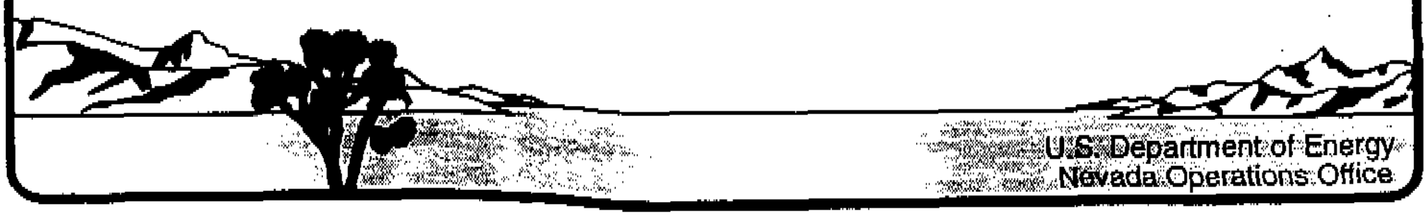
DOE/NV/10972--58

Floodplains and Wetlands Survey Results for the Gasbuggy and Gnome-Coach Sites, New Mexico

December 1993

Environmental Restoration



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List of Acronyms and Abbreviations

AEC	Atomic Energy Commission
BLM	Bureau of Land Management
C.F.R.	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE/NV	U.S. Department of Energy, Nevada Operations Office
EPA	U.S. Environmental Protection Agency
ft	feet
FICWD	Federal Interagency Committee for Wetland Delineation
FWS	U.S. Fish and Wildlife Service
km	kilometer(s)
m	meter(s)
mi	mile(s)
NEPA	National Environmental Policy Act
RI/FS	Remedial Investigation/Feasibility Study
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

1.0 Introduction

The Plowshare Program was initiated by the Atomic Energy Commission (AEC) to explore peaceful uses of nuclear explosives. In the 1960s, two tests under this program were conducted in New Mexico—Project GASBUGGY and Project GNOME (Figure 1-1). A third test, Project COACH, was planned for the same site where the Gnome test had been conducted, but was later cancelled. The DOE Nevada Operations Office (DOE/NV), formerly the AEC, plans to conduct a Remedial Investigation/Feasibility Study (RI/FS) at each site to determine the extent of residual subsurface contamination and the potential for surface contamination resulting from these nuclear detonations.

Before a RI/FS can be initiated, the National Environmental Policy Act (NEPA) of 1969 requires the U.S. Department of Energy (DOE) to evaluate the potential impacts that may occur as a result of performing these activities. DOE Order 5440.1E implementing NEPA require that the presence of environmentally sensitive resources such as cultural resources, sensitive species, wetlands, and floodplains be determined at such sites so that the appropriate level of NEPA documentation can be established. NEPA regulations are specified in 10 Code of Federal Regulations (C.F.R.) Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements." Executive Orders 11988 and 11990 require the DOE to prepare regulations to ensure that floodplains and wetlands, respectively, are considered and protected in all actions undertaken by the agency. In accordance with these requirements, plans to conduct floodplain and wetland field surveys at the Gasbuggy Site and the Gnome-Coach Site, as well as five other locations outside of New Mexico, were prepared in April of 1993 (DOE, 1993), with field surveys performed in June and July, 1993.

This report presents the results of the Level II floodplain and wetland survey for the Gasbuggy Site as outlined in *Survey Plans for DOE/NV Sites Outside of Nevada* (DOE, 1993) hereafter referred to as the "survey plan". The purpose of the Level II survey is to verify the presence of floodplains and wetlands at the site and, if present, delineate their boundaries and collect sufficient data such that adverse impacts potentially resulting from RI/FS field activities can be avoided. Existing information indicates that no floodplain or wetland areas occur at the Gnome-Coach Site (DOE, 1993); however, a field survey was conducted at this site for verification.

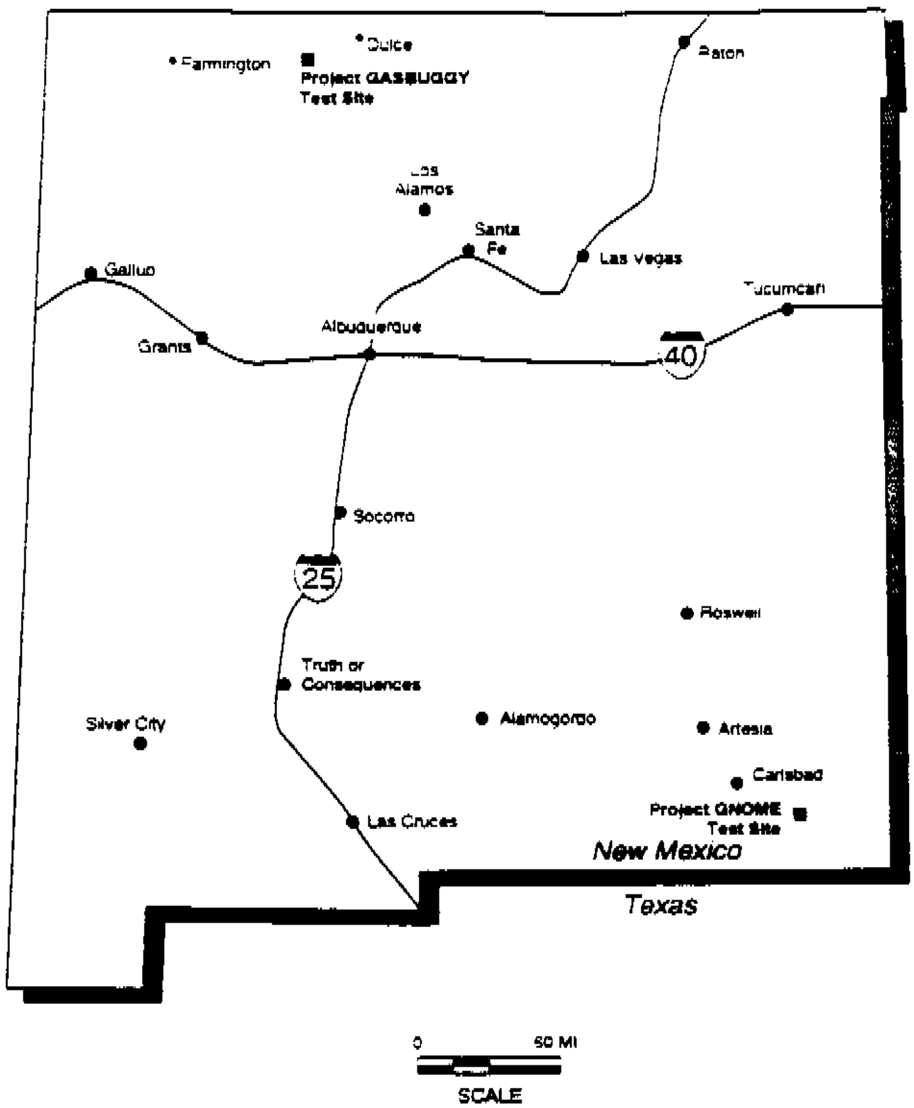

FIGURE 1-1
Locations of the Project GASBUGGY and Project GNOME Test Sites in New Mexico

2.0 Background

2.1 Floodplains and Wetlands Definition/Methodology

"Floodplains" are defined in the 10 C.F.R. Part 1022.4 as:

> *The lowlands adjoining inland and coastal waters and relatively flat areas and floodprone areas of offshore islands including, at a minimum, that area inundated by a 1 percent or greater chance flood in any given year. The base floodplain is defined as the 100 year (1.0 percent) floodplain. The critical action floodplain is defined as the 500 year (0.2 percent) floodplain.*

"Wetlands" are defined in the 10 C.F.R. Part 1022.4 as:

> *Those areas that are inundated by surface or groundwater with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.*

Wetlands generally include swamps, marshes, bogs, and similar areas. Recognizing the potential for continued or accelerated degradation of the nation's water, including wetlands, the U.S. Congress enacted the Clean Water Act. Section 404 of the Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to regulate the filling of waters of the United States and disturbance of wetlands. The Environmental Laboratory (EL), Army Corps of Engineers, has prepared the *Corps of Engineers Wetlands Delineation Manual* (EL, 1987). This manual describes technical guidelines and methods using a multiparameter approach to identify and delineate wetlands for purposes of Section 404 of the Clean Water Act. In accordance with this methodology, the following three parameters are diagnostic of wetlands: (1) the vegetation consists predominantly of hydrophytes; (2) the substrate is predominantly undrained, hydric soils; and (3) the substrate is saturated with water or covered by shallow water for a prolonged time during the growing season.

It is required that, under normal circumstances, all three of these conditions be met for an area to be defined as a wetland. "Normal circumstances" refers to the soil and hydrology conditions that are normally present, without regard to whether the vegetation has been removed (EL, 1987).

2.1.1 Vegetation

A "hydrophyte" is any "macrophyte that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" (EL, 1987). Since most plant species can tolerate a range of growing conditions, individual species are not solely restricted to either wetland or upland communities. The United States Fish and Wildlife Service (FWS) (Reed, 1988) has developed a classification scheme that assigns species to wetland indicator classes as follows:

Plant Indicator Status Categories

Indicator Category	Indicator Symbol	% Occurrence in Wetlands	Status Categories
Obligate Wetland Plants	OBL	>99	Plants that occur almost always in wetlands under natural conditions, but which may also occur rarely in nonwetlands.
Facultative Wetland Plants	FACW	67-99	Plants that occur usually in wetlands, but also occur (1% to 33%) in nonwetlands.
Facultative Plants	FAC	33-67	Plants with a similar likelihood of occurring in both wetlands and nonwetlands.
Facultative Upland Plants	FACU	33-1	Plants that occur sometimes in wetlands, but occur more often in nonwetlands.
Obligate Upland Plants	UPL	<1	Plants that occur rarely in wetlands, but occur almost always in nonwetlands under natural conditions.

The national list of wetland plants prepared by the FWS (Reed, 1988) is used for hydrophyte determinations. Hydrophytic vegetation is present if greater than 50 percent of the dominant plant species from all strata are OBL, FACW, and/or FAC. When greater than or equal to 50 percent of the dominant species are FACU and/or UPL and hydric soils and wetland hydrology are present, the area is also considered to have hydrophytic vegetation. If hydric soils and wetland hydrology are lacking, and normal circumstances exist, then an area is considered to be upland.

2.1.2 Soils

"Hydric soils" are soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (USDA, 1983). Soils are considered hydric when they are: (1) somewhat poorly drained and have a seasonal high water table less than 0.5 feet (ft) (0.15 meters [m]) from the surface or (2) poorly drained or very poorly drained and have a seasonal high water table less than 1.0 or 1.5 ft (0.30 or 0.46 m) from the surface. This high water table must be present for a week or more during the growing season (EL, 1987). Soils that are ponded or flooded for long or very long duration during the growing season are also classified as hydric. All organic soils (histosols) or mineral soils with a histic epipedon are considered hydric soils.

In the field, a hand auger is used to sample the soil to examine indicators of hydric soils, such as low chroma colors, mottling, organic accumulation, and high water table. Soils are generally examined to a depth of approximately 20 inches (0.51 m). Hydric conditions for mineral soils with low to moderate organic content were most commonly demonstrated by gleying and mottling. Gleyed soils develop when anaerobic soil conditions result in pronounced chemical reduction of iron, manganese, and other elements, thereby producing gray soil colors. Gleyed soils are manifested by the presence of neutral grey, bluish, or greenish colors through the soil matrix or in mottles (spots or streaks). Mineral soils are compared to a Munsell Soil Chart (Kollmorgen Corp., 1975) to determine soil color. Soil color is characterized by three features: hue, value, and chroma. Hue refers to the spectral color or chromatic composition of light reflected by the soil. Value refers to the amount of light reflected. Chroma refers to the purity or strength of the color. Soils were considered hydric if they were gleyed or if the top of the B horizon had a chroma of 1 or less if mottling was not present or a chroma of 2 or less when mottling was present.

Low chroma colors are an index of the degree of soil reduction as a result of anaerobic conditions. Low chroma colors include black, various shades of gray, and the darker shades of brown and red. These criteria allow most soils to be classified as either hydric or nonhydric. Hydric soils that have been effectively drained may, however, still show low chroma colors, but are no longer considered to be hydric because they lack the hydrology.

Low chroma colors may not be used as an indicator of hydric soils in those soils that are sandy, are deeply colored as a result of their parent materials, or have recently been formed (i.e., alluvial). These soils must be evaluated more carefully under the procedures outlined in Army Corps of Engineers *Wetlands Delineation Manual* (EL, 1987).

Sandy soils may be considered to be hydric if organic materials have accumulated above or in the surface horizon. Dark vertical streaking of subsurface horizons caused by the downward movement of organic matter also indicates a hydric soil. This streaking may be associated with a spodic horizon located at the average depth of the water table.

The U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS), in cooperation with the National Technical Committee for Hydric Soils, has prepared a national list of hydric soils (USDA, 1987). In addition, the SCS publishes county soil surveys for areas where soil mapping has been completed. Unlisted soils are considered to be nonhydric. However, some phases of unlisted soils may contain hydric inclusions and, thus, may be associated with wetlands. These cases must be individually verified in the field. Field soil characteristics should be given precedence over how a site is mapped on a county soil survey. Alluvial soils may not show hydric characteristics due to their recent formation, but may be considered to be hydric for the purposes of wetland delineation.

2.1.3 Hydrology

Wetland hydrology encompasses the hydrologic characteristics of areas that are inundated or have saturated soils for sufficient duration to support hydrophytic vegetation. Hydrologic indicators are generally used to determine the presence or absence of a wetland. Of the three technical criteria, wetland hydrology is generally the least exact, and indicators of wetland hydrology are sometimes difficult to establish in the field (EL, 1987). An area has wetland hydrology if the soil is saturated to the surface by groundwater or ponded or flooded with surface water for sometime during the growing season. Saturation to the surface can occur when the water table is 0.5 to 1.5 ft (0.15 to 0.46 m) below the surface depending on soil permeability.

Indicators of wetland hydrology may be divided into recorded data and field data. Recorded data may be obtained from aerial photographs, soil surveys, historical data, floodplain delineations, or tide/stream gauges. In the field, wetland hydrology may be evidenced by visual observation of saturation, inundation, or depth to standing water. However, it is not necessary to directly demonstrate the hydrology. Secondary field indicators of wetland hydrology include drainage patterns, morphological plant adaptations, oxidized root channels, water marks, surface scouring, water-stained leaves, sediment deposits, drift lines, moss lines, and bare areas. Unless an area has been hydrologically modified, the hydrologic parameter may also be inferred from the soil profile.

2.2 Background for the Gasbuggy Site Survey

Project GASBUGGY was the one of three experiments under the Plowshare Program to test the feasibility of using underground nuclear explosions to stimulate natural gas production. The 65-hectare (160-acre) Gasbuggy Gas Stimulation Test Site comprises the southwest ¼ of Section 36, Township 29 North, Range 4 West, Rio Arriba County, New Mexico. The detonation of the nuclear device at Gasbuggy was on December 10, 1967. Site demobilization was conducted during August and September 1978. The site is owned by the Federal government and the surface is currently managed by the U.S. Forest Service (USFS). The principal land use is grazing, although a USFS picnic ground is located on the site.

Examination of the U.S. Geological Survey (USGS) 7.5 minute topographic map of the Gasbuggy area (Leandro Canyon quadrangle) shows that the site lies entirely within Leandro Canyon, a relatively small, shallow-sloped tributary canyon to Dry Lake Canyon. The northeast corner of the Gasbuggy Site is dominated by the broad drainage channel of the canyon. The minimum slope of this drainage is approximately 2 percent as it crosses the Gasbuggy Site. The drainage basin above the Gasbuggy Site is approximately 200-hectares (about 500-acres) in size.

An initial survey of state wetland inventories and the Flood Insurance Rate Map for Rio Arriba County did not indicate either wetlands or floodplain areas occurring at the Gasbuggy Site (DOE, 1993). This is consistent with the small size of the upstream drainage basin and the drainage slopes through the site. The topographic map does show a cattle watering tank, Leandro Tank, in the drainage channel near the east side of the site. This is confirmed on a 1:12,000 scale color aerial photograph of the site taken in 1990. This photo shows that two berms have been constructed at Leandro Tank and that the main access road (Forest Road 357) into the canyon is elevated as it crosses the drainage upstream from Leandro Tank. Each of these structures was identified as possible sites of artificially created wetlands.

2.3 Background for the Gnome-Coach Site Survey

Project GNOME was conducted under the Plowshare Program. Detonated on December 10, 1961, in a bedded salt formation, the purpose of the experiment was to test whether the heat and materials produced by the explosion could be geologically contained for later recovery. The 259-hectare (640-acre) test site comprises Section 34, Township 23 South, Range 30 East, Eddy County, New Mexico, with an additional 16-hectares (40-acres) in the extreme northwest corner of Section 10 of that township, which was used as a command post. Surface contamination resulting from the testing program required later decontamination of parts of the sites. Some construction activities were begun for a second test, named Project COACH; however, this test was ultimately cancelled. In 1963, a radionuclide mobility experiment was conducted at this site by injecting into the Salado salt formation through monitoring wells water containing tritium, iodine-131, strontium-90, and cesium-137. Since 1972, the U.S. Environmental Protection Agency (EPA) has annually monitored for potential water contamination by testing surrounding wells. The site surface is currently managed by the Bureau of Land Management (BLM) and is used for grazing.

No obvious drainage pattern is discernable using contours on the USGS 7.5 minute topographic maps of Section 34 of the Gnome-Coach Site, which is split between the Los Medaños and Remuda Basin quadrangles. The extreme northwest corner of the section does appear to contribute surface flow to an off-site drainage into Nash Draw, a large depression west of the site. The command post is situated on a high point, with slopes running to the south into an off-site drainage channel. Available information indicates that no floodplain or wetland areas exist at the Gnome-Coach Site (DOE, 1993).

3.0 Procedure

3.1 Procedure for the Gasbuggy Site Survey

The Gasbuggy Site was surveyed for wetland areas concurrently with a sensitive species field survey. The survey was conducted over a 2½-day period (June 22 to June 24, 1993) by two biologists experienced with wetland habitats in New Mexico. The survey was conducted on the 65-hectare (160-acre) area defined in the survey plan (DOE, 1993). Because the boundaries of the Gasbuggy Site are not physically marked, the survey boundaries were estimated using a USGS 7.5 minute topographic map (the Leandro Canyon quadrangle) and 1:12,000 color aerial photograph from 1990. Where this information could not resolve questions of site boundary, the survey was extended beyond the probable site boundary to ensure site coverage.

The principal survey method entailed walking straight-line transects across the site. The transects were spaced approximately 40 m (130 ft) apart and generally oriented in a east-west direction. Each person was equipped with a Brunton compass so that corrections to the line of travel could be made intermittently. In areas of dense, woody vegetation and difficult terrain, some modifications to this pattern were required. Figure 3-1 shows the pattern of transects walked during the survey. A total of approximately 16 km (10 mi) of transects was walked. Potential wetland sites found during the walking survey were marked on a site map for later examination.

Upon returning to the potential wetland sites located during the walking survey, observations were made and recorded on Field Activity Daily Logs with regard to size of the area, plant species present, and any visual indicators of hydrology and disturbance regime. Larger sites were also photographed. Where soil color indicated possible hydric soil conditions, a small sample was collected for color analysis using a Munsell color chart.

3.2 Procedure for the Gnome-Coach Site Survey

The Gnome-Coach site was surveyed for wetlands concurrently with a sensitive species field survey. This survey was conducted over a 2½-day period (June 25 to June 27, 1993) by two biologists experienced with wetland habitats in New Mexico. The survey included the entire 275-hectare (680-acre) area defined in the survey plan (DOE, 1993).

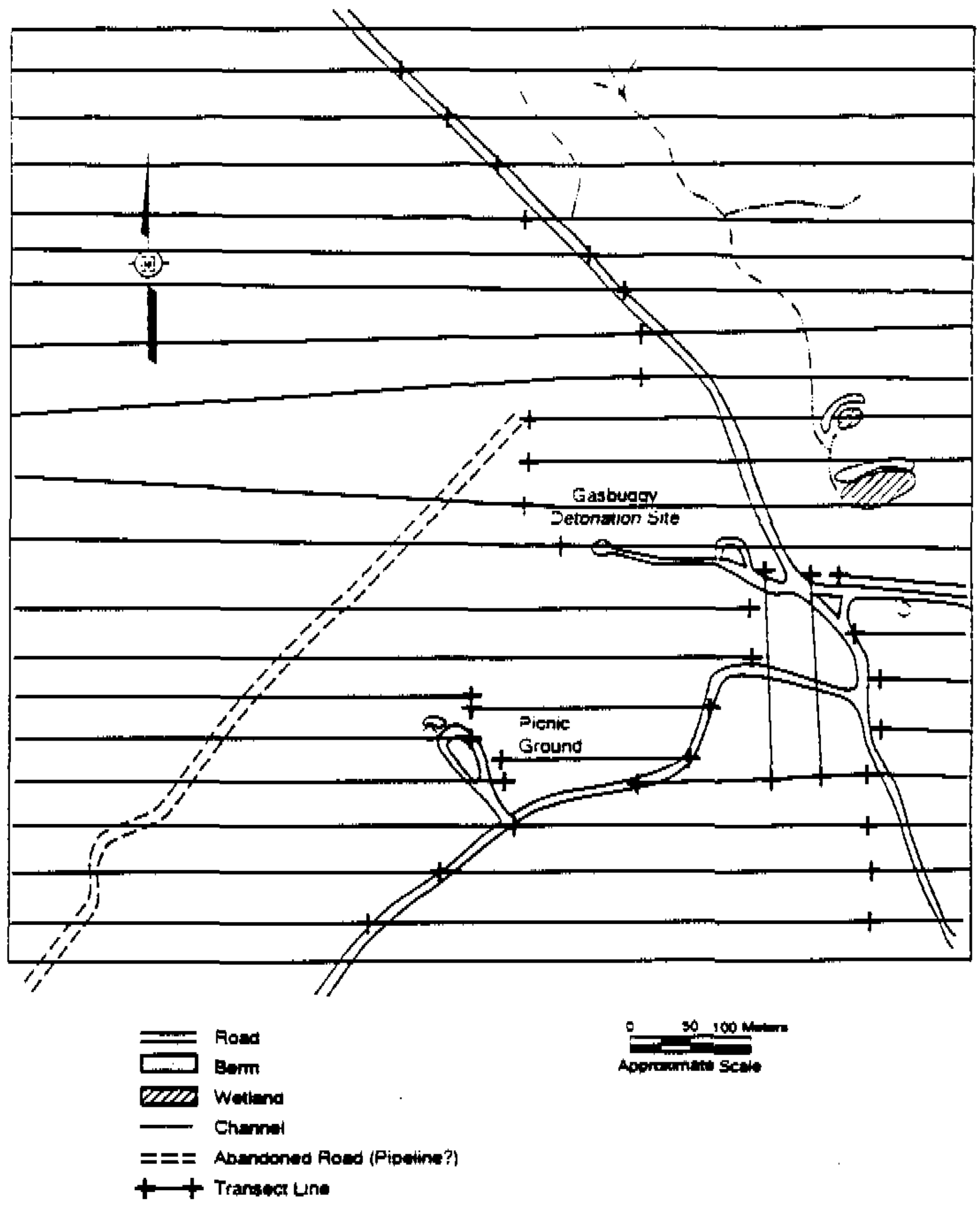

FIGURE 3-1
Pattern of transects used in the sensitive species survey at the Gasbuggy Test Site, New Mexico

The principal survey method entailed walking straight-line transects across the site. The transects were spaced approximately 80-m (260-ft) apart and each person was equipped with a Brunton compass so that corrections to the line of travel could be made intermittently. Figure 3-2 shows the pattern of transects walked during the survey of this section. The command post area was surveyed by walking a large circular pattern through the interior of the site. A total of approximately 33-km (20-mi) of transects was walked. USGS 7.5 minute topographic maps and a 1:10,000 black-and-white aerial photograph from 1977 were used in locating ground positions. The procedure described in Section 3.1 for the Gasbuggy Site would have been followed had a potential wetland site been found during the survey.

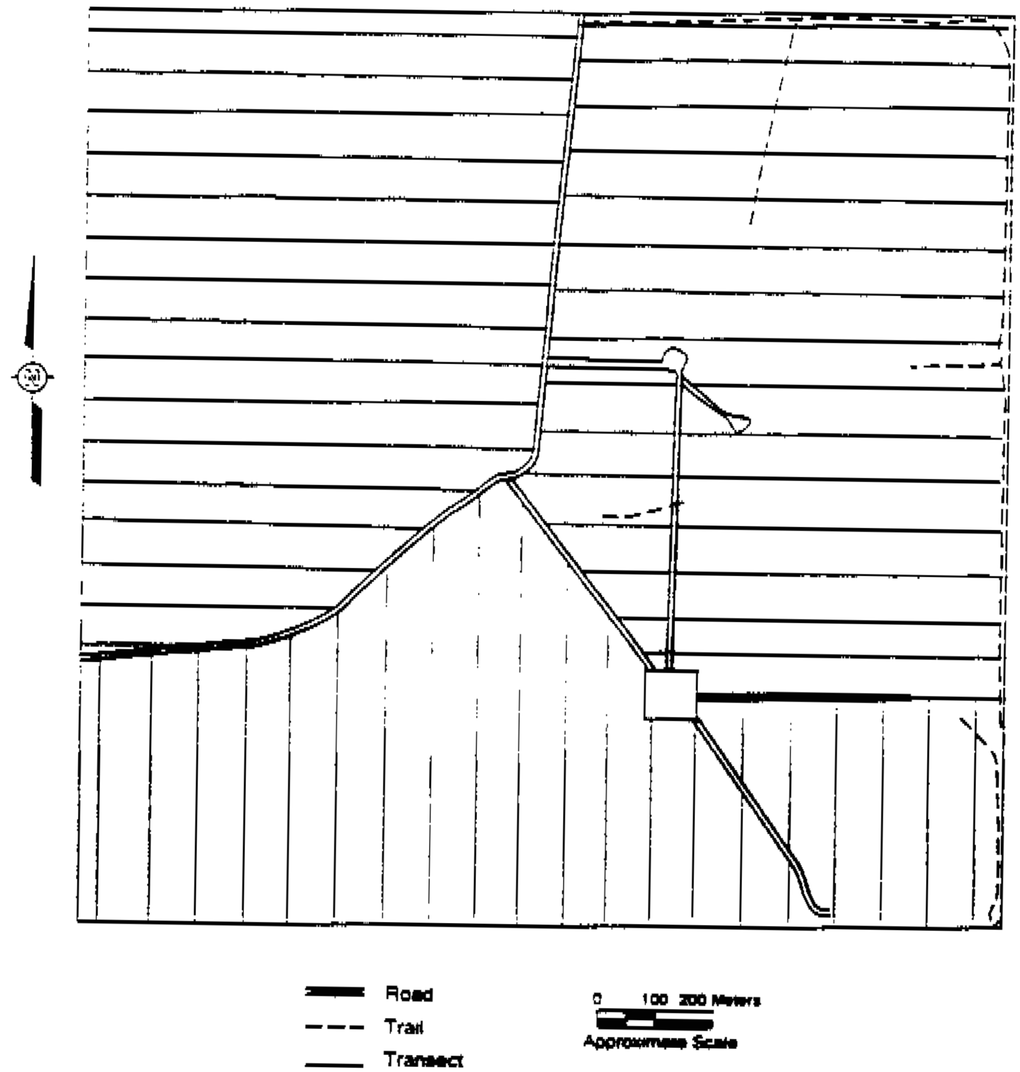

FIGURE 3-2
Pattern of transects used in the sensitive species survey at the Gnome-Coach Test Site (Section 34), New Mexico

4.0 Results

4.1 Results of the Gasbuggy Site Survey

Four potential wetland sites were located during the walking survey of the Gasbuggy Gas Stimulation Test Site (Figure 3-1). All are artificially created wetlands; three are constructed cattle tanks, and one is the result of water ponding at the upstream end of a culvert under the main access road (Forest Road 357). Two of the cattle tanks are at the site of the Leandro Tank. The upper impoundment was dry at the time of the survey and appeared to be largely silted in. The lower impoundment appeared newer and contained a small pool of water, about 10 by 15 m (30 by 50 ft) in size. This tank was probably built to replace the older one upstream, which still serves as a sediment catchment. Both berms have overflow channels around the west sides. The third cattle tank is a very small impoundment in one of the side drainages southwest of the Gasbuggy nuclear detonation site and immediately north of the USFS picnic ground. Although this tank had only a few small puddles in its bottom at the time of the survey, its maximum size was estimated at 10 by 10 m (30 by 30 ft). About 0.5-km (1,600-ft) downstream of the Gasbuggy Site boundary is a large berm and cattle tank with a greater capacity than the Leandro Tank.

Closer examination of the potential wetland area near the culvert showed no evidence of hydric soil development or hydrophytic vegetation. The small depression created at this culvert (about 5-m [15-ft] in diameter) probably contains waters for brief periods after surface flow events. The unvegetated fluvial sediments at this site indicate that it will probably silt in and therefore not develop into a permanent wetland site.

The older, upstream impoundment at the Leandro Tank showed the greatest development of wetland features. An oval-shaped area paced-off as 26 by 65 m (85 by 213 ft) was marked with ten orange surveying pin-flags. The soil in this area is a heavy, clayey texture, which exhibited drying cracks and cattle hoof prints. The vegetation on this soil is dominated by pale spikerush (*Eleocharis macrostachya*) and tiny mousetail (*Myosurus minimus*), both Obligate wetland species (Reed, 1988). Minor components in the vegetation included curly dock (*Rumex crispus*), watercress (*Rorippa curvipes*), and seedling cockleburs (*Xanthium strumarium*), all of which are either Obligate or Facultative Wetland plants (Reed, 1988). It can, therefore, be concluded that this vegetation is hydrophytic. The soil was found to be a dark yellowish brown (10 YR 3/2), which is visibly darker and grayer than the surrounding soils. The soil at this site is probably too young and too highly disturbed by cattle to have developed distinctive characteristics of a hydric soil. A hydric condition can be inferred from the presence of hydrophytic vegetation.

The newer cattle tank at the Leandro Tank is heavily impacted by cattle. The water was observed to be very turbid from suspended sediments, and the shoreline of the water was devoid of all plant life. The presence of water at this site at the time of the survey indicates a hydrologic condition capable of supporting the development of a hydric soil and hydrophytic vegetation; however, these factors have not developed due to the young age of the impoundment and the continuous impacts by watering and grazing cattle.

A similar situation exists at the small tank near the USFS picnic ground. The soil in this tank was found to be dark yellowish brown (10 YR 3/2). The bottom sediments were heavily impacted by cattle and nearly devoid of vegetation. Two plant species at this site that were not seen in upland areas were orchard grass (*Dactylis glomerata*) and timothy (*Phleum pratense*), which are both classified as Facultative Upland plants (Reed, 1988). Thus, only an inferred hydrologic regime supports the classification of this site as a wetland.

No field evidence was found to indicate that flooding had occurred along the drainages of Leandro Canyon in the recent past. High rainfall events may, however, fill the cattle tanks to their overflow levels. Runoff from such rainfall events may exceed the capacity of the three culverts that cross under the main access road, resulting in temporary ponding of water in the drainage channel immediately south of the road.

4.2 Results of the Gnome-Coach Site Survey

No wetland sites or floodplain areas were found during the survey of the Gnome-Coach Site.

5.0 Discussion

5.1 The Gasbuggy Site Survey

Through inferred hydrologic conditions based on field observations, aerial photography, and ecological judgment, four sites of artificially created wetlands were identified at the Gasbuggy Site. All have young soils that do not show distinctive characteristics of hydric soils. Only one of these sites, the old Leandro Tank impoundment, exhibits hydrophytic vegetation. Continuous impacts by grazing and watering cattle has probably impeded the development of hydrophytic vegetation at the other sites. (It should be kept in mind that the cattle tanks have been constructed as range developments and that these impacts are a result of their intended function.) Of these four sites, only the site at the road culvert does not meet the definition of a wetland based on the lack of soil and vegetative characteristics and the probable impermanence of the hydrology. The others may be classified as palustrine wetlands with unconsolidated shores (Cowardin et al., 1979).

All four sites may cause impounding of surface flows to the levels of the overflow or the level of the road if the culverts are clogged or have exceeded their capacities. Therefore, the areas within the drainage channels upstream of the berm and the area upstream of the elevated road, as well as the center of the channel, should be considered as a floodplain area.

5.2 The Gnome-Coach Site Survey

Due to the very sandy nature of the soils at the Gnome-Coach Test Site, a remarkable characteristic of this site is the near total absence of any type of surface drainage feature. Rainfall infiltrates almost immediately into the soil or flows a short distance to nearest depression where infiltration is fairly rapid. Only in the far northwest corner of Section 34 and at the command post site do the soils become calcic enough to result in significant runoff. Neither of these sites contains areas that could be considered a floodplain or a wetland.

6.0 Conclusion

6.1 The Gasbuggy Site

As discussed in Section 5.1, the combination of the areas within the drainage channels upstream of the berm, the area upstream of the elevated roads, and the center of the channel should be considered as a floodplain area. In addition, four sites of artificially created wetlands were identified at the Gasbuggy Site. The following considerations should be made for the protection of these floodplains and wetlands and for the prevention of flood damage during RI/FS field activities at the Gasbuggy Site:

- Cattle tanks should not be damaged or altered during RI/FS field activities.
- Any activity susceptible to flood damage should not be conducted within the maximum pool area of any bermed area, including the lowland area south of the elevated access road.
- Actions should be taken to prevent excessive discharges of sediments into drainages of Leandro Canyon.

6.2 The Gnome-Coach Site

No considerations for floodplain or wetland protection need to be considered during RI/FS work at the Gnome-Coach Site as none were identified.

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APPENDIX A

Photo 1. Project GASBUGGY Test Site. The old Leandro Tank wetland site, looking east-northeast across the main drainage channel from near the Surface Ground Zero.

Photo 2. Project GASBUGGY Test Site. The new Leandro Tank wetland site immediately downstream of the old tank (Photo 1), taken from the same camera station as Photo 1.

Photo 3. Project GASBUGGY Test Site. The cattle watering tank (dry) located north of the Forest Service Gasbuggy Picnic Ground.

APPENDIX B

Photo 4. Project GNOME/COACH Test Site. Typical, nearly featureless landscape of the Gnome/Coach Site. Vegetation in the foreground is dominated by shinnery oak, sandsage, and mesquite.

Photo 5. Project GNOME/COACH Test Site. Sparse Chihuahuan desert vegetation at the command post site. An old foundation is seen in the center of the photo.