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Avian Risk Assessment

Potential for Collisions and Electrocutions Associated with the Proposed Talimarjan Transmission Line Project, Uzbekistan

Prepared for

The World Bank
1818 H Street, NW
Washington, DC 20433 USA

November 18, 2010

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FINAL REPORT

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Executive Summary

The Supplemental Environment Impact Assessment (EIA) Report (NBT 2010) indicates that the Adyr lands in Kashkadarya and Samarkand oblasts, where the proposed 500 kV route is to be located, are ecologically important areas for resident and migratory birds. Thus, Uzbekistan and the region of the proposed project are within one of the major migratory flyways in Central Asia, the Central Asian Flyway. To address the potential effects of the Talimarjan Overhead Transmission Line (TOTL) project on resident and migratory birds, the World Bank has requested that an Avian Risk Assessment (ARA) be prepared. This ARA will characterize the likelihood or potential risks to birds from collisions and/or electrocutions associated with the proposed TOTL project and determine whether these risks will cause biologically significant adverse effects to resident and migrating birds found in the vicinity of the proposed TOTL route.

The main conclusions of the ARA are

- The migration corridor is a broad front that includes all of Uzbekistan *without* any “channels” or narrow corridors.

- The entire 218-km length of the transmission line route is located within this broad migration corridor.

- There are a number of species of migrating birds (e.g., birds of prey, waterfowl, pelicans and cranes) that are registered in the International Union for Conservation of Nature (IUCN) Red Book that pass through Uzbekistan and over the route in the spring and fall.

- These species are reported to be susceptible to electrocutions and collisions from interactions with power lines depending upon various exposure conditions such as nesting, roosting and foraging behavior, flight height, proximity to towers and power lines, weather conditions, types of power line equipment, configuration of the line, mitigative measures, etc.

- Within the corridor there may be some areas (habitats) presenting a higher risk for collision or electrocution of birds such as sites near water bodies or wetlands used as migratory stopovers or feeding or nesting sites. These can be identified during the baseline preconstruction monitoring and mitigation measures can be applied (e.g., increasing the density of bird diverters and deflectors; minor readjustments in the corridor route).

- The size of the Uzbekistani bird species populations registered in the IUCN Red Book and considered susceptible to electrocution and collision is very small compared to the size of their global populations. Based on exposure conditions and proposed mitigation pathways the numbers of these birds being injured and killed from collisions or electrocutions along the TOTL route will be low thus population effects for these registered species are not anticipated. Other anthropogenic factors (e.g., habitat loss, poaching, etc.) are more important factors affecting these migrating registered populations.

- The susceptibility of the Siberian Crane to collisions and the potential interaction of this species with the TOTL project and other power lines in Uzbekistan need to be considered in future conservation plans to reestablish passage of this species through Uzbekistan.

- The proposed engineering designs will reduce or eliminate the likelihood of electrocutions, and the use of markers and flight diverters will reduce the likelihood of collisions.

- The bird protection measures outlined in the Environmental Management Plan (e.g., horizontal layout and proper spacing of wires; use of diverters and deflectors[1]) are consistent with established international best practice and provide adequate mitigation of the avian risk given the nature of the migratory corridor and the species using it.

- Of the alternative routes considered, the selected route—which is at the lower elevation—avoids mountainous areas altogether so it is also the preferable one for minimizing risk to migratory birds.

Management recommendations for pre- and postconstruction monitoring and capacity building are described.

Acknowledgements

The authors would like to especially thank Jenny Carter and Karen Hill of Pandion Systems for their editorial help and advice.

[1] Diverters are used to reduce the likelihood of birds in flight colliding with wires; deflectors are used to discourage birds from nesting on transmission towers with the potential for electrocution.

1 Introduction

Due to the growth of demand for power in Uzbekistan, the problem of aging infrastructure, and the limited number of transmissions lines—1,850 km of 500 kV lines, 6,200 km of 220 kV lines, and 15,300 km of 110 kV lines—some provinces experience frequent overloading, power losses, and long power outages. To meet this energy need, three combined-cycle gas turbine (CCGT) units are being planned by Uzbekenergo, the state electricity utility in Uzbekistan: two adjacent to the existing Talimarjan Thermal Power Plant (TPP) and one in Navoi Province. In addition Uzbekenergo has proposed to expand the transmission grid with a new 500 kV transmission line between Talimarjan TPP and Sogdiana Substation in southern Uzbekistan, specifically in the oblasts of Kashkadarya and Samarkand. Development of this proposed transmission line is known as the Talimarjan Overhead Transmission Line (TOTL) project.

The Supplemental Environment Impact Assessment (EIA) Report (NBT 2010) indicates that the Adyr lands in Kashkadarya and Samarkand oblasts, where the proposed 500 kV route is to be located, are ecologically important areas for resident and migratory birds. Uzbekistan and the region that includes the TOTL route are within one of the major migratory flyways in Central Asia, the Central Asian Flyway. The Central Asian Flyway (CAF) area, includes Central Siberia, Mongolia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Iran and Afghanistan, the Gulf States and Oman, the Indian subcontinent and the Maldives (UNEP/CMS 2009).

To address the potential effects of the TOTL project on resident and migratory birds, the World Bank has requested that an Avian Risk Assessment (ARA) be prepared. This ARA will characterize the potential risks to birds from collisions and/or electrocutions associated with the proposed TOTL project and determine whether these risks will cause biologically significant adverse effects to resident and migrating birds found in the vicinity of the proposed TOTL route.

This ARA is based on available information. Details, such as the locations of potential risk habitats, should be added following preconstruction monitoring studies. The results of the ARA study will be incorporated into the supplemental EIA including the Environmental Management Plan (EMP).

The TOTL project consists of a new 500 kV transmission line from Talimarjan TPP to the existing Sogdiana substation (218 km) that will pass through the oblasts of Kashkadarya (131 km) and Samarkand (87 km). A new bay extension at Sogdiana substation will be constructed adjacent to the Talimarjan TPP on land that will be transferred from the local administration to Talimarjan TPP. The existing Karakul-Guzar line, which passes nearby, will also be linked to this substation by a connecting line. The locations of substations and proposed transmission lines are presented in Figure 1.

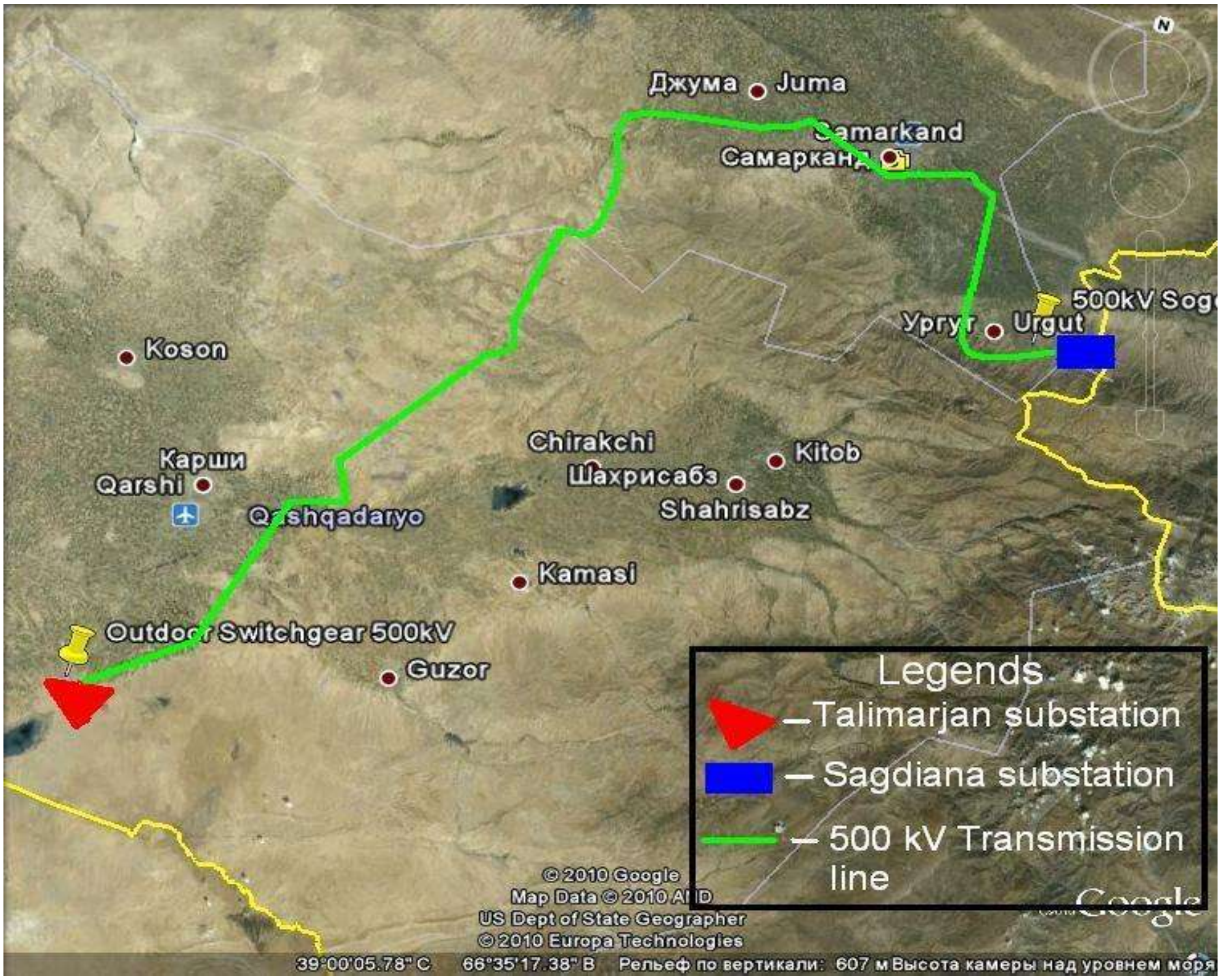

Figure 1. Location of a new OSG-500 kV transmission line at the Talimarjan TPP and a 500 kV transmission line from OSG-500 kV to the existing Sogdiana substation.

2 Avian Resources in the Vicinity of the Project Area

2.1 Species of Interest

Of the 434 species of birds living in various parts of Uzbekistan, the majority (greater than 85%) are migratory species that pass through Uzbekistan in the spring and fall; the remaining 10% to15% are resident species.[2]

[2] Dr. E. N. Lanovenco, Executive Senior Staff Scientist of the Institute of Zoology of Academy of Sciences of the Republic of Uzbekistan, Candidate of Biological Sciences Ornithological Paper: Answers To Questions Of Ornithology Consultant For Talimarjan Transmission Project, Sept 2010

2.2 Susceptible Species

Based on an analysis by UIZ and on existing literature and in-house data, about 320 species of birds occur in the TOTL project area. Of these species, 25 are resident (nonmigratory) species. Among them are a number of protected species with a special (listed) status included in the National Red Book and/or the International Red List of Threatened Species. Migratory species included in the International Red List are also included in Annex I of the International Convention on Migratory Species of Wild Animals and are subject to strict protection. IUCN's International Red List includes 27 species found in Uzbekistan that are reported potentially susceptible to power line collisions and electrocutions. Table 1 provides a list of key species potentially susceptible to collisions and electrocutions from the TOTL project along with their global population size and major threats to their survival (Lanovenko 2010).

Table 1. Potential Species Associated with the Uzbekistan Talimarjan Overhead Transmission Line Project, their Status, Estimated Population Size, and Threats

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
Cinereous (Black) Vulture *(Aegypius monachus)*	Near Threatened	1) 14,000–20,000 individuals worldwide 2) 7,200–10,000 pairs worldwide / 1,700–1,900 pairs in Europe and 5,500–8,000 pairs in Asia	1) Take (shooting, trapping, poisoning), and habitat loss 2) Take (accidentally or deliberately poisoning) and decreasing availability of food	1) B. U. Meyburg. 1994. Pg 128 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-25-2010)
Saker Falcon *(Falco cherrug)*	Vulnerable	1) 35,000 to 40,000 pairs worldwide (1994) 2) 19,200–34,000 individuals worldwide; Kazakhstan (2,000–5,000 pairs)	1) & 2) Loss of habitat and take (capture) for falconry	1) A. C. Kemp. 1994. Pgs 273–274 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-25-2010)
Lesser White-fronted Goose *(Anser*	Vulnerable	1) 100,000 individuals (late 1980s), drastic declines during 20th	1) Majority wintering on the Caspian Sea	1) C. Carboneras. 1992. Pg 582 in Handbook of the

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
erythropus)		century. 2) 20,000–25,000 individuals worldwide	2) Rapid population reduction in its key breeding population in Russia. Disturbance, habitat loss and degradation, and take (spring and illegal hunting) are factors in decline	Birds of the World. Vol 1. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-10)
Eastern Imperial Eagle *(Aquila heliaca)*	Vulnerable	1) 2,000 pairs (1994) 2) 5,200–16,800 individuals worldwide; The majority of the world population breeds in Russia (total 900–1000 pairs) and Kazakhstan (750–800 pairs)	1) Shooting, poisoning, trapping, habitat loss, power line collision, and electrocution. 2) Habitat loss or degradation	1) B. U. Meyburg. 1994. Pg 194 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-25-2010)
Pallas's Sea (Fish) Eagle *(Haliaeetus leucoryphus)*	Vulnerable	1) 2,500–9,999 individuals worldwide	1) habitat loss or degradation and disturbance 2) Population has undergone general decline for reason not fully understood	1) http://www.birdlife.org/index.html (9-26-10) 2) A. C. Kemp. 1994. Pgs 122 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain
Dalmatian Pelican *(Pelecanus crispus)*	Vulnerable	1) 1926–2710 pairs (1991) declining during 20th Century 2) 10,000–13,900 individuals worldwide; a majority breed in the countries of the former Soviet Union (2,700–3,500 pairs)	1) Many Greek birds killed after collisions with power line, habitat loss, and disturbance of colonies and elsewhere. High percentage of population in concentrated in limited range; e.g. Pakistan, "USSR."	1) F. Jutglar. 1992. Pg 310 in Handbook of the Birds of the World. Vol 1. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
			2)Habitat loss or degradation (wetland drainage), shooting and persecution by fishers	10)
Houbara Bustard *(Aythya nyroca)*	Vulnerable	1) 57,000–70,000 (1980–1991) 2) 160,000–257,000 individual worldwide	1) Declines mostly due to habitat destruction and hunting 2) Degradation and destruction of well-vegetated shallow pools and other wetland habitats, introduction of exotics	1) A Jutglar. 1992. Pg 617 in Handbook of the Birds of the World. Vol 1. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-10)
Houbara Bustard *(Chlamydotis undulate)*	Vulnerable	1) Kazakhstan 40,000–60,000 individuals and substantial numbers also in Uzbekistan 2) 49,000–62,000; individuals worldwide; in the mid-1990s population of *C. u.macqueenii* estimated to be in the range 39,000–52,000, with over 75% were in Kazakhstan and 15% in Uzbekistan	1) Habitat loss or degradation (agricultural practices), disturbance, and take (hunting) 2) Take due to hunting (falconry) and habitat loss or degradation	1) N. J. Collar. 1996. Pgs 264-265 in Handbook of the Birds of the World. Vol 3. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-10)
Demoiselle Crane *(Anthropoides virgo)*	Least Concern	1) 200,000–240,000 individuals worldwide 2) 230,000–280,000 individuals worldwide	1) Habitat loss (changing agricultural practices) , pesticide use, and take (hunting and poisoning)	1) Archibald, G. W. and C. W. Meine. 1996. Pgs 83-84 in Handbook of the Birds of the World. Vol 3. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-10)
Common (Eurasian) Crane *(Grus grus)*	Least Concern	1) 9,000–11,000 individuals worldwide	1) Habitat loss or degradation	1) Archibald, G. W. and C. W. Meine. 1996. Pg 88 in

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
		2) 360,000–370,000 individuals worldwide	2) Habitat loss and degradation (changes in agricultural practices), pesticide contamination, take (hunting, egg collection, and poisoning), Collisions with utility lines are frequent in highly developed areas along migration routes and in winter ranges (the leading cause of adult mortality at wintering areas in Spain)	Handbook of the Birds of the World. Vol 3. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (9-26-10)
(Europran) White Stork *(Ciconia ciconia)*	Least Concern	1) 150,000 breeding pairs (mid 1980s) 2) 500,000 - 520,000 individuals	1) Habitat degradation (drainage of wetlands), loss/conversion of foraging areas. Shortage of nesting site. Direct loss (hunting) during migration and collision with power lines. 2) Development, industrialization and intensification of agriculture practices. On winter grounds (Africa) possible high rates of mortality due to changes in feeding conditions (to drought; desertification) and use of pesticides to control of locust populations.	1) A. Elliott. 1992. Pgs 460-461 in Handbook of the Birds of the World. Vol 1. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain. 2) http://www.birdlife.org/index.html (10-12-10)
Osprey *(Pandion haliaetus)*	Least Concern	1) 500,000 individuals worldwide	Frequent and abundant throughout most of its worldwide range	http://www.birdlife.org/index.html (9-25-2010)
Steppe Eagle *(Aquila nipalensis)*	Least Concern	1) 40,000–60,000 2) 10,000 individuals worldwide	1) "Commonest eagle species of its size in the world." 2) Extremely large range does not approach the thresholds for Vulnerable. The	1) B. U. Meyburg. 1994. Pg 194 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
			population trend appears to be decreasing, decline does not approach the thresholds for Vulnerable	2) http://www.birdlife.org/index.html (9-26-10)
Golden Eagle *(Aquila chrysaetus)*	Least Concern	1) European population estimated at 4,500–5,000 pairs (late 1980s) in United States population estimated at 70,000 individuals (in 1980s) 2) 170,000 individuals worldwide	1) Has been persecuted in past as threat to livestock with poisoning and shooting. “Large number die due to collisions and electrocution but not apparently a significant [population level] factor”	1) J. Orta. 1994. Pg 197 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10
White-tailed Sea-Eagle *(Haliaeetus albicilla)*	Least Concern	1) 9,000–11,000 pairs (2008) 2) 20,000–39,600 individuals worldwide; 2004 European population at 5,000–6,600 breeding pairs	1) Main cause of decline; shooting, poisoning, habitat destruction	1) J. Orta. 1994. Pg 122 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10)
Merlin *(Falco columbarius)*	Least Concern	1) “. . . in 1980s as few as 10,000s of pairs in Eurasia.” 2) 1,300,000 individuals worldwide	1) Chemical (chlorinated hydrocarbons) accumulation lead to worldwide population decline – no longer an issue	1) A. C. Kemp. 1994. Pg 267 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10)
Common Kestrel *(Falco tinnunculus)*	Least Concern	1), 1,000,000–2,000,000 pairs 2) 5,000,000 individuals worldwide	1) Commonest diurnal raptor throughout much of its range. Some declines due to chemical (chlorinated	1) R. O. Bierregaard. 1994. Pg 259 in Handbook of the Birds of the World. Vol 2. J. del Hoyo,

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
			hydrocarbons) contamination in 1950s and 60s; not longer and issue	A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10)
Eurasian Sparrowhawk *(Accipiter nisus)*	Least Concern	1) 1,500,000 individuals worldwide	2) Declines due to chemical (chlorinated hydrocarbons) contamination in 1950s and 60s; not longer and issue	1) http://www.birdlife.org/index.html (9-26-10) 2) J. Orta. 1994. Pg 158 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain
Montagu's Harrier *(Circus pygargus)*	Least Concern	1) 7,000 pairs in western Europe 2) 100,000 individuals worldwide	1) Recent (1990s) declines in population due to habitat loss or degradation (changes in agricultural practices)	1) A. C. Kemp. 1994. Pgs 140 – 141 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10)
Pallid Harrier *(Circus macrourus)*	Near Threatened	1) ≤ 20,000 pairs in early 1990s 2) 18,000–30,000 individuals worldwide; large decline in Europe during 1970–1990, up to 30% of birds were lost (particularly from the key population in European Russia), the species continued to decline. It appears that the species has been extirpated from	1) Habitat loss or degradation 2) Habitat loss or degradation (conversion of grasslands to agriculture) and perhaps use of chemicals	1) A. C. Kemp. 1994. Pg 140 in Handbook of the Birds of the World. Vol 2. J. del Hoyo, A. Elliott, and J. Sargatal eds. Lynx Edicions, Barcelona. Spain 2) http://www.birdlife.org/index.html (9-26-10)

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
		Moldova and Belarus		
Marsh Harrier (*Circus aeruginosus*)	Least Concern	1. In Europe, the breeding population is estimated to number 93000-140000 breeding pairs, equating to 279000-420000 individuals (BirdLife International 2004). 2 Europe forms 25-49% of the global range, so a very preliminary estimate of the global population size is 500000-2000000 individuals, although further validation of this estimate is needed.	Habitat destruction due to drainage of wetlands is the one of the major threats to Western Marsh Habitat	http://www.iucnredlist.org/apps/redlist/details/144370/0/print
Egyptian Vulture (*Neophron percnopterus*)	Endangered	Global population estimates for the species are crude, but combining figures of 2,600-3,100 pairs in Europe, <2,000 pairs in central Asia, just a few thousand pairs now in the Indian Subcontinent, perhaps 1,000 pairs in the Middle East, and perhaps <7,500 pairs in Africa, gives a total of 30,000-40,000 mature individuals.	1. This species faces a number of threats across its range. Declines in parts of Africa are likely to have been driven by loss of wild ungulate populations and overgrazing in some areas by livestock. 2. Disturbance, lead poisoning (from gun-shot) and collision with powerlines are currently impacting upon European populations.	http://www.iucnredlist.org/apps/redlist/details/144347/0
Griffon Vulture (*Gyps fulvus*)	Least Concern	The population size is very large, 100,000 Mature individuals	Illegal persecution, especially through poisoning. Food shortage as a result of removing dead livestock (cows, sheeps, pigs) from the countryside can also threaten populations.	http://www.iucnredlist.org/apps/redlist/details/144353/0 http://www.europeanraptors.org/raptors/eurasian_griffon_vulture.html http://www.birdlife.org/datazone/speciesfactsheet.php?id=3378

Species Name (*Scientific Name*)	**Status: IUCN/URB***	**Estimated Size of the Overall Population**	**Threats (Including Any Mortality Estimates While Migrating)**	**Citations**
Booted Eagle (*Aquilla pennata*)	Least Concern	10,000 - 100,000 Mature individuals	Deforestation and loss of low intensity agricultural systems, human disturbance, persecution, locally wind farms	http://www.birdlife.org/datazone/speciesfactsheet.php?id=3543 http://eagleconservationalliance.org/discussions/
Imperial Eagle (*Aquilla heliacal*)	Vulnerable	5,200 - 16,800 Mature individuals	Habitat change (conversion of native forests to commercial forests with introduced species with consequent loss of prey), loss of nest sites (large trees), human disturbance, nest robbing, illegal trade, shooting, poisoning, shortage of prey species, and electrocution, live bird trade.	http://eagleconservationalliance.org/discussions/
Short-toed Eagle (*Circaetus gallicus*)	Least Concern	51,000 - 156,000 Mature individuals	The major threat to Short-toed Eagles is the reduction of suitable foraging habitats,	http://www.birdlife.org/datazone/speciesfactsheet.php?id=32257 http://www.ornisfennica.org/pdf/vol86-3/2Bakaloudis.pdf
Long-legged Buzzard (*Buteo rufinus*)	Least Concern	100,000 Mature individuals	1. Threatened by habitat destruction through intensification of agriculture in some areas. 2. Electrocution can also be a problem. Many losses through electrocution are reported from Russia .	http://www.birdlife.org/datazone/speciesfactsheet.php?id=32592 http://www.europeanraptors.org/raptors/long_legged_buzzard.html

* International Union for Conservation of Nature (IUCN) International Status; Uzbekistan Red Book Status (URB)

2.3 Bird Protection Polices

2.3.1 Laws, Regulations, and International Conventions

The following laws of the Republic of Uzbekistan have environmental protection provisions that include general and specific bird protection implications.

- "On Nature Protection" (1992)—established legal, financial, and organizational framework for environmental protection and efficient use of natural resources. The law aims at ensuring balanced relations between humans and nature and protection of ecosystems.
- "On Protection and Use of the Fauna" (1997)—regulates protection and usage of wild fauna under natural free conditions on land, water, atmosphere and the habitat, permanently or tempory, in the Republic of Uzbekistan, as well as in a semi-wild condition or in artificial environment for scientific and conservation (reintroduction / captive propagation) purposes.

The major effective regulatory documents in the area of environmental protection passed by the Cabinet of Ministers of the Republic of Uzbekistan include the following.

- Resolution by the Cabinet of Ministers No. 139 of 1 April 1998 "On National Strategy and Measures for Biological Diversity Conservation."

Under international cooperation in the field of environmental protection, the Republic of Uzbekistan has signed a number of International Conventions that should be implemented by the State Committee for Nature Protection of the Republic of Uzbekistan, including the following.

- Convention on Biodiversity (ratified in 1995)
- Convention on International Trade of Fauna and Flora (ratified in 1997)
- Convention on Protection of Migrant Wild Animals (ratified in 1998)
- Convention on wetlands of international significance, mainly habiatat for waterfowl—Ramsar Convention (Uzbekistan has acceded it in 2001)
- Agreement on protection of Afro-Euroasian migrating waterbirds (signed by Uzbekistan in 2003)
- Memorandum on Understanding of Slender-billed Curlew protection measures (1994)
- Memorandum on Understanding of Siberian Crane protection measures (1996)

2.3.2 Protected Areas

There are several ornithological sanctuaries *(zakazniks)* designated as protected areas established for preservation and support of birds in the Republic of Uzbekistan. *Zakaznik* corresponds to category IV of the IUCN Protected Areas. The following are ornithological *zakazniks* in Uzbekistan: the Sudochie, Karakyr and Dengizkul lakes for protection of water and wading birds, and Karnabchul for clay desert birds. There are two Ramsar sites in Uzbekistan—the Dengizkul and Aidarkul lakes. Inclusion of Kuimazar and Tudakul water reservoirs to the Ramsar list is pending consideration. None of these protected areas occur along the proposed TOTL route/Right-of-Way.

2.3.3 Designations

Endangered species designations are found in the National Red Book (1987, 2003, 2006). This document is published in Uzbekistan. It lists rare and endangered species of national and international significance. Its next (fourth) issue will be published in 2010. National protection status envisages the following treatment categories: 0 = "Regionally Extinct" (EX) or "Regionally Extinct in the Wild" (REW); 1 = "Critically Endangered" (CR) or "Endangered" (EN); 2 = "Vulnerable" (VU:R,[3] VU:D[4]); 3 = "Near Threatened" (NT). The most recent edition (published in 2006) included 48 bird species, of which 23 were included in the IUCN Red List of Threatened Species.

The Red Book of Uzbekistan (Volume 2: Animals, Invertebrates, Fish, Reptiles, Birds, Mammals, Toshkent, published by Chinor Enk 2006) has a short discussion on each species, which includes national and international protection status of the species, description of distribution, habitat, size, features of biology, constraints, breeding, safeguards, and a brief summary in English.

2.3.4 National Action Plans

National action plans for selected bird species are being developed as a part of an international action plan to protect those species. Action plans for Siberian Crane (*Grus leucogeranus*), Sociable Lapwing (*Vanellus gregarious*), White-headed Duck (*Oxiura leucocephala*), Black-winged Pratincole (*Glareola nordmani*), and Spoonbill (*Platalea leucorodia*) have already been developed, and action plans for Saker Falcon (*Falco cherrug*) and Egyptian Vulture (*Neophron percnopterus*) are being prepared.

2.3.5 Agencies and Organizations

The primary governmental agencies and departments responsible for protection of birds include the State Committee for Nature Protection of the Republic of Uzbekistan (GosComPriroda) and its department, State Inspection for the Protection of Flora and Fauna (GosBioControl); and the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan (MAWR) and its subdivision, Sanctuary, National Park, and Wildlife Department of Main Forestry Department.

In Uzbekistan, nongovernmental organizations with interest in the avian issues of the TOTL project include the UIZ and Uzbekistan's Society for the Protection of Birds.

2.4 Migration Patterns

2.4.1 Overall Pattern in the Uzbekistan and the Project Area

As discussed above, the majorities of birds occurring in Uzbekistan and in the TOTL project area are migratory and are a part of the Central Asian Flyway. Migration routes of these birds occur over the continents and oceans and stretch across a broad front. In some cases, due to the specific terrain, they become so narrow that they might correspond to the term "line" (along coast lines) or "bottleneck" (in the area of mountain ranges). For instance, the migration flyway

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[3] R = IUCN Regional

[4] D = IUCN Criterion for very small or restricted populations

narrows to a “line” along the west coast of the Caspian Sea, there is a “bottleneck” in the Chokpak Mountain Pass in the Karatau Mountains in Southern Kazakhstan 230 km from Tashkent, and there is a “bottleneck” in Georgia, Caucasus. However no such bottlenecks have been identified in the TOTL region.

Special research on migration flyways in Central Asia within the “Asia Program” was carried out in the 1980s and demonstrated that nocturnal migration over mountains and deserts of Central Asia and Kazakhstan occur in all groups of birds from the east coast of the Caspian Sea to the east border of Tien Shan. During nocturnal migration up to 90% of birds fly over Central Asia at high altitude; the remainder fly during daylight hours (Dolnik 1982). According to Mr. V. Dolnik’s and Mr. Bolshakov’s data (1985) spring nocturnal migration of birds over deserts has the shape of a broad front without concentration along any particular environmental tracks. This passage is not excessively long and nonstop. This type of migration pattern is called a continuous migration with shorter flights and multiple stopovers to rest and feed.

Other information sources indicate that the Karshi Steppe is being intensively crossed by the birds. During spring migration their numbers are much larger (both in quality and quantity) than during fall migration. Birds cross the Karshi Steppe towards the Kashkadaria and Zerafshan river valleys from southwest (away from the Amu Daria River Valley) to the northeast. During this period, they move along the steppe as a wide front that includes numerous temporary waterbodies and cultivated and uncultivated areas (Salikhbaev and Ostapenko 1967).

The main migration flyways passing over the territory of Uzbekistan are represented below (Figure 2). This figure shows that three migration paths (the Black Sea/Mediterranean, East Africa–West Asia, and Central Asia) cross the territory of Uzbekistan. In summary bird migration in the TOTL project area is considered to occur along a “broad” migration front over a wide area including all of Uzbekistan.

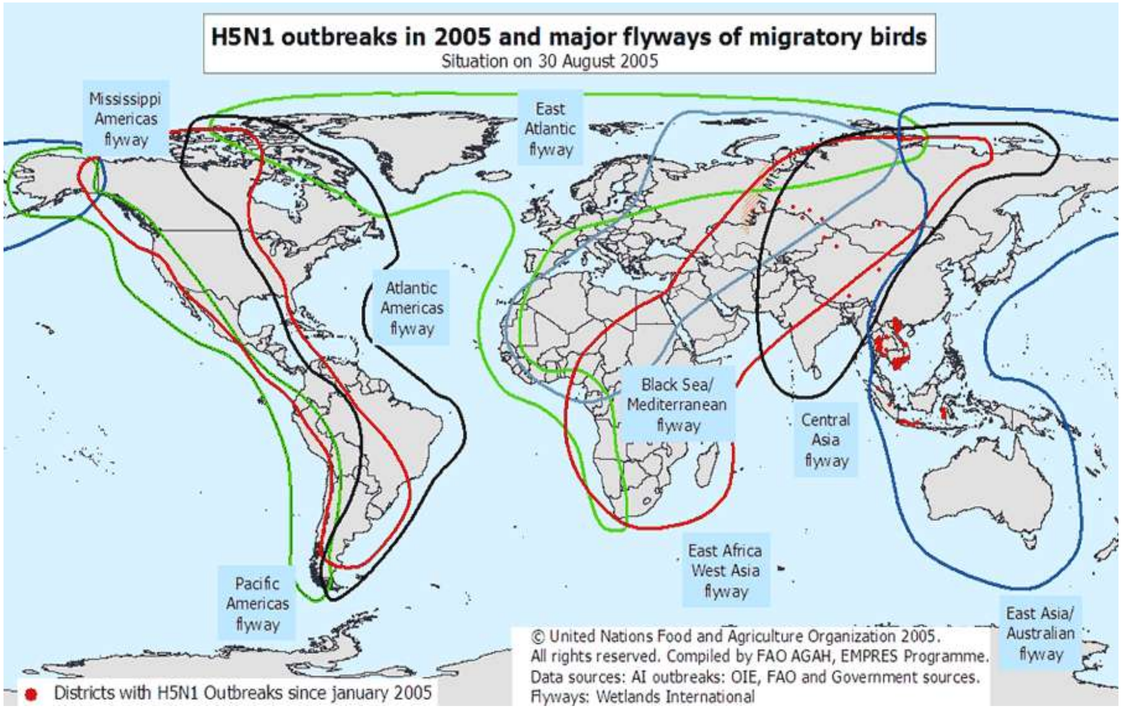

Figure 2. Major flyways of migratory birds.

A survey conducted by UIZ in August 2010 (during the public consultation on the project) showed that spring migration of cranes in the vicinity of the 500 kV transmission line area has a broad front pattern; fall migration was less distinct.

2.4.2 Timing of Migration

Migration takes place over the Tien Shan and Pamir mountains. As in the desert, most of the birds stop flying after dark (storks, pelicans, cranes, raptors, vultures). In the mountains predeparture distribution of birds is uniform rather than concentrated. Density of nocturnal migration during spring time over Tien Shan is similar to that over the desert, as those mountains do not pose as much of an obstacle. Over the mountains, the bulk of birds fly at an altitude of 3 to 3.5 km above sea level, which is slightly higher than an average height of the mountain ranges. After crossing the mountains, the flight altitude of birds declines sharply. In foothills and mountain systems, unlike in the plains, night passage of birds can occur at low altitude when birds interrupt migration due to strong or unfavorable winds.

Studies of diurnal migration reveals the location and concentration of bird migration stopovers generally occur on the shores of rivers and lakes, mountain passes, valleys, etc. For example, there is an indication that river valleys of Central Asia and Kazakhstan play an important role as tracks (channels) for visible day flying (Gavrilov 1979; Yanushevich et al. 1982). In Uzbekistan (in the framework of the “Asia Program”), active areas of diurnal visible migration occur along the river Kurkeles near Tashkent, the river Syr Darya in the Ferghana Valley, the northwestern and southern shores of the Aydarkul Lake located in the basin of the middle reaches of the Syr

Darya River, through Jizzakh Pass, near Gallyaaral, valleys of the Sherabad and the Surkhan rivers, and in the upper reaches of the Amu Darya. In general, it was found that birds bypass giant mountain ranges in the spring (the Pamirs, Tien Shan, Altai) and fly mainly along the foothills, river valleys, and other waterbodies, through the oases. Migratory birds also avoid deserts (Kara Kum, Kyzyl Kum, Muyun-Kum) (Yanushevich et al. 1982). According to the literature, the prevailing direction of diurnal and nocturnal migration of birds in Uzbekistan in the spring is northeast and in the fall is southwest (Dolnik 1985).

Based on this information, it is expected that concentrations of migrant birds will be observed in the spring in the southern foothills of Kapratepa and Zarafshan ridges near the TOTL project area and in the autumn in the north along the section passing in the Kashkadarya River valley and near Talimarjan, Chimkurgan, and Karatepa water reservoirs (Lanovenko 2010). It is likely that the greatest potential exposure to migratory birds would be while the birds are passing the foothills of the northern slopes of the Zeravshan Ridge and Karatepa Mountains, where local passage of low-flying birds occur.

Previous UIZ studies of migration of birds in other regions of Uzbekistan with the same environmental conditions indicated that high concentrations of birds of prey, cranes, and other species of birds were observed in the northern piedmont plain of the Nuratau Range during seasonal migrations. In addition to cranes, UIZ has repeatedly observed flocks of Dalmatian Pelicans in the foothills, where they were circling and gaining altitude and then flying in a southerly direction to cross the mountains.

During Fall, field research in the Guzar and Mangit areas, as well as in January on the road from the City of Karshi to Talimardjan Water Reservoir and Dekhkanabad areas, Steppe Eagles, Long-legged Buzzards, Griffon Vultures, Black Vultures, and Saker Falcons were commonly observed. In the spring, rain-fed wheat crops also attract cranes and geese.

Two species of cranes primarily migrate across Uzbekistan: Demoiselle Crane (*Anthropoides virgo*) and Common Crane (*Grus grus*) (Lanovenko and Kreuzberg 2002). They can be seen during migration in many parts of the country. Demoiselle Cranes fly around snow-capped ranges of the Tien Shan in the west and then turn northeast, reaching nesting grounds in Kazakhstan, Mongolia, and Transbaikalia, which results in their flying through Uzbekistan. In autumn, cranes change their flyway to cross the mountain ranges of the Tien Shan and then from Transbaikalia through the deserts of Central Asia, Tibet, and the Himalayas, reaching the wintering grounds in India and Pakistan (Gavrilov and Van Der Ven 2004). As a result, autumn migration of Demoiselle Crane in Uzbekistan is almost negligible. Common Cranes occur during migration in Uzbekistan in the spring and autumn (Lanovenko and Kreuzberg 2002).

In southern Uzbekistan (in the Surkhandaria Province) during the spring migration, both species of cranes cross the Kugitang Ridge near the town of Sherabad and then go to the Kashkadaria Province about 150 km from the TOTL project area (Lanovenko and Tretyakov 2008). They fly this route from the Indopakistan and Surkhandaria wintering grounds. Some 22,000 cranes are reported to winter near the town of Termez some 200 km from the TOTL project area. According to Mitropolsky (2008), the Dekhkanabad region of the Kashkadaria Province hosts up to 23,000 Demoiselle Cranes (*Anthropoides virgo*) during spring migration. Based on this distribution pattern, it is clear that the cranes fly both parallel and across the route of the TOTL. During various seasons up to 15 IUCN registered species of birds of prey were observed in the area of the TOTL route. In the Karshi Steppe were Saker Falcon (*Falco cherrug*), Merlin (*F. columbarius*), Common Kestrel (*F. tinnunculus*), Sparrow Hawk (*Accipiter nisus*), Montagu's Harrier (*Circus pygargus*), Pale Harrier (*C. macrourus*), Marsh Harrier (*C. aeruginosus*), Black Kite (*Milvus corshun*), Pallas' Sea Eagle (*Haliaeetus leucoryphus*), Egyptian Vulture (*Neophron percnopterus*), Griffon Vulture (*Gyps fulvus*), Black Vulture (*Aegypius monachus*), Booted Eagle (*Aquilla pennata*), Imperial Eagle *A. heliacal*), Long-legged Buzzard (*Buteo rufinus*), and Short-toed Eagle (*Circaetus gallicus*) (Salikhbaev and Ostapenko 1967). There are no publications on ornithological investigations in the Karatepa Mountains.

In Uzbekistan, a Long-legged Buzzard nest has been found on a power supply line not far from Akcha Station in the Akhangaran Region of the Tashkent Province. In the Central Kyzylkum Desert, Kestrel (*Falco tinnunculus*) nests have been found on power lines on repeated occasions. Mitropolsky et al. (1987) found that with Golden Eagles and Saker Falcons were able to expand their nesting range deeper into the desert by nesting on power lines in the Kyzylkum Desert. According to Zinoviev (1990), up to 40% of the Golden Eagle nests and up to 33% of the Saker Falcon nests in the Kyzylkum Desert were located on power lines. However, most of the nests observed on power lines were those of the White Stork and were predominantly concentrated in the basin of the middle course of the Syrdaria River including the Ferghana Valley in the Syrdaria and Tashkent provinces (Lanovenko et al. 1990). White Storks breed in the Samarkand region and in the Urgut district. The actual number of breeding and migrating birds is unknown.

2.4.3 Habitats Used In Migration

The TOTL project is located in the Karshi Steppe. It is home to an active migration and wintering of several species of large birds of prey characterized by a feeding type of migration including buzzards, harriers, eagles, and falcons. These birds do not make long-distance migration movements. Their migration is characterized as continuous migration with frequent stops (i.e., stopovers) for resting and feeding. The presence of transmission towers and the behavior of these birds to use transmission towers for perching and roosting creates a potentially exposure for electrocutions depending upon the design of the line. The foothills and the adjacent territory of the Karshi Steppe along the TOTL route is characterized by developed rain-fed farming. Local farmers grow mainly wheat. In the areas of rain-fed crops, there are usually many rodents, which in turn serve as food for birds of prey. This results in a concentration of birds of prey in areas within the rain-fed crops and potentially in the TOTL project area.

Species on the International Red List of Threatened Species have been observed here, including Ferruginous Duck (*Aythya nyroca*) and Lesser White-fronted Goose (*Anser erythropus*) (Wetlands International database on international winter census, IWC). This reservoir complies with the criteria of the Ramsar convention and is of international significance since it supports over 20,000 birds. Presently the Talimardjan Reservoir is classified as an important ornithological territory (IBA) in Uzbekistan and Central Asia and is included into the Birdlife International database and international network of critically important wetlands (Critical Site Network [CSN]). The Talimarjan Reservoir is located 10 km southwest from the Talimarjan TPP route. It is a migratory stopover site for the Mallard, Gray Goose, White-fronted Goose, Teal, Gadwall, and Red-crested Pochard (most common species). Other common species include

Great Crested Grebe, large and small Cormorants, Great White and Gray herons, Northern Pintail, White-tailed Eagle, Black-headed Gull (Filatov 2008), and Common Crane (IWC database, UIZ).

The Chimkurgan Reservoir is located 30 km from the TOTL project route. It is a stopover for migrating waterfowl and also serves as a wintering area. Over 20,000 birds winter here in various years, including the Ferruginous Duck and Lesser White-fronted Goose. This water body, similar to the previous one, is an IBA. Cormorant, Greylag Goose, Ruddy Shelduck, Common Crane, and Demoiselle Crane are the most common species at the Chimkurgan Reservoir (Belyalova 2008).

2.5 Reports on the Susceptibility of Birds to Collisions and Electrocutions in Uzbekistan

Systematic mortality monitoring using standard protocols has not been conducted in Uzbekistan and therefore reported quantities can be considered only indicators of mortality. In addition, information on the type of line, configuration, and separation of the energized and nonenergized equipment is not available so conclusions on the risk from different power line structures are not possible. These reports do indicate that specific species are susceptible to collisions and electrocutions. Incidental information has been collected and described here. It is known that during spring and autumn migration, medium and large size birds die on the power lines, among which are rare and declining species including the Steppe Eagle, Golden Eagle, Imperial Eagle, Osprey, Short-toed Eagle, Saker Falcon, and others (Abdunazarov 1987; Shernazarov Lanovenko 1994).

Observations of injury and mortality from power lines (without indication of voltage, distance, or duration of observation) have been carried out in the Tashkent, Djizak, Surkhandaria, Kashkadaria, Bukhara, Namangan, and Ferghana provinces of the Republic. Estimates of mortality of birds on power lines include up to 50 birds of prey in the Ferghana Valley and Samarkand and Surkhandaria provinces (predominantly buzzards and Common Kestrels); from 10 to 50 in Tashkent, Syrdaria, and Kashkadaria provinces (predominantly buzzards and Common Kestrels); from 300 to 5,000 in Djizak Province (eagles, buzzards, Osprey, kestrels); and from 200 to 500 in Navoi and Bukhara provinces (eagles, buzzards, large falcons, kestrels).

Birds of prey can be at risk from electrocutions when using power line towers as roost sites or nest sites. In another study of low voltage power lines (6–10kV), Abdunazarov (1987) reported the following composition of birds found dead in 1981–1984 in the Farish Steppe (Djizak Province): 3 Osprey (*Pandion haliaetus*) at a 30-km long area, 16 Steppe Eagles *(Aquila nipalensis*), 1 Imperial Eagle *(Aquila heliacal*), 1 Golden Eagle (*Aquila chrysaetus*), and 3 Short-toed Eagles (*Circaetus gallicus*). On 26 April 1989 (in the same area), 64 birds of prey were found dead of which 12 species have been registered. The following birds have been identified among them: 1 Osprey, 2 Sea Eagles (*Haliaeetus albicilla*), 2 Short-toed Eagles, 11 Steppe Eagles, 1 Golden Eagle, 1 Imperial Eagle, and 2 Saker Falcons (*Falco cherrug*).

On the 220 kV power line running from the Kyzyltepa Substation along the western bank of the Tudakul Lake (Navoi Province) (without indication of voltage, distance, or duration of observation), Dalmatian Pelican mortality has been regularly reported during the migration seasons. During a visit to the lake in January 2004, UIZ found seven burnt Dalmatian Pelicans under the power lines (size and type of line and conditions not reported). Dalmatian Pelicans have a specific route for landing on the lake, which crosses the transmission line. When a pelican flies between the conductors during wet weather (fog, rain, snow), an electric arc occurs and the birds are electrocuted. It is likely the number of dead pelicans here is much higher since the birds are quickly scavenged by jackals and foxes (Lanovenko 2007).

Bird species dying as a result of physical impact associated with power lines in Uzbekistan are mostly small Passeriformes (Millerbird), Sandpiper, rails (Corncrake), and Sand Grouse (Black-bellied Sand Grouse); quail have also been found. According to Nazarov and Zagrebin (1987), there are regular collisions of quail with power lines (size and type of line and conditions not reported) during the spring and fall migrations. In the central part of the Kyzyl Kum Desert over the period from 1997 to 2007, Mitropolsky (2009) collected the remains of birds of prey killed by power lines to collect humeri. Overall he collected 71 samples of 14 species of birds of prey in this area: Northern Goshawk (*Accipiter gentilis)*, Common Buzzard (*Buteo buteo*), Long-legged Buzzard (*Buteo rufinus)*, Hen Harrier (*Circus cyaneus)*, Marsh Harrier *(Circus aeruginosus)*,Golden Eagle *(Aquila chrysaetos)*, Eastern European Eagle (*A. heliaca)*, Steppe Eagle *(A. nipalensis)*, Spotted Eagle *(A. clanga)*, Cinerous Vulture *(Aegypyus monachus*), Griffon Falcon *(Gyps fulvus)*, Egyptian Vulture *(Neophron percnopterus)*, Short-toed Eagle *(Circaetus gallicus)*, and Kestrel (*Falco tinnunculus)* (size and type of line and conditions not reported).

In September 2007, an investigation was conducted to identify birds that were electrocuted along the power line running to the Navoi Mining and Metallurgical Complex in the central part of the Kyzyl Kum Desert. Golden Eagles, Steppe Eagles, Griffon Vultures, and Houbara Bustards (*Chlamydotis undulata*) have been identified among the carcasses (Kashkarov 2007; information bulletin for IBA project in Uzbekistan 2007). The exact cause of death is not known. In private discussions with the participants of this study (M. Mitropolsky and E. Filatova), it was determined that, for the most part, the birds were found under the lines instead of the transmission line towers. Therefore, it is assumed that in this case the birds died from collisions with conductors.

2.6 Potential Avian Habitats along the Project Route

The 218-km route mainly traverses existing rights-of-ways (ROW) with relatively flat topography and a mixture of cultivated and uncultivated lands. The following description is taken from the Talimarjan Thermal Power Project Resettlement Action Plan, August 2010.

The topography of the TOTL project area is mostly level for the first 36 km from the Sogdiana Substation with 14 turns or Angle Points through this section of the route. The route follows the northern foothills of the Zerafshan Ridge at an altitude of 926 to 1180 m and the northwest and northern offspurs of Karatepa Mountain at an altitude of 827 to 1105 m with large depression slopes, Karatepa water reservoir (600–620 m wide), two deep gorges, and the 220kV Samarkand-Suvli transmission line. From Angle Point 14 to 21, the route follows a pre-mountainous plane with small valleys starting from the northern slopes of Karatepa Mountain. After Angle Point 21, the route goes through a hillside to Angle Point 31 crossing between Angle Point 21 and 22 in densely populated Djam Creek Valley where there is a village 7 to 8 km long with homes sparsely located. Between Angle Points 23 and 24, there is a boundary road and many small collectors coming to Angle Point 33 before the Karshi-Kitab Railway. Upon crossing the railway, the route passes through agricultural land with many engineering structures including the Karshi-Termez Railway and the Karshi main canal. At Angle Points 38 and 39 it reaches the Talimarjan TPP.

The following describes land uses and terrestrial and aquatic habitat along the proposed TOTL project route (as described in the Resettlement Plan) beginning at the Sogdiana Substation at Talimarjan.

- Starting from the Sogdiana Substation, the route goes in a westerly direction along the northern slope of Zerafshan Ridge, turning by Angle Points 2, 3, 4, and 5 and again at the boundaries of the Baikishlak, Khodjakuduk, and Zinap villages, where it maintains a minimum distance of 200 m from any houses. This section is 8.8 km long and consists of 4 hectares of uncultivated forest land.
- The route then goes to Angle Point 5, turns to the northwest, and up to the passage through the Karatepa Water Reservoir, which crosses irrigated land for 2.2 km. This passage through the Karatepa Water Reservoir is to avoid the Karatepa village. The route from Angle Point 7 goes in a northerly direction along the eastern off spurs of the Karatepa Mountains on uncultivated land.
- Some 350 m after Angle Point 7, the route crosses the boundary of the Samarkand District. The total route length in the Samarkand District is 19.5 km, of which 2.2 km is irrigated land.
- From Angle Point 7 to Angle Point 14, the route passes Samarkand District along the northwestern and northern offspurs of the Karatepa Mountains, crossing small creeks, the largest of which are Ilonsai, Agalyksai, and Mirankulsai. Water in these creeks is present only in the spring. Villages are located along large gullies, which causes a turnout at distances of 0.5 to 1.0 km with a minimum distance of 100 m on both sides of the route. Land here is uncultivated and vegetation is poor; land is used as pasture in the spring. The total route length within the Samarkand District is 17.0 km.
- From Angle Point 14, the route goes along a pre-mountainous plane with small gullies starting from the northern slope of the Karatepa Mountains. By Angle Points 15, 16, and 17, the route turns toward the residences of the Tavanul, Ekrikul, and Sazagan villages at a minimum distance of 0.5 km. Land is uncultivated and is used as pasture in the spring.
- From Angle Point 17 to Angle Point 18, the route turns to the south, crosses the road to Samarkand-Karshi, two cable communication lines, and the Samarkand-Suvli 220kV transmission line. From Angle Point 18 the route goes in a westerly direction between the Mehnatkash and Kyzyl-Ravan villages at minimum distance of 400 m from any houses. From Angle Point 19 to Angle Point 20, the route turns right and again crosses the Samarkand-Karshi road and then turns to the southwest and passes uncultivated land with poor vegetation, making a turnout at distances of 1.5–2.0 km at the Sarykul, Andkirli, and Ibragim villages, and crossing the road and 10 kV line.
- By Angle Points 21 and 22, the route crosses the narrow and densely populated Djam

Creek Valley, where a village of the same name is located along the creek for 7 to 8 km. Water in Djam Creek is only present in the spring.

- From Angle Point 22 to the boundary with the Kashkadarya Region (Angle Point 23), the route goes in a southwesterly direction on uncultivated land; relief is smooth (adyrs).
- The total route length within the Nurabad District in the Samarkand Region is 60.5 km, where nearly 1 km is occupied by irrigated land and the rest of the land is uncultivated. Thus, within the Samarkand Region, the route length is 87.0 km; 4 km are on irrigated land and 83.0 km are on uncultivated land.
- The next route section passes the plane on the right bank of the Kashkadarya River with year round water, between Kattakishlak and Annaruz villages (3 km), where it crosses the 35 kV line, the road to Kokdala village, two 10 kV lines, and the road between the Kattakishlak and Annaruz villages and an aqueduct. Land is used for rain-fed crops, mainly wheat. The route then crosses the Chirakchi-Karshi road, the 110 kV Karshi-Chirakchi line, and a communication line.
- The route crosses the Kashkadaya River between the Katta-Kovchin and Dung-Kovchin villages, which are located on the left bank. After following the left bank for 8 km, the route goes over irrigated land—where cotton and cereal crops are cultivated—and 3 km of uncultivated land then crosses the Karasu River, which has water year round.
- After crossing the Karasu River, the route turns to the right and goes over pasture land, crossing a 35 kV transmission line, a main gas pipeline, and a 110 kV line, where it turns to the left and goes in a southerly direction for 2 km on irrigated lands and for 10 km on uncultivated land of the Agzikent highland and Kichik Djagilma Urochishche area crossing automobile road Tadjikishlak-Sherali, railway Karshi-Kitab, road Karshi-Guzar, and transmission line 220 kV Guzar-Karshi.
- Then the route turns to the left and goes along an irrigation canal (10 to 15 m wide) with year round water, making a turnout around the residences at a distance of 0.5 km. On this site, the route goes 3 km over uncultivated land, 4 km over irrigated land, 3 km over pasture, and crosses two local communication lines, two 10 kV transmission lines, and a water pipeline.
- The next section is 6.2 km long, crosses a pre-mountainous plane with uncultivated land that is used as pasture, and then crosses a water pipeline and a 10 kV transmission line.
- The 9.5-km route is parallel to the existing power transmission line 220 kV Karshi-Karshi Canal pumping station 3, crossing Karshi-Termez railway, Karshi-Talimarjan road, and several irrigation canals.
- The route then turns to the south and comes to a building of the Talimarjan TPP OSG 500 kV, crossing the existing Karakul-Guzar 500 kV line before the end pole. The Karshi Canal—which is approximately 20-m wide and provides year round water—several roads, and a110kV line. The end of the route is on irrigated land where cotton is cultivated.

There are a number of potentially signifcant stopover habitats in the region. The stopover habitat that the 500 kV transmission line route crosses is the Karatepa Water Reservoir. The transmission line also passes the Kattakurgan Water Reservoir at a distance of 30 to 35 km, the Chimkurgan Water Reservoir at a distance of 25 to 30 km, and the Talimarjan Water Reservoir at a distance of 10 to15 km.

The Karatepa Water Reservoir is very small. It is located in the northern foothills of the Karatepa Mountain range. There is no stable wintering habitat for waterfowl and during migration only a small number of waterfowl stop here.

Kattakurgan Water Reservoir is located 60 km to the west of Samarkand City. It is of significance for migrant birds (from 17.9 to 24.2 thousand during migration; Fundukchiev and Belyalova 2008) and wintering birds. Wintering conditions are not stable and depend on temperatures. Species observed in this reservoir with elevated protection status include Siberian Crane (*Grus leucigeranus*) and Ferruginous Duck (*Aythya nyroca*), and those with a URB (national) status include Pygmy Cormorant (*Phalacrocorax pygmaeus*), Spoonbill (*Platalea leucorodia*), Osprey (*Pandion haliaetus*), White-tailed Eagle (*Haliaeetus albicilla*), and Pin-tailed Sandgrouse (*Pterocles alchata*). Large flocks of migrating cranes, including Demoiselles, stop near the reservoir to rest. Wintering Greylag Goose (*Anser anser*) feed in adjacent fields.

Chimkurgan Water Reservoir is located in the Kashkadarya River basin 60 to70 km northeast of Karshi. It is important for wintering and migrating birds. In some years, more than 20,000 birds winter there. During the winter, elevated protection status species include Lesser White-fronted Goose (*Anser erythropus),* over flying Corn Crake (*Crex crex)*, and Ferruginous Duck (*Aythya nyroca).* Large flocks of migrating Common and Demoiselle cranes, which stop near the reservoir for resting, were also observed. Wintering geese make forage flights to the nearby fields.

Talimarjan Water Reservoir is located 45 km southwest of Karshi at the border of developed land and desert near the Turkmenistan border. It is located 10 km from the Talimarjan TPP. It is very important for wintering and migrating waterfowl (Lanovenko et al. 2007; Filatov 2008). Among the resident species, both the Lesser White-fronted Geese and White-tailed Eagles (wintering in small numbers) have elevated protection status. Geese (*Anser anser, A. albifrons, A. fabalis*) and Common Crane *(Grus grus*) use the nearby grain fields for feeding. During winter, they fly daily from the water reservoir to the fields. Over 50,000 waterbirds winter here annually.

In summary, the proposed route crosses an area with minimal relief except for the first 36 km where there are mountains and some exposed hard rocks. Principal aquatic habitats along the route include one water reservoir, two rivers, two canals, one main canal, and many small canals and collectors. The TOTL route is a mixture of uncultivated and cultivated land (rain-fed crops grown during the rainy season [March–April]).

3 Avian Risk Assessment for the Potential for Collisions and Electrocutions

3.1 General Approach

Given the potential complexity of this project and questions regarding the significance of the migratory bird issues, an ARA process was selected to characterize these risks. It is a process adapted from the U.S. Environmental Protection Agency's (USEPA) ecological risk assessment (ERA) methodology (USEPA 1998). The EPA defines an ERA as a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood or probability that one or more stressors (e.g., a power line) are causing or will cause adverse ecological effects. The ERA is a tool for considering available scientific information when selecting a course of action; it provides an evaluation of ecological risk that can be considered, in addition to other factors (e.g., social, legal, political, or economic), during project decision-making and management. This ERA methodology informs this analysis and provides an approach for identifying questions on primary, secondary, and tertiary effects that need to be answered.

Using this ERA methodology has several advantages. The methodology assures The World Bank, the Republic of Uzbekistan, and other stakeholders that all significant adverse avian interaction of the TOTL project will be identified. The methodology also allows for the identification of any significant data gaps.

Ecological risk assessment includes four phases (Figure 3).

- problem formulation
- analysis
- risk characterization
- risk management

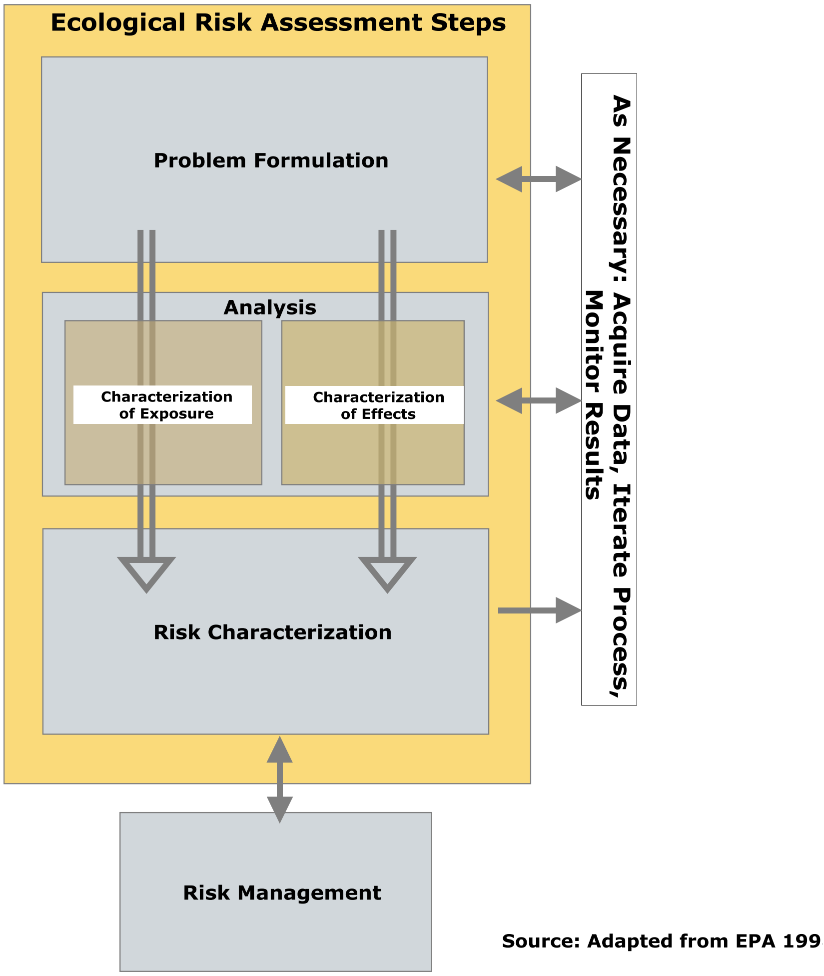

Figure 3. Generalized avian risk assessment process.[5]

3.2 Specific Avian Risk Assessment Steps

3.2.1 Problem Formulation

The problem formulation step involves identifying the critical questions regarding risk and provides an upfront opportunity for input from resource managers and other stakeholders in formulating study questions. Working hypotheses are developed on how and why stressors (e.g., earth-moving equipment associated with construction of the power line) might increase the likelihood of ecological effects (e.g., collision mortality, habitat loss, behavioral avoidance, etc.) to the different receptors (e.g., individual cranes, ducks, geese, etc.). From this information, assessment endpoints are developed. Assessment endpoints are attributes of these ecological receptors that are both considered important by society (e.g., IUCN Red Book designations) and

[5] Adapted from U.S. EPA. 1998. Guidelines for Ecological Risk Assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/R095/002F.

susceptible to the effects of power lines. These are measures for evaluating risks. The survivorship of a Red Book "vulnerable" species is an example of a societal value attributed to these receptors and can be designated as an assessment endpoint. Problem formulation also involves identifying the appropriate exposure and effects measurements and defining the spatial and temporal extent of the analysis (Figure 4).

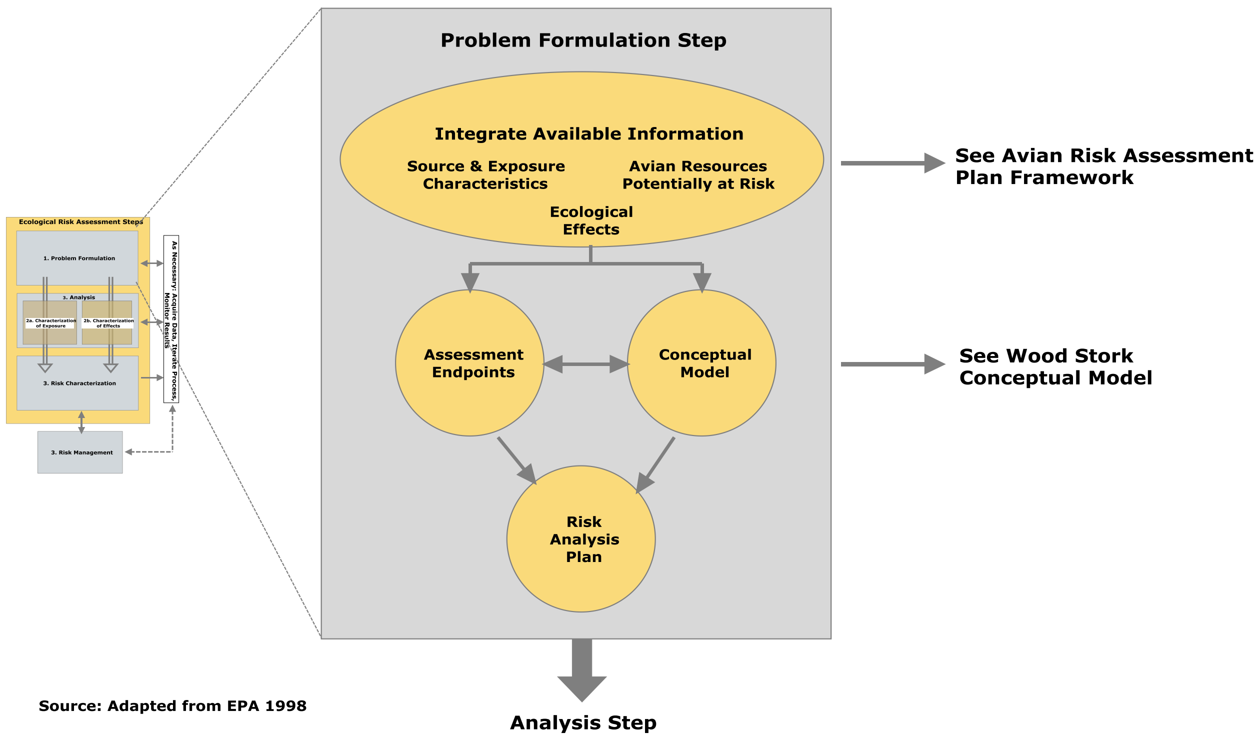

Figure 4. Problem formulation phase.

The goal of problem formulation is to construct a Conceptual Model that describes the problem and incorporates these working hypotheses into a process for evaluating the ecological relationships of bird interactions with the facilities within a power line ROW.

More specifically, problem formulation involves the following.

- Identifying data needs and sources and reviewing this information
- Selecting bird receptors and assessment endpoints
- Identifying the project stressors
- Developing a project-specific conceptual model of risks to birds
- Identifying project specific hypotheses
- Developing a risk assessment plan

The following information sources were reviewed for this project.

- Published literature on resident and migratory birds of Uzbekistan (see Section 4, Literature Cited and Reviewed)
- Observations and understanding of UIZ scientists

- General avian collision and electrocution information including APLIC (1994, 2005), Bevanger (1998), Janss (2001), and Jenkins et al. (2010)
- Uzbekenergo engineering design information
- World Bank Supplemental EIA
- World Bank Resettlement Plan

A review of the literature and discussions with knowledgeable scientists, including scientists from UIZ, has identified the main receptors potentially affected by electrocutions and collisions as the resident and migratory birds found in the vicinity of the proposed project route (see Section 2). As discussed in the previous section, a large number of bird species are potentially susceptible to injury and/or mortality from collision and electrocutions. This risk assessment has focused on those bird species that have elevated protected status internationally and in Uzbekistan. For risk assessment characterization purposes these species are grouped into several taxonomic categories: pelicans, storks, waterfowl, birds of prey or raptors, cranes, and bustards. The following is a list of the key species that have reported risk to electrocutions and collisions. These species are considered the receptors to the stressors causing collisions and/or electrocutions described below**.**

Pelicans
Dalmatian Pelican *(Pelecanus crispus)*
Great White Pelican (*Pelecanus onocrotalus*)

Waterfowl
White-fronted Goose *(Anser albifrons)*
Lesser White-fronted Goose *(Anser erythropus*)
Grey-lag Goose *(Anser anser)*
Ferruginous Duck *(Aythya nyroca)*

Storks
White Stork *(Ciconia ciconia)*

Cranes and Bustards
Common Crane *(Grus grus)*
Demoiselle Crane *(Anthropoides virgo)*
Houbara Bustard *(Chlamydotis undulate)*
Long-legged Buzzard (Buteo rufinus)

Birds of Prey
Griffon Vulture *(Gyps fulvus)*
Cinereous Vulture *(Aegypius monachus*)
Egyptian Vulture *(Neophron percnopterus)*
Griffon Vulture (Gyps fulvus)
White-tailed Eagle *(Haliaeetus albicilla)*
Pallas' Sea Eagle (*Haliaeetus leucoryphus*)
Osprey *(Pandion haliaetus)*
Golden eagle *(Aquila chrysaetus)*
Eastern Imperial Eagle *(Aquila heliaca*)
Spotted Eagle *(Aquila clanga)*
Steppe Eagle *(Aquila nipalensis)*
Booted Eagle (Aquilla pennata)
Short-toed Eagle *(Circaetus gallicus)*
Booted Eagle *(Aquilla pennata)*
Black Kite *(Milvus corshun)*
Marsh Harrier *(Circus aeruginosus)*
Hen Herrier *(Circus cyaneus)*
Montagu's Harrier *(Circus pygargus)*
Pallid Harrier *(Circus macrourus)*
Long-legged Buzzard *(Buteo rufinus)*
Common Buzzard *(Buteo buteo)*
Honey Buzzard *(Pernis apivorus)*
Sparrow Hawk *(Accipiter nisus)*
Kestrel *(Falco tinnunculus)*
Lesser Kestrel *(Falco naumanni)*
Hobby *(Falco subbuteo)*
Peregrine falcon *(Falco peregrinus)*
Merlin *(Falco columbarius)*
Saker Falcon *(Falco cherrug)*

The assessment endpoint is the survivorship of the species in light of the potential for collisions and electrocutions.

The primary stressor for this project is the proposed construction, maintenance, and operation of transmission lines placed in the ROW along the TOTL route, which may cause collisions and electrocutions. Specific engineering factors that characterize the stressors include the following.

- Tower design
- Conductor, overhead ground wire, and guy wire design
- ROW design, including configuration with the landscape

The specific stressors include the physical structure such as towers, phase conductors,[6] overhead ground wires,[7] and the juxtaposition of the energized equipment components.

For electrocutions, the most important stressor is the design condition (i.e., the separation between energized and/or grounded structures, conductors, hardware, and equipment that can be spanned by a bird to complete a circuit). Although electrocutions can occur on both distribution lines and transmission lines,[8] they are predominately associated with the energized equipment on the poles of distribution lines because these lines are built with smaller separation of energized equipment leading to the risk of electrocution (APLIC 2005).

For collisions, the most important stressor conditions relate to the visibility of the conductors and overhead ground wires. These include the size of the conductors, vertical separation between the phased conductors and the overhead ground wire, and the height of the phase conductors and overhead ground wire from the ground.

Figure 5 provides a simplified conceptual model of general avian interactions with a power line project. This conceptual model formed the basis for the project specific conceptual models used in this avian risk assessment.

[6] Conductors are material (usually steel and aluminum alloy and aluminum) in the form of a wire, cable or bus bar—suitable for carrying an electric current. A phase is the energized electrical conductor or conductor bundle.
[7] Overhead ground wire is wire that makes an electrical connection with the ground and is typically a smaller diameter than, and located above, the conductors.
[8] Distribution lines are systems with a circuit of low-voltage wires, energized at voltages less than 69 kV, and used to distribute electricity. Transmission lines are power lines designed and constructed to support voltages at 69 kV or above. Distribution lines are typically shorter, with conductors at lower elevations, than transmission lines.

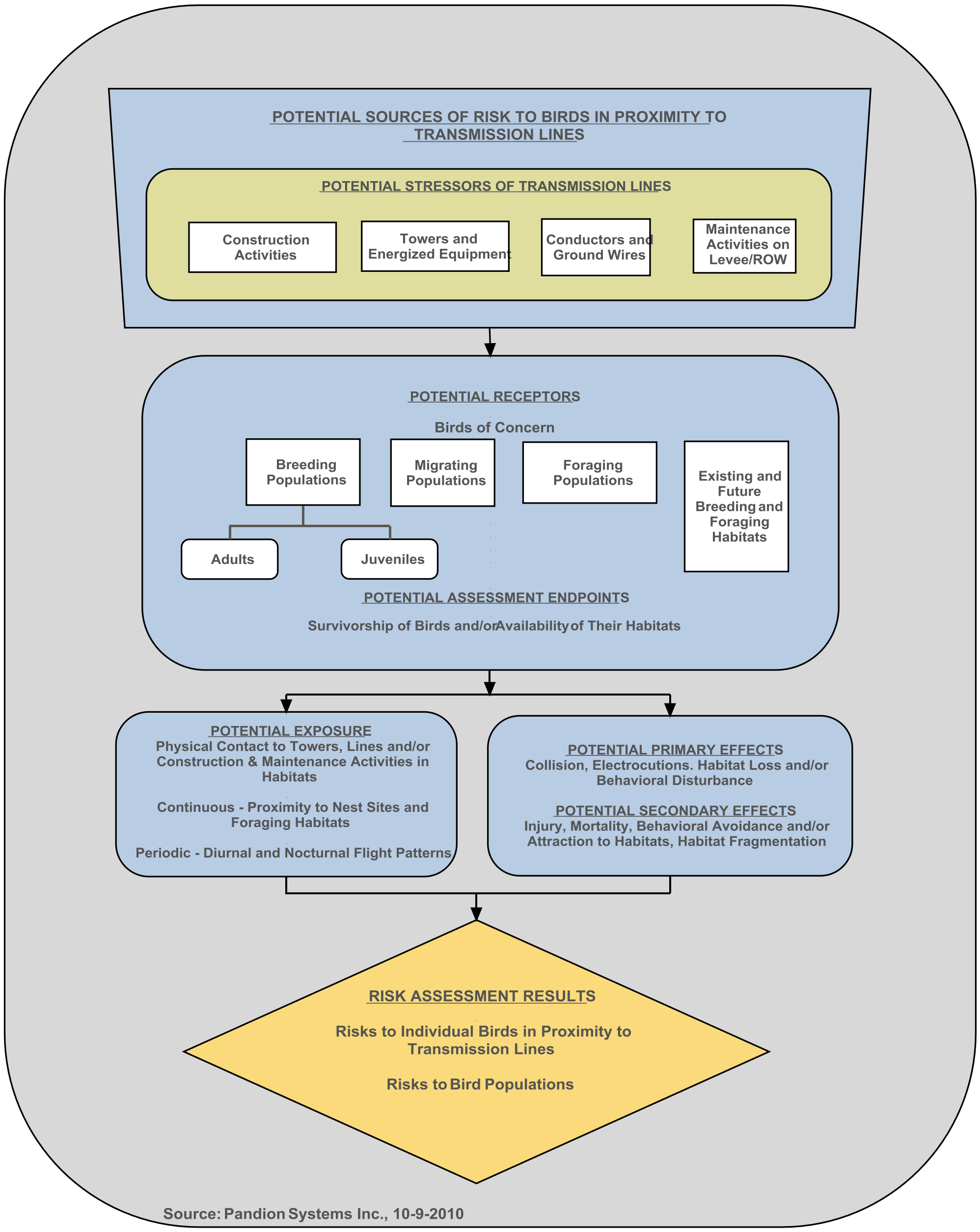

Figure 5. Simplified conceptual model of the potential interactions of birds with transmission lines.

As a part of problem formulation, risk hypotheses are developed to be tested. Risk hypotheses are specific statements or assumptions about the potential risk to assessment endpoints. They clarify and articulate relationships that are posited through the consideration of available data, information from scientific literature, and the best professional judgment of the risk assessors developing the conceptual models (EPA 1998). Based on the problem formulation analysis, two hypotheses are identified and will be tested.

- The proposed transmission lines will cause collision injury and mortality that will have population-level effects on the resident and migrating birds in the vicinity of the TOTL.
- The proposed transmission lines will cause electrocution mortality that will have population-level effects on the resident and migrating birds in the vicinity of the TOTL.

3.2.2 The Analysis Phase

The analysis phase is the phase that examines the two primary components of risk (exposure and effects) and their relationships between each other and ecosystem characteristics (Figure 6).

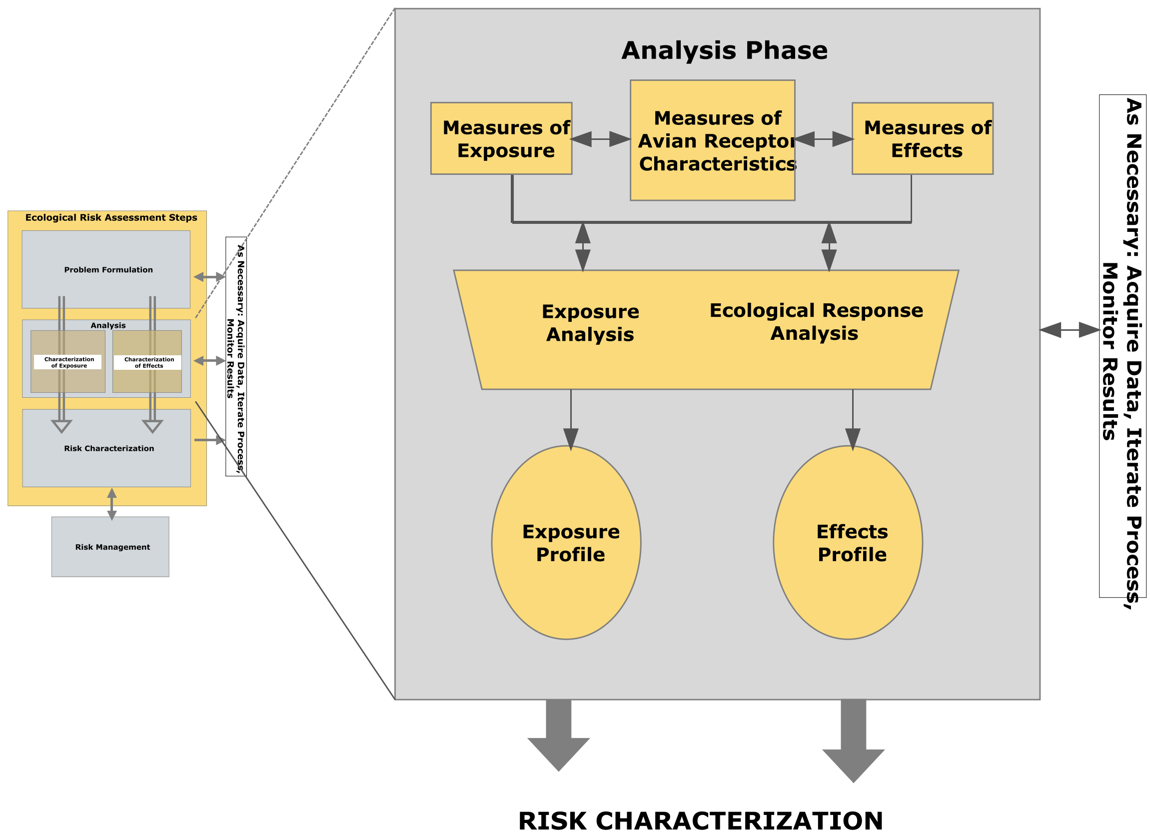

Figure 6. Diagram showing the analysis phase.

The objective of the analysis phase is to determine or predict the ecological responses to stressors under exposure conditions of interest. The analysis phase connects problem formulation with risk characterization. The assessment endpoints and conceptual models developed during the problem formulation phase provide the focus and structure for the analyses. Products of the analysis phase are summary profiles that describe exposure and the relationship between the stressor(s) and response. These profiles provide the basis for estimating and describing risks in risk characterization. The following occurs during the analysis phase (see Figure 6).

- Select the data to be used on the basis of their usefulness for evaluating the risk hypotheses.
- Analyze exposure by examining the sources of stressors, the distribution of stressors in the environment, and the extent of co-occurrence or contact.
- Analyze effects by examining stressor-response relationships, the evidence for causality, and the relationship between measures of effect and assessment endpoints (EPA 1998)

Exposure Analysis and Characterization

Exposure characterization describes potential or actual contact or co-occurrence of stressors (e.g., construction of access road) with receptors (e.g., nesting habitat). Exposure characterization is based on measures of exposure and the receptor characteristics that are used to analyze stressor sources, their distribution in the environment, and the extent and pattern of contact or co-occurrence. The objective of exposure characterization is to provide an exposure profile that identifies the receptor (i.e., the exposed ecological entity), describes the exposure pathway a stressor takes from the source to the receptor, and describes the intensity and spatial and temporal extent of co-occurrence or contact.

In evaluating this project, six exposure conditions are considered when estimating exposure including the following.

1. Number exposed (abundance per unit time or space exposed to stressor)
2. Intensity of exposure (amount or level of stressor)
3. Temporal exposure (duration, frequency, and timing of stressor)
4. Spatial exposure (proximity to stressor)
5. Behavioral exposure (avoidance, attraction, or acclimation of receptor to stressor)
6. Exposure is best expressed over some unit of time (day, month, season, and year)

The final product of exposure analysis is an exposure profile that identifies and describes the receptor and the exposure pathways along with the intensity and spatial and temporal extent of co-occurrence or contact. Depending on the risk assessment, the profile may be a written document or a module of a larger process model. It also describes the impact of variability and uncertainty on exposure estimates and reaches a conclusion about the likelihood that exposure will occur (EPA 1998). Questions that should be addressed by the exposure profile include the following.

- How does exposure occur?
- What is exposed?
- How much exposure occurs? When and where does it occur?
- How does exposure vary?
- How uncertain are the exposure estimates?
- What is the likelihood that exposure will occur?

Ecological Response Effects Analysis and Characterization

Effects characterization is the determination of the consequences of the exposure-response relationship to the receptors. An effects profile is developed that answers the following questions.

- What ecological entities are affected?
- What is the nature of the effect(s)?
- What is the intensity of the effect(s)?
- Where appropriate, what is the time scale for recovery?
- What causal information links the stressor with any observed effects?
- How do changes in measures of effects relate to changes in assessment endpoints?
- What is the uncertainty associated with the analysis?

Based on issues identified previously and a review of literature, the following are the primary and secondary ecological effects associated with transmission line projects.

Primary Effects

- Injury and/or death of birds from collisions with power conductors, overhead ground wires, and towers
- Injury and/or death of birds from electrocution from contact with energized equipment

Potential Secondary and Tertiary Effects

- Local, regional, or range-wide decline in the population because of mortality and changes in reproductive output
- Change in the use of the roosting and nesting habitats (e.g., stopover sites) because of altered flight patterns or loss of these habitats due to establishment of the lines
- Habitat fragmentation affecting species (population) distribution or occurrence because of construction and operation.

Effects profiles have been developed for potential specific primary and secondary effects of this project and are presented in the specific ecological risk assessments.

3.2.3 Risk Characterization Phase

Risk characterization is the final phase in the risk assessment framework. Risk (R) is defined as the likelihood of a hazardous event occurring. For example “there is a high likelihood or a 30% probability that some number of individuals of a species will collide with the lines during the life of the project.” It should be emphasized again that the risk values will have limited precision since exposure and effects vary due to different biological and environmental conditions, including regional conditions affecting a species. This risk assessment considers the weight of evidence from a variety of different types of sources. Although this risk assessment could over- or under-estimate the risk, this assessment evaluated the order of magnitude of error that might occur and the implications for the risk characterization. This is the integration of the exposure and the effects assessment results expressed as a statement of risk and results in an estimation and description of risk (Figure 7).

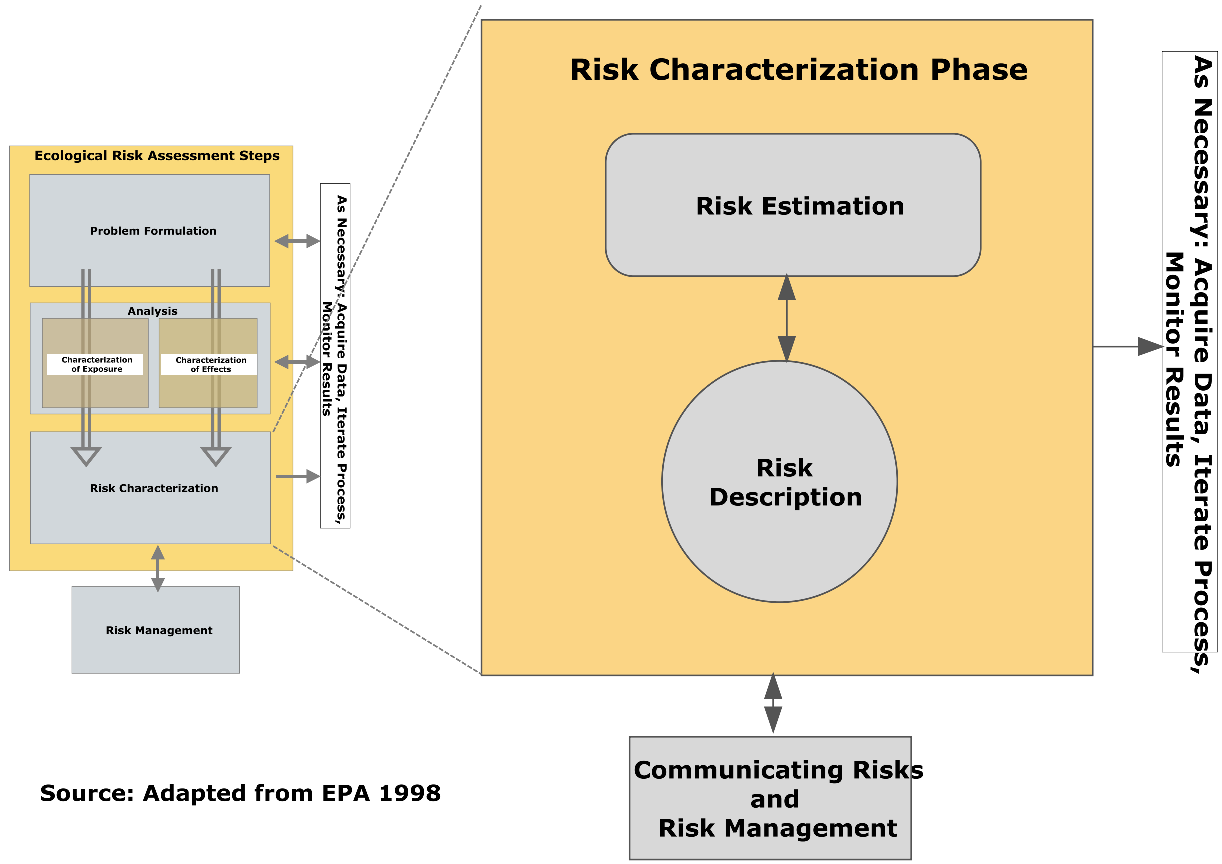

Figure 7. Risk characterization phase.

Qualitative and/or quantitative estimates of risk can be used in an ERA. These ERA estimates and associated methodologies have been used to characterize avian risk for different types of projects including pesticide use, land management, and wind energy projects. The qualitative or quantitative results are developed through written characterizations or though mathematical calculations of risks. Modeling may include a mathematical model, statistical model, or spatial model (e.g., GIS model). Depending upon the type of risk characterization required and data availability, one or more of these methodologies may be most appropriate. Sometimes a tiered risk assessment approach can be used starting with a qualitative assessment and proceeding to a quantitative risk assessment. For example, if more than one site is being compared for risks, a higher or lower risk ranking may be appropriate using a qualitative approach. If the level of uncertainty needs to be decreased or if a specific prediction of amount of mortality is required, a quantitative or modeled approach may be appropriate.[9]

[9] NWCC's Draft Ecological Risk Assessment White Paper, Revised March 2007
http://www.nationalwind.org/workgroups/wildlife/era.pdf

This assessment does use a qualitative risk analysis, or an estimate of number of birds anticipated to be affected, because at this time there is limited information on the exact location of the TOTL route relative to specific avian habitats and the lack of specific information on bird abundances and flight behavior of the species potentially affected. In addition, such a detailed evaluation is normally conducted on single species where site specific concerns have been identified and the actual ROW and transmission line design is known.

Non-numeric narrative descriptions of risks are used to characterize the risk to these species. This characterization can be used for management decision making. The resulting risk statement is descriptive and not mathematically quantifiable. It provides a qualitative comparative categorization of risk, such as lower risk, higher risk, etc. between two or more entitities subject to the same adverse effect. Implementing a qualitative (e.g., descriptive) methodology does not generally require conducting specific field studies before construction, but instead uses existing information on relevant life history of the species of interest, including flight behavior and habitat preferences, supplemented by site visits to confirm habitat conditions. (Such preconstruction field studies can be used in assisting in placement of the ROW in least risky locations.)

This approach uses existing information about the proposed site, its onsite ecological resources, literature on avian physiology and behavior of species of concern, and published reported effects (e.g., accounts of known mortality at existing power line projects). This approach is used as part of this ARA. It was chosen in part because of the qualitative nature of the assessment endpoints (e.g., survivorship of potentially susceptible resident and migratory birds and the availability of the data on these species in the TOTL project area).

The characterization of risk presents special challenges, especially when it is done qualitatively. The importance in avoiding subjective and unintended interpretation of assigned risk levels is very important. The naming of risk categories should include terminology that is acceptable to risk scientists and managers and not subject to media or political hyperbole. Although such terminology should be value-neutral, the various alternatives carry some level of social bias. Verbal descriptions of risks are likely to be taken literally; alphabetic scoring is subject to grading bias, numerical scoring may imply precision that does not exist (Newman and Zillioux 2009). Five categories of relative avian risk potential are used: Highest Potential, Higher Potential, Moderate Potential, Lower Potential, and Lowest Potential. These are defined by specific ecological criteria (Table 2).

In summary a qualitative approach was used to evaluate the risks from electrocutions and collisions. For electrocutions, emphasis is placed on a qualitative evaluation of the risk of exposure. For collisions, a qualitative approach was used to describe the likelihood of collisions along the proposed corridors.

Table 2. Relative Risk Levels for Potential Harm from the Proposed TOTL Project

Risk Level Categories	Relative Risk Level for Potential Harm
Highest Potential	Large scale, population level mortality, habitat destruction (or degradation) or behavioral disturbance Population decline Threat to species survival regionally
Higher Potential	Limited but locally to regionally important mortality, habitat destruction, or behavioral disturbance with limited population-level effects Local population decline possible
Moderate Potential	Limited and local mortality, habitat destruction and/or behavioral disturbance No population effects
Lower Potential	Limited or no mortality, habitat destruction and behavioral disturbance with no population level effects Exposure to species with minimal adverse effects
Lowest Potential	Mortality, habitat destruction and/or behavioral disturbance if any, limited to individuals, no empirical data to suggest adverse population effects Very limited or no exposure of species

Adapted from Newman and Zillioux (2009)

Conceptual Model for Collisions and Electrocutions

From this analysis, two conceptual models (Figures 8 and 9) were developed that describe the potential risk associated with collision and electrocution issues. The key components and the relationship to one another (e.g., receptors, stressors, effects, exposure, and risks and their relationship to one another) are depicted.

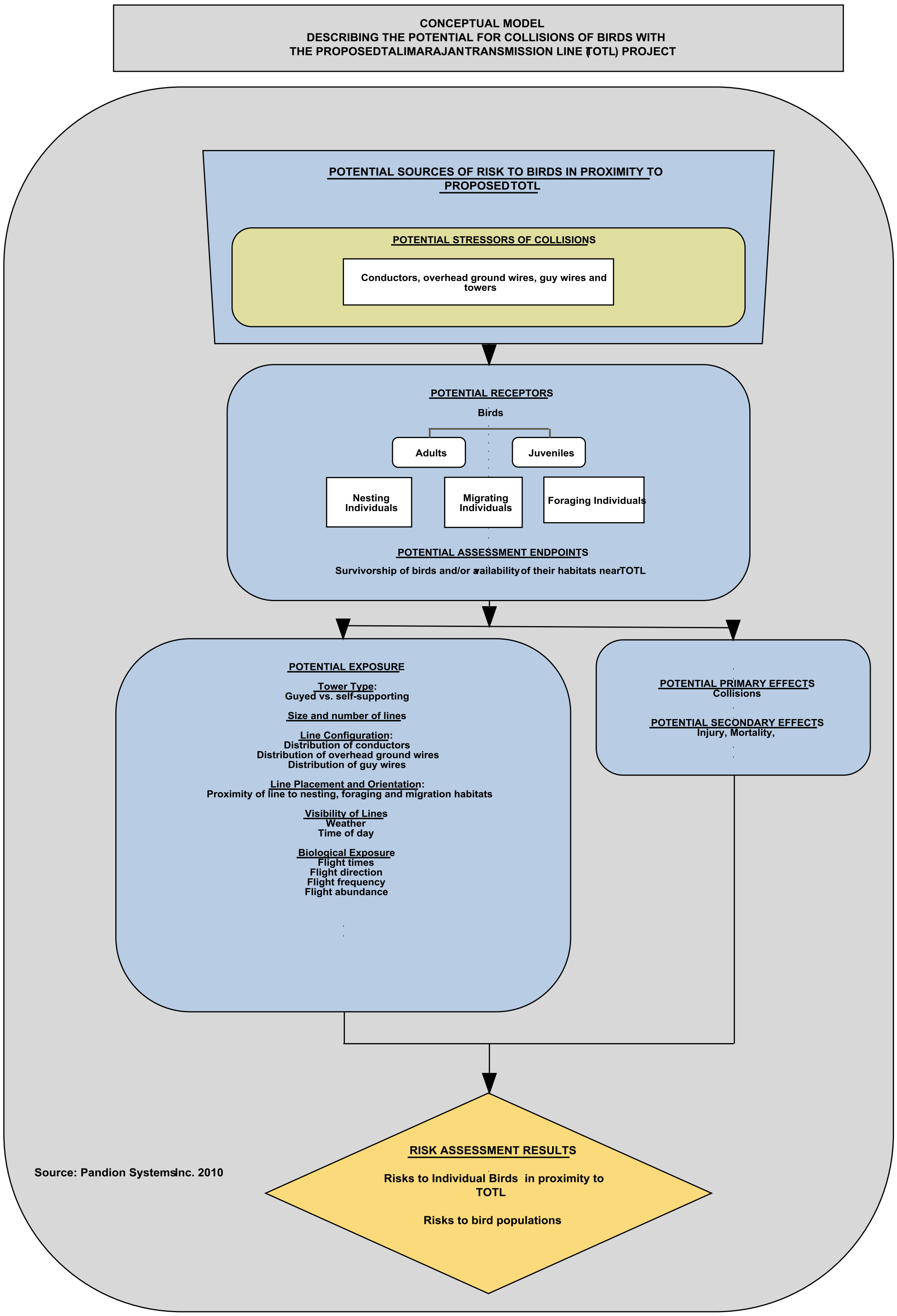

Figure 8. Avian collisions conceptual model.

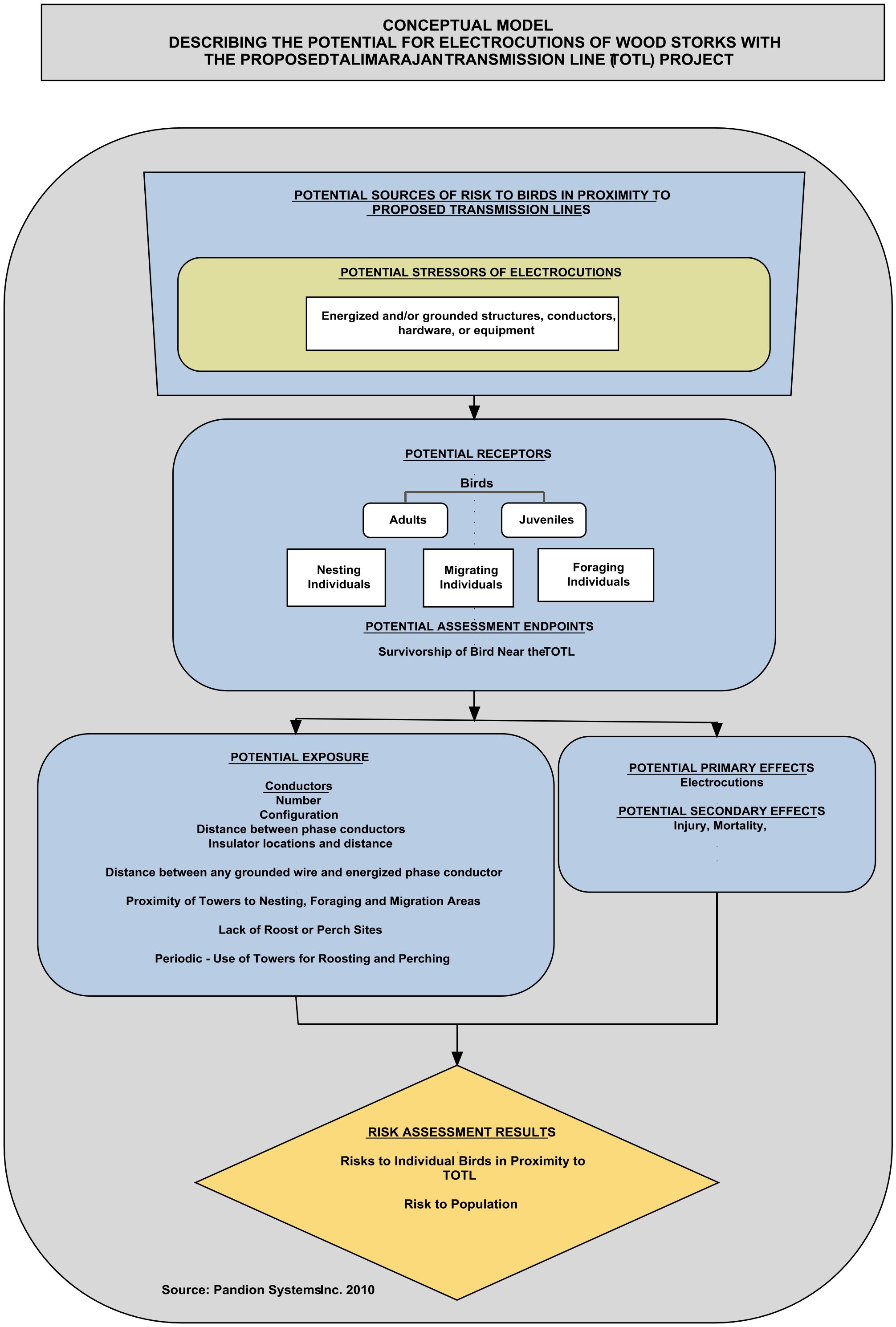

Figure 9. Avian electrocutions conceptual model.

3.3 Exposure Analysis Characterization

Five conditions need to be considered when estimating exposure.

- Number exposed (abundance per unit time or space exposed to stressor)
- Intensity of exposure (amount or level of stressor)
- Spatial exposure (proximity of receptor to stressor)
- Temporal exposure (duration, frequency, and timing of stressor)
- Behavioral exposure (avoidance, attraction, or acclimation of receptor to stressor)

All of these conditions apply to collision and electrocution risks. In addition there are other variables such as weather that can increase or decrease exposure. The following is a description of general exposure characteristics for collisions and electrocutions followed by an Exposure Profile.

Exposure Conditions

Number Exposed

Table 3 provides estimates of the global size of the populations of birds considered susceptible to collisions and/or electrocutions and where available estimates of the size of these populations in Uzbekistanbased on IUCN designations. Most species have global populations[10] that are in the thousands (e.g., Cinerous Vulture *[Aegypius monachus]* and the Dalmatian Pelican *[Pelecanus crispus]*) to hundreds of thousands (e.g., Demoiselle Crane *[Anthropoides virgo]* and Ospery *[Pandion haliaetus]*). In Uzbekistan these migrating populations are much smaller, often less than 100 individuals. No specific information is available on the number of each species occurring in the TOTL project area during migration but these numbers are expected to be very small because of the broad front migration and because the TOTL project area is a subset of the larger broad front migration.

Table 3. Estimates of Global and Uzbekistani Population Sizes for Birds Potentially Susceptible to Power Line Interactions

Species Name (*Scientific Name*)*	Estimated Size of the Global Population	Estimated Size of Uzbekistani Population**
Cinereous (Black) Vulture ***(Aegypius monachus)***	1) 14,000–20,000 individuals worldwide 2) 7,200–10,000 pairs worldwide / 1,700–1,900 pairs in Europe and 5,500–8,000 pairs in Asia	“In 1980s about 80 breeding pairs were recorded, as well as 75–80 individuals. At present, numbers decrease gradually.”
Saker Falcon ***(Falco cherrug)***	1) 35,000 to 40,000 pairs worldwide (1994) 2) 19,200–34,000 individuals	“From 1990s the numbers of some local populations have been declining. Totally, about 120–150 pairs are breeding in Uzbekistan; 500–700

[10] Global population is the total number of individuals of a taxon or species. This term is used in a specific sense in the IUCN Red List Criteria (IUCN 2001), Population is different from its common biological usage. *Population* is defined as the total number of individuals of the taxon. Within the context of a regional assessment, it may be advisable to use the term *global population* for this.

Species Name (*Scientific Name*)*	Estimated Size of the Global Population	Estimated Size of Uzbekistani Population**
	worldwide; Kazakhstan (2,000–5,000 pairs)	individuals are migrating; 100–150 individuals are wintering in southern regions."
Lesser White-fronted Goose ***(Anser erythropus)***	1) 100,000 individuals (late 1980s), drastic declines during 20th century. 2) 20,000–25,000 individuals worldwide	"At present, from 200 to 2,000 individuals during migration and wintering are recorded."
Eastern Imperial Eagle *(Aquila heliaca)*	1) 2,000 pairs (1994) 2) 5,200–16,800 individuals worldwide; The majority of the world population breeds in Russia (total 900–1000 pairs) and Kazakhstan (750–800 pairs)	"The numbers were always low. Single birds and small groups up to 15 individuals are recorded during migration."
Pallas's Sea (Fish) Eagle ***(Haliaeetus leucoryphus)***	1) 2,500–9,999 individuals worldwide	"Single, mostly migrating and wintering individuals, are recorded."
Dalmatian Pelican ***(Pelecanus crispus)***	1) 1926–2710 pairs (1991) declining during 20th Century 2) 10,000–13,900 individuals worldwide; a majority breed in the countries of the former Soviet Union (2,700–3,500 pairs)	"Recorded are about 250 breeding pairs, from several dozen to several hundred wintering individuals, and up to 1,000 migrating birds."
Ferruginous Duck *(Aythya nyroca)*	1) 57,000–70,000 (1980–1991) 2) 160,000–257,000 individual worldwide	"From 3.000 to 4.000 breeding pairs are recorded and as many as 7,000 wintering individuals."
Houbara Bustard *(Chlamydotis undulate)*	1) Kazakhstan 40,000–60,000 individuals and substantial numbers also in Uzbekistan 2) 49,000–62,000; individuals worldwide; in the mid-1990s population of *C. u.macqueenii* estimated to be in the range 39,000–52,000, with over 75% were in Kazakhstan and 15% in Uzbekistan	No Information available
Demoiselle Crane ***(Anthropoides virgo)***	1) 200,000–240,000 individuals worldwide 2) 230,000–280,000 individuals worldwide	No Information available
Common (Eurasian) Crane *(Grus grus)*	1) 9,000–11,000 individuals worldwide 2) 360,000–370,000 individuals worldwide	No Information available
White Stork ***(Ciconia ciconia)*** Near Threatened 3(NT), inhabits oases, irrigated fields, marshes and banks of rivers.	1) 150,000 breeding pairs (mid 1980s) 2) 500,000 - 520,000 individuals	"There are about 1500 breeding pairs (95% in the Ferghana valley), several hundred wintering individuals."

Species Name (*Scientific Name*)*	**Estimated Size of the Global Population**	**Estimated Size of Uzbekistani Population****
Limiting factors: destruction of habitats as a result of the changes of water regime of plain rivers and drying up of the marshes.		
Osprey *(Pandion haliaetus)*	1) 500,000 individuals worldwide	"The numbers were always low. On the migration single birds and small groups are noted."
Steppe Eagle *(Aquila nipalensis)*	1) 40,000–60,000 2) 10,000 individuals worldwide	"Sometimes about one hundred eagles migrate through some desert points per day. Several dozen roaming birds are recorded; single individuals winter irregularly in southern regions."
Golden Eagle *(Aquila chrysaetus)*	1) European population estimated at 4,500–5,000 pairs (late 1980s) in United States population estimated at 70,000 individuals (in 1980s) 2) 170,000 individuals worldwide	"The numbers were always low. In 1970–80s, 80–100 breeding pairs were recorded."
White-tailed Sea-Eagle *(Haliaeetus albicilla)*	1) 9,000–11,000 pairs (2008) 2) 20,000–39,600 individuals worldwide; 2004 European population at 5,000–6,600 breeding pairs	"On the migration, sole individuals, pairs, families and groups of birds are recorded. Nesting is single and irregular. About 300–400 birds overwinter."
Merlin *(Falco columbarius)*	1) ". . . in 1980s as few as 10,000s of pairs in Eurasia." 2) 1,300,000 individuals worldwide	No Information available
Common Kestrel *(Falco tinnunculus)*	1), 1,000,000–2,000,000 pairs 2) 5,000,000 individuals worldwide	No Information available
Eurasian Sparrowhawk *(Accipiter nisus)*	**1) 1,500,000 individuals worldwide**	**No Information available**
Montagu's Harrier *(Circus pygargus)*	1) 7,000 pairs in western Europe 2) 100,000 individuals worldwide	No Information available

Species Name (*Scientific Name*)*	**Estimated Size of the Global Population**	**Estimated Size of Uzbekistani Population****
Pallid Harrier *(Circus macrourus)*	1) ≤ 20,000 pairs in early 1990s 2) 18,000–30,000 individuals worldwide; large decline in Europe during 1970–1990, up to 30% of birds were lost (particularly from the key population in European Russia), the species continued to decline. It appears that the species has been extirpated from Moldova and Belarus	"Now numbers are low everywhere. Several hundred individuals are recorded during migration."
Great White Pelican (*Pelecanus onocrotalus*)	1) 7,350–10,500 pairs 2) 270,000 - 290,000 individuals	"There are 500–700 breeding pairs, several hundred wintering individuals and migrating flocks up to several thousand birds."
Egyptian Vulture *(Neophron percnopterus)*	Global population estimates for the species are crude, but combining figures of 2,600-3,100 pairs in Europe, <2,000 pairs in central Asia, just a few thousand pairs now in the Indian Subcontinent, perhaps 1,000 pairs in the Middle East, and perhaps <7,500 pairs in Africa, gives a total of 30,000-40,000 mature individuals.	No Information available
(Eurasian) Griffon Vulture *(Gyps fulvus)*	The population size is very large, 100,000 Mature individuals	"In 1980s, about 140 breeding pairs were recorded; the total numbers with young birds reaches several hundred individuals. At present, the numbers gradually decrease."
Booted Eagle (*Aquilla pennata*)	10,000 - 100,000 Mature individuals	"At present, the numbers sharply decreased."
Imperial Eagle *(Aquilla heliacal*)	5,200 - 16,800 Mature individuals	No Information available
Short-toed Eagle (*Circaetus gallicus*)	51,000 - 156,000 Mature individuals	"In 1970-80s, about 20 breeding pairs and about 50 single individuals were recorded in breeding season; the total number appeared to reach 30-40 breeding pairs. At present, the numbers sharply dropped."
Long-legged Buzzard (*Buteo rufinus*)	100,000 Mature individuals	No Information available

*Species in bold type are considered more important from a numbers, population trend and from a vulnerability behavior point of view. The others are of somewhat lessor priority.
**Based Red Book of Uzbekistan.

When compared with the global population estimates, the Uzbekistani population estimates (see Table 3 and compare Global estimates versus Uzbekistani estimates) are extremely small with relatively few individuals of these species passing through Uzbekistan and even fewer numbers passing over the TOTL route. *Therefore the likelihood of exposure of consequence to the regional population along the TOTL route will be very low for these registered species*.

Intensity of Exposure

Electrocution on a power line can occur when a bird simultaneously contacts two energized parts or an energized part and a grounded part. These events can cause outages and affect electrical reliability. The risk for electrocutions increases when the separation between the energized parts or an energized part and a grounded part of a power line is small enough to allow a bird to simultaneously contact its wings, feet, and/or head with those parts of a power line. This can occur when birds use power line poles or towers as hunting, resting, or roosting perches, and/or for nesting.

Because the separation of energized and/or grounded structures, hardware, or equipment is small on distribution poles, most electrocutions occur on lower voltage distribution poles rather than the higher voltage transmission line towers planned for this project (APLIC 2005).

The intensity of exposure for electrocutions is a function of the number of towers birds could potentially be exposed to from perching or roosting. For the 500-kV lines, towers will be spaced 100 to 1000 m apart and will result in approximately 550 to 620 towers along the TOTL route.

Although not a common event, large raptors, vultures, and herons can expel long streams of excrement on leaving a perch or nest site on a transmission tower. These "streamers" can cause flashovers and short-outs when they span energized conductors and other line structures. Flashovers are faults that originate on live hardware and travel through the streamer to the structure. Streamer-related faults are not normally lethal to birds, as streamers are often released as a bird departs from a structure. However, in some cases flashover mortalities do occur (APLIC 2006).

For collisions, the intensity of exposure is a also function of the number of towers and number of phase conductors and overhead ground wires, their size, vertical separation, orientation to the conductors and the length of the line. For the TOTL project there will be two overhead ground wires, an Optical Ground Wire (OPGW) and steel made ground wire. The 500 kV line is designed as a single circuit with three bundle conductors in each phase. The visible diameter of each phase subconductor will be approximately 28 mm to 29.2 mm. The total length of the transmission line will be 218 km.

Spatial Exposure

For electrocutions, the key spatial exposure condition is the physical separation between conductive components since exposure to electrocution is dependent on the distance between energized and grounded equipment and the physical dimensions of birds. Table 4 provides the wing span of the species evaluated in this risk assessment.

Table 4. Wing Span Length for Representative Species Potentially Associated with the TOTL Project

SPECIES NAME (*Scientific Name*)	Wing Span (cm)
Cinereous (Black) Vulture (*Aegypius monachus*)	250–295
Saker Falcon (*Falco cherrug*)	102–129
Lesser White-fronted Goose (*Anser erythropus*)	120–135

SPECIES NAME (*Scientific Name*)	**Wing Span (cm)**
Eastern Imperial Eagle (*Aquila heliaca*)	180–215
Pallas's Sea (Fish) Eagle *(Haliaeetus leucoryphus*)	180–205
Dalmatian Pelican (*Pelecanus crispus*)	310–345
(Europian) White Stork *(Ciconia ciconia)*	150-155
Ferruginous Duck *(Ayta nyroca)*	60-70
Houbara Bustard *(Chlamydotis undulate*)	140–160
Demoiselle Crane *(Anthropoides virgo)*	150–170
Common (Eurasian) Crane (*Grus grus)*	180–200
Osprey *(Pandion haliaetus)*	145–170
Steppe Eagle *(Aquila nipalensis)*	160–200
Golden Eagle *(Aquila chrysaetus)*	190–227
White-tailed Sea-Eagles *(Haliaeetus albicilla)*	200–245
Merlin *(Falco columbarius)*	50–67
Common Kestrel *(Falco tinnunculus)*	65–82
Eurasian Sparrowhawk *(Accipiter nisus)*	60–75
Montagu's Harrier *(Circus pygargus)*	97–115
Pallid Harrier *(Circus macrourus)*	95–120
Western Marsh Harrier *(Circus aeruginosus)*	110–130
Black Kite *(Milvus corshun migrans)*	135–155
Egyptian Vulture *(Neophron percnopterus)*	155–170
(Eurasian) Griffon Vulture *(Gyps fulvus)*	240–280
Golden Eagle *(Aquila chrysaetus)*	180–234
White-tailed Sea-Eagles *(Haliaeetus albicilla)*	182–244
Merlin *(Falco columbarius)*	61–69
Common Kestrel *(Falco tinnunculus)*	60–65
Eurasian Sparrowhawk *(Accipiter nisus)*	60–80
Montagu's Harrier *(Circus pygargus)*	97–115

Table 4 shows that the wing span for these species is considerably smaller than the proposed minimum clearance (4.5 m) between energized and non-energized components of TOTL towers. Therefore, the spatial electrocution exposure for birds of prey, ducks and geese, cranes, bustards, and storks to the energized and non-energized parts will be at or near zero.

For collisions, the key spatial exposure conditions are the tower height, span length, separation of the phase conductors and overhead ground wires, and height of conductors above ground level that birds would be exposed to while flying. The average span is 300 to 350 m and could range between 100 and 1,000 m. The final design is not complete. At this time the number of towers along the TOTL route may range from 550 to 620 towers. The proposed 500-kV transmission line will be constructed typically using 17 to 36 m tall, single-circuit, lattice poles directly embedded into the ground. The 500 kV line is designed as a single circuit with three bundle conductors in each of the three phases, placed in a horizontal (plane) configuration. The visible diameter of each phase subconductor will be approximately 28 to 29.2 mm separated horizontally and not in a vertical or triangular form (see Figures 10 and 11).

Figure 10. Example of a TOTL structure.

Figure 11. Example of a TOTL structure.

The overhead ground wire will be approximately 2.5 m above the upper phase conductor. The range in heights that birds would be exposed to (i.e., conductor/overhead ground wire height zone) for the line is 9 m (estimated lowest sag height) to 29+ m (tallest height of the overhead ground wire attached to the poles).

For collisions, another spatial exposure condition is the distance of the lines from the high use bird habitats such as stopover sites. Those birds initiating flights from roosting or feeding and very close to the transmission line will have less time to avoid the lines. The reservoirs are not along the TOTL route but are close enough that the birds using these stopover sites may fly over the transmission line. The distance from other major stopover sites are not known at this time but will be determined during preconstruction surveys.

Cranes and waterfowl use the Kattakurgan, Chimkurgan, and Talimarjan water reservoirs as stopover sites during migration. There is also a small winter population of Common Crane near Talimarjan Water Reservoir. Common Cranes also winter in the adjacent areas in Turkmenistan and to the northwest of the Talimarjan Water Reservoir in the area of the artificial lake. Reconnaissance examination of the TOTL route and interviews with the local population revealed that many cranes (numbers not given) occur in two locations during spring: around 12 km to the northwest of the Sogdiana Substation and also 4 km to the north from the Chimkurgan Water Reservoir. During fall migration a smaller number (compared to the spring) of cranes cross the Karatepa Mountains going south.

Table 5 provides a generalized spatial exposure analysis of selected species and their habitat associations and potential occurrence along the proposed TOTL.

Table 5. Generalized Spatial Exposure Analysis of Selected Species and their Habitat Associations and Potential Occurrence along the Proposed TOTL

Species Name (*Scientific Name*)	Habitat Preference	Transmission Route Sections with Possibility for Potential Habitat (? = uncertain association)
Cinereous (Black) Vulture (*Aegypius monachus*)	Forested hill and mountain areas, scrub, and arid to semi-arid alpine meadows and grassland. Forages over forested areas, steppe, and open grasslands	2, 4, 5, 6, 8, 9, 14
Saker Falcon (*Falco cherrug*)	Steppe (sometimes wooded), open grassland, rocky areas, plains, and foothills to mountains and high plateaus. Wider range of habitats outside the breeding season (open marshes, lakes); foraging can be some distance from nest area	2, 4, 5, 6, 8, 14
Lesser White-fronted Goose (*Anser erythropus*)	Winters mostly on dry ground; steppe and agricultural land. More terrestrial than typical goose	3?, 4, 5, 8(?), 9, 10, 11, 12, 13
Eastern Imperial Eagle (*Aquila heliaca*)	Nests in isolated large trees in plains or large forests in mountains. Forages in open, often cultivated, areas	2, 3, 4, 5, 10, 11, 12, 14
Pallas's Sea (Fish) Eagle (*Haliaeetus leucoryphus*)	Rivers and lakes, freshwater wetlands, and pools, often in arid areas or steppe	11, 16
Dalmatian Pelican (*Pelecanus crispus*)	Rivers, lakes, deltas, and estuaries. Will breed in small colonies and use traditional nesting areas (on islands or dense aquatic	11(?), 16

Species Name (*Scientific Name*)	Habitat Preference	Transmission Route Sections with Possibility for Potential Habitat (? = uncertain association)
	vegetation [e.g., *Phragmites* or *Typha*]). Winters in ice free lakes	
White Stork *(Ciconia ciconia)*	Open areas, frequently wetlands, steppe, savannahs, cultivated areas near pools, marshes, slow moving streams, ditches. Use trees and sometimes buildings, or power poles for nesting and roosting	3, 7, 9, 10, 11, 12, 13, 15, 16
Ferruginous Duck *(Ayta nyroca)*	Nests in shallow pools and marshes lined with aquatic vegetation or a vegetated shoreline. Winters in large lakes, lagoons, and coastal marshes	11(?), 16
Houbara Bustard *(Chlamydotis undulate*)	Arid sandy to semi-desert with tussock grass, wormwood steppe, and sandy grasslands. Will visit marginal cultivated areas outside nesting season	2?, 4, 5, 6, 8, 9, 14
Demoiselle Crane *(Anthropoides virgo)*	Savanna, steppe, other grasslands often close to streams, shallow lakes and wetlands, semi-desert or true desert with water available. Adapting to agricultural fields. Roosts in shallow water or wetlands	3, 4(?), 5, 6, 8, 9, 10, 11, 12, 13, 14, 16
Common (Eurasian) Crane (*Grus grus)*	Winter foraging in agricultural land and pastures. Roosts in nearby wetlands and shallow water areas	3, 4 (?), 8, 9, 10, 11, 12, 13, 14, 16
Osprey *(Pandion haliaetus)*	Shallow water (fresh, marine, or brackish) nests in dead or live trees, artificial structure near water. Will become accustom to human activity. Feeds in open water wherever fish are available	11, 15, 16
Steppe Eagle *(Aquila nipalensis)*	Steppe, semi-desert. Nests in lowlands, low hills. May nest on the ground, in bushes, low trees, or artificial structures	2, 4, 5, 6, 8, 14
Golden Eagle *(Aquila chrysaetus)*	Open deserted terrain (e.g., mountains, plateaus, and steppe); may use marshes. Prefers low or sparsely vegetated to wooded areas; nests in rocky faces, or large trees	2, 4, 5, 6, 8, 9, 14
White-tailed Sea-Eagles *(Haliaeetus albicilla)*	Diverse aquatic habitats, both fresh and marine; lakes, large rivers, and large marshes. Nests and roosts on sea cliffs or trees, rarely far from coast or large stretches of water; normally in lowlands	11, 16
Merlin *(Falco columbarius)*	Boreal forests, tundra to parklands, shrub-steppe, open prairie, and steppe; general preference for areas with trees or shrubs	2, 5, 8, 11, 14(?)

Species Name (*Scientific Name*)	**Habitat Preference**	**Transmission Route Sections with Possibility for Potential Habitat (? = uncertain association)**
Common Kestrel *(Falco tinnunculus)*	Variety of open to moderately wooded terrains with herbaceous vegetation or low shrubs in grassland, steppe, or sub-desert, cultivated lands, edges of developed areas. Perches or roosts in trees, on telephone poles, buildings, or rocky faces	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16
Eurasian Sparrowhawk *(Accipiter nisus)*	Forests (coniferous, deciduous, and mixed) open woodland. May winter in an area with very few trees	1, 2, 8, 14
Montagu's Harrier *(Circus pygargus)*	Open area with grass or shrubs; generally flat or rolling, less often in steppe terrain. Will use natural or disturbed areas (grasslands, meadows, fields, marshes, bogs, and young coniferous plantations). Nests on the ground, may roost communally	2, 3, 4, 5(?), 7, 8, 9, 10, 11, 12, 13, 14
Pallid Harrier *(Circus macrourus)*	Natural grasslands and dry steppe in flat or undulating terrain or on slopes, valleys with steppe vegetation, and semi-desert. In winter will also use un-irrigated wheat fields, open woodlands; infrequently uses marshes. Roosts colonially during migration and wintering; nests on the ground	2, 4, 5, 7, 8, 9, 14
Western Marsh Harrier *(Circus aeruginosus)*	Expansive areas of dense marsh vegetation in aquatic habitats (fresh and brackish) in lakes, reservoirs, rivers. Sometime open areas near wetlands. During migration and wintering can occur in alternate habitats (open forests); will roost communally	7, 8(?), 11(?), 12(?), 15, 16
Black Kite *(Milvus corshun migrans)*	Ubiquitous in semi-arid deserts to grasslands, savannas and woodlands; avoids dense forests. Nests in wooded area, rivers, lakes, wetlands, will use urban areas	1, 2, 4, 5, 7, 8, 9, 12, 13, 14
Egyptian Vulture *(Neophron percnopterus)*	Extensive open area mainly dry or arid regions; steppe, deserts, scrub, pastures, grain fields. Requires rocky sites for nesting	4, 5(?), 6, 10, 12
(Eurasian) Griffon Vulture *(Gyps fulvus)*	Expansive open areas; steppe, semi-desert with abrupt rocky areas, crags, and canyons for nesting and roosting; depends on live stock as food source	4, 5, 6, 8, 14

Temporal Exposure

In general, temporal exposure for electrocutions and collisions will be a function of the amount of time that the birds will interact with the line. For resident birds this exposure will be for the life of that particular species. For migrating birds, short-term temporal exposure will exist. Based on studies during spring (end of February to the middle of May) and fall migration (end of August–middle of November) in Uzbekistan, spring migration has the greatest abundance of birds and therefore the greatest exposure. During these migration periods there will be daily exposure as birds search for and use perching, roosting, and foraging habitats in the vicinity of TOTL.

Behavioral Exposure

Biological factors affecting the electrocution exposure of birds to power line poles and towers include bird size, habitat use, and perching and roosting behavior. Table 6 provides a list of species that are known to perch, roost, or nest on power line poles and towers. Birds of prey are the primary species known to use power line poles and towers.

Table 6. List of Species Potentially Susceptible to Electrocutions because of the Behavior to Perch, Roost, and/or Nest on Power Lines Poles or Towers

Species	Potential for Perching, Roosting or Nesting on Power Lines Poles and Towers
Pelicans	
Dalmatian Pelican *(Pelecanus crispus)*	No
White Stork (*Ciconia ciconia*)	Yes
Waterfowl	
White-fronted Goose *(Anser albifrons)*	No
Lesser White-fronted Goose *(Anser erythropus*)	No
Grey-lag Goose *(Anser anser)*	No
Ferruginous Duck *(Aythya nyroca)*	No
Birds of Prey	
Griffon Vulture *(Gyps fulvus)*	Rarely
Cinereous Vulture *(Aegypius monachus*)	Rarely if ever
Egyptian Vulture *(Neophron percnopterus)*	Yes
White-tailed Eagle *(Haliaeetus albicilla)*	Yes
Pallas' Sea Eagle *(Haliaeetus leucoryphus*)	Rarely
Osprey *(Pandion haliaetus)*	Yes
Golden eagle *(Aquila chrysaetus)*	Yes
Eastern Imperial Eagle *(Aquila heliaca*)	Yes
Spotted Eagle *(Aquila clanga)*	Yes
Steppe Eagle *(Aquila nipalensis)*	Yes
Short-toed Eagle *(Circaetus gallicus)*	Yes
Booted Eagle *(Aquilla pennata)*	Yes
Black Kite *(Milvus corshun)*	Yes
Marsh Harrier *(Circus aeruginosus)*	Yes
Hen Herrier *(Circus cyaneus)*	Yes
Montagu's Harrier *(Circus pygargus)*	Not commonly
Pallid Harrier *(Circus macrourus)*	Not commonly
Long-legged Buzzard *(Buteo rufinus)*	Yes
Common Buzzard *(Buteo buteo)*	Yes
Honey Buzzard *(Pernis apivorus)*	Not commonly
Sparrow Hawk *(Accipiter nisus)*	Yes
Kestrel *(Falco tinnunculus)*	Yes
Lesser Kestrel *(Falco naumanni)*	Yes

Species	Potential for Perching, Roosting or Nesting on Power Lines Poles and Towers
Hobby *(Falco subbuteo)*	Yes
Peregrine falcon *(Falco peregrinus)*	Yes
Merlin *(Falco columbarius)*	Yes
Saker Falcon *(Falco cherrug)*	Yes
Cranes and Bustards	
Common Crane *(Grus grus)*	No
Demoiselle Crane *(Anthropoides virgo)*	No
Houbara Bustard *(Chlamydotis undulate)*	No

For collisions, the overhead line will have a simple profile with the conductors positioned together in a horizontal plane with the ground wire above the conductors. Most birds exhibit avoidance behavior when approaching visible objects such as power lines in their flight path. For example, studies of wading birds, including the Wood Storks *(Mycteria americana)*, by Deng and Frederick (2001) have recorded avoidance of phase conductors and overhead ground wires by Wood Storks flying across a 500-kV line. They observed that 87% (639 wading birds including Wood Storks) flew above the overhead ground wire at night and 82% (34,546 birds including Wood Storks) during the day. They stated that the actual percentage at night is higher since radar showed more crossings at greater height than visual observations.

There are several papers that have investigated the relationship of the size of a bird and its maneuverability as important characteristics in evaluating a species' vulnerability to collisions with power lines (e.g., Bevanger 1994, 1998; Janss 2000; Rubolini et al. 2005). Rayner (1988) cited by Bevanger (1998) analyzed these characteristics in different orders of birds and developed six categories: poor flyers, waterbirds, diving birds, marine soarers, aerial predators, and thermal soarers. Bevanger, Janss, and Rubolini have evaluated the types of birds and their susceptibility to collisions (and electrocutions) and found that the "poor flyer" group such as rails, coots, and cranes are subject to collisions. They are characterized by birds with "high wing loading" (i.e., birds that are relatively heavy relative to their wing area). Waterbirds and diving birds such as ducks and geese also have high wing loadings and are subject to frequent collisions. Other birds that have high wing loading include large, heavy-bodied birds with large wing spans such as herons, cranes, swans, pelicans, and condors; these are frequently reported casualties. Such species generally lack agility to quickly negotiate obstacles. Heavy-bodied, fast fliers are also most vulnerable to collision. This flight morphology is typical of most waterfowl, coots, rails, grebes, pigeons and doves, and many shorebirds (sandpipers, plovers, and allies). This classification does not explain all collision risk and is subject to exceptions. For example gulls and terns, which are categorized as a low wing loading group, are subject to high collisions because of behavioral characteristics, such as flocking behavior and spending large amounts of time in the air.

Flocking species, such as waterfowl and wading birds, are more vulnerable to collisions than solitary species (Bevanger 1998; Crowder 2000; Crowder and Rhodes 2002; Drewitt and Langston 2008). The density of large flocks leaves little room to maneuver around obstacles; in fact, birds sometimes collide with each other when panicked (Brown 1993). Flocking also reduces visibility for trailing birds. Bevanger (1998) and Drewitt and Langston (2008) cite several studies that flocking behavior may lead to greater susceptibility, as birds in the back of the flock may have an obstructed view of an oncoming power line. Crowder (2000) and Crowder and Rhodes (2002) showed that flocks react to power lines at a greater distance from the line than do solitary birds. Scott et al. (1972) and James and Haak (1979) stated that flocking behavior was an important factor in collisions for Starlings (*Sturnus vulgaris*) and Snow Geese (*Chen caerulescens*). Trailing birds in a flock are often killed, presumably from not seeing the flaring of other birds in the flock.

Another exposure factor is flight height of the birds. For birds that are migrating, the flight heights can be quite high (>400 m) and well above the proposed maximum tower heights of 17 to 36 m. If birds are descending for stopover, these flights can be at the tower height. This would be an exposure issue if the tower is next to or within a stopover site.

For resident birds, if they cross the lines to and from nesting and foraging areas, they will have potentially high exposure

A final consideration of behavioral exposure is acclimation of these species to the presence of transmission lines in the habitat. All these species are routinely exposed to power lines and other similar tall structures such as communication towers during migration.

Another condition affecting exposure is weather. It is known that fog or other reduced visibility conditions can reduce flight height and also minimize detection/avoidance distances. The frequency and duration of these weather conditions[11] will increase the likelihood of lower flight heights. On the other hand, under stormy weather conditions foraging flights may be delayed until the weather conditions improve. In addition, strong winds can alter flight making it difficult to maneuver around or through power lines.

[11] The line can be divided by two sections in terms of the climatic conditions.

First Section – Sogdiana SS – angle 18 with the length 55.5 km – mountainous at the elevation 800–1,200 above sea level to the angle 14 and piedmont with the elevation up to 600 m above sea level from the angle 14 to the angle 18. Glaze – 15 mm (III glaze region). Wind pressure at the wiring level – 690 PA., Temperature: maximum +40°C, minimum -30°C, mean annual +10°C, with the glaze -5°C. Thunderstorm duration – up to 20 hours. Snow covers height – up to 25 cm.

The passage through Karatepa Reservoir at this site is envisaged by one climatic region higher in terms of the glaze (IV glaze region with the glaze wall thickness 20 mm).

Second Section– angle 18 – OSG of Talimarjan TPP with the length 16.1 km with elevation up to 600 – 400 m above sea level. Glaze – 10 mm (II glaze region). Wind pressure at the wiring level – 540 PA. Temperature: maximum +40°C, minimum -30°C, mean annual +10°C, with the glaze -5°C. Thunderstorm duration is up to 20 hours. Snow covers height – up to 25 cm.

Exposure Profiles for Electrocutions and Collisions

Table 7 provides an exposure profile for electrocutions. The primary factor that results in limited exposure for electrocutions is the large spacing of components compared to the wing span of these species at risk. This limited exposure will result in limited risk of electrocutions, if any, to birds of prey, waterfowl, cranes, and other species that might nest, roost, or perch on the transmission towers.

Table 7. Exposure Profile for Electrocutions

Major Exposure Conditions	Characteristics of Electrocution Exposure Condition	Importance of Exposure Conditions Contributing to Risk
Number exposed (abundance per unit time or space exposed to stressor)	Estimates for abundances along the TOTL are not known. For any given migratory species the numbers will be a subset of the total passing through Uzbekistan	Low importance since other factors such as Spatial and Behavioral Exposure conditions preclude the possibility of electrocutions occurring.
Intensity of exposure (amount or level of stressor)	There will be approximately 550 to 620 additional 500-kV towers added to the electrical transmission system in Uzbekistan. Spacing of the towers will range from 100 to 1,000 meters apart.	Would be of high importance because of the large number of potential perch sites but is actually of low importance since the spatial separation of energized and non-energized components precludes the possibility of electrocutions occurring.
Spatial exposure (proximity to stressor)	Energized equipment separated by 4.5 meters feet for the 500-kV compared to wing span of less than 3 meters for birds.	High importance since the separation of the potentially energized structures and equipment is greater than the ability of Uzbekistan birds to make contact.
Temporal exposure (duration, frequency, and timing of stressor)	Daily during the life of resident birds Highest in spring and lowest in fall for migrants, no exposure during non migratory season	Would be of high importance because of the large number of potential perch sites but is actually of low importance since the spatial separation of energized and non-energized components precludes the possibility of electrocutions occurring.
Behavioral exposure (avoidance, attraction, or acclimation of receptor to stressor)	Raptors and other groups do use towers for perching, roosting, and nesting.	Would be of high potential importance because of the large number of potential perch sites but actually is of low importance since the spatial separation of energized and non-energized components precludes the possibility of electrocutions occurring.

Table 8 provides an exposure profile for collisions. Exposure conditions indicate variable exposure for resident and migrant birds, which affects the likelihood for collisions with power lines. Of highest importance in reducing collision exposure is minimizing the vertical profile of the lines (e.g., horizontal versus vertical configuration), which enhances the ability of birds to avoid the lines while flying.

Table 8. Exposure Profile for Collisions

Major Exposure Conditions	Characteristics of Collision Exposure Condition	Importance of Exposure Conditions Contributing to Risk
Number exposed (abundance per unit time or space exposed to stressor)	Estimates for abundances along the TOTL are not known. For any given migratory species the numbers will be a subset of the total passing through Uzbekistan	Exposure increases as number of birds increase and decreases as the number of birds deceases.
Intensity of exposure (amount or level of stressor)	Three phases (each phase having bundle of three wires of 300 mm^2 dia each) in a horizontal plane and two overhead ground wires separated about 5 meters; approximately 218 km in length, and the wires range from a minimum of 9 to 36 m above the ground.	Important in increasing exposure because of the number and length of the lines. Important in decreasing exposure because of the highly visible profile resulting from collocation of the three transmission lines on a single ROW. The more visual the lines are in the corridors the greater the likelihood of detection and avoidance by flying birds
Spatial exposure (proximity to stressor)	Nocturnal migrants (most of the species) fly above level of transmission lines Diurnal migrants (e.g., may raptors, cranes, and waterfowl) will be exposed during foraging and feeding flights if they cross the transmission lines from feeding to roosting or perching sites.	Important for identifying segments of the line where higher number of flights will occur.
Temporal exposure (duration, frequency, and timing of stressor)	Daily variation during nesting and foraging (e.g., morning and evening foraging) daily during the life of resident birds Highest in spring and lowest in fall for migrants, little or no exposure during non migratory season	Important in identifying when high and repeated exposure will occur and the amount of repeated exposure over the life time of an individual bird.
Behavioral exposure (avoidance, attraction, or acclimation of receptor to stressor)	Behavioral avoidance of the majority of the birds is expected based on the literature	Highly important in contributing to reducing exposure and ultimately risk

Major Exposure Conditions	Characteristics of Collision Exposure Condition	Importance of Exposure Conditions Contributing to Risk
Other exposure conditions	Weather, fog, or other reduced visibility conditions may reduce flight height; strong winds also affect flight behavior and can affect detection/of the lines and avoidance distances.	Contributes to increasing spatial exposure during fog and low visibility conditions.

3.4 Effects Analysis Characterization

The Effects Characterization was developed to answer the following questions.

- What ecological entities are affected?
- What is the nature of the effect(s)?
- What is the intensity of the effect(s)?
- Where appropriate, what is the time scale for recovery?
- What causal information links the stressor with any observed effects?
- How do changes in measures of effects relate to changes in assessment endpoints?
- What is the uncertainty associated with the analysis?

Electrocution and Collision Effects

Ecological Entities Affected

The ecological entities that are potentially affected by electrocutions and collisions are individual resident and migratory birds found in the TOTL project areas (see Section 2.4).

Nature of the Effect(s)

Certain species are more susceptible to electrocutions and others to collisions. Some species are susceptible to both electrocutions and collisions (Figure 12). This susceptibility is a function of a variety of biological factors. Songbirds, storks, and raptors are the most susceptible because of their habit of nesting, perching, and roosting on power line poles or towers.

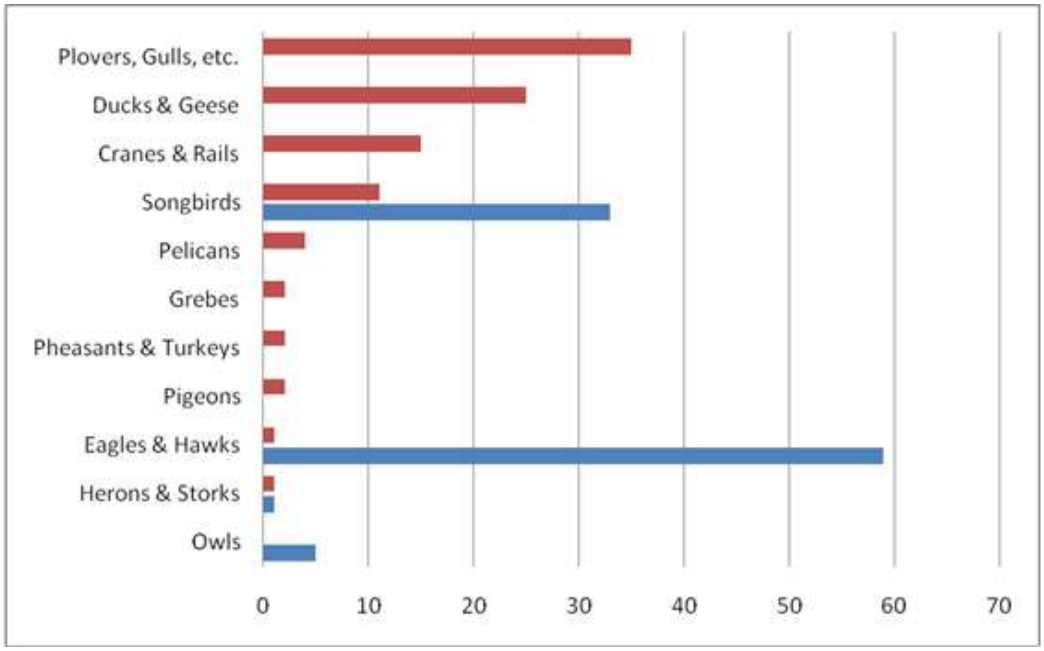

Figure 12. Percent mortality within bird groups reporting collisions (red bars) versus taxa reporting electrocutions (blue bars) based on 12,000 records.
(Source: Pandion Systems, Inc. [2010], adapted from Bevanger [1998])

Electrocutions do not normally occur on transmission lines since most are properly designed to limit opportunities for birds to roost or perch and there is typically sufficient spacing between energized parts to prevent electrocutions (APLIC 2006). Electrocutions are generally associated with lower voltage distribution lines (< 69-kV).

As stated in the exposure discussion, electrocution results in injury and mortality when a bird such as a crane simultaneously contacts energized structures or energized and grounded structures, hardware, or equipment. Specifically, electrocutions occur when contact is made to the phase conductors that are separated by less than the wingtip-to-wingtip or head-to-foot (flesh-to-flesh) distance of a bird or when the distance between grounded hardware (e.g., grounded wires, metal braces) and any phase conductor is less than the wrist-to-wrist or head-to-foot (flesh-to-flesh) distance of a bird. Typical effects include burn marks and singed feathers (APLIC 2006).

Collisions are generally associated with higher voltage transmission lines 138-kV or greater (APLIC 1994, 2006). Injury and mortality from collisions results when a flying bird collides with a physical structure (e.g., overhead ground wires or phase conductors) (APLIC 1994). The occurrence of bird collisions is frequently due to site specific conditions (e.g., presence of attractive habitats) and/or temporary/seasonal atmospheric conditions that reduce visibility (e.g., fog in the morning). Birds that fly in flocks (e.g., plovers, gulls, ducks, geese, cranes, rails, and songbirds) are the most susceptible to collisions because they have a reduced ability to see and negotiate obstacles and/or they are large and heavy-bodied birds with limited maneuverability. In flocks, more birds are exposed during a single time period, which can result in many simultaneous mortalities.

Intensity of the Effect(s)

Information that can be used to provide estimates of injuries and mortality from electrocutions and collisions in Uzbekistan is not available. As a generalization, electrocutions should be a rare event if the power line has sufficient spacing between energized and non-energized equipment. For collisions, individual birds (rather than a large number of birds) are likely to be at risk from collisions. Occasionally larger numbers of birds may be killed in an episodic event, such as poor weather conditions, affecting flocks of birds or ducks flying through a power line to and from feeding and nesting areas.

Appropriate Time Scale for Recovery

The effects from collisions and electrocutions to individual birds are generally permanent and irreversible. In some cases where injury is observed, the injured bird can be sent to a rehabilitation center for treatment of the injury (e.g., broken wing).

No population effects have been reported for bird collisions or electrocutions except for species with very low population sizes and low annual productivity, such as the Whooping Crane (*Grus americana*) (Jenkins et al. 2010).

Causal Information Linking the Stressor with any Observed Effects

Causal linkages regarding bird electrocutions come from observations and studies of avian and power line interactions. Bird (e.g., raptor) electrocutions have been reported since the 1970s (APLIC 2006; Bevanger 1998, 1999; Jenkins et al. 2010).

Causal linkages regarding bird collisions come from observations and studies of avian and power line interactions. Collision mortality of birds with utility lines, including power lines, has been reported for over 100 years (e.g., APLIC 1994, currently under revision 2010; Bevanger 1998, 1999; Jenkins et al. 2010).

Uncertainty Associated with the Analysis

The major type of uncertainty associated with collisions and electrocutions is the actual amount of mortality that has occurred. Such information is not available for this project. *For birds of prey there is a high degree of certainty that electrocutions will not occur given the engineering design of transmission towers even though they will use power lines as perch or roost sites. For ducks and geese there is also a high degree of certainty that mortality from electrocutions will not occur because they do not nest, perch, or roost on power line towers.*

Effects Profile

Table 9 provides an effects profile summary for collisions and electrocutions in the TOTL project study area.

Table 9. Effects Profile Summary for Collisions and Electrocutions

KEY EFFECT QUESTIONS	COLLISION EFFECTS Injury and/or death of birds from collisions with power conductors, overhead ground wires and towers	ELECTROCUTION EFFECTS Injury and/or death of birds from electrocutions from energized conductors, overhead ground wires, and equipment
What ecological entities are affected?	Primarily migrating birds – cranes, waterfowl, birds of prey.	Primarily migrating birds – cranes, birds of prey that perch, roost or nest on power poles.
What is the nature of the effect(s)?	If collisions occur there will be injury and mortality from colliding primarily with phase conductors and overhead ground wires. Results in trauma, including broken wings.	If electrocutions occur there will be injury and mortality from simultaneous contact of two energized parts and an energized part and grounded structures and equipment. Results in burn marks to feathers and feet.
What is the intensity of the effect(s)?	Actual numbers that have been killed are not known; however the numbers of potentially susceptible cranes migrating through the TOTL project area will be low (e.g., few individual to small flocks, numbers of waterfowl will be somewhat higher)	Actual numbers that have been killed are not known; however the numbers of potentially susceptible birds of prey migrating through the TOTL project area will be low (e.g., few individuals over a season).
Where appropriate, what is the time scale for recovery?	If injury occurs, rehabilitation may be possible; otherwise, effect will be permanent with no recovery of the affected bird.	Recovery not likely for birds that are electrocuted.
What causal information links the stressor with any observed effects?	Observations for the past 100 years of birds colliding with power lines.	Observations for the past 70 years of birds being electrocuted by power lines.
How do changes in measures of effects relate to changes in assessment endpoints?	If injury and mortality rates are very large (e.g., scores of bird in a few years), then a population and assessment endpoint of survivorship could be affected. However this level of mortality is not anticipated to occur and population level effects are anticipated to be negligible.	If injury and mortality rates are very large (e.g., scores of bird in a few years), then a population and assessment endpoint of survivorship could be affected. However this level of mortality is not anticipated to occur and population level effects are anticipated to be negligible.
What is the uncertainty associated with the analysis?	There is uncertainty regarding a specific mortality rate; however, based on the literature there is less uncertainty regarding the conclusion that the mortality rate will be low and population unaffected. This assessment considers the weight of evidence from a variety of different types of sources. Although this assessment	There is a high degree of certainty that electrocutions will not occur or be negligible given the engineering design of transmission towers. This assessment considers the weight of evidence from a variety of different types of sources. Although this assessment could over- or under-estimate the risk, the order of magnitude of error will be

KEY EFFECT QUESTIONS	COLLISION EFFECTS	ELECTROCUTION EFFECTS
	Injury and/or death of birds from collisions with power conductors, overhead ground wires and towers	**Injury and/or death of birds from electrocutions from energized conductors, overhead ground wires, and equipment**
	could over- or under-estimate the risk, the order of magnitude of error will be unsubstantial and would not affect the risk characterization.	unsubstantial and would not affect the risk characterization.

3.5 Risk Characterization

Risk characterization is the final phase in the risk assessment framework. It combines the results of the effects and exposure characterizations described above. As discussed in Section 3.2, risk is defined as the likelihood of a hazardous event occurring. In this case, what is the likelihood of TOTL causing injury and mortality to the resident and migrant birds, especially raptors, ducks and geese, cranes, storks, and other birds, over the life of the TOTL project. As discussed earlier five levels of risk are used (Highest Potential, Higher Potential, Moderate Potential, Lower Potential, and Lowest Potential) based on defined criteria (see Table 2).

In regards to injury and death from electrocution, the risks are considered to be of the "Lowest Potential." For the major groups of birds, birds of prey are considered most susceptible to electrocutions because of their use of transmission towers for perching, roosting, and nesting. Towers with relatively dense steel latticework are often used by raptors especially in habitats with few natural perch and nest sites such as trees, as they can provides more support for nests and roosting. However, it is unlikely that electrocutions of these species will occur given the spacing in energized and non-energized equipment being proposed for TOTL and the much smaller wingtip to wingtip dimensions and the use of perch discouragers. This spacing will provide more than adequate distance so that it is unlikely that birds will make electrical contact. In addition, this limited or no risk characterization does not consider the additional efficacy of installing perch guards, which will further reduce perching, roosting, and nesting by birds of prey and other species on towers and the likelihood of electrocutions and the occurrence of streamer outages. If nesting on a particular tower is a problem, the use of alternative nest platforms may be considered.

Several species of raptors (see Table 1) have global population numbers (e.g., Pallas's Sea Eagle and Pallid Harrier) that IUCN has determined as species at high risk of global extinction because of relatively low population levels. These species are migratory and their numbers along the TOTL route are expected to be quite low; thus electrocutions are considered unlikely or limited given the conditions described above and the very low probability of individuals occurring along the TOTL route. No affects to the overall populations of these species is expected. The Saker Falcon is a resident of Uzbekistan and has the potential to nest on power line poles. Its occurrence along the TOTL route is not known. Nesting guards should be considered if the recommended monitoring program (see Section 3.6.2) indicates the Saker Falcon is found in the area of TOTL.

For collisions and not considering mitigation through the use of markers and flight diverters a “Moderate Potential” for risk is characterized for raptors, ducks and geese, and cranes, storks, and pelicans. However, use of the above mentioned mitigation measures can reduce this risk to these risk further, possibly more than 50% (Jenkins et al. 2010) depending upon the species and the types of devices used.

For ducks and geese, some incidents of injury and mortality from collisions are likely to occur. Numerical predictions are not possible to make at this stage of the project. Based on the literature on waterfowl collisions, this mortality will primarily occur during the spring migration season where the TOTL route is in close proximity to waterbodies or grain fields that are bisected by the transmission line and when the largest numbers of waterfowl pass through Uzbekistan. Preconstruction monitoring (see Section 3.6.2) will better delineate where these potential risky areas occur on the TOTL route so that the previously mentioned mitigating structures can be concentrated in these areas. The larger these habitats are, the more ducks and geese will potentially be attracted and therefore the greater the likelihood of collisions.

Pelicans, in particular the Dalmatian Pelican, are known to be at risk for collisions and electrocutions with power lines. The circumstances of mortality (resulting from collisions or electrocutions) in Uzbekistan is not sufficiently understood to make specific recommendations for the TOTL project other than the use of markers and flight diverters. With these mitigations, mortality is expected to be limited and not result in population level effects.

There will be some incidents of collision mortality to storks and cranes especially to Demoiselle Cranes. Factors contributing to collisions in Uzbekistan are not understood. Numerical predictions are not possible to make. Based on the literature for waterfowl collisions, this mortality will occur primarily during the spring migration season where the TOTL route is in close proximity to waterbodies or grain fields that are bisected by the transmission line and when the largest numbers of cranes will pass through Uzbekistan. Preconstruction monitoring will better delineate where these potential risky areas occur on the TOTL route. The larger these habitats are, the greater the likelihood that cranes will be attracted and therefore the greater the likelihood of collisions.

There is no evidence to suggest that cranes will be exposed to any risk from electrocution. They are physically unable to perch on either power lines or poles and would have little inclination to fly between spans. The greatest threat to cranes comes from collision with power lines. Power line collisions have been a serious problem in some areas of North America (Brown and Drewien 1995; Schlorff 2005), but have been significantly reduced with the use of markers (Morkill and Anderson 1991). Power line collisions have hampered or compromised reintroduction efforts with Whooping Cranes and are the single greatest source of mortality for young cranes (Stehn and Wassenich 2008).

Special mention needs to be made of the Siberian Crane (*Grus leucogeranus*), one of the rarest birds in the world and listed as Critically Endangered (CR). The worldwide population is less than 4,000 individuals and it currently occurs in two main areas: northwestern Russia and Siberia. The Siberian nesting population (most of the known population) winters in China; the Russian nesting population (less than 200 individuals) winters in Iran (and formerly in India).

This Russian nesting population could migrate through Uzbekistan. In recent decades, the spatial distribution of Siberian Crane reported during the migration in Uzbekistan is broad enough to indicate the lack of a specific flightway. Therefore, migratory Siberian Cranes may occur in various regions of the country. In 2007, a Siberian Crane was reported at Kattakurgan Water Reservoir during spring migration. At the same time, there are data on several observations of Siberian Crane in the mid and upper reaches of the Amu Darya River both in Uzbekistan and in bordering regions of Turkmenistan.

At present, Russia, Kazakhstan, and Uzbekistan (in a program referred to as “Flight of Hope”) are discussing the possibility of a reintroduced population in Russia with a potential wintering stopover in southern Uzbekistan. However, no wintering sites for Siberian Crane in Uzbekistan have been identified. At this time there is no reason to believe that the proposed new population would have any association with the TOTL project. Nonetheless, a potential for future association should be acknowledged as plans for any new population develop because the loss of just one Siberian Crane (natural or artificial) could be significant.

In summary, some mortality for collisions is predicted to occur to all these species groups. However, population level effects for susceptible species are not anticipated from electrocutions and collisions for several reasons. Most of the susceptible species listed for conservation reasons occur in large numbers outside of Uzbekistan and limited mortality if any resulting from the TOTL project, once mitigated, is anticipated to be limited. The broad front migration, where migrating birds are spread throughout Uzbekistan, results in low densities in Uzbekistan. In addition they are exposed for only a short time, primarily during spring migration when the largest numbers of birds pass through Uzbekistan.

The likelihood of exposure of these birds to electrocution is unlikely because of the engineering design proposed for this project. The configuration of the line in a single horizontal plane (compared to two or more vertical conductors or phases) presents a narrower exposure zone for collisions. The risk of mortality from collisions can be further mitigated by the use of devices that will make the line more visible.

The survivorships of the species, the assessment endpoints are not anticipated to occur from this project. Based on this avian risk assessment the following two risk hypotheses are rejected.

- The proposed transmission lines will cause collision injury and mortality that will have population-level effects on the resident and migrating birds in the vicinity of the TOTL.
- The proposed transmission lines will cause electrocution mortality that will have population-level effects on the resident and migrating birds in the vicinity of the TOTL

In addition this level of risk will be further reduced by the implementation of mitigation measures such as rerouting of segments of the line, perch guards, markers, and flight diverters.

3.6 Recommendations for Risk Management

3.6.1 Mitigation Recommendations

This ARA is intended to aid in management decisions regarding ways to further avoid and minimize the risk of collisions and electrocutions. Strategies for addressing collisions should ensure that the transmission lines are sufficiently visible to birds in flight. Mitigation measures to address risk of collision are warranted and should be identified during final ROW selection and design at the conclusion of preconstruction surveys that will identify high use areas where collisions may occur. Mitigation measures may include rerouting certain segments to avoid high use bird areas and/or the use of markers and flight diverters to make the lines more visible. These decisions should be done in consultation with the World Bank, Uzbekenergo, and other NGOs such as UIZ.

Strategies for addressing electrocution should ensure distances between energized components or between energized and grounded components are sufficient to avoid electrocution of birds and should include the use of perch guards to reduce the likelihood of perching, roosting, and nesting, which in some circumstances leads to "streamers." These collision and electrocution mitigation strategies should be site specific, where warranted, and tailored to the relative risks in each geographic location along the TOTL route.

3.6.2 Monitoring Recommendations

This ARA has identified two monitoring recommendations: a preconstruction habitat monitoring program and a postconstruction mortality monitoring program

Preconstruction Habitat Monitoring

The ARA has identified the potential for certain types of high use bird areas that may be used as stopover sites and feeding areas (see Table 5). It is possible that these areas, depending upon their location and juxtaposition with the TOTL, could increase the risk for exposure to collisions. If the line is located in the vicinity of these habitats it may be warranted to use markers and/or deflectors to minimize collisions along these segments of the line. The objective of this Preconstruction Habitat Monitoring will be to identify the location of these higher use habitats and assess the likely use by the specific groups of birds that are susceptible to collisions. Depending on the location, size, and the importance of these habitats along the TOTL, recommendations may be made to shift the final alignment to reduce the risk of collisions assuming that such a shift in location does not affect other socio-economic resources along the line and is feasible for engineering point of view.

The timing for this preconstruction monitoring should occur before final ROW layouts are made and during spring migration when the largest numbers of birds are passing over the TOTL route. Attention should be paid to any areas along the route where natural habitat corridors exist (e.g., rivers, wetlands, ecotones, other natural linear features) that might be attractive to migrating birds (see Section 2.6, which describes land use features along the TOTL route that might be considered higher use habitats). This description was based on secondary information describing land use along the TOTL route. Site specific descriptions are recommended using aerial photography and "ground truthing"[12] to identify the quality and quantity of avian habitats along the route.

In addition, observations of bird usage in these higher use habitats including migratory bird use should be made. Bird observations should include early morning and early evening observations. The numbers of birds observed and their behavior (e.g., foraging, roosting, etc.) in these habitats should be recorded. If avian habitats occur on both sides of the route, observations of bird passage between these habitats should be made.

An avian habitat use sampling protocol should be developed for review and comment prior to conducting preconstruction studies. This protocol would describe methods for characterizing potential habitat use by migrating birds, the amount of these habitats, the quality of these habitats, bird use and movements, and the juxiposition of these habitats to the proposed transmission line. This protocol would be developed by Pandion in consultation with UIZ.

Post Construction Mortality Monitoring

After the line is built and energized, periodic monitoring of the line to assess the efficacy of the markers and diverters should be conducted. This monitoring may also show other segments of the line that have higher than expected levels of collisions. These areas would be identified and characterized as to the nature of the risky collisions. Recommendations may be made for additional marking and the use of diverters. Since the major bird use along the line is by spring and fall migrants, monitoring is recommended during these periods. Duration of monitoring will be developed based on local environmental conditions but would last several weeks. During Phase II of this ARA, specific monitoring protocols will be developed in conjunction with UIZ (see Section 3.6.3, Capacity Building).

A mortality monitoring protocol should be prepared for review and comment prior to postconstruction monitoring. This protocol should reflect the latest understanding and techniques for estimating mortality by accounting for sampling biases such as scavenger removal, searcher efficiency, and habitat biases. The mortality monitoring protocol would be developed by Pandion.

3.6.3 Capacity Building

Several areas of capacity building are required, including increasing the capacity of UIZ to undertake both the preconstruction and postconstruction monitoring. This is most important for postconstruction mortality monitoring where instruction and training should be provided in developing standardized approaches for collision and electrocution monitoring of transmission lines and towers. If the results of postconstruction monitoring are to be used for making recommendations for additional retrofitting, then the data collected needs to be comparable and corrected for the monitoring biases that exist in mortality monitoring (e.g., scavenger removal, searcher efficiency, habitat, and other potential biases).

[12] Verifying actual conditions on the ground.

It is also recommended that training in the use of ARA techniques for power lines be provided, including measures to avoid, minimize, and mitigate electrocutions and collisions. This training would be for staff of Uzbekenergo, UIZ, and other appropriate stakeholders.

Finally, it is recommended that a short course dealing with avian interactions with power lines be developed. Such a course would deal with the engineering and biological issues involving avian collisions and electrocutions, mitigation strategies, and remedial techniques for the protection of bird species.

Pandion would develop and implement this capacity building training. Specific details for this capacity building will be developed in consultation with the World Bank and implemented as a part of Phase II of this ARA.

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