PINEDALE ANTICLINE PROJECT AREA SAGE GROUSE MONITORING

2009 REPORT

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Executive Summary

In March 2009, The Pinedale Anticline Project Office (PAPO) contracted with KC Harvey, Inc. to monitor sage grouse in the Pinedale Anticline Project Area. The purpose of this work was to meet monitoring requirements of the Record of Decision, Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. The scope of this project included capturing and collaring sage grouse hens, tracking them to determine nesting success and habitat selection, and monitoring noise levels at leks.

In late March to mid-April, KC Harvey field scientists captured and collared 89 sage grouse hens from 21 known leks from five lek complexes in the Pinedale Anticline Project Area. Three of the lek complexes were in oil and gas development areas, and two were in reference areas. Wyoming Game and Fish Department provided guidance on the desired distribution of captured hens. The majority of hens were captured during a seven-day period between April 7 and April 14. Concurrently, noise-monitoring equipment was deployed for a series of 10-day and five-day periods at 13 leks within the development complexes.

After capture, the collared sage grouse hens were tracked between one and three times per week through their nesting period in early June. The hens were then tracked once monthly during the summer and fall to determine habitat selection. Fifteen of the collared hens were mortalities in 2009. Five were mortalities prior to nesting, five during the nesting period, and five after nesting.

Sixty-seven of the 84 collared hens attempting to nest were successful (80 percent). The percentage of successful nest attempts was slightly higher in development complexes compared to reference complexes. Thirty-one percent of sage grouse hens had a successful hatch, with a slightly higher hatch rate in reference area complexes compared to development area complexes.

Noise monitoring results indicated that none of the monitored leks had average noise levels above the thresholds defined by the Record of Decision, Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. However, review of these thresholds indicates that they were not developed using data from the Pinedale Anticline area. Noise data collection from the project area is recommended to determine if the existing noise thresholds are representative, or if they require modification.

Appendix A contains results of data analysis conducted that was beyond the scope of this project. This information may prove useful in more detailed analysis of habitat selection.

1.0 Introduction

The Pinedale Anticline Project Area (PAPA) is located in Sublette County, Wyoming, and covers approximately 198,037 acres of federal, state, and private land. The Jonah Infill Drilling Project Area covers approximately 30,500 acres adjacent to the PAPA. This monitoring project includes six sage grouse lek complexes both inside and outside of these two EIS areas (Figure 1).

Appendix B of the Record of Decision (ROD), Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project is a wildlife monitoring and mitigation matrix (BLM, 2008). This matrix lists species of concern in the Pinedale Anticline Project Area, criteria that require monitoring for each species, changes that will require mitigation, and potential mitigation responses. For sage grouse, Appendix B lists five parameters that require monitoring:

- Number of active leks in identified lek complexes,
- Peak numbers of males attending lek complexes,
- Nesting success and habitat selection,
- Winter concentration area use, and
- Noise levels at active leks.

The Wyoming Game and Fish Department (WGFD) took responsibility for the first two parameters listed above. Results presented in this report for these two tasks are directly from data provided by WGFD. Winter concentration area use was not included in this project due to a late project start date. Therefore, this project scope includes monitoring the remaining two parameters, nesting success and habitat selection, and noise levels at active leks. Reporting herein includes these two parameters and data provided by WGFD.

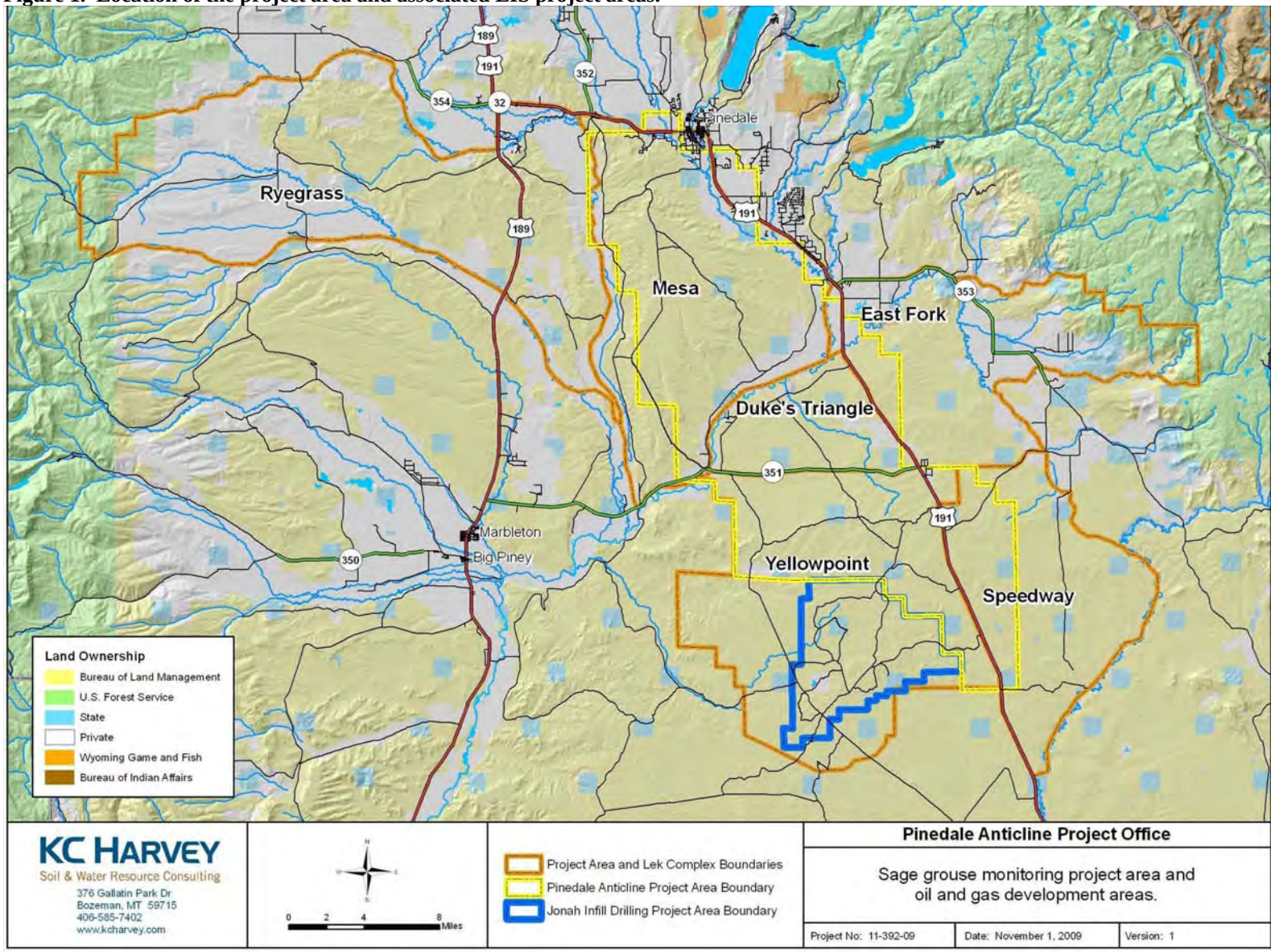
2.0 Project Tasks

This document reports four of the five required monitoring parameters listed above. In the 2008 ROD, nesting success and habitat selection are combined into one parameter requiring monitoring. However, conducting the monitoring and reporting results was better served by addressing these items separately. Therefore, the project tasks reported in the document are as follows:

- Number of active leks in identified lek complexes,
- Peak numbers of males attending lek complexes,
- Nesting success,
- Habitat selection, and
- Noise Monitoring.

Monitoring nesting success required capturing and attaching radio collars to sage grouse hens, tracking these hens to their nesting locations, and monitoring them every 2-5 days until they left their nests. Habitat selection began once the sage grouse hens were off their nests and required tracking the hens once monthly to determine their locations with respect to habitat. Finally, noise monitoring required deploying continuous noise monitoring equipment at selected active leks during the nesting period. These data were evaluated to determine if total noise exceeded background noise levels defined in the ROD.

Figure 1. Location of the project area and associated EIS project areas.



2.1. Active Leks

The wildlife monitoring and mitigation matrix in the ROD for the Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project states that monitoring of the number of active leks in identified lek complexes is required. The changes that will be monitored are:

- Active use on 70% of totalcurrent leks; Active use on 70% of leks in each complex (the development area complexes include the Mesa, Duke's Triangle, and Yellow Point complexes) compared to 2007 data.

The specific change requiring mitigation is:

- 30% decline in total number of active leks, or 30% decline in the number of leks in a single complex.

This project focused on five lek complexes, two reference complexes (Speedway and Ryegrass), and three development complexes (Yellowpoint, Duke's Triangle, and Mesa). At the onset of this project, WGFD removed the East Fork Complex (reference) from this monitoring project due to overlap with another sage grouse tracking effort. However, WGFD data on lek status and attendance includes all six-lek complexes. WGFD also provided lek locations, complex associations, and lek status data to the project team.

WGFD has identified 76 leks within the six lek complexes. Of these, 63 are occupied, nine are unoccupied, and four are unknown. Table 1 below lists the identified sage grouse leks and their status. Figure 2 shows the distribution of identified sage grouse leks and their status. Comparison of these data with active lek data collected in subsequent years will allow determining change and whether mitigation is required.

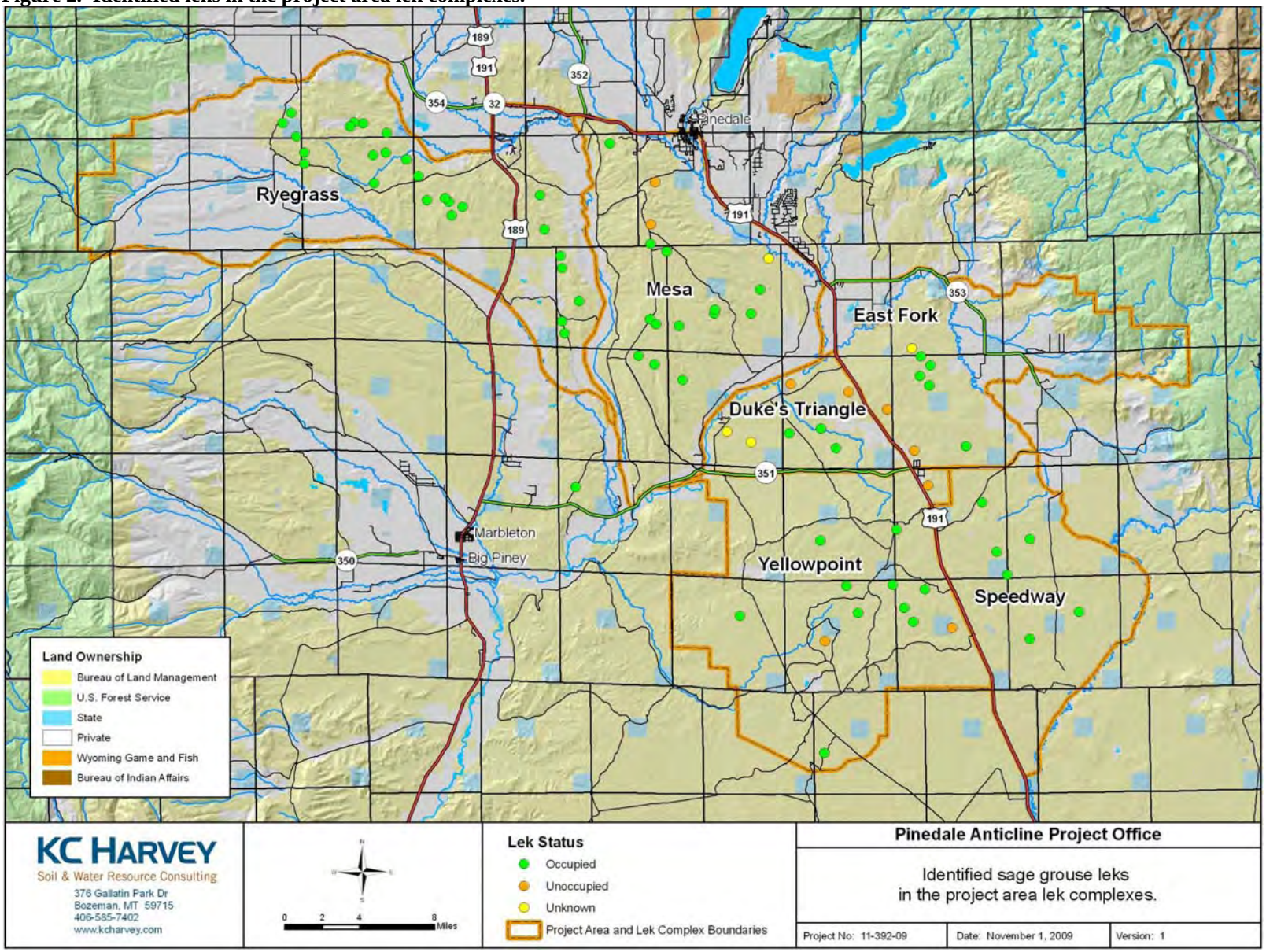
Table 1. List and status of sage grouse leks in the project area.

Area Type	Lek Complex	Lek Name	Lek Status
Reference	Speedway	Big John	Occupied
		Darby	Occupied
		Desert Reservoir	Occupied
		Hole 2	Occupied
		Mud Hole State	Occupied
		Speedway	Occupied
		Waterhole Draw	Occupied
	Ryegrass	Brodie Burn	Occupied
		Brodie Draw 1	Occupied
		Brodie Draw 2	Occupied
		Brodie Draw 3	Occupied
		Cut Across	Occupied
		Fear Ditch	Occupied
		Fear Ditch Res.	Occupied
		Grindstone Draw	Occupied
		Jewett Red Flat Res.	Occupied
		North Luman Ridge	Occupied
		North Luman Ridge Satellite	Occupied
		North Soapholes Creek	Occupied

Area Type	Lek Complex	Lek Name	Lek Status
		Old Reservoir	Occupied
		Onion Creek	Occupied
		Onion Springs	Occupied
		Ryegrass Draw	Occupied
		Ryegrass Draw Satellite	Occupied
		Ryegrass Draw South	Occupied
		Ryegrass Reservoir	Occupied
		Ryegrass Reservoir Satellite	Occupied
		Ryegrass Road Fork	Occupied
		Sommers	Occupied
		South Luman Ridge	Occupied
		South Soapholes Creek	Occupied
		Upper Onion Creek	Occupied
		Upper Onion Creek Satellite	Occupied
Development	Yellowpoint	June 2	Unoccupied
		Alkali Draw	Occupied
		Antelope State	Unoccupied
		Buckhorn Well 1	Occupied
		Clay Hill Well	Unoccupied
		Prairie Dog	Occupied
		Sand Draw 3	Occupied
		Sand Draw Reservoir	Occupied
		Shelter Cabin Res.	Occupied
		South Rocks	Occupied
		Stud Horse Butte E.	Occupied
		The Rocks	Occupied
		Yellowpoint Ridge S.	Occupied
	Duke's Triangle	Bench Road	Unoccupied
		Big Fred	Occupied
		Duke's Triangle New	Unknown
		East Fork Hill	Unoccupied
		Little Fred	Occupied
		Little Fred Satellite	Unknown
		Lower Sand Springs Draw	Occupied
	Mesa	Bloom Reservoir	Occupied
		Bloom Reservoir Satellite	Occupied
		Cat	Occupied
		Cora Y	Occupied
		Cutoff	Occupied
		Lovatt Draw Reservoir	Occupied
		Lovatt Draw Reservoir Satellite	Occupied
		Lovatt West	Occupied
		Mesa	Unoccupied
		Mesa Road 3	Occupied
		Mesa Road 3 Satellite	Occupied
		Mesa Spring	Occupied
		Mesa/Pole Creek	Unknown

Area Type	Lek Complex	Lek Name	Lek Status
		Mt. Airy Fence	Unoccupied
		Oil Road Fork	Occupied
		Oil Road Fork Satellite	Occupied
		Two Buttes	Occupied

Figure 2. Identified leks in the project area lek complexes.



2.2. Peak Number of Males Attending Leks

The wildlife monitoring and mitigation matrix in the ROD for the Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project states that monitoring of the peak number of male sage grouse attending lek complexes is required. The changes that will be monitored are:

- Total average 2-year change in numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes

The specific change requiring mitigation is:

- Average of 30% decline in numbers over 2 years compared to reference area.

The Wyoming Game and Fish Department monitors male sage grouse attendance at leks on an annual basis. WGFD provided 2009 peak male observation data for the six identified lek complexes (Table 2). Comparison of these data with data collected in subsequent years will allow determining the level of change and whether this requires mitigation. WGFD assumed the responsibility of determining if any changes in peak male attendance has occurred.

Table 2. Peak male attendance at identified leks in the six lek complexes, 2009 WGFD data.

Area Type	Complex	Lek	2009 Peak Male Attendance
Reference	East Fork	Blown-Out Reservoir	171
		Fremont Butte Well 2A	16
		Fremont Butte Well 2B	26
	Speedway	Big John	80
		Darby	75
		Desert Reservoir	150
		Mudhole State	142
		Speedway	88
		Waterhole Draw	70
	Ryegrass	Brodie Burn	0
		Brodie Draw 1	19
		Brodie Draw 2	18
		Brodie Draw 3	1
		Cut Across	7
		Fear Ditch	21
		Fear Ditch Res.	20
		Grindstone Draw	38
		Jewett Red Flat Res.	50
		North Luman Ridge	7
		North Soapholes Creek	26
		Old Reservoir	60
		Onion Springs	0
		Onion Springs 2	38
		Ryegrass Draw	147
		Ryegrass Draw South	49
		Ryegrass Reservoir	10
		Ryegrass Road Fork	33

Area Type	Complex	Lek	2009 Peak Male Attendance
		Sommers	15
		South Luman Ridge	40
		South Soapholes Creek	6
		Upper Onion Creek	121
Development	Yellowpoint	Alkali Draw	23
		Prairie Dog	38
		Sand Draw 3	0
		Sand Draw Reservoir	19
		Shelter Cabin Res.	44
		South Rocks	40
		Stud Horse Butte E.	0
		The Rocks	9
	Duke's Triangle	Little Fred	0
		Big Fred	0
		Lower Sand Springs Draw	13
	Mesa	Bloom Reservoir	97
		Cat	2
		Cutoff	34
		Lovatt Draw Reservoir	0
		Lovatt West	0
		Mesa Road 3	76
		Oil Road Fork	156
		Two Buttes	86
		Tyler Draw North	21

2.3. Nesting Success

The wildlife monitoring and mitigation matrix in the ROD for the Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project states that monitoring change in nesting success compared to reference areas is required. The change requiring mitigation is an average of 30 percent decline in numbers over two years compared to reference area.

Monitoring nesting success had two components, capture and marking of sage grouse and monitoring nesting success. The following two sub-sections describe the two components.

2.3.1. Capture and Marking

Sage grouse capture and marking began on March 23 and finished on April 17, 2009. During this time, KC Harvey field crews captured and affixed radio collars to 89 sage grouse hens using spot lighting and hoop net capture (Wakkinen, et.al., 1992, Connelly, et.al., 2003).

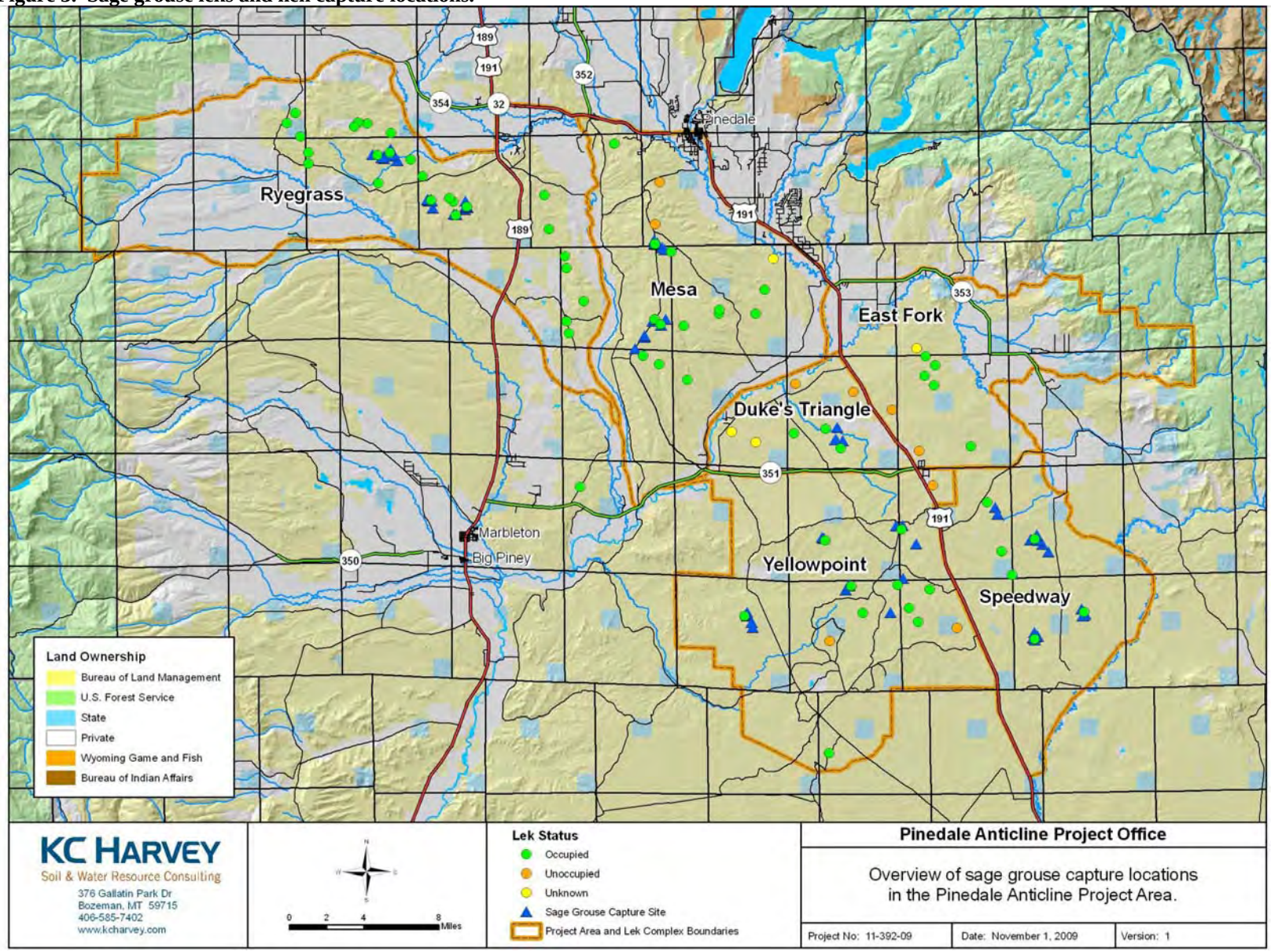
Wyoming Game and Fish Department personnel provided guidance on the desired distribution of sage grouse captured from each lek complex and approved the final number of sage grouse captured. Table 3 lists the sage grouse capture locations by lek complex and Figure 3 shows their locations. Approximately half of the hens collared were adults and half yearlings.

Table 3. Target numbers and actual numbers and locations of captured and collared sage grouse hens.

Area Type	Lek Complex	Target Number of Collared Hens	Number of Hens Collared	Adult Hens Collared	Yearling Hens Collared
Reference	East Fork	0	0	NA	NA
	Speedway	25	23	10	13
	Ryegrass	25	25	12	13
Development	Yellowpoint	20	20	9	11
	Duke's Triangle	10	5	4	1
	Mesa	20	16	8	8
	TOTALS	100	89	43	46

Peak sage grouse attendance occurred during a one week period between April 7 and April 14, 2009. This corresponds with the most successful capture period.

Figure 3. Sage grouse leks and hen capture locations.



2.3.2. Monitoring Nesting Success

KC Harvey field crews began tracking collared hens toward the end of the capture effort using receivers designed to pick up the radio collar frequencies. Field crews used both truck mounted and hand held tracking systems to track and monitor collared hens every two to five days during the nesting period. The objective was to determine if the hens nested, and whether eggs successfully hatched. The first tracked sage grouse hen nested approximately on April 15, and the last tracked hen nested approximately on June 1.

Monitoring Nesting Success Methods

When a hen was tracked at the same area two successive times within a five day period, the hen was approached to obtain a GPS location of the nest. When approaching a potential nesting hen location, field personnel took care to approach the site very slowly and circle the strong radio signal in a wide arc. This allowed triangulation of the nest location, and spotting the hen on the nest without flushing her. On the first nest location visit, the nest wasl not approached before 9:00 am or after 4:00 pm, nor during rain or snow. A GPS location was recorded from the observation point, along with azimuth and estimated distance to the nesting hen. When possible, photos were taken from the observation point to the base of the shrub canopy at the nest site. The nest site was not approached again, in subsequent visits, until the female's signal was no longer at the nest site. Once the hen left the immediate nest area, the nest site was approached to determine the fate of the egg clutch.

At the nest site, field personnel took the following photos:

- a close-up photo of the nest bowl and egg remnants (eg. at the bowl and/or scattered in the immediate area, as well as a close-up of egg remains);
- a photo of the nest from approximately three meters away from the entrance,
- an overhead photo from the top of the nest shrub canopy vertically to the nest, and
- photos from the nest area directed at typical vegetation,
- close up of egg fragments, and
- additional photos at the discretion of the field personnel.

Field personnel recorded the number of eggs and the egg fate. The area around the nest site was also searched for any shell remnants. A nest was recorded as a successful hatch if one or more of the eggs have membrane attached to the inner egg shell and signs of egg shell breakage are indicative of a normally pipped and hatched egg. Any depredation of a nest will be recorded as mammalian or avian predator, and if possible, a specific predator species was determined. Criteria used for determination of egg fate and predator type is from Sargeant, 1998. This document provides photographic, as well as written keys describing the effects of mammalian and avian predators on eggs at upland nest sites.

If eggs were predated, the hen was tracked for at least ten days to determine whether she re-nested. If re-nesting occurred, tracking was re-initiated, and the nest fate was determined following the same procedures for the first nest. Radio-tracking was suspended until the monthly tracking for hens with a successful hatch. Hens that did not attempt to nest were tracked until the last nesting hen completed nesting.

Nesting Success Results

The tables and figures below present summary data on capture, nesting, hatching, and mortality chronologically by project stage. Data are summarized by lek complex and reference vs. development areas. These will allow year to year comparison of nesting success with 2010 data as required in the ROD.

Table 4 through Table 7 summarize sage grouse fate from capture through habitat selection by lek complex, reference areas vs. development areas, and for the entire study area. Table 4 lists the number of collared hens, pre-nesting mortalities, and remaining hens by lek complex. Of the 89 collared hens, five were mortalities prior to initiating a nest. Table 8 summarizes data by individual lek.

Table 5 summarizes the nesting stage. There were five pre-nesting mortalities. Of the 84 remaining birds, 67 (80 percent) initiated a nest. There were five additional hen mortalities during the nesting period, and 10 hens made second nest attempts after an unsuccessful first nest attempt. The proportion of hens nesting in reference complexes was 74 percent compared to 87 percent for development areas. Figure 4 and Figure 5 further illustrate sage grouse hen nesting data by area and complex. These figures display the similarity in percentages of different sage grouse nesting outcomes throughout the project area.

Of the 89 collared birds, 28 (31 percent) had successful hatches. Egg predation was common, with 35 nests predated. Of the 35 predated nests, 20 were from mammalian predators, 11 from avian predators, and four were unknown. The percent of successful hatches was 33 percent in reference areas and 29 percent in development areas. After nesting, the remaining collared hens were tracked once monthly to assess habitat selection. During this time, five hens were mortalities, with one confirmed and two suspected harvests by hunters. Figure 6 illustrates capture, nesting, hatch, and mortality rates by lek complex.

Table 7 summarizes collared sage grouse hen fate. Of 89 sage grouse hens collared, five were mortalities prior to nesting. Of the remaining 84 collared hens, 67 attempted to nest. An additional five collared hens were mortalities during the nesting period. Five hens were also mortalities during the habitat selection (post-nest) period. One of the post-nest mortalities was a confirmed hunter harvested hen reported to WGFD. Figure 7 illustrates the timing of 2009 sage grouse mortality by project stage. Of the 15 mortalities in all complexes during 2009, seven were adult and eight were yearling hens.

Table 4. Sage grouse capture and pre-nesting summary, reference areas vs. development areas.

Location		Stage							
		Capture		Pre-Nest					
Area Type	Complex	Hens Collared		Pre-Nesting Mortalities		Pct Pre-Nesting Mortalities		Hens Remaining	
Reference	Speedway	48	23	2	1	4%	4%	46	22
	Ryegrass		25		1		4%		24
Development	Yellowpoint	41	20	3	1	7%	5%	38	19
	Duke's Triangle		5		1		20%		4
	Mesa		16		1		6%		15
	TOTALS	89		5		6%		84	

Table 5. Sage grouse nesting summary, reference areas vs. development areas.

Location		Stage													
		Nesting													
Area Type	Complex	Nesting Hens		Percent Nesting Hens		Non-Nesting Hens		Percent Non-Nesting Hens		Nesting Mortalities		Percent Nesting Mortalities		2nd Nest Attempts	
Reference	Speedway	34	14	74%	64%	12	8	26%	36%	3	2	6%	9%	3	0
	Ryegrass		20		83%		4		17%		1		4%		3
Development	Yellowpoint	33	17	87%	89%	5	2	13%	11%	2	2	5%	10%	7	4
	Duke's Triangle		4		100%		0		0%		0		0%		0
	Mesa		12		80%		3		20%		0		0%		3
	TOTALS	67		80%		17		20%		5		8%		10	

Table 6. Sage grouse hatch and post hatch summary, reference area vs. development area.

Location		Stage											
		Hatching								Post Nest (Habitat Selection)			
Area Type	Complex	Hatches		Pct Hatching		Predated Nests		Percent Predated Nests		Post Nest Predated Hens		Percent Predated Hens Post Nesting	
Reference	Speedway	16	7	33%	30%	18	5	49%	36%	4	3	8%	13%
	Ryegrass		9		36%		13		57%		1		4%
Development	Yellowpoint	12	5	29%	25%	17	9	43%	43%	1		2%	0%
	Duke's Triangle		3		60%		1		25%		1		20%
	Mesa		4		25%		7		47%				0%
	TOTALS	28		31%		35		45%		5		6%	

Table 7. Summary of collared sage grouse fate in 2009.

Location		Stage													
		Capture		Nesting						Hatching				Post Nest (Habitat Selection)	
Area Type	Complex	Hens Collared		Percent Nesting Hens		Percent Non-Nesting Hens		Percent Nesting Mortalities		Percent Hatching		Percent Predated Nests		Percent Post Nest Hen Mortality	
Reference	Speedway	48	23	74%	64%	26%	36%	6%	9%	33%	30%	49%	36%	8%	13%
	Ryegrass		25		83%		17%		4%		36%		57%		4%
Development	Yellowpoint	41	20	87%	89%	13%	11%	5%	10%	29%	25%	43%	43%	2%	0%
	Duke's Triangle		5		100%		0%		0%		60%		25%		20%
	Mesa		16		80%		20%		0%		25%		47%		0%
	TOTALS	89		80%		20%		6%		31%		45%		6%	

Table 8. Summary sage grouse capture, nest, hatch, and mortality data by lek.

Location			Stage								
			Capture	Pre-Nest	Nesting					Hatching	Post Nest
Area Type	Complex	Lek	Hens Collared	Pre-Nest Mortality	Nesting Hens	Non-Nesting Hens	Nesting Mortalities	2nd Nest Attempts	Predated Nests	Hatches	Post Nest Mortalities
Reference	Speedway	Big John	7		4	3		0	2	1	1
		Darby	4		4	0		0	1	2	1
		Mudhole State	9		6	3	1	0	2	4	
		Speedway	2		0	1	1	0	0	0	
		Waterhole Draw	1	1	0	0		0	0	0	
	Ryegrass	Fear Ditch	5		4	1		1	2	3	
		Fear Ditch Reservoir	3		2	1		0	1	1	
		Jewitt Red Flat Reservoir	9	1	9	0	1	1	6	2	
		Upper Onion Creek	8		6	2		1	4	3	1
Development	Yellowpoint	Alkai Draw	3		3	0	1	0	1	1	
		Prairie Dog	7		6	1		2	3	3	
		Sand Draw Reservoir	5		4	1	1	2	3	0	
		Shelter Cabin	3		3	0		0	1	1	
		South Rocks	1		1	0		0	1	0	
		The Rocks	1	1	0	0		0	0	0	
	Duke's Triangle	Little Fred	4		4	0		0	1	3	2
		Lower Sand Springs Draw	1	1	0	0		0	0	0	
	Mesa	Bloom Reservoir Satellite	1		1	0		1	2	0	
		Mesa Road 3	4		4	0		0	1	1	
		Mesa Road Satellite	3	1	2	0		0	0	1	
		Oil Fork Road	8		5	3		2	4	2	
		TOTALS	89	5	67	17	5	10	35	28	5

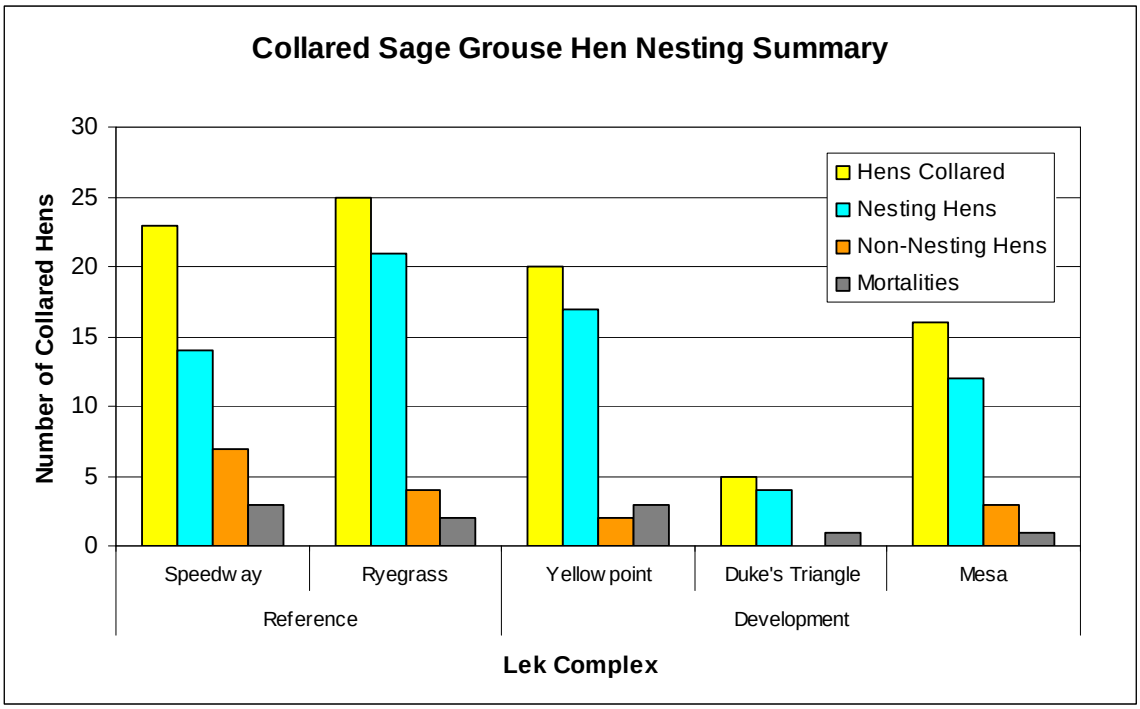


Figure 4. Sage grouse hens nesting summary by lek complex.

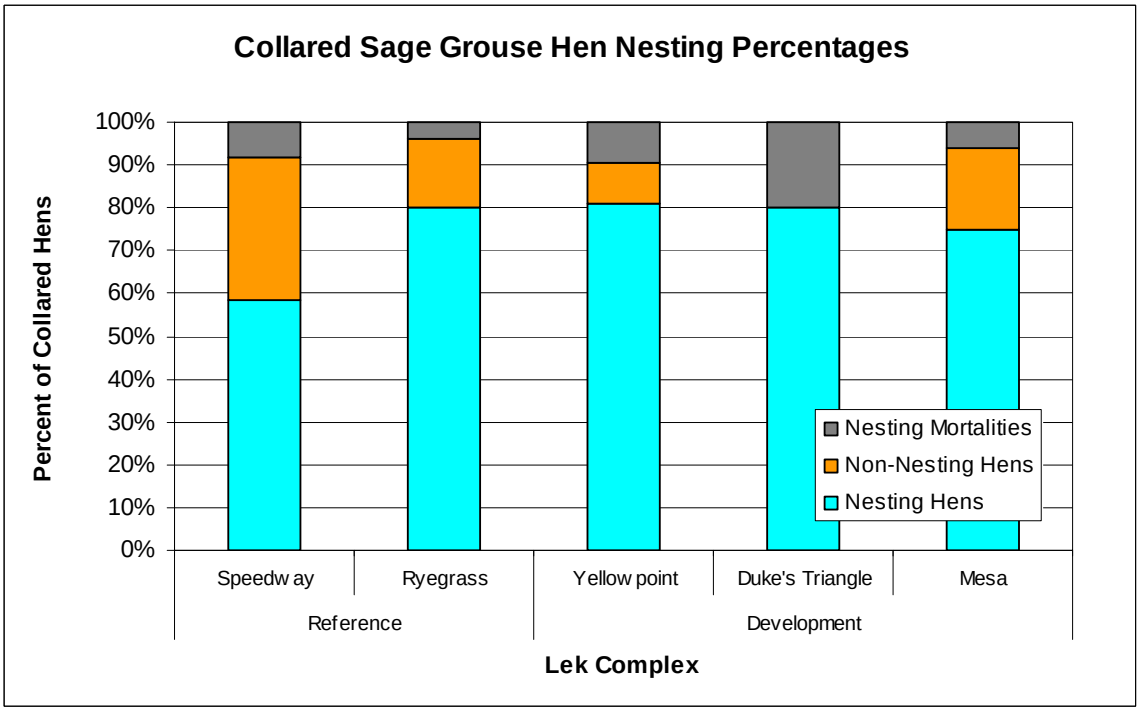


Figure 5. Sage grouse hen nesting percentages by lek complex.

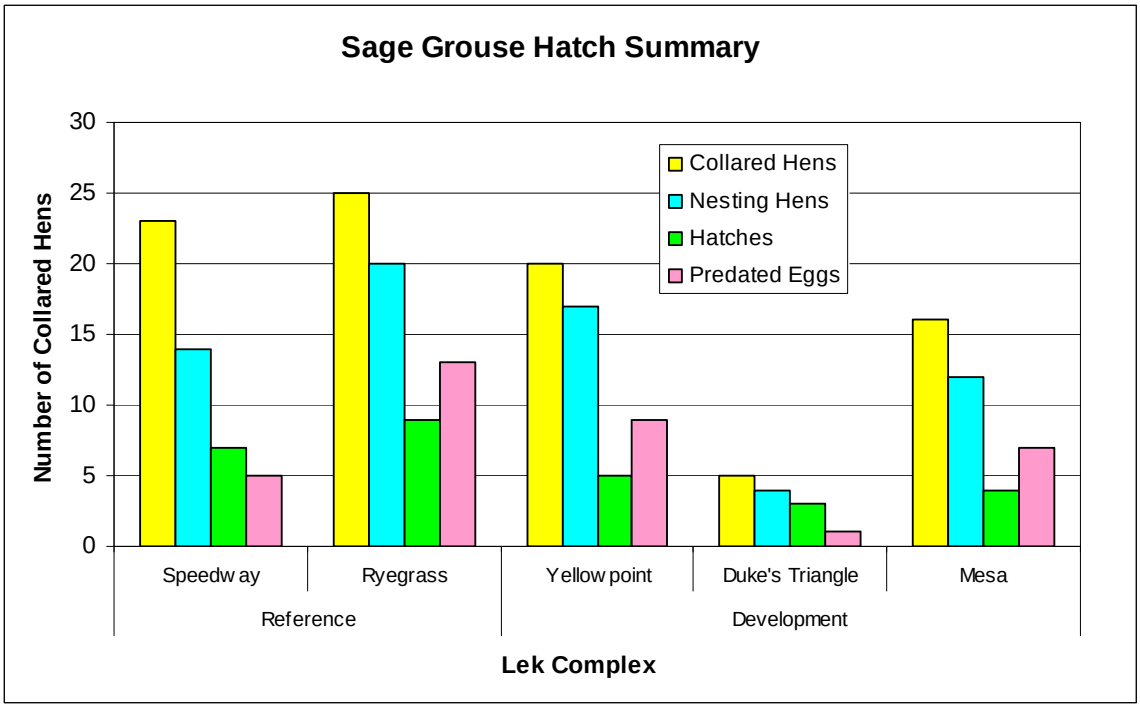


Figure 6. Collared sage grouse hatch summary by lek complex.

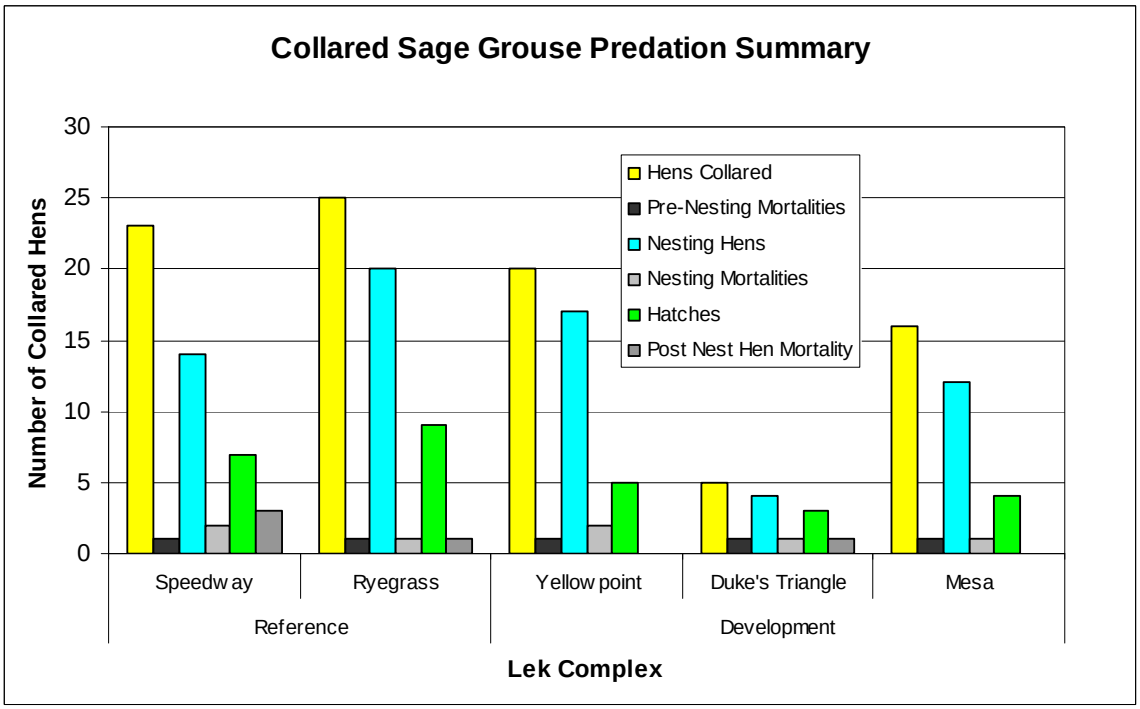


Figure 7. Collared sage grouse predation summary.

2.4. Habitat Selection

The wildlife monitoring and mitigation matrix in the ROD for the Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project states that monitoring change in nesting success compared to reference areas or change in nesting success and a concurrent change in habitat selection by nesting hens, in relation to development disturbance is required. The change requiring mitigation is an average of 15% per year decline over two years in nesting success compared to reference area, or a 0.5 km increase in avoidance distance per year over two consecutive years and a concurrent change of an average of 15% per year decline over two years in nesting success compared to reference area.

After the nesting period, KC Harvey field personnel tracked collared sage grouse hens once monthly to assess habitat selection using truck mounted and hand held VHF radio receivers set to scan the frequencies of the collared hens. If hens could not be located during the monthly ground tracking, an aerial flight was conducted to locate them.

Analysis of the distance between tracking locations and oil and gas development areas provides the information to determine the avoidance distance referred to in the ROD. Comparison of these distances from year to year will allow determination of whether the avoidance distance is increasing over time.

Additional analysis of sage grouse tracking data including distance to roads, proximity to water features, and vegetation communities is in Appendix A.

2.4.1. Proximity to Oil and Gas Development

The BLM Pinedale office provided a spatial dataset of oil and gas disturbance areas for this project. This dataset included well pads, pipelines, production facilities, and roads (Figure 9). Analysis sage grouse tracking locations with respect to this dataset provides a starting point to assess avoidance distances over time. Analysis was conducted using ESRI ArcGIS software, with results exported to spreadsheets for display.

For this analysis, oil and gas development was defined as all of the components in the BLM disturbance areas dataset with the exception of pipelines. Pipelines were omitted since they are re-seeded relatively quickly and are not associated with daily activity. Figure 8 below lists and illustrates the distribution of distance between sage grouse tracked locations and oil and gas development. The median distances for the three development complexes are similar, ranging from approximately 1200 to 1900 meters (0.75 to 1.1 miles).

Comparison of the 2009 data reported herein with 2010 and future year's data will satisfy the habitat selection monitoring requirements defined in the ROD.

	Yellowpoint	Duke's Triangle	Mesa	All Development Complexes
Q1	1,021	1,018	738	887
Min	67	540	0	0
Med	1,919	1,262	1,255	1,489
Max	20,853	2,742	39,308	39,308
Q3	6,490	1,811	2,043	2,522
N	195	53	152	400

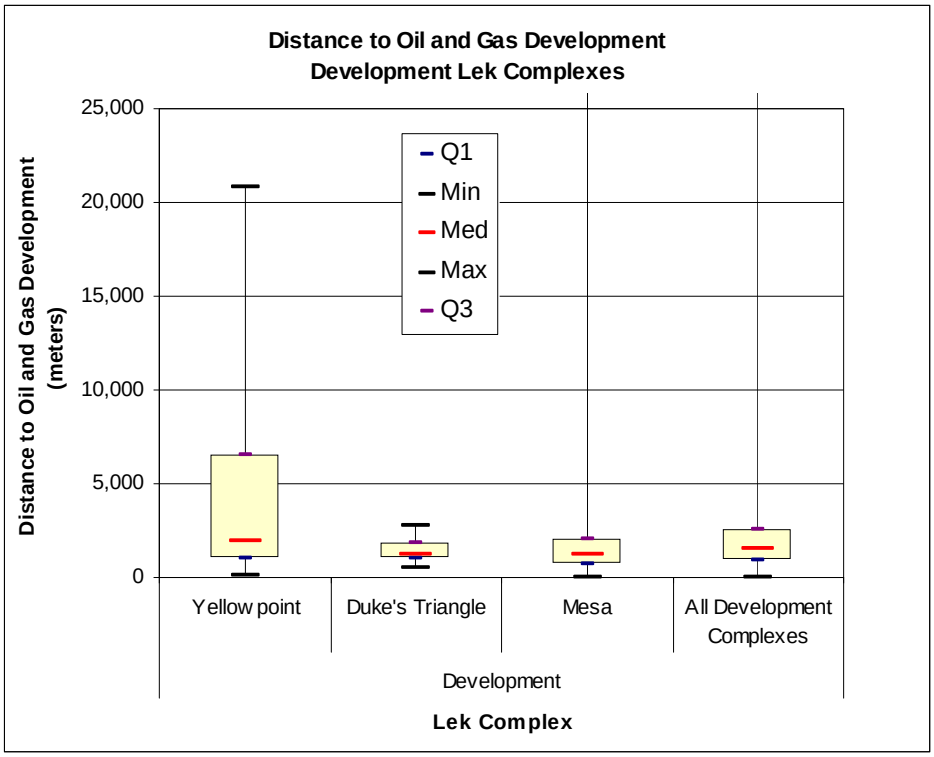


Figure 8. Summary of distances from development area sage grouse tracking locations and oil and gas development.

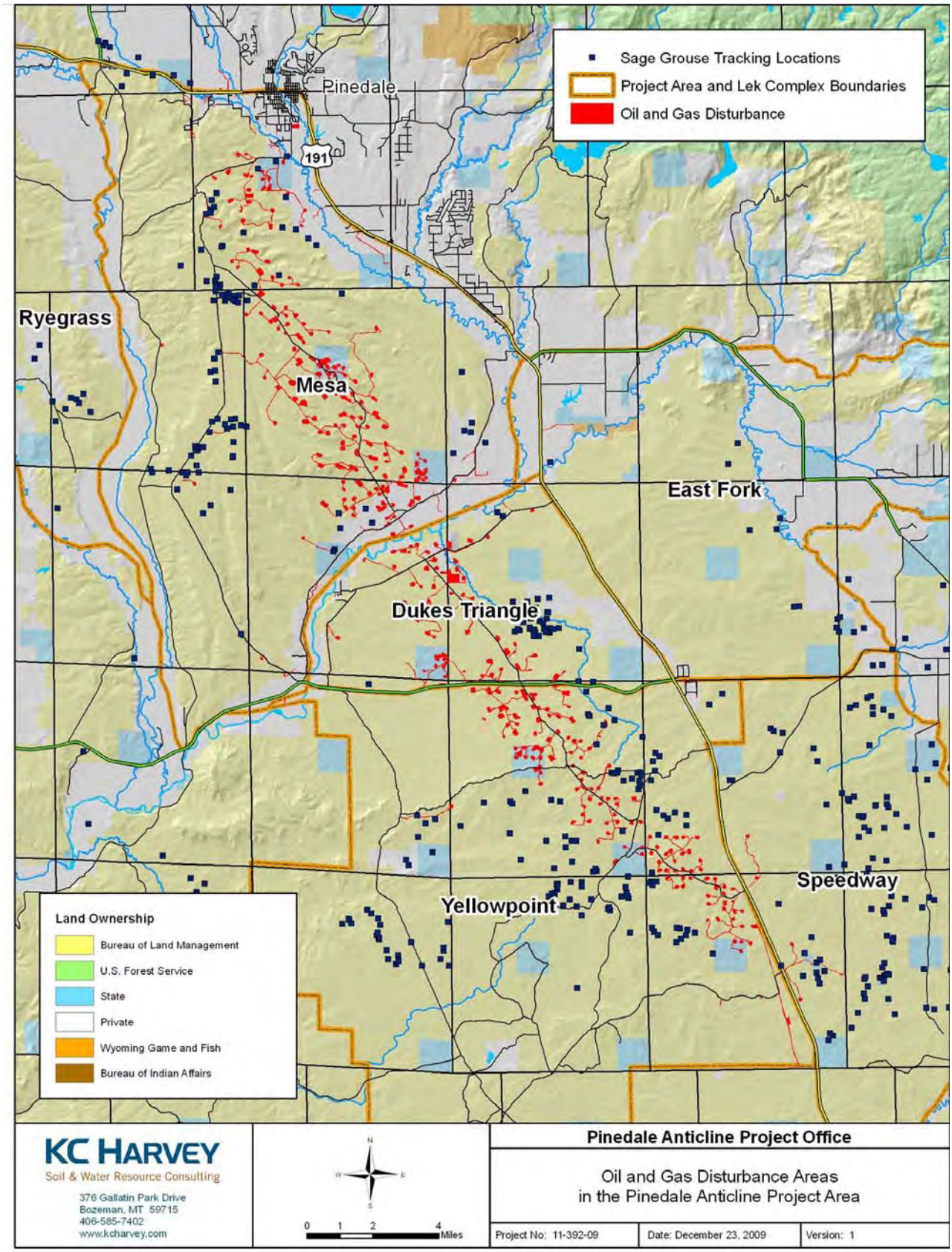


Figure 9. Oil and gas disturbance areas in the Pinedale Anticline Project Area.

2.5. Noise Monitoring

Appendix B of the Record of Decision (ROD), Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project (BLM, 2008) requires noise monitoring at sage grouse leks. The ROD states that the changes in background noise to be monitored are: "Noise levels demonstrated to impact peak lek use by male sage grouse and a concurrent change in the total average 2-year numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes."

Appendix B of the ROD indicates that the specific change in noise monitoring that will require mitigation is as follows: "Decibel levels at the lek more than 10 dBA above background measured from the edge of the lek (2000 ROD, p.27), and a concurrent average of 30% decline in peak numbers of male birds over 2 years vs. reference area." The purpose of this noise monitoring project was to determine the noise levels at leks during the male attendance period from late March to mid May.

The 2000 ROD (BLM, 2000) contains a noise analysis study defining the basis for choosing the threshold noise levels found in the 2000 and 2008 EIS documents (BLM, 1999). This study defines the baseline noise level of 39 dBA based on a similar setting to that of EPA's category of "Farm in Valley". The noise study also acknowledges that local conditions such as traffic, topography, and wind can alter background noise conditions. It is important to note that development of the 39 dBA background level did not include collection or analysis of any noise data from the project area. Therefore, the relevance of the 39 dBA value should be evaluated with respect to noise data from the project area.

Noise monitoring in the PAPA required three tasks:

- Selection of noise monitoring equipment,
- Deployment and maintenance of noise monitoring equipment, and
- Analysis of data and reporting results.

2.5.1. Selection of Noise Monitoring Equipment

Meeting the noise monitoring criteria of the ROD required equipment capable of measuring noise levels over an extended period. The RFP for sage grouse monitoring for this project specified using four noise monitors for two 10-day intervals during the strutting period. WGFD was responsible for identifying the approximately 16 current lek locations requiring monitoring.

The noise monitoring equipment selected for this project included four Quest - SoundPRO-DL-2-1/3-10 Class/Type 2 sound level meters. These hand held meters were used with weatherproof outdoor kits that fully enclose the sound meters and provide extended power. The kits included a weatherproof case, rechargeable 12-volt car batteries, cables, and adapters. This allowed deployment of the meters in adverse conditions for five to seven day periods between battery changes.

2.5.2. Deployment and Maintenance of Noise Monitoring Equipment

Noise monitoring took place between March 27 and May 17, 2009. Due to the late start of the project, it was not possible to monitor 16 locations for two 10-day periods each as requested in

the RFP. Alternatively, WGFD approved a plan to monitor 11 leks for a 10-day and a 5-day monitoring period, and two leks for a single 10-day period.

Field crews that were concurrently tracking sage grouse nesting installed fully charged batteries at five to seven day intervals and moved the noise meters as required. Table 9 lists the leks and monitoring periods and Figure 11 displays their locations.

Table 9. Sage grouse leks monitored and monitoring period durations.

Complex	Lek	Duration
Mesa	Oil Fork Road	One 10-day and one 5-day period
	Mesa Road 3	One 10-day and one 5-day period
	Lovatt West	One 10-day and one 5-day period
	Two Buttes	One 10-day and one 5-day period
	Bloom Reservoir	One 10-day period
	Cat	One 10-day period
Duke's Triangle	Lower Sand Springs Draw	One 10-day and one 5-day period
	Little Fred	One 10-day and one 5-day period
	Big Fred	One 10-day and one 5-day period
Yellowpoint	South Rocks	One 10-day and one 5-day period
	The Rocks	One 10-day and one 5-day period
	Shelter Cabin Reservoir	One 10-day and one 5-day period
	Alkali Draw	One 10-day and one 5-day period

2.5.3. Noise Monitoring Results

Summary data analysis indicates that average measured noise levels are all below the 10 dBA above background threshold level of 49 dBA defined in the ROD (Table 10). Two locations had noise levels below baseline (Two Buttes and Mesa Road 3), and the highest level was 47.4 dBA at the Lovatt West lek. Median noise levels are also below 49 dBA level at all measured locations.

Field personnel maintaining the noise meters noticed that windy conditions increased noise levels significantly, sometimes to greater than 50 dBA. Since windy conditions are common in the area, wind noise may contribute significantly to the background noise levels. Figure 10 illustrates the distribution of noise levels at the Oil Fork Road lek. It shows that 24 dBA is the most common measurement recorded. Note that the mean noise level for this lek was approximately 43 dBA, and the median was 32 dBA. This suggests that noise levels are typically low, but punctuated by periods of increased noise, possibly from wind.

Two sage grouse leks monitored for noise were observed to have significant noise sources nearby. The Little Fred lek had a drill rig active when WGFD was conducting lek counts in March (personal communication, WGFD). The Rocks lek in the Yellowpoint Complex is approximately one mile southeast of a compressor station. At both locations, during non-windy periods, sound was noticeably audible during field visits. However, the continuous noise monitoring did not identify these sources as significant.

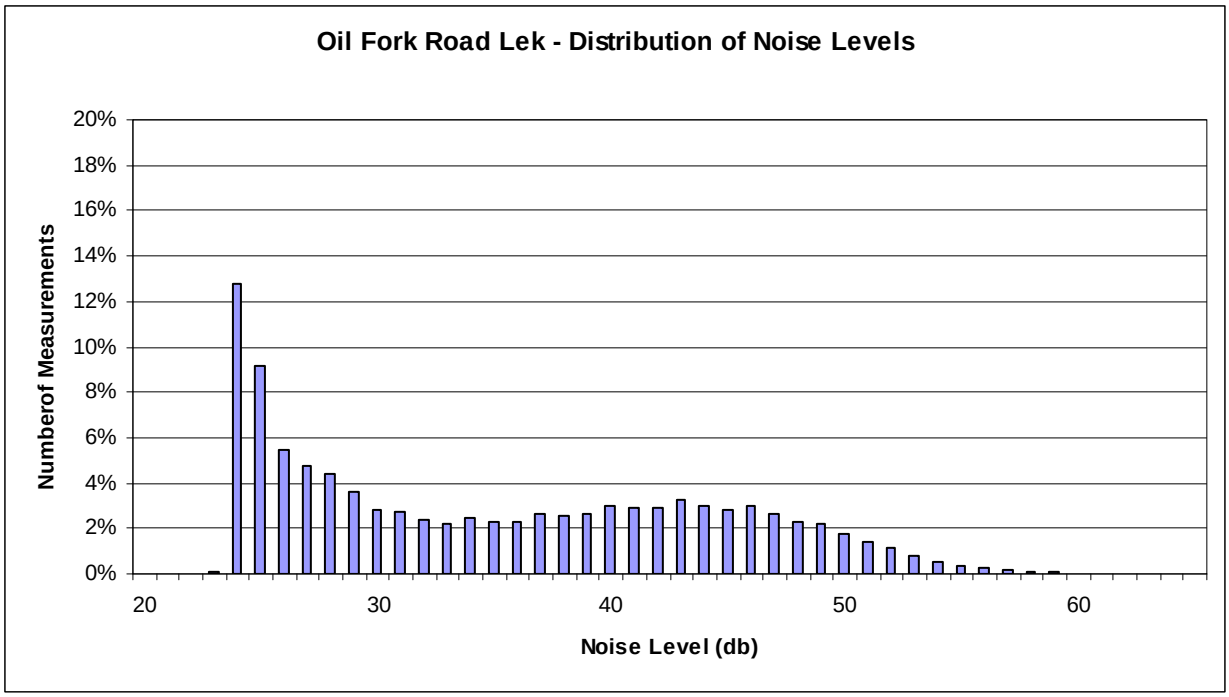


Figure 10. Distribution of noise level data collected at the Oil Fork Road lek, April 17-22, 2009.

Timing of noise levels is an important consideration. If variable noise levels during the course of a day are typical, threshold noise levels for monitoring should potentially be adjusted to compensate. To investigate noise level change with time of day, we took a closer look at data from four leks (Oil Fork Road, Little Fred, South Rocks, and the Rocks). Table 2 lists average noise levels for these leks during three time periods, early morning (12 AM-7 AM), daylight (7 AM-7 PM, and late evening (7 PM-12 AM). The time periods were selected based on natural breaks in the noise data.

Table 10. Summary noise monitoring results.

Complex	Lek	Average Noise Level (dBA)	Difference from 39 dBA Baseline	Median Noise Level (dBA)	Early AM (12AM- 7AM) Average Noise Level (dBA)	Daylight (7AM-7PM) Average Noise Level (dBA)	Late PM (7PM-12 AM) Average Noise Level (dBA)
Mesa	Oil Fork Road	42.8	3.8	33.0	34.5	53.1	51.4
	Mesa Road 3	32.5	-6.5	33.4			
	Lovatt West	47.4	8.4	33.2			
	Two Buttes	37.8	-1.2	35.6			
	Bloom Reservoir	41.9	2.9	29.2			
	Cat	44.3	5.3	28.1			
Duke's Triangle	Lower Sand Springs Draw	39.7	0.7	41.3			
	Little Fred	44.2	5.2	39.6	43.0	50.0	44.7
	Big Fred	42.4	3.4	33.5			
Yellowpoint	South Rocks	42.7	3.7	33.3	38.5	48.5	49.5
	The Rocks	44.4	5.4	33.1	43.3	50.2	42.6
	Shelter Cabin Reservoir	40.5	1.5	34.7			
	Alkali Draw	44.0	5.0	28.8			

In all cases, early morning hours (12AM-7AM) had the lowest measured average noise levels. Daylight hours (7 AM-7 PM) had the highest measured average noise levels at three of the four locations (Oil Fork Road, Little Fred, and the Rocks). At the South Rocks lek, measured average noise levels were high during the late evening period (7 PM-12 AM).

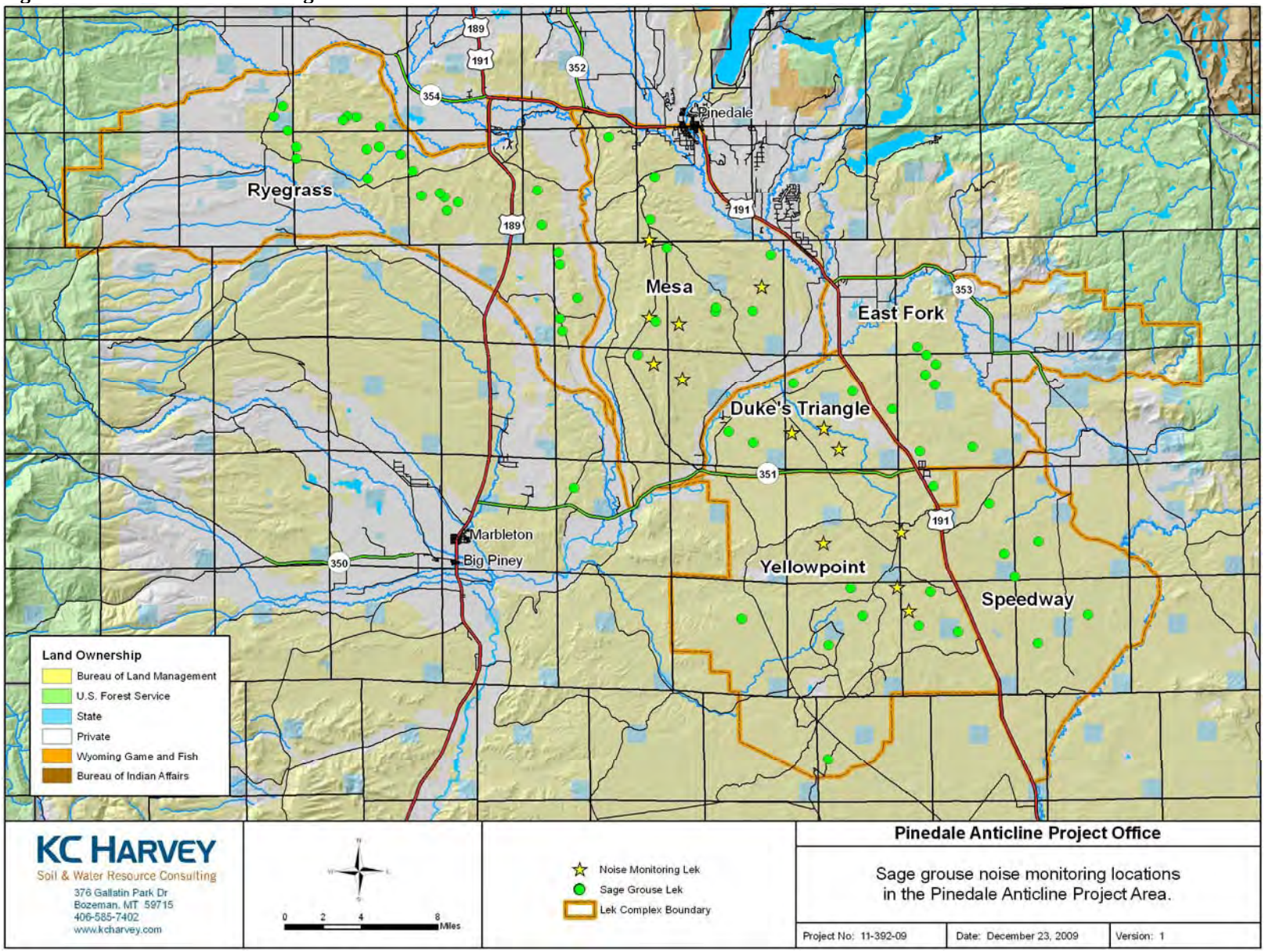
These results suggest that a single noise level threshold may not accurately reflect project area conditions. Background noise levels may be a function of:

- Time of day (and accompanying wind patterns),
- Weather,
- Local conditions such as topography, aspect, vegetation, and
- Development activity.

Noise monitoring results from 2009 indicate that threshold levels defined in the Record of Decision (ROD) documents from 2000 and 2008 for the Pinedale Anticline Project Area were not exceeded at monitored leks from late March to mid May. Observed variability in noise levels associated with windy conditions and at different times of day suggest that more data is required to develop local threshold noise levels.

Noise monitoring in 2010 should attempt to answer some of the unknowns in the noise conditions of the project area. This will determine if adjustment for the threshold noise levels defined in the ROD is warranted as part of adaptive management.

Figure 11. PAPA noise monitoring locations.



3.0 References Cited

BLM, 1999. Noise Analysis for the Pinedale Anticline Oil and Gas Exploration and Development Project, Sublette County, Wyoming. U.S. Bureau of Land Management, Pinedale Field Office, Pinedale, Wyoming. In cooperation with: U.S. Army Corps of Engineers, U.S. Forest Service, and the State of Wyoming.

BLM, 2000. Final Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project, Sublette County, Wyoming. U.S. Department of the Interior, Bureau of Land Management, Wyoming State Office. In cooperation with the U.S. Forest Service, U.S. Army Corps of Engineers, and the State of Wyoming.

BLM, 2008. Record of Decision for the Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project Sublette County, Wyoming. U.S. Department of the Interior, Bureau of Land Management, Cheyenne, Wyoming.

Connelly, et.al., 2003. Monitoring of Greater Sage-grouse Habitats and Populations. Station Bulletin 80, College of Natural Resources Experiment Station, Moscow, Idaho, University of Idaho.

JIO, 2007. Wildlife Monitoring Plan for the Jonah Infill Drilling Project, 2007. Prepared for the Bureau of Land Management, Pinedale Field Office. Prepared by the Jonah Interagency Mitigation and Reclamation Office.

KC Harvey, Inc., 2008. Soils, Vegetation, and Sage Grouse Habitat Mapping, Jonah Infill Area. Report to Jonah Infill Area operators and the Jonah Interagency Office.

Sargeant, A. B., M. A. Sovada, and R. J. Greenwood, 1998. Interpreting evidence of depredation of duck nests in the prairie pothole region. U.S. Geological Survey, Northern Prairie Wildlife Research Center, Jamestown, ND and Ducks Unlimited, Inc., Memphis, TN. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/birds/depred/index.htm (Version 02JUL99).

USGS, 2009. National Hydrography Dataset. http://nhd.usgs.gov/index.html

Wakkinen, W. L., Reese, K. P., Connelly, J. W., and Fischer. R. A. 1992. An Improved Spotlighting Technique for Capturing Sage Grouse. Wildlife Society Bulletin 20:425-426.

Appendix A – Additional Data

The following data analysis was conducted to gain insight on habitat selection of sage grouse. It is outside of the scope of this project, but is presented here to provide information that may be relevant to future monitoring.

Habitat Selection Supplemental Data

Spatial analysis presented in the following selection provides information on sage grouse habitat selection. This includes sage grouse movement patterns, proximity to roads, proximity to water features, and vegetation communities dominant in sage grouse usage areas.

Sage Grouse Movement Summary

Figure 12 illustrates vectors between sage grouse capture locations (leks) and nesting locations. Five sage grouse hens crossed major roads after capture and prior to nesting, four from the Ryegrass lek complex and one from the Speedway complex.

Collared sage grouse hens from each complex generally used a distinct area over the course of the 2009 data collection. Figure 13 below displays the location of all sage grouse vectors derived from tracking locations throughout 2009. Figure 13 and Figure 14 indicates that the collared sage grouse hens from each lek complex not only mate and nest in distinct areas, but also spend the brood rearing period in distinct areas. There is only minor overlap in the areas occupied by sage grouse hens from one complex with areas occupied by hens from other complexes. In Figure 14, each color represents density contours of sage grouse vectors. Each vector represents a straight line between tracking events for a single collared bird. The minimum density displayed (lightest shade of each color) represents greater than one sage grouse vector per square mile.

Figure 15 summarizes the straight line distances between sage grouse capture locations and corresponding nesting locations for collared hens by complex. Collared Ryegrass sage grouse hens traveled farthest from their capture locations to their nest locations (2.8 miles median value), and Duke's Triangle hens traveled the least (0.3 miles median value). Ryegrass hens exhibited the most variability in capture to nest distance. Figure 9 above also illustrates that within some lek complexes, there may be distinct populations of sage grouse. For example, in both the Ryegrass and Mesa complexes, there appear to be two groups of sage grouse that stay spatially separated during the mating and nesting periods. In the Yellowpoint complex, the map suggests there may be three distinct populations.

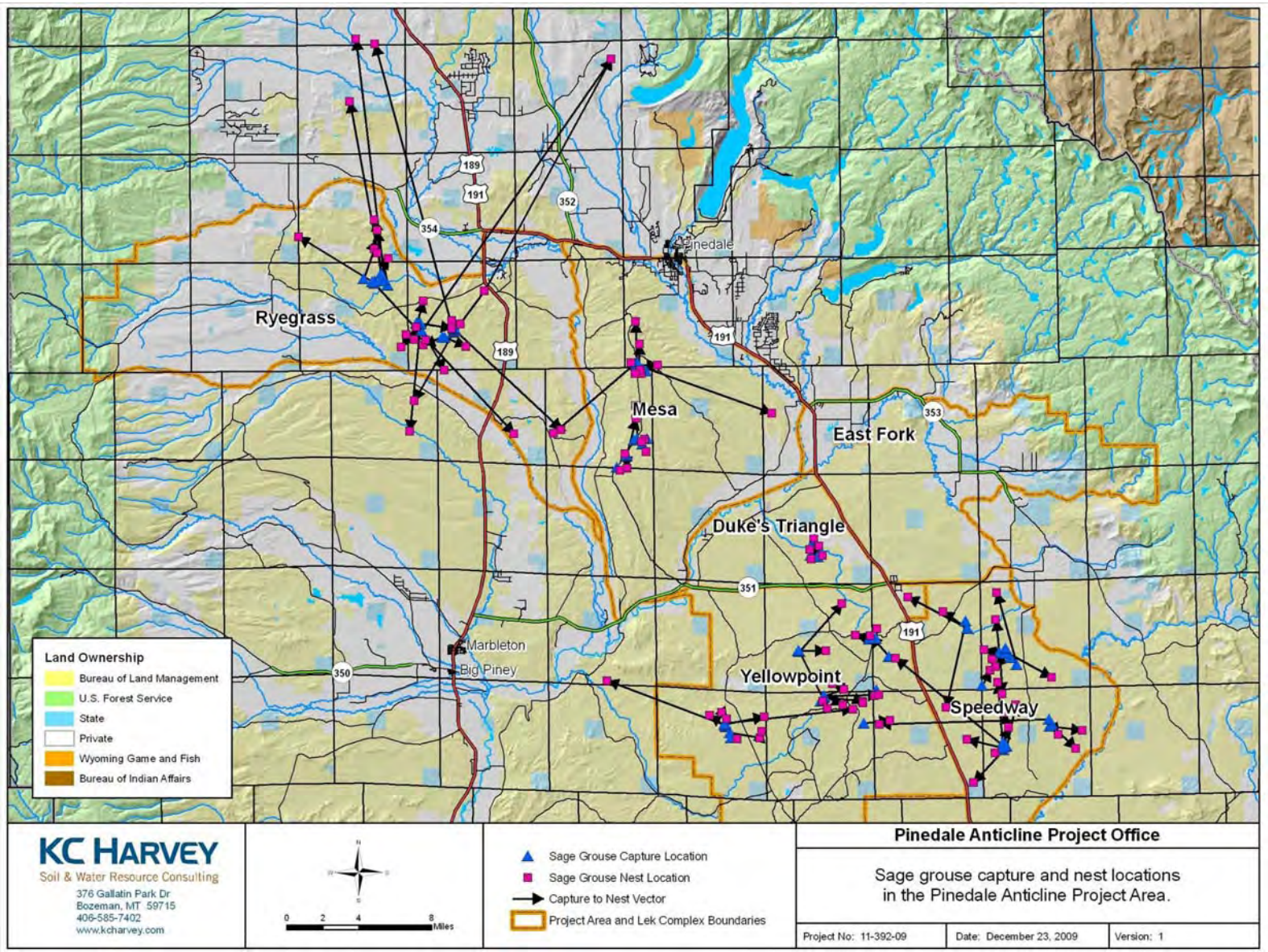


Figure 12. Sage grouse capture to nest vectors.

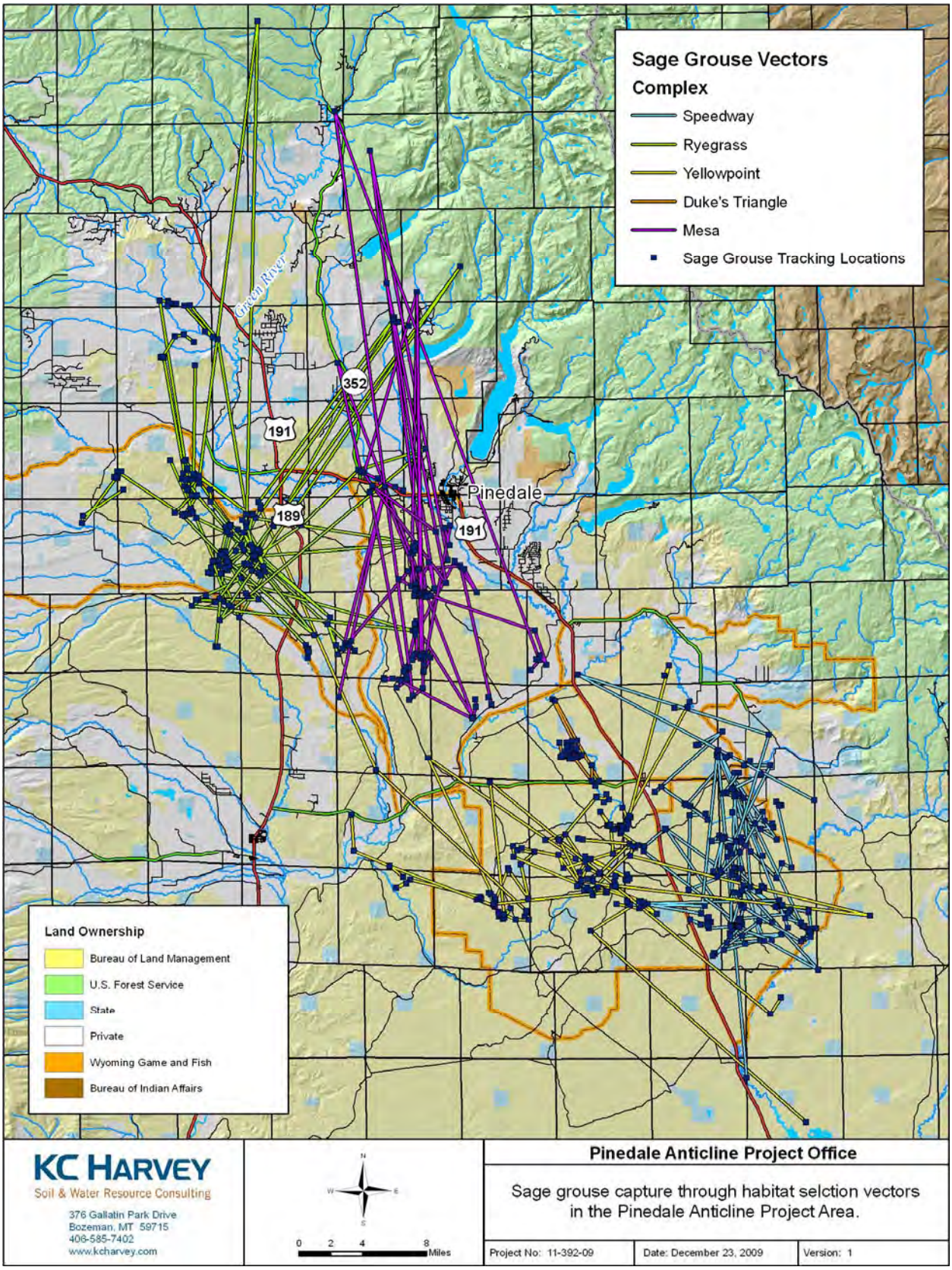


Figure 13. Sage grouse vectors from capture through habitat selection.

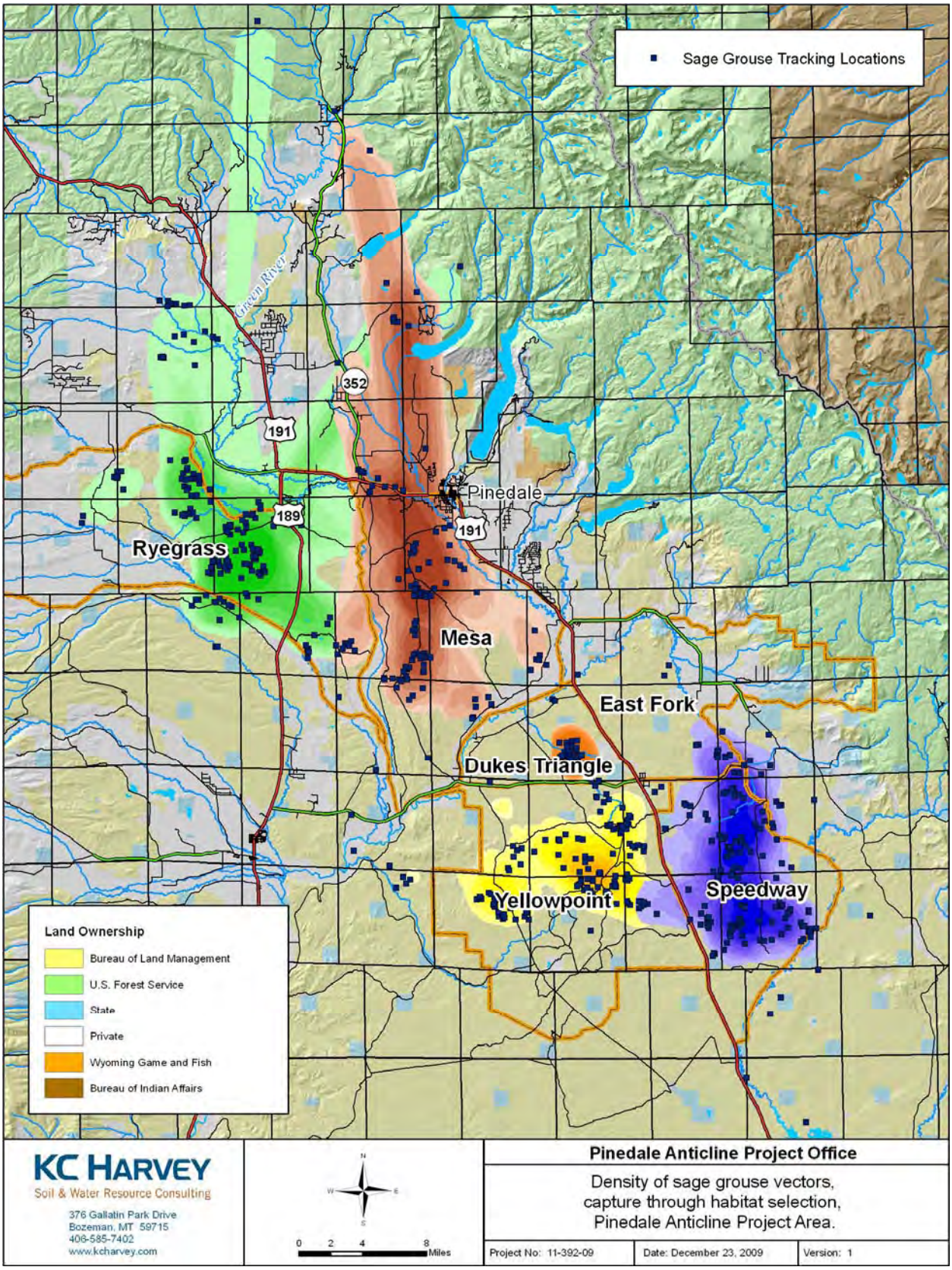


Figure 14. Density of sage grouse vectors, capture through habitat selection.

	Speedway	Ryegrass	Yellowpoint	Duke's Triangle	Mesa	All Complexes
Q1	1.2	1.3	1.0	0.3	0.4	0.7
Min	0.6	0.3	0.1	0.3	0.1	0.1
Med	1.9	2.8	1.5	0.3	0.6	1.8
Max	9.4	18.3	7.1	0.7	7.9	18.3
Q3	3.3	8.0	2.4	0.4	1.9	3.5
N	23	25	20	5	16	89

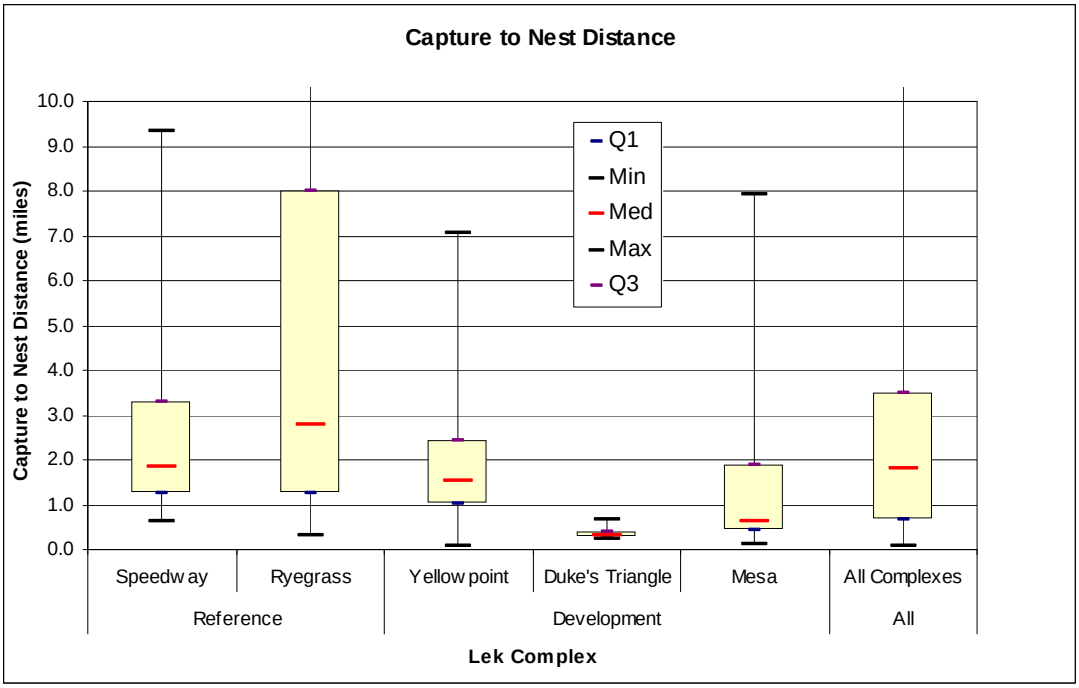


Figure 15. Capture location to nest location distances for sage grouse hens.

Proximity to Roads

Figure 12, Figure 13, and Figure 14 all illustrate that the majority of collared sage grouse hens did not cross major roads. Only five collared sage grouse hens crossed major roads between capture and nesting. Four of these hens were from the Ryegrass complex, and one from the Speedway complex.

Additional analysis of the sage grouse tracking locations with respect to major roads (highways) indicates that 75 percent of all recorded sage grouse locations are greater than 4000 meters (2.5 miles) from a major road. The exception is the Duke's Triangle Complex, where major roads surround the entire complex (Figure 16) and distances to major roads are smaller.

Analysis of sage grouse tracking locations with respect to major and minor roads (all roads) indicates that the median distances between these two are approximately 1100 meters (0.7 miles). Median distances between sage grouse tracking locations and roads in the Mesa Complex were considerably less, with a median value of approximately 300 meters (1000 feet) (Figure 17).

	Speedway	Ryegrass	Yellowpoint	Duke's Triangle	Mesa	All Complexes
Q1	4,128	4,237	3,833	2,550	5,482	3,727
Min	42	30	242	180	60	30
Med	6,575	6,655	6,339	2,700	7,078	6,391
Max	15,911	20,071	17,041	4,020	12,523	20,071
Q3	9,305	8,355	8,487	3,054	11,208	8,763
N	202	276	195	53	152	878

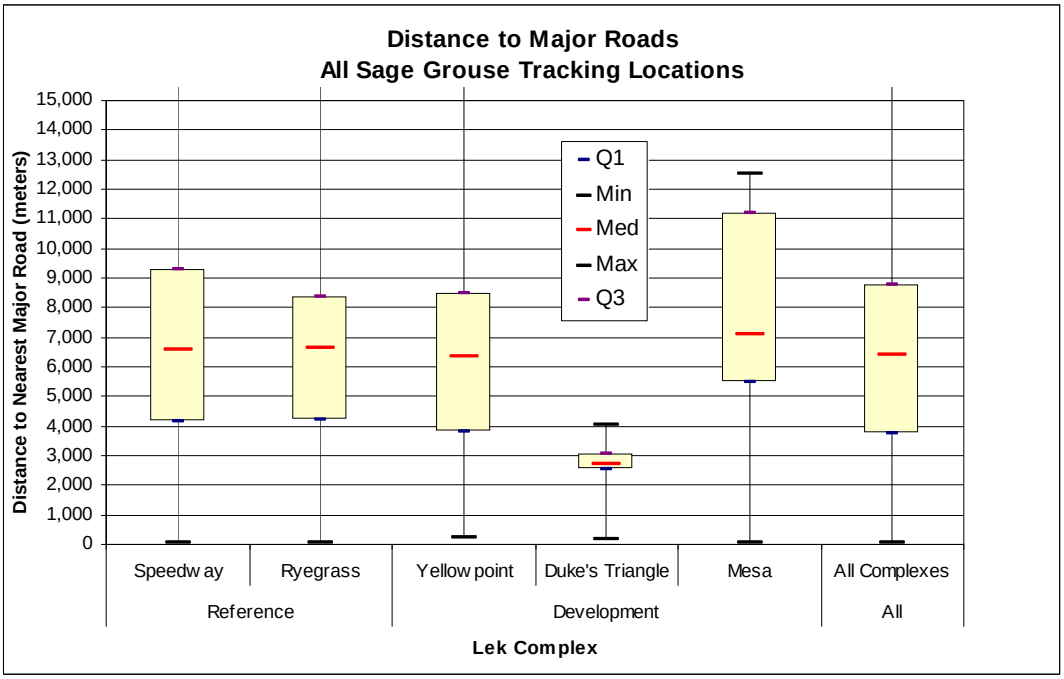


Figure 16. Summary of distance between sage grouse tracking locations and major roads.

	Speedway	Ryegrass	Yellowpoint	Duke's Triangle	Mesa	All
Q1	951	1,064	446	1,022	134	452
Min	0	0	0	108	0	0
Med	1,740	2,411	854	1,434	316	1,140
Max	5,395	5,738	4,548	2,596	2,708	5,738
Q3	2,656	3,301	1,309	1,939	531	2,228
N	202	276	195	53	152	878

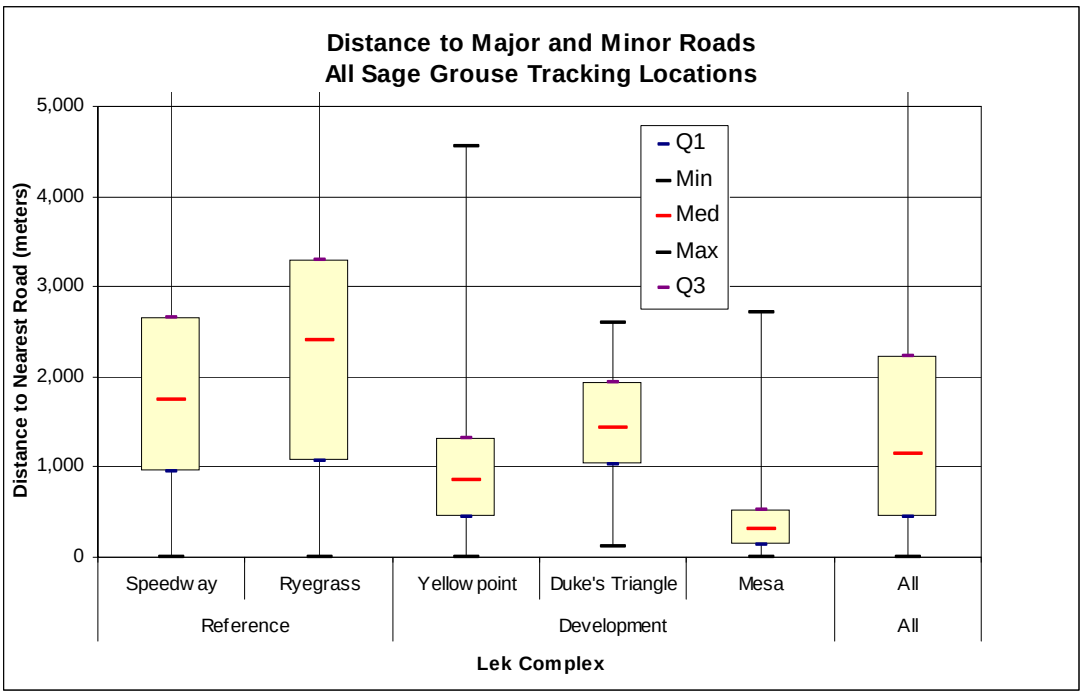


Figure 17. Summary of distance between sage grouse tracking locations and major and minor roads.

Distances between tracking locations and roads are greater in the reference area complexes than in the development area complexes due to higher road density in the development areas (Table 11). Road densities in the development areas range from 1.8 to 2.5 linear miles per square mile, compared to 1.1 to 1.2 linear miles per square mile in the reference areas.

Table 11. Road distribution in the project area lek complexes.

Area Type	Complex	Complex Area (square miles)	Road Length (miles)	Road Density (miles/square mile)
Reference	Speedway	105	122	1.2
	Ryegrass	238	259	1.1
	East Fork	123	129	1.1
Development	Yellowpoint	186	335	1.8
	Dukes Triangle	47	92	2.0
	Mesa	162	399	2.5

Proximity to Water

Field technicians tracking sage grouse during summer and fall months observed that tracking locations of sage grouse hens were frequently near a water source. Analysis of sage grouse tracking locations with respect to water confirmed these observations (Figure 18). For this analysis, water is defined as perennial streams, canals and ditches, named streams, and waterbodies from the National Hydrography Dataset (NHD) (USGS, 2009). For all complexes, 75 percent of tracking locations during the summer and fall habitat selection period were within 960 meters (0.6 miles) of a water source. The median distance to water was approximately 500 meters (0.3 miles).

Median distances to water from capture (lek) or nesting locations were typically much greater than distances from habitat selection locations. These distances were typically 30 percent to 100 percent greater. This indicates that proximity to water is a significant factor during the summer and fall months (brood rearing period) for sage grouse hens.

	Speedway	Ryegrass	Yellowpoint	Duke's Triangle	Mesa	All Complexes
Q1	424	150	485	164	123	180
Min	30	0	0	0	0	0
Med	752	300	872	237	238	480
Max	2,497	1,348	2,220	700	1,489	2,497
Q3	1,203	697	1,251	505	480	962
N	57	63	44	10	40	214

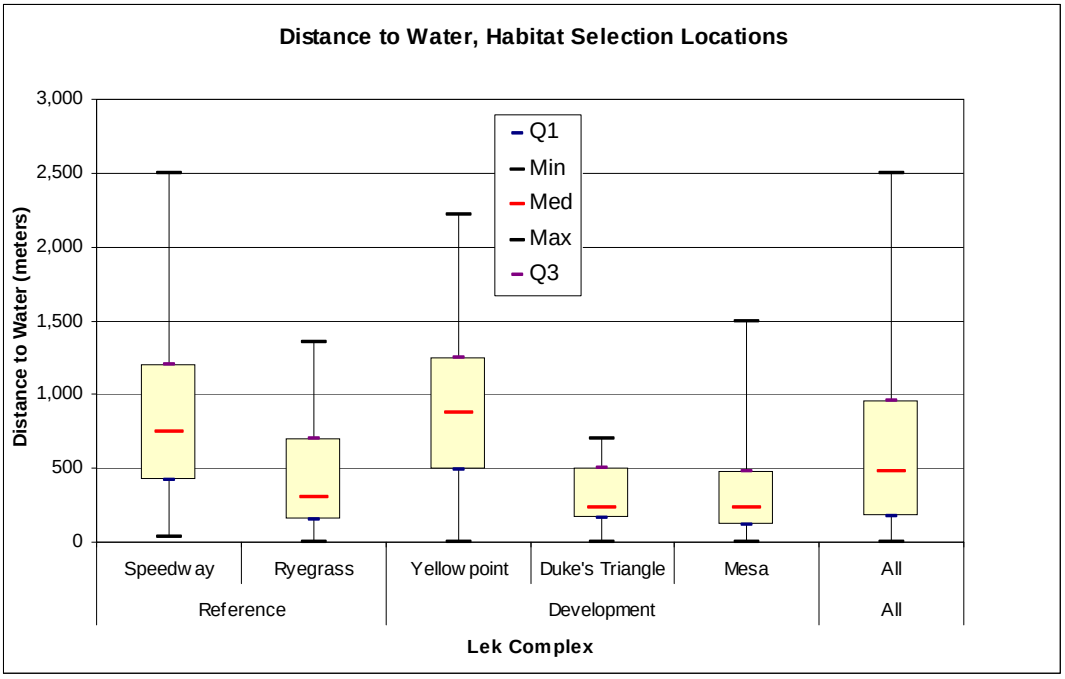


Figure 18. Summary of distance to water from sage grouse habitat selection locations.

Vegetation Communities

One of the objectives of this project was to assess the habitat selection of sage grouse hens after nesting, during the summer and fall months. The USGS has been developing a land cover dataset that was expected to provide the data necessary to complete this analysis. However, the USGS has not yet released this dataset.

In 2008, KC Harvey, Inc. conducted a vegetation, soils, and sage grouse habitat assessment for the Jonah Infill Area (KC Harvey, 2008). This project met the Jonah Interagency Office (JIO) wildlife management plan requirement for operators to map sage grouse seasonal habitats (JIO, 2007). The report and final datasets were delivered to operators, BLM, and JIO in October 2008. Vegetation and sage grouse habitat maps developed for the Jonah project are in Appendix A.

The Jonah vegetation and sage grouse habitat assessment used satellite imagery and LIDAR elevation data, supported by vegetation data collected for reclamation monitoring, to map land cover. This assessment resulted in development of high resolution (2.4 meter) vegetation and potential sage grouse habitat datasets. Table 8 lists the cover classes defined in the Jonah vegetation dataset and their distinguishing characteristics. The dataset distinguishes between undisturbed cover classes and disturbed cover classes associated with oil and gas development.

Table 12. Vegetation cover classes defined for the Jonah Infill Area, KC Harvey, Inc., 2008.

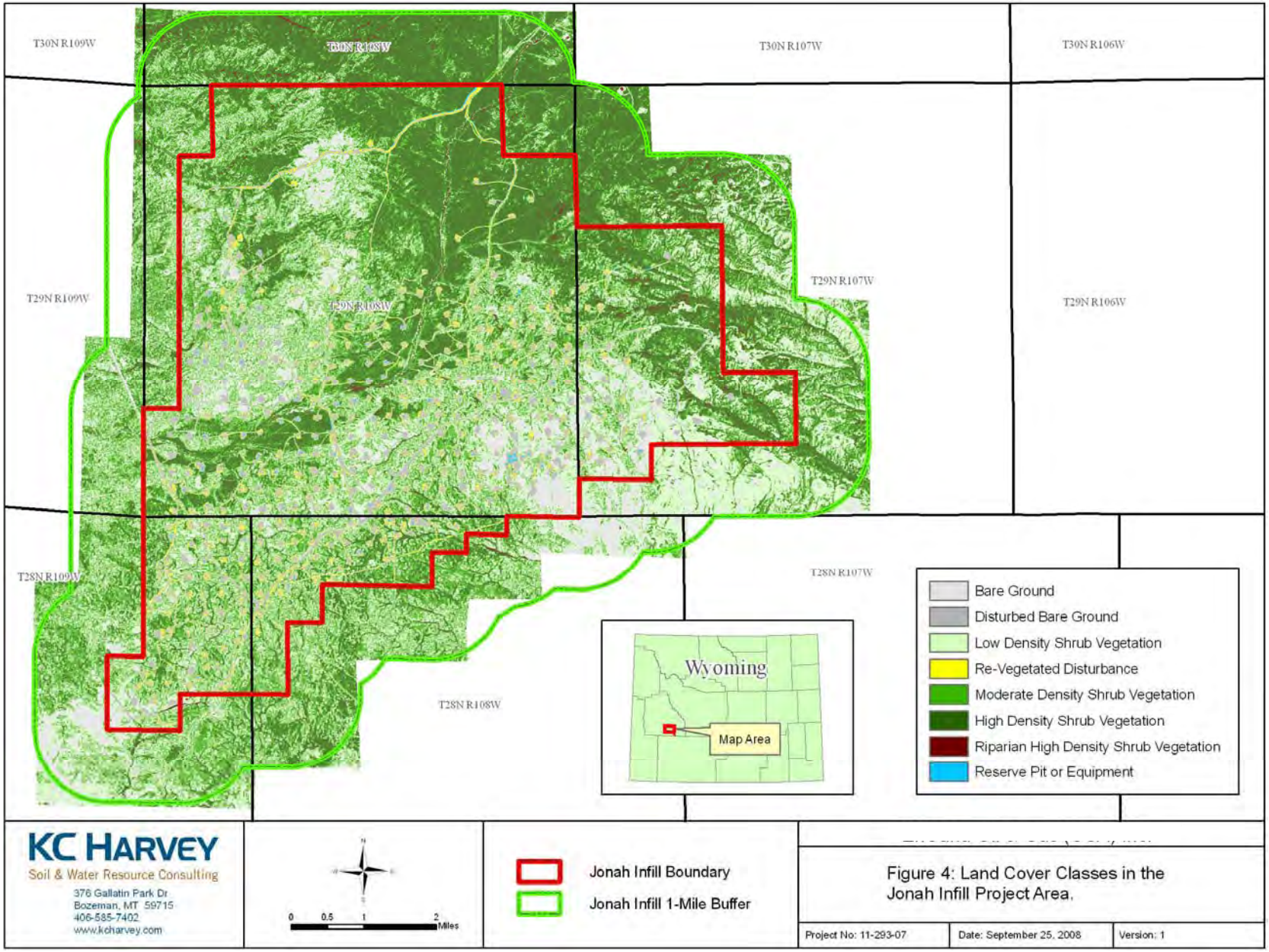
Land Cover Class	Type	Distinguishing Characteristic (Based on 2006 field vegetation data)	2009 Tracking Locations, Buffer Zone Analysis
Bare Ground (undisturbed areas with naturally occurring sparse vegetation)	Undisturbed	0-3% shrub canopy cover	0.5%
Low Density Vegetation (Sparse shrubs, grass, and forbs)	Undisturbed	4-11% shrub canopy cover	4.5%
Moderate Density Vegetation (Moderate shrubs, grass, and forbs	Undisturbed	8-22% shrub canopy cover	18%
High Density Vegetation (Dense shrubs, grass, forbs)	Undisturbed	17-28% shrub canopy cover	76%
Riparian High Density Vegetation	Undisturbed	>25% shrub canopy cover, greater shrub heights.	1%
Disturbed Bare (drill pads, roads, other infrastructure – no significant revegetation)	Disturbed	Minimal vegetation cover, in disturbed area.	
Re-vegetated (Disturbed areas with significant re-vegetation)	Disturbed	Spectral signature similar to moderate density vegetation, but in disturbed area. 2-16% grass.	
Water or Structures (dark areas that represent settling ponds or equipment)	Disturbed or no data	Dark spectral signature, water in ponds or equipment and infrastructure.	

Seventy-five sage grouse tracking locations from 10 sage grouse hens collared in 2009 were located in areas covered by the Jonah Infill Area study. Nine of these hens were captured on leks in the Yellowpoint Complex, and one was captured on a lek in the Speedway Complex.

To determine sage grouse habitat use, we created 30 meter buffer zones around the tracking locations and analyzed which vegetation classes are present in these areas. Seventy six percent of the total buffer zone area around the 75 sage grouse location points consisted of the high-density vegetation cover class (last column in Table 8). This cover class typically contains 17-28% shrub canopy cover, in addition to grass and forbs.

On a broad scale, the Jonah study identified a large area of potential sage grouse habitat covering the northeast portion of the Jonah Infill Area. Collared sage grouse hens from the Yellowpoint Complex extensively used this area in 2009.

Jonah Infill Area Vegetation and Sage Grouse Habitat Maps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Re-Vegetated Disturbance
Moderate Density Shrub Vegetation
High Density Shrub Vegetation
Riparian High Density Shrub Vegetation
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376 Gallatin Park Dr
Bozeman, MT 59715
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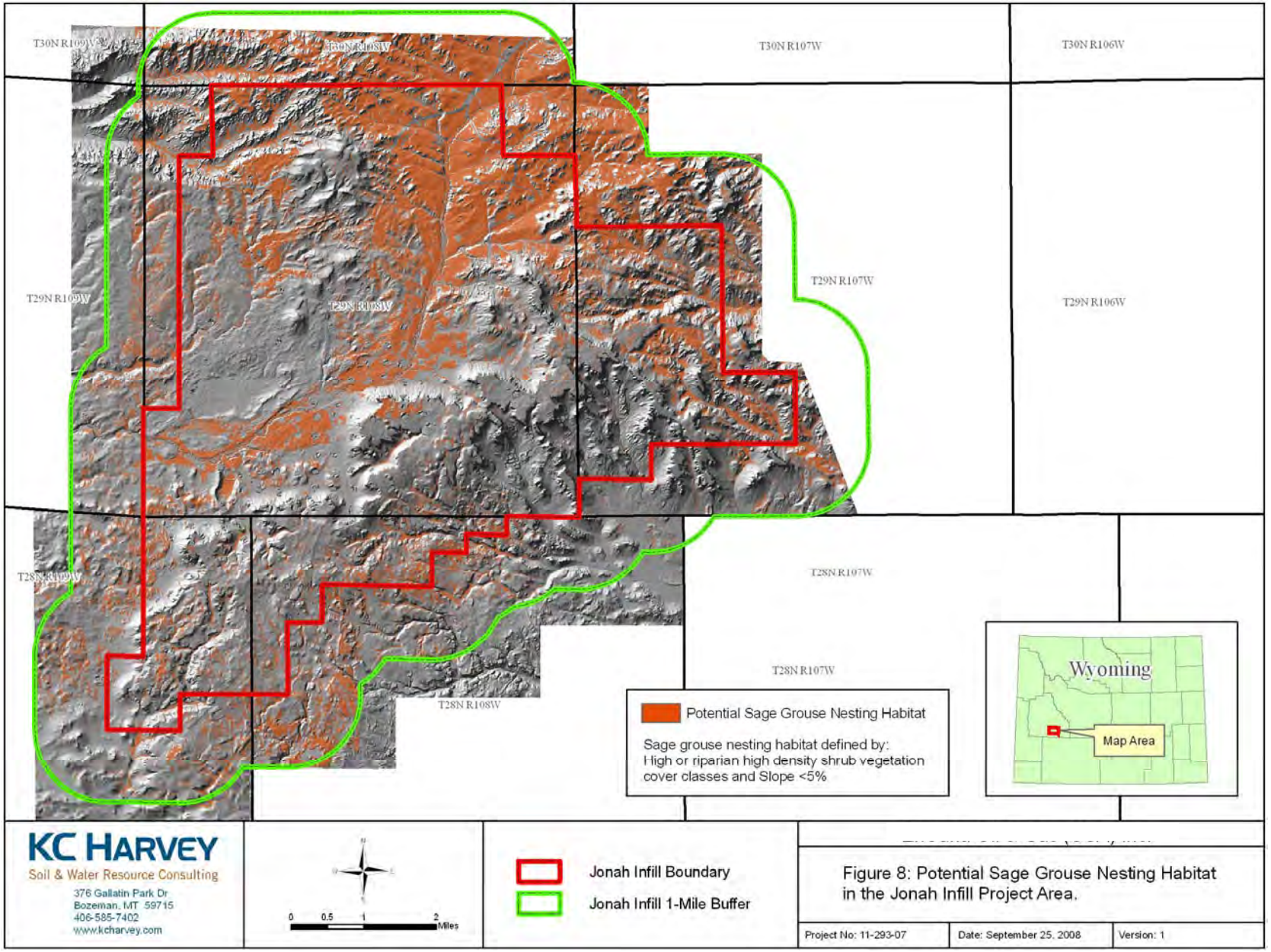
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T30N R106W
T29N R107W
T29N R106W
T28N R107W
T28N R107W
T28N R108W
Potential Sage Grouse Nesting Habitat
Sage grouse nesting habitat defined by:
High or riparian high density shrub vegetation cover classes and Slope <5%
Wyoming
Map Area
KC HARVEY
Soil & Water Resource Consulting
376 Gallatin Park Dr
Bozeman, MT 59715
406-585-7402
www.kcharvey.com
0 0.5 1 2 Miles
Jonah Infill Boundary
Jonah Infill 1-Mile Buffer
Figure 8: Potential Sage Grouse Nesting Habitat in the Jonah Infill Project Area.
Project No: 11-293-07
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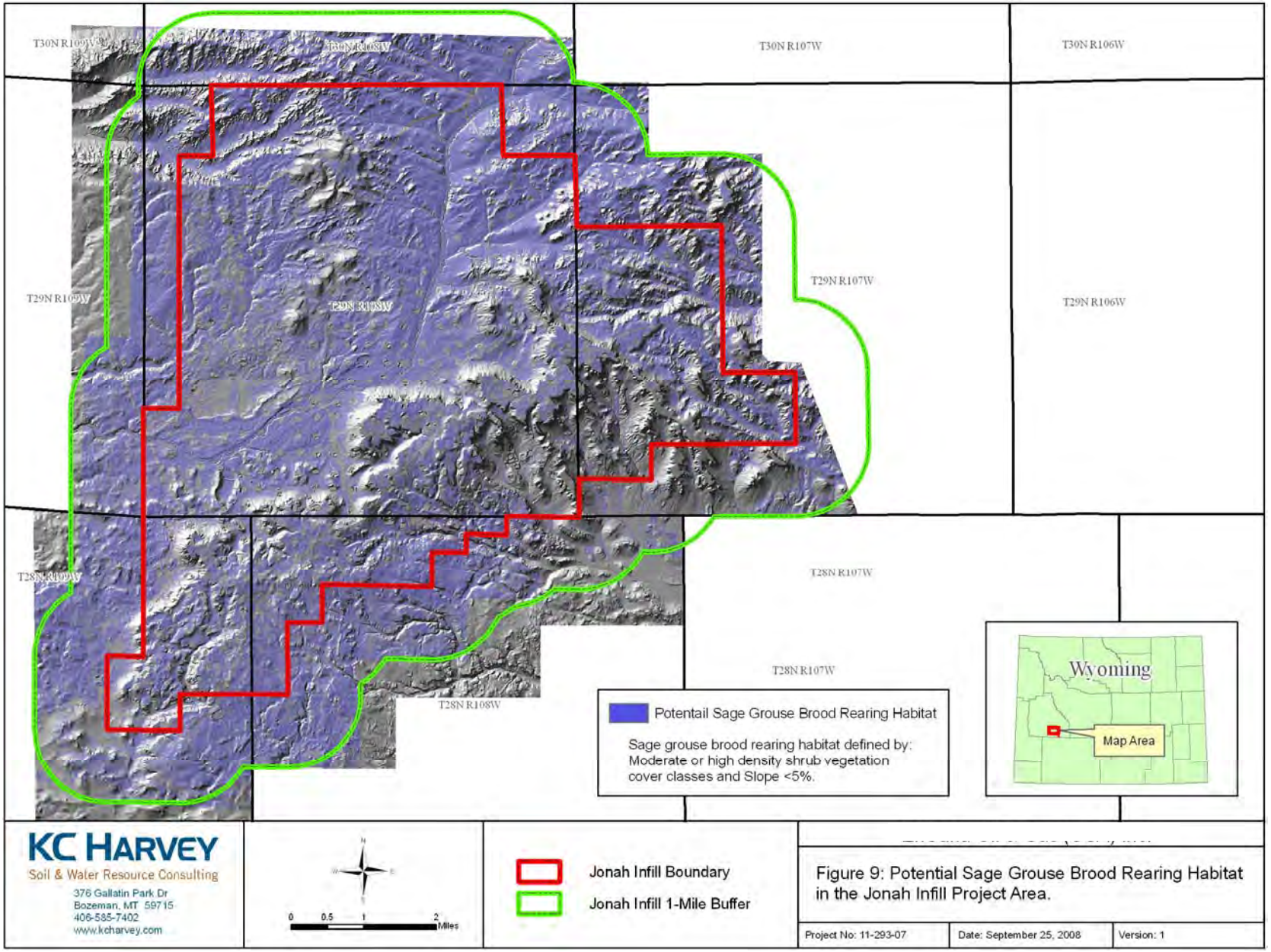
Version: 1


T30N R107W
T30N R106W
T29N R107W
T29N R106W
T28N R107W
T28N R107W
T28N R108W
Potentail Sage Grouse Brood Rearing Habitat
Sage grouse brood rearing habitat defined by:
Moderate or high density shrub vegetation
cover classes and Slope <5%.
Wyoming
Map Area
KC HARVEY
Soil & Water Resource Consulting
376 Gallatin Park Dr
Bozeman, MT 59715
406-585-7402
www.kcharvey.com
0 0.5 1 2 Miles
Jonah Infill Boundary
Jonah Infill 1-Mile Buffer
Figure 9: Potential Sage Grouse Brood Rearing Habitat in the Jonah Infill Project Area.
Project No: 11-293-07
Date: September 25, 2008
Version: 1