March 14, 2023

US Army Corps of Engineers
Sacramento District
Transmitted by email to DLL-DCP-EIS@usace.army.mil
RE: Draft Environmental Impact Statement for Delta Conveyance Project

Dear United States Army Corps of Engineers:

The Friends of Stone Lakes National Wildlife Refuge, Sierra Club Mother Lode Chapter and Sacramento Group, Environmental Council of Sacramento, Sacramento Audubon Society, Friends of Swainson's Hawk, Save Our Sandhill Cranes and Habitat 2020 (hereinafter, Environmental Groups) submit the following joint comments on the Draft Environmental Impact Statement (DEIS) for the Delta Conveyance Project. Our organizations have engaged with the Delta tunnels projects from the outset, beginning with negotiations on mitigation and enhancement measures for the Bay Delta Conservation Plan, then with the WaterFix project as a protestant during State Water Resources Control Board hearings, and now its successor, the Delta Conveyance Project.

Nevertheless, the Environmental Groups have not seen meaningful cooperation from the project developers. Stone Lakes National Wildlife Refuge (Stone Lakes NWR) is essentially ground zero for the project. The intakes, the tunnel intake structure, and the haul roads will have significant negative impacts on Stone Lakes NWR and its wildlife. As our comments herein will demonstrate, we find the DEIS to be deficient, incorrect and inadequate.

Please find, attached, a memorandum and supporting documents from Dr. Gary Ivey, Research Associate with the International Crane Foundation, with additional comments supporting and elaborating on our comments pertaining to the project's impacts on the Greater Sandhill Crane. Please include Dr. Ivey's memorandum in your Response to Comments on the DEIR which are equally applicable to this DEIS.

GENERAL COMMENT ON TERRESTRIAL VERTEBRATE SPECIES: THE EMPEROR HAS NO CLOTHES

For NEPA, determining a significant effect requires an examination of the intensity and the duration of an action on a resource. The examination in this DEIS of the actions associated with this project on vertebrate terrestrial species consistently yielded a determination that after mitigation measures, environmental commitments, and the implementation of the Compensatory Mitigation Plan (CMP), there likely would be no significant effects. This defies credulity since habitat loss is the primary driver for the listing of almost all the vertebrate terrestrial species covered in this DEIS, and since the action alternatives are going to result in more loss of habitat. As for intensity, it does not get more intense than the permanent loss of habitat for a species struggling due to loss of habitat. As for duration, much of the habitat loss is permanent, and the construction alone is projected to take upwards of 15 years, so even some of the temporary impacts will be multi -generational for some species.

Stepping back for a moment from the technical detail and specifics covered in this DEIS, and initially looking at just the broad strokes of the project, a fifteen year long project spread out over hundreds of square miles that will destroy or impact thousands of acres of habitat, one immediately assumes that this project is obviously going to create significant negative effects for terrestrial vertebrate species. A closer examination of the environmental commitments and mitigations of the CMP does not alleviate the initial assumption. In the end there still remains the reality that, 1) depending on the alternative and the species, thousands of acres of habitat would be lost with no clear indication of where or how much mitigation would occur, and 2) the analyzed CMP is located nowhere near where most of the populations of species would be impacted, rendering no benefit to those populations. And, conserving a few thousand acres of habitat to make up for the loss of a few thousand acres does not replace the lost habitat.

LOOKING CLOSER AT THE NAKED EMPEROR

The consistent refrain for all terrestrial species covered in the DEIS is:

> "Based on the information presented above, including proposed mitigation measures, environmental commitments, and implementation of the CMP, the effect of all action alternatives on (PICK YOUR COVERED TERRESTRIAL SPECIES HERE) does not appear to be significant. "

For the following reasons, we categorically disagree with this refrain:

The Proposed Mitigation Measures Are Incomplete

The following species have permanent foraging habitat impacts greater than 1000 acres regardless of the action alternative, with the impact ranges from the different alternatives provided below:

1. Bats: 2,023.17 to 3,234.24 acres
2. Tricolored Blackbird: 1538 to 2504.43 acres
3. Yellow-headed Blackbird: 1393.28 to 2252.94 acres
4. Loggerhead Shrike: 1399.17 to 2293.57 acres
5. Burrowing Owl: 1795.65 to 3048.82 acres
6. Swainson's Hawk: 1653.59 to 2697.47 acres

7. Horned Lark: 1391.31 to 2252.94 acres
8. Northern Harrier/Short Eared Owl: 1330.35 to 1955.82 acres
9. Golden Eagle/Feruginous Hawk/other raptors: 1391.31 to 2252.94 acres
10. White Tailed Kite: 1564 to 2443.68 acres
11. Lesser Sandhill Crane: 1212.28 to 1531.73 acres
12. Greater Sandhill Crane: 1072 to 1349 acres

And yet despite the magnitude of the loss of permanent foraging acres, we are not provided with a mitigation ratio for the compensatory mitigation for any of these species, or any of the other terrestrial vertebrate species. Nor are we provided with any indication of exactly where this mitigation might occur, beyond the CMP, for any of the terrestrial vertebrate species. So, despite the huge habitat losses, we have no idea how **much** land will be preserved for the species impacted nor where that land will be. Putting off the discussion of exactly how much and where the mitigation will occur makes it impossible for the reviewer to consider the appropriateness of that mitigation.

The Requirement for an Incidental Take Permit Is Not Discussed

As discussed in comments we submitted on the DEIR, there was no indication that a California Department of Fish and Wildlife 2081 Incidental Take Permit would be sought for this project. Similarly, no mention is made in this DEIS of 1) securing a state Incidental Take Permit, 2) securing a federal Endangered Species Act Incidental Take Permit through a Section 7 consultation, or 3) including incidental take statements in the biological opinions that would authorize the take of federally listed species as a result of the construction or operation of the action alternatives examined in this DEIS. If such a commitment was made and we missed it, the fact remains that deferring the specifics of mitigations to some future consultation does not allow the reviewer sufficient information to analyze the adequacy of those mitigations.

So, no indication is provided about mitigation ratios for the loss of impact, about where much of that mitigation will occur, and there is no assurance that state or federal wildlife agencies will be consulted about these important mitigations as part of the process of acquiring an Incidental Take Permit.

The Environmental Commitments Do Not Address Habitat

The environmental commitments are basically expanded best practices for the construction of the project and do not provide any commitments associated with habitat preservation or using a regional perspective for determining the most appropriate location for compensatory habitat replacement.

The CMP Does Not Effectively Mitigate Negative Effects to Vertebrate Terrestrial Species

Listed species in Stone Lakes National Wildlife Refuge and near the Consumnes River Preserve will suffer significant negative effects because of the project. Providing mitigation on Bouldin Island will do little to benefit these populations of species affected so far away. As examples, Swainson’s Hawks forage within ten miles of their nest sites, and the vast majority of Great Sandhill Cranes forage within only 3 miles from their roost sites. Clearly the populations of these impacted species would not be the ones benefitting from the Bouldin Island component of the CMP.

Some relevant citations regarding the distances Swainson’s Hawks will travel from nest sites are as follows:

> Swainson's hawk nests have not been found in apparently suitable urban areas in the Central Valley where foraging habitat is unavailable for 5-8 km (e.g., Lodi and Sacramento), thus requiring long-distance transport of prey throughout the entire nesting cycle. (England et al, 1995)

And further discussion from the same article about foraging distance:

> Swainson's hawks in the Central Valley of California will forage more than 15 km from a nest site. While these distant sites may be critical at times, long-distance foraging bouts are generally limited to periods when suitable foraging habitat is not available nearby due to crop phenology. Babcock (1995) observed prey caught at long distances from nest sites frequently was consumed by adult birds near the point of capture. Prey brought back to the nest to provision to young or a mate was generally caught near the nest. Presumably this pattern is due to the energetic inefficiency of transporting prey long distances. Similarly, Swainson's hawks are extremely rare in the northern and southern portions of the Central Valley where potential nest sites in urban and rural settings are surrounded by vineyards, orchards, rice, and cotton, all unsuitable Swainson's hawk foraging habitat (Estep 1989). The energetic cost of transporting prey these distances throughout the nesting cycle apparently is too great. (England et al., 1995)

As well, Fleishman et al, from 2016, states: "The majority of adult Swainson’s Hawks traveled distances up to 8–10 km from the nest throughout the breeding season." This clearly indicates that Swainson’s Hawks effected in the Stone Lakes National Wildlife and the Cosumnes River Preserve areas are not going to receive any benefit from the CMP, and since we do not know where other foraging or nesting habitat is to be secured as mitigation, it is also unclear if that mitigation will benefit those same populations of Swainson’s Hawks.

There is significant discussion about daily foraging distances in the comments to follow for Greater Sandhill Crane, and suffice it to say that they do not typically travel as far as the Swainson's Hawk, so the populations effected by this project in the Stone lakes and Cosumnes Preserve areas will also receive no benefit from the CMP.

THE APPLICABILITY OF DEIR COMMENTS

The California Environmental Quality Act (CEQA) defines procedures for environmental review and impact analysis of projects that need approval by local or state agencies. The National Environmental Policy Act (NEPA) does the same for projects that need approval by federal agencies. Both laws require that the potential environmental impacts of a proposed project be assessed, quantified, disclosed, minimized, and eliminated whenever possible.

The environmental impact statement (EIS) required under NEPA and the EIR required under CEQA are similar documents, yet have some crucial differences. For example, under NEPA, an agency can list all reasonable alternatives and their impacts, then choose their preferred project without regard to the severity of its impacts, even if it is more harmful to the environment. Under CEQA, the lead agency is required to mitigate all "significant" adverse environmental impacts to "the maximum extent feasible" and can approve a project only if the agency adopts a Statement of Overriding Considerations detailing the specific overriding economic, legal, social, technological, or other considerations that outweigh the project's significant, unavoidable impacts.

NEPA requires that the EIS discuss possible alternatives and mitigation measures that can be taken to reduce environmental effects. NEPA however does not require that the lead agency take any action to implement any mitigation measures to reduce environmental damages caused by the proposed project or legislation. NEPA only requires that the lead agency show that these mitigation and alternative measures were considered.

With these differences in mind, most of the DEIR comments that we made on this project about the impacts to vertebrate terrestrial species are applicable to this DEIS. The analysis in this DEIS relied heavily on that contained within the DEIR for this project. A DEIS is supposed to ensure that no laws are violated, so including comments from the DEIR that demonstrate that the California Environmental Quality Act, California Fully Protected Species statute, and California Endangered Species Act laws would be violated by this project makes those comments germane here. And so, we are including the DEIR terrestrial vertebrate species comments here as part of the comments on this DEIS and expect them to be responded to in the context of NEPA.

Here follows that portion of the submitted comments of the Environmental Groups on the DEIR for the Delta Conveyance Project that pertain to terrestrial species:

The DEIR Mitigation for Listed Terrestrial Species Is Not Consistent with CEQA Guidelines and DFW Requirements

The mitigation proposed in this DEIR conflict is inconsistent with CEQA Guideline 15126.4(a)(1)(B) for all of the vertebrate terrestrial species covered in Chapter 13. Similarly, the requirement for getting a 2081 incidental permit pertains to covered vertebrate terrestrial species in this DEIR and there needs to be a commitment in this DEIR to obtain an incidental permit for all of the covered vertebrate terrestrial species that will be impacted by this project as well as a Section 10(a)(b)(1) Incidental Take Permit. Finally, the DEIR fails to state enforceable method/s for conserving in perpetuity the lands for mitigation for loss of the covered vertebrate terrestrial species' foraging habitat, as well roosting and nesting habitat where applicable. Please see comments below pertaining to Swainson's Hawk for additional detail.

Mitigation Ratios Based on Thresholds After Mitigation Are Inadequate

The loss of habitat is a critical component for the listing of covered vertebrate terrestrial species. Conserving habitat at 1:1 or other mitigation ratio level does not make up for the habitat that was lost. At a 1:1 ratio, for every acre conserved there is an acre lost, and it is this ongoing loss of habitat that makes the impacts to all of the covered vertebrate terrestrial species significant and unavoidable.

This DEIR needs to change its significance findings for all covered vertebrate terrestrial species impacted by the loss of habitat to "significant and unavoidable."

This DEIR also needs to analyze and include cumulative impacts from other projects and activities, as does the DEIS, in determining the thresholds of significance. In the northern portion of the project area there is significant urban growth pressure from Elk Grove that would negatively impact/effect many of the same species being considered in the DEIR and the DEIS. Agricultural shifts from row crops to orchards and vineyards in the project area also puts additional pressure on listed species.

SWAINSON'S HAWK

The DEIR analysis conflicts with California Department of Fish and Wildlife Guidelines for Swainson's Hawks

Background Information: The California Department of Fish and Wildlife ("CDFW") performed a Status Review titled "Swainson's Hawk (Buteo swainsoni) in California (Reported to California Fish and Game Commission) 2016 Five-Year Status Report" that states:

> (T)he Department recommends retaining the Threatened classification for this species based on the following:

• On-going cumulative loss of foraging habitats throughout California • Significantly reduced abundance throughout much of the breeding range compared to historic estimates
• An overall reduction in the hawk's breeding range in California. (CDFW Status Report at p. 4.)

Critical to CDFW's review was the finding that "[t]he primary threat to the Swainson's Hawk population in California continues to be habitat loss, especially the loss of suitable foraging habitat, but also nesting habitat in some portions of the species' breeding range due to urban development and incompatible agriculture" (CDFW Status Report at p. 3).

The report specifically notes that "[t]he lack of suitable nesting habitat throughout much of the San Joaquin Valley, due to conversion of riparian systems and woodland communities to agriculture, also limits the distribution and abundance of Swainson's Hawks (California Department of Fish and Game 1993)." (Id. at p. 4).

CEQA Guideline 15126.4(a)(1)((B) states (with emphases added): Formulation of mitigation measures shall not be deferred until some future time. The *specific details of a mitigation measure, however, may be developed* after project approval when it is impractical or infeasible to include those details during the project's environmental review *provided that* the agency (1) commits itself to the mitigation, (2) *adopts specific performance standards the mitigation will achieve*, and (3) identifies the type(s) of potential action(s) that can feasibly achieve that performance standard and that will considered, analyzed, and potentially incorporated in the mitigation measure.

The Delta Conveyance DEIR conflicts with this guideline. The DEIR lists as a reference the Department of Fish and Game guidance on Swainson's Hawk mitigation (Staff Report Regarding Mitigation for Impacts on Swainson's Hawk in the Central Valley of California, California, Department of Fish and Game, November 8, 1994), but does not refer to those guidelines, much less commit to them, in its description of compensatory mitigation. It fails to commit to mitigation, including a mitigation ratio, a number of acres to be conserved in perpetuity, and a number of trees to be replaced. It fails to disclose the specific performance standards to be used for Swainson's Hawk impact mitigation.

The DEIR fails to commit DWR to obtaining a 2081 take permit for impacts to Swainson's Hawk of the project, nor does it require that its mitigation plans be approved by California Fish and Wildlife. The project cannot guarantee that it has reduced its impact on Swainson's Hawk to less than significant if it does not apply for a 2081 take permit and comply with the guidelines and conditions set by CDFW. This is a critical oversight, and must be corrected.

The DEIR inadequately defers until after the permitting process the impact and mitigation details required to be disclosed to the public in the DEIR. The DEIR states: The detailed restoration design work and management planning, which will include fully detailing performance standards, monitoring methods, and adaptive management actions, will occur between the project permitting phase and project completion. Other mitigation actions, including bank credit purchases and habitat protection, will also occur between permitting and project construction completion. To inform the mitigation planning process between permit issuance and mitigation land construction or preservation, DWR will prepare Draft and Final Habitat Mitigation Plans for affected species and wetlands. Compensatory mitigation would be secured in phases in accordance with the progress of construction. (p.3F-16)

The DEIR fails to state enforceable method for conserving in perpetuity the lands for mitigation for loss of Swainson's Hawk foraging habitat

CEQA requires that mitigation measures be capable of enforcement. Mitigation for loss of foraging habitat requires that a conservation easement held by a credible conservation manager, including an endowment for the permanent enforcement and monitoring of the habitat mitigation easement. Typically, the easement will be recorded prior to the issuance of a grading permit or prior to any grading, grubbing or disturbance of soil. To ensure that mitigation achieves the less than significant impact threshold, both the conservation easement and the conservation operator should be approved by CDFW. Deed restrictions would not meet the criteria for enforceable mitigation and the Environmental Groups do not believe they have been used for Swainson's Hawk conservation in California.

CDFW has a model easement that can be utilized with willing agricultural land owners. The Swainson's Hawk foraging habitat easement differs from an agricultural land conservation easement primarily in the addition of restrictions against orchards and vineyards and other crop types that interfere with foraging.

Although CMP-19b states that "Mitigation acres will be provided for all acres of habitat lost in the very high, high, medium and low value classes," it does not disclose the mitigation ratio or the number of acres to be acquired for mitigation, or the instrument for restricting uses. CDFW SWHA mitigation standards, and those of local ordinances and habitat conservation plans, generally require that mitigation for loss of any SWHA foraging habitat be at a ratio of 1:1, that the mitigation lands be protected in perpetuity by conservation easement or fee title, that a conservation manager be approved by CDFW and permanently endowed, include crop restrictions, and that mitigation lands be within 10 miles of the area impacted by the Project. The DEIR has none of these requirements. The project mitigation measure would allow a much smaller mitigation ratio. The EIR states that mitigation measures will be developed during the permitting process, but fail to state when the mitigation land, whether easements or fee title, will be acquired. The EIR mitigation measure would inappropriately allow the mitigation land to be acquired at some unspecified time after the project is completed, possibly never.

According to the DEIR, mitigation lands also could be located many miles distant from the area impacted by the project, and thus of little to no value to the population of hawks impacted by the project. CMP–19b expressly states "Foraging habitat will be protected within 3 miles of a known Swainson's hawk nest tree and within 50 miles of the project footprint." Protection of foraging lands more than 10 miles from the project impact will have no beneficial impact to the nesting pairs in the project area and will not contribute to their reproductive success. This is because Swainson's Hawks establish their nests adjacent to their foraging grounds and rely on feeding close to the nest. While the (mostly male) birds do occasional fly longer distances to feed during harvesting or flood events, they can't rely on utilizing long distance feeding grounds to provide for and recruit young into the population. If adults must hunt long distances from the nest site, the additional energy required may result in reduced nesting health and greater mortality. (Brian Woodbridge, Biology and Management of Swainson's Hawk in Butte Valley, California; US Forest Service Report, 19pp, 1985). The California State Department of Fish and Wildlife has thus established a ten-mile standard, which is the "flight distance between active (and successful) nest sites and suitable foraging habitats, as documented in telemetry studies (Estep 1989, Babcock 1993)." (California Department of Fish and Game, Staff Report Regarding Mitigation for Impacts to Swainson's Hawks (Buteo swainsoni) in the Central Valley of California, 1994). The Department of Fish and Wildlife further detailed and reinforced the ten-mile standard in a letter to the City of Elk Grove (January 12, 2018):

In order for CEQA Lead Agencies to lessen impacts to SWHA foraging habitat to below a level of significance, mitigation lands used to offset impacts must be located in a biologically supportable distance from the impact site. In addition to the City's [of Elk Grove] Swainson's Hawk Code, many biological consultants and mitigation bankers have expressed that this distance is, or should be, 10 miles. An accurate and biologically supportable distance to use when establishing a service area should consider the home ranges and core use areas used by both males and females.

Therefore, providing additional protected foraging habitat for other nesting pairs, not affected by the project, will not address impacts to the population affected by the project, and will not reduce its impact on the reproductive success and range of the species.

CMP-19b states that "Where feasible, protected foraging habitat will have land surface elevations equal to or greater than minus one-foot NAVD88 or will maintain levees around protected habitat, to minimize the risk of flooding and loss of suitable habitat due to future sea level rise." The Environmental Groups do not believe this level would protect habitat from flooding. Nor does the DEIR provide evidence to the contrary. Elevation at or below sea level is not considered suitable for SWHA nesting and foraging habitat due to exposure to potential flooding.

The DEIR states that "The unmitigated impact on SWHA ranges from 1800 acres in Alt 5 to a high of 3400 acres in Alt 2A. This is considered less than significant impact. (Table 13.0)." The Environmental Groups are concerned this statement is ambiguous. The DEIR must clarify if this number represents the number of acres impacted by the project before mitigation is acquired, or if this is the number of acres left unmitigated after mitigation is acquired. If there are 1800 to 3400 acres of foraging habitat that will not be mitigated, the project impacts have not been mitigated to less than significant. If these numbers represent the acre impact, then the DEIR should commit to 1800 to 3400 acres of mitigation for loss of foraging habitat, depending on the alternative chosen.

Based on the preceding discussion, this EIS is inadequate in that it relies on a severely flawed CEQA document to claim no impacts to state listed species. The Environmental Groups reject the DEIS claim that the mitigation, along with the CMP and environmental commitments, will reduce the effect of the action alternatives of the project on Swainson's Hawk to less than significant. We oppose certification of the EIR and EIS for this project.

PEREGRINE FALCON

The Peregrine Falcon Was Not Included in Impacts Analysis, AMMs, or Mitigations

The Peregrine Falcon is a California Fully Protected Species that can be found throughout the project area, but it was not included in the impact analyses in this DEIR. The Peregrine Falcon routinely ingests shorebirds when near wetland areas, but there was no discussion of the possible impacts to the falcon from methylated mercury, selenium, or byproducts from toxic algae, even though it eats fairly high up on the food chain and would therefore be more vulnerable to such toxins concentrating up through the food chain. This DEIR must include impacts analysis and AMMs and mitigations for Peregrine Falcon.

GREATER SANDHILL CRANE

General Comment on Status as a No Take Species.

Greater Sandhill Cranes are a “no take” species by virtue of their California Fully Protected Species status. For Fully Protected Species, California Fish and Game code section 86 states: “’Take’ means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.” This is a high bar in that no individuals that are Fully Protected can be killed during any phase of the construction and the operation of the Delta Conveyance project. “Take,” as defined by section 86 must be avoided in all circumstances and it is not acceptable to provide mitigation for incidental take except within the construct of a state approved Natural Communities Conservation Plan (NCCP). This project is not an NCCP, but rather a huge construction project that is regional in scope.

The Greater Sandhill Crane is also protected as a threatened species under the California Endangered Species Act (CESA) which defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” The big additional protection provided by CESA is that the species is not to be harmed. But unlike “Fully Protected Species” status, incidental take (harm in this case) can be mitigated. This difference in definitions explains why avoidance methods are being employed in the hopes that no Greater Sandhill Cranes are killed during the construction and operation of the project (Fully Protected Species status) and why land acquisition mitigations are being provided for the loss of Greater Sandhill Crane habitat (to address "harm," CESA). Our review will focus on whether the avoidance efforts are sufficient to ensure that no Greater Sandhill Cranes will be killed by any facets of the construction or operation of this project, and whether the land acquisition mitigations provided are adequate to address the harm caused by the project.

General Comment Regarding Staten Island Wintering Crane Importance and Tunnel Shaft Location.

The DEIR notes that:

> Staten Island is an important wintering area for sandhill cranes and regularly hosts a high density of greater and lesser sandhill cranes, particularly early in the winter season (Ivey et al. 2014b:9). Interested parties provided information that was used to identify a suitable location for the tunnel shaft on Staten Island (under Alternatives 1, 2a, 2b, and 2c) in a previously disturbed location adjacent to a road and powerline on the northern portion of the island (Delta Conveyance Design and Construction Authority 2022d:4) (DEIR, chapter 13-279).

To be clear, the interested parties who provided information (Sean Wirth, who was a terrestrial species stakeholder during some of the SEC process, provided this input after consultation with Dr. Gary Ivey) "that was used to identify a suitable location for the tunnel shaft on Staten Island" did not characterize the location as "suitable," but very clearly indicated, on more than one occasion, that the location near the existing structures on the northeast side of the island was "less horrible" than other options. The placement of a giant access shaft right in the middle of ground zero for crane populations in the Delta is flawed through and through no matter where the tunnel shaft was placed on the island. The enormity of the structure would cause a permanent visual disturbance for cranes, which could result in the permanent abandonment of the temporary roosting area north of the proposed location because of the impaired site lines created by such a large structure, would disrupt both roosting and foraging during construction, and would pose a permanent strike hazard for cranes on very foggy and dark days because of its height.

The Assumed Arrival Time for Greater Sandhill Times is Oversimplified

Setting September 15 as the de facto day that Greater Sandhill Cranes are going to arrive is problematic. Whereas this may be a useful date to consider if one wants to go out and see early arrivers, it is in no way a hard and fast parameter. Greater Sandhill Cranes have been seen much earlier than that date in the Delta, as an example, about 15 years ago a small flock was reported by Esther Milnes on August 18 (pers. discussion with Dr. Gary Ivey). Admittedly this flock was likely quite an outlier, but section 86 of CDFW code prohibits the take of any Greater Sandhill Cranes, no matter how much earlier they arrive then September 15th. As well, with climate change it would not be unreasonable to expect that arrival times could shift for cranes like it has for other birds. If as a result they left earlier from the Delta, this would not be problematic for this DEIR, but earlier arrival times would be. No consideration or discussion appears to have been provided in this DEIR addressing possible shifts in arrival times due to climate change. All analysis and avoidance measures for Greater Sandhill Cranes need to include arrival times as early as August 18th and possibly even earlier to address climate change shifts.

The Temporary Roosting Data is Outdated and Insufficient

The temporary roosting data being used for temporary roosting sites is outdated and not sufficient to identify potential impacts to Sandhill Cranes. The DEIR acknowledges that Greater Sandhill Cranes have a high level of philopatry for their roosting sites. But if Greater Sandhill Cranes have been using a roost site that is no longer available, they have no choice but to find a new roost site. Temporary roost sites are, by definition, not permanent. The data used for the location of roost sites in the DEIR is not current. It should be updated yearly to reflect the current locations of roost sites being utilized. Using older, and therefore not necessarily accurate, roosting data means that any analysis derived using those sites is also not necessarily accurate. Understanding where Sandhill Cranes are likely to forage is directly tied to where they roost. Identifying impacts to foraging cranes are an important consideration for the DEIR. This temporary roost site data deficiency needs to be corrected by using the most recent season's roosting data, and the analysis of impacts to roosting and foraging cranes needs to be updated and corrected accordingly. Additional analysis needs to be provided that considers how foraging locations may shift due to shifting roost sites. The construction window for this project is over a decade and these potential shifts could result in take of Greater Sandhill Crane if avoidance measures are not designed with these potential shifts in mind.

The Daily Travel Distance from Roosting Site to Foraging Area is Deficient

This DEIR relies heavily on the Ivey et al 2015 study looking at how far cranes migrate daily from their roost sites to foraging areas (Ivey, Dugger, Herziger, Cassaza, and Fleskes, 2015). The paper was not trying to determine the greatest distance that a crane would commute daily for feeding, but rather it was trying to determine commute distances in the context of conservation. To that end the discussion in the paper clearly states that habitats within 5 km of roosts for Greater Sandhill Cranes, which would encompass 95% of the studied Greater Sandhill Cranes, and within 10 km for Lesser Sandhill Cranes (90%), should be considered for making zoning and land use considerations. The remaining 5% of Greater Sandhill Cranes and the remaining 10% of Lesser Sandhill Cranes, that commute farther than the respective 5 km and 10 km also need to be considered in a DEIR that must ensure that no Greater Sandhill Cranes will be killed, and that must identify and mitigate for harmful impacts to Greater and Lesser Sandhill Cranes, even those that are outliers when it comes to long commuting distances.

It is important to remember that only 33 Greater Sandhill Cranes and 44 Lesser Sandhill Cranes were tracked for the study. Whereas this number of cranes were able to provide a statistically significant understanding of the relationship between roost sites and foraging sites, the same cannot be said for using the same data for determining the greatest distance that a crane might travel to forage. The Ivey et al paper (Ivey, Dugger, Herziger, Cassaza, and Fleskes, 2015) included a data point for a Greater Sandhill Crane traveling almost 9 kilometers from the roost site, and one for over 21 kilometers for a Lesser Sandhill Crane. So, the longest distance that might be travelled can be accurately described as longer than 9 km for Greater Sandhill Crane, and longer than 21 km for Lesser Sandhill Cranes. Given the thousands of cranes that winter in the project area, the extreme outliers could travel significantly further. There was no acknowledgement or discussion of this probability, nor does any of the impact analysis consider this probability.

The distances utilized by this DEIR for identifying possible impacts fall short and do not encompass possible impacts from this project on cranes throughout their winter landscape. This resulted in a deficient approach for identifying potential deadly impacts to Greater Sandhill Cranes and potentially harmful impacts to both Greater and Lesser Sandhill Cranes. Analysis should be done looking at possible impacts greater than 9 km from roost sites for Greater Sandhill Cranes because deadly impacts are possible in that range, as an example, a Greater Sandhill Crane being flushed when it is foraging 10 km from its roost site and hitting an existing power line on a cloudy day. For Lesser Sandhill Cranes that distance should be more then 21 kilometers to determine possibilities for harm. This deficiency will be commented on further in the context of new powerlines as well as potential impacts to foraging cranes.

The Analysis of Crane Collisions with Transmission Lines and Proposed Avoidance Measures Are Deficient Because Roosting and Travel Distance Data Are Deficient

There are descriptions and analyses of bird strikes with new powerlines with a particular focus on, and even an appendix devoted to, Sandhill Cranes because of a substantial historical record of this species being vulnerable to such strikes. The deficiencies discussed already about outdated roost site data and daily commute distances are evident here.

> Most greater sandhill crane movement in the Delta occurs within approximately 1.2 miles of their primary roost sites (Ivey et al. 2015:523) and Brown et al. (1987:131) found that no sandhill crane collisions occurred where distances from power lines to bird-use areas were greater than or equal to 1 mile (Avian Power Line Interaction Committee 2012:50). All proposed new aboveground towers and associated SCADA and transmission lines would be located at least 3 miles or more from the nearest known greater sandhill crane roost site under all alternatives (DEIR , chapter13, page 272).

Whereas it is true according to Ivey et al, 2015, that most Greater Sandhill Crane have daily commute distances in the Delta that occur within 1.2 miles of roost sites, and even that 95% of Greater Sandhill Cranes are commuting 5 km or less daily. But there remains the issue of the other 5% of Greater Sandhill Cranes which are travelling farther. As for Brown et al, 1987, bird use areas include both roosting and foraging, and his recommendation in that paper was to locate new transmission lines AT LEAST 2 km (which is 24.3% farther than the 1 mile attributed to Brown in this DEIR) from roosting and feeding sites. So, 1.243 miles from a crane use area would extend far beyond 1.2 or even three miles from the roost site based on the conclusions from the Ivey et al, 2015, paper, which demonstrated that Greater Sandhill Cranes can travel close to 9 km from roost sites, if not further. The correct math based on these two papers does not support a conclusion that locating new transmission lines at least 3 miles away from roost sites will avoid the possibility of a Greater Sandhill Crane being killed by a new transmission line. The correct math would be that new lines should be located at least 11 km from roost sites (9 km travel distance plus the additional 2 km added by Brown), and possibly significantly further away given the likelihood that some Greater Sandhill Cranes are at times travelling even further from their roost sites.

Locating new above ground towers and associated SCADA and transmission lines 3 miles or more from Greater Sandhill Crane roost sites is clearly inadequate to avoid possible powerline strikes for a bird that we know travels close to at least twice that distance (9 km data point from Ivey et al, 2015) and quite possible much more. Add to this the problem of outdated temporary roost data and it becomes impossible to accurately determine where to even start measuring the commute distances from. These deficiencies make it impossible to understand the potential impacts to Greater Sandhill Cranes. And, locating new transmission lines at least 3 miles from roost sites does not avoid the eventuality of Greater Sandhill Cranes being killed and Lesser Sandhill Cranes being harmed.

The same issues exist for the co-location of powerlines:

> Replacement aboveground transmission lines along Franklin Road would be placed at the same vertical height as the existing lines on the opposite side of the tower. Replacement aboveground transmission and SCADA lines located within 1.2 miles of known roost sites, in the absence of mitigation, could increase the potential for collision for greater sandhill cranes (within 3 miles of known roost sites for lesser sandhill cranes; Ivey et al. 2015:523) if they were not constructed within the same vertical prism as the existing lines. (DEIR, chapter 13-273)

As discussed above, the Ivey et al, 2015, and Brown et al. 1987, papers taken together suggest that any above ground transmission line within 11 km (6.83 miles), not 3 miles, of a roost site could increase the potential for collision for Greater Sandhill Crane and this was not analyzed in this DEIR. Further, constructing the new lines such that they are within the same prism as the existing lines does not guarantee that Greater Sandhill Cranes will not die hitting them. A bird gaining altitude as it flushes from a roost or forage site might clear the first lines as it gains altitude only to hit the new set of lines extending further out at the same elevation. Placing flight diverters may help, but the risk would remain. It is our understanding that the SCADA lines are to be installed significantly closer to the ground than the electrical lines. This would mean that Greater Sandhill Cranes would have to avoid both the lower SCADA lines and the upper electrical lines requiring them to avoid a new lower hazard as well as an elongated upper hazard. The SCADA lines are new and not necessarily being co-located on the same plane as existing communication lines. They present a clear hazard that is not avoided by co-locating the upper electrical lines on the same prism.

> The project alternatives have been designed to avoid any activities that would result in actions considered "take" of greater sandhill crane. The project alternatives would use existing power lines or underground conduit to the extent possible for the purpose of avoiding potential injury or direct mortality of the greater sandhill crane and all new aboveground lines would be located outside of the roost sites or foraging habitat for greater sandhill crane. (Chapter 13-274)

The analysis of above ground transmission lines did not reflect the amount of the landscape that Greater Sandhill Cranes are using outside of their roost sites, using 3 miles as opposed to a minimum of 11 km as an initial parameter. The co-location of the upper lines may result in fewer strikes than an entirely new alignment, but no evidence was provided that the additional width from adding new lines on the same plane is not a hazard to cranes gaining elevation as they flush. The SCADA lines introduce a new lower striking hazard with no evidence that Greater Sandhill Cranes will not hit them., even if flight diverters are installed on them. The Delta can have very thick fog, which could obscure even the best diverters.

The final transmission line deficiency is that there was no impact analysis of Greater Sandhill Cranes hitting EXISTING transmission lines after being flushed from foraging sites by construction activities. Attention was only given to new lines and only within 3 miles of roost sites. The DEIR acknowledges the possibility of flushing foraging cranes – as an example by construction vehicles on the haul roads – but it does not address the existing power line strike issue that could result from flushing foraging birds. The analysis should use current roost site data and consider all existing power lines and other potentially deadly physical obstructions like, but not limited to, fences, buildings, large equipment, poles etc. within a minimum of 11 kilometers, and potentially further, if the DEIR is unable to demonstrate that Greater Sandhill Cranes are not travelling even further, that might be hit by cranes being flushed from their forage sites by construction activity. No avoidance measures were presented for this potentiality, beyond 3 miles from roost sites, for Greater Sandhill Cranes, or mitigations provided for Lesser Sandhill Cranes, and only new transmission lines were considered within those 3 miles.

There appears to have been an assumption that the avoidance measures that were designed to keep Greater Sandhill Cranes from hitting transmission lines would also be protective for Lesser Sandhill Cranes. This was an erroneous assumption. As indicated earlier, Lesser Sandhill Cranes were documented flying more than 21 km from roost sites in the Ivey et al 2015 paper, which means that 21 km is a minimum distance to be considered and not the farthest distance that Lesser Sandhill Cranes are likely travelling because the sample group was only 44 birds. Adding the 2 km recommendation called for in the Brown 1987 paper, any powerline (new or existing) within a minimum distance of 23 km from a roost site that could be hit by a crane because of construction activities presents a potentially deadly or harmful threat. There were no avoidance or minimization measures or mitigations for transmission lines (new and existing) that addressed impacts for any cranes beyond 3 miles from roost sites. This is even though obvious mitigations exist like requiring the installation of flight diverters on any existing transmission lines within 23 km of a roost site that cranes might hit if they were flushed while foraging, particularly on foggy and dark days. For new powerlines, the avoidance and minimization measures should extend to include any line within a minimum of 11 km of roost sites for Greater Sandhill Cranes, and a minimum of 23 km for Lesser Sandhill Cranes. These avoidance and minimization measures will help but cranes, both Lesser Sandhill Cranes and Greater Sandhill Cranes, could still be killed or harmed by transmission lines because of construction activity for this project because of the significant number of days of very cloudy weather in the Delta when cranes are present, which could make even the best flight diverters inadequate. The transmission line impact potentiality is unavoidable and potentially significant, potentially fatal to Greater Sandhill Cranes, and no mitigations measures were provided for Lesser Sandhill Cranes that could be harmed beyond 3 miles from roost sites. Even if the avoidance and minimization measures are improved with more flight diverters on existing lines extending out to 23 kilometers from roost sites, it is still likely that Lesser Sandhill Cranes will be harmed or killed by collisions with immovable objects on very foggy and dark days.

The Proposed Avoidance and Minimization as Well as Mitigation Measures Are Not Adequate to Avoid Killing or Harming Greater Sandhill Cranes Because of Construction and Operation Related Noise Created by the Project

Construction and operation noise has the potential to cause cranes to flush and possibly hit transmission lines (new and existing) or other obstructions on the landscape. This DEIR suggests that cranes have been seen to acclimate to steady sources of noise, like that from a busy freeway. It also states that: “less is known about the ability of sandhill cranes to habituate to intermittent noise such as that associated with the operation of heavy equipment (e.g., pile drivers, construction cranes, compressors, heavy trucks) (DEIR, chapter 13-266).” A discussion followed this admission in an apparent effort to refine what is known about Sandhill Cranes ability to habituate to intermittent noise.

> Hazing techniques are regularly employed in North America to prevent sandhill cranes from causing significant crop damage or colliding with aircrafts (Barzin and Ballinger 2017:1). Hazing techniques such as propane cannons and pyrotechnics have been reported to lose their effectiveness as deterrents once individuals are no longer naïve to the auditory disturbance, particularly in high-value habitat (Barzin and Ballinger 2017:5–6), suggesting that cranes can habituate to extreme and sporadic sounds. Disturbance from waterfowl hunting

> can reduce habitat availability to sandhill cranes (Ivey et al. 2014a:27; Ivey et al. 2014c:16–17) and cranes have been observed to avoid roost sites once opening day of hunting season has begun (Ivey et al. 2014c:16). Sandhill cranes are present in the study area during the waterfowl hunting season (approximately October 23 through January 31), and hunting occurs throughout the study area on Bouldin Island, Little Mandeville Island, private duck clubs, Stone Lakes NWR within 1 mile of known roost sites, and from public waterways throughout the Delta. Cranes are therefore exposed to irregular, explosive sound from shotguns under existing conditions (a 12-gauge shotgun blast is approximately 165 dB) and respond to those disturbances throughout the winter season. (DEIR, chapter 13-266)

The referenced Barzin and Ballinger paper references the use of propane cannons and pyrotechnics. These devices appear to have been used in the Spring to protect corn kernels planted in the ground from cranes. It should be noted that crane behavior can vary depending on the season, and that how a crane behaves in the Spring (up on their breeding grounds) cannot be seen as a surrogate for how a crane will behave on its wintering grounds. And, even if the devices are not effective long term, the paper clearly indicated that it was initially effective, especially with naïve birds. Juvenile cranes would fit the definition of “naïve” and these are the same cranes most likely to flush when disturbed and hit a powerline, and, as has already been indicated in this comment letter, the modeling for powerline strikes is deficient to even determine the level of impacts. During the foggy wintering season in the project area, “naïve” Greater Sandhill Cranes would be particularly vulnerable to sound impacts and with the current avoidance measures “take” as defined by section 86 of CDFW code is a definite possibility. It is also worth noting that the suggestion that cranes could potentially acclimate to the construction disturbance is substantially undermined by the quote below

> Construction activities would not be expected to injure or kill sandhill crane individuals. If a bird is present in a region where construction activities are occurring, the bird would be expected to avoid the slow-moving or stationary equipment and move to other areas, as they would move away from any other trucks or farm equipment that could be present within or adjacent to agricultural habitats under existing conditions. (DEIR, chapter 13 – 265-6)

This quote surely suggests that cranes are going to move (flushing is indeed a type of movement) to avoid disturbances, which due to the nature of the construction is likely going to have a sound component. So, this DEIR is counting on them moving and not habituating and staying close to construction disturbances, which is quite different from some of the inferences/suggestions made in the last quote from this same DEIR. We are in general agreement that cranes will avoid these disturbances and we believe that the sound component of the construction is a big part of why they would move. But the problem we have been consistently bringing up is that the movement (flushing) is fraught because they could be injured or killed by obstructions in their environment at far greater distances from their roost sites than this DEIR analyzed or considered, or by obstructions other than new transmission lines within the areas that were analyzed.

Limiting construction activities greater than 50 dba to one hour before sunrise until one hour after sunrise does not limit heavy equipment or other vehicles from driving haul roads and access roads and potentially flushing cranes which could result in transmission line strikes – and here again the outdated roost site data and deficient daily commuting analysis are problematic. Similarly, construction sounds below 50 dba from stationary sources (intakes, shafts, etc.) have the same capability of flushing cranes.

As for the discussion about hunting disturbances in the Delta, it is important to highlight that the DEIR states, based on the 2014 Ivey paper: “Cranes have been observed to avoid roost sites once opening day of hunting season has begun,” suggesting a quite significant behavioral modification because of the gunfire (DEIR, chapter 13-267).” The DEIR quote also states that: “Cranes are therefore exposed to irregular, explosive sound from shotguns under existing conditions (a 12-gauge shotgun blast is approximately 165 dB) and respond to those disturbances throughout the winter season (DEIR, chapter 13-267).” The cranes’ response is the obvious concern here, but this quote infers that since cranes are adjusting to the hunting, they will also adjust to the noise impacts from the project. Beyond abandoning roost sites and possibly nearby foraging sites because of the gunfire, they may also be undergoing stress, which is harmful to their survival and their future ability to be successful breeders. The response to gunfire seems to undo the suggestion that cranes easily habituate to extreme disturbance as evidenced by avoiding roost sites. This suggests that the enhanced feeding opportunities’ mitigation provided in Bio -33 may help offset the reduction in foraging habitat available, but it is unclear how this might address the stress component of their response.

There are field tested techniques available that could help determine if specific aspects of the construction process are stressing cranes. Glucocorticoid metabolites have been used to gage stress levels in cranes in the field (Barcelo, 2012). Collecting and analyzing field samples for the presence and quantity of this stress indicator before construction begins and then comparing that to samples collected during construction could provide important feedback on whether the avoidance and minimization measures are effective or if they might need to be modified and improved.

Construction and Maintenance Vehicles Will Flush Cranes

The 15 mile an hour speed limit on the dirt haul roads (DEIR, chapter 3b-24), such as those needed to access the intakes, might be effective to avoid running over small species in the roadway, or flying across the roadway, but it is potentially more of an impact for cranes. Using the unpaved section of Staten Island Road as a surrogate, slowing down from the speed limit of 25 miles an hour there to take a photo of cranes near the road inevitably causes them to flush. Similarly, driving very slowly (10 to 15 miles an hour) along the same road hoping to get photos of cranes near the road also causes them to flush before a photo can be taken. Driving at the speed limit of 25 miles per hour often does not cause the cranes to flush. So, the 15 mile per hour speed limit on dirt roads might be good for avoiding roadkill, but it is also potentially problematic for flushing birds, including Greater Sandhill Cranes. Slow moving vehicles on the dirt haul roads may flush more birds than faster moving vehicles. Of concern here is that Greater Sandhill Cranes that are flushed may be killed or harmed, particularly on foggy and dark days. And again, the existing transmission line analysis, because of outdated roost site data and the approach used to determine daily commute distances for cranes, along with not considering other obstructions on the landscape that a crane might hit, was deficient and therefore unable to determine if cranes may be killed when flushed by these slow-moving vehicles even after avoidance and minimization measures and mitigations.

The intermittent nature of vehicles driving down the new construction roads makes habituation less likely for cranes. This would certainly also be the case during the operation of the project because maintenance and operation vehicles would be extremely intermittent, suggesting that any nearby cranes encountered would be flushed and vulnerable to mortality as a result. The intermittent usage of the haul roads exacerbates the likelihood that cranes will be flushed – claims that the cranes might be able to acclimate to steady vehicular flows is dismantled by the reality that for at least some of the construction, and for all of the operation and maintenance, the usage will be very intermittent and highly likely to flush any nearby cranes encountered, which on foggy and dark days could result in bird strikes on power lines.

This DEIR admits, in a quote we used earlier, the likelihood of flushing cranes but describes it as “moving:”

> Construction activities would not be expected to injure or kill sandhill crane individuals. If a bird is present in a region where construction activities are occurring, the bird would be expected to avoid the slow-moving or stationary equipment and move to other areas, as they would move away from any other trucks or farm equipment that could be present within or adjacent to agricultural habitats under existing conditions. (DEIR, chapter 13 – 265-6)

The DEIR also admits that maintenance activities would disturb cranes:

> The maintenance of aboveground water conveyance facilities for all project alternatives would result in periodic disturbances that could affect roosting and foraging sandhill cranes. Maintenance activities across all facilities that could affect sandhill cranes (all project alternatives) include repaving of access roads every 15 years, semiannual general and ground maintenance (e.g., mowing, vegetation trimming, herbicide application), and daily or weekly inspections by vehicle. Noise and visual disturbances from these maintenance activities at the intakes and shaft sites could disturb greater and sandhill cranes roosting or foraging in the vicinity of work areas if activities are conducted between October and mid-March (when cranes are present in the study area). However, as

> described above under construction-related effects, there is insufficient data to assess the effects that of maintenance noise levels would have on sandhill crane behavior, relative to existing conditions. Maintenance activities would generally be conducted during the day, except for emergency maintenance, and would therefore not require additional lighting. (Chapter 13-273)

It is difficult to impossible to conclude that with the proposed avoidance measures that for the 12 plus years of construction, followed by the decades of maintenance, that all cranes flushed by vehicles or other construction activity will avoid mortality from hitting powerlines or poles or fences or other obstructions during foggy and dark days, especially given the deficient analysis of existing powerlines and other obstructions within 11 km of roost sites, and the use of outdated roost site data.

The Proposed Compensatory Management Plan for Greater Sandhill Cranes Is Inappropriate

The DEIR in Appendix 3F states that:

> The implementation of the CMP would be required to offset the loss of roosting and foraging habitat by creating roosting and foraging habitat and protecting agricultural foraging habitat for sandhill cranes (Appendix 3F, Attachment 3F.1, Table 3F1-3, CMP-18a: *Sandhill Crane Roosting Habitat,* and CMP-18b: *Sandhill Crane Foraging Habitat*), which would reduce the impact associated with habitat loss to less than significant.

The proposed CMP that uses Bouldin Island for creating new roost and forage sites for Sandhill Crane is inappropriate for impacts to cranes at Stone Lakes National Wildlife Refuge and the Cosumnes River Preserve because it does not benefit the populations that are impacted by construction of the intakes and the launch shaft and RTM storage planned for north of Twin Cities Road. During the Terrestrial Stakeholder meetings back when the tunnel/s was part of the BDCP, there was agreement to build a roost and forage complex that would bridge the Stone Lakes and Cosumnes River populations providing continuity between two of the populations of cranes that were going to be severely impacted by the project. This possibility still exists as a shadow in the current DEIR:

> The CMP (see Impact BIO-1 for a summary discussion of the CMP) would offset the loss of greater sandhill crane and lesser sandhill crane roosting habitat by creating roosting habitat on Bouldin Island or in suitable lands that provide connectivity between Stone Lakes NWR and Cosumnes River Preserve, and managing these areas in perpetuity (Appendix 3F, Attachment 3F.1, Table 3F.1-3, CMP-18a: *Sandhill Crane Roosting Habitat*) (DEIR, chapter 13-274).

The use of Bouldin Island for the CMP gets significant analysis and discussion in this DEIR, whereas the connectivity option is only included in the part of one sentence and is given no analysis or consideration beyond this half sentence mention. Bouldin Island might be an appropriate location to consider for impacts to cranes on Staten Island (which is only relevant if the central alignment options are selected), but it is useless to address the impacts to the Stone Lakes National Wildlife Refuge and the Cosumnes River Preserve crane populations because it is way outside of the daily commuting distances of those cranes. There should be a commitment to provide this connectivity and the FEIR should include the analysis and the consideration appropriate for the potential impacts of this more appropriate compensatory mitigation option to be compliant with CEQA .

The DEIR and in Particular, the Compensatory Management Plan Fail to Acknowledge the Environmental Commitments in Both Prior Tunnel Projects That Would Mitigate for Impacts to Listed Species in Proximity to Those Impacts

The Friends of SLNWR comment letter of April 17, 2020 on the NOP for this project included the following comment:

> WaterFix environmental commitments must be included as part of project. The WaterFix tunnel project included a number of environmental commitments that were a product of extensive discussions with stakeholder groups associated with Stone Lakes NWR. These measures provided significant mitigation for impacts on terrestrial species, most notably greater sandhill cranes and Swainson's hawks. These environmental commitments must be included as part of the project, preferably as mitigation measures for the current tunnel project.

The DEIR does not include these commitments in Appendix 3B, Environmental Commitments and Best Management Practices. Of particular importance are the biologic commitments pertaining to the creation of an additional roosting site for sandhill cranes and other migratory species and to supplemental foraging sites to mitigate for disturbances during construction of intake facilities. The impacts associated with these species will be primarily located near the intake and tunnel construction sites. These commitments should appropriately be incorporated into the CMP.

The DEIR May Not Have Utilized the Most Recent Version of the South Sacramento Habitat Conservation Plan Throughout the Document

Table 13-106. Cumulative Impacts on Terrestrial Biological Resources from Plans, Policies, Programs) states:

> The South Sacramento Habitat Conservation Plan (HCP) is a regional plan to address issues related to species conservation, agricultural protection, and urban development in south Sacramento County. Adopted in 2018, the HCP covers 40 different species of plants and wildlife including 10 that are state or federally listed as threatened or endangered, and allow landowners to engage in the

> “incidental take” of listed species (i.e., to destroy or degrade habitat) in return for conservation commitments from local jurisdictions. (Chapter 13-493)

The 2010 draft of the SSHCP had 40 covered species, but the Plan adopted in 2018 had 28 making one wonder if an older version of the Plan was referenced for the preparation of some of this DEIR. A careful examination should be done to ensure that all references to the older Plan are corrected to reflect the content of the adopted version.

The Evaluation of Potential Conflicts with the South Sacramento Habitat Conservation Plan Is Inaccurate and Incomplete

The presentation of the potential conflicts with the South Sacramento Habitat Conservation Plan (SSHCP) is neither accurate nor complete and as a result is quite misleading and portrayed the conflict as very negligible, which is not the case.

It is important to understand that the SSHCP is divided into Preserve Planning Units (“PPUs”). Each unit features different geologies and ecologies and was designed with a specific focus of protecting specific covered species. The proposed massive-scale construction in and near Stone Lakes National Wildlife Refuge and the Cosumnes River Preserve – including the launch shaft and RTM storage site north of Twin Cities Road - is within PPU 6, which is an agricultural and grassland unit, as explained in the SSHCP:

PPU 6 encompasses 95,196 acres outside the UDA in the southwestern portion of the Plan Area. PPU 6 is bisected by Interstate 5. It is bordered on the west by the Sacramento River, on the south by the Mokelumne River, and Dry Creek. The dominant land covers in PPU 6 are Agriculture (58,458 acres) and Valley Grassland (17,633 acres). All of the SSHCP covered birds have been documented in PPU 6, including 281 (71%) occurrences for Swainson’s Hawk, 190 (92%) occurrences for Greater Sandhill Crane, and 55% or more of the occurrences for Northern Harrier and White-tailed Kite. Put simply, PPU 6 is the population stronghold for Greater Sandhill Crane and Swainson’s Hawk.

Comparing the Delta Conveyance’s project area overlap to the entire footprint of the SSHCP is an irrelevant and useless comparison. The only worthwhile comparison would be with PPU 6. The overlap with PPU 6 is over 46%, which leaves a very different impression as to the potential level of conflict compared to the 14% overlap with the entire plan area of the SSHCP presented in this DEIR in table 13-102. The biologically relevant overlap is large and concerning. This DEIR is aware of the overlap with PPU 6 but does not highlight it as the relevant unit for comparison but rather includes it in the context of the agricultural land and grassland the SSHCP needs for its conservation strategy (and it does so incorrectly, which will be discussed later): “Approximately 50% of the SSHCP PPU 6 overlaps with the study area (DEIR, chapter 13-449).”

This apples to oranges irrelevant comparison continues in table 13-103 and the discussion of the relationship between the impact acreage of the project and the total acreage of the HCPs, as well as for the acreage of the HCPs within the project area. Table 13-103 showed that, depending on the alternative, the proportion of surface impacts relative to the SSHCP plan area range between .1% and .2%. Again, we are presented with an extremely low number that would lead one to believe that there is no discernable conflict with the SSHCP – only a 14% plan overlap and an impossibly small .1 to .2% for surface area of impacts within the SSHCP. But this approach provides little useful information for what the scale of the actual conflict with the SSHCP is. A more appropriate way to understand the conflict is thru the impact of this project on the "feasibility for acquisition" for the SSHCP in PPU 6.

But before discussing the 'feasibility for acquisition," it is necessary to consider whether or not the habitat acquisition for impacts by the project in the PPU 6 overlap area need to be mitigated within the footprint of PPU 6. Chapter 7 of the SSHCP indicates that 92% of occurrences and almost all of the high population usage roost sites for cranes, and 71% of the Swainson's Hawks occurrences are in PPU 6. Greater Sandhill Cranes forage extensively within a 3.1 mile (5 km radius) of their roost sites (Ivey et al, 2015), and the vast majority of roost sites in the entire SSHCP Area are within PPU 6. Since many of the impacts associated with the Delta Tunnels project would occur within the footprint of the SSHCP and PPU 6, it is important that those impacts also be mitigated within PPU 6 such that the populations that are impacted receive the benefit of the mitigations. This is especially important for the impacts in Stone Lakes National Wildlife Refuge because the crane population there is the most constrained in the region with extensive urbanization to the north and the east. Similarly, the impacts to the Cosumnes River Preserve cranes will go on for more than a decade and using Bouldin Island or other far-flung locations will provide no relief or compensation for the cranes impacted there. The mitigations need to be provided within the ranges of the cranes that are impacted to compensate the populations impacted. Specifically, foraging habitat within the crane population stronghold in the SSHCP Area needs to be mitigated within that same stronghold; mitigation for foraging habitat loss also should be located within 1.2 miles of an active roost site to be the most effective. Similarly, the impacts to Swainson's Hawks, White-tailed Kite and Northern Harrier should also be mitigated as proximal to the impacts as possible. This means that the habitat acquisition needs of the Delta Conveyance project must be considered along with the project's impact footprint when examining conflict with the SSHCP. This translates to, at a minimum, doubling the impact footprint so that it includes at least a 1:1 mitigation ratio for compensatory habitat acquisition.

The Chapter 7 Conservation Strategy of the SSHCP lays out the habitat acquisition targets for each PPU in the Plan Area. For PPU 6, page 7-89 of the SSHCP ("Overview of Conservation Strategy in PPU 6") states: "Approximately 9750 acres will be preserved in PPU 6." According to Table 7-2 ("Summary of SSHCP Preserve System and Existing Preserves by Planning unit") on page 7-63 of the SSHCP, 28,079 acres of PPU 6 are already in existing preserves. And according to section 7.5.2.3 (SSHCP, p. 7-88), there are currently 3,436 acres of low-density development in PPU 6. Simple math (total acreage minus the land already preserved and the land already developed) yields a total of 63,657 acres of available inventory in PPU 6, not accounting for sea level or floodplain restrictions. And it should be noted that Swainson's Hawk mitigation must be located above sea level to satisfy CDFW requirements.

> Approximately 50% of the SSHCP PPU 6 overlaps with the study area (County of Sacramento et al. 2020: Figure 7-2). The SSHCP habitat conservation goal for PPU 6 of 8,465 acres of agriculture represents 14% of available agricultural land cover and 623 acres of grassland represents 4% of available grassland habitat in PPU 6 (County of Sacramento et al. 2018:7-87–7-88, Table 7-6) (DEIR, chapter 13-449)

Using the citations provided, the way these calculations were done was by taking the 8,466 acres of agricultural land and 623 acres of grassland listed in table 7-6 of the SSHCP and dividing by 58,458 acres of agriculture and 17,633 acres of grassland listed as the "dominant land covers in PPU 6" listed in Chapter 7, page 88 of the SSHCP.   As a ground truth to this math, adding 58,458 acres of agricultural land to the 17,633 acres of grassland yields a total of 76,091 acres. But as we already know from the math in the last paragraph, the inventory available to the SSHCP in PPU 6 is not more than 63,657 acres, which is 12,434 acres less than 76,091.   A closer look at the quote above exposes the problem. Those acreage amounts in those citations were not provided as available inventory but instead as "dominant land covers." To figure out the available inventory one must do the math that we did in the last paragraph, which yielded the 63,957 acres. There is not enough information in the SSHCP to figure out how much agricultural land and grassland is available in PPU 6 because percentages of the dominate land cover numbers (58.458 acres for agriculture and 17,633 acres) are included in the 28,079 acres of existing conservation. Since it is not possible to determine which portion of the 63, 657 acres is agricultural land and which is grassland, it makes sense to consider the entire combined 9750 acres in relation to the 63,657 acres, which indicates that for the conservation strategy of the SSHCP to be successful, 15.3% of all available inventory in PPU 6 would need to be acquired.

The SSHCP is only allowed to acquire properties to satisfy its habitat mitigation requirements from willing sellers and the reality is that some landowners may wish to sell, and some may not. This uncertainty is encompassed in the concept of the "feasibility for acquisition ratio." Given the need for willing sellers, "the feasibility for acquisition ratio" represents how much habitat is available compared to how much habitat is needed for mitigation. If there are 100 acres of inventory, and fifty are needed for mitigation, the "feasibility for acquisition ratio" is 50%. The lower the "feasibility for acquisition ratio," the more likely that enough willing sellers will be found to satisfy the acquisition requirements of the Conservation Strategy of an HCP.

The California Department of Fish and Wildlife ("CDFW") maintained during the preparation of the SSHCP that the Plan should strive for a ratio of 15% or less. Beyond increasing the likelihood that enough willing sellers would be available to successfully implement the Conservation Strategy, such a low ratio would go a long way to avoiding what has happened in the Natomas Basin Habitat Conservation Plan where so little inventory can be found for mitigation, which has resulted in exorbitant prices being paid for rice fields. These costs and the lack of availability led to a developer purchasing Swainson's Hawk mitigation within 200 feet of one of Sacramento International Airport's runways because little else could be found.

The effect on the "feasibility for acquisition ratio" is where the true conflict with the SSHCP becomes clear. As has already been established, the existing "feasibility for acquisition ratio" for the SSHCP for PPU 6 is 15.3%. It is likely that if the land covers (in this case agricultural land and grasslands) were able to be broken out by category (which there is not enough information to do), the feasibility for acquisition for agricultural land in PPU 6 would be quite a bit higher. The range of ground impacts from the Delta Conveyance project within PPU-6 presented in table 13-103 of this DEIR is 192.82 acres to 698.93 for the various alternatives. Those ranges need to be at least doubled to include the biologically appropriate habitat mitigations that need to be acquired within PPU-6. This causes the range to increase from 385.64 acres to 1,397.86 acres (one half for impact and one half for mitigation). Adding this range to the conservation target for the SSHCP in PPU 6 (9,750 acres) yields a range of 9,942.82 acres to 11,147.86 acres. Taking that range and determining the new "feasibility for acquisitions ratio" for the SSHCP combined with the Delta Conveyance projects increases the ratios from the 15.3% without this project to a range of 15.9% to 17.5%. This is the best numerical indication and measure of the conflict with the SSHCP. PPU 6 is already a constrained landscape to work with to achieve 9750 acres of habitat acquisition based on the "feasibility for acquisition ratio" starting out a 15.3%, not accounting for restrictions due to elevation or floodplain. The Delta Conveyance project effectually reduces the available land covers in PPU 6 for mitigation and increases the "feasibility for acquisition ratio." So, this project clearly conflicts with the SSHCP by driving its already too high "feasibility for acquisition ratio" even higher. Additionally, it is not clear how much overlapping conservation benefit—one habitat type benefitting multiple species—is planned in the proposed habitat acquisition mitigation or is even possible based on what might be available as inventory. So, the number of acres needed in PPU 6 could increase for the Delta Conveyance Project, making the ratio even worse.

Delta Conveyance Eminent Domain Will Have a Chilling Effect on Willing Sellers for the SSHCP

The Delta Conveyance project can take land by eminent domain for both the project footprint and for mitigation. The use of eminent domain to condemn properties needed for mitigation could have a substantial chilling effect on the willingness of sellers to participate in the SSHCP or other HCP similarly affected by the project. A competing project taking land away forcibly with eminent domain for mitigation in the same small area of PPU 6 by the Delta Conveyance project could paint the SSHCP in the same negative light for many prospective sellers. The negative consequences to conservation because of predictable reactions of landowners to widespread use of eminent domain cannot be overstated and it would be a grave mistake to discount them.

The Project Is Incompatible with and Would Interfere with Successful Implementation of the SSHCP

During a long series of terrestrial wildlife meetings for the earlier iteration of the project that was included within the BDCP, stakeholders pushed for Swainson's Hawk and Greater Sandhill Crane mitigation to be done in the footprint of Elk Grove's Sphere of Influence Amendment application that was rejected by the Local Area Formation Commission ("LAFCo") in 2013. The reasoning was that it would be extraordinarily difficult for the SSHCP to acquire mitigation in that footprint because of the inflated land prices there from built up speculative pressure, and this land was prime habitat for Swainson's Hawk, Greater Sandhill Crane, White-tailed Kite, and Northern Harrier; the area is also in immediate threat of being lost in the near future to urbanization.

It was suggested that purchasing mitigation acreage there would have a greatly reduced effect on the SSHCP because the Plan did not have the financial structure to purchase much in that geography—the fee structure of the SSHCP has the cost of 1,000 such acres amortized over the cost of all of the agricultural mitigation acres. We promoted the value of creating a greenbelt south of Elk Grove to insulate the habitats found further south from urban pressure and the resultant spike in pricing due to speculation, improving on the SSHCP's chances of acquiring the acres it needs there. It was further argued that this would help with the success of the SSHCP because in the absence of imminent urbanization, it could increase the willingness of sellers and maintain the affordability of purchasing mitigation properties.

The suggestion was rejected because this geography was not in the legislative boundary of the Delta and therefore would allegedly require legislation to amend that boundary if mitigation was to be contemplated there. And, since it was not within the project area of the NOP of the BDCP, that would need to be redone as well. But now, the Delta Conveyance project, like the Twin Tunnels iteration, is not beholden to the legislative boundary of the Delta and this is no longer a limiting factor. There would be substantial impacts from the construction and operations of the Delta Conveyance project to many of the species covered by the SSHCP, and many of those impacts, and the mitigation for those impacts, would occur within the same "inventory" footprint as the SSHCP, jeopardizing the success of the SSHCP. This suggestion would be a reasonable mitigation for the conflict with the SSHCP and the impacts to species within its footprint.

The Environmental Commitment to Manage Invasive Weeds Must Be Broadened

The DEIR makes reference to an environmental commitment to manage for invasive weeds:

> Environmental Commitment EC-14: *Construction Best Management Practices for Biological Resources* (Appendix 3B) would reduce the potential for

> the introduction and spread of invasive plants by ensuring that equipment used is cleaned and inspected before entering new areas (DEIR, chapter 3b-27).

Yet EC-14 (DEIR, chapter 3b-27) only commits to cleaning and inspecting vehicles that will enter aquatic habitats. It only calls for cleaning of terrestrial vehicles, not the inspecting.

> 30.) All equipment used for construction and habitat creation, enhancement, and management will be cleaned prior to entering work areas and before moving between work areas.
>
> 31.) Equipment to be used in aquatic habitats will be thoroughly cleaned and inspected for aquatic invasive plant propagules and animal species before entering aquatic habitats (DEIR, chapter 3b-27).

Given the threat of transporting terrestrial invasive plants, all equipment needs to be both thoroughly inspected and cleaned irrespective of whether it will be used in terrestrial or aquatic habitats.

CONCLUSION

This DEIS perpetuates the deficiencies from the DEIR as pertains vertebrate terrestrial species and does not acknowledge the significant level of effects from the action alternatives on those species.

This concludes the comments of our environmental groups. Please know that the Delta Conveyance is a transformative and controversial project for the State of California that will benefit some areas of the state at potentially significant cost to other areas of the state. As we and other commenters will undoubtedly document, this environmental document, together with its length and confusing organization, has significant errors and omissions that do not well serve the public interest. It behooves the sponsors to diligently pursue a thoughtful and diligent effort to improve the analysis and effectively communicate the project's impacts.

Sincerely,

Robert Burness
Committee Chair, Habitat 2020

Scott Finley
Board President, Friends of Stone Lakes National Wildlife Refuge

Barbara Leary
Executive Committee Chair, Sacramento Group, Sierra Club

Susan Herre
Board President, Environmental Council of Sacramento

Sean Wirth
Conservation Chair, Mother Lode Chapter, Sierra Club

Jude Lamare
Executive Officer, Friends of the Swainson's Hawk

William H. Weaver
Conservation Chair, Sacramento Audubon Society

Mike Savino
Board President, Save Our Sandhill Cranes

CC:

Gary Ivey ivey@savingcranes.org
Osha Meserve osha@semlawyers.com Bart McDermott
bart_mcdermott@fws.gov

Attachments:

Memorandum from Gary Ivey, Ph.D., Pacific Flyway Program, International Crane Foundation

Brown W. M. R. C. Drewien, and E. G. Bizeau. 1987. Mortality of cranes and waterfowl from power line collisions in the San Luis Valley, Colorado. In: Lewis JC, editor. Proceedings of the 1985 crane workshop. Grand Island, Nebraska, USA: Platte River Whooping Crane Maintenance Trust. pages 128–136.

Central Valley Joint Venture, 2006. Central Valley Joint Venture Implementation Plan – Conserving Bird Habitat. U.S. Fish and Wildlife Service, Sacramento, CA, USA.

Dwyer, J. F., A. K. Pandey, L. A. McHale, and R. E. Harness. 2019. Near-ultraviolet light reduced Sandhill Crane collisions with a power line by 98%. Condor, 121:1–10.

Ivey, G.L., B.E. Dugger, C.P. Herziger, M.L. Casazza, and J.P. Fleskes**.** 2015. Wintering ecology of sympatric subspecies of Sandhill Cranes: correlations between body size, site fidelity, and movement patterns. Condor 117: 518-529.

Ivey, G.L., C.P. Herziger, and D. A. Hardt. 2014. Conservation priorities and best management practices for wintering Sandhill Cranes in the Central Valley of California. Prepared for The Nature Conservancy of California. International Crane Foundation. Baraboo, WI, USA.

Additional bibliography

Babcock, K. W. (1995). Home range and habitat use of breeding Swainson’s Hawks in the Sacramento Valley ofCalifornia. Journal of Raptor Research 29:193–197.

England et.al, Nest Site Selection and Reproductive Performance of Urban-Nesting Swainson's Hawks. . . ., J Raptor Research, 29 (3), 179-186, 1995.

Estep, J. A., and J. L. Dinsdale (2012). Distribution,abundance, and habitat associations of nesting Swainson'sHawks in the central San Joaquin Valley,California. Central Valley Bird Club Bulletin 15:84–106.

Fleishman, E et al 2016 Space Use by Swainson's Hawk (Buteo swainsoni) in the Natomas Basin, California. Collabra, 2(1): 5, pp. 1–12, DOI: http://dx.doi.org/10.1525/collabra.35

THE CONDOR
Ornithological Applications
AmericanOrnithology.org

Volume XX, 2019, pp. 1–10
DOI: 10.1093/condor/duz008

RESEARCH ARTICLE

Near-ultraviolet light reduced Sandhill Crane collisions with a power line by 98%

James F. Dwyer,* Arun K. Pandey, Laura A. McHale, and Richard E. Harness

EDM International, Fort Collins, Colorado, USA
*Corresponding author: jdwyer@edmlink.com

Submission Date: 6 September, 2018; Editorial Acceptance Date: 25 February, 2019; Published May 6, 2019

ABSTRACT

Midflight collisions with power lines impact 12 of the world's 15 crane species, including 1 critically endangered species, 3 endangered species, and 5 vulnerable species. Power lines can be fitted with line markers to increase the visibility of wires to reduce collisions, but collisions can persist on marked power lines. For example, hundreds of Sandhill Cranes (*Antigone canadensis*) die annually in collisions with marked power lines at the Iain Nicolson Audubon Center at Rowe Sanctuary (Rowe), a major migratory stopover location near Gibbon, Nebraska. Mitigation success has been limited because most collisions occur nocturnally when line markers are least visible, even though roughly half the line markers present include glow-in-the-dark stickers. To evaluate an alternative mitigation strategy at Rowe, we used a randomized design to test collision mitigation effects of a pole-mounted near-ultraviolet light (UV-A; 380–395 nm) Avian Collision Avoidance System (ACAS) to illuminate a 258-m power line span crossing the Central Platte River. We observed 48 Sandhill Crane collisions and 217 dangerous flights of Sandhill Crane flocks during 19 nights when the ACAS was off, but just 1 collision and 39 dangerous flights during 19 nights when the ACAS was on. Thus, we documented a 98% decrease in collisions and an 82% decrease in dangerous flights when the ACAS was on. We also found a 32% decrease in the number of evasive maneuvers initiated within 25 m of the power line along the river, and a 71% increase in the number of evasive maneuvers initiated beyond 25 m when the ACAS was on. Sandhill Cranes reacted sooner and with more control, and experienced substantially fewer collisions, when the ACAS was on. Installation of the ACAS on other high-risk spans, and perhaps on other anthropogenic obstacles where birds collide, may offer a new solution to a long-running conservation dilemma.

Keywords: Antigone canadensis, ACAS, Avian Collision Avoidance System, line marking, Nebraska

La luz ultravioleta cercana redujo las colisiones de *Antigone Canadensis* con una línea eléctrica en un 98%

RESUMEN

Las colisiones a mitad de vuelo con líneas eléctricas afectan a 12 de las 15 especies de grullas del mundo, incluyendo 1 especie en peligro crítico, 3 especies en peligro y 5 especies vulnerables. Las líneas eléctricas pueden ser equipadas con marcadores de línea para aumentar la visibilidad de los cables y reducir las colisiones, pero las colisiones pueden continuar con las líneas eléctricas marcadas. Por ejemplo, cientos de individuos de *Antigone canadensis* mueren anualmente en colisiones con líneas eléctricas marcadas en el Centro Audubon Iain Nicolson en el Santuario Rowe (Rowe), una importante localidad de parada migratoria cerca de Gibbon, Nebraska. El éxito de esta medida de mitigación ha sido limitado debido a que la mayoría de las colisiones ocurren de noche cuando los marcadores de las líneas son menos visibles, aunque aproximadamente la mitad de los marcadores de líneas poseen calcomanías que brillan en la oscuridad. Para evaluar una estrategia alternativa de mitigación en Rowe, usamos un diseño aleatorio para analizar los efectos de mitigación de las colisiones de un Sistema de Prevención de Colisión de Aves (SPCA) con una luz ultravioleta cercana colocada en un poste (UV-A; 380–395 nm) que ilumina un sector de 258 m de una línea eléctrica que atraviesa el Río Platte Central. Observamos 48 colisiones de individuos de *A. canadensis* y 217 vuelos peligrosos de bandadas de *A. canadensis* durante 19 noches cuando el SPCA estuvo apagado, pero solo 1 colisión y 39 vuelos peligrosos durante 19 noches cuando el SPCA estuvo encendido. Por ende, documentamos una reducción del 98% en las colisiones y una disminución del 82% en los vuelos peligrosos cuando el SPCA estuvo encendido. También encontramos una disminución del 32% en el número de maniobras evasivas iniciadas a menos de 25 m de la línea de energía a lo largo del río y un aumento del 71% en el número en maniobras evasivas iniciadas más allá de los 25 m cuando el SPCA estuvo encendido. Los individuos de *A. canadensis* reaccionaron antes y con más control, y sufrieron sustancialmente menos colisiones cuando el SPCA estuvo encendido. La instalación del SPCA en otras porciones de alto riesgo, y tal vez en otros obstáculos antropogénicos donde chocan las aves, puede representar una nueva solución a un dilema de conservación de larga duración.

Palabras clave: Antigone canadensis, marcación de líneas, Nebraska, Sistema de Prevención de Colisión de Aves

INTRODUCTION

Of the world's 15 crane species, 4 (27%) are categorized as critically endangered or endangered, and 7 (47%) are vulnerable (ICF 2018, IUCN 2018). Only 4 species are categorized as of least concern, and of those, the Sandhill Crane (*Antigone canadensis*), the world's most abundant crane species (Gerber et al. 2014), endured decades of decline before continent-wide management actions in North America reversed the trajectory. Even today, the Florida population of Sandhill Cranes remains in decline despite successful population recoveries throughout the rest of the species' range (Gerber et al. 2014). Numerous factors, including habitat loss and degradation, human disturbance, hunting, illegal capture for commercial trade, and impacts from environmental contamination, are contributing factors in the declines of crane populations (Johnsgard 1983, Meine and Archibald 1996, ICF 2018).

Power line collisions have been identified as a threat to 12 crane species, including Sandhill Crane and the only other North American crane species, the Endangered Whooping Crane (*Grus americana*; Table 1). Power line collisions are particularly important for 4 endangered or critically endangered species. Only 3 species of cranes, Black Crowned-Crane (*Balearica pavonina*), White-naped Crane (*Antigone vipio*), and Demoiselle Crane (*Anthropoides virgo*), have not been documented colliding with power lines (IUCN 2018). However, given that these relatively unstudied species share ranges with affected species, and given the ongoing expansion of power lines worldwide (Jenkins et al. 2010), these species are also likely to be, or to become, vulnerable to power line collisions.

Identifying effective mitigation measures for crane collisions with power lines is critically important to global crane conservation and is becoming more important as power line networks expand globally (Jenkins et al. 2010). To mitigate collisions involving cranes (and other birds), electric utilities use line markers to increase the visibility of power lines to birds (Morkill and Anderson 1991, Wright et al. 2009, Murphy et al. 2016a). Line markers tend to reduce avian collision rates by at least 50% in published studies (Morkill and Anderson 1991, Brown and Drewien 1995, Barrientos et al. 2011). However, this statistic may overestimate the true effectiveness of line markers as studies quantitatively demonstrating no significant reductions in collisions may be underrepresented because power line operators hesitate to publish negative data (J. Dwyer personal observation).

At our study area near Rowe, Nebraska, USA (described below), over 300 Sandhill Crane collisions with

TABLE 1. Mortalities from collisions with power lines have been reported[a] for 12 of the world's 15 crane species.

Common name	Scientific name	Status	Trend	Continent(s)	Power line collisions reported
Siberian Crane	*Leucogeranus leucogeranus*	Critically Endangered	decreasing	Asia	Yes
Gray Crowned-Crane	*Balearica regulorum*	Endangered	decreasing	Africa	Yes
Red-crowned Crane	*Grus japonensis*	Endangered	decreasing	Asia	Yes
Whooping Crane	*Grus americana*	Endangered	increasing	North America	Yes
Black Crowned-Crane	*Balearica pavonina*	Vulnerable	decreasing	Africa	No
Sarus Crane	*Antigone antigone*	Vulnerable	decreasing	Asia, Australia	Yes
White-naped Crane	*Antigone vipio*	Vulnerable	decreasing	Asia	No
Wattled Crane	*Bugeranus carunculatus*	Vulnerable	decreasing	Africa	Yes
Black-necked Crane	*Grus nigricollis*	Vulnerable	decreasing	Asia	Yes
Blue Crane	*Anthropoides paradiseus*	Vulnerable	stable	Africa	Yes
Hooded Crane	*Grus monacha*	Vulnerable	increasing	Asia	Yes
Brolga	*Antigone rubicunda*	Least Concern	decreasing	Australia	Yes
Demoiselle Crane	*Anthropoides virgo*	Least Concern	increasing	Asia, Africa	No
Sandhill Crane	*Antigone canadensis*	Least Concern	increasing	North America, Asia	Yes
Common Crane	*Grus grus*	Least Concern	increasing	Asia, Europe, Africa	Yes

[a] Arnol et al. 1984, Brown et al. 1987, White 1987, Windingstad 1988, Masatomi 1991, Goldstraw and Du Gueslin 1991, Morkill and Anderson 1991, Alonso et al. 1994, Meine and Archibald 1996, Janss and Ferrer 2000, Sundar and Choudhury 2005, Stehn and Wassenich 2008, Shaw 2009, Wright et al. 2009, Shaw et al. 2010, Fanke et al. 2011, Folk et al. 2013, Veltheim et al. 2015, Haraguchi et al. 2016, IUCN 2018.

a marked power line were documented during a single spring migration (Murphy et al. 2016a, 2016b), clearly demonstrating the need for improved collision mitigation. At the time of the collisions, and during our study, the power line was marked (Figure 1) with a combination of black, white, yellow, and orange FireFly HW bird diverters that also included a glow-in-the-dark sticker on each side (FireFlys; P&R Tech, Beaverton, Oregon, USA) and marked with yellow spiral Bird Flight Diverters (BFDs; Preformed Line Products, Cleveland, Ohio, USA). Line marking was composed of 22 FireFlys and 22 BFDs installed on each of 2 overhead shield wires (88 line markers total) across a 258-m span for an average line marker spacing of 2.9 m. In general, spacing of 5–30 m between line markers is most commonly recommended and used (APLIC 2012). Even with line markers at 2–10 times as dense as the best available science recommends, hundreds of Sandhill Crane collisions occur annually on the power line (Wright et al. 2009, Murphy et al. 2016a, 2016b).

Because avian collision mortality tends to persist even after power lines are marked, and because of technical limitations for line marking, we questioned whether a more effective solution might be possible. In a review of avian vision, approximately half of avian groups that have been tested to date have been found to be sensitive to ultraviolet (UV) light (Harness et al. 2016), including bird species in the orders Anseriformes (waterfowl), Galliformes (grouse), Gaviiformes (loons), Procellariiformes (some seabirds), Ciconiiformes (storks), Pelecaniformes (pelicans), Strigiformes (owls), and Passeriformes (songbirds), all of which include species that are susceptible to collisions with power lines (APLIC 2012, Sporer et al. 2013, Bernardino et al. 2018). Many avian species not sensitive to UV light are sensitive to a broader violet spectrum than humans see (Harness et al. 2016). Human eyes are sensitive to light with a minimum wavelength of ~400 nm. Although human eyes contain cones capable of sensing shorter wavelengths, the UV-absorbing lens of the human eye prevents entry by those wavelengths (Jacobs 1992). In contrast, avian vision is sensitive to wavelengths as short as 320 nm, depending on the species, due to differences from humans in lens physiology and photoreceptors (Parrish et al. 1984, Aidala et al. 2012, Ödeen and Håstad 2013). Avian sensitivity to light has previously been explored as a potential mechanism of modifying bird behavior. For example, Blackwell et al. (2012) and Doppler et al. (2015) evaluated Canada Goose (*Branta canadensis*) and Brown-headed Cowbird (*Molothrus ater*) responses to "white" and 470 nm lights, respectively, mounted on model aircraft, and Foss et al.

FIGURE 1. Two types of line markers were present on the power line we studied at the Iain Nicolson Audubon Center at Rowe Sanctuary in central Nebraska, but were not effective in preventing Sandhill Crane collisions. (Overview) The span we studied crossing the Central Platte River. (Inset) Close view of a FireFly (left) and a Bird Flight Diverter (right) installed on the power line prior to our study.

(2017) evaluated the responses of Red-tailed Hawks (*Buteo jamaicensis*) when a tethered prey item was illuminated with 445 nm light. In all 3 studies, birds reacted differently in the artificially illuminated situations compared to control situations.

We therefore hypothesized that using near-ultraviolet (UV-A; wavelengths of 320–400 nm) light to illuminate power lines might be more effective in mitigating avian collisions than line markers alone, and may do so without increasing power line visibility to humans. To assess this possibility, we designed and tested the Avian Collision Avoidance System (ACAS), a UV-A illumination system we developed. The ACAS was designed to function on power lines without line markers, although the test described here includes a power line with line markers.

METHODS

Study Area

Over 500,000 Sandhill Cranes migrate annually through Nebraska, and many of these birds use the Platte River Valley as a migratory stopover site (Gerber et al. 2014). We studied the ACAS at a power line crossing the Central Platte River at the Iain Nicolson Audubon Center at Rowe Sanctuary (Rowe; Universal Transverse Mercator 14 T, 509599 m E, 4502114 N) within the Platte River Valley, near Gibbon, Nebraska. This is the same span of power line where hundreds of Sandhill Crane collisions historically occurred annually despite the presence of FireFly and BFD line markers (Wright et al. 2009, Murphy et al. 2016a, 2016b). Rowe was composed of river, river bank, wet meadow, and prairie habitats managed to protect and restore roosting, foraging, and loafing habitat for Sandhill Cranes and Whooping Cranes during migration (A. Pierson, Iain Nicolson Audubon Center at Rowe Sanctuary, personal communication).

Field Methods

The ACAS consisted of 4 UV-A lights, a junction box, 2 solar panels, a power storage and control box, cabling to connect those components, and a remote control (Figure 2). Each UV-A light was mounted on the crossarm of an H-frame structure supporting the power line span we studied, and each light produced peak wavelengths of 380 nm (2 lights; one 50 watt and one 100 watt) or 395 nm (2 lights, one 50 watt and one 100 watt). Each light was built around a Chanzon (Shenzhen, Guangdong, China) High Power LED Chip 100W Purple Ultraviolet light. We estimated production of 8,000–9,000 lumens per light, depending on ambient temperature, but this light did not appear bright to the human eye. The lower-wattage lights ensured that some light would be produced even if cloudy conditions prevented the solar panels from fully charging the batteries on some days. Each light produced a cone of illumination that spread 30° around a central axis. This relatively broad cone ensured that even if the lights were not installed perfectly parallel to the wires, the wires would still be illuminated throughout their entire span. The junction box was mounted just below the crossarm and distributed power to the UV-A lights. The pole-mounted solar panels charged batteries in the power storage and control unit located on the ground at the base of the H-frame structure. The power storage and control unit contained batteries, an inverter, custom-built control boards, and switches to store, convert, and route electrical power from the solar panels, through the junction box, and into the UV-A lights. The total cost for all components was ~$6,000, including various UV lights that we evaluated but did not use in the final construction.

We tested the ACAS by mounting it on an existing H-frame structure on the north bank of the Central Platte River at Rowe and directing the UV-A light along the 258-m span crossing the river. The upper wires of the power line were ~15 m above the surface of the river and adjacent banks. Dawson Public Power (Kearney, Nebraska), the owner and operator of the power line we studied, donated personnel time to install the ACAS on February 14, 2018, prior to the arrival of migrating Sandhill Cranes and Whooping Cranes, and to remove the ACAS on June 18, 2018, after migrating cranes had departed the study area.

We monitored cranes' responses to the ACAS an average of 5.2 nights per week from February 28, 2018, through April 19, 2018, bracketing the historical timing of collisions (March 4 to April 13; Wright et al. 2009, Murphy et al. 2016b). We randomly assigned the ACAS to be on or off during each night of observation. From a blind near the base of the H-frame structure on which the ACAS was installed, each night from 1 hr before sunset until 4.5 hr after sunset we observed collisions with the power line, post-collision flight behavior, reaction behavior as flocks approached the power line, and reaction distances (0–25 m or 26–50 m) perpendicular from the power line along the river (Murphy et al. 2016a). We recorded observations identically regardless of whether the ACAS was on or off. During daylight and dusk, we conducted observations with 8 × 42 binoculars. At night we conducted observations with a 3–12 × 50 thermal imaging monocular (Prometheus 336; Armasight, San Francisco, California, USA).

We recorded flight behavior when flocks of cranes flew over the power line within 25 m above river surface (10 m of the top of the power line) as was done in a previous study (Murphy et al. 2016a). This allowed us to focus specifically on cranes that could be at risk of collision, and to avoid recording cranes flying well above the power line that were not at risk of collision, which would have reduced the sensitivity of our analyses (Murphy et al. 2016a). We used the known height of the power line and known distances between the

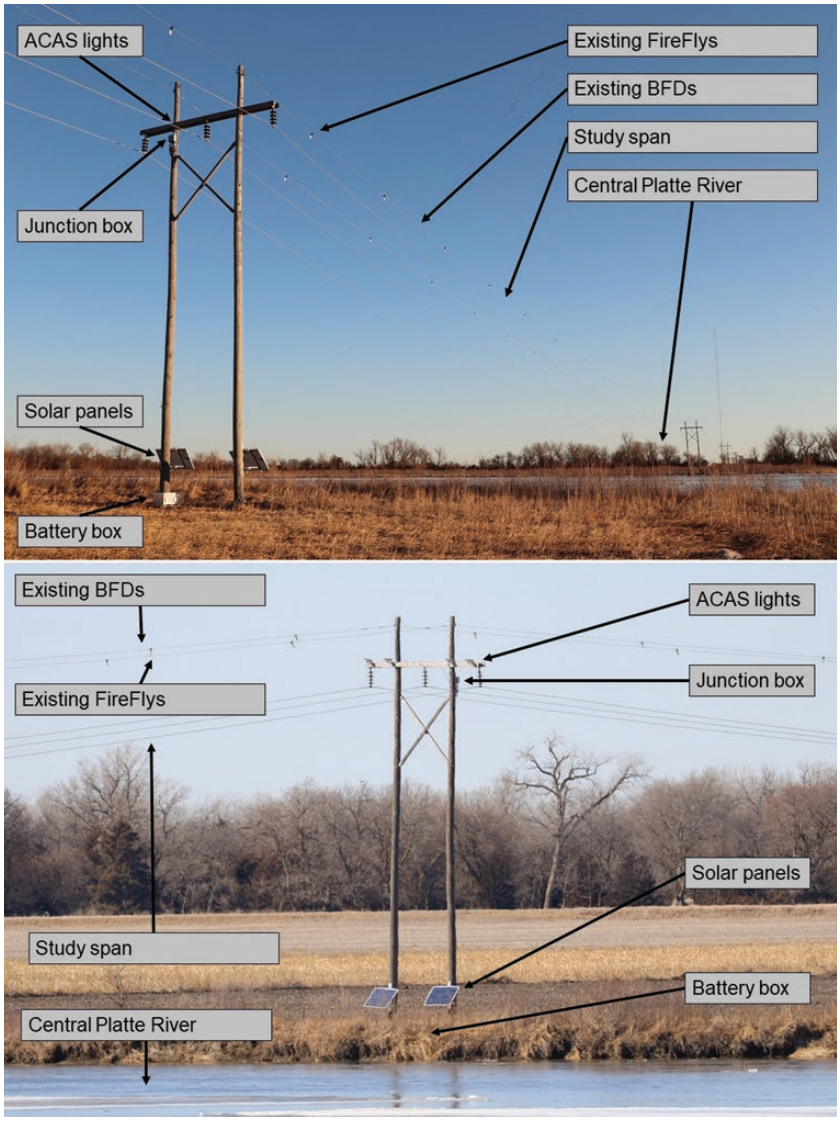

FIGURE 2. The Avian Collision Avoidance System (ACAS). (Top) Viewed from the northwest with the Central Platte River in the background. (Bottom) Viewed from the southeast with the Central Platte River in the foreground.

wires comprising the power line to gauge the flight height of cranes crossing over the power line, and to gauge the distance along the river from the power line at which cranes' flight behavior changed. To maintain consistency with previous studies of Sandhill Crane collisions with power lines in our general study area (Morkill and Anderson 1991), and with a previous study at this site (Murphy et al. 2016a), we defined a flock passing over the power line as an individual or discrete group. Passage over the line was infrequent enough that most flocks were temporally separated by at least 5 min. To ensure independence among data points, we did not record the passage over the line of flocks within 5 min of a previous flock. This approach made flocks, rather than individual Sandhill Cranes, our sampling unit for statistical analyses (Murphy et al. 2016a).

Each time a flock of Sandhill Cranes crossed over the power line within 25 m above the river surface, we recorded whether the ACAS was on or off, whether a collision occurred, whether it was day (1 hr before sunset to the end of civil dusk at 0.5 hr after sunset) or night, whether and how cranes maneuvered to avoid the power line, and the perpendicular distance from the power line at which those maneuvers occurred. If one or more collisions occurred, we also recorded the wire involved and the subsequent flight behavior of the crane involved.

We categorized maneuvers to avoid the power line as no reaction, gradual climb, flare, and reverse (Murphy et al. 2016a). No reaction occurred when the entire flock continued past the power line with the same direction, speed, and elevation above the river level as the flock had when approaching the power line. For this behavior, reaction distance was defined as zero. When no reaction occurred within 25 m above the river surface, we categorized these as dangerous flights. A gradual climb occurred when the entire flock maintained consistent flight direction, speed, and wingbeat, but adjusted flight height gradually to pass above the power line. When a gradual climb did not exceed 25 m above the river surface, we categorized this as a dangerous flight. A flare occurred when at least one member of the flock altered direction, speed, and wingbeat to suddenly gain the elevation needed to pass over the power line. A reverse occurred when at least one member of the flock altered direction, speed, and wingbeat to suddenly turn away from the power line. We recorded flares and reverses even if only a single member of the flock reacted because those behaviors were previously demonstrated to occur when at least some cranes in the flock were in danger of collision (Murphy et al. 2016a). We recorded post-collision flight as normal flight (steady wingbeats and elevation maintained), hampered flight (unsteady wingbeats and elevation maintained), flapping fall (unsteady wingbeats and elevation not maintained), and limp fall (no wingbeats and elevation not maintained).

The ethical guidelines followed in this study involved not disturbing roosting cranes. To achieve this, we scheduled installation of the ACAS prior to the cranes' arrival, and removal after their departure, and we ensured our observations did not disturb roosting cranes, which could have caused flocks to fly up into the power line.

Analytical Methods

We used 3 Fisher's exact probability tests to compare the proportions of collisions, dangerous flights, and reaction distances of Sandhill Crane flocks observed when the ACAS was off and when it was on. Because we conducted 3 Fisher's exact probability tests on the same data set, we used a Bonferroni correction to adjust our significance level to $\alpha = 0.017$. These tests statistically addressed our hypothesis that UV-A illumination would improve collision mitigation on the marked power line we studied. The Fisher's exact probability tests sacrificed some analytical resolution, however, because no additional information could be accommodated by the test when multiple collisions occurred within a flock. To address this, we also report the percent reduction of events (collisions, dangerous flights, and reaction distances) and the hourly rates of events when the ACAS was off and when it was on. We also report the percent difference in the number of flocks crossing the power line within 25 m above the river surface when the ACAS was off, compared to when the ACAS was on. We also report counts of collisions during the day and night, counts of the wires involved in collisions, and counts of post-collision flight behaviors.

RESULTS

We conducted 38 nights of monitoring including 19 nights when the ACAS was off, and 19 nights when the ACAS was on. We recorded 49 Sandhill Crane collisions from 37 flocks: 48 collisions when the ACAS was off, and 1 when it was on. Multiple collisions sometimes occurred within a single flock (Figure 3; $n = 8$ flocks; when multiple collisions occurred, min = 2 collisions, mean = 2.5 collisions, max = 4 collisions). Collisions occurred at a rate of 1 collision every 2.2 hr of observation when the ACAS was off, and 1 collision every 104.5 hr of observation when it was on. We also observed one American White Pelican (*Pelecanus erythrorhynchos*) collision when the ACAS was off.

We recorded a total of 916 flocks of cranes passing the power line within 25 m of the river surface (Table 2). Flocks with collisions were more likely to occur when the ACAS was off ($P < 0.001$), with 97% of flocks with collisions occurring during those times. Dangerous flights were also more likely to occur when the ACAS was off ($P < 0.001$), with 85% occurring during those times. Reaction distances were more likely to be within 25 m of the power line when the ACAS was off ($P < 0.001$), with 59% occurring during those times.

All of the collisions we observed happened at night ($\bar{x} = 162 \pm 98$ [SD] min after sunset), as did most (63%) dangerous flights ($\bar{x} = 118 \pm 71$ min after sunset). Most (94%) collisions involved the upper 2 wires (the overhead shield wires). Only 3 collisions involved conductors. Of the 49 Sandhill Crane collisions we observed, 17 cranes continued after the collision with normal flight, 14 continued with hampered flight, 12 fell while flapping, 4 fell limply, and 2 were obscured by other cranes which prevented us from identifying an outcome. We never observed any birds, bats, or insects circling the ACAS lights.

DISCUSSION

We observed a 98% reduction in Sandhill Crane collisions when UV-A light emitted by the ACAS illuminated the power line we studied. Our observations of flocks passing over the power line within 25 m above the river surface when the ACAS was on indicated that Sandhill Cranes were present during our study. Based on this, we conclude the ACAS was responsible for reducing collisions. We hypothesize the reason for the success of the ACAS was that it illuminated the entire length of all the wires in the span, including the previously installed line markers, allowing Sandhill Cranes to see and avoid the power line. In contrast, traditional non-illuminated line markers rely

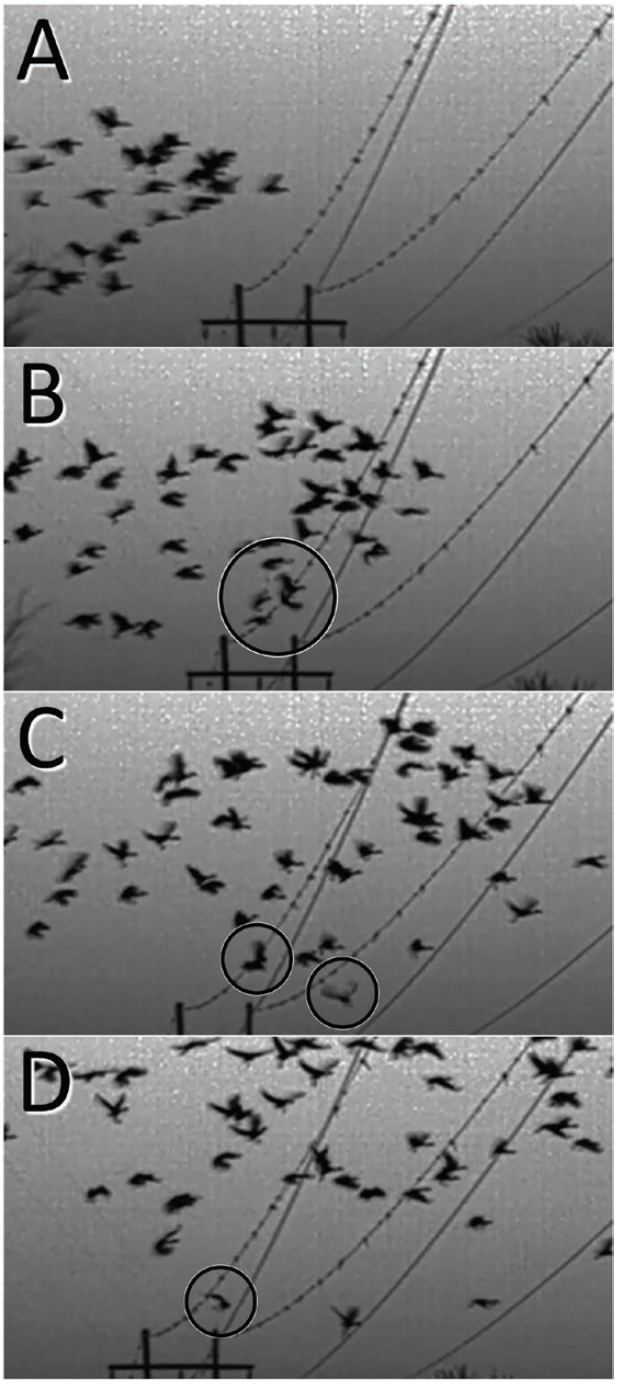

FIGURE 3. Example from thermal imaging monocular of multiple collisions within a single flock of Sandhill Cranes during an observation when the Avian Collision Avoidance System (ACAS) was turned off. (**A**) Organized V-shaped flock approaches the power line in darkness. (**B**) Two adjacent, near-simultaneous collisions (circled). (**C**) A third collision (left circle), and a crane involved in the previous collision falling out of the image frame (right circle). (**D**) The crane involved in the third collision falling out of the image frame (circled), and flock above in disarray.

on birds to infer the presence of suspended wires they may not see between and below the line markers they may see. Our findings of fewer flocks flying within 25 m above the river surface where the river was transected by the power line, and of fewer reaction distances <25 m from the power line along the river suggest that not only were collisions and dangerous flights reduced within the collision risk zone when the ACAS was on, but also that Sandhill Cranes avoided the power line sufficiently early and with sufficient altitude to entirely avoid the area we associated a priori with collision risk. Given the success of the ACAS with Sandhill Cranes, and our observation of one American White Pelican collision when the ACAS was off, it appears that installation of the ACAS on other high-risk spans or other anthropogenic obstacles may offer a relatively simple and easy solution to a problem that has stymied crane conservation in particular, and avian conservation in general, across 5 continents for decades. The ACAS may be especially useful at other river and wetland sites where natural features channel birds into relatively narrow flight corridors.

Though we designed the ACAS to function on power lines without line markers, that scenario was not tested in our study. Consequently, we do not know whether or how much the ACAS's illumination of line markers influenced our results or if our results would have been as positive if line markers were not present, particularly because line markers were unusually dense on this power line as a result of previous attempts to mitigate collisions. Future research should include testing the ACAS on unmarked power lines and on power lines fitted with different types and spacing of line markers than occurred in this study. Future research should also consider UV-reflective line markers to address the possibility that the ACAS is more effective as part of an illumination-plus-line-markers system. Alternatively, perhaps wires could be treated with a UV-reflective coating during installation to minimize the operations and maintenance obligations that line markers can create.

We do not know the specific contribution of power line collision mortality to threatened crane species, but population trajectories should be sensitive to changes in survival rate. Collision mortality is likely additive to other pressures (habitat loss and degradation, human disturbance, hunting, illegal capture for commercial trade, and impacts from environmental contamination), so mitigating collision mortality may have important conservation implications for cranes. More generally, avian collision risk extends well beyond crane species to include birds in groups as diverse as seabirds (Raine et al. 2017), raptors (Mojica et al. 2009), passerines (Rogers et al. 2014), and numerous others (Sporer et al. 2013, Harness et al. 2016, Bernardino et al. 2018). The ACAS would be most widely effective if other

TABLE 2. Occurrences of collisions, dangerous flights (flights in which the flock showed no reaction to the power line, the gradual climb was ≤25 m above the river surface, or a flare or reverse occurred), and reaction distances 0–25 m or 25–50 m from the line along the river in Sandhill Crane flocks observed at a power line crossing the Central Platte River at the Rowe Sanctuary near Gibbon, Nebraska. Of the 916 flocks observed, 521 occurred when the Avian Collision Avoidance System (ACAS) was off, and 395 occurred when the ACAS was on. Counted numbers are followed in parentheses by percentages.

	Flocks with collisions		Dangerous flights		Reaction distances	
ACAS	Yes	No	Yes	No	0–25 m	25–50 m
Off	36 (7)	485 (93)	217 (42)	304 (58)	483 (93)	38 (7)
On	1 (0)	394 (100)	39 (10)	356 (90)	330 (84)	65 (16)
Total	37	879	256	660	813	103

species and groups at risk of collision also perceived and responded to UV light. Numerous other avian species from Mallards (*Anas platyryhnchos*) to Eurasian Kestrels (*Falco tinnunculus*) to Zebra Finches (*Taeniopygia guttata*) are sensitive to UV light (Jane and Bowmaker 1988, Viitala et al. 1995, Lind et al. 2014). The ACAS or some other light-emitting system, if available, should be tested at other sites where vulnerable species are at risk of collision.

The ACAS is not the only collision mitigation technology to attempt to use light to mitigate wildlife collisions with power lines. For example, the solar-powered Overhead Warning Light (OWL) line marker flashes small lights perpendicular to the line on which the OWL is installed (Preformed Line Products 2017). In another example, Kaua'i Island Utility Cooperative (KUIC) used an array of green lasers to illuminate part of a power line on Hawaii during annual breeding seasons of endangered seabirds (KIUC 2015, 2016). To our knowledge, both of these examples are described from marketing materials rather than scientific publications, and unlike the ACAS's UV-A light, both use visible light that human residents may object to. Nevertheless, these systems illustrate the emerging conservation potential of light-based collision mitigation technologies. Unfortunately, light-based collision mitigation technologies have practical limitations that may make them most appropriate for collision hotspots rather than more general use. Specifically, the purchase, operation, and maintenance costs of these technologies likely exceeds that of traditional non-lighted line markers, although the costs of lighted systems may decrease as products reach commercial maturity. Installing these systems over many continuous power line spans is also likely to be impractical and cost-prohibitive in the near term, particularly in areas where collisions are infrequent. In those cases, traditional non-lighted line markers that include phosphorescent glow-in-the-dark materials (e.g., FireFly, or Power Line Sentry's Avian Flight Diverters, Fort Collins, Colorado, USA), may remain the best solution, given the competing considerations (budgets vs. conservation impacts) involved in marking power lines.

UV illumination may also be useful in conservation for other types of tall anthropogenic structures. For example, birds regularly collide with communication towers (Gehring et al. 2009, Longcore et al. 2012), meteorological towers, the guy wires supporting those towers (Gehring et al. 2011, Kerlinger et al. 2012), and wind turbines (Smith and Dwyer 2016). We hypothesize that collisions occur on these structures even when they are lighted because lighting does not illuminate either the guy wires when present, or the entire tower, regardless of the presence of guy wires. Future research should deploy the ACAS at the top or bottom of towers with histories of collisions, orient the ACAS along towers and guy wires, and evaluate whether collisions persist. Future research should also consider potential negative effects of the ACAS. We did not observe any wildlife circling the ACAS lights, but our study was conducted in early spring when nocturnal insects may have not yet emerged, and nocturnal avian and aerial mammalian insectivores may not have yet arrived from migration or emerged from hibernation. Future research on the ACAS should include documentation of nocturnal aerial insectivores around the lights, if present.

Additionally, although bats are commonly thought of as using echolocation for navigation, their ultrasonic pulses attenuate quickly in open space. Gorresen et al. (2015) suggested that bats use dim ambient light for large-scale navigation, a mechanism that could be leveraged for conservation if wind turbines are illuminated with UV light at night. In early testing, illuminating trees with UV light in areas frequented by endangered Hawaiian hoary bats (*Lasiurus cinereus semotus*) reduced bat activity in the lighted area despite an increase in insect activity (Gorresen et al. 2015). Illumination of wind turbines with the ACAS may offer similar benefits for bats and birds at risk of collision in wind resource areas.

ACKNOWLEDGMENTS

We thank J. Kaiser and G. Haines of Dawson Public Power for access to the power line we studied and for installing and then removing the Avian Collision Avoidance System (ACAS). We thank B. Taddicken and A. Pierson at the Iain Nicolson Audubon Center at Rowe Sanctuary for access, lodging, problem solving, and comments that improved this research. We thank A. H. Stewart, R. Foster, and S. Chapman at EDM International, Inc. (EDM), for helping to engineer and

construct the ACAS. L. Mojica and 2 anonymous reviewers provided comments that greatly improved this manuscript.

Funding statement: We thank J. Acklen and the Electric Power Research Institute (EPRI) for funding this research (project ID 10007710).

Ethics statement: The ethical guidelines followed in this study involved not disturbing roosting cranes. To achieve this, we scheduled installation of the ACAS prior to the cranes' arrival, and removal after their departure. We also conducted all monitoring from inside an enclosed blind that ensured our activities near the roost would not disturb nearby cranes. We were also prepared to terminate the study if collisions increased.

Author contributions: JFD, AKP, and REH conceived the idea, design, and experiment described here. JFD and LAM performed the experiment. JFD and REH wrote this manuscript. JFD, AKP, LAM, and REH designed the experimental and analytical methodology. JFD analyzed the data. AKP and REH contributed substantial materials and technical expertise.

LITERATURE CITED

Aidala, Z., L. Huynen, P. L. R. Brennan, J. Musser, A. Fidler, N. Chong, G. E. Machovsky Capuska, M. G. Anderson, A. Talaba, D. Lambert, and M. E. Hauber (2012). Ultraviolet visual sensitivity in three avian lineages: Paleognaths, parrots, and passerines. Journal of Comparative Physiology A 198:495–510.

Alonso, J. C., J. A. Alonso, and R. Muñoz-Pulido (1994). Mitigation of bird collisions with transmission lines through groundwire marking. Biological Conservation 67:129–134.

Arnol, J. D., D. M. White, and I. Hastings (1984). Management of the Brolga (*Grus rubicundus*) in Victoria. Technical Report Series Number 5, Victoria Fisheries and Wildlife Service, Department of Conservation, Forests, and Lands, Melbourne, Australia.

[APLIC] Avian Power Line Interaction Committee (2012). Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC, Washington, DC, USA.

Barrientos, R., J. C. Alonso, C. Ponce, and C. Palaćin (2011). Meta-analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25:893–903.

Bernardino, J., K. Bevanger, R. Barrientos, J. F. Dwyer, A. T. Marques, R. C. Martins, J. M. Shaw, J. P. Silva, and F. Moreira (2018). Bird collisions with power lines: State of the art and priority areas for research. Biological Conservation 222:1–13.

Blackwell, B. F., T. L. DeVault, T. W. Seamans, S. L. Lima, P. Baumhardt, and E. Fernández-Juricic (2012). Exploiting avian vision with aircraft lighting to reduce bird strikes. Journal of Applied Ecology 49:758–766.

Brown, W. M., and R. C. Drewien (1995). Evaluation of two power line markers to reduce crane and waterfowl collision mortality. Wildlife Society Bulletin 23:217–227.

Brown, W. M., R. C. Drewien, and E. G. Bizeau (1987). Mortality of cranes and waterfowl from powerline collisions in the San Luis Valley, Colorado. In Proceedings of the 1985 Crane Workshop (J. C. Lewis, Editor). Platte River Whooping Crane Maintenance Trust, Grand Island, NE, USA.

Doppler, M. S., B. F. Blackwell, T. L. DeVault, and E. Fernández-Juricic (2015). Cowbird responses to aircraft with lights tuned to their eyes: Implications for bird–aircraft collisions. The Condor: Ornithological Applications 117:165–177.

Fanke, J., G. Wibbelt, and O. Krone. (2011). Mortality factors and diseases in free-ranging Eurasian Cranes (*Grus grus*) in Germany. Journal of Wildlife Diseases 47:627–637.

Folk, M. J., T. A. Dellinger, and E. H. Leone (2013). Is male-biased collision mortality of Whooping Cranes (*Grus americana*) in Florida associated with flock behavior? Waterbirds 36:214–219.

Foss, C. R., D. J. Ronning, and D. A. Merker (2017). Intense short-wavelength light triggers avoidance response by Red-tailed Hawks: A new tool for raptor diversion? The Condor: Ornithological Applications 119:431–438.

Gehring, J., P. Kerlinger, and A. M. Manville II (2009). Communication towers, lights, and birds: Successful methods of reducing the frequency of avian collisions. Ecological Applications 19:505–514.

Gehring, J., P. Kerlinger, and A. M. Manville II (2011). The role of tower height and guy wires on avian collisions with communication towers. Journal of Wildlife Management 75:848–855.

Gerber, B. D., J. F. Dwyer, S. A. Nesbitt, R. C. Drewien, C. D. Littlefield, T. C. Tacha, and P. A. Vohs (2014). Sandhill Crane (*Antigone canadensis*). In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.31

Goldstraw, P. W., and P. B. Du Guesclin (1991). Bird casualties from collisions with a 500 kV transmission line in southwestern Victoria, Australia. Proceedings of the 1987 International Crane Workshop 1:219–224.

Gorresen, P. M., P. M. Cryan, D. C. Dalton, S. Wolf, J. A. Johnson, C. M. Todd, and F. J. Bonaccorso (2015). Dim ultraviolet light as a means of deterring activity by the Hawaiian hoary bat *Lasiurus cinereus semotus*. Endangered Species Research 28:249–257.

Haraguchi, Y., T. Yoshino, and K. Takase (2016). Numbers of dead cranes found at Izumi Plain, Japan (2003–2013), and their postmortem findings. Japanese Journal of Ornithology 65:153–160.

Harness, R. E., E. K. Mojica, J. F. Dwyer, and M. A. Landon (2016). Power Line Collision Mitigation and Avian Vision. Electric Power Research Institute, Palo Alto, CA, USA.

[ICF] International Crane Foundation (2018). Species field guide. Baraboo, WI, USA. https://www.savingcranes.org/species-field-guide/

[IUCN] International Union for the Conservation of Nature (2018). The IUCN Red List of Threatened Species: Version 2018-2. https://www.iucnredlist.org/

Jacobs, G. H. (1992). Ultraviolet vision in vertebrates. American Zoologist 32:544–554.

Jane, S. D., and J. K. Bowmaker (1988). Tetrachromatic color-vision in the duck (*Anas platyrhynchos* L.), microspectrophotometry of visual pigments and oil droplets. Journal of Comparative Physiology A 162:225–235.

Janss, G. F. E., and M. Ferrer (2000). Common Crane and Great Bustard collision with power lines: Collision rate and risk exposure. Wildlife Society Bulletin 28:675–680.

Jenkins, A. R., J. J. Smallie, and M. Diamond (2010). Avian collisions with power lines: A global review of causes and mitigation with a South African perspective. Bird Conservation International 20:263–278.

Johnsgard, P. A. (1983). Cranes of the World. Indiana University Press, Bloomington, IN, USA.

[KIUC] Kaua'i Island Utility Cooperative (2015). Lasers, diverters part of KIUC's expanded seabird protection efforts. [Press release.] http://kiuc.coopwebbuilder2.com/sites/kiuc/files/PDF/pr/pr2015-0817-laserbirds.pdf

[KIUC] Kaua'i Island Utility Cooperative (2016). KIUC continues testing lasers as part of seabird protection efforts. [Press release.] http://kiuc.coopwebbuilder2.com/sites/kiuc/files/PDF/pr/pr2015-0921-lasers.pdf

Kerlinger, P., J. Guarnaccia, A. Hasch, R. C. E. Culver, R. C. Curry, L. Tran, M. J. Stewart, and D. Riser-Espinoza (2012). Avian collision mortality at 50- and 60-m guyed towers in central California. The Condor 114:462–469.

Lind, O., M. Mitkus, P. Olsson, and A. Kelber (2014). Ultraviolet vision in birds: The importance of transparent eye media. Proceedings of the Royal Society B 281:1–9.

Longcore, T., C. Rich, P. Mineau, B. MacDonald, D. G. Bert, L. M. Sullivan, E. Mutrie, S. A. Gauthreaux, Jr., M. L. Avery, R. L. Crawford, et al. (2012). An estimate of avian mortality at communication towers in the United States and Canada. PLOS One 7:e34025.

Masatomi, H. (1991). Population dynamics of Red-crowned Cranes in Hokkaido since the 1950s. Proceedings of the 1987 International Crane Workshop 1:297–299.

Meine, C. D., and G. W. Archibald (1996). The Cranes: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland.

Mojica, E. K., B. D. Watts, J. T. Paul, S. T. Voss, and J. Pottie (2009). Factors contributing to Bald Eagle electrocutions and line collisions on Aberdeen Proving Ground, Maryland. Journal of Raptor Research 43:57–61.

Morkill, A. E., and S. H. Anderson (1991). Effectiveness of marking powerlines to reduce Sandhill Crane collisions. Wildlife Society Bulletin 19:442–449.

Murphy, R. K., J. F. Dwyer, E. K. Mojica, M. M. McPherron, and R. E. Harness (2016a). Reactions of Sandhill Cranes approaching a marked transmission power line. Journal of Fish and Wildlife Management 7:480–489.

Murphy, R. K., E. K. Mojica, J. F. Dwyer, M. M. McPherron, G. D. Wright, R. E. Harness, A. K. Pandey, and K. L. Serbousek (2016b). Crippling and nocturnal biases in a study of Sandhill Crane (*Grus canadensis*) collisions with a transmission line. Waterbirds 39:312–317.

Ödeen, A., and O. Håstad (2013). The phylogenetic distribution of ultraviolet sensitivity in birds. BMC Evolutionary Biology 13:1–10.

Parrish, J. W., J. A. Ptacek, and K. L. Will (1984). The detection of near-ultraviolet light by nonmigratory and migratory birds. The Auk 101:53–58.

Preformed Line Products (2017). Wildlife Protection Products. PLP, Cleveland, OH, USA. http://www.preformed.com/images/pdfs/Energy/Distribution/Wildlife_Protection/Raptor_Clamp-OWL/EN-ML-1195-2_WildlifeProtectionProducts.pdf

Raine, A. F., N. D. Holmes, M. Travers, B. A. Cooper, and R. H. Day (2017). Declining population trends of Hawaiian Petrel and Newell's Shearwater on the island of Kaua'i, Hawaii, USA. The Condor: Ornithological Applications 119:405–415.

Rogers, A. M., M. R. Gibson, T. Pockette, J. L. Alexander, and J. F. Dwyer (2014). Scavenging of migrant carcasses in the Sonoran Desert. Southwestern Naturalist 59:542–547.

Shaw, J. M. (2009). The end of the line for South Africa's national bird? Modelling power line collision risk for the Blue Crane. Master's thesis, Percy Fitzpatrick Institute of African Ornithology, University of Cape Town, South Africa.

Shaw, J. M., A. R. Jenkins, J. J. Smallie, and P. G. Ryan (2010). Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseua* in South Africa. Ibis 152:590–599.

Smith, J. A., and J. F. Dwyer (2016). Avian interactions with renewable energy infrastructure: An update. The Condor: Ornithological Applications 118:411–423.

Sporer, M. K., J. F. Dwyer, B. D. Gerber, R. E. Harness, and A. K. Pandey (2013). Marking power lines to reduce avian collisions near the Audubon National Wildlife Refuge, North Dakota. Wildlife Society Bulletin 37:796–804.

Stehn, T. V., and T. Wassenich (2008). Whooping Crane collisions with power lines: An issue paper. In Proceedings of the 10th North American Crane Workshop, Feb. 7–10, 2006 (M. J. Folk and S. A. Nesbitt, Editors). North American Crane Working Group, Zacatecas City, Zacatecas, Mexico.

Sundar, K. S. G., and B. C. Choudhury (2005). Mortality of Sarus Cranes (*Grus antigone*) due to electricity wires in Uttar Pradesh, India. Environmental Conservation 32:260–269.

Veltheim, I., F. Chavez-Ramirez, R. Hill, and S. Cook (2015). Assessing capture and tagging methods for Brolgas, *Antigone rubicunda* (Gruidae). Wildlife Research 42:373–381.

Viitala, J., E. Korpimäki, P. Palokangas, and M. Koivula (1995). Attraction of Kestrels to vole scent marks visible in ultraviolet light. Nature 373:425–427.

White, D. M. (1987). The status and distribution of the Brolga in Victoria, Australia. Proceedings of the 1983 International Crane Workshop 1:115–131.

Windingstad, R. M. (1988). Nonhunting mortality in Sandhill Cranes. Journal of Wildlife Management 52:260–263.

Wright, G. D., T. J. Smith, R. K. Murphy, J. R. Runge, and R. R. Harms (2009). Mortality of cranes (Gruidae) associated with powerlines over a major roost on the Platte River, Nebraska. Prairie Naturalist 41:116–120.

International Crane Foundation

Headquarters
E-11376 Shady Lane Road
P.O. Box 447
Baraboo, WI 53913-0447, USA
608-356-9462
608-356-9465 fax
info@savingcranes.org
www.savingcranes.org

Regional Offices
Phnom Penh, Cambodia
Beijing, China
Johannesburg, South Africa
Kampala, Uganda
Lusaka, Zambia
Rockport, Texas, USA

MEMO

To: Robert Burness, Friends of Stone Lakes National Wildlife Refuge

From: Gary Ivey, Ph.D., *Research Associate - Pacific Flyway Program, INTERNATIONAL CRANE FOUNDATION,* 1350 SE Minam Ave, Bend, OR 97702; Office: 541-383-2033

Cc: Osha Meserve, Sean Wirth

Re: **My Comments on the Delta Conveyance Project Public Draft Environmental Impact Report**

I am providing my comments on impacts and mitigation of Sandhill Cranes (*Antigone canadensis;* family *Gruidae*) addressed the Delta Conveyance Project Public Draft Environmental Impact Report (DEIR). I am focusing my comments on the Greater Sandhill Crane subspecies which is a “no take” species by virtue of their California Fully Protected Species status. For Fully Protected Species, California Fish and Game code section 86 states: This is a high bar in that no individuals that are Fully Protected can be killed during any phase of the construction and the operation of the Delta Conveyance project. “Take,” as defined by section 86 must be avoided in all circumstances and it is not acceptable to provide mitigation for incidental take except within the construct of a state approved Natural Communities Conservation Plan (NCCP). This project is not an NCCP, but rather a huge construction project that is regional in scope.

The Greater Sandhill Crane is also protected as a threatened species under the California Endangered Species Act (CESA) which defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” The big additional protection provided by CESA is that the species is not to be harmed. But unlike “Fully Protected Species” status, incidental take (harm in this case) can be mitigated. This difference in definitions explains why avoidance methods are being employed in the hopes that no Greater Sandhill Cranes are killed during the construction and operation of the project (Fully Protected Species status) and why land acquisition mitigations are being provided for the loss of Greater Sandhill Crane habitat (to address "harm," CESA). My review will focus on whether the avoidance efforts are sufficient to ensure that no Greater Sandhill Cranes will be killed by any facets of the construction or operation of this project, and whether the land acquisition mitigations provided are adequate to address the harm caused by the project.

Impacts on Sandhill Crane Modeled Habitat

The DEIR describes data used to develop modeled roosting and foraging Sandhill Crane habitat for greater and Lesser Sandhill Cranes (Appendix 13B, pages 13B-375-380 & pages 13B-386-390).

- These models are flawed because they primarily use my data on roost site locations (cited as Ivey et al. 2016) which were mapped from 2002 – 2013, data that is from 9 to 20 years old. Although the permanent roost sites are still in place, it is highly unlikely that many of the mapped temporary roost sites are still available on the landscape today. To be more precise about impacts to Sandhill Crane habitat and mitigation needs, new surveys of roost sites should be conducted before defining and implementing habitat mitigation for Sandhill Cranes.

- The DEIR's modeling approach for Greater Sandhill Crane habitat is particularly unreliable because of behavioral differences in the two subspecies. Because Greater Sandhill Cranes show very high fidelity to wintering sites, they are pretty much restricted to permanent (annually dependable) roost sites and are much less likely to use temporary sites unless they are very close to permanent roost sites (within 5 km; Ivey et al. 2015). Therefore, the actual landscape of modeled habitat for Greater Sandhill Cranes should be re-mapped using only the permanent roost sites, buffered by 5 km of potential foraging habitat (excluding incompatible crop types and other non-foraging habitats) and such a model would likely reduce modeled habitat acreage to at least half of the current model.

Appendix 13B provide figures depicting the modeled foraging and roosting habitat for greater and Lesser Sandhill Cranes (Figures 13B.58-1, page 13B-383 and 13B,59-1, page 13B-393, respectively).

- These models should be recreated using current information, as I state above. Additionally, Figure 13B-58-1, the model for Greater Sandhill Cranes, does not include the habitat areas at the very south end of the project boundary (as the Lesser Sandhill Crane model does). The San Joaquin River National Wildlife Refuge does manage permanent roost sites (as mapped in Figure 13B.59-1) which support Greater Sandhill Crane, so that area should also be mapped in the updated model for Greater Sandhill Cranes.

Chapter 13, page 13-264, lines 25-32 states: "The loss of both greater and Lesser Sandhill Crane foraging habitat under the eastern alignment alternatives (Alternatives 3, 4a, 4b and 4c) and the Bethany Reservoir alignment alternative (Alternative 5) would result from the construction of shafts located on New Hope Tract, Canal Tract, Terminous Tract, King Island, Lower Roberts Island, and Upper Jones Tract (both the eastern alignment and Bethany Reservoir alignment locations on Upper Jones Tract). Additional impacts on modeled foraging habitat for the Lesser Sandhill Crane subspecies would result from the construction of the Southern Complex and associated new SCADA lines (Alternatives 1, 2a, 2b, 2c, 3, 4a, 4b, and 4c; Appendix 13C)."

- The DEIR apparently fails to acknowledge the additional loss of 621.55 acres of Sandhill Crane agricultural foraging habitat on Bouldin Island for wetland mitigation in the CEQA conclusion which considers Sandhill Crane habitat losses after mitigation to be "less than significant." The Bouldin Island habitat loss acreage should also be fully mitigated.

Chapter 13, page 13-267, lines 44-46 state: "At the north Delta intakes, in-water pile driving required for the construction of cofferdams would be restricted to occur between June 15 and October 31, and therefore could overlap with up to 1.5 months of the year when cranes are present in the study area (September 15 through March 15).

- This overlap in time between the construction noise and Sandhill Crane wintering times could displace the Greater Sandhill Cranes using Stone Lakes NWR and could cause harm (take) to that group of birds. The work should be planned to begin 1.5 months earlier, if possible and conclude before September 15.

Chapter 13, page 13-274: The Compensatory Mitigation Plan (CMP) for Sandhill Cranes states that CMP-18a would offset the loss of Sandhill Crane roosting habitat by creating roosting habitat on Bouldin Island or in suitable lands that provide connectivity between Stone Lakes NWR and Cosumnes River Preserve and managing these areas in perpetuity.

- If a new roost site is to be provided at Bouldin Island, it should be placed towards the southern end of the island to allow cranes access to additional foraging areas and lessening overlap of foraging habitat with cranes roosting on Staten Island. If a new roost is to be provided between Stone Lakes National Wildlife Refuge (SLNWR) and Cosumnes River Preserve (CRP), it should be placed within the approved SLNWR boundary to the west edge (near Snodgrass Slough) to give cranes access to additional foraging areas that don't overlap with areas used by cranes roosting on SLNWR or CRP.

- This CMP should be specific, not vague, as it states: "Roosting habitat may be created on Bouldin Island or in suitable lands that provide connectivity between the Stone Lakes National Wildlife Refuge boundary and the Cosumnes River Preserve, subject to CDFW approval." It appears, based on Table 3F-4 that Bouldin Island has already been selected to provide a new roost site to meet the CMP standard. However, because of direct impacts to Sandhill Crane habitats on both Bouldin Island and the Twin Cities Complex, I would advise providing two new permanent 40-acre or larger roost sites, one at each location to ensure that the local cranes that are impacted by the project are benefited. A new roost site at Bouldin Island will not benefit cranes impacted between Cosumnes River Preserve and Stone Lakes NWR.

Appendix 3F, page 3F.1-7, CMP 18b states: "Protect high- to very high-value foraging habitat for Greater Sandhill Crane (corn, rice, wheat, and freshwater emergent wetlands), with at least 80% maintained in very high-value types (corn and rice) in any given year, subject to CDFW approval. This foraging habitat will be within 2 miles of known roost sites and will consider sea level rise and local seasonal flood events, and the location of foraging habitat loss. The patch size of protected cultivated lands will be at least 160 acres."

- This protected foraging habitat should be within 2 miles of <u>new</u> project roost sites to maximize the benefits of the new roosts. Otherwise, there is no guarantee that much the foraging habitats around the new roosts will remain in compatible crop types.

Pages 13-273-274: The CEQA Conclusion is that the loss of habitat from the construction of the project alternatives, and the potential for the disruption of normal behaviors from construction, operations, and maintenance activities on Greater Sandhill Crane and Lesser Sandhill Crane would be significant (page 13-273, lines 25-36) and that the implementation of the CMP would be required to offset the loss of habitat which would reduce the impact associated with habitat loss to less than significant (page 13-273, lines 37-41). Chapter 13, Page 13-3, Table 13-0 indicates a net loss of 1,427.66 acres of modeled Sandhill Crane habitat, after mitigation, and declares this loss would be "less than significant" after mitigation.

- This loss does not apparently include the additional foraging habitat loss impact of 621.55 acres from wetland mitigation from Bouldin Island. That acreage should be added to the impacts to Sandhill Crane foraging habitat from all alternatives.

- The CEQA conclusion that this lost acreage, after mitigation, is less than significant to Greater Sandhill Crane habitat is flawed, especially considering the additional loss from habitat mitigation at Bouldin Island. This habitat loss is a much higher percentage of Greater Sandhill Crane habitat, because the habitat model includes landscapes surrounding temporary roost sites, data which is very outdated (as I previously described). Also, given the continuing trend of conversion to incompatible crops in the Delta Region, by the time the mitigation is in place, the impact of the loss of 1,427.66 acres (+621.55 acres on Bouldin Island) be even higher. To best protect impacts to local Greater Sandhill Cranes, I would advise full mitigation for this acreage and placing it within 2 miles of new protected and managed in perpetuity roost sites with the foraging habitat also protected by prescribed site protection instruments for Sandhill Cranes.

- The contention that any loss of Sandhill Crane habitat in the study area is less than significant fails to consider that capacities of existing wintering sites to support Sandhill Cranes are threatened by habitat loss, which is occurring throughout the Central Valley (Ivey et al. 2014). The Delta is certainly under the greatest threat due to pressures from expanding urban areas and is losing habitat (grain fields) to incompatible permanent crops faster than other regions (estimated at 18.3% by 2040; Central Valley Joint Venture 2006:79), which could contribute to a reduction of the population. The Delta Greater Sandhill Cranes are already stressed by such habitat losses and so the effects of additional habitat loss will add risk to the population's future viability and cause them harm, which is take. All habitat losses should be fully mitigated.

Chapter 13, page 13-274, lines 39-41 states "Foraging habitat protected for 39 Swainson's hawk (Appendix 3F, Attachment 3F.1, Table 3F.1-3, CMP-19b: *Swainson's Hawk* 40 *Foraging Habitat*) would also benefit lesser sandhill crane.

- Foraging habitat protected for Swainson's Hawk would only benefit Lesser Sandhill Cranes if it was placed within 10 km of existing permanent roost sites. CMP-19b allows habitat to be provided "within 50 miles of the project footprint" which at that distance not available to Lesser Sandhill Cranes. Additionally, the focus will be on protecting habitats at "elevations equal or greater than -1 foot," which excludes much of the key permanent roost sites in the core of the Delta where the largest numbers of Sandhill Cranes occur.

- The values of crops selected for Swainson's Hawk (Appendix 13B, page 13B-488, Table 13b.72-1) are not the same as for Sandhill Cranes' high value grain crops (Appendix 13B, page 13B-379, Table 13B-58-1) which are low value for Swainson's Hawks. For cranes, high value alfalfa is a medium value Sandhill Crane crop, and grains are considered low value crops for Swainson's Hawks, and CMP 19a (Appendix 3F, page 3F.1-9) "no more than 15% of Swainson's hawk mitigation lands will be in low-value foraging habitat (grain crops) on an annual basis" reducing the value of Swainson's Hawk conservation habitat to cranes. Therefore, benefits to Sandhill Cranes would be very limited from Swainson's Hawk habitat conservation and not guaranteed to be where cranes can utilize these habitats and should not be considered as mitigation for crane habitat loss as such mitigation benefits to cranes will likely be insignificant.

Potential for Take of Greater Sandhill Cranes by Project Activities - Power Lines

Chapter 13, Page 13-271, lines 36-39 states: "Because most Greater Sandhill Crane movement in the Delta occurs within approximately 1.2 miles from their primary roost sites (Ivey et al. 2015:523), the proximity of aboveground lines to known roost sites is a key issue in evaluating collision risk (Morkill and Anderson 1990:8; Hays et al. 2021:1445)."

- The statement above is misleading. The 1.2 miles quotation from my PhD study is the average flight distance of Greater Sandhill Cranes from roosts to foraging sites, not necessary "most" flight movements. My survey sample to collect these flight distance data was limited to 33 Greater Sandhill Cranes (about 1% of the Delta flock) and this small subset of the population does not likely reflect the entire range of distances Greater Sandhill Cranes travel.

- The longest foraging flights for greaters in my study were 9 km (5.6 miles). Although the risk of power line collisions and mortalities likely diminishes with distance, there is still <u>always</u> risk of take of Greater Sandhill Cranes at distances much further than 1.2 miles. The DEIR should err on the side of Sandhill Cranes by extending the risk area to 9 km in consideration of locations of power line features. Otherwise, there would still be a risk of take of Greater Sandhill Cranes from power line collisions.

- Such power line mortality risk is exacerbated by the regular occurrence of periods of dense fog in the Delta which increases mortality risk from collision with power lines (Chapter 13, Page 13-271, lines 39-41).

Chapter 13, page 13-272, lines 13-19 state: "The project has been designed to avoid death or injury of Greater Sandhill Crane (or any other actions defined as "take" as defined by Section 86 of the California Fish and Game Code). To the maximum extent feasible, existing power lines and underground conduit would be used under all project alternatives. In order to avoid impacts on habitat, the project would not install new overhead power lines or SCADA routes in sensitive areas for Greater Sandhill Crane."

- The DEIR's basic assumptions of the Greater Sandhill Crane use areas being focused on a 3-mile zone around existing roost sites is flawed, as mortality risks to Greater Sandhill Cranes extend well beyond that zone. Also, use of existing lines (which pose a risk to cranes) while might lessen risk of take, it does not negate the potential for take of this species. The sensitive areas for Greater Sandhill Cranes should be defined as within 9 km of roost sites (see my comments below).

Chapter 13, page 13-272, lines 20-25 state: "Most Greater Sandhill Crane movement in the Delta occurs within approximately 1.2 miles of their primary roost sites (Ivey et al. 2015:523) and Brown et al. (1987:131) found that no Sandhill Crane collisions occurred where distances from power lines to bird-use areas were greater than or equal to 1 mile (Avian Power Line Interaction Committee 2012:50). All proposed new aboveground towers and associated SCADA and transmission lines would be located at least 3 miles or more from the nearest known Greater Sandhill Crane roost site under all alternatives."

- The statement about Brown et al. 1987 findings is apparently intended to support using the 3 mile area that the DEIR emphasizes for mitigation considerations for Greater Sandhill Cranes; however, the “bird-use areas” considered in that paper, include both roost sites and foraging areas and the foraging areas can be much further than a mile from roost sites, so using their paper to imply that a smaller risk area is valid is flawed logic. Again, I suggest the DEIR adopt a 9 km standard for use in defining Greater Sandhill Crane mitigation.

Chapter 13, page 13-273, lines 4-5 state: “Replacement aboveground transmission lines along Franklin Road would be placed at the same vertical height as the existing lines on the opposite side of the tower.”

- This statement apparently assumes that adding additional lines to existing lines “at the same vertical height as the existing lines” will not increase mortality risk for Greater Sandhill Cranes. This isn’t logical, as more lines in the flight path would likely increase risk of collisions. Brown et al. (1987) reported that mortalities increased when an additional line span was added in their study. Adding new line spans to lines within Sandhill Crane use areas (such as Franklin Road which transects Stone Lakes NWR could lead to increased risk of take of Greater Sandhill Cranes.

Chapter 13, page 13-272, lines 23-32 state: “All proposed new aboveground towers and associated SCADA and transmission lines would be located at least 3 miles or more from the nearest known Greater Sandhill Crane roost site under all alternatives. New aboveground lines north of SR 4 would be limited to one overhead 20-meter transmission line along SR 12 that would be required to connect a new substation to the existing overhead transmission lines to provide service to Bouldin Island under the central alignment alternatives (Alternatives 1, 2a, 2b, and 2c; Chapter 3, Figure 3-13) and one overhead 20-meter transmission line on Lower Roberts Island that would be required to connect a new substation to the existing overhead transmission lines under the eastern alignment alternatives (Alternatives 3, 4a, 4b, and 4c) and the Bethany Reservoir alignment (Alternative 5).”

- To effectively minimize risk of take of Greater Sandhill Cranes, the DEIR should use a 9 km standard in planning placement of new lines and associated SCADA and transmission lines.
- The new 20-meter transmission line on Lower Roberts Island would increase risk of take of Greater Sandhill Cranes and needs to be considered in determining measures to prevent take.

Chapter 13, page 13-272, lines 32-33 state” These short segments of aboveground lines are at least 3 miles from the nearest known Greater Sandhill Crane roost site (Appendix 13B, Section 13B.58, Figure 13B.58-1)”

- Regarding the new 20-meter overhead line on Lower Roberts Island being “at least 3 miles from the nearest known Greater Sandhill Crane roost site” – This statement is obviously not true (see Appendix 13B, Figure 13B.59-1 and Mapbook 3-3, Sheet 13 of 20).

Chapter 13, page 13-272, lines 44-46 and page 13-273 lines 1-5 state” Under all project alternatives, aboveground SCADA lines would be placed on existing poles or towers from Franklin Boulevard to Freeport Boulevard and from the Sacramento River to Scribner Road just east of Clarksburg. Replacement aboveground transmission lines on existing poles would be needed from the Franklin Substation, along Franklin Boulevard to Lambert Road. From the intersection of Lambert Road and Franklin Boulevard, these transmission lines would be extended underground to the Lambert batch plant, the intakes, and the Twin Cities Complex (Chapter 3, 3 Figure 3-13 and Figure 3-14). Replacement aboveground transmission lines along Franklin Road would be placed at the same vertical height as the existing lines on the opposite side of the tower.

- Addition of any new line spans on existing poles or towers would increase risk of take of Greater Sandhill Cranes; the more wires in their flight paths, the more likely they are to collide with them.

Chapter 13, page 13-273, lines 4-11 state” Replacement aboveground transmission and SCADA lines located within 1.2 miles of known roost sites, in the absence of mitigation, could increase the potential for collision for Greater Sandhill Cranes (within 3 miles of known roost sites for Lesser Sandhill Cranes; Ivey et al. 2015:523) if they were not constructed within the same vertical prism as the existing lines. This potential for collision, in the absence of mitigation, could also be exacerbated by construction-related effects (e.g., flushing caused by noise disturbance), especially in low-visibility conditions.

- Here, the DEIR again assumes that the 1.3 miles and 3 miles standards are good metrics for providing mitigation to minimize take of Greater Sandhill Cranes. As I have previously stated, a 9 km distance is more appropriate for mitigation of take.

- The DEIR again assumes that placing new lines on existing poles or towers in the same vertical plain will negate increased collision risk to Greater Sandhill Cranes. Again, the more wires (lines) in the cranes’ flight paths within 9 km of roost sites, the more likely they are to collide with them.

Chapter 13, page 13-274, lines 6-11 state: “BIO-2c: *Electrical Power Line Support Placement,* which requires that project lines installed on existing poles or towers be placed in the same vertical prism as existing lines where feasible, and that all project lines within 3 miles of greater sandhill crane roost sites be fitted with bird flight diverters that are visible under all conditions and based on APLIC or more current guidance (Avian Power Line Interaction Committee 2006, 2012), would minimize any additional potential collisions of greater or lesser sandhill cranes from project alternatives.”

- This statement only considers “project lines,” however, existing lines within this same landscape also pose a take threat to Greater Sandhill Cranes. To minimize take from flushing disturbances, all new and existing lines within 3 miles of Greater Sandhill Crane roost sites should be fitted with appropriate bird flight diverters that are visible under all conditions, including using near ultraviolet lights which has been shown to reduce sandhill crane collisions by 98% (Dwyer et al. 2019).

Potential for Take of Greater Sandhill Cranes by Project Activities – Construction and Maintenance

Chapter 13, page 13-263, lines 32-40 state: “The construction of all project alternatives would affect known roost sites and modeled foraging habitat for greater and lesser sandhill crane. Effects from construction activities would include the permanent and temporary loss of habitat and potential disturbance of roosting and foraging behaviors. Sandhill cranes show strong site fidelity to their roost sites and associated foraging habitat (Ivey et al. 2014a:2); however, there is sufficient habitat in the sandhill crane winter use area such that the permanent and temporary loss of habitat and potential disturbance of roosting and foraging behaviors caused by the project is not expected to lead to take of Greater Sandhill Crane, as defined by Section 86 of the California Fish and Game Code or injury or mortality of Lesser Sandhill Crane.”

- The contention above that there is sufficient habitat in the winter use area so that loss of habitat is not expected to lead to take of Greater Sandhill Cranes is flawed. Capacities of existing wintering sites to support Sandhill Cranes are threatened by habitat loss, which is occurring throughout the Central Valley (Ivey et al. 2014). The Delta is certainly under the greatest threat due to pressures from expanding urban areas and is losing habitat (grain fields) to incompatible permanent crops faster than other regions (estimated at 18.3% by 2040; Central Valley Joint Venture 2006:79), which could contribute to a reduction of the population. The Delta Greater Sandhill Cranes are already stressed by such habitat losses and so the effects of project construction and operations will add additional stress and risk to the population's future viability. This issue of cumulative impacts was not discussed or evaluated in the DEIR.

Chapter 13, Page 13-273, lines 12-24: *"Maintenance* - The maintenance of aboveground water conveyance facilities for all project alternatives would result in periodic disturbances that could affect roosting and foraging Sandhill Cranes. Maintenance activities across all facilities that could affect Sandhill Cranes (all project alternatives) include repaving of access roads every 15 years, semiannual general and ground maintenance (e.g., mowing, vegetation trimming, herbicide application), and daily or weekly inspections by vehicle. Noise and visual disturbances from these maintenance activities at the intakes and shaft sites could disturb greater and Sandhill Cranes roosting or foraging in the vicinity of work areas if activities are conducted between October and mid-March (when cranes are present in the study area)."

- Disturbance of Greater Sandhill Crane roosting and foraging behaviors from construction, noise, maintenance, and monitoring and surveying activities which flush Greater Sandhill Crane flocks pose a risk of take from collisions with new or existing power lines, causing injuries or mortalities.

- "October and mid-March" is not an accurate time period for when cranes are in the study area. Other sections of the DEIR use September 15 through March 15 as the crane wintering season, and this range should be stated here.

- While the September 15 through March 15 dates are generally valid for the crane wintering period, the DEIR should consider that some cranes may arrive or depart the study area earlier or later than those standard dates. For fall arrival, I have had personal reports of small numbers of cranes arriving in the Delta Region in mid-August. In spring, flocks of cranes have been reported as late as mid-April in the Delta Region. According to eBird data (eBird.org), pairs and singles have been reported in the study area throughout the month of May. There is one report of a flock of 50 on King Island on May 28, 2020, but I doubt the credibility of that report. The DEIR should recognize that there may be impacts to cranes on these outside dates and take measures to avoid disturbing them when they are known to be near a project work site such as stopping construction at that site and changing maintenance and monitoring plans to accommodate them.

Chapter 13, page 13-275, lines 13-16 state: "Construction will be avoided during the sandhill crane wintering season (September 15 through March 15) to the extent feasible. In addition, the following measures will be implemented to avoid and minimize impacts on greater and lesser sandhill crane and to avoid take of greater sandhill crane as defined by Section 86 of the California Fish and Game Code.

- The DEIR should consider that some cranes may arrive or depart the study area earlier or later than those standard dates, as I noted above, and adjust construction avoidance dates to avoid risking take of sandhill cranes in proximity to work sites.

Chapter 13, page 13-265, lines 14-16 and 13-266, lines 1-2 state: "Construction activities would not be expected to injure or kill sandhill crane individuals. If a bird is present in a region where construction activities are occurring, the bird would be expected to avoid the slow-moving or stationary equipment and move to other areas, as they would move away from any other trucks or farm equipment that could be present within or adjacent to agricultural habitats under existing conditions.

- The project would substantially increase traffic and other activities related to construction and ongoing monitoring and maintenance which will lead to increased risk of take of Greater Sandhill Cranes. Activities which flush Sandhill Cranes, such as traffic to and from work sites, could lead to power line mortalities. To avoid impacts to and potential take of Greater Sandhill Cranes, confine most activities, investigations, and helicopter surveys to months when cranes are absent (May-August) as much as feasible. One way to reduce this additional take would be to complete construction in crane use areas outside the Greater Sandhill Crane wintering period; however, there would still be disturbance from project maintenance and monitoring activities for the future of the project which could result in take.

General comments about other shortcomings in the DEIR

Appendix 13B, page 13B-374, lines 6-13 state: "The Cosumnes River floodplain, much of it protected within The Nature Conservancy's Cosumnes River Preserve, also supports significant winter crane use. Use may have increased in this area as continued conversion to vineyards on Delta Islands has reduced habitat availability in that area (Ivey et al. 2014a:27; Littlefield and Ivey 2000:23). As noted, crane use is entirely dependent on agricultural crop patterns. Conversion to unsuitable crop types effectively eliminates crane habitat. Over the last two decades, a substantial amount of conversion to vineyards has occurred on Delta islands and is considered among the most important conservation issues for the greater sandhill crane (Ivey et al. 2016:63).

- All 3 of these citations are incorrect in that the references cited mention both orchards and vineyards as incompatible crops, in addition to other development, not just vineyards. This account seems to mostly ignore the important threat of habitat losses through conversion to orchards (tree nuts and olives).

Appendix 13B, page 13B-376, lines 6-13 state: "Greater sandhill crane modeled roosting habitat consists of polygons of known roost sites. Permanent roost sites are those used regularly, year after year (e.g., Cosumnes River Preserve, Stone Lakes National Wildlife Refuge, and other wetlands managed for sandhill cranes), while temporary sites are those used during some years (e.g., lands that do not provide suitable crops or flooding every year due to rotating agricultural practices [Ivey et al. 2014a:6]). Known roost sites are based on sandhill crane surveys in the study area conducted between 2002 and 2013 (Ivey et al. 2016), 2017–2019 (Tsao pers comm.), and 2017–2020 (Wells pers. Comm.)."

- My 2016 paper cited by the DEIR does not provide enough detail to map roost sites and it does not include 2013 data, so this statement is in error. I believe the DEIR used a roost site GIS layer that I developed during the BDCP planning process. Also, most my roost site data is over 9 -20 years old and out of date and should not be relied on for Waterfix planning. New roost site surveys need to be conducted before project implementation.

Appendix 13F, page 13F-7, lines 11-14 state: **"**Construction would be complete by 2040, and no further construction impacts on Greater Sandhill Crane or Lesser Sandhill Crane would occur. Impacts on Sandhill Cranes as a result of operations of the alternatives is described in Impact BIO-33, Chapter 13, Section 13.3.3.4. The impact of operating the alternatives by 2040 would be the same."

- Compared to the No Project Alternative conditions, there would be an increased potential for Greater Sandhill Crane and Lesser Sandhill Cranes, if present, to have normal behaviors disrupted by permanent lighting in the areas where DWR facilities would be located.

Appendix 3F, Table 3F-4:

- The Total roosting habitat does not add up. Only 49.88 acres are included in the table, yet it shows a total of +72.39 acres.

Sources Cited:

Brown W. M. R. C. Drewien, and E. G. Bizeau. 1987. Mortality of cranes and waterfowl from power line collisions in the San Luis Valley, Colorado. In: Lewis JC, editor. Proceedings of the 1985 crane workshop. Grand Island, Nebraska, USA: Platte River Whooping Crane Maintenance Trust. pages 128–136.

Central Valley Joint Venture, 2006. Central Valley Joint Venture Implementation Plan – Conserving Bird Habitat. U.S. Fish and Wildlife Service, Sacramento, CA, USA.

Dwyer, J. F., A. K. Pandey, L. A. McHale, and R. E. Harness. 2019. Near-ultraviolet light reduced Sandhill Crane collisions with a power line by 98%. Condor, 121:1–10.

Ivey, G.L., B.E. Dugger, C.P. Herziger, M.L. Casazza, and J.P. Fleskes**.** 2015. Wintering ecology of sympatric subspecies of Sandhill Cranes: correlations between body size, site fidelity, and movement patterns. Condor 117: 518-529.

Ivey, G.L., C.P. Herziger, and D. A. Hardt. 2014. Conservation priorities and best management practices for wintering Sandhill Cranes in the Central Valley of California. Prepared for The Nature Conservancy of California. International Crane Foundation. Baraboo, WI, USA.