DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF THE BIRD CONTROL PROGRAM AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2016-2017

Prepared by

For

Forward Landfill Republic Services, Inc.
9999 South Austin Road
Manteca, CA
95336

Final LGL Report # TA4903-8

7 August 2017

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Table of Contents

Introduction

There is a general concern about the presence of birds in the vicinity of airports where they may collide with aircraft. This can threaten the safety of the aircraft. Municipal waste landfills often attract birds, primarily gulls of various species. For this reason, the siting of landfills near airports must be handled carefully. Fortunately, bird strikes are very rare events and damaging strikes are much rarer still, but they do occur.

The Forward Landfill has operated near Manteca, CA since 1973. An airstrip on the site of the Stockton Metropolitan Airport (SCK) began operation in April 1940. Thus, there is a long history (over 40 years) of co-existence between the landfill and the airport. An analysis of the reported bird strikes by aircraft using the Stockton Airport since 1991 indicates that the operating landfill has not been the source of birds struck by aircraft using the airport. This analysis is included later in this report.

Forward, Inc., a subsidiary of Republic Services, Inc., operates the Forward Landfill which is located close to SCK (Figure 1). Because birds can be attracted to landfills there is a potential to create a hazard to the safety of aircraft using the Stockton Airport and because the landfill had been known to have attracted gulls in previous winters (October-April), Forward, Inc. has instituted a gull control program at the landfill.

LGL Limited, an experienced bird hazard research firm, has been retained to monitor the success of the control program and to make recommendations for improvements to the program, if required. LGL is one of North America's leading ecological research firms. It has been involved with bird hazards to aircraft safety and associated wildlife control issues for over 40 years under the direction of Dr. Davis, the author of this report.

The present report provides an analysis of the success of the seventh year (2016-2017) of the falconry-based bird control program that was first instituted at Forward Landfill during the winter of 2010-2011. Reports of previous years of bird control are available (Davis 2011, 2012, 2013, 2016a, 2016b).

Previous Gull Use of Forward Landfill

Gulls are the principal birds that are attracted to edible waste that is disposed of at municipal solid waste landfills. Gulls winter in the Stockton area with first arrivals usually appearing in September or October. Gull numbers increase in November and December as migrants from further north arrive in the area. The Forward Landfill attracted gulls during winter in previous years, before control was initiated (see Davis 2011 for summary).

Gulls are not usually present in the Stockton area during the summer period (May to late September) and intensive gull control at the landfill is not required at that time. However, the landfill is monitored by landfill staff during the off-season for the presence of gulls. Any gulls that appear then are controlled by landfill staff using pyrotechnics. Control, if necessary, of early arriving gulls in September is conducted through the use of model aircraft.

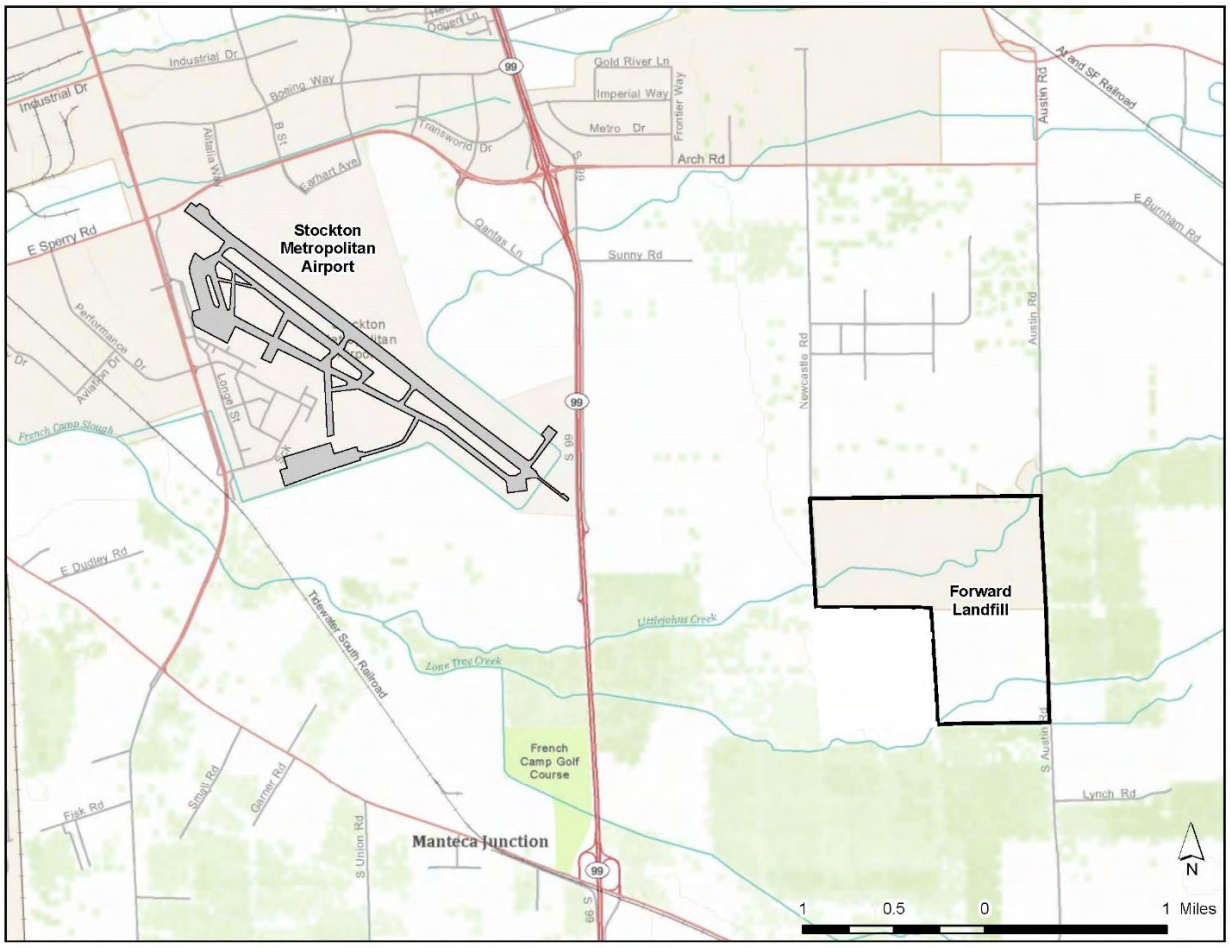

Figure 1. Location of Forward Landfill in relation to Stockton Metropolitan Airport.

A pilot gull control program was conducted at the Forward Landfill by Airstrike Bird Control, LLC. This was a falconry-based program that began on 9 March 2010 and concluded on 14 April 2010. Mr. Brad Felger, Manager of Airstrike Bird Control, estimated that there were approximately 3,000 gulls using the Forward Landfill when the pilot program began (B. Felger, pers. comm.).

Gull Control Program

The pilot gull control program had been successful and therefore, a full gull control program was instituted on an operational basis at Forward Landfill during the fall of 2010. The operational gull control program was again a falconry-based program operated by Airstrike Bird Control, LLC. The program used several falcons (Peregrine male, Peregrine female, Sakar Falcon, Gyrfalcon/Peregrine hybrid, etc.) to control gulls at and around the landfill. Control in subsequent years was based mainly on the use of male and female Peregrine Falcons. Control was achieved by flying the falcons to lure and by allowing them to chase the gulls on occasion. The program was also supplemented with the use of pyrotechnics to scare gulls away during conditions when it is difficult to fly the falcons (e.g. foggy and stormy conditions).

The objective of the control program was to prevent any gulls from feeding at the landfill or landing anywhere on the landfill property. If the gulls cannot feed at the landfill or loaf on the landfill or drink from occasional standing water, then they will stop returning to the landfill on subsequent days. There can be no gaps in the control coverage that might allow gulls to feed for even a few minutes because a gull can obtain all the food that it needs for the day in about 20 to 30 minutes of feeding at a landfill. Therefore, even small gaps in coverage could allow gulls to obtain enough food to encourage them to return to the landfill on a subsequent day.

In 2016-2017, the falconry-based gull control program by Airstrike Bird Control Inc. at Forward Landfill began on 24 October 2016 and continued until 31 March 2017. The main flights of gulls were late arriving in the fall of 2016 and the falconry program was not needed until late in October. However, small numbers of gulls appeared before late October and they were controlled by use of model aircraft and pyrotechnics by California Environmental from 22 August to 15 October 2016 on a 5-days per week basis. There are no data records from this early period but gull numbers were not large and gulls were not present every day.

Monitoring Program

The success of the gull control program has been monitored every winter by LGL Limited to provide an independent assessment of the program. The monitoring has included:

1. Daily observations made by the controllers during their control activities. These included records of all gulls that approached the landfill or flew past the landfill during the day.
2. Observations on and around the landfill by LGL personnel to confirm the observations by the controllers.
3. Observations at Forward Landfill by LGL personnel on Saturday afternoons and Sundays when the landfill was closed, the waste was covered, and the controllers were not on duty.
4. Observations at other landfills by LGL personnel to compare with the results from Forward Landfill.

The independent monitoring of the 2016-2017 program began on 5 November 2016 and continued until 5 May 2017. Several sources of data are used in the evaluation.

Observations at Forward Landfill – During Operations

Daily Observations by Controllers

The falconers who provided the daily bird control at the landfill kept records of the numbers of gulls that approached the landfill, the numbers of gulls that were controlled, and the numbers that flew past the landfill on route to other destinations. These data are summarized on a weekly basis in Table 1. The daily summaries are provided in Appendix 1.

Are Gulls Feeding at the Landfill?

The bird control program is designed to deter birds from feeding at the landfill. The observations by the controllers (falconers) indicated that no gulls were able to feed at the active

Table 1. Weekly summary of gull observations by falconers in the vicinity of the Forward Landfill.

Date in 2016-2017	# of gulls feeding at the landfill during week	Average # of flocks /day	Ave. Total # of gulls /day	Peak # of gulls at one time
2016				
Oct 24-30	0	3.2	25.0	75
Oct 31-Nov 5	0	0.8	1.8	6
Nov 7-12	0	1.2	2.5	3
Nov 14-19	0	2.7	23.2	29
Nov 21-26	0	4.5	44.5	27
Nov 28-Dec 3	0	3.5	26.2	17
Dec 5-10	0	3.5	9.5	6
Dec 12-17	0	1.5	12.2	30
Dec 19-24	0	2.0	5.5	12
Dec 26-31	0	2.0	7.8	27
2017				
Jan 2-7	0	10.3	105.3	70
Jan 9-14	0	6.2	71.0	37
Jan 16-21	0	5.7	32.5	21
Jan 23-28	0	3.2	46.2	37
Feb 1-4	0	2.5	39.0	86
Feb 6-11	0	10.5	210.0	85
Feb 13-18	0	8.7	145.0	78
Feb 20-25	0	6.0	57.0	38
Feb 27-Mar 4	0	1.7	13.5	18
Mar 6-11	0	3.0	22.7	25
Mar 13-18	0	2.0	20.5	26
Mar 20-25	0	1.8	12.7	19
Mar 27-31	0	0.6	4,8	11

disposal area of the landfill after the control program began (Table 1). However, as part of the bird control program, observations are made by an independent observer as an added oversight. The independent observer did not note any cases of gulls feeding at the landfill.

Gulls Approaching the Landfill and Flying Past the Landfill

The falconer conducting the gull control documented the numbers of gulls that approached and flew past the landfill. These observations are presented in Appendix 1 and summarized in Table 1. It is important to correctly interpret the data in Table 1 and Appendix 1. The numerical estimates of daily numbers of gulls are not estimates of the numbers at the landfill or even the numbers approaching the landfill. Some of the gulls in the totals were birds that flew past the landfill without visiting it. The numbers of such gulls were usually higher during the influxes of migrants and during periods of stormy weather that drove the gulls inland from the coast.

During the first three years of the study (2010-11, 2011-12, and 2012-2013), the number of flocks of gulls that approached or flew past the landfill ranged from 6.3 to 11.8 per day during the November-March period in each year, or a little over one flock per hour. During the three most recent years, the average numbers of flocks were lower: 4.1 per day in 2014-2015, 2.8 per day during 2015-2016, and 4.1 flocks per day in 2016-2017. The average flock size was 9 birds during 2014-2015, 11 birds during 2015-2016, and 9 birds during 2016-2017. These flock sizes were near the low end of the range of 7 to 21 birds during each of the first three years. These are very small numbers when compared to the large numbers that used to feed at the landfill before the control program began. The results indicate that the gull flight lines from gull night roosts in the delta or on San Francisco Bay no longer passed over the airport on route to Forward Landfill, but rather had moved to other daytime feeding areas.

Observations by LGL Personnel

LGL personnel conducted spot checks at the Forward Landfill. There were usually 6 visits per month and each visit was usually 3-4 hours long. The results of these visits are presented in Appendix 2 and summarized in Table 2.

The data gathered by the LGL personnel were consistent with the observations by the falconers on the same days (Table 1). In fact, the falconers generally recorded more birds because they were always searching for distant gulls approaching the landfill and they were on site earlier in the morning when more gulls approached the landfill. Therefore, it is again concluded that the data collected by the falconer/controllers are reliable and unbiased.

There had been a reduction in the numbers of gulls approaching or passing by the Forward Landfill over the first three years with the falconry control program in place. During the 2010-2011 period, there was an average of 1.0 flocks per hour of observation by the independent observer. This number declined in the second year (2011-2012) to 0.4 flocks per hour. During the third year (2012- 2013), the number of flocks of gulls approaching the landfill

Table 2. Summary of independent surveys of the Forward Landfill - 2016-2017.

Month	# of surveys	# of hours	# of gulls per 3 hours
2016*			
November	6	18	1.7
December	5	15	24.6
2017			
January	6	24	1.4
February	5	16	0.1
March	6	18	0.8
April	6	18	0.3
May	2	12	6.0

*Falconry program began on October 24, 2016 and ended on March 31, 2017.

declined further to an average of 0.2 flocks per hour. The number of flocks approaching or passing the Forward Landfill increased to 1.1 flocks per hour of observation in 2014-2015. During the peak period of October-March in 2015-2016, the number of flocks per hour declined to only 0.4 per hour. During the November-March period of 2016-2017, there also was an average of 0.4 flocks per hour. These are small numbers of flocks.

Observations at Forward Landfill – Weekends

The surveys during the first three years determined that gulls did not use the Forward Landfill on Saturday afternoons or Sundays when the landfill was closed and the controllers were not present. During the 2014-2015 study, the landfill was surveyed on 6 Sundays, once per month in October 2014 through March 2015. During those Sundays, the LGL observer noted 1.2 flocks per hour of gulls approaching and flying past the landfill. This was similar to the overall average of 1.1 flocks per hour when all days were considered. During the 2015-2016 period, only a single flock of gulls approached the landfill during 26 hours of surveys on Sundays; this was 0.04 flocks per hour. During the November-April period in 2016-2017, 3 flocks totaling 6 gulls were observed during 19 hours (0.2 flocks per hour) on six monthly surveys on Sundays. During the entire study, gulls have not been observed to feed at the covered landfill on Sundays.

Observations at Other Landfills

In order to interpret the results from Forward Landfill, it was necessary to examine the numbers of gulls that occurred at other municipal solid waste landfills in the area that did not have intensive gull control programs in place. Two such landfills were examined by LGL personnel: Foothill Landfill and North County Landfill. Each of these landfills had some bird control measures (pyrotechnics) that were used sporadically at Foothill Landfill. The control program at North County Landfill had been upgraded in 2015-2016 by using remote-controlled model airplanes and gliders during the week. That program was continued in 2016-2017. The control efforts at Foothill Landfill were by no means comparable to the program at Forward Landfill. Each landfill survey covered about a 2-3-hour period.

The **North County Landfill** is located approximately 18.5 miles NNE of the Forward Landfill (Figure 2). It was surveyed on 13 occasions from 3 November 2015 to 5 May 2016 (Table 3). During the October-March period, very few gulls fed at the landfill because the control program was quite effective. On average 550 gulls were noted flying past the landfill on a daily basis. Most of these gulls were believed to continue on to the Foothill Landfill. In previous years (see later in section) a large portion of those gulls stopped to feed at North County Landfill. Bird control in previous years was less intensive.

In 2016-2017, North County Landfill was surveyed twice per month from November through May. On three occasions during that period (12 December, 4 January, and 7 February), the gull control program was not operational. On each of these days, 3,100 to 3,600 gulls were present on the site (Table 3). On the other days, the control program was operational and gulls were not present. On those dates, gulls were noted flying past the North County Landfill on a route toward Foothill Landfill. The gull control program at North County was ended for the season at the end of March in 2017.

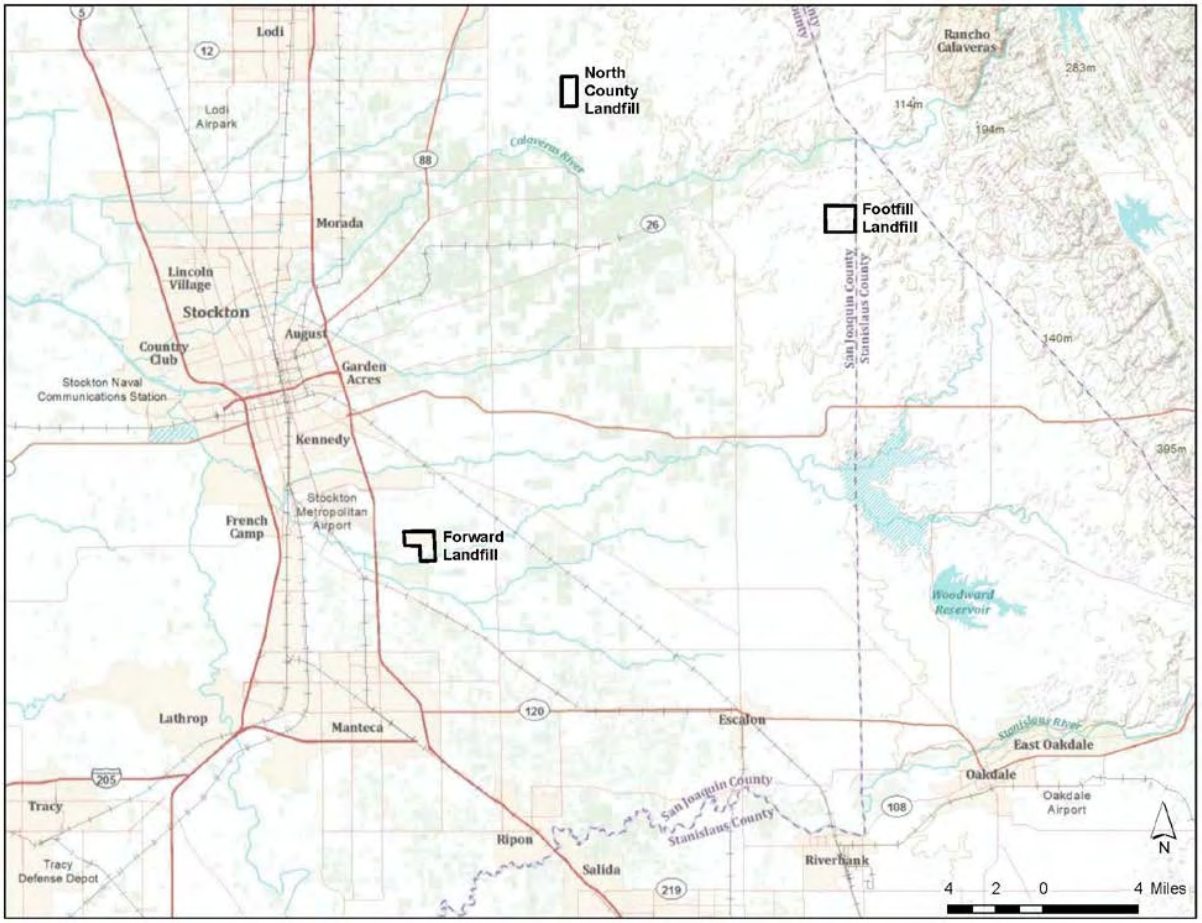

Figure 2. Locations of North County Landfill and Foothill Landfill.

Gull use of the North County Landfill had increased over the first three years of the present study (2010- 2013). During the November through March period, the average numbers of gulls per survey had increased from 709 in 2010-11, to 1,574 in 2011-12, to 2,462 in 2012-13. The average numbers of gulls per survey in the November 2014-March 2015 period was 456.6 gulls. During the November 2015-March 2016 period there was an average of 611 gulls per survey but most of those birds were flying past the landfill and heading toward Foothill Landfill. This pattern was because of the gull control at North County Landfill. As noted above and in Table 3, gulls were not present at North County on 7 of the 10 days with surveys during the November 2016-March 2017 period. Gulls were present on only three days when the control program was not operating; there was an average of 3,300 gulls present on each of those three days. The overall average for all 10 surveys was 990 gulls per survey. The patterns of gull use of North County Landfill had changed in recent years because of the presence of the gull control program.

The **Foothill Landfill** is located approximately 20.5 miles ENE of the Forward Landfill. It was surveyed twice per month from November 2016 to May 2017. During the November-March period (10 surveys), the peak number of gulls present was 4,400 on 26 January and the average was 2,728 gulls per survey (Table 4). Gulls began to leave the area in mid-March and were mostly gone by early April.

Table 3. Surveys of North County Landfill near Stockton, California - 2016-2017.

Date	Time of Survey	Maximum # of Gulls	Comments
2016			
Tues, Nov 1	09:00-12:00	0	gull control in place
Fri, Nov 11	07:00-10:00	0	gull control in place
Mon, Dec 12	07:00-10:00	3,600	fog and wind inhibiting gull control
Wed, Dec 28	07:00-10:00	0	gull control in place
2017			
Wed, Jan 4	08:00-12:00	3,100	gull control not operational
Fri, Jan 20	08:00-12:00	0	gull control in place
Tues, Feb 7	08:00-12:00	3,200	limited gull control
Mon, Feb 27	08:00-11:00	0	
Wed, Mar 8	12:00-14:30	0	gull control in place
Mon, Mar 20	08:00-11:00	0	gull control in place
Wed, Apr 5	08:00-11:00	36	Gull abatement finished for year
Thurs, Apr 27	08:00-11:00	0	
Wed, May 10	08:00-11:00	120	
Fri, May 19	08:00-11:00	0	

Table 4. Surveys of Foothill Landfill near Stockton, California - 2016-2017.

Date	Time of Survey	Maximum # of Gulls	Comments
2016			
Tues, Nov 8	07:00-10:00	3,100	
Fri, Nov 25	07:00-10:00	2,700	
Mon, Dec 5	07:00-10:00	4,100	
Thurs, Dec 22	07:00-10:00	3,000	foggy
2017			
Tues, Jan 10	09:00-12:00	3,200	
Wed, Jan 25	08:00-12:00	4,400	
Thurs, Feb 16	08:00-11:00	2,400	
Wed, Feb 22	08:00-10:00	0	
Fri, Mar 3	08:00-10:00	3,600	
Mon, Mar 27	08:00-11:00	780	
Fri, Apr 7	08:00-11:00	138	
Fri, Apr 21	08:00-11:00	0	
Fri, May 12	08:00-11:00	0	
Tues, May 23	08:00-11:00	0	

The average numbers of gulls per survey at Foothill Landfill during the November-March period in recent years has varied: 1,077 in 2010-11, 2,087 in 2011-12, 2,450 in 2012-13, 2,276 in 2015-2016, and 2,728 in 2016-2017. The reasons for the variation are not known but are probably related to variations in the numbers of gulls wintering in the region in different years, which may be a function of annual differences in the amount of rain. The increase at Foothill Landfill in the present year may be a function of the more effective gull control at North County Landfill

In previous years, the results from North County and Foothill landfills clearly indicated that significant numbers of gulls used these landfills even though there were some control efforts at each of the landfills. In both cases, there were significantly more gulls present than there were in the vicinity of the Forward Landfill during the same period.

The numbers of gulls at North County and Foothill Landfills are not directly comparable to the numbers at Forward Landfill. The numbers for North County and Foothill landfills are the averages of the peak numbers per survey. The closest comparisons from Forward Landfill are the averages of the peak numbers in Appendix 1. For example, over the five-month period (November 2016-March 2017.), the average peak number of gulls in the vicinity of the Forward Landfill was 12 gulls (13 gulls in 2015-2016) compared to 2,728 gulls feeding at Foothill Landfill (2,276 in 2015-2016). Also, the small numbers gulls at Forward Landfill were scared away quickly or were flying past the landfill whereas the gulls at Foothill Landfill were present there for most of the day.

Where Did the Gulls from Forward Landfill Go?

The question was asked where did the gulls that formerly fed at Forward Landfill go when they were prevented from feeding at that landfill. A detailed assessment of this question has not been conducted because it would have required intensive effort to collect baseline data in previous years before the control program began. Clearly, many of the gulls from Forward now go to other landfills in the region and feed at other areas. All of the natural feeding areas on waterbodies and in fields are still used by gulls. In addition, other anthropogenic or human created feeding sites are used. For example, gulls are using the Waste Transfer Station in south Stockton, the Town of Manteca, and the Stockton Sanitation Ponds.

Gull Behavior at Night

Gulls spend the night at communal roosts on large bodies of water where they occur in dense flocks. The use of the night roosts is traditional with particular roosts being used year after year. Gulls do not feed at inland terrestrial areas at night and they do not feed at landfills at night. The latter fact has been demonstrated at many landfills. The best documented case is the Atlantic County Utilities Authority where waste is disposed of at night. There has not been a single gull seen at night at that coastal landfill during over 19 years of operation (Davis and Hixon 2017). Because of this nocturnal behavior, it is not necessary to control gulls at night at the Forward Landfill.

History of Bird Strikes at Stockton Metropolitan Airport (SCK)

The Federal Aviation Administration (FAA) maintains an extensive database documenting wildlife/aircraft collisions at airports throughout the U.S. The FAA database includes records beginning in 1990 and contains over 175,000 strike records. As of 30 April 2016, the database contained records of 62 bird and mammal strikes associated with the Stockton Airport. It is well known that not all bird strikes are reported but the important strikes (those that affect flight, cause damage, etc.) are more likely to be reported than are strikes that cause no damage and often are not even detected by the flight crew. It is apparent that the airport has been much more diligent in reporting strikes in the past six years with 42 (68%) of the 62 strikes since 1990 recorded during that six-year period compared to only 20 strikes (32%) in the previous 21- year period.

A summary printout of the 62 reported strikes at the Stockton Metropolitan Airport is included as Table 5. The Forward Landfill has been operating during the entire 27-year period covered by the FAA data base. For the 20 years before the fall and winter of 2010-2011, there was no bird control program in place at the landfill. Therefore, if the landfill was attracting birds that were a threat to aircraft safety, the strike data from the airport should reflect that risk. Gulls are the group of birds that are attracted to the landfill and could pose a threat to aircraft using the Stockton Airport. One of the 62 reported strikes involved a black-tailed jackrabbit (Table 5); the remaining 61 bird strikes are examined in the following paragraphs.

Thirty-seven of the strikes involved identified birds that were not gulls. A thirty-eighth strike involved a gull carcass that was found on the airport on 28 October 2000; it was assumed to have been struck by an aircraft. Of the 22 strikes that involved unknown birds, 11 involved small birds that could not have been gulls. Of the 11 remaining strikes, 4 involved “medium” or “large” unknown birds and 7 involved “unknown bird or bat”. In theory, any of these 11 strikes could have involved gulls.

Two of the seven incidents involving birds of unknown size involved military aircraft in June 2006. This is a period when gulls are not present in the Stockton area; thus these two strikes undoubtedly did not involve gulls. A third strike occurred at night (8 April 2013) when gulls have returned to the coast. A fourth strike occurred on 8 October 1991 when a military KC135 struck a bird on its landing roll at SCK. It is possible that the bird may have been a gull resting on the airport runway. The fifth strike involved a business jet on its landing roll on 31 December 2011. The flight crew reported the strike at the time and must have seen the bird. Had it been a gull, it likely would have been reported as such or at least as a medium or large bird. A runway check was performed immediately after the incident but no carcass was found, again suggesting that a gull was not involved. The final two strikes of birds of unknown size each occurred in March 2016. One involved a single piston-engine aircraft (Cirrus SR20) at 14:40 on 31 March on approach to SCK; it was 5 nautical miles to the north of the airport at an altitude of 2500 ft. This strike was unlikely to have involved a bird from the landfill. The last strike occurred at 15:45 on 23 March; it involved a report by the pilot of a Cessna 206 of a strike to the leading edge of a wing that caused no damage. No other information on the type of bird or phase of flight was noted.

Table 5. Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

Date	Airport	Airline	Aircraft	Bird Species
04/20/2016	Stockton Metro	Unknown	Unknown	Swainson's Hawk
03/23/2016	Stockton Metro	Business	Cessna 206	Unknown bird
03/21/2016	Stockton Metro	Business	Cirrus SR20/22	Unknown bird
02/18/2016	Stockton Metro	Unknown	Unknown	Western Meadowlark
11/30/2015	Stockton Metro	Unknown	Unknown	Black-tailed Jackrabbit
11/28/2015	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
04/21/2015	Stockton Metro	Military	T-38	American Pipit
03/30/2015	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
03/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
03/13/2015	Stockton Metro	Coast Guard	C-130	Horned Lark
10/10/2014	Stockton Metro	Business	Learjet 45	Unknown small bird
04/14/2014	Stockton Metro	Unknown	Unknown	Swainson's Hawk
04/10/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/31/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/29/2014	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
01/14/2014	Stockton Metro	Unknown	Unknown	Rabbit
12/13/2013	Stockton Metro	Allegiant Air	MD-83	Red-tailed Hawk
11/19/2013	Stockton Metro	Business	C-340	Red-tailed Hawk
11/19/2013	Stockton Metro	Unknown	Unknown	Rock Pigeon
10/15/2013	Stockton Metro	Unknown	Unknown	European Starling
06/20/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
04/08/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird
02/22/2013	Stockton Metro	Military	C-12	Unknown bird or bat
12/02/2012	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
02/23/2012	Stockton Metro	Unknown	Unknown	Western Meadowlark
02/07/2012	Stockton Metro	Unknown	Unknown	Horned Lark
01/24/2012	Stockton Metro	Unknown	Unknown	Burrowing Owl
12/31/2011	Stockton Metro	Business	BE-400 BJET	Unknown bird
12/05/2011	Stockton Metro	Unknown	Unknown	Horned Lark
11/18/2011	Stockton Metro	Government	Lockheed C-130	Western Meadowlark
09/15/2011	Stockton Metro	Allegiant Air	MD-83	Turkey Vulture
07/30/2011	Stockton Metro	Unknown	Unknown	Barn Owl
06/28/2011	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2011	Stockton Metro	Unknown	Unknown	Horned Lark
05/27/2011	Stockton Metro	Allegiant Air	MD-83	American Kestrel
04/18/2011	Stockton Metro	Unknown	Unknown	Red-tailed hawk
02/15/2011	Stockton Metro	Privately Owned	C-414	White-tailed kite
01/02/2011	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
12/20/2010	Stockton Metro	Unknown	Unknown	Barn owl
08/02/2010	Stockton Metro	Unknown	Unknown	Tree Swallow
01/16/2010	Stockton Metro	Business	PA-46 Malibu	Unknown bird - large
12/28/2009	Stockton Metro	Business	Learjet-45	Unknown bird - medium
12/15/2008	Stockton Metro	Government	Lockheed C-130	Unknown bird - small

Table 5 (concluded). Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

09/09/2008	Stockton Metro	Business	Citation X	Unknown bird - small
08/09/2008	Stockton Metro	Business	BE-400 BJET	Unknown bird - small
01/23/2008	Stockton Metro	Allegiant Air	MD-80	Unknown bird - medium
08/17/2006	Stockton Metro	Military	T-6A	Black vulture
06/19/2006	Stockton Metro	Military	KC-10A	Unknown bird or bat
06/08/2006	Stockton Metro	Military	C-130H	Unknown bird or bat
08/15/2003	Stockton Metro	Business	Citation X	Hawks
05/10/2001	Stockton Metro	Military	KC-135E	Unknown bird - small
11/20/2000	Stockton Metro	Business	BE-90 King	Unknown bird - small
11/02/2000	Stockton Metro	Unknown	Unknown	Great horned owl
10/28/2000	Stockton Metro	Unknown	Unknown	Gulls
04/23/2000	Stockton Metro	Business	Citation II	Unknown bird - large
01/18/2000	Stockton Metro	Military	T-38A	Horned lark
01/11/2000	Stockton Metro	Business	C-340	Sparrows
08/09/1999	Stockton Metro	Business	C-152	Owls
03/31/1997	Stockton Metro	Unknown	BD-19	Ducks
01/26/1993	Stockton Metro	Business	HWKR SD-125	Barn owl
10/08/1991	Stockton Metro	Military	KC-135R	Unknown bird or bat

There were two strikes reportedly involving “large” birds and two involving birds of “medium” size. There was no information on the species involved although it should be noted that gulls are fairly easy to identify as gulls, if they are seen. Of the two incidents involving “large” birds, the first occurred on 23 April 2000 when most gulls have left the Stockton area. This involved a Cessna Citation II jet that struck a bird at 2000 ft while on climbout from Runway 29.

The aircraft was west of the airport at the time. It made a precautionary landing with a small amount of damage. Given the time of year and the altitude of the strike, it is unlikely that a gull was involved. The second strike of an unknown “large’ bird occurred on 16 January 2010 and involved a single-engine Piper 46 Malibu aircraft that was at an elevation of 2500 ft, 8-10 miles west of SCK on climbout from Runway 29. Given the altitude, it is unlikely that a gull was involved and given the location, it is unlikely that a bird from the landfill, which is east of the airport, was involved.

The two incidents involving unknown birds of “medium” size are discussed in this paragraph. The first involved an MD-80 twin-engine passenger jet that struck a bird at 400 ft while still over the airport on climb-out from Runway 29R on 23 January 2008. The pilot advised of the strike and continued on his flight with no damage to the aircraft. The second incident involved a Learjet 45, a small twin-engine business jet. The aircraft was on approach to Runway 29R in rain and fog on 28 December 2009. It broke out of the clouds and struck a bird over the runway. There was no damage and the strike had no effect on the flight.

In conclusion, of the 61 bird strike reports from Stockton Metropolitan Airport beginning in 1990, only one definitely involved a gull (carcass only) and four others might have involved gulls. Even allowing for significant under-reporting of bird strikes, five strikes at SCK in over 27

years with no damage reported indicates that the landfill has not posed a significant threat to aircraft using the Stockton Metropolitan Airport.

Thirty-eight of the reported bird strikes at SCK occurred since the gull control program was instituted at Forward Landfill. These strikes involved Barn Owls (4), a Burrowing Owl, a White- tailed Kite, Red-tailed Hawks (3), Swainson's Hawks (4), a Turkey Vulture, an American Kestrel, Horned Larks (4), Western Meadowlarks (3), Killdeers (2), an American Pipit, a Rock Pigeon, a European Starling, unidentified small birds (4), and two unidentified birds. No gulls were involved and none of the birds struck were attracted to the area by the landfill.

Conclusions

The studies reported here were designed to assess whether the gull control program at the Forward Landfill continued to be effective in eliminating any hazard to aircraft caused by the attraction of birds to the landfill. The control program continued to be completely effective at preventing gulls from feeding at, or otherwise using, the Forward Landfill. This was a huge reduction from the estimated 3,000 gulls that were present at the Forward Landfill in March 2010 when the pilot control program began. Observations at Foothill Landfill indicated that large numbers of gulls still continued to feed there in spite of sporadic control efforts with pyrotechnics. Bird control at North County Landfill was more systematic and intensive than at Foothill Landfill but substantial numbers of gulls (up to 3,600) still occurred at North County on days when the control was not operating.

The present study has documented the continued complete effectiveness of the gull control program at Forward Landfill. The program is not experimental but rather it is fully-operational using control techniques that are well-established and are used operationally and effectively at several landfills. The conversion of the Forward Landfill to a fully-controlled facility has insured that no bird hazard is created by the landfill.

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APPENDICES

Appendix 1. Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Oct 2016						
Mon 24	V.V.	3	11	5	gull sp.	two flocks (5,4) controlled by falcons; one flock of 2 is a fly-by
Tues 25	V.V.	5	26	7	gull sp.	3 flocks (6,5,7) controlled by falcon; 1 flock (6) by pyro; 1 flock (2) fly-by
Wed 26	V.V.	1	1	1	gull sp.	fly-by
Thurs 27	V.V.	8	75	35	gull sp.	5 flocks (19,4,35,2,7) controlled by falcon; 3 flocks (2,2,4) by pyro
Fri 28	V.V.	2	37	34	gull sp.	1 flock (34) controlled by falcon; 1 flock (3) is fly-by
Sat 29	V.V.	0	0	0		
Mon 31	V.V.	1	6	6	gull sp.	1 flock (6) controlled by pyro
Nov 2016						
Tues 1	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Wed 2	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Thurs 3	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Fri 4	V.V.	0	0	0		
Sat 5	V.V.	1	2	2	gull sp.	1 flock (1 bird) controlled by falcon
Mon 7	V.V.	0	0	0		
Tues 8	V.V.	0	0	0		
Wed 9	V.V.	2	4	3	gull sp.	1 flock (1 bird) controlled by pyro; 1 flock (3 birds) fly-by
Thurs 10	V.V.	1	2	2	gull sp.	1 flock (2) fly-by
Fri 11	V.V.	2	3	2	gull sp.	1 flock (2) controlled by falcon; 1 flock (1) by pyro
Sat 12	V.V.	2	6	3	gull sp.	1 flock (3) controlled by falcon; 1 flock (3) by pyro
Mon 14	V.V.	1	3	3	gull sp.	1 flock (3) is fly-by
Tues 15	V.V.	1	1	1	gull sp.	1 flock (1) controlled by falcon
Wed 16	V.V.	6	45	15	gull sp.	5 flocks (4,10,15,13,1) controlled by falcons; 1 flock (2) controlled by pyro
Thurs 17	V.V.	3	20	12	gull sp.	3 flocks (4,4,12) controlled by falcons
Fri 18	V.V.	2	18	1	gull sp.	2 flocks (6,12) controlled by falcons
Sat 19	V.V.	3	52	29	gull sp.	3 flocks (20,29,3) controlled by falcons
Mon 21	V.V.	13	168	27	gull sp.	12 flocks (14,3,6,15,27,15,10,27,16,11,13,7) controlled by falcons; 1 flock (4) fly-by
Tues 22	V.V.	2	5	4	gull sp.	2 flocks (1,4) controlled by falcons
Wed 23	V.V.	2	34	27	gull sp.	1 flock (27) controlled by falcon; 1 flock (7) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Thurs 24	V.V.	5	15	4	gull sp.	2 flocks (6 birds) dispersed by falcons; 3 flocks (4,2,3) fly-by
Fri 25	V.V.	3	27	12	gull sp.	2 flocks (12,7) controlled by falcons; 1 flock (8) fly-by
Sat 26	V.V.	2	18	17	gull sp.	1 flock (17) controlled by falcon; 1 flock (1) by pyro
Mon 28	V.V.	5	53	17	gull sp.	3 flocks (48 birds) controlled by falcon; 2 flocks (1,4) fly-by
Tues 29	V.V.	3	17	11	gull sp.	2 flocks (3,11) controlled by falcon; 1 flock (3) fly-by
Wed 30	V.V.	4	24	10	gull sp.	2 flocks (7,10) controlled by falcon; 2 flocks (3,4) fly-by
Dec 2016						
Thurs 1	V.V.	1	9	9	gull sp.	1 flock (9) controlled by falcon
Fri 2	V.V.	3	12	10	gull sp.	1 flock (10 birds) controlled by falcons; 2 flocks (1,1) were fly-bys
Sat 3	V.V.	5	42	14	gull sp.	5 flocks (4,7,7,10,14) controlled by falcons
Mon 5	M.C.	3	5	2	gull sp.	2 flocks (1,2) controlled by falcon; 1 flock (2) fly-by
Tues 6	M.C.	2	2	1	gull sp.	2 flocks (1,1) controlled by falcons
Wed 7	M.C.	4	11	5	gull sp.	1 flock (2 birds) controlled by falcon; 3 flocks (2,5,2) were fly-by
Thurs 8	M.C.	7	29	6	gull sp.	6 flocks (3,2,4,5,6,3 birds) controlled by falcon; 1 flock (6) fly-by
Fri 9	M.C.	3	7	3	gull sp.	2 flocks (5 birds) controlled by falcon; 1 flock (2) fly-by
Sat 10	M.C.	2	3	2	gull sp.	1 flock (1 bird) controlled by falcon; 1 flock (2) fly-by
Mon 12	V.V.	2	2	1	gull sp.	2 flocks (1,1) controlled by pyro
Tues 13	V.V.	1	1	1	gull sp.	1 flock(1) was a fly-by.
Wed 14	V.V.	2	5	3	gull sp.	2 flocks (3,2) controlled by pyro
Thurs 15	V.V.	2	30	17	gull sp.	2 flocks (13,17 birds) controlled by falcons
Fri 16	V.V.	1	30	30	gull sp.	1 flock (30 birds) controlled by falcon
Sat 17	V.V.	1	5	5	gull sp.	1 flock (5 birds) controlled by pyros
Mon 19	R.O.	2	3	2	gull sp.	2 flocks (1,2 birds) fly-by
Tues 20	V.V.	2	3	2	gull sp.	1 flock (2) controlled by pyro; 1 flock (1) fly-by
Wed 21	V.V.	0	0	0		
Thurs 22	R.O.	0	0	0		
Fri 23	V.V.	5	12	4	gull sp.	5 flocks (4,3,2,2,1) controlled with pyro
Sat 24	V.V.	3	15	12	gull sp.	1 flock (12 birds) controlled by falcon; 2 flocks (1,2) fly-by
Mon 26	V.V.	4	13	7	gull sp.	2 flocks (7,3) controlled by falcon; 2 flocks (1,2) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 27	V.V.	2	2	1	gull sp.	2 flocks (1,1) were fly-bys
Wed 28	V.V.	1	1	1	gull sp.	1 flock (1) was fly-by
Thurs 29	V.V.	1	1	1	gull sp.	1 flock (1) was fly-by
Fri 30	V.V.	3	3	1	gull sp.	3 flocks (1,1,1) fly-by
Sat 31	V.V.	1	27	27	gull sp.	1 flock (27) controlled by falcon
Jan 2017						
Mon 2	V.V.	14	180	40	gull sp.	12 flocks (160 birds) controlled by falcon; 1 flock (17) by pyro; 1 flock (3) fly-by
Tues 3	V.V.	8	234	70	gull sp.	6 flocks (211 birds) controlled by falcon; 1 flock (2) by pyro; 1 flock (21 birds) fly-by
Wed 4	V.V.	6	33	13	gull sp.	5 flocks (31 birds) controlled by falcon; 1 flock (20 fly-by
Thurs 5	V.V.	18	78	32	gull sp.	16 flocks (75 birds) controlled by falcon; 2 flocks (3) fly-by
Fri 6	V.V.	8	11	2	gull sp.	8 flocks (11 birds) controlled by falcon
Sat 7	V.V.	8	84	27	gull sp.	8 flocks (84 birds) controlled by falcon
Mon 9	V.V.	10	194	34	gull sp.	10 flocks (194 birds) controlled by falcon
Tues 10	V.V.	9	148	37	gull sp.	7 flocks (146 birds) controlled by falcon; 2 flocks (2) fly-by
Wed 11	V.V.	12	63	15	gull sp.	8 flocks (59 birds) controlled by falcon; 4 flocks (4) fly-by
Thurs 12	V.V.	4	14	10	gull sp.	2 flocks (12 birds) controlled by falcon; 2 flocks (2) fly-by
Fri 13	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Sat 14	V.V.	1	6	6	gull sp.	1 flock (6 birds) fly-by
Mon 16	V.V.	10	34	11	gull sp.	4 flocks (13 birds) controlled by falcon
Tues 17	V.V.	4	13	4	gull sp.	10 flocks (34 birds) controlled by falcon
Wed 18	V.V.	8	30	10	gull sp.	8 flocks (30 birds) controlled by falcon
Thurs 19	V.V.	3	9	5	gull sp.	3 flocks (9 birds) fly-by
Fri 20	V.V.	5	53	21	gull sp.	4 flocks (51 birds) controlled by falcon; 1 flock (2 birds) fly-by
Sat 21	V.V.	4	56	20	gull sp.	4 flocks (56 birds) controlled by falcon
Mon 23	V.V.	8	163	37	gull sp.	7 flocks (151 birds) controlled by falcon; 1 flock (12 birds) fly-by
Tues 24	V.V.	7	109	27	gull sp.	7 flocks (109 birds) controlled by falcon
Wed 25	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Thurs 26	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Fri 27	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Sat 28	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Feb 2017						
Wed 1	V.V.	0	0	0		
Thurs 2	V.V.	2	84	80	gull sp.	1 flock (80 birds) controlled by falcon; 1 flock (4) fly-by
Fri 3	V.V.	2	11	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (4) fly-by
Sat 4	V.V.	6	61	21	gull sp.	3 flocks (45 birds) controlled by falcon; 3 flocks (16) fly-by
Mon 6	V.V.	12	394	68	gull sp.	12 flocks (394 birds) controlled by falcon
Tues 7	V.V.	13	147	27	gull sp.	10 flocks (142 birds) controlled by falcon; 3 flocks (5) fly-by
Wed 8	V.V.	10	162	3	gull sp.	6 flocks (128 birds) controlled by falcon; 4 flocks (34 birds) fly-by
Thurs 9	V.V.	9	182	45	gull sp.	5 flocks (147 birds) controlled by falcon; 4 flocks (35) fly-by
Fri 10	V.V.	12	271	85	gull sp.	12 flocks (271 birds) controlled by falcon
Sat 11	V.V.	7	104	51	gull sp.	5 flocks (93 birds) controlled by falcon; 2 flocks (11) fly-by
Mon 13	V.V.	9	73	21	gull sp.	7 flocks (66 birds) controlled by falcon; 2 flocks (7) fly-by
Tues 14	V.V.	6	21	6	gull sp.	6 flocks (21 birds) controlled by falcon
Wed 15	V.V.	4	19	6	gull sp.	3 flocks (18 birds) controlled by falcon; 1 flock (1) fly-by
Thurs 16	V.V.	5	29	12	gull sp.	4 flocks (27 birds) controlled by falcon; 1 flock (2) fly-by
Fri 17	V.V.	16	624	78	gull sp.	16 flocks (624 birds) controlled by falcon
Sat 18	V.V.	12	104	24	gull sp.	12 flocks (104 birds) controlled by falcon
Mon 20	V.V.	25	256	38	gull sp.	24 flocks (251 birds) controlled by falcon; 1 flock (5 birds) fly-by
Tues 21	V.V.	4	48	22	gull sp.	3 flocks (44 birds) controlled by falcon; 1 flock (4 birds) fly-by
Wed 22	V.V.	2	8	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (1) fly-by
Thurs 23	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Fri 24	V.V.	2	19	17	gull sp.	2 flocks (19 birds) fly-by
Sat 25	V.V.	2	10	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (3 birds) fly-by
Mon 27	V.V.	4	34	13	gull sp.	4 flocks (34 birds) controlled by falcon
Tues 28	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon
Mar 2017						
Wed 1	V.V.	0	0	0		
Thurs 2	V.V.	1	6	6	gull sp.	1 flock (6 birds) fly-by
Fri 3	V.V.	2	19	18	gull sp.	2 flocks (19 birds) fly-by

Appendix 1 (concluded). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Sat 4	V.V.	2	20	13	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (13 birds) fly-by
Mon 6	V.V.	4	48	25	gull sp.	4 flocks (48 birds) controlled by falcon
Tues 7	V.V.	3	35	22	gull sp.	1 flock (2 birds) controlled by falcon; 1 flock (4 birds) fly-by
Wed 8	V.V.	2	6	4	gull sp.	2 flocks (32 birds) controlled by falcon; 1 flock (3 birds) fly-by
Thurs 9	V.V.	3	14	7	gull sp.	1 flock (7 birds) controlled by falcon; 2 flocks (7 birds) fly-by
Fri 10	V.V.	3	21	12	gull sp.	3 flocks (21 birds) controlled by falcon
Sat 11	V.V.	3	12	7	gull sp.	2 flocks (5 birds) controlled by falcon; 1 flock (7) fly-by
Mon 13	V.V.	2	8	6	gull sp.	2 flocks (8 birds) fly-by
Tues 14	V.V.	4	32	12	gull sp.	4 flocks (32 birds) controlled by falcon
Wed 15	V.V.	1	17	17	gull sp.	1 flock (17 birds) controlled by falcon
Thurs 16	V.V.	1	7	6	gull sp.	1 flock (7 birds) fly-by
Fri 17	V.V.	2	30	26	gull sp.	1 flock (26 birds) controlled by falcon; 1 flock (4) fly-by
Sat 18	V.V.	2	29	17	gull sp.	2 flocks (29 birds) controlled by falcon
Mon 20	V.V.	3	12	7	gull sp.	1 flock (7 birds) controlled by falcon; 2 flocks (5 birds) fly-by
Tues 21	V.V.	3	43	19	gull sp.	2 flocks (35 birds) controlled by falcon; 1 flock (8) fly-by
Wed 22	V.V.	2	18	12	gull sp.	2 flocks (18 birds) controlled by falcon
Thurs 23	V.V.	2	2	1	gull sp.	2 flocks (2 birds) fly-by
Fri 24	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Sat 25	V.V.	0	0	0		
Mon 27	V.V.	0	0	0		
Tues 28	V.V.	2	17	11	gull sp.	1 flock (11 birds) controlled by falcon; 1 flock (6) fly-by
Wed 29	V.V.	0	0	0		
Thurs 30	V.V.	0	0	0		
Fri 31	V.V.	1	7	7	gull sp.	1 flock (7 birds) fly-by

Appendix 2. Results of independent surveys of the Forward Landfill - 2016-2017.

Date		Time of Survey	# of hours	# of gulls	Notes
Nov 2016					
Sat 5	GP	09:00-12:00	3	0	
Thurs 10	GP	10:00-13:00	3	0	
Wed 16	GP	12:00-15:00	3	4	
Mon 21	GP	07:00-10:00	3	4	Fog. Gulls heard only
Sun 27	GP	08:00-11:00	3	2	Fog.
Wed 30	GP	13:00-17:00	3	0	
Dec 2016					
Fri 2	GP	10:00-13:00	3	23	
Wed 7	GP	08:00:10:30	2.5	15	Heavy fog
Sat 10	GP	07:00-10:00	3	17	
Thurs 15	GP	07:00-10:00	3	many	Many gulls controlled by falconer with falcon and pyro
Mon 19	GP	07:00-10:00	3	68	47 gulls fly over without control being necessary
Sun 25	GP	07:00-10:00	3	0	Limited visibillty due to fog
Jan 2017					
Mon 2	GP	08:00-12:00	4	6	Wind and rain. Control by pyros
Fri 6	GP	08:00-12:00	4	0	
Mon 9	GP	08:00-12:00	4	0	
Satr 14	GP	08:00-12:00	4	3	
Wed 18	GP	08:00-12:00	4	0	
Sun 29	GP	08:00-12:00	4	2	
Feb 2017					
Wed 1	GP	08:00-12:00	4	0	Fog heavy early in period
Fri 3	GP	08:00-11:00	3	some	Gulls controlled by pyro but visibilty restricted by fog
Tues 14	GP	08:00-11:00	3	0	
Sun 19	GP	08:00-11:00	3	2	fly-by
Sat 25	GP	08:00-11:00	3	0	Fog limited visibility
Tues 28	GP	08:00-11:00	3	0	

Appendix 2 (concluded). Results of independent surveys of the Forward Landfill - 2016-2017.

Date		Time of Survey	# of hours	# of gulls	Notes
Mar 2017					
Wed 1	GP	08:00-11:00	3	0	
Sun 5	GP	08:00-11:00	3	0	
Tues 7	GP	08:00-11:00	3	4	3 fly-by
Tues 14	GP	08:00-11:00	3	0	
Fri 17	GP	08:00-11:00	3	0	
Sat 25	GP	08:00-11:00	3	1	
Apr 2017					
Mon 3	GP	08:00-11:00	3	0	
Fri 7	GP	08:00-11:00	3	2	
Sat 15	GP	08:00-11:00	3	0	
Wed 19	GP	08:00-11:00	3	0	
Sun 23	GP	08:00-11:00	3	0	good cover
Tues 25	GP	08:00-11:00	3	0	
May 2017					
Mon 1	GP	08:00-11:00	3	12	
Fri 5	GP	08:00-11:00	3	0	

June 25, 2015

Erin Fanning
Environmental Manager
Forward, Inc.
9999 S. Austin Road
Manteca, CA 95336
Email: EFanning@republicservices.com

Re: June 2015 Biological Surveys at the Forward Landfill, San Joaquin County

Dear Erin:

The purpose of this letter is to provide the results of biological surveys conducted by WRA, Inc. (WRA) at and adjacent to the Forward Landfill (hereafter landfill) north of the City of Manteca in San Joaquin County, California, on June 19, 2015. Specifically, WRA conducted the following surveys:

- A survey for gulls (family Laridae) at the landfill.
- A survey for nesting Swainson's hawks (*Buteo swainsoni*) within 0.25 mile of the WMU FU-13 area and the compost processing/storage area.

All observations were made by WRA wildlife biologist Patricia Valcarcel. The individual field efforts are discussed in more detail below.

Gull Survey

Methods

The survey was conducted from the high vantage point in the southern portion of the site where no active landfill activities are currently taking place, and most previous gull surveys by WRA have been conducted (Figure 1, attached). Nearly all of the landfill property was visible from this area, including the active face located approximately 0.5 mile to the north. Observations were made using binoculars, a spotting scope (with 60x zooming capability) as well as the naked eye. The active face and other portions of the landfill were observed continuously from 8:30 AM to 10:45 AM, with the primary goal of enumerating and identifying to species any gulls present. All wildlife species observed at the landfill during the survey were noted.

Results and Discussion

No gulls were observed throughout the survey, neither in association with the landfill or simply flying over the site.

Several blackbirds (red-winged [*Agelaius phoeniceus*] and/or Brewer's [*Euphagus cyanocephalus*]) and rock pigeons (*Columba livia*) were loafing and foraging on the ground near the active face throughout the observation period. One American kestrel (*Falco sparverius*) was observed briefly foraging near the active face, and a common raven (*Corvus corax*) was also observed in the immediate vicinity of the active face.

Swainson's Hawk Nesting Survey

Swainson's hawk is listed as Threatened under the California Endangered Species Act and is a U.S. Fish and Wildlife Service Bird of Conservation Concern. This species is a summer (breeding) resident in California's Central Valley, and winters primarily in South America. Nesting occurs in trees, and sites typically used include the edge of bands of riparian vegetation, isolated patches of oak woodland, lone trees, and also planted and natural trees associated with roads and farmyards and in adjacent urban residential areas. Foraging occurs in open areas, including grasslands, open woodlands, and agricultural lands. While breeding, adults feed primarily on rodents (and other vertebrates); large insects (e.g., grasshoppers, dragonflies) comprise most of the diet during the remainder of the year. The nesting season occurs from April through July.

According to CDFW's Natural Diversity Database, there are several documented Swainson's hawk nesting occurrences within 2.0 miles of the landfill, the nearest being approximately 0.1 mile north of its eastern portion, and most recently used in 2002. One active Swainson's hawk nest in a valley oak (*Quercus lobata*) along Austin Road was observed by WRA during a focused survey at the landfill in 2014.

Methods

As requested by Forward, Inc., the 2015 Swainson's hawk nesting survey covered all accessible areas within 0.25 mile of WMU FU-13 (location of the current active face) and the compost processing/storage area in the southeastern portion of the landfill property. There are a variety of medium- to large-sized trees that provide suitable nesting habitat within this area, primarily along or adjacent to Austin Road as shown in Figure 1. Note that the raised portion of the landfill extending into the northern portion of WMU FU-13 is approximately 120 feet higher in elevation than the southern portion of WMU FU-13, and this elevation difference visually obstructs most of the creek north of the landfill from southern WMU FU-13, and is not publicly accessible. For this reason, survey efforts along the creek did not cover the portion of the creek greater than approximately 0.2 mile from Austin Road.

Trees within the survey area were then examined more directly (using the spotting scope, binoculars, and the naked eye) from 7:30 to 8:30 AM, and again from 10:45 to 11:10 am. The survey area was also observed opportunistically in the course of other activities at the site on June 19, most particularly during the gull survey which allowed for the examination of most of the focal trees with the spotting scope, and also the ability to search for hawks and focal activity areas. All Swainson's hawks and nests potentially being used by the species were noted.

Results and Discussion

One Swainson's hawk was observed perched in the oak tree used for nesting in 2014. The individual was perched and did not move during the entire focused Swainson's hawk survey. There appeared to be a nest structure on the limb, and the individual was assumed to be attending a nest. At the start of the gull survey, the individual had left the oak tree. Swainson's hawks were observed soaring over the landfill throughout the gull survey; a maximum of two

individuals were seen simultaneously. The two birds were observed soaring at lower-elevation over Austin Road, several times. Following the gull survey, the oak tree was investigated once more while the Swainson's hawk was still away foraging. A nest structure was confirmed, and was determined to be active based on the observed Swainson's hawk behavior (nest attendance). Although no chicks were observed, it is likely chicks have recently hatched or are in the process of hatching based upon time of the season and behavior of the hawk attending the nest.

The active nest is located on the northeast side of the tree and marginally over Austin Road itself (Figure 1). Based on the results of the 2014 survey and fact that Swainson's hawks are likely to nest in the same immediate area each year, landfill personnel had previously installed signage alerting workers to the presence of the nest and an associated 50-foot-radius exclusion buffer. No other stick nests or localized Swainson's hawk activity were observed in the other surveyed trees. Although many of the trees along the creek north of the landfill featured dense foliage and/or were not accessible at close range, no Swainson's hawks were observed in association with the creek area.

The San Joaquin County Multi-species Habitat Conservation and Open Space Plan[1] (SJMSCP) provides avoidance and mitigation requirements for covered species, including Swainson's hawk. WRA understands that landfill operations are covered under the SJMSCP, which outlines incidental take minimization measures for Swainson's hawk (section 5.2.4.11, p. 5-37). As per the SJMSCP, "retained" Swainson's hawk nest trees that become occupied during construction activities shall have a construction exclusion buffer with a radius that is "two times the dripline of the tree, measured from the nest." WRA believes that this minimization measure applies to and is appropriate for the nest along Austin Road, for the following reasons:

- The nest tree became occupied while standard landfill operations were occurring (e.g., daily depositing/consolidation of garbage at the active face, trucks and other equipment entering and exiting the site). These operations were and remain visible and audible from the nest tree.
- The nest tree has been established for two consecutive years with a high baseline of activity from landfill operations in the vicinity.
- The nest tree is located directly adjacent to a busy road with habitual traffic (in both directions) including many large trucks, the vast majority of which are entering or exiting the landfill; the birds occupying the nest appear fully habituated to the immediate presence of these vehicles.

Thus, WRA believes that the previously-established buffer radius of 50 feet (i.e., twice that of the maximum dripline of the tree) is sufficient to avoid adverse impacts to the nest form landfill operations. This buffer is shown in Figure 1, and would remain in place until young in the nest have fledged (or the nest otherwise becomes inactive). If no follow-up surveys to determine nest status are conducted, the buffer should remain in place until September 1, 2015 (the end of the general breeding bird season, when all Swainson's hawk breeding activity should be concluded). WRA also recommends that landfill employees and others associated with operations continue to maintain the maximum distance feasible from the nest while on foot or otherwise outside of vehicles, as the nesting birds are unlikely to be habituated to such an approach.

[1] Published November 2000. Available online at: http://www.sjcog.org/DocumentCenter/View/5

Please do not hesitate to contact me if you would like additional information or have questions about any of these survey efforts and recommendations.

Sincerely,

Patricia Valcarcel
Wildlife Biologist

Attachment: Figure 1

Figure 1. June 2015 Wildlife Surveys

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ENVIRONMENTAL CONSULTANTS

Forward Landfill
San Joaquin County, California

Date: June 2015
Map By: Derek Chan
Base Source: ESRI/Bing Maps

Path: L:\Acad 2000 Files\16000\16193-2\GIS\ArcMap\WildlifeSurveys_20150625.mxd

REPUBLIC SERVICES

Mr. Russell Stark
Director
Stockton Metropolitan Airport
5000 South Airport Way, Ste 202
Stockton, CA 95206

July 6, 2018

RE: Forward Landfill – Infill Development Project

Dear Mr. Stark:

This letter provides notification, as required by California Code of Regulations (CCR) Title 27, Article 4, Section 20270 (b), of the proposed lateral expansion of the existing Forward Landfill located in Manteca, California. This proposed expansion is currently undergoing environmental review and analysis by San Joaquin County.

Forward has placed in its operating record the demonstration required by 40 Code of Federal Regulations section 258.10 and CCR Title 27, Article 4, Section 20270 (c) that the proposed lateral expansion will not create a hazard to aircraft or public safety. The demonstration is entitled "Demonstration of the Effectiveness of the Bird Control Program at the Forward Landfill, Manteca, California – 2017-2018," prepared by LGL Limited Environmental Research Associates (author: Dr. Rolph Davis) dated June 7, 2018). A copy is enclosed for your records, along with prior year reports.

If you have questions or comments regarding the above information, please contact me at (209) 547-7520.

Sincerely,

Kevin Basso
General Manager

cc: Rob Fishburn – Republic Services
Ron Elliott – Stockton Airport

Enclosures

9999 South Austin Road
Manteca, CA 95336
(209) 982-4298 / (209) 982-1009 fax
EFanning@republicservices.com

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF BIRD CONTROL AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2017-2018

Prepared by

For

Forward Landfill Republic Services, Inc.
9999 South Austin Road
Manteca, CA
95336

LGL Final Report # TA4903-9

7 June 2018

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF BIRD CONTROL AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2017-2018

Prepared by

Rolph A. Davis, Ph.D.

LGL Limited
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P.O. Box 280, 22 Fisher St.
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For

Forward Landfill Republic Services, Inc.
9999 South Austin Road
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95336

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7 June 2018

Table of Contents

Introduction

There is a general concern about the presence of birds in the vicinity of airports where they may collide with aircraft. This can threaten the safety of the aircraft. Municipal waste landfills often attract birds, primarily gulls of various species. For this reason, the siting of landfills near airports must be handled carefully. Fortunately, bird strikes are very rare events and damaging strikes are much rarer still, but they do occur.

The Forward Landfill has operated near Manteca, CA since 1973. An airstrip on the site of the Stockton Metropolitan Airport (SCK) began operation in April 1940. Thus, there is a long history (over 45 years) of co-existence between the landfill and the airport. An analysis of the reported bird strikes by aircraft using the Stockton Airport since 1991 indicates that the operating landfill has not been the source of birds struck by aircraft using the airport. This analysis is included later in this report.

Forward, Inc., a subsidiary of Republic Services, Inc., operates the Forward Landfill which is located close to SCK (Figure 1). Because birds can be attracted to landfills there is a potential to create a hazard to the safety of aircraft using the Stockton Airport and because the landfill had been known to have attracted gulls in previous winters (October-April), Forward, Inc. has instituted a gull control program at the landfill.

LGL Limited, an experienced bird hazard research firm, has been retained to monitor the success of the control program and to make recommendations for improvements to the program, if required. LGL is one of North America's leading ecological research firms. It has been involved with bird hazards to aircraft safety and associated wildlife control issues for over 40 years under the direction of Dr. Davis, the author of this report.

The present report provides an analysis of the success of bird control in the eighth year (2017-2018) of control at the Forward Landfill. During the first seven years, a falconry-based control program was in place at the landfill. That program was initiated during the winter of 2010-2011. The situation in 2017-2018 was different and no falconry program was necessary. That situation is the subject of the present report. Reports of previous years of bird control are available (Davis 2011, 2012, 2013, 2016a, 2016b, 2017).

Previous Gull Use of Forward Landfill

Gulls are the principal birds that are attracted to edible waste that is disposed of at municipal solid waste landfills. Gulls winter in the Stockton area with first arrivals usually appearing in September or October. Gull numbers increase in November and December as migrants from further north arrive in the area. The Forward Landfill attracted gulls during winter in previous years, before control was initiated (see Davis 2011 for summary).

Gulls are not usually present in the Stockton area during the summer period (May to late September) and intensive gull control at the landfill is not required at that time. However, the landfill is monitored by landfill staff during the off-season for the presence of gulls. Any gulls that appear then are controlled by landfill staff using pyrotechnics. Control, if necessary, of early arriving gulls in September is conducted through the use of pyrotechnics or model aircraft.

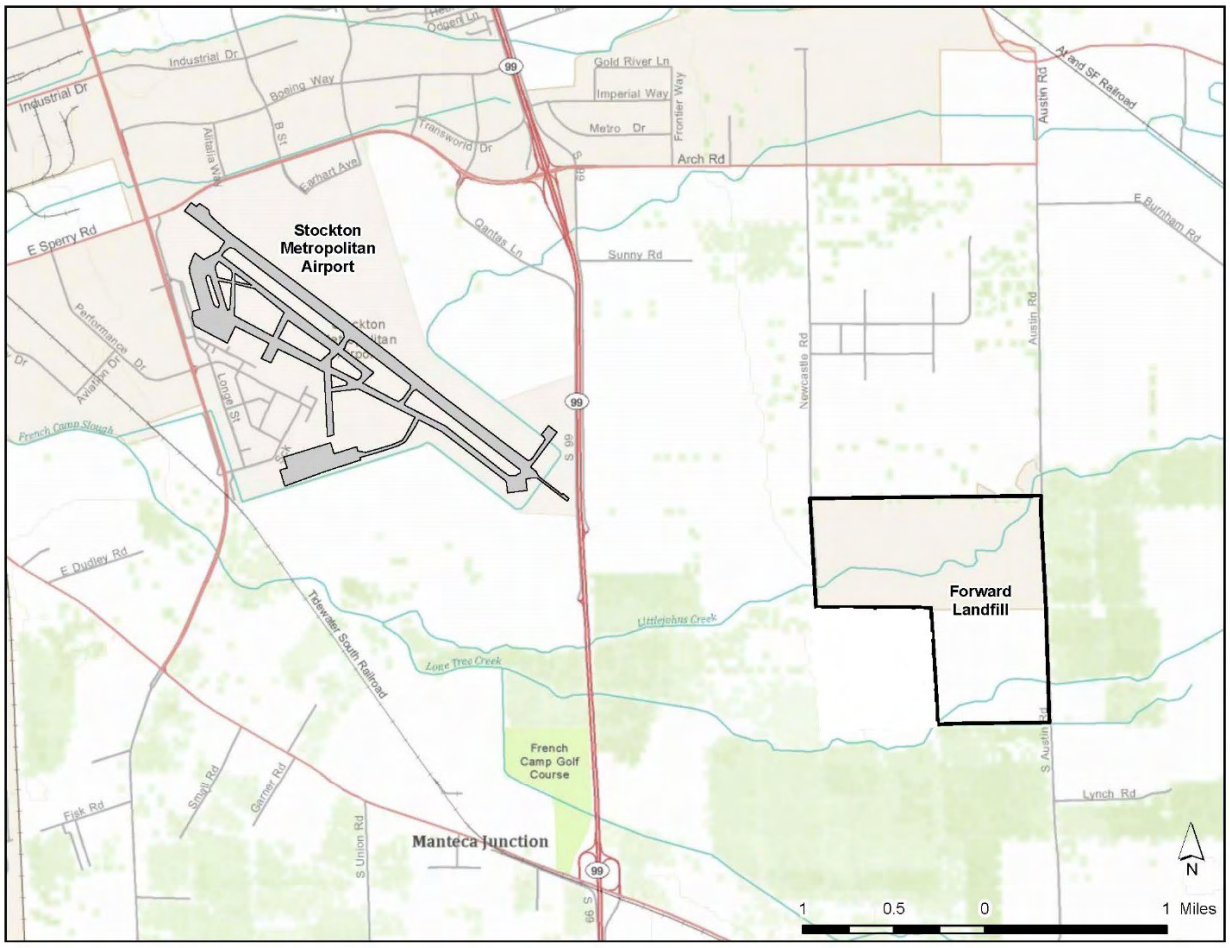

Figure 1. Location of Forward Landfill in relation to Stockton Metropolitan Airport.

A pilot gull control program was conducted at the Forward Landfill by Airstrike Bird Control, LLC. This was a falconry-based program that began on 9 March 2010 and concluded on 14 April 2010. Mr. Brad Felger, Manager of Airstrike Bird Control, estimated that there were approximately 3,000 gulls using the Forward Landfill when the pilot program began (B. Felger, pers. comm.).

Gull Control Program

The pilot gull control program had been successful and therefore, a full gull control program was instituted on an operational basis at Forward Landfill during the fall of 2010. The operational gull control program from 2011 to April 2017 was a falconry-based program operated by Airstrike Bird Control, LLC. The program used several falcons (Peregrine male, Peregrine female, Sakar Falcon, Gyrfalcon/Peregrine hybrid, etc.) to control gulls at and around the landfill. Control in subsequent years was based mainly on the use of male and female Peregrine Falcons. Control was achieved by flying the falcons to lure and by allowing them to chase the gulls on occasion. The program was also supplemented with the use of pyrotechnics to scare gulls away during conditions when it is difficult to fly the falcons (e.g. foggy and stormy conditions).

The objective of the control program was to prevent any gulls from feeding at the landfill or landing anywhere on the landfill property. If the gulls cannot feed at the landfill or loaf on the landfill or drink from occasional standing water, then they will stop returning to the landfill on subsequent days. There can be no gaps in the control coverage that might allow gulls to feed for even a few minutes because a gull can obtain all the food that it needs for the day in about 20 to 30 minutes of feeding at a landfill. Therefore, even small gaps in coverage could allow gulls to obtain enough food to encourage them to return to the landfill on a subsequent day.

Observations by landfill staff and LGL Limited at Forward Landfill in September and October 2017 indicated that gulls were not visiting the landfill. Therefore, the initiation of the falconry program was deferred until gulls began to arrive. However, gulls did not visit the landfill during the late fall (November-December) and the falconry program was not necessary and was not implemented. The occasional gull that frequented the landfill was easily scared off by the use of pyrotechnics and landfill staff at the active waste disposal area. Similarly, gulls did not visit the Forward Landfill during the January-mid-May period. This was the case even though the falconry-based control program was not in place. The lack of use by gulls was independently documented by the LGL observer who surveyed the site 6 times per month (see later sections and Appendix 1).

There was a contingency plan in place in case gulls did begin trying to use the Forward Landfill and there was a time gap before the falconry-program could be re-instituted at the landfill. During that period, landfill staff would protect the active disposal area by using pyrotechnics. In addition, California Environmental would immediately institute control using radio-controlled model aircraft. Each of these programs would have been effective in their own right if they had been needed to cover the gap before the falconry program could be re-instituted.

Monitoring Program

The success of the gull control at Forward Landfill has been monitored every winter since 2011-2012 by LGL Limited to provide an independent assessment of the program. The monitoring has included:

1. In previous years, daily observations made by the controllers during their control activities. These included records of all gulls that approached the landfill or flew past the landfill during the day. In 2017-2018, because there was no falconry-based program, these daily observations were not available.
2. Observations on and around the landfill by LGL personnel to independently assess the situation at the landfill.
3. Observations at other landfills by LGL personnel to compare with the results from Forward Landfill.

The independent monitoring of the 2017-2018 program began on 3 September and continued until 15 May 2018.

Observations at Forward Landfill – During Operations

Daily Observations by Controllers

In previous years, the falconers who provided the daily bird control at the landfill kept records of the numbers of gulls that approached the landfill, the numbers of gulls that were controlled, and the numbers that flew past the landfill on route to other locations. These observations were not available in 2017-2018 because the it was not necessary to use the falconry-based program. The landfill staff that used pyrotechnics had other responsibilities at the active disposal area and could not make these types of observations.

Observations by LGL Personnel

LGL personnel conducted surveys at the Forward Landfill. There were 6 visits per month and each visit was usually 3 hours long. Searches for gulls were conducted throughout each three-hour period. The results of those surveys are presented in Appendix 1 and summarized in Table 1. The surveys were conducted over 8.5 months and involved 51 surveys covering 151.5 hours of observations (Appendix 1).

Very few gulls approached the landfill during the independent surveys. Only 7 individuals or groups were observed and three of them circled over the landfill and then flew off without requiring the use of pyrotechnics. Therefore, only 4 of the groups were actually scared off with pyrotechnics. These are remarkably small numbers and are lower than in previous years when the falconry-based control program had been necessary.

Over the years, the numbers of gulls approaching or passing over the landfill have been documented during the peak November-March period by the independent observer. During the 2010-2011 period, there was an average of 1.0 flocks per hour of observation by the independent observer. This number declined in the second year (2011-2012) to 0.4 flocks per hour. During the third year (2012- 2013), the number of flocks of gulls approaching the landfill

Table 1. Summary of independent surveys of the Forward Landfill - 2017-2018.

Month	# of surveys	# of hours	# of gulls per 3 hours
2017*			
September	6	17.5	0.2
October	6	18	0.2
November	6	18	0.7
December	6	18	0.5
2018			
January	6	18	0.0
February	6	16	0.2
March	6	18	0.0
April	6	17	0.2
May	3	9	0.0

* Falconry program was not conducted during the 2017-2018 winter.

declined further to an average of 0.2 flocks per hour. The corresponding number of flocks approaching or passing the Forward Landfill increased to 1.1 flocks per hour of observation in 2014-2015. During the peak period of October-March in 2015-2016, the number of flocks per hour declined to only 0.4 per hour. During the November-March period of 2016-2017, there also was an average of 0.4 flocks per hour. These are small numbers of flocks but the numbers were even lower in 2017-2018, when the number of flocks was only 0.1 per hour during the November-March period.

Observations at Forward Landfill – Weekends

The surveys during the first three years determined that gulls did not use the Forward Landfill on Saturday afternoons or Sundays when the landfill was closed and the controllers were not present. During the 2014-2015 study, the landfill was surveyed on 6 Sundays, once per month in October 2014 through March 2015. During those Sundays, the LGL observer noted 1.2 flocks per hour of gulls approaching and flying past the landfill. This was similar to the overall average of 1.1 flocks per hour when all days were considered. During the 2015-2016 period, only a single flock of gulls approached the landfill during 26 hours of surveys on Sundays; this was 0.04 flocks per hour. During the November-April period in 2016-2017, 3 flocks totaling 6 gulls were observed during 19 hours (0.2 flocks per hour) on six monthly surveys on Sundays. During the entire study, gulls have not been observed to feed at the covered landfill on Sundays. No gulls were present on the single Sunday survey (12 November) during the 2017-2018 study. Single surveys were conducted monthly (9 in total) on Saturdays during 2017-2018. Only a single gull was seen during the nine surveys; it circled the landfill and then flew off without landing on the afternoon of 9 December 2017.

Are Gulls Feeding at the Landfill?

Gull control at the Forward Landfill is designed to deter birds from feeding at the landfill. The observations by the independent biologists indicated that no gulls were able to feed at the active disposal area of the landfill (Table 1).

Observations at Other Landfills

In order to interpret the results from Forward Landfill, it was necessary to examine the numbers of gulls that occurred at other municipal solid waste landfills in the area that did not have full-time intensive gull control programs in place. Two such landfills were examined by LGL personnel: Foothill Landfill and North County Landfill. Each of these landfills had some bird control measures (pyrotechnics) that were used sporadically at Foothill Landfill. The control program at North County Landfill had been upgraded in 2015-2016 by using remote-controlled model airplanes and gliders during the week. That program was continued in 2016-2017 and 2017-2018. The control efforts at Foothill Landfill were by no means comparable to the program at North County Landfill. Each landfill survey covered about a 3-hour period.

The **North County Landfill** is located approximately 18.5 miles NNE of the Forward Landfill (Figure 2). It was surveyed 17 times (twice per month) from September 2017 to mid-May 2018 (Table 2). On the four surveys in September and October, small numbers of gulls were present and feeding at the landfill; numbers ranged from 24 to 160 and averaged 59 per survey. In

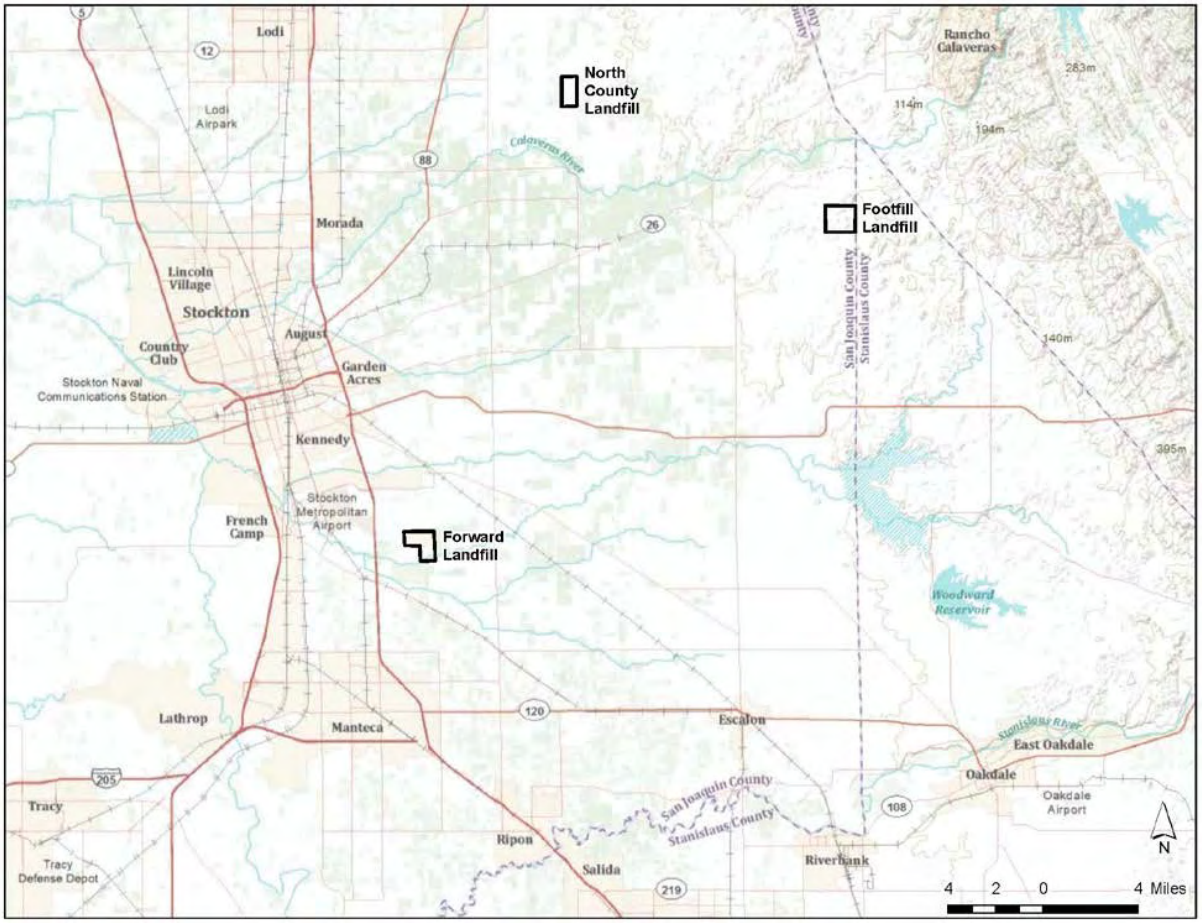

Figure 2. Locations of North County Landfill and Foothill Landfill.

November through March, an effective gull control program using model aircraft was in place on most days. When the program was in place, gulls flew past the North County Landfill and headed in the direction of the Foothill Landfill. On five days when these birds could be counted (no fog), an average of 520 gulls flew past during each of the three-hour surveys (Table 2). Gulls were not present in April and early May, even though the gull control program was not in operation during that period.

The North County Landfill was surveyed on 13 occasions from 3 November 2015 to 5 May 2016. During the November-March period, very few gulls fed at the landfill because the control program was quite effective. On average 550 gulls were noted flying past the landfill on a daily basis, heading toward Foothill Landfill. In previous years (see later in section) a large portion of those gulls stopped to feed at North County Landfill. Bird control in previous years was less intensive.

In 2016-2017, North County Landfill was surveyed twice per month from November through May. On three occasions during that period (12 December, 4 January, and 7 February), the gull control program was not operational. On each of these days, 3,100 to 3,600 gulls (average

Table 2. Surveys of North County Landfill near Stockton, California - 2017-2018.

Date	Time of Survey	Maximum # of Gulls	Comments
2017			
Tues, Sep 11	07:00-10:00	24	feeding - no control in place
Wed, Sep 26	07:00-10:00	26	feeding - no control in place
Mon, Oct 2	07:00-10:00	160	feeding - no control in place
Mon, Oct 23	09:00-12;00	24	feeding - no control in place
Thurs, Nov 2	07:30-11:30	0	400 fly past - gull control in place
Thurs, Nov 23	07:00-10:00	0	fog
Thurs, Dec 7	07:00-10:00	69	scared off by control program
Mon, Dec 18	07:00-10:00	0	1,450 fly past - gull control in place
2018			
Fri, Jan 5	08:00-11:00	120	gull control not operational
Fri, Jan 26	08:00-11:00	0	280 fly past - gull control in place
Mon. Feb 5	07:00-10:00	0	390 fly past - gull control in place
Tues, Feb 20	07:00-10:00	0	some fly past - gull control in place
Mon, Mar 5	08:00-11:00	0	460 fly past - gull control in place
Tues, Mar 20	07:00-10:00	0	38 fly past - gull control in place
Wed, Apr 4	07:00-10:00	0	0 gulls fly past
Fri, Apr 20	08:00-11:00	0	0 gulls fly past
Fri, May 11	08:00-11:00	0	0 gulls fly past

of 3,300) were present on the site. On the other days, the control program was operational and gulls were not present. On those dates, gulls were noted flying past the North County Landfill on a route toward Foothill Landfill. The gull control program at North County was ended for the season at the end of March in 2017. Gulls were not present at North County on the 7 of 10 days with control in place during the November 2016-March 2017 period. The overall average for all 10 surveys was 990 gulls per survey.

Gull use of the North County Landfill was higher in the early years of the study. During the November through March period, the average numbers of gulls per survey was 709 in 2010-11, 1,574 in 2011-12, 2,462 in 2012-13, and 457 in 2013-14. The patterns of gull use of North County Landfill had changed in recent years because of the presence of the gull control program.

The **Foothill Landfill** is located approximately 20.5 miles ENE of the Forward Landfill (Figure 2). It was surveyed 17 times (twice per month) from September 2017 to mid-May 2018 (Table 3). Although pyrotechnics were used occasionally by landfill staff to reduce gull numbers at the landfill, none were being used during the 17 surveys. Gulls were present at the landfill during the four surveys in September and October with an average of 225 gulls per survey. During the peak November-March period, there was an average of 614 gulls on each of the 10 surveys. The highest number on a survey was 1,800 gulls on 28 December 2017. With the exception of 2 gulls on 10 April, gulls had left the area by mid-March. The numbers present in 2017-2018 were less than in previous years.

The average numbers of gulls per survey at Foothill Landfill during the November-March period in recent years has varied: 1,077 in 2010-11, 2,087 in 2011-12, 2,450 in 2012-13, 2,276 in 2015-2016, and 2,728 in 2016-2017 compared to only 614 in 2017-2018. The reasons for the variation are not known but are probably related to variations in the numbers of gulls wintering in the region in different years, which may be a function of annual differences in the amount of rain.

In previous years, the results from North County and Foothill landfills clearly indicated that significant numbers of gulls used these landfills even though there were some control efforts at each of the landfills. In both cases, there were significantly more gulls present than there were in the vicinity of the Forward Landfill during the same period. The same pattern was observed in 2017-2018.

The numbers of gulls at North County and Foothill Landfills are not directly comparable to the numbers at Forward Landfill. The numbers for North County and Foothill landfills are the averages of the peak numbers per survey. The closest comparisons from Forward Landfill are the average numbers of gulls per survey in Appendix 1. For example, over the five-month period (November 2017-March 2018), the average number of gulls in the vicinity of the Forward Landfill was 0.3 gulls compared to 614 gulls feeding at Foothill Landfill.

Corresponding numbers in previous years are presented here. Over the five-month period (November 2016-March 2017.), the average peak number of gulls in the vicinity of the Forward Landfill was 12 gulls (13 gulls in 2015-2016) compared to 2,728 gulls feeding at Foothill Landfill (2,276 in 2015-2016). Also, the small numbers gulls at Forward Landfill were scared away quickly or were flying past the landfill whereas the gulls at Foothill Landfill were present there for most of the day.

Table 3. Surveys of Foothill Landfill near Stockton, California - 2017-2018.

Date	Time of Survey	Maximum # of Gulls	Comments
2017			
Thurs, Sep 20	07:00-10:00	40	feeding - no gull control seen
Mon, Sep 24	13;00-16:00	80	feeding - no gull control seen
Mon, Oct 9	07:00-10:00	480	feeding - no gull control seen
Thurs, Oct 19	07:00-10:00	300	feeding - no gull control seen
Mon, Nov 13	06:30-09:30	620	feeding - no gull control seen
Mon, Nov 27	07:00-10:00	460	feeding - no gull control seen
Mon, Dec 11	07:30-10:30	1,280	feeding - no gull control seen
Thurs, Dec 28	07:30-10:30	1,800	feeding - no gull control seen
2018			
Mon, Jan 8	07:00-10:00	260	feeding - no gull control seen
Mon, Jan 15	09:00-12:00	400	feeding - no gull control seen
Mon, Feb 12	13:00-16:00	280	feeding - no gull control seen
Mon, Feb 26	07:00-10:00	840	feeding - no gull control seen
Mon, Mar 12	07:00-10:00	200	feeding - no gull control seen
Fri, Mar 30	08:00-11:00	0	
Tues, Apr 10	07:00-10:00	2	
Fri, Apr 27	07:00-10:00	0	
Mon, May 7	08:00-11:00	0	

Where Did the Gulls from Forward Landfill Go?

The question was asked where did the gulls that formerly fed at Forward Landfill go when they were prevented from feeding at that landfill. A detailed assessment of this question has not been conducted because it would have required intensive effort to collect baseline data in previous years before the control program began. Clearly, many of the gulls from Forward now go to other landfills in the region and feed at other areas. All of the natural feeding areas on waterbodies and in fields are still used by gulls. In addition, other anthropogenic or human created feeding sites are used. For example, gulls are using the Waste Transfer Station in south Stockton, the Town of Manteca, and the Stockton Sanitation Ponds.

Gull Behavior at Night

Gulls spend the night at communal roosts on large bodies of water where they occur in dense flocks. The use of the night roosts is traditional with particular roosts being used year after year. Gulls do not feed at inland terrestrial areas at night and they do not feed at landfills at night. The latter fact has been demonstrated at many landfills. The best documented case is the Atlantic County Utilities Authority where waste is disposed of at night. There has not been a single gull seen at night at that coastal landfill during over 20 years of operation (Davis and Hixon 2017). Because of this nocturnal behavior, it is not necessary to control gulls at night at the Forward Landfill.

History of Bird Strikes at Stockton Metropolitan Airport (SCK)

The Federal Aviation Administration (FAA) maintains an extensive database documenting wildlife/aircraft collisions at airports throughout the U.S. The FAA database includes records beginning in 1990 and contains over 175,000 strike records. As of 28 May 2018, the database contained records of 75 bird and mammal strikes associated with the Stockton Airport. It is well known that not all bird strikes are reported but the important strikes (those that affect flight, cause damage, etc.) are more likely to be reported than are strikes that cause no damage and often are not even detected by the flight crew. It is apparent that the airport has been much more diligent in reporting strikes in the past eight years with 57 (76%) of the 75 strikes since 1990 recorded during that eight-year period compared to only 20 strikes (24%) in the previous 21- year period.

A summary printout of the 75 reported strikes at the Stockton Metropolitan Airport is included as Table 4. A record of a strike involving a gopher snake on 10 June 2016 is not included in the analyses in this report. The Forward Landfill has been operating during the entire 29-year period covered by the FAA data base. For the 20 years before the fall and winter of 2010-2011, there was no bird control program in place at the landfill. Therefore, if the landfill was attracting birds that were a threat to aircraft safety, the strike data from the airport should reflect that risk. Gulls are the group of birds that are attracted to the landfill and could pose a threat to aircraft using the Stockton Airport. One of the 75 reported strikes involved a black-tailed jackrabbit (Table 4); the remaining 74 bird strikes are examined in the following paragraphs.

Forty-eight of the strikes involved identified birds that were not gulls. A forty-ninth strike involved a gull carcass that was found on the airport on 28 October 2000; it was assumed to have been struck by an aircraft. Of the 25 strikes that involved unknown birds, 14 involved small birds

Table 4. Reported bird strikes at Stockton Metropolitan Airport; 1990-2017. (Data downloaded from FAA Wildlife Strike Database – 28 May 2018.)

Date	Airport	Airline	Aircraft	Bird Species
05/04/2017	Stockton Metro	Unknown	Unknown	Blackbirds
02/01/2017	Stockton Metro	Unknown	Unknown	Western Meadowlark
01/24/2017	Stockton Metro	Unknown	Unknown	Pipits
11/12/2016	Stockton Metro	Unknown	Unknown	Western Meadowlark
10/29/2016	Stockton Metro	Business	Bell-407	Unknown bird – small
10/16/2016	Stockton Metro	ABX Air	B-767-200	Unknown bird – small
10/03/2016	Stockton Metro	Unknown	Unknown	Barn Owl
09/08/2016	Stockton Metro	Unknown	Unknown	Swainson's Hawk
08/10/2016	Stockton Metro	Unknown	Unknown	Barn Owl
07/22/2016	Stockton Metro	Unknown	Unknown	Red-tailed Hawk
06/22/2016	Stockton Metro	Government	C-206 Station	Hawks
06/10/2016	Stockton Metro	Unknown	Unknown	Gopher Snake
06/02/2016	Stockton Metro	Air Transport Intl.	B-767-200	Unknown bird – small
06/02/2016	Stockton Metro	Unknown	Unknown	European Starling
05/30/2016	Stockton Metro	Allegiant Air	MD-88	European Starling
04/10/2016	Stockton Metro	Unknown	Unknown	Swainson's Hawk
03/31/2016	Stockton Metro	Business	Cirrus SR20/22	Unknown bird
03/23/2016	Stockton Metro	Business	Cessna 206	Unknown bird
02/18/2016	Stockton Metro	Unknown	Unknown	Western Meadowlark
11/30/2015	Stockton Metro	Unknown	Unknown	Black-tailed Jackrabbit
11/28/2015	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
04/21/2015	Stockton Metro	Military	T-38	American Pipit
03/30/2015	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
03/13/2015	Stockton Metro	Coast Guard	C-130	Horned Lark
10/10/2014	Stockton Metro	Business	Learjet 45	Unknown small bird
04/14/2014	Stockton Metro	Unknown	Unknown	Swainson's Hawk
04/10/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/31/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/29/2014	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
01/14/2014	Stockton Metro	Unknown	Unknown	Rabbit
12/13/2013	Stockton Metro	Allegiant Air	MD-83	Red-tailed Hawk
11/19/2013	Stockton Metro	Business	C-340	Red-tailed Hawk
11/19/2013	Stockton Metro	Unknown	Unknown	Rock Pigeon
10/15/2013	Stockton Metro	Unknown	Unknown	European Starling
06/20/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
04/08/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird
02/22/2013	Stockton Metro	Military	C-12	Unknown bird or bat
12/02/2012	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
02/23/2012	Stockton Metro	Unknown	Unknown	Western Meadowlark
02/07/2012	Stockton Metro	Unknown	Unknown	Horned Lark
01/24/2012	Stockton Metro	Unknown	Unknown	Burrowing Owl
12/31/2011	Stockton Metro	Business	BE-400 BJET	Unknown bird
12/05/2011	Stockton Metro	Unknown	Unknown	Horned Lark
11/18/2011	Stockton Metro	Government	Lockheed C-130	Western Meadowlark

Table 4 (concluded). Reported bird strikes at Stockton Metropolitan Airport; 1990-2017. (Data downloaded from FAA Wildlife Strike Database – 28 May 2018.)

09/15/2011	Stockton Metro	Allegiant Air	MD-83	Turkey Vulture
07/30/2011	Stockton Metro	Unknown	Unknown	Barn Owl
06/28/2011	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2011	Stockton Metro	Unknown	Unknown	Horned Lark
05/27/2011	Stockton Metro	Allegiant Air	MD-83	American Kestrel
04/18/2011	Stockton Metro	Unknown	Unknown	Red-tailed hawk
02/15/2011	Stockton Metro	Privately Owned	C-414	White-tailed kite
01/02/2011	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
12/20/2010	Stockton Metro	Unknown	Unknown	Barn owl
08/02/2010	Stockton Metro	Unknown	Unknown	Tree Swallow
01/16/2010	Stockton Metro	Business	PA-46 Malibu	Unknown bird - large
12/28/2009	Stockton Metro	Business	Learjet-45	Unknown bird - medium
12/15/2008	Stockton Metro	Government	Lockheed C-130	Unknown bird - small
09/09/2008	Stockton Metro	Business	Citation X	Unknown bird - small
08/09/2008	Stockton Metro	Business	BE-400 BJET	Unknown bird - small
01/23/2008	Stockton Metro	Allegiant Air	MD-80	Unknown bird - medium
08/17/2006	Stockton Metro	Military	T-6A	Black vulture
06/19/2006	Stockton Metro	Military	KC-10A	Unknown bird or bat
06/08/2006	Stockton Metro	Military	C-130H	Unknown bird or bat
08/15/2003	Stockton Metro	Business	Citation X	Hawks
05/10/2001	Stockton Metro	Military	KC-135E	Unknown bird - small
11/20/2000	Stockton Metro	Business	BE-90 King	Unknown bird - small
11/02/2000	Stockton Metro	Unknown	Unknown	Great horned owl
10/28/2000	Stockton Metro	Unknown	Unknown	Gulls
04/23/2000	Stockton Metro	Business	Citation II	Unknown bird - large
01/18/2000	Stockton Metro	Military	T-38A	Horned lark
01/11/2000	Stockton Metro	Business	C-340	Sparrows
08/09/1999	Stockton Metro	Business	C-152	Owls
03/31/1997	Stockton Metro	Unknown	BD-19	Ducks
01/26/1993	Stockton Metro	Business	HWKR SD-125	Barn owl
10/08/1991	Stockton Metro	Military	KC-135R	Unknown bird or bat

that could not have been gulls. Of the 11 remaining strikes, 4 involved "medium" or "large" unknown birds and 7 involved "unknown bird or bat". In theory, any of these 11 strikes could have involved gulls.

Two of the seven incidents involving birds of unknown size involved military aircraft in June 2006. This is a period when gulls are not present in the Stockton area; thus these two strikes undoubtedly did not involve gulls. A third strike occurred at night (8 April 2013) when gulls have returned to the coast. A fourth strike occurred on 8 October 1991 when a military KC135 struck a bird on its landing roll at SCK. It is possible that the bird may have been a gull resting on the airport runway. The fifth strike involved a business jet on its landing roll on 31 December 2011. The flight crew reported the strike at the time and must have seen the bird. Had it been a gull, it likely would have been reported as such or at least as a medium or large bird. A runway check was performed immediately after the incident but no carcass was found, again suggesting that a

gull was not involved. The final two strikes of birds of unknown size each occurred in March 2016. One involved a single piston-engine aircraft (Cirrus SR20) at 14:40 on 31 March on approach to SCK; it was 5 nautical miles to the north of the airport at an altitude of 2500 ft. This strike was unlikely to have involved a bird from the landfill. The last strike occurred at 15:45 on 23 March; it involved a report by the pilot of a Cessna 206 of a strike to the leading edge of a wing that caused no damage. No other information on the type of bird or phase of flight was noted.

There were two strikes reportedly involving "large" birds and two involving birds of "medium" size. There was no information on the species involved although it should be noted that gulls are fairly easy to identify as gulls, if they are seen. Of the two incidents involving "large" birds, the first occurred on 23 April 2000 when most gulls have left the Stockton area. This involved a Cessna Citation II jet that struck a bird at 2000 ft while on climbout from Runway 29. The aircraft was west of the airport at the time. It made a precautionary landing with a small amount of damage. Given the time of year and the altitude of the strike, it is unlikely that a gull was involved. The second strike of an unknown "large' bird occurred on 16 January 2010 and involved a single-engine Piper 46 Malibu aircraft that was at an elevation of 2500 ft, 8-10 miles west of SCK on climbout from Runway 29. Given the altitude, it is unlikely that a gull was involved and given the location, it is unlikely that a bird from the landfill, which is east of the airport, was involved.

The two incidents involving unknown birds of "medium" size are discussed in this paragraph. The first involved an MD-80 twin-engine passenger jet that struck a bird at 400 ft while still over the airport on climb-out from Runway 29 on 23 January 2008. The pilot advised of the strike and continued on his flight with no damage to the aircraft. The second incident involved a Learjet 45, a small twin-engine business jet. The aircraft was on approach to Runway 29 in rain and fog on 28 December 2009. It broke out of the clouds and struck a bird over the runway. There was no damage and the strike had no effect on the flight.

In conclusion, of the 74 bird strike reports from Stockton Metropolitan Airport beginning in 1990, only one definitely involved a gull (carcass only) and four others might have involved gulls. Even allowing for significant under-reporting of bird strikes, five strikes at SCK in over 29 years with no damage reported indicates that the landfill has not posed a significant threat to aircraft using the Stockton Metropolitan Airport.

Fifty-two of the reported bird strikes at SCK have occurred since the gull control program was instituted at Forward Landfill. These strikes involved Barn Owls (6), a Burrowing Owl, a White- tailed Kite, Red-tailed Hawks (4), Swainson's Hawks (5), Turkey Vulture (1), American Kestrel (1), unidentified hawk (1), Horned Larks (4), Western Meadowlarks (5), Killdeers (2), American Pipit (2), Rock Pigeon (1), European Starling (3), blackbird species (1), unidentified small birds (7), and two unidentified birds. Since bird control began at Forward Landfill eight years ago, no gulls have been struck and none of the birds struck were attracted to the area by the landfill.

Conclusions

The studies reported here were designed to assess whether gull control at the Forward Landfill continued to be effective in eliminating any hazard to aircraft caused by the attraction of birds to the landfill. Control continued to be completely effective at preventing gulls from feeding at, or otherwise using, the Forward Landfill during the September 2017 to May 2018 period. This was a huge reduction from the estimated 3,000 gulls that were present at the Forward Landfill in March 2010 when the pilot control program began. Observations at Foothill Landfill indicated that gulls continued to feed there in spite of very sporadic control efforts with pyrotechnics. However, the average numbers at Foothill Landfill (614 on surveys during November 2017-March 2018) were much lower than in previous years (e.g. 2,728 per survey during the corresponding period in 2016-2017).

Bird control at North County Landfill was more systematic, more intensive, and much more effective than at Foothill Landfill. When the bird control program was in place, gulls did not feed at the North County Landfill. Overall, gull numbers in the Stockton area were much reduced from previous years. It is not clear why the numbers were lower. Even without the falconry-based program in place at Forward Landfill, gulls were rarely seen there in 2017-2018 and those few showed little interest in feeding there.

The present study has documented the continued complete effectiveness of gull control at Forward Landfill. The gull control is fully- operational using control techniques that are well-established and are used operationally and effectively at several landfills. The conversion of the Forward Landfill to a fully-controlled facility has insured that no bird hazard is created by the landfill.

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APPENDIX

Appendix 1. Results of independent surveys of the Forward Landfill - 2017-2018.

Date	Time of Survey	# of hours	# of gulls	Notes
Sep 2017				
Mon 3	13;00-16:00	3	1	Scared off with a pyro
Fri 7	08:00-11:00	3	0	
Fri 14	13:00-16:00	3	0	
Mon 17	08:00-11:00	3	0	
Sat 22	14:00-16:30	2.5	0	
Fri 28	09:00-12:00	3	0	
Oct 2017				
Thurs 5	08:00-11:00	3	0	
Thurs 12	12;00-15:00	3	0	
Mon 16	07:00-10:00	3	0	
Sat 21	09:00-12:00	3	0	
Thurs 26	09:00-12:00	3	1	Did not land.
Mon 30	11:00-14:00	3	0	3 gulls over prison
Nov 2017				
Mon 6	13:00-16:00	3	0	1 gull flew past LF, did not stop
Sun 12	09:00-12:00	3	0	
Thurs 16	06:00-09:30	3	0	
Mon 20	12:00-15:00	3	4	Quickly scared off with pyro
Sat 25	07:00-10:00	3	0	fog
Thurs 30	07:00-10:00	3	0	fog
Dec 2017				
Mon 4	13:00-16:00	3	0	
Sat 9	14:00-17:00	3	1	circled LF and then flew off
Thurs 14	07:00-10:00	3	0	2 gulls over prison
Thurs 21	13:00-16:00	3	2	scared off quickly with pyro
Wed 27	07:00-10:00	3	0	fired at unseen gulls above fog - did not land
Fri 29	14:00-17:00	3	0	7 circling over dumpster at prison
Jan 2018				
Tues 2	08:00-11:00	3	0	
Sat 13	08:00-11:00	3	0	

Appendix 1 (Concluded). Results of independent surveys of the Forward Landfill - 2017-2018.

Date	Time of Survey	# of hours	# of gulls	Notes
Thurs 18	08:00-11:00	3	0	
Tues 23	07:00-10:00	3	0	
Mon 29	13:00-16:00	3	0	
Wed 31	08:00-11:00	3	0	
Feb 2018				
Fri 2	09:00-12:00	3	0	4 gulls at prison
Wed 7	10:00-13:00	3	0	
Sat 10	07:00-10:00	3	0	
Thurs 15	09:00-12:00	3	1	scared away with pyro
Fri 23	12:00-15:00	3	0	
Wed 28	07:00-10:00	3	0	
Mar 2018				
Fri 2	09:00-12:00	3	0	
Wed 7	10:00-13:00	3	0	
Sat 10	08:00-11:00	3	0	
Fri 16	13:00-16:00	3	0	
Thurs 22	07:00-10:00	3	0	
Mon 26	09:00-12:00	3	0	
Apr 2018				
Mon 2	08:00-11:00	3	1	flew over LF
Fri 6	07:00-10:00	3	0	
Sat 14	08:00-11:00	3	0	
Mon 16	12:00-15:00	3	0	
Tues 24	09:00-11:00	2	0	
Mon 30	07:00-10:00	3	0	
May 2018				
Tues 1	08:00-11:00	3	0	
Sat 5	07:00-10:00	3	0	
Tues 15	08:00-11:00	3	0	

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF THE BIRD CONTROL PROGRAM AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2016-2017

Prepared by

For

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Final LGL Report # TA4903-8

7 August 2017

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Table of Contents

Introduction

There is a general concern about the presence of birds in the vicinity of airports where they may collide with aircraft. This can threaten the safety of the aircraft. Municipal waste landfills often attract birds, primarily gulls of various species. For this reason, the siting of landfills near airports must be handled carefully. Fortunately, bird strikes are very rare events and damaging strikes are much rarer still, but they do occur.

The Forward Landfill has operated near Manteca, CA since 1973. An airstrip on the site of the Stockton Metropolitan Airport (SCK) began operation in April 1940. Thus, there is a long history (over 40 years) of co-existence between the landfill and the airport. An analysis of the reported bird strikes by aircraft using the Stockton Airport since 1991 indicates that the operating landfill has not been the source of birds struck by aircraft using the airport. This analysis is included later in this report.

Forward, Inc., a subsidiary of Republic Services, Inc., operates the Forward Landfill which is located close to SCK (Figure 1). Because birds can be attracted to landfills there is a potential to create a hazard to the safety of aircraft using the Stockton Airport and because the landfill had been known to have attracted gulls in previous winters (October-April), Forward, Inc. has instituted a gull control program at the landfill.

LGL Limited, an experienced bird hazard research firm, has been retained to monitor the success of the control program and to make recommendations for improvements to the program, if required. LGL is one of North America's leading ecological research firms. It has been involved with bird hazards to aircraft safety and associated wildlife control issues for over 40 years under the direction of Dr. Davis, the author of this report.

The present report provides an analysis of the success of the seventh year (2016-2017) of the falconry-based bird control program that was first instituted at Forward Landfill during the winter of 2010-2011. Reports of previous years of bird control are available (Davis 2011, 2012, 2013, 2016a, 2016b).

Previous Gull Use of Forward Landfill

Gulls are the principal birds that are attracted to edible waste that is disposed of at municipal solid waste landfills. Gulls winter in the Stockton area with first arrivals usually appearing in September or October. Gull numbers increase in November and December as migrants from further north arrive in the area. The Forward Landfill attracted gulls during winter in previous years, before control was initiated (see Davis 2011 for summary).

Gulls are not usually present in the Stockton area during the summer period (May to late September) and intensive gull control at the landfill is not required at that time. However, the landfill is monitored by landfill staff during the off-season for the presence of gulls. Any gulls that appear then are controlled by landfill staff using pyrotechnics. Control, if necessary, of early arriving gulls in September is conducted through the use of model aircraft.

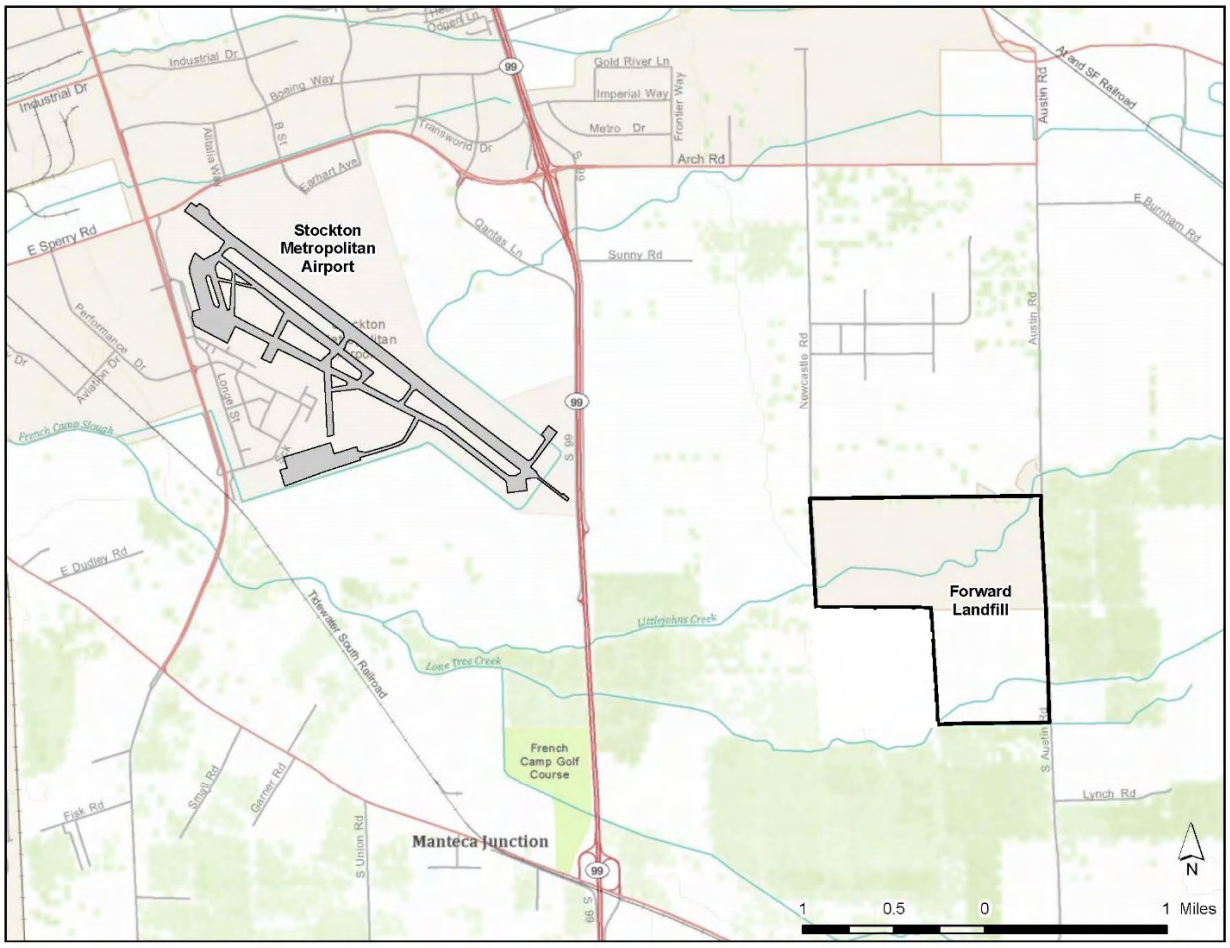

Figure 1. Location of Forward Landfill in relation to Stockton Metropolitan Airport.

A pilot gull control program was conducted at the Forward Landfill by Airstrike Bird Control, LLC. This was a falconry-based program that began on 9 March 2010 and concluded on 14 April 2010. Mr. Brad Felger, Manager of Airstrike Bird Control, estimated that there were approximately 3,000 gulls using the Forward Landfill when the pilot program began (B. Felger, pers. comm.).

Gull Control Program

The pilot gull control program had been successful and therefore, a full gull control program was instituted on an operational basis at Forward Landfill during the fall of 2010. The operational gull control program was again a falconry-based program operated by Airstrike Bird Control, LLC. The program used several falcons (Peregrine male, Peregrine female, Sakar Falcon, Gyrfalcon/Peregrine hybrid, etc.) to control gulls at and around the landfill. Control in subsequent years was based mainly on the use of male and female Peregrine Falcons. Control was achieved by flying the falcons to lure and by allowing them to chase the gulls on occasion. The program was also supplemented with the use of pyrotechnics to scare gulls away during conditions when it is difficult to fly the falcons (e.g. foggy and stormy conditions).

The objective of the control program was to prevent any gulls from feeding at the landfill or landing anywhere on the landfill property. If the gulls cannot feed at the landfill or loaf on the landfill or drink from occasional standing water, then they will stop returning to the landfill on subsequent days. There can be no gaps in the control coverage that might allow gulls to feed for even a few minutes because a gull can obtain all the food that it needs for the day in about 20 to 30 minutes of feeding at a landfill. Therefore, even small gaps in coverage could allow gulls to obtain enough food to encourage them to return to the landfill on a subsequent day.

In 2016-2017, the falconry-based gull control program by Airstrike Bird Control Inc. at Forward Landfill began on 24 October 2016 and continued until 31 March 2017. The main flights of gulls were late arriving in the fall of 2016 and the falconry program was not needed until late in October. However, small numbers of gulls appeared before late October and they were controlled by use of model aircraft and pyrotechnics by California Environmental from 22 August to 15 October 2016 on a 5-days per week basis. There are no data records from this early period but gull numbers were not large and gulls were not present every day.

Monitoring Program

The success of the gull control program has been monitored every winter by LGL Limited to provide an independent assessment of the program. The monitoring has included:

1. Daily observations made by the controllers during their control activities. These included records of all gulls that approached the landfill or flew past the landfill during the day.
2. Observations on and around the landfill by LGL personnel to confirm the observations by the controllers.
3. Observations at Forward Landfill by LGL personnel on Saturday afternoons and Sundays when the landfill was closed, the waste was covered, and the controllers were not on duty.
4. Observations at other landfills by LGL personnel to compare with the results from Forward Landfill.

The independent monitoring of the 2016-2017 program began on 5 November 2016 and continued until 5 May 2017. Several sources of data are used in the evaluation.

Observations at Forward Landfill – During Operations

Daily Observations by Controllers

The falconers who provided the daily bird control at the landfill kept records of the numbers of gulls that approached the landfill, the numbers of gulls that were controlled, and the numbers that flew past the landfill on route to other destinations. These data are summarized on a weekly basis in Table 1. The daily summaries are provided in Appendix 1.

Are Gulls Feeding at the Landfill?

The bird control program is designed to deter birds from feeding at the landfill. The observations by the controllers (falconers) indicated that no gulls were able to feed at the active

Table 1. Weekly summary of gull observations by falconers in the vicinity of the Forward Landfill.

Date in 2016-2017	# of gulls feeding at the landfill during week	Average # of flocks /day	Ave. Total # of gulls /day	Peak # of gulls at one time
2016				
Oct 24-30	0	3.2	25.0	75
Oct 31-Nov 5	0	0.8	1.8	6
Nov 7-12	0	1.2	2.5	3
Nov 14-19	0	2.7	23.2	29
Nov 21-26	0	4.5	44.5	27
Nov 28-Dec 3	0	3.5	26.2	17
Dec 5-10	0	3.5	9.5	6
Dec 12-17	0	1.5	12.2	30
Dec 19-24	0	2.0	5.5	12
Dec 26-31	0	2.0	7.8	27
2017				
Jan 2-7	0	10.3	105.3	70
Jan 9-14	0	6.2	71.0	37
Jan 16-21	0	5.7	32.5	21
Jan 23-28	0	3.2	46.2	37
Feb 1-4	0	2.5	39.0	86
Feb 6-11	0	10.5	210.0	85
Feb 13-18	0	8.7	145.0	78
Feb 20-25	0	6.0	57.0	38
Feb 27-Mar 4	0	1.7	13.5	18
Mar 6-11	0	3.0	22.7	25
Mar 13-18	0	2.0	20.5	26
Mar 20-25	0	1.8	12.7	19
Mar 27-31	0	0.6	4,8	11

disposal area of the landfill after the control program began (Table 1). However, as part of the bird control program, observations are made by an independent observer as an added oversight. The independent observer did not note any cases of gulls feeding at the landfill.

Gulls Approaching the Landfill and Flying Past the Landfill

The falconer conducting the gull control documented the numbers of gulls that approached and flew past the landfill. These observations are presented in Appendix 1 and summarized in Table 1. It is important to correctly interpret the data in Table 1 and Appendix 1. The numerical estimates of daily numbers of gulls are not estimates of the numbers at the landfill or even the numbers approaching the landfill. Some of the gulls in the totals were birds that flew past the landfill without visiting it. The numbers of such gulls were usually higher during the influxes of migrants and during periods of stormy weather that drove the gulls inland from the coast.

During the first three years of the study (2010-11, 2011-12, and 2012-2013), the number of flocks of gulls that approached or flew past the landfill ranged from 6.3 to 11.8 per day during the November-March period in each year, or a little over one flock per hour. During the three most recent years, the average numbers of flocks were lower: 4.1 per day in 2014-2015, 2.8 per day during 2015-2016, and 4.1 flocks per day in 2016-2017. The average flock size was 9 birds during 2014-2015, 11 birds during 2015-2016, and 9 birds during 2016-2017. These flock sizes were near the low end of the range of 7 to 21 birds during each of the first three years. These are very small numbers when compared to the large numbers that used to feed at the landfill before the control program began. The results indicate that the gull flight lines from gull night roosts in the delta or on San Francisco Bay no longer passed over the airport on route to Forward Landfill, but rather had moved to other daytime feeding areas.

Observations by LGL Personnel

LGL personnel conducted spot checks at the Forward Landfill. There were usually 6 visits per month and each visit was usually 3-4 hours long. The results of these visits are presented in Appendix 2 and summarized in Table 2.

The data gathered by the LGL personnel were consistent with the observations by the falconers on the same days (Table 1). In fact, the falconers generally recorded more birds because they were always searching for distant gulls approaching the landfill and they were on site earlier in the morning when more gulls approached the landfill. Therefore, it is again concluded that the data collected by the falconer/controllers are reliable and unbiased.

There had been a reduction in the numbers of gulls approaching or passing by the Forward Landfill over the first three years with the falconry control program in place. During the 2010-2011 period, there was an average of 1.0 flocks per hour of observation by the independent observer. This number declined in the second year (2011-2012) to 0.4 flocks per hour. During the third year (2012- 2013), the number of flocks of gulls approaching the landfill

Table 2. Summary of independent surveys of the Forward Landfill - 2016-2017.

Month	# of surveys	# of hours	# of gulls per 3 hours
2016*			
November	6	18	1.7
December	5	15	24.6
2017			
January	6	24	1.4
February	5	16	0.1
March	6	18	0.8
April	6	18	0.3
May	2	12	6.0

*Falconry program began on October 24, 2016 and ended on March 31, 2017.

declined further to an average of 0.2 flocks per hour. The number of flocks approaching or passing the Forward Landfill increased to 1.1 flocks per hour of observation in 2014-2015. During the peak period of October-March in 2015-2016, the number of flocks per hour declined to only 0.4 per hour. During the November-March period of 2016-2017, there also was an average of 0.4 flocks per hour. These are small numbers of flocks.

Observations at Forward Landfill – Weekends

The surveys during the first three years determined that gulls did not use the Forward Landfill on Saturday afternoons or Sundays when the landfill was closed and the controllers were not present. During the 2014-2015 study, the landfill was surveyed on 6 Sundays, once per month in October 2014 through March 2015. During those Sundays, the LGL observer noted 1.2 flocks per hour of gulls approaching and flying past the landfill. This was similar to the overall average of 1.1 flocks per hour when all days were considered. During the 2015-2016 period, only a single flock of gulls approached the landfill during 26 hours of surveys on Sundays; this was 0.04 flocks per hour. During the November-April period in 2016-2017, 3 flocks totaling 6 gulls were observed during 19 hours (0.2 flocks per hour) on six monthly surveys on Sundays. During the entire study, gulls have not been observed to feed at the covered landfill on Sundays.

Observations at Other Landfills

In order to interpret the results from Forward Landfill, it was necessary to examine the numbers of gulls that occurred at other municipal solid waste landfills in the area that did not have intensive gull control programs in place. Two such landfills were examined by LGL personnel: Foothill Landfill and North County Landfill. Each of these landfills had some bird control measures (pyrotechnics) that were used sporadically at Foothill Landfill. The control program at North County Landfill had been upgraded in 2015-2016 by using remote-controlled model airplanes and gliders during the week. That program was continued in 2016-2017. The control efforts at Foothill Landfill were by no means comparable to the program at Forward Landfill. Each landfill survey covered about a 2-3-hour period.

The **North County Landfill** is located approximately 18.5 miles NNE of the Forward Landfill (Figure 2). It was surveyed on 13 occasions from 3 November 2015 to 5 May 2016 (Table 3). During the October-March period, very few gulls fed at the landfill because the control program was quite effective. On average 550 gulls were noted flying past the landfill on a daily basis. Most of these gulls were believed to continue on to the Foothill Landfill. In previous years (see later in section) a large portion of those gulls stopped to feed at North County Landfill. Bird control in previous years was less intensive.

In 2016-2017, North County Landfill was surveyed twice per month from November through May. On three occasions during that period (12 December, 4 January, and 7 February), the gull control program was not operational. On each of these days, 3,100 to 3,600 gulls were present on the site (Table 3). On the other days, the control program was operational and gulls were not present. On those dates, gulls were noted flying past the North County Landfill on a route toward Foothill Landfill. The gull control program at North County was ended for the season at the end of March in 2017.

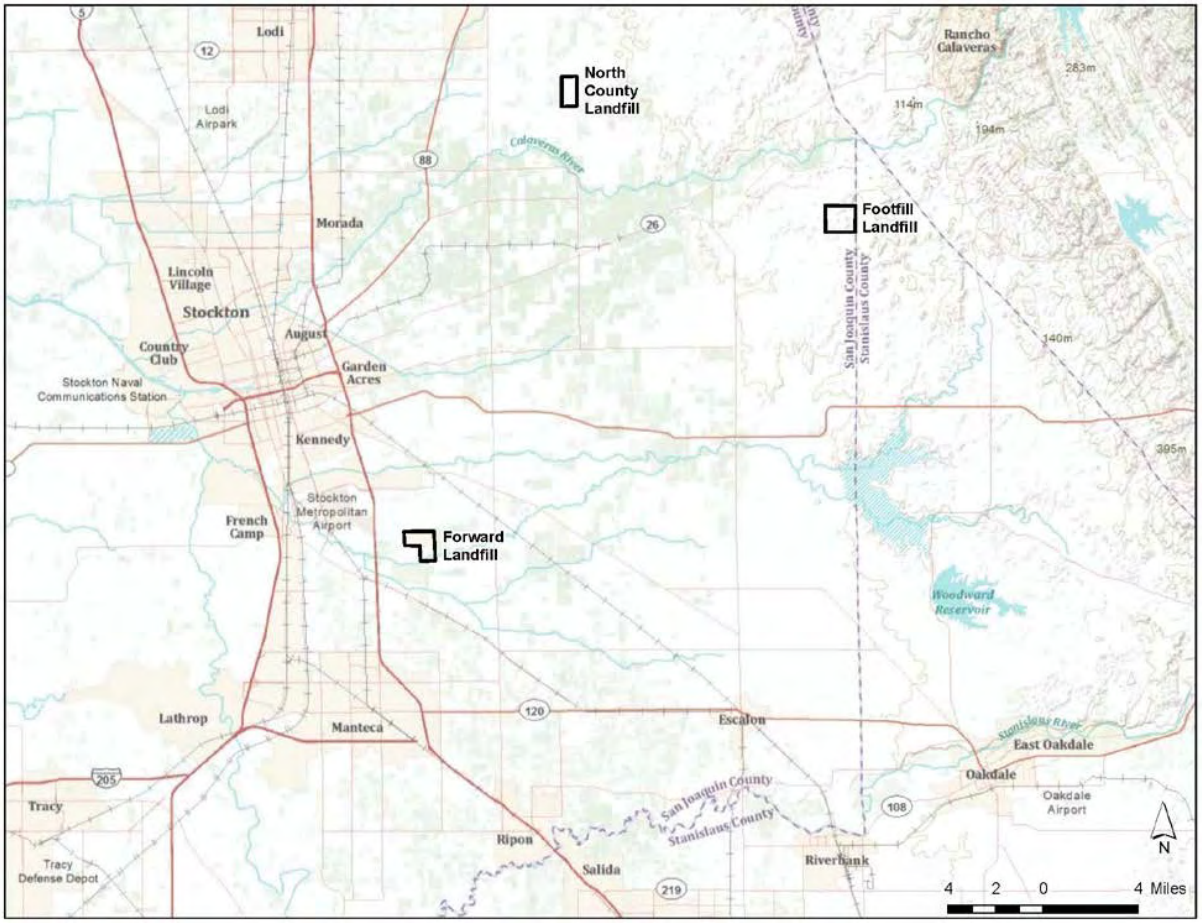

Figure 2. Locations of North County Landfill and Foothill Landfill.

Gull use of the North County Landfill had increased over the first three years of the present study (2010- 2013). During the November through March period, the average numbers of gulls per survey had increased from 709 in 2010-11, to 1,574 in 2011-12, to 2,462 in 2012-13. The average numbers of gulls per survey in the November 2014-March 2015 period was 456.6 gulls. During the November 2015-March 2016 period there was an average of 611 gulls per survey but most of those birds were flying past the landfill and heading toward Foothill Landfill. This pattern was because of the gull control at North County Landfill. As noted above and in Table 3, gulls were not present at North County on 7 of the 10 days with surveys during the November 2016-March 2017 period. Gulls were present on only three days when the control program was not operating; there was an average of 3,300 gulls present on each of those three days. The overall average for all 10 surveys was 990 gulls per survey. The patterns of gull use of North County Landfill had changed in recent years because of the presence of the gull control program.

The **Foothill Landfill** is located approximately 20.5 miles ENE of the Forward Landfill. It was surveyed twice per month from November 2016 to May 2017. During the November-March period (10 surveys), the peak number of gulls present was 4,400 on 26 January and the average was 2,728 gulls per survey (Table 4). Gulls began to leave the area in mid-March and were mostly gone by early April.

Table 3. Surveys of North County Landfill near Stockton, California - 2016-2017.

Date	Time of Survey	Maximum # of Gulls	Comments
2016			
Tues, Nov 1	09:00-12:00	0	gull control in place
Fri, Nov 11	07:00-10:00	0	gull control in place
Mon, Dec 12	07:00-10:00	3,600	fog and wind inhibiting gull control
Wed, Dec 28	07:00-10:00	0	gull control in place
2017			
Wed, Jan 4	08:00-12:00	3,100	gull control not operational
Fri, Jan 20	08:00-12:00	0	gull control in place
Tues, Feb 7	08:00-12:00	3,200	limited gull control
Mon, Feb 27	08:00-11:00	0	
Wed, Mar 8	12:00-14:30	0	gull control in place
Mon, Mar 20	08:00-11:00	0	gull control in place
Wed, Apr 5	08:00-11:00	36	Gull abatement finished for year
Thurs, Apr 27	08:00-11:00	0	
Wed, May 10	08:00-11:00	120	
Fri, May 19	08:00-11:00	0	

Table 4. Surveys of Foothill Landfill near Stockton, California - 2016-2017.

Date	Time of Survey	Maximum # of Gulls	Comments
2016			
Tues, Nov 8	07:00-10:00	3,100	
Fri, Nov 25	07:00-10:00	2,700	
Mon, Dec 5	07:00-10:00	4,100	
Thurs, Dec 22	07:00-10:00	3,000	foggy
2017			
Tues, Jan 10	09:00-12:00	3,200	
Wed, Jan 25	08:00-12:00	4,400	
Thurs, Feb 16	08:00-11:00	2,400	
Wed, Feb 22	08:00-10:00	0	
Fri, Mar 3	08:00-10:00	3,600	
Mon, Mar 27	08:00-11:00	780	
Fri, Apr 7	08:00-11:00	138	
Fri, Apr 21	08:00-11:00	0	
Fri, May 12	08:00-11:00	0	
Tues, May 23	08:00-11:00	0	

The average numbers of gulls per survey at Foothill Landfill during the November-March period in recent years has varied: 1,077 in 2010-11, 2,087 in 2011-12, 2,450 in 2012-13, 2,276 in 2015-2016, and 2,728 in 2016-2017. The reasons for the variation are not known but are probably related to variations in the numbers of gulls wintering in the region in different years, which may be a function of annual differences in the amount of rain. The increase at Foothill Landfill in the present year may be a function of the more effective gull control at North County Landfill

In previous years, the results from North County and Foothill landfills clearly indicated that significant numbers of gulls used these landfills even though there were some control efforts at each of the landfills. In both cases, there were significantly more gulls present than there were in the vicinity of the Forward Landfill during the same period.

The numbers of gulls at North County and Foothill Landfills are not directly comparable to the numbers at Forward Landfill. The numbers for North County and Foothill landfills are the averages of the peak numbers per survey. The closest comparisons from Forward Landfill are the averages of the peak numbers in Appendix 1. For example, over the five-month period (November 2016-March 2017.), the average peak number of gulls in the vicinity of the Forward Landfill was 12 gulls (13 gulls in 2015-2016) compared to 2,728 gulls feeding at Foothill Landfill (2,276 in 2015-2016). Also, the small numbers gulls at Forward Landfill were scared away quickly or were flying past the landfill whereas the gulls at Foothill Landfill were present there for most of the day.

Where Did the Gulls from Forward Landfill Go?

The question was asked where did the gulls that formerly fed at Forward Landfill go when they were prevented from feeding at that landfill. A detailed assessment of this question has not been conducted because it would have required intensive effort to collect baseline data in previous years before the control program began. Clearly, many of the gulls from Forward now go to other landfills in the region and feed at other areas. All of the natural feeding areas on waterbodies and in fields are still used by gulls. In addition, other anthropogenic or human created feeding sites are used. For example, gulls are using the Waste Transfer Station in south Stockton, the Town of Manteca, and the Stockton Sanitation Ponds.

Gull Behavior at Night

Gulls spend the night at communal roosts on large bodies of water where they occur in dense flocks. The use of the night roosts is traditional with particular roosts being used year after year. Gulls do not feed at inland terrestrial areas at night and they do not feed at landfills at night. The latter fact has been demonstrated at many landfills. The best documented case is the Atlantic County Utilities Authority where waste is disposed of at night. There has not been a single gull seen at night at that coastal landfill during over 19 years of operation (Davis and Hixon 2017). Because of this nocturnal behavior, it is not necessary to control gulls at night at the Forward Landfill.

History of Bird Strikes at Stockton Metropolitan Airport (SCK)

The Federal Aviation Administration (FAA) maintains an extensive database documenting wildlife/aircraft collisions at airports throughout the U.S. The FAA database includes records beginning in 1990 and contains over 175,000 strike records. As of 30 April 2016, the database contained records of 62 bird and mammal strikes associated with the Stockton Airport. It is well known that not all bird strikes are reported but the important strikes (those that affect flight, cause damage, etc.) are more likely to be reported than are strikes that cause no damage and often are not even detected by the flight crew. It is apparent that the airport has been much more diligent in reporting strikes in the past six years with 42 (68%) of the 62 strikes since 1990 recorded during that six-year period compared to only 20 strikes (32%) in the previous 21- year period.

A summary printout of the 62 reported strikes at the Stockton Metropolitan Airport is included as Table 5. The Forward Landfill has been operating during the entire 27-year period covered by the FAA data base. For the 20 years before the fall and winter of 2010-2011, there was no bird control program in place at the landfill. Therefore, if the landfill was attracting birds that were a threat to aircraft safety, the strike data from the airport should reflect that risk. Gulls are the group of birds that are attracted to the landfill and could pose a threat to aircraft using the Stockton Airport. One of the 62 reported strikes involved a black-tailed jackrabbit (Table 5); the remaining 61 bird strikes are examined in the following paragraphs.

Thirty-seven of the strikes involved identified birds that were not gulls. A thirty-eighth strike involved a gull carcass that was found on the airport on 28 October 2000; it was assumed to have been struck by an aircraft. Of the 22 strikes that involved unknown birds, 11 involved small birds that could not have been gulls. Of the 11 remaining strikes, 4 involved “medium” or “large” unknown birds and 7 involved “unknown bird or bat”. In theory, any of these 11 strikes could have involved gulls.

Two of the seven incidents involving birds of unknown size involved military aircraft in June 2006. This is a period when gulls are not present in the Stockton area; thus these two strikes undoubtedly did not involve gulls. A third strike occurred at night (8 April 2013) when gulls have returned to the coast. A fourth strike occurred on 8 October 1991 when a military KC135 struck a bird on its landing roll at SCK. It is possible that the bird may have been a gull resting on the airport runway. The fifth strike involved a business jet on its landing roll on 31 December 2011. The flight crew reported the strike at the time and must have seen the bird. Had it been a gull, it likely would have been reported as such or at least as a medium or large bird. A runway check was performed immediately after the incident but no carcass was found, again suggesting that a gull was not involved. The final two strikes of birds of unknown size each occurred in March 2016. One involved a single piston-engine aircraft (Cirrus SR20) at 14:40 on 31 March on approach to SCK; it was 5 nautical miles to the north of the airport at an altitude of 2500 ft. This strike was unlikely to have involved a bird from the landfill. The last strike occurred at 15:45 on 23 March; it involved a report by the pilot of a Cessna 206 of a strike to the leading edge of a wing that caused no damage. No other information on the type of bird or phase of flight was noted.

Table 5. Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

Date	Airport	Airline	Aircraft	Bird Species
04/20/2016	Stockton Metro	Unknown	Unknown	Swainson's Hawk
03/23/2016	Stockton Metro	Business	Cessna 206	Unknown bird
03/21/2016	Stockton Metro	Business	Cirrus SR20/22	Unknown bird
02/18/2016	Stockton Metro	Unknown	Unknown	Western Meadowlark
11/30/2015	Stockton Metro	Unknown	Unknown	Black-tailed Jackrabbit
11/28/2015	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
04/21/2015	Stockton Metro	Military	T-38	American Pipit
03/30/2015	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
03/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
03/13/2015	Stockton Metro	Coast Guard	C-130	Horned Lark
10/10/2014	Stockton Metro	Business	Learjet 45	Unknown small bird
04/14/2014	Stockton Metro	Unknown	Unknown	Swainson's Hawk
04/10/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/31/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/29/2014	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
01/14/2014	Stockton Metro	Unknown	Unknown	Rabbit
12/13/2013	Stockton Metro	Allegiant Air	MD-83	Red-tailed Hawk
11/19/2013	Stockton Metro	Business	C-340	Red-tailed Hawk
11/19/2013	Stockton Metro	Unknown	Unknown	Rock Pigeon
10/15/2013	Stockton Metro	Unknown	Unknown	European Starling
06/20/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
04/08/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird
02/22/2013	Stockton Metro	Military	C-12	Unknown bird or bat
12/02/2012	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
02/23/2012	Stockton Metro	Unknown	Unknown	Western Meadowlark
02/07/2012	Stockton Metro	Unknown	Unknown	Horned Lark
01/24/2012	Stockton Metro	Unknown	Unknown	Burrowing Owl
12/31/2011	Stockton Metro	Business	BE-400 BJET	Unknown bird
12/05/2011	Stockton Metro	Unknown	Unknown	Horned Lark
11/18/2011	Stockton Metro	Government	Lockheed C-130	Western Meadowlark
09/15/2011	Stockton Metro	Allegiant Air	MD-83	Turkey Vulture
07/30/2011	Stockton Metro	Unknown	Unknown	Barn Owl
06/28/2011	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2011	Stockton Metro	Unknown	Unknown	Horned Lark
05/27/2011	Stockton Metro	Allegiant Air	MD-83	American Kestrel
04/18/2011	Stockton Metro	Unknown	Unknown	Red-tailed hawk
02/15/2011	Stockton Metro	Privately Owned	C-414	White-tailed kite
01/02/2011	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
12/20/2010	Stockton Metro	Unknown	Unknown	Barn owl
08/02/2010	Stockton Metro	Unknown	Unknown	Tree Swallow
01/16/2010	Stockton Metro	Business	PA-46 Malibu	Unknown bird - large
12/28/2009	Stockton Metro	Business	Learjet-45	Unknown bird - medium
12/15/2008	Stockton Metro	Government	Lockheed C-130	Unknown bird - small

Table 5 (concluded). Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

09/09/2008	Stockton Metro	Business	Citation X	Unknown bird - small
08/09/2008	Stockton Metro	Business	BE-400 BJET	Unknown bird - small
01/23/2008	Stockton Metro	Allegiant Air	MD-80	Unknown bird - medium
08/17/2006	Stockton Metro	Military	T-6A	Black vulture
06/19/2006	Stockton Metro	Military	KC-10A	Unknown bird or bat
06/08/2006	Stockton Metro	Military	C-130H	Unknown bird or bat
08/15/2003	Stockton Metro	Business	Citation X	Hawks
05/10/2001	Stockton Metro	Military	KC-135E	Unknown bird - small
11/20/2000	Stockton Metro	Business	BE-90 King	Unknown bird - small
11/02/2000	Stockton Metro	Unknown	Unknown	Great horned owl
10/28/2000	Stockton Metro	Unknown	Unknown	Gulls
04/23/2000	Stockton Metro	Business	Citation II	Unknown bird - large
01/18/2000	Stockton Metro	Military	T-38A	Horned lark
01/11/2000	Stockton Metro	Business	C-340	Sparrows
08/09/1999	Stockton Metro	Business	C-152	Owls
03/31/1997	Stockton Metro	Unknown	BD-19	Ducks
01/26/1993	Stockton Metro	Business	HWKR SD-125	Barn owl
10/08/1991	Stockton Metro	Military	KC-135R	Unknown bird or bat

There were two strikes reportedly involving “large” birds and two involving birds of “medium” size. There was no information on the species involved although it should be noted that gulls are fairly easy to identify as gulls, if they are seen. Of the two incidents involving “large” birds, the first occurred on 23 April 2000 when most gulls have left the Stockton area. This involved a Cessna Citation II jet that struck a bird at 2000 ft while on climbout from Runway 29.

The aircraft was west of the airport at the time. It made a precautionary landing with a small amount of damage. Given the time of year and the altitude of the strike, it is unlikely that a gull was involved. The second strike of an unknown “large’ bird occurred on 16 January 2010 and involved a single-engine Piper 46 Malibu aircraft that was at an elevation of 2500 ft, 8-10 miles west of SCK on climbout from Runway 29. Given the altitude, it is unlikely that a gull was involved and given the location, it is unlikely that a bird from the landfill, which is east of the airport, was involved.

The two incidents involving unknown birds of “medium” size are discussed in this paragraph. The first involved an MD-80 twin-engine passenger jet that struck a bird at 400 ft while still over the airport on climb-out from Runway 29R on 23 January 2008. The pilot advised of the strike and continued on his flight with no damage to the aircraft. The second incident involved a Learjet 45, a small twin-engine business jet. The aircraft was on approach to Runway 29R in rain and fog on 28 December 2009. It broke out of the clouds and struck a bird over the runway. There was no damage and the strike had no effect on the flight.

In conclusion, of the 61 bird strike reports from Stockton Metropolitan Airport beginning in 1990, only one definitely involved a gull (carcass only) and four others might have involved gulls. Even allowing for significant under-reporting of bird strikes, five strikes at SCK in over 27

years with no damage reported indicates that the landfill has not posed a significant threat to aircraft using the Stockton Metropolitan Airport.

Thirty-eight of the reported bird strikes at SCK occurred since the gull control program was instituted at Forward Landfill. These strikes involved Barn Owls (4), a Burrowing Owl, a White- tailed Kite, Red-tailed Hawks (3), Swainson's Hawks (4), a Turkey Vulture, an American Kestrel, Horned Larks (4), Western Meadowlarks (3), Killdeers (2), an American Pipit, a Rock Pigeon, a European Starling, unidentified small birds (4), and two unidentified birds. No gulls were involved and none of the birds struck were attracted to the area by the landfill.

Conclusions

The studies reported here were designed to assess whether the gull control program at the Forward Landfill continued to be effective in eliminating any hazard to aircraft caused by the attraction of birds to the landfill. The control program continued to be completely effective at preventing gulls from feeding at, or otherwise using, the Forward Landfill. This was a huge reduction from the estimated 3,000 gulls that were present at the Forward Landfill in March 2010 when the pilot control program began. Observations at Foothill Landfill indicated that large numbers of gulls still continued to feed there in spite of sporadic control efforts with pyrotechnics. Bird control at North County Landfill was more systematic and intensive than at Foothill Landfill but substantial numbers of gulls (up to 3,600) still occurred at North County on days when the control was not operating.

The present study has documented the continued complete effectiveness of the gull control program at Forward Landfill. The program is not experimental but rather it is fully-operational using control techniques that are well-established and are used operationally and effectively at several landfills. The conversion of the Forward Landfill to a fully-controlled facility has insured that no bird hazard is created by the landfill.

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APPENDICES

Appendix 1. Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Oct 2016						
Mon 24	V.V.	3	11	5	gull sp.	two flocks (5,4) controlled by falcons; one flock of 2 is a fly-by
Tues 25	V.V.	5	26	7	gull sp.	3 flocks (6,5,7) controlled by falcon; 1 flock (6) by pyro; 1 flock (2) fly-by
Wed 26	V.V.	1	1	1	gull sp.	fly-by
Thurs 27	V.V.	8	75	35	gull sp.	5 flocks (19,4,35,2,7) controlled by falcon; 3 flocks (2,2,4) by pyro
Fri 28	V.V.	2	37	34	gull sp.	1 flock (34) controlled by falcon; 1 flock (3) is fly-by
Sat 29	V.V.	0	0	0		
Mon 31	V.V.	1	6	6	gull sp.	1 flock (6) controlled by pyro
Nov 2016						
Tues 1	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Wed 2	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Thurs 3	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Fri 4	V.V.	0	0	0		
Sat 5	V.V.	1	2	2	gull sp.	1 flock (1 bird) controlled by falcon
Mon 7	V.V.	0	0	0		
Tues 8	V.V.	0	0	0		
Wed 9	V.V.	2	4	3	gull sp.	1 flock (1 bird) controlled by pyro; 1 flock (3 birds) fly-by
Thurs 10	V.V.	1	2	2	gull sp.	1 flock (2) fly-by
Fri 11	V.V.	2	3	2	gull sp.	1 flock (2) controlled by falcon; 1 flock (1) by pyro
Sat 12	V.V.	2	6	3	gull sp.	1 flock (3) controlled by falcon; 1 flock (3) by pyro
Mon 14	V.V.	1	3	3	gull sp.	1 flock (3) is fly-by
Tues 15	V.V.	1	1	1	gull sp.	1 flock (1) controlled by falcon
Wed 16	V.V.	6	45	15	gull sp.	5 flocks (4,10,15,13,1) controlled by falcons; 1 flock (2) controlled by pyro
Thurs 17	V.V.	3	20	12	gull sp.	3 flocks (4,4,12) controlled by falcons
Fri 18	V.V.	2	18	1	gull sp.	2 flocks (6,12) controlled by falcons
Sat 19	V.V.	3	52	29	gull sp.	3 flocks (20,29,3) controlled by falcons
Mon 21	V.V.	13	168	27	gull sp.	12 flocks (14,3,6,15,27,15,10,27,16,11,13,7) controlled by falcons; 1 flock (4) fly-by
Tues 22	V.V.	2	5	4	gull sp.	2 flocks (1,4) controlled by falcons
Wed 23	V.V.	2	34	27	gull sp.	1 flock (27) controlled by falcon; 1 flock (7) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Thurs 24	V.V.	5	15	4	gull sp.	2 flocks (6 birds) dispersed by falcons; 3 flocks (4,2,3) fly-by
Fri 25	V.V.	3	27	12	gull sp.	2 flocks (12,7) controlled by falcons; 1 flock (8) fly-by
Sat 26	V.V.	2	18	17	gull sp.	1 flock (17) controlled by falcon; 1 flock (1) by pyro
Mon 28	V.V.	5	53	17	gull sp.	3 flocks (48 birds) controlled by falcon; 2 flocks (1,4) fly-by
Tues 29	V.V.	3	17	11	gull sp.	2 flocks (3,11) controlled by falcon; 1 flock (3) fly-by
Wed 30	V.V.	4	24	10	gull sp.	2 flocks (7,10) controlled by falcon; 2 flocks (3,4) fly-by
Dec 2016						
Thurs 1	V.V.	1	9	9	gull sp.	1 flock (9) controlled by falcon
Fri 2	V.V.	3	12	10	gull sp.	1 flock (10 birds) controlled by falcons; 2 flocks (1,1) were fly-bys
Sat 3	V.V.	5	42	14	gull sp.	5 flocks (4,7,7,10,14) controlled by falcons
Mon 5	M.C.	3	5	2	gull sp.	2 flocks (1,2) controlled by falcon; 1 flock (2) fly-by
Tues 6	M.C.	2	2	1	gull sp.	2 flocks (1,1) controlled by falcons
Wed 7	M.C.	4	11	5	gull sp.	1 flock (2 birds) controlled by falcon; 3 flocks (2,5,2) were fly-by
Thurs 8	M.C.	7	29	6	gull sp.	6 flocks (3,2,4,5,6,3 birds) controlled by falcon; 1 flock (6) fly-by
Fri 9	M.C.	3	7	3	gull sp.	2 flocks (5 birds) controlled by falcon; 1 flock (2) fly-by
Sat 10	M.C.	2	3	2	gull sp.	1 flock (1 bird) controlled by falcon; 1 flock (2) fly-by
Mon 12	V.V.	2	2	1	gull sp.	2 flocks (1,1) controlled by pyro
Tues 13	V.V.	1	1	1	gull sp.	1 flock(1) was a fly-by.
Wed 14	V.V.	2	5	3	gull sp.	2 flocks (3,2) controlled by pyro
Thurs 15	V.V.	2	30	17	gull sp.	2 flocks (13,17 birds) controlled by falcons
Fri 16	V.V.	1	30	30	gull sp.	1 flock (30 birds) controlled by falcon
Sat 17	V.V.	1	5	5	gull sp.	1 flock (5 birds) controlled by pyros
Mon 19	R.O.	2	3	2	gull sp.	2 flocks (1,2 birds) fly-by
Tues 20	V.V.	2	3	2	gull sp.	1 flock (2) controlled by pyro; 1 flock (1) fly-by
Wed 21	V.V.	0	0	0		
Thurs 22	R.O.	0	0	0		
Fri 23	V.V.	5	12	4	gull sp.	5 flocks (4,3,2,2,1) controlled with pyro
Sat 24	V.V.	3	15	12	gull sp.	1 flock (12 birds) controlled by falcon; 2 flocks (1,2) fly-by
Mon 26	V.V.	4	13	7	gull sp.	2 flocks (7,3) controlled by falcon; 2 flocks (1,2) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 27	V.V.	2	2	1	gull sp.	2 flocks (1,1) were fly-bys
Wed 28	V.V.	1	1	1	gull sp.	1 flock (1) was fly-by
Thurs 29	V.V.	1	1	1	gull sp.	1 flock (1) was fly-by
Fri 30	V.V.	3	3	1	gull sp.	3 flocks (1,1,1) fly-by
Sat 31	V.V.	1	27	27	gull sp.	1 flock (27) controlled by falcon
Jan 2017						
Mon 2	V.V.	14	180	40	gull sp.	12 flocks (160 birds) controlled by falcon; 1 flock (17) by pyro; 1 flock (3) fly-by
Tues 3	V.V.	8	234	70	gull sp.	6 flocks (211 birds) controlled by falcon; 1 flock (2) by pyro; 1 flock (21 birds) fly-by
Wed 4	V.V.	6	33	13	gull sp.	5 flocks (31 birds) controlled by falcon; 1 flock (20 fly-by
Thurs 5	V.V.	18	78	32	gull sp.	16 flocks (75 birds) controlled by falcon; 2 flocks (3) fly-by
Fri 6	V.V.	8	11	2	gull sp.	8 flocks (11 birds) controlled by falcon
Sat 7	V.V.	8	84	27	gull sp.	8 flocks (84 birds) controlled by falcon
Mon 9	V.V.	10	194	34	gull sp.	10 flocks (194 birds) controlled by falcon
Tues 10	V.V.	9	148	37	gull sp.	7 flocks (146 birds) controlled by falcon; 2 flocks (2) fly-by
Wed 11	V.V.	12	63	15	gull sp.	8 flocks (59 birds) controlled by falcon; 4 flocks (4) fly-by
Thurs 12	V.V.	4	14	10	gull sp.	2 flocks (12 birds) controlled by falcon; 2 flocks (2) fly-by
Fri 13	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Sat 14	V.V.	1	6	6	gull sp.	1 flock (6 birds) fly-by
Mon 16	V.V.	10	34	11	gull sp.	4 flocks (13 birds) controlled by falcon
Tues 17	V.V.	4	13	4	gull sp.	10 flocks (34 birds) controlled by falcon
Wed 18	V.V.	8	30	10	gull sp.	8 flocks (30 birds) controlled by falcon
Thurs 19	V.V.	3	9	5	gull sp.	3 flocks (9 birds) fly-by
Fri 20	V.V.	5	53	21	gull sp.	4 flocks (51 birds) controlled by falcon; 1 flock (2 birds) fly-by
Sat 21	V.V.	4	56	20	gull sp.	4 flocks (56 birds) controlled by falcon
Mon 23	V.V.	8	163	37	gull sp.	7 flocks (151 birds) controlled by falcon; 1 flock (12 birds) fly-by
Tues 24	V.V.	7	109	27	gull sp.	7 flocks (109 birds) controlled by falcon
Wed 25	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Thurs 26	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Fri 27	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Sat 28	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Feb 2017						
Wed 1	V.V.	0	0	0		
Thurs 2	V.V.	2	84	80	gull sp.	1 flock (80 birds) controlled by falcon; 1 flock (4) fly-by
Fri 3	V.V.	2	11	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (4) fly-by
Sat 4	V.V.	6	61	21	gull sp.	3 flocks (45 birds) controlled by falcon; 3 flocks (16) fly-by
Mon 6	V.V.	12	394	68	gull sp.	12 flocks (394 birds) controlled by falcon
Tues 7	V.V.	13	147	27	gull sp.	10 flocks (142 birds) controlled by falcon; 3 flocks (5) fly-by
Wed 8	V.V.	10	162	3	gull sp.	6 flocks (128 birds) controlled by falcon; 4 flocks (34 birds) fly-by
Thurs 9	V.V.	9	182	45	gull sp.	5 flocks (147 birds) controlled by falcon; 4 flocks (35) fly-by
Fri 10	V.V.	12	271	85	gull sp.	12 flocks (271 birds) controlled by falcon
Sat 11	V.V.	7	104	51	gull sp.	5 flocks (93 birds) controlled by falcon; 2 flocks (11) fly-by
Mon 13	V.V.	9	73	21	gull sp.	7 flocks (66 birds) controlled by falcon; 2 flocks (7) fly-by
Tues 14	V.V.	6	21	6	gull sp.	6 flocks (21 birds) controlled by falcon
Wed 15	V.V.	4	19	6	gull sp.	3 flocks (18 birds) controlled by falcon; 1 flock (1) fly-by
Thurs 16	V.V.	5	29	12	gull sp.	4 flocks (27 birds) controlled by falcon; 1 flock (2) fly-by
Fri 17	V.V.	16	624	78	gull sp.	16 flocks (624 birds) controlled by falcon
Sat 18	V.V.	12	104	24	gull sp.	12 flocks (104 birds) controlled by falcon
Mon 20	V.V.	25	256	38	gull sp.	24 flocks (251 birds) controlled by falcon; 1 flock (5 birds) fly-by
Tues 21	V.V.	4	48	22	gull sp.	3 flocks (44 birds) controlled by falcon; 1 flock (4 birds) fly-by
Wed 22	V.V.	2	8	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (1) fly-by
Thurs 23	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Fri 24	V.V.	2	19	17	gull sp.	2 flocks (19 birds) fly-by
Sat 25	V.V.	2	10	7	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (3 birds) fly-by
Mon 27	V.V.	4	34	13	gull sp.	4 flocks (34 birds) controlled by falcon
Tues 28	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon
Mar 2017						
Wed 1	V.V.	0	0	0		
Thurs 2	V.V.	1	6	6	gull sp.	1 flock (6 birds) fly-by
Fri 3	V.V.	2	19	18	gull sp.	2 flocks (19 birds) fly-by

Appendix 1 (concluded). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Sat 4	V.V.	2	20	13	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (13 birds) fly-by
Mon 6	V.V.	4	48	25	gull sp.	4 flocks (48 birds) controlled by falcon
Tues 7	V.V.	3	35	22	gull sp.	1 flock (2 birds) controlled by falcon; 1 flock (4 birds) fly-by
Wed 8	V.V.	2	6	4	gull sp.	2 flocks (32 birds) controlled by falcon; 1 flock (3 birds) fly-by
Thurs 9	V.V.	3	14	7	gull sp.	1 flock (7 birds) controlled by falcon; 2 flocks (7 birds) fly-by
Fri 10	V.V.	3	21	12	gull sp.	3 flocks (21 birds) controlled by falcon
Sat 11	V.V.	3	12	7	gull sp.	2 flocks (5 birds) controlled by falcon; 1 flock (7) fly-by
Mon 13	V.V.	2	8	6	gull sp.	2 flocks (8 birds) fly-by
Tues 14	V.V.	4	32	12	gull sp.	4 flocks (32 birds) controlled by falcon
Wed 15	V.V.	1	17	17	gull sp.	1 flock (17 birds) controlled by falcon
Thurs 16	V.V.	1	7	6	gull sp.	1 flock (7 birds) fly-by
Fri 17	V.V.	2	30	26	gull sp.	1 flock (26 birds) controlled by falcon; 1 flock (4) fly-by
Sat 18	V.V.	2	29	17	gull sp.	2 flocks (29 birds) controlled by falcon
Mon 20	V.V.	3	12	7	gull sp.	1 flock (7 birds) controlled by falcon; 2 flocks (5 birds) fly-by
Tues 21	V.V.	3	43	19	gull sp.	2 flocks (35 birds) controlled by falcon; 1 flock (8) fly-by
Wed 22	V.V.	2	18	12	gull sp.	2 flocks (18 birds) controlled by falcon
Thurs 23	V.V.	2	2	1	gull sp.	2 flocks (2 birds) fly-by
Fri 24	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Sat 25	V.V.	0	0	0		
Mon 27	V.V.	0	0	0		
Tues 28	V.V.	2	17	11	gull sp.	1 flock (11 birds) controlled by falcon; 1 flock (6) fly-by
Wed 29	V.V.	0	0	0		
Thurs 30	V.V.	0	0	0		
Fri 31	V.V.	1	7	7	gull sp.	1 flock (7 birds) fly-by

Appendix 2. Results of independent surveys of the Forward Landfill - 2016-2017.

Date		Time of Survey	# of hours	# of gulls	Notes
Nov 2016					
Sat 5	GP	09:00-12:00	3	0	
Thurs 10	GP	10:00-13:00	3	0	
Wed 16	GP	12:00-15:00	3	4	
Mon 21	GP	07:00-10:00	3	4	Fog. Gulls heard only
Sun 27	GP	08:00-11:00	3	2	Fog.
Wed 30	GP	13:00-17:00	3	0	
Dec 2016					
Fri 2	GP	10:00-13:00	3	23	
Wed 7	GP	08:00:10:30	2.5	15	Heavy fog
Sat 10	GP	07:00-10:00	3	17	
Thurs 15	GP	07:00-10:00	3	many	Many gulls controlled by falconer with falcon and pyro
Mon 19	GP	07:00-10:00	3	68	47 gulls fly over without control being necessary
Sun 25	GP	07:00-10:00	3	0	Limited visibillty due to fog
Jan 2017					
Mon 2	GP	08:00-12:00	4	6	Wind and rain. Control by pyros
Fri 6	GP	08:00-12:00	4	0	
Mon 9	GP	08:00-12:00	4	0	
Satr 14	GP	08:00-12:00	4	3	
Wed 18	GP	08:00-12:00	4	0	
Sun 29	GP	08:00-12:00	4	2	
Feb 2017					
Wed 1	GP	08:00-12:00	4	0	Fog heavy early in period
Fri 3	GP	08:00-11:00	3	some	Gulls controlled by pyro but visibilty restricted by fog
Tues 14	GP	08:00-11:00	3	0	
Sun 19	GP	08:00-11:00	3	2	fly-by
Sat 25	GP	08:00-11:00	3	0	Fog limited visibility
Tues 28	GP	08:00-11:00	3	0	

Appendix 2 (concluded). Results of independent surveys of the Forward Landfill - 2016-2017.

Date		Time of Survey	# of hours	# of gulls	Notes
Mar 2017					
Wed 1	GP	08:00-11:00	3	0	
Sun 5	GP	08:00-11:00	3	0	
Tues 7	GP	08:00-11:00	3	4	3 fly-by
Tues 14	GP	08:00-11:00	3	0	
Fri 17	GP	08:00-11:00	3	0	
Sat 25	GP	08:00-11:00	3	1	
Apr 2017					
Mon 3	GP	08:00-11:00	3	0	
Fri 7	GP	08:00-11:00	3	2	
Sat 15	GP	08:00-11:00	3	0	
Wed 19	GP	08:00-11:00	3	0	
Sun 23	GP	08:00-11:00	3	0	good cover
Tues 25	GP	08:00-11:00	3	0	
May 2017					
Mon 1	GP	08:00-11:00	3	12	
Fri 5	GP	08:00-11:00	3	0	

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF THE BIRD CONTROL PROGRAM AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2015-2016

Prepared by

For

Forward Landfill Republic Services, Inc.
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95336

LGL Report # TA4903-7

30 September 2016

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF THE BIRD CONTROL PROGRAM AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2015-2016

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Table of Contents

Introduction

There is a general concern about the presence of birds in the vicinity of airports where they may collide with aircraft. This can threaten the safety of the aircraft. Municipal waste landfills often attract birds, primarily gulls of various species. For this reason, the siting of landfills near airports must be handled carefully. Fortunately, bird strikes are very rare events and damaging strikes are much rarer still, but they do occur.

The Forward Landfill has operated near Manteca, CA since 1973. An airstrip on the site of the Stockton Metropolitan Airport (SCK) began operation in April 1940. Thus, there is a long history (over 40 years) of co-existence between the landfill and the airport. An analysis of the reported bird strikes by aircraft using the Stockton Airport since 1991 indicates that the operating landfill has not been the source of birds struck by aircraft using the airport. This analysis is included later in this report.

Forward, Inc., a subsidiary of Republic Services, Inc., operates the Forward Landfill which is located close to SCK (Figure 1). Because birds can be attracted to landfills there is a potential to create a hazard to the safety of aircraft using the Stockton Airport and because the landfill had been known to have attracted gulls in previous winters (October-April), Forward, Inc. has instituted a gull control program at the landfill.

LGL Limited, an experienced bird hazard research firm, has been retained to monitor the success of the control program and to make recommendations for improvements to the program, if required. LGL is one of North America's leading ecological research firms. It has been involved with bird hazards to aircraft safety and associated wildlife control issues for over 40 years under the direction of Dr. Davis, the author of this report.

The present report provides an analysis of the success of the sixth year (2015-2016) of the falconry-based bird control program that was first instituted at Forward Landfill during the winter of 2010-2011. Reports of previous years of bird control are available (Davis 2011, 2012, 2013, 2016).

Previous Gull Use of Forward Landfill

Gulls are the principal birds that are attracted to edible waste that is disposed of at municipal solid waste landfills. Gulls winter in the Stockton area with first arrivals usually appearing in September or October. Gull numbers increase in November and December as migrants from further north arrive in the area. The Forward Landfill attracted gulls during winter in previous years, before control was initiated (see Davis 2011 for summary).

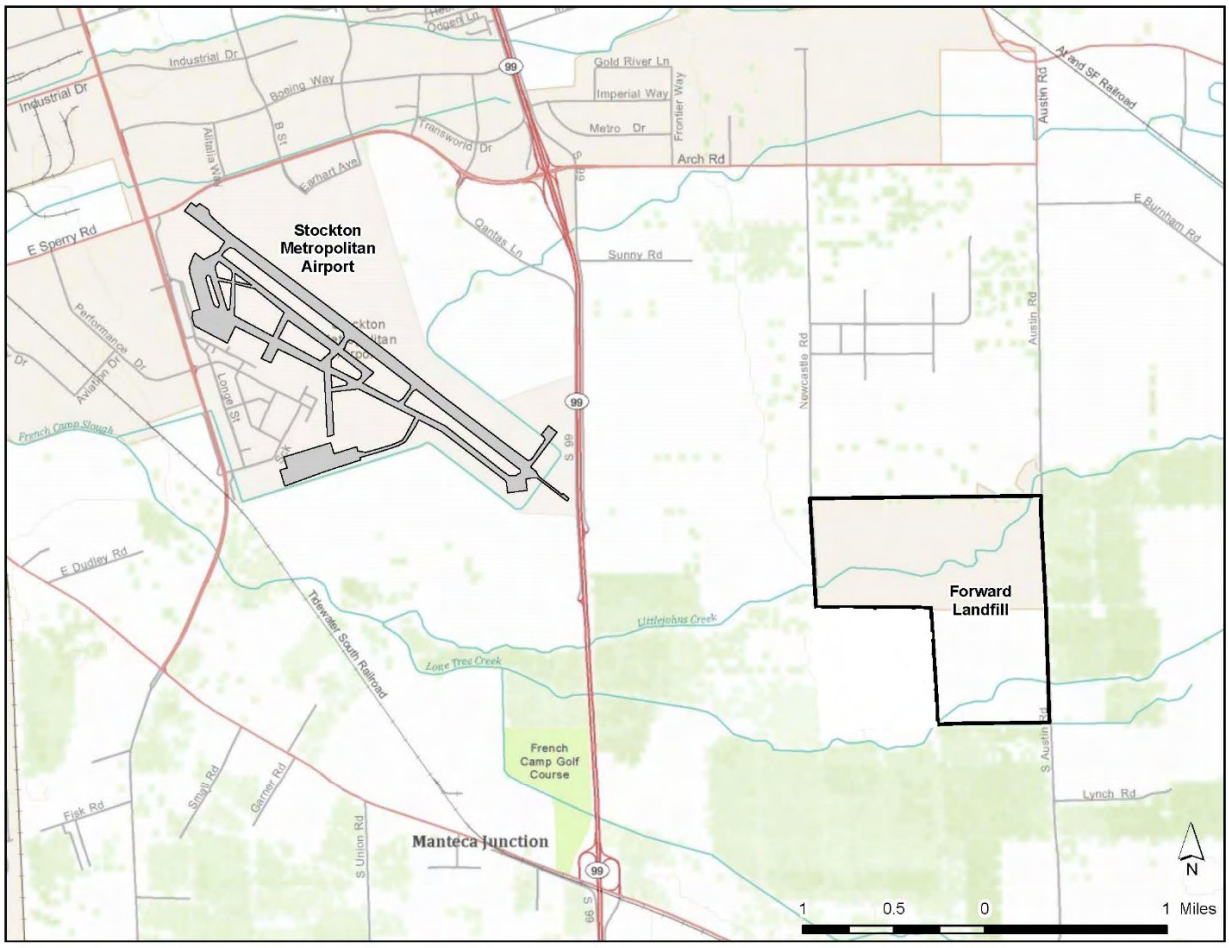

Figure 1. Location of Forward Landfill in relation to Stockton Metropolitan Airport.

Gulls are not usually present in the Stockton area during the summer period (May to late September) and intensive gull control at the landfill is not required at that time. However, the landfill is monitored by landfill staff during the off-season for the presence of gulls. Any gulls that appear then are controlled by landfill staff using pyrotechnics. Control, if necessary, of early arriving gulls in September is conducted through the use of model aircraft.

A pilot gull control program was conducted at the Forward Landfill by Airstrike Bird Control, LLC. This was a falconry-based program that began on 9 March 2010 and concluded on 14 April 2010. Mr. Brad Felger, Manager of Airstrike Bird Control, estimated that there were approximately 3,000 gulls using the Forward Landfill when the pilot program began (B. Felger, pers. comm.).

Gull Control Program

The pilot gull control program had been successful and therefore, a full gull control program was instituted on an operational basis at Forward Landfill during the fall of 2010. The operational gull control program was again a falconry-based program operated by Airstrike Bird Control, LLC. The program used several falcons (Peregrine male, Peregrine female, Sakar Falcon,

Gyrfalcon/Peregrine hybrid, etc.) to control gulls at and around the landfill. Control in subsequent years was based mainly on the use of male and female Peregrine Falcons. Control was achieved by flying the falcons to lure and by allowing them to chase the gulls on occasion. The program was also supplemented with the use of pyrotechnics to scare gulls away during conditions when it is difficult to fly the falcons (e.g. foggy and stormy conditions).

The objective of the control program was to prevent any gulls from feeding at the landfill or landing anywhere on the landfill property. If the gulls cannot feed at the landfill or loaf on the landfill or drink from occasional standing water, then they will stop returning to the landfill on subsequent days. There can be no gaps in the control coverage that might allow gulls to feed for even a few minutes because a gull can obtain all the food that it needs for the day in about 20 to 30 minutes of feeding at a landfill. Therefore, even small gaps in coverage could allow gulls to obtain enough food to encourage them to return to the landfill on a subsequent day.

In 2015-2016, the falconry-based gull control program by Airstrike Bird Control Inc. at Forward Landfill began on 26 October 2015 and continued until 26 March 2016. The program was supplemented with control using pyrotechnics before the falconry program began and after it had finished. The gulls were late arriving in the fall of 2015 and the falconry program was not needed until late in October.

Monitoring Program

The success of the gull control program has been monitored every winter by LGL Limited to provide an independent assessment of the program. The monitoring has included:

1. Daily observations made by the controllers during their control activities. These included records of all gulls that approached the landfill or flew past the landfill during the day.
2. Observations on and around the landfill by LGL personnel to confirm the observations by the controllers.
3. Observations at Forward Landfill by LGL personnel on Saturday afternoons and Sundays when the landfill was closed, the waste was covered, and the controllers were not on duty.
4. Observations at other landfills by LGL personnel to compare with the results from Forward Landfill.

The independent monitoring of the 2015-2016 program began on 4 October 2015 and continued until 16 May 2016. Several sources of data are used in the evaluation.

Observations at Forward Landfill – During Operations

Daily Observations by Controllers

The falconers who provided the daily bird control at the landfill kept records of the numbers of gulls that approached the landfill, the numbers of gulls that were controlled, and the numbers that flew past the landfill on route to other destinations. These data are summarized on a weekly basis in Table 1. The daily summaries are provided in Appendix 1.

Table 1. Weekly summary of gull observations by falconers in the vicinity of the Forward Landfill.

Date in 2015-2016	# of gulls feeding at the landfill during week	Average # of flocks /day	Ave. Total # of gulls /day	Peak # of gulls at one time
2015				
Oct 26-31	0	1.2	12.8	50
Nov 2-7	0	3.2	51.2	100
Nov 9-14	0	2.7	28.0	40
Nov 16-21	0	2.0	9.0	15
Nov 23-28	0	4.7	53.0	42
Nov 30-Dec 5	0	4.0	55.3	40
Dec 7-12	0	2.8	28.7	78
Dec 14-19	0	3.8	21.0	18
Dec 21-26	0	2.5	59.5	80
2016				
Jan 2	0	3.0	31.0	17
Jan 4-9	0	5.0	62.8	37
Jan 11-16	0	3.3	31.5	22
Jan 18-23	0	4.3	63.0	39
Jan 25-30	0	2.3	15.8	16
Feb 1-6	0	2.2	7.8	12
Feb 8-13	0	1.8	14.5	30
Feb 15-20	0	3.7	37.5	80
Feb 22-27	0	1.3	8.5	30
Feb 29-Mar 5	0	2.2	12.7	22
Mar 7-12	0	2.0	15.2	17
Mar 14-19	0	1.7	18.3	30
Mar 21-26	0	1.0	3.0	10

Are Gulls Feeding at the Landfill?

The bird control program is designed to deter birds from feeding at the landfill. The observations by the controllers (falconers) indicated that no gulls were able to feed at the active disposal area of the landfill after the control program began (Table 1). However, as part of the bird control program, observations are made by an independent observer as an added oversight. The independent observer did not note any cases of gulls feeding at the landfill.

Gulls Approaching the Landfill and Flying Past the Landfill

The falconer conducting the gull control documented the numbers of gulls that approached and flew past the landfill. These observations are presented in Appendix 1 and summarized in Table 1. It is important to correctly interpret the data in Table 1 and Appendix 1. The numerical estimates of daily numbers of gulls are not estimates of the numbers at the landfill or even the numbers approaching the landfill. Some of the gulls in the totals were birds that flew past the landfill without visiting it. The numbers of such gulls were usually higher during the influxes of migrants and during periods of stormy weather that drove the gulls inland from the coast.

During the first three years of the study (2010-11, 2011-12, and 2012-2013), the number of flocks of gulls that approached or flew past the landfill ranged from 6.3 to 11.8 per day during the November-March period in each year, or a little over one flock per hour. During the two most recent years, the average numbers of flocks were lower: 4.1 per day in 2014-2015 and 2.8 during 2015-2016. The average flock sizes during 2014-2015 and 2015-2016 were 9 per day and 11 per day, respectively which was near the low end of the range of 7 to 21 birds during each of the first three years. These are very small numbers when compared to the large numbers that used to feed at the landfill before the control program began. The results indicate that the gull flight lines from gull night roosts in the delta or on San Francisco Bay no longer passed over the airport on route to Forward Landfill, but rather had moved to other daytime feeding areas.

Observations by LGL Personnel

LGL personnel conducted spot checks at the Forward Landfill. There were usually 6 visits per month and each visit was usually 3-4 hours long. The results of these visits are presented in Appendix 2 and summarized in Table 2.

Table 2. Summary of independent surveys of the Forward Landfill - 2015-2016.

Month	# of surveys	# of hours	# of gulls feeding at landfill/ 4 hours	# of control events/ 4 hours	# of gulls controlled/ 4 hours	# flocks flying past landfill/ 4 hours	# gulls flying past landfill/ 4 hours
2015*							
October	6	24	0.0	0.7	13.2	0.3	0.8
November	6	24	0.0	1.5	3.8	0.7	0.7
December	6	24	0.0	2.0	25.2	0.2	0.5
2016							
January	6	24	0.0	2.2	15.8	0.2	1.2
February	3	8.25	0.0	1.5	2.4	0.5	0.5
March	6	15.75	0.0	0.0	0.0	0.0	0.0
April	6	23.5	0.0	0.0	0.0	0.0	0.0
May	4	16	0.0	0.0	0.0	0.0	0.0

*Falconry program began on October 26, 2015 and ended on March 26, 2016

The data gathered by the LGL personnel were consistent with the observations by the falconers on the same days (Table 1). In fact, the falconers generally recorded more birds because they were always searching for distant gulls approaching the landfill and they were on site earlier in the morning when more gulls approached the landfill. Therefore, it is again concluded that the data collected by the falconer/controllers are reliable and unbiased.

There had been a reduction in the numbers of gulls approaching or passing by the Forward Landfill over the first three years with the falconry control program in place. During the 2010-2011 period, there was an average of 1.0 flocks per hour of observation by the independent observer. This number declined in the second year (2011-2012) to 0.4 flocks per hour. During the third year (2012- 2013), the number of flocks of gulls approaching the landfill declined further to an average of 0.2 flocks per hour. The number of flocks approaching or passing the Forward Landfill increased to 1.1 flocks per hour of observation in 2014-2015. During the peak period of October-March in the present year (2015-2016), the number of flocks per hour declined to only 0.4 per hour. This was a small number of flocks.

Observations at Forward Landfill – Weekends

The surveys during the first three years determined that gulls did not use the Forward Landfill on Saturday afternoons or Sundays when the landfill was closed and the controllers were not present. During the 2014-2015 study, the landfill was surveyed on 6 Sundays, once per month in October 2014 through March 2015. During those Sundays, the LGL observer noted 1.2 flocks of gulls approaching and flying past the landfill. This was similar to the overall average of 1.1 flocks per hour when all days were considered. During the 2015-2016 period, only a single flock of gulls approached the landfill during 26 hours of surveys on Sundays; this was 0.04 flocks per hour. During the entire study, gulls have not been observed to feed at the covered landfill on Sundays.

Observations at Other Landfills

In order to interpret the results from Forward Landfill, it was necessary to examine the numbers of gulls that occurred at other municipal solid waste landfills in the area that did not have intensive gull control programs in place. Two such landfills were examined by LGL personnel: Foothill Landfill and North County Landfill. Each of these landfills had some bird control measures (pyrotechnics) that were used sporadically at Foothill Landfill. The control program at North County had been upgraded in 2015-2016 by using remote-controlled model airplanes and gliders during the week. The control efforts at Foothill Landfill were by no means comparable to the program at Forward Landfill. Each landfill survey covered about a 2-3-hour period.

The **North County Landfill** is located approximately 18.5 miles NNE of the Forward Landfill (Figure 2). It was surveyed on 13 occasions from 3 November 2015 to 5 May 2016 (Table 3). During the October-March period, very few gulls fed at the landfill although an average of 550 gulls flew past the landfill on a daily basis. Most of these gulls were believed to continue on to the Foothill Landfill. In previous years (see next paragraph) a large portion of these gulls stopped to feed at North County Landfill. Bird control in previous years was less intensive.

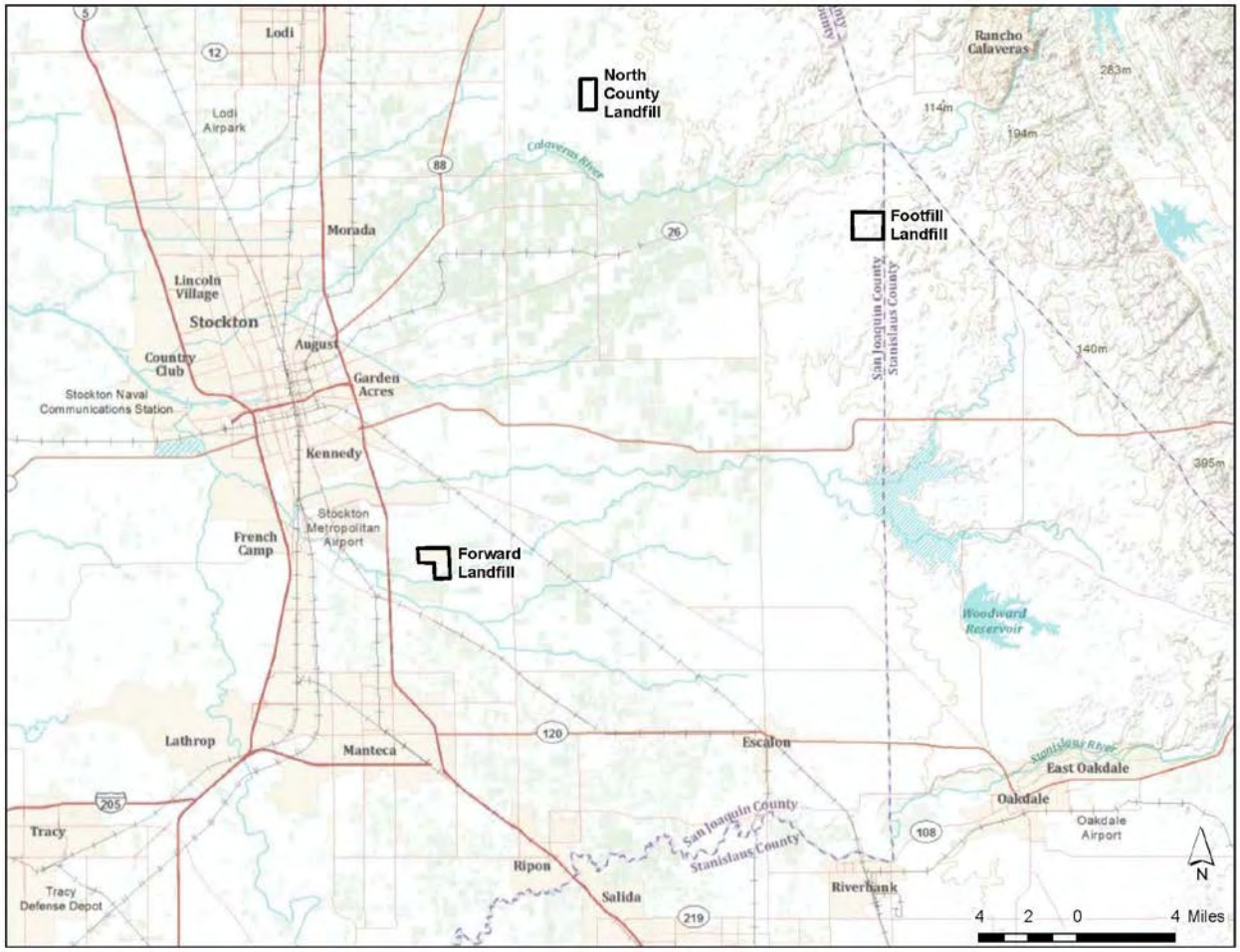

Figure 2. Locations of North County Landfill and Foothill Landfill

By April in 2016, the numbers of gulls passing the North County Landfill began to decline and most of the gulls had left the area by early May.

Gull use of the North County Landfill had increased over the first three years of study (2010-2013). During the November through March period, the average numbers of gulls per survey had increased from 709 in 2010-11, to 1,574 in 2011-12, to 2,462 in 2012-13. The average numbers of gulls per survey in the November 2014-March 2015 period was 456.6 gulls. This was a significant reduction from earlier years and was a function of the increased bird control efforts at that landfill.

The Foothill Landfill is located approximately 20.5 miles ENE of the Forward Landfill. It was surveyed 13 times from 6 November 2015 to 19 May 2016. Substantial numbers of gulls were present with an average of 2,276.2 gulls on each of the 9 surveys in the November-March period. Numbers peaked in February and March (3700-4,000) (Table 4). Similar to the pattern at North County Landfill, numbers declined substantially in April and most had returned north by May.

Table 3. Surveys of North County Landfill near Stockton, California - 2015-2016.

Date	Time of Survey	Maximum # of Gulls	Comments
2015			
Tues, Nov 3	11:15-13:15	0	
Thurs, Nov 19	10:45-12:45	22	
Tues, Nov 24	06:30-0830	16	
Fri, Dec 4	13:15-15:15	42	
Mon, Dec 28	07:45-09:45	150*	
2016			
Fri, Jan 8	11:45-13:45	1500*	
Thurs, Jan 21	13:15-15:15	22*	
Wed, Feb 17	11:45-13:45	2500*	
Wed, Mar 2	08:00-11:00	700*	
Thurs, Mar 24	12:00-14:30	550*	
Mon, Apr 4	07:30-11:30	156*	
Thurs, Apr 21**	11:00-14:30	110	
Thurs, May 5	09:00-12:00	2	

* All gulls on these dates were fly-bys because of bird control at site

** Gull control at landfill ceased on April 15

Table 4. Surveys of Foothill Landfill near Stockton, California - 2015-2016.

Date	Time of Survey	Maximum # of Gulls	Comments
2015			
Fri, Nov 6	11;45-13:45	1,526	
Thurs, Nov 19	08:00-10:00	1,060	
Thurs, Dec 10	07:45-09:45	2,400	
Thurs, Dec 31	07:00-09:00	1,000	
2016			
Sat, Jan 9	13:15-15:15	1,000	Very Foggy and Wet
Mon, Jan 25	12:45-14:45	2,000	Very Foggy
Mon, Feb 15	10:20-13:30	3,800	
Mon, Mar 7	08:00-10:00	4,000	
Tues, Mar 23	13:00-14:30	3,700	
Wed, Apr 6	08:00-11:00	340	
Fri, Apr 22	11:00-13:30	64	
Wed, May 11	08:00-11:00	6	
Thurs, May 19	09:00-12:00	0	

The average numbers of gulls per survey at Foothill Landfill during the November-March period in recent years has varied: 1,077 in 2010-11, 2,087 in 2011-12, 2,450 in 2012-13, and 2,276 in 2015-2016. The reasons for the variation are not known but are probably related to variations in the numbers of gulls wintering in the region in different years, which may be a function of annual differences in the amount of rain.

In previous years, the results from North County and Foothill landfills clearly indicated that significant numbers of gulls used these landfills even though there were some control efforts at each of the landfills. In both cases, there were significantly more gulls present than there were in the vicinity of the Forward Landfill during the same period. In 2015-2016, the gulls at North County Landfill were mainly recorded flying past the landfill whereas the gulls at Foothill Landfill were feeding there and spent most of the day at that site.

The numbers of gulls at North County and Foothill Landfills are not directly comparable to the numbers at Forward Landfill. The numbers for North County and Foothill landfills are the averages of the peak numbers per survey. The closest comparisons from Forward Landfill are the averages of the peak numbers in Appendix 1. For example, over the five-month period (November-March.), the average peak number of gulls in the vicinity of the Forward Landfill was 13 gulls compared to the 2,276 feeding at Foothill Landfill and 550 flying past the controlled North County Landfill. Also, the small numbers gulls at Forward Landfill were scared away quickly or were flying past the landfill whereas the gulls at Foothill Landfill were present there for most of the day.

Where Did the Gulls from Forward Landfill Go?

The question was asked where did the gulls that formerly fed at Forward Landfill go when they were prevented from feeding at that landfill. A detailed assessment of this question has not been conducted because it would have required intensive effort to collect baseline data in previous years before the control program began. Clearly, many of the gulls from Forward now go to other landfills in the region and feed at other areas. All of the natural feeding areas on waterbodies and in fields are still used by gulls. In addition, other anthropogenic or human created feeding sites are used. For example, gulls are using the Waste Transfer Station in south Stockton, the Town of Manteca, and the Stockton Sanitation Ponds.

Gull Behavior at Night

Gulls spend the night at communal roosts on large bodies of water where they occur in dense flocks. The use of the night roosts is traditional with particular roosts being used year after year. Gulls do not feed at inland terrestrial areas at night and they do not feed at landfills at night. The latter fact has been demonstrated at many landfills. The best documented case is the Atlantic County Utilities Authority where waste is disposed of at night. There has not been a single gull seen at that coastal landfill during over 13 years of operation (Davis and Hixon 2011). Because of this nocturnal behavior, it is not necessary to control gulls at night at the Forward Landfill.

History of Bird Strikes at Stockton Metropolitan Airport (SCK)

The Federal Aviation Administration (FAA) maintains an extensive data base documenting wildlife/aircraft collisions at airports throughout the U.S. The FAA data base includes records beginning in 1990 and contained 172,370 strike records by 10 September 2015, the latest update. As of 10 September 2015, the data base contained records of 55 bird and mammal strikes associated with the Stockton Airport. It is well known that not all bird strikes are reported but the important strikes (those that affect flight, cause damage, etc.) are more likely to be reported than are strikes that cause no damage and often are not even detected by the flight crew. It is apparent that the airport has been much more diligent in reporting strikes in the past five years with 35 (64%) of the 55 strikes since 1990 recorded during that five-year period compared to 20 strikes (36%) in the previous 21- year period.

A summary printout of the 55 strikes at the Stockton Metropolitan Airport is included as Table 5. The Forward Landfill has been operating during the entire 26-year period covered by the FAA data base. For the 20 years before the fall and winter of 2010-2011, there was no bird control program in place at the landfill. Therefore, if the landfill was attracting birds that were a threat to aircraft safety, the strike data from the airport should reflect that risk. Gulls are the group of birds that are attracted to the landfill and could pose a threat to aircraft using the Stockton Airport. The 55 reported strikes (Table 5) are examined in the following paragraphs.

Thirty-three of the strikes involved identified birds that were not gulls. A thirty-fourth strike involved a gull carcass that was found on the airport on 28 October 2000; it was assumed to have been struck by an aircraft. Of the 20 strikes that involved unknown birds, 11 involved small birds that could not have been gulls. Of the 9 remaining strikes, 4 involved "medium" or "large" unknown birds and 5 involved "unknown bird or bat". In theory, any of these 9 strikes could have involved gulls.

Two of the four incidents involving birds of unknown size involved military aircraft in June 2006. This is a period when gulls are not present in the Stockton area; thus these two strikes undoubtedly did not involve gulls. A third strike occurred at night (8 April 2013) when gulls have returned to the coast. A fourth strike occurred on 8 October 1991 when a military KC135 struck a bird on its landing roll at SCK. It is possible that the bird may have been a gull resting on the airport runway. The fifth strike involved a business jet on its landing roll on 31 December 2011. The flight crew reported the strike at the time and must have seen the bird. Had it been a gull, it likely would have been reported as such or at least as a medium or large bird. A runway check was performed immediately after the incident but no carcass was found, again suggesting that a gull was not involved.

There were two strikes reportedly involving "large" birds and two involving birds of "medium" size. There was no information on the species involved although it should be noted that gulls are fairly easy to identify as gulls, if they are seen. Of the two incidents involving "large" birds, the first occurred on 23 April 2000 when most gulls have left the Stockton area. This involved a Cessna Citation II jet that struck a bird at 2000 ft while on climbout from Runway 29.

Table 5. Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

Date	Airport	Airline	Aircraft	Bird Species
04/21/2015	Stockton Metro	Military	T-38	American Pipit
03/30/2015	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
03/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
03/13/2015	Stockton Metro	Coast Guard	C-130	Horned Lark
10/10/2014	Stockton Metro	Business	Learjet 45	Unknown small bird
04/14/2014	Stockton Metro	Unknown	Unknown	Swainson's Hawk
04/10/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/31/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/29/2014	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
01/14/2014	Stockton Metro	Unknown	Unknown	Rabbit
12/13/2013	Stockton Metro	Allegiant Air	MD-83	Red-tailed Hawk
11/19/2013	Stockton Metro	Business	C-340	Red-tailed Hawk
11/19/2013	Stockton Metro	Unknown	Unknown	Rock Pigeon
10/15/2013	Stockton Metro	Unknown	Unknown	European Starling
06/20/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
04/08/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird
02/22/2013	Stockton Metro	Military	C-12	Unknown bird or bat
12/02/2012	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
02/23/2012	Stockton Metro	Unknown	Unknown	Western Meadowlark
02/07/2012	Stockton Metro	Unknown	Unknown	Horned Lark
01/24/2012	Stockton Metro	Unknown	Unknown	Burrowing Owl
12/31/2011	Stockton Metro	Business	BE-400 BJET	Unknown bird
12/05/2011	Stockton Metro	Unknown	Unknown	Horned Lark
11/18/2011	Stockton Metro	Government	Lockheed C-130	Western Meadowlark
09/15/2011	Stockton Metro	Allegiant Air	MD-83	Turkey Vulture
07/30/2011	Stockton Metro	Unknown	Unknown	Barn Owl
06/28/2011	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2011	Stockton Metro	Unknown	Unknown	Horned Lark
05/27/2011	Stockton Metro	Allegiant Air	MD-83	American Kestrel
04/18/2011	Stockton Metro	Unknown	Unknown	Red-tailed hawk
02/15/2011	Stockton Metro	Privately Owned	C-414	White-tailed kite
01/02/2011	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
12/20/2010	Stockton Metro	Unknown	Unknown	Barn owl
08/02/2010	Stockton Metro	Unknown	Unknown	Tree Swallow
01/16/2010	Stockton Metro	Business	PA-46 Malibu	Unknown bird - large
12/28/2009	Stockton Metro	Business	Learjet-45	Unknown bird - medium
12/15/2008	Stockton Metro	Government	Lockheed C-130	Unknown bird - small
09/09/2008	Stockton Metro	Business	Citation X	Unknown bird - small
08/09/2008	Stockton Metro	Business	BE-400 BJET	Unknown bird - small
01/23/2008	Stockton Metro	Allegiant Air	MD-80	Unknown bird - medium
08/17/2006	Stockton Metro	Military	T-6A	Black vulture
06/19/2006	Stockton Metro	Military	KC-10A	Unknown bird or bat
06/08/2006	Stockton Metro	Military	C-130H	Unknown bird or bat
08/15/2003	Stockton Metro	Business	Citation X	Hawks
05/10/2001	Stockton Metro	Military	KC-135E	Unknown bird - small

Table 5 (concluded). Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

11/20/2000	Stockton Metro	Business	BE-90 King	Unknown bird - small
11/02/2000	Stockton Metro	Unknown	Unknown	Great horned owl
10/28/2000	Stockton Metro	Unknown	Unknown	Gulls
04/23/2000	Stockton Metro	Business	Citation II	Unknown bird - large
01/18/2000	Stockton Metro	Military	T-38A	Horned lark
01/11/2000	Stockton Metro	Business	C-340	Sparrows
08/09/1999	Stockton Metro	Business	C-152	Owls
03/31/1997	Stockton Metro	Unknown	BD-19	Ducks
01/26/1993	Stockton Metro	Business	HWKR SD-125	Barn owl
10/08/1991	Stockton Metro	Military	KC-135R	Unknown bird or bat

The aircraft was west of the airport at the time. It made a precautionary landing with a small amount of damage. Given the time of year and the altitude of the strike, it is unlikely that a gull was involved. The second strike of an unknown "large' bird occurred on 16 January 2010 and involved a single-engine Piper 46 Malibu aircraft that was at an elevation of 2500 ft, 8-10 miles west of SCK on climbout from Runway 29. Given the altitude, it is unlikely that a gull was involved and given the location, it is unlikely that a bird from the landfill, which is east of the airport, was involved.

The two incidents involving unknown birds of "medium" size are discussed in this paragraph. The first involved an MD-80 twin-engine passenger jet that struck a bird at 400 ft while still over the airport on climb-out from Runway 29R on 23 January 2008. The pilot advised of the strike and continued on his flight with no damage to the aircraft. The second incident involved a Learjet 45, a small twin-engine business jet. The aircraft was on approach to Runway 29R in rain and fog on 28 December 2009. It broke out of the clouds and struck a bird over the runway. There was no damage and the strike had no effect on the flight.

In conclusion, of the 55 strike reports from Stockton Metropolitan Airport beginning in 1990, only one definitely involved a gull (carcass only) and three others might have involved gulls. Even allowing for significant under-reporting of bird strikes, four strikes at SCK in over 26 years with no damage reported indicates that the landfill has not posed a significant threat to aircraft using the Stockton Metropolitan Airport.

Thirty-two of the reported bird strikes at SCK occurred since the gull control program was instituted at Forward Landfill. These strikes involved Barn Owls (3), a Burrowing Owl, a White-tailed Kite, Red-tailed Hawks (3), Swainson's Hawks (3), a Turkey Vulture, an American Kestrel, Horned Larks (4), Western Meadowlarks (2), a Killdeer, an American Pipit, a Rock Pigeon, a European Starling, unidentified small birds (4), and two unidentified birds. No gulls were involved and none of the birds struck were attracted to the area by the landfill.

Conclusions

The studies reported here were designed to assess whether the gull control program at the Forward Landfill continued to be effective in eliminating any hazard to aircraft caused by the attraction of birds to the landfill. The control program continued to be completely effective at

preventing gulls from feeding at, or otherwise using, the Forward Landfill. This was a huge reduction from the estimated 3,000 gulls that were present at the Forward Landfill in March 2010 when the pilot control program began. Observations at North County Landfill indicated that substantial numbers of gulls still approached that site where they used to feed and observations at Foothill Landfill indicated that large numbers of gulls still continued to feed in spite of sporadic control efforts with pyrotechnics.

The study reported here has documented the continued complete effectiveness of the gull control program at Forward Landfill. The program is not experimental but rather it is fully-operational using control techniques that are well-established and are used operationally and effectively at several landfills. The conversion of the Forward Landfill to a fully-controlled facility will insure that no bird hazard is created by the landfill in the future.

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APPENDICES

Appendix 1. Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Oct 2015						
Mon 26	V.V.	2	7	6	gull sp.	both flocks controlled by falcons
Tues 27	V.V.	1	17	17	gull sp.	flock controlled by falcon
Wed 28	V.V.	1	1	1	gull sp.	fly-by
Thurs 29	V.V.	1	1	1	gull sp.	fly-by
Fri 30	V.V.	1	1	1	gull sp.	fly-by
Sat 31	V.V.	1	50	50	gull sp.	fly-by
Nov 2015						
Mon 2	V.V.	5	210	100	gull sp.	2 flocks (196) by falcons and 3 flocks (14) by pyros
Tues 3	V.V.	4	9	6	gull sp.	3 flocks (8 birds) controlled by falcon; 1 fly-by
Wed 4	V.V.	1	5	5	gull sp.	fly-by
Thurs 5	V.V.	5	68	23	gull sp.	flock of 9 is fly-by; Other 4 flocks (59) controlled by falcons and pyros
Fri 6	V.V.	1	1	1	gull sp.	fly-by
Sat 7	V.V.	3	14	6	gull sp.	2 flocks (10 birds) controlled by falcons; 1 flcok controlled by pyros
Mon 9	V.V.	8	155	40	gull sp.	all 8 flocks controlled by falcons
Tues 10	V.V.	5	6	2	gull sp.	3 flocks (4 birds) controlled by falcons; 2 flocks (2 birds) controlled by pyros
Wed 11	V.V.	2	5	3	gull sp.	both flocks (5 birds) controlled by falcons
Thurs 12	V.V.	0	0	0		
Fri 13	V.V.	1	2	2	gull sp.	flock controlled by falcon
Sat 14	V.V.	0	0	0		
Mon 16	V.V.	6	36	15	gull sp.	2 flocks (21 birds) controlled by falcon; 3 flocks (11 birds); flock of 2 fly-by
Tues 17	V.V.	1	5	5	gull sp.	flock controlled by pyros
Wed 18	V.V.	2	10	6	gull sp.	flock of 6 controlled by falcons; flock of 4 controlled by pyros
Thurs 19	V.V.	1	6	6	gull sp.	flock controlled by pyros
Fri 20	V.V.	1	1	1	gull sp.	fly-by
Sat 21	V.V.	1	1	1	gull sp.	bird controlled by pyros
Mon 23	V.V.	1	2	2	gull sp.	flock controlled by pyros

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 24	V.V.	10	90	42	gull sp.	3 flocks (49 birds) controlled by falcon; 5 flocks (32) controlled by pyros; 2 flocks (9) fly-by
Wed 25	V.V.	0	0	0	gull sp.	
Thurs 26	V.V.	11	212	40	gull sp.	10 flocks (200 birds) dispersed by falcons; 1 flock (12 birds) by pyro
Fri 27	V.V.	6	14	5	gull sp.	1 flock (2 birds) controlled by falcon; 4 flocks (9 birds) by pyro; 1 flock (3) fly-by
Sat 28	V.V.	0	0	0	gull sp.	
Mon 30	V.V.	5	29	20	gull sp.	1 flock (20 birds) controlled by falcon; 4 flocks (9 birds) controlled by pyro
Dec 2015						
Tues 1	V.V.	1	1	1	gull sp.	controlled by falcon
Wed 2	V.V.	1	18	18	gull sp.	fly-by
Thurs 3	V.V.	9	187	40	gull sp.	8 flocks (182 birds) controlled by falcons; 1 flock of 5 birds controlled by pyros
Fri 4	V.V.	4	73	40	gull sp.	1 flock (3 birds) controlled by pyro; 3 flocks (70 birds) were fly-bys
Sat 5	V.V.	4	24	11	gull sp.	2 flocks (19) controlled by falcon; 2 flocks (5 birds) controlled by pyros
Mon 7	V.V.	1	6	6	gull sp.	1 flock (6 birds) controlled with pyro
Tues 8	V.V.	1	1	1	gull sp.	bird controlled by falcon
Wed 9	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by pyro
Thurs 10	V.V.	7	149	78	gull sp.	3 flocks (139 birds) controlled by falcon; 2 flocks (5) by pyro; 2 flocks (5) fly-by
Fri 11	W.C.	4	10	6	gull sp.	3 flocks (9 birds) controlled by falcon; 1 bird fly-by
Sat 12	W.C.	3	4	2	gull sp.	1 flock (2 birds) controlled by falcon; 1 controlled by pyro; 1 fly-by
Mon 14	W.C.	12	70	13	gull sp.	7 flocks (64 birds) controlled by falcon; 3 flocks (3) controlled by pyro; 2 flocks (3) fly-by
Tues 15	V.V.	2	30	18	gull sp.	1 flock (18 birds) controlled by falcon; 1 flock of 12 was a fly-by.
Wed 16	V.V.	2	3	2	gull sp.	1 flock (1 bird) controlled by falcon; one flock of 2 was a fly-by
Thurs 17	V.V.	2	8	6	gull sp.	1 flock (2 birds) controlled by pyro; 1 flock of 6 was a fly-by
Fri 18	V.V.	4	14	6	gull sp.	4 flocks (14 birds) controlled by falcon
Sat 19	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyros
Mon 21	V.V.	7	219	80	gull sp.	3 flocks (167 birds) controlled by falcon; 3 flocks (51) controlled by pyro; 1 bird fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 22	V.V.	1	1	1	gull sp.	1 bird controlled by falcon
Thurs 24	V.V.	1	7	7	gull sp.	1 flock (7 birds) was a fly-by
Sat 26	V.V.	1	11	11	gull sp.	1 flock (11 birds) controlled by pyro
Jan 2016						
Sat 2	V.V.	3	31	17	gull sp.	3 flocks (31 birds) controlled by falcon
Mon 4	V.V.	7	51	16	gull sp.	7 flocks (51 birds) controlled by falcon
Tues 5	V.V.	5	91	37	gull sp.	4 flocks (87 birds) controlled by falcon; 1 flock (4 birds) fly-by
Wed 6	V.V.	9	157	37	gull sp.	9 flocks (157 birds) controlled by falcon
Thurs 7	V.V.	0	0	0	gull sp.	
Fri 8	V.V.	2	5	3	gull sp.	2flocks (5 birds) controlled by pyro
Sat 9	V.V.	7	42	20	gull sp.	5 flocks (39 birds) controlled by falcon; 2 flocks (3 birds) by pyro
Mon 11	V.V.	5	21	7	gull sp.	5 flocks (21 birds) controlled by falcon
Tues 12	V.V.	3	21	12	gull sp.	3 flocks (21 birds) controlled by pyro
Wed 13	V.V.	3	9	4	gull sp.	3 flocks (9 birds) controlled by pyro
Thurs 14	V.V.	0	0	0	gull sp.	
Fri 15	V.V.	4	64	22	gull sp.	4 flocks (64 birds) controlled by falcon
Sat 16	V.V.	5	74	22	gull sp.	5 flocks (74 birds) controlled by falcon
Mon 18	V.V.	2	42	31	gull sp.	2 flocks (42 birds) fly-by
Tues 19	V.V.	2	3	2	gull sp.	2 flocks (3 birds) fly-by
Wed 20	V.V.	4	82	31	gull sp.	2 flocks (56 birds) controlled by falcon; 1 flock (6 birds) by pyro; 1 flock (20 birds) fly-by
Thurs 21	V.V.	9	127	39	gull sp.	3 flocks (82 birds) controlled by falcon; 3 flocks (10 birds) by pyro; 3 flocks (35) fly-by
Fri 22	V.V.	5	82	37	gull sp.	4 flocks (66 birds) controlled by falcon; 1 flock (16 birds) fly-by
Sat 23	V.V.	4	42	21	gull sp.	1 flock (21 birds) controlled by falcon; 1 flock (4 birds) by pyro; 2 flocks (17) fly-by
Mon 25	V.V.	6	41	15	gull sp.	4 flocks (30 birds) controlled by falcon; 1 flock (1 bird) by pyro; 1 flock (10) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 26	V.V.	2	7	6	gull sp.	2 flocks (7 birds) controlled by falcon
Wed 27	V.V.	1	6	6	gull sp.	1 flock (6 birds) controlled by falcon
Thurs 28	V.V.	1	3	3	gull sp.	1 flock (3 birds) controlled by falcon
Fri 29	V.V.	2	12	11	gull sp.	1 flock (1 bird) controlled by pyro; 1 flock (11 birds) fly-by
Sat 30	V.V.	2	26	16	gull sp.	2 flocks (26 birds) controlled by falcon
Feb 2016						
Mon 1	V.V.	3	15	8	gull sp.	1 flock (2 birds) controlled by falcon; 2 flocks (13 birds) by pyro
Tues 2	V.V.	4	23	12	gull sp.	3 flocks (22 birds) controlled by falcon; 1 bird by pyro
Wed 3	V.V.	1	1	1	gull sp.	1 bird fly-by
Thurs 4	V.V.	1	1	1	gull sp.	1 bird fly-by
Fri 5	V.V.	2	2	2	gull sp.	2 flocks (2 birds) controlled by falcon
Sat 6	V.V.	2	5	3	gull sp.	2 flocks (5 birds) controlled by falcon
Mon 8	V.V.	2	3	2	gull sp.	2 flocks (3 birds) controlled by falcon
Tues 9	V.V.	1	1	1	gull sp.	1 bird controlled by pyro
Wed 10	V.V.	2	4	3	gull sp.	1 flock (bird) controlled by pyro; 1 flock (3 birds) fly-by
Thurs 11	V.V.	3	47	30	gull sp.	3 flocks (47 birds) controlled by falcon
Fri 12	V.V.	1	15	15	gull sp.	1 flock (15 birds) fly-by
Sat 13	V.V.	2	17	15	gull sp.	2 flocks (17 birds) controlled by falcon
Mon 15	V.V.	2	9	6	gull sp.	1 flock (3 birds) controlled by falcon; 1 flock (6 birds) fly-by
Tues 16	V.V.	6	9	3	gull sp.	4 flocks (7 birds) controlled by falcon; 1 flock (1 bird) by pyro; 1 flock (1 bird) fly-by
Wed 17	M.C.	4	23	11	gull sp.	4 flocks (23 birds) controlled by falcon
Thurs 18	M.C.	2	103	80	gull sp.	2 flocks (103 birds) controlled by falcon
Fri 19	M.C.	5	53	25	gull sp.	5 flocks (53 birds) controlled by falcon
Sat 20	M.C.	3	28	24	gull sp.	2 flocks (4 birds) controlled by falcon; 1 flock (24 birds) fly-by
Mon 22	V.V.	3	35	30	gull sp.	1 flock (4 birds) controlled by falcon; 1 flock (1 bird) by pyro; 1 flock (30 birds) fly-by
Tues 23	V.V.	2	9	5	gull sp.	1 flock (4 birds) controlled by falcon; 1 flock (5 birds) by pyro
Wed 24	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by pyro

Appendix 1 (concluded). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Thurs 25	V.V.	0	0	0	gull sp.	
Fri 26	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon
Sat 27	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyro
Mon 29	V.V.	5	17	6	gull sp.	3 flocks (14 birds) controlled by falcon; 2 flocks (3 birds) by pyro
Mar 2016						
Tues 1	V.V.	1	10	10	gull sp.	1 flock (10 birds) controlled by pyro
Wed 2	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by pyro
Thurs 3	V.V.	1	22	22	gull sp.	1 flock (22 birds) controlled by pyro
Fri 4	V.V.	2	7	4	gull sp.	1 flock (3 birds) controlled by pyro; 1 flock (4 birds) fly-by
Sat 5	V.V.	3	16	7	gull sp.	2 flocks (9 birds) controlled by falcon; 1 flock (7 birds) fly-by
Mon 7	V.V.	6	58	17	gull sp.	4 flocks (27 birds) controlled by falcon; 2 flocks (31 birds) fly-by
Tues 8	V.V.	1	1	1	gull sp.	1 flcok (1 bird) controlled by falcon
Wed 9	V.V.	2	20	16	gull sp.	1 flock (4 birds) controlled by pyro; 1 flock (16 birds) fly-by
Thurs 10	V.V.	0	0	0	gull sp.	
Fri 11	V.V.	2	3	2	gull sp.	1 flock (2 birds) controlled by falcon; 1 flock (1 bird) by pyro
Sat 12	V.V.	1	9	9	gull sp.	1 flock (9 birds) controlled by pyro
Mon 14	V.V.	4	91	30	gull sp.	4 flocks (91 birds) fly-by
Tues 15	V.V.	1	6	6	gull sp.	1 flock (6 birds) fly-by
Wed 16	V.V.	2	3	2	gull sp.	2 flocks (3 birds) were controlled by pyro
Thurs 17	V.V.	1	6	6	gull sp.	1 flock (6 birds) controlled by pyro
Fri 18	V.V.	1	3	3	gull sp.	1 flock (3 birds) controlled by pyro
Sat 19	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyro
Mon 21	V.V.	2	11	10	gull sp.	2 flocks (11 birds) controlled by pyro
Tues 22	V.V.	2	2	1	gull sp.	2 flocks (2 birds) controlled by falcon
Wed 23	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyro
Thurs 24	V.V.	0	0	0	gull sp.	
Sat 26	V.V.	0	0	0	gull sp.	

Appendix 2. Results of independent surveys of the Forward Landfill - 2015-2016.

Date		Time of Survey	# of hours	# of control events	# of gulls	Notes
Oct 2015						
Sun 4	JD	08:00-12:00	4	0	0	
Mon 6	JD	11:30-15:30	4	0	0	
Tues 13	JD	07:30-11:30	4	2	77	flocks of 75 and 2 controlled with pyro
Thurs 15	JD	07:30-11:30	4	1	1	1 flock (1 bird) controlled with pyro
Thurs 22	JD	10:15-14:15	4	1	6	1 flock(1 bird) controlled with pyro; two flocks (5 birds) were flyby
Thurs 29	JD	11:15-15:15	4	0	0	
Nov 2015						
Sun 1	JD	09:00-13:00	4	0	0	
Tues 3	JD	06:30-11:30	4	5	15	5 flocks (12 birds) controlled by falcon; 3 flocks (3 birds) were flyby
Fri 6	JD	07:00-11:00	4	1	2	1 flock (2 birds) controlled with pyro
Tues 24	JD	09:15-13:15	4	1	5	1 flock of 5 birds controlled by falcon
Wed 25	JD	06:30-11:30	4	1	3	1 flock of 3 birds controlled by falcon
Fri 27	JD	09:30-13:30	4	1	3	1 bird controlled by falcon and 1 flock (2 gulls) fly-by
Dec 2015						
Fri 4	JD	10:30-14:30	4	0	0	
Sun 6	JD	11:30-15:30	4	0	0	
Thurs 10	JD	10:30-14:30	4	0	3	one flock of 3 birds is a flyby
Mon 21	JD	07:00-11:00	4	10	147	7 flocks (103 birds) controlled by falcon; 3 flocks (44 birds) controlled by pyro
Mon 28	JD	10:30-14:30	4	1	1	I bird controlled with pyro
Thurs 31	JD	09:45-13:45	4	1	3	1 flock (3 birds) controlled by falcon
Jan 2016						
Fri 8	JD	07:00-11:00	4	1	3	1 flock (3 birds) controlled with pyro
Sat 9	JD	08:30-12:30	4	2	6	2 flocks (6 birds) controlled by falcon
Sun 17	JD	10:00-14:00	4	0	7	one flock of 7 birds was a flyby
Thurs 21	JD	08:30-12:30	4	6	78	2 flocks (40 birds) controlled by falcon; 4 flocks (38 birds) controlled with pyro

Appendix 2 (concluded). Results of independent surveys of the Forward Landfill - 2014-2015.

Date		Time of Survey	# of hours	# of control events	# of gulls	Notes
Mon 25	JD	08:00-12:00	4	4	6	3 flocks (5 birds) controlled by falcon; one bird controlled with pyro
Tues 26	JD	07:30-11:30	4	2	2	2 flocks (2 birds) controlled by falcon
Feb 2016						
Fri 19	GP	09:00-12:00	3	1	2	1 flock (2 birds) controlled by falcon
Thurs 25	GP	10:30-13:30	3	0	1	1 gull flew by
Mon 29	GP	10:30-12:45	2.25	2	3	2 flocks (3 birds) controlled with pyro
Mar 2016						
Sat 5	GP	09:00-11:30	2.5	0	0	
Thurs 10	GP	10:00-12:30	2.5	0	0	
Sun 13	GP	09:00-11:00	2	0	0	
Tues 15	GP	11:00-14:00	3	0	0	
Wed 23	GP	14:00-16:45	2.75	0	0	
Mon 28	GP	12:00-15:00	3	0	0	
Apr 2016						
Fri 1	GP	07:00-11:00	4	0	0	
Tues 5	GP	09:00-13:00	4	0	0	
Thurs 14	GP	07:00-11:00	4	0	0	
Sat 16	GP	07:30-11:00	3.5	0	0	
Tues 19	GP	12:00-16:00	4	0	0	
Mon 25	GP	08:00-12:00	4	0	0	
May 2016						
Sun 1	GP	08:30-12:30	4	0	0	
Sat 7	GP	08:15-12:15	4	0	0	
Thurs 12	GP	10;00-14:00	4	0	0	
Mon 16	GP	10:00-14:00	4	0	0	

DEMONSTRATION OF THE CONTINUED EFFECTIVENESS OF THE BIRD CONTROL PROGRAM AT THE FORWARD LANDFILL, MANTECA, CALIFORNIA – 2014-2015

Prepared by

For

Forward Landfill
Republic Services, Inc.
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95336

LGL Report # TA4903-6

1 April 2016

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Table of Contents

Introduction

There is a general concern about the presence of birds in the vicinity of airports where they may collide with aircraft. This can threaten the safety of the aircraft. Municipal waste landfills often attract birds, primarily gulls of various species. For this reason, the siting of landfills near airports must be handled carefully. Fortunately, bird strikes are very rare events and damaging strikes are much rarer still, but they still do occur.

The Forward Landfill has operated near Manteca, CA since 1973. An airstrip on the site of the Stockton Metropolitan Airport (SCK) began operation in April 1940. Thus, there is a long history (over 40 years) of co-existence between the landfill and the airport. An analysis of the reported bird strikes by aircraft using the Stockton Airport since 1991 indicates that the operating landfill has not been the source of birds struck by aircraft using the airport. This analysis is included later in this report.

Forward, Inc., a subsidiary of Republic Services, Inc., operates the Forward Landfill which is located close to SCK (Figure 1). Because birds can be attracted to landfills there is a potential to create a hazard to the safety of aircraft using the Stockton Airport and because the landfill had been known to attract gulls in previous winters (October-April), Forward, Inc. has instituted a gull control program at the landfill.

LGL Limited, an experienced bird hazard research firm, has been retained to monitor the success of the control program and to make recommendations for improvements to the program, if required. LGL is one of North America's leading ecological research firms. It has been involved with bird hazards to aircraft safety and associated wildlife control issues for over 40 years under the direction of Dr. Davis, the author of this report.

The present report provides an analysis of the success of the fifth year (2014-2015) of the bird control program that was first instituted at Forward Landfill during the winter of 2010-2011. Reports of previous years of bird control are available (Davis 2011, 2012, 2013, 2014, 2015).

Previous Gull Use of Forward Landfill

Gulls are the principal birds that are attracted to edible waste that is disposed of at municipal solid waste landfills. Gulls winter in the Stockton area with first arrivals usually appearing in September or October. Gull numbers increase in November and December as migrants from further north arrive in the area. The Forward Landfill attracted gulls during winter in previous years, before control was initiated (see Davis 2011 for summary).

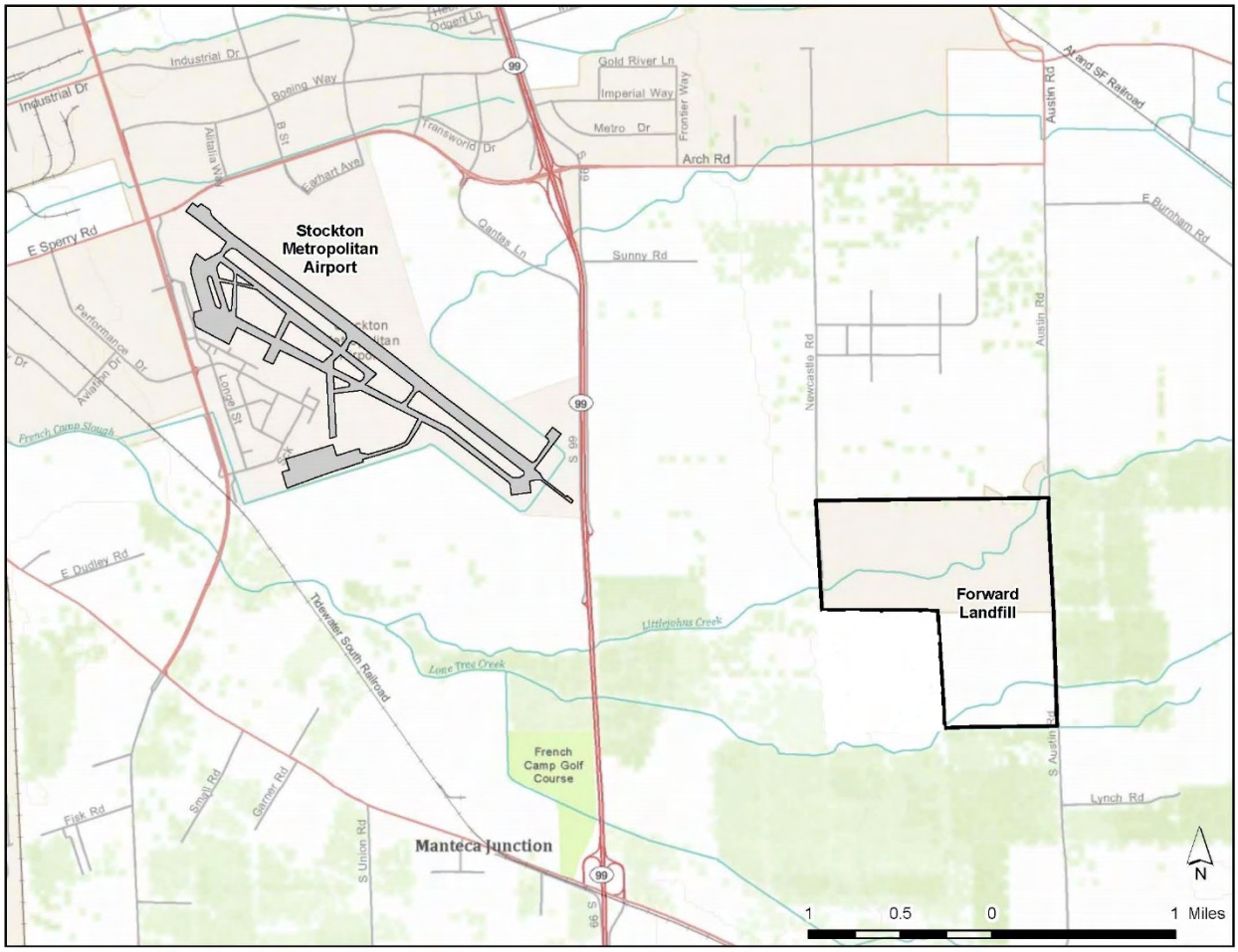

Figure 1. Location of Forward Landfill in relation to Stockton Metropolitan Airport.

Gulls are not usually present in the Stockton area during the summer period (May to late September) and intensive gull control at the landfill is not required at that time. However, the landfill is monitored by landfill staff during the off-season for the presence of gulls. A few gulls were present in the Stockton area during late July and August in 2014. They were controlled by landfill staff using pyrotechnics.

A pilot gull control program was conducted at the Forward Landfill by Airstrike Bird Control, LLC. This was a falconry-based program that began on 9 March 2010 and concluded on 14 April 2010. Mr. Brad Felger, Manager of Airstrike Bird Control, estimated that there were approximately 3,000 gulls using the Forward Landfill when the pilot program began (B. Felger, pers. comm.).

Gull Control Program

The pilot gull control program had been successful and therefore, a full gull control program was instituted on an operational basis at Forward Landfill during the fall of 2010. The operational gull control program was again a falconry-based program operated by Airstrike Bird

Control, LLC. The program used several falcons (Peregrine male, Peregrine female, Sakar Falcon, Gyrfalcon/Peregrine hybrid, etc.) to control gulls at and around the landfill. Control in subsequent years was based mainly on the use of male and female Peregrine Falcons. Control was achieved by flying the falcons to lure and by allowing them to chase the gulls on occasion. The program was also supplemented with the use of pyrotechnics to scare gulls away during conditions when it is difficult to fly the falcons (e.g. foggy and stormy conditions).

The objective of the control program was to prevent any gulls from feeding at the landfill or landing anywhere on the landfill property. If the gulls cannot feed at the landfill or loaf on the landfill or drink from occasional standing water, then they will stop returning to the landfill on subsequent days. There can be no gaps in the control coverage that might allow gulls to feed for even a few minutes because a gull can obtain all the food that it needs for the day in about 20 to 30 minutes of feeding at a landfill. Therefore, even small gaps in coverage could allow gulls to obtain enough food to encourage them to return to the landfill on a subsequent day.

In 2014-2015, the falconry-based gull control program by Airstrike Bird Control Inc. at Forward Landfill began on 22 September 2014 and continued until 20 April 2015. The program was supplemented with control using pyrotechnics before the falconry program began and after it had finished.

Monitoring Program

The success of the gull control program has been monitored every winter by LGL Limited to provide an independent assessment of the program. The monitoring has included:

1. Daily observations made by the controllers during their control activities. These included records of all gulls that approached the landfill or flew past the landfill during the day.
2. Observations on and around the landfill by LGL personnel to confirm the observations by the controllers.
3. Observations at Forward Landfill by LGL personnel on Saturday afternoons and Sundays when the landfill was closed, the waste was covered, and the controllers were not on duty.
4. Observations at other landfills by LGL personnel to compare with the results from Forward Landfill.

The independent monitoring of the 2014-2015 program began on 3 October 2014 and continued until 25 July 2015. Several sources of data are used in the evaluation.

Observations at Forward Landfill – During Operations

Daily Observations by Controllers

The falconers who provided the daily bird control at the landfill kept records of the numbers of gulls that approached the landfill, the numbers of gulls that were controlled, and the numbers that flew past the landfill on route to other destinations. These data are summarized on a weekly basis in Table 1. The daily summaries are provided in Appendix 1.

Table 1. Weekly summary of gull observatons by falconers in the vicinity of the Forward Landfill.

Date in 2014-15	# of gulls feeding at the landfill during week	Average # of flocks /day	Ave. Total # of gulls /day	Peak # of gulls at one time
Sep 22-27	0	1.5	7.7	28
Sep 29-Oct 4	0	1.7	3.5	6
Oct 6-9	0	1.3	3.5	6
Oct 13-18	0	1.7	3.2	4
Oct 20-25	0	3.7	15.7	32
Oct 27-Nov 1	0	2.7	9.3	32
Nov 3-8	0	2.7	8.2	16
Nov 10-15	0	3.5	20.7	32
Nov 24-29	0	2.8	7.2	4
Dec 1-6	0	7.3	63.5	27
Dec 8-13	0	5.2	54.3	31
Dec 15-20	0	3.8	52.2	80
Dec 23-27	0	2.6	22.0	33
Dec 29-Jan3	0	8.2	59.8	26
Jan 5-10	0	2.8	6.2	4
Jan 12-17	0	5.0	16.8	15
Jan 17-24	0	7.3	46.0	33
Jan 26-31	0	3.8	29.0	49
Feb 2-7	0	6.5	89.0	60
Feb 9-14	0	3.0	181.2	300
Feb 16-21	0	3.3	15.2	12
23-Feb	0	10.0	53.0	20
Mar 2-7	0	1.0	6.8	15
Mar 9-14	0	4.0	35.2	22
Mar 16-21	0	1.4	7.6	10
Mar 23-28	0	1.2	2.2	3
Mar 30-Apr 3	0	0.6	2.4	4
Apr 6-11	0	1.0	5.7	14
Apr 13-20	0	1.2	4.4	14

Are Gulls Feeding at the Landfill?

The bird control program is designed to deter birds from feeding at the landfill. The observations by the controllers (falconers) indicated that no gulls were able to feed at the active disposal area of the landfill after the control program began (Table 1). However, as part of the bird control program, observations are made by an independent observer as an added oversight. The independent observer did not note any cases of gulls feeding at the landfill.

Gulls Approaching the Landfill and Flying Past the Landfill

The falconer conducting the gull control documented the numbers of gulls that approached and flew past the landfill. These observations are presented in Appendix 1 and summarized in Table 1. It is important to correctly interpret the data in Table 1 and Appendix 1. The numerical estimates of daily numbers of gulls are not estimates of the numbers at the landfill or even the numbers approaching the landfill. Many of the gulls in the totals were birds that flew past the landfill without visiting it. The numbers of such gulls were usually higher during the influxes of migrants and during periods of stormy weather that drove the gulls inland from the coast.

During the first three years of the study (2010-11. 2011-12, and 2012-2013), the number of flocks of gulls that approached or flew past the landfill ranged from 6.3 to 11.8 per day during the November-March period in each year, or a little over one flock per hour. During the 2014-2015 period, the average number of flocks was 4.1 per day, less than during the first three years. The average flock size during 2014-2015 was 9 per day which was near the low end of the range of 7 to 21 birds during each of the first three years. These are very small numbers when compared to the large numbers that used to feed at the landfill before the control program began. The results indicate that the gull flight lines from gull night roosts in the delta or on San Francisco Bay no longer passed over the airport on route to Forward Landfill, but rather had moved further north en route to Foothill and North County landfills.

Observations by LGL Personnel

LGL personnel conducted spot checks at the Forward Landfill. There were 6 visits per month and each visit was 4 hours long. The results of these visits are presented in Appendix 2 and summarized in Table 2.

Table 2. Summary of independent surveys of the Forward Landfill - 2014-2015.

Month	# of surveys	# of hours	# of gulls feeding at landfill/ 4 hours	# of control events/ 4 hours	# of gulls controlled/ 4 hours	# flocks flying past landfill/ 4 hours	# gulls flying past landfill/ 4 hours
2014							
October*	6	24	0.0	0.3	1.0	0.5	8.2
November	6	24	0.0	1.0	2.3	0.8	2.0
December	6	24	0.0	5.2	33.7	3.8	36.3
2015							
January	7	28	0.0	1.3	1.7	1.3	7.0
February	6	24	0.0	3.0	12.7	3.5	21.8
March	6	24	0.0	0.3	0.5	2.5	15.0
April	6	24	0.0	0.5	1.5	0.0	0.0
May	6	24	0.0	0.0	0.0	0.0	0.0
June	6	24	0.0	0.0	0.0	0.0	0.0
July	6	24	0.0	0.8	1.8	1.0	2.7

*Falconry program began on September 22, 2014 and ended on April 20, 2015

The data gathered by the LGL personnel were consistent with the observations by the falconers on the same days (Table 1). In fact, the falconers generally recorded more birds because they were always searching for distant gulls approaching the landfill and they were on site earlier in the morning when more gulls approached the landfill. Therefore, it is again concluded that the data collected by the falconer/controllers are reliable and unbiased.

There had been a reduction in the numbers of gulls approaching or passing by the Forward Landfill over the first three years with the falconry control program in place. During the 2010-2011 period, there was an average of 1.0 flocks per hour of observation by the independent observer. This number declined in the second year (2011-2012) to 0.4 flocks per hour. During the third year (2012-2013), the number of flocks of gulls approaching the landfill declined further to an average of 0.2 flocks per hour. In the present year (2014-2015), the number of flocks approaching or passing the Forward Landfill was 1.1 flocks per hour of observation. This was an increase but was still a small number of flocks.

Observations at Forward Landfill – Weekends

The surveys during the first three years determined that gulls did not use the Forward Landfill on Saturday afternoons or Sundays when the landfill was closed and the controllers were not present. During the 2014-2015 study, the landfill was surveyed on 6 Sundays, once per month in October 2014 through March 2015. During those Sundays, the LGL observer noted 1.2 flocks of gulls approaching and flying past the landfill. This was similar to the overall average of 1.1 flocks per hour when all days were considered. During the six Sundays, no gulls were observed to feed, or even land, at the landfill.

Observations at Other Landfills

In order to interpret the results from Forward Landfill, it was necessary to examine the numbers of gulls that occurred at other municipal solid waste landfills in the area that did not have intensive gull control programs in place. Two such landfills were examined by LGL personnel: Foothill Landfill and North County Landfill. Each of these landfills had some bird control measures (pyrotechnics) that were used sporadically and North County used remote-controlled model airplanes and gliders on several mornings per week. However, the control efforts at the two landfills were by no means comparable to the program at Forward Landfill. Each landfill survey covered about a 3-hour period.

The **North County Landfill** is located approximately 18.5 miles NNE of the Forward Landfill (Figure 2). It was surveyed on 22 occasions from 27 October 2014 to 28 May 2015 (Table 3). During the October through mid-December period, the landfill supported 300-500 gulls. There was an influx of migrants in late December (1600 gulls per survey on two surveys). The numbers returned to 200-500 in January through mid-February. Then the gulls began returning to the north and the numbers dropped to zero by early April (Table 3).

Figure 2. Locations of North County Landfill and Foothill Landfill

Gull use of the North County Landfill had increased over the first three years of study (2010-2013). During the November through March period, the average numbers of gulls per survey had increased from 709 in 2010-11, to 1,574 in 2011-12, to 2,462 in 2012-13. The average numbers of gulls per survey in the November 2014-March 2015 period was 456.6 gulls. This was a significant reduction from earlier years and was a function of the increased bird control efforts at that landfill.

The **Foothill Landfill** is located approximately 20.5 miles ENE of the Forward Landfill. It was surveyed 24 times from 9 October 2014 to 29 May 2015. Numbers of gulls were small (4 per survey) on 2 surveys in early to mid-October; the numbers from late October to mid-December ranged from 200 to 500 (Table 4). The main group of migrants returned in mid-December when 2,200 were present on the 18th. This was similar to the pattern at North County Landfill. Numbers remained high through January and February ranging from 1,500 to 3,500. Numbers began to diminish in March and April as birds returned to the north (Table 4).

Table 3. Surveys of North County Landfill near Stockton, California - 2014-2015.

Date	Time of Survey	Maximum # of Gulls	Comments
2014			
Mon, Oct 27	08:00-10:00	300	
Tues, Nov 25	07:15-09:15	500	
Fri, Nov 28	11:15-13:15	500	
Sat, Nov 29	07:00-09:00	500	
Thurs, Dec 18	11:00-13:00	500	
Mon, Dec 29	11:15-14:15	2,000	
Tues, Dec 30	08:00-10:00	1,200	
2015			
Wed, Jan 7	08:00-10:00	200	
Mon, Jan 12	11:45-13:45	300	
Tues, Jan 27	08:00-10:00	500	
Thurs, Feb 5	11:45-13:45	2	
Thurs, Feb 12	14:30-16:30	500	
Thurs, Feb 26	11:30-13:45	92	
Thurs, Mar 5	09:45-11:45	22	
Mon, Mar 16	12:30-14:30	14	
Mon, Mar 23	11:15-13:15	19	
Thurs, Apr 2	11:45-13:45	6	
Wed, Apr 15	11:45-13:45	0	
Mon, Apr 27	08:00-10:00	0	
Thurs, May 7	13:45-15:45	0	
Wed, May 20	13:45-15:45	0	
Thurs, May 28	14:00-16:00	0	

Table 4. Surveys of Foothill Landfill near Stockton, California - 2014-2015.

Date	Time of Survey	Maximum # of Gulls	Comments
2014			
Thurs, Oct 9	12:00-14:40	4	
Tues, Oct 21	07:15-09:15	4	
Mon, Oct 27	10:30-12:30	200	
Mon, Nov 10	11:00-13:00	500	
Tues, Nov 25	10:00-12:00	500	
Fri, Nov 28	08:30-10:30	200	
Mon, Dec 1	07:00-09:00	200	
Mon, Dec 8	09:15-10:45	200	
Thurs, Dec 18	08:00-10:00	2,200	
2015			
Tues, Jan 6	12:00-14:00	2,100	
Mon, Jan 19	09:00-11:00	1,500	Very Foggy
Tues, Jan 27	10:45-12:45	2,500	
Fri, Feb 6	07:00-09:00	2,800	
Thurs, Feb 12	11:45-13:45	3,500	
Thurs, Feb 26	08:30-10:30	1,160	
Thurs, Mar 5	07:00-09:00	470	
Tues, Mar 17	10:30-12:30	800	
Wed, Mar 25	08:00-10:00	1,500	
Thurs, Apr 9	09:15-11:15	14	
Thurs, Apr 16	07:00-08:45	189	
Mon, Apr 27	10:45-12:45	42	
Fri, May 8	07:30-09:30	203	
Thurs, May 21	13:45-15:45	225	
Fri, May 29	14:30-16:30	42	

During the first three years of the study, the average number of gulls per survey at Foothill Landfill during the November-March period was 1,077 in 2010-11, 2,087 in 2011-12, and 2,450 in 2012-13. The average number per survey in November-March in 2014-15 was 1,342 gulls. The differences in numbers from year to year is partly related to the timing of the migration. The main migration in 2014-15 was later than in some previous years when more birds were present in November and early December.

The results from North County and Foothill landfills clearly indicate that significant numbers of gulls use these landfills even though there were control efforts at each of the landfills. In both cases, there were significantly more gulls present than there were in the vicinity of the Forward Landfill during the same period. In addition, the gulls at North County and Foothill Landfills were feeding whereas those at Forward Landfill were scared away before they could feed. Therefore, the numerical data are not directly comparable. Furthermore, the numbers for North County and Foothill landfills are the averages of the peak numbers per survey. The closest comparisons from Forward Landfill are the averages of the peak numbers in Appendix 1. For example, over the five-month period (November-March.), the average peak number of gulls in the vicinity of the Forward Landfill was 12 gulls compared to the 1,342 at Foothill Landfill and 457 at North County that were actually feeding at those landfills. Also, the gulls at Forward Landfill scared away quickly or were flying past the landfill whereas the gulls at the other two landfills were present there for most of the day.

Where Did the Gulls from Forward Landfill Go?

The question was asked where did the gulls that formerly fed at Forward Landfill go when they were prevented from feeding at that landfill. A detailed assessment of this question has not been conducted because it would have required intensive effort to collect baseline data in previous years before the control program began. Clearly, many of the gulls from Forward now go to other landfills in the region and feed at other areas. All of the natural feeding areas on waterbodies and in fields are still used by gulls. In addition, other anthropogenic or human created feeding sites are used. For example, gulls are using the Waste Transfer Station in south Stockton, the Town of Manteca, and the Stockton Sanitation Ponds.

Gull Behavior at Night

Gulls spend the night at communal roosts on large bodies of water where they occur in dense flocks. The use of the night roosts is traditional with particular roosts being used year after year. Gulls do not feed at inland terrestrial areas at night and they do not feed at landfills at night. The latter fact has been demonstrated at many landfills. The best documented case is the Atlantic County Utilities Authority where waste is disposed of at night. There has not been a single gull seen at that coastal landfill during over 13 years of operation (Davis and Hixon 2011). Because of this nocturnal behavior, it is not necessary to control gulls at night at the Forward Landfill.

History of Bird Strikes at Stockton Metropolitan Airport (SCK)

The Federal Aviation Administration (FAA) maintains an extensive data base documenting wildlife/aircraft collisions at airports throughout the U.S. The FAA data base includes records beginning in 1990 and contained 172,370 strike records by 10 September 2015, the latest update. As of 10 September 2015, the data base contained records of 55 bird and mammal strikes associated with the Stockton Airport. It is well known that not all bird strikes are reported but the important strikes (those that affect flight, cause damage, etc.) are more likely to be reported than are strikes that cause no damage and often are not even detected by the flight crew. It is apparent that the airport has been much more diligent in reporting strikes in the past five years with 35 (64%) of the 55 strikes since 1990 recorded during that five-year period compared to 20 strikes (36%) in the previous 21-year period.

A summary printout of the 55 strikes at the Stockton Metropolitan Airport is included as Table 5. The Forward Landfill has been operating during the entire 26-year period covered by the FAA data base. For the 20 years before the fall and winter of 2010-2011, there was no bird control program in place at the landfill. Therefore, if the landfill was attracting birds that were a threat to aircraft safety, the strike data from the airport should reflect that risk. Gulls are the group of birds that are attracted to the landfill and could pose a threat to aircraft using the Stockton Airport. The 55 reported strikes (Table 5) are examined in the following paragraphs.

Thirty-three of the strikes involved identified birds that were not gulls. A thirty-fourth strike involved a gull carcass that was found on the airport on 28 October 2000; it was assumed to have been struck by an aircraft. Of the 20 strikes that involved unknown birds, 11 involved small birds that could not have been gulls. Of the 9 remaining strikes, 4 involved “medium” or “large” unknown birds and 5 involved “unknown bird or bat”. In theory, any of these 9 strikes could have involved gulls.

Two of the four incidents involving birds of unknown size involved military aircraft in June 2006. This is a period when gulls are not present in the Stockton area; thus these two strikes undoubtedly did not involve gulls. A third strike occurred at night (8 April 2013) when gulls have returned to the coast. A fourth strike occurred on 8 October 1991 when a military KC135 struck a bird on its landing roll at SCK. It is possible that the bird may have been a gull resting on the airport runway. The fifth strike involved a business jet on its landing roll on 31 December 2011.

The flight crew reported the strike at the time and must have seen the bird. Had it been a gull, it likely would have been reported as such or at least as a medium or large bird. A runway check was performed immediately after the incident but no carcass was found, again suggesting that a gull was not involved.

There were two strikes reportedly involving “large” birds and two involving birds of “medium” size. There was no information on the species involved although it should be noted that gulls are fairly easy to identify as gulls, if they are seen. Of the two incidents involving “large” birds, the first occurred on 23 April 2000 when most gulls have left the Stockton area. This involved a Cessna Citation II jet that struck a bird at 2000 ft while on climbout from Runway 29.

Table 5. Reported bird strikes at Stockton Metropolitan Airport; 1990-2015. (Data downloaded from FAA Wildlife Strike Database.)

Date	Airport	Airline	Aircraft	Bird Species
04/21/2015	Stockton Metro	Military	T-38	American Pipit
03/30/2015	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
03/28/2015	Stockton Metro	Unknown	Unknown	Killdeer
03/13/2015	Stockton Metro	Coast Guard	C-130	Horned Lark
10/10/2014	Stockton Metro	Business	Learjet 45	Unknown small bird
04/14/2014	Stockton Metro	Unknown	Unknown	Swainson's Hawk
04/10/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/31/2014	Stockton Metro	Military	C-12	Swainson's Hawk
03/29/2014	Stockton Metro	Allegiant Air	MD-83	Unknown small bird
01/14/2014	Stockton Metro	Unknown	Unknown	Rabbit
12/13/2013	Stockton Metro	Allegiant Air	MD-83	Red-tailed Hawk
11/19/2013	Stockton Metro	Business	C-340	Red-tailed Hawk
11/19/2013	Stockton Metro	Unknown	Unknown	Rock Pigeon
10/15/2013	Stockton Metro	Unknown	Unknown	European Starling
06/20/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
04/08/2013	Stockton Metro	Allegiant Air	MD-83	Unknown bird
02/22/2013	Stockton Metro	Military	C-12	Unknown bird or bat
12/02/2012	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
02/23/2012	Stockton Metro	Unknown	Unknown	Western Meadowlark
02/07/2012	Stockton Metro	Unknown	Unknown	Horned Lark
01/24/2012	Stockton Metro	Unknown	Unknown	Burrowing Owl
12/31/2011	Stockton Metro	Business	BE-400 BJET	Unknown bird
12/05/2011	Stockton Metro	Unknown	Unknown	Horned Lark
11/18/2011	Stockton Metro	Government	Lockheed C-130	Western Meadowlark
09/15/2011	Stockton Metro	Allegiant Air	MD-83	Turkey Vulture
07/30/2011	Stockton Metro	Unknown	Unknown	Barn Owl
06/28/2011	Stockton Metro	Unknown	Unknown	Barn Owl
05/28/2011	Stockton Metro	Unknown	Unknown	Horned Lark
05/27/2011	Stockton Metro	Allegiant Air	MD-83	American Kestrel
04/18/2011	Stockton Metro	Unknown	Unknown	Red-tailed hawk
02/15/2011	Stockton Metro	Privately Owned	C-414	White-tailed kite
01/02/2011	Stockton Metro	Allegiant Air	MD-83	Unknown bird-small
12/20/2010	Stockton Metro	Unknown	Unknown	Barn owl
08/02/2010	Stockton Metro	Unknown	Unknown	Tree Swallow
01/16/2010	Stockton Metro	Business	PA-46 Malibu	Unknown bird - large
12/28/2009	Stockton Metro	Business	Learjet-45	Unknown bird - medium
12/15/2008	Stockton Metro	Government	Lockheed C-130	Unknown bird - small
09/09/2008	Stockton Metro	Business	Citation X	Unknown bird - small
08/09/2008	Stockton Metro	Business	BE-400 BJET	Unknown bird - small
01/23/2008	Stockton Metro	Allegiant Air	MD-80	Unknown bird - medium
08/17/2006	Stockton Metro	Military	T-6A	Black vulture
06/19/2006	Stockton Metro	Military	KC-10A	Unknown bird or bat
06/08/2006	Stockton Metro	Military	C-130H	Unknown bird or bat
08/15/2003	Stockton Metro	Business	Citation X	Hawks
05/10/2001	Stockton Metro	Military	KC-135E	Unknown bird - small

Table 5 (concluded). Reported bird strikes at Stockton Metropolitan Airport; 1990-2013. (Data downloaded from FAA Wildlife Strike Database.)

11/20/2000	Stockton Metro	Business	BE-90 King	Unknown bird - small
11/02/2000	Stockton Metro	Unknown	Unknown	Great horned owl
10/28/2000	Stockton Metro	Unknown	Unknown	Gulls
04/23/2000	Stockton Metro	Business	Citation II	Unknown bird - large
01/18/2000	Stockton Metro	Military	T-38A	Horned lark
01/11/2000	Stockton Metro	Business	C-340	Sparrows
08/09/1999	Stockton Metro	Business	C-152	Owls
03/31/1997	Stockton Metro	Unknown	BD-19	Ducks
01/26/1993	Stockton Metro	Business	HWKR SD-125	Barn owl
10/08/1991	Stockton Metro	Military	KC-135R	Unknown bird or bat

The aircraft was west of the airport at the time. It made a precautionary landing with a small amount of damage. Given the time of year and the altitude of the strike, it is unlikely that a gull was involved. The second strike of an unknown "large' bird occurred on 16 January 2010 and involved a single-engine Piper 46 Malibu aircraft that was at an elevation of 2500 ft, 8-10 miles west of SCK on climbout from Runway 29. Given the altitude, it is unlikely that a gull was involved and given the location, it is unlikely that a bird from the landfill, which is east of the airport, was involved.

The two incidents involving unknown birds of "medium" size are discussed in this paragraph. The first involved an MD-80 twin-engine passenger jet that struck a bird at 400 ft while still over the airport on climb-out from Runway 29R on 23 January 2008. The pilot advised of the strike and continued on his flight with no damage to the aircraft. The second incident involved a Learjet 45, a small twin-engine business jet. The aircraft was on approach to Runway 29R in rain and fog on 28 December 2009. It broke out of the clouds and struck a bird over the runway. There was no damage and the strike had no effect on the flight.

In conclusion, of the 55 strike reports from Stockton Metropolitan Airport beginning in 1990, only one definitely involved a gull (carcass only) and three others might have involved gulls. Even allowing for significant under-reporting of bird strikes, four strikes at SCK in over 26 years with no damage reported indicates that the has not posed a significant threat to aircraft using the Stockton Metropolitan Airport.

Thirty-two of the reported bird strikes at SCK occurred since the gull control program was instituted at Forward Landfill. These strikes involved Barn Owls (3), a Burrowing Owl, a White-tailed Kite, Red-tailed Hawks (3), Swainson's Hawks (3), a Turkey Vulture, an American Kestrel, Horned Larks (4), Western Meadowlarks (2), a Killdeer, an American Pipit, a Rock Pigeon, a European Starling, unidentified small birds (4), and two unidentified birds. No gulls were involved and none of the birds struck were attracted to the area by the landfill.

Conclusions

The studies reported here were designed to assess whether the gull control program at the Forward Landfill continued to be effective in eliminating any hazard to aircraft caused by the attraction of birds to the landfill. The control program continued to be completely effective at

preventing gulls from feeding at, or otherwise using, the Forward Landfill. This was a huge reduction from the estimated 3,000 gulls that were present at the Forward Landfill in March 2010 when the pilot control program began. Observations at North County Landfill and Foothill Landfill indicated that large numbers of gulls continued to feed at these partially controlled landfills.

The study reported here has documented the continued complete effectiveness of the gull control program at Forward Landfill. The program is not experimental but rather it is fully-operational using control techniques that are well-established and are used operationally and effectively at several landfills. The conversion of the Forward Landfill to a fully-controlled facility will insure that no bird hazard is created by the landfill in the future.

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APPENDICES

Appendix 1. Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Sep 2014						
Mon 22	V.V.	2	8	4	gull sp.	1 flock controlled by each of falcon and pyro
Tues 23	V.V.	0	0	0		
Wed 24	V.V.	1	1	1	gull sp.	1 landed, scared off by falcon
Thurs 25	V.V.	3	33	28	gull sp.	2 flocks fly-by; flock of 28 controlled by falcon and pyro
Fri 26	V.V.	2	2	1	gull sp.	both were fly-bys
Sat 27	V.V.	1	2	2	gull sp.	fly-by
Mon 29	V.V.	1	2	2	gull sp.	controlled by falcon
Tues 30	V.V.	4	13	6	gull sp.	all flocks controlled by falcon
Oct 2014						
Wed 1	V.V.	2	2	1	gull sp.	one fly-by and one by falcon
Thura 2	V.V.	2	2	1	gull sp.	one controlled by falcon and other by pyro
Fri 3	V.V.	1	2	2	gull sp.	controlled by falcon
Sat 4	V.V.	0	0	0		
Mon 6	V.V.	3	11	6	gull sp.	All 3 controlled by falcon and pyros
Tues 7	V.V.	1	1	1	gull sp.	Controlled by falcon and pyro
Wed 8	V.V.	0	0	0		
Thurs 9	V.V.	1	2	2	gull sp.	flock controlled by falcon
Mon 13	V.V.	3	5	3	gull sp.	flock of 3 controlled by falcon; other 2 flocks controlled by pyro
Tues 14	V.V.	0	0	0		
Wed 15	V.V.	2	5	4	gull sp.	falcon used on large flock; pyro used on single bird
Thurs 16	V.V.	1	2	2	gull sp.	controlled by falcon
Fri 17	V.V.	1	4	4	gull sp.	controlled by falcon
Sat 18	V.V.	3	3	1	gull sp.	All controlled by pyro
Mon 20	V.V.	2	20	19	gull sp.	large flock controlled by falcon and pyro; single controlled by pyro
Tues 21	V.V.	0	0	0		
Wed 22	V.V.	1	4	1	gull sp.	controlled by falcon and pyro
Thurs 23	V.V.	4	29	11	gull sp.	flock of 11 was a fly-by; others controlled by falcon and pyro

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Fri 24	V.V.	3	34	32	gull sp.	flock 32 was a fly-by; two singles controlled by pyro
Sat 25	V.V.	1	7	7	gull sp.	flcok controlled by falcon
Mon 27	V.V.	5	5	1	gull sp.	one controlled by falcon and four by pyro
Tues 28	V.V.	3	36	32	gull sp.	all controlled by falcon and pyro
Wed 29	V.V.	2	2	1	gull sp.	1 floxk controlled by falcon; other controlled by pyro
Thurs 30	V.V.	2	8	6	gull sp.	1 flock (6 birds) dispersed by falcon; 1 flock (2 birds) by pyro
Fri 31	V.V.	2	3	2	gull sp.	1 flock controlled by falcon; 1 flock by pyro
Nov 2014						
Sat 1	V.V.	2	2	1	gull sp.	controlled by fpyro
Mon 3	V.V.	5	26	16	gull sp.	3 flocks (20 birds) controlled by falcon; 2 flocks (6 birds) controlled by pyro
Tues 4	V.V.	2	2	1	gull sp.	controlled by falcon
Wed 5	V.V.	2	2	1	gull sp.	both controlled by pyro
Thurs 6	V.V.	4	12	8	gull sp.	flock of 8 was a fly-by; 3 flocks (4 birds) controlled by pyro
Fri 7	V.V.	1	2	2	gull sp.	controlled by falcon
Sat 8	V.V.	2	5	3	gull sp.	two flocks controlled by falcon
Mon 10	V.V.	3	23	17	gull sp.	1 flock (5 birds) a fly-by; two flocks (18 birds) controlled with pyro
Tues 11	V.V.	4	17	7	gull sp.	all 4 flocks controlled by falcon
Wed 12	V.V.	4	41	32	gull sp.	3 flocks (40 birds) were fly-bys; one bird controlled by falcon
Thurs 13	V.V.	7	39	10	gull sp.	4 flocks (24 birds) controlled by falcon; 1 flock of 7 a fly-by; 2 flocks (8 birds) by pyro
Fri 14	V.V.	2	3	2	gull sp.	2 flocks controlled by falcon
Sat 15	V.V.	1	1	1	gull sp.	1 fly-by
Mon 17	V.V.	3	34	27	gull sp.	3 flocks (34 birds) controlled by falcon
Tues 18	V.V.	5	15	7	gull sp.	3 flocks (7 birds) controlled by falcon; 1 flock of 7 was a fly-by; and a single controlled by
Wed 19	V.V.	6	33	9	gull sp.	5 flocks (26 birds) controlled by falcon; one flock of 7 was a fly-by
Fri 21	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Sat 22	V.V.	4	62	21	gull sp.	3 flocks (58 birds) controlled by falcon; one flock of 4 birds bcontrolled by pyro
Mon 24	V.V.	4	7	3	gull sp.	3 flocks (5 birds) controlled by falcon; one flock of 2 birds controlled by pyro
Tues 25	V.V.	3	9	4	gull sp.	1 flock of 3 controlled by falcon; 1 flock of 2 controlled by pyro; 1 flock of 4 was a fly-by
Wed 26	V.V.	3	5	2	gull sp.	2 flocks (4 birds) controlled by falcon; one flock of 1 bird controlled by pyro
Thurs 27	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon
Fri 28	V.V.	2	8	4	gull sp.	2 flocks were fly-bys
Sat 29	V.V.	4	12	4	gull sp.	2 flocks (7 birds) controlled by falcon; 1 flock of 2 controlled by pyro; 1 flock of 3 was a fl

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Dec 2014						
Mon 1	V.V.	6	34	16	gull sp.	4 flocks (31 birds) controlled by falcon; 1 flock (1 bird) controlled by pyro; 1 flock (2) fly-by
Tues 2	V.V.	8	42	17	gull sp.	2 flocks (20 birds) controlled by falcon; 2 flocks (2 birds) by pyro; 4 flocks (20) fly-by
Wed 3	V.V.	6	57	17	gull sp.	5 flocks (55 birds) controlled by falcon; 1 flock (2 birds) fly-by
Thurs 4	V.V.	7	106	27	gull sp.	3 flocks (47 birds) controlled by falcon; 1 flock (1 bird) by pyro; 3 flocks (58 birds) fly-by
Fri 5	V.V.	8	64	18	gull sp.	3 flocks (22 birds) controlled by falcon; 1 flock (2 birds) by pyro; 4 flocks (40 birds) fly-by
Sat 6	V.V.	9	78	19	gull sp.	5 flocks (35 birds) controlled by falcon; 1 flock (6 birds) by pyro; 3 flocks (37 birds) fly-by
Mon 8	V.V.	9	54	12	gull sp.	4 flocks (20 birds) controlled by falcon; 1 flock (1 bird) by pyro; 4 flocks (33 birds) fly-by
Tues 9	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyro
Wed 10	V.V.	11	126	27	gull sp.	7 flocks (77 birds) controlled by falcon; 1 flock (1 bird) by pyro; 3 flocks (47 birds) fly-by
Thurs 11	V.V.	1	14	14	gull sp.	1 flock (14 birds) controlled by falcon
Fri 12	V.V.	3	45	22	gull sp.	1 flock (22 birds) controlled by falcon; 2 flocks (23 birds) fly-by
Sat 13	V.V.	6	86	31	gull sp.	6 flocks (86 birds) controlled by falcon
Mon 15	V.V.	9	243	80	gull sp.	7 flocks (214 birds) controlled by falcon; 2 flocks (29 birds) fly-by
Tues 16	V.V.	4	16	7	gull sp.	2 flocks (8 birds) controlled by falcon; 2 flocks (8 birds) by pyro
Wed 17	V.V.	4	13	4	gull sp.	2 flocks (6 birds) controlled by falcon; 2 flocks (7 birds) by pyro
Thurs 18	V.V.	4	37	12	gull sp.	3 flocks (35 birds) controlled by falcon; 1 flock (2 birds) by pyro
Fri 19	V.V.	2	4	2	gull sp.	2 flocks (4 birds) controlled by pyro
Sat 20	V.V.	0	0	0	gull sp.	
Mon 22	V.V.	5	77	33	gull sp.	3 flocks (72 birds) controlled by falcon; 2 flocks (5 birds) by pyro
Tues 23	V.V.	2	4	2	gull sp.	2 flocks (4 birds) by pyro
Wed 24	V.V.	2	15	10	gull sp.	2 flocks (15 birds) controlled by falcon
Fri 26	V.V.	2	30	18	gull sp.	1 flock (12 birds) controlled by falcon; 1 flock (18 birds) by pyro
Sat 27	V.V.	2	6	4	gull sp.	1 flock (4 birds) controlled by falcon; 1 flock (2 birds) by pyro
Mon 29	V.V.	14	121	20	gull sp.	6 flocks (57 birds) controlled by falcon; 4 flocks (54 birds); 4 flocks (10 birds) fly-by
Tues 30	V.V.	3	10	8	gull sp.	3 flocks (10 birds) fly-by
Wed 31	V.V.	9	17	5	gull sp.	2 flocks (4 birds) controlled by falcon; 6 flocks (8 birds) by pyro; 1 flock (5 birds) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Jan 2015						
Fri 2	V.V.	10	136	26	gull sp.	6 flocks (84 birds) controlled by falcon; 1 flock (6 birds) by pyro; 3 flocks (46 birds) fly-by
Sat 3	V.V.	5	15	7	gull sp.	3 flocks (5 birds) by pyro; 2 flocks (10 birds) fly-by
Mon 5	V.V.	4	9	3	gull sp.	2 flocks (4 birds) controlled by falcon; 1 flock (3 birds) by pyro; 1 flock (2 birds) fly-by
Tues 6	V.V.	4	6	3	gull sp.	3 flocks (3 birds) controlled by pyro; 1 flock (3 birds) fly-by
Wed 7	V.V.	3	7	3	gull sp.	1 flock (3 birds) controlled by falcon; 2 flocks (4 birds) fly-by
Thurs 8	V.V.	3	6	3	gull sp.	1 flock (3 birds) controlled by falcon; 1 flock (1 bird) by pyro; 1 flock (2 birds) fly-by
Fri 9	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Sat 10	V.V.	2	6	4	gull sp.	1 flock (4 birds) controlled by falcon; 1 flock (2 birds) fly-by
Mon 12	V.V.	0	0	0	gull sp.	Dense fog
Tues 13	V.V.	3	10	8	gull sp.	1 flock (1 bird) controlled by falcon; 1 flock (8 birds) by pyro; 1 flock (1 bird) fly-by
Wed 14	M.C.	4	4	1	gull sp.	1 flock (1 bird) controlled by falcon; 3 flocks (3 birds) by pyro
Thurs 15	M.C.	5	9	4	gull sp.	2 flocks (6 birds) controlled by falcon; 3 flocks (3 birds) by pyro
Fri 16	M.C.	7	28	12	gull sp.	3 flocks (15 birds) controlled by falcon; 4 flocks (13 birds) by pyro
Sat 17	M.C.	11	50	15	gull sp.	3 flocks (20 birds) controlled by falcon; 5 flocks (12 birds) by pyro; 3 flocks (18 birds)fly-by
Mon 19	V.V.	14	104	21	gull sp.	5 flocks (53 birds) controlled by falcon; 8 flocks (44 birds) by pyro; 1 flock (7 birds) fly-by
Tues 20	V.V.	13	121	33	gull sp.	2 flocks (40 birds) controlled by falcon; 6 flocks (35 birds) by pyro; 6 flocks (46 birds) fly-by
Wed 21	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by pyro
Thurs 22	V.V.	6	35	7	gull sp.	2 flocks (11 birds) controlled by falcon; 4 flocks (24 birds) by pyro
Fri 23	V.V.	6	6	1	gull sp.	6 flocks (6 birds) controlled by pyro; Dense fog.
Sat 24	V.V.	4	9	6	gull sp.	2 flocks (2 birds) controlled by pyro; 2 flocks (7 birds) fly-by. Dense fog.
Mon 26	V.V.	4	10	4	gull sp.	4 flocks (10 birds) controlled by pyro
Tues 27	V.V.	6	67	19	gull sp.	2 flocks (21 birds) controlled by falcon; 4 flocks (46 birds) fly-by
Wed 28	V.V.	5	8	2	gull sp.	5 flocks (8 birds) control by falcon
Thurs 29	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by. Very dense fog
Fri 30	V.V.	3	6	3	gull sp.	3 flocks (6 birds) controlled by falcon
Sat 31	V.V.	4	82	49	gull sp.	4 flocks (82 birds) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Feb 2015						
Mon 2	V.V.	2	3	2	gull sp.	2 flocks (3 birds) controlled by falcon
Tues 3	V.V.	3	5	2	gull sp.	3 flocks (5 birds)fly-by
Wed 4	V.V.	2	2	1	gull sp.	2 flocks (2 birds)fly-by
Thurs 5	V.V.	11	52	14	gull sp.	4 flocks (20 birds) controlled by falcon; 7 flocks (32 birds) fly-by
Fri 6	V.V.	9	65	40	gull sp.	6 flocks (19 birds) controlled by falcon; 1 flock (1 bird) by pyro; 2 flocks (45 birds) fly-by
Sat 7	V.V.	12	407	60	gull sp.	10 flocks (370 birds) controlled by falcon;1 flock (4 birds) by pyro; 1 flock (33 birds) fly-by
Mon 9	V.V.	8	1,045	300	gull sp.	7 flocks (1040 birds) control by falcon; 1 flock (5 birds) by pyro
Tues 10	V.V.	2	8	6	gull sp.	1 flock (6 birds) controlled by falcon; 1 flock (2 birds) by pyro
Wed 11	V.V.	4	27	14	gull sp.	2 flocks (6 birds) were controlled by falcon; 2 flocks (21 birds) fly-by
Thurs 12	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Fri 13	V.V.	3	6	2	gull sp.	2 flocks (4 birds) controlled by falcon; 1 flock (2 birds) by pyro
Sat 14	V.V.	0	0	0		
Mon 16	V.V.	2	6	4	gull sp.	2 flocks (6 birds) by pyro
Tues 17	V.V.	2	4	2	gull sp.	1 flock (2 birds) controlled by falcon; 1 flock (2 birds) fly-by
Wed 18	V.V.	3	6	4	gull sp.	2 flocks (2 birds) by pyro; 1 flock (4 birds) fly-by
Thurs 19	V.V.	4	9	3	gull sp.	3 flocks (6 birds) by pyro; 1 flock (3 birds) fly-by
Fri 20	V.V.	4	28	12	gull sp.	2 flocks (8 birds) controlled by falcon; 1 flock (1 bird) by pyro; 1 flock (12 birds) fly-by
Sat 21	V.V.	5	38	12	gull sp.	1 flock (7 birds) controlled by falcon; 1 flock (4 birds) by pyro; 3 flocks (27 birds) fly-by
Mon 23	V.V.	10	53	20	gull sp.	4 flocks (29 birds) controlled by falcon; 2 flocks (8 birds) by pyro; 4 flocks (16) fly-by
Mar 2015						
Mon 2	V.V.	4	32	15	gull sp.	3 flocks (30 birds) controlled by falcon; 1 flock (2 birds) fly-by
Tues 3	V.V.	0	0	0		
Wed 4	V.V.	0	0	0		
Thurs 5	V.V.	2	9	7	gull sp.	2 flocks (9 birds) fly-by
Fri 6	V.V.	0	0	0		
Sat 7	V.V.	0	0	0		
Mon 9	V.V.	3	15	7	gull sp.	3 flocks (15 birds) fly-by

Appendix 1 (continued). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Tues 10	V.V.	6	37	10	gull sp.	1 flock (7 birds) controlled by falcon; 5 flocks (30) fly-by
Wed 11	V.V.	5	62	21	gull sp.	3 flocks (44 birds) controlled by falcon; 2 flocks (18 birds) fly-by
Thurs 12	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by pyro
Fri 13	V.V.	6	69	22	gull sp.	3 flocks (42 birds) controlled by falcon; 3 flocks (27 birds) fly-by
Sat 14	V.V.	3	26	12	gull sp.	2 flocks (19 birds) controlled by falcon; 1 flock (7 birds) fly-by
Mon 16	V.V.	3	22	8	gull sp.	1 flock (6 birds) controlled by falcon; 2 flocks (16 birds) fly-by
Tues 17	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Wed 18	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Thurs 19	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by falcon
Sat 21	V.V.	1	10	10	gull sp.	1 flock (10 birds) controlled by falcon
Mon 23	V.V.	3	4	2	gull sp.	3 flocks (4 birds) controlled by falcon
Tues 24	V.V.	2	3	2	gull sp.	1 flock (2 birds) controlled by falcon; 1 flock (1 bird) fly-by
Wed 25	V.V.	0	0	0		
Thurs 26	V.V.	0	0	0		
Fri 27	V.V.	1	3	3	gull sp.	1 flock (3 birds) by pyro
Sat 28	V.V.	1	3	3	gull sp.	1 flock (3 birds) controlled by falcon
Mon 30	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by falcon
Tues 31	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by falcon
Apr 2013						
Wed 1	V.V.	0	0	0		
Thurs 2	V.V.	1	4	4	gull sp.	1 flock (4 birds) controlled by falcon
Fri 3	V.V.	0	0	0		
Mon 6	V.V.	1	14	14	gull sp.	1 flock (14 birds) controlled by pyro
Tues 7	V.V.	2	15	11	gull sp.	2 flocks (15 birds) controlled by falcon
Wed 8	V.V.	0	0	0		
Thurs 9	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by pyro
Fri 10	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Sat 11	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon

Appendix 1 (concluded). Summary of Daily Falconry Logs – Forward Landfill.

Date	Obs	# of flocks	Total # of gulls	Peak # of gulls	Species	Notes
Mon 13	V.V.	1	1	1	gull sp.	1 flock (1 bird) controlled by falcon
Tues 14	V.V.	1	2	2	gull sp.	1 flock (2 birds) controlled by falcon
Wed 15	V.V.	2	4	3	gull sp.	1 flock (1 bird) controlled by falcon; 1 flock (3 birds) fly-by
Thurs 16	V.V.	1	1	1	gull sp.	1 flock (1 bird) fly-by
Mon 20	V.V.	1	14	14	gull sp.	1 flock (14 birds) controlled by falcon

Appendix 2. Results of independent surveys of the Forward Landfill - 2014-2015.

Date		Time of Survey	# of hours	# of control events	# of gulls	Notes
Oct 2014						
Fri 3	JD	07:00-11:00	4	1	2	1 flock (2 gulls) controlled by falcon; no other gulls seen
Thurs 9	JD	06:55-11:00	4	0	0	
Sun 12	JD	08:45-12:45	4	0	43	1 flock (43 birds) was a fly-by
Fri 17	JD	07:00-11:00	4	1	7	1 flock (4 birds) controlled by falcon; 1 flock (3 birds) was a fly-by
Tues 21	JD	10:15-14:15	4	0	0	
Mon 27	JD	14:00-18:00	4	0	3	1 flock (3 birds) was a fly-by
Nov 2014						
Thurs 6	JD	07:00-11:00	4	1	2	1 flock (2 gulls) controlled by falcon; no other gulls seen
Mon 10	JD	13:30-17:30	4	0	0	No gulls seen
Tues 11	JD	07:00-11:00	4	2	15	Includes 3 flocks (9 birds) fly-by
Sun 16	JD	11:00-15:00	4	0	1	Gull was a fly-by
Mon 24	JD	09:15-13:15	4	2	2	No other gulls seen
Sat 29	JD	09:45-13:45	4	1	6	Includes 1 flock (2 gulls) fly-by
Dec 2014						
Mon 1	JD	10:00-14:00	4	5	37	Includes 1 flock (3 gulls) fly-by
Mon 8	JD	11:50-15:50	4	6	74	Includes 2 flocks (41 birds) fly-by\
Sun 21	JD	08:15-12:15	4	0	151	Includes 9 flocks (151 birds) fly-by
Mon 29	JD	07:30-11:30	4	9	119	Includes 3 flocks (9 birds) fly-by
Tues 30	JD	10:30-14:30	4	4	19	Includes 3 flocks (4 birds) fly-by
Wed 31	JD	07:10-11:10	4	7	20	Includes 5 flocks (10 Birds) fly-by
Jan 2015						
Sun 4	JD	09:00-13:00	4	0	30	Includes 4 flocks (30 birds) fly-by
Tues 6	JD	07:15-11:15	4	2	4	Includes 2 flocks (2 birds) fly-by
Wed 7	JD	11:00-15:00	4	0	0	No gulls seen at landfill. 32 gulls on airport near end of runway at Arch Road
Mon 12	JD	07:00-11:00	4	0	8	Includes 1 flock (8 birds) fly-by
Fri 23	JD	08:00-12:00	4	2	2	
Sat 24	JD	07:30-11:30	4	3	13	Includes 2 flocks (9 birds) fly-by
Fri 30	JD	07:00-11:00	4	2	4	

Appendix 2 (continued). Results of independent surveys of the Forward Landfill - 2014-2015.

Date		Time of Survey	# of hours	# of control events	# of gulls	Notes
Feb 2015						
Thurs 5	JD	07:00-11:00	4	6	44	Includes 4 flocks (21 birds) fly-by
Thurs 12	JD	07:00-11:00	4	1	2	includes 1 flock (1 bird) fly-by
Fri 13	JD	09;00-13:00	4	3	25	Includes 2 flocks (20 birds) fly-by
Sun 15	JD	08:00-12:00	4	0	65	9 flocks (65 birds) fly over landfill. No birds land at landfill.
Fri 20	JD	13:30-17:30	4	2	5	Includes 1 flock (3 birds) fly-by
Mon 23	JD	06:15-10:15	4	6	76	Includes 4 flocks (21 birds) fly-by
Mar 2015						
Wed 4	JD	07:00-11:00	4	0	7	Includes 2 flocks (7 birds) fly-by
Sun 15	JD	07:45-11:45	4	0	47	Includes 5 flocks (47 birds) fly-by
Mon 16	JD	07:45-11:45	4	0	29	Includes 4 flocks (29 birds) fly-by
Tues 17	JD	13:00-17:00	4	0	0	No gulls seen
Mon 23	JD	06:30-10:30	4	2	10	includes 4 flocks (7 birds) fly-by
Wed 25	JD	10:45-14:46	4	0	0	No gulls seen
Apr 2015						
Thurs 2	JD	07:00-11:00	4	1	4	
Mon 6	JD	06:30-10:30	4	1	4	
Thurs 9	JD	12:00-16:00	4	0	0	No gulls seen
Wed 15	JD	07:00-11:00	4	1	1	
Thurs 16	JD	09:45-13:45	4	0	0	
Sun 26	JD	08:00-11:00	0	0	0	
May 2015						
Thurs 7	JD	09:00-13:00	4	0	0	No gulls seen
Fri 8	JD	10:15-14:15	4	0	0	No gulls seen
Wed 20	JD	09:00-13:00	4	0	0	No gulls seen
Thurs 21	JD	09:00-13:00	4	0	0	No gulls seen
Thurs 28	JD	09:15-13:15	4	0	0	No gulls seen
Fri 29	JD	09:45-13:45	4	0	0	No gulls seen

Appendix 2 (concluded). Results of independent surveys of the Forward Landfill - 2014-2015.

Date		Time of Survey	# of hours	# of control events	# of gulls	Notes
Jun 2015						
Thurs 4	JD	09:00-13:00	4	0	0	No gulls seen
Sun 7	JD	10:00-14:00	4	0	0	No gulls seen
Thurs 18	JD	10:30-14:30	4	0	0	No gulls seen
Fri 19	JD	09:30-13:30	4	0	0	No gulls seen
Thurs 25	JD	07:00-11:00	4	0	0	No gulls seen
Fri 29	JD	07:15-11:15	4	0	0	No gulls seen
Jul 2015						
Thurs 9	JD	07:30-11:30	4	0	7	1 flock (7 birds) circled site at 200ft and flew off to NE
Mon 13	JD	08:00-12:00	4	0	1	One circled site at 100 ft and then flew off
Wed 15	JD	07:45-11:45	4	0	0	No gulls seen
Sun 19	JD	11:30-15:30	4	0	0	No gulls seen
Thurs 23	JD	09:30-13:30	4	2	8	Includes 2 flocks (4 birds) fly-by; 2 flocks (4 birds) controlled with pyro
Sat 25	JD	08:45-12:45	4	3	11	Includes 2 flocks (4 birds) fly-by; 3 flocks (7 birds) controlled with pyro

EDUCATION

1972	Ph.D. Animal Ecology, University of Western Ontario.
1964	Graduate courses in Wildlife Biology, University of Guelph.
1963	B.A. Geography, University of Toronto.

PROFESSIONAL EXPERIENCE

2017 -	Director, Senior Consultant, LGL Limited
2005 - 2016	Executive Chairman, LGL Limited
1979 - 2005	President and CEO of LGL Limited
1974 - 1979	Vice-President, Operations, and Director, Eastern Region, LGL Limited
1972	Joined LGL Limited.

Ornithological Studies

- Conducted a five-year review of gull populations associated with the Trail Road Landfill and the Ottawa International Airport.
- Advised the airport on design of a new thoroughbred racetrack on property adjacent to the Edmonton International Airport to reduce attractions to birds.
- Designed and implemented programs to control Turkey Vultures in Michigan and Illinois.
- Member of the Steering Committee of the Bird Strike Association of Canada (BSAC). The BSAC is recognized by Transport Canada and ICAO as the official bird strike organization in Canada.
- Senior Advisor for an audit of the SMS Wildlife Control Program at St. John's International Airport.
- Continued for the 20th consecutive year, monitoring of gull control program at the Atlantic County Utilities Authority Landfill near the Atlantic City International Airport and the FAA Technical Center.
- For the Aerodrome Safety Branch of Transport Canada, conducted a critical review of the efficacy of all known bird hazard control techniques available for use on airport
- Advised on bird hazard issues associate with the rehabilitation of a landfill adjacent to the St. Louis International Airport and designed a bird control program to minimize any bird hazards to aircraft using the airport.
- Continued monitoring of the gull control program and assessing bird hazard to aircraft safety associated with the Orchard Hills Landfill, near the Chicago-Rockford Airport (19 years).

- Provided senior design input for program to control gull nesting on the rooftops in the Bruce Nuclear Station.

- Senior scientist on program to monitor the attractiveness of offshore oil production platforms to seabirds on the Grand Banks. A related study developed techniques for monitoring the attractiveness to Leach's Storm-Petrels of gas flares on the offshore platforms at night.

- Continued monitoring of the gull control program and assessing bird hazard to aircraft safety associated with the Winnebago Landfill near the Chicago-Rockford Airport (13 years).

- Directed a one-year study of gull populations and movements at a landfill near the Edmonton International Airport and conducted follow-up studies associated with a new control program.

- Conducted an analysis of the potential effects of a proposed landfill on the safety of aviation at a nearby General Aviation Airport in Rockingham County, North Carolina.

- Implemented a gull control program at a major landfill near Houston gaining control of the landfill, turning the control over to landfill staff, and then monitoring the continued success of the control program.

- Assessed the bird hazard to aircraft safety risks associated with a landfill near an airport in central California and designed a bird control program to eliminate potential risks. Success of program monitored for 6 years to date.

- Designed, implemented, conducted and monitored a gull control program at a landfill in Calgary, Alberta (2010-2012).

- Conducted a Stage 1 Safety Assessment of proposed landfill sites near the airstrip in Arviat, Nunavut.

- Provided an independent assessment of a proposed bird control program to be implemented at the Yellowknife Landfill in the Northwest Territories.

- Assessed the potential for disturbance effects from a coastal marina on migrating Red Knots.

- Conducted an assessment of the proposed expansion of the Bracebridge Landfill on the safety of aircraft using the Muskoka Airport.

- Completed a one-year study of bird populations associated with a landfill in the Galveston, Texas area and designed a gull control program to be implemented by landfill staff.

- Reviewed and upgraded a bird control program in place in Lansing, Michigan to assure that it continued to provide protection to aircraft using the Lansing Airport.

- Provided advice on the design and operation of a dredging program in Hamilton Harbour to reduce the effects on colonial nesting birds and migrating waterfowl in the area.

- Conducted a one-year study of bird use of the largest Houston-area landfill to provide a baseline against which the success of a bird control program could be measured. Designed and implemented the bird control program and monitored its success for one year.

- Conducted three-year study of bird populations in support of a proposed new landfill in western Pennsylvania. Assisted with applications to the state regulatory body.

- Conducted a 14-month study of bird use of the Pagel Landfill in Winnebago County, IL, provided input to a permit application, and designed a bird control program to be implemented at the landfill. The activities were in support of an application for a landfill expansion. The success of the bird control program was monitored for 3 years.

- Conducted a study of gull populations at the Atascocita Landfill near the Houston International Airport, provided input to a permit application, and developed a bird control program in support of an application for a landfill expansion. Subsequently implemented the bird control program as part of a permit condition. Monitoring continued for 4 years.

- Provided advice to Transport Canada on land-use zoning regulations (under the federal Aeronautics Act) that were put in place near the Pickering Airport Site to reduce bird hazards to aircraft safety. Project included field studies, determination of safety zones and hazardous land-uses, and mitigation measures that could be put in place to reduce hazards.

- Represented Thurston County, Washington (near Olympia) in a lawsuit about alleged damages caused by birds attracted to their recently closed landfill. The case was settled after "examination for discovery" of Dr. Davis. Subsequently provided testimony for an insurance company involved in a dispute over the settlement.

- Monitored the bird control program designed and initiated by LGL Limited at BFI's Tower Landfill in 1993. The control program was continuously monitored and was highly successful for the next 17 years.

- Participated in a formal System Safety Review at the Vancouver International Airport to evaluate potential bird hazards arising from land-uses in areas surrounding the airport.

- Evaluated vulture use of a landfill on the coastal plain of the Gulf of Mexico in Texas in relation to a lawsuit. The lawsuit was settled.

- Conducted a full-year study of bird populations at several landfills and bird attractions in western Pennsylvania in preparation for an application to re-open a presently closed landfill. The project involved bird surveys in two subsequent years, research on vulture control at landfills, preparation of permit application materials for the state and for the FAA, and design of a bird control program for use at the site.

- Conducted a Stage 1 Safety Analysis regarding a proposed First Nation landfill at North Spirit Lake in northern Ontario.

- Evaluated bird use of the Anguilla Landfill in St. Croix, U.S. Virgin Islands in response to concerns raised by the FAA about bird hazards to aircraft safety at the adjacent airport, the main international airport on the island. Prepared short-term and long-term bird control plans for the landfill.

- Conducted a study of bird use at a transfer station near the Dover Air Force Base in Delaware and provided expert testimony at regulatory hearings.

- Demonstration of methods to control vultures, crows and starlings at a landfill in western Pennsylvania.

- Assessed potential bird hazards to aircraft safety associated with two proposed sites for a food-waste composting facility in the vicinity of CFB Trenton, the main air transport base for the Canadian Forces.

- Conducted a site assessment and design evaluation of a proposed solid waste transfer station to be constructed near the DuPage Airport in DuPage County, Illinois.

- Conducted Stage 1 Safety Analyses regarding proposed First Nation landfills at Poplar Hill and at Deer Lake in northern Ontario.

- Developed a national model for use by Transport Canada (the regulatory agency) at airports across Canada to control land-use surrounding airports. The model accounts for aircraft flight patterns, altitudes and risk; bird types, numbers and behavior; types of land-uses and their location in relation to high risk safety zones. Wrote guideline material for use by Transport Canada in controlling hazardous land-uses near Canadian airports.

- Conducted Stage 1 and Stage 2 Safety Analyses in conjunction with the proposed Couchiching First Nation Landfill in northwestern Ontario.

- Assessed bird hazards to aircraft safety at the Bluefields Airport, Nicaragua.

- Project Director for a study of fall staging Snow Geese on the Yukon North Slope during the fall of 2001.

- Project Director for a reconnaissance survey of molting waterfowl along the Yukon coast in summer 2001.

- Assessed potential bird hazards to aircraft safety associated with new landfills proposed for Rankin Inlet and Repulse Bay in Nunavut, Canada

- Project Director for an intensive survey of birds in the Mackenzie River Delta and a reconnaissance level survey along the Mackenzie River Valley south to northern Alberta. The studies were in support of an application to construct a natural gas pipeline up the valley.

- On behalf of the Thunder Bay Airport Authority, conducted a risk assessment of bird hazards to aircraft safety at the airport. The report included recommendations for reducing risks that were mostly associated with birds adjacent to the airport.

- Conducted a bird hazard study and associated risk assessment to serve as the basis for aeronautical zoning around the Pickering Airport site northeast of Toronto. Developed a protocol for determination of acceptable mitigation measures to reduce bird attractions at various land-uses near the airport site.

- Provided an independent review of the bird control program for the Tri-County Landfill for the Pennsylvania Department of Environmental Protection, the landfill regulator in Pennsylvania.

- Project Director for a study of bird-use of Ottawa's main landfill (Trail Road Landfill) and the relation of gulls using the landfill to existing bird hazard problems at the Ottawa International Airport. The landfill was granted approval for its expansion.

- Project Director for a three-year study of land-uses around airports in Canada for Transport Canada. Recommended changes to policies controlling these land-uses and improved methods for control of the bird hazard to aircraft safety issue.

- Continuing Consultant to Canada's Department of National Defence on matters relating to potential bird hazards associated with storm water management ponds on lands near the helicopter base at CFB Edmonton.

- Provided advice on the siting of a landfill near a Royal Australian Air Force Base near Brisbane, Australia.

- Assessed gull use of a landfill near Morris, Illinois including night roosting locations, flight lines, and numbers and species at the landfill. Results were related to aircraft safety issues at a nearby General Aviation airport.

- Provided an independent review of a planned bird control program for the proposed Jefferson County Landfill. The review was for the state regulator, the Pennsylvania Department of Environmental Protection.

- Project Director for an assessment of potential bird hazards to aircraft safety associated with a new landfill near the airport at Fort Severn, Ontario along the coast of Hudson Bay.

- Conducted an assessment of potential habitat for Cooper's and Red-shouldered Hawks on a proposed development site in the New Jersey Pinelands.

- Assessed potential bird hazard to aircraft safety issues associated with the site-selection process for a new landfill on lands of the Kasabonika Lake First Nation in Northern Ontario.

- Evaluated bird hazard to aircraft safety issues related to a proposed new landfill at Sachigo Lake on lands of the Windigo First Nation in Northern Ontario.

- Preliminary assessment of bird control issues at the Cedar Hills Landfill near Seattle, Washington.

- Project Director for an assessment of potential bird hazards to aircraft safety associated with a new landfill at Moosonee, Ontario near the coast of James Bay.

- Evaluated potential bird hazards to aircraft safety associated with a proposed waste Transfer Station near Logan International Airport at Boston, MA. Provided expert testimony at regulatory hearings.

- On behalf of the Greater Toronto Airports Authority, conducted a critical review of the existing wildlife control program at a major international airport (Lester B. Pearson International Airport) and recommended changes and improvements to be included in the Terms of Reference for renewal of the program. The review was designed to meet forthcoming changes to the airport certification requirements of Transport Canada.

- Evaluated the efficacy of techniques for excluding deer from airports for the Aerodrome Safety Branch of Transport Canada the agency regulating air safety in Canada.

- Designed and implemented a successful gull control program at the Atlantic County, New Jersey, landfill located about 2 miles from the end of the main runway at Atlantic City International Airport. The program is monitored by LGL Limited and the success is overseen by a committee of representatives from the Federal Aviation Administration, U.S. Air Force, Air National Guard, Atlantic City Airport, U.S. Department of Agriculture, State of New Jersey, ACUA, and LGL Limited. Intensive monitoring continues and the program remains successful in its sixth year (2003).

- Conducted a 15 month baseline study of gull populations in the vicinity of the new Denver International Airport in Colorado and then designed, instituted and monitored a gull control program at a nearby landfill. The control program has been monitored for a period of ten years (to 2003) and continues to be successful.

- Prepared the bird monitoring and management plan mandated by the regulatory agency for the Orchard Hills Landfill near Rockford, Illinois. Subsequently conducted the 3-year monitoring program and two additional years to 2003.

- Prepared two chapters for Transport Canada's Bird Control Handbook. Sharing the Skies published in 2001.

- Assessed the potential bird hazard to aircraft impacts of construction of a thoroughbred race track immediately adjacent to the Calgary International Airport.

- Reviewed the potential effects on marine birds of a possible shipping-related oil spill in Placentia Bay and off southern Newfoundland for the Terra Nova Offshore Development Project. Possible rehabilitation of oiled birds and other methods of mitigation were examined.

- Conducted a preliminary evaluation of potential bird hazards to aircraft safety associated with potential expansions of two landfills in San Diego County, California.

- Documented gull population over a one year cycle and assessed potential bird hazards to aircraft associated with proposed landfill sites in Brown County (Green Bay), Wisconsin.

- Monitored the effectiveness of the bird control program at the Niagara Road 12 Landfill, Grimsby, Ontario.

- Conducted studies of bird hazards to aircraft and bird nuisance issues related to a major regional landfill for the Region of York/Metropolitan Toronto area for the Interim Waste Authority Ltd. Fieldwork included full year studies of gull feeding, nesting and roosting locations and flightlines among them.

- Conducted studies on bird hazards to aircraft and bird disease and nuisance issues associated with the site selection process for a major regional landfill near Toronto International Airport in Peel Region for the Interim Waste Authority Ltd. Fieldwork included full year studies of gull behaviour including flightlines, night roosting, landfill use, and nesting areas.

- Provided advice on the location of a food waste composting facility at CFB Cold Lake, Alberta for National Defence Headquarters.

- Evaluated gull use of a small landfill in the western suburbs of Chicago, IL.

- Designed and monitored a bird control program for the new Rosser Landfill north of the Winnipeg International Airport.

- Reviewed the available information about the large bird populations along the Toronto waterfront and assessed the potential bird hazards associated with an expansion of the Toronto City Centre Airport (formerly called the Toronto Island Airport).

- Evaluated bird hazard to aircraft issues at the City of Harlingen, Texas landfill and recommended gull control measures.

- Conducted a 6-month study of gull and crow numbers, movements and behaviour in the Chatham, Ontario area to determine whether a proposed landfill expansion would jeopardize air safety at the Chatham Airport. Safety was improved by eliminating a substantial gull nesting colony at the existing landfill. LGL subsequently designed a bird control program for implementation at the expanded landfill.

- Designed and implemented a gull control program at a sanitary landfill in Biloxi, Mississippi.

- Assessed potential bird hazard to aircraft issues associated with a new landfill near the Rhinelander Airport in Oneida County, north-central Wisconsin and conducted a one year study of gulls in the area.

- Evaluated potential bird nuisance and health effects associated with the proposed expansion of the Ridge Landfill, Chatham, Ontario.

- On behalf of National Defence Headquarters, provided a critical analysis of an environmental assessment and bird control plan for a landfill off the end of the main runway at CFB Trenton. Provided testimony at subsequent hearings conducted by the Ontario Environmental Assessment Board.

- Participated in the development of a revised bird control plan to allow for the safe operation of Vancouver International Airport after the approximate doubling of its runway capacity.

- Designed a bird control plan for an ash and by-pass landfill near the Huntsville (Alabama) International Airport.

- Advised a large waste management company on possible bird hazards to aircraft problems associated with a potential landfill site in the Atlanta, Georgia region.

- Assessed potential bird hazards to aircraft safety associated with the new Gaza International Airport, Palestine.

- Evaluated potential bird hazards to aircraft associated with a landfill expansion near the Shell Lake Municipal Airport, in northwestern Wisconsin.

- Evaluated potential bird hazards to aircraft associated with a landfill expansion near a small airstrip in southeastern Wisconsin.

- Evaluated potential bird hazards to aircraft safety associated with large concentrations of bald eagles along a salmon spawning river near the Squamish, B.C. Airport.

- Conducted a preliminary survey of gull populations and movements in the Kirkland Lake region of Ontario.

- Directed and conducted the field phase and analysis of LGL's 18 month study of bird populations at the proposed new Toronto International Airport (Pickering) for Canada Ministry of Transport. The study in 1972-73 also involved detailed studies of gull movements and radar assessments of bird hazards to aircraft.

- Conducted a one year study of potential bird hazards to aircraft associated with a landfill expansion near Troy, Wisconsin.

- Evaluated potential bird hazards to aircraft associated with a Wet-Dry Recycling Facility near the Guelph Air Park, devised a bird control plan, and monitored the results during construction and operation of the facility. The project included 3 years of gull baseline and monitoring studies.

- Conducted a study of gull numbers and movements in relation to landfills near the Collingwood Municipal Airport for the Town of Collingwood and provided advice on landfill siting to Simcoe County.

- Conducted an 8 month, and a subsequent 2 month, study of bird hazards to aircraft using the Winnipeg (Manitoba) International Airport. The studies and assessments involved two existing landfills and a proposed new landfill.

- Advised L.B. Pearson International Airport (Toronto) on management of stormwater ponds to minimize bird hazards to aircraft.

- Advised Transport Canada on potential hazards from stormwater ponds proposed near Pearson International Airport in Toronto.

- Assessed the potential bird hazards to aircraft safety associated with several proposed sites for new sewage lagoons at Moosonee, ON, at the south end of James Bay.

- Evaluated the potential bird hazard to aircraft concerns associated with a food waste composting facility located near the Oshawa Airport.

- For Transport Canada, documented the need for bird hazard zoning and recommended the extent of zoning restrictions required on lands surrounding L.B. Pearson International Airport (Toronto).

- Advised on the design, conduct and reporting of LGL's 18-month scientific evaluation of the overhead wire system as an effective measure to control gull use of a landfill site in Niagara Falls.

- Supervised LGL's input to the design (overhead wires) and operation of bird control measures at a new landfill operated by the City of Anchorage near a U.S. Army air base.

- Responsible for the design of an operational bird (gull) control management plan to meet FAA specifications at a landfill site near Niagara Falls International Airport.

- Conducted a one year study of bird hazards to aircraft, bird related health hazards, and agricultural damage caused by gulls at landfills in the Essex-Windsor area and reviewed gull control options.

- Revised manual entitled "Airfield Grounds Management - Reduction of Bird Hazards" for Canada Department of National Defence.

- On behalf of Transport Canada, reviewed proposed bird management plan for a federal conservation area adjacent to Vancouver International Airport.

- Evaluated the effectiveness of the taste aversive ReJeX-iT for reducing gull numbers at Metropolitan Toronto's main landfill.

- Conducted gull studies and assessed potential bird hazards to aircraft associated with the expansion of the Ridge Landfill near the Chatham airport in southwestern Ontario.

- Assessed potential bird hazards to aircraft associated with a golf course development and a recreational club near the Oshawa Airport.

- Assessed gull use of athletic fields at Marquette University in Milwaukee, Wisconsin and recommended methods for excluding the gulls.

- Provided an assessment of potential bird hazards to aircraft associated with potential landfill sites in North Simcoe County.

- Assessed potential bird hazards and bird nuisance concerns related to the proposed landfill in an open pit mine near Kirkland Lake in northern Ontario.

- On behalf of Transport Canada, conducted a study of winter gull numbers and movements in St. John's, Newfoundland and assessed the effects of major movements on the safety of aircraft using the St. John's Airport. A second study examined the situation in the June-September period.

- Evaluated bird hazard to aircraft issues associated with the Fall River, Massachusetts airport and adjacent landfill.

- Conducted a one year monitoring program to determine the numbers, movement patterns, and towering behaviour of gulls near the Grimsby Airpark before the approved new Niagara Road 12 Landfill was constructed.

- Assessed the bird hazard to aircraft implications of the re-opening of the Quinte Landfill off the end of the runway at CFB Trenton.

- Advised Canada Department of National Defence on bird hazard issues related to registered airport zoning regulations around CFB Greenwood and CFB Shearwater in Nova Scotia, CFB Trenton in Ontario, CFB Edmonton (Namao) in Alberta, and CFB Comox in BC.

- Designed a bird control plan for an industrial waste treatment facility (WDRF at Guelph) in Southern Ontario.

- Studied bird hazards to aircraft associated with a landfill in northeastern Illinois.

- On behalf of the Vancouver Airport Authority, reviewed bird hazard to aircraft implications of the proposed Sea Island Conservation Area adjacent to the new runway at the Vancouver (B.C.) International Airport.

- Designed a bird management plan for a landfill that was adjacent to a National Wildlife Refuge in SW Louisiana.

- Provided an independent assessment of potential gull problems associated with a proposed landfill near Hamilton at the west end of Lake Ontario and appeared at Joint Board hearings.
- Evaluated gull control options for the proposed Essex-Windsor Regional Landfill in SW Ontario.
- Designed and monitored the effectiveness of a gull control program at the Foothills Landfill in the foothills near Denver, Colorado.
- Conducted a one year monitoring program of the effectiveness of a gull control program at the Britannia Landfill, near Toronto, Ontario.
- Principal investigator on a literature synthesis to determine bird deterrent methods that would be effective at preventing birds from becoming oiled during an oil spill in the Beaufort Sea.
- Evaluated potential bird hazards to aircraft at a proposed new landfill near the Richmond Airport in Virginia. The study included a one year gull monitoring program.
- Advised on a bird control program for a major new landfill in Halton Region, west of Toronto, Ontario.
- Conducted a full year study to document potential bird hazards to aircraft associated with a landfill expansion near the Rockford, Illinois airport. Presented evidence at the associated regulatory hearings.
- Evaluated bird hazards to aircraft at the LaCrosse (Wisconsin) Municipal Airport.
- Evaluated the relative bird hazards to aircraft at several proposed landfill sites in southern Michigan.
- Assessed potential bird populations at a proposed landfill site near a municipal airport in western Pennsylvania.
- Evaluated bird hazards to aircraft and prepared a gull control plan for a waste transfer station near Atlantic City International Airport.
- Studied gull numbers and movements in relation to a proposed landfill near the Dane County Airport at Madison, Wisconsin and prepared a gull control program for the site.
- Evaluated bird hazards to aircraft at a proposed new regional airport in central Ontario.
- Participated in a one year study of gull populations at an airport used by light aircraft near a major new regional landfill site in Halton Region.
- Developed a bird control program for a landfill near the Jacksonville (Florida) International Airport and provided expert testimony at hearings.

- Participated in LGL's studies of bird hazards to aircraft associated with the proposed expansion of the runway system at Vancouver International Airport.

- Prepared a bird control plan for a proposed major regional landfill site near Toronto's Pearson International Airport and assessed gull movements in the vicinity for the Regional Municipality of Peel.

- Provided technical assessment and expert testimony at hearings regarding a landfill site and waste recovery facility adjacent to the FAA Technical Center airport in Atlantic County, N.J.

- Independent monitor of a one-year bird control program at a large regional landfill (Britannia) near Toronto's International Airport.

- Provided technical evaluation of bird hazards to piston-engine aircraft using a small airport near a landfill in the Niagara Peninsula of Ontario and conducted a one year baseline study prior to monitoring the effects of a new landfill.

- Evaluation of the effects of road-building on colonies of Great Blue Herons and design of mitigation measures.

- Senior input to three year program to monitor populations of sea-associated birds in the Alaskan Beaufort Sea and in Kasegaluk Lagoon, Chukchi Sea.

- Evaluated the existing gull populations and movements and bird hazards to aircraft at the Niagara Falls International Airport.

- Documented gull use of areas near a proposed landfill site in Peel Region and gull use of major uncontrolled landfills in the vicinity.

- Coauthor of the reports on a series of studies of the effect of aircraft disturbance on bird populations. Component studies included effects on

    - staging Snow Geese,
    - terrestrial bird populations,
    - nesting waterfowl (Brant, Common Eider, Glaucous Gull, and Arctic Tern),
    - moulting sea ducks, and
    - waterfowl in the Mackenzie Valley.

- Co-author of a series of studies on the effects of a fixed noise source (gas compressor simulator) on bird populations. Component studies addressed effects on staging Snow Geese and on terrestrial breeding birds.

- Evaluated the effect of human disturbance on breeding terrestrial birds on the Yukon North Slope and breeding populations of loons, geese and Herring Gulls for three years in the Hudson Bay lowlands.

- Conducted a four year study of the comparative behaviour and ecology of Arctic and Red-throated Loons in the Hudson Bay lowlands and the Labrador Peninsula.

- Studied the molt migration of Canada Geese.

- Studied the reproductive biology of Canada Geese and Snow Geese.

- Conducted studies of bird populations in the Mackenzie Valley and along the Yukon/Alaska North Slope and Brooks Range for assessment of the 'Mackenzie Valley' gas pipeline and later for the Polar Gas Y-Line.

- Conducted studies of bird populations in the Canadian High Arctic, central Arctic, Keewatin District, northern Manitoba and northwestern Ontario for the proposed Polar Gas Project natural gas pipeline.

- Supervised and coauthored LGL's intensive surveys of seabirds and sea-associated birds (including Thayer's Gull, Glaucous Gull and Black-legged Kittiwake) in Lancaster Sound in 1976 for Norlands Petroleums Ltd.

- Directed LGL's major two-year study of marine birds in northern Baffin Bay, Lancaster Sound and Jones Sound for the Eastern Arctic Marine Environmental Study (EAMES) conducted for DIAND and funded by Petro-Canada.

- Conducted studies of bird and mammal populations on Melville Island, N.W.T. and adjacent waters in relation to natural gas production and transportation for the Arctic Pilot Project.

- Supervised the conduct and reporting of the two-year Offshore Labrador Studies (OLABS) of seabirds (including gulls) and marine mammals in the Labrador Sea and northern Newfoundland.

- Studied and collected birds in southern Ontario, northern Ontario, James Bay, Northwest Territories, and British Honduras for the Department of Ornithology, Royal Ontario Museum.

Environmental Impact Assessments

- Participated in environmental assessment of the effects of a multiple ship seismic program in Baffin Bay off the coast Greenland.

- Assessed the potential effects of underwater noise from an offshore LNG Terminal in Florida.

- Provided advice on potential effects on marine mammals (bowheads, narwhals, belugas, and seals) of the year-round marine shipment of iron ore from the proposed Mary River Iron Mine on northern Baffin Island and appeared at two sets of Technical and Regulatory Hearings.

- Senior technical advisor on the potential effects of underwater noise on marine mammals for the Deep Panuke Project off the coast of Nova Scotia. The project will become operational in late 2012.

- Prepared environmental assessments and marine mammal monitoring programs for a seismic exploration program in the Canadian Beaufort Sea in 2006, 2007, and 2008 for submission to the Inuvialuit Environmental Screening Committee and the National Energy Board.

- Project Director for an environmental assessment of the potential acoustic effects of an offshore LNG terminal and related sub-sea pipeline on marine mammals and sea turtles in Massachusetts Bay off Boston.

- Assisted with an environmental assessment of the effects offshore seismic research in Baffin Bay, Davis Strait and Lancaster Sound.

- Project Director for Bird and Marine Mammal sections of an application for offshore exploration drilling in the southern Beaufort Sea. The EIS was prepared for submission to the Inuvialuit Impact Review Board and the Canadian Environmental Assessment Agency (CEAA).

- Presentation on the effects of seismic exploration on marine animals to the Royal Society of Canada Expert Panel examining the implications of lifting the moratorium on offshore oil and gas exploration in British Columbia.

- Provided input on marine mammal and bird issues regarding a lawsuit over offshore drilling rights in the Canadian High Arctic.

- Assisted with the preparation of the Environmental Assessment, and subsequent marine mammal monitoring program, of Marathon Oil's 3-D seismic program that was conducted along the Scotian Shelf in 2003.

- Project Director for the bird portions of the Environmental Assessment of the planned Mackenzie Valley gas pipeline from the Mackenzie River delta to northern Alberta.

- Prepared an Environmental Assessment of the effects of seismic exploration on the marine system off Cape Breton Island in the southern Gulf of St. Lawrence. Provided testimony to hearings of the Public Review Commission created by the Governments of Canada and Nova Scotia. Subsequently prepared an update to the EA and participated on a committee of experts providing a technical review of the scientific issues involved.

- Project Director for a series of studies conducted to determine the environmental feasibility of constructing a large diameter natural gas pipeline under the Beaufort Sea from Prudhoe Bay, Alaska to the Yukon Coast of Canada. The studies wer designed to serve as the basis for regulatory filings with the U.S. Federal Energy Regulatory Commission and the Canada National Energy Board.

- Reviewed the potential effects of seismic exploration on marine animals in the Beaufort Sea for the Canada Department of Fisheries and Oceans.

- Prepared an Environmental Assessment of the drilling of an offshore exploration well at the Emma prospect on the Scotian Shelf for Mobil Oil Canada.

- Prepared the descriptive and effects sections for marine mammals and birds in an EIS for offshore exploration drilling in the southeastern Beaufort Sea.

- Presented a half-day seminar on the state-of-the-art knowledge of the effects of offshore seismic exploration surveys on marine mammals to a group of arctic regulators from the Fisheries Joint Management Committee (Canada/Inuvialuit) and Department of Fisheries and Oceans.

- Prepared an Environmental Assessment of the drilling of an offshore exploration well in the French sector of the St. Pierre Bank south of Newfoundland for Mobil Oil Canada.

- Prepared an Environmental Assessment of the drilling of an offshore exploration well at the Adamant N-97 prospect on the Scotian Shelf for Exxon-Mobil Oil Limited.

- Participated in an environmental assessment of a shallow water seismic exploration program on and adjacent to the sensitive Sable Island offshore of Nova Scotia.

- Project Director for a Class Environmental Assessment of the effects of offshore oil and gas exploration on the marine system of the Scotian Shelf, Laurentian Channel and the St. Pierre Bank off eastern Canada.

- Prepared bird, marine mammals, sea turtle and cumulative effects sections of the EIS for the White Rose offshore development on the Grand Bank for Husky Oil Ltd.

- Prepared an environmental assessment of the potential biological effects of seismic exploration on the marine mammals and fisheries resources of Georges Bank off SW Nova Scotia. Appeared before the review panel considering lifting of the drilling moratorium on the Canadian portion of Georges Bank.

- Project Director for a major Class Environmental Assessment of the effects on marine mammals, birds, fish and sea turtles of underwater noise associated with offshore seismic exploration by the oil and gas industry on the Scotian Shelf along Canada's east coast. The study was prepared for the regulatory agency, the Canada/Nova Scotia Offshore Petroleum Board.

- Prepared analyses of the effects of naval training exercises on marine mammals in the Maritime Forces Pacific Ranges of the Canadian Department of National Defence, as part of an overall environmental assessment of the military training exercises.

- Conducted assessment of the environmental effects of the Terra Nova oil development on birds and marine mammals on the Grand Bank, 300 km offshore of Newfoundland for PetroCanada Inc.

- Conducted an environmental review of the potential effects of seismic exploration off the south coast of Newfoundland for Gulf Canada Resources Inc.

- Prepared an assessment of the probable effects on marine mammals of underwater noise and disturbance associated with the Sable Offshore Energy Project which was designed to bring natural gas and condensates ashore from six offshore production platforms on the Scotian Shelf off eastern Canada. Provided expert testimony before a Joint Board representing the National Energy Board, a Canadian Environmental Assessment Act panel, and the Province of Nova Scotia.

- Project Director for an environmental review of the effects of military activities on the tank and artillery range at ATC Meaford. The project included development of measures for the rehabilitation of important vegetative communities and habitats.

- Conducted an Initial Environmental Evaluation (IEE) for the upgrading and potential expansion of the High Arctic Data Communication System on Ellesmere Island, Devon Island, and Cornwallis Island for Canada Department of National Defence.

- Evaluated impact assessment methodologies for use before the Environmental Impact Review Board.

- Involved with the planning and conduct of the Beaufort Region Environmental Assessment and Monitoring (BREAM) project (1990-93).

- Evaluated the effects of operational discharges from ships in waters under jurisdiction of the Canadian Coast Guard.

- Participated in the Initial Environmental Evaluation of the Arctic Subsurface Surveillance System in the High Arctic for Canada Department of National Defence.

- Prepared Initial Environmental Evaluation of the Northern Fleet operation of the Canadian Coast Guard.

- Reviewed environmental assessment procedures used at a regional airport in Ontario.

- Prepared an assessment of potential wildlife restoration techniques for use in the event of an oil spill in the Beaufort Sea.

- Prepared assessment of the feasibility of instituting environmental regulations for arctic shipping.

- Prepared the Initial Environmental Evaluation (IEE) of the Class 8 icebreaker proposed by the Canadian Coast Guard.

- Technical advisor to the Environmental Impact Review Board (EIRB) reviewing winter offshore oil exploration drilling at Isserk in the coastal Beaufort Sea.

- Technical advisor to the Environmental Impact Review Board evaluating open water offshore drilling in the Beaufort Sea.

- Involved with project engineering design and subsequent preparation of the Environmental Impact Statement and Mitigation Plans for birds and marine systems for the Polar Gas Project. Application submitted to DIAND for referral to National Energy Board and Federal Environmental Review Office.

- Prepared the Environmental Impact Statement for the effects of offshore exploratory drilling in Lancaster Sound on populations of seabirds and marine mammals. Defended the EIS at two federal Environmental Assessment Review Panel (EARP) hearings.

- Prepared the bird, mammal, marine system, and countermeasures sections of an Environmental Impact Statement for offshore exploratory drilling in northern Baffin Bay for Petro-Canada. The EIS was not formally submitted because declining oil prices rendered the proposed drilling program uneconomic.

- Prepared and defended the bird and mammal sections of the Environmental Impact Statements at three EARP hearings and at National Energy Board hearings for the Arctic Pilot Project. This project involved the production and pipeline transport of natural gas in the High Arctic, a liquification plant, year-round transport to Europe and the east coast of North America by icebreaking LNG tankers, and potential gasification terminals in Nova Scotia and Quebec.

- Directed and prepared the bird and marine mammal components of the Environmental Impact Statement for oil and gas production in the Beaufort Sea and transportation by pipeline and/or ship through the Northwest Passage or Bering Strait. Appeared as an expert witness at EARP hearings in Resolute and Inuvik.

- Prepared a report on environmental issues and impacts associated with an updated application for offshore drilling in Lancaster Sound for the Consolidex-Magnorth- Oakwood consortium.

- Prepared marine bird and mammal sections of the EIS for offshore oil production from the Endicott field in the Alaskan Beaufort Sea for the U.S. Army Corps of Engineers.

- Major participant on birds and marine mammals in the Beaufort Environmental Monitoring Project (BEMP) for DIAND (1983-87) and the Beaufort Region Environmental Assessment and Monitoring (BREAM) project (1990-91).

Marine Mammal Studies

- Project Supervisor for studies in support of the Baffinland project. Studies included winter and spring surveys of arctic marine mammals in Hudson Strait and Foxe Basin; open water

surveys off north Baffin Island; behavioural studies of narwhal responses to arctic shipping; and the design of complex effects monitoring studies regulatory review.

- Invited Expert to a Special Meeting of the Scientific Committee of the International Whaling Commission on Southern Right Whales.

- Project Director for field studies of marine mammals and birds in the southern Beaufort Sea to support an application under CEAA and the Inuvialuit Impact Review Board for exploration drilling in nearshore marine areas.

- Project Director for a two-month field monitoring study of the effects of nearshore seismic exploration on beluga whales and bowhead whales in the southeastern Beaufort Sea. The study involved aerial and ship-based observations and a program of underwater acoustic measurements.

- Project Director for an acoustical measurement and marine mammal monitoring program for the Canadian Hydrographic Service in the Beaufort Sea.

- Participated in an assessment of the potential effects of underwater noise on northern bottlenose whales and sperm whales occupying the proposed marine protected area of the Gully on the Scotian Shelf, off eastern Canada.

- Project Director for a survey of bowhead and beluga whales off the Yukon coast during summer in 2001.

- Technical expert on marine mammal issues providing input to a GAP Analyses of issues related to offshore exploration for natural gas in the southeastern Beaufort Sea for the Environmental Studies Research Funds and offshore exploration and development for the Department of Indian and Northern Affairs Canada (2001-02).

- Participated in an assessment of noise issues related to key whale species in the proposed Gully Marine Protected Area off Nova Scotia for Department of Fisheries and Oceans.

- Project Director for a program to measure the underwater noise from pile-driving associated with installation of oil and gas production platforms in offshore waters of the Scotian Shelf.

- Provision of advice on the design and implementation of programs to monitor the effects of the Sable Offshore Energy Project on marine mammals of the Scotian Shelf.

- Conducted a five month study of the responses of whales to the high speed (75 km/h) ferry that began service on the Bar Harbor, ME, to Yarmouth, NS run in 1998. Monitoring was continued for three months in each of 1999, 2000, 2001 and 2002. Subsequent monitoring continued through 2006.

- Review of the effects of underwater noise associated with the Middle Shoal dredging project, Cape Breton, Nova Scotia.

- Evaluated the potential effects of ice-breaking ore carriers, and associated underwater noise, on the ringed seal populations in the Voisey's Bay region of Labrador. Appeared as a technical expert at the regulatory hearings into the project.

- Preparation of a series of scientific papers on arctic marine mammals (beluga whale, narwhal, and Atlantic walrus) in Canadian High Arctic and Greenland waters in collaboration with Danish scientists and other LGL scientists.

- Member of technical panel advising Canada Department of Fisheries and Oceans on its Arctic Science Program.

- Preparation of an international report on the effects of underwater noise on arctic marine mammals for the Greenland Environmental Research Institute, Government of Denmark.

- Determined responses of bowhead whales to an offshore drilling operation in the Alaskan Beaufort Sea for SWEPI.

- Assessment of underwater noise characteristics of an operating drillship and patterns of bowhead migration at the Hammerhead and Corona drilling sites in Camden Bay, Alaska, for Unocal, SWEPI, and the Alaska Oil and Gas Association.

- Evaluation of the responses of migrating bowhead whales to an active drilling operation at an artificial island (Sandpiper Island) in the Alaskan Beaufort Sea.

- Major study of the reproductive biology of bowhead whales in the summering range in 1985 for ten Alaskan oil companies and three government agencies.

- Evaluation of the potential for offshore drilling from Seal Island to influence fall bowhead migration through nearshore Alaskan waters (1984) for Shell Western E & P Inc.

- Retrospective analyses of the relationships of bowhead distribution and oceanographic and hydrographic features in the Canadian Beaufort Sea from 1980-83 for Environmental Studies Revolving Fund.

- Aerial photography study of bowheads to determine distribution, movements, behaviour and residence times in relation to offshore industrial activities in the Canadian Beaufort Sea (1984) for DIAND, DFO and DSS.

- Chairman of NOAA/OCSEAP workshop on marine mammals and offshore oil exploration in the Chukchi Sea.

- Aerial surveys of bowhead whales and other mammals in the SE Beaufort Sea for ESRF in 1983.

- Length distribution and photographic identification of bowhead whales in the Beaufort Sea for U.S. National Marine Fisheries Service (1982).

- Winter distribution of marine mammals in west Greenland, Baffin Bay and Davis Strait for Arctic Pilot Project (1981-82).
- Birds and marine mammals in the Labrador Sea, Strait of Belle Isle, and NE Newfoundland for OLABS (Petro-Canada operator) (1981-83).
- Bowhead whales in the Beaufort Sea and Amundsen Gulf for a consortium of Canadian and Alaskan oil companies (1981).
- Bowhead whales and ringed seals in the SE Beaufort Sea for Dome Petroleum Ltd. (1980).
- White whales in Hudson Strait and eastern Hudson Bay for Canadian Department of Fisheries and Oceans (1980-81).
- Marine mammals, birds and resource harvesting in Baffin Bay, Jones Sound, Lancaster Sound, Prince Regent Inlet and Gulf of Boothia for Petro-Canada EAMES Project (1978-80).
- Birds and marine mammals in Lancaster Sound for Norlands Petroleums Ltd. (1976).
- Marine mammals and birds in the central and High Arctic (1973-1977) and Victoria Island (1980) for Polar Gas Project; Senior author of a comprehensive review of the status and management of arctic marine mammals for NWT Science Advisory Board, and chairman of an international workshop on management of arctic marine mammals for DFO.
- Member Danish/Canadian Working Group on the Arctic Pilot Project (1980-83).
- Invited expert at Scientific Committee of the International Whaling Commission (1979, 1982, 1983, 1986, 1991) to present papers on the behaviour and status of populations of bowhead whales, narwhals and white whales.

PROFESSIONAL MEMBERSHIPS

American Ornithologists Union (Life Member)
Association of Field Ornithologists
British Ornithologists Union
Colonial Waterbird Society
Wilson Ornithological Society
Australian Ornithologists Union
Neotropical Bird Club
Cooper Ornithological Society (Life Member)
Ontario Field Ornithologists (Life)
The Wildlife Society
Arctic Institute of North America (Life Member)

REPORTS AND PUBLICATIONS

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2017 Davis, R.A. Demonstration of the continued effectiveness of the bird control program at the Forward Landfill, Manteca, California – 2016-2017. Rep. by LGL Limited, King City, ON for Forward Landfill Inc., Manteca, CA. 25 p.

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2017 Davis, A.R., Harris, R.E. and R.A. Davis. Assessment of potential bird hazards to aircraft safety at the Wapekeka, Ontario airport associated with a proposed landfill expansion – a Stage 1 safety analysis. Report by LGL Limited, King City, ON for True Grit Engineering. 23 pp.

2017 Davis, R.A. and B. Hixon. Night disposal of municipal solid waste at the ACUA Landfill – 228 month report: 15 Dec 1997 to 14 December 2016. Rep. by LGL Limited, King City, ON for Atlantic County Utilities Authority, Egg Harbor Twp., NJ. 165 p.

2017 Davis, R.A. Monitoring of potential bird hazards to aircraft associated with Advanced Disposal Services Orchard Hills Landfill in northern Illinois, autumn 2016. Rep. No: TA2208-21 by LGL Limited, King City, ON for Advanced Disposal Services Orchard Hills Landfill, Inc., Davis Junction, IL. 25 p.

2017 Davis, A.R. and R.A. Davis. The spring 2017 gull control program at the Leduc and District Regional Landfill, Leduc, Alberta. LGL Report No. TA8219-5 by LGL Limited, King City, ON for Leduc and District Regional Waste Management Authority, City of Leduc, Alberta. 8 pp.

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2016 Davis, R.A. Effectiveness of the bird control program at the Winnebago Landfill, Rockford, IL, autumn 2015. Rep. by LGL Limited, King City, ON for Winnebago Reclamation Services, Inc., Rockford, IL. 18 p.

2016 Davis, A.R., Harris, R.E. and R.A. Davis. The spring 2016 gull control program at the Leduc and District Regional Landfill, Leduc, Alberta. LGL Report No. TA8219-4 by LGL Limited, King City, ON for Leduc and District Regional Waste Management Authority, City of Leduc, Alberta. 5 pp.

2016 Davis, R.A. Monitoring of potential bird hazards to aircraft associated with Advanced Disposal Services Orchard Hills Landfill in northern Illinois, autumn 2015. Rep. No: TA2208-19 by LGL Limited, King City, ON for Advanced Disposal Services Orchard Hills Landfill, Inc., Davis Junction, IL. 27 p.

2016 Monitoring of the gull control program at the Atascocita Recycling and Disposal Facility, Humble, Texas – 2015. Rep. by LGL Limited, King City, ON for Waste Management of Texas, Atascocita RDF, Humble, TX. 6 p.

2016 Davis, R.A. and B. Hixon. Night disposal of municipal solid waste at the ACUA Landfill – 216 month report: 15 Dec 1997 to 14 December 2015. Rep. by LGL Limited, King City, ON for Atlantic County Utilities Authority, Egg Harbor Twp., NJ. 167 p.

2016 Davis, R.A. Demonstration of the continued effectiveness of the bird control program at the Forward Landfill, Manteca, California – 2014-2015. Rep. by LGL Limited, King City, ON for Forward Landfill Inc., Manteca, CA. 27 p.

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2015. Davis, R.A. Bird management and control plans for various barrier options at West Lake site, Bridgeton Landfill, St. Louis, MO. Rep. by LGL Limited, King City, ON for Bridgeton Landfill, Bridgeton, MO. 13 p.

2015 Davis, R.A. and B. Hixon. Night disposal of municipal solid waste at the ACUA Landfill – 204 month report: 15 Dec 1997 to 14 December 2014. Rep. by LGL Limited, King City, ON for Atlantic County Utilities Authority, Egg Harbor Twp., NJ. 160 p.

2015 Davis, R.A. Monitoring of the gull control program at the Atascocita Recycling and Disposal Facility, Humble, Texas – 2014. Rep. by LGL Limited, King City, ON for Waste Management of Texas, Atascocita RDF, Humble, TX. 6 p.

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2014 Davis, R.A. Monitoring of the gull control program at the Atascocita Recycling and Disposal Facility, Humble, Texas – 2012-2013. Rep. by LGL Limited, King City, ON for Waste Management of Texas, Atascocita RDF, Humble, TX. 6 p.

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2013 Lewis, S. and R.A. Davis. Discussion of the compatibility of airports and landfills. A White Paper. Prep. By Lewis Engineering and LGL Limited for San Joaquin County on behalf of Forward Landfill Inc.

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2011 Davis, R.A. Assessment of potential bird hazards to aircraft safety associated with the proposed PBK Landfill in Rockingham County, North Carolina – A Stage 1 Safety Analysis. Rep. by LGL Limited, King City, ON for Brooks, Pierce, McLendon, Humphrey & Leonard, L.L.C., Greensboro, NC. 64 p.

2011 Davis, R.A. and B. Hixon. Night disposal of municipal solid waste at the ACUA Landfill – 168 month report: 15 Dec 1997 to 14 December 2010. Rep. by LGL Limited, King City, ON for Atlantic County Utilities Authority, Egg Harbor Twp., NJ. 174 p.

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