Boundary Hydroelectric Project (FERC No. 2144)

Study No. 15

Waterfowl/Waterbird Study

Interim Report

Prepared for
Seattle City Light

Prepared by
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Tetra Tech

March 2008

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Study No. 15 – Waterfowl/Waterbird Study
Interim Report
Boundary Hydroelectric Project (FERC No. 2144)

1 INTRODUCTION

Study No. 15, the Waterfowl/Waterbird Study, is being 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 interim report describes study efforts through October 2007.

2 STUDY OBJECTIVES

The primary goal of the Waterfowl/Waterbird Study is 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 of this study is to provide information on populations of piscivorous waterbirds in the Project area, particularly cormorants.

Specific objectives of the study are 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 period.

3 STUDY AREA

The study area for 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). The study area extended approximately 8 miles along the Pend Oreille River from the Box Canyon tailrace downstream to Metaline Falls and encompassed the reservoir, the reservoir fluctuation zone, and all suitable waterfowl nesting habitat within 200

feet of the high water level (approximately 2,019 feet NAVD 88 [2,015 feet NGVD 29][1]) and within the SCL-owned Boundary Wildlife Preserve (BWP).[2] For the purposes of estimating populations of piscivorous waterbirds and the habitats they use, the study area also included the reservoir from Metaline Falls to Boundary Dam.

Relative to waterfowl, although the study area was focused primarily on the reach upstream of Metaline Falls, areas of potentially suitable habitat extending from Metaline Falls to Boundary Dam were also surveyed.

Concerning the reservoir fluctuation zone, the range of water surface elevations recorded during the survey periods for this study is presented below; these ranges represent 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
- 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 ISR, SCL agrees 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.

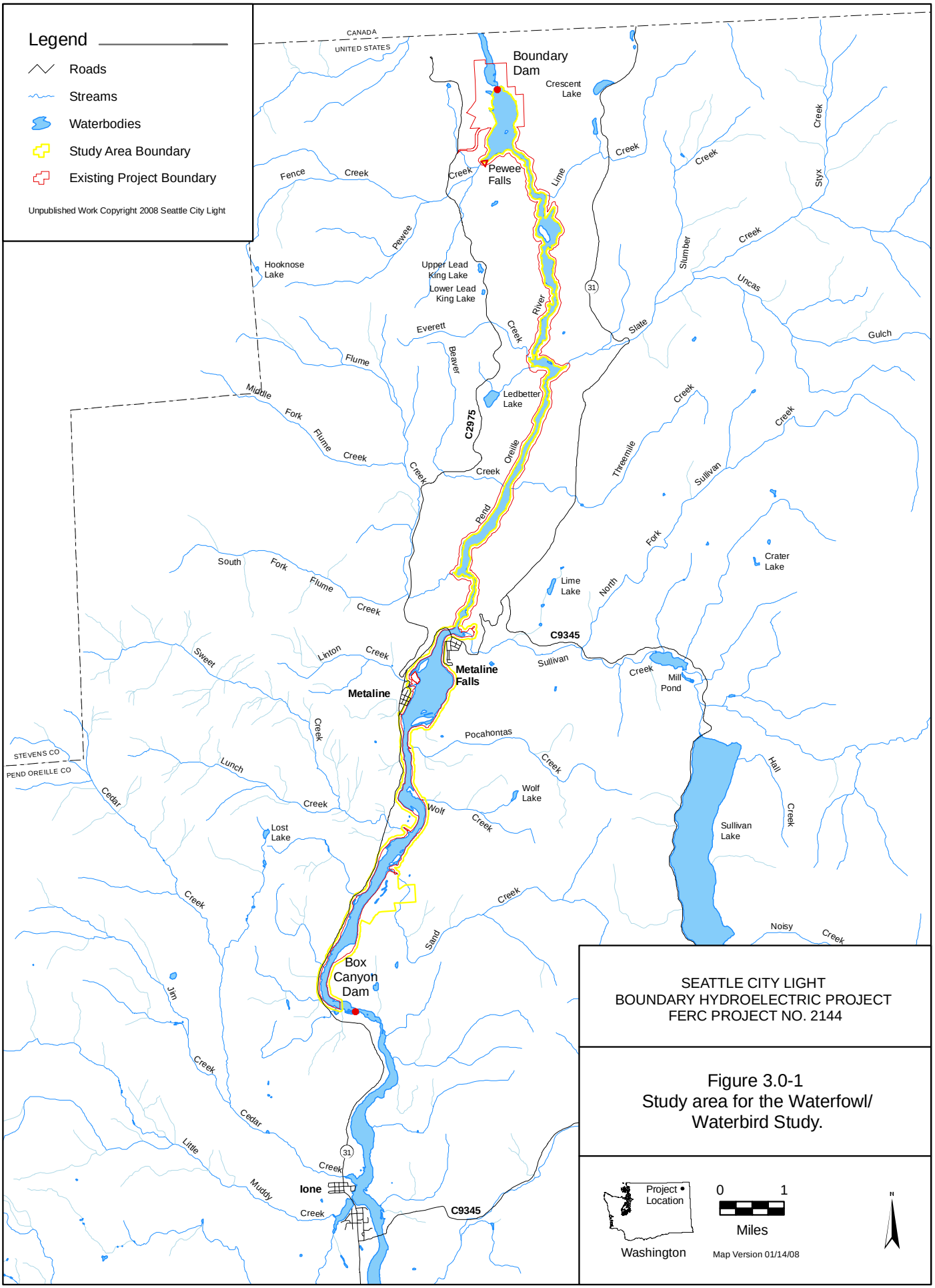

Figure 3.0-1
Study area for the Waterfowl/ Waterbird Study.

4 METHODS

Six tasks were identified for this study. They were:

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

The methodologies for tasks completed or initiated in 2007 are described in detail below; methods for tasks to be completed in 2008 are described in the RSP.

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

As described in the RSP, estimating the amount of suitable habitat for ground-nesting waterfowl under current operations involves the development of maps based on hydrology, bathymetry, topographic, and vegetation community data. Existing hydrology, topography, and vegetation data were acquired and will be utilized when the full suite of data needed for this task are available. A complete bathymetric dataset was not available and the Hydraulic Routing Model (see Study 7, Mainstem Aquatic Habitat Modeling Interim Report [SCL 2008a]), which is needed to accurately describe pool elevations at specific locations, was still under development at the writing of this interim report. Consequently, mapping and estimating habitat for ground-nesting waterfowl under current operations will occur in 2008.

Another key element in estimating habitat is to understand local breeding habitat requirements for target species. Concerning Canada geese (*Branta canadensis*), these requirements were determined from a literature review and the results of the waterfowl nest surveys (Task 3). For mallards (*Anas platyrhynchos*), an accurate definition of suitable nesting habitat in the study area will require further literature review and input from the relicensing participants. Information concerning habitat requirements for Canada geese is presented in this report.

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

The hydrologic and bathymetric datasets required to complete this task were still under development at the writing of this interim report. Thus, this task will be completed at a later date and the results will be reported in the Updated Study Report (USR).

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 during April–June 2007 to document waterfowl ground nests. Complete surveys of existing suitable nesting habitat

were conducted by biologists systematically walking through accessible areas (Figure 4.3-1). 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 (for ground nests)
- Evidence of human disturbance

Maps showing the surveyed area and locations of nests were generated using Geographic Information System (GIS) software. 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 will allow for an assessment of the effects of potential reservoir level fluctuations on current-year nest sites (e.g., flooding or land-bridging).

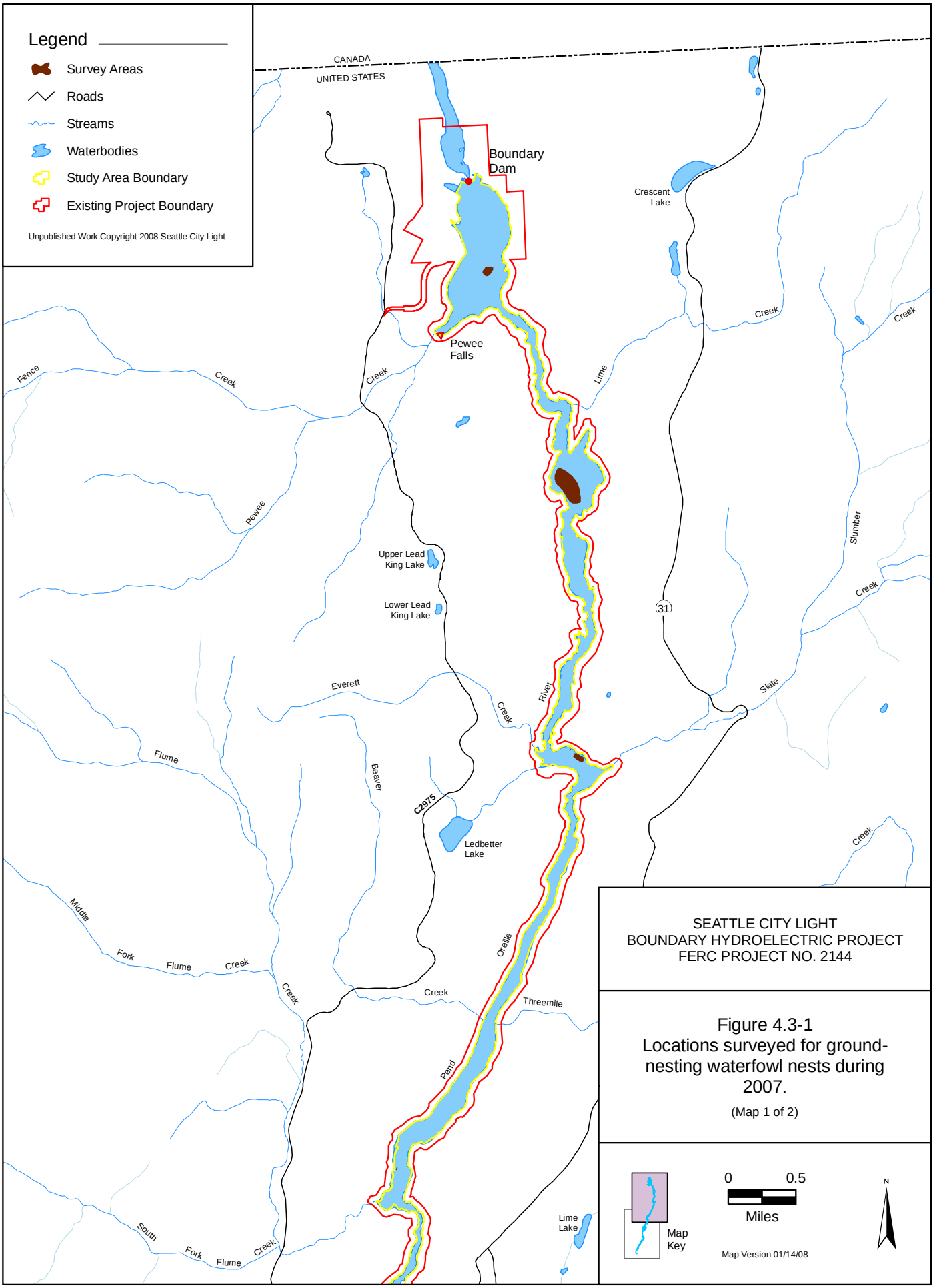

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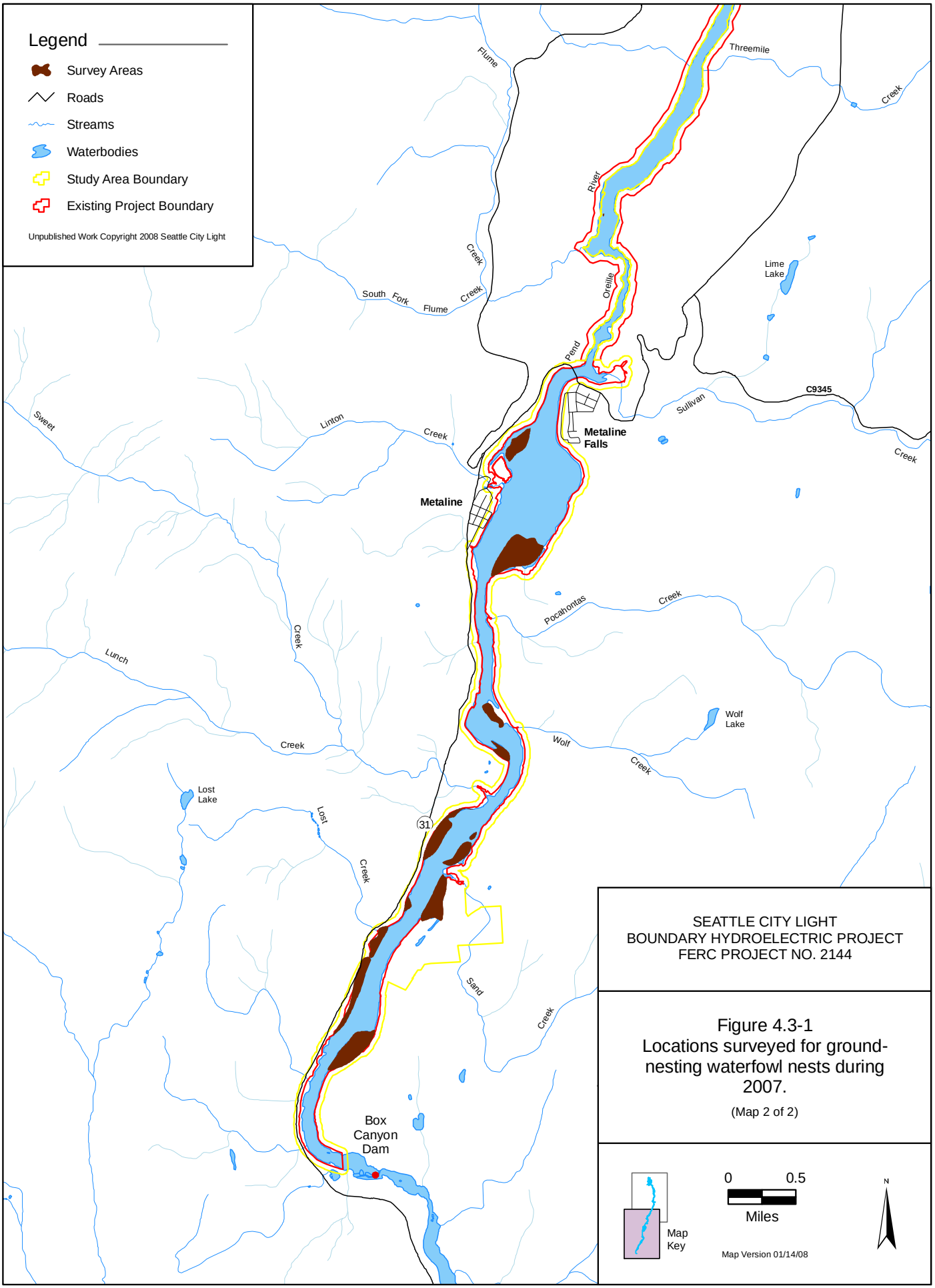
Figure 4.3-1
Locations surveyed for ground-nesting waterfowl nests during 2007.

(Map 1 of 2)


Legend
Survey Areas
Roads
Streams
Waterbodies
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
Threemile
Creek
Flume
River
Creek
South Fork Flume Creek
Oreille
Pend
Lime Lake
C9345
Sullivan
Creek
Sweet
Linton
Creek
Metaline Falls
Metaline
Pocahontas
Creek
Creek
Lunch
Wolf Lake
Wolf
Creek
Creek
Lost Lake
Lost
Creek
31
Sand
Creek
Box Canyon Dam
SEATTLE CITY LIGHT
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FERC PROJECT NO. 2144
Figure 4.3-1
Locations surveyed for ground-nesting waterfowl nests during 2007.
(Map 2 of 2)
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Miles
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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 surveys (Task 5); rare, threatened, and endangered wildlife species surveys (Study 18 [see SCL 2008b]), and big game surveys (Study 19 [see SCL 2008c]). Eight surveys of the reservoir were conducted between April and September 2007 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 target species included double-crested cormorants and great blue herons (per the RSP), sightings of all piscivorous waterbirds were recorded. Common merganser was added as a target species based on recent work by Dr. Julia Parrish (University of Washington) showing that this piscivorous duck is a major threat to juvenile salmonids in the mid-Columbia River.

To supplement the data from the piscivorous waterbird surveys, crews conducting other resource studies along the reservoir were asked to incidentally record sightings of the piscivorous species.

4.5. Fall Migration and Winter Surveys

Surveys to assess migration and wintering use of the reservoir by waterfowl began in September 2007, and will be conducted monthly through March 2008. As with all other wildlife surveys, waterfowl were (and will continue to be) recorded to location using GPS, and plotted onto maps.

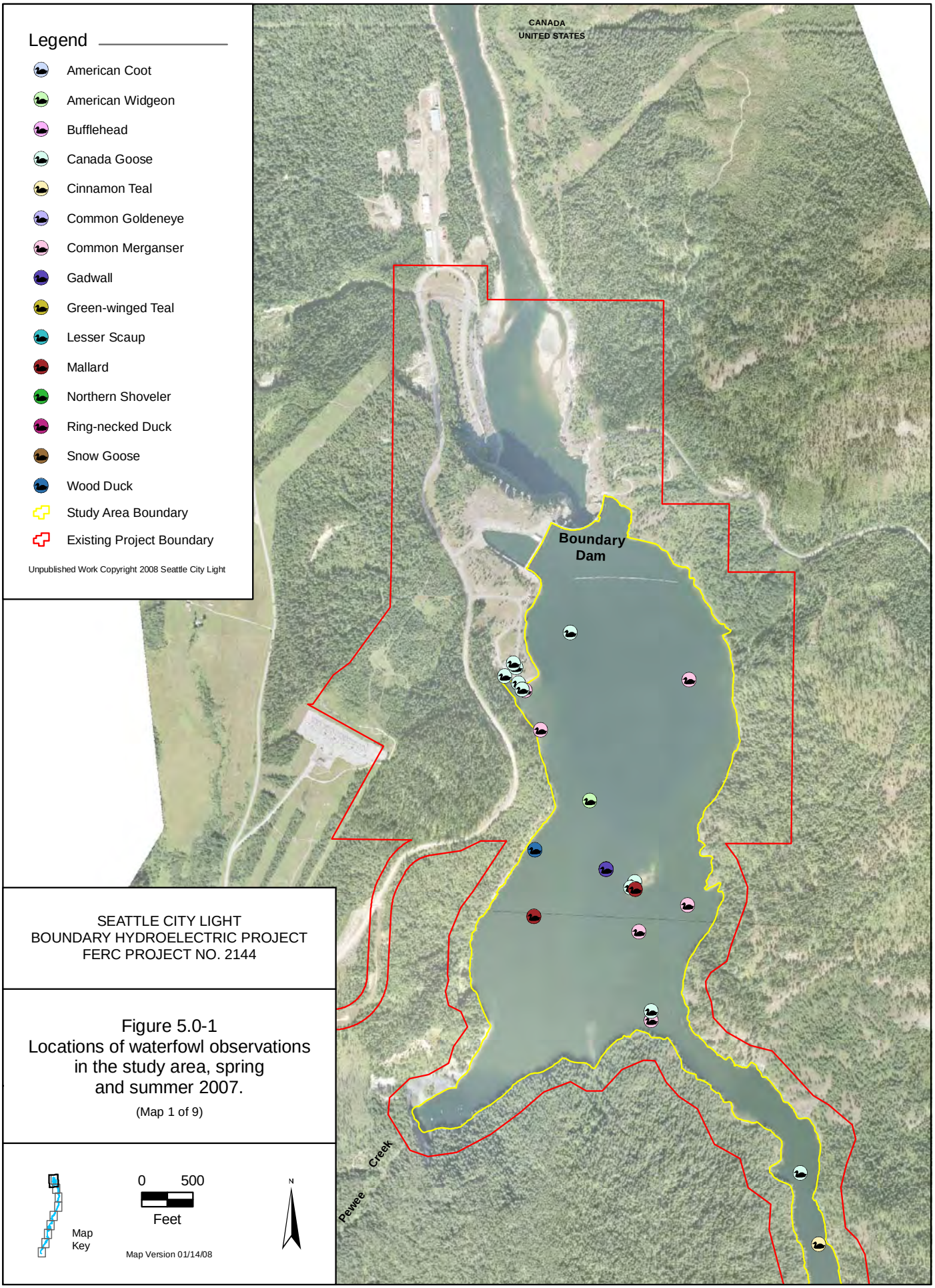
4.6. Documentation and Effects Assessment

All data collected in the field were recorded on datasheets using GPS units and/or directly on maps or aerial photographs. Field forms were scanned and archived, and field data were entered into spreadsheets for eventual analysis. Location data were entered into the Project GIS database and output as maps for reporting.

Because the waterfowl study is a 2-year study, data collection is not complete. Consequently, assessing Project effects on waterfowl and waterbirds is not addressed in this interim report; the effects assessment will be addressed in the USR.

5 PRELIMINARY RESULTS

Surveys for this study documented all species of waterfowl and waterbirds observed on or near the reservoir. In total, 15 species of waterfowl (Figure 5.0-1) and 18 species of waterbirds (Figure 5.0-2) were observed in the study area from April through October 2007. A list of all species observed is provided in Appendix 1. More detail on target species of waterfowl and piscivorous waterbirds is summarized in the following sections.


Legend
American Coot
American Widgeon
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Green-winged Teal
Lesser Scaup
Mallard
Northern Shoveler
Ring-necked Duck
Snow Goose
Wood Duck
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
CANADA
UNITED STATES
Boundary Dam
Pewee Creek
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.
(Map 1 of 9)
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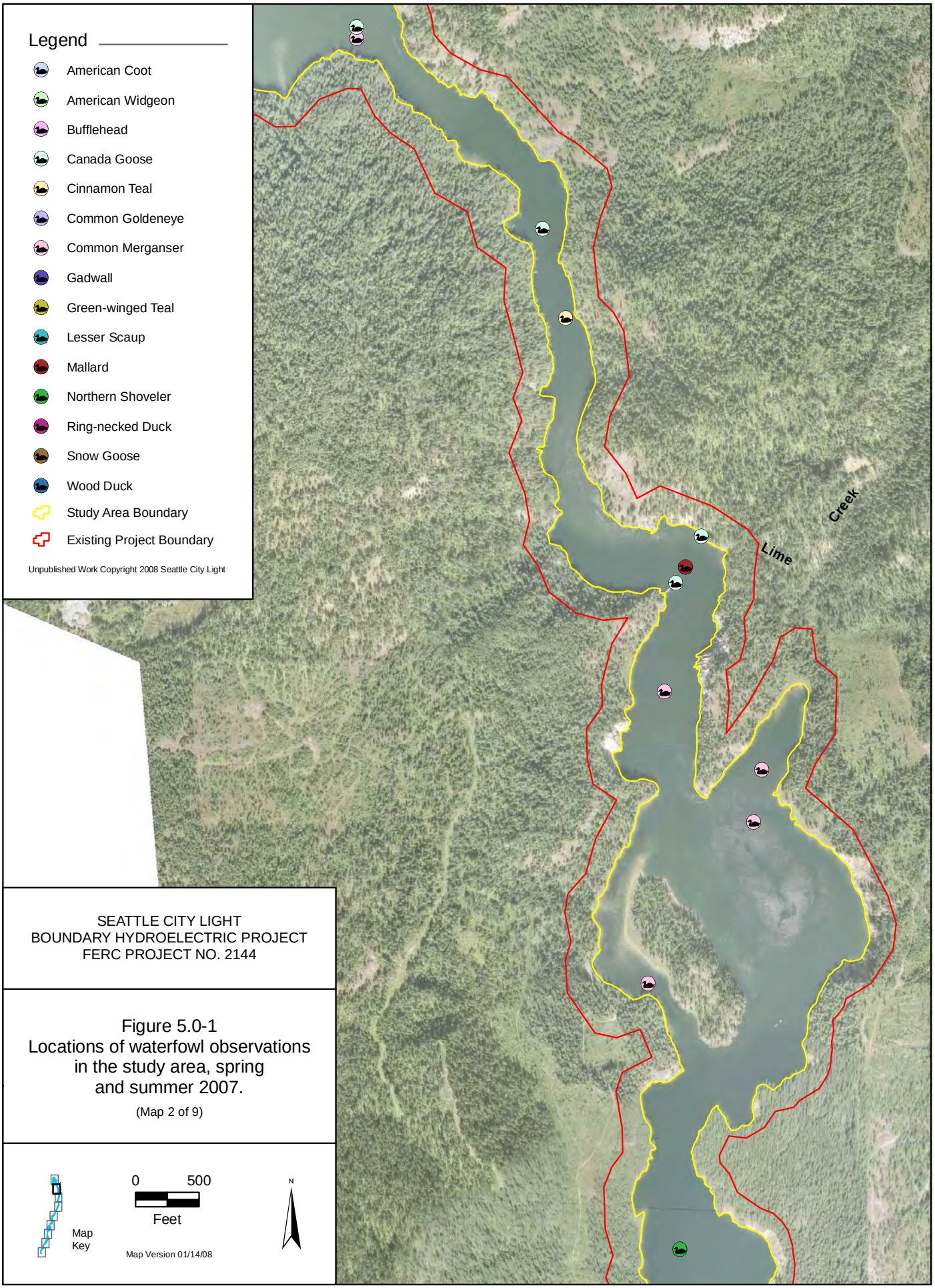

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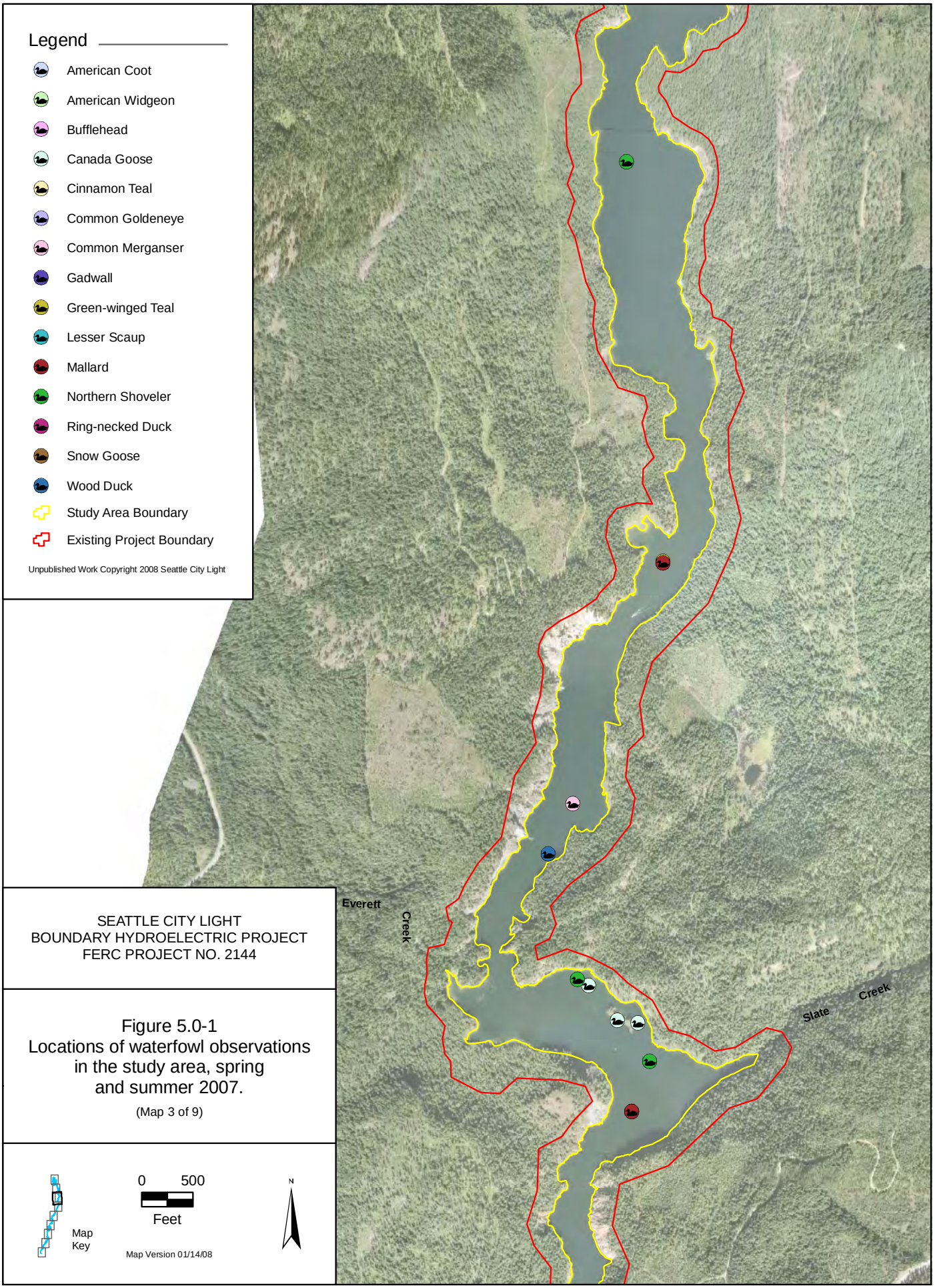
Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 2 of 9)



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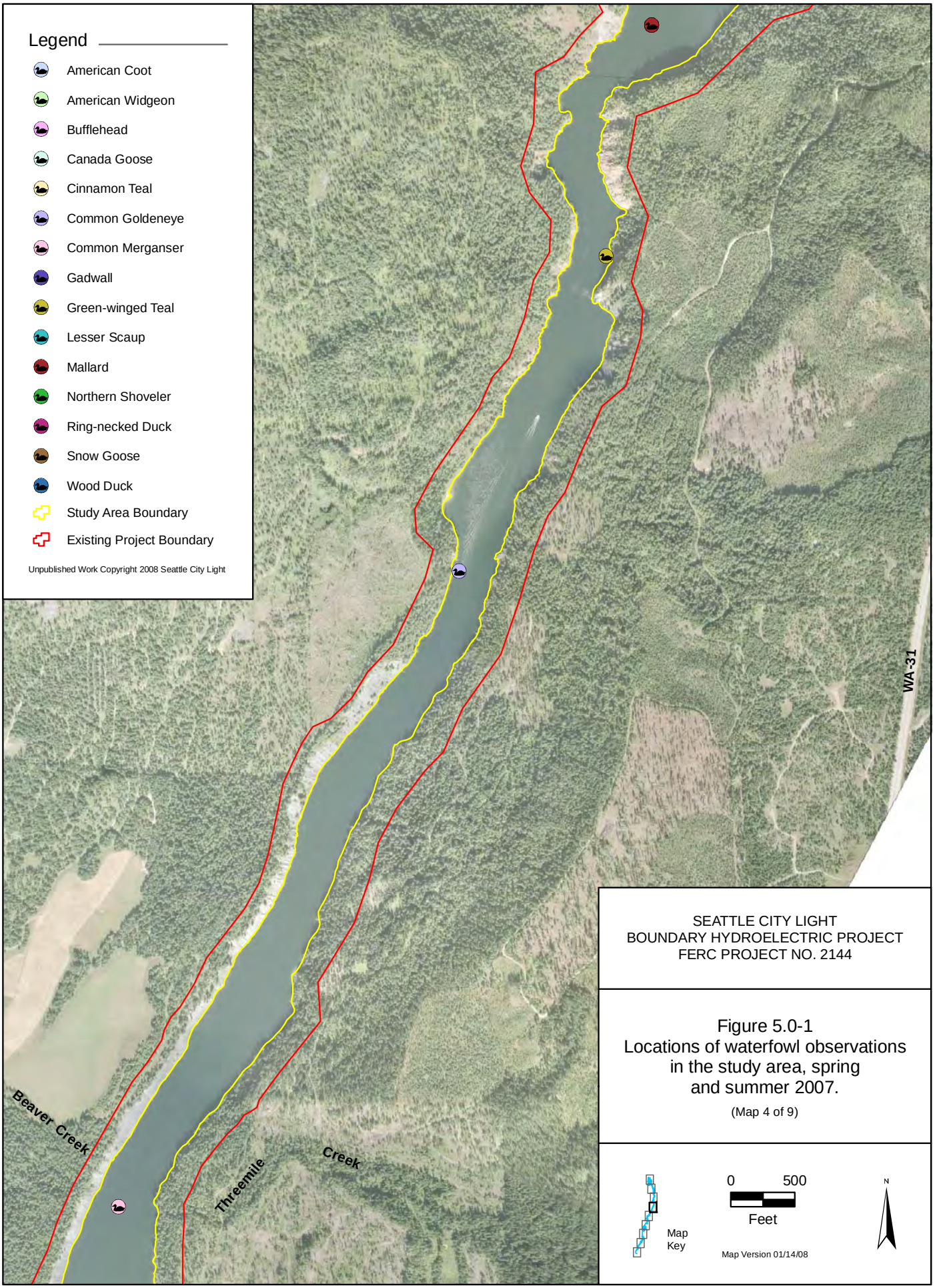
FERC PROJECT NO. 2144

Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 3 of 9)


Legend
American Coot
American Widgeon
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Green-winged Teal
Lesser Scaup
Mallard
Northern Shoveler
Ring-necked Duck
Snow Goose
Wood Duck
Study Area Boundary
Existing Project Boundary
Unpublished Work Copyright 2008 Seattle City Light
WA-31
Beaver Creek
Threemile
Creek
SEATTLE CITY LIGHT
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FERC PROJECT NO. 2144
Figure 5.0-1
Locations of waterfowl observations
in the study area, spring
and summer 2007.
(Map 4 of 9)
Map
Key
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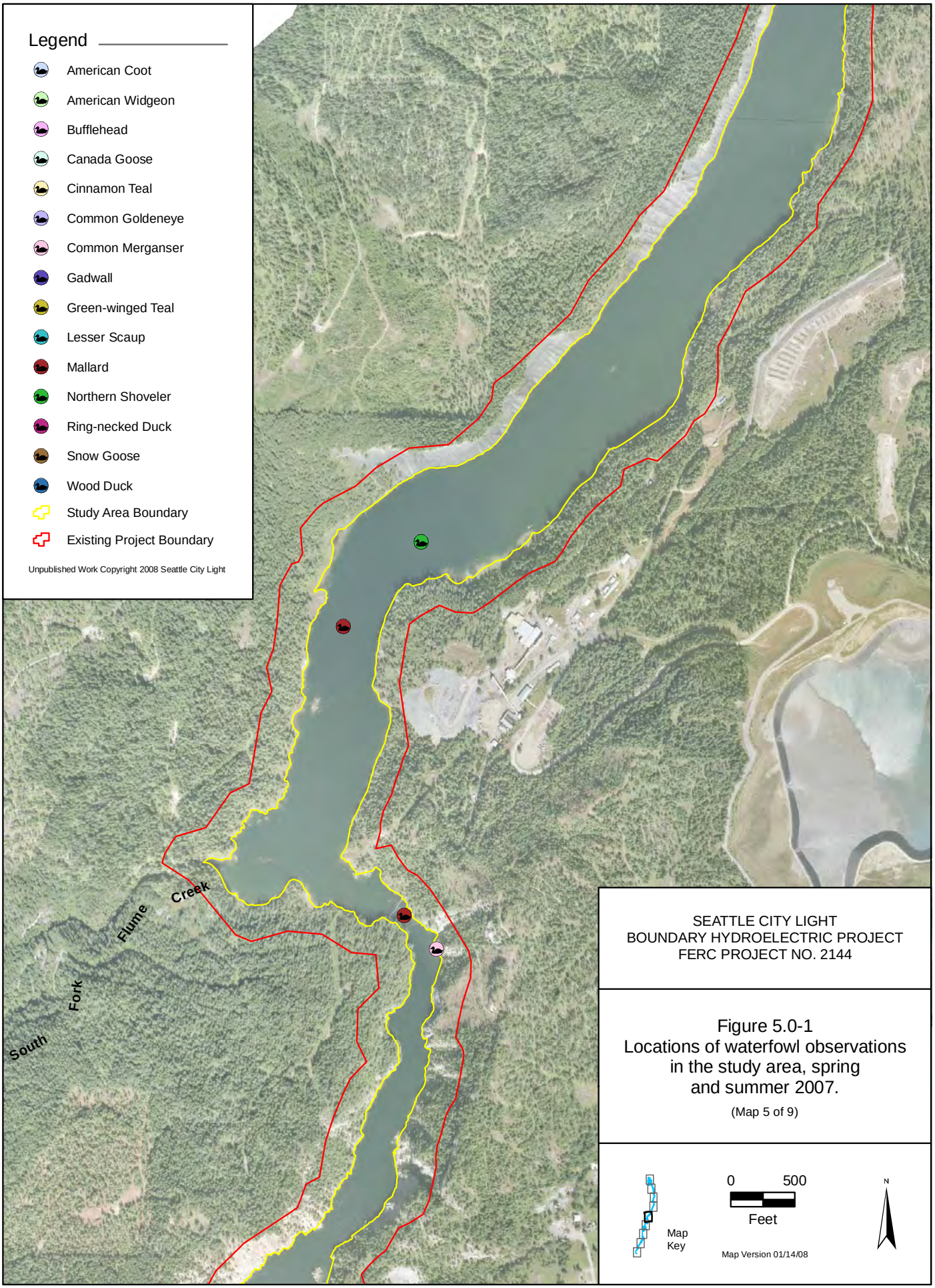
Legend
American Coot
American Widgeon
Bufflehead
Canada Goose
Cinnamon Teal
Common Goldeneye
Common Merganser
Gadwall
Green-winged Teal
Lesser Scaup
Mallard
Northern Shoveler
Ring-necked Duck
Snow Goose
Wood Duck
Study Area Boundary
Existing Project Boundary
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South Fork Flume Creek
SEATTLE CITY LIGHT
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FERC PROJECT NO. 2144
Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.
(Map 5 of 9)
Map Key
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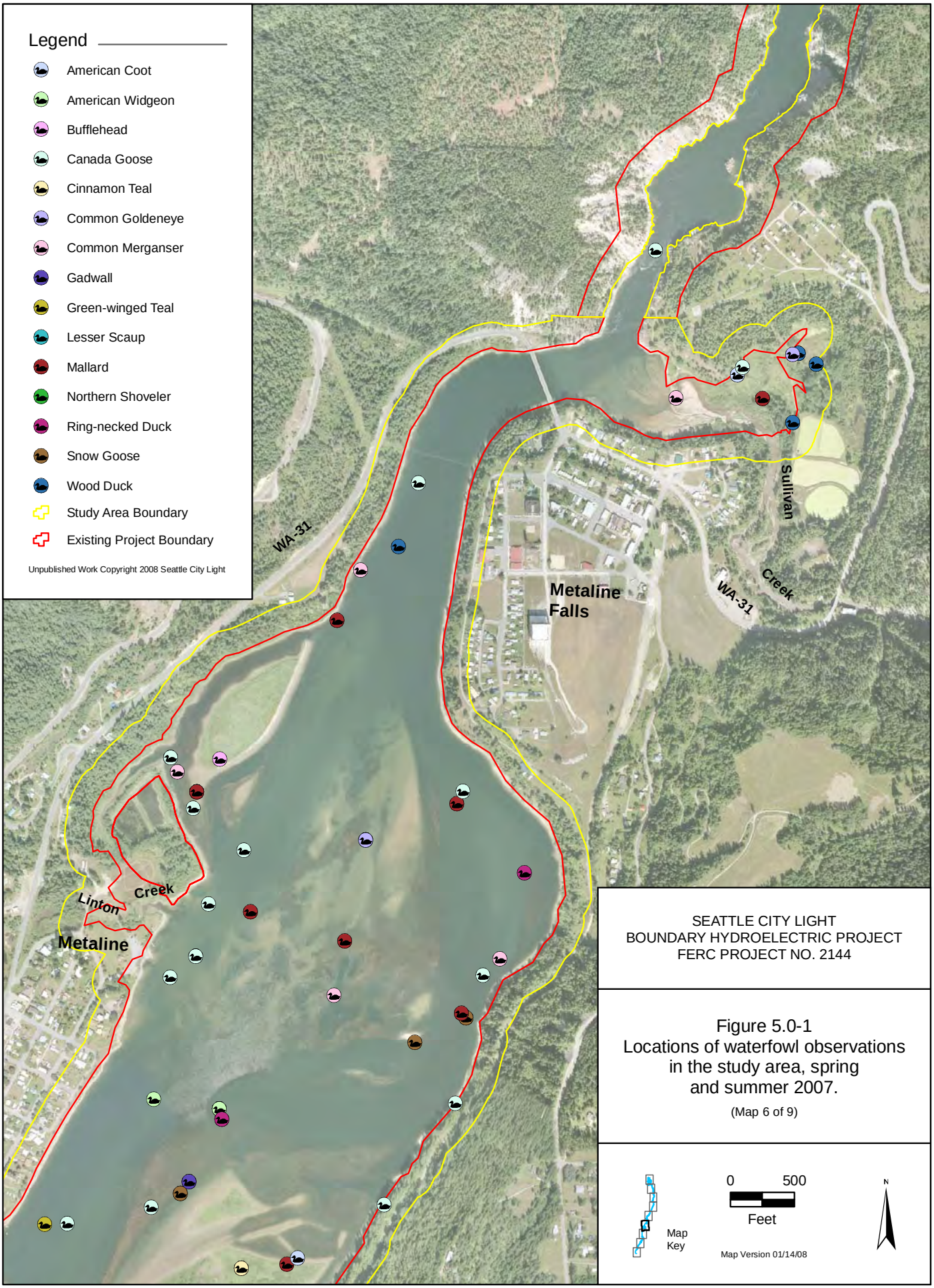

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FERC PROJECT NO. 2144

Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 6 of 9)

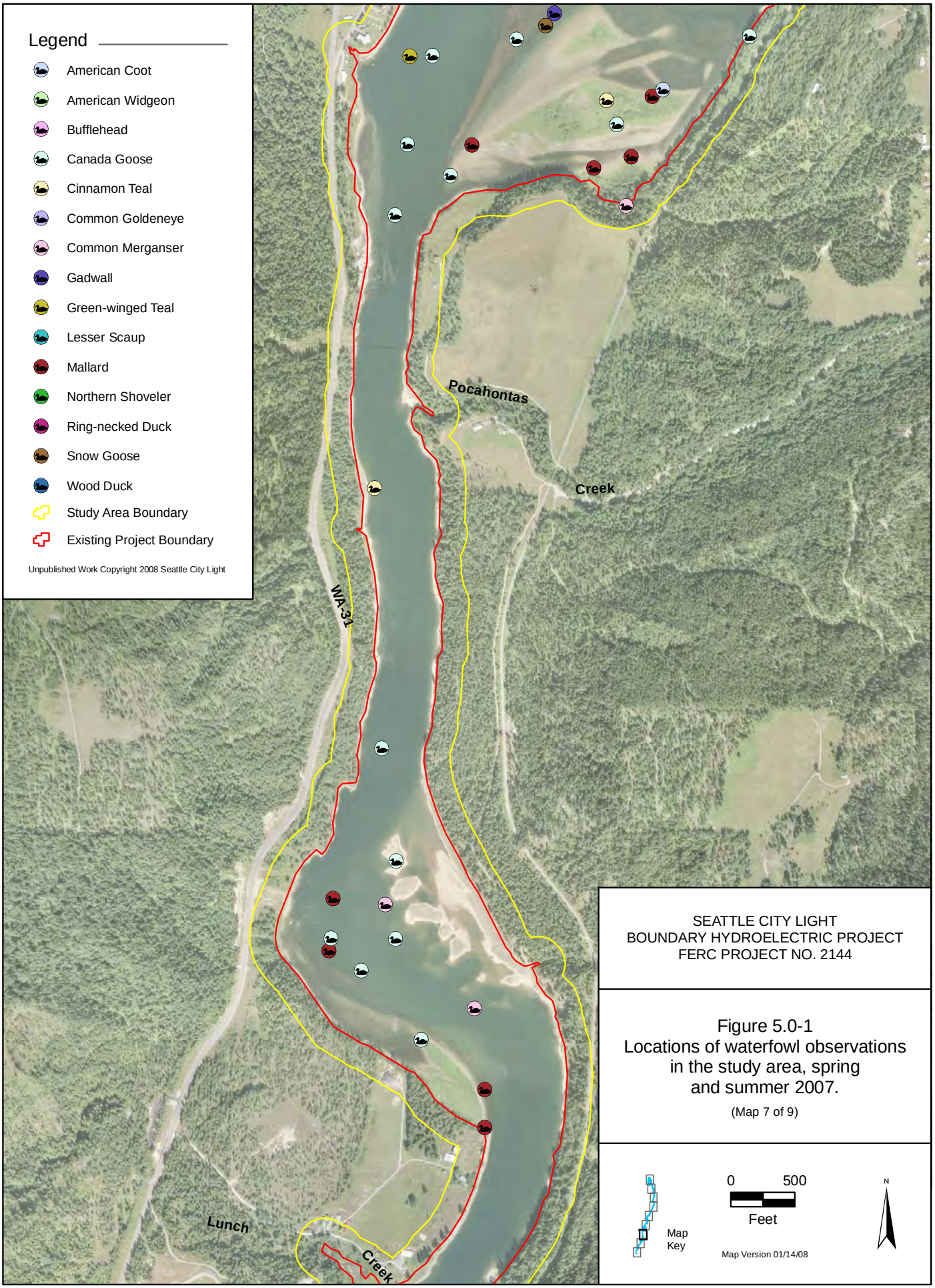

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Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 7 of 9)

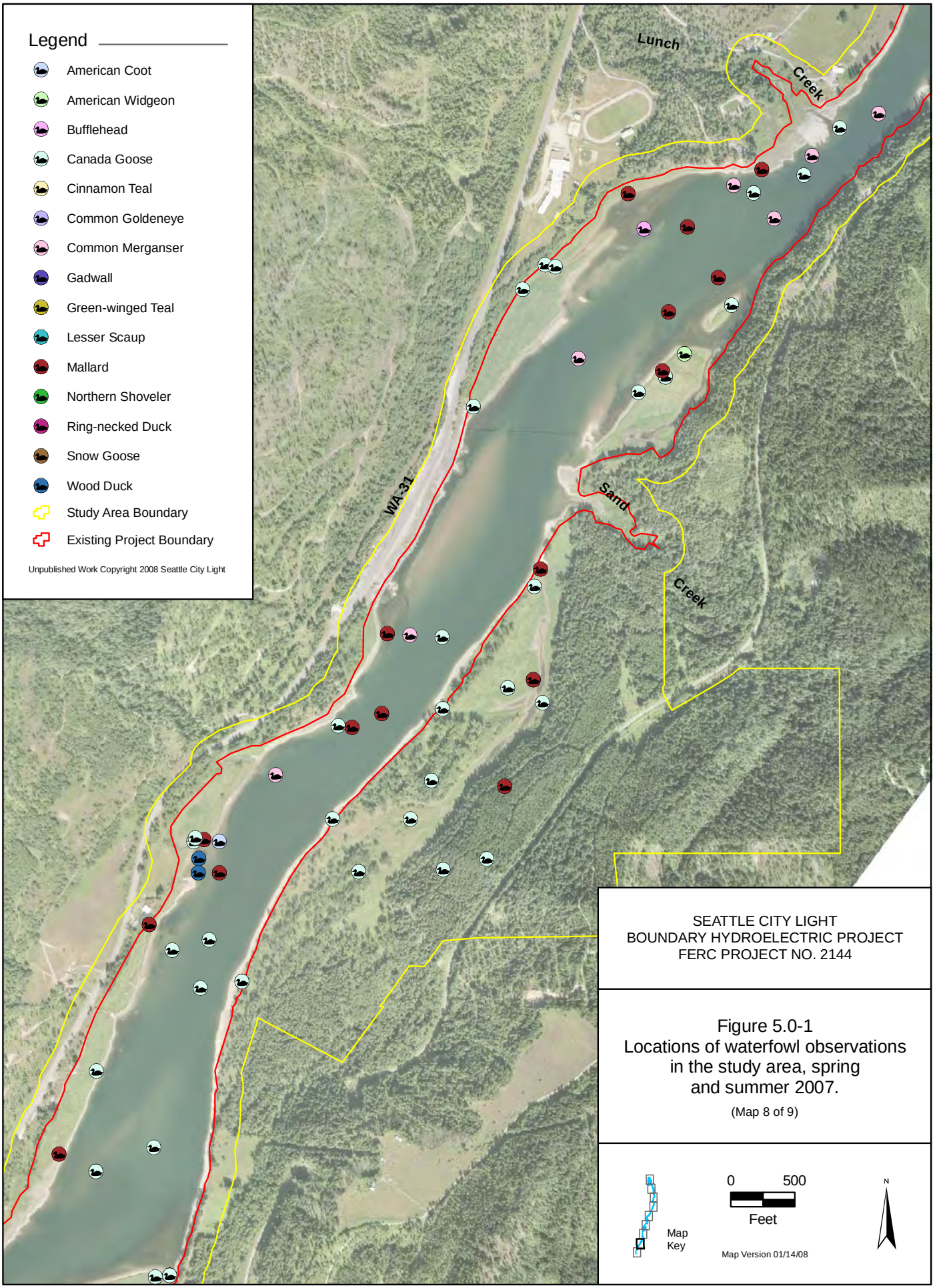

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Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 8 of 9)

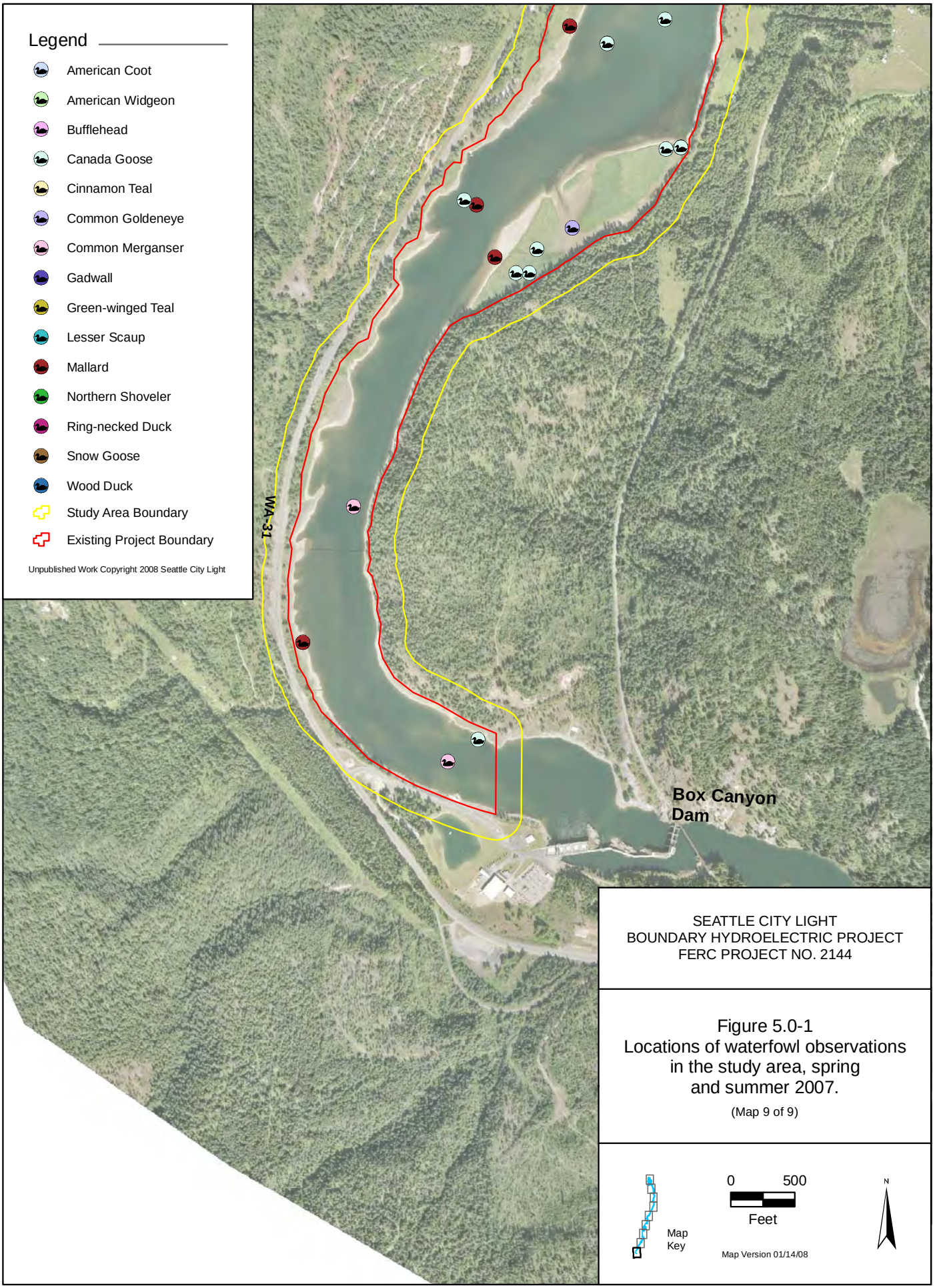

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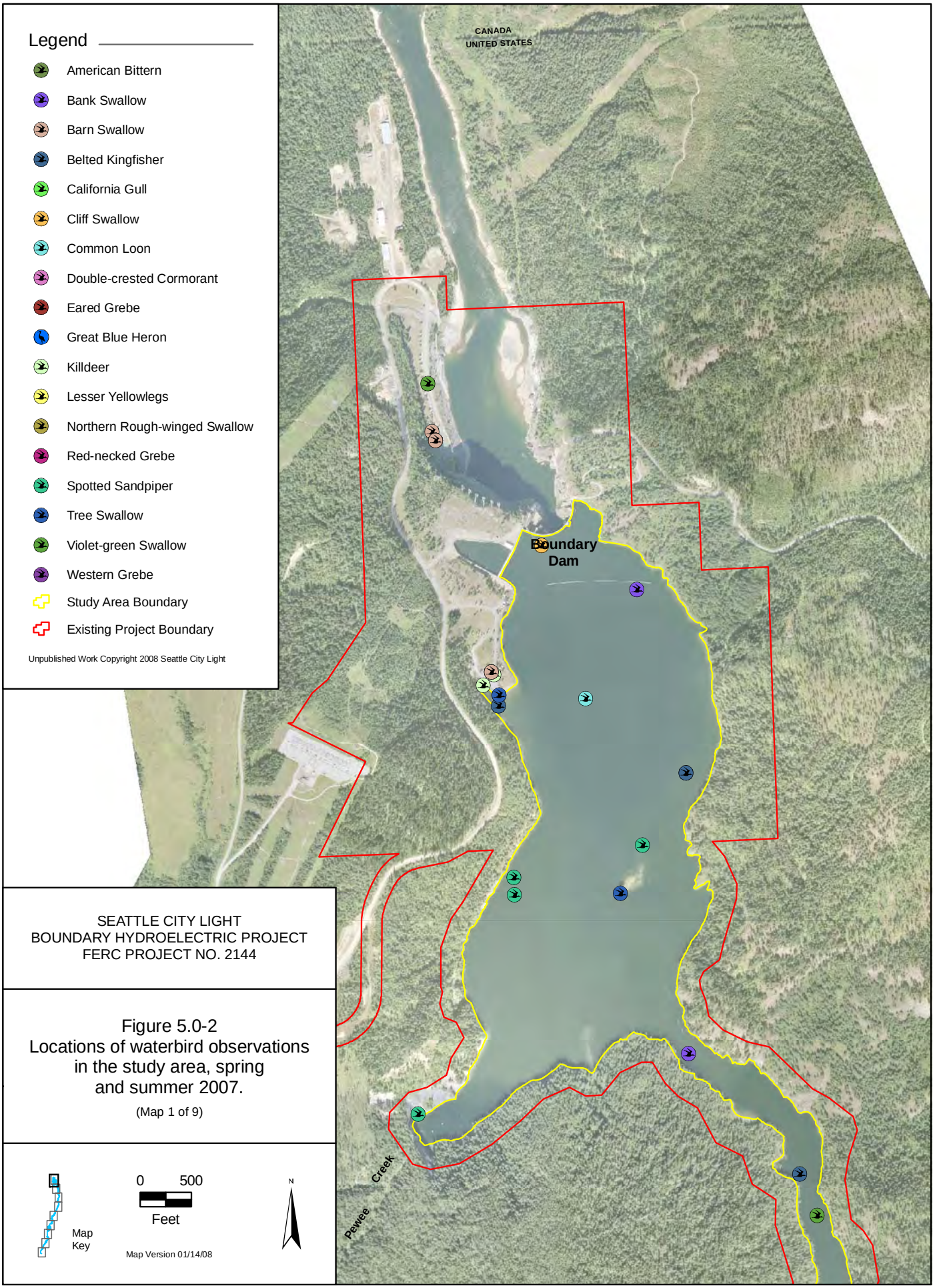
Figure 5.0-1
Locations of waterfowl observations in the study area, spring and summer 2007.

(Map 9 of 9)


Legend
American Bittern
Bank Swallow
Barn Swallow
Belted Kingfisher
California Gull
Cliff Swallow
Common Loon
Double-crested Cormorant
Eared Grebe
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
CANADA
UNITED STATES
Boundary Dam
Pewee Creek
SEATTLE CITY LIGHT
BOUNDARY HYDROELECTRIC PROJECT
FERC PROJECT NO. 2144
Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.
(Map 1 of 9)
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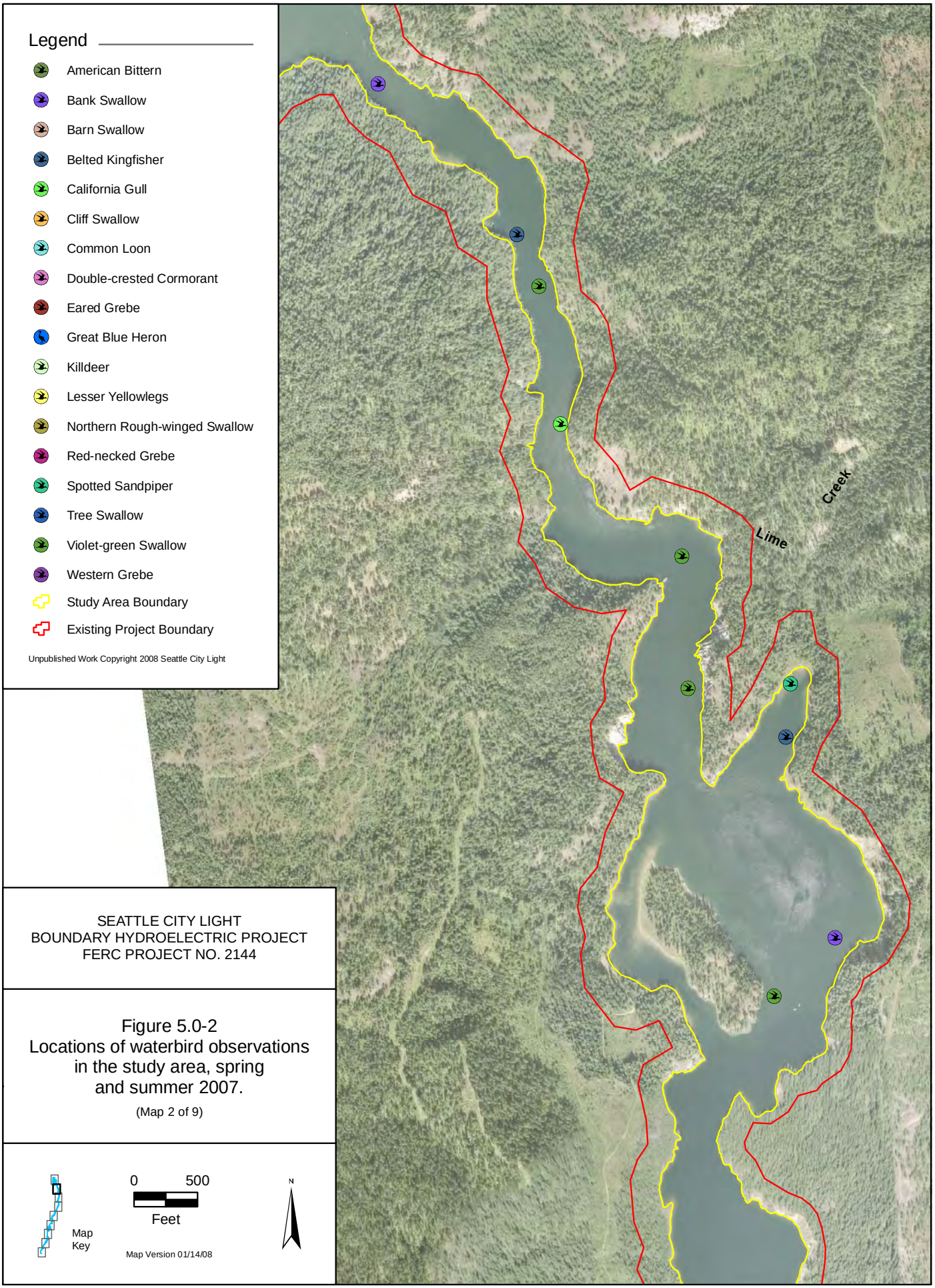

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 2 of 9)

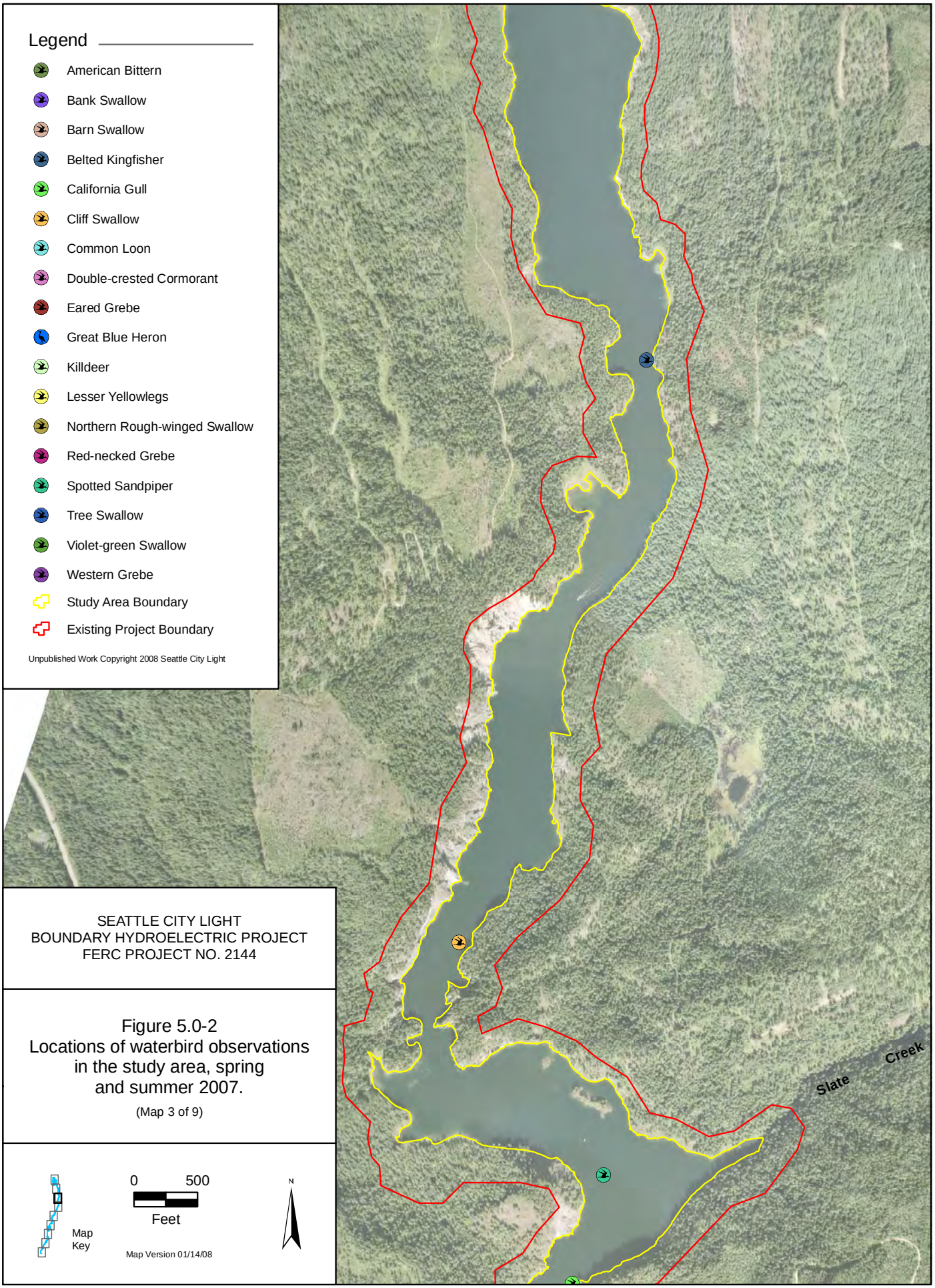

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 3 of 9)

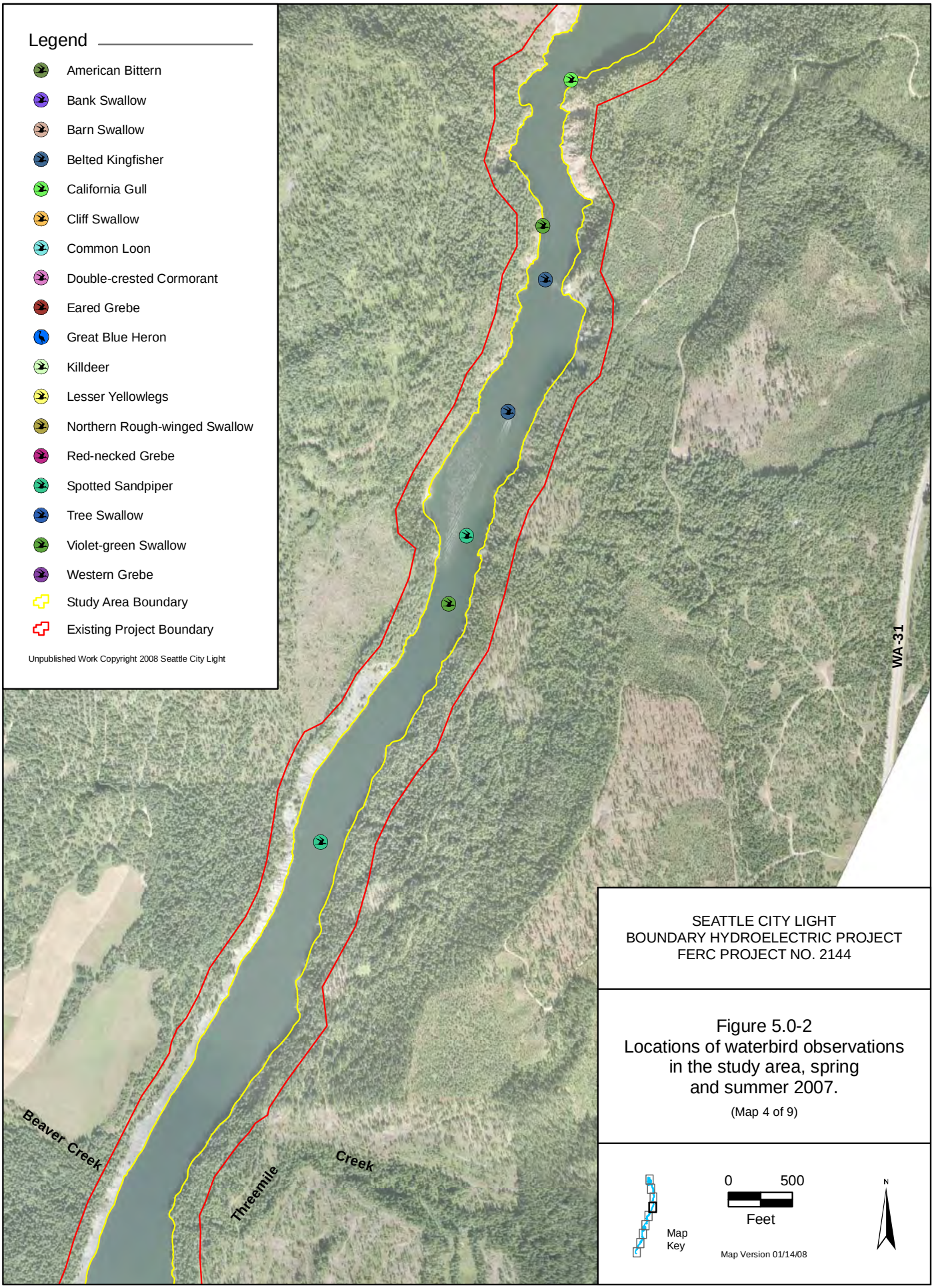

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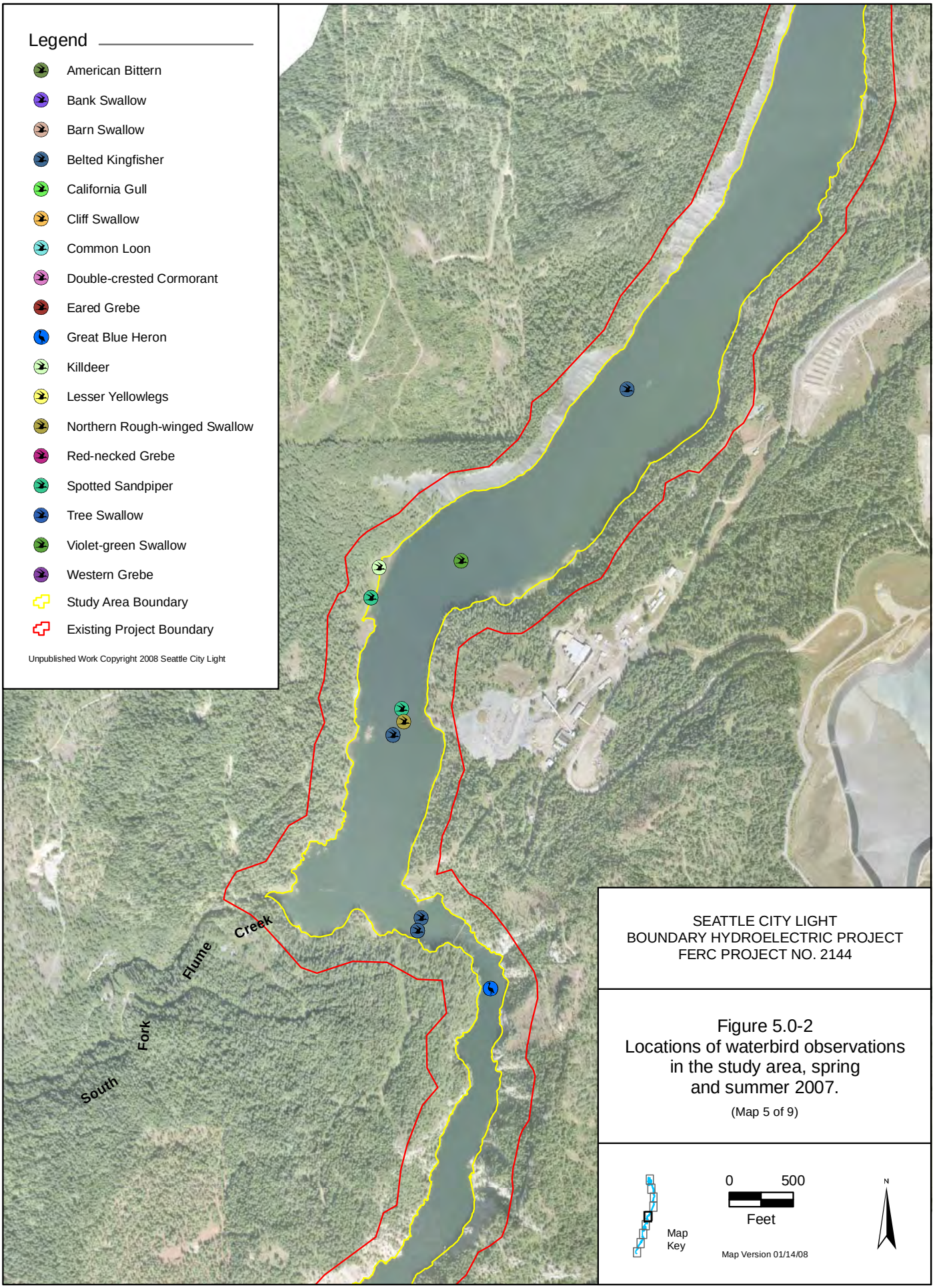
Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 4 of 9)


Legend
American Bittern
Bank Swallow
Barn Swallow
Belted Kingfisher
California Gull
Cliff Swallow
Common Loon
Double-crested Cormorant
Eared Grebe
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
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FERC PROJECT NO. 2144
Figure 5.0-2
Locations of waterbird observations
in the study area, spring
and summer 2007.
(Map 5 of 9)
Map
Key
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500
Feet
Map Version 01/14/08
N

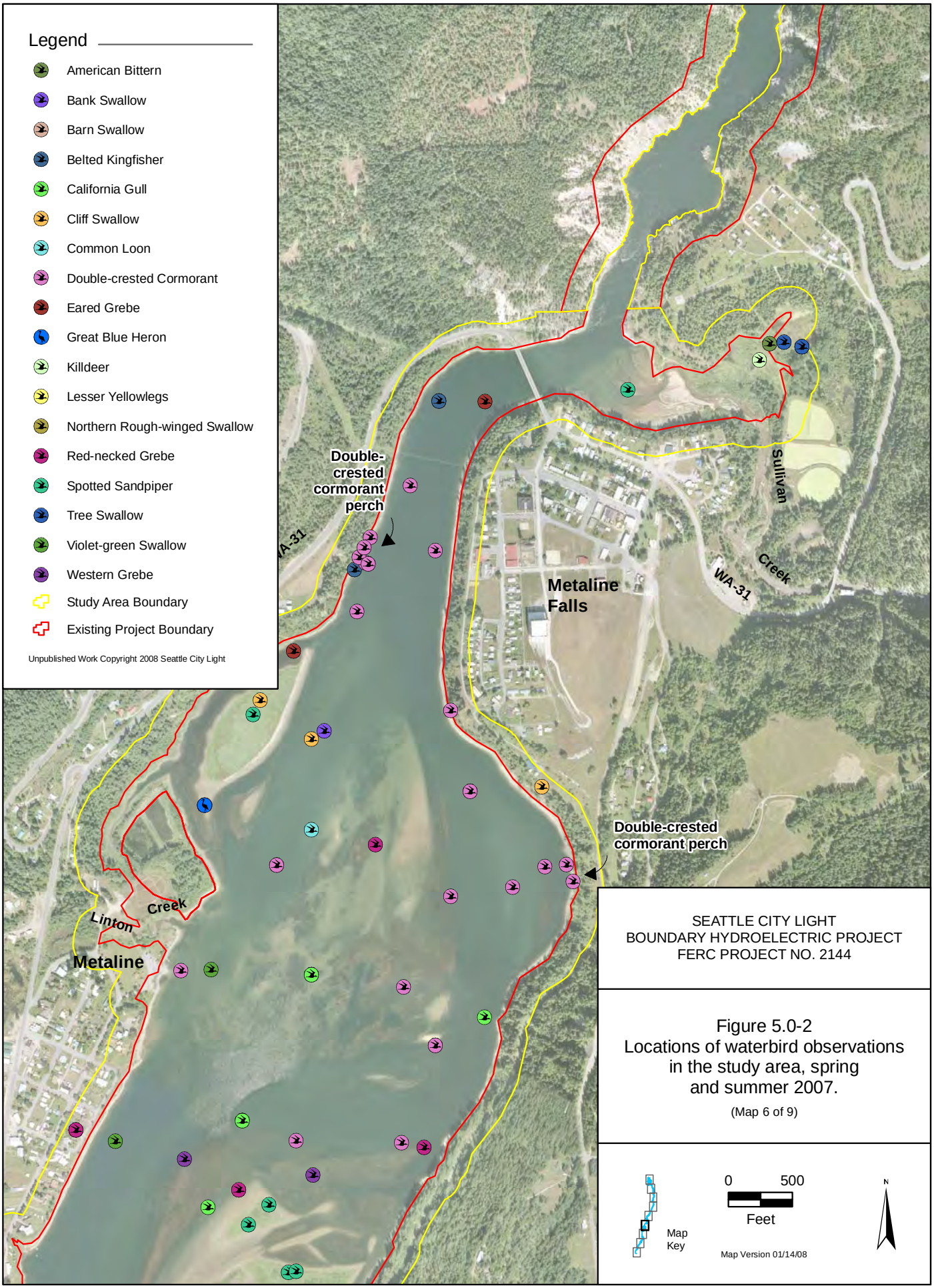

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 6 of 9)

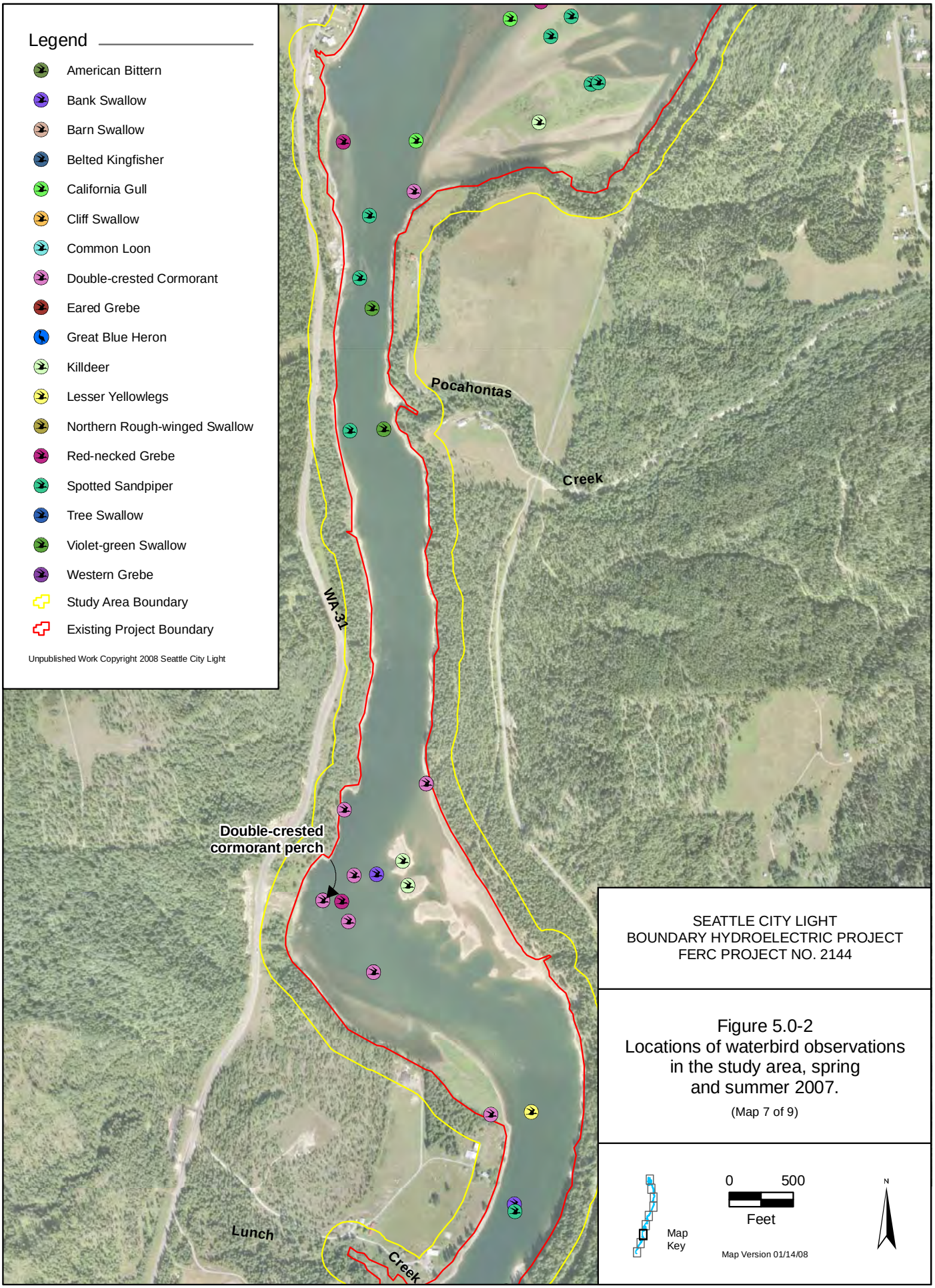

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 7 of 9)

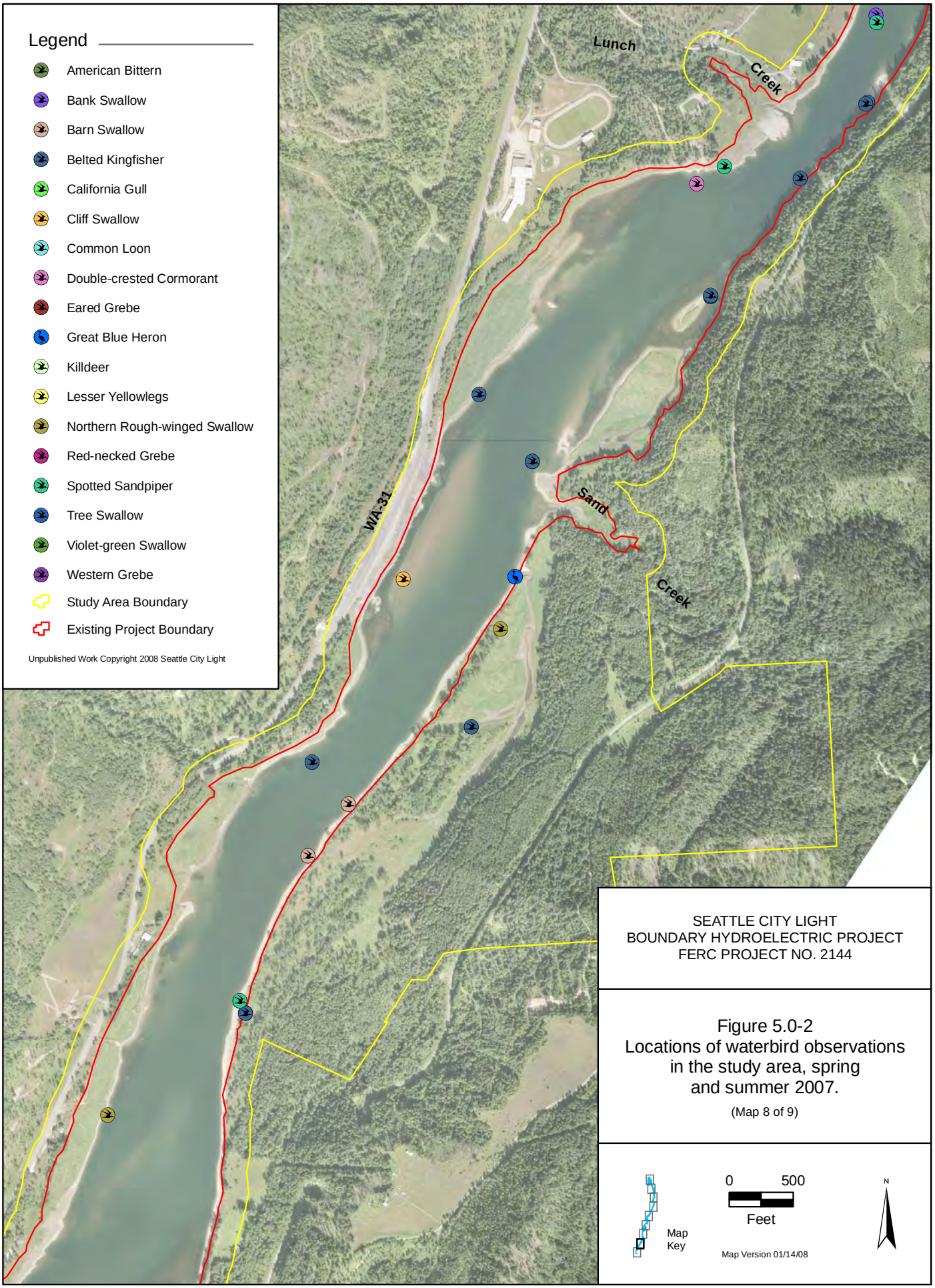

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 8 of 9)

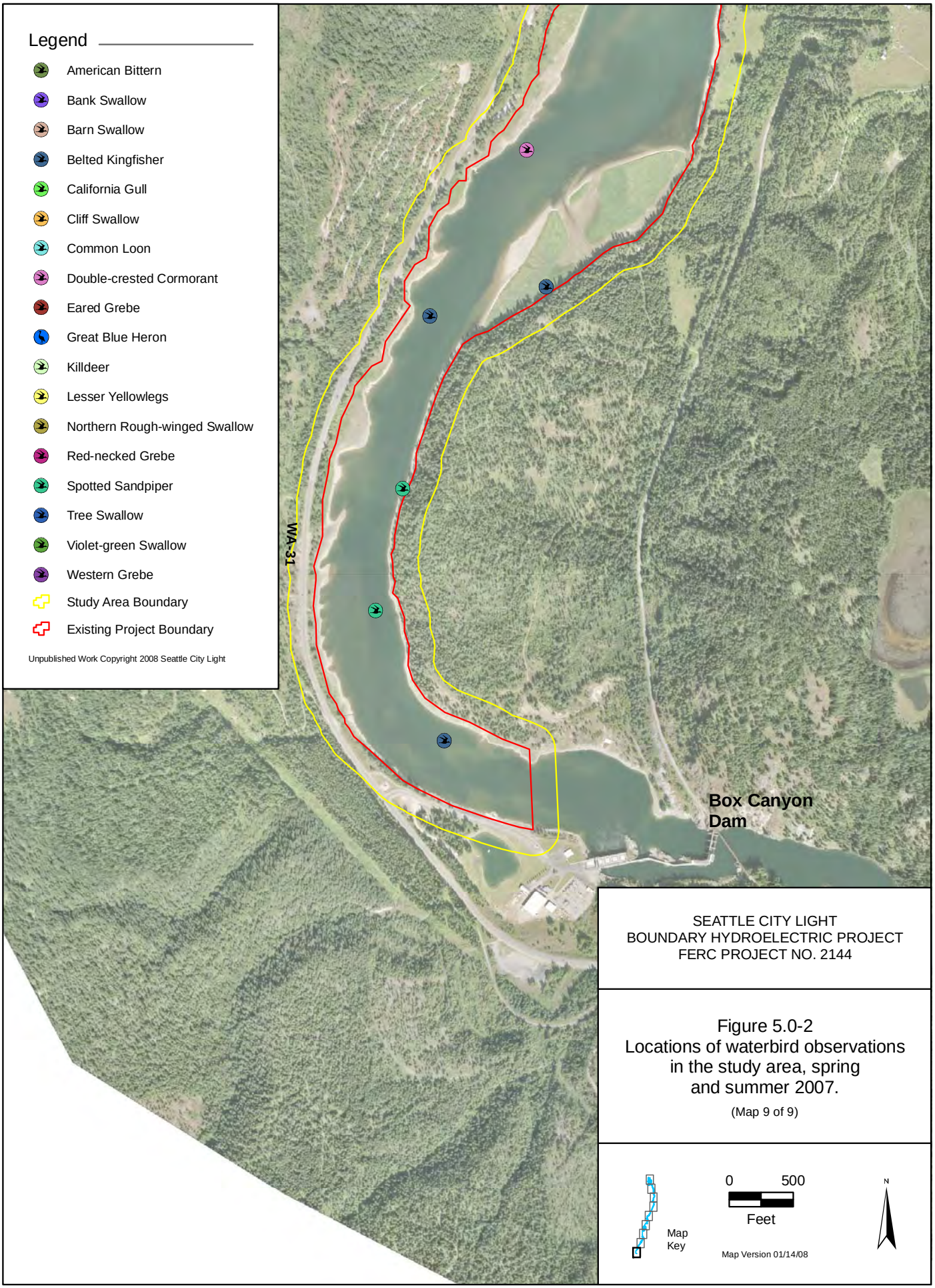

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Figure 5.0-2
Locations of waterbird observations in the study area, spring and summer 2007.

(Map 9 of 9)

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

Based on the findings of the spring 2007 surveys, two species of ground-nesting waterfowl—Canada goose and mallard—are known to nest within the study area.

This section presents the local breeding habitat requirements for Canada geese; additional review and consultation is required to understand the local breeding habitat requirements for mallards. Further, additional analyses related to estimating existing habitat will be presented in the USR.

5.1.1. Canada Geese

Great Basin Canada geese nest in a variety of situations including cliff-faces, abandoned eagle and osprey nests, on muskrat and beaver houses, on artificial platforms, and on mainland shorelines, but mostly on riverine islands (Fitzner et al. 1994). Forty-one of the 44 goose nests recorded in the study area were found on islands. 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, either because of land-bridging or because the distance between the island and the mainland was shortened (Fitzner et al. 1994, Zoellick et al. 2004). Consequently, only island habitats were deemed suitable as nesting habitat for Canada geese.

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 (Figure 5.1-1). These islands include Rat Island (Project river mile [PRM] 17.7) located in the Boundary forebay, and three small islands located at PRMs 22.0, 22.1, and 24.6. Collectively, these islands total 0.74 acre and were used by six nesting pairs. A fifth island, Everett Island (PRM 19.6), is large (13 acres), wooded, and separated from the mainland by a shallow channel. The steep terrain and an established bald eagle nesting territory may preclude goose nesting on this island, although a possible nesting attempt occurred on the northern tip (based on the sighting of a single goose that appeared "attached" to the site).

There are five islands (or island complexes) in the upper reservoir, upstream of Metaline Falls (Figure 5.1-2). Collectively, these islands provide approximately 40 acres of suitable nesting habitat between Metaline Falls and Box Canyon Dam for Great Basin Canada geese:

1. The large island immediately north of the town of Metaline (7.2 acres) is covered mainly by reed canarygrass and is separated from the mainland by a fairly deep channel (located at PRM 27.5).
2. A small complex of islands (PRM 28.9) occurs across the river from the town of Metaline. The largest island (9.53 acres) separates into two islands during high water. The third island (1.45 acres) lies north of the other islands and remains separate during normal pool fluctuations. All of these islands support riparian shrubs and trees.

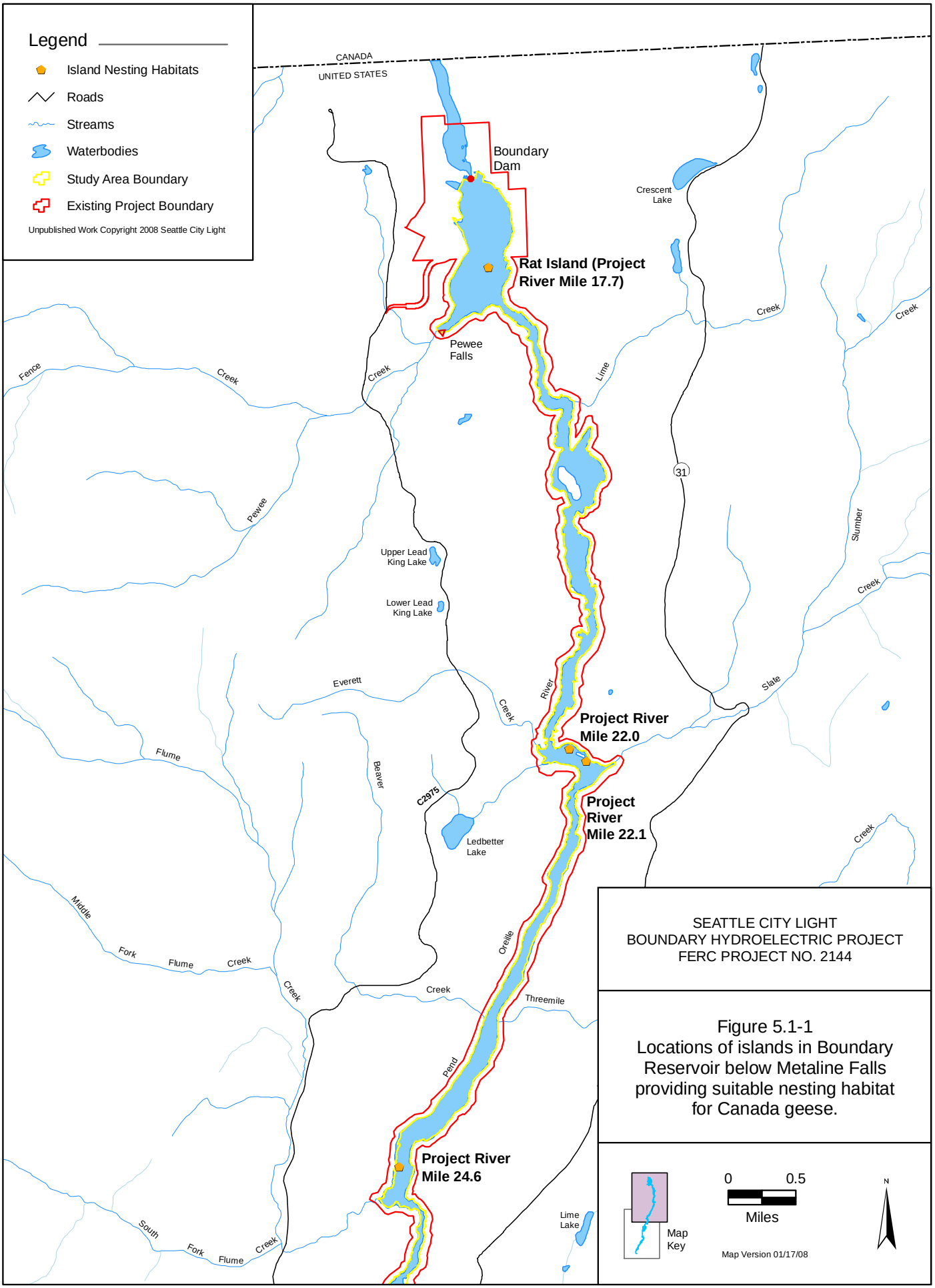

Figure 5.1-1
Locations of islands in Boundary Reservoir below Metaline Falls providing suitable nesting habitat for Canada geese.

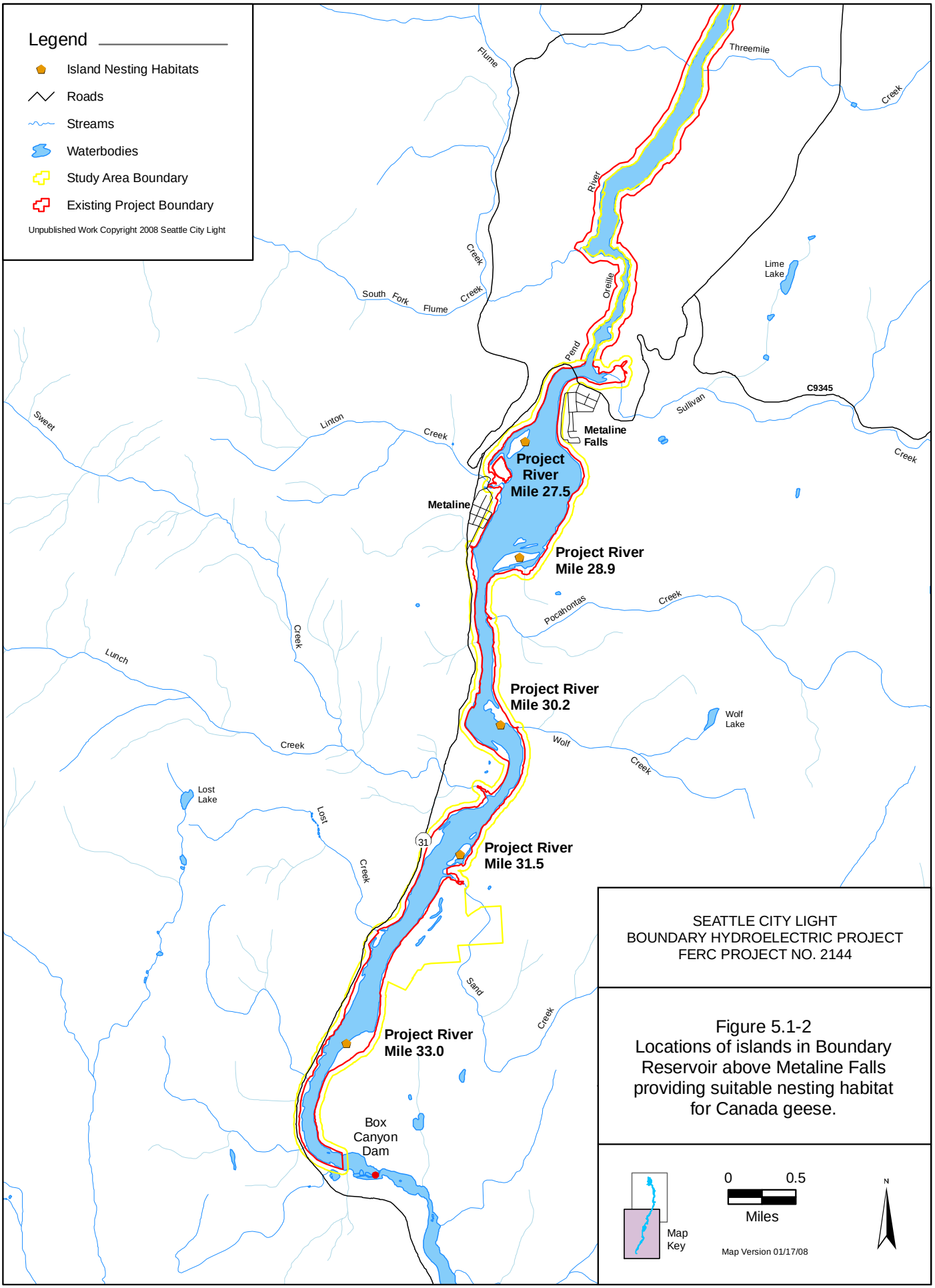

Figure 5.1-2
Locations of islands in Boundary Reservoir above Metaline Falls providing suitable nesting habitat for Canada geese.

3. A complex of cobbled islands is located upstream of the town of Metaline at PRM 30.2. Depending on water levels, this island complex consists of five to seven small islands largely devoid of vegetation (probably from scouring) during the nesting season. Later in the summer (mid to late June), a sparse layer of herbaceous plants develops. The lack of total cover during the goose nesting season probably accounts for the lack of goose nesting. These islands are not considered suitable nesting habitat.
4. A large island near Sand Creek (5.67 acres, PRM 31.5) is located adjacent to a much smaller (0.4 acre, PRM 31.2) island. Both are covered by reed canarygrass and separated from the mainland by a narrow channel, although the smaller island is much more isolated from the mainland.
5. The last island complex consists of another large island (15.07 acres) across the river from the Box Canyon gage (PRM 33.0), which is covered by reed canarygrass and separates into two and three islands during high water. It is separated from the mainland by a very narrow channel.

Without the availability of the hydraulic routing model, an assessment of the amount of flooding or land-bridging of island habitats used by Canada geese in 2007 has not yet been conducted. However, from the field investigations, it appeared evident that land-bridging occurred during the 2007 prime nesting season on the island complexes at PRMs 28.9, 31.5, and 33.0. Land-bridging did not occur at the large island near Metaline or at any of the islands downstream of Metaline Falls. Further, none of the nest sites established during the primary nesting season were flooded in 2007, although two late nests established in beach wrack (primarily dead tufted loosestrife [*Lysimachia thyrsiflora*]) near the water's edge at the south end of the large island near Metaline were inundated by high water, but apparently only briefly as both nests were successful.

5.1.2. Mallards

Although mallards nest in a wide variety of habitats (Drilling et al. 2002), some of which are available in the study area, the study area does not appear to support an abundance of breeding mallards (see Section 5.3). It is unclear at this time whether nesting habitat is actually limited, or whether the lack of some other habitat component (such as brooding habitat), or some other factor, may be limiting mallard production in the study area. Additional work is needed to determine what actually constitutes suitable mallard nesting habitat in the study area before mapping and estimating the extent of existing mallard nesting habitat can be completed. This work will be conducted in 2008 and will be reported in the USR. Relicensing participants will be consulted regarding the definition of what constitutes suitable nesting habitat for mallards.

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

This analysis will be conducted in 2008 and the results will be presented in the USR.

5.3. Waterfowl Nest Searches

Ground-nesting waterfowl nest searches were conducted at all islands, backwater sloughs, and wetlands within the study area (refer back to Figure 4.3-1). During these searches, 44 Canada goose nests were found (see Table 5.3-1 and Appendix 2), 41 of them on islands (Figures 5.3-1 to 5.3-7). The remaining three nests were found: 1) on a land-bridged point of land on the west bank of the river, just south of Lost Creek (at PRM 32.4); 2) on a steep slope above the mouth of Sullivan Creek; and 3) in an abandoned bald eagle nest at the BWP. Thirty (68 percent) of the nests successfully hatched goslings, while 9 (20 percent) were lost to predation, 2 (4 percent) were abandoned, and 3 (7 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 its presence in the study area. All three mammals are potential predators of both goose nests 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]	Average Dist. to Water's Edge (ft)
		Successful	Predated	Abandoned	Unknown		
PRM 33.1 Island	1				1	7	31.4
PRM 31.5 Island	3		1	1	1	6	11.9
PRM 31.2 Island	1	1				7	14.0
PRM 28.9 Island	7	1	5	1		6	31.4
PRM 27.5 Island	23	23				3.7	43.7
PRM 25.6 Island	1		1			N/A	14.9
PRM 22.1 Island	2	2				6.5	8.1
PRM 22.0 Island	1	1				N/A	14
PRM 17.7 Island	2	2				5	27.4
Non-islands	3		2		1	N/A	N/A
All Nests	44	30 (68%)	9 (20%)	2 (4%)	3 (7%)	5.7 (3–7)	34.4 (3.9–123.0)

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.
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 near Metaline alone, all of which on this island appeared to have been successful. Other successful nests were found at: 1) Rat Island in the Boundary forebay (two 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 31.2) near Sand Creek, suggesting that isolation from the mainland is a prerequisite to nesting success. Both mainland nests, excluding the goose nest in the BWP bald eagle nest, were unsuccessful.

The distance of goose nests to the water's edge averaged 34.4 feet and ranged between 3.9 and 123.0 feet (Table 5.3-1). Heights of nests above the waterline at the time of measurement were also recorded. This information, in conjunction with the hydraulic routing model, will be used later to establish nest elevations and to assess the potential of these nests to flood with normal pool operations. None of the goose nests were known to have been lost to flooding during the 2007 nesting season, although one, and possibly two, late nests (both established on a mudflat below the vegetation line) were briefly flooded based on waterline and beach wrack evidence. However, both nests were successful, suggesting that the inundation was brief and not significant enough to carry the eggs away.

Nest density was high compared to other Columbia Basin Canada goose populations. Overall, approximately 1 goose pair nested per 1 acre of island nesting habitat (excluding Everett Island and the islands at PRM 30.2), which is higher than the 1 pair nested per 1.5 per acre found by Buss and Wing (1966).

Observed clutch size ranged from 3 to 7 and averaged 5.7 (Table 5-3.1), which is similar to the 5.5 average (Hanson and Eberhardt 1971) and the 6.05 average (Fitzner et al. 1994) recorded for Columbia River populations of this subspecies. However, some of the nests did not have full clutches at the time of survey, so the true average would be higher. Backdating suggests that most egg-laying was initiated the last week of March. Seventeen nests, many with full clutches, were recorded on the large island near Metaline on April 6 during a pre-study site visit. The island was not resurveyed during the late April waterfowl surveys to avoid disturbing the large number of geese nesting there. The island was surveyed again on May 11, when three successful nests not discovered during the April 6 survey were found, plus an additional three nests with incubating/laying hens representing a wave of late nesters. These late nests had only three or four eggs, suggesting they were still in the process of laying. 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. We surmise that these geese were avoiding nesting in the dense stands of reed canarygrass that by May 11 were actively growing and were already a few feet high.

Fledgling success was not evaluated as part of this study, but we did attempt to count broods (some were mixed) in June. We estimated that there were 13 broods (totaling 60 goslings) in the upper reservoir and 2 broods in the lower reservoir surviving as of June 14–15, representing a brood survival rate of 54 percent (15 of 28). This rate is very 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, nearly 150 geese were observed near Metaline (including a single blue-phase snow goose [*Chen caerulescens*]). Interestingly, none of these geese were observed in the upper reservoir during a cultural resource site visit the following day. Nearly 50 geese were then observed on the upper reservoir on July 26. Clearly by mid-July geese from several sources were moving on and off the reservoir.

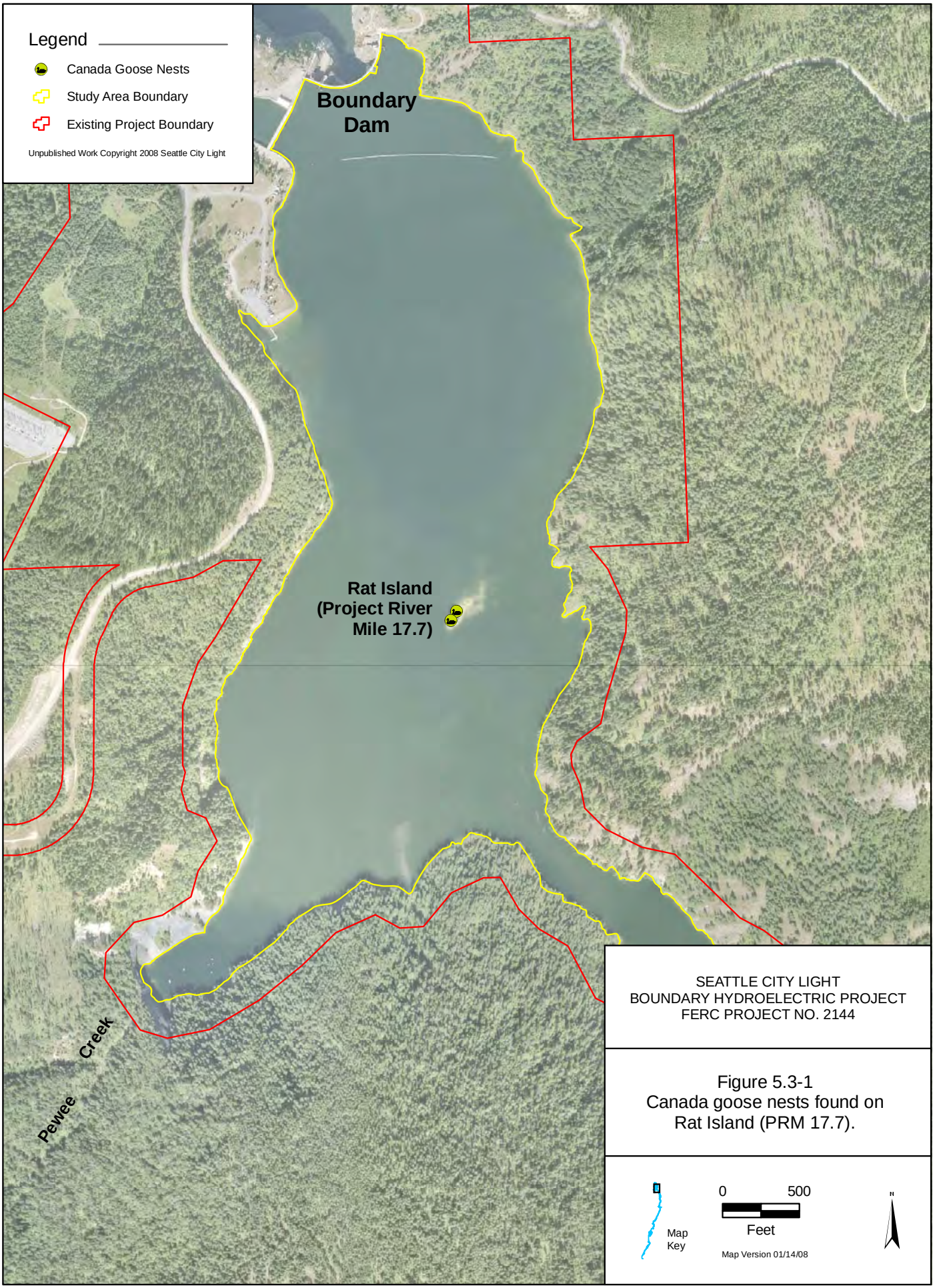

Figure 5.3-1
Canada goose nests found on Rat Island (PRM 17.7).

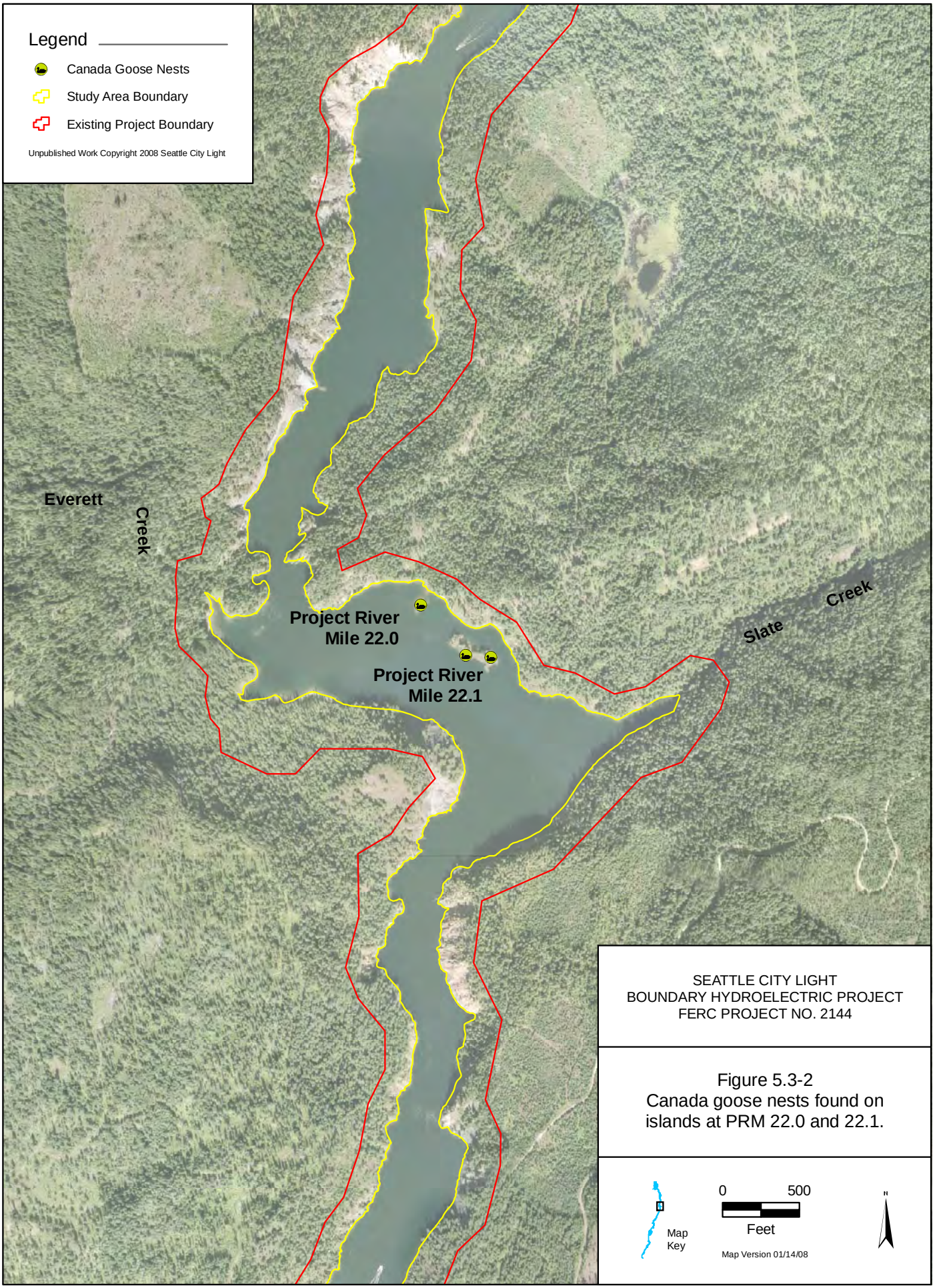

Figure 5.3-2
Canada goose nests found on islands at PRM 22.0 and 22.1.

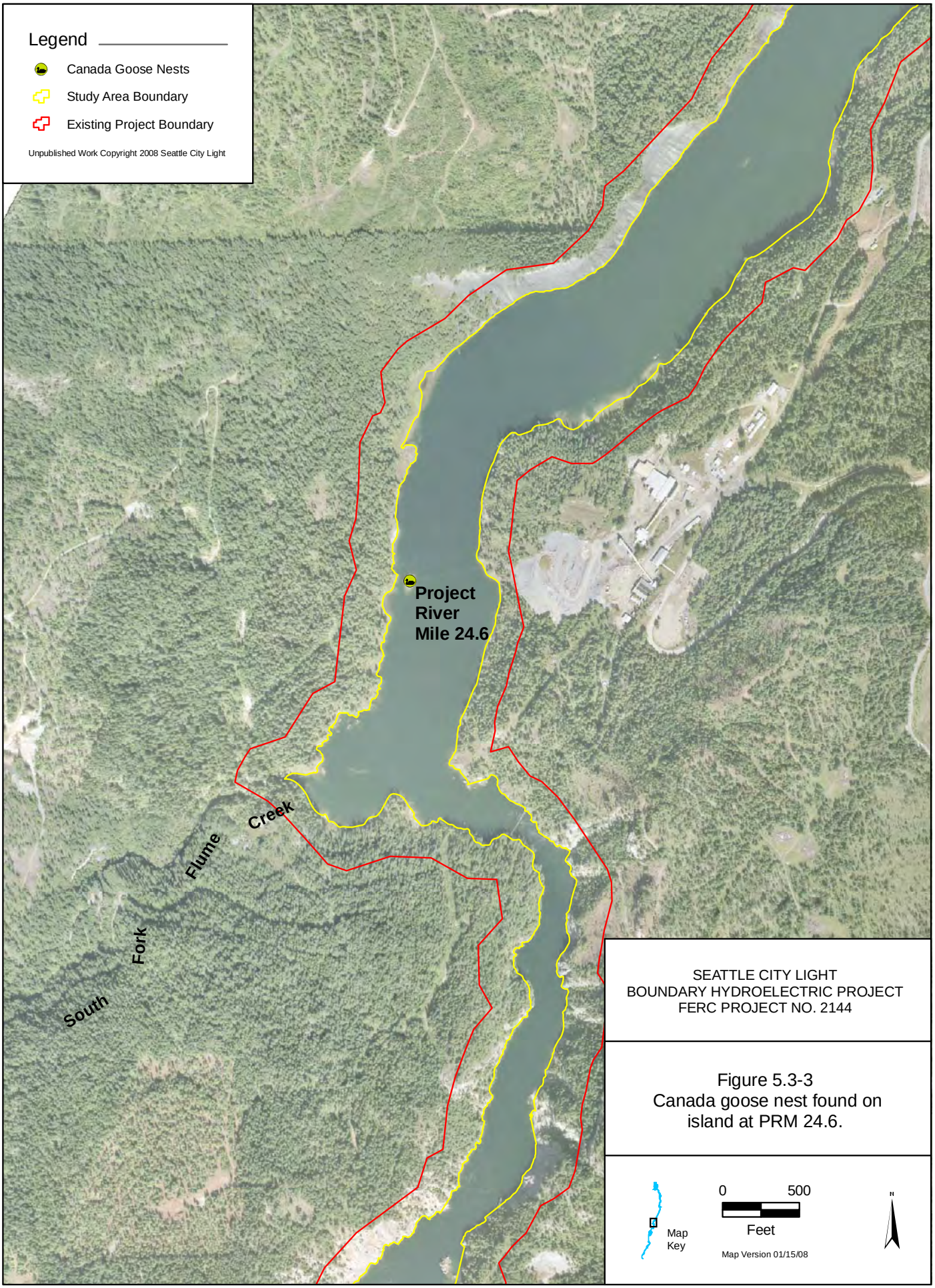

Figure 5.3-3
Canada goose nest found on island at PRM 24.6.

Figure 5.3-4
Canada goose nests found on island at PRM 27.5 and on the mainland near the mouth of Sullivan Creek.

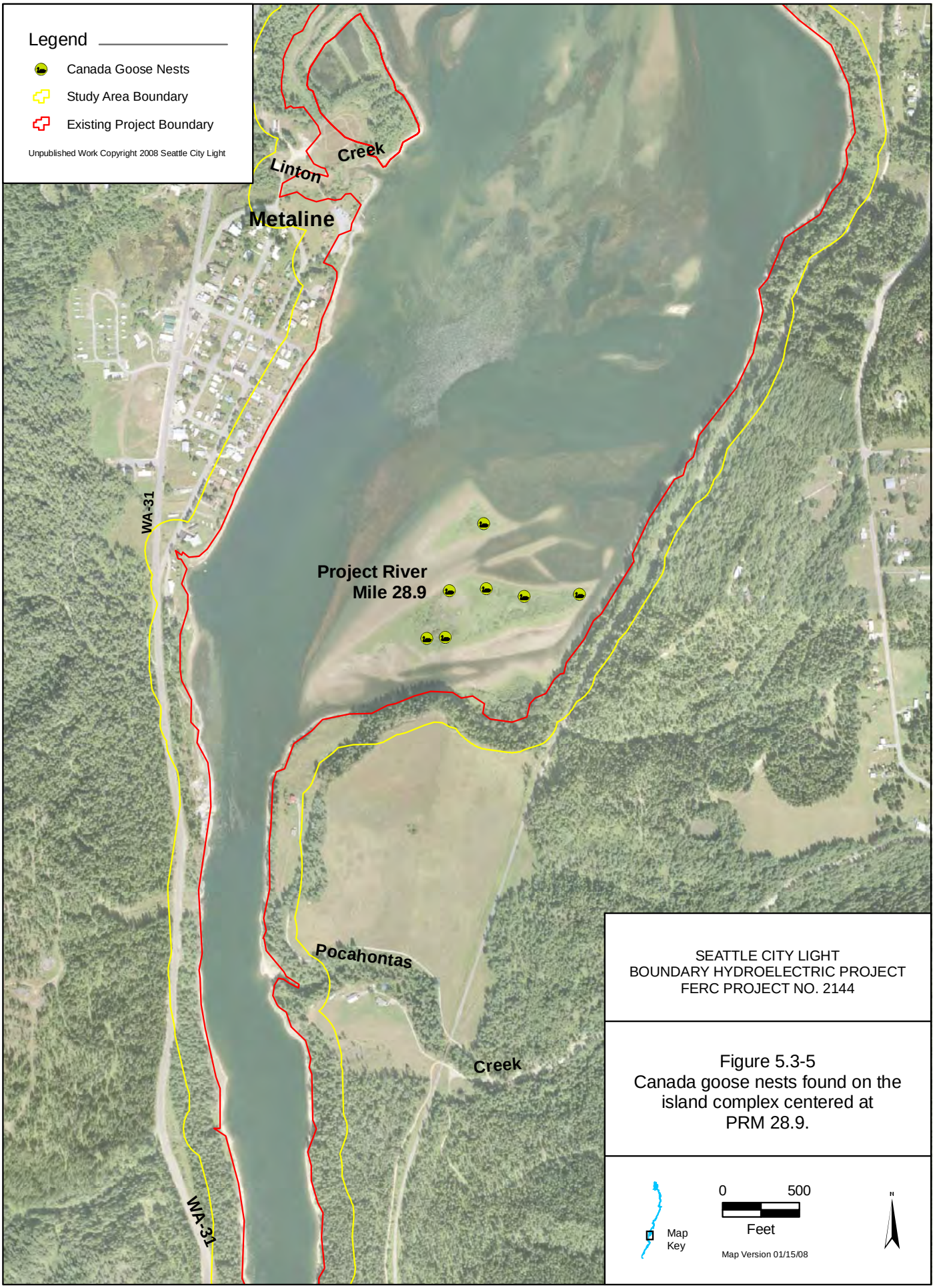

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Figure 5.3-5
Canada goose nests found on the island complex centered at PRM 28.9.

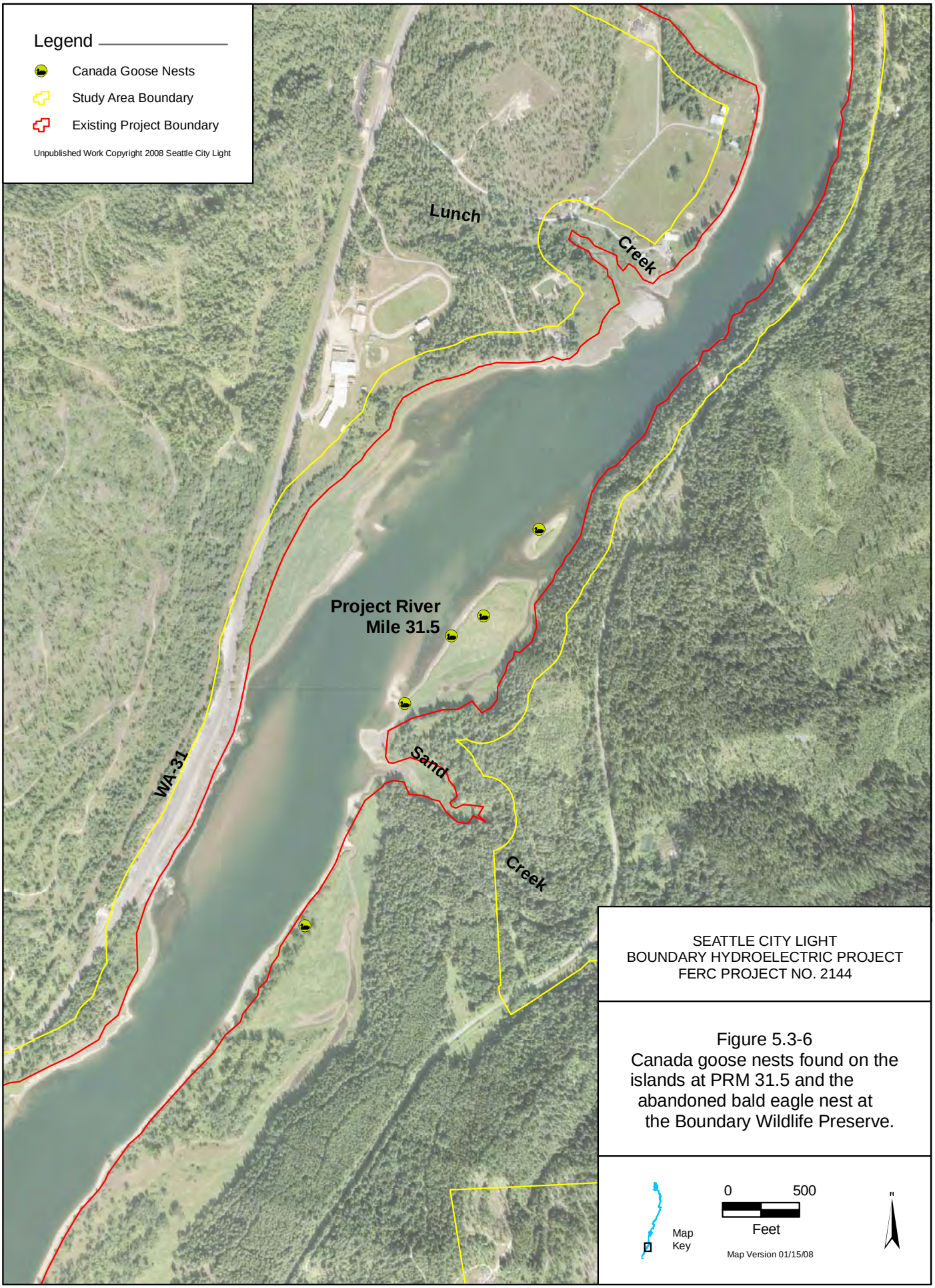

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Figure 5.3-6
Canada goose nests found on the islands at PRM 31.5 and the abandoned bald eagle nest at the Boundary Wildlife Preserve.

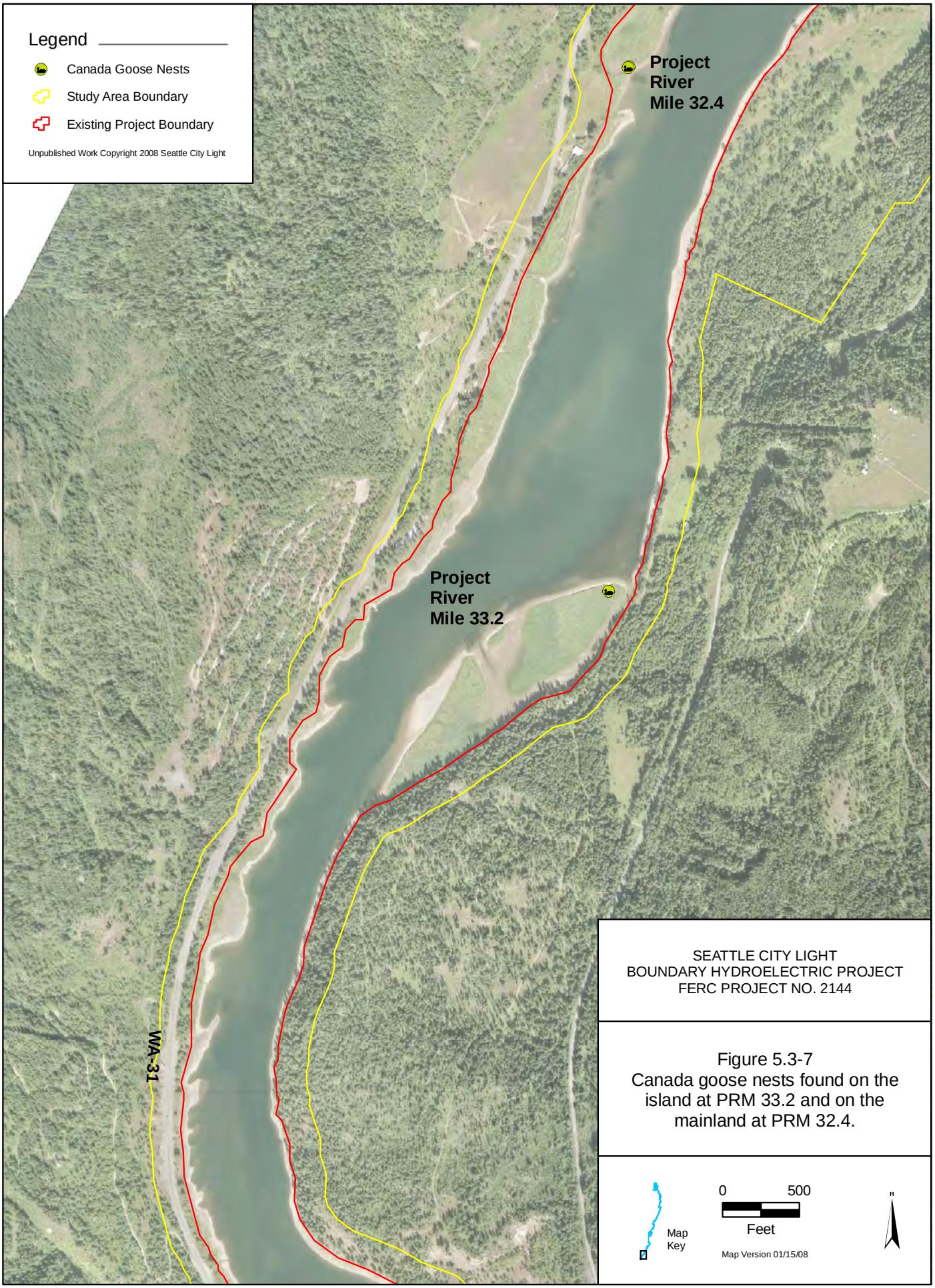

Figure 5.3-7
Canada goose nests found on the island at PRM 33.2 and on the mainland at PRM 32.4.

The only other ground-nesting waterfowl nest observed was a mallard nest on Rat Island in the Boundary forebay, found incidentally during a survey for RTE wildlife on June 17. The nest was situated on the island shoreline, right at the waterline; a follow up visit on July 11 found the eggs to have successfully hatched. Three other mallard broods were observed: 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. None of these broods were unexpected because pairs or single males (suggesting nesting hens nearby) were observed earlier at or near these locations; however the nests could not be found (in one case the nest was suspected to occur on private land and the survey crew did not have permission to access this site).

5.4. Piscivorous Waterbird Survey Results

Eleven species of piscivorous birds were recorded in the study area during the spring and summer 2007 surveys (Table 5.4-1). Four of the species—common loon, western grebe, bald eagle, and osprey—are discussed in Study 18 (SCL 2008a); the great blue heron is also an RTE species but is discussed here in detail because it was called out in the RSP as a piscivorous species of concern. Single common loons were observed in April and May, western grebes were observed in April as migrants, 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. Other grebes recorded included eared (which is only slightly piscivorous) and red-necked (pied-billed grebes were recorded during the 2005 reconnaissance survey but not in 2007). Most of the grebes were recorded during April and early May, and occurred generally as stopover migrant groups. One to two red-necked grebes appeared again in July, August, and September. No evidence of breeding grebes was found. Belted kingfishers were found during all surveys and at least three breeding territories occur on the reservoir.

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

	Wildlife Survey Number[1]								
Species	**1**	**2**	**3**	**4**	**5[2]**	**6**	**7**	**8**	**9**
Common Loon	1		1						
Eared Grebe[3]	61	2							
Red-necked Grebe	7	1				1		2	1
Western Grebe	3								
Double-crested Cormorant		4	18	20		17	18	10	27
Great Blue Heron			3			7	1		9
Common Merganser	8	25	4	5		18	18	3	17
California Gull							6	5	2
Belted Kingfisher	3	7	2	3		1	1	8	5
Osprey	9	6	2	10		8	4	2	1
Bald Eagle	7	5	3	10		5	11	15	2

Notes:
1 Survey dates: 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
2 No reservoir surveys were conducted during Wildlife Survey 5.
3 Eats mainly invertebrates, fish only infrequently.

Two species, double-crested cormorant and great blue heron, are target species discussed in greater detail below given their potential impact to fish populations and their prevalence on Box Canyon Reservoir. Common mergansers have also been added to this target species list based on recent research in the Columbia Basin suggesting these piscivorous ducks have the potential to be a significant impact on fish populations.

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 apparently found all year along the Columbia River system. Additional nesting colonies appeared at Umatilla National Wildlife Refuge in the 1970s, at the Potholes in the 1980s, and finally 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 Boundary study area.

Double-crested cormorants began increasing in eastern Washington in the mid-1900s coinciding 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 cormorant impacts to Columbia River salmon recovery efforts has led to federal, state, and tribal agencies annually removing over 800 birds along the mid-Columbia River (USDA 2003). Recent studies by the Columbia Bird Research Team revealed that 10 to 20 percent of the diet of the Foundation Island (near the Tri-Cities) cormorant nesting population was composed of salmonids (mostly steelhead smolts), while the Potholes Reservoir population ate almost no salmonids. The Box Canyon relicensing efforts recognized that the development of the Box Canyon impoundment, plus the availability of pilings near the Usk Bridge, partially account for the establishment of an expanding cormorant colony at Usk. In addition to concerns related to fisheries, piscivorous birds are being 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).

During this study, double-crested cormorants first appeared at the Boundary Reservoir in May, when four were observed near the Metaline Falls Bridge on May 9 (no cormorants were observed during dedicated or incidental surveys during April). By May 30, at least 18 cormorants were found on the upper reservoir. Through June and July, between 17 and 20 cormorants were recorded, dropping to 10 in August then rising to 27 in September. 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 5.0-2). No evidence of breeding was observed (most of the observed cormorants were juveniles) and no cormorants were observed north of Metaline Falls. The Boundary Reservoir birds may represent non-breeders supplemented by post-breeders in September.

Although double-crested cormorants could be feeding on Boundary Reservoir salmonids, preferred cormorant 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, and may be the attraction for the birds' presence.

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 breeding at a colony near Usk (Duke 2001). State population trends are unclear, although 169 herons were killed annually between 1997 and 2001 as part of a mid-Columbia salmonid protection program (USDA 2003).

In 2007, no great blue herons were observed during surveys conducted in mid-April or mid-May (although a single heron was observed flying near the Box Canyon tailrace during a pre-study site visit in early April). The first great blue heron sighting occurred on May 30 at the PRM 28.9 island complex, with another single bird observed on May 31 at Sullivan Creek. No sightings of herons occurred during a June 15 survey of the upper reservoir or June 16 survey of the Sullivan Creek wetlands. By July 10, however, juveniles began showing up in the shallows of the large island near Metaline (PRM 27.5) and the PRM 28.9 and 30.2 island complexes (six were observed at this last location). By July 26, only one great blue heron was observed in the upper reservoir, suggesting the mid-July event was a brief influx of adult and juvenile herons from outside the study area. In September, nine herons were recorded (eight in the upper reservoir), representing a possible fall movement of birds. Overall, great blue heron use of the Boundary reservoir area is sporadic and low, 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. 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 (Parrish 2004). Consequently, they have been elevated to target species status for this study.

In the study area, common mergansers are a regular breeding species on the upper reservoir, and they were observed during all spring and summer survey periods. The number of common mergansers using the reservoir during the first two survey periods was difficult to ascertain because birds were constantly moving around. A high count occurred on May 10 when 18 mergansers in seven groups were recorded in the lower reservoir; seven birds in two groups were observed the previous day in the upper reservoir. Most of these birds moved out by the end of May when we began to see only broods. The first brood, a hen with two ducklings, was observed near the BWP on May 30. A hen with a single duckling (possibly the same group from

May 30) was observed near the Metaline boat launch on June 15. Two broods, each with a single hen, and another single adult, totaling 18 birds, were observed on July 10; one brood (9 ducklings) near the BWP, and the second (6 ducklings) near the PRM 33.0 island. On July 26, a group of 18 mergansers was observed on the BWP shoreline and probably represented a uniting of the two broods observed on July 10. Subsequently, our data indicate that three broods were produced in 2007, all on the upper reservoir.

Four common mergansers were recorded in the Boundary Dam tailrace on July 9. Four mergansers (probably a brood) were again sighted in these same waters during a cultural resources site visit on July 11.

Our best estimate is that about 20 mergansers used the Boundary Reservoir during the spring and summer, with spring migrants being replaced by summer broods as the season progressed. Three broods were produced in the upper reservoir and possibly a fourth in the Boundary Dam tailrace area. There is incidental evidence that the broods on the reservoir were reduced by bald eagle predation.

In general, common mergansers were observed throughout the spring and summer season, with very little activity in the lower reservoir. Compared to the literature (Foreman 1979; Wood 1985, 1986), even upper reservoir densities were low with a maximum of approximately two mergansers per Project river mile.

5.5. Fall Migration and Winter Survey Results

One fall migration survey for waterfowl was conducted prior to preparing this interim report. During this survey, conducted on September 7 and 8, eight waterfowl species and seven waterbird species were recorded. Most observations were observed in the large reservoir pool just offshore of the town of Metaline, including the island complex at PRM 28.9.

The most commonly observed waterfowl were mallards (78), Canada geese (53), common mergansers (15), and northern shovelers (12). The geese and mergansers are likely spring and summer residents, whereas the mallards and shovelers, plus the American widgeon (3), gadwall (2), and ring-necked duck (2) were recently arrived fall migrants. A single blue-phased snow goose arrived in late summer and has been observed with the local Canada geese on a regular basis through September. As the reservoir was drawn down to approximately 1,970 feet at the time of the September surveys, most of the geese and ducks were observed using the exposed gravel bars north of the PRM 28.9 island complex. The most common of the waterbirds were double-crested cormorants (27), great blue herons (8), belted kingfishers (5), and California gulls (2), although spotted sandpipers, which were not rigorously recorded during the September survey, remained ubiquitous along the reservoir shoreline. Additional species recorded included American coot (1) and red-necked grebe (1).

5.6. Effects Assessment

The effects assessment will not be conducted until all study tasks are complete. The results from this assessment will be provided in the USR.

6 SUMMARY

As discussed previously in this report, progress has been made on four of the six study tasks. Fall and winter surveys will continue monthly through March 2008. Further field surveys for nesting waterfowl are scheduled for April to June 2008. Other tasks that require outputs from the Hydraulic Routing Model will be conducted when those data are available.

Although no major conclusions can be drawn at this time, spring and summer waterfowl and piscivorous waterbird (with the exception of Canada geese) use of Boundary Reservoir appears to be low.

7 VARIANCES FROM FERC-APPROVED STUDY PLAN AND PROPOSED MODIFICATIONS

No deviations from the FERC-approved RSP were made. Because waterfowl were recorded during reservoir-based surveys targeting other species (e.g., big game), more survey data on waterfowl reservoir use were collected than originally proposed in the RSP.

The 2007 waterfowl nesting surveys showed that geese are major breeders in the study area, but ducks are not. Consultation is planned with relicensing participants to determine whether the spring 2008 nesting surveys should be scheduled with more emphasis on geese (data rich) or ducks (data poor).

Incidental sighting information on piscivorous waterbirds submitted by other researchers in 2007 provided very little additional information beyond that collected during the numerous wildlife surveys. Based on this result, the incidental sighting collection forms will not be distributed to non-wildlife research teams in 2008.

8 REFERENCES

Buss, I.O., and L.D. Wing. 1966. Pre-impoundment observations of wintering mallards and nesting Canada geese on the Snake River, southeast Washington. Resource Studies, University of Washington 34:1–36.

Drilling, N., R. Titman, and R. McKinney. 2002. Mallard (*Anas platyrhynchos*). Number 658 *in* A. Poole and F. Gill, editors. *The Birds of North America*. The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.

Duke (Duke Engineering and Services). 2001. Response to FERC's additional information request (AIR). February 27, 2001. FERC Docket No. P-2042-013. Box Canyon Hydroelectric Project, Public Utility District No. 1 of Pend Oreille County, Newport, Washington, USA.

Eberhardt, L.E., R.G. Anthony, and W.H. Rickard. 1989. Survival of juvenile Canada geese during the rearing period. *Journal of Wildlife Management* 53:372-377.

Fitzner, R.E., L.E. Eberhardt, W.H. Rickard, Jr., and R.H. Gray. 1994. Great basin Canada goose nesting on the mid-Columbia River, Washington – an historical perspective and update, 1981–1990. *Northwest Science* 68:37–42.

Foreman, L.D. 1979. Flock size and density of common mergansers in northwestern California. *California Fish and Game* 65:124–127.

Hanson, W.C., and L.L. Eberhardt. 1971. The Columbia River Canada goose population 1950-1970. Wildlife Monograph 28.

Jewett, S.G., W.P. Taylor, W.T. Shaw, and J.W. Aldrich. 1953. *Birds of Washington State*. University of Washington Press, Seattle, Washington, USA.

Johnson, D.H. 1979. Estimating nest success: the Mayfield method and an alternative. *Auk* 96:651–661.

Parrish, Julia. 2004. "Avian predation in the Mid-Columbia region." PowerPoint presentation given to the Northwest Power and Conservation Council, Portland, Oregon, August 31, 2004. Available online at: http://www.nwcouncil.org/news/2004_09/enews_avian.pdf

SCL (Seattle City Light). 2007. Revised Study Plan for the Boundary Hydroelectric Project (FERC No. 2144). Seattle, Washington. February 2007. Available online at: http://www.seattle.gov/light/news/issues/bndryRelic/br_document.asp

SCL. 2008a. Study 7 – Mainstem Aquatic Habit Modeling Study Interim Report for the Boundary Hydroelectric Project (FERC No. 2144). Prepared by Tetra Tech and TRPA. March 2008.

SCL. 2008b. Study 18 – Rare, Threatened, and Endangered Wildlife Species Study Interim Report for the Boundary Hydroelectric Project (FERC No. 2144). Prepared by Tetra Tech EC, Inc. March 2008.

SCL. 2008c. Study 19 – Big Game Study Interim Report for the Boundary Hydroelectric Project (FERC No. 2144). Prepared by Tetra Tech EC, Inc. March 2008.

USDA (United States Department of Agriculture). 2003. Piscivorous bird damage management for the protection of juvenile salmonids on the mid-Columbia River. USDA Animal and Plant Health Inspection Service, Wildlife Services. 153 pp.

Vermeer, K., and L. Rankin. 1984. Population trends in nesting double-crested and pelagic cormorants in Canada. *Murrelet* 65:1–9.

Wahl, T.R., B. Tweit, and S.G. Mlodinow. 2005. *Birds of Washington: status and distribution.* Oregon State University Press, Corvallis, Oregon, USA.

Wood, C. C. 1985. Aggregate response of common mergansers: predicting flock size and abundance on Vancouver Island salmon streams. *Canadian Journal of Fisheries and Aquatic Sciences* 42:1259–1271.

Wood, C. C. 1986. Dispersion of common merganser breeding pairs in relation to the availability of juvenile Pacific salmon in Vancouver Island streams. *Canadian Journal of Zoology* 64:756–765.

Zoellick, B. W., H. M. Ulmschneider, B. S. Cade, and A. W. Stanley. 2004. Isolation of Snake River islands and mammalian predation on waterfowl nests. *Journal of Wildlife Management* 68:650–662.

Appendix 1. Waterfowl and Waterbirds Observed in Study Area 2007

Table A.1-1. Waterfowl and waterbirds seen in the study area, April–October 2007.

Common Name	Scientific Name
Waterfowl	
snow goose	*Chen caerulescens*
Canada goose	*Branta canadensis*
wood duck[1]	*Aix sponsa*
mallard	*Anas platyrhynchos*
gadwall	*Anas strepera*
green-winged teal	*Anas crecca*
American widgeon	*Anas americana*
northern shoveler	*Anas clypeata*
cinnamon teal	*Anas cyanoptera*
ring-necked duck	*Aythya collaris*
lesser scaup	*Aythya affinis*
common goldeneye	*Bucephala clangula*
bufflehead	*Bucephala albeola*
common merganser	*Mergus merganser*
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*
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*

Note:

1 Two lone ducklings suspected to be wood ducks were observed near the BWP on May 30. A brood of six juvenile wood ducks was observed across the river from the BWP on June 16. A brood with six wood duck ducklings was observed in the upper pond at the Sullivan Creek wetland on May 31, while a brood with 11 ducklings was found at this pond on June 16. In addition, two other wood duck broods (eight and seven ducklings) were observed on the sewage ponds adjacent to the upper pond at Sullivan Creek on June 16, all suggesting that portions of the Project area serve as wood duck production sites.

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Appendix 2. Waterfowl Nest Records

Table A.2-1. Raw data gathered during visits to waterfowl nests found in the Project area, spring–summer 2007.

Date	Nest ID	Spp.	Habitat	Island Location (with PRM)	UTM Coords.		Surface elevation	Dist to water's edge (ft)	Elevation from water surface (ft)	Clutch size	Unhatched eggs	Hatched	Predation	Abandon	Flooded	Unknown
					Easting	Northing										
4/20/07	C-1	CAGO		Rat (17.7)	469815	5404786	1996.06	14.2	6.9	7	0					
4/20/07	C-2	CAGO			469907	5405823	1995.99	35	8.3				x			
4/20/07	C-3	CAGO	in old eagle nest		470651	5406334	1995.61	---	---							x
4/20/07	C-4	CAGO	reed canarygrass	PRM 31.5	471030	5406929	1995.56	14.9	8.2	7	0					
4/20/07	C-5	CAGO	reed canarygrass	PRM 31.5	470965	5406892	1995.56	26.7	8.3	5	0					
4/20/07	C-6	CAGO		PRM 31.5	470866	5406763	1995.56	29.5	6.6	6	0			x		
4/20/07	C-7	CAGO		PRM 31.2	471149	5407095	1995.56	14	4.6	7	0					
4/21/07	C-8	CAGO		Rat (17.7)	474681	5425012	1996.80	7	16.2	4	0					
4/21/07	C-9	CAGO	at base of tree	Rat (17.7)	474669	5424994	1996.80	47.8	18.5	6	0					
4/21/07	C-10	CAGO		PRM 22.0	475388	5419265	1996.31	31.4	11.3			x				
4/21/07	C-11	CAGO		PRM 22.1	475473	5419161	1996.14	8.5	16.5	6	0					
4/21/07	C-12	CAGO	small rock edge	PRM 22.1	475534	5419154	1996.08	10.1	19	7	0					
4/21/07	C-13	CAGO		PRM 25.6	473069	5414403	1995.95	17.2	9.7				x			
4/22/07	C-14	CAGO	nest in willows	PRM 28.9	471913	5410555	1996.37	14	3.3	6	0					
4/22/07	C-15	CAGO		PRM 28.9	472096	5410406	1996.39	32.5	5.8				x			
4/22/07	C-16	CAGO		PRM 28.9	471986	5410407	1996.39	22.5	3.8				x			
4/22/07	C-17	CAGO		PRM 28.9	471912	5410426	1996.41	46.2	4.4				x			
4/22/07	C-18	CAGO		PRM 28.9	471826	5410334	1996.43	43.4	3.8		1			x		
4/22/07	C-19	CAGO		PRM 28.9	471790	5410334	1996.43	20.6	2.5				x			
4/22/07	C-20	CAGO		PRM 28.9	471839	5410426	1996.43	19.6	3.8				x			
4/22/07	C-21	CAGO	steep bank		473109	5412551	1996.47	---	---		1		x			
5/11/07	N-1	CAGO	reed canarygrass	PRM 27.5	471952	5411692	1999.16	56.3	6.3			x				
5/11/07	N-2	CAGO	reed canarygrass	PRM 27.5	471927	5411644	1999.19	3.9	4.3			x				
5/11/07	N-3	CAGO	reed canarygrass	PRM 27.5	471867	5411613	1999.19	26.1	4.2			x				
5/11/07	N-4	CAGO	reed canarygrass	PRM 27.5	471889	5411638	1999.19	71	3.8			x				
5/11/07	N-5	CAGO	reed canarygrass	PRM 27.5	471899	5411693	1999.16	32	4.6			x				
5/11/07	N-6	CAGO	reed canarygrass	PRM 27.5	471929	5411724	1999.11	80.5	4			x				
5/11/07	N-7	CAGO	reed canarygrass	PRM 27.5	471890	5411753	1999.11	28.6	2.1			x				
5/11/07	N-8	CAGO	reed canarygrass	PRM 27.5	471913	5411742	1999.11	16.1	3.1			x				
5/11/07	N-9	CAGO	reed canarygrass	PRM 27.5	471951	5411730	1999.11	123	3.5			x				

Table A.2-1, continued...

Date	Nest ID	Spp.	Habitat	Island Location (with PRM)	UTM Coords.		Surface elevation	Dist to water's edge (ft)	Elevation from water surface (ft)	Clutch size	Unhatched eggs	Hatched	Predation	Abandon	Flooded	Unknown
					Easting	Northing										
5/11/07	N-10	CAGO	reed canarygrass	PRM 27.5	471980	5411766	1999.07	103	3.7			x				
5/11/07	N-11	CAGO	reed canarygrass	PRM 27.5	471993	5411819	1999.07	36.3	5.6			x				
5/11/07	N-12	CAGO	reed canarygrass	PRM 27.5	472009	5411814	1999.07	68.6	6			x				
5/11/07	N-13	CAGO	reed canarygrass	PRM 27.5	472042	5411843	1999.07	7.1	2.8			x				
5/11/07	N-14	CAGO	reed canarygrass	PRM 27.5	472006	5411754	1999.07	8.3	6.7			x				
5/11/07	N-15	CAGO	reed canarygrass	PRM 27.5	471999	5411739	1999.07	8	7.4			x				
5/11/07	N-16	CAGO	reed canarygrass	PRM 27.5	471976	5411716	1999.16	40.5	6			x				
5/11/07	N-17	CAGO	reed canarygrass	PRM 27.5	471921	5411667	1999.19	75.6	5.1			x				
5/11/07	N-18	CAGO	reed canarygrass	PRM 27.5	471844	5411612	1999.19	10.2	1		3					
5/11/07	N-19	CAGO	reed canarygrass	PRM 27.5	471853	5411606	1999.19	19.4	2.3		4					
5/11/07	N-20	CAGO	reed canarygrass	PRM 27.5	471939	5411750	1999.11	49.5	4			x				
5/11/07	N-21	CAGO	reed canarygrass	PRM 27.5	471991	5411726	1999.07	12.1	6.9		4					
5/11/07	N-22	CAGO	reed canarygrass	PRM 27.5	471955	5411784	1999.03	86.3	3.3			x				
5/11/07	N-23	CAGO	reed canarygrass	PRM 27.5	471842	5411691	1999.03	17.4	1.6			x				
6/17/07	M-1	MALL	alder clump	Rat (17.7)	474683	5424990	1998.97	2.2	1.5	7	7					

Notes:

1 Surface elevation as measured at the USGS Box Canyon gage at the time the nest was visited and converted to NAVD 88; *not* corrected for high water during breeding season.

PRM – Project river mile