at three perch sites and there was no evidence of breeding in the study area. Great blue herons were relatively uncommon in the study area. They were virtually absent late winter to early spring and peaked during the summer (high count of 7); no evidence of breeding was found. Between 14 and 26 common mergansers were found to use the study area year-round. Three broods were recorded in the upper reservoir and one in the Boundary tailrace in 2007, but only one brood was observed in the upper reservoir in 2008.

- The dominant fall migrants in the study area were mallards, American coots, and American wigeons, whereas mallards, wigeons, and northern pintails dominated the spring migration period. Resident Canada geese and mergansers were also found in the fall and spring and were the only waterfowl of note during the winter months except for a few Barrow's goldeneyes.

Project effects on waterfowl can be summarized as follows:

- When water surface elevations are increased due to spring runoff (generally when average water surface elevations at the Box Canyon gage exceed 1,996 feet NAVD 88 [1,992 feet NGVD 29] [R2 Resource Consultants, Inc. 2008]), Project operations can increase water surface elevations in the upper reservoir by an additional 1.1 to 1.6 feet, potentially increasing flood-related loss of goose nests. When maximum water surface elevations would have been between 2,002 and 2,006 feet NAVD 88 (1,998 and 2,002 feet NGVD 29), which occurred about 5.3 percent of the time during the goose nesting season over the period of the 19-year hydrologic record, Project operations could have resulted in the loss to flooding of up to an additional 12 nests,

assuming island-nesting geese annually nested at similar elevational ranges as in 2007.

- Three islands in the upper reservoir have the potential to land-bridge during the Canada goose nesting season exposing island-nesters to increased risk to mammalian predators such as coyotes, especially during dry years. Land-bridging occurs most often during the evening hours when the reservoir tends to be at its lowest point, which coincides with nocturnal activity periods of mammalian predators.

- Recreationists have the potential to impact nesting geese by visiting islands with active goose nests during the nesting season, leading to nest abandonment or predation. However, boating use of Boundary Reservoir during March and early April is probably low and unlikely to impact nesting geese.

- As shown in the Study 16 Final Report (SCL 2009b), daily water fluctuations (in the absence of flood conditions) have little or no effect on existing woody riparian vegetation (defined as suitable mallard nesting habitat) along the upper reservoir study area, but may be limiting establishment of new stands where the fluctuations have removed finer soils.

Flooding associated with seasonal high flows that coincide with goose nesting is the only non-Project activity likely to have a significant effect on waterfowl production. Seasonal high water may have flooded over 50 percent of the nests in nearly one-third of the years represented in the 1987–2005 hydrologic record. Absent the Project contribution to seasonal flooding, over half of the nests would have been lost in approximately 20 percent of the years represented in the hydrologic record. Seasonal flooding has the potential to flood all island goose nests, and probably did so in 1997.

7 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

Waterfowl were recorded during reservoir-based surveys targeting other species (e.g., big game and RTE wildlife), resulting in more survey data on waterfowl reservoir use than originally proposed in the RSP. Due to the fact that only one duck nest was found in the lower reservoir (outside the nesting study area) in 2007, and only a very few broods were noted, the 2008 ground-nesting duck surveys focused on broods rather than nests. Because no duck nests were found, the assessment of duck nest sites relative to water surface elevation fluctuations during normal, wet, and dry years could not be accomplished. However, an assessment of potential duck nesting habitat relative to fluctuations during normal, wet, and dry years was done by assuming that all the woody riparian habitat identified in Study 16 provided potential duck nesting habitat. Further, because Canada geese nest on the higher elevations of islands, they naturally avoid flooding except during the most extreme high water years. Thus, it became clear that limiting the goose nest assessment to normal, wet, and dry years would not provide an accurate assessment of the effects of hydrology on nesting; all nests would be lost in a wet year, and none in a dry or normal year. To better refine the assessment, the elevational distribution of

the 2007 nests was compared with the maximum water surface elevations (during the goose nesting season) for each year of the 19-year hydrologic record. These deviations from the RSP were approved by the relicensing participants during a March 4, 2008, meeting.

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