Appendix I – Bald Eagle Compensatory Mitigation

BALD EAGLE COMPENSATORY MITIGATION

Overview

The objective of the bald eagle mitigation included in this HCP is to compensate for the effects of bald eagle take associated with the operation of MidAmerican Energy's wind energy projects in Iowa. This mitigation should ensure that MidAmerican's activities, including implementation of the HCP, will contribute to bald eagle populations in the Plan Area remaining in a stable to increasing trajectory relative to the USFWS's most recent eagle population estimate (USFWS 2016a).

Mitigation actions are designed to increase bald eagle survival and reproductive potential by protecting or enhancing existing occupied habitats to sustain or grow the distribution and availability of nesting and winter roost sites as well as reducing unnatural sources of bald eagle fatalities. The larger sources of bald eagle fatalities can include electrocution from contacting aboveground power lines and associated infrastructure (Allison 2012), ingestion of lead (Scheuhammer and Norris 1996, Miller et al. 2002), collisions with structures (e.g., wind turbines, power lines; Lehman 2001), or collisions with vehicles while feeding on roadside carcasses.

MidAmerican Energy has prepared this technical report to summarize techniques for calculating an eagle compensatory mitigation fund. The techniques used for calculating compensatory mitigation costs include: power pole retrofits, lead abatement, and eagle rehabilitation. The following sections describe each of these techniques and its corresponding Resource Equivalency Analysis (REA). These techniques were applied assuming they would be used to offset an estimated take of 10 bald eagles fatalities per year or 300 bald eagle fatalities over a 30-year permit term.

Power Pole Retrofits

Introduction to Power Pole Retrofits

Numerous bald and golden eagle deaths occur from collisions with and electrocutions from power lines (Lehman et al. 2007). For example, over 500 golden eagles are estimated to be killed due to electrocution every year and while similar extrapolated estimates are not available for bald eagles, electrocution has been one of the leading causes of human caused mortality for bald eagles. The majority of deaths are associated with low-voltage power lines or transformers where eagles can simultaneously touch conductor and ground wires, causing electrocution (Lehman 2001, Lehman et al. 2007). Transmission lines of 69 kilovolts and above typically pose low electrocution risk to eagles because the line spacing exceeds the physical dimensions of eagles (Dwyer et al. 2015).

The Avian Power Line Interaction Committee (APLIC) provided guidance documents that identify avian protection plan guidelines (APLIC 2005), and minimization methods for avian electrocutions and collisions (APLIC 2006, 2012). This includes delineated clearances on power poles for a range of voltages – following these guidelines will minimize electrocution risk to large at-risk bird species. The USFWS has developed a REA model that results in estimates of the number of high risk electric power poles that would need to be retrofitted following APLIC guidance to avoid electrocution of eagles (USFWS 2013).

REA Methodologies

Following the resource equivalency analysis (REA) example in the USFWS ECP Guidance (2013), MidAmerican has calculated the number of power-pole retrofits needed to offset the anticipated level of bald eagle take associated with operation of its wind energy facilities in Iowa. In the ECP Guidance, a REA compares the injury or loss of eagles caused by wind facilities (debit) to the benefits from efforts designed to improve eagle survival or increase productivity (credits).

As described in the Draft Midwest Wind Energy Multi-Species HCP (USFWS 2016b), the original model was written assuming all the power pole retrofits were completed up front prior to eagle fatality occurrence from the wind energy facility. The basic model under this assumption results in approximately 27 poles per eagle taken, under the assumption the retrofitted poles last 10 years and the mitigation is all done upfront. The model results in approximately 9 poles per eagle taken if it is assumed the retrofitted poles are maintained for 30 years.

The USFWS REA is currently undergoing revision based on more recent information specific to bald eagles and power pole retrofits in the Midwest. Until that time that the REA is updated, the preliminary estimates of the number of power poles requiring retrofit to offset take from operation of the MidAmerican Energy wind energy projects will be based on the assumptions from the original USFWS model.

Calculation of Necessary Compensatory Mitigation Costs

To roughly estimate cost of a power pole retrofit program using the 9 poles per eagle taken from the original model, MidAmerican assumed a 30-year avoided loss from power pole retrofits and mitigation implemented upfront. On a per eagle basis, the mitigation value from pole retrofitting is $30,600. Multiplying through by the number of eagles taken per year (10) by the 30-year project lifespan (30) resulted in 2,700 poles to be retrofitted. At an estimated cost of $3,400 per pole, the total cost to avoid 300 eagle deaths is $9,180,000.

Lead Abatement

Introduction to Lead Abatement

Lead abatement programs focus on reduction of lead ingestion that results when eagles scavenge carcasses containing lead. Primary sources of lead include fishing tackle and lead shot or bullet fragments in the carcasses and viscera of game and other animals. Lead poisoning accounts for an estimated 10% to 15% of the recorded post-fledging mortality in bald and golden eagles in Canada and the United States (Scheuhammer and Norris 1996, Miller et al. 2002).

Programs designed to reduce lead bullet usage, or reduce gut/offal piles left by hunters in areas accessible to eagles, may reduce eagle fatalities by decreasing the number of incidents of lead poisoning. Cochrane et al. (2015) proposed a REA from abating lead poisoning in eagles.

REA Methodologies

Following the lead abatement model presented in Cochrane et al. (2015), MidAmerican calculated the number of eagle deaths avoided through converting hunters to non-lead ammunition.

The lead abatement model considered several factors that affect ingestion of lead by eagles, including: the quantity of gut piles, eagle density, the area of the hunt unit, and the percentage of hunters that use non-toxic ammunition. Expected mortality increases with availability of gut piles per eagle, and amount of blood lead concentration increase per gut pile ingested. For this analysis, the quantity of gut piles was estimated as 90% of total deer harvest reported by county (Iowa DNR 2015), eagle density ranged from 0.067 eagles/mi^2 (0.0259 eagles/km^2) to 0.093 eagles/mi^2 (0.0359 eagles/km^2), and Iowa hunt units corresponded to counties. The analysis focused on the counties with the highest density of gut pile per 100 square kilometer, as determined by deer harvest reported in 2015 and county area.

The lead abatement analysis assumed the following: 1) the number of gut piles consumed by eagles increases with the quantity of gut piles in the hunt unit (county) and decreases with increased eagle density, 2) eagles consume no more than five gut piles per month, 3) eagles ingest lead in direct proportion to lead ammunition use or lead fragment abundance, 4) maximum increase in blood lead concentration per scavenge is 1,000 mg/dL, 5) there are at least 3 days and no more than 30 days between scavenging events, 6) blood lead half-life is between 10 and 20 days, 7) blood lead concentrations greater than 100 – 120 mg/dL are associated with acute mortality, and 8) there are no indirect sub-lethal effects at low blood lead concentrations.

Given deer harvest data from each county in Iowa, and minimum and maximum eagle density, the lead abatement model was run 5,000 times and obtained 5,000 different simulations for each county. The simulations provided the basis for understanding variations in model prediction and are summarized as the median (50th), conservative (20th), and generous (80th) percentile simulations at each eagle density. The median (50th) percentile simulation suggested that conversion to non-lead type ammunition of 50% of hunters from six to eight of the most heavily deer harvested counties would offset the estimated take of 10 eagles (Figure 1; 50th percentile, range: 9.853 – 10.15 eagle deaths avoided). The conservative (20th) percentile simulation suggested that conversion to non-lead type ammunition of 50% of hunters from 13 to 19 of the most heavily deer harvested counties would offset the estimated take of 10 eagles (Figure 1; 20th percentile, range: 9.689 – 10.44 eagle deaths avoided).

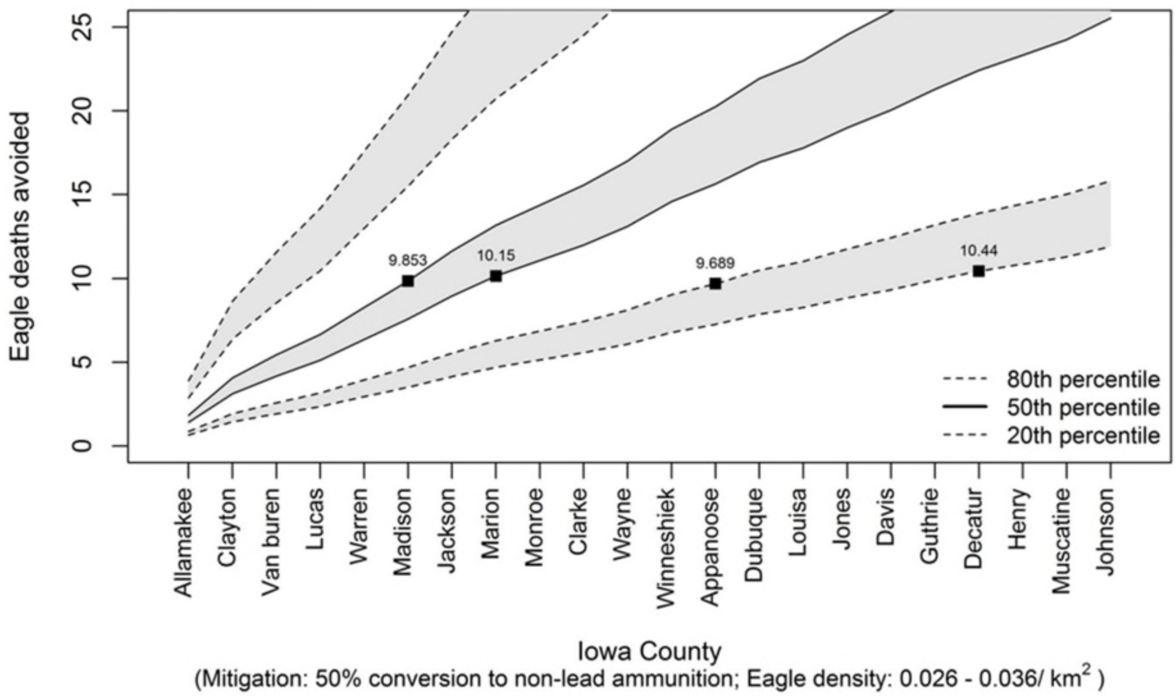

Figure 1. Annual eagle deaths avoided through a mitigation scenario that converts 50% lead ammunition use to non-lead use, cumulative by county, for the top 20 counties with greatest gut pile density as reported by Iowa DNR (2015). Eagle density ranged from 0.067 to 0.093 eagles/mi^2 (0.0259 to 0.0359 eagles/km^2).

The simulations summarized and ranked by county provide detail on cumulative area as well. At maximum eagle density, the median (50th) percentile simulation indicated that the conversion of 50% of hunters who hunt in Allamakee, Clayton, Van Buren, Lucas, Warren and Madison Counties, an area of 3,470 mi^2 (8,980 km^2), would avoid 9.853 eagle mortalities as result of toxic lead ingestion (Figure 2, Table 1). With the addition of Jackson County (636 mi^2; 1,650 km^2), 11.6 eagle mortalities per year are expected to be avoided. At the minimum eagle density, 10.15 eagle mortalities could be prevented with the conversion of 50% of hunters from these 7 counties plus Marion County. In this situation, the higher density of eagles allowed for fewer conversions of hunters to prevent the same number of eagle mortalities.

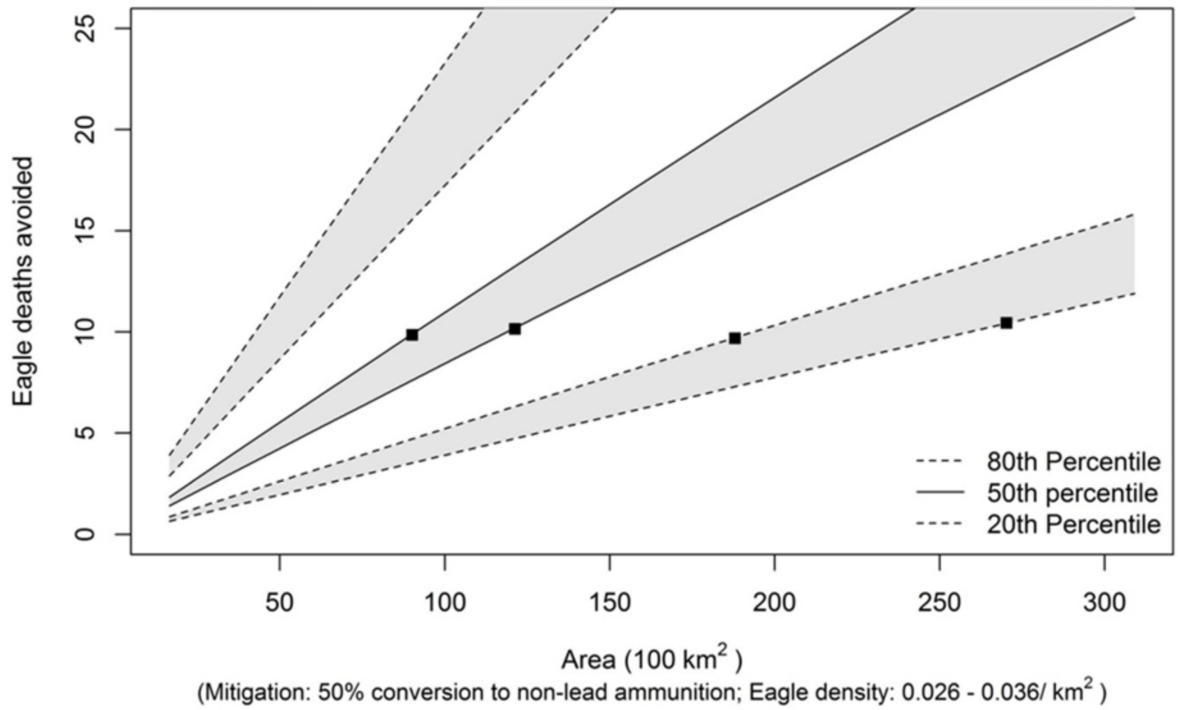

Figure 2. Annual eagle deaths avoided through a mitigation scenario that converts 50% lead ammunition use to non-lead use, cumulative by area, for the top 20 counties with greatest gut pile density as reported by Iowa DNR (2015). Eagle density ranged from 0.067 to 0.093 eagles/mi^2 (0.0259 to 0.0359 eagles/km^2).

Table 1. Summary of eagle deaths avoided through a mitigation scenario that converts 50% lead ammunition use to non-lead use for the top 22 counties in Iowa ranked by highest gut pile density.

					Maximum Eagle Density (0.0359/km^2; 0.093/mi^2)				Minimum Eagle Density (0.0259/km^2; 0.067/mi^2)			
County	County area (100 km^2)	Cumulative area (100 km^2)	Total gut piles (90% of harvest)	Gut piles per 100 km^2	Deaths avoided 20th percentile	Deaths avoided 50th percentile	Cumulative deaths avoided 20th percentile	Cumulative deaths avoided 50th percentile	Deaths avoided 20th percentile	Deaths avoided 50th percentile	Cumulative deaths avoided 20th percentile	Cumulative deaths avoided 50th percentile
Allamakee	16.58	16.58	3270.6	197.262	0.869	1.835	0.869	1.835	0.649	1.407	0.649	1.407
Clayton	20.18	36.76	3943.8	195.431	1.058	2.232	1.927	4.067	0.791	1.711	1.440	3.118
Van Buren	12.56	49.32	2273.4	181.003	0.657	1.379	2.584	5.446	0.491	1.062	1.931	4.180
Lucas	11.16	60.48	1901.7	170.403	0.581	1.218	3.165	6.664	0.435	0.94	2.366	5.120
Warren	14.81	75.29	2454.3	165.719	0.770	1.612	3.935	8.276	0.576	1.245	2.942	6.365
Madison	14.53	89.82	2342.7	161.232	0.755	1.577	4.690	9.853	0.566	1.218	3.508	7.583
Jackson	16.47	106.29	2493.9	151.421	0.852	1.781	5.542	11.634	0.640	1.375	4.148	8.958
Marion	14.35	120.64	1969.2	137.226	0.737	1.537	6.279	13.171	0.555	1.189	4.703	10.147
Monroe	11.21	131.85	1508.4	134.558	0.575	1.197	6.854	14.368	0.432	0.927	5.135	11.074
Clarke	11.16	143.01	1467.9	131.532	0.572	1.190	7.426	15.558	0.431	0.921	5.566	11.995
Wayne	13.62	156.63	1771.2	130.044	0.697	1.449	8.123	17.007	0.525	1.123	6.091	13.118
Winneshiek	17.87	174.50	2217.6	124.096	0.911	1.891	9.034	18.898	0.686	1.468	6.777	14.586
Appanoose	12.85	187.35	1584.0	123.268	0.655	1.358	9.689	20.256	0.493	1.055	7.270	15.641
Dubuque	15.75	203.10	1923.3	122.114	0.802	1.663	10.491	21.919	0.604	1.292	7.874	16.933
Louisa	10.41	213.51	1170.0	112.392	0.527	1.086	11.018	23.005	0.397	0.848	8.271	17.781
Jones	14.89	228.40	1630.8	109.523	0.751	1.549	11.769	24.554	0.567	1.211	8.838	18.992
Davis	13.03	241.43	1417.5	108.787	0.656	1.354	12.425	25.908	0.496	1.060	9.334	20.052
Guthrie	15.31	256.74	1656.0	108.165	0.770	1.588	13.195	27.496	0.582	1.245	9.916	21.297
Decatur	13.78	270.52	1468.8	106.589	0.691	1.427	13.886	28.923	0.523	1.119	10.439	22.416
Henry	11.24	281.76	1187.1	105.614	0.564	1.163	14.450	30.086	0.427	0.913	10.866	23.329
Muscatine	11.37	293.13	1188.9	104.565	0.569	1.174	15.019	31.260	0.431	0.922	11.297	24.251
Johnson	15.90	309.03	1649.7	103.755	0.794	1.640	15.813	32.900	0.602	1.288	11.899	25.539

Calculation of Necessary Compensatory Mitigation Costs

To estimate cost of a lead abatement program, MidAmerican assumed a hunter success rate of 40% and estimated annual costs of $20 per hunter for one box of non-lead ammunition ($15) and hunter education ($5). Multiplied over the 30-year project life-span, the total cost to avoid 300 eagle deaths is $2,039,535 at low eagle densities (Table 2; 0.067 eagles/mi^2; 0.0259 eagles/km^2) and $1,606,560 at high eagle densities (Table 3; 0.093 eagles/mi^2; 0.0359 eagles/km^2). On a per eagle basis, the mitigation value from lead abatement is $6,798.45 at low eagle densities and $5,355.20 at high eagle densities.

The average of high and low total costs to avoid 300 eagle deaths is $1,823,100 with a per eagle mitigation value of $6,077.

Table 2. Estimated 30-year costs of a lead abatement program at low eagle density (0.067 eagles/mi^2; 0.0259 eagles/km^2).

County	# Gut Piles	# of Hunters	Eagle deaths avoided (50th percentile)	Estimated 30-year cost
Allamakee	197.26	493.15	1.407	$295,890
Clayton	195.43	488.58	1.711	$293,145
Van Buren	181.00	452.50	1.062	$271,500
Lucas	170.40	426.00	0.94	$255,600
Warren	165.72	414.30	1.245	$248,580
Madison	161.23	403.08	1.218	$241,845
Jackson	151.42	378.55	1.375	$227,130
Marion	137.23	343.08	1.189	$205,845
TOTAL	**1359.69**	**3399.23**	**10.147**	**$2,039,535**

Table 3. Estimated 30-year costs of a lead abatement program at high eagle density (0.093 eagles/mi^2; 0.0359 eagles/km^2).

County	# Gut Piles	# of Hunters	Eagle deaths avoided (50th percentile)	Estimated 30-year cost
Allamakee	197.26	493.15	1.835	$295,890
Clayton	195.43	488.58	2.232	$293,145
Van Buren	181.00	452.50	1.379	$271,500
Lucas	170.40	426.00	1.215	$255,600
Warren	165.72	414.30	1.612	$248,580
Madison	161.23	403.08	1.577	$241,845
TOTAL	**1071.04**	**2677.6**	**10.147**	**$1,606,560**

Rehabilitation

Introduction/Methodologies

Rehabilitation programs focus on treatment, rehabilitation, and re-release of wild eagles that were previously sick or injured to the local or regional eagle population. Treatment addresses major injuries, acute illnesses, toxicity, dehydration, starvation, and malnutrition. Rehabilitation includes physical therapy and flights under controlled circumstances to evaluate muscle strength, extent of healing, and capacity for re-release. Re-release occurs in appropriate habitat, weather-permitting, and considers the time of year relative to the bird's age and breeding status. Some rehabilitation centers also participate in lead poisoning research. In that case, eagles may be x-rayed and a liver sample obtained to determine if lead ammunition or fishing tackle were ingested.

A REA or equivalent model does not exist for rehabilitation programs at this time. In lieu of a REA, MidAmerican obtained rehabilitation costs from The Raptor Center, a non-profit wildlife rehabilitation center in St. Paul, Minnesota, and Saving Our Avian Resources (SOAR), a smaller non-profit wildlife rehabilitation center in Dedham, Iowa. Together, these facilities treat about 120 eagles and release about 30 eagles to the wild per year. While not all of the eagles survive in the wild after a release, there does appear to be evidence of the value of rehabilitation. For example, 50 to 68% of the eagles released from The Raptor Center have been tracked and seen again more than six weeks after the release, and in several cases these eagles have gone on to successfully nest and raise young (Duke et al. 1981, Martell et al. 1991).

Calculation of Necessary Compensatory Mitigation Costs

MidAmerican Energy obtained rehabilitation cost estimates of about $2,300 per eagle from The Raptor Center and SOAR. This could be anywhere from a simple case that includes admission, minimal treatment, and an average stay might be $700-800/eagle, to a more complicated case that includes a broken bone(s) and surgery might cost up to $4,000/eagle. Given information referenced above suggests that at least half of the rehabilitated eagles survive to six weeks, MidAmerican assumed a cost of $4,600 per eagle (double the average cost per eagle), might result in at least one eagle returning to the wild for extended periods. As such, a contribution of $1,380,000 could help successfully return at least 300 injured or sick eagles to the wild over the 30-year permit term.

<u>SUMMARY</u>

MidAmerican Energy used three techniques to calculate compensatory mitigation value on a per eagle basis and for total potential take of 300 eagles at 10 eagles per year. The per-eagle mitigation value ranged from $30,600 for a power pole retrofit program, to $6,077 for a lead abatement program, and $4,600 per eagle for a rehabilitation program. The compensatory mitigation cost for total potential take of 300 eagles ranged from $9,480,000 for a power pole retrofit program, to $1,832,100 for a lead abatement program, and $1,380,000 for a rehabilitation program. The large range in compensatory mitigation value and cost suggests some mitigation programs may be more efficient than others.

MidAmerican will develop an Eagle Conservation Fund based on averaging the per eagle cost estimates from the lead abatement and rehabilitation techniques (($6,077+$4,600)/2 = $5,340/eagle). MidAmerican's Eagle Conservation Fund will be applied to a number of bald eagle conservation programs throughout Iowa that might include:

- a local/regional non-profit environmental organization actively involved in educating the public on the negative impacts of lead in the environmental on eagles and other wildlife;
- a local/regional non-profit environmental organization actively involved in making non-toxic (lead-free) fishing tackle and/or ammunition available to the local hunters or anglers; and/or
- a local/regional rehabilitation center actively involved in the treatment, rehabilitation, and re-release of wild eagles to the local/regional eagle population.

Consistent with these calculations, MidAmerican and the Mitigation Entity will evaluate acceptable uses for mitigation funds. This could include directing mitigation dollars towards power pole retrofits to minimize eagle electrocution risks, habitat protection and/or enhancement, or road kill carcass removal programs to reduce risk of eagle-vehicle collisions.

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