REVIEW OF THE GEOLOGY AND HYDROLOGY OF THE EAGLE FLAT AREA, HUDSPETH COUNTY, TEXAS

by

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Introduction

On February 27, 1991, the Texas Low-Level Radioactive Waste Disposal Authority requested that the Bureau of Economic Geology perform a preliminary review of the geology and hydrology of the Eagle Flat area in eastern Hudspeth County, Texas. The purpose of this review was to briefly summarize what is known about the geology and hydrology of the area from a survey of the published literature, to conduct a field reconnaissance of the area, and to comment on factors that the Authority may want to consider in its general assessment of the suitability of the area as a host for a repository for low-level radioactive wastes.

Recent maps of land ownership indicate that the State does not own any sections in the main Eagle Flat area, although the State does retain an interest in the mineral rights on some sections. To minimize upstream drainage, avoid drainage basins that flow to the Rio Grande, and maximize the potential for thick basin-fill deposits, the portion of Eagle Flat that lies southeast of the road to Grayton Lake, west of the drainage divide between Grayton Lake and Eagle Flat Draw, and between the Texas and Pacific and Southern Pacific railroad tracks, has been indicated as an area of potential interest. For the purposes of this report, this block of land is referred to as the "Eagle Flat site." The Eagle Flat site is shown on the Grayton Lake 7.5-minute quadrangle topographic map published by the U.S. Geological Survey.

Geology of the Eagle Flat Area

Introduction:

The following discussion of the geology of the Eagle Flat area is based on published references and a brief reconnaissance field examination of the area on March 7 and 8, 1991. Except where references are cited, the geologic description is based on the Van Horn-El Paso and Marfa Sheets (1:250,000) of the Geologic Atlas of Texas (Barnes, 1979; 1983). The reader is also referred to Underwood (1963), King (1965), and Henry and Price (1985) for more detailed geologic maps and descriptions, and to a summary of the regional geology in a previous contract report for the Authority by Raney and Collins (1990). U.S. Geological Survey 7.5-minute topographic maps of Eagle Flat include Allamore, Bean Hills, Grayton Lake, Devil Ridge, Dome Peak, and Sierra Blanca.

Surficial Sediments and Geomorphology:

Eagle Flat is an alluvial valley that trends generally northeast-southwest from west of the Carrizo Mountains to east of Sierra Blanca (figure 1). The valley has generally low relief with little incision by modern drainages. The margins of the valley are typically either alluvial slopes or alluvial fans with poorly developed drainage channels and gradients that increase toward the bedrock outcrops of the surrounding hills and mountains. Scattered hills and bedrock ridges are more common along the southern margin of Eagle Flat than the northern margin. From this it can be inferred that the thickness of sediments filling the basin may be somewhat asymmetric; sediments are probably relatively thin on the south side of Eagle Flat compared with more axial and northern locations.

Grayton Lake is a closed basin in the central part of Eagle Flat that is the termination of a large drainage basin that extends well to the west and north through the region of Sierra Blanca. About 5 miles east of

Grayton Lake is a subtle drainage divide between drainages that flow westerly into Grayton Lake and those that carry runoff to the east into Camel Draw and Eagle Flat Draw and eventually into Salt Basin-Lobo Valley south of Van Horn. Eagle Flat Draw and its tributaries appear to be a better integrated and more well developed drainage network than is the system of drainages that feed Grayton Lake. This may reflect the continued lowering of local base level in the Salt Basin-Lobo Valley area due to late Cenozoic faulting. If the Grayton Lake depression is structurally controlled, the general lack of modern incision in the drainages that feed Grayton Lake may indicate either that there have been no recent faulting events to downdrop the basin or that any structural lowerings have been so minor as not to cause incision. Less than 1.5 miles south of Grayton Lake is another subtle drainage divide that separates the Grayton Lake Drainage from the Red Hills Arroyo that feeds into Red Light Draw (Quitman Arroyo), south of the Eagle Mountains, which leads to the Rio Grande. It should be noted that northern and western Eagle Flat does not drain into Red Hills Arroyo as is indicted on the old Army Map Service 1:250,000 topographic maps or in the report by Gates and others (1980).

The Eagle Flat site lies on the north flank of the Eagle Flat basin on the alluvial slope between the mountains to the north and Grayton Lake to the southwest. Elevations at the site range from about 4,320 to 4,450 feet. The maximum gradient lies in the northwestern part of the site where a 50-foot change in elevation occurs over a horizontal distance of about 3,000 feet. The floor of Grayton Lake is at an elevation of about 4,275 feet and the highest peaks of adjacent Streeruwitz Hills, north of the site, are between 5,000 and 5,030 feet. Maximum relief from mountain crest to Grayton Lake is about 750 feet; this change in elevation occurs over a distance of less than 4 miles. Most of the relief is accounted for by the bold escarpment in the bedrock and the adjacent apron of detritus.

Surficial sediments of Eagle Flat consist of Quaternary windblown sand, alluvium, colluvium, and alluvial fan deposits. Grayton Lake, an internally drained, ephemeral lake basin, may contain lacustrine sediments with some alkali- or salt-impregnated clays. King (1965) mapped Grayton Lake as an alkali flat. Older Quaternary sediments, possibly including units equivalent to the series of Quaternary gravels present in the Hueco bolson, are mapped along the southern margin of Eagle Flat at the edge of the Eagle Mountains. Well-developed sequences of gravel deposits were not observed during the reconnaissance, but possible terrace levels indicating periods of stability and subsequent incision are present in the Green River area.

No data from drilling are readily available on the older Cenozoic sediments that are inferred to underlie the surficial deposits. Closed-basin, "bolson" sediments, equivalent to those of the Hueco bolson, may be present at relatively shallow depth. Elevations of the Eagle Flat area are similar to those of areas on the flanks of the Finlay and Malone Mountains where the Camp Rice and Fort Hancock Formations are exposed. Eagle Flat surface elevations are, however, higher (200 to 400 feet) than the elevation of the highest outcrops of bolson fill in tributaries to Quitman Arroyo in the Red Light bolson south of the Eagle Mountains. However, even if bolson deposits are present in the shallow subsurface at the Eagle Flat site, the proximity to bedrock sources of sediment implies that one may expect to find more alluvial fan deposits of coarser grained detritus than is typical of the Fort Hancock Formation at the Fort Hancock site.

Borrow pits between Allamore and Hot Wells, a borrow pit north of Grayton Lake, and a dirt tank northwest of Grayton Lake expose fine-grained sediments below and interbedded with coarser grained materials. The fine-grained sediments are mostly fine to very fine sands and silts with minor floating clasts probably derived from local bedrock; calcic soils are weakly to moderately well developed and commonly contain calcic nodules locally. Most exposures are about 6 feet deep, the most intense calcic soil development occurring within 3 feet of the present surface. The uppermost materials generally are coarse-grained fluvial deposits with very weak calcic soil development that are locally mantled by windblown sands. Surface stability is indicated by the presence of the well-developed calcic horizon, an absence of incised arroyos (except locally in the Eagle Flat Draw drainage), ventifacts, and moderately well developed desert varnish on Precambrian cobbles on surfaces of desert pavement formed by deflation or sheetwash.

Reconnaissance examination of bolson deposits in the Green River area and in Red Light Draw (Quitman Arroyo) indicates that these relatively small basins tend to have sediments that are coarser grained than is typical of much of the Fort Hancock Formation in the Hueco Bolson. Fine to medium sands appear to be the dominant grain size with lesser silt and rare clay-rich units; also relatively common are coarser clasts and fluvial-channel deposits. Some of these deposits are indistinguishable, on the basis of visual estimates of grain size, color, and calcic soil development, from the fine-grained older sediments observed on Eagle Flat, although the Eagle Flat deposits are not mapped as bolson deposits on the published maps.

Bedrock Geology:

Bedrock is exposed east of Eagle Flat in the Carrizo Mountains, north of Eagle Flat in the Streeruwitz Hills-Allamore area, and south of Eagle Flat in the Devil Ridge-Eagle Mountain area.

The oldest rocks of the region are exposed in the Carrizo Mountains. These Precambrian rocks of the Carrizo Mountain Group include both metamorphosed igneous (granodiorite, amphibolite, metarhyolite) and sedimentary rocks. They are inferred to have been deposited about 1,200 to 1,300 mya and then metamorphosed about 1,000 mya (Denison, 1980). The metamorphic rocks were subjected to two or more periods of deformation during the Precambrian, and metamorphic grade generally increases from north to south in the Carrizo Mountains (Henry and Price, 1985). The Precambrian rocks are locally overlain by much younger, unmetamorphosed sedimentary rocks of the Permian Hueco Limestone.

North of the site, in the Streeruwitz Hills-Allamore area, are outcrops of younger Precambrian rocks. These include less intensely metamorphosed limestone, conglomerate, phyllite, and volcanic and intrusive igneous rocks of the Allamore Formation overlain by sandstones and conglomerates of the

Hazel Formation and the younger Van Horn sandstone. At the south edge of the hills, rocks of the older Carrizo Mountain Group have been thrust over the Allamore Formation along the Streeruwitz thrust fault (King, 1965). This thrust fault is of probable Precambrian age, as the thrusting event does not deform the Van Horn sandstone of probable Precambrian age (King, 1965). The Precambrian rocks are locally directly overlain by the Hueco Limestone or by younger Cretaceous sedimentary rocks of the Campagrande Formation.

South of the Eagle Flat site, in the Eagle Mountains-Devil Ridge area, rocks of Precambrian to Tertiary age crop out. Carrizo Mountain Group rocks overlain by Hueco Limestone in crop out in a small area the eastern Eagle Mountains. Marine sedimentary rocks of Cretaceous age are the dominant rocks exposed in this area. From oldest to youngest these units are the Yucca, Bluff Mesa, Campagrande, Cox Sandstone, Finlay, Benevides, Loma Plata, Eagle Mountains, Buda, and Ojinaga Formations.

Small intrusives of Tertiary igneous rock are present at scattered localities in the Carrizo Mountains-Eagle Mountains-Devil Ridge area. A large area of Tertiary intrusive and extrusive volcanic rocks is present in the central Eagle Mountains in the Eagle Mountains caldera (Henry and Price, 1985). The Eagle Mountains caldera is dated at 35 to 36 Ma; the nearby Van Horn Mountains caldera is dated at 38 Ma (Henry and Price, 1989, table 3). All Tertiary igneous activity in the Trans-Pecos region is Miocene or older (Henry and Price, 1985).

The bedrock beneath the Cenozoic sediments can only be inferred from projections of formations, contacts, and faults exposed in outcrops of the surrounding hills and mountains. No drill hole data have been examined for this preliminary review. The southern part of Eagle Flat is clearly underlain by Cretaceous units at relatively shallow depth. The northern part of the basin is probably floored by Precambrian rocks, possibly the upper plate of the Streeruwitz thrust, overlain at least locally by Permian or Cretaceous sedimentary rocks. The Hillside fault (see below) also projects through this area, as does the inferred Cenozoic fault of Henry and Price (1985).

Tectonics and Structural Geology:

The tectonics of the region have been the subject of many publications and are not discussed here in detail. A previous summary of the tectonic history was prepared for the Authority last year (Raney and Collins, 1990), and only the major events that are important to understanding the Eagle Flat area are briefly mentioned below.

The Precambrian rocks of the Carrizo Mountains are strongly deformed and have been thrust onto less severely faulted and folded younger Precambrian rocks present in the Streeruwitz Hills-Allamore area along the Streeruwitz thrust fault. Overlying Paleozoic (Hueco Limestone) and younger rocks are locally displaced along high-angle faults, but warping and tilting is generally less than 10 degrees.

The Texas Lineament, a much-debated regional tectonic feature (see Albritton and Smith, 1965; King, 1965; Muehlberger, 1980), has been hypothesized to project through the region between Van Horn and Sierra Blanca, and thus would pass through the Eagle Flat area. King (1965, p. 118), who mapped the geology in the Eagle Flat area that includes the supposed trace of the Texas Lineament, was skeptical of its existence and cited one of the early proponent's (Ransome, 1915, p. 295) description of the Lineament, "vaguely defined and perhaps in part imaginary," as an "unflattering, but probably just, characterization of this feature." More recent proponents have tended to view the Lineament as a broad zone of deep crustal weakness that has influenced the northwesterly trend of some of the mapped faults of the region.

The Hillside fault, a major high-angle fault of the area that strikes northwesterly and is coincident with the northern edge of the Carrizo Mountains, has been cited as an element of the Texas Lineament. King (1965) described field evidence to refute major strike-slip displacement along the Hillside fault since the

Precambrian. The Hillside fault is a major displacement fault, north side downthrown, that has faulted units at least as young as Cretaceous in excess of 1,000 feet (King, 1965).

Cretaceous and older sedimentary rocks in the Devil Ridge-Eagle Mountains area contain folds and thrust faults related to the late Mesozoic or early Tertiary Laramide Orogeny. Fold axes trend northwesterly, and translation was generally to the northeast. High-angle faults, many of small displacement (Underwood, 1963), may in part be related to Laramide deformation. They are mapped as much more numerous in Cretaceous rocks than in post-Laramide igneous rocks, but some are clearly shown to displace the Tertiary rocks in the Eagle Mountains. Eagle Flat occurs in the transition zone between rocks to the southwest that were moderately to strongly deformed by Laramide tectonism and rocks to the northeast on the Diablo Plateau that were relatively mildly deformed by Laramide tectonism.

Late Cenozoic faults are present in the Salt Basin-Lobo Valley area less than 20 miles easterly from Grayton Lake. The town of Valentine, near the site of the largest recorded earthquake in Texas, the 1931 magnitude 6.4 (Doser, 1987) Valentine event, lies about 55 miles southeast of Grayton Lake. No faults that clearly displace Quaternary sediments are shown on the published maps of Eagle Flat.

Many small-displacement faults are shown by Underwood (1963) as projecting beneath Quaternary sediments on the north side of the Eagle Mountains. Faults that are indicated as being present within or as offsetting Quaternary units are almost all on the Red Light Draw side of the Eagle Mountains (Underwood, 1963). Mapping by King (1965), north of Eagle Flat, generally shows faults that are restricted to pre-Quaternary units, although at at least one locality, near the Old Circle Ranch about 8.5 miles north of Allamore, a fault is indicated to be present in Quaternary alluvium.

Henry and Price (1985) inferred that the Eagle Flat basin may be fault bounded. They projected a northern bounding structure as an arc that trends west-northwesterly to more northwesterly from north of Grayton Lake to the southwest edge of the southern Carrizo Mountains. This fault may be present on cross section J-J' (Gates and others, 1980), which indicates that the bedrock is at least 500 feet deeper in the hanging wall of the fault. At its southeastern terminus, the inferred structure has a similar strike to a mapped fault along the west side of the Van Horn Mountains that appears to be visible in Quaternary sediments. Viewed from the Green River road, this fault appears to have a linear trend and to mark the contact between bedrock in its footwall, to the east, and Quaternary sediments in its hanging wall, to the west. There is a distinct change in slope and vegetation across the fault. The inferred southern bounding structure (Henry and Price, 1985) is mapped mostly along the northeastern flank of the Eagle Mountains and terminates several miles to the southeast of Grayton Lake. There is no obvious surficial expression of this fault.

Hydrology of the Eagle Flat Area

Surface Water:

There are no perennial streams in the Eagle Flat region. Grayton Lake is an ephemeral lake that contains water only after storms have produced significant runoff. Most of the Grayton Lake drainage basin lies to the west and northwest of Grayton Lake. The site area lies to the northeast of Grayton Lake where a repository may be located such that the drainage basin upstream from the facility is restricted to no more than 2 or 3 square miles. The region drained by Grayton Lake is large, but it is presumed that it would take an exceptional precipitation event, or series of events, to fill the basin to the level of the highest closed contour (4,310) shown on the topographic map. Maximum depth of water that could be contained within the Grayton Lake basin is about 40 feet. If excess waters were to flow into the basin, the water would crest the drainage divide at the southeast side of the basin (at an elevation between 4,310 and 4,320 feet) and flow into tributaries to Red Hills Arroyo and then into Quitman Arroyo to the southeast.

Surface drainages that drain into Grayton Lake are not well incised and appear to be poorly integrated. Drainages are locally better defined on the alluvial aprons at the base of the surrounding highlands than on the lower gradient alluvial slopes and distal alluvial fans that comprise much of the Eagle Flat area. Runoff may be locally contained in drainages, but large precipitation events probably result in shallow sheet flow over large areas. Drainages at the east end of Eagle Flat that are part of the Eagle Flat Draw drainage network are better integrated and somewhat more deeply incised and probably are more capable of containing typical precipitation events within the defined channels. Sheet flow is probably still operative outside the channels in the interfluvial areas, especially during large events. The effects of man-made features, especially the railroads and the interstate highway, on surface-water flow may be locally important, but they have not been evaluated. The Authority staff report that FEMA maps indicate flooding is restricted to areas adjacent to the major drainages that feed Eagle Flat Draw and to the immediate vicinity of Grayton Lake.

Ground Water:

Ground-water quantity, quality, and elevation are poorly constrained by available data. Regional interpretations are based on sparse well control (Gates and others, 1980; White and others, 1980; Mullican and others, in review). Data for only one well in the Grayton Lake site are shown by Gates and others (1980, figures 17 and 18).

The Grayton Lake site is mapped (Gates and others, 1980, figure 17) as having between about 700 and less than 500 feet of basin-fill deposits. The one well in the southeast corner of the site has a recorded thickness of 690 feet of sediments above bedrock. The water level in this well (figure 18) is at 700 feet below surface, or 10 feet below the base of the basin fill. The water levels appear to rise steeply in elevation to both the northeast and the southwest away from the basin axis. Recharge to the ground waters beneath the site may occur, in part, on the Diablo Plateau where alluvial cover is thin or bedrock crops out. Gates and others (1980, figure 19) inferred that the eastern one-third to one-half of the site area is underlain by basin fill that contains fresh water (water with less than 1000 milligrams per liter dissolved solids). This map seems at odds with the data from the one well in the Grayton Lake site that indicates that no water was present in the basin-fill sediments. It is possible that no saturated basin-fill sediments are present beneath all or part of the Grayton Lake site area. The northwestern limit of fresh water in basin-fill sediments, known to be present in southeastern Eagle Flat, must be near the site area, but it needs to be more precisely defined. Gates and others (1980) suggested that no large volumes of fresh ground water are known in the Eagle Flats area, although small volumes may be produced near Allamore.

West of the Eagle Flat site, in the vicinity of Sierra Blanca, most ground water is produced from rocks of Cretaceous age (Campagrande Limestone and Cox Sandstone). The basin fill is generally less than 500 feet thick and is mostly unsaturated. The water is also of lower quality, slightly to moderately saline, than that in the basin-fill sediments of the southeastern portion of Eagle Flats. Much of the water requires some treatment prior to use as a source of drinking water (White and others, 1980). Water levels are commonly 750 to 1,000 feet below surface, and most wells produce less than 100 gallons per minute. The storativity of the aquifer appears to be fracture controlled, as is also true of the bedrock aquifer near Allamore, and wells commonly have specific capacities of only a few gallons per minute per foot of drawdown.

A potentiometric surface compiled by Mullican and others (in review), using the data available in the Texas Water Commission data base, suggests that the Eagle Flat site lies near a hydrologic divide. Ground water east of the site tends to flow eastward toward Van Horn and the Salt Basin; ground water west of the site tends to flow westward and southwestward toward the Rio Grande. This agrees with Gates and others (1980) who suggested that waters from the northwestern end of Eagle Flats probably discharge through Cretaceous rocks toward the Rio Grande. The mountains of the Allamore-Streeruwitz area to the north of the site and the Eagle Mountains to the southwest are probable highs on the potentiometric surface.

Beyond the confines of Eagle Flat, it has been suggested that potential sources of water that will meet drinking water standards may occur in upper Red Light Draw and near the Guerra No. 1 test hole on the northeast side of central Red Light Draw (Young, 1976). Young (1976) cited previous studies as indicating that Red Light Draw is not only the most likely area in Hudspeth County where a well field could be developed that would produce good quality drinking water, but it may contain the only areas where such a water supply could be developed.

Geothermal Waters:

Eagle Flat lies within the region of Trans-Pecos that is known to contain geothermal resources. The two known occurrences closest to the site are at Sierra Blanca and Hot Wells. Both occurrences contain waters at near 100 degrees Fahrenheit. Waters from the Sierra Blanca well contain about 2,700 total dissolved solids (TDS), whereas TDS content at Hot Wells is only 320 (Hoffer, 1980).

Issues

The following is a partial list of some of the issues that may be pertinent to those making decisions regarding the viability of a site for a low-level waste repository in the central Eagle Flat area. This is not a comprehensive list, and the impact of most of these factors on facility design and performance assessment cannot be accurately determined on the basis of available data. It is, however, useful to consider each factor before attempting to arrive at a general conclusion regarding the possible suitability of this area.

Geologic and Hydrologic Issues:

1. Complex Geology--The bedrock geology of the area is moderately complex. Precambrian through Mesozoic age rocks have been subjected to several periods of deformation, and the bedrock geology beneath the site is only inferred from projection of units in adjacent hills and mountains. The area lies near the northeastern margin of the Laramide deformation and includes structures some workers have related to the Texas Lineament.

   Complex geology is primarily an issue with regard to performance assessment and the ability of scientists to model the site. The complexity of the bedrock may not be an issue if the facility can be shown to meet performance objectives based on modeling of the presumed host media, the basin-fill sediments. The basin-fill sediments are not especially complex for this depositional environment and, with much more data, could be adequately modeled.

2. Recent Tectonics and Seismicity--Eagle Flat lies within the Trans-Pecos region and thus has a moderate potential for future earthquakes to occur. The same assumptions regarding the magnitude of the "floating" earthquake that were made for the Fort Hancock site are also pertinent to the Eagle Flat area. Several faults within 25 miles of Eagle Flat have been active during the Quaternary, although Eagle Flat itself has little evidence of Quaternary faulting compared to the Salt Basin-Lobo Valley-Valentine area, the Green River area, or Red Light Draw. The southeast end of the surface expression of the Amargosa fault, in Mexico, lies about 25 to 30 miles southwest of the Grayton Lake area.

   Eagle Flat is probably a tectonic basin, but few data are available to indicate the location of bounding structures or the timing or magnitude of past events. The initial review suggests there are no surface indications of fault scarps in the surficial basin-fill sediments in the immediate vicinity of the site. Low-sun-angle aerial photographs will be needed to identify any subtle scarps that may exist. Geophysical methods may be useful in delineating the location of faults.

3. Fissures--Fissures are present in basin-fill sediments in areas near Eagle Flat Draw and in Red Light Draw. None are known at the site, but access has been limited, and careful study is needed. Locally thick vegetation will require detailed examination of high-quality aerial photographs and probably a helicopter survey.

4. Host Sediments--Only the upper few feet of the potential host sediments can be observed in outcrop. Sufficient silt and clay (minor) may be present to decrease the permeability, but beds of more sandy to conglomeratic materials may also be present. Alternating beds of diverse grain size may also serve to inhibit permeability. Extensive core drilling may be needed to characterize the host sediments adequately for numerical modeling.

   The thickness of the basin-fill sediments is poorly constrained, but probably ranges from less than 500 to about 700 feet thick. Drilling and geophysical methods may be needed to establish this parameter.

5. Erosion and Surface Stability--The surface of the site area appears to be quite stable. Few indications of incision by modern drainages are present, and the presence of such features as desert varnish on surface cobbles suggests extensive periods of stability. Minor sheetwash and eolian deposition and deflation appear to be the most active processes. Better access to the site is needed to evaluate this issue.

6. Flooding--Locating a facility within the site area would limit upstream drainage. The runoff from torrential rains is unlikely to be contained in the low-relief drainages on the site, and shallow sheetwash may occur. It is presumed that water depths will be insufficient to constitute flooding. The existing highway and railroads may have significant impacts on how and where surface waters flow. Detailed topographic maps may be required to adequately model runoff, but more general models may indicate if potential problems are likely to be present.

   Eagle Flat Draw has a subtle drainage divide with the Grayton Lake drainage. Although it seems improbable that flood waters in the Eagle Flat Draw drainage would attain sufficient elevation to crest the divide, this possibility should be addressed by the modeling. At worst, such a scenario would only eliminate part of the area being considered.

   As long as the facility is above 4,320 feet in elevation, waters are unlikely to rise fast enough in Grayton Lake to flood any facility from the southwest. This possibility can be readily modeled.

7. Depth to Water Table--The thickness of the unsaturated zone is poorly constrained. Data from the closest well indicate that the depth to water is 700 feet and that the water occurs in bedrock rather than in basin-fill sediments. Regional data suggest that the site may be near a hydrologic divide between waters that discharge slowly southwesterly toward the Rio Grande and those that flow easterly toward the Salt Basin. More data on the saturated zone are needed to determine flow velocities beneath the site area.

   The role of Grayton Lake in possible recharge of waters to the subsurface is unknown. This is of concern, because any contaminants from a facility at the site could be carried by surface runoff into Grayton Lake. Possibilities to be evaluated are that waters ponded in Grayton Lake may recharge the deep subsurface aquifer, may follow permeable zones in host sediments beneath the facility, or may follow other permeable pathways through bedrock to be discharged into the Red Light Draw area to the south. The probability of any of these scenarios and their impact on performance assessment are unknown.

8. Water quality--Assuming that the ground water is in Cretaceous bedrock, as at Sierra Blanca, the water is possibly somewhat saline. The site is, however, near the zone of fresh water in basin-fill sediments that has been identified in the eastern Eagle Flat area. The waters may be geothermal, although it is unclear what effect, if any, this would have on performance-assessment analyses. Currently available well data are too sparse to address these issues.

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