DOYLE DRIVE REPLACEMENT PROJECT

Avian and Noise Monitoring – Baseline Surveys

Prepared for
Arup–Parsons Brinckerhoff Joint Venture

December 2009

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1. Introduction

The Biological Monitoring Program (Arup PB Joint Venture, 2009) for the Doyle Drive Replacement Project (project) requires bird and noise monitoring, in order to assess potential construction-related noise impacts on birds in the Presidio of San Francisco. Bird and noise monitoring will be conducted at four locations, Stations A through D, near Doyle Drive construction activities (**Figure 1**).

The Biological Monitoring Program for the Doyle Drive Replacement Project (Arup PB Joint Venture, 2009) requires two bird/noise surveys prior to the start of construction activities (construction is expected to begin in January 2010), in an attempt to establish a baseline for ambient noise, bird abundance, and bird activity at each of the four monitoring stations. Subsequent bird/noise surveys will thereafter occur quarterly, throughout the duration of the project. If sensitive species are nesting in proximity to the construction sites, behavioral/disturbance monitoring will be conducted at the nest sites. If adverse impacts are noted, the Monitoring Lead (Justin Mercer, Arup PB Joint Venture) and a Caltrans Biologist will consult with Presidio Trust and National Park Service biologists to discuss potential remediation to minimize impacts.

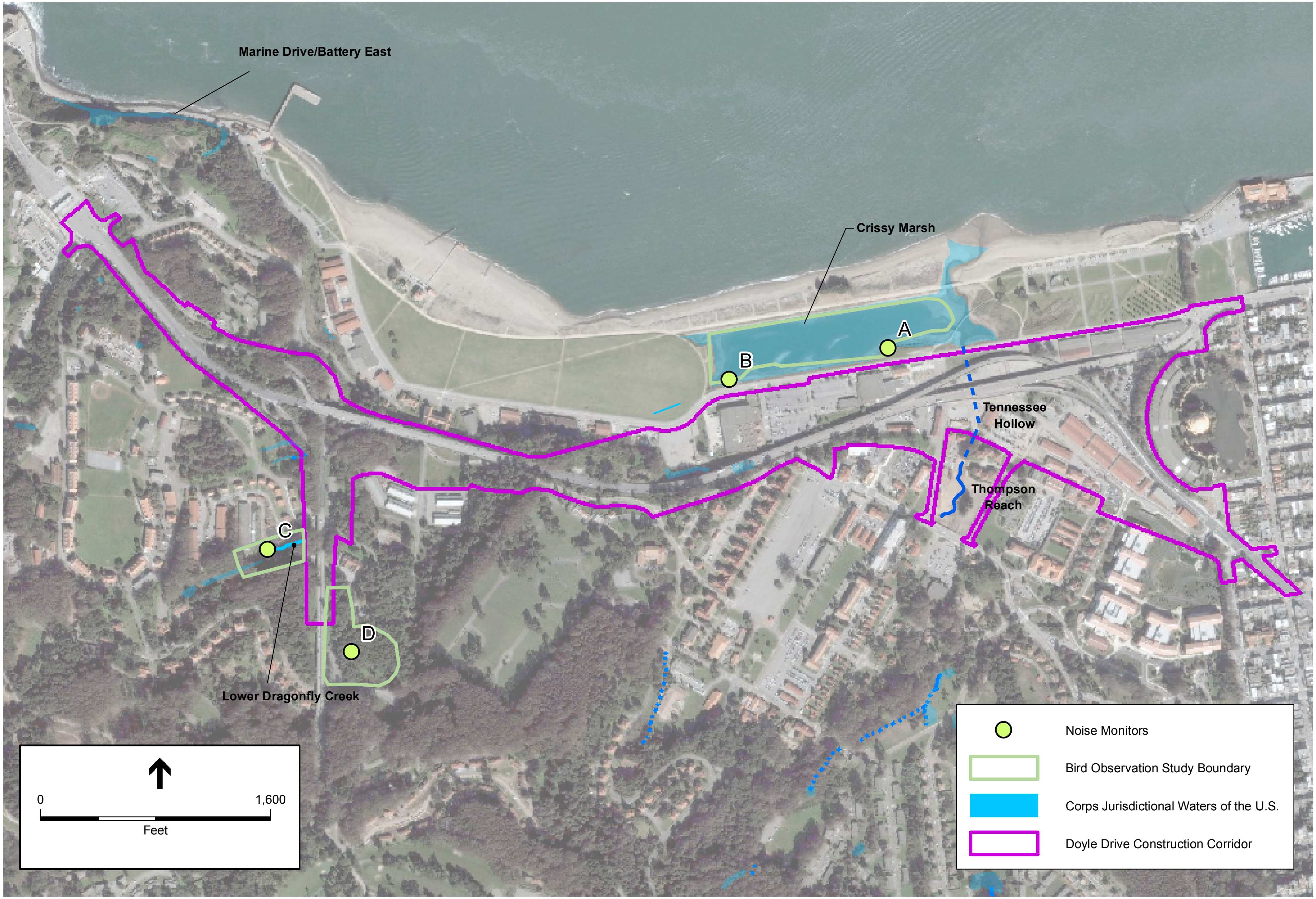
ESA noise specialist Benjamin Frese set up sound level meters to record noise from November 3 through November 5, and from December 1 through December 3, 2009. Baseline avian surveys were conducted on November 3 and 4, 2009 and December 1 and December 2, 2009 by ESA biologists Dana Ostfeld, Martha Lowe, and Bryan Olney. This report documents the results of the baseline noise and avian surveys.

2. Objectives

Raptors, shorebirds, and passerine birds nesting, roosting, or foraging near ongoing disturbances are less disturbed by human intrusion than birds in more remote areas. The Doyle Drive construction corridor receives a high amount of ongoing disturbance, because it is in a national park that receives heavy visitor use, and is bisected by two major roads (Doyle Drive [U.S. 101] and Highway 1). Noise studies conducted in the Presidio in 2004 found that noise levels from traffic and other sources ranged from 57 decibels on the A-weighted scale (dBA)[1] to 84.5 dBA, with an average of 70 dBA (ESA, 2004).

Automobile noise can range up to 90 dBA at 50 feet (EPA, 1978), and construction activities typically operate in the range of 80-90 dBA at 50 feet (Schexnayder & Ernzen, 1999). In a natural setting, where background noise is typically less than 60 dBA, the impacts of an increase in noise such as sound generated during construction would be potentially significant for wildlife (i.e., an increase from less than 60 dBA to 80 – 90 dBA). However at the Presidio, noise typical of construction and roadway operation is not expected to be substantially different from the existing noise levels.

[1] A decibel (dB) is a unit of sound energy intensity. Sound waves, traveling outward from a source, exert a sound pressure level (commonly called "sound level") measured in dB. An A-weighted decibel (dBA) is a decibel corrected for the variation in frequency response to the typical human ear at commonly encountered noise levels.



SOURCE: ESA, 2009; Parsons Brinckerhoff, 2004; National Park Service, 2007

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Figure 1
Bird and Noise Monitoring Locations

Nevertheless, as there is a high density of nesting and migratory birds in the Presidio, noise and bird monitoring surveys are considered prudent to ensure that there is no observable harassment of birds by project construction noise.

The objective of this study is not to document bird reactions to one-time noise events. Discrete loud noise events associated with construction activities (e.g., the alarm signal of a truck backing up, or a truck backfiring) would be similar to those caused by other loud disturbances common to the Doyle Drive corridor, such as a car honking, or humans approaching the bird. These loud noise events are expected to temporarily startle birds, and cause them to briefly abandon a nest, roost, or foraging location. However, birds usually return to the area within minutes after the short-term disturbance is over.

The objective of this study is to monitor long-term disturbance noise (i.e., noise that occurs for several hours a day, on a daily basis) associated with the Doyle Drive Replacement Project, which could result in changed behavior of bird species. For example, if it can be shown that shorebird abundance at Crissy Marsh is empirically observed to be reduced during the fall and winter (which is typically when there is high bird abundance) as a result of project construction noise, then ESA would recommend further study of the phenomenon or consultation with the National Park Service and the Presidio Trust.

3. Noise

To describe noise environments and to assess impacts on noise-sensitive areas, a frequency weighting measure, which simulates human perception, is commonly used. It has been found that A-weighting of sound levels best reflects the human ear's reduced sensitivity to low frequencies, and correlates well with human perceptions of the annoying aspects of noise – presumed to be similar to birds for the purposes of this study. The A-weighted decibel scale (dBA) is cited in most noise criteria. Decibels are logarithmic units that conveniently compare the wide range of sound intensities to which the human ear is sensitive. **Table 1**, below, identifies decibel levels for common sounds heard in the environment.

TABLE 1
TYPICAL NOISE LEVELS

Noise Level (dBA)	Outdoor Activity	Indoor Activity
90+	Gas lawn mower at 3 feet, jet flyover at 1,000 feet	Rock band
80–90	Diesel truck at 50 feet	Loud television at 3 feet
70–80	Gas lawn mower at 100 feet, noisy urban area	Garbage disposal at 3 feet, vacuum cleaner at 10 feet
60–70	Commercial area	Normal speech at 3 feet
40–60	Quiet urban daytime, traffic at 300 feet	Large business office, dishwasher next room
20–40	Quiet rural, suburban nighttime	Concert hall (background), library, bedroom at night
10–20		Broadcast / recording studio
0	Lowest threshold of human hearing	Lowest threshold of human hearing

SOURCE: Modified from Caltrans Technical Noise Supplement, 1998

4. Noise and Wildlife

Noise pollution can be detrimental to wildlife, and bird populations are particularly susceptible because they rely on acoustic signals for mating, predator evasion, and communication between adults and offspring, among other behaviors. Reijnen and Foppen (1994) showed that male willow warblers (*Phylloscopus trochilus*) experience difficulties in mate attraction near highways, as a result of noise pollution. Ellis (1981) describes studies that show “noticeably alarmed” responses in raptors to sounds within the 82 - 114 dBA range (Ellis, 1981). Jehl and Cooper (1980) found that seabirds flushed off their nests at 72–89 dBA, and Stewart (1982) found that seabirds were absent for as long as 10 minutes at 115 dBA.

More recent research has found certain types of unnatural noise to be disruptive to bird life at a much lower level. Delaney et al. (1999) found that spotted owl flush rates in response to chain saws were apparent at levels above 46 dBA. Finally, West et al. (2007) found that chronic intense noise (e.g., oil field compressor station) of 92 dBA or more may induce physiological stress in some bird species, if they cannot avoid exposure. None of these studies were able to conclude that nest failure resulted from higher noise levels. Nevertheless, a single stimulus event clearly had an effect on bird behavior, and the studies suggest that short-term loud noises can affect foraging and roosting birds by temporarily disturbing these behaviors, and may deter bird use of an area (including nesting) if such noises persist over the long-term.

Birds using the Doyle Drive project study area are accustomed to a high level of ambient noise due to the already existing human, vehicle, and airplane traffic, as well as sirens, alarms, and other noises from the roads in the project site. Despite these birds’ current tolerance for noise, increasing noise levels could potentially hinder mate attraction, disrupt reproductive success of breeding birds, and/or reduce the general use of the study area by migratory birds for wintering, foraging, or roosting purposes. While there is no generally accepted threshold of significance for noise impacts on birds, and different bird species can tolerate different levels of noise, some biologists believe that an increase of less than 10 dBA above background noise is generally unproblematic for birds (Nicholoff, 2003).

5. Methods

5.1 Noise

On November 2 and November 30, 2009, ESA noise specialist Benjamin Frese deployed four Metrosonics Model db308 sound level meters at each of the four stations (see **Appendix B** for photos of the sound level meters at each of the four stations). These precision sound level meters are calibrated prior to a noise study to ensure the accuracy of the measurements. Calibration results of the sound level meters are recorded in a database to track the variation of the sound level meter prior to the calibration.

The meters were attached to a fence, pole, or tree, and the microphone was pointed downward to drain moisture. These sound level meters recorded continuously from 12 am on Tuesday morning through 12 am on Friday morning during the first round of baseline studies (11/3 – 11/5), and 6 am on Tuesday morning through 6 am on Friday morning for the second round of baseline studies (12/1 – 12/3). The sound level meters recorded four noise measurements:

(1) Leq – The average noise exposure level per hour.

(2) Lmax – The instantaneous maximum noise level per hour.

(3) L10 – The noise level that is equaled or exceeded 10 percent of the specified time period (in this case, the noise level exceeded 6 minutes out of each hour).

(4) L90 – The noise level that is equaled or exceeded 90 percent of the specified time period (in this case, the noise level exceeded 54 minutes out of each hour).

All noise measurements are logged into the memory of the sound level meter and downloaded to a computer at the end of the noise study.

5.2 Birds

In early November and early December, 2009, ESA biologists conducted two rounds of baseline avian surveys at Stations A through D (see **Table 2** for when each station was surveyed, and Figure 1 for locations of Stations A through D, and the study boundary for each of the stations). As shown in Figure 1, the bird observation study boundary for each of the stations varied from an approximately 250-foot radius to a 1,600-foot radius from the station. At Stations C and D the study area was limited to less than 500 feet from the sound level station, so that bird data was limited to where noise data was also being captured, but at Crissy Marsh the study area was expanded substantially because: (1) it was important to capture the location of birds over the entire Marsh, to see if their locations on the Marsh change throughout the course of the Doyle Drive project (as a result of project-related noise); and (2) the existing conditions of the site (e.g., topography and vegetation) allowed monitors to make bird observations at a greater distance.

TABLE 2
AVIAN SURVEY DATES AND SURVEYORS

	11/3/09	**11/4/09**	**12/1/09**	**12/2/09**
Station A	M. Lowe		D. Ostfeld	
Station B		B. Olney		M. Lowe
Station C		D. Ostfeld		D. Ostfeld
Station D	D. Ostfeld			B. Olney

SOURCE: ESA, 2009

Avian monitoring was conducted using 10X42 binoculars and a basic point count method. Surveys were conducted from approximately 7 am to 9 am. All birds seen from each point were identified and their behavior was documented (behavioral categories included nesting, foraging, roosting, loafing, or transient). No nesting birds were observed during these baseline surveys.

6. Site Conditions

Conditions on November 3, 2009 were sunny and cool to start, with the temperature ranging from 50°F to 60°F, and winds ranging from 5 to 10 miles per hour. Conditions on November 4, 2009 were similar but slightly cooler, with fog and high clouds. Temperatures started around 50°F, and warmed to approximately 55°F. Conditions on December 1, 2009 were sunny and cool, with temperatures ranging from 45°F to 54°F. Conditions were overcast and cool on December 2, 2009, with temperatures ranging from 45°F to 50°F.

Stations A and B are immediately adjacent to Crissy Marsh, which provides shallow water, mudflats, and islands, depending on the tide level. Surrounding the lagoon is tidal marsh dominated by pickleweed (*Salicornia virginica*) and salt grass (*Distichlis spicata*), as well as areas restored of dune habitat. On the south side of the lagoon, Pacific wax myrtle (*Myrica californica*), coyote brush (*Baccharis pilularis*) and other shrubs have been planted in some areas to provide screening between the road and the lagoon. Crissy Marsh is located approximately 500 feet north of Doyle Drive. Pedestrian trails and sidewalks are adjacent to upland habitat and within 100 feet of marsh and aquatic habitat. Old Mason Street is also immediately adjacent to upland habitat and within 100-150 feet of aquatic and island habitat (Figure 1). Traffic noise from Doyle Drive and Old Mason Street combined with a constant procession of pedestrians and dogs create an environment with high ambient noise and human activity levels.

Station C is in riparian habitat on the west side of Dragonfly Creek. West of Station C is a plant nursery, and the area northeast of Station C was recently dominated by eucalyptus trees, but these trees were cleared in October for the Doyle Drive Replacement Project. Dominant plants here include willow (*Salix* spp.), dogwood (*Cornus* sp.), Himalayan blackberry (*Rubus discolor*), and snowberry (*Symphoricarpos albus* var. *laevigata*). Ambient noise at this location can be attributed to traffic from Highway 1 approximately 250 feet east, demolition of a building approximately 500 feet west, construction at Building 682 approximately 500 feet east, pedestrian traffic at the Native Plant Nursery immediately west, and nearby traffic on Schofield Road , Storey Avenue and other roads west and northwest of this station.

Station D is located in a Monterey cypress (*Cupressus macrocarpa)* forest, east of Park Boulevard and Highway 1. Southwest of Station D there is a patch of toyon (*Heteromeles arbutifolia)* and willow (*Salix* spp.), and west of Park Boulevard is a grassland and large patches of blackberry. Ambient noise at this location can be attributed to traffic on Park Boulevard immediately west, Highway 1 approximately 200 feet west, and construction activities at building 682, approximately 600 feet north of the sound level meter.

7. Results

7. 1 Noise

Table 3 summarizes the maximum and average noise measurements recorded at each station. **Table 4** shows the range, average, and maximum noise levels recorded over the three-day monitoring period, during typical work hours (7 am – 5 pm), and typical non-work hours (5 pm – 7 am). **Table 5** shows hourly noise levels at each station, during the time that ESA conducted avian monitoring. See **Appendix C** for figures depicting noise measurements recorded for each hour, at each station.

TABLE 3
MAXIMUM AND AVERAGE NOISE LEVELS, PER DAY

Location	Lmax - daily maximum noise level (dBA)	Leq - hourly average noise level range (dBA)
Station A. Crissy Marsh (East)	Nov. 3: 90 Nov. 4: 89 Nov. 5: 86 Dec. 1: 84 Dec. 2: 80 Dec. 3: 79	Nov. 3: 50 - 59 Nov. 4: 50 - 62 Nov. 5: 44 – 62 Dec. 1: 53 - 63 Dec. 2: 48 - 66 Dec. 3: 45 - 63
Station B. Crissy Marsh (West)	Nov. 3: 85 Nov. 4: 88 Nov. 5: 99 Dec. 1: 106 Dec. 2: 91 Dec. 3: 86	Nov. 3: 48 - 64 Nov. 4: 48 - 65 Nov. 5: 46 – 69 Dec. 1: 52 - 73 Dec. 2: 45 - 65 Dec. 3: 45 - 64
Station C. Utility Pole at Dragonfly Creek	Nov. 3: 87 Nov. 4: 93 Nov. 5: 96 Dec. 1: 80 Dec. 2: 79 Dec. 3: 81	Nov. 3: 51 - 79 Nov. 4: 50 - 79 Nov. 5: 50 – 68 Dec. 1: 53 - 61 Dec. 2: 48 - 61 Dec. 3: 47 - 62
Station D. East of Park Blvd.	Nov. 3: 88 Nov. 4: 88 Nov. 5: 88 Dec. 1: 88 Dec. 2: 88 Dec. 3: 91	Nov. 3: 50 - 64 Nov. 4: 51 - 65 Nov. 5: 51 – 66 Dec. 1: 58 - 65 Dec. 2: 52 - 66 Dec. 3: 52 - 76

SOURCE: ESA, 2009

TABLE 4
AVERAGE DAY AND NIGHT NOISE LEVELS* DURING 3-DAY BASELINE SURVEYS

	Range (dBA)		Average (dBA)		Maximum (dBA)	
	7 am - 5 pm**	**5 pm - 7 am†**	**7 am - 5 pm**	**5 pm - 7 am**	**7 am - 5 pm**	**5 pm - 7 am**
November 3 – November 5						
Station A	53 - 62	44 - 58	57	53	86	73
Station B	61 - 69	46 - 65	63	57	99	87
Station C	63 - 79	50 - 64	68	57	96	80
Station D	62 - 66	51 - 63	64	58	88	78
December 1 – December 3						
Station A	52 - 66	45 - 60	57	54	84	77
Station B	61 - 73	45 - 65	64	56	106	83
Station C	58 - 62	47 - 60	60	55	81	75
Station D	63 - 76	52 - 65	66	60	91	88

* Noise levels are hourly averages.

** 7 am – 5 pm is a typical construction work-day for the Doyle Drive Replacement Project.

† 5 pm – 7 am was recorded for all days except November 5, when the noise meter only recorded fro m 5 pm – 12 am, and on December 3, when the noise meter only recorded from 5 pm – 6 am.

SOURCE: ESA, 2009

TABLE 5
AVERAGE HOURLY NOISE LEVELS (LEQ) DURING THE AVIAN MONITORING PERIOD (6 AM TO 10 AM)*, NOV. 3 – NOV. 5 AND DEC. 1 – DEC. 3

TIME	6:00 – 6:59 a.m.	7:00 – 7:59 a .m.	8:00 – 8:59 a .m.	9:00 – 9:59 a .m.
Station A				
Nov. 3	59 dBA	54 dBA	53 dBA	53 dBA
Nov. 4	55 dBA	58 dBA	57 dBA	58 dBA
Nov. 5	52 dBA	53 dBA	57 dBA	58 dBA
Dec. 1	55 dBA	55 dBA	53 dBA	53 dBA
Dec. 2	54 dBA	57 dBA	57 dBA	57 dBA
Dec. 3	52 dBA	52 dBA	52 dBA	54 dBA
Station B				
Nov. 3	62 dBA	62 dBA	62 dBA	62 dBA
Nov. 4	60 dBA	63 dBA	64 dBA	64 dBA
Nov. 5	64 dBA	63 dBA	62 dBA	63 dBA
Dec. 1	60 dBA	63 dBA	62 dBA	63 dBA
Dec. 2	59 dBA	63 dBA	64 dBA	64 dBA
Dec. 3	59 dBA	62 dBA	61 dBA	61 dBA
Station C				
Nov. 3	64 dBA	65 dBA	66 dBA	72 dBA
Nov. 4	62 dBA	64 dBA	63 dBA	76 dBA
Nov. 5	62 dBA	64 dBA	66 dBA	66 dBA
Dec. 1	60 dBA	61 dBA	61 dBA	61 dBA
Dec. 2	58 dBA	61 dBA	61 dBA	61 dBA
Dec. 3	58 dBA	61 dBA	62 dBA	62 dBA
Station D				
Nov. 3	62 dBA	64 dBA	64 dBA	64 dBA
Nov. 4	64 dBA	64 dBA	65 dBA	65 dBA
Nov. 5	59 dBA	62 dBA	64 dBA	66 dBA
Dec. 1	63 dBA	65 dBA	65 dBA	65 dBA
Dec. 2	63 dBA	66 dBA	66 dBA	66 dBA
Dec. 3	63 dBA	66 dBA	66 dBA	76 dBA

* Avian monitoring for this baseline study was only 7 – 9 am. An additional hour before and after this monitoring period is included in this table for consistency with future avian monitoring tables, which may occur earlier/later depending on when sunrise occurs.

SOURCE: ESA, 2009

7.2 Birds

Station A –Over 343 individuals of 23 different species were observed on November 3, 2009, and over 202 individuals of 19 different species were observed on December 1, 2009 (**Appendix A**). Ambient noise was 53 – 55 dBA during the avian monitoring for both baseline studies (Table 5). Most of these birds were foraging or loafing on island and mudflat habitat within the lagoon. The most common species observed were ring-billed and western gulls, killdeer, and American coot. Brown pelicans and Canada geese were common transients through the area, and bufflehead and greater scaup were the most common ducks in the lagoon. As the tide came in on December 1, and the Crissy Marsh islands and intertidal shoreline areas disappeared, the number of sandpipers (which were in the intertidal areas) and loafing gulls and cormorants (which were on the islands in the lagoon) decreased. **Figures 2** through **5**, below, show the location of larger concentrations of birds at Crissy Marsh during the baseline studies.

Station B – Over 312 individuals belonging to 20 different species were observed on November 4, 2009, and approximately 187 individuals of 23 different species were observed on December 2, 2009 (Appendix A). Ambient noise was 63 – 64 dBA during the avian monitoring for both baseline studies (Table 5). Most birds observed were foraging or loafing on island habitat or rafting in open water. The most common species observed in Crissy Marsh were ring-billed and western gulls, western and least sandpipers, ruddy duck, semipalmated plover, Canada goose, and American coot. Brown pelicans, American crows, and common raven were typical transients through the area. Locations of larger concentrations of birds at Crissy Marsh are shown in Figures 2 through 5, below.

SOURCE: ESA, 2009

Doyle Drive Replacement Project. D207446

Figure 2

Locations of Groups of Birds at Crissy Marsh – 11/3/09, Station A

SOURCE: ESA, 2009

Doyle Drive Replacement Project. D207446

Figure 3

Locations of Groups of Birds at Crissy Marsh – 11/4/09, Station B

SOURCE: ESA, 2009

Doyle Drive Replacement Project. D207446

Figure 4

Locations of Groups of Birds at Crissy Marsh – 12/1/09, Station A

SOURCE: ESA, 2009

Doyle Drive Replacement Project. D207446

Figure 5

Locations of Groups of Birds at Crissy Marsh – 12/2/09, Station B

Station C – At least 37 individuals of 14 different species were observed on November 4, 2009, and 30 individuals of 11 different species were observed on December 2, 2009 (Appendix A). Ambient noise was 61 – 64 dBA during the avian monitoring for both baseline studies (Table 5). White-crowned sparrow, ruby-crowned kinglet, dark-eyed junco, and yellow-rumped warbler were the most common species. A red-shouldered hawk was seen flying over the site several times, and into a eucalyptus tree along Highway 1 just southeast of the study area.

Station D – At least 38 individuals belonging to 9 different species were observed on November 3, 2009, and at least 38 individuals belonging to 8 different species were observed on December 2, 2009 (Appendix A). Ambient noise was 64 – 66 dBA during the avian monitoring for both baseline studies (Table 5). The most common species heard were pygmy nuthatch and yellow-rumped warbler, which were foraging in the upper canopy of the Monterey cypress trees. A number of songbirds, including Townsend's warbler and ruby-crowned kinglet, were foraging in the toyon and willow plants west of Park Boulevard. White-crowned sparrows were most abundant in the grasses and blackberry shrubs on the west side of Park Boulevard.

8. Discussion

8.1 Noise

During both baseline surveys, all stations had daily (7 am – 5 pm) ambient noise levels of 57 dBA or above which is generally considered high, but typical in an urban setting (Table 4). While we cannot specify noise sources of unattended noise measurements, most noise recorded at stations A through D can generally be attributed to automobile traffic. Average hourly noise measurements vary little between the three days within each station, which suggests that the daily patterns recorded November 3 through November 5 and December 1 through December 3 are fairly typical. Station A, showing the lowest ambient levels, lies furthest from heavy automobile traffic. Station B, which is in the same general area as Station A but closer to Mason Street, receives higher ambient noise levels due to the traffic along Mason Street. Stations C and D are close to roads such as Highway 1 and Park Boulevard, and thus receive higher noise levels than Stations A and B. The highest hourly noise levels during the day (7 am – 5 pm) was 68 dBA, recorded at Station C during the first round of baseline surveys (Table 4); this is most likely due to nearby construction activities that day, including tree clearance along Dragonfly Creek, and deconstruction of a building west of the Native Plant Nursery (the latter activity is independent of the Doyle Drive Replacement Project). Average hourly highs at Station C were significantly lower in December than they were in November, suggesting that construction activities had lessened or halted completely.

During the avian monitoring period, ambient noise levels were similar at Stations B, C, and D (Leq was 61 – 66 dBA), but were approximately 8.5 dBA quieter at Station A (Leq was 52 – 58 dBA) (Table 5). As discussed in the preceding paragraph, Station A is the quietest location because it is the furthest away from roads and other disturbance. While the loudest range and average of hourly noise levels were recorded at Station C during our November baseline study (likely due to nearby construction activities) (Table 3 and Table 4), noise levels were not significantly higher than the others at Station C until after 9 am, which is after completion of avian monitoring at this site (Table 5). Thus, presumably the loud construction activities at this site did not influence birds during the survey.

The L90 (again, this is the dBA that is exceeded 54 minutes out of each hour) gives a good description of background noise, which can generally be attributed to traffic at the four stations. At all four stations the L90 levels gradually increase throughout the day, and are highest from approximately 7 am through 6 pm (Appendix B). This is what would be expected at these stations.

The L10 represents only six minutes of exceeded noise levels per hour, and is a good indicator of construction noise occurring within the project area. At Station A, the L10 is generally less than 60 dBA during the day in November baseline surveys, but is above 60 dBA for several hours each day during December baseline surveys (Appendix B); this is likely a result of PG&E or other construction activities in Mason Street, in early December. The L10 at Stations B and D hovered around 65 – 68 dBA during the day for both baseline studies, except for a few hours at Station D on December 3rd, when the L10 was greater than 70 dBA. Similarly, L10 at Station C was generally in the mid-to-upper 60s during the day during both baseline studies, but exceeded 75 dBA for several hours on November 3 and November 4; again, this is likely due to nearby construction activities (tree and stump removal was taking place immediately north of Station C on these two days).

Maximum noise levels recorded are almost always short, discrete events, such as a car back-firing. At all of the stations, maximum noise levels generally ranged from the 80s to the 90s (Table 3 and Table 4). The highest maximum noise level recorded during our baseline studies was 106 dBA, which was recorded at 3 pm on December 1, at Station B (Appendix B). The L10 did not increase during this hour, which suggests that this maximum noise level was a short-term event, that occurred for less than six minutes (in all likelihood, this event was only a few seconds long).

8.2 Birds

Birds were observed foraging, loafing, or flying at all four noise/bird monitoring locations. Some of the species observed are year-round residents of the area, although even among resident populations individuals may be migratory, and winter and summer populations may be composed of different individuals. Waterfowl and shorebirds were the most common type of birds observed at Stations A and B, while passerines were the most common birds at Stations C and D. Many of the species observed, such as the ring-billed gull, bufflehead, western grebe, whimbrel, willet, golden-crowned sparrow, Townsend's warbler, and yellow-rumped warbler, are not known to breed in San Francisco (San Francisco Field Ornithologists, 2003). Most of these species are tolerant to human presence and are often found in urban and otherwise developed areas.

As birds do not nest in early November and December, it is not surprising that we did not observe any nesting birds at the monitoring stations during our baseline surveys. Even during the breeding season most species are unlikely to nest at Crissy Marsh, due to the pedestrians and dogs present here, the proximity to Mason Street, and the lack of adequate buffer between pathways and potential salt marsh or upland nesting habitat. There is a greater likelihood for birds to nest at Stations C and D due to the greater shrub and tree cover at these locations, but human and vehicle traffic at these stations would prohibit disturbance-sensitive species from nesting here as well.

9. Conclusion

Traffic noise and pedestrian activity combine to provide fairly high disturbance levels audibly and visually at all four monitoring stations, and birds present at these stations are acclimated to this disturbance. Specifically, Stations A and B at Crissy Marsh are encircled by walking trails that are within 100 feet, and Mason Street is approximately 200 feet south; Station C is adjacent to Highway 1 and the Native Plant Nursery, there are construction activities at Building 682 on the east side of Highway 1 and demolition of a building approximately 500 west of the sound level meter; and Station D is immediately adjacent to Park Boulevard and Highway 1,700 feet south of Ghilotti Bros. electric line activities in Lincoln Boulevard and McDowell Avenue, and approximately 600 feet south of construction activities at Building 682.

As demonstrated during November baseline studies at Station C, construction activities will undoubtedly result in increased noise at the noise/bird monitoring stations, and could disturb birds using the area. If this is the case, birds nesting, foraging, or roosting in these areas might leave, or they could be exposed to increased predation if they can't hear predators as well. It will be difficult to correlate changes in bird behavior and numbers at the monitoring stations with Doyle Drive construction noise due to seasonal variability in the bird populations. The Presidio part of the Pacific Flyway, and Crissy Marsh in particular receives large numbers of migratory birds whose behaviors are determined by exogenous factors other than noise. In addition, birds and noise will only be monitored for two days every three months throughout the duration of the project, which will generate a relatively small dataset. Finally, other noise factors occurring during the short monitoring periods, such as a car backfiring or a low-flying plane, could result in greater short-term disturbance than the construction activities, which could confound the attempt to correlate changes in bird behavior with the longer-term construction activities. Nevertheless, we anticipate that this study will detect any gross changes in bird use at these four monitoring locations. This study would detect, for example, disappearance of a species of bird from a monitoring site altogether, or a shift in use from one end of Crissy Marsh to the other.

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