Appendix C Notice of Preparation (NOP) and Comments Received on NOP

NOTICE OF PREPARATION

ENVIRONMENTAL IMPACT REPORT FOR THE WESTERN AGGREGATES LLC YUBA COUNTY OPERATIONS AMENDED RECLAMATION PLAN

On the basis of the Initial Study prepared for the Western Aggregates LLC Yuba County Operations Amended Reclamation Plan (the proposed project), the State Mining and Geology Board, acting as the lead agency pursuant California Environmental Quality Act Guidelines (CEQA Guidelines) Section 15050, has determined that the proposed project may have a significant impact on the environment. Therefore, the lead agency hereby gives notice that an Environmental Impact Report (EIR) for this project will be prepared in accordance with the requirements of CEQA.

Project Location

The Amended Reclamation Plan area is approximately 1,960 acres (project site) located in an unincorporated portion of Yuba County, California, south of the Yuba River, north of Hammonton-Smartville Road, and approximately equidistant (20 miles) between Marysville and Smartsville (see Figure 1). The site is situated at the western edge of the Sierra Nevada foothills, approximately 1 mile south of the south bank of the Yuba River, and north of Beale Air Force Base.

Site Description

The majority of the approximately 1,960-acre project site is characterized by active mining operations, a processing facility, numerous dredge tailing ridges interspersed with waterways and areas of native riparian and wetland vegetation, and small to large siltation and freshwater ponds created by past and ongoing mining activities. Access to the project site is via an access road (generally referred to as Hammonton Road), which intersects with Hammonton-Smartville Road approximately 1 mile south of the mine processing plant. The project site is located within the area commonly referred to as the Yuba Goldfields.

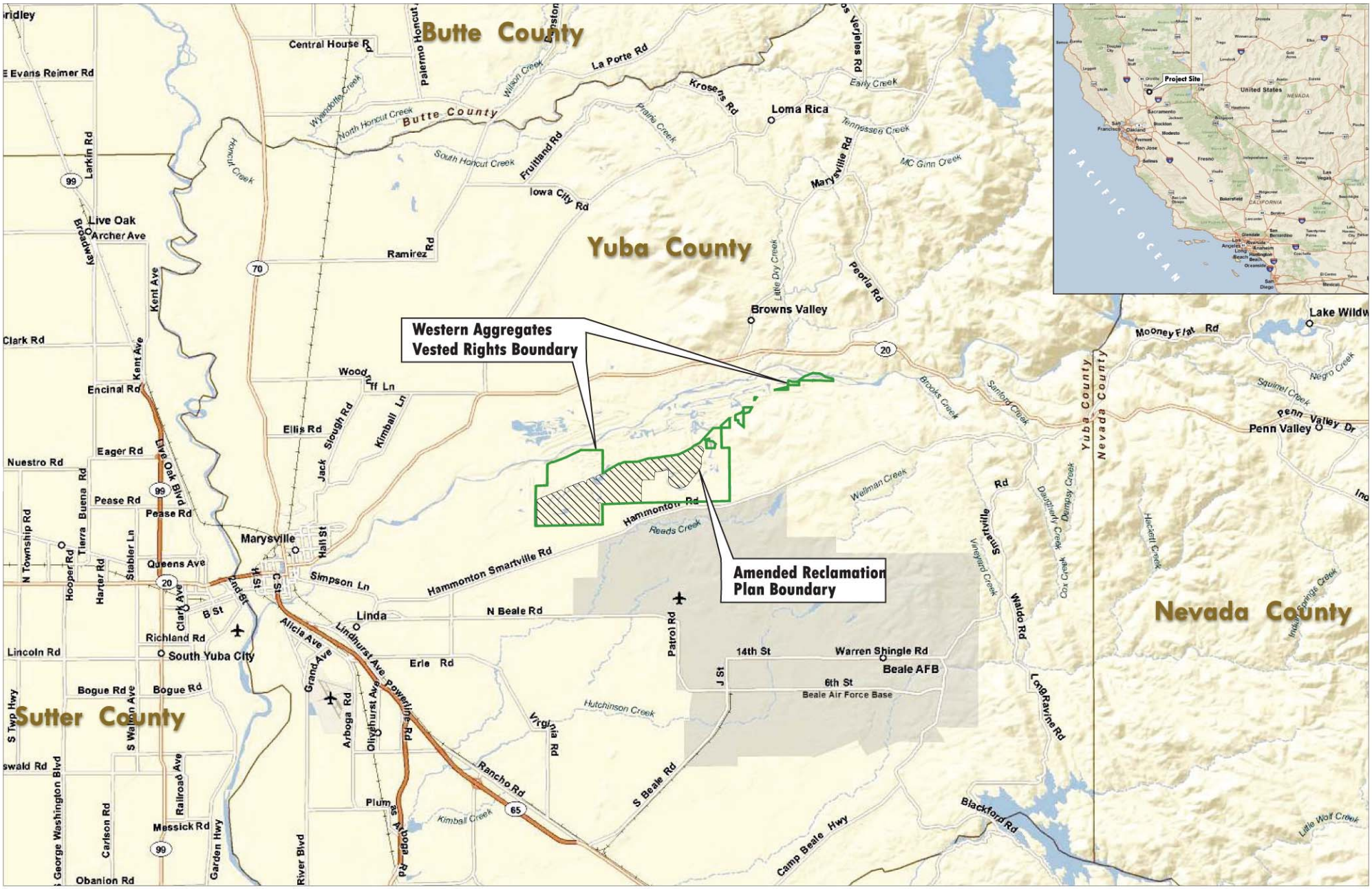
The project site has been historically excavated for materials from above and below the groundwater table. In recent years, mining has primarily occurred in the central and south-central portion of the project site, where above-ground tailing piles have been removed and material has been excavated below the water table creating areas of open water.

Western Aggregates' processing plant is located in the southern portion of the project site where the company maintains processing equipment (crushers, screens, and conveyors, maintenance structures, fuel storage area, and product stockpiles), a scalehouse, a shop building, an above-ground fuel island, and administrative offices. The primary equipment storage area is situated in the southwestern portion of the processing plant area. A large Designated Disposal Area (DDA) which serves as the sediment settling pond is situated in the northeast portion of the processing area. Product stockpiles are located adjacent to the processing area. While a majority of the site currently contains or historically contained large tailings piles created by extensive dredging operations, approximately 30 acres adjacent to the processing area and a larger area in the southeast corner of the project site (west of Hammonton Road) were unaffected by prior dredging operations and currently support open annual grassland that are currently used primarily for livestock grazing.

Project Description

Under the Amended Reclamation Plan, site reclamation would be carried out in three phases to coincide with three remaining phases of ongoing vested aggregate mining and processing operations within the 1,960-acre area. Implementation of the plan will ultimately create a series of lakes, varying in size, and open space areas supporting a variety of wildlife habitat types including aquatic lake, marsh, woodland and upland habitats.

Activities specific to site reclamation will be the focus of the EIR's impact evaluation. While the EIR, in keeping with the requirements of CEQA, will not directly address the impact of vested mining activities, implementation of the reclamation plan is tied to these activities. Existing on-site conditions created by mining operations and future conditions that are anticipated to be created by vested mining operations over the life of the project will



Area Map

Western Aggregates LLC
Yuba County, California

Figure 1

LEGEND

- Vested Rights Boundary
- Amended Reclamation Plan Boundary and Operating Area for Aggregates

N

0 3
Miles

Source: Lilburn Corp., 03/2011 (TAG)

LILBURN CORPORATION

serve as environmental baseline conditions from which reclamation plan impacts will be measured. Mining operations as described in the *Amended Reclamation Plan for Western Aggregates LLC Yuba County Operations* (May 2012) will remove sand and gravel deposits (aggregates) to a depth of -20 feet below msl (100 feet below the average lake surface level). However, mining depths may vary in certain areas, and may reach 85 feet below msl (165 feet below the average lake surface level) based on local ground conditions, geology, changes in market conditions, and changes in mining technology, where such changes may be implemented without materially disrupting the shorelines, marshes, or other habitats contemplated by the Amended Reclamation Plan.

Approximately 1,960 acres of the 3,900-acre Vested Rights Area will be affected by Western's surface mining operations which are projected to terminate within the 1,960-acre area in approximately 45 years pursuant to the Amended Reclamation Plan. The actual time frame for termination, however, is dependent on economic factors (e.g., demand and competition), reserves, ultimate mining depths and quality of mined materials. The total aggregate reserve within the Amended Reclamation plan area is estimated at about 414 million tons.

As stated in the Amended Reclamation Plan, the vested mining operations will remove dredge piles or excavate previously undredged lands in a manner supportive of aquatic and terrestrial wildlife habitat. The proposed Amended Reclamation Plan will use fines available from mining operations, including residual dredge fines, fines from the settling pond(s), and overburden, to implement site revegetation as specified in the Amended Reclamation Plan. Commercially available broadcast seeding will be applied to these areas for erosion control purposes and to enhance natural revegetation. No off-site importation of fines is proposed. In areas where topsoil will be disturbed, the soil will be salvaged and stockpiled for use in revegetation to the extent necessary.

Upon final completion of mining, the aggregate processing plant will be razed and all equipment will be dismantled and removed. As detailed in the Amended Reclamation Plan, the plant site and roads and utilities serving the site will be prepared, revegetated, and reclaimed.

Potentially Significant Environmental Impacts Identified in the Initial Study

The Initial Study prepared for the proposed project addresses the broad range of potential environmental impacts listed in the CEQA Guidelines Appendix G environmental checklist. The proposed project was found to have potentially significant impacts in the following areas:

Biological Resources

Even though site reclamation will result in a net long-term increase in wildlife habitat on the project site, proposed reclamation activities could result in potentially significant impacts on biological resources in and adjacent to the project site as a result of site preparation and revegetation operations. Therefore, this impact will be further addressed in the Draft EIR.

Hydrology and Water Quality

The proposed project will result in the long-term maintenance of five large lakes and the creation vegetated shorelines around those lakes. Because the primary source of water supply to these lakes is subsurface water, the long-term maintenance of these lakes could have a significant effect on groundwater supply and/or movement either alone or in combination with other existing and planned reclamation projects in the Yuba Goldfields region. This impact will be further addressed in the Draft EIR.

In addition, proposed site reclamation could have a potentially significant impact on water quality because of the potential presence of mercury in reclaimed areas. This impact on surface and groundwater quality will be further addressed in the Draft EIR.

Land Use

The proposed long-term maintenance of open water, wetlands and marsh habitat on the Western Aggregates site could attract resident and migratory waterfowl. Because the project site is within the flight path of aircraft taking off and landing at Beale Air Force Base, activities that would result in a significant attraction of birds could present a hazard and may be inconsistent with the Beale AFB Joint Land Use Study. This impact will be further addressed in the Draft EIR.

Air Traffic Hazard

For reasons discussed above under "Land Use," the proposed project could indirectly result in a potential hazard to air traffic using Beale Air Force Base. This impact will be further addressed in the Draft EIR.

Required Discretionary Actions

The Applicant (Western Aggregates LLC) cannot implement the proposed project unless the State Mining and Geology Board, which is the CEQA lead agency, grants a series of discretionary approvals. The actions necessary for project approval include, but are not limited to the following:

- **Certification of the EIR**—Certification that the Final EIR adequately identifies the significant environmental effects of the proposed project, pursuant to CEQA and the CEQA Guidelines.
- **Project Approval**—Approval of the Amended Reclamation Plan; and
- **Mitigation Monitoring**—Adoption of a Mitigation Monitoring Plan to reflect the measures required to mitigate significant impacts of the project.

In addition, the following regulatory agencies may be Responsible Agencies:

- **California Department of Fish and Wildlife**
- **State Water Resources Control Board**
- **Central Valley Regional Water Quality Control Board**
- **Feather River Air Quality Management District**

Comments Requested

The Western Aggregates LLC Amended Reclamation Plan NOP and Initial Study will be circulated for public review and comment beginning on April 3, 2013 for a period of 30 days. All comments on the Initial Study should be submitted in writing to the State Mining and Geology Board, at the following address no later than May 2, 2013:

Mr. Will Arcand, Senior Engineering Geologist
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, California 95814-3528

Upon its completion, the Draft EIR will be circulated for public review and comment for a period of at least 45 days. All written comments on the Draft EIR will be presented in a Final EIR along with written responses to each comment as required by CEQA. After consideration of the Final EIR, the State Mining and Geology Board will hold a public hearing at which time the Board will consider certification of the Final EIR and approval of the Western Aggregates LLC Yuba County Operations Amended Reclamation Plan.

Public Scoping Session

A public scoping meeting will be held at the following time and location:

Date/Time: **April 18, 2013 / 6:30 PM**

Location: **Yuba County Government Center**
915 8th Street
Marysville, California 95901

All interested parties are encouraged to attend. All substantive written comments submitted on the NOP/Initial Study and those presented during the scoping meeting will be taken into consideration during the preparation of the Draft EIR.

STATE MINING AND GEOLOGY BOARD

DEPARTMENT OF CONSERVATION

801 K Street • Suite 2015 • Sacramento, California 95814

PHONE: 916 / 322-1082 • FAX: 916 / 445-0738 • TDD: 916 / 324-2555 • INTERNET: conservation.ca.gov/smgb

April 12, 2013

Re: Notice of Review Period Extension and Rescheduled Public Scoping Meeting for the Notice of Preparation and Initial Study, Amended Reclamation Plan for Western Aggregates, LLC (CA Mine ID #91-58-0001, SCH# 2013042008), Yuba County

To Whom It May Concern:

Due to scheduling conflicts, the State Mining and Geology Board (SMGB) has extended the review period and rescheduled the public scoping meeting for the previously released Notice of Preparation (NOP) and Initial Study (IS) for the project titled *Western Aggregates LLC Yuba County Operations Amended Reclamation Plan* (Project).

You have been identified as a Responsible Agency, Trustee Agency or Interested Party regarding this Project, and are invited to provide comments. Please note that the public comment period for this IS now runs until close of business on May 17, 2013. In addition, the public scoping meeting that was originally scheduled for April 18, 2013, is now rescheduled as follows:

Date/Time: **May 15, 2013 / 6:30 PM**
Location: **Marysville City Hall**
City Council Chambers
526 C Street
Marysville, California 95901

Please see the enclosed Notice for further information. Questions and comments regarding this Project should be directed to the attention of Will J. Arcand, Senior Engineering Geologist with the SMGB at the above address, or by e-mail to smgb@consrv.ca.gov.

Sincerely,

Stephen M. Testa
Executive Officer

Enclosure

STATE MINING AND GEOLOGY BOARD

DEPARTMENT OF CONSERVATION

801 K Street • Suite 2015 • Sacramento, California 95814

PHONE: 916 / 322-1082 • FAX: 916 / 445-0738 • TDD: 916 / 324-2555 • INTERNET: conservation.ca.gov/smgb

NOTICE OF REVIEW PERIOD EXTENSION AND RESCHEDULED PUBLIC SCOPING MEETING

Notice of Preparation and Initial Study prepared for the *Western Aggregates LLC Yuba County Operations Amended Reclamation Plan (SCH# 2013042008)*

Due to scheduling conflicts, the State Mining and Geology Board (SMGB) has rescheduled the public scoping meeting for the Notice of Preparation (NOP) and Initial Study (IS) prepared for the *Western Aggregates LLC Yuba County Operations Amended Reclamation Plan* (Project). In order to accommodate this rescheduled public scoping meeting, the SMGB is extending the review period for these previously released documents through close of business on Friday, May 17, 2013.

The SMGB will conduct a public scoping meeting as part of the environmental review process for the above project. The public scoping meeting that was originally scheduled for April 18, 2013, is now rescheduled as follows:

Date/Time: **May 15, 2013 / 6:30 PM**
Location: **Marysville City Hall**
City Council Chambers
526 C Street
Marysville, California 95901

The SMGB, acting as lead agency, along with their environmental consultant, will summarize the environmental review process and Amended Reclamation Plan for this mining Project. Representatives from Western Aggregates will also discuss the Amended Reclamation Plan and will be on hand to answer technical questions about the Project.

Questions and comments regarding the NOP/IS, and questions regarding the public scoping meeting should be directed to Will Arcand, Senior Engineering Geologist with the SMGB at the following address:

State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, CA 95814

Phone: (916) 322-1082
Fax: (916) 445-0738
e-mail: smgb@conservation.ca.gov

STATE MINING AND GEOLOGY BOARD

DEPARTMENT OF CONSERVATION

801 K Street • Suite 2015 • Sacramento, California 95814

PHONE: 916 / 322-1082 • FAX: 916 / 445-0738 • TDD: 916 / 324-2555 • INTERNET: conservation.ca.gov/smgb

April 4, 2012

Harl Sanderson
9 CES/CD
6451 B Street
Beale AFB, CA 95903

Re: Notice of Preparation and Initial Study, Amended Reclamation Plan for Western Aggregates, LLC (CA Mine ID #91-58-0001), Yuba County

To Whom It May Concern:

Pursuant to the California Environmental Quality Act (PRC Section 21000 et seq.), the California State Mining and Geology Board (SMGB), as lead agency, has released a Notice of Preparation and an Initial Study (IS) for the project titled *Western Aggregates LLC Yuba County Operations Amended Reclamation Plan* (Project).

The Project would involve the phased reclamation of 1,960 acres of aggregate mining operations over a 45 year period. Specific reclamation activities are described in the enclosed IS.

You have been identified as a Responsible Agency, Trustee Agency or Interested Party regarding this Project, and are invited to provide comments. The public comment period for this IS runs until close of business on May 2, 2013.

Questions, comments and responses regarding the enclosed IS should be provided to the SMGB office by being sent to the attention of Will J. Arcand, Senior Engineering Geologist, via regular mail to the above address, or by e-mail to smgb@consrv.ca.gov.

Sincerely,

Stephen M. Testa
Executive Officer

Enclosure

NOTICE OF PREPARATION

ENVIRONMENTAL IMPACT REPORT FOR THE WESTERN AGGREGATES LLC YUBA COUNTY OPERATIONS AMENDED RECLAMATION PLAN

On the basis of the Initial Study prepared for the Western Aggregates LLC Yuba County Operations Amended Reclamation Plan (the proposed project), the State Mining and Geology Board, acting as the lead agency pursuant California Environmental Quality Act Guidelines (CEQA Guidelines) Section 15050, has determined that the proposed project may have a significant impact on the environment. Therefore, the lead agency hereby gives notice that an Environmental Impact Report (EIR) for this project will be prepared in accordance with the requirements of CEQA.

Project Location

The Amended Reclamation Plan area is approximately 1,960 acres (project site) located in an unincorporated portion of Yuba County, California, south of the Yuba River, north of Hammonton-Smartville Road, and approximately equidistant (20 miles) between Marysville and Smartsville (see Figure 1). The site is situated at the western edge of the Sierra Nevada foothills, approximately 1 mile south of the south bank of the Yuba River, and north of Beale Air Force Base.

Site Description

The majority of the approximately 1,960-acre project site is characterized by active mining operations, a processing facility, numerous dredge tailing ridges interspersed with waterways and areas of native riparian and wetland vegetation, and small to large siltation and freshwater ponds created by past and ongoing mining activities. Access to the project site is via an access road (generally referred to as Hammonton Road), which intersects with Hammonton-Smartville Road approximately 1 mile south of the mine processing plant. The project site is located within the area commonly referred to as the Yuba Goldfields.

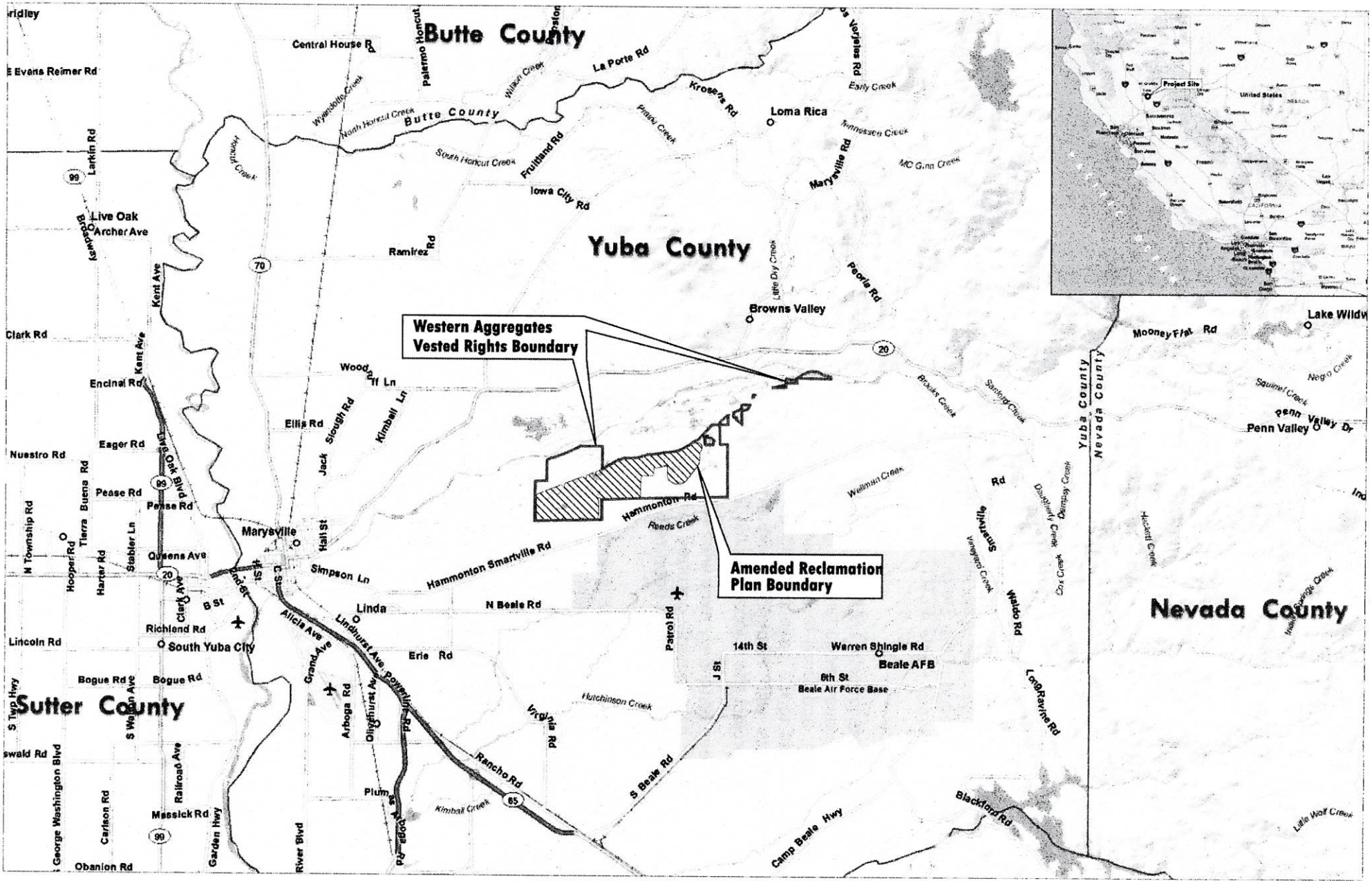
The project site has been historically excavated for materials from above and below the groundwater table. In recent years, mining has primarily occurred in the central and south-central portion of the project site, where above-ground tailing piles have been removed and material has been excavated below the water table creating areas of open water.

Western Aggregates' processing plant is located in the southern portion of the project site where the company maintains processing equipment (crushers, screens, and conveyors, maintenance structures, fuel storage area, and product stockpiles), a scalehouse, a shop building, an above-ground fuel island, and administrative offices. The primary equipment storage area is situated in the southwestern portion of the processing plant area. A large Designated Disposal Area (DDA) which serves as the sediment settling pond is situated in the northeast portion of the processing area. Product stockpiles are located adjacent to the processing area. While a majority of the site currently contains or historically contained large tailings piles created by extensive dredging operations, approximately 30 acres adjacent to the processing area and a larger area in the southeast corner of the project site (west of Hammonton Road) were unaffected by prior dredging operations and currently support open annual grassland that are currently used primarily for livestock grazing.

Project Description

Under the Amended Reclamation Plan, site reclamation would be carried out in three phases to coincide with three remaining phases of ongoing vested aggregate mining and processing operations within the 1,960-acre area. Implementation of the plan will ultimately create a series of lakes, varying in size, and open space areas supporting a variety of wildlife habitat types including aquatic lake, marsh, woodland and upland habitats.

Activities specific to site reclamation will be the focus of the EIR's impact evaluation. While the EIR, in keeping with the requirements of CEQA, will not directly address the impact of vested mining activities, implementation of the reclamation plan is tied to these activities. Existing on-site conditions created by mining operations and future conditions that are anticipated to be created by vested mining operations over the life of the project will



Area Map

Western Aggregates LLC
Yuba County, California

Figure 1

LEGEND

- Vested Rights Boundary
- Amended Reclamation Plan Boundary and Operating Area for Aggregates

LILBURN CORPORATION

serve as environmental baseline conditions from which reclamation plan impacts will be measured. Mining operations as described in the *Amended Reclamation Plan for Western Aggregates LLC Yuba County Operations* (May 2012) will remove sand and gravel deposits (aggregates) to a depth of -20 feet below msl (100 feet below the average lake surface level). However, mining depths may vary in certain areas, and may reach 85 feet below msl (165 feet below the average lake surface level) based on local ground conditions, geology, changes in market conditions, and changes in mining technology, where such changes may be implemented without materially disrupting the shorelines, marshes, or other habitats contemplated by the Amended Reclamation Plan.

Approximately 1,960 acres of the 3,900-acre Vested Rights Area will be affected by Western's surface mining operations which are projected to terminate within the 1,960-acre area in approximately 45 years pursuant to the Amended Reclamation Plan. The actual time frame for termination, however, is dependent on economic factors (e.g., demand and competition), reserves, ultimate mining depths and quality of mined materials. The total aggregate reserve within the Amended Reclamation plan area is estimated at about 414 million tons.

As stated in the Amended Reclamation Plan, the vested mining operations will remove dredge piles or excavate previously undredged lands in a manner supportive of aquatic and terrestrial wildlife habitat. The proposed Amended Reclamation Plan will use fines available from mining operations, including residual dredge fines, fines from the settling pond(s), and overburden, to implement site revegetation as specified in the Amended Reclamation Plan. Commercially available broadcast seeding will be applied to these areas for erosion control purposes and to enhance natural revegetation. No off-site importation of fines is proposed. In areas where topsoil will be disturbed, the soil will be salvaged and stockpiled for use in revegetation to the extent necessary.

Upon final completion of mining, the aggregate processing plant will be razed and all equipment will be dismantled and removed. As detailed in the Amended Reclamation Plan, the plant site and roads and utilities serving the site will be prepared, revegetated, and reclaimed.

Potentially Significant Environmental Impacts Identified in the Initial Study

The Initial Study prepared for the proposed project addresses the broad range of potential environmental impacts listed in the CEQA Guidelines Appendix G environmental checklist. The proposed project was found to have potentially significant impacts in the following areas:

Biological Resources

Even though site reclamation will result in a net long-term increase in wildlife habitat on the project site, proposed reclamation activities could result in potentially significant impacts on biological resources in and adjacent to the project site as a result of site preparation and revegetation operations. Therefore, this impact will be further addressed in the Draft EIR.

Hydrology and Water Quality

The proposed project will result in the long-term maintenance of five large lakes and the creation vegetated shorelines around those lakes. Because the primary source of water supply to these lakes is subsurface water, the long-term maintenance of these lakes could have a significant effect on groundwater supply and/or movement either alone or in combination with other existing and planned reclamation projects in the Yuba Goldfields region. This impact will be further addressed in the Draft EIR.

In addition, proposed site reclamation could have a potentially significant impact on water quality because of the potential presence of mercury in reclaimed areas. This impact on surface and groundwater quality will be further addressed in the Draft EIR.

Land Use

The proposed long-term maintenance of open water, wetlands and marsh habitat on the Western Aggregates site could attract resident and migratory waterfowl. Because the project site is within the flight path of aircraft taking off and landing at Beale Air Force Base, activities that would result in a significant attraction of birds could present a hazard and may be inconsistent with the Beale AFB Joint Land Use Study. This impact will be further addressed in the Draft EIR.

Air Traffic Hazard

For reasons discussed above under "Land Use," the proposed project could indirectly result in a potential hazard to air traffic using Beale Air Force Base. This impact will be further addressed in the Draft EIR.

Required Discretionary Actions

The Applicant (Western Aggregates LLC) cannot implement the proposed project unless the State Mining and Geology Board, which is the CEQA lead agency, grants a series of discretionary approvals. The actions necessary for project approval include, but are not limited to the following:

- **Certification of the EIR**—Certification that the Final EIR adequately identifies the significant environmental effects of the proposed project, pursuant to CEQA and the CEQA Guidelines.
- **Project Approval**—Approval of the Amended Reclamation Plan; and
- **Mitigation Monitoring**—Adoption of a Mitigation Monitoring Plan to reflect the measures required to mitigate significant impacts of the project.

In addition, the following regulatory agencies may be Responsible Agencies:

- **California Department of Fish and Wildlife**
- **State Water Resources Control Board**
- **Central Valley Regional Water Quality Control Board**
- **Feather River Air Quality Management District**

Comments Requested

The Western Aggregates LLC Amended Reclamation Plan NOP and Initial Study will be circulated for public review and comment beginning on April 3, 2013 for a period of 30 days. All comments on the Initial Study should be submitted in writing to the State Mining and Geology Board, at the following address no later than May 2, 2013:

Mr. Will Arcand, Senior Engineering Geologist
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, California 95814-3528

Upon its completion, the Draft EIR will be circulated for public review and comment for a period of at least 45 days. All written comments on the Draft EIR will be presented in a Final EIR along with written responses to each comment as required by CEQA. After consideration of the Final EIR, the State Mining and Geology Board will hold a public hearing at which time the Board will consider certification of the Final EIR and approval of the Western Aggregates LLC Yuba County Operations Amended Reclamation Plan.

Public Scoping Session

A public scoping meeting will be held at the following time and location:

Date/Time: **April 18, 2013 / 6:30 PM**

Location: **Yuba County Government Center**
915 8th Street
Marysville, California 95901

All interested parties are encouraged to attend. All substantive written comments submitted on the NOP/Initial Study and those presented during the scoping meeting will be taken into consideration during the preparation of the Draft EIR.

Tackett, M Alice

From: Arcand, Will@DOC [Will.Arcand@conservation.ca.gov]
Sent: Wednesday, April 24, 2013 9:34 AM
To: Hanson, Richard B
Cc: Tackett, M. Alice
Subject: FW: Initial Comments on Amended Reclamation Plan for Western Aggregates (dated 4 Apr)
Attachments: [Untitled].pdf

Hi Rick:

Please see e-mail message below containing initial comments from Harl Sanderson at Beal AFB.

Thanks,
Will

-----Original Message-----
From: Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1 [mailto:harl.sanderson@beale.af.mil]
Sent: Tuesday, April 23, 2013 2:38 PM
To: SMGB@DOC; whartman@co.yuba.ca.us
Cc: EPalmeri@co.yuba.ca.us; Williams, Anissa F GS11 USAF ACC 9 CES/CEAO; Capra, Gregory S GS14 USAF ACC 9 CES/CD; Gerry, Joni L Civ USAF ACC 9 CES/CEA; Cox, Ryan N Maj USAF ACC 9 RW/SEF; Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Subject: Initial Comments on Amended Reclamation Plan for Western Aggregates (dated 4 Apr)

ATTN: Mr. Will J. Arcand

Dear Mr. Arcand,

Subject report on page 3, "Potentially Significant Environmental Impacts Identified in the Initial Study" subtitle, "Hydrology and Water Quality" raises significant concern to our flight safety program.

Increase in wildlife habitat and creation of five large lakes and vegetated shorelines around those lakes creates an unacceptable bird habitat on our runway 15 approach into Beale AFB. Additionally, it is not consistent with the Joint Land Use Study completed in concert with Yuba County

RECOMMENDATION: Continue to highlight this impact in development of your Draft EIR.

Regards,

Harl Sanderson

HARL H. SANDERSON, JR., GS-14, DAF
Deputy Director for Installation Support
9 MSG/CD-1
6000 C Street
Beale AFB CA 95903
Phone: (commercial) (530) 634-5057/2311--FAX: 2758 DSN 368-2311/5057
e-mail: harl.sanderson@beale.af.mil

-----Original Message-----
From: Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
[mailto:harl.sanderson@beale.af.mil]
Sent: Thursday, May 02, 2013 2:34 PM
To: Arcand, Will@DOC
Subject: FW: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested 2 May 2013))
Importance: High

-----Original Message-----
From: Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Sent: Thursday, May 02, 2013 1:53 PM
To: 'WILL.ARCAND@CONSRV.CA.GOV'
Subject: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested 2 May 2013))
Importance: High

Will,

Here are the comments that I dispatched to your organizational box earlier today.

As always, feel free to contact me.

Regards,

Harl

HARL H. SANDERSON, JR., GS-14, DAF
Deputy Director for Installation Support
9 MSG/CD-1
6000 C Street
Beale AFB CA 95903
Phone: (commercial) (530) 634-5057/2311--FAX: 2758
DSN 368-2311/5057
e-mail: harl.sanderson@beale.af.mil

-----Original Message-----
From: Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Sent: Thursday, May 02, 2013 8:19 AM
To: smgb@consrv.ca.gov
Cc: Hartman, Wendy; EPalmeri@co.yuba.ca.us; Edwards, Matthew R LtCol USAF ACC 9 RW/SE; Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO; Williams, Anissa F GS11 USAF

ACC 9 CES/CEAO; Gerry, Joni L Civ USAF ACC 9 CES/CEA; Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Subject: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested 2 May 2013))
Importance: High

TO: Mr. Will Arcand, Senior Engineering Geologist

State Mining and Geology Board

801 K Street, Suite 2015

Sacramento, California 95814-3528

Please incorporate the concerns in the attached letters from safety and flight operations agencies on Beale AFB regarding the amended reclamation plan for Western Aggregates in the area North of Beale AFB.

Attached are the emails from Beale AFB Flight Safety (9 RW/SE) and 9th Operations Group (9 OG/CC) in response to the Notice of Preparation of the Amended Reclamation Plan for Western Aggregates. The email "Signed Wetlands Memo" has a letter attached indorsed by 9 OG/CC, Col Haines. The email "FW: Notice of Preparation." is a memo from 9 RW/SE, Maj Edwards, with supporting information attached. Both documents reflect 9 OG and 9 RW/SE opposition to the proposed reclamation plan to convert Western Aggregates area to wildlife habitat. They are well written and understandable.

Please contact me direct if you have any concerns or questions about our submission.

Regards,

Harl Sanderson

HARL H. SANDERSON, JR., GS-14, DAF
Deputy Director for Installation Support
9 MSG/CD-1
6000 C Street
Beale AFB CA 95903
Phone: (commercial) (530) 634-5057/2311--FAX: 2758
DSN 368-2311/5057
e-mail: harl.sanderson@beale.af.mil

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 9TH OPERATIONS GROUP (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

23 Apr 13

MEMORANDUM FOR 9 CES/CEA

FROM: 9 OG/CC

SUBJECT: Re: Notice of Preparation and Initial Study, Amended Reclamation Plan for Western Aggregates, LLC (CA Mine ID #91-58-0001). Yuba County

1. In response to subject memorandum from the State Mining and Geology Board dated 4 Apr 12, I strongly recommend against the development of the land as described in the project. The memorandum states:

> Implementation of the plan will ultimately create a series of lakes, varying in size, and open space areas supporting a variety of wildlife habitat types including aquatic lake, marsh, woodland and upland habitats.

2. Development of lakes and marshes on the approach corridor to the runway will attract resident waterfowl and increase bird strikes. Bird strikes cause aircraft accidents and USAF guidance on this subject states:

> Fresh water is one of the most important airfield wildlife attractants, especially in arid regions and near the seacoast. Standing water creates a source of drinking water and a breeding place for insects, amphibians and other food sources for birds (AFPAM 91-212).

3. Title 14 Code of Federal Regulations, part 139.337 and FAA Advisory Circular150/5200-33 advise to alleviate or eliminate wildlife hazards near airports in order to prevent bird strikes. In light of that, and because placement of these wetlands may increase the risk of loss of life and aircraft due to the increased potential for waterfowl/bird strikes, I ask you strongly recommend disapproval of the proposed placement of new wetlands on the approach to Runway 15 at Beale

CLARK.JOSEPH.R.1246504489
Digitally signed by CLARK.JOSEPH.R.1246504489
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=CLARK.JOSEPH.R.1246504489
Date: 2013.04.24 10:38:33 -07'00'

JOSEPH R. CLARK, Capt, USAF
Airfield Operations Flight Commander

ONE TEAM...ONE FIGHT!

1st Ind to 9 CES/CEA, 23 Apr 13, Notice of Preparation and Initial Study

9 OSS/CC

MEMORANDUM FOR 9 OG/CC

Recommend concurrence with the above.

GRYN.PETER.J.1236679884 Digitally signed by GRYN.PETER.J.1236679884 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=GRYN.PETER.J.1236679884 Date: 2013.04.24 11:28:02 -07'00'

DANIELLE L. BARNES, Lt Col, USAF
Commander, 9th Operations Support Squadron

2d Ind to 9 CES/CEA, 23 Apr 13, Notice of Preparation and Initial Study

9 OG/CC

MEMORANDUM FOR 9 CES/CEA

I concur/~~do not concur~~ with the above memorandum. It would be extremely detrimental to flight operations at Beale AFB if a wetlands area was located along the final approach corridor to our primary runway. Questions regarding this memorandum may be directed to Mr. Gerald Sikorski, 9 OSS/OSAA at Gerald.Sikorski@Beale.AF.Mil or (530) 634-4823.

HAINES.ROBERT.M.1173729932 Digitally signed by HAINES.ROBERT.M.1173729932 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=HAINES.ROBERT.M.1173729932 Date: 2013.04.25 13:43:25 -07'00'

ROBERT M. HAINES, Colonel, USAF
Commander

From: Clark, Joseph R Capt USAF ACC 9 OSS/OSA [joseph.clark1@beale.af.mil]
Sent: Thursday, April 25, 2013 4:45 PM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Cc: Harris, Lee N Civ USAF ACC 9 OSS/OSA; Seals, Yolanda N 1stLt USAF ACC 9 OSS/OSA; Cieloha, Brandon J Capt USAF ACC 9 OSS/ADO
Subject: FW: Signed Wetlands Memo
Attachments: Tab 1 - Wetlands MemoV3.pdf

Ms. Rolfsness, attached is a Memo from the OG/CC regarding the wetlands to the north.

Capt Clark

-----Original Message-----
From: Cieloha, Brandon J Capt USAF ACC 9 OSS/ADO
Sent: Thursday, April 25, 2013 4:41 PM
To: Clark, Joseph R Capt USAF ACC 9 OSS/OSA; Seals, Yolanda N 1stLt USAF ACC 9 OSS/OSA; Harris, Lee N Civ USAF ACC 9 OSS/OSA
Cc: Nobriga, Nicholas A Maj USAF ACC 9 OSS/DO
Subject: Signed Wetlands Memo

Moose,

It's signed by the OG. Go ahead and send it over to CE.

Brandon

//Signed--bjc//
BRANDON J. CIELOHA, Capt, USAF
9th Operations Support Squadron
Assistant Director of Operations
Beale AFB, CA
DSN: 368-9465/ Comm: (530)634-9465

From: Edwards, Matthew R Maj USAF ACC 9 RW/SE [Matthew.Edwards@beale.af.mil]
Sent: Wednesday, April 24, 2013 5:08 PM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Cc: Clavenna, Michael L LtCol USAF ACC 9 OG/CD; Gray, Bradley S CTR USAF AFISRA 306 IS/TOI; Cieloha, Brandon J Capt USAF ACC 9 OSS/ADO; Clark, Joseph R Capt USAF ACC 9 OSS/OSA; Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA; Munson, Daniel D Capt USAF ACC 9 RW/SEF; Laughlin, James A Mr USAF ACC 9 RW/SE
Subject: FW: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)
Attachments: FAA Advisory Circular Excerpt.pdf; BASH90-09.pdf; 150_5200_33b.pdf

Sheri,

BLUF: 9RW/SE and USDA response for the preparation & reclamation plan for Western Aggregates is to discontinue any reclamation work North of Beale due to increased flight safety hazards to personnel and aircraft. Specifically, exclude any reclamation inside of a 5 mile radius of Beale's runway in order to preserve life and assets.

Discussion:

1) In order to preserve life and aircraft, per FAA guidance (see attached Advisory Circular) wildlife attractants should be no closer than 5 miles from the farthest edge of the airport's Airport Operating Area (AOA). The addition of lakes in this area will significantly impact the population of waterfowl, gulls, and a variety of other bird species. Because of their size, weight, flocking behavior and relative abundance, waterfowl and gulls can be particularly hazardous to aircraft. This was illustrated in the highly publicized bird strike of flight 1549 which landed in the Hudson river and miraculously no lives were lost. Even one strike from these species can be devastating, and increasing the risk associated with striking these species is unacceptable.

2) Air Force BASH team recommendation:
These 5 large lakes, resulting in a net long-term increase in wildlife habitat will be in the approach and departure flight path of traffic. A bird strike occurring at this critical flight location can render an aircraft unrecoverable. Therefore, placement of water attractants at the approach or departure end of a runway must be avoided. Additionally, consider existing water bodies such as Tiechert pond on the north end of the approach corridor. Ill advised placement of new lakes can put birds directly in the path of aircraft as they transit from one location to another.

3) Local Impact:
Bird surveys conducted since 2010 indicate Tiechert pond, which is smaller than the proposed lakes, supports 1500-2000 waterfowl per day in fall and winter months. At Beale AFB, waterfowl and gulls currently account for 5% of all birdstrikes, and account for the highest number of damaging bird strikes at Beale AFB. This accounts for over 23% of total damages to all struck aircraft. These five larger lakes will significantly increase the risk of life threatening bird strikes, while also increasing the amount of damaging bird

strikes at Beale AFB. Since 2006 Beale AFB has had 7 damaging strikes attributed to waterfowl and gulls, accounting for over $130,000 in damage. Increasing not only the number of water attractants but the size of the lakes will probably introduce additional waterfowl species that are not currently found close to the Beale AOA because of the relatively small size of the current ponds.

4) Civilian Data
According to an FAA study from 1990-2009 (attached), although gulls represent the most frequently struck species, waterfowl account for significantly more damaging strikes. Introducing a water attractant that will increase both species is not recommended.

Please keep 9RW/SE advised of any action points in order to voice any concerns. Thank you.

VR,

Mango

//Signed//
MATTHEW R. EDWARDS, Maj, USAF
9 RW Chief of Safety
DSN: 312-368-4025
COM: (530) 634-4025

Sir,

Please review our response and forward the final draft to Sheri Rolfsness. Please include Gerald Sikorski, Brandon Cieloha, Joseph Clark (9 OSS/OSA) and/or one of the OG Deputies so the OG has the opportunity to see our response and use it as required. Jim may have more stats, etc. if you think of any relevant numbers that may be worthwhile.

V/R,

Daniel Munson, Capt, USAF

Chief of Flight Safety

9th Reconnaissance Wing

DSN 368-8876

Comm 530-218-0730

-----Original Message-----

From: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Sent: Tuesday, April 23, 2013 4:23 PM
To: Munson, Daniel D Capt USAF ACC 9 RW/SEF; Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Hi Capt Munson and Mr. Sikorski,

I uploaded the files with the entire draft Environmental Impact Report to the AMRDEC Safe file transfer web site for both of you. You will receive an email with a link and a password so you can download them to your computer for review. I did Mr. Sikorski's this morning and just finished uploading the files for Capt Munson.

In the meantime, I also received the attached email where Mr. Sanderson, 9 MSG/CD-1, highlighted two areas of concern for Beale and requested the EIR address impacts in those areas fully. Since he has already responded with comments on behalf of Beale AFB, I'm not sure whether I still need to provide him our comments. But I will definitely forward any comments you put together. My suspense was to provide comments to Mr. Capra to forward to Mr. Sanderson by COB tomorrow -- if you are able to meet that, it would be great. If not, I think your comments would be taken seriously even if they are late so don't let the suspense discourage you from submitting them.

Thanks for your help,

Sheri

-----Original Message-----
From: Munson, Daniel D Capt USAF ACC 9 RW/SEF
Sent: Tuesday, April 23, 2013 1:37 PM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Cc: Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Sheri,

I haven't seen this yet, can you send the details please?

-----Original Message-----
From: Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Sent: Tuesday, April 23, 2013 11:03 AM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Cc: Clark, Joseph R Capt USAF ACC 9 OSS/OSA; Laughlin, James A Mr USAF ACC 9 RW/SE; Munson, Daniel D Capt USAF ACC 9 RW/SEF; Langford, Nathan T MSgt USAF ACC 9 OSS/OSAA
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Sheri, we have comments and I'm sure flight safety will have comments too. Please ensure you have our comments before you reply to the state. We are

reviewing out birdstrike data at present so we can present evidence, and will give our comments to you shortly. One of the most important things to note is the altitude of the U-2 on no flap approaches over the proposed lake will expose pilot/aircraft to greater risk of birdstrike.

I haven't had time to read the whole document yet. Have you found, do you know of, any references to a wildlife mitigation plan within the document?

Thank you.

V/R,
//"SI"//
GERALD W. SIKORSKI, GS-12, DAFC
Airfield Manager
9 OSS/OSAA, Beale AFB, CA
COMM (530) 634-4823
MOBILE (530) 713-6735
DSN: 368-3196/2002

-----Original Message-----
From: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Sent: Tuesday, April 23, 2013 9:18 AM
To: Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Sure, it's on it's way,

-----Original Message-----
From: Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Sent: Monday, April 22, 2013 3:24 PM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Sheri, can you sent me this via AMRDEC

Thank you.

V/R,
//"SI"//
GERALD W. SIKORSKI, GS-12, DAFC
Airfield Manager
9 OSS/OSAA, Beale AFB, CA
COMM (530) 634-4823
MOBILE (530) 713-6735
DSN: 368-3196/2002

-----Original Message-----
From: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO
Sent: Monday, April 15, 2013 10:50 AM
To: Cox, Ryan N Maj USAF ACC 9 RW/SEF; Munson, Daniel D Capt USAF ACC 9

RW/SEF; Laughlin, James A Mr USAF ACC 9 RW/SE; Hoxie, Shea Capt USAF ACC 9 RW/JA; Sikorski, Gerald W Civ USAF ACC 9 OSS/OSA
Cc: Williams, Anissa F GS11 USAF ACC 9 CES/CEAO; Gerry, Joni L Civ USAF ACC 9 CES/CEA; Steinmetz, Dan L Civ USAF ACC 9 CES/CEAO
Subject: FW: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

Hi Everybody,

I've been asked to coordinate a response to a Reclamation Plan for Western Aggregates.

The attached Notice of Preparation describes it in general terms. The actual Amended Reclamation Plan is 75 MB in size. I can provide a copy on CD or upload it to the AMRDEC Safe file transfer site for your review. Please let me know your preference.

The gist of the plan is that when Western Aggregates is finished mining the Yuba Goldfields north of Beale AFB, they would convert the property to wildlife habitat including five lakes. The State Mining and Geology Board requires mining operations to develop a plan like this, to prevent them from walking away from the mining operation and leaving an eyesore once they've gleaned all the profit they can from the site. In this plan, they show the five lakes lying mostly outside of Beale's designated approach/departure corridor. I believe they requested input from Kirsten Christopherson on ways to reduce BASH hazard and specifically avoided putting the lakes within the approach/departure corridor based on that input.

My suspense to provide comments to Mr. Capra is 25 Apr. I would really appreciate it if you can review and provide any comments/concerns you have on this proposed reclamation plan by 24 Apr so I can meet my suspense. Thanks for your help, and have a great week!

Sheri

Sheri Rolfsness, P.E., GS-12
9 CES/CEAO
6451 B St., Beale AFB, CA 95903-1708
(530) 634-2593 DSN 368-2593

-----Original Message-----
From: Capra, Gregory S GS14 USAF ACC 9 CES/CD
Sent: Tuesday, April 09, 2013 6:06 PM
To: Gerry, Joni L Civ USAF ACC 9 CES/CEA
Cc: Williams, Anissa F GS11 USAF ACC 9 CES/CEAO; George, Brian M Maj USAF ACC 9 CES/CEO; Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO; 9 CES/CC Commander
Subject: RE: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

OPR: CEA
S: 25 Apr

Please coordinate a response with SE, JA and OSS coord. We can talk at the

BASH meeting tomorrow.

v/r
Greg

GREGORY S. CAPRA, P.E., LEED AP
Deputy Base Civil Engineer

6451 B Street
Beale AFB CA 95903
DSN 368-2943 Comm (530)634-2943
Fax (530) 634-3298

-----Original Message-----
From: Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Sent: Tuesday, April 09, 2013 2:51 PM
To: Rolfsness, Sheri L Civ USAF ACC 9 CES/CEAO; Capra, Gregory S GS14 USAF ACC 9 CES/CD
Cc: Gerry, Joni L Civ USAF ACC 9 CES/CEA; Williams, Anissa F GS11 USAF ACC 9 CES/CEAO; Sanderson, Harl H Civ USAF ACC 9 MSG/CD-1
Subject: Notice of Preparation & Reclamation Plan for Western Aggregates (Comments Requested NLT 26 Apr 13)

BLUF: Need review and comments on the attached for possible

Greg: Unsure how I received the attached as it is addressed to 9 CES/CD (with my name).

Sheri:

- I received the attached NOP on Western Aggregates plans, from The State Mining and Geology Board (Dept of Conservation), involving the phased reclamation of 1,960 acres of aggregate mining.

- The obvious impact to Beale AFB flight operations is from creation of five large lakes & a vegetated shoreline around the lakes--creating possible Air Traffic Hazards to Beale.

A public scoping meeting is scheduled for 18 April-1830 at the Yuba County Government Center in Marysville.

I have placed a copy of the accompanying CD in 9 CES' distribution box located in 9 MSG.

Regards,

Harl

HARL H. SANDERSON, JR., GS-14, DAF
Deputy Director for Installation Support
9 MSG/CD-1
6000 C Street
Beale AFB CA 95903
Phone: (commercial) (530) 634-5057/2311--FAX: 2758
DSN 368-2311/5057
e-mail: harl.sanderson@beale.af.mil

SECTION 1.

GENERAL SEPARATION CRITERIA FOR HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

1-1. INTRODUCTION. When considering proposed land uses, airport operators, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. Land-use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife strikes.

The FAA recommends the minimum separation criteria outlined below for land-use practices that attract hazardous wildlife to the vicinity of airports. Please note that FAA criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA). (See the discussion of the synergistic effects of surrounding land uses in Section 2-8 of this AC.)

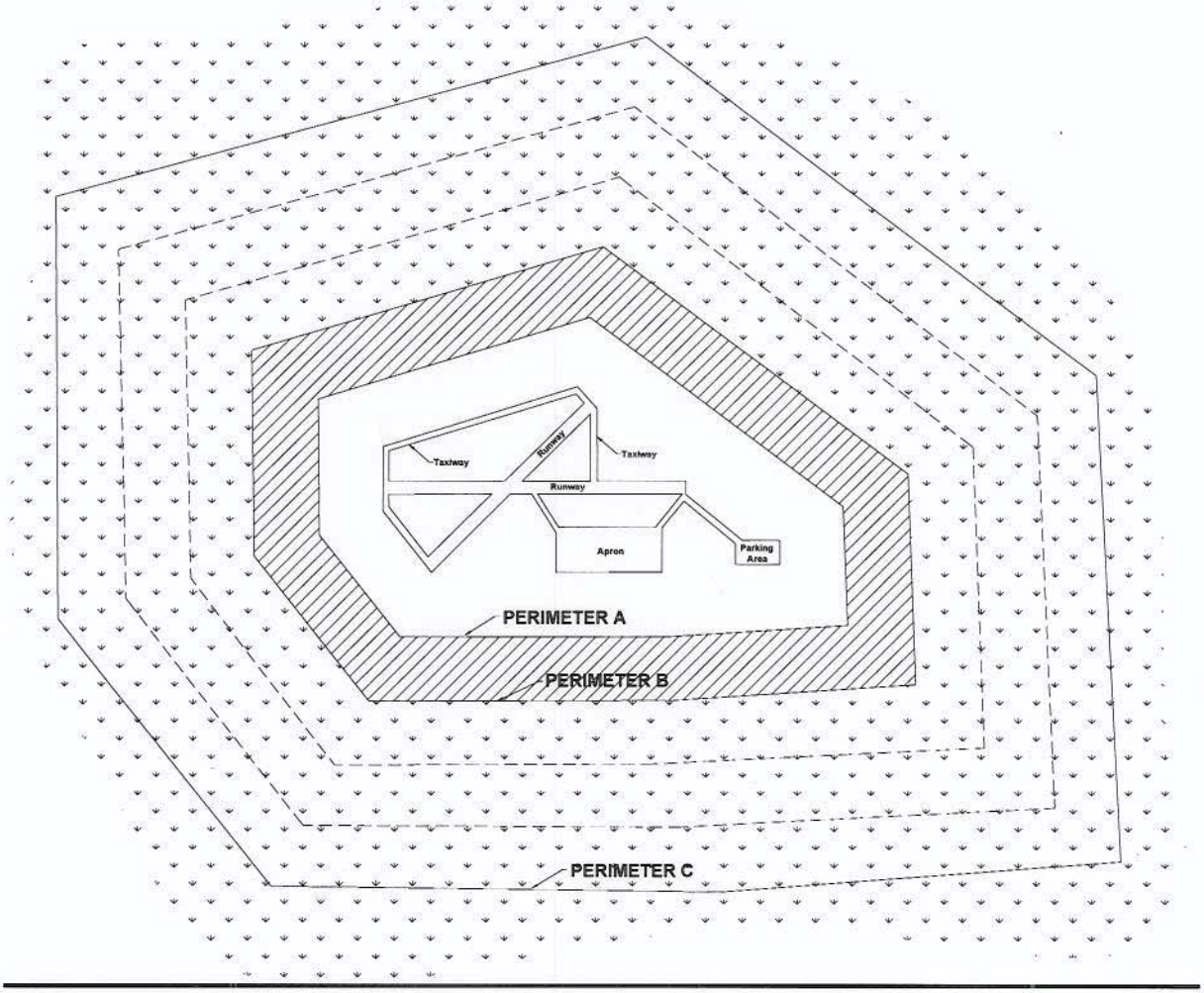
The basis for the separation criteria contained in this section can be found in existing FAA regulations. The separation distances are based on (1) flight patterns of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 feet and 90 percent occur under 3,000 feet above ground level), and (3) National Transportation Safety Board (NTSB) recommendations.

1-2. AIRPORTS SERVING PISTON-POWERED AIRCRAFT. Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 5,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance measured from the nearest aircraft operations areas.

1-3. AIRPORTS SERVING TURBINE-POWERED AIRCRAFT. Airports selling Jet-A fuel normally serve turbine-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 10,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance from the nearest aircraft movement areas.

1-4. PROTECTION OF APPROACH, DEPARTURE, AND CIRCLING AIRSPACE. For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport's AOA and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

Figure 1. Separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated.



PERIMETER A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.

PERIMETER B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.

PERIMETER C: 5-mile range to protect approach, departure and circling airspace.

Table 1. Ranking of 25 species groups as to relative hazard to aircraft (1=most hazardous) based on three criteria (damage, major damage, and effect-on-flight), a composite ranking based on all three rankings, and a relative hazard score. Data were derived from the FAA National Wildlife Strike Database, January 1990–April 2003.[1]

Species group	Ranking by criteria			Composite ranking[2]	Relative hazard score[3]
	Damage[4]	Major damage[5]	Effect on flight[6]		
Deer	1	1	1	1	100
Vultures	2	2	2	2	64
Geese	3	3	6	3	55
Cormorants/pelicans	4	5	3	4	54
Cranes	7	6	4	5	47
Eagles	6	9	7	6	41
Ducks	5	8	10	7	39
Osprey	8	4	8	8	39
Turkey/pheasants	9	7	11	9	33
Herons	11	14	9	10	27
Hawks (buteos)	10	12	12	11	25
Gulls	12	11	13	12	24
Rock pigeon	13	10	14	13	23
Owls	14	13	20	14	23
H. lark/s. bunting	18	15	15	15	17
Crows/ravens	15	16	16	16	16
Coyote	16	19	5	17	14
Mourning dove	17	17	17	18	14
Shorebirds	19	21	18	19	10
Blackbirds/starling	20	22	19	20	10
American kestrel	21	18	21	21	9
Meadowlarks	22	20	22	22	7
Swallows	24	23	24	23	4
Sparrows	25	24	23	24	4
Nighthawks	23	25	25	25	1

[1] Excerpted from the *Special Report for the FAA, "Ranking the Hazard Level of Wildlife Species to Civil Aviation in the USA: Update #1, July 2, 2003".* Refer to this report for additional explanations of criteria and method of ranking.

[2] Relative rank of each species group was compared with every other group for the three variables, placing the species group with the greatest hazard rank for $\geq$ 2 of the 3 variables above the next highest ranked group, then proceeding down the list.

[3] Percentage values, from Tables 3 and 4 in Footnote 1 of the *Special Report*, for the three criteria were summed and scaled down from 100, with 100 as the score for the species group with the maximum summed values and the greatest potential hazard to aircraft.

[4] Aircraft incurred at least some damage (destroyed, substantial, minor, or unknown) from strike.

[5] Aircraft incurred damage or structural failure, which adversely affected the structure strength, performance, or flight characteristics, and which would normally require major repair or replacement of the affected component, or the damage sustained makes it inadvisable to restore aircraft to airworthy condition.

[6] Aborted takeoff, engine shutdown, precautionary landing, or other.

U. S.
DEPARTMENT OF
TRANSPORTATION
FEDERAL
AVIATION
ADMINISTRATION

WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES 1990–2009

U.S.
Department of
Agriculture
Animal and
Plant Health
Inspection
Service
Wildlife
Services

FEDERAL AVIATION ADMINISTRATION
NATIONAL WILDLIFE STRIKE DATABASE
SERIAL REPORT NUMBER 16

REPORT OF THE ASSOCIATE ADMINISTRATOR FOR AIRPORTS
OFFICE OF AIRPORT SAFETY AND STANDARDS
AIRPORT SAFETY & CERTIFICATION
WASHINGTON, DC

MAY 2011

The Federal Aviation Administration produced this report in cooperation with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services.

AUTHORS

Richard A. Dolbeer, Science Advisor, Airport Wildlife Hazards Program, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 6100 Columbus Ave., Sandusky, OH 44870

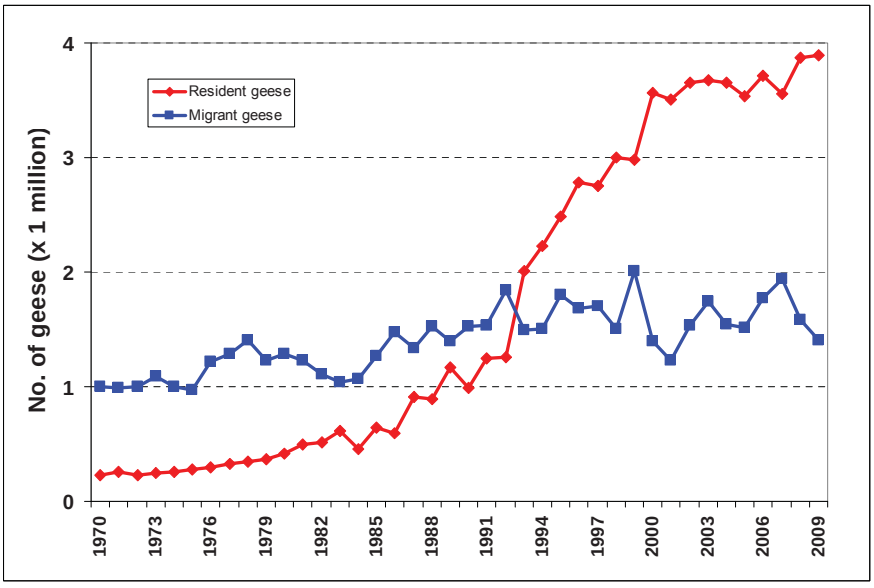
Sandra E. Wright, Wildlife Strike Database Manager, Airport Wildlife Hazards Program, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 6100 Columbus Ave., Sandusky, OH 44870

John R. Weller, National Wildlife Biologist, Office of Airport Safety and Standards, Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC 20591

Michael J. Begier, National Coordinator, Airports Wildlife Hazards Program, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, 1400 Independence Ave., SW, Washington, DC 20250

COVER

The emergency forced landing of US Airways Flight 1549 in the Hudson River on 15 January 2009 after Canada geese were ingested in both engines on the Airbus 320 dramatically demonstrated to the public that bird strikes are a serious aviation safety issue. AP Photo.



The Canada goose population in North America (migrant and resident birds) increased from about 1.2 million in 1970 to 5.3 million in 2009 (Dolbeer and Seubert 2010).

Anyone with quality photographs of aircraft damage resulting from wildlife strikes or of wildlife at airports is encouraged to submit them to one of the authors for consideration in future wildlife strike publications.

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ACKNOWLEDGMENTS

The database files and support programs used to enter and organize strike data initially were established by ***E. LeBoeuf*** and ***J. Rapol,*** Federal Aviation Administration (FAA), Office of Airport Safety and Standards, Washington, DC, and were subsequently updated by ***A. M. Dickey*** and ***A. Newman,*** Embry-Riddle Aeronautical University, Prescott, AZ. ***E. C. Cleary***, who retired from the FAA in 2007, was instrumental in developing and co-authoring previous reports in this series. We acknowledge his long-standing contributions to the database. We greatly appreciate the assistance provided by these above-acknowledged professionals. ***S. Agrawal*** and ***R. King,*** FAA William J. Hughes Technical Center, Atlantic City, NJ, also provided critical support and advice. Finally, we acknowledge and thank all of the people who took the time and effort to report wildlife strikes — pilots, mechanics, control tower personnel, airport operations personnel, airline flight safety officers, USDA, Animal and Plant Health Inspection Service (APHIS), Wildlife Services biologists, and many others. Sponsorship and funds for the ongoing maintenance and analysis of the FAA National Wildlife Strike Database are provided by the FAA, Office of Airport Safety and Standards, Washington, DC; Airports Division, Airport Technology Branch, FAA William J. Hughes Technical Center, Atlantic City, NJ; and the Office of the Deputy Administrator, USDA APHIS Wildlife Services Program.

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EXECUTIVE SUMMARY

The emergency forced landing of US Airways Flight 1549 in the Hudson River on 15 January 2009 after Canada geese were ingested in both engines on the Airbus 320 dramatically demonstrated to the public that bird strikes are a serious aviation safety issue. However, the civil and military aviation communities have long recognized that the threat from aircraft collisions with wildlife (wildlife strikes) is real and increasing. Globally, wildlife strikes have killed more than 229 people and destroyed over 210 aircraft since 1988. Factors that contribute to this increasing threat are growing populations of large birds and increasing air traffic by quieter, turbofan-powered aircraft.

This report presents a summary analysis of data from the National Wildlife Strike Database (NWSD) for the 20-year period 1990 through 2009. To supplement the statistical summary of data, a sample of significant wildlife strikes to civil aircraft in the USA during 2009 is also presented to demonstrate the widespread and diverse nature of the problem.

The number of strikes annually reported has increased five-fold from 1,793 in 1990 to 9,474 in 2009 (99,411 for 1990–2009). During the five years between 2004 and 2008, there was an average of 20 reported wildlife strikes/ day. This increased to an average of 26 reported strikes per day in 2009; a 25-percent rise from 2008 and the largest single-year increase (1,872) for reported strikes. Birds were involved in 97.2 percent of the strikes, terrestrial mammals in 2.3 percent, bats in 0.4 percent, and reptiles in 0.1 percent. Although the number of reported strikes has steadily increased, the number of reported damaging strikes has actually declined from 765 in 2000 to 601 in 2009.

Fifty-two percent of bird strikes occurred between July and October; 31 percent of deer strikes occurred in October and November. Terrestrial mammals are more likely to be struck at night (63 percent), whereas birds are struck more often during the day (62 percent). Both birds (61 percent) and terrestrial mammals (63 percent) are more likely to be struck during the landing (i.e., descent, approach, or landing roll) phase of flight compared to take-off and climb (37 percent and 34 percent, respectively).

For commercial and general aviation (GA) aircraft, 72 and 76 percent of bird strikes, respectively, occurred at or below 500 feet above ground level (AGL). Above 500 feet AGL, the number of strikes declined by 33 percent for each 1,000-foot gain in height for commercial aircraft, and by 41 percent for GA aircraft.

From 1990 to 2009, 415 species of birds and 35 species of terrestrial mammals have been identified as struck by aircraft. Waterfowl, gulls, and raptors are the species groups of birds with the most damaging strikes; artiodactyls (mainly deer) and carnivores (mainly coyotes) are the terrestrial mammals with the most damaging strikes. Although the percentage of bird strikes causing damage has averaged 14 percent for the 20-year period, this number has declined from 20 percent in 1990 to 9 percent in 2009. For terrestrial mammals (20-year average of 61 percent), the decline has been from 86

percent in 1990 to 32 percent in 2009. Overall, 55 strikes have resulted in a destroyed aircraft; 33 (60 percent) of these occurred at GA airports.

This annual report is based on information from a portion of the available data fields contained in the NWSD. These reports provided summary information on the nature of wildlife strikes in a format that continues to be found useful by the aviation industry. The NWSD was made available by the FAA to the public on April 24, 2009, and interested parties now have the opportunity to query and examine the data independently at the newly updated FAA wildlife strike database website (http://wildlife.faa.gov). The new site has search fields that enable users to find data on specific airports, airlines, aircraft, and engine types, as well as damage incurred, date of strike, species struck, and state without having to download the entire database. The FAA also developed software to make strike reporting easier. Now, anyone who needs to report a wildlife strike can do so via the web or mobile devices like the Blackberry and iPhone. Although wildlife strike reporting is voluntary, and in some cases uneven, it has steadily increased and continues to provide adequate data to determine national trends and for the development of national policy. Analyses of the database can produce dissimilar comparisons that involve subject matter such as airports and airlines. Disparities that contribute to this variability include the presence/ absence of an airport-based wildlife hazard management program, integration of internal airline and airport strike reporting with the NWSD, variability in geography and topography of the airport, on-site and off-site habitats and wildlife attractants, aircraft type, number and time of day of aircraft movements, and the proximity of seasonal avian migration routes. Although the largest single-year increase for reported strikes occurred in 2009, there continues to be a need for increased reporting from GA airports, various certificated airports, and airlines and more detailed reporting of information (i.e., species identification, damage incurred, estimated costs) about wildlife strikes.

The successful mitigation efforts at airports that have reduced damaging strikes in recent years, which must be sustained, have done little to reduce strikes outside the airport such as occurred with US Airways Flight 1549 in 2009 (Dolbeer 2011, in press[1]). Consequently, additional measures are needed. First, the general public and aviation community must widen its view of wildlife management to consider habitats and land uses that attract hazardous wildlife within 5 miles of airports. Second, on-going research and mitigation efforts to further develop bird-detecting radar and bird migration forecasting and to study avian sensory perception to enhance aircraft detection and avoidance by birds should be maintained. Finally, Federal regulations and guidance on wildlife hazards at airports should continue to be reviewed and where necessary revised to incorporate new information about wildlife hazards and wildlife strike reporting trends. The FAA is taking a number of actions in these areas.

Effective and resourceful mitigation of wildlife hazards depends, in part, on quality strike data. There continues to be a need for increased and more detailed reporting of information about wildlife strikes. The FAA is focusing on improving the reporting rates of those airports and air carriers not fully participating in the program and in the transfer

[1] "In press" means the paper being cited has been officially accepted for publication but has not yet been published.

of data from miscellaneous FAA and industry databases under the existing voluntary system. Outreach efforts initiated to increase the quantity and quality of strike reports include the aforementioned updated FAA wildlife strike database website (http://wildlife.faa.gov), new strike reporting capabilities via mobile devices like the Blackberry and iPhone, and the creation of informational posters, placards, and quick reference thumb guides. The FAA and USDA have also increased outreach efforts through cooperative efforts with the Bird Strike Committee USA, Embry Riddle Aeronautical University, and various leading groups in the aviation community.

An Embraer 120 struck a white pelican at 2,600 feet above ground level after departure from an airport in Utah on 31 July 2009. The aircraft returned safely to the airport with the bird lodged in the radome. The aircraft was out of service for 48 hours; cost of repairs was $150,000. Photo courtesy G. Rokich.

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WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES, 1990–2009

On 4 November 2009, a western grebe penetrated the windshield and injured the pilot of this Beechcraft 99 aircraft at about 6,800 feet above ground level on approach to an airport in Arizona. The pilot made an emergency landing. Photo courtesy K. Patterson.

INTRODUCTION

The emergency forced landing of US Airways Flight 1549 in the Hudson River on 15 January 2009 after Canada geese were ingested in both engines on the Airbus 320 (National Transportation Safety Board 2009, Marra et al. 2009) dramatically demonstrated to the public that bird strikes are a serious aviation safety issue. However, the civil and military aviation communities have long recognized that the threat to human health and safety from aircraft collisions with wildlife (wildlife strikes) is real and increasing (Dolbeer 2000, MacKinnon et al. 2001). Globally, wildlife strikes have killed more than 229 people and destroyed over 220 aircraft since 1988 (Richardson and West 2000; Thorpe 2003; 2005; Dolbeer, unpublished data). Three factors that contribute to this increasing threat:

1. Many populations of wildlife species commonly involved in strikes have increased markedly in the last few decades and adapted to living in urban environments, including airports. For example, from 1980 to 2007, the resident (non-migratory) Canada goose population in the USA and Canada increased at a mean rate of 7.3 percent per year (Sauer et al. 2008). Other species showing significant mean annual rates of increase included bald eagles (4.6 percent), wild turkeys (12.1 percent), turkey vultures (2.2 percent), American white pelicans (2.9 percent), double-crested cormorants (4.0 percent), and sandhill cranes (5.0 percent). Thirteen of the 14 bird species in North America with mean body masses greater than 8 pounds have shown significant population increases over the past three decades (Dolbeer and Eschenfelder 2003). The white-tailed deer population increased from a low of about 350,000 in 1900 to over 30 million in the past decade (Adams et al. 2009, McCabe and McCabe 1997, Hubbard et al. 2000).

2. Concurrent with population increases of many large bird species, air traffic has increased since 1980. Passenger enplanements in the USA increased from about 310 million in 1980 to 690 million in 2009 (2.8 percent per year), and commercial air traffic increased from about 18 million aircraft movements in 1980 to 26 million in 2009 (1.2 percent per year, Federal Aviation Administration 2010). USA commercial air traffic is predicted to continue growing at a rate of about 1.2 percent per year to 37 million movements by 2030.

3. Commercial air carriers have replaced their older three- or four-engine aircraft fleets with more efficient and quieter, two-engine aircraft. In 1965, about 90 percent of the 2,100 USA passenger aircraft had three or four engines. In 2005, the USA passenger fleet had grown to about 8,200 aircraft, and only about 10 percent had three or four engines (U.S. Department of Transportation 2009). With the steady advances in technology over the past several decades, today's two-engine aircraft are more powerful than yesterday's three- and four-engine aircraft, and they are more reliable. However, in the event of a multiple ingestion event (e.g., the US Airways Flight 1549 incident on 15 January 2009), aircraft with two engines may have vulnerabilities not shared by their three- or four-engine-equipped counterparts. In addition, previous research has indicated that birds are less able to detect and avoid modern jet aircraft with quieter turbofan engines (Chapter 3, International Civil Aviation Organization 1993) than older aircraft with noisier (Chapter 2) engines (Burger 1983, Kelly et al. 1999).

As a result of these factors, experts within the Federal Aviation Administration (FAA), U.S. Department of Agriculture (USDA), U.S. Navy, and U.S. Air Force expect the risk of wildlife-aircraft collisions to be a continuing challenge over the next decade.

The FAA has initiated several programs to address this important safety issue. Among the various programs is the collection and analysis of data from wildlife strikes. The FAA began collecting wildlife strike data in 1965. However, except for

cursory examinations of the strike reports to determine general trends, the data were never submitted to rigorous analysis until the 1990s. In 1995, the FAA, through an interagency agreement with the USDA, Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS), initiated a project to obtain more objective estimates of the magnitude and nature of the national wildlife strike problem for civil aviation. This project involves having specialists from the WS program: (1) edit all strike reports (FAA Form 5200-7, *Bird/Other Wildlife Strike Report*) received by the FAA since 1990 to ensure consistent, error-free data; (2) enter all edited strike reports in the NWSD; (3) supplement FAA-reported strikes with additional, non-duplicated strike reports from other sources; (4) provide the FAA with an updated computer file each month containing all edited strike reports; and (5) assist the FAA with the production of annual and special reports summarizing the results of analyses of the data from the NWSD. Such analyses are critical to determining the economic cost of wildlife strikes, the magnitude of safety issues, and most important, the nature of the problems (e.g., wildlife species involved, types of damage, height and phase of flight during which strikes occur, and seasonal patterns). The information obtained from these analyses provides the foundation for FAA policies and guidance and for refinements in the development, implementation, and justification of integrated research and management efforts to reduce wildlife strikes.

A medical Eurocopter 135 struck a black vulture on 8 November 2009 in North Carolina while en route, causing substantial damage to the tail. Aircraft made emergency landing in residential yard. Photo courtesy J. Gusler.

The first annual report on wildlife strikes to civil aircraft in the USA, covering 1994, was completed in November 1995 (Dolbeer et al. 1995). Since then we have published subsequent reports covering the years 1993–1995, 1992–1996, 1991–1997, 1990–1998, 1990–1999, 1990–2000, 1990–2001, 1990-2002, 1990-2003, 1990-2004, 1990-2005, 1990-2006, 1990-2007, and 1990–2008 (Cleary et al. 1996, 1997, 1998, 1999, 2000, 2002a, 2002b, 2003, 2004, 2005, 2006, 2007; Dolbeer and Wright 2008, Dolbeer et al. 2009). This is the 16th report in the series and covers the 20-year period of 1990 through 2009. The current and historic annual reports are accessible as PDF documents at http://wildlife.faa.gov.

This report presents a summary analysis of data from the FAA's National Wildlife Strike Database for the 20-year period 1990 through 2009. Unless noted otherwise, all totals are for the 20-year period, and percentages are of the total known.

Because of the large amount of data, most tables do not display data for individual years.

To supplement the statistical summary of data presented in tables and graphs, a sample of significant wildlife strikes to civil aircraft in the USA during 2009 is presented in Appendix A. These recent strike examples demonstrate the widespread and diverse nature of the problem. A more extensive list of significant strike events (1990-2009) and additional resources and reports are available at http://wildlife.faa.gov.

RESULTS

NUMBER OF REPORTED STRIKES

For the 20-year period (1990–2009), 99,411 strikes were reported to the FAA. Birds were involved in 97.2 percent of the reported strikes, terrestrial mammals in 2.3 percent, bats in 0.4 percent, and reptiles in 0.1 percent (Table 1).

The number of strikes annually reported has increased five-fold from 1,793 in 1990 to 9,474 in 2009 (Table 1, Figure 1). The 25-percent increase in reported strikes from 2008 to 2009 was the largest 1-year increase recorded. We suggest that the increase in reports of strikes, especially in 2009 following the Airbus 320 forced-landing in the Hudson River (NTSB 2010), primarily has been a result of an increased awareness of the wildlife strike issue and cooperation within the aviation industry to report strikes.

An MD-90 departing an Arizona airport on 2 November 2009 struck two western grebes at 9,300 feet above ground level. One grebe tore the fuselage above the eyebrow window, activating the depressurization alarm. The aircraft returned to airport safely. Photo courtesy L. Duncan.

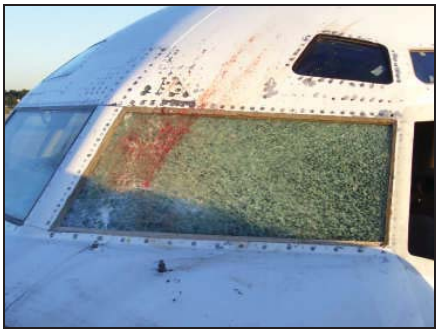
Although the number of reported strikes has steadily increased, it is important to note that the number of reported damaging strikes has actually declined in recent years. The number of reported strikes with damage to aircraft increased from 372 in 1990 to a peak of 765 in 2000. This number has subsequently declined by 21 percent to 601 in 2009 (Table 1, Figure 2). For commercial aircraft, the rate of damaging strikes (number per 100,000 aircraft movements) has also declined since 2000 (Table 2, Figures 3). The rate of damaging strikes with general aviation (GA) aircraft has remained

stable since 1997 (Table 3, Figure 3). These declines in damaging strikes for commercial aviation have occurred in spite of an increase in populations of hazardous wildlife species (Dolbeer 2000, Dolbeer and Eschenfelder 2003).

In May 2009, the FAA authorized a study through the FAA Airport Technology Research and Development Branch to review the NWSD and determine the current level of reporting and if it is sufficient to determine national trends. The study also reviewed whether strike reporting should be mandated and how the FAA can increase its data collection.

This study (Dolbeer 2009a,b) identified that the total number of strikes reported has increased from 20 percent during the period from 1990 to 1994 to 39 percent from 2004 to 2008 at airports certificated under 14 Code of Federal Regulations (CFR) Part 139. Although there is a higher level of reporting, the number of damaging strikes has not increased. This important fact is attributed to the successful implementation of professionally run wildlife hazard programs at many certificated airports. The current overall reporting rate of 39 percent is adequate to determine national trends in wildlife strikes, determine the hazard level of wildlife species that are being struck, and provide a scientific foundation for FAA policies and guidance on the mitigation of risk from wildlife strikes. As these are the main purposes of the NWSD, the FAA does not believe mandatory reporting is required at this time.

The study did identify reporting gaps among certificated airports, air carriers, and general aviation (GA) airports. Less than 6 percent of all strike reports come from GA airports identified in the National Plan of Integrated Airport Systems (NPIAS), and reporting rates average less than 1/20 of the rates at Part 139 airports. From 2004 to 2008, 84 (16 percent) Part 139 airports and 2,170 (85 percent) of the 2,560 NPIAS GA airports did not have a single strike reported. As a result, the FAA is conducting outreach with the aviation community and investigating the availability of alternative strike data sources to close these reporting gaps. The FAA also simplified strike reporting in July 2010 through the use of mobile devices and previously available online reporting. Now, anyone who needs to report a wildlife strike can do so via the web or their mobile devices. Additionally, continued emphasis on strike reporting requirements often incorporated into airport Wildlife Hazard Management Plans and annual wildlife hazard awareness training programs for airport personnel



A B-727 on final approach into a mid-southern USA airport at night on 29 September 2009 struck several migrating great egrets. Besides damage to the captain's windshield, bird remains were ingested in two engines. The plane landed safely. Photo courtesy FedEx.

should continue to benefit strike reporting.

METHODS OF REPORTING STRIKES

Most (68 percent) of the 99,411 strike reports submitted between 1990 and 2009 were filed using the paper (40 percent) or electronic (28 percent) version of FAA Form 5200-7, *Bird/Other Wildlife Strike Report*. Since the online version of this form became available in April 2001, use of the electronic reporting system has climbed dramatically. In 2009, 71 percent of the strike reports were submitted electronically compared to 20 percent in 2002 (Table 4).

SOURCE OF REPORTS

Airline personnel and pilots filed 28 percent and 24 percent of the strike reports, respectively, whereas 34 percent of known strikes were reported by airport ground personnel (Table 5). About 85 percent of the reported strikes involved commercial aircraft; the remainder involved business, private, and government aircraft (Table 6). Reports were received from all 50 states, from some USA territories, and from foreign countries when USA-registered aircraft were involved (Table 7). California, Texas, Florida, and New York had the most bird strike reports (8,347; 7,063; 6,230; and 5,237, respectively). Eleven other states each had more than 2,000 bird strikes reported. New York, Colorado, California, Texas, Illinois, New Jersey, and Michigan each had greater than 100 terrestrial mammal strikes. In all, strikes were reported at 1,822 airports (1,585 airports in the USA and 237 foreign airports where USA-based aircraft were involved).

TIMING OF OCCURRENCE AND PHASE OF FLIGHT OF STRIKES

Most bird strikes (52 percent) occurred between July and October (Figure 4); 62 percent occurred during the day (Table 8); 61 percent occurred during the landing (descent, approach, or landing roll) phase of flight; and 37 percent occurred during take-off run and climb (Table 9).

Most terrestrial mammal strikes occurred between July and November; with 31 percent of deer strikes concentrated in October-November (Figure 4). Most terrestrial mammal strikes (63 percent) occurred at night (Table 8), 63 percent occurred during the final approach or landing roll, and 34 percent occurred during the take-off run or initial climb (Table 9).

HEIGHT ABOVE GROUND LEVEL (AGL) OF STRIKES

Commercial aircraft – About 41 percent of the bird strikes with commercial aircraft occurred when the aircraft was at 0 feet AGL, 72 percent occurred at 500 feet or less AGL, and 92 percent occurred at or below 3,500 feet AGL (Table 10). Less than 1 percent of bird strikes occurred above 10,500 feet AGL. Above 500 feet AGL, the number of reported strikes declined consistently by 33 percent for each

1,000-foot gain in height (Figure 5). The record height for a reported bird strike involving a commercial aircraft in USA was 30,000 feet AGL.

General aviation (GA) aircraft – About 40 percent of the bird strikes with GA aircraft occurred when the aircraft was at 0 feet AGL, 76 percent occurred at 500 feet or less AGL, and 97 percent occurred at or below 3,500 feet AGL (Table 11). Less than 1 percent of bird strikes occurred above 10,500 feet AGL. Above 500 feet AGL, the number of reported strikes declined consistently by 41 percent for each 1,000-foot gain in height (Figure 5). The record height for a reported bird strike involving a GA aircraft in USA was 32,500 feet AGL.

Terrestrial mammal strikes predominately occurred at 0 feet AGL; however, 9 percent of the reported strikes occurred while the aircraft was in the air (e.g., when the aircraft struck deer or other wildlife with the landing gear) (Table 9).

AIRCRAFT COMPONENTS DAMAGED

The aircraft components most commonly reported as struck by birds were the nose/radome, windshield, engine, wing/rotor, and fuselage (Table 12). Aircraft engines were the component most frequently reported as being damaged by bird strikes (31 percent of all damaged components). There were 11,907 strike events in which a total of 12,493 engines were reported as struck (11,343 events with one engine struck, 547 with two engines struck, 12 with three engines struck, and 5 with four engines struck). In 3,638 damaging bird strike events involving engines, a total of 3,757 engines were damaged (3,522 events with one engine damaged, 114 with two engines damaged, 1 with three engines damaged, and 1 with four engines damaged).

On 14 November 2009, an Airbus 319 departing a central USA airport ingested snow geese into both engines at 4,000 feet above ground level. The #2 engine lost power. Pilot made an emergency landing at airport. Cost of repairs was $2.7 million. Photo courtesy B. Johnson.

Aircraft components most commonly reported as struck by terrestrial mammals were the landing gear, propeller, and wing/rotor. These same components ranked highest for the parts most often reported as damaged by mammals (Table 12).

REPORTED DAMAGE AND EFFECT-ON-FLIGHT

Of the 96,626 bird strikes reported, 74,855 provided some indication as to the nature and extent of any damage. Of these 74,855 reports, 64,670 (86 percent)

indicated the strike did not damage the aircraft; 5,407 (7 percent) indicated the aircraft suffered minor damage; 2,569 (3 percent) indicated the aircraft suffered substantial damage; 2,178 (3 percent) reported an uncertain level of damage; and 31 reports (less than 1 percent) indicated the aircraft was destroyed as a result of the strike (Table 13).

Of the 2,307 terrestrial mammal strikes reported, 1,499 reports provided some indication as to the nature and extent of any damage. Of these 1,499 reports, 582 (39 percent) indicated the strike did not damage the aircraft; 484 (32 percent) indicated the aircraft suffered minor damage; 348 (23 percent) indicated the aircraft suffered substantial damage; 61 (4 percent) reported an uncertain level of damage; and 24 (2 percent) indicated the aircraft was destroyed as a result of the strike (Table 13). Not surprisingly, a much higher percentage of terrestrial mammal strikes (61 percent) resulted in aircraft damage than did bird strikes (14 percent). Deer (964 strikes, Table 15) were involved in 42 percent of the 2,307 terrestrial mammal strikes.

Although the percentage of bird strikes causing damage averaged 14 percent for the 20-year period, this number has declined from 20 percent in 1990 to 9 percent in 2009. For terrestrial mammals (20-year average of 61 percent), the decline has been from 86 percent in 1990 to 32 percent in 2009 (Figure 6).

In 12 percent and 53 percent of the bird and terrestrial mammal strike reports, respectively, an adverse effect-on-flight was reported (Table 14). Three percent of bird strikes resulted in an aborted take-off compared to 17 percent of terrestrial mammal strikes.

Turkey vultures, because of their size and soaring behavior, are one of the most hazardous bird species to aviation. From 1990–2009, 363 strikes involving turkey vultures and civil aircraft were reported in USA.

WILDLIFE SPECIES INVOLVED IN STRIKES

Table 15 shows the number of reported strikes, strikes causing damage, strikes having a negative effect-on-flight, strikes involving more than one animal, the reported aircraft down time, and the reported costs by identified wildlife species for the 20-year period, 1990 through 2009.

Overall, 43,410 (45 percent) of the 96,626 bird strike reports provided information on the type of bird (e.g., gull or hawk). Furthermore, 28,469 (66 percent) of these 43,410 reports provided identification to species level (e.g., ring-billed gull or red-tailed hawk, Table 15). Thus, birds were identified to species level in 29 percent of the 96,626 reported bird strikes for the

period. Species identification has improved from less than 20 percent in the early 1990s to over 40 percent in 2008–2009 (Figure 7). In all, 415 species of birds have been identified as struck by aircraft, and 186 of these species were reported as causing damage during the 20-year period.

Gulls (18 percent), doves/pigeons (15 percent), raptors (13 percent), and waterfowl (8 percent) were the most frequently struck bird groups (Table 16). Gulls were involved in 2.3 times more strikes than waterfowl (7,894 and 3,391, respectively). Waterfowl, however, were involved in 1.2 times more damaging strikes (1,503 or 30 percent of all damaging strikes in which the bird type was identified) than were gulls (1,204 or 24 percent of all damaging strikes in which the bird type was identified). Gulls were responsible for the greatest number of bird strikes (1,862 or 21 percent) that involved multiple birds.

The most frequently struck terrestrial mammals were artiodactyls — primarily deer (44 percent) — and carnivores — primarily coyotes (32 percent) (Tables 15, 16). Artiodactyls were responsible for 93 percent of the mammal strikes that resulted in damage and 81 percent of the mammal strikes that involved multiple animals. In all, 35 identified species of terrestrial mammals and 8 identified species of bats were reported struck; 20 identified species of terrestrial mammals and 1 identified species of bat caused damage (Table 15).

From 1990–2009, at least 16 species of gulls were involved in 7,893 reported strikes with civil aircraft in the USA. It is widely recognized that open-faced, putrescible waste landfills and garbage containers attract gulls — the most frequently struck group of birds in the USA. However, these landfills and garbage containers also can attract other birds hazardous to aviation.

Table 17 ranks the 97 species of birds and 12 species of terrestrial mammals with 25 or more reported strikes (Table 15) by the percentage of strikes that resulted in damage to the aircraft. This ranking provides a means of objectively estimating the relative hazard level of species to aircraft operations.

Human Fatalities and Injuries Due to Wildlife Strikes

For the 20-year period, reports were received of 10 wildlife strikes that resulted in 24 human fatalities. Five of these strikes resulting in 7 fatalities involved unidentified species of birds. Red-tailed hawks (8), American white pelicans (5), Canada geese (2), white-tailed deer (1), and brown-pelicans (1) were responsible for the other 17 fatalities. Reports were received of 174 strikes that resulted in 217 human injuries. Waterfowl (ducks and geese; 42 strikes, 47 humans

injured), vultures (25 strikes, 27 injuries), and deer (20 strikes, 27 injuries) caused 87 (62 percent) of the 140 strikes resulting in injuries in which the species or species group was identified.

AIRCRAFT DESTROYED DUE TO WILDLIFE STRIKES

For the 20-year period, reports were received of 55 aircraft destroyed or damaged beyond repair due to wildlife strikes (Tables 13, 18). The majority (35 or 64 percent) were small (less than 2,250 kg maximum take-off mass) GA aircraft. Terrestrial mammals (primarily white-tailed deer) were responsible for 24 (44 percent) of the incidents. Canada geese (5 incidents) and vultures (3 incidents) were responsible for 8 (42 percent) of the 19 incidents involving birds in which the species or species group was identified.

Thirty-three (60 percent) of the 55 wildlife strikes resulting in a destroyed aircraft occurred at GA airports, 14 occurred away from an airport, 7 occurred at Part 139 airports, and 1 occurred at a foreign airport certificated for passenger service (Table 18). General aviation airports, often located in rural areas with inadequate fencing to exclude large mammals, face unique challenges in mitigating wildlife risks to aviation (DeVault et al. 2008; Dolbeer et al. 2008).

ECONOMIC LOSSES DUE TO WILDLIFE STRIKES

Although the number of reported strikes has steadily increased five-fold from 1,793 in 1990 to 9,474 in 2009 (99,411 for 1990–2009), the number of reported damaging strikes has actually declined from 765 in 2000 to 601 in 2009. For the 20-year period, reported losses from bird strikes totaled 424,936 hours of aircraft downtime and $374.9 million in monetary losses. Reported losses from terrestrial mammal strikes totaled 258,250 hours of aircraft downtime and $39.7 million in monetary losses. Bat strikes resulted in 102 hours of aircraft downtime and $3.2 million in losses. Reptile strikes resulted in 3 hours of aircraft downtime (Table 15).

Of the 16,518 reports that indicated the strike had an adverse effect on the aircraft and/or flight, 4,853 provided an estimate of the aircraft down time (Σ = 683,291 hours, avg. = 140.8 hours down time/incident, Table 19). Of the reports providing a damage cost estimate for the incident, 2,828 gave an estimate of the direct aircraft damage cost (Σ = $372.7 million, avg. = $131,798 damage/incident), and 1,340 gave an estimate of other monetary losses (Σ = $45.0 million, avg. = $33,603 lost/incident). Other monetary losses include such expenses as lost revenue, the cost of putting passengers in hotels, re-scheduling aircraft, and flight cancellations.

Analysis of 14 groups of strike reports from three Part 139 airports certificated for passenger service and three airlines for the years 1991 to 2004 indicated that 11 to 21 percent of all strikes were reported to the FAA (Cleary et al. 2005, Wright and Dolbeer 2005). An independent analysis of strike data for a certificated airport in

Hawaii in the 1990s indicated a similar reporting rate (Linnell et al. 1999). Analyses of strike data from 2004 to 2008 indicated strike reporting at Part 139 airports had improved to 39 percent (Dolbeer 2009a). Strike reporting for GA aircraft is estimated at less than 5 percent (Dolbeer et al. 2008, Dolbeer 2009a). In addition to the underreporting of strikes at GA airports, only 28 percent of the 16,518 reports from 1990 to 2009 indicating an adverse effect provided estimates of aircraft downtime, 17 percent provided estimates of direct costs, and 8 percent provided estimates of other (indirect) costs (Table 19). Furthermore, many reports providing cost estimates were filed before aircraft damage and downtime had been fully assessed. The FAA is working to improve the percentage of strike reports from GA aircraft.

Assuming (1) all 16,518 reported wildlife strikes that had an adverse effect on the aircraft and/or flight engendered similar amounts of downtime and/or monetary losses and (2) that these reports are all of the damaging strikes that occurred, then at a minimum, wildlife strikes cost the USA civil aviation industry 116,285 hours per year of aircraft downtime and $137 million in monetary losses ($109 million per year in direct costs and $28 million per year in associated costs, Table 19).

Further, if we assume that the 16,518 reported strikes indicating an adverse effect represent, on average, 20 percent of the total strikes that occurred with commercial and GA aircraft from 1990 to 2009, the annual cost of wildlife strikes to the USA civil aviation industry is estimated to be 581,424 hours of aircraft downtime and $683 million in monetary losses ($544 million per year in direct costs and $139 million per year in associated costs, Table 19).

Mitigating the risk of wildlife strikes at and in the vicinity of airports requires a comprehensive assessment of the hazardous wildlife species present and the supportive foods and habitats. Based on the assessment, a wildlife hazard management plan must be developed to eliminate these attractants and to disperse hazardous species. Photo courtesy USDA.

CONCLUSIONS

This analysis of 20 years of strike data reveals the magnitude and nature of wildlife strikes with civil aircraft in the USA and documents that progress is being made in reducing damaging strikes. Although wildlife strikes continue to pose a significant economic and safety risk for civil aviation in the USA, management actions to mitigate the risk have been implemented at many airports in the past decade (e.g., Wenning et al. 2004, DeFusco et al. 2005, Dolbeer 2006*a*, Human Wildlife Conflicts Journal 2009). These efforts are likely responsible for the general

decline in reported strikes with damage from 2000 to 2009 (Figures 2, 3) in spite of continued increases in populations of Canada geese and other large bird species. For example, USDA/APHIS/WS biologists provided assistance at 822 airports nationwide in 2009 to mitigate wildlife risks to aviation compared to only 42 airports in 1991 and 193 in 1998 (Begier and Dolbeer 2010). However, much work remains to be done to reduce wildlife strikes.

To address the problem, airport managers first need to assess the wildlife hazards on their airports with the help of qualified airport wildlife biologists (FAA Advisory Circular 150/5200-36). They then must take appropriate actions, under the guidance of professional biologists trained in wildlife damage management at airports, to minimize the risks posed by wildlife.

The manual *Wildlife Hazard Management at Airports* (Cleary and Dolbeer 2005) provides guidance to airport personnel and biologists on conducting wildlife hazard assessments and developing and implementing wildlife hazard management plans. PDF versions of the manual are available online in English, Spanish, and French at http://wildlife.faa.gov. The Airport Cooperative Research Program (ACRP) Report 32: *Guidebook for Addressing Aircraft/Wildlife Hazards at General Aviation Airports* (Cleary and Dickey 2010) provides similar guidance but specifically for the GA airport community.

Management efforts to reduce the risks of bird strikes have primarily focused on airports since various historical analyses of bird strike data for civil aviation have indicated the majority of strikes occur in this environment (during take-off and landing at ≤500 feet above ground level). Dolbeer (2011, in press) conducted a trend analysis of bird strike data involving commercial air carriers that indicated the percentage of all strikes that occurred at more than 500 feet increased significantly from about 25 percent in 1990 to 30 percent in 2009. The percentage of all *damaging* strikes that occurred at more than 500 feet increased at a greater rate, from about 37 percent in the early 1990s to 45 percent in 2005 to 2009. Dolbeer (2011, in press) also examined trends in strike rates (strikes/1 million commercial aircraft movements) for strikes occurring at less than or equal to and more than 500 feet. From 1990 to 2009, the damaging strike rate at more than 500 feet increased from about 2.5 to 4.0, whereas the damaging strike rate for strikes at 500 or less feet has remained stable since 2000. The successful mitigation efforts at airports that have reduced damaging strikes in recent years, which must be sustained, have done little to reduce strikes outside the airport such as occurred with US Airways Flight 1549 in 2009 (Dolbeer 2011, in press).

First, the general public and aviation community must widen its view of wildlife management to consider habitats and land uses within 5 miles of airports. Wetlands, dredge-spoil containment areas, municipal solid waste landfills, and wildlife refuges can attract hazardous wildlife. Such land uses, as discussed in FAA Advisory Circular 150/5200-33B, Hazardous Wildlife Attractants on or Near Airports,, are often incompatible with aviation safety and should either be prohibited

near airports or designed and operated in a manner that minimizes the attraction of hazardous wildlife. Second, on-going research and mitigation efforts to further develop and incorporate avian radar and bird migration forecasting and to study avian sensory perception to enhance aircraft detection and avoidance by birds should be maintained. Third, Federal regulations and guidance on wildlife hazards at airports should continue to be reviewed, and where necessary revised, to incorporate new information about wildlife hazards and wildlife strike reporting trends. Finally, there continues to be a need for increased and more detailed reporting of information about wildlife strikes, such as species identification and number of wildlife struck, time and altitude of strike, and damage estimation and/or final cost.

Cleary et al. (2005), Wright and Dolbeer (2005), and Dolbeer (2009a) indicated that strike reporting at Part 139 airports has increased from about 20 percent in the 1990s to 39 percent in 2004 to 2008. The percentage of bird strikes in which the bird was identified to species has improved from less than 20 percent in the early 1990s to over 40 percent in 2008 to 2009. Overall, only 17 percent of strike reports indicating an adverse effect on the aircraft or flight provided at least a partial estimate of economic losses resulting from the strike for the 20-year reporting period.

Reporting a Strike and Identifying Species of Wildlife Struck

Pilots, air traffic controllers, airport operations, aircraft maintenance personnel, and anyone else having knowledge of a strike should report the incident to the FAA using FAA Form 5200-7. Strikes can be reported electronically via the internet (http://wildlife.faa.gov) and mobile devices, or Form 5200-7 can be accessed and printed for mailing in reports.

It is important to include as much information as possible on FAA Form 5200-7. All reports are carefully screened to identify duplicate reports prior to being entered into the database. Reports of the same incident filed by different people are combined and often provide a more complete record of the strike event than would be possible if just one report were filed.

The identification of the exact species of wildlife struck (e.g., ring-billed gull, Canada goose, mallard, mourning dove, or red-tailed hawk as opposed to gull, goose, duck, dove, or hawk) is particularly important. This species information is critical for biologists developing and implementing wildlife risk management programs at airports because a problem that cannot be measured or defined cannot be solved. Bird strike remains that cannot be identified by airport personnel can often be identified by a local biologist trained in ornithology or by sending feather and other remains in a sealed plastic bag (with FAA Form 5200-7) to:

Material sent via Express Mail Service:	**Material sent via U.S. Postal Service:**
Feather Identification Lab Smithsonian Institution NMNH E600, MRC 116 10th & Constitution Ave NW Washington, DC 20560-0116 (label package "safety investigation material") Phone: 202-633-0787 or 202-633-0791	Feather Identification Lab Smithsonian Institution NMNH E600, MRC 116 PO Box 37012 Washington, DC 20013-7012 (not recommended for priority cases)

The number of bird strike cases processed by the Smithsonian Feather Identification Lab for the FAA (civil aviation) in FY 2009 was 983 with 1,064 separate identifications of species (C. Dove, unpublished data). In addition, the Lab processed 3,538 cases with 4,355 identifications for the U.S. Air Force and 400 cases with 415 identifications for the Navy (not discussed in this report). Approximately 18 percent of the bird strike cases submitted for identification included multiple samples or impact points. DNA analysis was used in 68 percent of all identifications to identify, supplement, or verify traditional identification methods.

Whenever possible, reporters should send whole feathers as diagnostic characteristics are often found in the downy barbules at the feather base. Wings, as well as breast and tail feathers, should be sent whenever possible. Beaks, feet, bones, and talons are also useful diagnostic materials. Even blood smears can provide material for DNA analysis (Dove et al. 2008). Do not send entire bird carcasses through the mail. However, photographs of the carcasses can be very useful supplemental documentation.

Guidelines for Collecting Bird Strike Material

- Always include any feather material available.
- Include copy of report (AFSAS, WESS, or FAA 5200-7).
- Always secure all remains in re-sealable plastic bag.

Feathers:

Whole Bird – Pluck a variety of feathers (breast, back, wing, tail)
Partial Bird – Collect a variety of feathers with color or pattern
Feathers only – Send all material available. Do not cut feathers from the bird (downy part at the base of the feathers is needed). Do not use any sticky substance (no tape or glue).

Tissue/blood ("Snarge"):

Dry material – Scrape or wipe off into a clean re-closeable bag **or** wipe area with pre-packaged alcohol wipe **or** spray with alcohol to loosen material then wipe with clean cloth/gauze. (Do not use water, bleach, or other cleansers; they destroy DNA.)

Fresh material – Wipe area with alcohol wipe and/or clean cloth/gauze **or** apply fresh tissue/blood to an FTA® DNA collecting card.

FTA® Micro Card and Sterile Applicators

If you send a lot of fresh blood/ tissue samples for DNA identification, you may want to consider getting Whatman FTA® DNA cards. The material is sampled with a sterile applicator and placed onto the surface of the card that "fixes" the DNA in the sample. For more information on ordering these items contact the Feather Lab.

Note: If you only occasionally send blood/ tissue samples, a paper towel with alcohol or alcohol wipe is still a good option for this type of material.

Additional information on sending bird remains to the Smithsonian is available at http://wildlife.faa.gov.

FAA Activities for Mitigating Wildlife Strikes

In 2010, the FAA continued a multifaceted approach for mitigating wildlife strikes. This included continuing a robust research program, making improvements to the NWSD and outreach, incorporating new technology to increase and simplify strike reporting, and providing Airport Improvement Program (AIP) funding to airports to conduct Wildlife Hazard Assessments (WHAs) and develop Wildlife Hazard Management Plans (WHMPs).

Strike Reporting

Following the US Airways Flight 1549 accident, there was considerable public attention on the estimated 20-percent strike reporting rate in the USA. This rate had been based on studies in the mid 1990s and early 2000s. The FAA believed that the actual current level of strike reporting was higher because of the proliferation of wildlife hazard mitigation efforts at airports as well as outreach efforts by the FAA and the USDA.

As described above, in May 2009**,** the FAA authorized a study through the FAA Airport Technology Research and Development Branch to review the National Wildlife Strike Database and determine the current level of reporting and if it is sufficient to determine national trends and develop national policy. The report also reviewed whether strike reporting should be mandated and how the FAA could increase its data collection. The report (Dolbeer 2009a,b) concluded that the reporting rate has increased from 20 percent for the period 1990 to1994 to 39 percent for 2004 to 2008 at Part 139 airports.

As there is still room for improvement, the FAA retooled the existing wildlife strike database website (http://wildlife-mitigation.tc.faa.gov/wildlife/) to make it more user-friendly and to allow more advanced data mining. The new site (http://wildlife.faa.gov) has search fields that enable users to find data on specific airports, airlines, aircraft and engine types, as well as damage incurred, date of strike, species struck, and state without having to download the entire database.

The FAA also developed software to make strike reporting easier. Now, anyone who needs to report a wildlife strike can do so via the web or their mobile devices. Also, the FAA made strike reporting easier by creating a generic web site. When airline and airport employees report a wildlife strike, the information is automatically sent to the FAA's wildlife strike database.

Wildlife Hazard Mitigation Research

For the last 15 years, the FAA and the USDA have conducted a research program to make airports safer by reducing the risks of aircraft-wildlife collisions. The research efforts designed to improve wildlife management techniques and practices on and near airports include:

- Methods for making airport habitats less attractive to species that are the most dangerous in terms of aircraft collisions. This is accomplished by studying which species use the airport property, how they behave in that environment, and why they are attracted
- Techniques for controlling species by restricting access to attractive features like storm water ponds
- Technologies for harassing and deterring hazardous species
- Evaluation of avian radar systems for detecting and tracking birds on or near airports
- Aircraft-mounted alternating, pulse lights to enhance aircraft detection and deter wildlife strikes

Cooperative research between the USDA/APHIS/Wildlife Services National Wildlife Research Center and North Carolina State University investigated resident Canada goose behavior, movement patterns, and habitat preference throughout the greater Greensboro, NC, area. Photo courtesy J. Weller.

Bird Radar

In 2001, the FAA began working with the U.S. Air Force to develop a radar system for detecting and tracking birds on or near airports. In 2006, the FAA refocused the radar research to evaluate the capability of commercially available, low-cost, portable radars to reliably detect and track birds on or near airports.

Bird radars were evaluated at Seattle-Tacoma International Airport and the Whidbey Island Naval Air Station in 2007, followed by deployments at Chicago's O'Hare International Airport and New York's John F. Kennedy International Airport in 2009 and 2010, respectively. As a result of the radar evaluation, the FAA published a performance specification, Advisory Circular 150/5220-25, Airport Avian Radar Systems, that airports can use for the competitive procurement of bird radar systems. The guidelines provide the operational considerations of acquiring and using the technology to enhance wildlife hazard mitigation practices on civil airports. Under some circumstances, procurement of bird radar systems may be eligible for funding under the FAA's Airport Improvement Program (AIP).

Wildlife Hazard Assessments and Wildlife Hazard Management Plans

The FAA is encouraging all certificated airports to conduct wildlife hazard assessments until finalization of a proposal to require all Part 139 certificated airports to complete a WHA. In response to National Transportation Safety Board (NTSB) Recommendation A-10-75, the FAA has proposed amending 14 CFR §

139.337 to require all Part 139 certificated airports to conduct a WHA, require periodic completion of a WHA, provide an option for continuous wildlife monitoring as an alternative to periodic WHAs, and clarify the requirements for personnel conducting a WHA. These WHAs will allow an airport to:

- Identify trends in wildlife use of the airport (habitat preferences, seasonal composition and abundance of wildlife species, geography of strikes, seasonality of strikes, time and phase of flight of strikes, etc.)
- Prevent future strikes through operational changes, habitat (attractant) modifications, customized harassment, and/ or species removal
- Evaluate the overall risk level of wildlife strikes and the efficacy of the airport's wildlife hazard mitigation program (e.g., determine redundancy of species specific hazards, monitor reduction of onsite damaging strikes, monitor wildlife program communication and response efficiency, and improve overall program through annual review)

A WHA provides fundamental wildlife and habitat information for an effective, airport-specific WHMP. The WHMP outlines a plan of action to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife on and around an airport. The FAA supports completion of wildlife hazard assessments and wildlife hazard management plans by providing financial assistance from the AIP.

Mitigating Strikes at GA Airports

The FAA is also encouraging federally-obligated GA airports to conduct Wildlife Hazard Assessments. . For example, one of the ways the FAA has done that is by sponsoring a research study under the Airport Cooperative Research Program (ACRP). The final report, *Guidebook for Addressing Aircraft/Wildlife Hazards at General Aviation Airports* has been published. It provides practical guidance on how to address wildlife strikes at airports with a specific emphasis on the general aviation community.

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TABLES

Table 1. Number of reported wildlife strikes to civil aircraft by wildlife group, USA, 1990–2009 (see Figures 1 and 2).

Year	Birds	Bats	Terrestrial mammals[1]	Reptiles[1]	Total strikes	Strikes with damage
1990	1,737	4	52	0	1,793	372
1991	2,252	3	54	0	2,309	398
1992	2,351	2	73	1	2,427	366
1993	2,391	6	67	0	2,464	399
1994	2,458	2	82	1	2,543	462
1995	2,640	5	84	8	2,737	499
1996	2,838	1	91	3	2,933	504
1997	3,350	1	95	14	3,460	581
1998	3,654	3	111	7	3,775	590
1999	5,001	7	96	1	5,105	704
2000	5,863	16	124	3	6,006	765
2001	5,636	8	139	8	5,791	644
2002	6,045	19	119	15	6,198	671
2003	5,850	20	127	5	6,002	631
2004	6,401	27	127	6	6,561	623
2005	7,076	27	132	7	7,242	607
2006	7,036	49	143	10	7,238	598
2007	7,516	53	175	7	7,751	568
2008	7,368	46	183	5	7,602	527
2009	9,163	68	233	10	9,474	601
Total	**96,626**	**367**	**2,307**	**111**	**99,411**	**11,110**

[1] For terrestrial mammals and reptiles, species with body masses <1 kilogram (2.2 lbs) are excluded from database (Dolbeer et al. 2005).

Table 2. Number and rate of reported wildlife strikes and strikes with damage for commercial air carrier aircraft, USA, 1990–2009 (see Figure 3).

	No. of reported strikes			Strikes/100,000 movements	
Year	All strikes	Strikes with damage	Aircraft movements (x 1 million)[1]	All strikes	Strikes with damage
1990	1,336	213	23.27	5.74	0.92
1991	1,775	250	24.79	7.16	1.01
1992	1,806	210	25.18	7.17	0.83
1993	1,779	229	25.57	6.96	0.90
1994	1,903	281	26.59	7.16	1.06
1995	2,017	321	27.05	7.46	1.19
1996	2,086	312	27.58	7.56	1.13
1997	2,456	363	27.77	8.84	1.31
1998	2,515	363	28.01	8.98	1.30
1999	3,849	474	28.76	13.38	1.65
2000	4,472	510	29.54	15.14	1.73
2001	4,155	442	29.16	14.25	1.52
2002	4,405	463	27.62	15.95	1.68
2003	4,280	416	27.91	15.34	1.49
2004	4,686	402	28.89	16.22	1.39
2005	5,164	417	29.25	17.65	1.43
2006	4,908	404	28.31	17.34	1.43
2007	5,002	353	28.47	17.57	1.24
2008	4,574	332	27.95	16.36	1.19
2009	6,089	386	25.48	23.90	1.51
Total	69,257	7,141	547.15	12.66	1.31

[1] Departures and arrivals by air carrier, commuter, and air taxi service (FAA 2010).

Table 3. Number and rate of reported wildlife strikes and strikes with damage for general aviation aircraft, USA, 1990–2009 (see Figure 3).

	No. of reported strikes			Strikes/100,000 movements	
Year	All strikes	Strikes with damage	Aircraft movements (x 1 million)[1]	All strikes	Strikes with damage
1990	457	159	77.83	0.59	0.20
1991	534	148	83.84	0.64	0.18
1992	621	156	82.63	0.75	0.19
1993	685	170	80.70	0.85	0.21
1994	640	181	79.50	0.81	0.23
1995	720	178	77.52	0.93	0.23
1996	847	192	79.30	1.07	0.24
1997	1,004	218	80.27	1.25	0.27
1998	1,260	227	84.60	1.49	0.27
1999	1,256	230	85.70	1.47	0.27
2000	1,534	255	87.47	1.75	0.29
2001	1,636	202	86.31	1.90	0.23
2002	1,793	208	86.17	2.08	0.24
2003	1,722	215	83.84	2.05	0.26
2004	1,875	221	83.08	2.26	0.27
2005	2,078	190	81.56	2.55	0.23
2006	2,330	194	80.57	2.89	0.24
2007	2,749	215	80.75	3.40	0.27
2008	3,028	195	78.23	3.87	0.25
2009	3,385	215	74.56	4.54	0.29
Total	30,154	3,969	1,634.42	1.84	0.24

[1] Itinerant and local departures and arrivals by general aviation aircraft (FAA 2010).

Table 4. Source of information for reported wildlife strikes to civil aircraft, USA, 1990–2009.

Source	20-year total	% of total known
FAA Form 5200-7[1] (Paper)	39,815	40
FAA Form 5200-7E[2] (Electronic)	27,727	28
Airline report	13,522	14
Multiple[3]	8,706	9
Airport report	4,608	5
Other[4]	1,405	1
Preliminary Aircraft Incident Report	889	1
Engine manufacturer	858	1
Aircraft Incident Report	826	1
Daily Report (FAA)	711	1
Aviation Safety Reporting System	196	0
National Transportation Safety Board	80	0
Aircraft Incident Preliminary Notice	68	0
Total	**99,411**	**100**

[1] Bird/Other Wildlife Strike Report.

[2] Electronic filing of reports (http://wildlife.faa.gov) began in April 2001. In 2001, 0.4 percent of reports were filed electronically compared to 20, 28, 32, 37, 46, 62, 67, and 71 percent in 2002 through 2009, respectively. The paper version of FAA Form 5200-7 (mailed to FAA headquarters) declined from 57 percent of all reports in 2001 to 9 percent in 2009.

[3] More than one type of report was filed for the same strike.

[4] Various sources, such as news media and Commercial Incident Reports.

Table 5. Person filing report of wildlife strike to civil aircraft, USA, 1990–2009.

Person filing report	20-year total	% of total known
Airline Operations	22,801	28
Pilot	19,598	24
Carcass Found[1]	16,696	21
Airport Operations	10,317	13
Tower	9,839	12
Other	2,085	3
Total known	**81,336**	**100**
Unknown	**18,075**	
Total	**99,411**	

[1] Airport personnel found wildlife remains within 200 feet of a runway centerline that appeared to have been struck by aircraft and no strike was reported by pilot, tower, or airline.

Table 6. Number of reported wildlife strikes to civil aircraft by type of operator, USA, 1990–2009.

Type of operator	20-year total	% of total known
Commercial	69,257	85
Business	9,141	11
Private	2,156	3
Government/ Police[1]	501	1
Total known	**81,055**	**100**
Unknown	**18,356**	
Total	**99,411**	

[1] U.S. Coast Guard aircraft were involved in 152 of these strikes.

Table 7. Number of reported bird, bat, terrestrial mammal, and reptile strikes to civil aircraft by USA state, including the District of Columbia (DC), Puerto Rico (PR), USA-possessed Pacific Islands (PI), and the U.S. Virgin Islands (VI), 1990–2009.

State	Reported strikes (20-year total)					State	Reported strikes (20-year total)				
	Birds	Bats	T. mammals	Reptiles	Total		Birds	Bats	T. mammals	Reptiles	Total
AK	686	1	35	0	722	NC	1,600	2	35	0	1,637
AL	783	2	11	0	796	ND	324	0	16	0	340
AR	373	1	20	1	395	NE	1,069	10	17	0	1,096
AZ	1,569	36	74	0	1,679	NH	500	7	7	0	514
CA	8,347	6	137	0	8,490	NJ	2,694	4	114	11	2,823
CO	3,347	14	156	0	3,517	NM	254	2	32	0	288
CT	982	1	22	0	1,005	NV	484	0	11	0	495
DC	2,053	4	47	2	2,105	NY	5,237	9	166	26	5,438
DE	81	0	1	0	82	OH	3,202	11	100	0	3,313
FL	6,230	13	83	49	6,375	OK	913	1	37	5	956
GA	1,475	2	35	0	1,512	OR	1,624	2	12	0	1,638
HI	2,203	0	8	0	2,211	PA	3,066	6	97	0	3,169
IA	732	2	25	0	759	PI	162	0	0	0	162
ID	250	0	10	0	260	PR	173	2	0	6	181
IL	4,380	6	116	1	4,503	RI	392	1	14	0	407
IN	1,302	2	30	0	1,334	SC	449	0	26	0	475
KS	330	1	12	0	343	SD	236	0	14	1	251
KY	2,478	5	21	0	2,504	TN	2,951	2	22	0	2,975
LA	1,708	11	25	2	1,746	TX	7,063	110	135	1	7,309
MA	1,277	1	25	0	1,303	UT	1,252	4	20	0	1,276
MD	1,095	6	69	1	1,171	VA	1,190	4	63	2	1,259
ME	288	0	16	0	304	VI	99	0	0	0	99
MI	2,378	13	104	1	2,496	VT	122	0	3	0	125
MN	1,001	11	29	0	1,041	WA	1,489	3	25	0	1,517
MO	2,296	9	44	0	2,349	WI	899	5	64	0	968
MS	320	0	11	0	331	WV	210	0	56	0	266
MT	148	0	14	0	162	WY	100	0	8	0	108
					Total known[1]		**85,886**	**332**	**2,274**	**109**	**88,581**
					Foreign[2]		**2,093**	**10**	**9**	**0**	**2,112**
					Unknown		**8,667**	**25**	**24**	**2**	**8,718**
					Total		**96,626**	**367**	**2,307**	**111**	**99,411**

[1] Strikes were reported at 1,585 airports in the USA. The numbers include 1,358 bird strikes and 4 bat strikes that occurred enroute where the state where the strike occurred was reported.

[2] Strikes to USA air carriers were reported at 237 foreign airports.

Table 8. Reported time of occurrence of wildlife strikes with civil aircraft, USA, 1990–2009[1].

	Birds		Terrestrial mammals	
Time of day	20-year total	% of total known	20-year total	% of total known
Dawn	2,564	4	45	3
Day	39,888	62	361	25
Dusk	3,166	5	128	9
Night	18,385	29	897	63
Total known	**64,003**	**100**	**1,431**	**100**
Unknown	**32,623**		**876**	
Total	**96,626**		**2,307**	

[1] In addition, 367 strikes with bats were reported from 1990–2009: time not reported (269), night (76), dusk (9), day (11), and dawn (2). Also, 111 strikes with reptiles were reported from 1990–2009: time not reported (93), day (11), night (4), dusk (2), and dawn (1).

Table 9. Reported phase of flight at time of occurrence of wildlife strikes with civil aircraft, USA, 1990–2009[1].

	Birds		Terrestrial mammals	
Phase of flight	20-year total	% of total known	20-year total	% of total known
Parked	42	<1	1	<1
Taxi	258	<1	39	2
Take-off Run	13,313	19	506	32
Climb	12,579	18	35	2
En Route	1,674	2	0	0
Descent	2,615	4	0	0
Approach	27,605	40	107	7
Landing Roll	11,690	17	882	56
Total known	**69,776**	**100**	**1,570**	**100**
Unknown	**26,850**		**737**	
Total	**96,626**		**2,307**	

[1] In addition, 367 strikes with bats were reported from 1990-2009: phase of flight not reported (275), approach (59), landing roll (11), climb (10), descent (5), take-off run (4), and en route (3). Also, 111 strikes with reptiles were reported: phase of flight not reported (85), take-off run (11), taxi (5), approach (5; pilot had a missed approach because reptile was on the runway), and landing roll (5).

Table 10. Number of reported bird strikes to commercial civil aircraft by height (feet) above ground level (AGL), USA, 1990–2009. See Figure 5 for graphic analysis of strike data from 500 to 18,500 feet AGL[1].

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	20-year total	% of total known	% cum-ulative total	20-year total	% of total known	% cum-ulative total
0	21,070	41	41	1,455	30	30
1-500	15,603	31	72	1,355	28	58
501-1500	5,351	11	82	682	14	72
1501-2500	2,712	5	88	418	9	81
2501-3500	2,035	4	92	266	6	86
3501-4500	1,204	2	94	152	3	90
4501-5500	881	2	96	120	2	92
5501-6500	630	1	97	96	2	94
6501-7500	402	1	98	61	1	95
7501-8500	324	1	99	60	1	97
8501-9500	176	<1	99	26	1	97
9501-10,500	220	<1	99	40	1	98
>10,500	333	<1	100	101	2	100
Total known	**50,941**	**100**		**4,832**	**100**	
Unknown height	**17,526**			**2,120**		
Total	**68,467**			**6,952**		

[1] A more detailed analysis of bird strikes by height AGL is provided by Dolbeer (2006*b*).

Table 11. Number of reported bird strikes to general aviation aircraft by height (feet) above ground level (AGL), USA, 1990–2009. See Figure 5 for graphic analysis of strike data from 500 to 18,500 feet AGL[1].

Height of strike (feet AGL)	All reported strikes			Strikes with damage		
	20-year total	% of total known	% cumulative total	20-year total	% of total known	% cumulative total
0	4,280	40	40	549	19	19
1-500	3,918	37	76	967	34	54
501-1500	1,313	12	89	677	24	77
1501-2500	592	6	94	308	11	88
2501-3500	277	3	97	153	5	94
3501-4500	133	1	98	69	2	96
4501-5500	75	1	99	37	1	97
5501-6500	46	<1	99	22	1	98
6501-7500	37	<1	99	16	1	99
7501-8500	14	<1	100	4	<1	99
8501-9500	12	<1	100	7	<1	99
9501-10,500	11	<1	100	7	<1	99
>10,500	24	<1	100	16	<1	100
Total known	**10,732**	**100**		**2,832**	**100**	
Unknown height	**17,427**			**401**		
Total	**28,159**			**3,233**		

Table 12. Civil aircraft components reported as being struck and damaged by wildlife, USA, 1990–2009.

	Birds (20-year total)				Terrestrial mammals (20-year total)			
Aircraft component	Number struck	% of total	Number damaged	% of total	Number struck	% of total	Number damaged	% of total
Windshield	14,843	17	711	6	7	<1	14	1
Engine(s)[1]	12,493	14	3,757	31	155	8	159	10
Nose	12,601	14	727	6	87	4	86	5
Wing/rotor	11,659	13	2,754	23	230	11	242	15
Fuselage	11,077	13	472	4	114	6	125	8
Radome	10,987	12	1,179	10	13	1	14	1
Other	6,719	8	913	8	287	14	256	16
Landing gear	3,960	4	385	3	815	40	379	23
Propeller	2,217	3	214	2	267	13	259	16
Tail	1,179	1	484	4	53	3	68	4
Light	635	1	491	4	33	2	40	2
Total[2]	**88,370**	**100**	**12,087**	**100**	**2,061**	**100**	**1,642**	**100**

[1] For birds, 12,493 engines were reported as struck in 11,907 strike events involving engines (11,343 events with one engine struck, 547 with two engines struck, 12 with three engines struck, and 5 with four engines struck). A total of 3,757 engines were damaged in 3,638 bird strike events with engine damage (3,522 events with one engine damaged, 114 with two engines damaged, 1 with three engines damaged, and 1 with 4 engines damaged). For terrestrial mammals, 155 engines were reported as struck in 145 strike events (135 events with one engine struck and 10 with two engines struck). A total of 159 engines were damaged in 141 terrestrial mammal strike events with engine damage (123 events with one engine damaged and 18 with two engines damaged). Some engines were damaged without being struck when the landing gear collapsed.

[2] In addition, bat strikes had 123 and 7 components reported as struck and damaged, respectively: radome/nose (37, 0), windshield (26, 0), engine (12, 3), propeller (1, 0), wing/rotor (18, 3), fuselage (10, 0), tail (2, 0), other (11, 0), landing gear (5, 0), light (1, 1). For reptile strikes, there were 21 and 5 components reported struck and damaged, respectively: windshield (1, 1), wing/rotor (1, 1), fuselage (1, 1), landing gear (16, 0); tail (1, 1), other (1, 1).

Table 13. Number of civil aircraft with reported damage resulting from wildlife strikes, USA, 1990–2009. See Tables 1, 2, and 3 and Figure 5 for trends in damaging strikes from 1990–2009.

	Reported strikes					
	Birds		Terrestrial mammals		Total[1]	
Damage category[2]	20-year total	% of total known	20-year total	% of total known	20-year total	% of total known
None	**64,670**	**86**	**582**	**39**	**65,375**	**85**
Damage	**10,185**	**14**	**917**	**61**	**11,110**	**15**
Minor	5,407	7	484	32	5,894	8
Uncertain	2,178	3	61	4	2,240	3
Substantial	2,569	3	348	23	2,921	4
Destroyed	31	<1	24	2	55	0
Total known	**74,855**	**100**	**1,499**	**100**	**76,485**	**100**
Unknown	**21,771**		**808**		**22,926**	
Total	**96,626**		**2,307**		**99,411**	

[1] Included in totals are 367 and 111 strikes involving bats and reptiles, respectively. For bats, 107 reports indicated no damage, 253 failed to report if damage occurred, 3 reported minor damage, 1 reported uncertain level of damage, and 3 reported substantial damage. For reptiles, 16 reports indicated no damage, 94 failed to report if damage occurred, and 1 reported substantial damage.

[2] The damage codes and descriptions follow the *International Civil Aviation Organization Bird Strike Information System (1989):* Minor = the aircraft can be rendered airworthy by simple repairs or replacements and an extensive inspection is not necessary; Uncertain = the aircraft was damaged, but details as to the extent of the damage are lacking; Substantial = the aircraft incurs damage or structural failure that adversely affects the structure strength, performance, or flight characteristics of the aircraft and that would normally require major repair or replacement of the affected component (specifically excluded are bent fairings or cowlings; small dents or puncture holes in the skin; damage to wing tips, antenna, tires, or brakes; and engine blade damage not requiring blade replacement); Destroyed = the damage sustained makes it inadvisable to restore the aircraft to an airworthy condition.

Table 14. Reported effect-on-flight (EOF) of wildlife strikes to civil aircraft, USA, 1990–2009.

	Reported strikes					
	Birds		Terrestrial mammals		Total[1]	
Effect-on-flight[2]	20-year total	% of total known	20-year total	% of total known	20-year total	% of total known
None	**51,278**	**88**	**538**	**47**	**51,926**	**87**
Negative effect	**6,879**	**12**	**599**	**53**	**7,489**	**13**
Precautionary landing	3,555	6	90	8	3,649	6
Aborted take-off	1,602	3	194	17	1,796	3
Engine shutdown	335	1	27	2	362	1
Other	1,387	2	288	25	1,682	3
Total known	**58,157**	**100**	**1,137**	**100**	**59,415**	**100**
Unknown	**38,469**		**1,170**		**39,996**	
Total	**96,626**		**2,307**		**99,411**	

[1] Included in totals are 367 and 111 strikes involving bats and reptiles, respectively. For bats, 90 reports indicated no effect-on-flight, 274 failed to report if an effect-on-flight occurred, and 3 reported a precautionary landing. For reptiles, 20 reports indicated no effect-on-flight, 83 failed to report if an effect-on-flight occurred, 1 reported a precautionary landing, and 7 reported "other".

[2] Effect-on-flight: None = flight continued as scheduled, although delays and other cost caused by inspections or repairs may have been incurred after landing; Aborted take-off = pilot aborted the take-off; Precautionary landing = pilot landed at other-than-destination airport after strike; Engine shut down = pilot shut down the engine or the engine stopped running because of strike; Other = miscellaneous effects, such as reduced speed because of shattered windshield, emergency landing at other-than-destination airport, flight delays, or crash landing; Unknown = report did not give sufficient information to determine an effect-on-flight (Dolbeer et al. 2000).

Table 15. Total reported strikes, strikes causing damage, strikes having a negative effect-on-flight (EOF), strikes involving >1 animal, aircraft downtime, and costs by identified wildlife species for civil aircraft, USA, 1990–2009 (page 1 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Birds						
Loons	**22**	**14**	**9**	**0**	**2,885**	**1,766,200**
Loons	3	3	2		557	251,200
Common loon	18	10	6		2,280	1,513,000
Red-throated loon	1	1	1		48	2,000
Grebes	**48**	**10**	**7**	**8**	**168**	**2,109,470**
Grebes	8	1		1		
Eared grebe	6	1		1	10	100,000
Western grebe	15	6	5	6	86	1,900,000
Pied-billed grebe	10		1			0
Horned grebe	6	2	1		72	109,470
Red-necked grebe	2					
Clark's grebe	1					
Albatrosses/shearwaters	**54**	**7**	**6**		**149**	**62,500**
Laysan albatross	31	6	5		149	62,500
Black-footed albatross	5	1				
Bonin petrel	3					
Wedge-tailed shearwater	9		1			
Townsend's shearwater	5					
Fork-tailed storm-petrel	1					
Tropicbirds	**12**	**8**	**7**		**172**	**75,300**
Tropicbirds	6	5	4		124	40,200
White-tailed tropicbird	3	2	2		48	29,500
Red-tailed tropicbird	3	1	1			5,600
Pelicans	**61**	**30**	**25**	**8**	**479**	**2,516,523**
Pelicans	4	2			80	
Australian pelican	1	1	1			
Brown pelican	48	22	18	5	327	266,523
American white pelican	8	5	6	3	72	2,250,000
Red- footed booby	**1**					
Cormorants	**83**	**30**	**19**	**11**	**282**	**2,984,722**
Cormorants	8	2	2			180,000
Great cormorant	2	1		2		
D.-crested cormorant	72	27	17	9	282	2,804,722
Pelagic cormorant	1					
Anhinga	**18**	**7**	**7**	**3**	**117**	**7,800**

Table 15. Continued (page 2 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Frigatebirds	**12**	**5**	**2**		**21**	**18,400**
Frigatebirds	3	2	1		18	13,500
Great frigatebird	7	2	1		3	4,900
Magnificent frigatebird	2	1	0			
Herons/bitterns	**397**	**75**	**57**	**15**	**3,491**	**5,175,396**
Herons	49	13	9	4	99	3,200
Gray heron	1	1	1			
Great blue heron	235	51	41	6	2,679	4,829,810
Blk-crowned night-heron	37	4	2	2	49	281,200
Little blue heron	4					
Green heron	7					
Yell.-crowned night heron	12	3	2	1	18	17,000
Tricolored heron	1					
American bittern	6	3	2		646	44,186
Yellow bittern	45			2		
Egrets	**536**	**60**	**80**	**133**	**3,805**	**5,329,697**
Egrets	279	31	42	79	3,467	3,465,140
Cattle egret	189	19	30	46	178	12,775
Great egret	44	8	7	7	134	1,851,782
Snowy egret	24	2	1	1	26	
Storks	**11**	**4**	**2**	**2**	**24**	**20,000**
White stork	1	1				
Wood stork	10	3	2	2	24	20,000
Ibises/spoonbills	**21**	**5**	**5**	**5**	**1**	
Ibises	5		1	1		
Glossy ibis	1			1		
White ibis	6	1	1	1		
White-faced ibis	8	4	2	2		
Roseate spoonbill	1		1		1	
Waterfowl	**3,391**	**1,503**	**744**	**1,238**	**121,553**	**144,074,372**
Ducks, geese, swans	134	64	31	54	763	847,075
Ducks	689	238	114	227	5,270	4,060,096
American wigeon	30	15	6	9	3,951	1,083,089
Northern pintail	60	38	21	33	1,509	1,869,439
Green-winged teal	25	10	6	9	732	688,142
Blue-winged teal	15	8	3	8	145	608,440
Eurasian wigeon	1			1		
Mallard	521	129	63	117	9,253	5,399,639

Table 15. Continued (page 3 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Common eider	3	2	1	1		
Ring-necked duck	10	5	3	4	1,080	78,468
Greater scaup	4	1	1	1		
Wood duck	25	9	4	6	294	85,704
Muscovy duck	1	1			120	443,332
Common goldeneye	3	2	1			2,000
Red-breasted merganser	4	1		1	2	
Hooded merganser	5	2		1	30	27,023
Common merganser	2	2	2	1	120	2,500
Northern shoveler	28	14	3	12	1,668	1,340,020
Gadwall	22	6	3	5	414	1,521,678
Canvasback	11	4	1	4	335	2,154,077
American black duck	31	3	1	11	36	1,500
Mottled duck	14	4	3	3	24	
Lesser scaup	20	12	7	8	1,263	165,000
Ruddy duck	17	5	1		24	8,446
Redhead	3	1		1		
Bufflehead	5	1	1	1	40	4,874
Long-tailed duck	3	2	2	1	3	1,100
Philippine duck	1	1	1	1	96	9,456,000
Blk-bellied whistling-duck	1					
Cinnamon teal	3				8	
White-winged scoter	1	1	1	1	1,400	430,000
Hawaiian duck	2					
Geese	320	195	83	112	24,424	2,000,117
Snow goose	90	71	35	49	7,589	20,245,986
Canada goose	1,238	630	336	535	60,152	88,904,019
Brant	20	9	3	7	108	51,271
Gr white-fronted goose	14	10	3	9	292	1,500,547
Emperor goose	1					
Swans	2	1				
Mute swan	5			1		
Tundra swan	5	4	2	3	336	144,790
Trumpeter swan	2	2	2	1	72	950,000
Raptors	**5,724**	**925**	**632**	**219**	**87,547**	**55,982,962**
Hawks, eagles, vultures	29	16	7	1	2,559	17,550
Vultures	268	154	76	27	22,619	9,312,759
Black vulture	53	32	22	6	5,261	1,458,658

Table 15. Continued (page 4 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Turkey vulture	363	185	126	18	23,995	4,532,437
Osprey	168	37	25	3	2,268	292,923
White-tailed kite	14	4	2		46	5,000,000
Black kite	2	1	1			
Mississippi kite	1					
Swallow-tailed kite	1					
Eagles	7	3	2	1		
Bald eagle	125	53	36	9	6,340	14,402,681
White-breasted sea-eagle	1	1	1			
Golden eagle	8	2	4		3,696	801,000
Hawks	1,041	205	145	28	9,871	4,009,818
Northern goshawk	1					
Red-tailed hawk	1,122	182	127	26	9,078	6,709,526
Rough-legged hawk	40	2	2			167
Red-shouldered hawk	15	1	2		41	900
Swainson's hawk	53	5	4	1	16	350,000
Sharp-shinned hawk	11					
Cooper's hawk	39	2	2		3	
Ferruginous hawk	9	1	1		24	3,200,000
Broad-winged hawk	9	1		1		
Harris' hawk	2					
White-tailed hawk	1					
Eurasian buzzard	1				24	
Northern harrier	70	2	1	2		200,000
Lappet-faced vulture	1	1	1		240	4,000,000
Falcons	41	3	4	1	81	30,100
Peregrine falcon	149	10	3	6	78	235,500
Gyrfalcon	1					
Merlin	40		2	1	3	130
Crested caracara	6	2	1		2	
Prairie falcon	9					
American kestrel	2,019	19	34	88	1,302	1,428,813
Eurasian kestrel	4	1	1			
Gallinaceous birds	**160**	**44**	**35**	**28**	**1,830**	**620,287**
Grouse	7	2		3	2	
Greater sage-grouse	6	4	4	1	337	256,077
Sharp-tailed grouse	1	1	1		24	500
Ptarmigans	6	4	1	2	57	57,500

Table 15. Continued (page 5 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Black francolin	3					
Quails	10		2	2		
Northern bobwhite	6	2	3	1	73	800
Scaled quail	3					
Pheasants	1	1				
Ring-necked pheasant	60	14	10	5	863	92,000
Partridges	1					
Red-legged partridge	1					
Gray partridge	5	2	1	3	24	120
Chukar	2		1	1		
Gray francolin	2					
Guineafowl	1	1		1		
Wild turkey	45	13	12	9	450	213,290
Cranes	**101**	**39**	**29**	**33**	**2,413**	**434,560**
Cranes	12	3	5	2	31	250,000
Sandhill crane	88	35	24	31	2,334	134,260
Whooping crane	1	1			48	50,300
Rails/gallinules	**98**	**20**	**9**	**6**	**1,993**	**1,001,426**
Rails	3	1	1	1		
Sora	10		1		20	
Common moorhen	3	1	1		24	990
American coot	72	17	5	5	1,877	974,986
Purple gallinule	3	1	1		72	25,450
Virginia rail	3					
Clapper rail	4					
Shorebirds	**3,158**	**84**	**110**	**514**	**1,477**	**3,420,818**
Shorebirds	19			9		
American oystercatcher	18			2		
Plovers, lapwings	1			1		
Plovers	42	3	4	8	24	
European golden-plover	3					
American golden-plover	62	3	4	21	16	2,000
Black-bellied plover	49	4	3	8	20	164,254
Snowy plover	1			1		
Killdeer	1,823	35	42	185	340	2,636,463
Pacific golden-plover	519	3	9	81	35	2,200
Semipalmated plover	32			13		
Wilson's plover	1					

Table 15. Continued (page 6 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Northern lapwing	1	1	1	1	25	
Southern lapwing	1	1	1			8,000
Sandpipers	180	11	22	69	169	106,560
Upland sandpiper	106	4	6	12	12	1,000
Spotted sandpiper	9	1		3		
Willet	5			2		
Wilson's snipe	31	3	2	4	19	12,615
American woodcock	29	1	2	3		
Dunlin	17	3	2	5	504	205,300
Baird's sandpiper	11			1		
Western sandpiper	43	2	3	28	93	106,566
Pectoral sandpiper	7	1	1	2		300
Sanderling	16	1	2	8		
Buff-breasted sandpiper	13			4		
Ruddy turnstone	5			1		
Least sandpiper	34	1	3	14	3	
Semipalmated sandpiper	28			12		
Lesser yellowlegs	3			1		
Short-billed dowitcher	5	1		1		
Hudsonian godwit	1	1	1	1	96	23,495
Solitary sandpiper	2			1		
Greater yellowlegs	2	1			48	8,000
Long-billed dowitcher	6			2	1	
Red knot	2					
White-rumped sandpiper	4					
Black turnstone	1					
Marbled godwit	1	1	1	1	48	144,065
Curlews	1			1		
Eurasian curlew	1					
Whimbrel	9	1	1	1	24	
Long-billed curlew	3					
Red-necked phalarope	2					
Wilson's phalarope	1			1		
American avocet	4	1		3		
Black-necked stilt	4			3		
Gulls/jaegers	**7,894**	**1,204**	**980**	**1,862**	**53,437**	**36,241,330**
Parasitic jaeger	1					

Table 15. Continued (page 7 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Gulls	5,576	968	766	1,477	39,424	19,168,196
Herring gull	776	84	79	92	1,940	1,710,951
Mew gull	46	6	4	8	28	86,717
Ring-billed gull	894	85	75	178	5,536	2,991,930
Glaucous-winged gull	59	12	8	10	290	346,545
Great black-backed gull	72	7	5	4	27	250,000
Franklin's gull	56	3	6	22	19	139,000
Laughing gull	244	16	18	41	731	534,136
Bonaparte's gull	27	2	3	7		65,000
Lesser black-backed gull	3	1	1	1		
Western gull	67	9	5	8	126	680,857
California gull	60	8	7	8	4,860	361,948
Heermann's gull	1			1		
Black-headed gull	2					
Thayer's gull	3					
Yellow-legged gull	3	3	3	3	456	9,906,050
Glaucous gull	4			2		
Terns/kittiwakes	**117**	**4**	**3**	**26**	**4**	
Terns	38	2		12		
Caspian tern	18			1		
Common tern	12			2		
Gull-billed tern	3					
Fairy tern	2					
White tern	3		1	1		
Arctic tern	3	1		2		
Roseate tern	1					
Forster's tern	8		1	2	4	
Least tern	7			2		
Black noddy	3			2		
Brown noddy	6		1	1		
Royal tern	2					
Sooty tern	1					
Black-legged kittiwake	2					
Red-legged kittiwake	1					
Black skimmer	7	1		1		
Pigeons/doves	**6,410**	**363**	**431**	**1,574**	**22,661**	**11,282,378**
Pigeons, doves	14	1	1	10	24	400
Pigeons	16	2	2	6	9	300

Table 15. Continued (page 8 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Common wood-pigeon	3					
Band-tailed pigeon	4	1		2	16	
Doves	922	45	77	248	1,175	295,610
Rock pigeon	1,782	199	180	622	14,060	5,208,449
Mourning dove	3,408	109	162	666	7,169	5,503,214
Spotted dove	95	3	6	5	133	274,405
Zebra dove	121	2	3	15	3	
Inca dove	14					
Island turtle dove	4					
White-winged dove	20	1			72	
Common ground-dove	7					
Parrots	**14**			**1**		
Parrots	6			1		
Budgerigar	7					
Nanday parakeet	1					
Cuckoos/roadrunners	**14**	**1**		**3**		
Cuckoos	2			1		
Yellow-billed cuckoo	10	1		2		
Common cuckoo	1					
Greater roadrunner	1					
Owls	**1,306**	**90**	**56**	**10**	**1,545**	**5,596,892**
Owls	265	29	15	4	960	296,875
Barn owl	558	26	19	4	248	1,900,310
Snowy owl	66	6	6		84	331,053
Short-eared owl	213	7	7		58	1,268,171
Long-eared owl	8	2	1			
Northern saw-whet owl	4					
Burrowing owl	76	1		1	1	
Barred owl	10	1	1			
Northern pygmy-owl	1					
Eastern screech-owl	3	2			24	7,558
Western screech-owl	2					
Great horned owl	100	16	7	1	170	1,792,925
Nightjars	**213**	**2**		**14**		
Nightjars	6	1				
Whip-poor-will	2					
Common poorwill	7					
Lesser nighthawk	6					

Table 15. Continued (page 9 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Chuck-will's-widow	2					
Common nighthawk	190	1		14		
Swifts	**140**	**5**	**3**	**11**	**26**	
Swifts	10	1		2		
Chimney swift	104	2	3	9	1	
Common swift	1	1				
Vaux's swift	14				24	
White-throated swift	11	1			1	
Hummingbirds	**6**					
Hummingbirds	2					
R.-throated hummingbird	1					
Anna's hummingbird	2					
Blk-chinned hummingbird	1					
Belted kingfisher	**8**					
Woodpeckers	**60**	**3**	**4**	**2**	**1**	**15,000**
Woodpeckers	9		1			
Northern flicker	38	3				
Yellow-bellied sapsucker	8		1	2		
Hairy woodpecker	3					
Red-naped sapsucker	1		1			15,000
Downy woodpecker	1		1		1	
Unidentified passiformes	**122**	**9**	**3**	**16**	**66**	**91,405**
Flycatchers	**162**	**1**	**4**	**9**	**1**	**9,800**
Tyrant flycatchers	12			1	1	
Eastern wood-pewee	3					
Great crested flycatcher	1					
Eastern kingbird	10	1	1			9,800
Scissor-tailed flycatcher	55		2	4		
Acadian flycatcher	1					
Say's phoebe	3					
Western kingbird	69		1	3		
Ash-throated flycatcher	1					
Western wood-pewee	1					
Sulphur-bellied flycatcher	1					
Eastern phoebe	1					
Yellow-bellied flycatcher	1			1		
Least flycatcher	2					
Hammond's flycatcher	1					

Table 15. Continued (page 10 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Larks	**1,136**	**13**	**21**	**263**	**74**	**510,729**
Larks	8			3		
Sky lark	28			1		
Horned lark	1,100	13	21	259	74	510,729
Swallows	**2,424**	**20**	**50**	**561**	**173**	**37,714**
Swallows	565	6	26	177	32	
Purple martin	84	2	1	22	3	
Bank swallow	109	2	4	46	5	
Barn swallow	1,070	7	13	190	117	23,907
Cliff swallow	376	3	3	61	11	13,742
Tree swallow	192		3	63	5	65
Violet-green swallow	10			1		
N. rough-winged swallow	17					
Cave swallow	1			1		
Starlings/mynas	**2,377**	**96**	**132**	**909**	**2,250**	**4,345,705**
European starling	2,330	95	131	896	2,246	4,345,705
Mynas	4			2		
Common myna	43	1	1	11	4	
Crows/ravens	**509**	**54**	**46**	**74**	**6,609**	**1,477,603**
Crows	228	25	22	35	906	144,000
American crow	248	21	19	36	5,562	1,265,113
Carrion crow	1					
Hooded crow	1	1	1			
Northwestern crow	3			1		
Common raven	28	7	4	2	141	68,490
Jays/magpies	**25**	**2**	**2**	**4**	**1**	**555**
Blue jay	9					
Yellow-billed magpie	8			2		
Black-billed magpie	8	2	2	2	1	555
Chickadees	**24**	**1**		**7**		
Chickadees	5	1		2		
Black-capped chickadee	15			2		
Mountain chickadee	2			2		
Gray-headed chickadee	1			1		
Carolina chickadee	1					
Red-vented bulbul	**2**			**1**		
Wrens	**61**	**1**	**2**	**9**		
Wrens	43	1	1	9		

Table 15. Continued (page 11 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Marsh wren	4		1			
House wren	7					
Carolina wren	2					
Rock wren	1					
Cactus wren	3					
Winter wren	1					
Mimics	**84**	**1**	**2**	**3**		**120**
Brown thrasher	9					120
Curve-billed thrasher	1					
Northern mockingbird	47	1	2			
Tropical mockingbird	1					
Gray catbird	26			3		
Thrushes	**424**	**33**	**24**	**37**	**1,647**	**2,369,647**
Thrushes	16	2	1	1	7	25,500
Western bluebird	2				3	
Swainson's thrush	19	3	1	2	26	2,002,025
Redwing	1					
American robin	339	23	18	29	1,582	322,137
Hermit thrush	14	1		1	22	3,800
Eastern bluebird	4					
Mountain bluebird	5			2		
Gray-cheeked thrush	3					
Varied thrush	15	4	2	1	7	15,905
Wood thrush	5		1	1		280
Veery	1		1			
Kinglets	**9**			**1**		
Golden-crowned kinglet	2					
Ruby-crowned kinglet	7			1		
Wrentits/gnatcatchers	**2**					
Wrentit	1					
Blue-gray gnatcatcher	1					
American pipit	**18**			**3**		
Waxwings	**25**		**1**	**6**	**4**	
Bohemian waxwing	1			1		
Cedar waxwing	24		1	5	4	
Loggerhead shrike	**7**		**1**			
Vireos	**17**	**1**		**2**		
Vireos	3					
Yellow-throated vireo	1					

Table 15. Continued (page 12 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Warbling vireo	5			1		
Red-eyed vireo	7	1		1		
Cassin's vireo	1					
Japanese white-eye	**1**					
Warblers	**134**	**3**	**5**	**9**	**31**	**6,612**
Wood warblers	27	1		2		1,700
Canada warbler	3					
Yellow-breasted chat	4					
Pine warbler	3					
Black-and-white warbler	4					
Northern parula	3					
Ovenbird	8	1	2		1	100
Wilson's warbler	11			1	4	4,569
Common yellowthroat	9		1		1	
Yellow-rumped warbler	15			2		43
Blackpoll warbler	6			2	1	200
Mourning warbler	1					
American redstart	1				3	
Orange-crowned warbler	2					
Yellow warbler	5	1		1	17	
Northern waterthrush	3					
Nashville warbler	7		1	1		
Townsend's warbler	2					
Palm warbler	5					
Magnolia warbler	5		1		2	
Blk-throated blue warbler	2					
Prothonotary warbler	1					
MacGillivray's warbler	2					
Yellow-throated warbler	3					
Blk-throated gray warbler	1				2	
Blk-throated grn warbler	1					
Meadowlarks	**1,120**	**12**	**24**	**124**	**237**	**266,452**
Meadowlarks	288	2	7	26	14	
Eastern meadowlark	480	3	7	43	7	
Western meadowlark	352	7	10	55	216	266,452
Blackbirds/orioles	**1,496**	**93**	**102**	**410**	**1,472**	**1,047,802**
Blackbirds	1,074	74	79	325	588	863,897

Table 15. Continued (page 13 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Red-winged blackbird	101	3	6	13	7	750
Yellow-headed blackbird	6	1	1	1		
Brewer's blackbird	29			3		
Brown-headed cowbird	86	2	3	29	11	5,155
Bobolink	9		1			
Rusty blackbird	1					
Orioles	5					
Baltimore oriole	6		1	1		
Orchard oriole	1					
Bullock's oriole	1					
Grackles	80	6	2	20	720	133,000
Common grackle	72	5	7	16	123	45,000
Boat-tailed grackle	6	1	1		20	
Great-tailed grackle	12			2		
Scarlet tanager	3	1				
Western tanager	4		1		3	
Finches	**341**	**6**	**24**	**129**	**83**	**10,000**
Finches	59	1	5	16	4	
Lapland longspur	8			3		
Chtnut-collared longspur	1					
Dark-eyed junco	24	2	2	3	49	9,000
Rose-breasted grosbeak	2					
Island canary	1					
Pine siskin	3			2	1	
Tropical mockingbird	1					
Purple finch	2					
Evening grosbeak	1					
American goldfinch	26		1	1	3	
House finch	38			4		
Smith's longspur	1					
Dickcissel	3			1		
White-winged crossbill	1					
Red avadavat	2			1		
McCown's longspur	1					
Lesser goldfinch	1					
Red-crested cardinal	4			1	1	
Northern cardinal	3					
Snow bunting	133	2	16	92	23	1,000
Indigo bunting	1					

Table 15. Continued (page 14 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Lazuli bunting	1					
Lark bunting	25	1		5	2	
Sparrows	**2,602**	**47**	**96**	**624**	**611**	**85,640**
Sparrows	2,315	43	94	598	598	50,440
Harris's sparrow	1					
Swamp sparrow	7					
Savannah sparrow	118	1		11	5	1,000
Fox sparrow	11	1				4,100
White-throated sparrow	21	1	1	2		
Golden-crowned sparrow	3			1		
Field sparrow	14					
Lark sparrow	8					
White-crowned sparrow	9					
Grasshopper sparrow	17	1	1	1	4	29,700
Java sparrow	2			1		
Vesper sparrow	9			1		
Chipping sparrow	12			2		
Lincoln's sparrow	6					
Song sparrow	36			7	3	400
Sage sparrow	5				1	
American tree sparrow	7					
Black-throated sparrow	1					
Towhees	**6**	**1**			**9**	**13,151**
Rufous-sided towhee	4	1			9	13,151
Green-tailed towhee	1					
California towhee	1					
Waxbills/mannikins	**115**	**0**	**2**	**54**	**10**	**3,600**
Waxbills, mannikins	2					
Common waxbill	3					
Mannikins	23			11		
Nutmeg mannikin	43		1	22	8	1,600
Black-headed munia	43		1	20	2	2,000
White-throated munia	1			1		
House sparrow	**77**	**2**	**1**	**11**	**2**	

Table 15. Continued (page 15 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Total known birds	**43,410**	**4,938**	**3,804**	**8,992**	**319,361**	**289,012,568**
Total unknown birds	**53,216**	**5,247**	**3,075**	**5,760**	**105,575**	**85,889,663**
Unknown bird - ? Size	24,200	2,652	1,314	1,521	29,460	30,346,696
Unknown bird-large	2,011	850	399	229	31,524	30,685,730
Unknown bird-medium	7,055	1,072	595	952	34,573	12,544,958
Unknown bird-small	19,950	673	767	3,058	10,018	12,312,279
Total birds[3]	**96,626**	**10,185**	**6,879**	**14,752**	**424,936**	**374,902,231**
Flying mammals (bats)						
Old world fruit bats	5	1	2	1	72	3,069,400
Vesper bats	3					
Red bat	19	1		1	1	
Hoary bat	3					
East. Small-footed myotis	1					
Little brown bat	20			1		
Big brown bat	4					
Silver-haired bat	3					
Free-tailed bats	9			1		270
Brazilian free-tailed bat	33		1			
Pocketed free-tailed bat	1					
Total known bats	**101**	**2**	**3**	**4**	**73**	**3,069,670**
Total unknown bats	**266**	**5**		**29**	**29**	**106,440**
Total bats[4]	**367**	**7**	**3**	**33**	**102**	**3,176,110**
Terrestrial mammals						
Marsupials (opossum)	**86**					
Xenarthyras (armadillo)	**21**	**1**	**4**		**10**	**1,000**
Lagomorphs	**290**	**7**	**8**	**5**	**20**	**104,484**
Hares	4					
Black-tailed jackrabbit	91	2	1			24,384
White-tailed jackrabbit	26			1	1	
Rabbits	122	2	3	4	13	2,100
Eastern cottontail	44	3	4		6	78,000
Desert cottontail	3					
Rodents	**150**	**2**	**2**	**4**	**3**	
Pocket gophers	2					
Squirrels	2					
Prairie dogs	5		1	1		
Black-tailed prairie dog	15					

Table 15. Continued (page 16 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Gunnison's prairie dog	11			3		
Woodchuck	89	2	1		3	
Woodrats	2					
Muskrat	13					
N. American porcupine	11					
Carnivores	**737**	**50**	**108**	**11**	**14,290**	**3,164,976**
Canids	3		1			
Coyote	321	29	72	5	11,680	2,776,040
Domestic dog	32	10	17	1	96	301,000
Foxes	72	4	7	1	10	750
Red fox	63	2	6		340	52,000
Common gray fox	4	1	1		2	186
Raccoon	63	3	3	2	2,160	35,000
White-nosed coati	1					
Ringtail	1					
Skunks	79		1	1	2	
Striped skunk	71			1		
River otter	2	1				
Badger	2					
Mink	1					
Domestic cat	19					
Small indian mongoose	3					
Artiodactyls	**1,003**	**847**	**467**	**83**	**242,919**	**36,379,187**
Deer	30	27	15		696	197,000
White-tailed deer	879	735	401	73	204,986	29,206,056
Mule deer	55	50	27	3	11,232	881,827
Wapiti (elk)	11	11	6	1	11,660	5,581,204
Moose	5	4	4			
Caribou	2	2	1			
Cattle	9	9	7	3	9,215	357,000
Pronghorn	9	8	5	2	5,130	156,100
Swine (pigs)	1					
Collared peccary	2	1	1	1		
Perissodactyls	**4**	**4**	**3**		**1,008**	**23,849**
Horse	3	3	3		1,008	23,849
Burro	1	1				
Total known t. mammals	**2,291**	**911**	**592**	**103**	**258,250**	**39,673,496**
Total unknown t. mammal	**16**	**6**	**7**	**1**		
Total terrestrial mammals[5]	**2,307**	**917**	**599**	**104**	**258,250**	**39,673,496**

Table 15. Continued (page 17 of 17).

Wildlife group or species	20-year totals					
	Number of reported strikes				Reported economic losses[1]	
	Total	With dam-age	With neg. EOF	With multiple animals[2]	Aircraft down time (hrs)	Reported costs ($)
Reptiles						
Turtles	**88**		**2**	**2**		
Turtles	52		2	1		
Florida soft shell turtle	4					
Eastern box turtle	5					
Common snapping turtle	3					
Diamondback terrapin	22			1		
Painted turtle	2					
American alligator	**15**	**1**	**2**		**3**	
Green iguana	**8**		**4**			
Total reptiles	**111**	**1**	**8**	**2**	**3**	
Total known (all species)	**45,913**	**5,852**	**4,407**	**9,101**	**577,687**	**331,755,734**
Total (unknown species)	**53,498**	**5,258**	**3,082**	**5,790**	**105,604**	**85,996,103**
Grand total	**99,411**	**11,110**	**7,489**	**14,891**	**683,291**	**417,751,837**

[1] These reported economic losses by species and species groups should be considered as relative indices of losses and not as actual estimated losses. For commercial aviation, an estimated 20 percent of strikes were reported in the 1990s and about 39 percent from 2004–2008. General aviation reporting rates are much lower than for commercial aviation. In addition, only about 45 percent of reported strikes identified the wildlife species or species group responsible, 1990–2009. Furthermore, less than 25 percent of reported strikes indicating damage also provided an estimate of the cost of damage or the downtime (see Table 19). Finally, even when cost estimates were provided, many reports were filed before aircraft damage had been fully assessed. See Table 19 for a more detailed projection of actual economic losses.

[2] More than one animal was struck by the aircraft.

[3] Of the 96,626 reported bird strikes, 43,410 (45 percent) identified the bird at least to species group. Of the 43,410 reports with birds identified to species group, 28,469 (66 percent) identified the bird to exact species (415 species total of which 186 caused damage). Thus, the bird was identified to species in 29 percent of the reported strikes, 1990–2009. Species identification has improved from less than 20 percent in the early 1990s to over 40 percent in 2008–2009 (Figure 7).

[4] Of the 367 reported bat strikes, 101 (28 percent) identified the bat at least to species group. Of the 101 reports with bats identified to species group, 84 (84 percent) identified the bat to exact species (8 species total of which 1 caused damage). Thus, the bat was identified to species in 23 percent of the reported strikes.

[5] Of the 2,307 reported terrestrial mammal strikes, 2,291 (99 percent) identified the mammal at least to species group. Of the 2,291 reports with mammals identified to species group, 1,970 (86 percent) identified the mammal to exact species (35 species total of which 20 caused damage). Thus, the mammal was identified to species in 85 percent of the reported strikes.

Table 16. Number of reported strikes, strikes with damage, and strikes involving multiple animals for the four most commonly struck bird groups and three most commonly struck terrestrial mammal groups, civil aircraft, USA, 1990–2009.

	Reported strikes		Strikes with damage		Strikes with >1 animal	
Species group[1]	20-year total	% of total known	20-year total	% of total known	20-year total	% of total known
Birds						
Gulls	7,894	18	1,204	24	1,862	21
Pigeons/ doves	6,410	15	363	7	1,574	18
Raptors	5,724	13	925	19	219	2
Waterfowl	3,391	8	1,503	30	1,238	14
All other known	19,991	46	943	19	4,099	46
Total known birds	**43,410**	**100**	**4,938**	**100**	**8,992**	**100**
Unknown birds	**53,216**		**5,247**		**5,760**	
Total birds	**96,626**		**10,185**		**14,752**	
Terrestrial mammals						
Artiodactyls	1,003	44	847	93	83	81
Carnivores	737	32	50	5	11	11
Lagomorphs	290	13	7	1	5	5
All other known	261	11	7	1	4	4
Total known t. mammals	**2,291**	**100**	**911**	**100**	**103**	**100**
Unknown t. mammals	**16**		**6**		**1**	
Total t. mammals	**2,307**		**917**		**104**	

[1] See Table 15 for listing of species within each species group.

Table 17. Bird and terrestrial mammal species with 25 or more reported strikes with civil aircraft in USA, 1990–2009 (Table 15), ranked by percent of strikes resulting in damage to aircraft (page 1 of 3)[1].

Rank	Wildlife species	Total reported strikes	Percent of strikes:		
			Causing damage	Causing negative EOF	Involving multiple animals
	Birds				
1	Snow goose	90	79	39	54
2	Northern pintail	60	63	35	55
3	Black vulture	53	60	42	11
4	Turkey vulture	363	51	35	5
4	Canada goose	1,238	51	27	43
5	American wigeon	30	50	20	30
5	Northern shoveler	28	50	11	43
6	Brown pelican	48	46	38	10
7	Bald eagle	125	42	29	7
8	Green-winged teal	25	40	24	36
8	Sandhill crane	88	40	27	35
9	Dbl.-crested cormorant	72	38	24	13
10	Wood duck	25	36	16	24
11	Wild turkey	45	29	27	20
12	Common raven	28	25	14	7
12	Mallard	521	25	12	23
13	American coot	72	24	7	7
14	Ring-necked pheasant	60	23	17	8
15	Osprey	168	22	15	2
15	Great blue heron	235	22	17	3
16	Glaucous-winged gull	59	20	14	17
17	Laysan albatross	31	19	16	0
18	Great egret	44	18	16	16
19	Red-tailed hawk	1,122	16	11	2
19	Great horned owl	100	16	7	1
20	Western gull	67	13	8	12
20	California gull	60	13	12	13
20	Mew gull	46	13	9	17
21	Rock pigeon	1,782	11	10	35
21	Blk-crowned night-heron	37	11	5	5
21	Herring gull	776	11	10	12
22	Cattle egret	189	10	16	24
22	Wilson's Snipe	30	10	7	13
22	American black duck	31	10	3	36
22	Great black-backed gull	72	10	7	6
22	Ring-billed gull	894	10	8	20
23	Swainson’s hawk	53	9	8	2
23	Snowy owl	66	9	9	0

Table 17. continued (page 2 of 3)

Rank	Wildlife species	Total reported strikes	Percent of strikes:		
			Causing damage	Causing negative EOF	Involving multiple animals
	Birds (continued)				
23	American crow	248	9	8	15
24	Black-bellied plover	49	8	6	16
24	Northern flicker	38	8	0	0
25	Bonaparte's gull	27	7	11	26
25	Common grackle	72	7	10	22
25	American robin	339	7	5	9
25	Peregrine falcon	149	7	2	4
25	Laughing gull	244	7	7	17
25	Franklin's gull	56	5	11	39
25	Cooper's hawk	39	5	5	0
25	Rough-legged hawk	40	5	5	0
25	American golden-plover	62	5	7	34
25	Western sandpiper	43	5	7	65
25	Barn owl	558	5	3	1
26	European starling	2,330	4	6	39
26	Lark bunting	25	4	0	20
26	Upland sandpiper	106	4	6	11
27	American woodcock	29	3	7	10
27	Short-eared owl	213	3	3	0
27	Mourning dove	3,408	3	5	20
27	Spotted dove	95	3	6	5
27	Red-winged blackbird	101	3	6	13
27	Northern harrier	70	3	1	3
27	Least sandpiper	34	3	9	41
27	House sparrow	**77**	3	1	14
28	Purple martin	84	2	1	26
28	Common myna	43	2	2	26
28	Brown-headed cowbird	86	2	4	34
28	Northern mockingbird	47	2	4	0
28	Western meadowlark	352	2	3	16
28	Killdeer	1,823	2	2	10
28	Chimney swift	104	2	3	9
28	Bank swallow	109	2	4	42
28	Zebra dove	121	2	3	12
28	Snow bunting	133	2	12	69
29	Burrowing owl	76	1	0	1
29	Horned lark	1,100	1	2	24
29	American kestrel	2,019	1	2	4
29	Cliff swallow	376	1	1	16
29	Savannah sparrow	118	1	0	9
29	Barn swallow	1,070	1	1	18

Table 17. continued (page 3 of 3)

Rank	Wildlife species	Total reported strikes	Percent of strikes:		
			Causing damage	Causing negative EOF	Involving multiple animals
	Birds (continued)				
29	Pacific golden-plover	519	1	2	16
29	Eastern meadowlark	480	1	2	9
29	Common nighthawk	190	1	0	7
30	Yellow bittern	45	0	0	4
30	Merlin	40	0	5	3
30	Semipalmated plover	32	0	0	41
30	Semipalmated sandpiper	28	0	0	43
30	Scissor-tailed flycatcher	55	0	4	7
30	Western kingbird	69	0	1	4
30	Sky lark	28	0	0	4
30	Tree swallow	192	0	2	33
30	Gray catbird	26	0	0	12
30	Brewer's blackbird	29	0	0	10
30	American goldfinch	26	0	4	4
30	House finch	38	0	0	11
30	Song sparrow	36	0	0	19
30	Nutmeg manikin	43	0	2	51
30	Black-headed munia	43	0	2	47
	Terrestrial mammals				
1	Mule deer	55	91	49	6
2	White-tailed deer	879	84	46	8
3	Domestic dog	32	31	53	3
4	Coyote	321	9	22	2
5	Eastern cottontail	44	7	9	0
6	Raccoon	63	5	5	3
7	Red fox	63	3	10	0
8	Woodchuck	89	2	1	0
8	Black-tailed jackrabbit	91	2	1	0
9	Opossum	86	0	0	0
9	White-tailed jackrabbit	26	0	0	4
9	Striped skunk	71	0	0	1

[1] See Dolbeer and Wright (2009) for a more detailed discussion of the use of wildlife strike data to rank species as to their hazard level to air operations and for use in airport Safety Management Systems.

Table 18. Number of civil aircraft lost (destroyed or damaged beyond repair) after striking wildlife by wildlife species and aircraft mass category, USA, 1990–2009[1].

Wildlife species or species group	Aircraft[2] mass category (Maximum take-off mass) ≤2,250 kg	2,251-5,700 kg	5,701-27,000 kg	>27,000 kg	Total aircraft lost
White-tailed deer	12	5	1		18
Unknown bird	10	1	1		12
Canada goose	1	3		1	5
Vultures[3]	3				3
Cattle	1	1			2
Hawks	2				2
Amer. white pelican		1			1
Bald eagle	1				1
Brown pelican	1				1
Cormorants	1				1
Coyote			1		1
Domestic dog	1				1
Ducks	1				1
Eastern cottontail	1				1
Eurasian kestrel				1	1
Mourning dove			1		1
Red-tailed hawk		1			1
Ring-billed gull		1			1
Wapiti (elk)			1		1
Total	**35**	**13**	**5**	**2**	**55**

[1] Thirty-three (60 percent) of the 55 wildlife strikes resulting in a destroyed aircraft occurred at General Aviation airports, 14 occurred away from an airport, 7 occurred at USA airports certificated for passenger service under 14 CFR Part 139, and 1 occurred at a foreign airport certificated for passenger service.

[2] Engine types on the 55 destroyed aircraft were piston (40), turbofan (6), turbojet (2), turboprop (5), and turboshaft (2). Aircraft operator was business (26), private (24), and commercial transport (5).

[3] Two turkey vultures and 1 unknown species of vulture (either turkey or black).

Table 19. Number of reported wildlife strikes indicating damage or a negative effect-on-flight (EOF) and reported losses in hours of downtime and U.S. dollars, for civil aircraft, USA, 1990–2009.

	Number of reports				Reported time (hours) aircraft out of service (No. of reports)	Cost in millions of dollars ($) (Number of reports)		
	Total reports	Reports indicating adverse effect	Reports indicating aircraft damage	Reports indicating negative EOF		Direct cost	Other cost	Total cost
20-yr total	99,411	16,518	11,110	7,489	683,291 (4,853)	372.724 (2,828)	45.028 (1,340)	417.752
20-yr avg.	4,971	826	556	374	34,165 (243)	18.636 (141)	2.251 (67)	20.887
Mean losses per incident reported					**140.8**	**0.132**	**0.034**	**0.166**
Estimated annual losses								
Minimum[1]					**116,285**	**108.852**	**27.752**	**136.604**
Maximum[2]					**581,424**	**544.259**	**138.762**	**683.021**

[1] Minimum values are based on the assumption that all 16,518 reported strikes indicating an adverse effect (negative EOF and/or damage) to aircraft (mean of 826/year) incurred similar amounts of damage and/or downtime and that these reports are all of the adverse-effect strikes that occurred, 1990–2009.

[2] Analyses of strike data from 1991–2004 indicated that 11 to 21 percent of strikes were reported for air carrier aircraft at Part 139 airports certificated for passenger traffic (Linnell et al. 1999, Cleary et al. 2005, Wright and Dolbeer 2005). Analyses of strike data from 2004–2008 indicated strike reporting at Part 139 airports had improved to 39 percent (Dolbeer 2009a). Strike reporting for General Aviation (GA) aircraft is estimated at less than 5 percent (Dolbeer et al. 2008, Dolbeer 2009a). Maximum values for reported losses are based on the assumption that the 16,518 reported strikes indicating an adverse effect represent, on average, 20 percent of the total strikes that occurred with commercial and GA aircraft from 1990–2009.

Figures

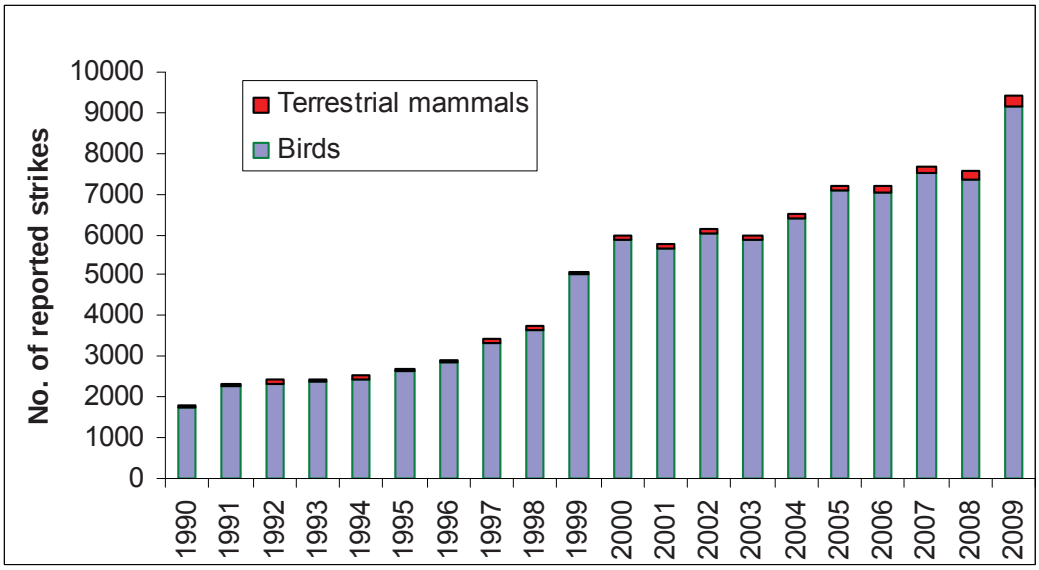


Figure 1. Number of reported bird (N = 96,626) and terrestrial mammal (N = 2,307) strikes to civil aircraft, USA, 1990–2009. Additionally, 367 and 111 strikes involving bats and reptiles, respectively, were reported for a total of 99,411 strikes by all species of wildlife (see Table 1).

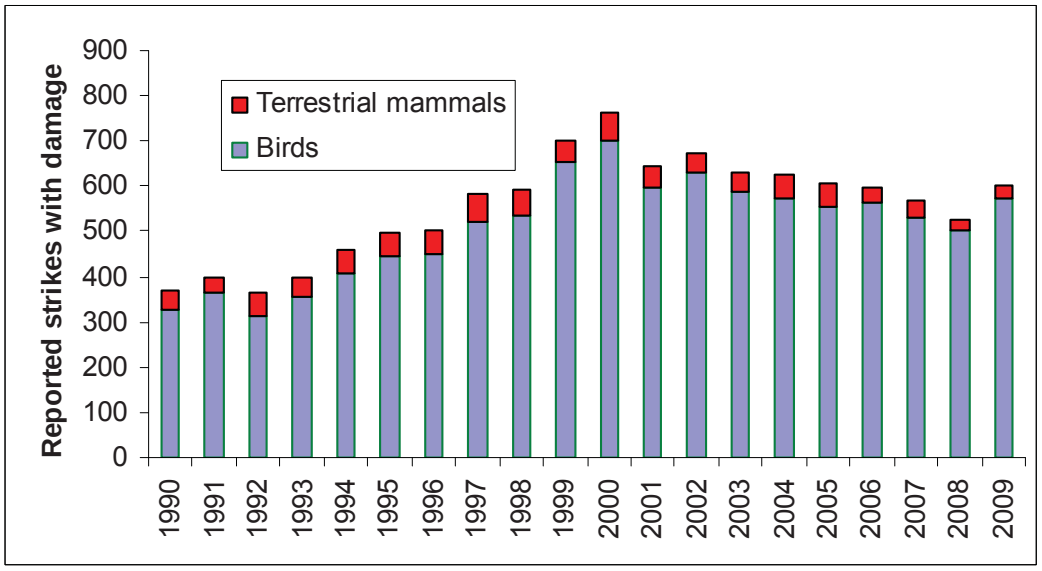


Figure 2. Number of reported bird (N = 10,185) and terrestrial mammal (N = 917) strikes causing damage to civil aircraft, USA, 1990–2009. Additionally, 7 and 1 damaging strikes involving bats and reptiles, respectively, were reported for a total of 11,110 damaging strikes by all species of wildlife (see Table 1).

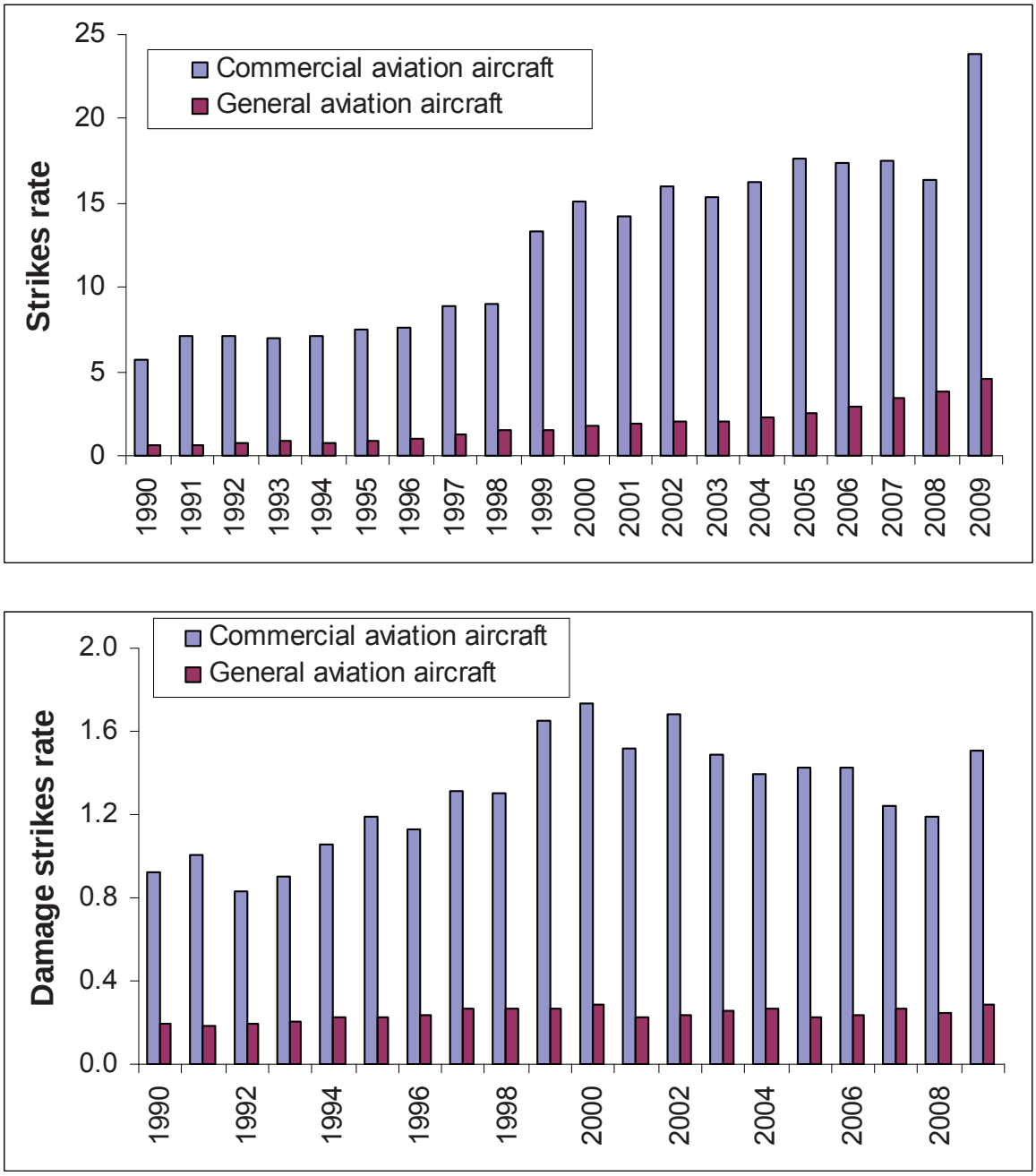


Figure 3. The strike rate (number of reported wildlife strikes per 100,000 aircraft movements, top graph) and damaging strike rate (number of reported damaging wildlife strikes per 100,000 aircraft movements, bottom graph) for commercial (air carrier, commuter, and air taxi service) and general aviation aircraft, USA, 1990–2009 (see Tables 2 and 3).

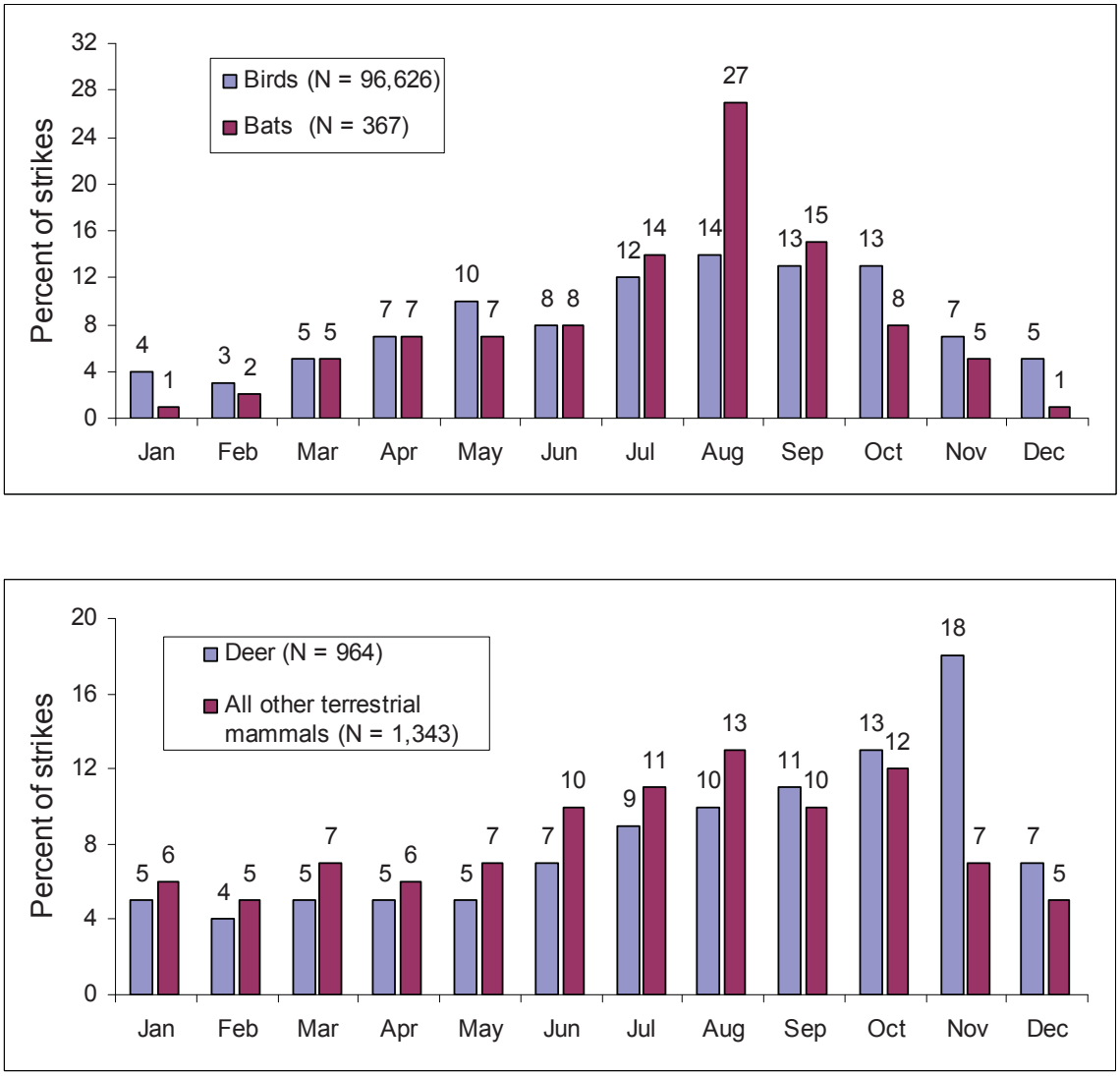
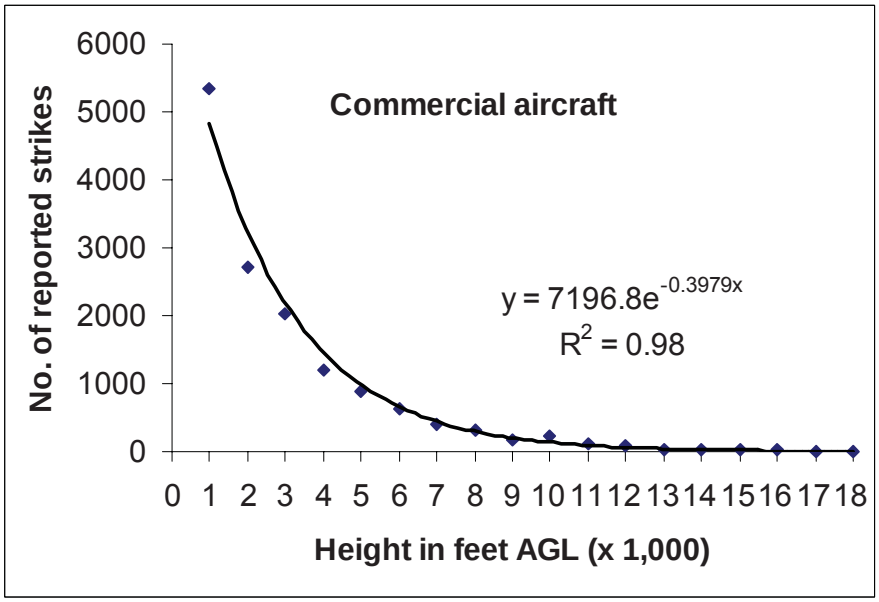


Figure 4. The percentage of reported bird and bat strikes (top graph) and deer and other terrestrial mammal strikes (bottom graph) with civil aircraft by month, USA, 1990–2009. In addition, 110 strikes with reptiles were reported, of which 58 percent occurred in May–July. Deer strikes comprised 879 white-tailed deer, 55 mule deer, and 30 deer not identified to species.



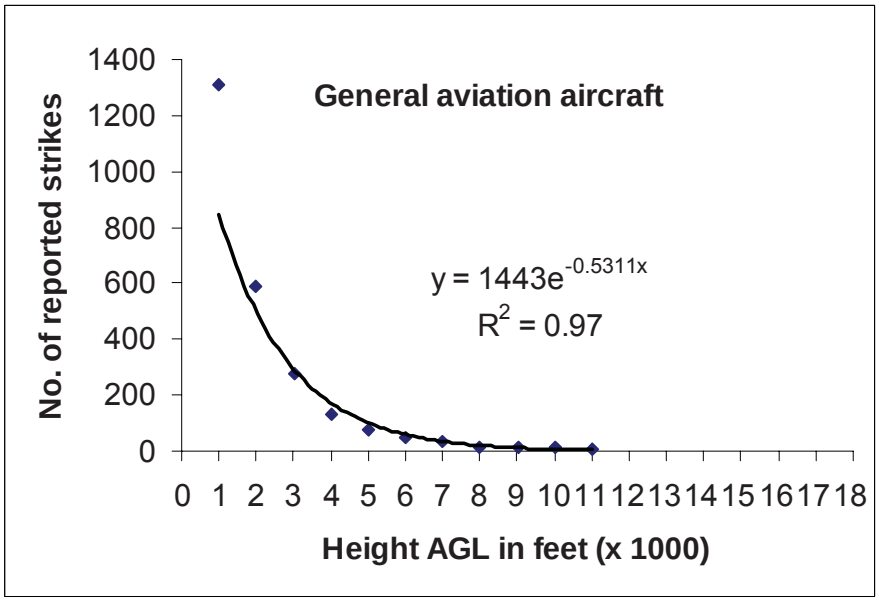


Figure 5. Number of reported bird strikes with commercial (top graph) and general aviation aircraft (bottom graph) in USA from 1990–2009 by eighteen 1,000-foot height intervals above ground level from 501–1,500 feet (interval 1) to 17,501–18,500 feet (interval 18). Above 500 feet, the number of reported strikes declined consistently by 33 percent and 41 percent for each 1,000 foot gain in height for commercial and general aviation aircraft, respectively. The negative exponential equations explained 97 to 98 percent of the variation in number of strikes by 1000-foot intervals from 500 to 18,500 feet. See Tables 10 and 11 for sample sizes.

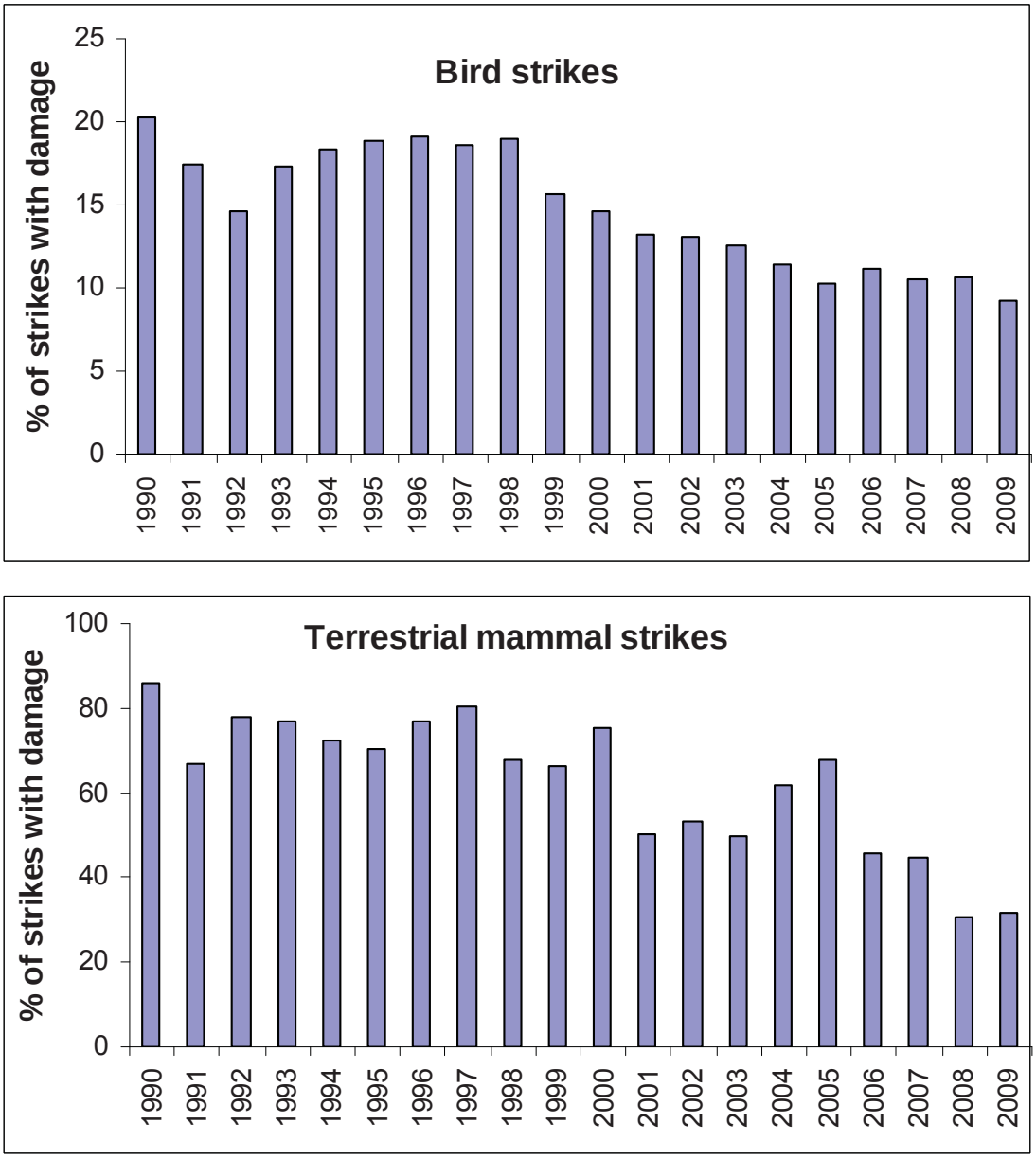


Figure 6. The percentage of reported bird strikes (top graph) and terrestrial mammal strikes (bottom graph) that indicated damage to the civil aircraft, USA, 1990–2009. See Tables 1 and 13 for sample sizes and classifications of damage.

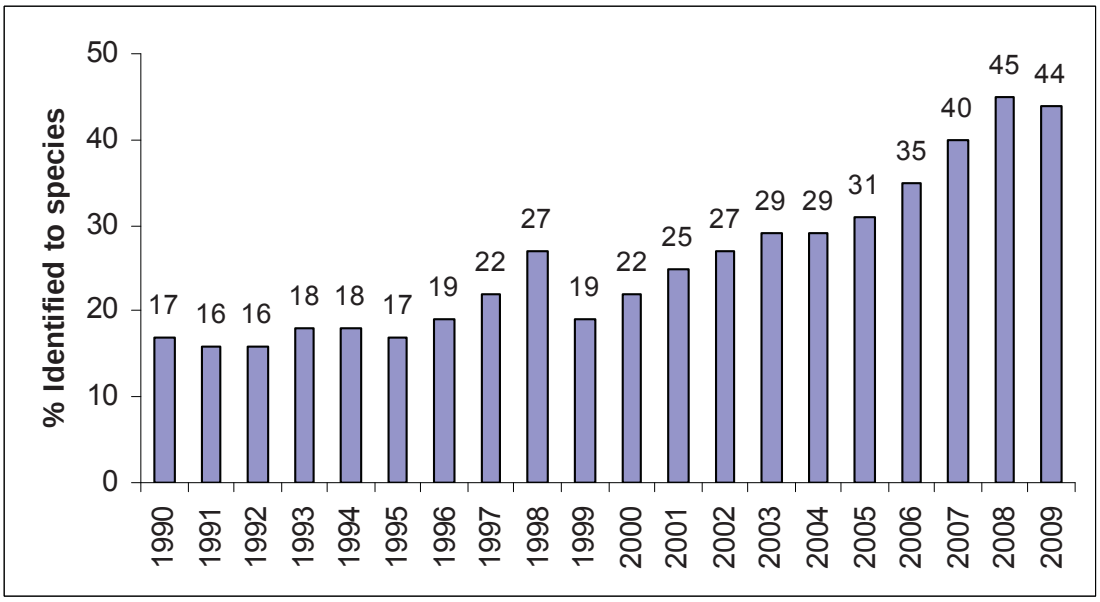


Figure 7. The percentage of reported bird strikes with civil aircraft in which the bird was identified to species, USA, 1990–2009. See Tables 1 and 15 for sample sizes.

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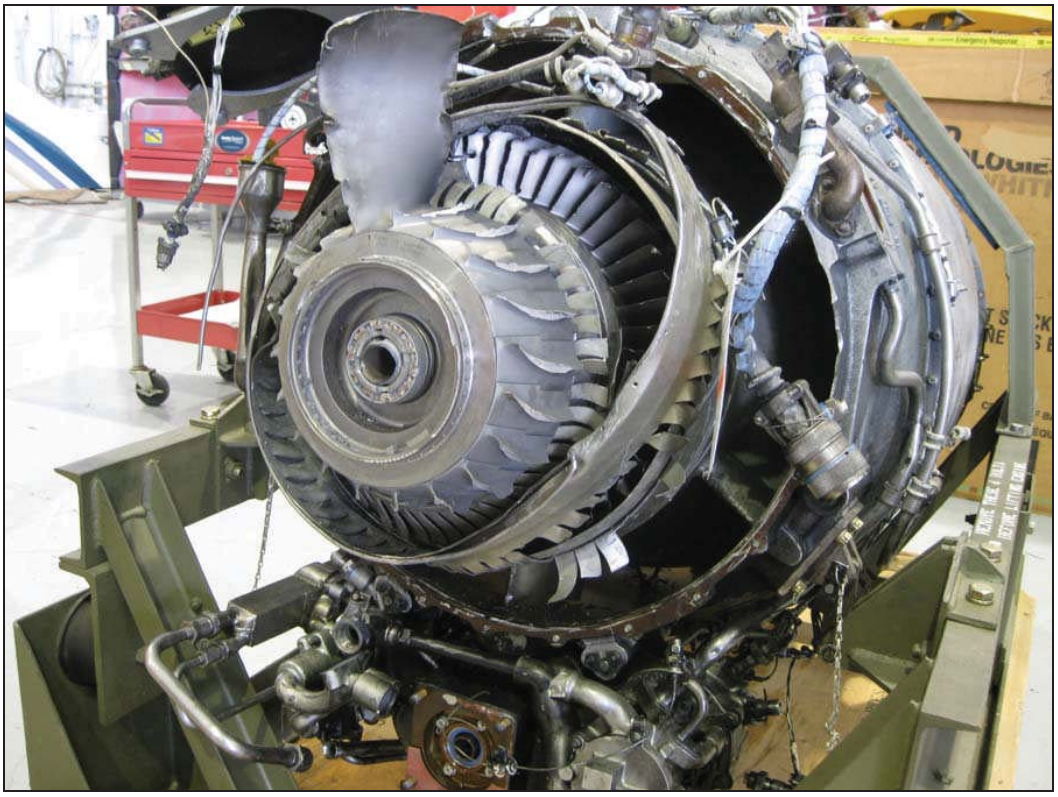
APPENDIX A.

SELECTED SIGNIFICANT WILDLIFE STRIKES TO U.S. CIVIL AIRCRAFT, 2009



A Beechcraft 400 departing a Texas airport on 31 July 2009 ingested a recently fledged yellow-crowned night heron into the #2 engine during the take-off run, causing an uncontained failure. The pilot aborted take-off. Photo courtesy USDA.

The U.S. Department of Agriculture, through an interagency agreement with the Federal Aviation Administration, compiles a database of all reported wildlife strikes to U.S. civil aircraft and to foreign carriers experiencing strikes in the USA. We compiled 99,411 strike reports from 1,585 USA airports and 237 foreign airports for 1990 through 2009 (9,474 strikes in 2009). The following 2009 examples from the database show the serious impact that strikes by birds or other wildlife can have on aircraft. These examples, from throughout the USA, demonstrate the widespread and diverse nature of the problem. The examples are not intended to highlight or criticize individual airports because strikes have occurred on almost every airport in the USA. Some of the strike examples reported here occurred off airport property during approach or departure. For more information on wildlife strikes or to report a strike, visit http://wildlife.faa.gov and www.birdstrike.org.

Date:	4 January 2009
Aircraft:	Sikorksy S-76C++
Airport:	Near Morgan City, LA
Phase of Flight:	En Route (700' AGL)
Effect on Flight:	Crashed in a marsh
Damage:	Aircraft destroyed
Wildlife Species:	Red-tailed hawk
Comments from Report: Helicopter crashed while en route to an offshore work site. Eight people were killed. One seriously injured. Initial analysis of the flight data recorder indicated that the helicopter was cruising at 138 knots when the cockpit voice recorder indicated a loud noise followed by a substantial increase in the background noise level that was recorded on both intercoms and area microphones. About one second after the loud noise, the torque of both engines dropped simultaneously to near zero. DNA and feather samples were taken from the windshield and right side engine inlet filter. Additional swabs were taken from various parts of the aircraft. NTSB investigated. ID by the Smithsonian, Division of Birds.	

Date:	5 January 2009
Aircraft:	B-747-400
Airport:	Chicago O'Hare Intl. (IL)
Phase of Flight:	Climb (<8,000 AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine #3
Wildlife Species:	Red-tailed hawk
Comments from Report: During climb, bird(s) was/were ingested in the #3 engine. Altitude of strike was not reported, but the aircraft turned back at around 8,000 feet AGL and dumped 30,000 kg of fuel. ID by the Smithsonian, Division of Birds. Aircraft out of service at least 3 days.	

Date:	15 January 2009
Aircraft:	A-320
Airport:	LaGuardia Intl. (NY)
Phase of Flight:	Climb (2,900' AGL)
Effect on Flight:	Engines shut down, landed in Hudson River
Damage:	Aircraft destroyed
Wildlife Species:	Canada goose
Comments from Report: During initial climb, aircraft had multiple birdstrikes and lost thrust in both engines. Pilot ditched in the Hudson River less than 6 minutes after take-off. Observers in offices along the river said the aircraft narrowly missed hitting buildings. Several boats were used to rescue the 150 passengers and 5 crew members as the aircraft sank. Everyone on board survived. Area hospitals treated several minor injuries and one serious injury. NTSB investigated. ID by the Smithsonian, Division of Birds. Geese were found to be migratory rather than resident. Cost of lost aircraft estimated at $36 million.	

Date:	17 January 2009
Aircraft:	Eurocopter AS 350
Airport:	Forrest City, AR
Phase of Flight:	En Route (1,200' AGL)
Effect on Flight:	Emergency landing
Damage:	Both windshields, chin bubble, engine nacelle, and nose
Wildlife Species:	Snow goose
Comments from Report: Helicopter hit a flock of birds around the Forrest City area and made an emergency landing. The a/c hit about 6 birds. Both windscreens were broken as well as the nose cone, engine nacelle, and pilot's chin bubble. The pilot suffered some minor injuries and everyone was shaken up. The crew members were not wearing helmets and were fortunate the pilot's vision remained intact to land the aircraft. Aircraft was trailered for repairs. Time out of service was 3 months and costs totaled $100,000.	

Date:	1 February 2009
Aircraft:	Schweizer G-164B
Airport:	Private airstrip near Ferriday, LA
Phase of Flight:	Approach (20' AGL)
Effect on Flight:	Impacted runway and flipped over
Damage:	Destroyed
Wildlife Species:	Double-crested cormorant and red-winged blackbirds
Comments from Report: While on short final, the bi-wing aircraft hit a flock of birds, which penetrated the windscreen and impacted pilot in the face, temporarily blinding him. Pilot attempted a go-around but aircraft impacted the runway, nosed over and came to rest inverted. Pilot reported a cormorant came through the windshield. Photo showed red-winged blackbirds on field. The fuselage sustained structural damage. NTSB investigated. Aircraft was destroyed.	

Date:	3 February 2009
Aircraft:	B-757-200
Airport:	Denver Intl. (CO)
Phase of Flight:	Climb (2,100' AGL)
Effect on Flight:	Emergency landing
Damage:	Engine
Wildlife Species:	Bald eagle
Comments from Report: Amber alert precautionary landing. Pilot reported seeing and hitting a large bird during climb through 7,500 ft MSL. Bird hit right side of engine cowling making a large dent before entering the engine where it damaged all fan blades. Aircraft returned to Denver. ID by the Smithsonian, Division of Birds. Cost reported to be $14 - $20 million.	

Date:	16 February 2009
Aircraft:	B-757-200
Airport:	Mineta San Jose Intl. (CA)
Phase of Flight:	Take-off run
Effect on Flight:	Aborted take-off
Damage:	Engine
Wildlife Species:	California gull
Comments from Report: Saw gulls during taxi. During take-off run, captain saw birds on runway, they began flying, resulting in numerous strikes on fuselage and wings. Right engine began to vibrate significantly. Pilot aborted take-off, exited runway, and shut down the right engine. Passengers were bused to San Francisco, where they were booked on other flights. ID by the Smithsonian, Division of Birds.	

Date:	16 February 2009
Aircraft:	Cessna 402
Airport:	Fort Lauderdale Intl. (FL)
Phase of Flight:	Climb (600' AGL)
Effect on Flight:	Precautionary landing
Damage:	Windshield
Wildlife Species:	Black vulture
Comments from Report: Pilot had just taken off when he saw a flock of vultures ahead. One smashed through the windshield, hitting the pilot in the face, causing injury. Blood splattered all over the cockpit. Firefighters were on hand for the landing. Pilots in the area have reported a growing vulture problem.	

Date:	5 March 2009
Aircraft:	Agusta 109E
Airport:	Shands Hospital (FL)
Phase of Flight:	Approach (700' AGL)
Effect on Flight:	Emergency landing at base
Damage:	Windshield, switches, light
Wildlife Species:	Lesser scaup
Comments from Report: A duck shattered the windshield and entered the cockpit. The pilot received cuts and an eye injury. A trauma patient was on board as they approached the rooftop helipad at Shands Hospital. The bird broke switches and circuit breakers on the overhead instrument panel before landing on the foot of a crewmember. The aircraft landed at the ShandsCair helipad, rather than on the hospital roof. Patient was transported by ambulance. ID by the Smithsonian, Division of Birds, based on photo.	

Date:	16 March 2009
Aircraft:	B-757-200
Airport:	New Orleans Intl. (LA)
Phase of Flight:	Take-off run
Effect on Flight:	Precautionary landing
Damage:	Engine #2
Wildlife Species:	Herring gull
Comments from Report: Pilot reported seeing up to 10 gulls on the runway during rotation. Ingestion caused vibration in the #2 engine. An emergency was declared and aircraft returned to airport, landing safely. Smoke rings were seen coming from the engine during landing. Three blades were replaced along with a leaky hydraulic actuator. Passengers were booked on other flights. ID by Smithsonian, Division of Birds. Time out of service 24 hours.	

Date:	21 March 2009
Aircraft:	B-737-800
Airport:	Newark Liberty Intl. (NJ)
Phase of Flight:	Approach (1,200' AGL)
Effect on Flight:	Engine shutdown
Damage:	Engine, wing, landing gear
Wildlife Species:	Canada goose
Comments from Report: On final approach, right engine ingested a Canada goose and flamed out repeatedly. Safe landing made. Emergency vehicles were dispatched. Damage to right engine and left leading edge of wing. Nose gear had bird lodged in it. ID by Smithsonian, Division of Birds.	

Date:	22 March 2009
Aircraft:	A-310
Airport:	Gerald R Ford Intl. (MI)
Phase of Flight:	Take-off run
Effect on Flight:	Aborted take-off
Damage:	Engine
Wildlife Species:	Snowy owl
Comments from Report: Five intake fan blades, 4 fan exit vane platforms, and acoustic liner sheet were damaged. ID by the Smithsonian, Division of Birds. Time out of service was 38 hours, cost reported as $303,500.	

Date:	3 May 2009
Aircraft:	C-414
Airport:	Cavern City Air Terminal (NM)
Phase of Flight:	Landing roll
Effect on Flight:	Lost brakes
Damage:	Engine, propeller, wing, landing gear
Wildlife Species:	Mule deer
Comments from Report: Three mule deer crossed the runway during landing. The right engine, right landing gear, and right flaps were damaged. The deer got caught in the landing gear. The right brakes were lost. Time out of service was 1 month.	

Date:	7 June 2009
Aircraft:	B-747-400
Airport:	Los Angeles Intl. (CA)
Phase of Flight:	Climb (150’ AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine
Wildlife Species:	Black-crowned night-heron
Comments from Report: At about ¼ mile off end of runway, a bird was ingested into the # 1 engine, which caused vibrations. Pilot entered a holding pattern to burn off fuel before returning to land. Seven fan blades were replaced. Time out of service was 33 hours. Cost of damage and other costs totaled $250,000. ID by Smithsonian, Division of Birds.	

Date:	26 June 2009
Aircraft:	Bell 407
Airport:	Odessa, DE
Phase of Flight:	En Route (700' AGL)
Effect on Flight:	Landed in a field
Damage:	Windshield, rotor, fuselage, tail, antenna, overhead switch panel
Wildlife Species:	Unknown (possibly vulture or eagle)
Comments from Report: Medic observer caught a brief glimpse of a large bird just prior to impact as it approached from the left side of the aircraft in the pilot's blind spot. Impact took place simultaneously with medic's warning. Both windshields were broken. Pilot sustained a small puncture to his left hand and minor lacerations and contusions to his neck, apparently from the Plexiglas windshield. Helmets were worn and visors were down. Remains were scattered throughout the cockpit. The pilot immediately landed in a field. Aircraft had to be trucked out for repairs. Time out of service was 16 days. Cost of repairs was $25,000.	

Date:	29 June 2009
Aircraft:	DC-9-31
Airport:	Gerald R. Ford Intl. (MI)
Phase of Flight:	Approach
Effect on Flight:	None
Damage:	Engine
Wildlife Species:	Mallard
Comments from Report: Remains found over large area covering 25' x 100' all left of runway centerline. Obvious ingestion. Largest piece less than 2.5" by 1". ATC had no reports of a birdstrike. Remains found at 1030. Operator found at 1320. Pilot unavailable. Engine had to be replaced. ID by Smithsonian, Division of Birds.	

Date:	30 June 2009
Aircraft:	B-737-800
Airport:	LaGuardia Intl. (NY)
Phase of Flight:	Approach (900' AGL)
Effect on Flight:	Aircraft was towed to gate
Damage:	Landing gear
Wildlife Species:	Great blue heron
Comments from Report: Aircraft hit a bird on approach. After landing, pilot noticed the nose gear's hydraulics were not working. A large bird was found in the landing gear. Aircraft had to be towed to the gate.	

Date:	4 July 2009
Aircraft:	Lancair LC-42
Airport:	Ocean City Municipal (NJ)
Phase of Flight:	Landing roll
Effect on Flight:	Ran off runway
Damage:	Propeller, landing gear, engine cowling and airframe
Wildlife Species:	Canada goose
Comments from Report: During landing roll, aircraft hit two Canada geese. The plane veered off the right side of the runway and hit a concrete runway light-mounting pad. The nose landing gear collapsed and the nose wheel assembly separated from the landing gear. The right main landing gear and its wheel assembly were damaged, and the brake wheel backer plate was jammed against its wheel assembly preventing rotation. The engine was rebuilt.	

Date:	7 July 2009
Aircraft:	B-737-300
Airport:	Baltimore Washington Intl. (MD)
Phase of Flight:	Climb (25’ AGL)
Effect on Flight:	Precautionary landing
Damage:	Engines #1 and #2, tail
Wildlife Species:	European starling
Comments from Report: Birds were ingested in both engines. The number 2 first stage fan sustained many bent blades and the #1 engine had 1 blade damaged. The right horizontal stabilizer was dented, and the leading edge was replaced. No internal engine damage found during borescope inspection. The landing gear, wing, and radome were hit numerous times but sustained no damage. Approximately 67 starlings were removed from the runway. Aircraft was out of service 4.5 hours.	

Date:	31 July 2009
Aircraft:	Embraer 120
Airport:	Salt Lake City Intl. (UT)
Phase of Flight:	Climb (2,600’ AGL)
Effect on Flight:	Precautionary landing
Damage:	Radome
Wildlife Species:	White pelican
Comments from Report: A pelican hit the aircraft as it climbed to about 2,600’ AGL. Aircraft returned to the airport with the bird lodged in the radome. Time out of service was 48 hours. Cost of repairs was $150,000.	

Date:	31 July 2009
Aircraft:	BE-400
Airport:	Sugar Land Regional (TX)
Phase of Flight:	Take-off run
Effect on Flight:	Aborted take-off, uncontained engine failure
Damage:	Engine
Wildlife Species:	Yellow-crowned night-heron
Comments from Report: During take-off run, approaching 95 knots, the pilots saw 1 large and 2 smaller birds. The larger bird was ingested into the #2 engine, which immediately rolled back. Take-off was aborted. The engine cowling and multiple turbine blades had separated from the aircraft. It is believed that the bird hit the spinner, which fell into the fan. One wing and material from inside the engine were sent to the Smithsonian. NTSB investigated. ID by Smithsonian, Division of Birds.	

Date:	15 August 2009
Aircraft:	MD-11
Airport:	Los Angeles Intl. (CA)
Phase of Flight:	Climb (100’ AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine
Wildlife Species:	Western gull
Comments from Report: Pilot reported a bird strike upon rotation. The aircraft returned with a bird ingestion in the #1 engine. Emergency was declared with a heavy landing. Six turbine blades were replaced. ID by Smithsonian, Division of Birds. Cost estimated at $135,000, and time out of service was 30 hours.	

Date:	17 August 2009
Aircraft:	Embraer 175
Airport:	Charlotte/Douglas Intl. (NC)
Phase of Flight:	Take-off run
Effect on Flight:	Aborted take-off
Damage:	Engine, landing gear
Wildlife Species:	Canada goose
Comments from Report: During take-off run, encountered a large flock of geese. One bird was ingested in the #2 engine, one hit the nose landing gear, and another hit the right landing gear. The pilot made a high-speed aborted take-off, stopping safely, and taxied to the apron. The flight was delayed for 2.5 hrs while a replacement aircraft was brought in. ID by Smithsonian, Division of Birds.	

Date:	29 September 2009
Aircraft:	B-727-200
Airport:	Memphis Intl. (TN)
Phase of Flight:	Approach (3,700' AGL)
Effect on Flight:	None
Damage:	Windshield
Wildlife Species:	Great egret
Comments from Report: The captain's front window was struck, and the inner window panel shattered. Two engines ingested birds but sustained no damage. Time out of service was 37 hours. Cost estimated at $10,820. ID by Smithsonian, Division of Birds.	

Date:	11 October 2009
Aircraft:	MD-88
Airport:	Greater Rochester Intl. (NY)
Phase of Flight:	Climb (200' AGL)
Effect on Flight:	Engine shut down and precautionary landing
Damage:	Engine
Wildlife Species:	Unknown
Comments from Report: Aircraft hit a flock of birds during climb from ROC. Left engine stalled, and there was an in-flight shutdown. Unknown if pilot commanded the shutdown. Returned to land. The left engine had multiple fan blades with major damage.	

Date:	18 October 2009
Aircraft:	Piaggio P 180
Airport:	Monmouth Executive Airport (NJ)
Phase of Flight:	Take-off run
Effect on Flight:	Aborted take-off
Damage:	Nose, propeller, wing, fuselage
Wildlife Species:	Canada goose
Comments from Report: Bird struck the nose cone, which damaged the radar and avionics bay. Both propellers were damaged. Engine nacelles needed to be repaired. Minor damage to left wing. Time out of service was 8 days. Cost totaled $105,000.	

Date:	2 November 2009
Aircraft:	MD-90
Airport:	Phoenix Sky Harbor Intl. (AZ)
Phase of Flight:	Climb (9,300' AGL)
Effect on Flight:	Precautionary landing
Damage:	Fuselage
Wildlife Species:	Western grebe
Comments from Report: Bird hit top of aircraft and tore back 18 inches of the fuselage just above the right flight deck eyebrow window. A second strike tore a large hole just below the co-pilot's wing in front of the landing gear. These strikes activated the depressurization alarm. Aircraft returned to land. NTSB investigated. ID by Smithsonian, Division of Birds	

Date:	4 November 2009
Aircraft:	BE-99
Airport:	Show Low Regional (AZ)
Phase of Flight:	Approach (~6800' AGL)
Effect on Flight:	Emergency landing
Damage:	Windshield
Wildlife Species:	Western grebe
Comments from Report: Bird shattered the windshield, injuring the pilot. NTSB investigated. ID by Smithsonian, Division of Birds.	

Date:	14 November 2009
Aircraft:	A 319
Airport:	Kansas City Intl. (MO)
Phase of Flight:	Climb (4,000' AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine
Wildlife Species:	Snow goose
Comments from Report: Flight had just departed when pilot reported multiple bird strikes about 4 miles north of the airport. First report was loss of #2 engine. When the crew attempted to advance the throttle, there was a series of severe compressor stalls. Passengers described it as fireballs being ejected from the engine. The crew declared an emergency and returned to MCI. Upon landing, pilot reported both engines had stalled. Damage to #2 engine consisted of a dent in the lower lip and a hole in the underside of the cowling. The # 2 engine had internal damage. NTSB investigated. ID by Smithsonian, Division of Birds.	

Date:	6 December 2009
Aircraft:	Embraer 145
Airport:	Philadelphia Intl. (PA)
Phase of Flight:	Approach (2,000' AGL)
Effect on Flight:	Engine shut down
Damage:	Engine
Wildlife Species:	Snow goose
Comments from Report: Pilot declared an emergency due to a bird strike and engine shutdown while on approach. A huge bang shook the aircraft, and then the engine went out. Time out of service was 48 hours, and costs were $306,000. ID by Smithsonian, Division of Birds.	

Date:	22 December 2009
Aircraft:	B-717-200
Airport:	Baltimore Washington Intl. (MD)
Phase of Flight:	Climb (3,500' AGL)
Effect on Flight:	Precautionary landing
Damage:	Nose, wing, fuselage, engine cowling and engine
Wildlife Species:	Snow goose
Comments from Report: Multiple strikes with bird debris on wings and nose. The pilots reported that they hit 6 or 7 geese 4 miles west after departure. Pilots reported flight control problems, abnormal vibrations in both engines and upon landing, the #1 engine was smoking. ID by Smithsonian, Division of Birds.	

Date:	22 December 2009
Aircraft:	B-727-200
Airport:	Edmonton Intl. (Alberta, Canada)
Phase of Flight:	Climb (100' AGL)
Effect on Flight:	Precautionary landing
Damage:	Engine #3
Wildlife Species:	Short-eared owl
Comments from Report: Aircraft maintenance performed a bird strike inspection on the #2 engine after it was removed from the aircraft for ice FOD. Evidence of strike was found. Time out of service was 41 hours. Costs totaled $1.3 million. ID by Smithsonian, Division of Birds. (USA carrier)	

U.S. Department
of Transportation

Federal Aviation Administration

Advisory Circular

Subject: HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS	**Date:** 8/28/2007	**AC No:** 150/5200-33B
	Initiated by: AAS-300	**Change:**

1. PURPOSE. This Advisory Circular (AC) provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

2. APPLICABILITY. The Federal Aviation Administration (FAA) recommends that public-use airport operators implement the standards and practices contained in this AC. The holders of Airport Operating Certificates issued under Title 14, Code of Federal Regulations (CFR), Part 139, Certification of Airports, Subpart D (Part 139), may use the standards, practices, and recommendations contained in this AC to comply with the wildlife hazard management requirements of Part 139. Airports that have received Federal grant-in-aid assistance must use these standards. The FAA also recommends the guidance in this AC for land-use planners, operators of non-certificated airports, and developers of projects, facilities, and activities on or near airports.

3. CANCELLATION. This AC cancels AC 150/5200-33A, *Hazardous Wildlife Attractants on or near Airports*, dated July 27, 2004.

4. PRINCIPAL CHANGES. This AC contains the following major changes, which are marked with vertical bars in the margin:

a. Technical changes to paragraph references.

b. Wording on storm water detention ponds.

c. Deleted paragraph 4-3.b, *Additional Coordination.*

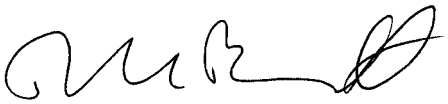
5. BACKGROUND. Information about the risks posed to aircraft by certain wildlife species has increased a great deal in recent years. Improved reporting, studies, documentation, and statistics clearly show that aircraft collisions with birds and other wildlife are a serious economic and public safety problem. While many species of wildlife can pose a threat to aircraft safety, they are not equally hazardous. Table 1

ranks the wildlife groups commonly involved in damaging strikes in the United States according to their relative hazard to aircraft. The ranking is based on the 47,212 records in the FAA □ational Wildlife Strike Database for the years 1990 through 2003. These hazard rankings, in conjunction with site-specific Wildlife □azards Assessments (W□A), will help airport operators determine the relative abundance and use patterns of wildlife species and help focus hazardous wildlife management efforts on those species most likely to cause problems at an airport.

□ost public-use airports have large tracts of open, undeveloped land that provide added margins of safety and noise mitigation. These areas can also present potential hazards to aviation if they encourage wildlife to enter an airport□s approach or departure airspace or air operations area (AOA). Constructed or natural areas□ such as poorly drained locations, detention/retention ponds, roosting habitats on buildings, landscaping, odor-causing rotting organic matter (putrescible waste) disposal operations, wastewater treatment plants, agricultural or aquaculture activities, surface mining, or wetlands□ can provide wildlife with ideal locations for feeding, loafing, reproduction, and escape. □ven small facilities, such as fast food restaurants, taxicab staging areas, rental car facilities, aircraft viewing areas, and public parks, can produce substantial attractions for hazardous wildlife.

During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives worldwide, as well as billions of dollars in aircraft damage. □azardous wildlife attractants on and near airports can jeopardize future airport expansion, making proper community land-use planning essential. This AC provides airport operators and those parties with whom they cooperate with the guidance they need to assess and address potentially hazardous wildlife attractants when locating new facilities and implementing certain land-use practices on or near public-use airports.

6. MEMORANDUM OF AGREEMENT BETWEEN FEDERAL RESOURCE AGENCIES. The FAA, the U.S. Air Force, the U.S. Army Corps of □ngineers, the U.S. □nvironmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture - Wildlife Services signed a □emorandum of Agreement (□OA) in July 2003 to acknowledge their respective missions in protecting aviation from wildlife hazards. Through the □OA, the agencies established procedures necessary to coordinate their missions to address more effectively existing and future environmental conditions contributing to collisions between wildlife and aircraft (wildlife strikes) throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety while protecting the □ation□s valuable environmental resources.



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Director, Office of Airport Safety
and Standards

Table 1. Ranking of 25 species groups as to relative hazard to aircraft (1 most hazardous) based on three criteria (damage, major damage, and effect-on-flight), a composite ranking based on all three rankings, and a relative hazard score. Data were derived from the FAA ational Wildlife Strike Database, January 1990 April 2003.[1]

Species group	Ranking by criteria			Composite ranking[2]	Relative hazard score[3]
	Damage[4]	ajor damage[5]	ffect on flight		
Deer	1	1	1	1	100
ultures	2	2	2	2	4
eese	3	3		3	55
Cormorants/pelicans	4	5	3	4	54
Cranes	7		4	5	47
agles		9	7		41
Ducks	5	8	10	7	39
Osprey	8	4	8	8	39
Turkey/pheasants	9	7	11	9	33
erons	11	14	9	10	27
awks (buteos)	10	12	12	11	25
ulls	12	11	13	12	24
Rock pigeon	13	10	14	13	23
Owls	14	13	20	14	23
. lark/s. bunting	18	15	15	15	17
Crows/ravens	15	1	1	1	1
Coyote	1	19	5	17	14
ourning dove	17	17	17	18	14
Shorebirds	19	21	18	19	10
Blackbirds/starling	20	22	19	20	10
American kestrel	21	18	21	21	9
eadowlarks	22	20	22	22	7
Swallows	24	23	24	23	4
Sparrows	25	24	23	24	4
ighthawks	23	25	25	25	1

[1] xcerpted from the *Special Report for the FAA, "Ranking the Hazard Level of Wildlife Species to Civil Aviation in the USA: Update #1, July 2, 2003".* Refer to this report for additional explanations of criteria and method of ranking.

[2] Relative rank of each species group was compared with every other group for the three variables, placing the species group with the greatest hazard rank for 2 of the 3 variables above the next highest ranked group, then proceeding down the list.

[3] Percentage values, from Tables 3 and 4 in Footnote 1 of the *Special Report*, for the three criteria were summed and scaled down from 100, with 100 as the score for the species group with the maximum summed values and the greatest potential hazard to aircraft.

[4] Aircraft incurred at least some damage (destroyed, substantial, minor, or unknown) from strike.

[5] Aircraft incurred damage or structural failure, which adversely affected the structure strength, performance, or flight characteristics, and which would normally require major repair or replacement of the affected component, or the damage sustained makes it inadvisable to restore aircraft to airworthy condition.

Aborted takeoff, engine shutdown, precautionary landing, or other.

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SECTION 1.

GENERAL SEPARATION CRITERIA FOR HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

1-1. INTRODUCTION. When considering proposed land uses, airport operators, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. □and-use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife strikes.

The FAA recommends the minimum separation criteria outlined below for land-use practices that attract hazardous wildlife to the vicinity of airports. Please note that FAA criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport□s approach or departure airspace or air operations area (AOA). (See the discussion of the synergistic effects of surrounding land uses in Section 2-8 of this AC.)

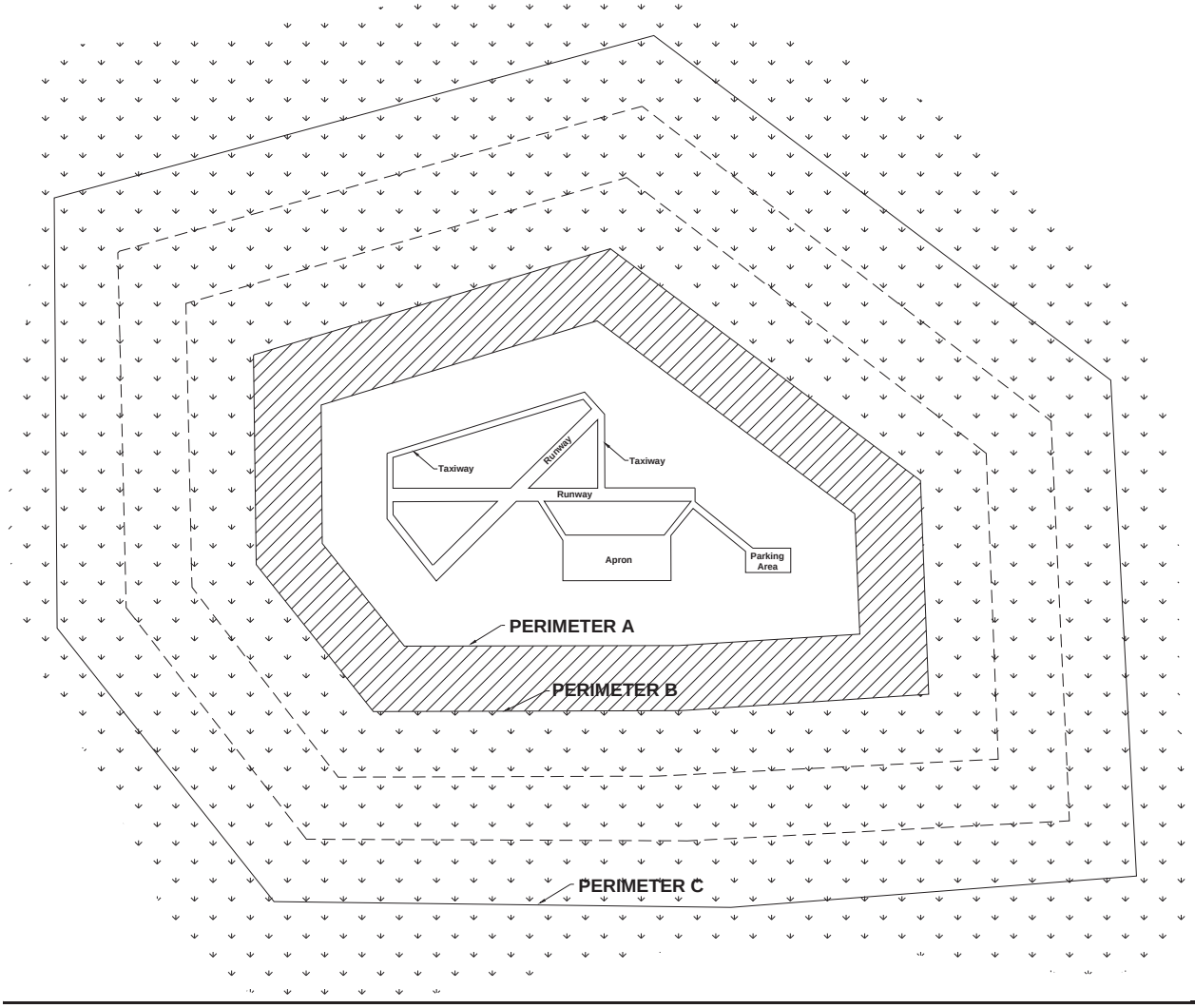
The basis for the separation criteria contained in this section can be found in existing FAA regulations. The separation distances are based on (1) flight patterns of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 feet and 90 percent occur under 3,000 feet above ground level), and (3) □ational Transportation Safety Board (□TSB) recommendations.

1-2. AIRPORTS SERVING PISTON-POWERED AIRCRAFT. Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. □otwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 5,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport□s AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance measured from the nearest aircraft operations areas.

1-3. AIRPORTS SERVING TURBINE-POWERED AIRCRAFT. Airports selling Jet-A fuel normally serve turbine-powered aircraft. □otwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 10,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport□s AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance from the nearest aircraft movement areas.

1-4. PROTECTION OF APPROACH, DEPARTURE, AND CIRCLING AIRSPACE. For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport□s AOA and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

Figure 1. Separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated.



P□RI□ □T□R A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.

P□RI□ □T□R B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.

P□RI□ □T□R C: 5-mile range to protect approach, departure and circling airspace.

SECTION 2.

LAND-USE PRACTICES ON OR NEAR AIRPORTS THAT POTENTIALLY ATTRACT HAZARDOUS WILDLIFE.

2-1. GENERAL. The wildlife species and the size of the populations attracted to the airport environment vary considerably, depending on several factors, including land-use practices on or near the airport. This section discusses land-use practices having the potential to attract hazardous wildlife and threaten aviation safety. In addition to the specific considerations outlined below, airport operators should refer to *Wildlife Hazard Management at Airports,* prepared by FAA and U.S. Department of Agriculture (USDA) staff. (This manual is available in English, Spanish, and French. It can be viewed and downloaded free of charge from the FAA's wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov.). And, *Prevention and Control of Wildlife Damage,* compiled by the University of Nebraska Cooperative Extension Division. (This manual is available online in a periodically updated version at: ianrwww.unl.edu/wildlife/solutions/handbook/.)

2-2. WASTE DISPOSAL OPERATIONS. Municipal solid waste landfills (MSWLF) are known to attract large numbers of hazardous wildlife, particularly birds. Because of this, these operations, when located within the separations identified in the siting criteria in Sections 1-2 through 1-4, are considered incompatible with safe airport operations.

a. Siting for new municipal solid waste landfills subject to AIR 21. Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (Public Law 106-181) (AIR 21) prohibits the construction or establishment of a new MSWLF within 6 statute miles of certain public-use airports. Before these prohibitions apply, both the airport and the landfill must meet the very specific conditions described below. These restrictions do not apply to airports or landfills located within the state of Alaska.

The airport must (1) have received a Federal grant(s) under 49 U.S.C. 47101, et. seq. (2) be under control of a public agency (3) serve some scheduled air carrier operations conducted in aircraft with less than 60 seats and (4) have total annual enplanements consisting of at least 51 percent of scheduled air carrier enplanements conducted in aircraft with less than 60 passenger seats.

The proposed MSWLF must (1) be within 6 miles of the airport, as measured from airport property line to MSWLF property line, and (2) have started construction or establishment on or after April 5, 2001. Public Law 106-181 only limits the construction or establishment of some new MSWLF. It does not limit the expansion, either vertical or horizontal, of existing landfills.

NOTE: Consult the most recent version of AC 150/5200-34, *Construction or Establishment of Landfills Near Public Airports,* for a more detailed discussion of these restrictions.

b. Siting for new MSWLF not subject to AIR 21. If an airport and □SW□F do not meet the restrictions of Public □aw 10□-181, the FAA recommends against locating □SW□F within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport□s AOA to the closest planned □SW□F cell.

c. Considerations for existing waste disposal facilities within the limits of separation criteria. The FAA recommends against airport development projects that would increase the number of aircraft operations or accommodate larger or faster aircraft near □SW□F operations located within the separations identified in Sections 1-2 through 1-4. In addition, in accordance with 40 CFR 258.10, owners or operators of existing □SW□F units that are located within the separations listed in Sections 1-2 through 1-4 must demonstrate that the unit is designed and operated so it does not pose a bird hazard to aircraft. (See Section 4-2(b) of this AC for a discussion of this demonstration requirement.)

d. Enclosed trash transfer stations. □nclosed waste-handling facilities that receive garbage behind closed doors□process it via compaction, incineration, or similar manner□and remove all residue by enclosed vehicles generally are compatible with safe airport operations, provided they are not located on airport property or within the Runway Protection □one (RP□). These facilities should not handle or store putrescible waste outside or in a partially enclosed structure accessible to hazardous wildlife. Trash transfer facilities that are open on one or more sides□that store uncovered quantities of municipal solid waste outside, even if only for a short time□ that use semi-trailers that leak or have trash clinging to the outside□or that do not control odors by ventilation and filtration systems (odor masking is not acceptable) do not meet the FAA□s definition of fully enclosed trash transfer stations. The FAA considers these facilities incompatible with safe airport operations if they are located closer than the separation distances specified in Sections 1-2 through 1-4.

e. Composting operations on or near airport property. Composting operations that accept only yard waste (e.g., leaves, lawn clippings, or branches) generally do not attract hazardous wildlife. Sewage sludge, woodchips, and similar material are not municipal solid wastes and may be used as compost bulking agents. The compost, however, must never include food or other municipal solid waste. Composting operations should not be located on airport property. Off-airport property composting operations should be located no closer than the greater of the following distances: 1,200 feet from any AOA or the distance called for by airport design requirements (see AC 150/5300-13, *Airport Design*). This spacing should prevent material, personnel, or equipment from penetrating any Object Free Area (OFA), Obstacle Free □one (OF□), Threshold Siting Surface (TSS), or Clearway. Airport operators should monitor composting operations located in proximity to the airport to ensure that steam or thermal rise does not adversely affect air traffic. On-airport disposal of compost by-products should not be conducted for the reasons stated in 2-3f.

f. Underwater waste discharges. The FAA recommends against the underwater discharge of any food waste (e.g., fish processing offal) within the separations identified in Sections 1-2 through 1-4 because it could attract scavenging hazardous wildlife.

g. Recycling centers. Recycling centers that accept previously sorted non-food items, such as glass, newspaper, cardboard, or aluminum, are, in most cases, not attractive to hazardous wildlife and are acceptable.

h. Construction and demolition (C&D) debris facilities. C□D landfills do not generally attract hazardous wildlife and are acceptable if maintained in an orderly manner, admit no putrescible waste, and are not co-located with other waste disposal operations. □owever, C□D landfills have similar visual and operational characteristics to putrescible waste disposal sites. When co-located with putrescible waste disposal operations, C□D landfills are more likely to attract hazardous wildlife because of the similarities between these disposal facilities. Therefore, a C□D landfill co-located with another waste disposal operation should be located outside of the separations identified in Sections 1-2 through 1-4.

i. Fly ash disposal. The incinerated residue from resource recovery power/heat-generating facilities that are fired by municipal solid waste, coal, or wood is generally not a wildlife attractant because it no longer contains putrescible matter. □andfills accepting only fly ash are generally not considered to be wildlife attractants and are acceptable as long as they are maintained in an orderly manner, admit no putrescible waste of any kind, and are not co-located with other disposal operations that attract hazardous wildlife.

Since varying degrees of waste consumption are associated with general incineration (not resource recovery power/heat-generating facilities), the FAA considers the ash from general incinerators a regular waste disposal by-product and, therefore, a hazardous wildlife attractant if disposed of within the separation criteria outlined in Sections 1-2 through 1-4.

2-3. WATER MANAGEMENT FACILITIES. Drinking water intake and treatment facilities, storm water and wastewater treatment facilities, associated retention and settling ponds, ponds built for recreational use, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. To prevent wildlife hazards, land-use developers and airport operators may need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near all public-use airports to ensure a safe airport environment.

a. Existing storm water management facilities. On-airport storm water management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces, such as pavement and terminal/hangar building roofs. □xisting on-airport detention ponds collect storm water, protect water quality, and control runoff. Because they slowly release water

after storms, they create standing bodies of water that can attract hazardous wildlife. Where the airport has developed a Wildlife □azard □anagement Plan (W□□P) in accordance with Part 139, the FAA requires immediate correction of any wildlife hazards arising from existing storm water facilities located on or near airports, using appropriate wildlife hazard mitigation techniques. Airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

Where possible, airport operators should modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. The FAA recommends that airport operators avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Detention basins should remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, the detention facility should include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that may provide nesting habitat.

When it is not possible to drain a large detention pond completely, airport operators may use physical barriers, such as bird balls, wires grids, pillows, or netting, to deter birds and other hazardous wildlife. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office.

The FAA recommends that airport operators encourage off-airport storm water treatment facility operators to incorporate appropriate wildlife hazard mitigation techniques into storm water treatment facility operating practices when their facility is located within the separation criteria specified in Sections 1-2 through 1-4.

b. New storm water management facilities. The FAA strongly recommends that off-airport storm water management systems located within the separations identified in Sections 1-2 through 1-4 be designed and operated so as not to create above-ground standing water. Stormwater detention ponds should be designed, engineered, constructed, and maintained for a maximum 48□hour detention period after the design storm and remain completely dry between storms. To facilitate the control of hazardous wildlife, the FAA recommends the use of steep-sided, rip-rap lined, narrow, linearly shaped water detention basins. When it is not possible to place these ponds away from an airport□s AOA, airport operators should use physical barriers, such as bird balls, wires grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office. All vegetation in or around detention basins that provide food or cover for hazardous wildlife should be eliminated. If soil conditions and other requirements allow, the FAA encourages

the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

c. Existing wastewater treatment facilities. The FAA strongly recommends that airport operators immediately correct any wildlife hazards arising from existing wastewater treatment facilities located on or near the airport. Where required, a W□□P developed in accordance with Part 139 will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should encourage wastewater treatment facility operators to incorporate measures, developed in consultation with a wildlife damage management biologist, to minimize hazardous wildlife attractants. Airport operators should also encourage those wastewater treatment facility operators to incorporate these mitigation techniques into their standard operating practices. In addition, airport operators should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

d. New wastewater treatment facilities. The FAA strongly recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in Sections 1-2 through 1-4. Appendix 1 defines wastewater treatment facility as □any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes.□ The definition includes any pretreatment involving the reduction of the amount of pollutants or the elimination of pollutants prior to introducing such pollutants into a publicly owned treatment works (wastewater treatment facility). During the site-location analysis for wastewater treatment facilities, developers should consider the potential to attract hazardous wildlife if an airport is in the vicinity of the proposed site, and airport operators should voice their opposition to such facilities if they are in proximity to the airport.

e. Artificial marshes. In warmer climates, wastewater treatment facilities sometimes employ artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. The FAA strongly recommends against establishing artificial marshes within the separations identified in Sections 1-2 through 1-4.

f. Wastewater discharge and sludge disposal. The FAA recommends against the discharge of wastewater or sludge on airport property because it may improve soil moisture and quality on unpaved areas and lead to improved turf growth that can be an attractive food source for many species of animals. Also, the turf requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw, both of which can attract hazardous wildlife. In addition, the improved turf may attract grazing wildlife, such as deer and geese. Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

2-4. WETLANDS. Wetlands provide a variety of functions and can be regulated by local, state, and Federal laws. □ormally, wetlands are attractive to many types of wildlife, including many which rank high on the list of hazardous wildlife species (Table 1).

NOTE: If questions exist as to whether an area qualifies as a wetland, contact the local division of the U.S. Army Corps of □ngineers, the □atural Resources Conservation Service, or a wetland consultant qualified to delineate wetlands.

a. Existing wetlands on or near airport property. If wetlands are located on or near airport property, airport operators should be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations. At public-use airports, the FAA recommends immediately correcting, in cooperation with local, state, and Federal regulatory agencies, any wildlife hazards arising from existing wetlands located on or near airports. Where required, a W□□P will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

b. New airport development. Whenever possible, the FAA recommends locating new airports using the separations from wetlands identified in Sections 1-2 through 1-4. Where alternative sites are not practicable, or when airport operators are expanding an existing airport into or near wetlands, a wildlife damage management biologist, in consultation with the U.S. Fish and Wildlife Service, the U.S. Army Corps of □ngineers, and the state wildlife management agency should evaluate the wildlife hazards and prepare a W□□P that indicates methods of minimizing the hazards.

c. Mitigation for wetland impacts from airport projects. Wetland mitigation may be necessary when unavoidable wetland disturbances result from new airport development projects or projects required to correct wildlife hazards from wetlands. Wetland mitigation must be designed so it does not create a wildlife hazard. The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4.

(1) Onsite mitigation of wetland functions. The FAA may consider exceptions to locating mitigation activities outside the separations identified in Sections 1-2 through 1-4 if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or ground water recharge, which cannot be replicated when moved to a different location. Using existing airport property is sometimes the only feasible way to achieve the mitigation ratios mandated in regulatory orders and/or settlement agreements with the resource agencies. Conservation easements are an additional means of providing mitigation for project impacts. Typically the airport operator continues to own the property, and an easement is created stipulating that the property will be maintained as habitat for state or Federally listed species.

□itigation must not inhibit the airport operator□s ability to effectively control hazardous wildlife on or near the mitigation site or effectively maintain other aspects of safe airport operations. □nhancing such mitigation areas to attract hazardous wildlife must be avoided. The FAA will review any onsite mitigation proposals to determine compatibility with safe airport operations. A wildlife damage management biologist should evaluate any wetland mitigation projects that are needed to protect unique wetland functions and that must be located in the separation criteria in Sections 1-2 through 1-4 before the mitigation is implemented. A W□□P should be developed to reduce the wildlife hazards.

(2) Offsite mitigation of wetland functions. The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4 unless they provide unique functions that must remain onsite (see 2-4c(1)). Agencies that regulate impacts to or around wetlands recognize that it may be necessary to split wetland functions in mitigation schemes. Therefore, regulatory agencies may, under certain circumstances, allow portions of mitigation to take place in different locations.

(3) Mitigation banking. Wetland mitigation banking is the creation or restoration of wetlands in order to provide mitigation credits that can be used to offset permitted wetland losses. □itigation banking benefits wetland resources by providing advance replacement for permitted wetland losses□consolidating small projects into larger, better-designed and managed units□ and encouraging integration of wetland mitigation projects with watershed planning. This last benefit is most helpful for airport projects, as wetland impacts mitigated outside of the separations identified in Sections 1-2 through 1-4 can still be located within the same watershed. Wetland mitigation banks meeting the separation criteria offer an ecologically sound approach to mitigation in these situations. Airport operators should work with local watershed management agencies or organizations to develop mitigation banking for wetland impacts on airport property.

2-5. DREDGE SPOIL CONTAINMENT AREAS. The FAA recommends against locating dredge spoil containment areas (also known as Confined Disposal Facilities) within the separations identified in Sections 1-2 through 1-4 if the containment area or the spoils contain material that would attract hazardous wildlife.

2-6. AGRICULTURAL ACTIVITIES. Because most, if not all, agricultural crops can attract hazardous wildlife during some phase of production, the FAA recommends against the used of airport property for agricultural production, including hay crops, within the separations identified in Sections 1-2 through 1-4. . If the airport has no financial alternative to agricultural crops to produce income necessary to maintain the viability of the airport, then the airport shall follow the crop distance guidelines listed in the table titled □□inimum Distances between Certain Airport Features and Any On-Airport Agricultural Crops□found in AC 150/5300-13, *Airport Design*, Appendix 17. The cost of wildlife control and potential accidents should be weighed against the income produced by the on-airport crops when deciding whether to allow crops on the airport.

a. Livestock production. Confined livestock operations (i.e., feedlots, dairy operations, hog or chicken production facilities, or egg laying operations) often attract flocking birds, such as starlings, that pose a hazard to aviation. Therefore, The FAA recommends against such facilities within the separations identified in Sections 1-2 through 1-4. Any livestock operation within these separations should have a program developed to reduce the attractiveness of the site to species that are hazardous to aviation safety. Free-ranging livestock must not be grazed on airport property because the animals may wander onto the AOA. Furthermore, livestock feed, water, and manure may attract birds.

b. Aquaculture. Aquaculture activities (i.e. catfish or trout production) conducted outside of fully enclosed buildings are inherently attractive to a wide variety of birds. □xisting aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4 must have a program developed to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should also oppose the establishment of new aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4.

c. Alternative uses of agricultural land. Some airports are surrounded by vast areas of farmed land within the distances specified in Sections 1-2 through 1-4. Seasonal uses of agricultural land for activities such as hunting can create a hazardous wildlife situation. In some areas, farmers will rent their land for hunting purposes. Rice farmers, for example, flood their land during waterfowl hunting season and obtain additional revenue by renting out duck blinds. The duck hunters then use decoys and call in hundreds, if not thousands, of birds, creating a tremendous threat to aircraft safety. A wildlife damage management biologist should review, in coordination with local farmers and producers, these types of seasonal land uses and incorporate them into the W□□P.

2-7. GOLF COURSES, LANDSCAPING AND OTHER LAND-USE CONSIDERATIONS.

a. Golf courses. The large grassy areas and open water found on most golf courses are attractive to hazardous wildlife, particularly Canada geese and some species of gulls. These species can pose a threat to aviation safety. The FAA recommends against construction of new golf courses within the separations identified in Sections 1-2 through 1-4. □xisting golf courses located within these separations must develop a program to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should ensure these golf courses are monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be immediately implemented.

b. Landscaping and landscape maintenance. Depending on its geographic location, landscaping can attract hazardous wildlife. The FAA recommends that airport operators approach landscaping with caution and confine it to airport areas not associated with aircraft movements. A wildlife damage management biologist should review all landscaping plans. Airport operators should also monitor all landscaped areas on a continuing basis for the presence of hazardous wildlife. If

hazardous wildlife is detected, corrective actions should be immediately implemented.

Turf grass areas can be highly attractive to a variety of hazardous wildlife species. Research conducted by the USDA Wildlife Services□ □ational Wildlife Research Center has shown that no one grass management regime will deter all species of hazardous wildlife in all situations. In cooperation with wildlife damage management biologist, airport operators should develop airport turf grass management plans on a prescription basis, depending on the airport□s geographic locations and the type of hazardous wildlife likely to frequent the airport

Airport operators should ensure that plant varieties attractive to hazardous wildlife are not used on the airport. Disturbed areas or areas in need of re-vegetating should not be planted with seed mixtures containing millet or any other large-seed producing grass. For airport property already planted with seed mixtures containing millet, rye grass, or other large-seed producing grasses, the FAA recommends disking, plowing, or another suitable agricultural practice to prevent plant maturation and seed head production. Plantings should follow the specific recommendations for grass management and seed and plant selection made by the State University Cooperative □xtension Service, the local office of Wildlife Services, or a qualified wildlife damage management biologist. Airport operators should also consider developing and implementing a preferred/prohibited plant species list, reviewed by a wildlife damage management biologist, which has been designed for the geographic location to reduce the attractiveness to hazardous wildlife for landscaping airport property.

c. Airports surrounded by wildlife habitat. The FAA recommends that operators of airports surrounded by woodlands, water, or wetlands refer to Section 2.4 of this AC. Operators of such airports should provide for a Wildlife □azard Assessment (W□A) conducted by a wildlife damage management biologist. This W□A is the first step in preparing a W□□P, where required.

d. Other hazardous wildlife attractants. Other specific land uses or activities (e.g., sport or commercial fishing, shellfish harvesting, etc.), perhaps unique to certain regions of the country, have the potential to attract hazardous wildlife. Regardless of the source of the attraction, when hazardous wildlife is noted on a public-use airport, airport operators must take prompt remedial action(s) to protect aviation safety.

2-8. SYNERGISTIC EFFECTS OF SURROUNDING LAND USES. There may be circumstances where two (or more) different land uses that would not, by themselves, be considered hazardous wildlife attractants or that are located outside of the separations identified in Sections 1-2 through 1-4 that are in such an alignment with the airport as to create a wildlife corridor directly through the airport and/or surrounding airspace. An example of this situation may involve a lake located outside of the separation criteria on the east side of an airport and a large hayfield on the west side of an airport, land uses that together could create a flyway for Canada geese directly across the airspace of the airport. There are numerous examples of such situations□

therefore, airport operators and the wildlife damage management biologist must consider the entire surrounding landscape and community when developing the W□□P.

SECTION 3.

PROCEDURES FOR WILDLIFE HAZARD MANAGEMENT BY OPERATORS OF PUBLIC-USE AIRPORTS.

3.1. INTRODUCTION. In recognition of the increased risk of serious aircraft damage or the loss of human life that can result from a wildlife strike, the FAA may require the development of a Wildlife □azard □anagement Plan (W□□P) when specific triggering events occur on or near the airport. Part 139.337 discusses the specific events that trigger a Wildlife □azard Assessment (W□A) and the specific issues that a W□□P must address for FAA approval and inclusion in an Airport Certification □anual.

3.2. COORDINATION WITH USDA WILDLIFE SERVICES OR OTHER QUALIFIED WILDLIFE DAMAGE MANAGEMENT BIOLOGISTS. The FAA will use the Wildlife □azard Assessment (W□A) conducted in accordance with Part 139 to determine if the airport needs a W□□P. Therefore, persons having the education, training, and expertise necessary to assess wildlife hazards must conduct the W□A. The airport operator may look to Wildlife Services or to qualified private consultants to conduct the W□A. When the services of a wildlife damage management biologist are required, the FAA recommends that land-use developers or airport operators contact a consultant specializing in wildlife damage management or the appropriate state director of Wildlife Services.

NOTE: Telephone numbers for the respective USDA Wildlife Services state offices can be obtained by contacting USDA Wildlife Services Operational Support Staff, 4700 River Road, Unit 87, Riverdale, □D, 20737-1234, Telephone (301) 734-7921, Fax (301) 734-5157 *(http://www.aphis.usda.gov/ws/)*.

3-3. WILDLIFE HAZARD MANAGEMENT AT AIRPORTS: A MANUAL FOR AIRPORT PERSONNEL. This manual, prepared by FAA and USDA Wildlife Services staff, contains a compilation of information to assist airport personnel in the development, implementation, and evaluation of W□□Ps at airports. The manual includes specific information on the nature of wildlife strikes, legal authority, regulations, wildlife management techniques, W□As, W□□Ps, and sources of help and information. The manual is available in three languages: □nglish, Spanish, and French. It can be viewed and downloaded free of charge from the FAA□s wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov/. This manual only provides a starting point for addressing wildlife hazard issues at airports. □azardous wildlife management is a complex discipline and conditions vary widely across the United States. Therefore, qualified wildlife damage management biologists must direct the development of a W□□P and the implementation of management actions by airport personnel.

There are many other resources complementary to this manual for use in developing and implementing W□□Ps. Several are listed in the manual□s bibliography.

3-4. WILDLIFE HAZARD ASSESSMENTS, TITLE 14, CODE OF FEDERAL REGULATIONS, PART 139. Part 139.337(b) requires airport operators to conduct a Wildlife □azard Assessment (W□A) when certain events occur on or near the airport.

Part 139.337 (c) provides specific guidance as to what facts must be addressed in a W□A.

3-5. WILDLIFE HAZARD MANAGEMENT PLAN (WHMP). The FAA will consider the results of the W□A, along with the aeronautical activity at the airport and the views of the airport operator and airport users, in determining whether a formal W□□P is needed, in accordance with Part 139.337. If the FAA determines that a W□□P is needed, the airport operator must formulate and implement a W□□P, using the W□A as the basis for the plan.

The goal of an airport□s Wildlife □azard □anagement Plan is to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife on and around the airport.

The W□□P must identify hazardous wildlife attractants on or near the airport and the appropriate wildlife damage management techniques to minimize the wildlife hazard. It must also prioritize the management measures.

3-6. LOCAL COORDINATION. The establishment of a Wildlife □azards Working □roup (W□W□) will facilitate the communication, cooperation, and coordination of the airport and its surrounding community necessary to ensure the effectiveness of the W□□P. The cooperation of the airport community is also necessary when new projects are considered. Whether on or off the airport, the input from all involved parties must be considered when a potentially hazardous wildlife attractant is being proposed. Airport operators should also incorporate public education activities with the local coordination efforts because some activities in the vicinity of your airport, while harmless under normal leisure conditions, can attract wildlife and present a danger to aircraft. For example, if public trails are planned near wetlands or in parks adjoining airport property, the public should know that feeding birds and other wildlife in the area may pose a risk to aircraft.

Airport operators should work with local and regional planning and zoning boards so as to be aware of proposed land-use changes, or modification of existing land uses, that could create hazardous wildlife attractants within the separations identified in Sections 1-2 through 1-4. Pay particular attention to proposed land uses involving creation or expansion of waste water treatment facilities, development of wetland mitigation sites, or development or expansion of dredge spoil containment areas. At the very least, airport operators must ensure they are on the notification list of the local planning board or equivalent review entity for all communities located within 5 miles of the airport, so they will receive notification of any proposed project and have the opportunity to review it for attractiveness to hazardous wildlife.

3-7 COORDINATION/NOTIFICATION OF AIRMEN OF WILDLIFE HAZARDS. If an existing land-use practice creates a wildlife hazard and the land-use practice or wildlife hazard cannot be immediately eliminated, airport operators must issue a □otice to Airmen (□OTA□) and encourage the land□owner or manager to take steps to control the wildlife hazard and minimize further attraction.

SECTION 4.

FAA NOTIFICATION AND REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS

4-1. FAA REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS.

a. The FAA discourages the development of waste disposal and other facilities, discussed in Section 2, located within the 5,000/10,000-foot criteria specified in Sections 1-2 through 1-4.

b. For projects that are located outside the 5,000/10,000-foot criteria but within 5 statute miles of the airport's AOA, the FAA may review development plans, proposed land-use changes, operational changes, or wetland mitigation plans to determine if such changes present potential wildlife hazards to aircraft operations. The FAA considers sensitive airport areas as those that lie under or next to approach or departure airspace. This brief examination should indicate if further investigation is warranted.

c. Where a wildlife damage management biologist has conducted a further study to evaluate a site's compatibility with airport operations, the FAA may use the study results to make a determination.

4-2. WASTE MANAGEMENT FACILITIES.

a. Notification of new/expanded project proposal. Section 503 of the Wendell . Ford Aviation Investment and Reform Act for the 21st Century (Public aw 10-181) limits the construction or establishment of new SWF within statute miles of certain public-use airports, when both the airport and the landfill meet very specific conditions. See Section 2-2 of this AC and AC 150/5200-34 for a more detailed discussion of these restrictions.

The nvironmental Protection Agency (PA) requires any SWF operator proposing a new or expanded waste disposal operation within 5 statute miles of a runway end to notify the appropriate FAA Regional Airports Division Office and the airport operator of the proposal (40 CFR 258, *Criteria for Municipal Solid Waste Landfills*, Section 258.10, *Airport Safety*). The PA also requires owners or operators of new SWF units, or lateral expansions of existing SWF units, that are located within 10,000 feet of any airport runway end used by turbojet aircraft, or within 5,000 feet of any airport runway end used only by piston-type aircraft, to demonstrate successfully that such units are not hazards to aircraft. (See 4-2.b below.)

When new or expanded SWF are being proposed near airports, SWF operators must notify the airport operator and the FAA of the proposal as early as possible pursuant to 40 CFR 258.

b. Waste handling facilities within separations identified in Sections 1-2 through 1-4. To claim successfully that a waste-handling facility sited within the separations identified in Sections 1-2 through 1-4 does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material other than that as outlined in 2-2.d. The FAA strongly recommends against any facility other than that as outlined in 2-2.d (enclosed transfer stations). The FAA will use this information to determine if the facility will be a hazard to aviation.

c. Putrescible-Waste Facilities. In their effort to satisfy the □PA requirement, some putrescible-waste facility proponents may offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, no such facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible-waste landfill began operating. For this reason, demonstrations of experimental wildlife control measures may not be conducted within the separation identified in Sections 1-2 through 1-4.

4-3. OTHER LAND-USE PRACTICE CHANGES. As a matter of policy, the FAA encourages operators of public-use airports who become aware of proposed land use practice changes that may attract hazardous wildlife within 5 statute miles of their airports to promptly notify the FAA. The FAA also encourages proponents of such land use changes to notify the FAA as early in the planning process as possible. Advanced notice affords the FAA an opportunity (1) to evaluate the effect of a particular land-use change on aviation safety and (2) to support efforts by the airport sponsor to restrict the use of land next to or near the airport to uses that are compatible with the airport.

The airport operator, project proponent, or land-use operator may use FAA Form 74□0-1, *Notice of Proposed Construction or Alteration*, or other suitable documents similar to FAA Form 74□0-1 to notify the appropriate FAA Regional Airports Division Office. Project proponents can contact the appropriate FAA Regional Airports Division Office for assistance with the notification process.

It is helpful if the notification includes a 15-minute quadrangle map of the area identifying the location of the proposed activity. The land-use operator or project proponent should also forward specific details of the proposed land-use change or operational change or expansion. In the case of solid waste landfills, the information should include the type of waste to be handled, how the waste will be processed, and final disposal methods.

a. Airports that have received Federal grant-in-aid assistance. Airports that have received Federal grant-in-aid assistance are required by their grant assurances to take appropriate actions to restrict the use of land next to or near the airport to uses that are compatible with normal airport operations. The FAA recommends that airport operators to the extent practicable oppose off-airport land-use changes or practices within the separations identified in Sections 1-2 through 1-4 that may attract hazardous wildlife. Failure to do so may lead to noncompliance with applicable grant assurances. The FAA will not approve the placement of airport

development projects pertaining to aircraft movement in the vicinity of hazardous wildlife attractants without appropriate mitigating measures. Increasing the intensity of wildlife control efforts is not a substitute for eliminating or reducing a proposed wildlife hazard. Airport operators should identify hazardous wildlife attractants and any associated wildlife hazards during any planning process for new airport development projects.

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APPENDIX 1. DEFINITIONS OF TERMS USED IN THIS ADVISORY CIRCULAR.

1. **GENERAL.** This appendix provides definitions of terms used throughout this AC.

    1. **Air operations area.** Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An air operations area includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron.

    2. **Airport operator.** The operator (private or public) or sponsor of a public-use airport.

    3. **Approach or departure airspace.** The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

    4. **Bird balls.** □igh-density plastic floating balls that can be used to cover ponds and prevent birds from using the sites.

    5. **Certificate holder.** The holder of an Airport Operating Certificate issued under Title 14, Code of Federal Regulations, Part 139.

    6. **Construct a new MSWLF.** To begin to excavate, grade land, or raise structures to prepare a municipal solid waste landfill as permitted by the appropriate regulatory or permitting agency.

    7. **Detention ponds.** Storm water management ponds that hold storm water for short periods of time, a few hours to a few days.

    8. **Establish a new MSWLF.** When the first load of putrescible waste is received on-site for placement in a prepared municipal solid waste landfill.

    9. **Fly ash.** The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or waste used to operate a power generating plant.

    10. **General aviation aircraft.** Any civil aviation aircraft not operating under 14 CFR Part 119, Certification: Air Carriers and Commercial Operators.

    11. **Hazardous wildlife.** Species of wildlife (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard

    12. **Municipal Solid Waste Landfill (MSWLF).** A publicly or privately owned discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR □ 257.2. An □SW□F may receive

other types wastes, such as commercial solid waste, non-hazardous sludge, small-quantity generator waste, and industrial solid waste, as defined under 40 CFR □ 258.2. An □SW□F can consist of either a stand alone unit or several cells that receive household waste.

13. **New MSWLF.** A municipal solid waste landfill that was established or constructed after April 5, 2001.

14. **Piston-powered aircraft.** Fixed-wing aircraft powered by piston engines.

15. **Piston-use airport.** Any airport that does not sell Jet-A fuel for fixed-wing turbine-powered aircraft, and primarily serves fixed-wing, piston-powered aircraft. Incidental use of the airport by turbine-powered, fixed-wing aircraft would not affect this designation. □owever, such aircraft should not be based at the airport.

16. **Public agency.** A State or political subdivision of a State, a tax-supported organization, or an Indian tribe or pueblo (49 U.S.C. □ 47102(19)).

17. **Public airport.** An airport used or intended to be used for public purposes that is under the control of a public agency□and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft is publicly owned (49 U.S.C. □ 47102(20)).

18. **Public-use airport.** An airport used or intended to be used for public purposes, and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft may be under the control of a public agency or privately owned and used for public purposes (49 U.S.C. □ 47102(21)).

19. **Putrescible waste.** Solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds (40 CFR □257.3-8).

20. **Putrescible-waste disposal operation.** □andfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

21. **Retention ponds.** Storm water management ponds that hold water for several months.

22. **Runway protection zone (RPZ).** An area off the runway end to enhance the protection of people and property on the ground (see AC 150/5300-13). The dimensions of this zone vary with the airport design, aircraft, type of operation, and visibility minimum.

23. **Scheduled air carrier operation.** Any common carriage passenger-carrying operation for compensation or hire conducted by an air carrier or commercial

operator for which the air carrier, commercial operator, or their representative offers in advance the departure location, departure time, and arrival location. It does not include any operation that is conducted as a supplemental operation under 14 CFR Part 119 or as a public charter operation under 14 CFR Part 380 (14 CFR □ 119.3).

24. **Sewage sludge.** Any solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage□scum or solids removed in primary, secondary, or advanced wastewater treatment process□and a material derived from sewage sludge. Sewage does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works. (40 CFR 257.2)

25. **Sludge.** Any solid, semi-solid, or liquid waste generated form a municipal, commercial or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effect. (40 CFR 257.2)

26. **Solid waste.** Any garbage, refuse, sludge, from a waste treatment plant, water supply treatment plant or air pollution control facility and other discarded material, including, solid liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (8□ Stat. 880), or source, special nuclear, or by product material as defined by the Atomic □nergy Act of 1954, as amended, (□8 Stat. 923). (40 CFR 257.2)

27. **Turbine-powered aircraft.** Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft rotary-wing aircraft.

28. **Turbine-use airport.** Any airport that sells Jet-A fuel for fixed-wing turbine-powered aircraft.

29. **Wastewater treatment facility.** Any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (P.□. 92-500) as amended by the Clean Water Act of 1977 (P.□. 95-57□) and the Water □uality Act of 1987 (P.□. 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. (See 40 CFR Section 403.3 (q), (r), □ (s)).

30. Wildlife. Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring thereof (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this AC, wildlife includes feral animals and domestic animals out of the control of their owners (14 CFR Part 139, Certification of Airports).

31. Wildlife attractants. Any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's AOA. These attractants can include architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands.

32. Wildlife hazard. A potential for a damaging aircraft collision with wildlife on or near an airport.

33. Wildlife strike. A wildlife strike is deemed to have occurred when:

a. A pilot reports striking 1 or more birds or other wildlife.

b. Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike.

c. Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife.

d. Bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified.

e. The animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal) (Transport Canada, Airports Group, *Wildlife Control Procedures Manual*, Technical Publication 11500, 1994).

2. RESERVED.

State of California -The Natural Resources Agency *EDMUND G. BROWN JR., Governor*
DEPARTMENT OF FISH AND Wildlife *CHARLTON H. BONHAM, Director*
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95667
(916) 358-2900
http://www.wildlife.ca.gov

May 16, 2013

Will Arcand
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, CA 95814

Subject: Comments on the Notice of Preparation and Initial Study for the Amended Reclamation Plan for Western Aggregates, LLC (CA Mine ID #91-58-0001, SCH #2013042008)

Dear Mr. Arcand:

The California Department of Fish and Wildlife (CDFW; formerly California Department of Fish and Game) is providing comments on the Notice of Preparation and Initial Study (NOP/IS) for the Amended Reclamation Plan for Western Aggregates, LLC (project) as both a trustee agency and responsible agency under the California Environmental Quality Act (CEQA). As trustee for the State's fish and wildlife resources, the CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species. The CDFW may also be a responsible agency for a project affecting biological resources where we will exercise our discretion after the lead agency to approve or carry out a proposed project or some facet thereof.

CDFW's response to the NOP/IS focuses on the potential effects of the project. The CDFW may provide additional comments after release of the Environmental Impact Report (EIR). At that time, CDFW anticipates commenting on the project within the context of and using the State Mining and Geology Board's analysis of potential significant impacts from the project, and the adequacy of proposed mitigation for such impacts contained in the EIR.

The project consists of an amended reclamation plan for 1,960 acres of aggregate mining operations, which is projected to terminate in approximately 45 years (2058). Reclamation activities would occur in three phases approximately every 15 years and would be initiated following the termination of mining activities subsequent to each mining phase. The project is located in Yuba County, south of the Yuba River, north of Hammonton-Smartville Road, and approximately four miles northeast of the City of Marysville. The project is located within the *Browns Valley, California* United States Geologic Survey (USGS) 7.5-minute quadrangle.

Reclamation Plan

The CDFW recommends that the reclamation plan include using locally available, non-invasive, native species. On page 33 of the IS, the plan calls for commercially available broadcast seed mix. The composition of the seed mix is not described. CDFW recommends that the project proponent consider using a seed mix with a high percentage of native seeds. In addition, the proposed plants used for revegetation in Table 2-2 on page 34 states that the plan will only use commercially available species. Commercially available species may include varietals and propagates not native to California or the region. The plant species found locally may have adapted to regional conditions and therefore may be genetically different than commercially available species. Original genetic material for plantings should be collected from within 50 miles of the project. CDFW recommends choosing a local reference site that can be used to determine species composition and success of the restoration. CDFW recommends that the project not plant, seed, or otherwise introduce invasive, non-native plant species. Non-native, invasive plant species include those identified in the California Invasive Plant Council's Inventory Database, which is accessible at: http://www.cal-ipc.org/ip/inventory/weedlist.php.

To properly evaluate the potential impacts associated with the project, additional clarifying information should be incorporated into the EIR analysis. There is no set period for when restoration occurs after mining of the site ceases. The EIR analysis should consider that impacts to sensitive species or resources (e.g. nesting birds or elderberry shrubs, etc.) may increase if species occupy the site during and after mining activities. Restoration activities have the potential to impact sensitive resources, if present. In addition, the project description (page 33) mentions breaching previously restored areas. Since sensitive species may occupy the restored areas, there is potential for impacts to occur if these areas are breached after they have been restored. The EIR should analyze these impacts and provide avoidance and minimization measures for this potential action.

Nesting Migratory Birds and Raptors

The project includes ground disturbance and removal of vegetation, all of which have the potential to disturb bird species or nests protected under FGC §3503, including but not limited to killdeer (*Charadrius vociferus*), burrowing owl (*Athene cunicularia*), bank swallow (*Riparia riparia*), and western yellow-billed cuckoo (*Coccyzus americanus)*. If the project activities occur during the nesting season (approximately between March 1st and September 1st), construction activities could result in disturbance to nesting raptors and other migratory birds. Raptors and other migratory birds are protected under the Migratory Bird Treaty Act and FGC §3503 and 3503.5; therefore, potential impacts may be considered potentially significant unless mitigation is incorporated. Earth-moving and vegetation disturbance should avoid nesting season or propose mitigation measures to reduce this impact to a less-than-significant level. If ground disturbance or vegetation removal is proposed during the nesting season, a survey for nests should be conducted by a qualified biologist to avoid nest removal/disturbance.

All measures to protect active nests should be performance-based. While some birds may tolerate disturbance within 250 feet of construction activities, other birds may have

a different disturbance threshold and "take" (FGC §2081 and §3503.5) could occur if the temporary disturbance buffers are not designed to reduce stress to that individual pair. The CDFW recommends including performance-based protection measures for avoiding all nests protected under the Migratory Bird Treaty Act and FGC §3503.5. Below is an example of a performance-based protection measure:

> Should construction activities cause the nesting migratory bird or raptor to vocalize, make defensive flights at intruders, get up from a brooding position, or fly off the nest, then increase the exclusionary buffer such that activities are far enough from the nest to stop this agitated behavior by the migratory bird or raptor. The exclusionary buffer should remain in place until the chicks have fledged or as otherwise determined by a qualified biologist.

Certain bird species are of greater conservation concern and may not be detected with preconstruction nest surveys. Bank swallow and western yellow-billed cuckoo are both State-listed species. The CDFW recommends that protocol-level surveys are conducted if suitable habitat is located within an area that could be directly or indirectly by project activities. In addition, if burrowing owl, a California species of special concern, is present during earth-moving or other disturbance activities whether nesting or overwintering, the project may result in take or needless destruction of a nest. If habitat is present, the CDFW recommends a year of protocol-level surveys to determine species presence (DFG 2012). If burrowing owl is present, develop avoidance, minimization and mitigation measures based on the project and site-specific conditions.

Riparian Habitat

The project is adjacent to the Yuba River and its associated riparian habitat. Remnant riparian habitat may be located within or adjacent to the project activities. As a responsible agency under CEQA, the CDFW must rely on the CEQA analysis for the project when exercising our discretion after the lead agency to approve or carry out some facet of a proposed project, such as the issuance of a Lake and Streambed Alteration Agreement (LSA). Therefore, the EIR should include specific, enforceable measures to be carried out onsite that will avoid or minimize and/or mitigate within the same stream system for project impacts to the natural resources.

Regional Conservation Plans

Although the Yuba-Sutter Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP) has not yet been adopted, the parties have signed the Planning Agreement, which requires a consistency review of interim projects in the Planning Area. This project is a "Reportable Interim Project" as described in the Planning Agreement, which outlines an interim project process (Section 6.6). This process must be followed for all projects that meet the interim project definition. Since this process was not completed, the CDFW recommends that the CEQA document analyze the project's consistency with the HCP/NCCP and provide the necessary documentation to the CDFW as outlined in the Planning Agreement. In addition, the EIR analysis should include how this project is consistent with the Reclamation Plans surrounding the projects.

Thank you for considering our comments. CDFW personnel are available for consultation regarding biological resources and strategies to minimize impacts. If you have questions please contact Angela Calderaro, Staff Environmental Scientist, by e-mail at angela.calderaro@wildlife.ca.gov or by phone at (916) 358-2920.

Sincerely,

Tina Bartlett

Tina Bartlett
Regional Manager

ec: Jeff Drongesen
Jennifer Navicky
Angela Calderaro
Department of Fish and Wildlife

State Clearinghouse

References

California Department of Fish and Game (DFG). 2009. *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities*. November 24, 2009. http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/Protocols_for_Surveying_and_Evaluating_Impacts.pdf

California Department of Fish and Game (DFG). 2012. Staff Report on Burrowing Owl Mitigation. March 7, 2012. Accessed online 12/28/12 at http://www.dfg.ca.gov/wildlife/nongame/docs/BUOWStaffReport.pdf

Wiggins, D. 2005. Yellow-billed Cuckoo (Coccyzus americanus): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. March 25, 2005. Accessed online 12/28/12 at: http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf.

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Rm. 151
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-2380 FAX: (916) 574-0682

April 25, 2013

Mr. Will Arcand
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, California 95814

Subject: Western Aggregates LLC Yuba County Operations Amended Reclamation Plan
SCH Number: 2013042008
Document Type: Notice of Preparation

Dear Mr. Arcand:

Staff of the Central Valley Flood Protection Board (Board) has reviewed the subject document and provides the following comments:

The proposed project is located adjacent to or within the Yuba River which is under the jurisdiction of the Central Valley Flood Protection Board. The Board is required to enforce standards for the construction, maintenance, and protection of adopted flood control plans that will protect public lands from floods. The jurisdiction of the Board includes the Central Valley, including all tributaries and distributaries of the Sacramento River, the San Joaquin River, and designated floodways (Title 23 California Code of Regulations (CCR), Section 2).

A Board permit is required prior to starting the work within the Board's jurisdiction for the following:

- The placement, construction, reconstruction, removal, or abandonment of any landscaping, culvert, bridge, conduit, fence, projection, fill, embankment, building, structure, obstruction, encroachment, excavation, the planting, or removal of vegetation, and any repair or maintenance that involves cutting into the levee (CCR Section 6);

- Existing structures that predate permitting or where it is necessary to establish the conditions normally imposed by permitting. The circumstances include those where responsibility for the encroachment has not been clearly established or ownership and use have been revised (CCR Section 6);

- Vegetation plantings will require the submission of detailed design drawings; identification of vegetation type; plant and tree names (i.e. common name and scientific name); total number of each type of plant and tree; planting spacing and irrigation method that will be utilized within the project area; a complete vegetative management plan for maintenance to prevent the interference with flood control, levee maintenance, inspection, and flood fight procedures (CCR Section 131).

Vegetation requirements in accordance with Title 23, Section 131 (c) states "Vegetation must not interfere with the integrity of the adopted plan of flood control, or interfere with maintenance, inspection, and flood fight procedures."

The accumulation and establishment of woody vegetation that is not managed has a negative impact on channel capacity and increases the potential for levee over-topping. When a channel develops vegetation that then becomes habitat for wildlife, maintenance to initial baseline conditions becomes more difficult as the removal of vegetative growth is subject to federal and State agency requirements for on-site mitigation within the floodway.

Hydraulic Impacts - Hydraulic impacts due to encroachments could impede flood flows, reroute flood flows, and/or increase sediment accumulation. The project should include mitigation measures for channel and levee improvements and maintenance to prevent and/or reduce hydraulic impacts. Off-site mitigation outside of the State Plan of Flood Control should be used when mitigating for vegetation removed within the project location.

The permit application and Title 23 CCR can be found on the Central Valley Flood Protection Board's website at http://www.cvfpb.ca.gov/. Contact your local, federal and State agencies, as other permits may apply.

The Board's jurisdiction, including all tributaries and distributaries of the Sacramento River and the San Joaquin River, and designated floodways can be viewed on the Central Valley Flood Protection Board's website at http://gis.bam.water.ca.gov/bam/.

If you have any questions, please contact me by phone at (916) 574-0651, or via email at jherota@water.ca.gov.

Sincerely,

James Herota

James Herota
Staff Environmental Scientist
Projects and Environmental Branch

cc: Governor's Office of Planning and Research
State Clearinghouse
1400 Tenth Street, Room 121
Sacramento, California 95814

RECEIVED BY
STATE MINING & GEOLOGY BOARD
Department of Conservation
MAY 02 2013

CALIFORNIA
Water Boards

Central Valley Regional Water Quality Control Board

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

29 April 2013

Will Arcand
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, CA 95814

CERTIFIED MAIL
7012 2210 0002 1419 9852

COMMENTS TO NOTICE OF PREPARATION FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, WESTERN AGGREGATES LLC YUBA COUNTY OPERATIONS AMENDED RECLAMATION PLAN PROJECT, SCH NO. 2013042008, YUBA COUNTY

Pursuant to the State Clearinghouse's 3 April 2013 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Notice of Preparation for the Draft Environmental Impact Report* for the Western Aggregates LLC Yuba County Operations Amended Reclamation Plan Project, located in Yuba County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/.

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 97-03-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml.

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACOE). If a Section 404 permit is required by the USACOE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916) 557-5250.

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACOE permit, or any other federal permit, is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

Waste Discharge Requirements

If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project will require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit2.shtml.

If you have questions regarding these comments, please contact me at (916) 464-4684 or tcleak@waterboards.ca.gov.

for Trevor Cleak
Environmental Scientist

cc: State Clearinghouse Unit, Governor's Office of Planning and Research, Sacramento

THREE RIVERS LEVEE IMPROVEMENT AUTHORITY
1114 Yuba Street, Suite 218
Marysville, CA 95901
Office (530) 749-7841 Fax (530) 749-6990

May 15, 2013

Mr. Will Arcand, Senior Engineering Geologist
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, CA 95814-3528

Re: Western Aggregates LLC Yuba County Operations Amended Reclamation Plan Initial Study, dated April 2013

Three Rivers Levee Improvement Authority (TRLIA), submits the following comment on the subject Initial Study:

Since 2004 Three Rivers Levee Improvement Authority (TRLIA) has been working to improve the Reclamation District 784 levee system to meet both 100-year and 200-year flood protection requirements. Until recently the proposed TRLIA improvements ended at the southwest corner of the Yuba Goldfields. The State Plan of Flood Control also terminates at the southwest corner of the Yuba Goldfields with the understanding that the Goldfields serves as high ground, which prevents Yuba River flood flows from flanking the Reclamation District 784 (TRLIA improved) levee system and flooding protected areas (Linda, Olivehurst, Arboga, and Plumas Lake). Historically the Goldfields have served as high ground; however, recently both the USACE and TRLIA evaluations have determined that erosion along the south bank of the Yuba River Tailings Mounds are increasing the risk of flooding from the Yuba River through the Goldfields. TRLIA looks forward to working with Western Aggregates to ensure that the Reclamation Plan is consistent with TRLIA's flood protection goals in the future.

Please feel free to contact me, if you have questions or comments. My phone numbers are: 530-749-5679 (office), and 916-765-4981 (cell), or email pbrunner@co.yuba.ca.us

Sincerely,

Paul G. Brunner, P.E.
Executive Director

CC: Andrea Clark/TRLIA Downey Brand

May 24, 2013

Mr. Will Arcand
Senior Engineering Geologist
State Mining and Geology Board
801 K Street, Suite 2015
Sacramento, CA 95814-3528

Re: Comments on Western Aggregates LLC Yuba County Operations Amended Reclamation Plan Initial Study (May 2012)

Dear Mr. Arcand,

Yuba County Water Agency has reviewed the subject document and has the following comments for your consideration. The Initial Study calls for the excavation and removal of 414 million tons of aggregate with a volume of 276.1 million cubic yards, creating five ponds approximately 100 feet deep that would contain more than 170,000 acre-feet of water. The plan also states that additional excavation to a total depth of 165 feet is possible, which would result in more than 250,000 acre-feet of water stored in the excavated ponds. The creation of this large amount of stored water could affect groundwater levels and storage in the Yuba groundwater basin and could affect the operation of irrigation water canals in close proximity to the ponds. Additionally, YCWA has monitored flow and temperatures in the lower Yuba River and has documented some of the effects that water flowing through the Goldfields has on flows and water temperatures in the lower Yuba River. Due to the close proximity of the planned ponds to the Yuba River, and the large amount of water that would be stored in these ponds, they would have the potential to affect flows and water temperatures in the river. Because of the potential to affect all of these areas, YCWA requests that Western Aggregates LLC coordinate with YCWA in the development of these ponds to ensure no significant negative impacts occur.

Thank you for the opportunity to review and comment on the Initial Study document. Please contact Scott Matyac, Water Resources Manager, at 530-741-6278 ext. 117 or smatyac@ycwa.com if you have any questions or need further information regarding our comments.

Sincerely yours,

Curt Aikens
General Manager

cc: Lloyd Burns

1220 F Street · Marysville, CA 95901-4740 · 530.741.6278 · *Fax:* 530.741.6541
www.ycwa.com

4-28-2013

Mr. Will J Arcand
Senior Engeneering
geologist.

To whom it may.

As a long Time Resident of almost 40 jeavs
I have a deep Paine + concern abaute Water-
issue also abaute the enclosed map.
Please, I don't see any Township Section, I find this
Map very confusing.

Maby in the Future a Meeting
on Site be very informative, to clarify
this Project. Please feel free to conduct me
at Phone # 530 743-5639

Mailing Address PO Box 1323
Penn Valley, Calif. 95946

Respectfully
Elfrieb Calvert

Thank you for the Notice

copy made

Telephone Comments
Western Agg NOP/IS

WSA

4/12/13 - Frieda Calvert - Just got her mail w/NOP and CD. Map on NOP looks like they are going to mine right in front of her property.

4/26/13 - Ted Lowe
9500 Buena Vista
Marysville, CA 95901
} Requested Enviromental Documents.

5/-/13 - Harl Sanderson - Bal AFB
- Additional comments forwarded to SMGB Mailbox - will also forward to WSA e-mail.

5/9/13 - Paul Brunner - TRLIA
- High Ground ... Training Wall Erosion, working with Western and other miners to maintain flood protection. Will submit comment letter.

5/17/13 - Scott Matyak Yuba County Water Agency
Water Resources Manager
- They may submit general written comment by the end of the Month.

(1)