

Benefits to Wildlife from the Application of Water Produced by Coal Bed Natural Gas Development

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OVERVIEW

The production of coal bed natural gas (CBNG) in Wyoming has become a major industry and the discharge of large amounts of produced water associated with these operations is a major issue. Although this circumstance has generated opinions regarding the disposal and use of these waters, it has also created the opportunity to do something beneficial with the water. This paper focuses on the potential for using these pumped waters for the beneficial use of wildlife.

The value of wetlands is well known, and the establishment of new wetland areas through the application of produced water would significantly increase the biological diversity of areas and regions where CBNG is being developed. Over time, the function and value of these newly-created wetland areas would equal those associated with natural wetlands. A summary of these functions and values is shown in Table 1.

Table 1. Examples of functions and values for wetlands (adapted from various sources).

<u>Functions</u>	<u>Examples of Functions</u>	<u>Examples of Values</u>
Hydrology	Aquifer recharge/discharge Water storage and regulation Climate control	Water quality/quantity Flood control
Biogeochemical cycling and storage	Nutrient source/transformer/sink Sediment and organic matter sink	Water quality Erosion control
Bioproductivity and decomposition	Net primary productivity Carbon storage/release Detritus output for aquatic organisms Mineralization and release of N, S, C, and P	Food chain support Water quality Recreation Commercial products
Ecosystem processes	Habitat for plant and animal species* Food chain support Maintenance of biotic diversity	Recreation/aesthetics** Commercial products Water quality/quantity

* Wetlands provide food and water or shelter to over 90% of Wyoming's wildlife; 75-80% of all waterfowl breed in or around wetlands; 43% of all federally-listed species are dependant upon wetlands for survival (Cheyenne Botanical Gardens 2003).

** Hunting, fishing, trapping, photography, bird watching, outdoor classrooms of environmental education, and the enjoyment of open spaces.

WILDLIFE WATER NEEDS

Water can benefit wildlife in a number of ways, both directly and indirectly and these major benefits are summarized below:

Direct Benefits

- Drinking
- As habitat - many species like waterfowl and fish live in or on the water.

Indirect Benefits

- The production of food
- The production of cover

The degree to which produced water meets wildlife needs and produces benefits varies according to the location of discharge sites on the landscape and the number and types of discharge facilities. The timing, quantity, and duration of produced water discharge will have a cumulative beneficial impact upon wildlife and their habitats that are adjacent or proximal to discharge sites. Because many of the areas where CBNG is being developed have a naturally semi arid climate and suffer periodic drought conditions, the addition of produced water to these parched landscapes is likely to produce benefits to wildlife that are both immediate and pronounced. The lack of water in general, and during drought in particular, is stressful to wildlife and can threaten their survival. The surface discharge of produced water in these areas can provide an alternative water source for wildlife during stressful drought periods and help to alleviate limiting conditions caused by lack of water.

PREREQUISITES

To insure that the surface application of produced water provides benefits to wildlife, the adherence to the following protocol is recommended:

- Development of a water management plan that has been approved or developed by a land management agency such as the Bureau of Land Management (BLM), Forest Service (FS), or Natural Resource Conservation Service (NRCS).
- Certification of and input to the management plan by the Wyoming Game and Fish Department and the Fish and Wildlife Service.
- Water quality and quantity must be controlled or adjusted so as to insure that its application to the land surface and discharge into retention ponds, reservoirs, and downstream waterways produces beneficial effects.

OBJECTIVES

Gary Beach, a former administrator of the Water Quality Division of the WDEQ set forth the following criteria to demonstrate that the surface discharge of produced water would generate benefits to wildlife. According to these five criteria, a beneficial use for wildlife can be demonstrated by:

- Enhancing existing habitat for wildlife
- Creating new habitat for wildlife
- Increasing wildlife populations
- Allowing existing wildlife populations to disperse
- Benefitting both resident and migratory wildlife populations

APPLICATION METHODS

Examples of primary applications of produced water that can be beneficial to wildlife:

- Surface irrigation
- Creation of new water bodies
- Enhancement of existing water bodies
- Downstream discharge
- Provision of dispersed watering tanks

WYOMING SPECIES

A large number of mammals, birds, reptiles, amphibians, and fish occur within the areas in Wyoming where CBNG is currently being developed. For purposes of this document, the potential benefits of produced water to wildlife are described for each of the wildlife groups defined in WDEQ, Land Quality Division Guideline Number 5 (WDEQ 1994) relative to the five criteria set forth by Gary Beach in 2002 at a planning meeting in which the format and content of Beneficial Use Statements were discussed.

Big Game (Wild Ungulates)

As detailed below, the surface discharge of produced water can generate benefits for big game animals (mule deer, white-tailed deer, elk, and pronghorn) that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - Produced water is expected to improve forage quality and quantity adjacent to water discharge sites through increasing vegetative vigor, growth, and diversity. If new reservoirs and other watering sites are constructed and distributed widely over the production area, perennial water for wild ungulates would be

provided at sites and during seasons where water was previously unavailable. Because produced water is relatively warm, a certain amount of ice-free water would be expected to be available to ungulates even during the winter months. The increased availability of free water is of great value to animals in a region of limited precipitation, and is particularly critical during drought periods.

Create New Habitat for Wildlife - Development of new water sources and their eventual discharge into existing ephemeral channels and other water courses will create new foraging habitat through increased annual production of vegetation and eventual establishment of wetland species. Thermal/hiding cover will also be increased and would provide increased protection for deer and pronghorn fawns from predation during this critical stage of their development. The use of produced water for the irrigation of palatable forage crops in strategic locations would create new feeding areas and increase the availability of nutritious forage.

Increase Wildlife Populations - Increasing the number of watering points would reduce distances animals need to travel to get to water and will decrease caloric expenditures and exposure to predators during trips to watering areas. This is particularly important during the winter months, drought periods, and the fawning period in early summer. Wild ungulates commonly consume snow during the winter as a water source. However, the utilization of relatively warm, ice-free produced water during the winter would be beneficial in that it would reduce the physiological expenditure of calories required to melt snow. These reductions in the expenditure of calories and exposure to predators would collectively contribute to the survival potential of wild ungulates in areas surrounding the produced water developments and enhance the potential for increases in populations. The improvement in forage quantity and quality adjacent to produced water discharge sites and the application of irrigation water to nutritious forage crops will also contribute to the potential for increasing carry capacities for wild ungulates (Yoakum and Spalinger 1979, Wallmo 1981, Halls 1984). The increase in hiding cover for fawns would increase their survival rate and allow for a higher recruitment rate into the population.

Allow Existing Wildlife Population to Disperse - The placement of reservoirs and watering sites in areas where no perennial water was previously available would increase the potential for better dispersal of wild ungulates and a more even and complete utilization of forage resources across the range. The careful distribution of forage crop irrigation site across the area would also contribute to a more uniform dispersal of animals.

Benefit both Resident and Migratory Wildlife Populations - Both resident and migratory wild ungulate populations would benefit from the surface discharge of produced water.

Upland Game Birds

The surface discharge of produced water can generate benefits for upland game birds (greater sage-grouse, sharp-tailed grouse, wild turkey) that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - The discharge of produced water would generally enhance the existing habitats of upland game birds by increasing vegetation diversity and annual production. Although some improvements in all seasonal habitats are likely, brood-rearing habitats in particular would benefit from increased grass and forb diversity and growth adjacent to wet areas. Increases in existing insect populations associated with vegetation near new perennial water sources is also likely to occur and will provide improved brood foraging opportunities. Perhaps more importantly, a suitable new niche for an entire guild of riparian/wetland-obligate insect species, that are presently absent, would be created. Insects such as damselflies and dragonflies, civil bruet, common skimmers, darners, and numerous fly species, would significantly increase diversity and expand the food web for a large number of avian species, including upland game birds.

Create New Habitat for Wildlife - Development of new water sources and their eventual discharge into ephemeral and other water courses would create new habitat for upland game birds. The new areas of perennially moist vegetation and enhanced growth near produced water discharge points and along historically ephemeral water courses are likely to be used as brood-rearing and foraging areas by upland game birds. Upland game birds in Wyoming are adapted to moderately dry habitats, and benefit from moist or wet areas, especially during the brood-rearing period (Peterson 1970, Eng 1986). The use of produced water for the irrigation of palatable forage crops in strategic locations would create new feeding areas and increase the availability of nutritious forage.

Increase Wildlife Populations - The use of surface produced water to create new reservoirs and moist to wet drainage courses along with the irrigation of forage crops would help to increase upland game populations in three ways. First, the quality of quality of existing brood-rearing habitats would be improved through the addition of surface water. Second, the number of areas that provide brood-rearing habitat will be increased through the creation of new produced water discharge points. The creation of new moist areas will produce lush patches of vegetation that provide hiding cover, insects, and forbs that are critical to the survival of young birds. Third, the use of produced water for the irrigation of palatable forage crops in strategic locations would create new feeding areas, increase the availability of nutritious forage, and increase the carrying capacity of the area.

Allow Existing Wildlife Population to Disperse - The creation of new produced water discharge points increases the potential for better dispersal of upland game birds during the early summer when hens with broods are seeking forbs and insects which are particularly important to young birds. Also, the use of produced water for the irrigation of palatable forage crops in strategic locations would help to disperse upland game birds during the late summer and early fall months by creating new feeding areas with moist, nutritious forage that could be used during a time of the year when moist natural forage is limited.

Benefit both Resident and Migratory Wildlife Populations - Although upland game birds populations in Wyoming make seasonal movements, most are not considered to be migratory. Thus, the benefits of the surface discharge of produced water would apply mostly to resident populations. However, certain greater sage-grouse populations in

Wyoming do migrate and would benefit in the ways listed above during the nesting, brood-rearing, and late summer/early fall periods of the year.

Raptors

The surface discharge of produced water can generate benefits for raptors that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - An increase in availability of raptor prey species would be expected to occur due to increases in both the numbers and diversity of small mammal, bird species, and large insects that inhabit areas adjacent to the produced water discharge points and outflow channels. A variety of small mammal, bird, and large insect species are associated with riparian habitats, and the increase in area, growth, and vigor of riparian vegetation that would result from the discharge of produced water is expected to provide improved habitat for them, and result in an increase in the abundance of raptor prey species.

Create New Habitat for Wildlife - New foraging habitats for raptors would be created through the surface application of produced water. Water discharged into reservoirs and stream channels, as well as that used to irrigate forage crops, would provide new habitats for raptor prey species and create foraging areas for raptors that previously did not exist. If fish are stocked in newly created water bodies, the potential for attracting and supporting fish eating raptor species such as bald eagles and ospreys would be enhanced.

Increase Wildlife Populations - The increase in prey base abundance and diversity described above creates the potential for an increase in raptor chick production and survival. The increase in prey availability may also allow more breeding pairs of raptors to establish territories and further contribute to increased raptor production.

Allow Existing Wildlife Population to Disperse - The increased dispersion and production in prey populations would increase the potential for more raptor pairs to occupy the area and for them to extend their territories into areas not previously used because of limited prey production.

Benefit both Resident and Migratory Wildlife Populations - Improvements in prey base abundance and diversity would benefit both resident and migratory species of raptors.

Waterfowl and Shorebirds

The surface discharge of produced water can generate benefits for waterfowl and shorebirds that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - Existing habitat for waterfowl and shorebirds would be enhanced by the surface discharge of produced water by providing additional water flow in streams which were previously ephemeral and increasing water availability in existing water reservoirs.

Create New Habitat for Wildlife - Produced water stored in newly developed retention reservoirs would in time create new nesting, brood-rearing, and foraging habitats for waterfowl and shorebirds through the development of submergent, emergent and shoreline vegetation. The food base, comprised of plants, insects, reptiles, amphibians, and fish, that would be created would support a wide variety of waterfowl and shorebird species.

Increase Wildlife Populations - Waterfowl and shorebird populations would increase due to the creation of new habitats and the improvement of existing habitats resulting from the surface discharge of produced water. These improvements would increase carrying capacity and production through increases in nesting and brood-rearing habitats. The emergent and adjacent vegetation around the reservoirs would increase the potential for brood survival by providing escape cover and foraging areas.

Allow Existing Wildlife Population to Disperse - The creation of new, more widely dispersed habitats (ponds and reservoirs) would result in less concentration of both resident and migratory waterfowl and shorebirds on existing water bodies and produce better dispersal of birds over the area.

Benefit both Resident and Migratory Wildlife Populations - Resident and migratory populations of waterfowl and shorebirds would benefit from the increased number of ponds, reservoirs, and marshy areas that are the product of the surface discharge of produced water. During seasonal migration periods the birds would benefit from the existence of a greater number of open water stopover points where they can rest and replenish energy reserves. Resident species would benefit by having improved foraging, nesting, brood-rearing, and escape habitats.

Passerine Birds

The surface discharge of produced water can generate benefits for passerine birds that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - The surface discharge of produced water would enhance existing habitats by increasing the growth and vigor of vegetation on and around produced water discharge areas, thereby enhancing passerine nesting and foraging habitats.

Create New Habitat for Wildlife - New nesting and foraging habitats for riparian-reliant passerine birds would be created by the increase in emergent and mesic species of vegetation associated with the surface discharge of produced water into new ponds, reservoirs, and ephemeral stream channels.

Increase Wildlife Populations - The increased nesting habitat and food sources provided to passerines by increased vegetation growth and vigor due to the surface discharge of produced water will contribute to increased brood production and survival. These new habitats would also increase the number of stopover points for certain passerine species during migration periods and could increase survival rates of migrants.

Allow Existing Wildlife Population to Disperse - The application of surface discharge water over the area creates new and more widely dispersed foraging and nesting habitats for passerine bird species, which, in turn, would increase their dispersal over the area.

Benefit both Resident and Migratory Wildlife Populations - Riparian vegetation resulting from produced water release and storage would provide increased stopover points where certain species of passerine birds can rest and forage during migration periods. Resident species would also benefit by having more and improved nesting, brood-rearing, and escape habitat.

Other Mammals

The surface discharge of produced water can generate benefits for other mammals (rodents, rabbits, hares, predators) that meet four of Gary Beaches' five criteria for beneficial use.

Enhance Existing Habitat for Wildlife - The access to water and improved vegetation quality quantity, and diversity adjacent to wet areas created by the surface discharge of produced water would provide improved foraging and reproduction habitats for some species of mammals.

Create New Habitat for Wildlife - Perennial surface water and associated vegetation produced by the surface discharge of produced water would provide new habitats for mammals such as muskrats, voles, shrews, and a variety of other rodents. The perennial water habitats and the increased prey populations they produce would also create additional foraging areas and food items for predatory mammal species.

Increase Wildlife Populations - Increases in populations of small herbivorous mammal species are likely due to the increase of the food base and suitable habitats created by the surface discharge of produced water. These increases in small mammal populations would, in turn, contribute to increases in populations of predatory mammal species such as foxes, coyotes, raccoons, and skunks.

Allow Existing Wildlife Population to Disperse - The increased dispersal of small mammal habitats resulting from the creation of wet areas due to the surface discharge of produced water would result in an increase in the dispersal of mammalian species which would expand their ranges to take advantage of the new resources.

Reptiles and Amphibians

The surface discharge of produced water can generate benefits for reptiles and amphibians that meet all five of Gary Beaches' criteria for beneficial use.

Enhance Existing Habitat for Wildlife - The surface discharge of produced water would enhance existing habitats by increasing the soil moisture levels and the growth, vigor, and diversity of vegetation on and around produced water discharge areas. Such changes to

the existing habitats would make them more suitable for reptiles and amphibians by increasing the moisture levels and food items required by these species.

Create New Habitat for Wildlife - Prey abundance (insects, small mammals, and young reptiles and amphibians) would increase in the newly created wet habitats in and around perennial and ephemeral waters and moist habitats and would provide many new habitats that are suitable for foraging, breeding, and young rearing of reptile and amphibian species.

Increase Wildlife Populations - Reptiles and amphibians would benefit from the establishment of new reservoirs in historically dry areas. The water from the surface discharge of produced water is likely to provide new spawning and young-rearing areas for amphibians and increase the adult population in these wet habitats. The increase in the small mammal prey base may also increase reptile populations around produced water sources.

Allow Existing Wildlife Population to Disperse - The increased distribution of the new riparian habitats created by the surface discharge of produced water would result in a corresponding increase in the distribution of reptile and amphibian populations over the area. Amphibian and reptile dispersal into currently uninhabited areas may also provide the opportunity for small-scale range expansions for some species.

Benefit both Resident and Migratory Wildlife Populations - Although reptile and amphibian populations exhibit seasonal movements, they are not normally considered to be migratory. However, the new riparian habitats created by the surface discharge of produced water could attract and support herptiles from other areas, as well and benefitting resident populations.

Fish

The surface discharge of produced water will generate benefits for fish if the reservoirs with suitable waters are stocked. This has been done in a number of cases and in some places created has new recreational fisheries.

Threatened, Endangered, Proposed, Candidate, and Sensitive Species

There are a number of wildlife species of concern that are know to occur in areas of CBNG development. Overall the surface discharge of produced water will generate benefits for most of these species that are the same as described in other sections of this paper.

SUMMARY

Of the wildlife groups defined in the WDEQ, Land Quality Division Guideline Number 5, all would benefit from surface discharge of produced water. Cumulatively, the surface discharge of produced water would enhance existing wildlife habitats and create new wildlife habitats which would lead to increased populations and dispersal of both resident and migratory wildlife species. Because the major areas of CBNG development in

Wyoming have a generally arid climate and experience periodic prolonged droughts, new water sources produced by the surface discharge of produced water would provide an immediate, as well as a long-term, benefit to wildlife. The value of perennial water supplies suitable for wildlife consumption and of an adequate quality and quantity to enhance and create wild habitats cannot be overemphasized.

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