



# Site-specific Protocol for Monitoring Sandhill Cranes

## *Muleshoe and Grulla National Wildlife Refuges*

Survey ID Number: FF02RTMU00-002; FF02RNGR00-005



**ON THE COVER**

Sandhill cranes leaving Paul's Lake at Muleshoe National Wildlife Refuge  
Photograph by: Daniel Raleigh, Texas Tech University

## National Wildlife Refuge System Survey Protocol Signature Page

**Protocol Title:** Site-specific Protocol for Monitoring Sandhill Cranes: *Muleshoe and Grulla National Wildlife Refuges*

**Version<sup>1</sup> :** 1.0

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Muleshoe National Wildlife Refuge and  
Grulla National Wildlife Refuge

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| Version <sup>1</sup> | Date | Author | Change Made | Reason for Change |
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<sup>1</sup> Version is a decimal number with the number left of decimal place indicating the number of times this protocol has been approved (e.g., first approved version is 1.0.; prior to first approval all versions are 0.x; after first approval, all minor changes are indicated as version 1. x until the second approval and signature, which establishes version 2.0, and so on).

<sup>2</sup> Signature of station representative designated lead in development of a site-specific survey protocol.

<sup>3</sup> Signature signifies approval of a site-specific survey protocol.

<sup>4</sup> Signature by Regional I&M Coordinator signifies approval of a protocol framework to be used at multiple stations within a Region.

<sup>5</sup> Signature by National I&M Coordinator signifies approval of a protocol used at multiple stations from two or more Regions.

## Survey Protocol Summary

*The site-specific protocol for monitoring of sandhill cranes at Muleshoe and Grulla National Wildlife Refuges is based on the national protocol framework for the Integrated Waterbird Management and Monitoring Approach for Nonbreeding Waterbirds (Loges et al. 2015). The purpose of this protocol is to estimate temporal abundance patterns of migrating and wintering sandhill cranes on the refuge and on surrounding lands. Information from this survey will contribute, in part, to determining the energetic needs of local crane populations during fall, winter and spring. Information from this survey is being incorporated into a LCD for the Southern High Plains (Daniels et al. 2017). A secondary goal of this survey is to collect information on wetland habitat conditions, which may influence crane abundance.*

*The survey protocol employs both visual bird counts and visual habitat assessments. Observers count sandhill cranes while the birds are on their roost sites (i.e., saline lakes) or while flying off of their roost sites. Cranes are counted from a designated observation point at eight saline lakes in and around Muleshoe and Grulla National Wildlife Refuges. Site condition surveys (habitat surveys) are completed at the time of the crane counts, and address information such as weather, water depth, vegetation and disturbance. Monitoring occurs biweekly from late-September through end of March.*

### **Suggested citation:**

Linner KL, Johnson WP, Grisham BA, Conway WC. 2018. Site-specific protocol for monitoring of sandhill cranes: Muleshoe and Grulla National Wildlife Refuges. U.S. Fish and Wildlife Service (Region 2), National Wildlife Refuge System, Muleshoe National Wildlife Refuge, Muleshoe, Texas.

This protocol is available from ServCat [<https://ecos.fws.gov/ServCat/Reference/Edit/95665>]

## Acknowledgments

This protocol was developed with the input and cooperation of Jude Smith and Melanie Hartman of Muleshoe National Wildlife Refuge. Tim Huckaby assisted with developing the data dictionary and uploading survey units into the IWMM website. Kris Metzger provided assistance with editing this protocol. Cinthia Eichhorn assisted with setting up ServCat project files and reviewing data management elements.

National Framework followed: This site-specific protocol for monitoring of Waterbirds is based on the “[National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative \(IWMM\) approach](#)” (Loges et al. 2015). This framework was updated in 2017 (Loges et al. 2017), and this updated version is available at <https://ecos.fws.gov/ServCat/Reference/Profile/83678>.

Template used: This template was adopted from a template developed for reporting Technical Reports or Long-term Monitoring Protocols by the National Park Service. The template was initially modified and provided by Jennifer Smetzer and Bill Thompson of Region 5 of the National Wildlife Refuge System. Subsequent to drafting of the *Survey Protocol Handbook*, Sean Blomquist (Region 3 I&M) and Pat Ward (NRPC I&M) modified the template to match format suggested in that Survey Protocol Handbook (USFWS 2014), with reviews from Jana Newman and Lee O’Brien (Natural Resources Program Center, I&M, National Wildlife Refuge System).

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# Narrative

## Element 1: Introduction

### *Background*

The text below has been taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitat” (Loges et al. 2015, pp 1-3), but has been modified to be site specific.

Sustaining healthy populations of waterbirds (e.g., waterfowl, shorebirds, and long-legged wading birds) that migrate long distances is a major challenge for land managers, and numerous questions remain pertaining to waterbird management and conservation. For example, how important is a single survey site in the big picture over time and across the landscape? How can multiple managers coordinate management of wetlands, farmlands, or influence conservation practices across the landscape so that the birds have the right amount and quality of habitat, at the right time, in the right places? As part of the Integrated Waterbird Management and Monitoring (IWMM) approach, managers and scientists have developed monitoring protocols, decision support models, and databases to inform waterbird management decisions at multiple spatial scales. These products will support clear and transparent decision making processes with respect to waterbird habitat management.

The Integrated Waterbird Management and Monitoring program was initiated by conducting structured decision-making workshops to develop an operational framework for management and monitoring of waterfowl, shorebirds, and wading birds, collectively referred to as waterbirds, at local, regional and flyway spatial scales (Coppen et al. 2007, Laskowski et al. 2008, Lor et al. 2008). Through these workshops the IWMM initiative provided a multi-scaled adaptive management process to inform local and regional managers about how they can best support the needs of local populations of migrating and wintering waterbirds. The program includes a monitoring component that assesses how well managers are meeting their management objectives and an adaptive feedback loop that allows strategies to be adjusted to improve management performance.

Generally, the three purposes for a refuge to adopt the IWWM protocol framework are: a) to understand how waterbirds respond to habitat conditions; b) to inform decision making in a strategic manner; and, c) to assess the efficacy of/improve conservation actions and planning (Lyons et al. 2008). In this instance, Muleshoe and Grulla National Wildlife Refuges have identified a need for a sandhill crane monitoring protocol and have stepped-down the national IWWM protocol-framework to a local, site specific approach. Data will be used for site-specific abundance, documenting migration chronology, and exploring relationships between sandhill crane numbers, landscape conditions (how many cranes can the landscape support) and threats.

The Comprehensive Conservation Plan for the two refuges calls for addressing the connection between sandhill crane numbers and local habitat availability (USFWS 2004). Sandhill cranes in the Southern High Plains typically roost on saline lakes, obtain drinking water from springs/seeps associated with saline lakes, and forage in croplands. Muleshoe NWR provides

saline lake habitat, but foraging takes place in “off-refuge” croplands. The suitability of foraging grounds near the refuge is threatened by changing agricultural practices and wind energy development. The ability to influence the landscape for sandhill cranes will require working with conservation partners and private landowners to maintain foraging grounds. As a result, Muleshoe and Grulla NWRs have developed a Landscape Conservation Design (LCD) in cooperation with the Playa Lakes Joint Venture and other partners (Daniels et al. 2017). This LCD outlines local population abundance goals as well as food resource (energetic) goals that are developed in a Strategic Habitat Conservation framework. The saline lakes covered in this survey will be used to further inform and refine objectives, and evaluate LCD performance and delivery with respect to meeting sandhill crane population objectives.

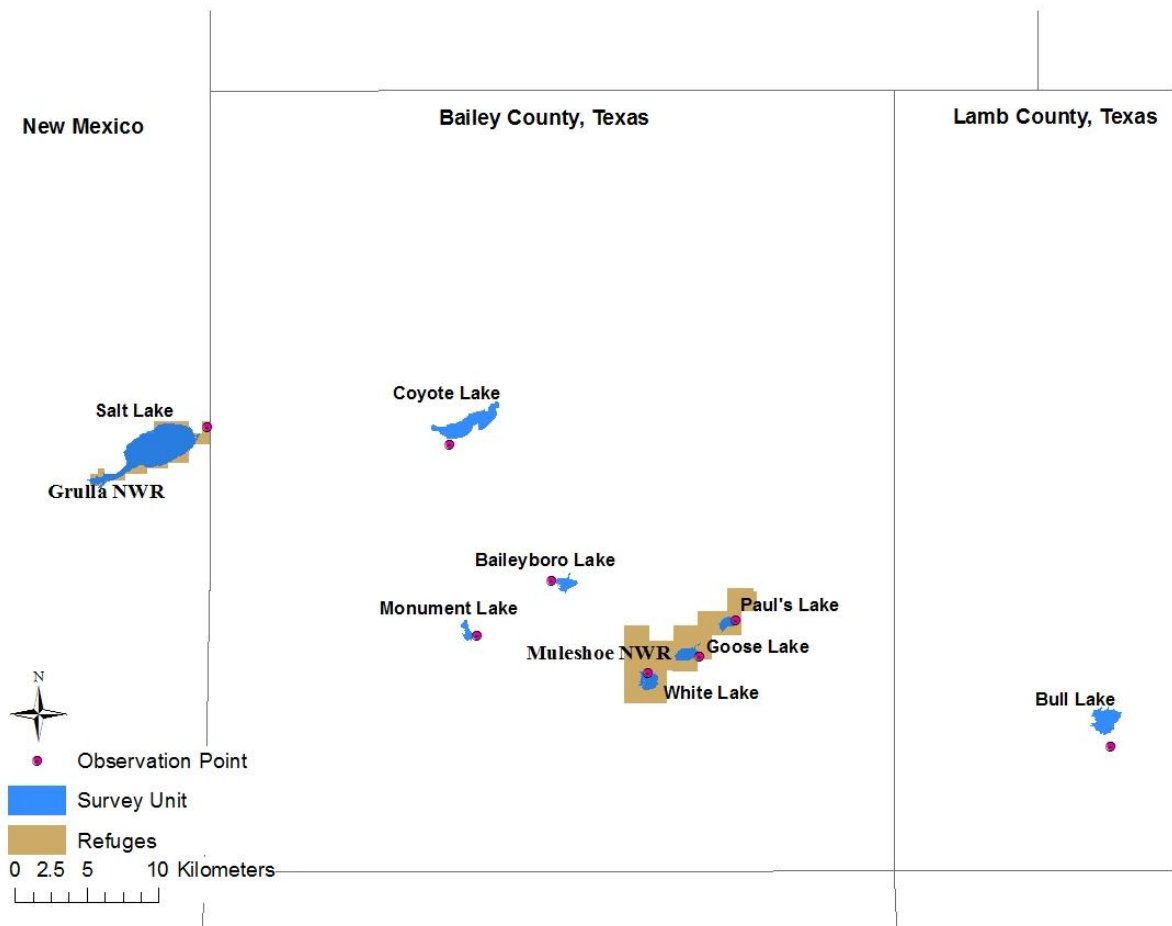
## **Objectives**

The following is based on the Inventory and Monitoring Plan for Muleshoe NWR and Grulla NWR ([USFWS 2013](#)), and Muleshoe’s biological priorities [[87454](#)], which were developed in 2017.

From 2002-2014, approximately 15% of the Mid-Continent Population of sandhill cranes wintered on Muleshoe NWR. Both Muleshoe and Grulla NWRs were created for conserving migratory birds; however, Grulla was established specifically for the conservation of sandhill cranes. Both refuges have a goal of maintaining or increasing sandhill crane abundance on the refuge and surrounding landscape. The purpose of this protocol is to monitor sandhill crane use, and thus provide the Muleshoe and Grulla NWR with information on sandhill crane abundance for the eight saline lakes identified in Figure 1.1. This abundance information will be used to inform and evaluate LCD delivery.

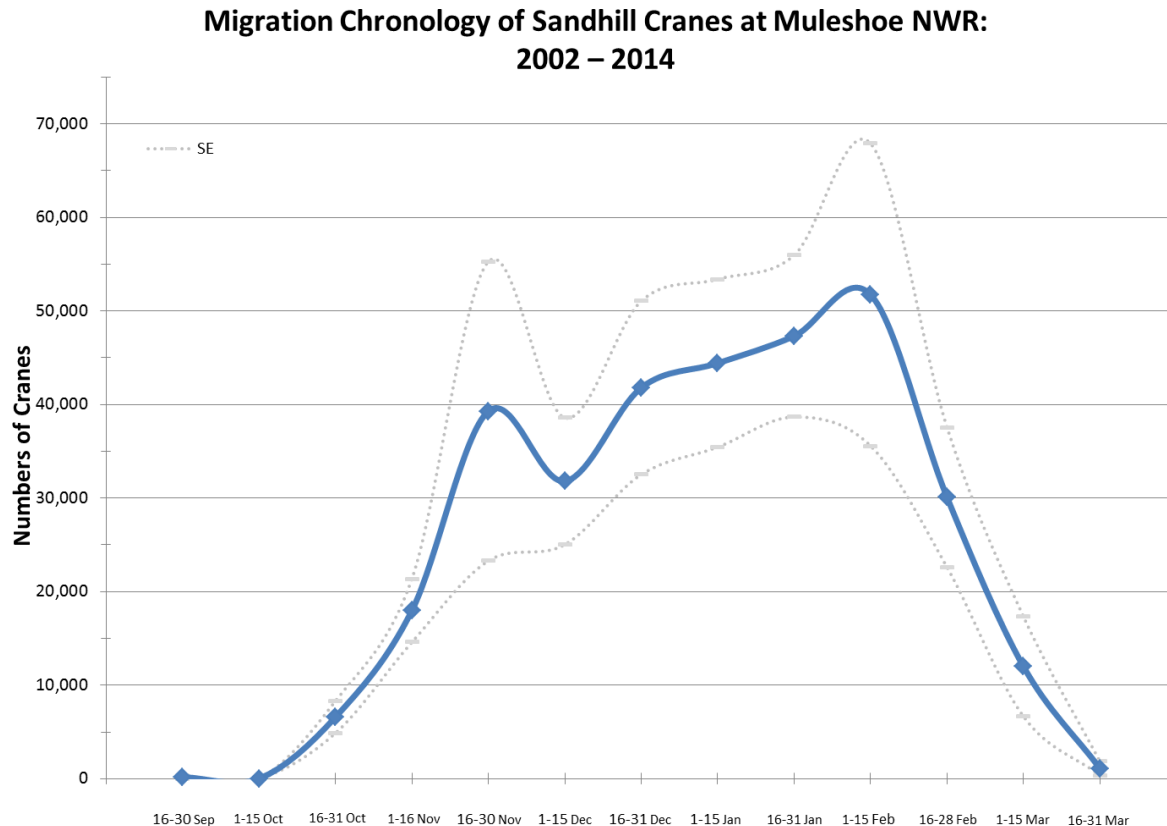
Historic survey data (2002-2013) suggest sandhill crane use days on Muleshoe NWR total approximately 4.9 million between fall arrival and spring departure (Figure 1.2). A “use day” is defined as 1 crane for 1 day; for example 30 cranes for 5 days would equal 150 crane-use days. Use days are useful for converting crane abundance to energetic needs, or kcal, that the landscape needs to provide. Although this protocol does not address carrying capacity of the landscape, it feeds into the LCD (Daniels et al. 2017), which describes use-day and landscape carrying capacity (kcal) goals for sandhill cranes. Data from this survey effort will be used to evaluate sandhill crane response as it relates to implementation of the conservation design. Automated reported mechanisms of IWMM allow for easy conversions of survey results to use days (see Element 4: Data Management and Analysis).

Abundance data from Paul’s Lake, Goose Lake, and White Lake (Muleshoe NWR) will be provided to organizations partnering in the LCD every five years, or earlier if requested. This information will be used to evaluate implementation of the LCD (Daniels et al. 2017), and for refining objectives and initiatives. The current population objective for these three lakes combined is 4.9 million sandhill crane use-days. Maintaining this abundance goal will require working with partners to implement landscape sustainability and suitability initiatives. These initiatives will be defined as the LCD moves from planning to roll out phases. Note that quantifying energetic and habitat objectives are not addressed in this protocol, only sandhill crane abundance.



**Figure 1.1.** Muleshoe and Grulla National Wildlife Refuge sandhill crane survey area. Survey units are labeled in bold font.

Abundance data from this survey will be used to set local crane-use day goals for the remaining saline lakes (survey units that do not occur on Muleshoe NWR). After five years of survey data have been collected, refuge staff will work with LCD partners to develop local population objectives for each saline lake. Lake-specific goals will be incorporated into the LCD (Daniels et al. 2017). The lake-specific goals will be reported as “crane use day” goals.



**Figure 1.2.** Migration chronology of sandhill cranes at Muleshoe NWR. Crane use days were calculated from 11 years of refuge-based survey data. The cross year average for each biweekly period was multiplied by the number of days in that period (14 or 15) to obtain a crane-use day estimate for that biweekly period; crane-use days for each biweekly period were then summed across the year. From 2002 - 2014, this was equivalent to about 4.9 million use days annually.

## Element 2: Sampling Design

### *Sample design*

This protocol outlines the approach to collect sandhill crane abundance data on saline lakes in and around Muleshoe and Grulla NWR's. As per the IWMM protocol framework (Loges et al. 2015), there is no spatial design. Census techniques are used to assess waterbird abundance and environmental conditions. Data are collected by survey unit.

### *Sampling units, sample frame, and target universe*

#### *Sampling Units*

The text below is largely taken from the "National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats" (Loges 2015), but has been modified to be site specific.

The IWMM protocol framework (Loges et al. 2015) defines a survey unit as a single managed or unmanaged wetland on a single date during the non-breeding season. All survey units addressed in this protocol are unmanaged wetlands, as recurring management actions are not applied. For purposes of this survey, a “sample unit” is equivalent to a survey unit. The IWMM protocol framework does not prescribe a theoretical design to allocate a sample of locations within a surveyed area, so the framework suggests the terminology “survey unit” instead of sample units (Loges et al. 2015). Boundaries of survey units should be fixed through the season and across years to ensure data comparability.

There are eight survey units addressed in this protocol; all are natural saline lakes. They were selected because they occur either on Muleshoe NWR or Grulla NWR, occur in proximity to the refuges, and to inform development and refinement of the landscape conversation design (Daniels et al. 2017). The survey units represent approximately 16% of all possible saline lakes in the Southern High Plains (Rosen et al. 2013), and perhaps >32% of functional saline lakes (Daniels et al. 2017). Detailed information and maps of each survey unit are included in SOPs 1 and 4. We delineated waterbird survey units by U.S. Fish and Wildlife Service (USFWS) wetland boundaries [<https://www.fws.gov/wetlands/nwi/Overview.html>]. The USFWS wetland boundaries represent the extent of the lake when full and the outer boundary of the wetland layers represents the survey units in ArcGIS. A shapefile (ESRI 1998) of survey units is archived on ServCat at: <https://ecos.fws.gov/ServCat/Reference/Profile/95415>.

### *Sample Frame*

The comprehensive survey site includes Muleshoe NWR (Paul’s Lake, Goose Lake, and White Lake), Grulla NWR (Salt Lake), and four additional saline lakes in the vicinity (Bull Lake, Baileyboro Lake, Coyote Lake, and Monument Lake). Within the site, there are eight total survey units (Figure 1.1) spanning Roosevelt County in New Mexico and Bailey and Lamb Counties in Texas.

### *Target Universe*

The Mid-Continent Population of sandhill cranes is the target species for this survey protocol. Per the IWMM framework, census techniques are used to assess waterbird abundance and environmental conditions. Both Muleshoe and Grulla NWRs play a crucial role in the conservation of the Mid-Continent Population of sandhill cranes. From 2001–2014, annual surveys at Muleshoe NWR suggest 15% of the Mid-Continent flock may be congregated on the refuge when crane abundance peaks during winter. Sandhill cranes use the saline lakes on the refuge for roosting (night) and loafing (mid-day). This survey will target those cranes that roost on saline lakes in the western portion of the Southern High Plains from September through March. Similar to waterfowl, sandhill cranes that roost on saline lakes typically forage in surrounding croplands during the day (Iverson et al. 1985, Johnson et al. 2014)

### *Assigning IWMM Site, Survey Unit and Observer Codes*

Site, survey unit, and observer codes were assigned by IWMM staff (Table SOP 4.1). If additional assistance is needed with IWMM codes for site, survey unit or observers, please contact the IWMM Science Coordinator ([iwmmprogram@gmail.com](mailto:iwmmprogram@gmail.com)). If observers do not know the codes, they may be left blank, but it will then be necessary to fill in name details (e.g., Paul’s Lake) so that codes can be completed latter. IWMM survey unit codes can be assigned to data sheets by cross-referencing units codes with lake names (e.g., Paul’s lake) using Table SOP 4.1.

### ***Sample selection and size***

All four saline lakes on Muleshoe and Grulla NWR's were included as survey units, as well as four off-refuge saline lakes. Off-refuge lakes were selected based on proximity to the refuge and importance to landscape planning (Daniels et al. 2017). The survey units represent approximately 16% of all possible saline lakes in the Southern High Plains (Rosen et al. 2013), and >32% of functional saline lakes in the Southern High Plains (Daniels et al. 2017). Survey coverage of these lakes is needed to inform LCD development and evaluation (Daniels et al. 2017).

Due to occasional personnel constraints, all survey units may not be surveyed during every survey session. The survey units on Muleshoe and Grulla NWRs have the highest priority and will be surveyed during each bi-weekly survey session. If survey personnel are limited, the Refuge Manager or his/her designee will perform a reconnaissance survey <2 days before the scheduled survey to prioritize off-refuge saline lakes. Survey units will be prioritized based on sandhill crane use and water availability. Off-refuge survey units with the most sandhill crane use will be prioritized highest. Off-refuge survey units that are dry and not-holding birds will be prioritized lowest and may not be surveyed. "Non-surveyed units will be recorded as not-surveyed, not "0" (zero) birds.

### ***Survey timing and schedule***

#### ***Seasonality***

Surveys will occur annually. They will begin in the third week of September and end in the last week of March. This time period should capture both migrating and wintering sandhill cranes (Seyffert 2001).

#### ***Schedule***

Sandhill crane surveys and unit condition surveys will occur bi-weekly on a consistent weekday (e.g., Wednesday). All units will be counted on the same day.

#### ***Survey time***

Observers will arrive at their initial survey unit at least 45 minutes before sunrise, and begin surveying when light is sufficient to identify and count sandhill cranes. Birds must be counted either on roost sites or while exiting (flying off) roost sites. The surveys last approximately 2-3 hours from start to finish.

Observers will begin surveying units from the survey point approximately 30 minutes before sunrise, or when there is enough light to identify and count sandhill cranes. Birds must be counted either on roost sites or while exiting (flying off) roost sites. The surveys last approximately one to two hours from start to finish.

### ***Sources of error***

The text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges 2015), but has been modified to be site-specific.

Detection of sandhill cranes is likely to be imperfect, thus biasing estimates. Inaccuracy occurs when some individuals are unavailable for detection (e.g., hidden behind other birds), when individuals that are available are not perceived by the observer, or when observers underestimate or overestimate extremely large flocks. Many factors can influence detectability, including observer ability and attention, habitat conditions and weather. Unlike managed wetlands (for example, moist soil units), detectability of sandhill cranes due to changing vegetation structure throughout the season should be a minor issue, as saline lakes are largely devoid of vegetation. However, the size of flocks occurring on single survey units will likely vary by magnitudes across the survey period. In general, observers tend to underestimate flocks of large birds in excess of 2,000 (Boyd 2000), and the degree of bias (of the underestimate) increases as flock size increases. Past estimates of sandhill cranes on individual saline lakes may exceed 50,000 (Muleshoe NWR, unpubl). Training may improve the ability of observers to estimate large flocks (refer to SOP 2).

## **Element 3: Field Methods and Processing of Collected Materials**

### ***Pre-survey logistics and preparation***

The following field equipment is required for the sandhill crane survey:

- Good optical equipment, including a spotting scope
- Thermometer (°C)
- Map of assigned survey units (see SOP 4)
- GPS if unfamiliar with survey locations
- Waterbird Survey Form for Individual Survey Units (SM-5)

An appropriate number of vehicles will need to be secured / arranged, depending on the number of staff and volunteers, to conduct this survey.

### ***Establishment sampling units***

Sampling units are described in SOP 1 and SOP 4. GPS locations (Table SOP 4.1) and directions for navigating to each observation point are also included in SOP 4.

### ***Data collection procedures***

#### ***Measurements***

The following attributes will be recorded for each survey unit (see SM-5). See SOPs 2 and 3 for data collection procedures.

- Counts of sandhill cranes
- Visibility (%)



- Wind speed (km/h class)
- Water gauge reading\*
- Water depth (cm class)
- Ice (% cover class)
- Water coverage (% of survey unit with surface water)
- Habitat cover (% of cover class)
- Waterbird disturbance response (class)
- Disturbance source (class)
- Chronic human disturbance (class)

\*only record if the saline lake has a staff gauge; most lakes do not have one.

#### *Methods: site condition surveys*

Detailed site condition survey methods for the measurements listed above can be found in SOP 3.

#### *Methods: estimating sandhill crane abundance*

Sandhill cranes roost on shallow saline lakes at night, disperse to feed on agricultural fields during the day, and return to the saline lakes in late afternoon or evening. Surveys are best conducted while cranes are concentrated at their roost sites (saline lakes). The survey units include eight roost sites: Baileyboro Lake, Bull Lake, Coyote Lake, Goose Lake, Paul's Lake, Monument Lake, Salt Lake and White Lake. Observers will arrive at their assigned observation point (see SOP 4, Table SOP 4.1) at least 45 minutes before sunrise. If the count is not completed before cranes begin to leave the roost site, observers may estimate crane numbers by counting cranes as they fly off the site (exit count). For more detailed count instructions see SOP 2.

#### ***Processing of collected materials***

No materials/specimens are collected during this survey. Data entry is addressed in Element 4 and SOP 5.

Dead/diseased specimens observed during the survey are not to be collected as part of this effort. Notify the Refuge Manager or Refuge Biologist for instructions on how to proceed with documenting the disease/mortality event, and the Refuge Manager or Refuge Biologist will decide if specimen collection is warranted. For additional information see SM-4.

#### ***End-of-season procedures***

It is strongly recommended that data entry be kept current throughout the field season to end-of-season. However, any data sheets not already turned into the Survey Coordinator (Refuge Biologist) should be submitted at this time. The Survey Coordinator is responsible for entering, (or designated someone to enter) information recorded on field data sheets into the IWMM database.

The Survey Coordinator will also archive data sheets at the end of the season. Original paper copies of the data sheets will be scanned and saved as a .pdf file. The scanned documents should

be compressed, stored in ServCat [95666], and linked to the project [95413]. Care should be taken to make sure scanned documents are readable. When building the .pdf file, scanned data sheets should be arranged (ordered) by survey date and then survey unit name. Compressed files should be named by survey year prior to archiving in ServCat.

The IWMM Science Coordinator may establish entry deadlines on an as-needed basis. See Element 5 for a detailed description of reporting procedures at the end of the season.

## **Element 4: Data Management and Analysis**

Text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site specific.

The Survey Coordinator will enter collected data into the IWMM’s centralized, online database. IWMM’s database is a member of the Avian Knowledge Network (AKN). This database houses bird survey and habitat condition information. The database can also be used for managing site-specific surveys and collaboration with others. For information about the AKN, please see [www.avianknowledge.net](http://www.avianknowledge.net). Additional details concerning data entry are available in SOP 5.

### ***Data entry, verification, and editing***

Any edits to an original data sheet should be made with a red pen. The error should have a single line drawn through it and the correction written beside it. The researcher that corrected the data should initial and provide any necessary additional information in the margin nearest the correction. After the original data sheet has been reviewed following QA/QC procedures, data should be entered into the IWMM database within one week after the survey was completed. The link to the IWMM portal is

<https://data.pointblue.org/partners/iwmm/login/?returnUrl=%2Fscience%2Fiwmm-portal%2F>

See SOP 5 for instructions on entering data into the online IWMM data entry portal. For additional information and tips, review the “Step by Step Database Documentation” PowerPoint available through the following link: <http://iwmmprogram.org/protocols-data-forms/>.

### ***Metadata***

Text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site specific.

Metadata should adhere to AKN standards and will be accessible via the IWMM’s database. IWMM maintains a project record that documents administrative details regarding its national program which is available by email request to [iwmmprogram@gmail.com](mailto:iwmmprogram@gmail.com). Muleshoe and Grulla NWRs will also maintain an online project site, as a companion to the physical documents held at the refuges. The web address for the online site is

<https://ecos.fws.gov/ServCat/Reference/Profile/95413>; this is a ServCat site, which requires

USFWS issued credentials. See SM-3 for a visualization of the appropriate linkage structure for generated references related to this site-specific protocol.

The project site will include the site-specific protocol [95665], supporting geo-spatial records [95415], archived data sheets [95666], and annual reports [95667]. Additionally, annual IWMM/AKN records specific to this survey will be downloaded each April and backed up on ServCat project site [95833]. This back up will include records of survey dates, observer names, survey units, start time, end time, habitat conditions, bird counts, and other records specific to each survey. It is suggested that this backup be a .csv file.

### ***Data security and archiving***

#### ***IWMM Project - Overall***

Text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site specific.

Point Blue Conservation Science (PBCS) will host IWMM’s database on its servers. For hosted databases, PBCS provides incremental daily backups onsite, weekly offsite backups, and semi-annual backups that occur offsite at Cornell University.

#### ***Data sheets***

Following the survey, data sheets will be collected from each surveyor and stored in the Refuge Biologist’s office for data entry. If a surveyor is unable to transfer data sheets to the biologist, they will be given to the Refuge Manager and he/she will transfer it to the biologist as soon as possible. After the original data sheet has been reviewed following QA/QC procedure, data should be entered in the IWMM/AKN portal

[<https://data.pointblue.org/partners/iwmm/login/?returnUrl=%2Fscience%2Fiwmm-portal%2F>].

After data entry, data sheets should be copied so that there are two sets of hard copy data sheets. Each set should be held in a three-ring binder, with pages organized by survey date (earliest to latest). The binder with the original data sheets should be housed in the office of the Refuge Biologist (Buffalo Lake NWR). The binder with copies should be transferred to Muleshoe NWR at the end of the survey season. Having hard copies of the data sheets stored in two locations will ensure long-term security and access to original data. Binders should be stored in file cabinets, which are clearly labeled, at each refuge at the end of the survey season.

In addition, at the end of each season the original paper copies of the data sheets will be scanned, and saved as a .pdf file. The scanned documents should be compressed, stored in ServCat [95666], and linked to the project [95413]. Care should be taken in scanning the documents and building the .pdf file so that data sheets are in order by survey data and then survey unit name. Compressed files should be named by survey year prior to archiving in ServCat. See SM-3 for a visualization of the appropriate linkage structure for generated references related to this site-specific protocol.

### *Spatial Files*

GIS files associated with the surveys can be found on ServCat [\[95415\]](#) along with associated metadata and data dictionaries. See SM-3 for a visualization of the appropriate linkage structure for generated references related to this site-specific protocol.

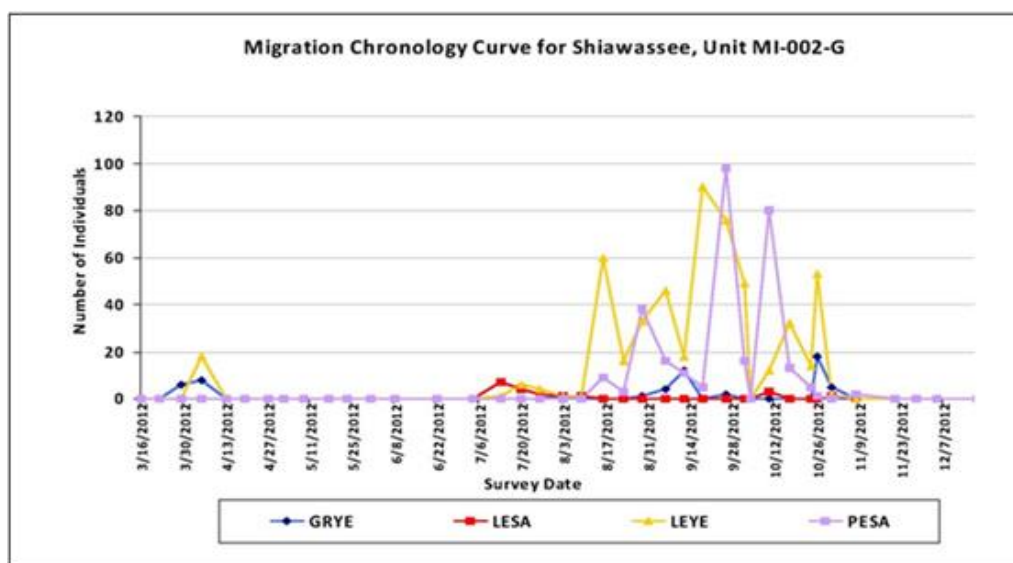
### **Analysis methods**

Text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

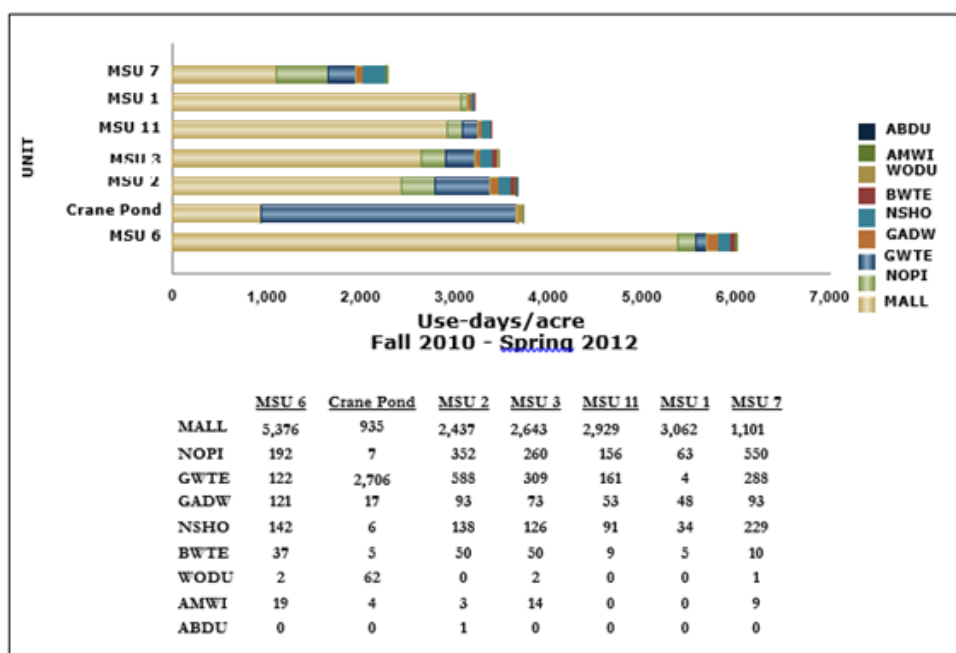
Data should be analyzed using the most appropriate means to meet the sampling objectives and provide summaries that effectively inform the management objectives.

The analytical tools available through IWMM’s database will be used to aid in the two refuge’s management decision-making, and provided to LCD partners (Daniels et al. 2017) for revision, review and assessment of management initiatives.

To estimate temporal patterns of abundance, Muleshoe and Grulla NWRs will use the migration curve tool, which allows users to plot observed waterbird counts against date (Figure 4.1). To allow the refuge to provide partners with useful information for evaluation LCD implementation and progress, the IWMM tools and programmed analyses should be used to calculate sandhill crane use-days by individual survey units and across survey units (Figure 4.2; Farmer and Durbian 2006). This information may then be compared to estimates at the scale of the LCD or smaller (Daniels et al. 2017). Other reporting tools are available for producing customized summaries of these metrics by different time or geographic scales.



**Figure 4.1.** Example of migration curve. Migration chronology for greater yellowlegs (GRYE), least sandpiper, lesser yellowlegs (LESA), and pectoral sandpipers (PESA) produced from an interim version of the IWMM database. The Migration Curve for this survey would be specific to sandhill cranes. *Figure taken from Loges et al. 2015.*



**Figure 4.2.** Example of data report. Dabbling duck use-day by unit and species illustrating variation in the relative composition of dabbling duck use density across units of interest at Clarence Cannon NWR. Use-days may be summarized by species or guilds for individual units, user defined unit group. Use-day data from this survey would be specific to sandhill cranes. *Figure taken from Loges et al. 2015.*

## Software

Because reports are generated through the online IWMM program and online AKN portal, additional software is not required for analysis. However, the Refuge Biologist and other users may use any software that is appropriate to fulfill the objectives of the survey.

## Element 5: Reporting

### *Implications and application*

#### *Objectives and Methods*

This purpose of this survey is to estimate abundance of migrating and wintering sandhill cranes at saline lakes on Muleshoe and Grulla NWRs and surrounding areas. Specifically, the survey aims to estimate numbers of birds before they depart, or as they are departing, nighttime roost sites (saline lakes) to forage in surrounding croplands. Information from this survey will contribute, in part, to estimating energetic needs of the local, wintering sandhill crane population (that is, estimating minimal carrying capacity requirements of the local population), and informing an LCD for the Southern High Plains.

#### *Summary of Results*

The text below is largely taken from the “National Protocol Framework for the Inventory and

Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but it has been modified to be site-specific.

The data summary tools provided by the IWMM database will provide a foundation for reporting. Data summaries represent common formats reported in migratory bird surveys; observation summaries, migration curves (Figure 4.1) and use-days (Figure 4.2). The spatial scale, time period, and taxon level of the data summaries will be defined by the Refuge Biologist or researcher based on need. Bird observation summaries report frequency, average abundance, average count, birds/hour, maximum count, and total count for a user-defined period, scale and taxon. Migration curves plot raw or percent of maximum counts for all surveys over a user-defined period. A data export function will also allow cooperators to summarize data outside of the IWMM database.

Summarized results will be converted to .pdf file format, stored on ServCat [\[95667\]](#) and linked to the project [\[95413\]](#).

### ***Reporting schedule***

The Survey Coordinator (Refuge Biologist) will generate end-of-season reports to summarize the data collected for the survey season. Short-term reports will initially be the primary type of report created, but as the survey continues periodic comprehensive reports may be appropriate. Ideally, these reports will be completed and submitted within one month after the conclusion of the last survey in March. The frequency of such reports may vary depending on the Refuge Biologist’s need, or based on requests of partners with a vested interest in the data.

### ***Report distribution***

The text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site specific.

End-of-season reports will be distributed to the Refuge Manager and Zone Biologist. Discussion and analysis of reports will assist refuge staff in making informed management decisions that will contribute to the refuge’s goals. A hard copy of the report should be filed with the data sheets/binders.

Electronic copies of reports and graphs will be converted to .pdf file format, stored on ServCat [\[95667\]](#) and linked to the project [\[95413\]](#).

### ***Wildlife Health Reporting***

The text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015).

Suspicious or unusually high-number of mortalities should be reported to the Refuge Manager or her/his designee. Contact information and instructions for reporting and collecting specimens, and wildlife health issues can be found at the Wildlife Health office’s internal website:

<https://sites.google.com/a/fws.gov/fws-wildlife-health/products>. Additional information is available in SM-4.

## **Element 6: Personnel Requirements and Training**

### ***Roles and responsibilities***

Refuge Biologist (Survey Coordinator) – Works with Refuge Manager to set biweekly survey schedule, ensures field equipment and data sheets are available for each surveyor, ensure data sheets are available for each surveyor, trains all surveyors, enters data from field data sheets into IWMM data entry portal within one week of the survey, responsible for proofing survey data after it is entered online, responsible for all aspects of data management (including archiving data sheets on ServCat), and produces end of year reports.

Refuge Manager – Works with Refuge Biologist to set biweekly schedule. Responsible for reconnaissance surveys and prioritizing survey units for each survey. For example, if reconnaissance surveys indicate some saline lakes are dry and not used by sandhill cranes, the Refuge Manager will prioritize those units lowest and they will only be surveyed if adequate staff are available. If reconnaissance surveys indicate all saline lakes have water and are used by substantial numbers of sandhill cranes, then the Refuge Manager will work to secure additional help/surveyors. Ensures necessary personnel are available for each survey; each survey typically requires 3-4 individuals, depending on habitat conditions and crane abundance.

Observers – Follow instructions of Survey Coordinator, fully understand all field survey procedures, read protocol, read SOPs related to collection of field data, become familiar with survey units and observation points, and give completed data sheets to Refuge Biologist after each survey. Surveyors are responsible for understanding the protocol, SOPs, and all aspects of the survey including how to complete the data sheet. Data sheets that are not completed properly may render the data, and survey effort, unusable.

### ***Qualifications***

All surveys need to be conducted by qualified individuals. Surveyors should be able to:

- Identify sandhill cranes
- Understand how to fully and accurately complete field data sheets
- Estimate large numbers of sandhill cranes using recommended techniques
- Follow survey protocols
- Utilize maps, written instructions, and/or a GPS to navigate

### ***Training***

The text below is taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.



Participants in this survey should visit the IWMM project [website](#) to become familiar with the program and access additional training resources (such as recorded webinars, downloadable presentations, and manuals). Inexperienced waterbird surveyors must practice counting and estimation techniques before participating in this survey. This can be done in the field or at a desktop computer using Wildlife Counts software: <http://wildlifecounts.com/index.html>.

Surveyors should also be trained for dealing with any hazards, and in case the need should arise, proper procedures for reporting dead/injured sandhill cranes or other waterbirds. Wildlife die offs should be reported to the Refuge Manager and/or Refuge Biologist at the conclusion of the survey. For instructions on how to handle and submit waterfowl carcasses for cause of death diagnosis, please see SM-4 as well as the Mortality Event Response instructions on the Wildlife Health office internal website: <https://sites.google.com/a/fws.gov/fws-wildlife-health/products>.

If information is needed on the IWMM program, contact the Zone Biologist or IWMM Science Coordinator. To access the IWMM Q&A forum or messaging features, a membership is required. E-mail requests to [iwmmprogram@gmail.com](mailto:iwmmprogram@gmail.com).

For More Information:

- IWMM National Project Coordinator—For **name and contact information** see <http://iwmmprogram.org/>
- IWMM National Science Coordinator— For **name and contact information** see <http://iwmmprogram.org/>
- IWMM Southwest Region Representatives:  
**Paige Schmidt**, U.S. Fish and Wildlife Service, Zone Biologist, 9014 E. 21st Street, Tulsa, OK 74129 [Paige\\_Schmidt@fws.gov](mailto:Paige_Schmidt@fws.gov)  
**Bill Johnson**, U.S. Fish and Wildlife Service, NWRS-Division of Biological Services, PO Box 277, Canyon, TX 79015, [bill\\_johnson@fws.gov](mailto:bill_johnson@fws.gov), 806-499-3254
- IWMM Midwest Region Representative:  
**Brian Loges**, Zone Biologist, Two Rivers National Wildlife Refuge, HC 82 Box 107 Brussels, IL [Brian\\_Loges@fws.gov](mailto:Brian_Loges@fws.gov)

## Element 7: Operational Requirements

A typical survey will usually be conducted by 3-4 individuals, including the Refuge Manager and Refuge Biologist (Survey Coordinator). The minimum equipment requirements to complete the survey include: this protocol, SOPs 1 - 4, binoculars and/or a spotting scope for each observer, a 4-wheel drive vehicle, data sheets, pencil, and something to aid navigation (i.e. map or GPS). The Survey Coordinator (Refuge Biologist) will provide data sheets to all surveyors, and training to new surveyors. Surveyors are responsible for understanding the protocol, SOPs, and asking questions to clarify any and all aspects of the survey they are uncertain about, including completion of the data sheet.



## **Budget**

**Table 7.1.** Estimated cost to conduct sandhill crane surveys at Muleshoe and Grulla NWRs.

| Item                                       | Estimated Cost <sup>5</sup>                    |
|--|--|
| Startup Supplies                           |  |
| 5 pairs of binoculars <sup>1</sup>         | \$5000   |
| 5 clipboards <sup>1</sup>                  | \$50   |
| 5 spotting scopes and tripods <sup>1</sup> | \$7500 (not required, but observer preference) |
| 5 GPS units <sup>1</sup>                   | \$1000   |
| Reoccurring Supplies                       |  |
| batteries                                  | \$30   |
| equipment replacement                      | \$500  |
| fuel and misc.                             | \$500  |
| Approximate Staff Time <sup>2</sup>        |  |
| protocol development <sup>1, 3</sup>       | \$7250   |
| conducting surveys <sup>4</sup>            | \$5616 (season/annual)                         |
| data management <sup>5</sup>               | \$648  |
| Survey costs:                              |  |
| total start up                             | \$20800 (initial equipment + protocol)         |
| surveys                                    | \$7294 (annual recurring)                      |

<sup>1</sup>Start up cost, only needs to be purchased once and replaced on an as-needed basis. Many items on this list are already held by the refuge or participating surveyors and were purchased for reasons not specific to this survey.

<sup>2</sup>Calculated at average employee cost of \$75,000 per year (\$36 per hour).

<sup>3</sup>Site-specific protocol development is estimated to have taken about 200 hours of staff time (narrative, unit delineation, map creation, edits, etc.)

<sup>4</sup>Estimate is for 4 paid employees at 2 hours each per survey day, for 13 surveys annually (Sep – Mar) (4 x 2 x 13 = total hours; total hours x \$36 = staff costs). In addition, 4 hours are added to each survey (4 x 13) to allow for reconnaissance survey of off-refuge survey units. The estimate does not account for any unpaid volunteers, which if available, lessen the cost of the survey.

<sup>5</sup>Calculated based on estimated 13 surveys per year: 1 hour of data management time per survey + 5 additional hours for end-of-year data management and reporting (18 hours x \$36).

## **Staff time**

Survey time will vary depending on how many sandhill cranes are roosting on survey units (saline lakes). Each survey takes 3-4 individuals about 2 hours each to complete (so 6 to 8 hours total).

Assuming 4 observers are required for each of the 13 surveys, and observers spend 2 hours each per survey (4 x 2 x 13), approximately 104 total survey hours are required per year (Sep – Mar). Additionally, 52 hours are added for reconnaissance surveys (4 hours for each of the 13 survey periods), and 18 total hours per year (Sep – Mar) are added for data management. Thus, approximately 174 total hours are required to complete this survey annually, or 0.08 of a full time employee's (FTE) time annually.

## ***Schedule***

This survey will begin during the last two week period (second half) of September and continue until the last two week period of March. The first sandhill cranes of the fall migration are typically observed in late October or early September (Seyffert 2001, USFWS unpubl.). Sandhill cranes have typically departed the Southern High Plains, including Muleshoe and Grulla NWRs, by late March (Seyffert 2001, USFWS unpubl.).

Surveyors should be at their observation points at least 45 prior to sunrise. The time needed to survey each lake will vary, but cranes tend to depart saline lakes between 15 before to 30 minutes after sunrise. If a surveyor is assigned more than one saline lake, the Refuge Manager and Refuge Biologist will make the survey unit assignments based on proximity of survey units and the number of cranes expected to be roosting on the lakes. Sandhill cranes will only be counted if roosting on the lake or during their exit flight (as they depart a saline lake). No cranes will be counted in fields. The survey will end after all assigned lakes have been surveyed, or within 1 hour after sunrise. However, inclement weather conditions may keep cranes on roost up to several hours after sunrise, in which case the Survey Coordinator may allow the survey time frame to extend longer if needed.

## ***Coordination***

Coordination among the Refuge Manager, Refuge Biologist (Survey Coordinator), and surveyors is vital. The Refuge Manager is responsible for insuring there are enough surveyors to complete the task, and the Refuge Biologist is responsible for training surveyors. Training, which includes familiarizing surveyors with the protocol, SOPs and data sheets, must take place prior to survey day. There will not be sufficient time to bring new surveyors up to speed on the morning of the survey. If logistics do not allow the Refuge Biologist to train new surveyors, training may be performed by the Refuge Manager.

During the survey, vehicle radios or cell phones may be used to communicate between surveyors. Do not utilize any communication device, including but not limited to USFWS issued cell phones or personal cell phones, while operating a moving vehicle. If communication is necessary, safely pull over to the side of the road and completely stop the vehicle before using a phone or radio.

Communication with external partners that use the survey data or results will primarily take place through distribution of end-of-year (end-of-season) reports. It may also take place when external partners make periodic, but unscheduled, requests for data or reports.

## Element 8: References

- Boyd WS. 2000. A comparison of photo counts versus visual estimates for determining the size of snow goose flocks. *Journal of Field Ornithology* 71:686-690.
- Coppen JL, Heglund PJ, Delehanty S, Fox T, Johnson R, Jones MT, Kenow K, Lonsdorf E, Thogmartin W. 2007. Waterfowl migration case study from the Structured Decision Making Workshop, 25-29 March 2007. Upper Mississippi River Environmental Science Center-LaCrosse, Wisconsin.
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- Loges BW, Tavernia BG, Wilson AM, Stanton JD, Herner-Thogmartin JH, Casey J, Coluccy JM, Coppen JL, Hanan M, Heglund PJ, Jacobi SK, Jones T, Knutson MG, Koch KE, Lonsdorf EV, Laskowski HP, Lor SK, Lyons JE, Seamans ME, Stanton W, Winn B, Ziemba LC. 2015. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative (IWMM) approach. U.S. Fish and Wildlife Service, Natural Resources Program Center, Fort Collins, Colorado.  
[http://www.iwmmprogram.org/documents/IWMM\\_NationalProtocolFramework\\_Ver1.0\\_Aproved.pdf](http://www.iwmmprogram.org/documents/IWMM_NationalProtocolFramework_Ver1.0_Aproved.pdf) (March 2018); <https://ecos.fws.gov/ServCat/Reference/Profile/83678> (ServCat link to updated, 2017 version)
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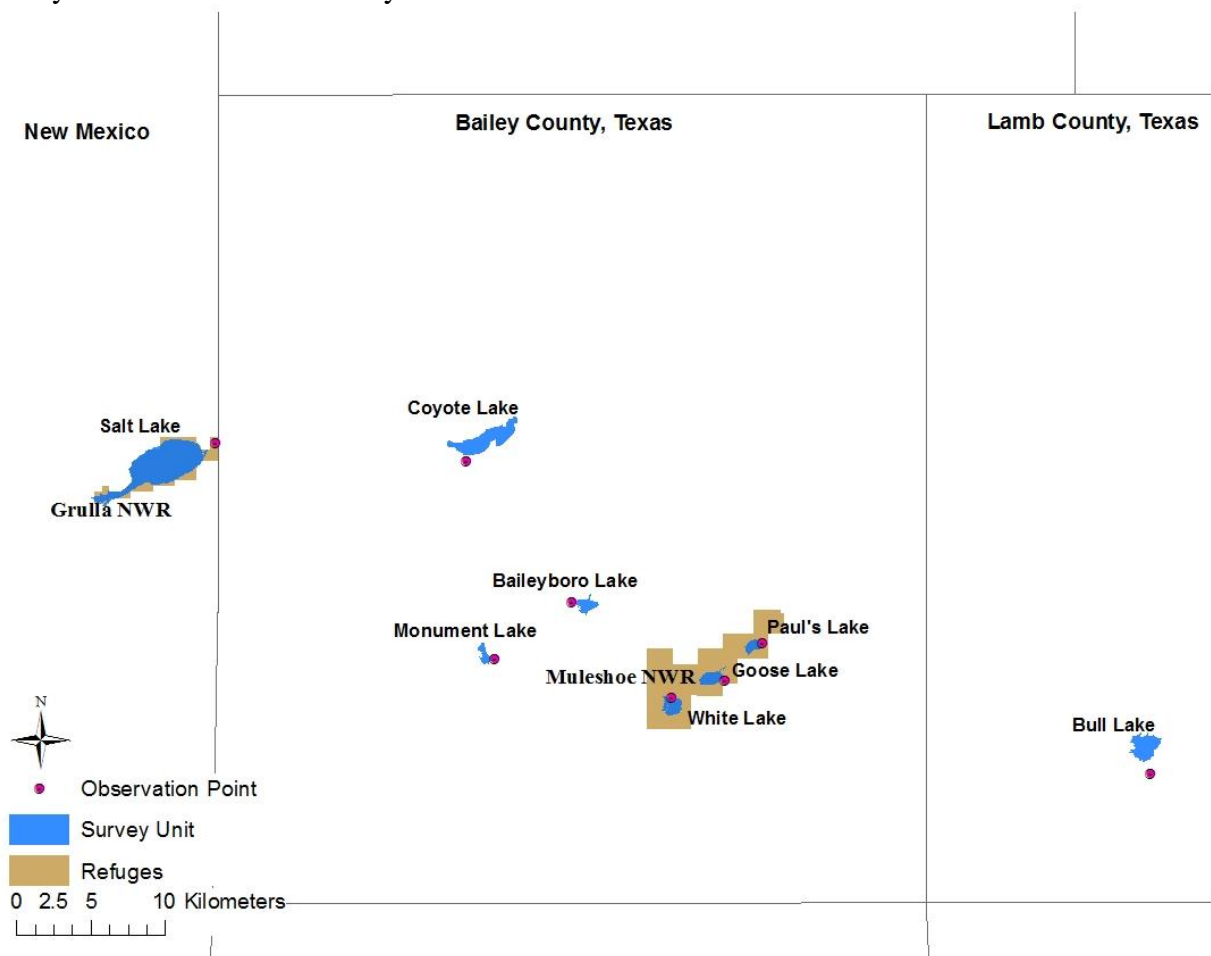
## Appendices

# Standard Operating Procedures (SOP)

## SOP 1: Sampling Design

The text below is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

The survey units are Paul’s Lake, Goose Lake, White Lake, Salt Lake, Baileyboro Lake, Bull Lake, Coyote Lake and Monument Lake. The survey units (Figure SOP 1.1) span Roosevelt County in New Mexico to Bailey and Lamb Counties in Texas.



**Figure SOP 1.1.** Muleshoe and Grulla National Wildlife Refuge sandhill crane units.

### *Target Universe*

Sandhill cranes are the target species for this survey protocol. Specifically, we are concerned with assessing abundance of those that occur in the western Southern High Plains from late September – March. As per the IWMM framework, census techniques are used to assess waterbird abundance and environmental conditions.

Crane counts will take place from the survey unit's designated observation point. Observation point locations are listed in Table SOP 4.1. Percent visibility of each survey unit was visually estimated by the lead author (K. Linner) from the observation point by scanning the unit with binoculars (Table SOP 4.1). Except for Coyote Lake, which is counted as an "exit count," there is > 70% visibility of each survey unit. Figure captions for Figures SOP 4.1 – SOP 4.8 (see SOP 4) contain driving directions. A shapefile (ESRI 1998) of the survey unit boundaries is available on ServCat [[95415](#)]

#### *Assigning IWMM Site, Survey Unit and Observer Codes*

Site, survey unit (Table SOP 4.1.) and observer codes were assigned by IWMM staff. If additional assistance is needed with IWMM codes for site, survey unit, or observers, please contact the IWMM Science Coordinator ([iwmmprogram@gmail.com](mailto:iwmmprogram@gmail.com); additional contact information is available from <http://iwmmprogram.org/>). If observers do not know the codes, please leave them blank, but make sure that you fill in name details (for example, Paul's Lake) so that the codes can be subsequently completed by the Refuge Biologist. Any questions concerning codes by observers should be reconciled with the Refuge Biologist immediately following completion of the survey.

#### ***Sample selection and size***

All saline lakes on Muleshoe and Grulla NWRs were included as survey units, as well as four off-refuge saline lakes. Due to occasional personnel constraints, all eight survey units may not be surveyed during every survey session. Muleshoe and Grulla survey units have the highest priority and will be surveyed during each survey. If survey personnel are going to be limited, the refuge manager or his/her designee will perform a reconnaissance survey units <2 days before the scheduled survey to prioritize off-refuge saline lakes. Survey units will be prioritized based on sandhill crane numbers and water availability. Off-refuge survey units holding the largest number of sandhill cranes will be prioritized highest. Off-refuge survey units that are dry and absent of cranes will be prioritized lowest and may not be surveyed. "Non-surveyed" units will be recorded as not-surveyed, not "0" (zero) birds.

#### ***Survey timing and schedule***

##### *Seasonality*

Surveys will occur annually. They will begin late September and end in late March to encompass the presence of migrating and wintering sandhill cranes.

##### *Schedule*

Sandhill Crane surveys and unit condition surveys will occur bi-weekly on a consistent weekday (e.g., Wednesday). All units will be counted on the same day.

##### *Survey time*

Observers will arrive at their initial survey unit at least 45 minutes before sunrise, and begin surveys when there is enough light to identify and count sandhill cranes. Birds must be counted

either on roost sites or while exiting (flying off) roost sites. The surveys last approximately 1-2 hours from start to finish.

### **Sources of error**

The text below is taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

Detection of sandhill cranes is likely to be imperfect, thus biasing estimates. Inaccuracy occurs when some individuals are unavailable for detection (e.g., hidden behind other birds), when individuals that are available are not perceived by the observer, or when observers under or overestimate extremely large flocks. Many factors can influence detectability, including observer ability and attention, habitat conditions, and weather. Unlike management units (for example, moist soil units), detectability of sandhill cranes due to changing vegetation structure throughout the season should be a minor issue, as saline lakes are mostly devoid of vegetation. However, the size of flocks occurring on single survey units will likely vary tremendously across the survey period. Observers tend to underestimate flocks of large birds in excess of 2,000 (Boyd 2000), and the degree of bias (of the underestimate) increases as flock size increases. Estimates of sandhill cranes on individual saline lakes may exceed 50,000 (Iverson et al. 1985, Muleshoe NWR, unpublished). Training may improve the ability of observers to estimate large flocks; refer to SOP 2.

### **References**

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[http://www.iwmmprogram.org/documents/IWMM\\_NationalProtocolFramework\\_Ver1.0\\_Approved.pdf](http://www.iwmmprogram.org/documents/IWMM_NationalProtocolFramework_Ver1.0_Approved.pdf) (March 2018); <https://ecos.fws.gov/ServCat/Reference/Profile/83678> (ServCat link to updated, 2017 version)



## **SOP 2: Data Collection Methods – Counting and Estimating Sandhill Cranes**

Sandhill cranes roost on shallow saline lakes at night, disperse to feed on agricultural fields during the day, and return to the saline lakes in late afternoon or evening (Iverson et al. 1985). Muleshoe and Grulla NWRs conduct surveys while cranes are at their roost sites (saline lakes). The survey units include eight roost sites: Baileyboro Lake, Bull Lake Coyote Lake, Goose Lake, Monument Lake, Paul's Lake, Salt Lake and White Lake. Observers should arrive at survey units at least 45 minutes before sunrise. Surveys are conducted from designated observation points (SOP 4, Table SOP 4.1). If the count is not completed before cranes begin to leave the roost site, observers may estimate crane numbers by counting cranes as they fly off the site (exit count). All surveys conducted at Coyote Lake will be by exit counts.

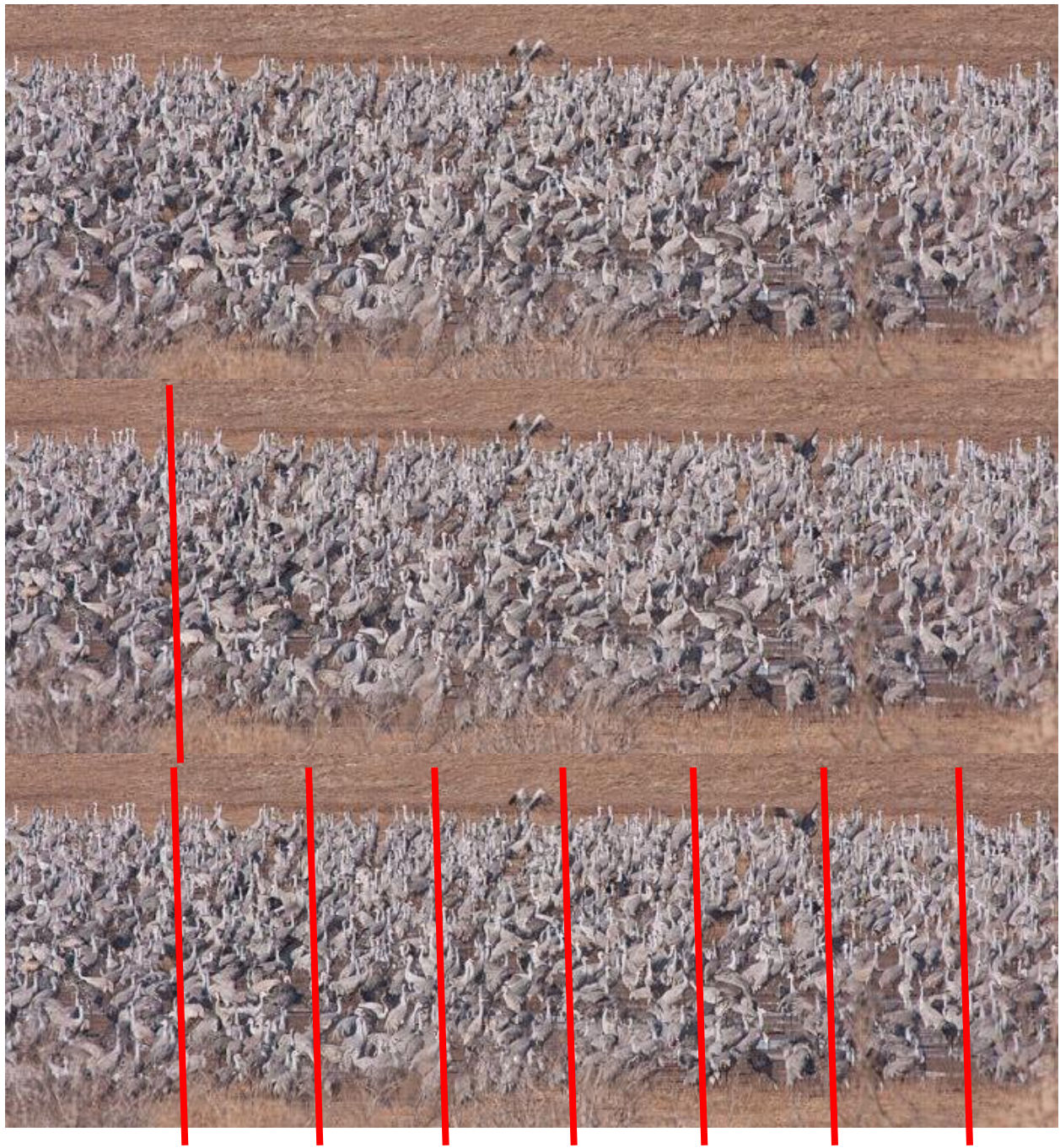
The text below largely follows the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

Counts or approximated counts of individual sandhill cranes are recorded on the Waterbird & Unit Condition Survey form (see SM-5). The four letter AOU code for sandhill cranes is SACR. Observers may use the AOU code, or spell out sandhill crane.

Be careful not to count individual sandhill cranes more than once. When in doubt about whether an individual sandhill crane was already counted, err on the side of not double-counting. If you find that no sandhill cranes are present, still record survey condition information (e.g., disturbance, depth, etc).

Visually scan the survey unit systematically, counting individual sandhill cranes. For larger sites, or sites where there are large numbers of sandhill cranes, it is often more practical to estimate numbers. A spotting scope will be required at most survey units. Estimating numbers may be necessary if sandhill cranes move around the wetland or are in very tightly packed flocks.

To survey sandhill cranes in a flock, first estimate a ‘block’ of sandhill cranes, e.g. 5, 10, 20, 50, 100, 500, 1000 cranes depending on the total number. To do this, count a small number of sandhill cranes (e.g., 10) to gain a sense of what a group of 10 looks like. Then count by 10s to 50s or 100 cranes to gain a sense of what 50 or 100 looks like. The block is then used as a model to measure the remainder of the flock. In the example below (Figure SOP 2.1) we use ‘blocks’ of 100 birds to arrive at an estimate of 800 sandhill cranes.



**Figure SOP 2.1.** Estimating flock size for a group of sandhill cranes. Count members within a block, for example 100 individuals, then see how many blocks there are in the group. In this example, 8 blocks x 100 individuals/block = 800 individuals in the group. Photo courtesy of Texas Tech University.

*Survey Tip*

If surveying sites with large numbers of sandhill cranes, it is often best to count in teams of two, one person counting while the other records the numbers on the data sheet. Alternatively, some

people like to use recording devices, so that they are not constantly interrupting counts to record information.

#### *Additional Training and Information*

Participants, particularly first-time surveyors, should visit the IWMM project [website](#) to become familiar with the program and access additional training resources (such as recorded webinars, downloadable presentations, and manuals). Inexperienced waterbird surveyors must practice their counting and estimation techniques before participating in this survey. This can be done in the field or at a desktop computer using Wildlife Counts software:

<http://wildlifecounts.com/index.html>.

#### *Safety*

The Refuge Manager or his/her designee should inform surveyors of local hazards, and data collectors should ask if there is anything they should be aware of. Although the need for communication with other surveyors may occur during the course of the survey, do not utilize communication devices while operating a moving vehicle. If communication is necessary, safely pull over to the side of the road and completely stop the vehicle before using a phone or radio.

#### *Wildlife die-offs*

Wildlife die-offs and sick cranes should be reported to the Refuge Manager and/or Refuge Biologist at the conclusion of the survey. Sandhill cranes in the Southern High Plains regularly succumb to mycotoxin and aflatoxin poisoning, non-contagious diseases resulting from eating moldy peanuts and waste grains. Cranes suffering from mycotoxin poisoning typically cannot hold their heads up or fly. The survey should not be stopped to pursue or collect such birds, but they should be reported to the Refuge Manager and/or Refuge Biologist.

Information on the proper procedures for reporting dead/injured sandhill cranes or other waterbirds is available from the National Wildlife Health Center in Madison, Wisconsin. For instructions on how to handle and submit waterfowl carcasses for cause of death diagnosis, please see SM-4 as well as the Mortality Event Response instructions on the Wildlife Health office internal website: <https://sites.google.com/a/fws.gov/fws-wildlife-health/products>.

#### ***Equipment***

The following field equipment is required for the sandhill crane monitoring survey:

- Good optical equipment, including a spotting scope
- Thermometer (°C)
- Map of the site and unit boundaries
- Waterbird & Unit Condition Survey form (SM-5)
- Pen / pencil

An appropriate number of vehicles will need to be secured / arranged, depending on the number of staff and volunteers, to conduct this survey.

## **References**

- Iverson CG, Vohs PA, Tacha TC. 1985. Distribution and abundance of sandhill cranes in Western Texas. *Journal of Wildlife Management* 49:250-255.
- Loges BW, Tavernia BG, Wilson AM, Stanton JD, Herner-Thogmartin JH, Casey J, Coluccy JM, Coppen JL, Hanan M, Heglund PJ, Jacobi SK, Jones T, Knutson MG, Koch KE, Lonsdorf EV, Laskowski HP, Lor SK, Lyons JE, Seamans ME, Stanton W, Winn B, Ziemba LC. 2015. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative (IWMM) approach. U.S. Fish and Wildlife Service, Natural Resources Program Center, Fort Collins, Colorado.  
[http://www.iwmmprogram.org/documents/IWMM\\_NationalProtocolFramework\\_Ver1.0\\_Aproved.pdf](http://www.iwmmprogram.org/documents/IWMM_NationalProtocolFramework_Ver1.0_Aproved.pdf) (March 2018); <https://ecos.fws.gov/ServCat/Reference/Profile/83678> (ServCat link to updated, 2017 version)



### SOP 3: Data Collection Methods – Site Condition Survey

The text below is taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

#### **Site condition surveys**

##### *Percent Visibility*

As required by the IWMM protocol framework (Loges et al. 2015),  $\geq 70\%$  of each survey unit is visible from observation points (vantage points); the one exception is Coyote Lake, which is counted as an exit survey. The estimated percentage of each survey unit that is visible from vantage points is in Table SOP 4.1.

##### *Appropriate Weather*

Surveys during inclement weather should be avoided. Do not survey sandhill cranes in fog and, if possible, avoid rain due to visibility and logistical reasons. The IWMM framework suggests avoiding waterbird surveys in high winds (Beaufort force  $\geq 3$ ; Loges et al. 2015); however, due to pervasiveness of high wind speeds at the survey area, surveying in higher winds is allowed if wind speeds do not impede visibility. Due to the size of the birds and the shallow nature of the wetlands, sandhill cranes roosting on saline lakes will likely not be obstructed from an observer’s view due to wind driven waves or moving vegetation.

Record temperatures ( $^{\circ}\text{C}$ ) at the start of the survey and also estimate Beaufort wind scale (Table SOP 3.1).

**Table SOP 3.1.** The Beaufort Wind Scale

| KPH   | Beaufort | Description     | Appearance of wind effects                                     |
|-------|----------|-----------------|--|
| <2    | 0        | Calm            | Calm, smoke rises vertically                                   |
| 2–5   | 1        | Light Air       | Smoke drift indicates wind direction, still wind vanes         |
| 6–11  | 2        | Light Breeze    | Wind felt on face, leaves rustle, vanes begin to move          |
| 12–19 | 3        | Gentle Breeze   | Leaves and small twigs constantly moving, light flags extended |
| 20–29 | 4        | Moderate Breeze | Raises dust and loose paper; small branches are moved          |
| 30–39 | 5        | Fresh Breeze    | Small trees in leaf begin to sway                              |
| 40–50 | 6        | Strong Breeze   | Large branches in motion; umbrellas used with difficulty       |

##### *Water Gauge Reading*

Record water level readings at units with a gauge each time a survey is conducted. If the survey unit has a gauge, be sure to provide the measurement units of the water level gauge.

##### *Water Depth*

Estimate the percent of the unit in each of six water depth categories (Table SOP 3.2) corresponding to waterbird guild use (Ma et al. 2010). Percent cover estimates should sum to 100% across the six depth categories.

**Table SOP 3.2.** Categories of water depth

| Category              |
|-----------------------|
| Dry                   |
| Saturated/mudflat     |
| 0–5 cm (0 to 2 in)    |
| 5–15 cm (2 to 6 in)   |
| 15–25 cm (6 to 10 in) |
| >25 cm (> 10 in)      |

If ice is present, do not treat it as dry – instead estimate the depth of water and ice.

#### *Percent of ice cover*

Across the entire survey unit, visually estimate and record the percent of the water surface that is covered by ice.

#### *Water coverage*

Across the entire survey unit, visually estimate and record the percent of the survey unit that is covered by water.

#### *Habitat Cover*

Visually estimate the percent of the survey unit that is water, bare ground, and emergent vegetation. Cowardin et al. (1979) classifications suggested in the IWMM protocol framework (Loges et al. 2015) poorly describe saline lakes. Categories used are consistent with Loges et al. (2015), but will be limited to water, emergent, shrub-scrub (salt cedar), and bare ground for this survey. To aid in estimating percent water coverage, maps of each lake may be carried to the field and areas of water coverage may be sketched on the lakes. Emergent and shrub-scrub components are not always found on saline lakes. If present, emergent and shrub-scrub vegetation will typically be restricted to areas strongly influenced by inflows from springs, which are dispersed along edges/margins of the lakes. Refer to Rosen et al. (2013) for images of emergent components of saline lakes.

#### *Interspersion*

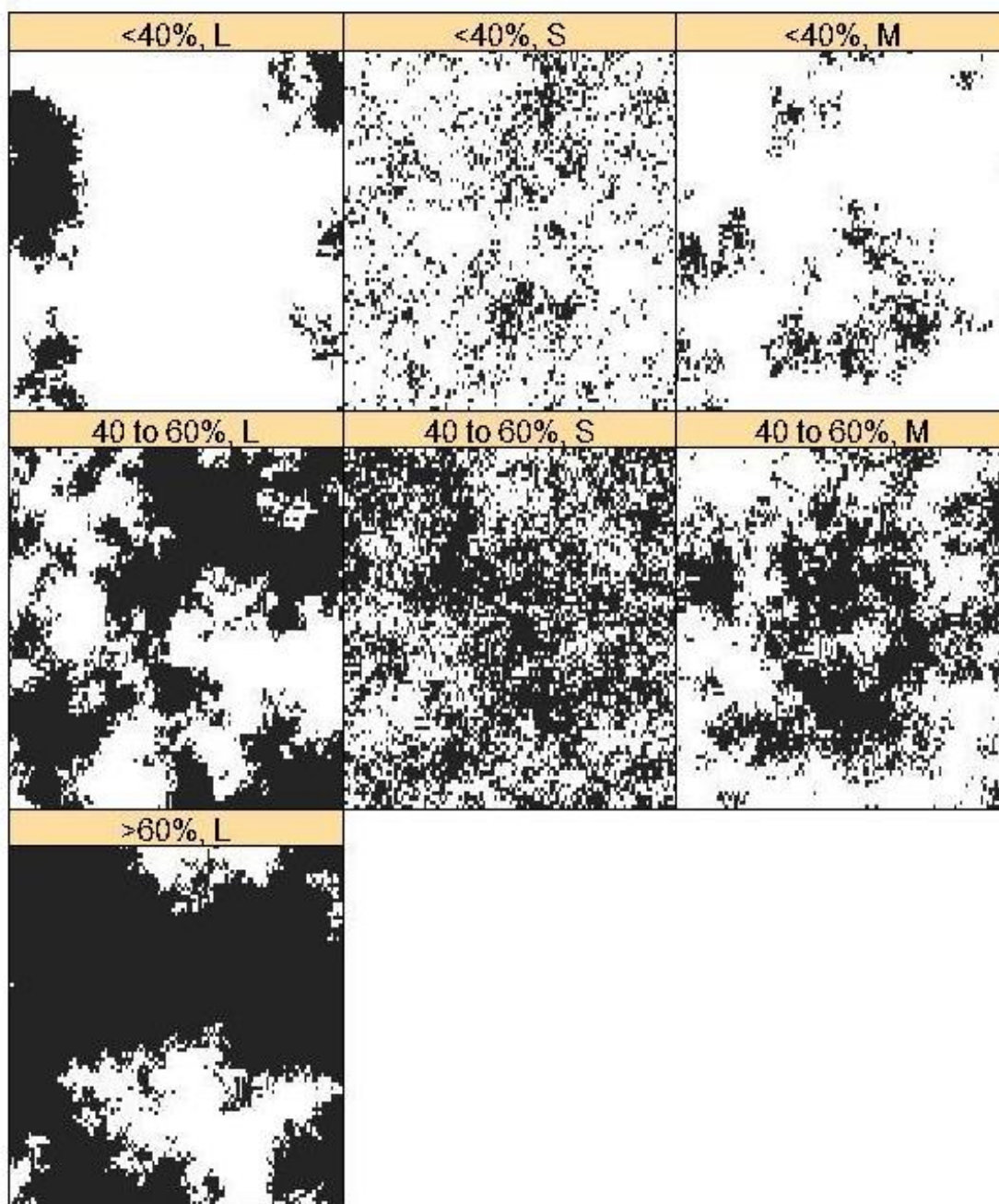
The configuration of vegetation and water/bare ground patches within a survey unit can influence habitat quality. The IWMM protocol framework (Loges et al. 2015) calls for defining vegetation patches as scrub-shrub, forest, and emergent, and defining water/bare ground patches as open water, submerged aquatic vegetation, floating-leaved aquatic vegetation, and bare ground. If the pluvial saline lakes in study area have an emergent or scrub-shrub (salt cedar) component, it is likely restricted to the immediate area of the margins or immediate areas of the springs. Springs are located either along edges of the systems or in uplands near the systems. Therefore, saline lakes will typically be completely open and coverage by water and bare ground (mud/organic or cobble) will approach 100%.

IWMM uses three interspersion configuration classes (Figure SOP 3.1) based on Suir et al. (2013). The three configuration classes are:

- Class L includes large and connected patches of water/bare ground features
- Class S contains small, disconnected patches of water/bare ground

- Class M contains discernible regions of both classes L and S

These classes reflect the interspersion, or inter-mixing, of vegetation and water/bare ground patches. Assign the survey unit to one of the configuration classes as an indicator of interspersion. Note that, when water/bare ground covers >60% of a unit, the only possible configuration class is L. Saline lakes addressed in this protocol will almost always fall into the Class L category.



**Figure SOP 3.1.** Examples of three configuration categories (L; S; M). The three categories are illustrated for different levels of water/bare ground cover (<40%; 40 to 60%; >60%). Water/bare ground areas are represented in black above whereas vegetated areas are represented in white. In the case of saline lakes, which are primarily open water, the interspersed image would always be >60%, L. The open saline lakes would have even larger patches of black, representing water and bare ground.

### *Vegetation Height*

Use ocular estimation to assess the percentage of the unit in each of seven vegetation height categories (Table SOP 3.3). Note the height being measured is the uppermost canopy, so the



percent cover estimates should sum to 100% across all categories. Note that saline lakes will mostly be in the <2.5 cm category due to bare ground and mud approaching 100% coverage.

Table SOP 3.3. Categories of vegetation height.

| Category     | Description   |
|--------------|---|
| <2.5 cm      | includes bare ground (e.g. mudflat) and water                                   |
| 2.5 to 15 cm | short vegetation, e.g. grazed grassland, sprouting crops, dwarf spikerush, etc. |
| 15 to 30 cm  | short herbaceous  |
| 30 to 60 cm  | medium forbs and grasses  |
| 60 cm to 3 m | shrubs and low trees plus tall herbaceous vegetation and grasses.               |
| 3 to 6 m     | shrubs, trees, tall herbaceous  |
| >6 m         | tall trees  |

#### *Disturbance severity*

Record any disturbance that is or has affected sandhill cranes abundance in the survey unit either during or immediately prior to surveys. Score the disturbance on a scale 1 to 4 (Table SOP 3.4).

Table SOP 3.4. Severity scale and associated definitions of sandhill crane response to disturbance.

| Scale | Severity   | Definition                                     |
|-------|------------|--|
| 1     | Light/none | no effect on sandhill cranes                   |
| 2     | Moderate   | some sandhill cranes move but stay within unit |
| 3     | Heavy      | some sandhill cranes leave unit                |
| 4     | Limiting   | most/all sandhill cranes leave the unit        |

#### *Disturbance source*

If there is disturbance (see Disturbance Severity above), check the appropriate box to identify its source. Multiple sources can be checked. Potential sources are listed in Table SOP 3.5.

Table SOP 3.5. Types of disturbance

| Code | Description    |
|------|----------------|
| 1    | Pedestrian     |
| 2    | Loose dog      |
| 3    | Hunting        |
| 4    | Fishing        |
| 5    | Boats          |
| 6    | Motor vehicles |
| 7    | Aircraft       |
| 8    | Raptor         |
| 9    | Other          |

#### *Human Disturbance*

Characterize each survey unit for the period between the last and the current sandhill crane survey (Table SOP 3.6). For off-refuge sites, ask the Refuge Manager if uncertain. For public lands, check site regulations or consult with refuge management.

Table SOP 3.6. Chronic disturbance classes and their definitions.

| Class | Description  |
|-------|--|
| 1     | No entry into the unit for any reason.   |
| 2     | Closed to all use with entry into unit by resource managers or designees for management activities, surveys, or other controlled non-hunting activities.                       |
| 3     | Managed access for all activities including firearms hunting. May include effort to control use levels and temporal closures (i.e. hunting units that close in the afternoon). |
| 4     | Open access via trail, viewing platforms etc. No firearms hunting allowed.   |
| 5     | Open access, including firearms hunting, often with routine restrictions but without a site specific management program to control the level of authorized use.                |
| 6     | Unknown  |

## References

- Cowardin LM, Carter V, Golet FC, LaRoe ET. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. <https://www.fws.gov/wetlands/documents/classwet/index.html>
- Loges BW, Tavernia BG, Wilson AM, Stanton JD, Herner-Thogmartin JH, Casey J, Coluccy JM, Coppen JL, Hanan M, Heglund PJ, Jacobi SK, Jones T, Knutson MG, Koch KE, Lonsdorf EV, Laskowski HP, Lor SK, Lyons JE, Seamans ME, Stanton W, Winn B, Ziemba LC. 2015. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative (IWMM) approach. U.S. Fish and Wildlife Service, Natural Resources Program Center, Fort Collins, Colorado.  
[http://www.iwmmprogram.org/documents/IWMM\\_NationalProtocolFramework\\_Ver1.0\\_Approved.pdf](http://www.iwmmprogram.org/documents/IWMM_NationalProtocolFramework_Ver1.0_Approved.pdf) (March 2018); <https://ecos.fws.gov/ServCat/Reference/Profile/83678> (ServCat link to updated, 2017 version)
- Ma Z, Cai Y, Li B, Chen J. 2010. Managing wetland habitats for waterbirds: an international perspective. *Wetlands* 30:15–27.
- Rosen D J, Caskey, AD, Conway WC, Haukos DA. 2013. Vascular flora of saline lakes in the Southern High Plains of Texas and eastern New Mexico. *Journal of the Botanical Research Institute of Texas* 7:595-602.
- Suir GM, Evers DE, Steyer GD, Sasser CE. 2013. Development of a reproducible method for determining the quantity of water and its configuration in a marsh landscape. *Journal of Coastal Research, Special Issue* 63:110–117.

## SOP 4: Locations of Survey Units – Driving Directions

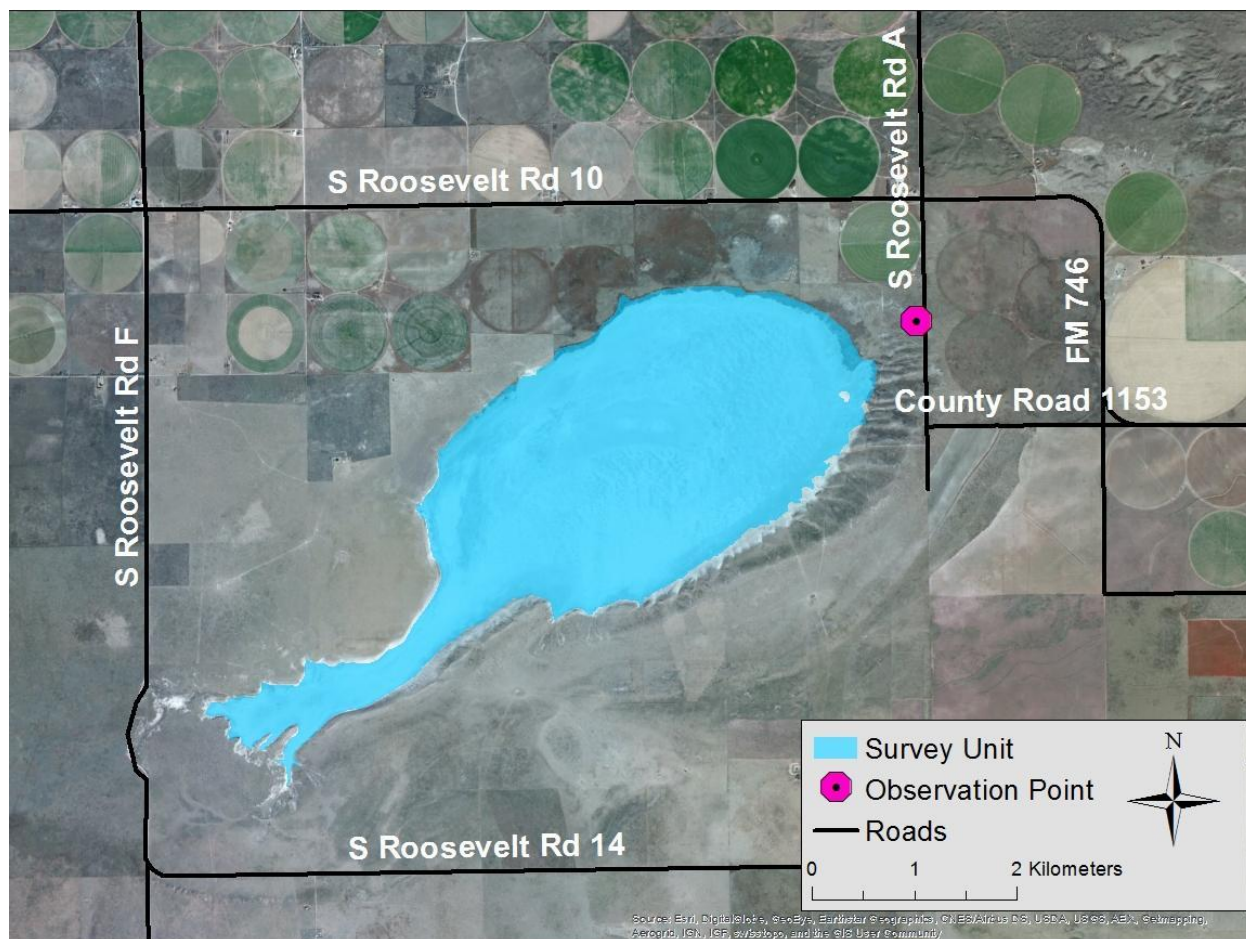
The location of each observation point is in Table SOP 4.1, and figures below (Figures SOP 4.1 - 4.8) contain general driving directions associated with each observation point and survey unit.

Table SOP 4.1 Observation point locations\* for each survey unit and estimated percent visibility

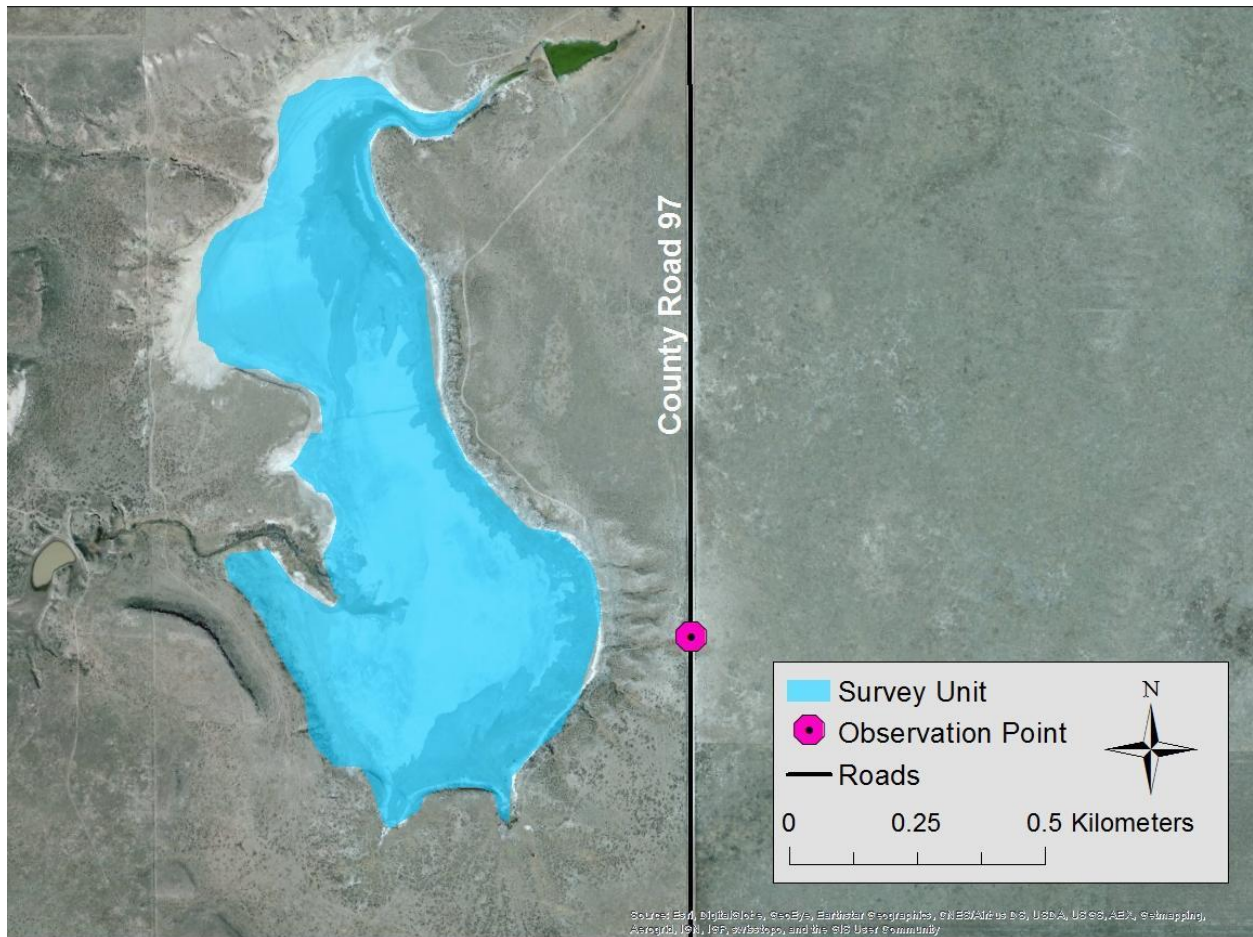
| <b>Survey Point</b>    | <b>IWMM Survey Unit Codes</b> | <b>UTM Easting* (m)</b> | <b>UTM Northing* (m)</b> | <b>Approx. visibility of survey unit (%)</b> |
|------------------------|-------------------------------|-------------------------|--------------------------|--|
| Salt Lake (Grulla NWR) | TX-003-SL                     | 680372                  | 3775200                  | 95   |
| Monument Lake          | TX-003-ML                     | 696225                  | 3761060                  | 95   |
| Coyote Lake            | TX-003-CL                     | 694237                  | 3774295                  | <50**  |
| Baileyboro Lake        | TX-003-BB                     | 700429                  | 3765001                  | 95   |
| Paul's Lake            | TX-003-PL                     | 711118                  | 3762476                  | 90   |
| Goose Lake             | TX-003-GL                     | 709083                  | 3759907                  | 95   |
| White Lake             | TX-003-WL                     | 706131                  | 3758750                  | 95   |
| Bull Lake              | TX-003-BL                     | 733032                  | 3754224                  | 85   |

\*Recorded in Universal Transverse Mercator zone 13N

\*\*Exit count only (birds counted in flight as the depart roost site)

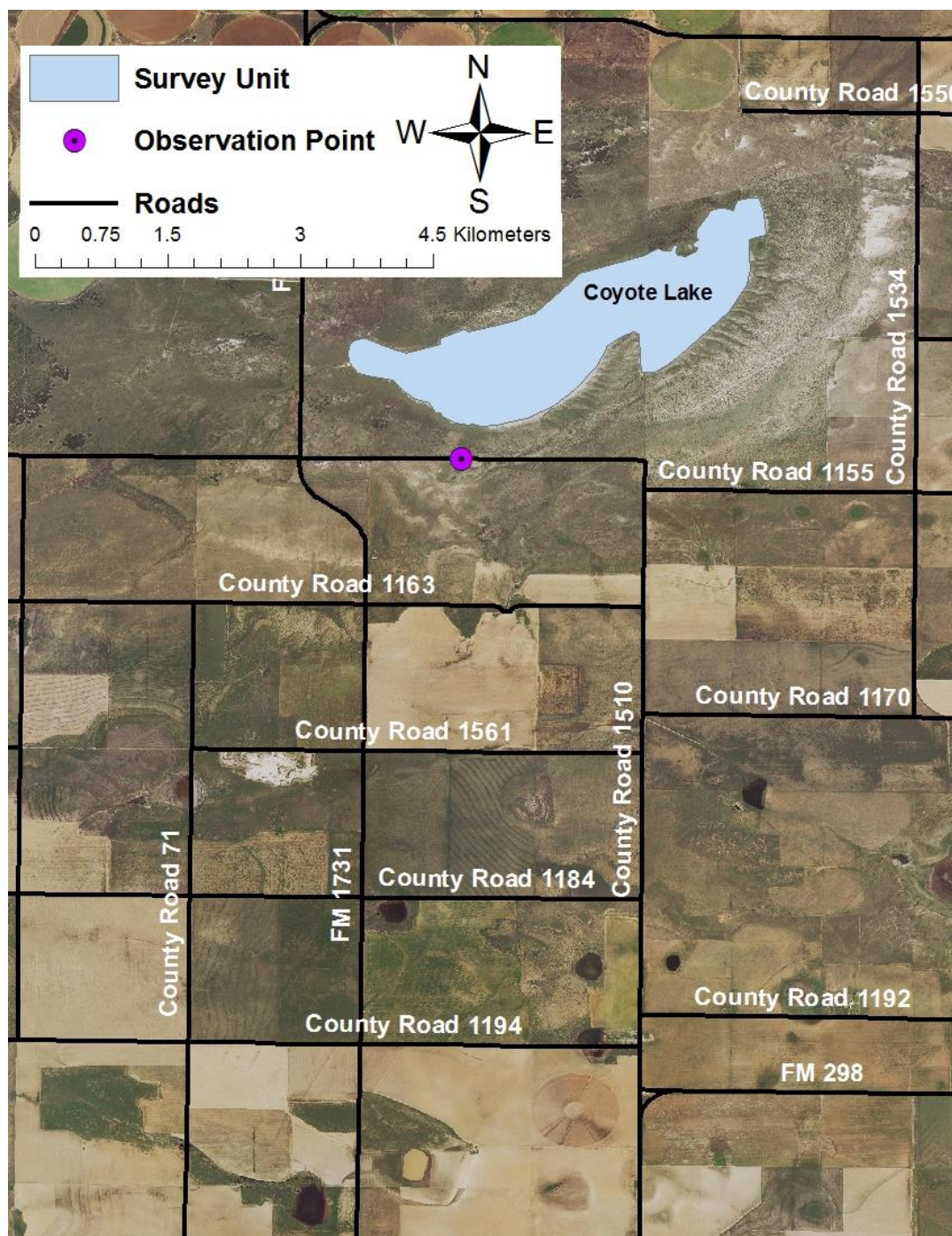


**Figure SOP 4.1.** Salt Lake Survey Unit: The observation point is located on Grulla NWR, approximately 29.5 km northwest of the Muleshoe NWR refuge visitor center. From the visitor center, travel east onto County Road (CR) 1248, then turn north onto HWY 214. Go west on CR 1170, then north onto CR 1510. Turn west onto Farm-to-Market (FM) 746 and continue as it curves until S Roosevelt Rd A and turn south. Enter the parking area on west side of road and walk towards Salt Lake to observation point.

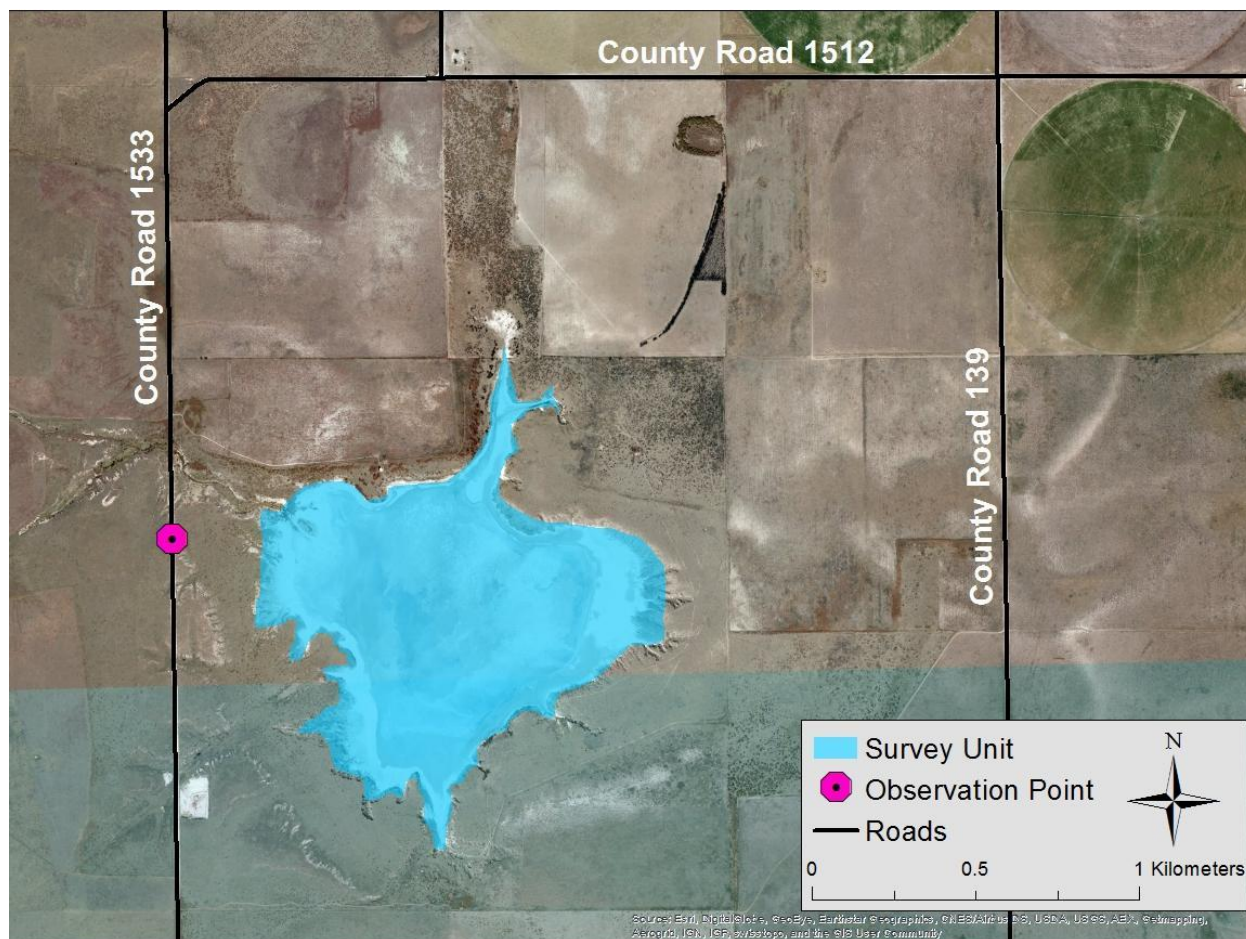


**Figure SOP 4.2.** Monument Lake Survey Unit: The observation point is located approximately 9.3 km west of Muleshoe NWR visitor center on County Road (CR) 97. From the visitor center, exit Muleshoe NWR on west side via CR 1248 and turn north onto CR 149. Travel on CR 149 approximately 3 km and turn west onto CR 1223, then south onto CR 139. Go west on CR 1233, then north on CR 1533, west again on CR 1223, and finally south onto CR 97 to the observation point. Alternately, from the visitor center one could travel east on CR 1248 to highway 214 and turn south. Then turn west onto CR 1272, north onto CR 1533, west onto CR 1259 and finally north onto CR 97 to observation point.



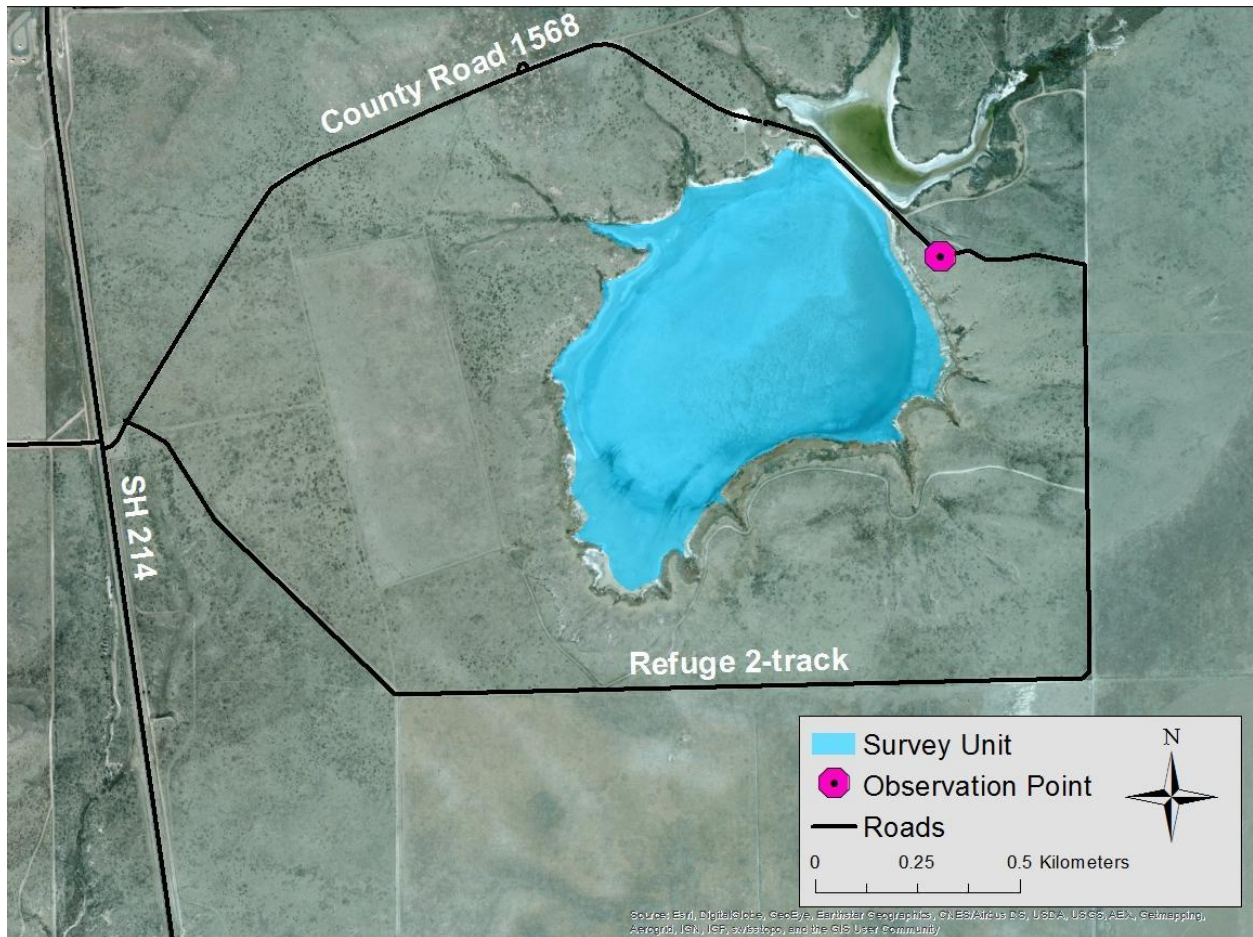


**Figure SOP 4.3.** Coyote Lake Survey Unit: The observation point is located approximately 18.5 km northwest of Muleshoe NWR visitor center along County Road (CR) 1153. From the visitor center, exit Muleshoe NWR on west side via CR 1248 and turn north onto CR 149. On CR 149 travel 8.2 km, and then turn west onto HWY 298. Continue on HWY 298 approximately 8.8 km, then turn north on CR 1510 (Rd 97). Drive north on CR 1510 approximately 7 km to FM 746. Travel west on CR 1153 (FM 746) approximately 1.5 km to observation point.



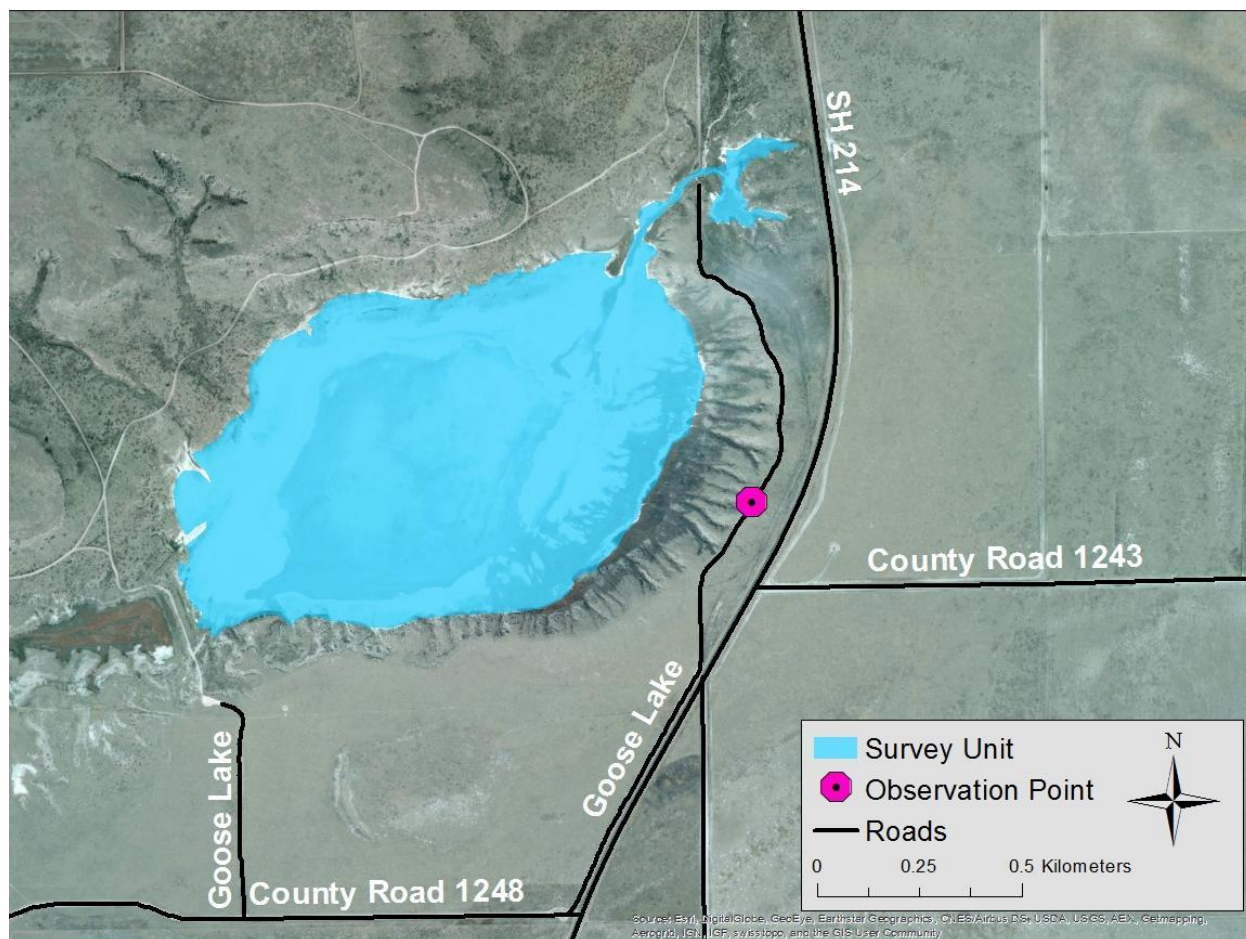
**Figure SOP 4.4.** Baileyboro Lake Survey Unit: The observation point is located approximately 7.2 km northwest of Muleshoe NWR visitor center on County Road (CR) 1533. From the visitor center, exit Muleshoe NWR on west side via CR 1248 and turn north onto CR 149. Continue on CR 149 until reaching CR 1512, then travel west on CR 1512 and until reaching CR 1533. Travel south on CR 1533 until you reach observation point.



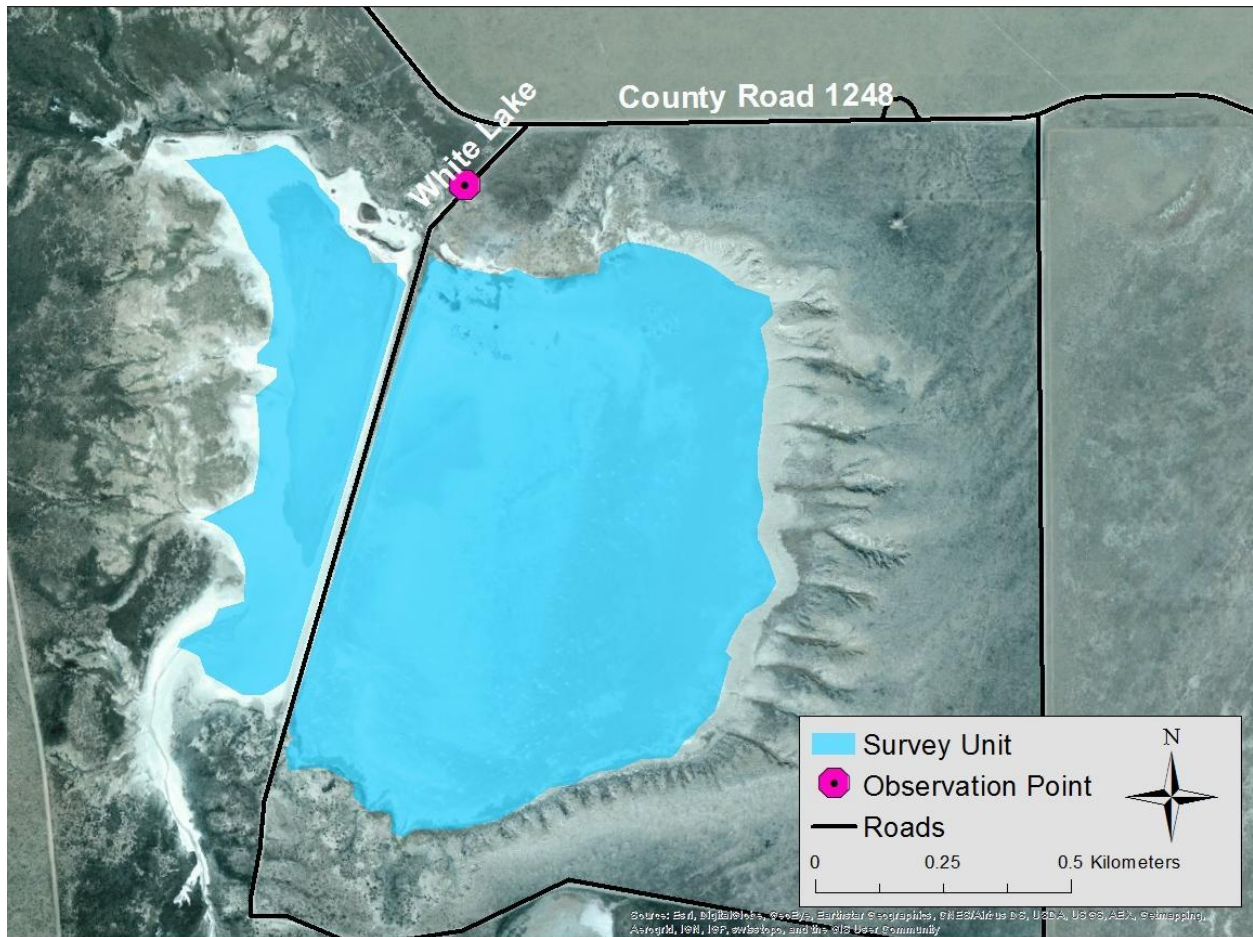


**Figure SOP 4.5.** Paul's Lake Survey Unit: The observation point is located on Muleshoe NWR approximately 6.5 km northwest of the Muleshoe NWR visitor center. From the visitor center, take County Road (CR) 1248 east to HWY 214, and turn north. Then turn right onto CR 1568 and almost immediately turn right onto a two-track refuge road; follow this road to observation point.



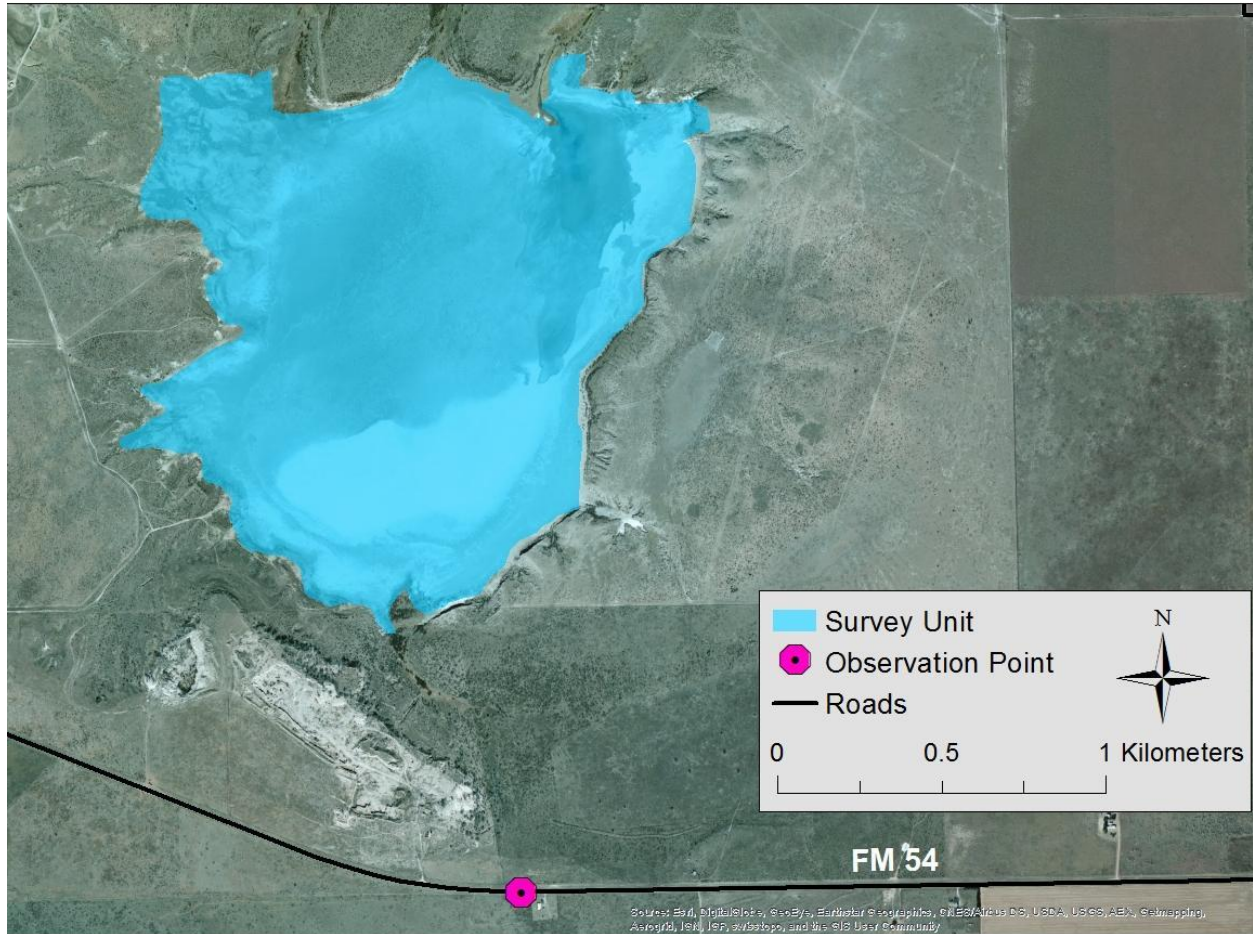


**Figure SOP 4.6.** Goose Lake Survey Unit: The observation point is located on Muleshoe NWR on Goose Lake Road approximately 3.7 km east of Muleshoe NWR visitor center. From the visitor center, turn north onto Goose Lake Road just before you reach HWY 214. Continue north to the observation point.



**Figure SOP 4.7.** White Lake Survey Unit: The observation point is located on Muleshoe NWR approximately 1.0 km southwest of the Muleshoe NWR visitor center. Travel east from the visitor center on County Road (CR) 1248, and quickly turn right onto White Lake Road to the observation point.





**Figure SOP 4.8.** Bull Lake Survey Unit: The observation point is located approximately 28.0 km east of Muleshoe NWR visitor center on Farm to Market (FM) 54. From the visitor center, travel east on County Road (CR) 1248, then turn south onto HWY 214. Turn east onto FM 37, and continue east when it turns into FM 54. The observation point is on the north side of the road at the historical marker.

## **SOP 5: Data Entry and Management Instructions**

The text in this SOP is largely taken from the “National Protocol Framework for the Inventory and Monitoring of Nonbreeding Waterbirds and their Habitats” (Loges et al. 2015), but has been modified to be site-specific.

Data collected using this protocol must be entered into the IWMM/AKN portal [<https://data.pointblue.org/partners/iwmm/login/?returnUrl=%2Fscience%2Fiwmm-portal%2F>]. This SOP describes the database for waterbird counts and provides instructions for data entry, data verification, and database administration.

### ***Terminology***

Using the database to enter or manage data requires knowledge of a few salient terms. In the AKN system:

- AKN “Project Leader” = Typically a Survey Coordinator (often this individual is in a Refuge Biologist position) as defined by Natural Wildlife Refuge System I&M policy (701 FW 2) or in general a ‘cooperator’ using this survey protocol framework. This person can give permissions to field biologists and technicians for data entry and validation. This is the person that will be contacted if there are questions about the data and who has a commitment to the accuracy and the validity of data entered from your site. Throughout this SOP this role is referred to as the “Project Leader” to denote that this is not the Refuge Project Leader.
- Project = the name of the refuge or other area over which a survey is conducted.
- Field Observer = the person or persons collecting data via this protocol.
- Data Entry Technician = the person entering data collected. Note that one individual can have multiple roles, such as Survey Coordinator or Data Entry Technician

### ***Gain Access to the Database***

The Survey Coordinator (the Refuge Biologist at Muleshoe NWR) is the refuge lead on the survey and must have database access permission from IWMM’s Science Coordinator before survey data for the refuge can be entered. The IWMM Science Coordinator will assign the Survey Coordinator permissions for project creation, project access and data entry.

### ***Proof and Archive the Data Sheets***

Data entry errors influence the quality and utility of collected data. However, many of these types of errors can be controlled through data organization, checking and entry techniques. The following steps should be used to reduce errors in the database and make original data recording materials available for future reference, back-up or checking.

1. Organize data sheets by survey unit to facilitate data upload. Proofread the data sheets ensuring that they have been filled out completely. Data should be entered within one week of the survey.
2. Mark corrections on original data sheets with red pen. Any corrected errors, or changes made by the data “proofer” (that are entered differently into the database than they appear on the data sheet) should be circled, initialed in the margins, and corrected. Notes should

be written in the margins or in the comments section to document the reason for the corrections.

3. Follow the steps in the “**Enter the Data**” section below.
4. At the end of the survey season, scan the data sheets to have a digital archive. The scanned documents should be compressed, stored in the USFWS Service Catalog (ServCat) [95666] and linked to the project [95413]. Care should be taken in scanning the documents and building the .pdf file so that data sheets are in order by survey date and then survey unit name. Compressed files should be named by survey year prior to archiving in ServCat. The Zone Biologist can assist with archiving the data sheets at the end of the survey season. The original data sheets should also be copied. The originals should be kept at Buffalo Lake NWR and the copy should be kept at Muleshoe NWR.
5. At the end of the survey season, entered data should be exported from the IWMM site as a .csv file and archived in ServCat [95833]. If the data are associated with a survey report, also include these data as an Appendix to the report, archive the report in ServCat, and link it as a product to the overall project [95413]. See SM-3 for a visualization of appropriate ServCat linkages.

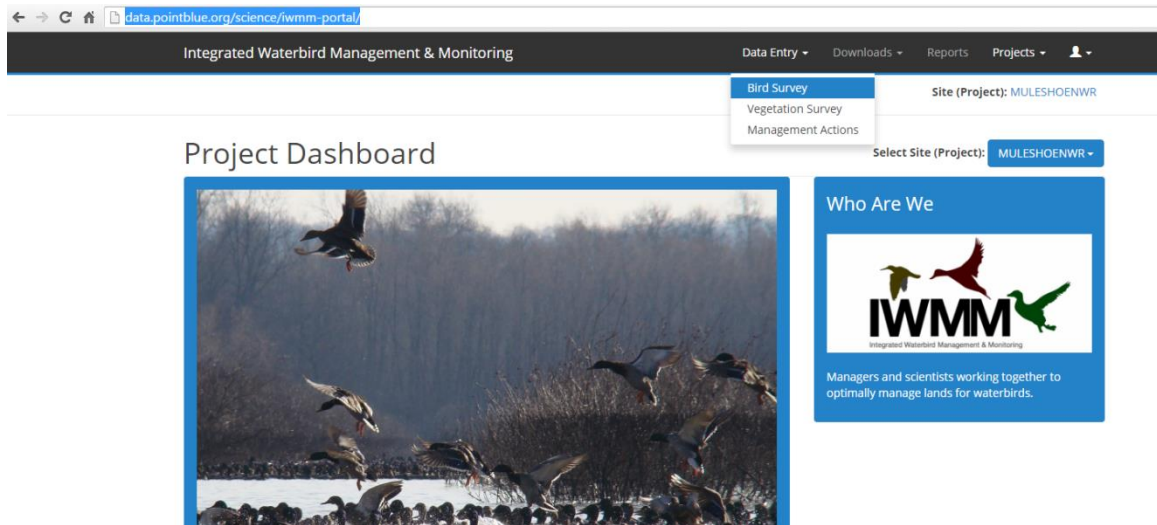
### ***Enter the Data***

Prepare for data entry:

1. Organize your data and guidance materials to aid the data entry process.
2. A data form will help verify that you have all the required data entry fields for your project.
3. A description of the methods used for this survey.
4. The name and contact information of the Survey Coordinator (the person who can be contacted regarding questions about these data).

Enter the bird survey data into the AKN database:

1. Navigate through the IWMM website to the database interface and log in to the data entry web site using your email address and password [at <http://data.pointblue.org/science/iwmm-portal/>].
2. Make sure the Project Dashboard page (Figure SOP 5.1) shows “MULESHOENWR” as the Site (Project).



**Figure SOP 5.1.** Screen grab of Project Dashboard, with “MULESHOENWR” selected as project site and “Bird Survey” selected under Data Entry tab.

3. Navigate to the “Data Entry” drop-down menu and select “Bird Survey” (do this by “hovering over” Data Entry and clicking on Bird Survey)
4. Click the link for the appropriate “Survey Unit” listed on the data sheet. The options on the data entry portal will look similar to Figure SOP 5.2

## Survey Units

Where are the observations located?

[Quick Tips >>](#)

- [Baileyboro Lake \(TX-003-BB\)](#)
- [Bull Lake \(TX-003-BL\)](#)
- [Coyote Lake \(TX-003-CL\)](#)
- [Goose Lake \(TX-003-GL\)](#)
- [Monument \(TX-003-ML\)](#)
- [Paul's Lake \(TX-003-PL\)](#)
- [Salt Lake \(TX-003-SL\)](#)
- [White Lake \(TX-003-WL\)](#)

**Figure SOP 5.2.** Screen grab of Survey Unit options; make sure the survey unit selected matches the field data sheet.

5. The only available options for the “Observation Protocol” and the “Site-condition Protocol” are pre-selected. They are “IWMM\_GroundSurvey” and “IWMM\_SurveySiteConditions,” respectively (Figure SOP 5.3). Click the “Start” button.

+ Create a new visit

Choose from the protocols below and select the *Start* button.

[Quick Tips >>](#)

Observation protocol ⓘ

IWMM\_GroundSurvey - IWMM Ground-based Survey ▼

Environmental conditions protocol ⓘ

IWMM\_SurveySiteConditions - IWMM Site Conditions During Waterbird Survey ▼

Start

**Figure SOP 5.3.** Screen grab of data entry options; these should be preselected; if not, they are the only available options under the dropdown.

6. Enter all waterbird codes under species (the code for sandhill crane is SACR, Figure SOP 5.4), unit condition, and vegetation data from the data sheet into the database. Be sure that all necessary data has been collected and entered; the system does not accept blank fields.

| # | Species ⓘ             | Count ⓘ | Note ⓘ     |   |
|---|-----------------------|---------|------------|---|
| 1 | SACR                  | 3000    | Headed NNE | ✕ |
| 2 | SACR - Sandhill Crane |         |            | ✕ |

**Figure SOP 5.4.** Screen grab of species entry options; the 4 letter AOU code for sandhill crane is SACR.

7. Click “Save All” at the bottom of the page when all data has been entered.

8. You can click the black “i” button to get help for each field (Figure SOP 5.5). They are available under the Ground Survey and Survey Site Condition portals. They become useful if you have questions.

The screenshot displays a data entry form for 'Site Conditions'. At the top, there is a section for '\* Estimation Method' with a dropdown menu. Below this, the 'ICE AND FLOOD DURATION' section includes fields for '\* Ice Cover' (with a percentage input), '\* Flood Duration' (with a dropdown), and '\* Assessment Method' (with a dropdown). The 'HABITAT COVER' section follows, with fields for '\* Open Water', '\* Scrub-Shrub', '\* Forest', '\* Emergent', and '\* Bare Ground', each with a percentage input. A help popup is open for the '\* Open Water' field, titled 'Habitat Cover Percentage'. The popup text reads: 'Enter the percentage of the unit that is Open Water, which includes submerged aquatic vegetation and floating-leaved aquatic vegetation. For more information, see rock bottom, unconsolidated bottom, aquatic bed in *Classification of Wetland and Deepwater Habitats of the United States* (Cowardin et al. 1979). All Habitat Cover Percentages must sum to 100%.' Below the habitat cover fields, there are sections for '\* Severity' (with a dropdown), '\* Disturbance Source' (with a 'Select one or more...' dropdown), and '\* Chronic Disturbance' (with a dropdown). At the bottom, there are five more percentage input fields labeled '\* 0 to 15cm', '\* 15 to 30cm', '\* 30 to 60cm', '\* 60cm to 3m', and '\* 3 to 6m'.

**Figure SOP 5.5.** Screen grab of Site Conditions data entry page; Note “i” button for the Habitat Cover has been clicked, and additional instructions and information about the field is viewable.

9. After all data from each data sheet have been entered or uploaded, proof the data in the database, review the data forms and sorting summaries (from queries) to check for errors, and blank fields. As each data sheet (or any digital file output) is proofed, date and initial that the input data were reviewed and checked against the original data records. The person performing data entry will also verify the data has been proofed in the database by changing the status of the data records from “RAW” to “CLEAN”. This is done by clicking the “Proofing completed” box (See Figure SOP 5.6).



Integrated Waterbird Management & Monitoring

Data Entry ▾ Downloads Reports Projects ▾ ▾

Site (Project): MULESHOENWR (Project Leader) Type: Area Search Location: Baileyboro Lake (TX-003-BB) V

Review or Edit Survey Unit Visit

Detailed information about a specific set of observations for a survey. **Double click to edit** any data with the blue vertical bar ( | ) next to it.

[Quick Tips >>](#)

Sections

Select a section name to jump down to.

- Overview** General information about this visit.
- [Env Conditions](#) Other information collected during the visit.
- [Observations](#) Details of observations recorded during visit.
- [Species List](#) Summary of species recorded, each compared to eBird by county and month.
- [Visits in Same Year](#) Selectable list of visits at same location in the same year.

Data status is currently RAW. When you have finished proofing and reviewing this visit, click:

**Proofing completed**

Overview

[Quick Tips >>](#)

Project: MULESHOENWR

Site: Baileyboro Lake (TX-003-BB)

Date : 2018-02-07

Observation Protocol: [IWMM\\_GroundSurvey](#)

Start time : 06:56

**Figure SOP 5.6.** Screen grab showing the “proofing completed” button; clicking the blue proofing completed button changes record status from “RAW” to “CLEAN”. It should not be clicked until data have been proofed. For data saved as RAW and proofed at a later date, this screen can be pulled up by clicking the hyperlink for “date” associated with records for individual survey locations (survey units) (see Figure SOP 5.7).

### Verify and Validate

AKN uses a tiered set of levels for indicating the data validation and access (see bullets below). Once the individual entering data is finished, he or she needs to notify the “Project Leader” (Refuge Biologist at Muleshoe NWR) that data are entered and ready to be proofed. The Project Leader will:

1. Ensure all data sheets have been initialed.
2. Compare the data sheets with the data records in the database and if there are no errors, then change the status of the records to the next appropriate level (see the user’s manual for the database).
3. Discuss any questionable data entry or field observer errors with the Data Entry Technician and/or Field Observer. If there are errors, the Project Leader will open record(s) for editing.
4. After all errors are satisfactorily resolved in the database, set the status back. Then the Project Leader will change the status of records in the database.
5. Upon a final quality check and review of entered data, the coordinator will set the access to:
  1. Records from Goose Lake, Paul’s Lake, White Lake, and Salt Lake will be assigned **LEVEL 3** (Figures SOP 5.8, and paragraph below concerning AKN’s data access levels); these survey units occur on NWR lands.

- Records from Baileyboro Lake, Bull Lake, Coyote Lake, Monument Lake will be assigned an access level of “**APPROVED**” (Figures SOP 5.8) These survey units occur off-refuge.

Site (Project): MULESHOENWR (Project Leader) Type: Area Search Location: Paul's Lake (TX-003-PL)

IWMM\_SurveySiteConditions - IWMM Site Conditions During Waterbird Survey

Start

⇒ Review / edit an existing visit  
Review and edit an existing visit below by selecting the date.  
[Quick Tips >>](#)

Download CSV

| Date              | Visit | Count | Start Time | End Time | Protocol          | Status            |
|-------------------|-------|-------|------------|----------|-------------------|-------------------|
| 2018-02-21        |       | 1554  | 06:50      | 08:05    | IWMM_GroundSurvey | AVAILABLE Level 3 |
| <u>2018-02-07</u> |       | 353   | 07:13      | 08:15    | IWMM_GroundSurvey | CLEAN             |
| 2018-01-24        |       | 69    | 07:12      | 08:00    | IWMM_GroundSurvey | CLEAN             |
| 2018-01-10        |       | 2     | 07:10      | 07:45    | IWMM_GroundSurvey | CLEAN             |
| 2017-12-27        |       | 2980  | 07:10      | 08:15    | IWMM_GroundSurvey | CLEAN             |

**Figure SOP 5.7.** Right click on the date (yellow arrow to left) to change access levels for a record (yellow arrow to right). See Figure SOP 5.8 for proceeding after the record has been opened for edit.

Overview

[Quick Tips >>](#)

Project: MULESHOENWR  
 Site: Paul's Lake (TX-003-PL)  
 Date : 2018-02-21  
 Observation Protocol: IWMM\_GroundSurvey  
 Start time : 06:50  
 End time : 08:05  
 Observer : Hartman, Melanie  
 # of other observers : 0  
 Other observer names : Glenda Copley  
 Notes :  
 Data Sharing Level :  
 Delete this visit

Environmental Conditions

[Quick Tips >>](#)

Location: Paul's Lake (TX-003-PL)  
 Time: 06:50  
 Env Condition Protocol: IWMM\_SurveySiteConditions

RAW  
 CLEAN  
 APPROVED  
 AVAILABLE Level 1  
 AVAILABLE Level 2  
 AVAILABLE Level 3  
 AVAILABLE Level 4  
 AVAILABLE Level 5  
 RESTRICTED

**Figure SOP 5.8.** Double click on “CLEAN” to change a proofed record to either “APPROVED” OR “LEVEL 3”. Only survey units located on NWR lands should be assigned Level 3 access.

The following are AKN's data access levels. These are applicable to each record in the network individually, so that individual records may have different access levels. Data published using one of the five levels below are stored in the AKN's primary data warehouses. The warehouses serve as the primary archives of all AKN data. No applications connect directly to the warehouses, but data from a warehouse are ported to separate data views created specifically to optimize the performance of an application that connects to it. Data owners can specify how their data can be used in the data views, with the option that their data are not available to the public at all.

- *Level 1:* Some information about the data are made available to individuals other than project members. Specifically, only metadata about the datasets are made available to any application or service.
- *Level 2:* Same as Level 1 with the following addition: data can be used in certain publicly available, predefined visualizations (i.e. maps and graphs), but direct access to the data is restricted.
- *Level 3:* Data are used in publicly available, predefined visualizations (i.e. maps and graphs). Additionally, the complete Bird Monitoring Data Exchange (BMDE) data set is available upon request, subject to approval from the original data provider.
- *Level 4:* Data can be used in publicly available, predefined visualizations (i.e. maps and graphs) and also may be available upon request. Additionally, some components of the data are made available to existing bioinformatic efforts (Global Biodiversity Information Facility [[GBIF](#)] and [ORNIS](#)). These bioinformatic efforts only provide the data "marked-up" to Darwin Core, used to describe primary occurrence (location, date and species for example).
- *Level 5:* Data are used in publicly available, predefined visualizations (i.e. maps and graphs) and are available to existing bioinformatic efforts. Additionally, the complete BMDE data set is available for download directly via download tools.
- *RAW:* Data were input but no further review or processing has taken place. Data are available for project use only and not to the AKN.
- *Clean:* Data were input and reviewed by member(s) of the project team. Data are available for project use only and not to the AKN.
- *Approved:* Data were reviewed by project management, but no indication has been made of AKN data sharing levels. Data are available for project use only and not to the AKN.
- *Restricted:* Same as "Approved" and not distributed and shared to other AKN partners automatically. All access to data must come through requests to the contributing institution project management.

### ***Database Maintenance and Archiving***

AKN is responsible for performing periodic backups of the database. Editing data that has already been "verified" in the database must be made in the AKN database by the Project Leader via the interface. Contact IWMM's Science Coordinator for assistance if numerous edits are needed.

## **References for SOP 5**

Loges BW, Tavernia BG, Wilson AM, Stanton JD, Herner-Thogmartin JH, Casey J, Coluccy JM, Coppen JL, Hanan M, Heglund PJ, Jacobi SK, Jones T, Knutson MG, Koch KE, Lonsdorf EV, Laskowski HP, Lor SK, Lyons JE, Seamans ME, Stanton W, Winn B, Ziemba LC. 2015. National protocol framework for the inventory and monitoring of nonbreeding waterbirds and their habitats, an Integrated Waterbird Management and Monitoring Initiative (IWMM) approach. U.S. Fish and Wildlife Service, Natural Resources Program Center, Fort Collins, Colorado.  
[http://www.iwmmprogram.org/documents/IWMM\\_NationalProtocolFramework\\_Ver1.0\\_Approved.pdf](http://www.iwmmprogram.org/documents/IWMM_NationalProtocolFramework_Ver1.0_Approved.pdf) (March 2018); <https://ecos.fws.gov/ServCat/Reference/Profile/83678> (ServCat link to updated, 2017 version)

## Supplemental Materials (SM)

### SM-1: Data Dictionaries for supporting GIS files

The tables below pertain to the attributes in the supporting GIS files (ESRI format). These GIS files are archived on ServCat [[95415](#)].

Table SM-1.1: Attribute description (field name description) for the survey unit shapefile.

| Field      | Descriptor               | Definition  |
|------------|--------------------------|---|
| FID        | 0-6                      | Unique number assigned by ArcMap to identify each polygon   |
| Shape      | Polygon, Polyline, Point | Geometry of the shapefile.  |
| WetlandID  | Unique identifier        | Unique identifier for each wetland created by Texas Tech University, Center for Geospatial Technology.  |
| WetType    | Wetland classification   | Saline Lake = large isolated wetland in contact with groundwater; classification created by Texas Tech University, based on National Wetlands Inventory and Cowardin et al. 1979 <sup>1</sup> . |
| Comment    | Name of saline lake      | Unique name for each survey unit (saline lake).   |
| SqMeters   | Numeric                  | Area, in square meters, of the saline lake.   |
| Acres      | Numeric                  | Area, in acres, of the saline lake.   |
| StAbbr     | State abbreviation       | Two letter US Postal Code abbreviation of the state where survey unit is located.   |
| CountyName | County name              | Name of the county where survey unit is located.  |
| LonNAD83   | Longitude                | Approximate longitude of centroid of saline lake in NAD 1983 decimal degrees.   |
| LatNAD83   | Latitude                 | Approximate latitude of centroid of saline lake in NAD 1983 decimal degrees.  |

<sup>1</sup> See References for SM-1 below

Table SM-1.2: Attribute descriptions (field name descriptions) for the observation point shapefile.

| Field    | Descriptor                | Definition  |
|----------|---------------------------|---|
| FID      | 0-6                       | Unique number assigned by ArcMap to identify each point.  |
| Shape    | Point ZM                  | Geometry of the shape file corresponding to the FID; ZM is an artifact of importing the spatial file into ArcGIS from a GPS unit  |
| OBJECTID | 1-8                       | Identification number for the point.  |
| Name     | Name of Saline Lake       | Name of survey unit (saline lake) associated with observation point.  |
| Type     | GPS reference type        | WPT = waypoint. Set of coordinates held in a GPS unit; in this case the waypoint is the observation point. This field is carried over from importing the original spatial file from a GPS unit. |
| Symbol   | GPS symbol type and color | Symbol type (flag) and color representing the waypoint in a GPS unit; this field is carried over from importing the original spatial file from a GPS unit.                                      |

### References for SM-1

Cowardin LM, Carter V, Golet FC, LaRoe ET. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. <https://www.fws.gov/wetlands/documents/classwet/index.html>

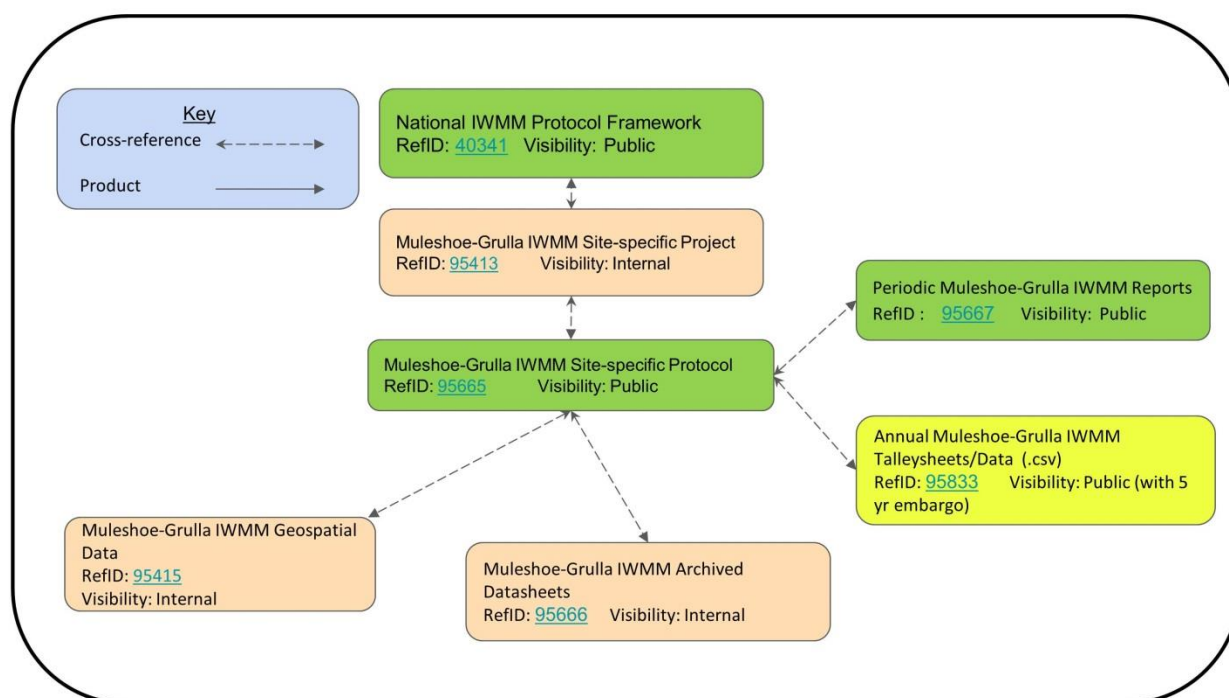
## **SM-2: Useful navigation tools**

The ServCat site below contains Google Earth files (.kmz) of the survey units and observation points. Observation points can also be downloaded in two files types that are compatible with certain GPS units (.gdb and gpx). The .gdb file is a “Garmin Format” that is typically compatible with Garmin units and the Garmin software BaseCamp™. The .gpx file is in “GPX eXchange Format” and is typically compatible with Garmin and other brands of GPS units.

The ServCat link is <https://ecos.fws.gov/ServCat/Reference/Profile/95415>.

### SM-3. Service Catalogue(ServCat) Organization for the IWMM Project.

For the purpose of keeping track of files and facilitating data sharing, the Survey Coordinator should maintain an organized reference structure in the USFWS Service Catalogue (ServCat). See Figure SM-3.1 for the organization of references pertaining to this project. Future reports should be linked as a product of the Muleshoe-Grulla IWMM Site-specific Project ([95413](#)). The geospatial data reference ([95415](#)) should be updated with future changes to shapefiles. Scanned digital copies of data sheets ([95666](#)) should be compressed by year in a .zip file and annually uploaded into ServCat. Likewise, a spreadsheet (.csv) of the annual data (tally sheets) should be downloaded from the IWMM site and archived in ServCat ([95833](#)).



**Figure SM-3.1.** Linkage structure for references dealing with this site-specific IWMM project in the USFWS Service Catalogue (ServCat).



## SM-4: Health and Safety Guidance for Handling Sick or Dead Wild Birds

This document provides procedures for protecting personnel while handling wild birds. Also refer to the Wildlife Health office internal website at <https://sites.google.com/a/fws.gov/fws-wildlife-health/products> for a more complete guide.

| GUIDANCE FOR HANDLING WILD BIRDS DEPENDING ON THE CURRENT CONDITIONS:  |   |  |  |
|--|---|--|--|
| CONDITIONS   | ACTIVITY  | PPE  | WORK PRACTICE  |
| 1.a. Zoonotic avian influenza is <b>not known or suspected</b> in wild birds within North America or the Pacific Islands.                          | Handling apparently healthy birds.  | Follow all PPE and standard work practices recommended for normal operations at your station. Consult regional health and safety expertise regarding zoonotic disease risks in your area.  | <ol style="list-style-type: none"> <li>1. Wash your hands often and thoroughly for at least 30 seconds (using soap/water or alcohol-based hand sanitizer) before eating, smoking, using cell phone and touching your face, hair, or exposed skin.</li> <li>2. If working indoors, work in well-ventilated areas. When working outdoors, work upwind of animals to decrease the risk of inhaling airborne particulate matter such as dust, feathers, or dander.</li> <li>3. Gloves, aprons, goggles, face shields, rubber boots, and coveralls that can be easily disinfected may also be worn to prevent skin and mucous membrane contact with biological materials, and prevent movement of biological materials to other sites.</li> </ol>   |
| 1.b. Zoonotic avian influenza is <b>not known or suspected</b> in wild birds within North America or the Pacific Islands.                          | Handling sick or dead birds.  | Follow all PPE and standard work practices recommended for normal operations at your station. Consult regional health and safety expertise regarding zoonotic disease risks in your area.  | <ol style="list-style-type: none"> <li>1. Remove gloves and wash your hands often and thoroughly for at least 30 seconds (using soap/water or alcohol-based hand sanitizer) before eating, smoking, using cell phone and touching your face, hair, or exposed skin.</li> <li>2. If working indoors, work in well-ventilated areas. When working outdoors, work upwind of animals to decrease the risk of inhaling airborne particulate matter such as dust, feathers, or dander.</li> <li>3. Aprons, goggles, face shields, rubber boots, and coveralls that can be easily disinfected may also be worn to prevent skin and mucous membrane contact with biological materials, and prevent movement of biological materials to other sites.</li> </ol>   |
| 2.a. Zoonotic avian influenza is <b>confirmed<sup>1</sup> or presumed to be present</b> in wild birds within North America or the Pacific Islands. | Handling, investigation, or disposal of any healthy or sick, live or dead wild birds. | <ul style="list-style-type: none"> <li>• Impermeable gloves (pvc or nitrile) or heavy duty rubber work gloves</li> <li>• Goggles</li> <li>• NIOSH-approved disposable N-95 particulate respirator<sup>2</sup>. Workers must be fit-tested and medically cleared annually prior to wearing a respirator.</li> <li>• Disposable Tyvek coveralls or raingear that can be disinfected</li> <li>• Waders, hip-boots, rubber boots or boot covers</li> </ul> | <p>In addition to the work practices listed above:</p> <ol style="list-style-type: none"> <li>1. Suppress dust at the work site using water</li> <li>2. Minimize direct contact with birds and their secretions, feathers, and dander.</li> <li>3. Minimize contact with carcasses when bagging birds.</li> <li>4. Contact recipient laboratories prior to collection and shipping; follow their guidelines.</li> </ol> <p>Remove PPE in the following order:</p> <ol style="list-style-type: none"> <li>1. Carefully remove coveralls and boot covers and discard as contaminated material if disposable.</li> <li>2. Disinfect rubber boots.</li> <li>3. Remove gloves and immediately wash hands thoroughly with soap and water (or an alcohol-based hand gel when soap and clean water are not available).</li> <li>4. Remove eye protection and place in designated receptacle for subsequent cleaning and disinfection.</li> <li>5. Remove N-95 disposable respirator and discard.</li> <li>6. Immediately after all PPE has been removed, wash hands thoroughly a second time and wash face.</li> </ol> |



|  |   |  |   |
|--|---|--|---|
| 2.b. Zoonotic avian influenza is <b>confirmed<sup>1</sup></b> or <b>presumed to be present</b> in wild birds within North America or the Pacific Islands | Cleaning and disinfecting equipment known or suspected to be contaminated with zoonotic avian influenza | <ul style="list-style-type: none"> <li>• Impermeable gloves (pvc or nitrile) or heavy duty rubber work gloves</li> <li>• Goggles</li> <li>• NIOSH-approved disposable N-95 particulate respirator<sup>2</sup>. Workers must be fit-tested and medically cleared annually prior to wearing a respirator.</li> <li>• Disposable Tyvek coveralls or raingear that can be disinfected</li> <li>• Waders, hip-boots, rubber boots or boot covers</li> </ul> | <p>In addition to the work practices listed above:</p> <ol style="list-style-type: none"> <li>1. Clean surfaces of equipment and reusable PPE with detergent and water, then disinfect with a virucide (such as Virkon®) that kills avian influenza viruses. Follow the label instructions.</li> <li>2. <a href="http://www.epa.gov/pesticides/factsheets/avian.htm">www.epa.gov/pesticides/factsheets/avian.htm</a> lists registered products. If a registered product is not available, use 3/4 cup of household bleach (5.25-6.00% sodium hypochlorite) per gallon of water for hard, non-porous surfaces.</li> <li>3. Avoid generating mists with water sprayers during equipment decontamination procedures.</li> <li>4. Do not touch any part of exposed person (especially the face) with gloved hands. Replace torn or damaged gloves immediately.</li> <li>5. Additional protection (such as aprons and face shields) may be desired during equipment decontamination to prevent contact with contaminated material.</li> <li>6. If there is known exposure to body fluids of the carcass (examples: knife cut, needle stick) contact your health care professional and provide a complete history of your activities.</li> </ol> <p>Carefully remove PPE in the order as described above in section 2a.</p> |
| Key for colored conditions sections:   | Green - Low risk conditions   | Orange - Medium risk conditions  | Red - High risk conditions  |

<sup>1</sup> Refers to situations where the National Veterinary Services Laboratory confirmed the presence of an avian influenza virus that is pathogenic for humans in a wild bird or a presumptive diagnosis of an avian influenza virus from a wild bird found dead or moribund.

<sup>2</sup> Use of respirators including N-95 filtering facepiece respirators requires implementing a Respiratory Protection Program as required by the Occupational Safety and Health Administration. This includes training, fit-testing, and fit-checking to ensure appropriate respirator selection and use. To be effective, respirators must provide a proper sealing surface on the wearer's face. Detailed information on respiratory protection programs is provided at: [www.osha.gov/SLTC/etools/respiratory/index.html](http://www.osha.gov/SLTC/etools/respiratory/index.html) and [www.cdc.gov/niosh/topics/respirators/](http://www.cdc.gov/niosh/topics/respirators/). Under certain high risk conditions such as handling large numbers of birds in a confined area confirmed to have the HPAI virus, it may be necessary to upgrade respiratory protection to powered air purifying respirators (PAPR) or other protection options.

Opening carcasses in the field is not recommended as this may increase the risk of disease transmission and decrease the diagnostic value of the carcass. Consult DOI health and safety officers for more guidance if this activity is necessary.

Designated protective measures should be applied for at least 30 days after the date of the last detection of zoonotic avian influenza in wild birds within North America or the Pacific Islands.

## **SM-5: Waterbird Survey Form – Individual Units**

The next two pages are the front and back of the standard IWMM form for recording waterbird surveys by individual units. In order to be certain observers have habitat condition codes, print double-sided (condition codes should be on back of form). Refer to the IWMM website for the most up-to-date form: <http://iwmmprogram.org/protocols-data-forms/>.

Current link (March 2018) for single sided form

[http://www.iwmmprogram.org/documents/IWMM\\_Bird\\_Survey\\_Form\\_Single-unit\\_2017.pdf](http://www.iwmmprogram.org/documents/IWMM_Bird_Survey_Form_Single-unit_2017.pdf)

## Waterbird & Unit Condition Survey

[illegible]

\* Please leave blank if unknown

**a, tide conditions:** 1 = high; 2 = almost high, rising; 3 = almost high, falling; 4 = half tide, rising; 5 = half tide, falling; 6 = almost low, rising; 7 = almost low, falling; 8 = low; 9 = not observed, not applicable, or observations made during more than one period

**b, gauge units:** 1=feet/tenths, 2=feet/inches, 3=meters

**c, flood duration:** 1 = surface water present for > 90 days; 2 = surface water present 30-90 days, 3 = surface water present < 30 days; 4 = permanent inundation; 5 = no information

**d, submersed aquatic vegetation**

**e, interspersions:** class "L" = includes large water/bare ground features with connected patches and linear edge; Class "S" = contains small, disconnected patches of water/bare ground with increased random distribution and fewer instances of connection; Class "M" = consists of patterns that contain discernible regions of both configuration classes L and S

**f, disturbance severity:** 1 = no effect on waterbirds; 2 = some waterbirds move but stay within unit; 3 = some waterbirds leave unit; 4 = most/all waterbirds leave unit

**g, disturbance codes (may be more than one):** 1=Pedestrian, 2=Loose dog, 3=Hunting, 4= Fishing, 5=Boats, 6=Motor Vehicles, 7=Aircraft, 8=Raptor

**h, chronic disturbance:** 1 = no entry into the unit for any reason; 2 = Closed to all use with entry into unit by resource managers or designees for management activities, surveys, or other controlled non-hunting activities; 3 = Managed access for all activities including firearms hunting. May include effort to control use levels and temporal closures; 4 = open access via trail, viewing platforms etc. No firearms hunting allowed; 5 = Open access, including firearms hunting, often with routine restrictions but without a specific management program to control the level of authorized use; 6 = unknown

# Appendix

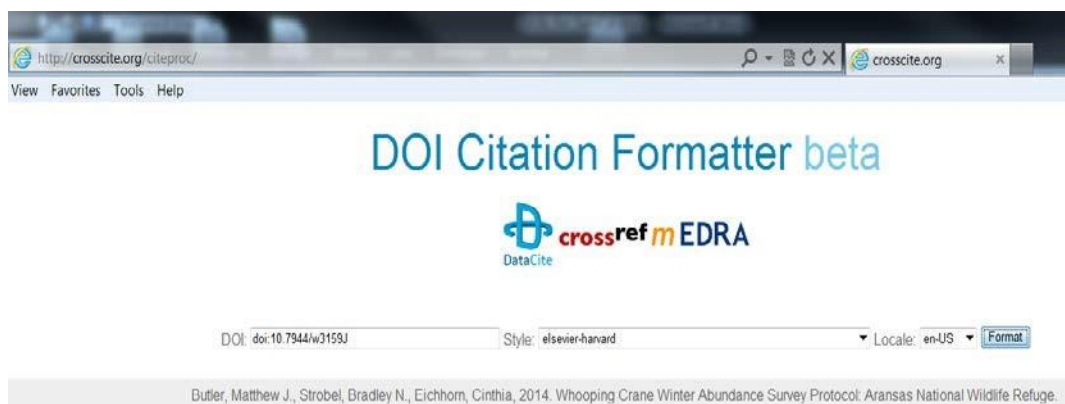
## Appendix A. Appendix D. Using Digital Object Identifiers (DOIs) for ServCat Public References.

If uploading a peer-reviewed protocol, report, or dataset to ServCat that will be made publicly available on data.gov and possibly cited, request a digital object identifier (DOI) from R2 NWRS Biological Sciences. However, if your report or dataset will be available outside of ServCat/data.gov on a journal site or data repository like Dryad, those sites should assign your products a DOI.

| Step | Action  |
|------|---|
| 1    | Contact your R2 Zone Biologist to discuss what document and data products will be stored in ServCat and accessible to the public through data.gov.  |
| 2    | Zone Biologist contacts R2 NWRS Regional I&M Data Manager (DM) and provides the ServCat Reference ID.   |
| 3    | Once you receive the DOI from the Regional I&M DM, test the DOI in a search engine. As an example, type the following DOI into a search engine or the web address/url box of a search engine:<br>doi:10.7944/W3159J |



- 4 Add the DOI to your ServCat reference abstract. See this ServCat reference as an example: <https://ecos.fws.gov/ServCat/Reference/Profile/28073>.
- 5 You can use web citation tools to help with citation formats using the DOI. The example below is found at <http://crosscite.org/>





## Appendix B. Peer-review documentation form and reviewer comments and author responses

| <p><b>Protocol Title:</b> Site-specific Protocol for Monitoring Sandhill Cranes: <i>Muleshoe and Grulla National Wildlife Refuges</i></p> <p><b>Version<sup>1</sup>:</b> 1.0</p> <p><b>Date of First Complete Draft:</b> June 2018</p> <p><b>Date of Approval:</b></p>   |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|--|------|--|-------------|-------------------|---------|------|--------|-------------|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <p><b>Refuge Names:</b></p> <p>Muleshoe National Wildlife Refuge</p> <p>Grulla National Wildlife Refuge</p>  |      | <p><b>Authors and Affiliations</b></p> <p>Kristen M. Linner, Graduate Intern, Texas Tech University</p> <p>William P. Johnson, Zone Biologist, National Wildlife Refuge System</p> <p>Blake A. Grisham, Texas Tech University</p> <p>Warren C. Conway, Texas Tech University</p> |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <p><sup>1</sup> See <a href="#">Survey Protocol Template</a> instructions on assigning versions.</p>   |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <p><b>Protocol Type (Select One):</b> A) New Survey Protocol Framework, B) Revised Survey Protocol Framework, <b>C) New Site-specific Survey Protocol,</b> D) Revised Site-specific Survey Protocol</p>  |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Version</th> <th style="width: 15%;">Date</th> <th style="width: 15%;">Author</th> <th style="width: 30%;">Change Made</th> <th style="width: 25%;">Reason for Change</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>  |      |  |             |                   | Version | Date | Author | Change Made | Reason for Change |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Version  | Date | Author   | Change Made | Reason for Change |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <p><b>Internal review(s):</b> List reviewer comments and describe how they were addressed or why they were not, along with each reviewer's name, date review was completed or received, organization, and contact information. If no internal review is used, please briefly describe exemption. Attach separate sheets as necessary.</p> <p>We solicited internal reviews for the site-specific protocol for Muleshoe and Grulla NWRs. An internal USFWS review was completed on 30 May 2018 by Brenda Zaun, Zone Biologist, Southwest Arizona National Wildlife Refuge Complex (9300 E. 28th Street, Yuma, Arizona 85365). Comments originating from Brenda Zaun listing all suggested document changes and edits, along with replies/comments to each suggested change, follow (beginning on page XX. Comments from Brenda Zaun were incorporated to the document and addressed by William P. Johnson (co-author). In addition, Cinthia Eichhorn, Regional Data Manager for Region 2 Division of Biological Services, made comments on the data management plan for a different IWMM site-specific protocol that were incorporated into data management elements for this protocol.</p> |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <p><b>External review(s):</b> List reviewer comments and describe how they were addressed or why they were not along with each reviewer's name, date review was completed or received, organization, and contact information. If no external review is used, please briefly describe exemption. Attach separate sheets as necessary.</p> <p>This site-specific protocol is based on well established, and peer reviewed national protocol framework (Loges et al. 2015). Because of this, and because of the limited geographic scope of this protocol, we did not solicit external peer-review consistent with the U.S. Fish and Wildlife Service survey protocol handbook (USFWS 2013).</p> <p>US Fish and Wildlife Service. 2013. How to develop survey protocols, a handbook (Version 1.0). Fort Collins, Colorado: US Department of Interior, Fish and Wildlife Service, National Wildlife Refuge System, Natural Resource Program Center.</p>  |      |  |             |                   |         |      |        |             |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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