# APPENDIX D

# AESTHETIC RESOURCES

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# APPENDIX D

# AESTHETIC RESOURCES

This appendix supports the DOE analyses of potential impacts to aesthetic resources described in Sections 4.2.3 and 4.3.3 of the Rail Alignment EIS.

The U.S. Department of Energy (DOE) used U.S. Department of the Interior, Bureau of Land Management (BLM or the Bureau), methodologies to evaluate visual values along the Caliente and Mina rail alignments. The BLM considers visual resources when addressing aesthetic issues during BLM planning. These resources include natural or manmade physical features that give a landscape its character and value as an environmental factor. The BLM uses a visual resource management system to classify the aesthetic value of its lands and to set management objectives (DIRS 173052-BLM 1984, all).

**Scenic quality** is a measure of the visual appeal of a tract of land. Areas are rated based on key factors including landform, vegetation, water, color, adjacent scenery, scarcity, and cultural modifications (DIRS 101505-BLM 1986, Section II).

**Sensitivity levels** are a measure of public concern for scenic quality. Areas are ranked high, medium, or low based on types of users, amount of use, public interest, adjacent land uses, and whether they are special areas (DIRS 101505-BLM 1986, Section III).

The BLM classification of visual resource value, the visual resource inventory, involves assessing visual resources and assigning them to one of four visual resource management classes based on three factors: ***scenic quality***, visual sensitivity (***sensitivity levels***), and distance from travel or observation points (DIRS 101505-BLM 1986, all). The BLM uses a combination of the ratings of these three factors to assign a visual resource inventory class to a piece of land, ranging from Class I to Class IV, with Class I representing the highest visual values. Each visual resource class is subsequently associated with a management objective, defining the way the land may be developed or used. Each BLM district assigns visual resource management classes to its lands during the resource management planning process. Table D-1 lists the BLM management objectives for visual resource classes.

The BLM uses visual resource contrast ratings to assess the visual impacts of proposed projects and activities on the existing landscape (DIRS 173053-BLM 1986, all). The Bureau looks at basic elements of design to determine levels of contrast created between a proposed project and the existing ***viewshed.*** Depending on the visual resource management objective for a particular location, varying levels of contrast are acceptable.

Contrast ratings are determined from locations called key observation points, which are usually along commonly traveled routes such as highways or frequently used county roads or in communities. To identify key observation points along the Caliente and Mina rail alignments, DOE considered the following factors: angle of observation, number of viewers, how long the project would be in view, relative project size, season of use, and light conditions. BLM guidance (DIRS 173053-BLM 1986, Section IIC) recommends that key observation points for linear projects, such as the proposed railroad, include the following:

- Most-critical viewpoints (for example, views from communities at road crossings)
- Typical views encountered in representative landscapes, if not covered by critical viewpoints
- Any special project or landscape features such as river crossings and substations

**Table D-1.** BLM visual resource management classes and objectives.[a]

| Visual resource class | Objective | Acceptable changes to land |
|---|---|---|
| Class I | Preserve the existing character of the landscape. | Provides for natural ecological changes but does not preclude limited management activity. Changes to the land must be small and must not attract attention. |
| Class II | Retain the existing character of the landscape. | Management activities may be seen but should not attract the attention of the casual observer. Changes must repeat the basic elements of form, line, color, and texture of the predominant natural features of the characteristic landscape. |
| Class III | Partially retain the existing character of the landscape. | Management activities may attract attention but may not dominate the view of the casual observer. Changes should repeat the basic elements in the predominant natural features of the characteristic landscape. |
| Class IV | Provides for management activities that require major modifications of the existing character of the landscape. | Management activities may dominate the view and be the major focus of viewer attention. An attempt should be made to minimize the impact of activities through location, minimal disturbance, and repeating the basic elements. |

a. Source: DIRS 101505-BLM 1986, Section V.B.

## D.1 Caliente Rail Alignment

This section provides photographs taken from key observation points along the Caliente rail alignment. For some views, DOE has added simulations to the baseline photographs to show how the rail line, trains, or facilities would appear. Figure D-1 shows the locations of the key observation points and the BLM visual resource management classifications of the lands in the viewsheds. Figures D-2 through D-83 are photographs along the Caliente rail alignment.

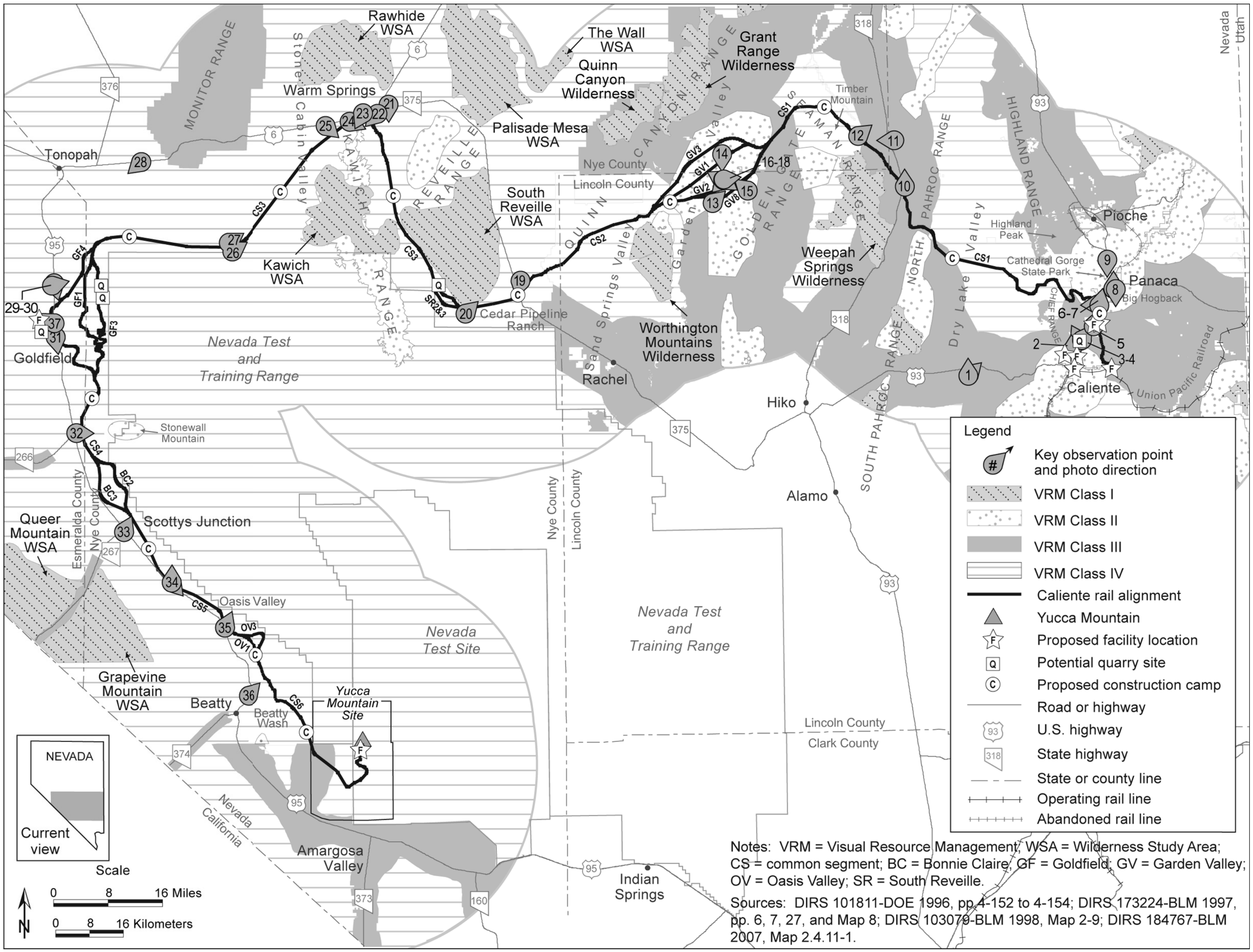



**Figure D-1.** Visual resource management classifications and key observation points along the Caliente rail alignment.

**Figure D-2.** View northeast from key observation point 1 at U.S. Highway 93 in Dry Lake Valley toward the Burnt Springs and Chief Ranges. Rail line would not be visible because it would be screened by Burnt Springs Range.

**Figure D-3.** View north from key observation point 1 on U.S. Highway 93 in Dry Lake Valley. Highland Range on right. Rail line would not be visible in valley because of distance.

**Figure D-4.** View north from key observation point 2 on U.S. Highway 93 toward location of Staging Yard Caliente-Indian Cove option.

**Figure D-5.** Simulation of Staging Yard Caliente-Indian Cove option in view north from key observation point 2. Office buildings would be visible in background.

**Figure D-6.** Simulation of train approaching Staging Yard Caliente-Indian Cove option in view north from key observation point 2.

**Figure D-7.** View north-northwest from key observation point 3 on U.S. Highway 93. Rock conveyor to deliver ballast to Staging Yard Caliente-Indian Cove option would cross over highway here. (See Figure D-9 for a simulation of conveyor appearance.)

**Figure D-8.** View north-northeast from key observation point 4 on U.S. Highway 93. Rock conveyor to deliver ballast to Staging Yard Caliente-Upland option would cross over highway here.


**Figure D-9.** Simulation of rock conveyor and construction trains on the Caliente alternative segment (closest to viewer) and quarry siding in view north-northeast from key observation point 4.

**Figure D-10.** View north-northeast from key observation point 5 on U.S. Highway 93 over location of Staging Yard Caliente-Upland option. Note existing buildings.


**Figure D-11.** Simulation of Staging Yard Caliente-Upland option in view north-northeast from key observation point 5.

**Figure D-12.** View north-northeast from key observation point 6 on U.S. Highway 93 at location where rail line would cross highway.


**Figure D-13.** Simulation of U.S. Highway 93 crossing over rail line in view north-northeast from key observation point 6.


**Figure D-14.** Simulation of train on rail line at U.S. Highway 93 crossing over rail line in view north-northeast from key observation point 6.

**Figure D-15.** View west from key observation point 7 on U.S. Highway 93 just north of rail line crossing, toward Highland Range and Bennett Pass.


**Figure D-16.** Simulation of track in view west from key observation point 7.


**Figure D-17.** Simulation of train close to U.S. Highway 93 in view west from key observation point 7.


**Figure D-18.** View south from key observation point 8 along U.S. Highway 93 at intersection with State Route 319, toward Big Hogback. Rail line would not be visible in this view.


**Figure D-19.** View north from key observation point 8 along U.S. Highway 93 at intersection with State Route 319. Photograph taken to show that Cathedral Gorge is not visible from highway here.

**Figure D-20.** View south from key observation point 9 at Miller Point in Cathedral Gorge Park toward rail alignment location. Rail line would be barely discernible, if visible at all.

**Figure D-21.** Panorama from northwest to northeast from key observation point 10 on State Route 318, toward location of rail line crossing.

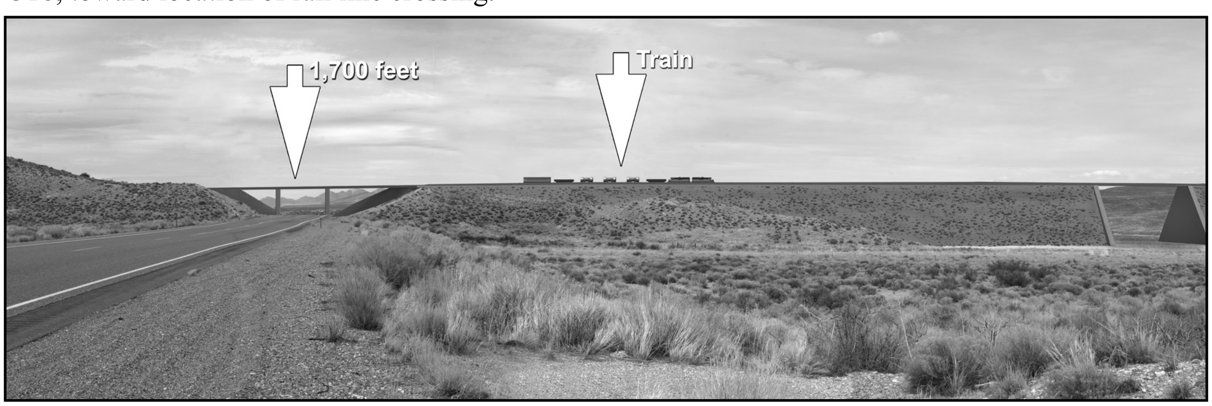



**Figure D-22.** Simulation of crossing structure and train on rail line in view northwest to northeast from key observation point 10.

**Figure D-23.** View west toward Timber Mountain and northern Seaman Range from key observation point 11 off county road west of State Route 318 north of rail line crossing. White River visible in foreground.


**Figure D-24.** Simulation of track in view west from key observation point 11.

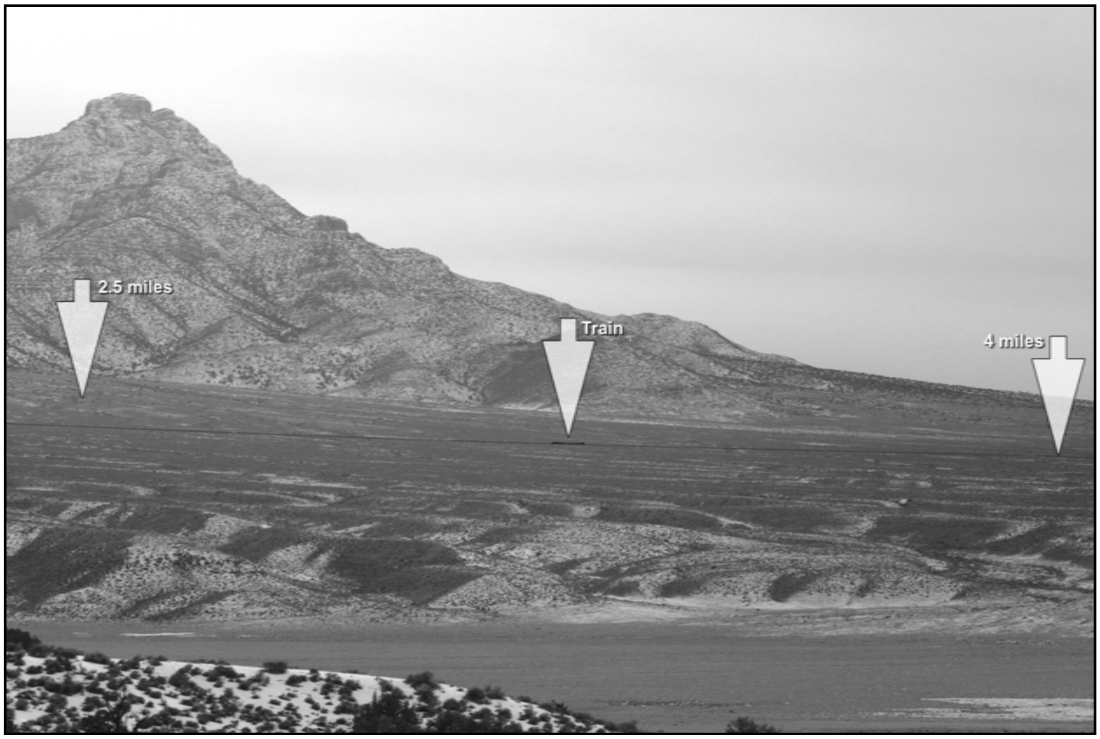



**Figure D-25.** Simulation of track and train in view west from key observation point 11.

**Figure D-26.** View east-northeast from key observation point 12 on Timber Mountain Pass Road toward location of rail line crossing. White River visible in right midground.


**Figure D-27.** Simulation of track and signals at rail line crossing of Timber Mountain Pass Road in view east-northeast from key observation point 12.


**Figure D-28.** Simulation of train at rail line crossing of Timber Mountain Pass Road in view east-northeast from key observation point 12.

**Figure D-29.** View northeast from key observation point 13 on a county road in south Garden Valley. Modifications associated with *City* sculpture visible as light band across midground, with trees on a ranch at right.

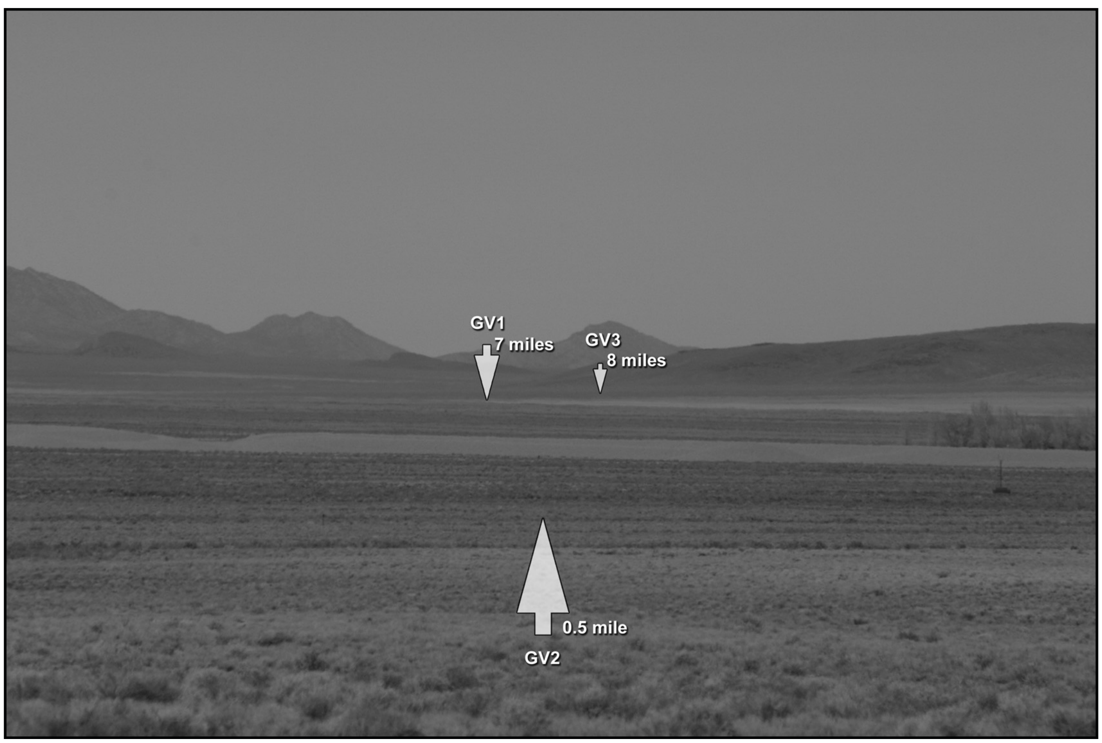



**Figure D-30.** Simulation from key observation point 13 of track on Garden Valley alternative segment 2 in foreground, Garden Valley alternative segments 1 and 3 in background, coming from east entry to valley. Note simulation of communications tower in right midground along Garden Valley alternative segment 2. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley alternative segment 2.

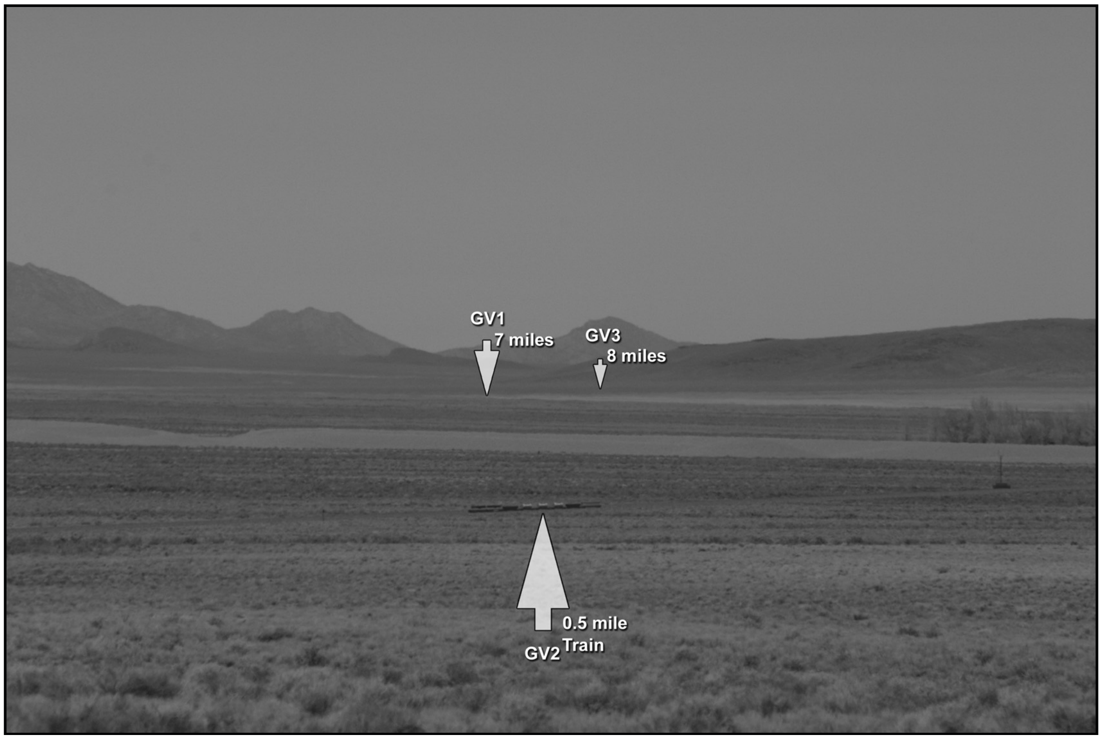



**Figure D-31.** Simulation of train on Garden Valley alternative segment 2 in view northeast from key observation point 13. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley alternative segment 2.

**Figure D-32.** View south from key observation point 14 on county road in middle of Garden Valley toward south end of the Golden Gate Range. Tops of some *City* sculpture mounds and ranch visible at left midground.

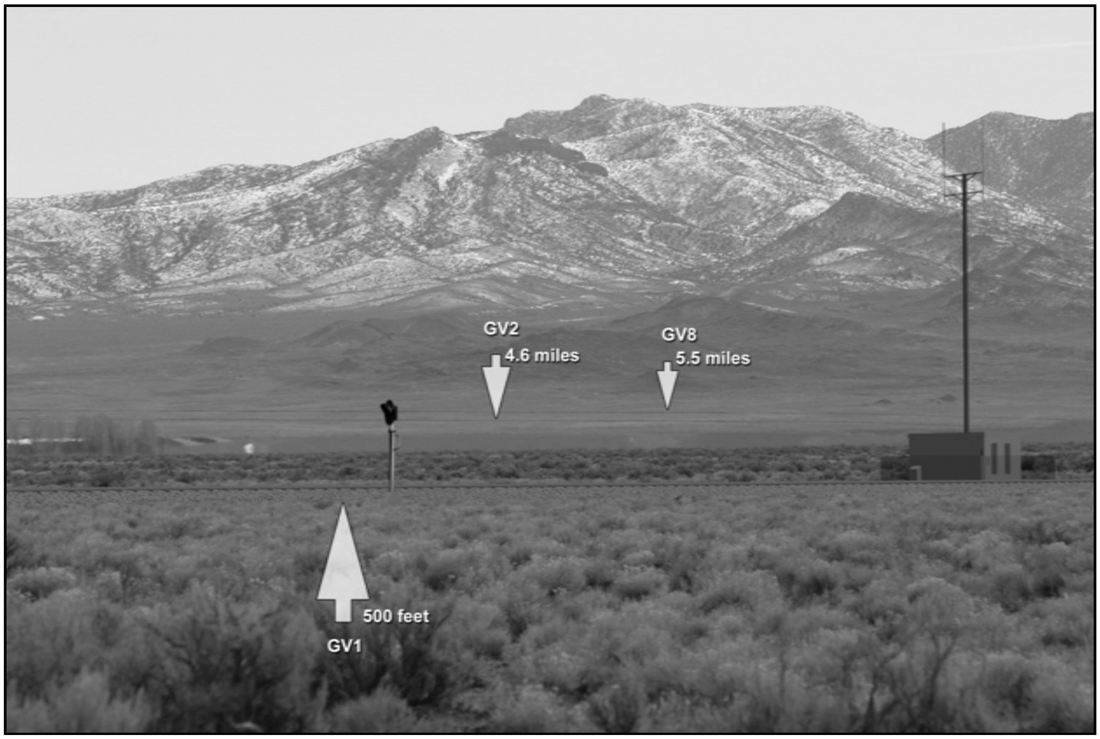



**Figure D-33.** Simulation from key observation point 14 of track on nearby Garden Valley alternative segment 1, distant Garden Valley alternative segment 2, and more distant Garden Valley alternative segment 8. Note simulation of signal and communications tower along Garden Valley alternative segment 1. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley 1.

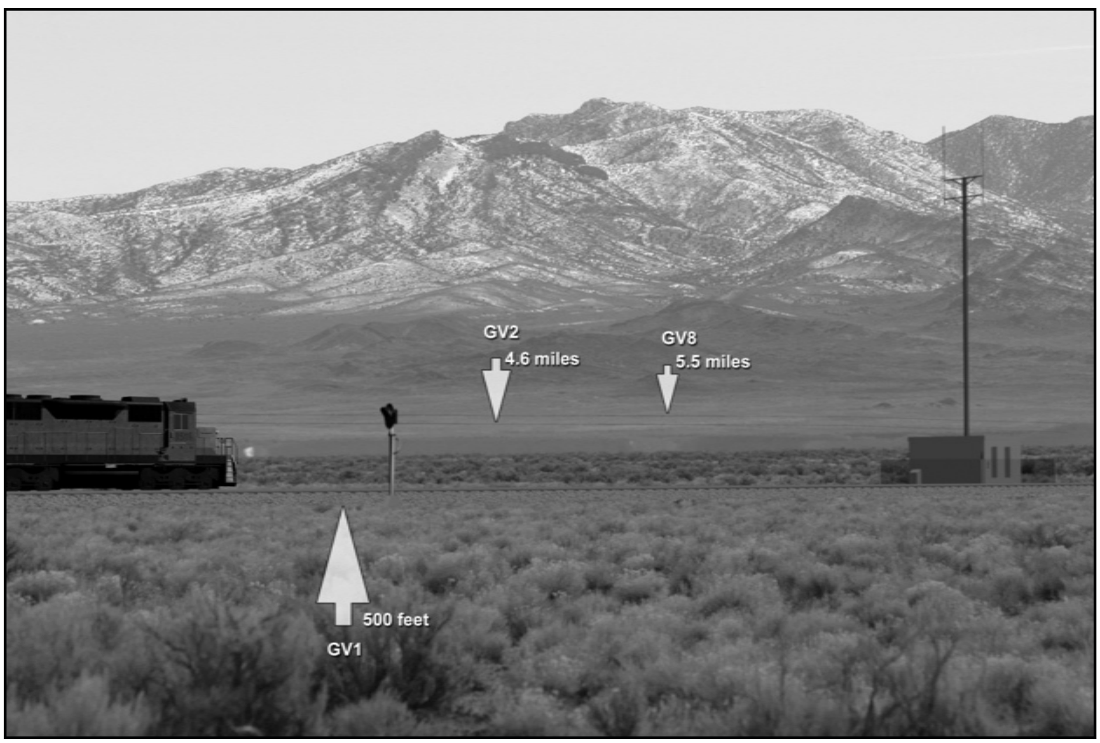



**Figure D-34.** Simulation of train on Garden Valley alternative segment 1 in view south from key observation point 14. Garden Valley alternative segment 2 and Garden Valley alternative segment 8 in distant midground. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley 1.

**Figure D-35.** View northwest toward Quinn Canyon Range from key observation point 15 on county road south of Garden Valley. Tops of some *City* sculpture mounds visible in midground, ranch in right midground.

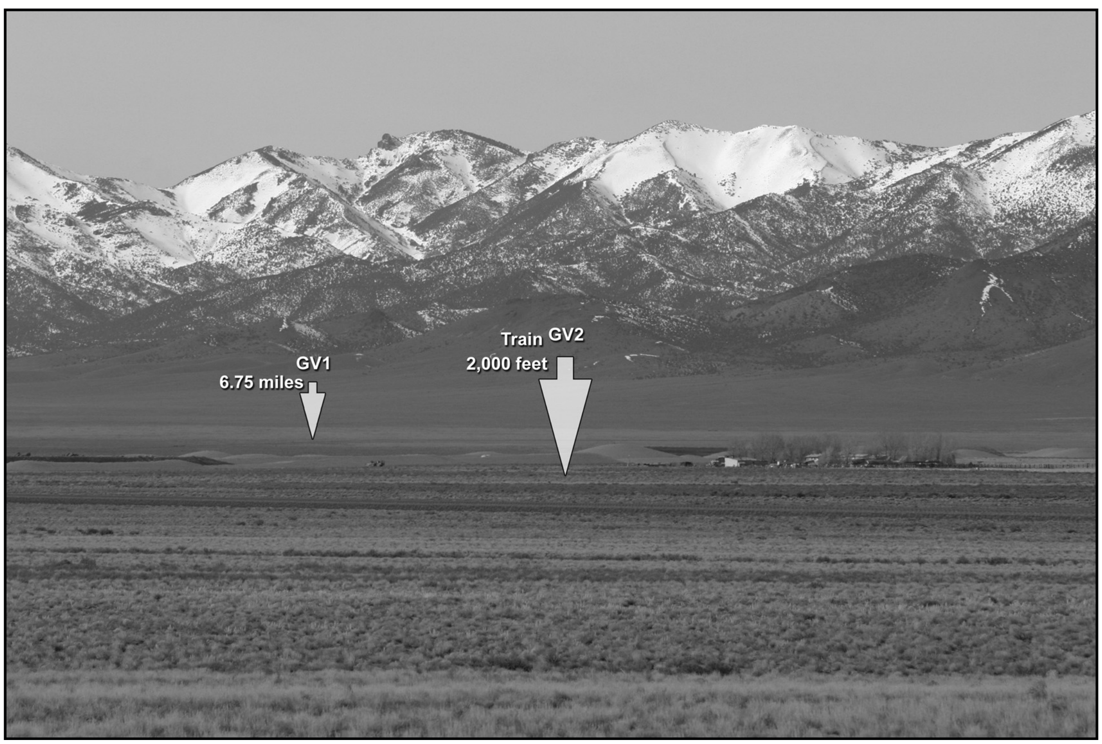



**Figure D-36.** Simulation of track on Garden Valley alternative segment 1 (background) and Garden Valley alternative segment 2 in view northwest from key observation point 15. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley 2.

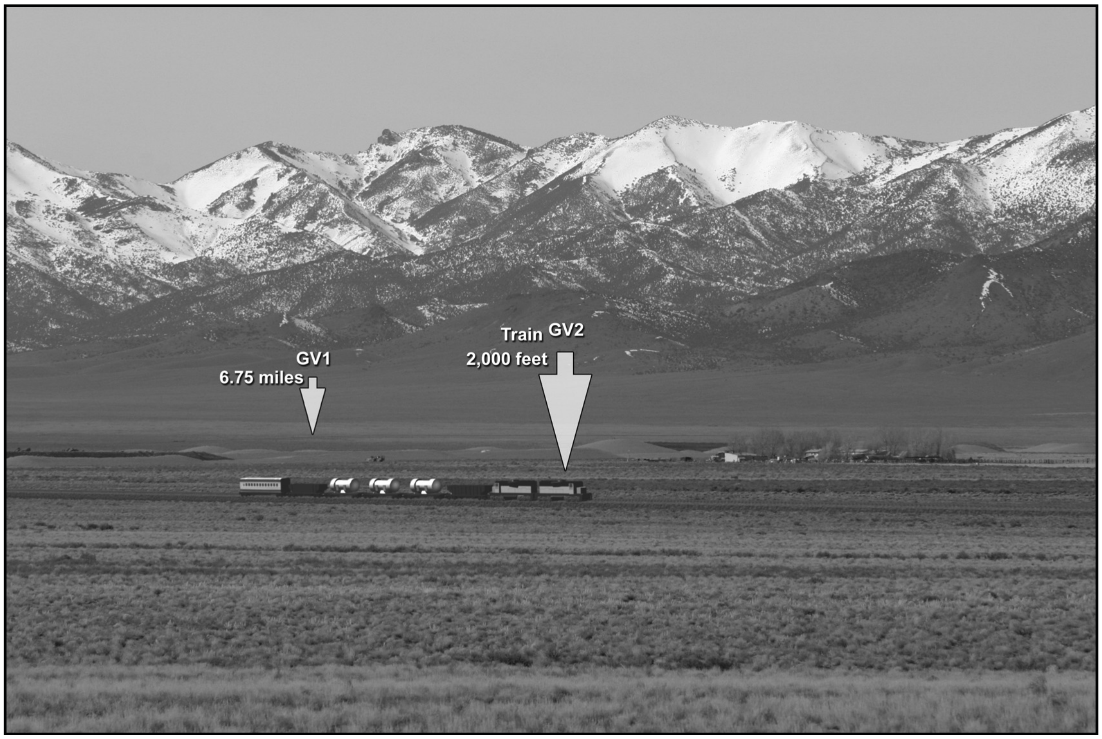



**Figure D-37.** Simulation of trains on Garden Valley alternative segment 2 (closest to viewer) and Garden Valley alternative segment 1 in view northwest from key observation point 15. Not in picture is an earthwork berm that would mask the linear feature of Garden Valley 2.

**Figure D-38.** View northwest toward the Quinn Canyon Range from key observation point 16 on top of a *City* mound.


**Figure D-39.** Simulation of track on Garden Valley alternative segment 1 (midground) and Garden Valley alternative segment 3 (background) in view northwest from key observation point 16.

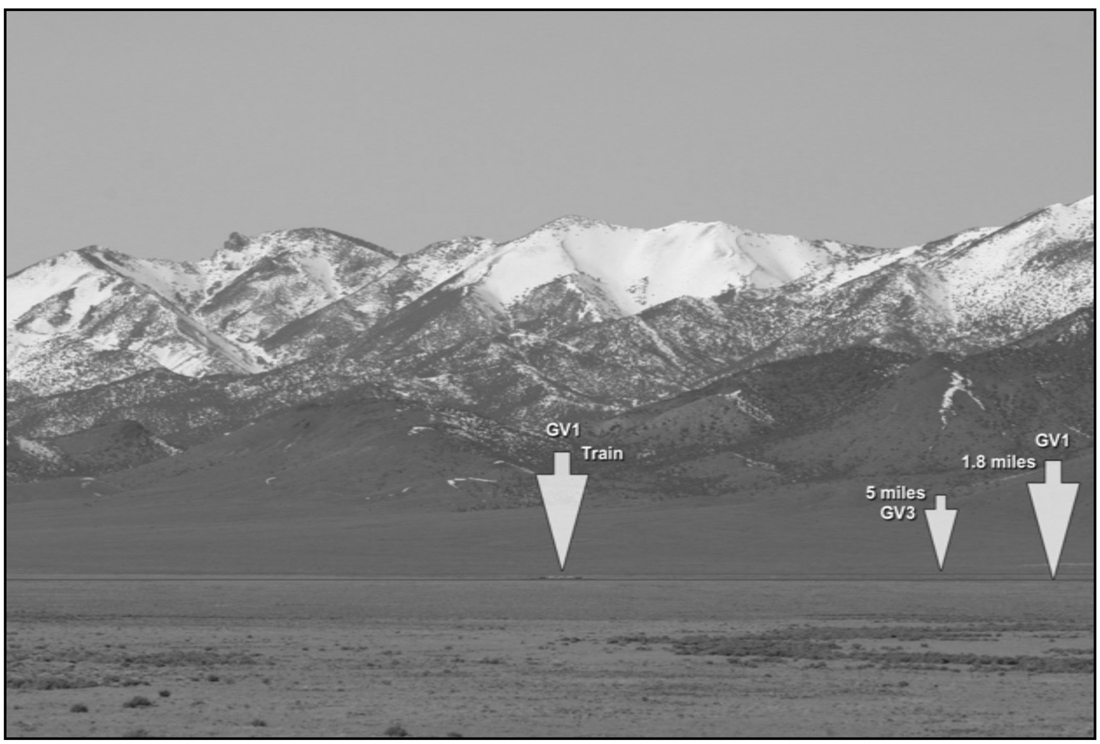



**Figure D-40.** Simulation of trains on Garden Valley alternative segment 1 and Garden Valley alternative segment 3 in view northwest from key observation point 16.

**Figure D-41.** View west-southwest from key observation point 16 on top of a *City* mound over Garden Valley between the Worthington and Quinn Canyon Ranges.


**Figure D-42.** Simulation of track on Garden Valley alternative segment 1 across midground of view, Garden Valley alternative segment 3 more distant, in view west-southwest from key observation point 16. Construction camp would be at greater distance from viewer, off photo on left.

**Figure D-43.** View southwest toward the Worthington Range from key observation point 17 on top of a *City* mound.


**Figure D-44.** Simulation of track on Garden Valley alternative segments 2 and 8 in view southwest from key observation point 17. On west side Garden Valley alternative segments 2 and 8 are approximately 1 mile apart; the two simulated tracks are not visible as distinct lines because of the distance and local topography. Instead, the visible line is slightly thicker than it would be if only one alternative segment were shown. The alternative segments merge into a single segment at about the center of the picture.

**Figure D-45.** View southeast from key observation point 18 on top of a *City* mound toward the Golden Gate Range.

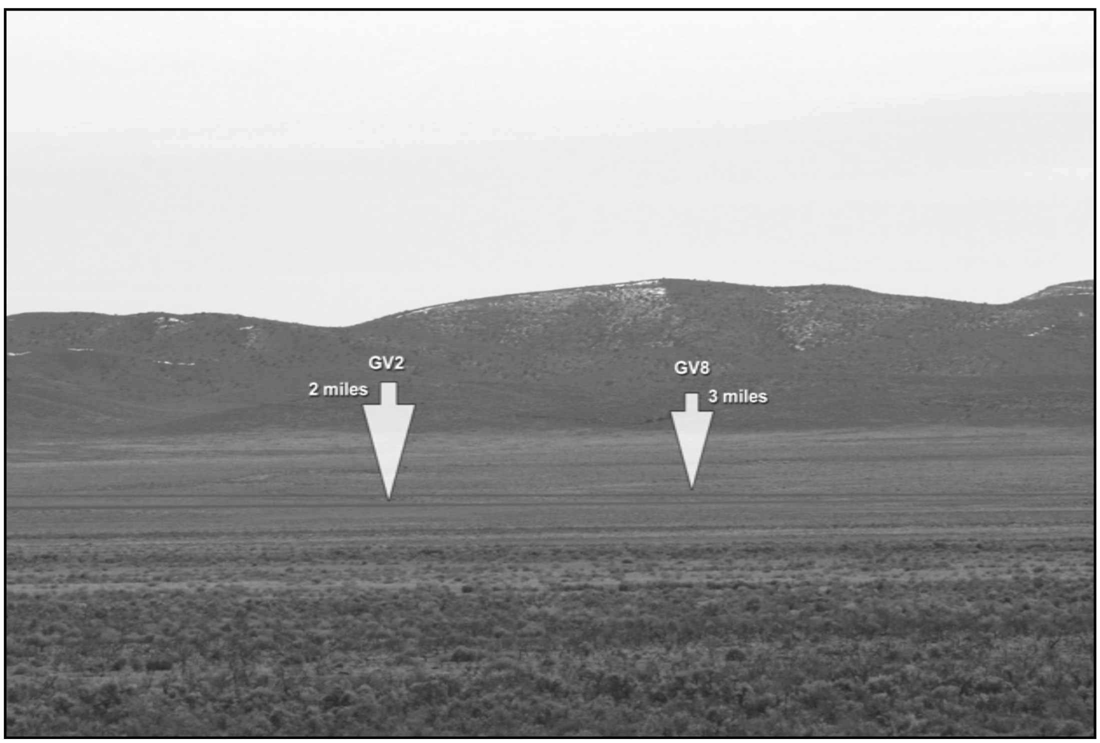



**Figure D-46.** Simulation of track on Garden Valley alternative segment 2 and Garden Valley alternative segment 8 (more distant) in view southeast from key observation point 18.

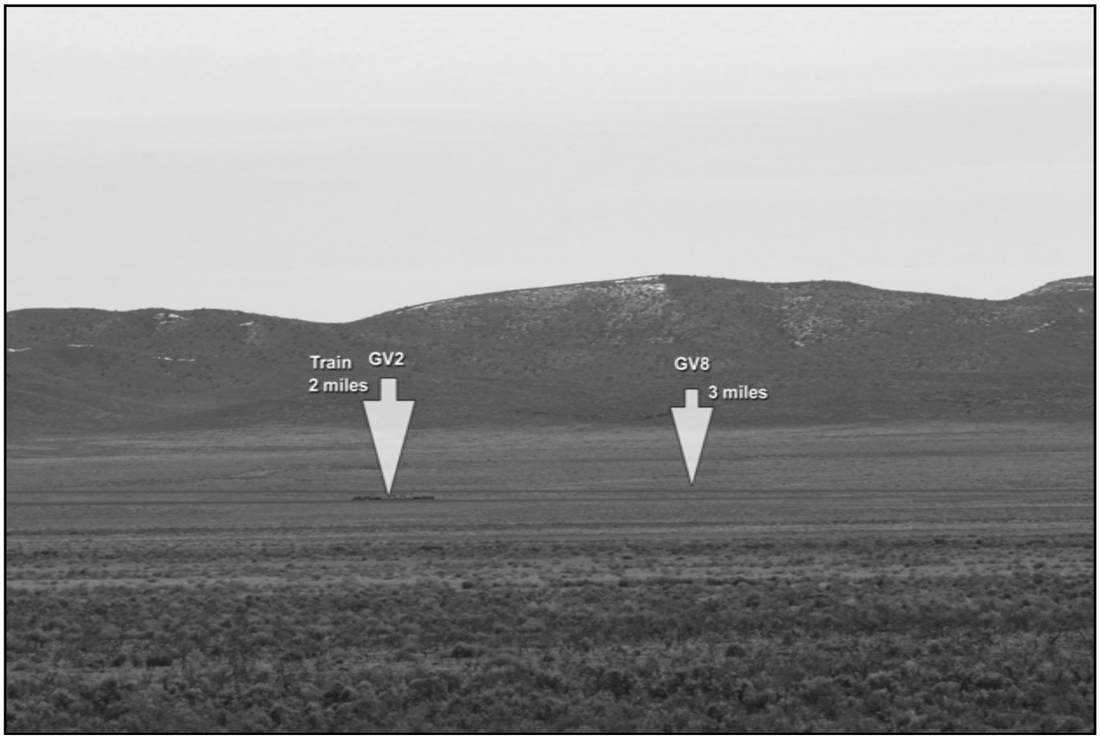



**Figure D-47.** Simulation of train on Garden Valley alternative segment 2 and track on Garden Valley alternative segment 8 (more distant) in view southeast from key observation point 18.

**Figure D-48.** View slightly north of east from key observation point 18 on top of a *City* mound, toward Water Gap. Note distant scar of Timber Mountain Pass Road over the Seaman Range in left midground.


**Figure D-49.** Simulation of track on Garden Valley alternative segment 2 and Garden Valley alternative segment 8 (more distant) in view slightly north of east from key observation point 18.

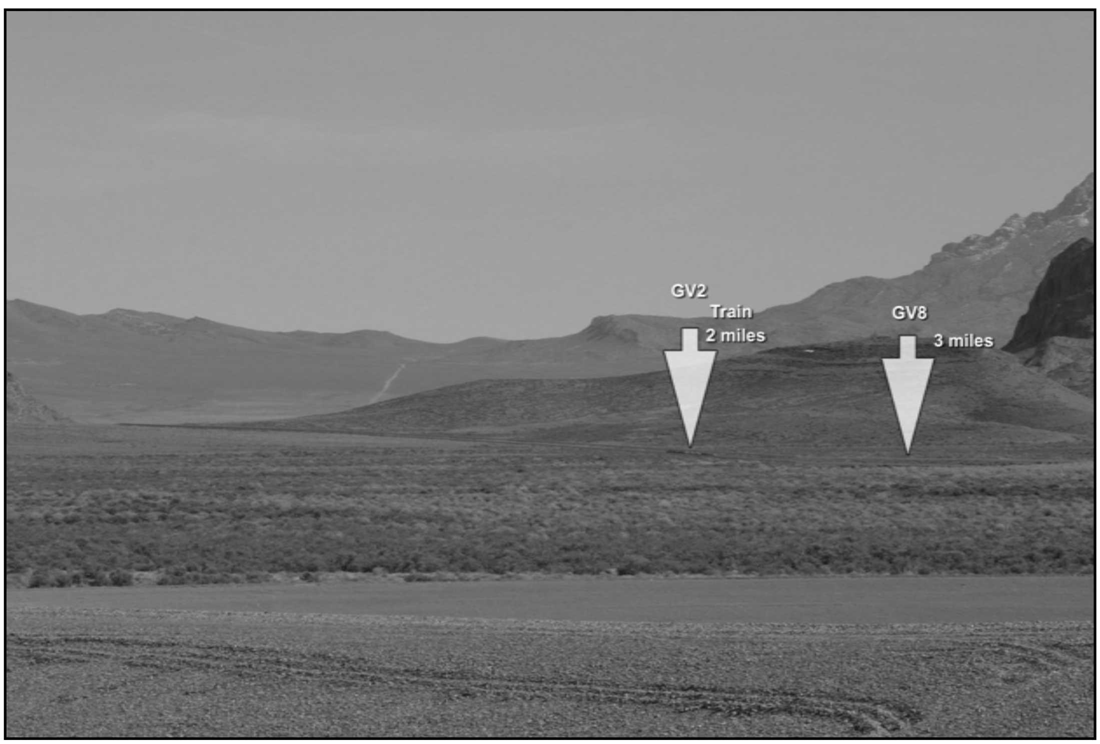



**Figure D-50.** Simulation of train on Garden Valley alternative segment 2 and track on Garden Valley alternative segment 8 (more distant) in view slightly north of east from key observation point 18.

**Figure D-51.** View south-southwest from key observation point 19 on State Route 375 near rail line crossing.


**Figure D-52.** Simulation of track and construction camp in view south-southwest from key observation point 19.

**Figure D-53.** View northeast from key observation point 20 at Cedar Pipeline Ranch. Quinn Canyon Range in center and right background; cone in center midground is Black Top.


**Figure D-54.** Simulation of track in view northeast from key observation point 20.

**Figure D-55.** View south from key observation point 21 on State Route 375 near intersection with U.S. Highway 6. View shows Reveille Valley with Kawich Range in middle ground. Rail line would be too distant to be seen in this view.

**Figure D-56.** View southwest from key observation point 22 on U.S. Highway 6 near intersection with State Route 375 toward the Kawich Range.


**Figure D-57.** Simulation of train in view from key observation point 22. As noted on photograph, much of the rail line would be obscured by topography from this viewpoint.

**Figure D-58.** View south-southwest from key observation point 23 on U.S. Highway 6 on east side of Warm Springs Summit.


**Figure D-59.** Simulation of track in view south-southwest from key observation point 23. Note simulation of signal in left midground, communications tower in right midground. Power poles are not simulations.


**Figure D-60.** Simulation of train in view south-southwest from key observation point 23. Note simulation of signal in left midground, communications tower in right midground. Power poles are not simulations.

**Figure D-61.** View east-southeast from key observation point 24 on Highway 6 toward the Kawich Range at Warm Springs Summit.


**Figure D-62.** Simulation of rail line in view east-southeast from key observation point 24. Track would be in a cut at this location so viewers would not see it, but the line of the cut would be discerned behind and roughly paralleling the power poles.

**Figure D-63.** View southeast from key observation point 25 on U.S. Highway 6 toward the Kawich Range. Highway visible on left, road to Clifford mine visible as snow track in center and right. Track would be in a cut at this location so viewers would not see it.

**Figure D-64.** View east-northeast toward the Kawich Range from key observation point 26 on Test and Training Range Road near location of rail line crossing.

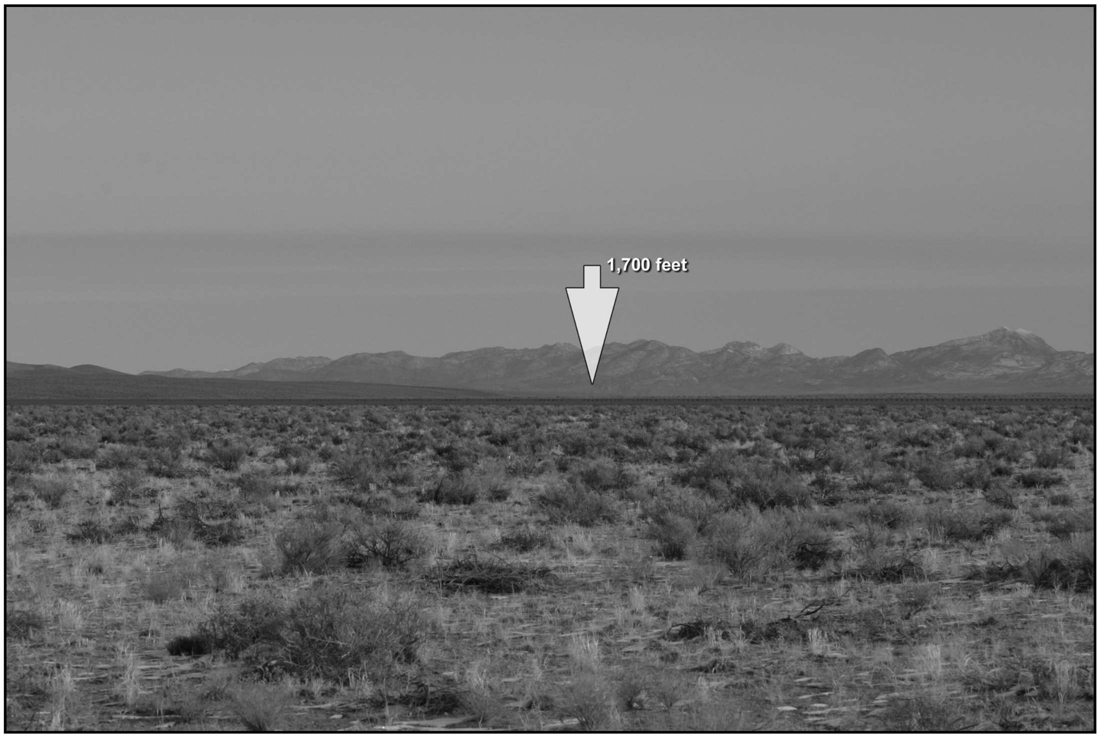



**Figure D-65.** Simulation of track in view east-northeast from key observation point 26.

**Figure D-66.** View east-northeast toward the Kawich Range from key observation point 27 on Test and Training Range Road near location of rail line crossing. Reed's Ranch visible in center midground.

**Figure D-67.** View southwest toward Pilot Peak from key observation point 28 on U.S. Highway 6. Rail line would be approximately two-thirds of the distance between viewer and mountains.

**Figure D-68.** View east-northeast from key observation point 29 north of Goldfield on U.S. Highway 95. Activities and facilities at possible quarry in hills at right side of photo could be seen but would not attract attention.

**Figure D-69.** View south-southeast from key observation point 30 at north end of Goldfield on U.S. Highway 95.


**Figure D-70.** Simulation of track on Goldfield alternative segment 4 in view from key observation point 30. Distance and topography would obscure much of the rail line.

**Figure D-71.** View south-southeast from key observation point 31 on U.S. Highway 95 south of Goldfield.


**Figure D-72.** Simulation of Goldfield alternative segment 4 crossing over U.S. Highway 95 in view south-southeast from key observation point 31.


**Figure D-73.** Simulation of train on Goldfield alternative segment 4 in view south-southeast from key observation point 31.

**Figure D-74.** View east toward Stonewall Mountain from key observation point 32 on U.S. Highway 95 at intersection with State Route 266.

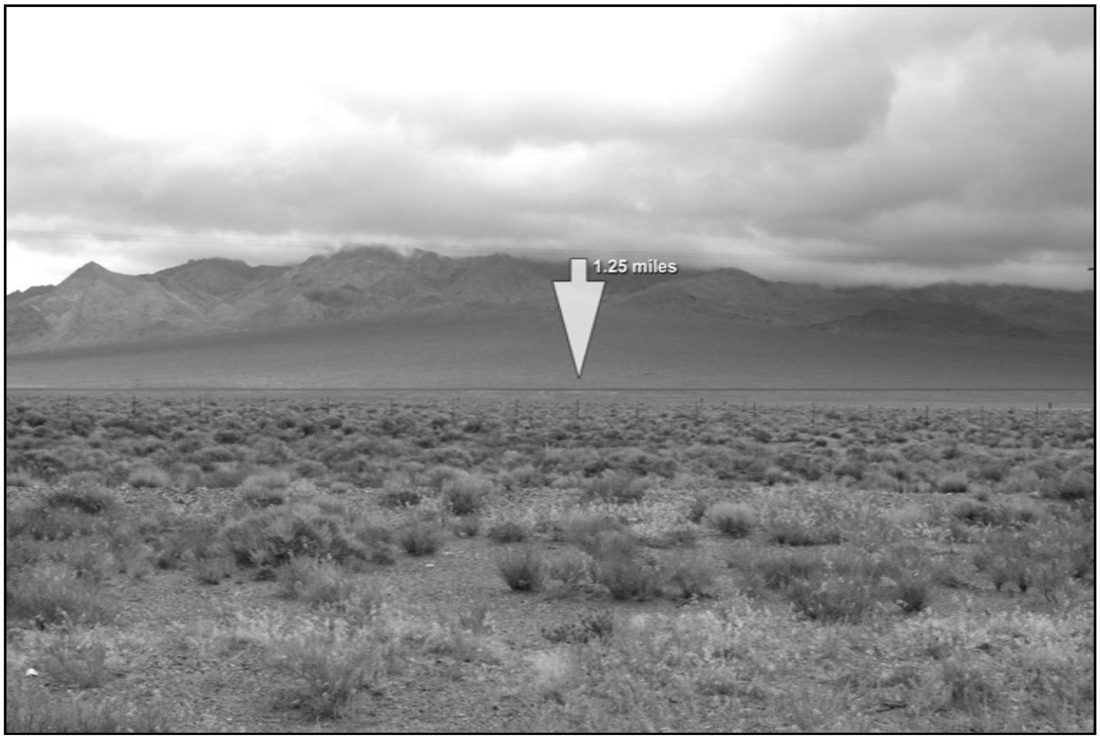


**Figure D-75.** Simulation of track in view east from key observation point 32. Stonewall Mountain in background.

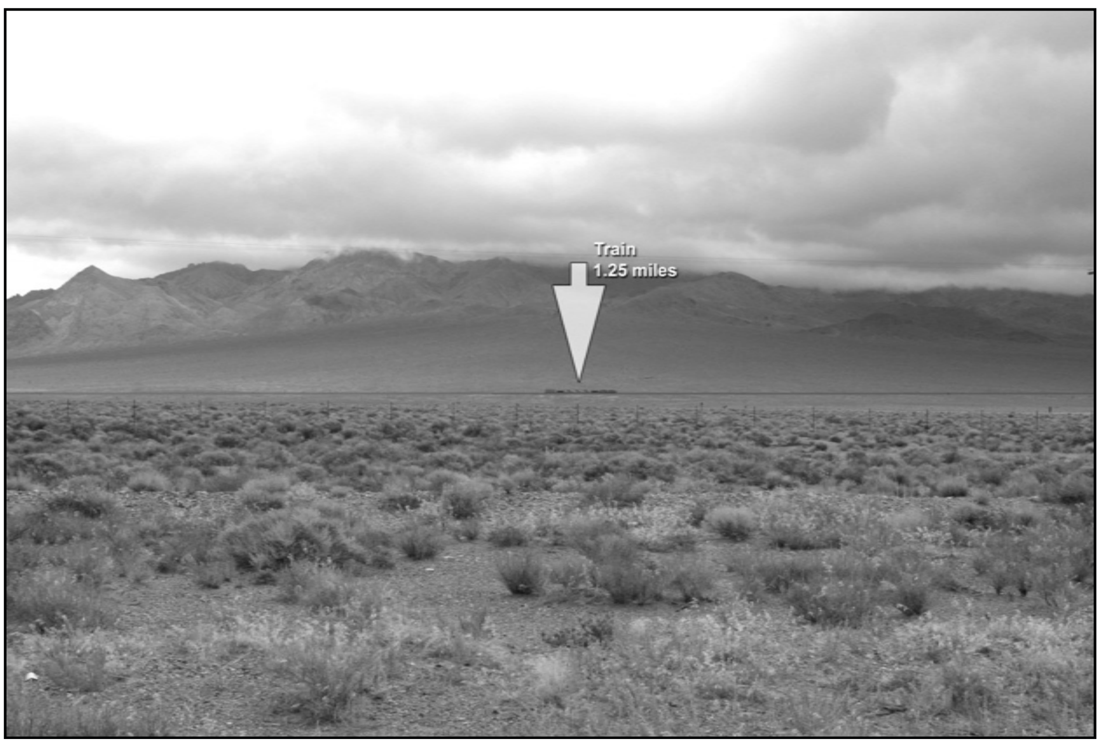


**Figure D-76.** Simulation of train in view east from key observation point 32. Stonewall Mountain in background.

**Figure D-77.** View north-northeast from key observation point 33 on U.S. Highway 95 at intersection with State Route 267. Rail line would be several miles in the distance.

**Figure D-78.** View southeast from key observation point 34 on U.S. Highway 95. Cut would remove lower slope at far right to keep rail line on flat grade.

**Figure D-79.** View north from key observation point 34 on U.S. Highway 95 toward same cut location shown in Figure D-78. Cut would remove lower slope at far left to keep rail line on flat grade.

**Figure D-80.** View north-northeast from key observation point 35 on U.S. Highway 95 across a typical landscape. This most northerly of views from this point across the Amargosa River Valley toward Oasis Valley is where the rail line would be closest to the highway.

**Figure D-81.** View northeast from key observation point 36 on U.S. Highway 95 looking across the road that would be used for construction access to Beatty Wash. Rail line, bridge, and construction camp would not be visible from this point.

**Figure D-82.** View northeast from key observation point 37 on U.S. Highway 95.

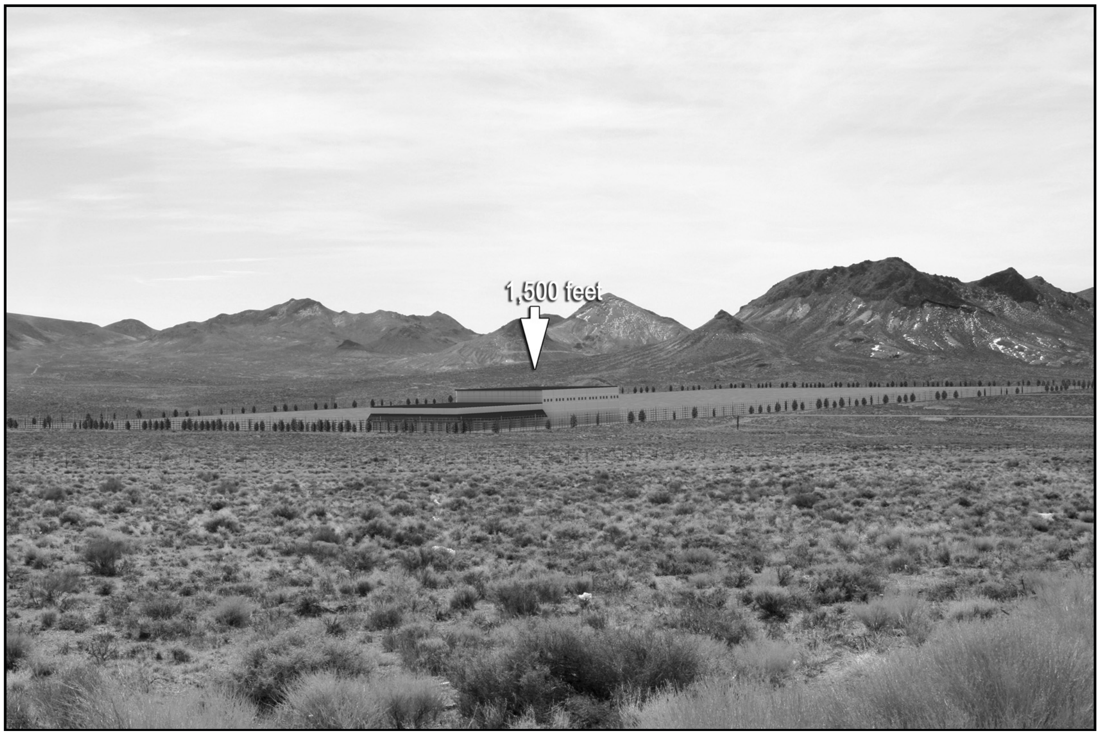


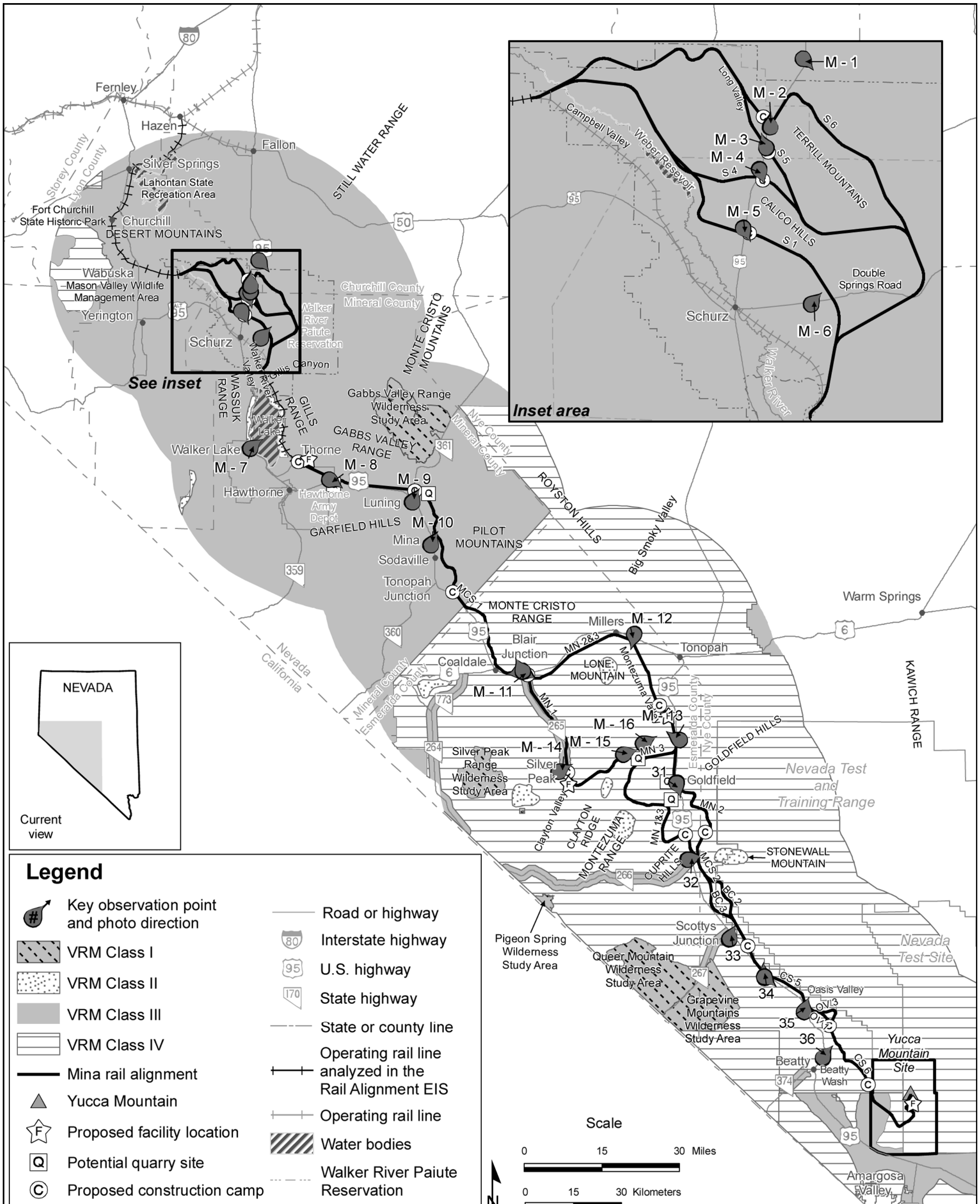

**Figure D-83.** Simulation of Maintenance-of-Way Headquarters Facility, which would be built if DOE selected Goldfield alternative segments 1 or 3, in view northeast from key observation point 37 on U.S. Highway 95.

**Figure D-83a.** View northwest from key observation point 38 on U.S. Highway 95.


**Figure D-83b.** Simulation of Maintenance-of-Way combined Headquarters and Trackside Facility, which would be built if DOE selected Goldfield alternative segment 4, with construction train on siding in view northwest from key observation point 38 on U.S. Highway 95.

# D.2 Mina Rail Alignment

This section provides photographs taken from key observation points along the Mina rail alignment. For some views, DOE has added simulations to the baseline photographs to show how the rail line, trains, or facilities would appear. Figure D-84 shows the locations of the key observation points and the BLM visual resource management classifications of the lands in the viewsheds. Key observation points 31 through 36 are the same as those shown in Section D.1 for the Caliente rail alignment.




Sources: Modified from DIRS 103079-BLM 1998, Map 2-9; DIRS 179571-Knight 2007, all; DIRS 173224-BLM 1997, pp. 6, 7, 27, and Map 8-9; DIRS 155970-DOE 2002, pp. 3-158 and 3-159, DIRS 179560-BLM 2001, Map VRM-1.
Notes: VRM = Visual Resource Management; CS = common segment; MCS = Mina common segment; S = Schurz; MN = Montezuma; BC = Bonnie Claire; OV = Oasis Valley.

**Figure D-84.** Visual resource management classifications and key observation points along the Mina rail alignment.

**Figure D-85.** View southeast from key observation point M-1 on U.S. Highway 95 toward location of Schurz alternative segment 6 against hills.


**Figure D-86.** Simulation of Schurz alternative segment 6 across Rawhide Flats southeast from key observation point M-1 on U.S. Highway 95.


**Figure D-87.** Simulation of train on Schurz alternative segment 6 across Rawhide Flats southeast from key observation point M-1 on U.S. Highway 95.

**Figure D-88.** View northeast from key observation point M-2 on U.S. Highway 95 toward location of Schurz alternative segment 6 and rail-over-road crossing.


**Figure D-89.** Simulation of Schurz alternative segment 6 and grade-separated crossing of U.S Highway 95, view northeast from key observation point M-2.


**Figure D-90.** Simulation of train on Schurz alternative segment 6 and grade-separated crossing of U.S Highway 95, view northeast from key observation point M-2.

**Figure D-91.** View north in Long Valley, toward location of proposed grade-separated crossing of U.S. Highway 95 over Schurz alternative segment 5 from key observation point M-3.


**Figure D-92.** U.S. Highway 95 in Long Valley, simulation of grade-separated crossing of U.S. Highway 95 over Schurz alternative segment 5 from key observation point M-3.

**Figure D-93.** View south from key observation point M-4 at intersection of U.S. Highway 95 and Weber Dam Road, toward location of Schurz alternative segment 4 and grade-separated crossing.


**Figure D-94.** Simulation of U.S. Highway 95 grade-separated crossing and Schurz alternative segment 4, view south from key observation point M-4 near intersection of highway and Weber Dam Road.


**Figure D-95.** Simulation of U.S. Highway 95 grade-separated crossing and train on Schurz alternative segment 4, view south from key observation point M-4 near intersection of highway and Weber Dam Road.

**Figure D-96.** View south from key observation point M-5 on U.S. Highway 95 east of Schurz alternative segments, toward location of Schurz alternative segment 1 grade-separated crossing.

**Figure D-97.** View east from key observation point M-6 on Double Springs Road toward location of at-grade crossing of Schurz alternative segment 1.


**Figure D-98.** Simulation of at-grade Double Springs Road crossing and Schurz alternative segment 1, view east from key observation point M-6.


**Figure D-99.** Simulation of at-grade Double Springs Road crossing and train on Schurz alternative segment 1, view east from key observation point M-6.


**Figure D-100.** View east from key observation point M-7 in the town of Walker Lake across lake toward existing Department of Defense Branchline South. Photo shows the visibility of the existing line at distance of 9.3 kilometers (5.8 miles).

**Figure D-101.** View southeast from key observation point M-8 on U.S. Highway 95 just east of Hawthorne toward location of potential Garfield Hills quarry facilities.

**Figure D-102.** Simulation of Garfield Hills quarry facilities in view southeast from key observation point M-8 on U.S. Highway 95.

**Figure D-103.** View east from key observation point M-9 in the town of Luning toward potential Gabbs Range quarry site.


**Figure D-104.** Simulation of Gabbs Range quarry from key observation point M-9 in view east from Luning.


**Figure D-105.** Simulation of train and Gabbs Range quarry from key observation point M-9 in view east from Luning.

**Figure D-106.** View east from the town of Mina toward Mina common segment 1.


**Figure D-107.** Simulation of Mina common segment 1 in view east from key observation point M-10 at high point in the town of Mina.


**Figure D-108.** Simulation of train on Mina common segment 1 in view east from key observation point M-10 at high point in the town of Mina.

**Figure D-109.** View from key observation point M-11 at intersection of State Route 265 and U.S. Highway 95 (Blair Junction) north to Mina common segment 1 toward Monte Cristo Range. The rail line would travel through the area in the foreground between the viewer and the hills.

**Figure D-110.** View from key observation point M-11 at intersection of State Route 265 and U.S. Highway 95 (Blair Junction) south-southeast over State Route 265 to Montezuma alternative segment 1.

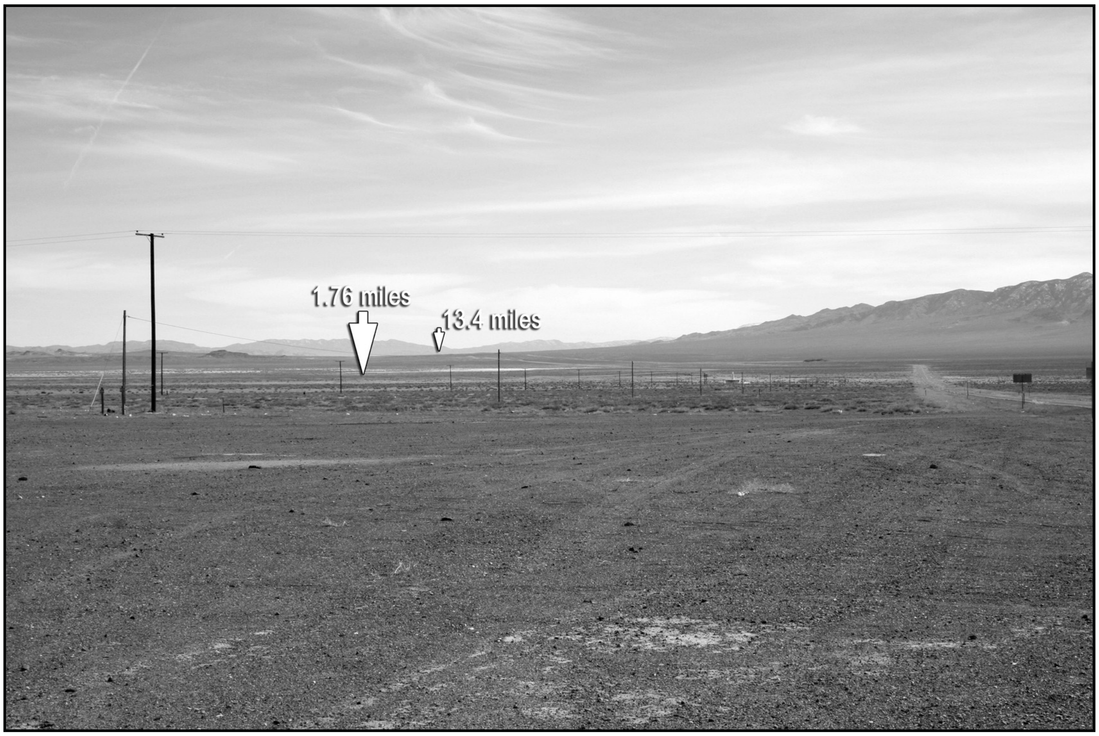



**Figure D-111.** Simulation of Montezuma alternative segment 1 running south along State Route 265 in view south-southeast from key observation point M-11 at Blair Junction.


**Figure D-112.** Simulation of train on Montezuma alternative segment 1 running south along State Route 265 in view south-southeast from key observation point M-11 at Blair Junction.

**Figure D-113.** View from key observation point M-11 at intersection of State Route 265 and U.S. Highway 95 (Blair Junction) west over Mina common segment 1.

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**Figure D-116.** View northeast from key observation point M-14 on Main Street in Silver Peak, south of the Chemetall Foote Corporation processing plant toward Montezuma alternative segment 1. The rail line would cross the white playa bottom in the middleground, and would be visible due to color discrepancy with the ballast material.

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**Figure D-122.** View east toward Stonewall Mountain from key observation point 32 on U.S. Highway 95 at intersection with State Route 266.

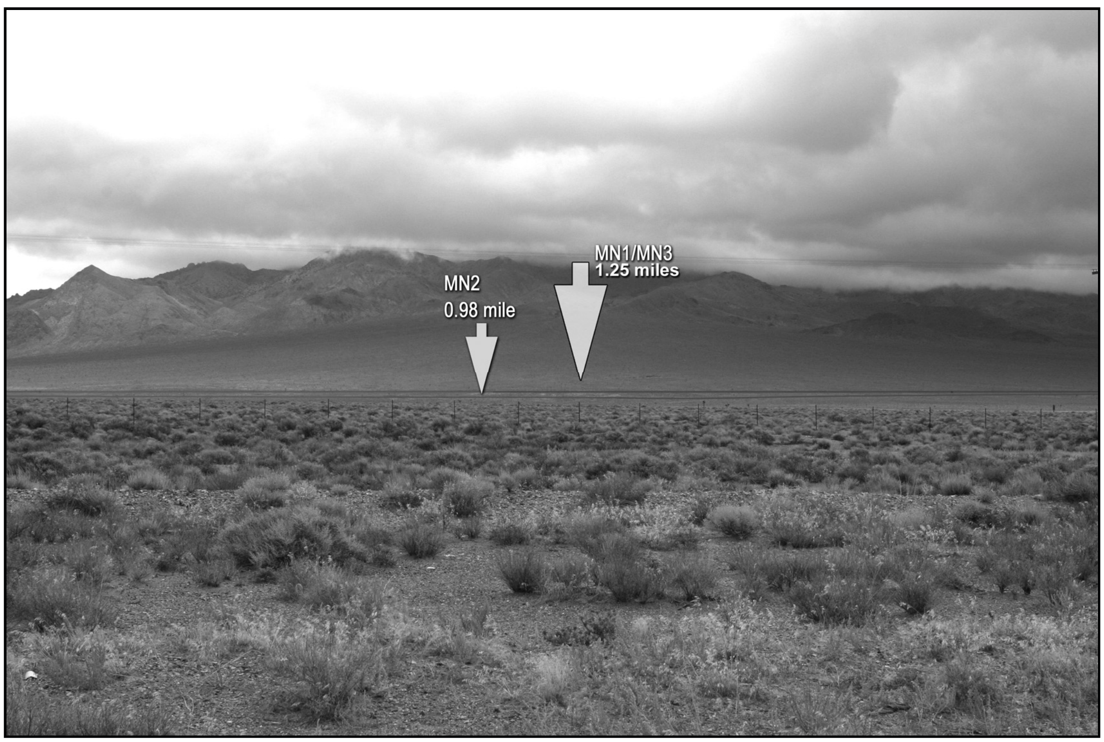


**Figure D-123.** Simulation of Montezuma alternative segments 1 and 3 (middleground) and Montezuma alternative segment 2 (foreground) in view east from key observation point 32. Stonewall Mountain in background.

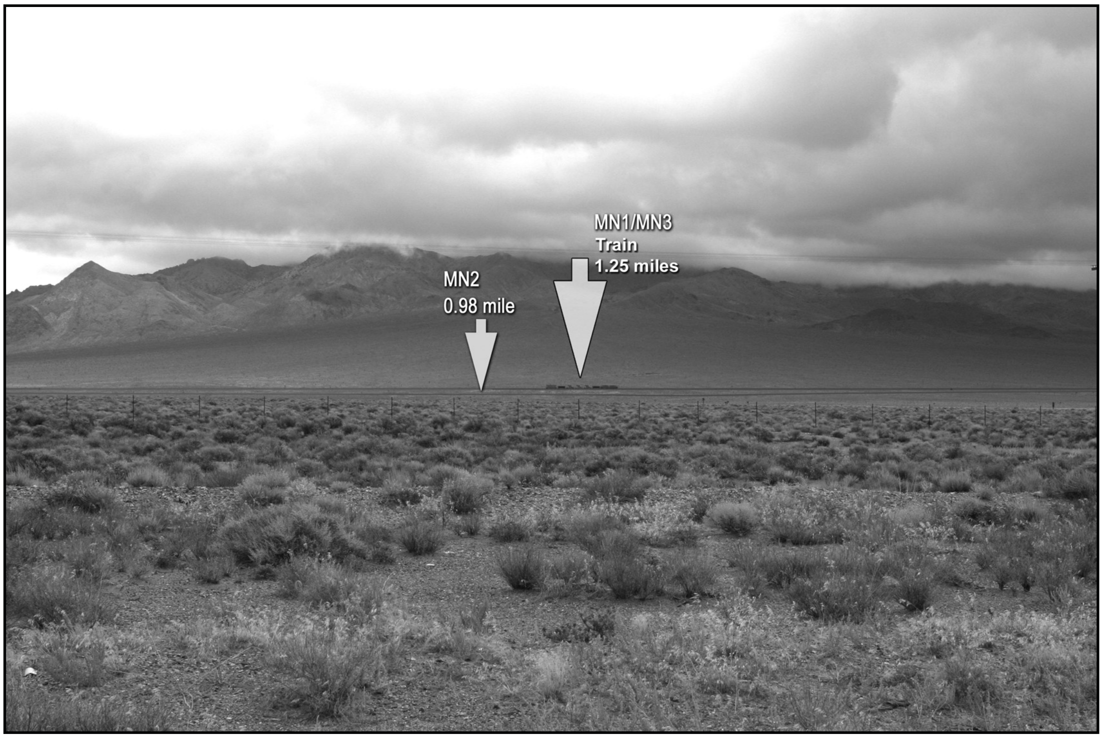


**Figure D-124.** Simulation of train on Montezuma alternative segments 1 and 3 (middleground) with Montezuma alternative segment 2 in foreground. View east from key observation point 32 with Stonewall Mountain in background.

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**Figure D-128.** View north-northeast from key observation point 35 on U.S. Highway 95 across a typical landscape. This most northerly of views from this point across the Amargosa River Valley toward Oasis Valley is where the rail line would be closest to the highway.

**Figure D-129.** View northeast from key observation point 36 on U.S. Highway 95 looking across the road that would be used for construction access to Beatty Wash. Rail line, bridge, and construction camp would not be visible from this point.

# D.3 References

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| Reference | Author/Date | Document Title |
|---|---|---|
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# APPENDIX E

# AIR QUALITY ASSESSMENT METHODOLOGY

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| NAAQS | National Ambient Air Quality Standards |
| $NO_2$ | nitrogen dioxide |
| $NO_x$ | nitrogen oxides |
| $PM_{10}$ | particulate matter with an aerodynamic diameter equal to or less than 10 micrometers |
| $PM_{2.5}$ | particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers |
| $SO_2$ | sulfur dioxide |
| VOCs | volatile organic compounds |

# APPENDIX E

# AIR QUALITY ASSESSMENT METHODOLOGY

This appendix describes the methods DOE used to develop the assessments of potential impacts to air quality provided in Sections 4.2.4 and 4.3.4 of the Rail Alignment EIS.

Section E.4 defines terms shown in ***bold italics***.

This appendix provides detail on the basis for:

- The air quality modeling methodology for construction and operation of the proposed railroad
- The emission inventory as used in the air quality modeling and for the county-level emission inventory comparison
- Site-specific details on the air quality modeling employed for each location where the U.S. Department of Energy (DOE or the Department) performed an assessment

Section E.1 is an overview of the air quality modeling methodology and assumptions; Section E.2 addresses the Caliente rail alignment; and Section E.3 addresses the Mina rail alignment.

## E.1 Overview of Air Quality Modeling Methodology and Assumptions

This section describes the general approach DOE used to model potential impacts to existing ***ambient air*** quality that would result from emissions during railroad construction and operations along the Caliente rail alignment or the Mina rail alignment.

Air quality is generally a regional issue, and compliance with federal and state air quality standards is most often determined at the county level. Historic data on pollutant emissions inventories and compliance status for the State of Nevada are calculated at the county level, and these provide the best means of comparison to the potential impacts from proposed railroad construction and operations. Therefore, the air quality assessment considered impacts associated with increases in total emissions levels and compliance with regulatory standards at the county level.

However, stationary point sources (such as quarries) and mobile sources of air emissions (such as operating trains and automobiles) can subject certain locations, such as population centers (known as receptors), to higher localized levels of pollutants than a regional analysis would suggest. Therefore, DOE also selected more focused study locations within the region of influence in which to model air quality impacts to specific receptors. The Department modeled potential impacts to air quality using the U.S. Environmental Protection Agency (EPA) ***AERMOD*** Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). Model inputs included (1) the estimated air pollutant emissions rates that would be produced by railroad construction and operations activities and (2) local meteorology, where appropriate.

DOE modeled a set of scenarios for the Caliente rail alignment and a set for the Mina rail alignment, in which each combination of location and activity represents one scenario. Generally, the methodology employed to determine potential impacts from air emissions for a scenario involved the following steps:

1. Determine the appropriate air pollutant emissions rates from all facilities in question at the given location.

2. Set up the modeling scenarios in AERMOD to accurately represent the expected layout of emissions sources and position receptors to capture the maximum expected impact from the scenario, including terrain effects on concentration.

3. Obtain at least 3 years of appropriate meteorological inputs for the modeling scenario.

4. Run the model for 3-year periods for the given scenario with unit values (1 gram per second) for emission rates from all sources.

5. Post-process the model output to adjust the unit emission rates for the actual emission rates for each pollutant from each source and determine peak concentrations for all air pollutants of concern and for all averaging periods.

6. Combine the peak and background concentrations and compare them with the applicable ***National Ambient Air Quality Standards*** (NAAQS) to determine if the scenario would have the potential to exceed the NAAQS.

DOE based the air quality modeling effort on the following:

- Emissions from all construction activities involving surface disturbance, laying track, and other processes would have a release height of 0.5 meter (1.6 feet), representing a typical exhaust height, with an initial vertical dimension of 0.46 meter (1.5 feet) to reflect surface or near-surface releases. Emissions from locomotives would have a release height of 5 meters (16 feet) (DIRS 173568-California Environmental Protection Agency 2004, Appendix G) with an initial vertical dimension of 2.3 meters (7.5 feet).

- DOE modeled construction and operations activities along the rail line and rail sidings as volume sources because those emissions would have both a horizontal and a vertical dimension associated with the train stacks and buoyant plumes. Modeling the highly linear rail line as a volume source best represents the initial shape of the plume. The Department modeled activities during quarry operations as area sources to maximize flexibility in source shape and orientation.

- DOE determined maximum air pollutant concentrations near construction and operations activities. The Department set the distance between each activity and the closest receptors on both sides of the edge of the construction right-of-way during the construction phase and on both sides of the edge of the operations right-of-way during the operations phase. The spacing between receptors averaged 25 meters along the right-of-way. All receptors were set at a standard breathing height of 1.8 meters (5.9 feet) above ground level.

- For purposes of modeling, DOE took the layout of each facility for the Caliente rail alignment from *Facilities–Design Analysis Report Caliente Rail Corridor, Task 10: Facilities, Rev. 03* (DIRS 180919-Nevada Rail Partners 2007, all).

- For purposes of modeling, DOE took the layout of each facility for the Mina rail alignment from *Facilities–Design Analysis Report Mina Rail Corridor, Task 10: Facilities, Rev. 00* (DIRS 180873-Nevada Rail Partners 2007, pp. 3-1 and 3-2).

- Construction activity along the rail alignment and at all facilities would occur for 12 hours per day, 5 days each week for the duration of each activity.

- During the construction phase, quarries would operate evenly over a 250-day-per-year schedule (average of 5 days per week), 12 hours per day each week. DOE set receptor locations at the quarry fence line (DIRS 180922-Nevada Rail Partners 2007, pp. 3-7 and 3-8; DIRS 183641-Shannon & Wilson 2007, pp. 15 and 33). Spacing between receptors averaged 50 meters along the fence line.

- DOE determined air pollutant concentrations at all receptors for each scenario using the AERMOD dispersion modeling system version 07026 (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). This software is currently the EPA-recommended model for regulatory applications and is appropriate for this application. Meteorological and terrain inputs for AERMOD were prepared with the ***AERMET*** and ***AERMAP*** preprocessors, respectively. Both employ version 06341.
- DOE aggregated the concentration values from each air pollutant source in each scenario and adjusted from unit to actual emission rates. Generally, this procedure operated by reading the individual model output files for each source group in each scenario, summing the contribution from each source group at each receptor and outputting the receptor exhibiting the peak concentration of each air pollutant.
- DOE computed maximum concentrations (along with maximum background concentration) for all sources in each scenario for all ***criteria pollutants*** and compared these maximums to the Nevada and National Ambient Air Quality Standards.

## E.2 Caliente Rail Alignment

The Caliente rail alignment region of influence for air quality and climate consists of the air basins in three counties (Lincoln, Nye, and Esmeralda) in Nevada through which the rail line would run. DOE performed air quality modeling in four locations: the two largest population centers near the Caliente rail alignment (Caliente in Lincoln County and Goldfield in Esmeralda County), and potential quarry sites northwest of Caliente (CA-8B) and in South Reveille Valley (NN-9B).

For the Caliente rail alignment, the Department modeled a total of eight scenarios, as listed in Table E-1.

**Table E-1.** Air quality modeling scenarios for railroad construction and operations along the Caliente rail alignment.

| Scenario | Activity | Location |
|---|---|---|
| 1 | Rail line construction | Near the City of Caliente (Lincoln County) |
| 2 | Facility construction | Interchange Yard in Caliente |
| 3 | Rail line construction and quarry operations | Potential quarry site CA-8B northwest of Caliente |
| 4 | Rail line construction and quarry operations | Potential quarry site NN-9B in South Reveille Valley (Nye County) |
| 5 | Rail line construction | Near Goldfield (Esmeralda County) |
| 6 | Railroad operations | Near Caliente |
| 7 | Facility operations | Interchange Yard in Caliente |
| 8 | Railroad operations | Near Goldfield |

## E.2.1 CONSTRUCTION IMPACT ASSESSMENT – CALIENTE RAIL ALIGNMENT

### E.2.1.1 Overview

DOE assumed a total duration of the construction phase to be the shortest under consideration (4 years), with 36 months of construction and the remaining 12 months allocated to installation, testing of signal and communications equipment, and commissioning. This assumption produced conservative (high) emission estimates, because longer periods of construction would result in lower annual emission rates.

The construction impact assessment included emissions and impacts to air quality associated with the construction of the rail line, access roads, wells, quarries, construction camps, and construction-material storage piles. *Construction Plan Caliente Rail Corridor, Task 14: Construction Planning Support, Rev. 01* (DIRS 180922-Nevada Rail Partners 2007, all) provides more detail on construction and associated emissions.

The construction impact assessment also included emissions and air quality impacts associated with the construction of the Interchange Yard at the Interface with the Union Pacific Railroad Mainline in Lincoln County, which DOE expects would occur during the first year of the rail line construction phase. Details on the activity and emissions at this facility were taken from the *Air Quality Emission Factors and Socio-Economic Model Input Caliente Rail Corridor, Task 13: EIS Interface Support, Rev. 03* (DIRS 182825-Nevada Rail Partners 2007, all) (the Caliente Rail Corridor Task 13 document).

#### *E.2.1.1.1 Exhaust Emissions*

DOE based the estimated exhaust emissions associated with construction of the proposed railroad along the Caliente rail alignment on engineering estimates of activity levels for construction crews operating in either rugged or gentle terrain. The Department assumed the use of similar construction equipment in both types of terrain, but assumed that the duration of activities would be longer in rugged terrain. Rugged terrain would require significant cut-and-fill operations.

DOE estimated exhaust emissions consisting of ***nitrogen oxides*** ($NO_x$), ***particulate matter*** with aerodynamic diameters equal to or less than 10 micrometers ($PM_{10}$) and 2.5 micrometers ($PM_{2.5}$), ***sulfur dioxide*** ($SO_2$), ***carbon monoxide*** (CO), carbon dioxide ($CO_2$), and ***volatile organic compounds*** (VOCs) from both nonroad and onroad equipment. Nonroad equipment would include bulldozers, graders, front-end and backhoe loaders, excavators, scrapers, cranes, compactors, tampers, drills, and other equipment. Onroad equipment would include equipment licensed for onroad use that would be used for construction of the proposed railroad (such as pickup, dump, and water trucks).

To determine annual nonroad equipment exhaust emissions, DOE used engineering estimates of equipment size, activity levels, annual hours of operation, and horsepower ratings for the construction equipment as reported in the Caliente Rail Corridor Task 13 document. This document included in its analysis an adjustment to operating hours for the cut-and-fill operations. Activity hours for locations assessed as needing considerable cut and fill operations were increased by 50 percent. Emissions factors for corresponding classes of nonroad equipment used in construction were conservatively estimated from EPA Tier 1 (typically, 1997 to 2003 model-year equipment) emissions standards based on horsepower ratings from *Exhaust and Crankcase Emissions Factors for Nonroad Engine Modeling—Compression-Ignition* (DIRS 174089-EPA 2004, all). Exhaust emissions of $NO_x$ were conservatively converted to ***nitrogen dioxide*** ($NO_2$) at the rate of 20 percent.

To determine exhaust emissions from onroad equipment, annual operating hours from the Caliente Rail Corridor Task 13 document (DIRS 182825-Nevada Rail Partners 2007, all) were converted to annual miles traveled assuming average operating speeds of 24 kilometers (15 miles) per hour and combined with emissions factors for appropriate vehicle classifications from the EPA MOBILE 6.2 vehicle emission modeling software (DIRS 174201-EPA 2003, all; DIRS 181954-EPA 2007, all; DIRS 181955-EPA 2004, all).

#### E.2.1.1.2 Fugitive Dust Emissions

DOE estimated particulate matter emissions from ***fugitive dust*** associated with construction activities along the Caliente rail alignment based on the calculations in the Caliente Rail Corridor Task 13 document (DIRS 182825-Nevada Rail Partners 2007, all). These calculations are based on EPA emission factor guidance from *AP-42, Compilation of Air Pollutant Emission Factors* (DIRS 103679-EPA 1991, Section 13.2.3) and the *WRAP Fugitive Dust Handbook* (DIRS 174081-Countess 2004, Chapters 3, 6, and 9). DOE estimated fugitive dust emissions for soil disturbance from grading, scraping, bulldozing, and other rail line construction activities; wind erosion; construction-material stockpiles; construction and operation of concrete batch plants; construction camps; rail line facilities; quarry and excavation activities; and construction of new access roads or upgrades of unpaved roads.

The rail line construction right-of-way would be nominally 150 meters (500 feet) on either side of the centerline of the rail alignment (300 meters [1,000 feet] total width). In addition, the Caliente rail alignment would include:

- Two major bridges (over Beatty Wash and the White River) and a series of minor bridges.
- Twelve construction camps 0.1 square kilometer (25 acres) each.
- Sites for four railroad operations support facilities (the Interchange Yard, Staging Yard, Maintenance-of-Way Trackside Facility, and Rail Equipment Maintenance Yard) that would occupy 0.06 square kilometer, 0.2 square kilometer, 0.06 square kilometer, and 0.4 square kilometer (15, 50, 15, and 100 acres), respectively.
- A total of 23 kilometers (14 miles) of access roads to facilities, plus the access roads on either side of the rail line.
- Four hundred storage piles to be used in track construction that would be located along the rail route.

Fugitive dust emissions would also be associated with the operation of batch plants (including two coarse and fine storage piles), with new road construction or upgrades, and with quarry and excavation operations. In addition to the rail roadbed construction activity, a substantial amount of fugitive dust emissions would be related to haul trucks in the construction zone.

DOE would ensure that best management practices were implemented during construction to minimize air emissions of particulates. These measures typically would include the application of water or other dust suppressants on disturbed land, and limiting vehicle speeds on all unpaved roads. The EPA provides guidance on estimating emissions, including emissions in specific size ranges and information on watering as a dust-control method for unpaved roads (*WRAP Fugitive Dust Handbook* [DIRS 174081-Countess 2004, pp. 3-13 and 3-14] and in AP-42, Section 13.2.2 [DIRS 103679-EPA 1991, all]). The handbook provides additional guidance on the effectiveness of water in suppressing fugitive dust during construction. Emissions-control efficiency ranges from approximately 40 to 85 percent for short durations (DIRS 174084-Piechota et al. 2002, all), depending on meteorology, soil water content, soil type, and other factors. Typical effectiveness values of 70 percent are characteristic of the southwestern United States (DIRS 174215-Maricopa County 2004, all) for applications on the order of hours. For realistic estimation of fugitive dust emissions, DOE assumed:

- A 74-percent best management practice reduction for most fugitive dust emission sources (DIRS 174081-Countess 2004, Executive Summary, pp. 3 and 3-14)

Based on operational guidance, DOE assumed all of the following:

- An 84-percent reduction for construction-material storage piles (DIRS 174081-Countess 2004, Executive Summary, p. 3)
- A 62-percent reduction for batch plant operations (DIRS 174081-Countess 2004, Table 4-2, p. 4-5)
- A 70-percent reduction for quarry operations (DIRS 174081-Countess 2004, Executive Summary, p. 3)

### E.2.1.2 Lincoln County Detail

#### *E.2.1.2.1 Emissions Inventory*

DOE based the total emissions expected to occur within Lincoln County from rail line construction along the Caliente rail alignment on the anticipated rail alignment options (common segments and alternative segments) through the county, which range from approximately 132 kilometers (82 miles) to approximately 148 kilometers (92 miles), depending on the route chosen. Lincoln County was allocated the fraction of total emissions arising from rail line construction, alignment access road construction, well construction, and construction-material storage piles. Emissions from construction activities that would occur only in Lincoln County (for example, construction of the Interchange Yard, specific access roads, and one quarry) were allocated solely to Lincoln County. DOE estimated annual exhaust and fugitive dust emissions of VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that would be attributable to rail line construction activities in Lincoln County, including construction of the Interchange Yard, for each of the assumed 4 years of construction. The Department determined the highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase. The analysis compares construction-related emissions with 2002 Lincoln County data on annual pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.2.1.2.2 Air Quality Modeling*

**E.2.1.2.2.1 Construction Activity.** DOE modeled air quality to determine how construction activities would be likely to impact air pollutant concentrations at Caliente. Modeling included both the rail line and the Interchange Yard. The Department used the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all) for all model runs.

Caliente meteorological data were provided primarily by the Desert Research Institute-operated Community Environmental Monitoring Program. For missing hours in this record, DOE substituted data from the Pioche Community Environment Monitoring Program site (obtained from the Desert Research Institute) and cloud-cover data from McCarran International Airport in Las Vegas. This surface meteorological data represent the best available information for this region, for which meteorological data are sparse. Upper-air data were taken from Elko, Nevada (National Weather Service station 72582). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Elko is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record for 1999, 2000, and 2001 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

In all cases, emission rates were expressed in units of grams per second for the appropriate activity and the resulting highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at all receptors were determined for each model year.

DOE modeled the construction of a portion of the Caliente alternative segment that would begin near Caliente and extend to the northwest for 2 kilometers (1.3 miles) through an area of private property near the city. DOE chose this location for the modeling runs because it represents the closest location of the Caliente rail alignment to population centers.

Because the Department would use existing rail line, construction emissions modeled included only the emissions from the use of locomotives to deliver ballast to subsequent portions of the rail line under construction once the initial rail had been laid. This modeling used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). DOE assumed rail line construction would occur at a rate of 260 hours per month (nominally12 hours per day, 5 days per week). The peak result from the model runs was used to determine all averaging periods.

DOE also modeled emissions from construction of the proposed 0.06-square-kilometer (15-acre) Interchange Yard in Caliente. DOE set receptor locations surrounding the proposed Interchange Yard along the public roads that would parallel the Yard. Receptors were set at a standard breathing height of 1.8 meters (5.9 feet) and a release height of 0.5 meter (1.6 feet) was employed to reflect near-surface releases from equipment and dust. Construction activities would include surface work, laying track, and building structures for the Interchange Yard. DOE assumed construction of the Interchange Yard would occur at an average rate of 260 hours per month (nominally 12 hours per day, 5 days per week).

**E.2.1.2.2.2 Quarry Activity.** DOE also performed air quality modeling to estimate air pollutant concentrations resulting from activity at potential quarry site CA-8B northwest of the City of Caliente (DIRS 180922-Nevada Rail Partners 2007, all). All modeling was performed using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

Caliente meteorological data was provided primarily by the Desert Research Institute-operated Community Environmental Monitoring Program. For missing hours in this record, DOE substituted data from the Pioche Community Environment Monitoring Program site (obtained from the Desert Research Institute) and cloud-cover data from McCarran International Airport in Las Vegas. This surface meteorological data represent the best available information for this region, for which meteorological data are sparse. Upper-air data were taken from Elko, Nevada (National Weather Service station 72582). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Elko is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record for 1999, 2000, and 2001 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

DOE calculated emissions for each of the assumed 3 years of quarry operation, including emissions associated with construction of the quarry facilities during the first year of the construction phase. Emissions included those from the quarry, plant, railroad siding, and access roads. All sources were taken as surface-based releases. Annual emissions were distributed evenly over a 250-day-per-year work schedule (average of 5 days per week), operating between 6:00 a.m. and 6:00 p.m. Receptor locations were set at the fence line surrounding the potential quarry at a standard breathing height of 1.8 meters (5.9 feet).

Next DOE determined the highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations of each air pollutant at all receptors over all 3 years of meteorological data. Therefore, the analysis approach represents a conservative estimate of air pollutant concentrations.

## E.2.1.3 Nye County Detail

### *E.2.1.3.1 Emissions Inventory*

The total emissions expected to occur within Nye County from construction of the proposed rail line along the Caliente rail alignment were based on the proposed rail alignment options (common segments and alternative segments) through the county, which range from 342 kilometers (213 miles) to 398 kilometers (247 miles). Nye County was allocated the fraction of total emissions arising from rail line construction, alignment access road construction, well construction, and construction-material storage piles. Emissions from construction activities that would occur only in Nye County (for example, the Maintenance-of-Way Trackside Facility and construction and operation of one quarry and facility access roads) were allocated solely to Nye County. DOE estimated exhaust and fugitive dust emissions that would be attributable to rail line construction and associated facility construction activity in Nye County for each of the assumed 4 years of construction. The highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase were used in subsequent analysis.

### *E.2.1.3.2 Air Quality Modeling*

DOE also performed modeling to determine potential impacts to air quality associated with construction-related activity at proposed quarry site NN-9B in South Reveille Valley (DIRS 180922-Nevada Rail Partners 2007, Appendix B, pp. B-11, B-12, and B-34 through B-37). All model runs were made using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

For surface meteorological data, DOE relied primarily on the nearby Tonopah Nevada National Weather Service site because of the availability of complete hourly weather data, including cloud-cover data. DOE also used matching upper-air meteorological data from the National Weather Service Mercury/Desert Rock site as model input. DOE was able to assemble a complete 4-year meteorological record for 1989, 1990, 1991, and 1992 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

DOE calculated air pollutant emissions for each of the assumed 3 years of quarry operation associated with construction of the rail line, which included emissions associated with the construction of the quarry facilities during the first year of the construction phase. DOE then modeled the peak annual emissions from activity inside the facility, including the quarry, plant, railroad siding, and access road as area sources. All sources were taken as surface-based releases. Annual emissions were distributed evenly over a 250-day-per-year work schedule (average of 5 days per week), operating between 6:00 a.m. and 6:00 p.m. Receptor locations were set at the fence line surrounding the potential quarry at a standard breathing height of 1.8 meters (5.9 feet).

DOE determined the highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations of each air pollutant at all receptors over all 4 years of meteorological data. Therefore, the analysis approach represents a conservative estimate of air pollutant concentrations.

## E.2.1.4 Esmeralda County Detail

### *E.2.1.4.1 Emissions Inventory*

The total emissions expected to occur within Esmeralda County from rail line construction along the Caliente rail alignment are based on the anticipated rail alignment options (common segments and alternative segments) through the county, which range from 22 kilometers (14 miles) to 44 kilometers (27 miles). Esmeralda County was allocated the fraction of total emissions that would result from rail line construction, alignment access-road construction, well construction, and construction-material storage piles. DOE estimated exhaust and fugitive dust emissions that would be attributable to rail line construction and associated facility construction activity in Esmeralda County for each of the assumed 4 years of construction. The highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase were determined.

#### *E.2.1.4.2 Air Quality Modeling*

DOE modeled air quality to determine the impact of emissions from construction of a segment of the rail alignment (Goldfield alternative segment 4; see Figure 2-9 in Chapter 2 of this Rail Alignment EIS) passing near Goldfield extending for 4.7 kilometers (2.9 miles) near the town. DOE selected Goldfield alternative segment 4 as the most conservative alignment in relation to proximity to population and the exposure to emissions from construction of the rail line. All modeling runs were made using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE used surface meteorological data from the Tonopah Nevada National Weather Service site in the analysis because of the complete hourly weather data, including cloud-cover data. DOE used matching upper-air meteorological data from the National Weather Service Mercury/Desert Rock site in the modeling effort. DOE was able to assemble a 4-year meteorological record for 1989, 1990, 1991, and 1992 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

In all cases, an appropriate emissions rate was determined with units of grams per second or grams per second per square meter for the appropriate activity, and the resulting highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at all receptors were determined for each model year. In addition to the receptors placed alongside the construction and permanent operation rights-of-way, DOE also placed five key receptors at locations within Goldfield. These include the tanks west of Goldfield alternative segment 4, the School Bus Maintenance Facility east of the alignment, and three houses east of the alignment at the periphery of the town nearest the alignment. DOE determined pollutant concentrations at each of these locations in addition to those at the rights-of-ways to indicate potential project impact at key locations in addition to the overall maximum impact at any location along the modeling domain.

DOE modeled construction emissions in two phases. The first phase modeled the emissions associated with construction activities, including surface disturbance, laying track, and other processes with a release height of 0.5 meter (1.6 feet) to reflect surface or near-surface releases from equipment activity. This represented the initial portion of rail line construction. For the second modeling phase, DOE modeled the emissions from the use of locomotives to deliver ballast to subsequent portions of the rail line under construction once the initial rail had been laid. This modeling used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). For both model runs, DOE assumed rail line construction would occur at a rate of 260 hours per month. The highest year results from the two model runs were combined for the annual average to estimate the peak annual average concentration. For the shorter-term averages, the higher concentration was reported from each of these phases because the track construction and the subsequent ballast deliveries would not occur simultaneously.

## E.2.2 RAILROAD OPERATIONS IMPACT ASSESSMENT – CALIENTE RAIL ALIGNMENT

### E.2.2.1 Overview

The operations impact assessment included estimating emissions and potential impacts to air quality associated with operation of the rail line and railroad operations support facilities.

#### *E.2.2.1.1 Emissions from Rail Line Operation*

Spent nuclear fuel and high-level radioactive waste would be transported along the rail line sealed in rail casks. Each DOE cask car would have a gross weight as high as 240 metric tons (264 tons); naval cask cars would weigh as much as 355 metric tons (390 tons). The railroad would operate for up to 50 years. DOE would use two to three 4,000-horsepower, diesel/electric locomotives with a maximum weight of approximately 180 metric tons (198 tons) when fully fueled and ready for use to transport the spent nuclear fuel and high-level radioactive waste.

Emissions associated with railroad operations would be related to the weight of the trains and their frequency. To conservatively estimate emissions, each train trip was assumed to operate with the nominal number of three cask cars per trip, but with the maximum number of locomotives and peak activity along the rail line. This estimate results in a total of six train cars (one escort car, three cask cars, and two buffer cars) plus the maximum number of three locomotive engines per trip, with an equal number returning unloaded each week.

DOE expects that train shipments to the repository would peak around 2013 to 2036 (DIRS 182826-Nevada Rail Partners 2007, Table 1, p. 4-2). At that time, there would be eight one-way cask train trips per week, in addition to the other trains anticipated to operate on the rail line. Other trains would include those needed for fuel oil, repository construction, and maintenance-of-way trains. DOE expects the total rail traffic on the rail line during the peak year would average 17 one-way trips per week (DIRS 175036-BSC 2005, Table 4-2). DOE made the most conservative estimate of activity along the rail line by assuming this activity level throughout the life of the project. DOE then estimated emissions from railroad operations by combining this activity level with estimates of the weight and fuel consumption of the train and appropriate emission factors (DIRS 174085-Sierra Research and Caretto 2004, pp. 6 and 18), and then dividing the emissions among the counties in which the railroad would operate. Although the level of activity would remain constant, because locomotive emission rates generally are expected to decrease throughout the life of the project due to improvement in emission control technologies, total emissions could decrease over the life of the project.

To assess the impact to air quality from railroad operations emissions near Goldfield (in Esmeralda County) and Caliente (in Lincoln County), DOE modeled air quality using the EPA AERMOD Version 07026 model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). In this assessment, a portion of the alternative segments that would pass nearest the two communities were modeled using local meteorological data. To assess the significance of potential impacts to air quality, comparisons were made with the applicable Nevada and National Ambient Air Quality Standards.

#### *E.2.2.1.2 Emissions from Facility Operations*

The operations impact assessment also included emissions and potential impacts to air quality associated with operation of the Interchange Yard in Lincoln County. Other facilities would have similar or smaller operations or would be too distant from public access; therefore, their potential to impact air quality would be low.

DOE treated operations at the Interchange Yard as continuous throughout the life of the proposed railroad. Details on the activity and emissions at these facilities were taken from the Caliente Rail Corridor Task 13 document (DIRS 182825-Nevada Rail Partners 2007, Appendix C) and *Facilities–Design Analysis Report Caliente Rail Corridor, Task 10: Facilities, Rev. 03* (DIRS 180919-Nevada Rail Partners 2007, all).

## E.2.2.2 Lincoln County Detail

### *E.2.2.2.1 Emissions Inventory*

DOE based the estimated amount of emissions expected to occur within Lincoln County from railroad operations on the possible rail alignments through the county (common segments and alternative segments), which range from approximately 132 kilometers (82 miles) to approximately 148 kilometers (92 miles) depending on the route chosen. Lincoln County was allocated the fraction of total emissions arising from railroad operations. Emissions from facility operations that would occur only in Lincoln County (operation of the Interchange Yard) were allocated solely to Lincoln County. Exhaust emissions attributable to operation of the railroad were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Lincoln County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### *E.2.2.2.2 Air Quality Modeling*

A portion of the Caliente alternative segment begins near Caliente and extends to the northwest for 1 kilometer (0.62 mile) through an area of private property near the city. DOE performed air quality modeling of the air pollutants released from railroad operations near Caliente using the EPA AERMOD Version 07026 (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all) dispersion model.

Caliente meteorological data was provided primarily by the Desert Research Institute-operated Community Environmental Monitoring Program. For missing hours in this record, DOE substituted data from the Pioche Community Environment Monitoring Program site (obtained from the Desert Research Institute) and cloud-cover data from McCarran International Airport in Las Vegas. This surface meteorological data represent the best available information for this region, for which meteorological data are sparse. Upper-air data were taken from Elko, Nevada (National Weather Service station 72582). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Elko is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record for 1999, 2000, and 2001 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

In all cases, DOE determined an appropriate emissions rate representing the average activity of the railroad corresponding to the above-determined total emissions with units of grams per second for the appropriate activity. Operations emissions were modeled with a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). DOE assumed the railroad would operate 24 hours per day, 7 days per week.

DOE also modeled emissions with AERMOD based on the operation of the Interchange Yard on a 0.06-square-kilometer (15-acre) site in Caliente. Receptor locations were set surrounding the Interchange Yard along the public roads, which would parallel the Yard. Operations activities would include locomotive switcher and truck operations. DOE assumed the facility would operate 24 hours per day, 7 days per week. Appropriate emissions rates were determined that represented this average activity profile.

DOE determined the highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations from all receptors for each model year.

### E.2.2.3 Nye County Detail

#### *E.2.2.3.1 Emissions Inventory*

DOE estimated total emissions that would be associated with operation of the railroad through Nye County using the same procedure as previously described for Lincoln County. The anticipated routes through Nye County range from 342 kilometers (213 miles) to 398 kilometers (247 miles).

The analysis compares operations-related emissions with 2002 Nye County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.2.2.3.2 Air Quality Modeling*

Because none of the Caliente rail alignment alternative segments or common segments would pass near a community in Nye County, DOE did not perform any air quality modeling for proposed railroad operations.

### E.2.2.4 Esmeralda County Detail

#### *E.2.2.4.1 Emissions Inventory*

DOE based the estimated amount of emissions expected to occur within Esmeralda County from railroad operations on the possible rail alignments (common segments and alternative segments) through the county, which range from approximately 22 kilometers (14 miles) to 44 kilometers (27 miles) depending on route chosen. Esmeralda County was allocated the fraction of total emissions that would result from railroad operations. Exhaust emissions attributable to railroad operations were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Esmeralda County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.2.2.4.2 Air Quality Modeling*

DOE performed air quality modeling of the air pollutants that would be released from railroad operations near Goldfield using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). DOE modeled Goldfield alternative segment 4 over a total distance of 4.7 kilometers (2.9 miles) from northwest of the town, through the town, and turning to exit southeast of the town.

As with the Caliente modeling, the general layout was selected to reflect emissions into the area of private property around Goldfield. DOE modeled railroad operations emissions with a release height of 5 meters (16 feet) (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). DOE assumed the railroad would operate 24 hours per day, 7 days per week.

DOE used surface meteorological data from the Tonopah Nevada National Weather Service site in the analysis because of the complete hourly weather data, including cloud-cover data. DOE used matching upper-air meteorological data from the National Weather Service Mercury/Desert Rock site in the modeling. DOE was able to assemble a 4-year meteorological record for 1989, 1990, 1991, and 1992 of hourly data, and these data were preprocessed by AERMET for input into AERMOD. An emissions rate expressed in grams per second was determined to represent the average operation of the trains.

The highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at any receptor were determined for each modeled year.

#### E.2.2.5 Greenhouse Gas Emission Inventory Methodology

The methodology used to compute $CO_2$ emissions from operations activity along the rail line is similar to that used for other products of combustion (for example, nitrogen oxides). Because greenhouse gas emissions are important only over a much broader region, the $CO_2$ emissions were summed over the entire rail line.

However, in some cases emission factors were not readily available, such as $CO_2$ for locomotives. For this case $CO_2$ emissions were calculated based on an average emission rate over the entire rail alignment of 485 grams per brake horsepower-hour, based on a 20.8 brake horsepower-hours per gallon fuel efficiency and $CO_2$ emission rate of 22.23 pounds per gallon for diesel fuel (DIRS 174089-EPA 2004). Furthermore, for the Cask Maintenance Facility emissions and Staging Yard switching engine emissions, regulated air pollutant emission rates (for example, CO) were provided by the engineering analysis but not $CO_2$ emission rates, nor was activity information available to determine $CO_2$ emissions directly. In these cases, total $CO_2$ emissions were estimated by scaling from CO values, as the principal combustion products by mass are CO and $CO_2$. For the combined operations at the Cask Maintenance Facility, a scaling factor of 93 was used, based on the overall ratio of construction emissions of $CO_2$ and CO. This is in the typical range for a hot stabilized truck-size diesel engine used during construction at the Cask Maintenance Facility. For the switcher operations, the $CO_2$ emissions were determined based on the ratio of the rail operations $CO_2$ and CO emission factors, approximately 379. These larger-size locomotive engines are more efficient, leading to reduced CO emissions per gallon of fuel burned, which results in a higher $CO_2$ to CO ratio.

### E.2.3 SHARED-USE OPTION – CALIENTE RAIL ALIGNMENT

Although the Shared-Use Option would require the construction of some additional sidings in Lincoln and Nye Counties, the additional sidings would be placed parallel to existing track and would not require additional roadbed foundation, only laying of track. Given that these activities would result in minimal additional construction-related emissions over those produced under the Proposed Action without shared use, it was not necessary to calculate an annual emissions inventory, or conduct additional air quality modeling to assess construction-related impacts for the Shared-Use Option beyond those already conducted for evaluation of the Proposed Action without shared use.

DOE calculated emissions for the three additional round trips per week of commercial train activity consisting of 20 cars and three locomotives in each of the three counties. The emissions for each county were determined by scaling the total emissions along the Caliente rail alignment by the anticipated range of distances associated with the various possible rail alignment options through each county.

The analysis compares operations-related emissions associated with the Shared-Use Option with each county's 2002 data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO060NEI2002D.000, all).

Emissions would increase marginally beyond those associated with railroad operations without shared use. In turn, the maximum air pollutant concentrations would increase marginally. Therefore, DOE did not perform additional and separate air quality modeling of air pollutant concentrations for railroad operations along the Caliente rail alignment under the Shared-Use Option.

# E.3 Mina Rail Alignment

The Mina rail alignment region of influence for air quality and climate consists of the five counties (Churchill, Lyon, Mineral, Esmeralda, and Nye) in Nevada through which the rail line would run. DOE performed air quality modeling in seven Nevada locations along the Mina rail alignment: Schurz, Hawthorne, Garfield Hills, Mina, Silver Peak, Malpais Mesa, and Goldfield to determine the impact at the largest population centers near the Mina rail alignment (Schurz, Hawthorne, Mina, and Silver Peak), and quarry sites (Garfield Hills and Malpais Mesa). The Department modeled a total of 14 scenarios, as listed in Table E-2.

**Table E-2**. Air quality modeling scenarios for railroad construction and operations along the Mina rail alignment.

| Scenario | Activity | Location |
|---|---|---|
| 1 | Rail line construction | Near Schurz |
| 2 | Facility construction | Staging Yard at Hawthorne |
| 3 | Rail line construction | Near Hawthorne |
| 4 | Quarry operations | Potential quarry site at Garfield Hills |
| 5 | Rail line construction | Near Mina |
| 6 | Rail line construction | Near Silver Peak |
| 7 | Quarry operations | Potential quarry site at Malpais Mesa |
| 8 | Rail line construction | Goldfield |
| 9 | Railroad operations | Near Schurz |
| 10 | Facility operations | Staging Yard in Hawthorne |
| 11 | Railroad operations | Near Hawthorne |
| 12 | Railroad operations | Near Mina |
| 13 | Railroad operations | Near Silver Peak |
| 14 | Railroad operations | Goldfield |

## E.3.1 CONSTRUCTION IMPACT ASSESSMENT – MINA RAIL ALIGNMENT

### E.3.1.1 Overview

DOE assumed a total duration of the construction phase to be the shortest under consideration (4 years), with 36 months of construction and the remaining 12 months allocated to installation, testing of signal and communications equipment, and commissioning. This assumption produced conservative (high) emission estimates, because longer periods of construction would result in lower annual emission rates. The construction impact assessment included emissions and impacts to air quality associated with construction of the rail line, access roads, wells, and construction-material storage piles. *Construction*

*Plan Mina Rail Corridor, Task 14: Construction Plan Mina Rail Corridor, Rev. 00* (DIRS 180875-Nevada Rail Partners 2007, all) provides additional detail on construction and associated emissions.

The construction impact assessment also included emissions and air quality impacts associated with the construction of a Staging Yard at Hawthorne in Mineral County, which DOE expects would occur during the first year of the construction phase. Details on the activity and emissions at this facility were taken from the *Air Quality Emission Factors and Socio-Economic Model Input Mina Rail Corridor, Task 13: EIS Interface Support, Rev. 02* (DIRS 182825-Nevada Rail Partners 2007, Chapters 2 and 3, Appendices A through C).

#### *E.3.1.1.1 Exhaust Emissions*

DOE based the estimated exhaust emissions associated with construction of the proposed railroad along the Mina rail alignment on engineering estimates of activity levels for construction crews operating in either rugged or gentle terrain. The Department assumed the use of similar construction equipment in both types of terrain, but assumed that the duration of activities would be longer in rugged terrain. Rugged terrain would require significant cut-and-fill operations.

DOE estimated exhaust emissions ($NO_x$, $PM_{10}$, $PM_{2.5}$, $SO_2$, CO, VOCs) from both nonroad and onroad equipment. Nonroad equipment would include bulldozers, graders, front-end and backhoe loaders, excavators, scrapers, cranes, compactors, tampers, drills, and other equipment. Onroad equipment would include equipment licensed for onroad use that would be used for construction of the railroad (such as pickup, dump, and water trucks).

To determine annual nonroad equipment exhaust emissions, DOE used engineering estimates of equipment size, activity levels, annual hours of operation, and horsepower ratings for the construction equipment as reported in the Mina Rail Corridor Task 13 document (DIRS 180874-Nevada Rail Partners 2007, Appendix B). This document included in its analysis an adjustment to operating hours for the cut-and-fill operations. Emissions factors for corresponding classes of nonroad equipment used in construction were conservatively estimated from Tier 1 (typically, 1997 to 2003 model-year equipment) emissions standards based on horsepower ratings from *Exhaust and Crankcase Emissions Factors for Nonroad Engine Modeling—Compression-Ignition* (DIRS 174089-EPA 2004, all).

To determine exhaust emissions from onroad equipment, annual operating hours from the Mina Rail Corridor Task 13 document (DIRS 180874-Nevada Rail Partners 2007, Appendix B) were converted to annual miles traveled assuming average operating speeds of 24 kilometers (15 miles) per hour and combined with emissions factors for appropriate vehicle classifications from the EPA MOBILE 6.2 vehicle emission modeling software (DIRS 174201-EPA 2003, all; DIRS 181954-EPA 2007, all; DIRS 181955-EPA 2004, all).

#### *E.3.1.1.2 Fugitive Dust Emissions*

DOE estimated particulate matter emissions from fugitive dust associated with construction activities along the Mina rail alignment based on the calculations in the Mina Rail Corridor Task 13 document (DIRS 180874-Nevada Rail Partners 2007, Appendix B). These calculations are based on EPA emission factor guidance from *AP-42, Compilation of Air Pollutant Emission Factors* (DIRS 103679-EPA 1991, Section 13.2.3) and the *WRAP Fugitive Dust Handbook* (DIRS 174081-Countess 2004, Chapters 3, 6, and 9). DOE estimated fugitive dust emissions for soil disturbance from grading, scraping, bulldozing, and other rail line construction activities; wind erosion; construction material stockpiles; construction and operation of concrete batch plants; construction camps; rail line facilities; quarry and excavation activities; and construction of new access roads or upgrades of unpaved roads.

The proposed rail line construction right-of-way would be nominally 150 meters (500 feet) on either side of the centerline of the rail alignment (300 meters [1,000 feet] total width). In addition, the Mina rail alignment would include:

- Two major bridges (over Beatty Wash and the Walker River) and a series of minor bridges
- Ten construction camps 0.1 square kilometer (25 acres) each
- Sites for three railroad operations support facilities (Hawthorne Staging Yard, Maintenance-of-Way Facility, and Rail Equipment Maintenance Yard) that would occupy 0.2 square kilometer, 0.06 square kilometer, 0.4 square kilometer (50, 15, and 100 acres), respectively
- A total of 18 kilometers (11 miles) of access roads to facilities, plus the access roads on either side of the rail line
- Three-hundred storage piles to be used in track construction that would be located along the rail route

Fugitive dust emissions would also be associated with the operation of batch plants (including two coarse and fine storage piles), with new road construction or upgrades, and with quarry and excavation operations. In addition to the rail roadbed construction activity, a substantial amount of fugitive dust emissions would be related to haul trucks in the construction zone.

DOE would ensure that best management practices were implemented during construction to minimize air emissions of particulates. These measures typically would include the application of water or other dust suppressants on disturbed land, and limiting vehicle speeds on all unpaved roads. The EPA provides guidance on estimating emissions, including emissions in specific size ranges and information on watering as a dust-control method for unpaved roads (*WRAP Fugitive Dust Handbook* [DIRS 174081-Countess 2004, pp. 3-13 and 3-14]) and in AP-42, Section 13.2.2 (DIRS 103679-EPA 1991, all). The handbook provides additional guidance on the effectiveness of water in suppressing fugitive dust during construction. Emissions-control efficiency ranges from approximately 40 to 85 percent for short durations (DIRS 174084-Piechota et al. 2002, all), depending on meteorology, soil water content, soil type, and other factors. Typical effectiveness values of 70 percent are characteristic of the southwestern United States (DIRS 174215-Maricopa County 2004, all) for applications on the order of hours. For realistic estimation of fugitive dust emissions, DOE assumed:

- A 74-percent best practice reduction for most fugitive dust emission sources (DIRS 174081-Countess 2004, Executive Summary, p. 3, and p. 3-14)

Based on operational guidance, DOE assumed all of the following:

- An 84-percent reduction for construction-material storage piles (DIRS 174081-Countess 2004, Executive Summary, p. 3)
- A 62-percent reduction for batch plant operations (DIRS 174081-Countess 2004, Table 4-2, p. 4-5)
- A 70-percent reduction for quarry operations (DIRS 174081-Countess 2004, Executive Summary, p. 3)

### E.3.1.2 Churchill County Detail

#### *E.3.1.2.1 Emissions Inventory*

DOE based the total emissions expected to occur within Churchill County from rail line construction along the Mina rail alignment on the anticipated rail alignment options (common segments and alternative segments, and movement of construction materials such as concrete ties, steel rails, and ballast) through the county, which range from approximately 17 kilometers (11 miles) to approximately 31 kilometers (20 miles), depending on the route chosen. Churchill County was allocated the fraction of total emissions arising from rail line construction, alignment access-road construction, and construction-material storage piles. DOE estimated annual exhaust and fugitive dust emissions of VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that would be attributable to rail line construction activities in Churchill County. DOE determined the highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase. The analysis compares construction-related emissions with 2002 Churchill County data on annual pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.3.1.2.2 Air Quality Modeling*

Because the Department has not identified any potential quarry sites in Churchill County, and because of the relatively small amount of emissions that would be associated with construction in Churchill County, DOE did not perform any site-specific air quality modeling for that area.

### E.3.1.3 Lyon County Detail

#### *E.3.1.3.1 Emissions Inventory*

DOE based the total emissions expected to occur within Lyon County from rail line construction along the Mina rail alignment on the anticipated rail alignment options (common segments and alternative segments, and movement of construction materials such as concrete ties, steel rails, and ballast) through the county, which range from approximately 61 kilometers (38 miles) to approximately 81 kilometers (51 miles), depending on the route chosen. Lyon County was allocated the fraction of total emissions arising from rail line construction, alignment access-road construction, and construction-material storage piles. DOE estimated annual exhaust and fugitive dust emissions of VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that would be attributable to rail line construction activities in Lyon County for each of the assumed 4 years of construction. The Department determined the highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase. The analysis compares construction-related emissions with 2002 Lyon County data on annual pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.3.1.3.2 Air Quality Modeling*

Because DOE has not identified any potential quarry sites in Lyon County, and because of the relatively limited amount of emissions that would be associated with construction in Lyon County, DOE did not conduct any site-specific air quality modeling.

### E.3.1.4 Mineral County Detail

#### *E.3.1.4.1 Emissions Inventory*

DOE based the total emissions expected to occur within Mineral County from rail line construction along the Mina rail alignment on the anticipated rail alignment options (common segments and alternative segments, and movement of construction materials such as concrete ties, steel rails, and ballast) through the county, which range from approximately 153 kilometers (95 miles) to approximately 171 kilometers (106 miles), depending on the route chosen. Mineral County was allocated the fraction of total emissions arising from rail line construction, alignment access-road construction, well construction, and construction-material storage piles. Emissions from construction activities that would occur only in Mineral County (for example, construction of the Staging Yard at Hawthorne, specific access roads, and one quarry) were allocated solely to Mineral County. The Department estimated annual exhaust and fugitive dust emissions of VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that would be attributable to rail line construction activities in Mineral County, including construction of the Staging Yard, for each of the assumed 4 years of construction. DOE determined the highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase. The analysis compares construction-related emissions with 2002 Mineral County data on annual pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### *E.3.1.4.2 Air Quality Modeling*

**E.3.1.4.2.1 Construction Activity.** DOE modeled air quality to determine how construction activities would be likely to affect air pollutant concentrations near Schurz, Hawthorne (including the Staging Yard at Hawthorne), and Mina. Modeling included both the rail line and the Staging Yard. All modeling runs were made using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE modeled Schurz using the meteorological data collected by the Walker River Paiute Tribe in Schurz as reported through the Tribal Environmental Exchange Network. For missing hours in this record, DOE substituted data from the Fallon, Nevada, site (obtained from the Desert Research Institute) and also used cloud-cover data from Fallon because Schurz does not record cloud-cover information. This surface meteorological data represents the best available information for Schurz. Upper-air data for this location were taken from Reno, Nevada (National Weather Service station 72489). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Reno is routine in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record for 2004, 2005, and 2006 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

DOE modeled Hawthorne, the Staging Yard location, and Mina using the meteorological data collected by National Renewable Energy Laboratory at Luning 7W as reported through the Western Region Climate Center. For missing hours in this record, DOE substituted data from the Fallon and Reno, Nevada, sites (obtained from the Desert Research Institute) and also used cloud-cover data from Fallon because Luning does not record cloud-cover information. This surface meteorological data represents the best hourly meteorological information available for Hawthorne. Upper-air data for this location were taken from Reno, Nevada (National Weather Service station 72489). Thus, it was possible to assemble a 3-year meteorological record for 2004, 2005, and 2006 of hourly data, and these data were preprocessed by AERMET for input into AERMOD.

Because DOE would use existing rail line near Hawthorne, construction emissions modeled included only the emissions from the use of locomotives to deliver ballast to subsequent portions of the rail line under construction once the initial rail had been laid. For locations south of the Staging Yard at Hawthorne, where there is no existing track, construction emissions included both surface emissions from laying track and emissions from ballast delivery. Both modeling runs used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). DOE assumed rail line construction would occur at a rate of 260 hours per month. The peak results from the modeling runs were taken to determine all averaging periods.

DOE also modeled emissions from construction of the proposed 0.2-square-kilometer (50-acre) Staging Yard at Hawthorne. DOE set receptor locations surrounding the proposed Staging Yard along the public roads that would parallel the Yard. Receptors were set at a standard breathing height of 1.8 meters (5.9 feet) and a release height of 0.5 meter (1.6 feet) was employed to reflect near-surface releases from construction equipment. Construction activities would include surface work, laying track, and building structures for the Staging Yard. DOE assumed construction of the Staging Yard would occur at an average rate of 260 hours per month.

DOE also modeled air quality to determine the impact of emissions from construction near Schurz and Mina. DOE selected Schurz alternative segment 1 as the most conservative alignment in relation to proximity to Schurz and the exposure to emissions from rail line construction. All modeling runs were made using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

In all cases, emission rates were expressed in units of grams per second for the appropriate activity and the resulting highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at all receptors were determined for each model year.

For Schurz and Mina, DOE modeled construction emissions in two phases. The first phase modeled the emissions associated with construction activities, including surface disturbance, laying track, and other processes with a release height of 0.5 meter (1.6 feet) to reflect surface or near-surface releases from equipment activity. This represented the initial portion of rail line construction. For the second modeling phase, DOE modeled the emissions from the use of locomotives to deliver ballast to subsequent portions of the rail line under construction once the initial rail had been laid. This modeling used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). For both model runs, DOE assumed rail line construction would occur at a rate of 260 hours per month. The highest year results from the two model runs were combined for the annual average to estimate the peak annual average concentration. For the shorter-term averages, the higher concentration was reported from each of these phases because the track construction and the subsequent ballast deliveries would not occur simultaneously.

**E.3.1.4.2.2 Quarry Activity**. DOE also performed air quality modeling to estimate air pollutant concentrations resulting from activity at the Garfield Hills quarry site east of Hawthorne (DIRS 183636-Shannon & Wilson 2007, pp. 32-37). All modeling analyses were made using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE used the same set of meteorological data as used for Hawthorne and Mina.

DOE calculated emissions for each of the assumed 3 years of quarry operation, including emissions associated with construction of the quarry facilities during the first year of the construction phase. Emissions included those from the quarry, plant, railroad siding, and access roads. All sources were taken as surface-based releases. Annual emissions were distributed evenly over a 250-day-per-year work schedule, operating between 6:00 a.m. and 6:00 p.m. Receptor locations were set at the fence line surrounding the potential quarry at a standard breathing height of 1.8 meters (5.9 feet).

Next DOE determined the highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations of each air pollutant at all receptors over all 3 years of meteorological data. Therefore, the analysis approach represents a conservative estimate of air pollutant concentrations.

## E.3.1.5 Esmeralda County Detail

### *E.3.1.5.1 Emissions Inventory*

DOE based the total emissions expected to occur within Esmeralda County from rail line construction along the Mina rail alignment on the anticipated rail alignment options (common segments and alternative segments, and movement of construction materials such as concrete ties, steel rails, and ballast) through the county, which range from approximately 134 kilometers (83 miles) to approximately 175 kilometers (109 miles), depending on the route chosen. Esmeralda County was allocated the fraction of total emissions arising from rail line construction, alignment access-road construction, well construction, and construction-material storage piles. Emissions from construction activities that would occur only in Esmeralda County (for example, specific access roads, and one quarry) were allocated solely to Esmeralda County. DOE estimated annual exhaust and fugitive dust emissions of VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that would be attributable to rail line construction activities in Esmeralda County for each of the assumed 4 years of construction. DOE determined the highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase. The analysis compares construction-related emissions with 2002 Esmeralda County data on annual pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### *E.3.1.5.2 Air Quality Modeling*

**E.3.1.5.2.1 Construction Activity.** DOE modeled air quality to determine how construction activities would be likely to impact air pollutant concentrations near Goldfield and Silver Peak. All modeling was performed using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE modeled Silver Peak using the Tonopah Airport meteorological data collected by the National Weather Service. For missing hours in this record, DOE substituted data from the Desert Rock, Nevada, site (obtained from the Desert Research Institute). This surface meteorological data represents the best available hourly weather information for Silver Peak. Upper-air data for this location were taken from Desert Rock, Nevada. Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Desert Rock is routine in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record of hourly data for 2004, 2005, and 2006 for Silver Peak and a 4-year record for 1989, 1990, 1991, and 1992 for Goldfield. The older meteorological data were readily available for use in the Goldfield modeling. These data were preprocessed by AERMET for input into AERMOD.

DOE modeled air quality in Silver Peak to determine the impact of emissions from construction of the rail alignment. DOE modeled the alternative segment (Montezuma 1) as the most conservative segment in relation to proximity to Silver Peak and the exposure to emissions from rail line construction. DOE also modeled air quality to determine the impact of emissions from construction of a segment of the rail alignment (Goldfield alternative segment 4) passing near Goldfield extending for 4.7 kilometers (2.9 miles) near the town. DOE selected Goldfield alternative segment 4 as the most conservative segment in relation to proximity to population and the exposure to emissions from construction of the rail line. In addition to the receptors placed alongside the construction and permanent operations rights-of-way, DOE also placed five receptors at key locations within Goldfield. These include the tanks west of Goldfield alternative segment 4, the School Bus Maintenance Facility east of the segment, and three houses east of the segment at the periphery of the town nearest the alignment. DOE determined pollutant concentrations at each of these locations in addition to those at the rights-of-ways to indicate potential project impacts at key locations in addition to the overall maximum impact at any location along the modeling domain. All modeling was performed using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

In all cases, emission rates were expressed in units of grams per second or grams per second per square meter for the appropriate activity and the resulting highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at all receptors were determined for each model year.

DOE modeled the Silver Peak and Goldfield construction emissions in two phases. The first phase modeled the emissions associated with construction activities, including surface disturbance, laying track, and other processes with a release height of 0.5 meter (1.6 feet) to reflect surface or near-surface releases from equipment activity. This represented the initial portion of rail line construction. For the second modeling phase, DOE modeled the emissions from the use of locomotives to deliver ballast to subsequent portions of the rail line under construction once the initial rail had been laid. This modeling used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). For both modeling studies, DOE assumed rail line construction would occur at a rate of 260 hours per month. The highest-year results from the two modeling runs were combined for the annual average to estimate the peak annual average concentration. For the shorter-term averages, the higher concentration was reported from each of these phases because the track construction and the subsequent ballast deliveries would not occur simultaneously.

**E.3.1.5.2.2 Quarry Activity.** DOE also performed air quality modeling to estimate air pollutant concentrations resulting from activity at the potential Malpais Mesa quarry site near Goldfield (DIRS 183636-Shannon & Wilson 2007, pp. 14 to 21). All model runs were made using the AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE used the same set of meteorological data as used for Silver Peak. DOE calculated emissions for each of the assumed 3 years of quarry operations, including emissions associated with construction of the quarry facilities during the first year of the construction phase. Emissions included those from the quarry, plant, railroad siding, and access roads. All sources were taken as surface-based releases. Annual emissions were distributed evenly over a 250-day-per-year work schedule, operating between 6:00 a.m. and 6:00 p.m. Receptor locations were set at the fence line surrounding the potential quarry at a standard breathing height of 1.8 meters (5.9 feet).

Next DOE determined the highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations of each air pollutant at all receptors over all 3 years of meteorological data. Therefore, the analysis approach represents a conservative estimate of air pollutant concentrations.

## E.3.1.6 Nye County Detail

### *E.3.1.6.1 Emissions Inventory*

DOE based the total emissions expected to occur within Nye County from construction of the proposed railroad along the Mina rail alignment on the proposed rail alignment options (common segments and alternative segments, and movement of construction materials such as concrete ties, steel rails, and ballast) through the county, which range from 126 kilometers (78 miles) to 148 kilometers (92 miles). Nye County was allocated the fraction of total emissions arising from rail line construction, alignment access-road construction, well construction, and construction-material storage piles. Emissions from construction activities that would occur only in Nye County (for example, the Rail Equipment Maintenance Yard and facility access roads) were allocated solely to Nye County. DOE estimated exhaust and fugitive dust emissions that would be attributable to rail line construction and associated facility construction activity in Nye County for each of the assumed 4 years of construction. The highest annual emission values for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ over the 4-year construction phase were used in subsequent analysis.

### *E.3.1.6.2 Air Quality Modeling*

Because no quarries are proposed for the southern portion of Nye County in the vicinity of the Mina alignment and the rail line would not pass near any communities, DOE did not conduct any site-specific air quality modeling.

## E.3.2 RAILROAD OPERATIONS IMPACT ASSESSMENT – MINA RAIL ALIGNMENT

### E.3.2.1 Overview

The operations impact assessment included estimating emissions and potential impacts to air quality associated with proposed railroad operations.

#### *E.3.2.1.1 Emissions from Railroad Operations*

Spent nuclear fuel and high-level radioactive waste would be transported along the proposed rail line sealed in rail casks. Each DOE cask car would have a gross weight as high as 240 metric tons (264 tons); naval cask cars would weigh as much as 355 metric tons (390 tons). The railroad would operate for up to 50 years. DOE would use two to three 4,000-horsepower, diesel/electric locomotives with a maximum weight of approximately 180 metric tons (198 tons) when fully fueled and ready for use to transport the spent nuclear fuel and high-level radioactive waste.

Emissions associated with railroad operations would be related to the weight of the trains and their frequency. To conservatively estimate emissions, each train trip was assumed to operate with the nominal number of three cask cars per trip, but with the maximum number of locomotives and peak activity along the rail line. This estimate results in a total of six train cars (one escort car, three cask cars, and two buffer cars) plus the maximum number of three locomotive engines per trip, with an equal number returning unloaded each week.

DOE expects that train shipments to the repository would peak around 2013 to 2036 (DIRS 182826-Nevada Rail Partners 2007, Table 1, p. 4-2). At that time, there would be eight one-way cask train trips per week, in addition to the other trains anticipated to operate on the rail line. Other trains would include those needed for fuel oil, repository construction, and maintenance-of-way trains. DOE expects the total rail traffic on the rail line during the peak year would average 17 one-way trips per week (DIRS 175036-BSC 2005, Table 4.2). DOE made the most conservative estimate of activity along the rail line by assuming this activity level throughout the life of the project. DOE then estimated emissions from railroad operations by combining this activity level with estimates of the weight and fuel consumption of the train and appropriate emission factors (DIRS 174085-Sierra Research and Caretto 2004, pp. 6 and 18), and then dividing the emissions among the counties in which the railroad would operate. Although the level of activity would remain constant, because emissions factors generally decrease throughout the life of the project due to improvement in locomotive control technologies, total emissions could decrease over the life of the project.

To assess the potential impacts to air quality from railroad operations emissions near Schurz, the Staging Yard, Hawthorne, and Mina (all in Mineral County) and Silver Peak (in Esmeralda County), DOE modeled air quality using the EPA AERMOD Version 07026 model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). In this assessment, a portion of the alternative segments that would pass near the two communities were modeled as a series of volume sources using local historical meteorological data. To assess the significance of potential impacts to air quality, comparisons were made with the applicable National Ambient Air Quality Standards.

#### *E.3.2.1.2 Emissions from Facility Operations*

The operations impact assessment also included emissions and potential impacts to air quality associated with operation of the Staging Yard at Hawthorne in Mineral County. Other facilities (such as the Maintenance-of-Way Facility) would have similar or smaller operations or would be too distant from public access; therefore, their potential to impact air quality would be low.

DOE treated operations at the Staging Yard at Hawthorne as continuous throughout the life of the proposed railroad. Details on the activity and emissions at these facilities were taken from the Mina Rail Corridor, Task 13: EIS Interface Support (DIRS 180874-Nevada Rail Partners 2007, Appendix C) and Facilities–Design Analysis Report Mina Rail Corridor, Task 10: Facilities (DIRS 180873-Nevada Rail Partners 2007, pp. 3-1 and 3-2).

### E.3.2.2 Churchill County Detail

DOE estimated total emissions that would be associated with operation of the railroad through Churchill County from railroad operations on the possible rail alignments through the county (common segments and alternative segments), which range from 17 kilometers (11 miles) to 31 kilometers (20 miles), or between 67 and 69 percent of the total Mina rail alignment. Based on this percentage, Churchill County was allocated a corresponding fraction of total emissions arising from railroad operations. Exhaust emissions attributable to operation of the railroad (none in Churchill County) were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Churchill County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### E.3.2.3 Lyon County Detail

DOE based the estimated amount of emissions expected to occur within Lyon County from railroad operations on the possible rail alignments through the county (common segments and alternative segments), which range from approximately 81 kilometers (51 miles) to approximately 61 kilometers (38 miles) depending on the route chosen. Lyon County was allocated the fraction of total emissions arising from railroad operations. Exhaust emissions attributable to operation of the railroad were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Lyon County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### E.3.2.4 Mineral County Detail

#### *E.3.2.4.1 Emissions Inventory*

DOE based the estimated amount of emissions expected to occur within Mineral County from railroad operations on the possible rail alignments (common segments and alternative segments) through the county, which range from approximately 153 kilometers (95 miles) to 171 kilometers (106 miles) depending on route chosen. Mineral County was allocated the fraction of total emissions that would result from railroad operations. Exhaust emissions attributable to railroad operations, including facilities (Staging Yard at Hawthorne) were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Mineral County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### *E.3.2.4.2 Air Quality Modeling*

DOE performed air quality modeling of the air pollutants that would be released from railroad operations near the communities of Schurz, Hawthorne, and Mina, as well as in the vicinity of the Staging Yard using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

DOE modeled Schurz using the meteorological data collected by the Walker River Paiute Tribe in Schurz as reported through the Tribal Environmental Exchange Network. For missing hours in this record, DOE substituted data from the Fallon, Nevada, and Reno, Nevada, sites (obtained from the Desert Research Institute) but also used cloud-cover data from Fallon as Schurz does not record cloud-cover information. This surface meteorological data represents the best available information for Schurz. Upper-air data for this location were taken from Reno, Nevada (National Weather Service station 72489). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Reno is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record of hourly data for 2004, 2005, and 2006. These data were preprocessed by AERMET for input into AERMOD.

DOE modeled Hawthorne, the Staging Yard, and Mina using the meteorological data collected by National Renewable Energy Laboratory at Luning 7W as reported through the Western Region Climate Center. For missing hours in this record, DOE substituted data from the Fallon, Nevada, site (obtained from the Desert Research Institute) and also used cloud-cover data from Fallon as Luning does not record cloud-cover information. This surface meteorological data represents the best hourly meteorological information available for Hawthorne. Upper-air data for this location were taken from Reno, Nevada (National Weather Service station 72489). Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Reno is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record of hourly data for 2004, 2005, and 2006 and these data were preprocessed by AERMET for input into AERMOD.

DOE selected Schurz alternative segment 1 as the most conservative segment in relation to proximity to Schurz, Hawthorne, and Mina using the common segments. All modeling was made using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all). These model runs used a release height of 5 meters (16 feet) to reflect locomotive emission release height (DIRS 173568-California Environmental Protection Agency 2004, Appendix G). The peak results from the modeling runs were taken to determine all averaging periods.

DOE also modeled emissions from operation of the proposed 0.2-square-kilometer (50-acre) Staging Yard at Hawthorne. DOE set receptor locations surrounding the proposed Staging Yard along the public roads that would parallel the Yard. Receptors were set at a standard breathing height of 1.8 meters (5.9 feet) and a release height of 0.5 meter (1.6 feet) was employed to reflect near-surface releases from equipment and dust. Operations activities would include light running repairs, switching between Union Pacific Railroad and DOE locomotives, sorting of trains for delivery, and car inspection, refueling, and sanding. In all cases, emission rates were expressed in units of grams per second or grams per second per square meter for the appropriate activity and the resulting highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at all receptors were determined for each model year.

### E.3.2.5 Esmeralda County Detail

#### *E.3.2.5.1 Emissions Inventory*

DOE based the estimated amount of emissions expected to occur within Esmeralda County from railroad operations on the possible rail alignments (common segments and alternative segments) through the county, which range from approximately 134 kilometers (83 miles) to 175 kilometers (109 miles) depending on route chosen. Esmeralda County was allocated the fraction of total emissions that would result from railroad operations. Exhaust emissions attributable to railroad, including support facilities (Maintenance-of-Way Facility in Esmeralda County), were computed with the peak annual emissions for VOCs, CO, $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$.

The analysis compares operations-related emissions with 2002 Esmeralda County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

#### *E.3.2.5.2 Air Quality Modeling*

DOE modeled Silver Peak and Goldfield using the Tonopah Airport meteorological data collected by the National Weather Service. For missing hours in this record, DOE substituted data from the Desert Rock, Nevada, site (obtained from the Desert Research Institute). This surface meteorological data represents the best available hourly weather information for Silver Peak. Upper-air data for this location were taken from Desert Rock, Nevada. Upper-air data are representative of a much larger geographical area than surface stations and the use of upper-air data from a distance as far away as Desert Rock is routinely done in air quality analyses. Thus, it was possible to assemble a 3-year meteorological record of hourly meteorological data for 2004, 2005, and 2006 for Silver Peak and a 4-year meteorological record for 1989, 1990, 1991, and 1992 for Goldfield. The older meteorological data was readily available for use in the Goldfield modeling. These data were preprocessed by AERMET for input into AERMOD.

DOE modeled air quality in Silver Peak to determine the impact of emissions from operation of the rail alignment near Silver Peak. DOE modeled the alternative segment (Montezuma 1) as the most conservative alignment in relation to proximity to Silver Peak and the exposure to emissions from railroad operations. DOE also modeled air quality to determine the impact of emissions from the operation of a segment of the rail alignment (Goldfield alternative segment 4) passing near Goldfield extending for 4.7 kilometers (2.9 miles) near the town. DOE selected Goldfield alternative segment 4 as the most conservative alignment in relation to proximity to population and the exposure to emissions from operation of the railroad. In addition to the receptors placed alongside the construction and permanent operation rights-of-way, DOE also placed five receptors at key locations in Goldfield. These include the tanks west of Goldfield alternative segment 4, the School Bus Maintenance Facility east of the alignment, and three houses east of the alignment at the periphery of the town nearest the alignment. DOE determined pollutant concentrations at each of these locations in addition to those at the rights-of-way to indicate potential project impact at key locations in addition to the overall maximum impact at any location along the modeling domain. All model runs were made using the EPA AERMOD Version 07026 dispersion model (DIRS 174202-EPA 2002, all; DIRS 181091-EPA 2004, all; DIRS 181090-EPA 2007, all).

The highest 1-hour, 3-hour, 8-hour, 24-hour, and annual average concentrations at any receptor were determined for each model year.

### E.3.2.6 Nye County Detail

DOE estimated total emissions that would be associated with operation of the railroad through Nye County using the same procedure as previously described for Esmeralda County. The anticipated routes through Nye County range from 126 kilometers (78 miles) to 148 kilometers (92 miles).

The analysis compares operations-related emissions with 2002 Nye County data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

### E.3.2.7 Greenhouse Gas Emission Inventory Methodology

The methodology used to compute $CO_2$ emissions from operations activity along the rail line is similar to that used for other products of combustion. Due to the aggregate nature of greenhouse gas impacts, these emissions were calculated on a cumulative basis along the entire rail line, not with county resolution.

However, emission factors for $CO_2$ for locomotives and for the operation of many facilities are not available from the EPA's models and/or were not compatible with the level of information needed, such as total facility emissions. In these cases, the following was assumed. Operations $CO_2$ emissions along the rail alignment for all trains, including the Shared-Use Option, were calculated as 485 grams per brake horsepower-hour, based on a 20.8 brake horsepower-hours per gallon fuel efficiency and $CO_2$ emission rate of 22.23 pounds per gallon for diesel fuel (DIRS 174089-EPA 2004, all). Furthermore, in the cases of the total Cask Maintenance Facility emissions and Interchange Yard switching engine emissions, criteria species emission rates (for example, CO) were provided by the engineering analysis but $CO_2$ emission rates were not, nor was adequate activity information provided to calculate $CO_2$ emissions. In these cases, total $CO_2$ emissions were estimated by scaling from CO values. For the combined operations at the Cask Maintenance Facility, a scaling factor of 93 was used, based on the overall ratio of construction emissions of $CO_2$ and CO. For the switcher operations, the $CO_2$ emissions were determined based on the ratio of the rail operations $CO_2$ and CO emission factors, approximately 379.

## E.3.3 SHARED-USE OPTION – MINA RAIL ALIGNMENT

Although the Shared-Use Option would require the construction of some additional sidings along the alignment, the additional sidings would be placed parallel to existing track and would not require additional roadbed foundation, only laying of track. Given that these activities would result in minimal additional construction-related emissions over those produced under the Proposed Action without shared use, it was not necessary to calculate an annual emissions inventory, or conduct additional air quality model runs to assess construction-related impacts for the Shared-Use Option beyond those already conducted for evaluation of the Proposed Action without shared use.

DOE calculated emissions for 18 additional one-way trips per week north of Schurz and ten additional one-way trips south of Schurz of commercial train activity consisting of 60 cars and three locomotives. The emissions for each county were determined by scaling the total emissions along the Mina rail alignment by the anticipated range of distances associated with the various possible rail alignment options through each county.

The analysis compares operations-related emissions associated with the Shared-Use Option with each county's 2002 data on annual air pollutant emissions obtained from the EPA National Emissions Inventory database (DIRS 177709-MO0607NEI2002D.000, all).

Emissions would increase marginally beyond those associated with railroad operations without shared use. In sum, the maximum air pollutant concentrations would increase marginally. Therefore, DOE did not perform additional and separate air quality modeling of air pollutant concentrations for railroad operations along the Mina rail alignment under the Shared-Use Option.

# E.4 Glossary

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| AERMAP (AERMOD Maps terrain Preprocessor) | The terrain preprocessor that uses data from the Digital Elevation Model Database and creates a file suitable for use within AERMOD. This file contains elevation and hill-height scaling factors for each receptor for use by AERMOD. |
| AERMET (AERMOD Meteorological Preprocessor) | The meteorological preprocessor component of AERMOD. Surface meteorological observations, hourly cloud-cover observations, and twice-a-day upper air sounds are "preprocessed" by AERMET into data used by AERMOD. |
| AERMOD (AMS/EPA Regulatory Model) | A short-range steady-state air quality dispersion model. The model incorporates air dispersion concepts based on the state-of-the-science understanding of planetary boundary layer turbulence structure and scaling concepts. AERMOD became the U.S. Environmental Protection Agency's preferred air dispersion model in place of ISC3 on December 9, 2005. |
| ambient air | The surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures. It is not the air in the immediate proximity to emission sources. |
| carbon monoxide | A colorless, odorless, poisonous gas produced by incomplete fossil-fuel combustion; one of the six pollutants for which there is a ***National Ambient Air Quality Standard***. |
| contaminant | A substance that contaminates (pollutes) air, soil, or water. It could also be a hazardous substance that does not occur naturally or that occurs at levels greater than those occurring naturally in the surrounding ***environment***. |
| criteria pollutants | Six common pollutants (***ozone***, ***carbon monoxide***, ***particulate matters***, ***sulfur dioxide***, lead, and ***nitrogen dioxide***) known to be hazardous to human health and the environment, and for which the U.S. Environmental Protection Agency sets ***National Ambient Air Quality Standards*** under the Clean Air Act. See ***toxic air pollutants***. |
| environment | (1) Includes water, air, and land and all plants and humans and other animals living therein, and the interrelationship existing among these. (2) The sum of all external conditions affecting the life, development, and survival of an organism. |
| fugitive dust | ***Particulate matter*** composed of soil; can include emissions from haul roads, wind erosion of exposed soil surfaces, and other activities in which soil is removed or redistributed. |
| hazardous chemical | As defined under the Occupational Safety and Health Act (Public Law 91-956) and the Emergency Planning and Community Right-to-Know Act (42 U.S.C. 116), a chemical that is a physical or health hazard. |

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| hazardous pollutant | A ***hazardous chemical*** that can cause serious health and environmental hazards; listed on the federal list of hazardous air pollutants (Clean Air Act; 42 U.S.C. 7412). See ***toxic air pollutants***. |
| National Ambient Air Quality Standards | Standards established on a federal or state level that define the limits for airborne concentrations of designated ***criteria pollutants*** [***nitrogen dioxide***, ***sulfur dioxide***, ***carbon monoxide***, ***particulate matter*** with aerodynamic diameters less than 10 micrometers ($PM_{10}$), particulate matter with aerodynamic diameters less than 2.5 micrometers ($PM_{2.5}$), ***ozone***, and lead] to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards). |
| nitrogen dioxide | See ***nitrogen oxides***. |
| nitrogen oxides (oxides of nitrogen) | Gases formed in great part from atmospheric nitrogen and oxygen when combustion occurs under conditions of high temperature and high pressure; a major air pollutant. Two primary nitrogen oxides, nitric oxide (NO) and ***nitrogen dioxide*** ($NO_2$), are noteworthy airborne ***contaminants***. Nitric oxide combines with atmospheric oxygen to produce nitrogen dioxide. Both nitric oxide and ***nitrogen dioxide*** can, in high concentrations, cause lung cancer. ***Nitrogen dioxide*** is a ***criteria pollutant***. |
| particulate matter | Any finely divided solid or liquid material other than pure water (such as dust, smoke, mist, fumes, or smog) found in air or emissions. |
| ozone ($O_3$) | The triatomic (three atoms in the molecule) form of oxygen; in the stratosphere, ozone protects the Earth from the sun's ultraviolet radiation but in lower levels of the atmosphere, it is an air pollutant. |
| $PM_{2.5}$ | All ***particulate matter*** with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers. |
| $PM_{10}$ | All ***particulate matter*** with an aerodynamic diameter less than or equal to a nominal 10 micrometers. Particles less than this diameter are small enough to be breathable and could be deposited in lungs. |
| sulfur dioxide | A pungent, colorless gas produced during the burning of sulfur-containing fossil fuels. It is the main pollutant involved in the formation of acid rain. Coal- and oil-burning electric utilities are the major source of sulfur dioxide in the United States. Inhaled sulfur dioxide can damage the human respiratory tract and can severely damage vegetation. See ***criteria pollutants***, ***National Ambient Air Quality Standards***. |
| toxic air pollutants | ***Hazardous pollutants*** not listed as either ***criteria pollutants*** or hazardous pollutants. |
| volatile organic compound (VOC) | Organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the atmosphere. |

# E.5 References


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# APPENDIX F

# FLOODPLAIN AND WETLANDS ASSESSMENT

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BLM | Bureau of Land Management |
| CFR | Code of Federal Regulations |
| DIRS | Document Input Reference System |
| DOE | U.S. Department of Energy |
| EIS | environmental impact statement |
| FEIS | final environmental impact statement |
| FEMA | Federal Emergency Management Agency |
| NEPA | National Environmental Policy Act |

# APPENDIX F

# FLOODPLAIN AND WETLANDS ASSESSMENT

## F.1 Introduction

Pursuant to Executive Order 11988, *Floodplain Management*, each federal agency is required, when conducting activities in a floodplain, to take actions to reduce the risk of flood damage; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. Pursuant to Executive Order 11990, *Protection of Wetlands*, each Federal agency is to avoid, to the extent practicable, the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists. The U.S. Department of Energy (DOE or the Department) issued regulations that implement these Executive Orders (10 Code of Federal Regulations [CFR] 1022, *Compliance with Floodplain/Wetlands Environmental Review Requirements*). In accordance with the terms of this regulation, specifically 10 CFR 1022.11(d), DOE must prepare a floodplain assessment for proposed actions that would take place in floodplains and a wetlands assessment for any proposed actions that would occur in wetlands. The purpose of this appendix is to meet both of these requirements.

This assessment was also prepared in accordance with Title 40 CFR 230, which provides Section 404(b)(1) guidelines for the specification of disposal sites for dredged or fill material. This assessment aids DOE in demonstrating that the preferred alignment represents the least environmentally damaging practicable alternative.

DOE plans to seek authorization pursuant to section 404(r) of the Clean Water Act for the discharge of dredged or fill material in connection with the construction of the railroad. Section 404(r) provides that the discharge of dredged or fill material as part of the construction of a federal project specifically authorized by Congress is not prohibited by or otherwise subject to regulation under Section 404, and other specified sections of the Clean Water Act, if information on the effects of such discharge, including consideration of the guidelines developed under subsection 404(b)(1) of the Act, is included in an EIS for such project and submitted to Congress before the actual discharge and prior to either the authorization of such project or an appropriation of funds for such construction. Section F.5 of this Appendix summarizes the analyses conducted that address those guidelines and the Department's conclusions about whether the proposed action would comply with the implementing regulations of subsection 404(b)(1) of the Clean Water Act. DOE estimates that it would seek authorization pursuant to Section 404(r) following issuance of a record of decision selecting a rail alignment and prior to actual discharge of dredged or fill material in connection with construction of the railroad and prior to an appropriation of funds for such construction.

In February 2002, DOE published the *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (hereinafter referred to as the Yucca Mountain FEIS) (DIRS 155970-DOE 2002, all). As part of that environmental impact statement (EIS) process, DOE prepared a floodplain/wetlands assessment in accordance with 10 CFR Part 1022, and published the assessment as Appendix L of the Yucca Mountain FEIS. The assessment examined the effects of repository construction and operation and potential construction of a rail line on (1) floodplains near the Yucca Mountain site, and (2) floodplains and areas that may have wetlands along potential rail alignments.

Because DOE chose rail as the preferred mode of transporting spent nuclear fuel, high-level radioactive waste, and other materials to the repository site, the Rail Alignment EIS evaluates the potential effects of the construction and operation of the railroad on floodplains and wetlands along the proposed rail alignment. The EIS also evaluates potential impacts to floodplains and wetlands from the implementation of the Shared-Use Option.

In accordance with 10 CFR 1022.13, this Floodplain and Wetlands Assessment includes a Project Description (see Section F.2), an analysis of floodplain and wetland impacts (see Section F.3), and a discussion of alternatives (see Section F.4).

# F.2 Project Description

Chapter 2 of the Rail Alignment EIS contains a detailed description for the Proposed Action and two implementing alternatives (the Caliente Implementing Alternative and the Mina Implementing Alternative, each with a Shared-Use Option). Sections 3.2.5 and 3.3.5 of the Rail Alignment EIS describe the existing environment for surface-water resources along the Caliente and Mina rail alignments; this appendix does not repeat that information. This section of the Floodplain and Wetlands Assessment provides additional information on floodplains and wetlands associated with the Caliente and Mina rail alignments. Section F.3 provides additional data regarding potential impacts to floodplains and wetlands to support the floodplain and wetlands assessment.

## F.2.1 FLOODPLAIN DATA REVIEW

Title 10 CFR Part 1022.11 lists four sources of information that must be reviewed to determine whether a proposed action would be located within a floodplain. These sources include the following:

- Flood Insurance Rate Maps or Flood Hazard Boundary Maps prepared by the Federal Emergency Management Agency (FEMA)
- Information from a land-administering agency or from other government agencies with floodplain determination expertise
- Information in safety basis documents as defined in 10 CFR Part 830 (*Nuclear Safety Management*)
- DOE environmental documents

DOE collected and analyzed floodplain data, which are provided in Section F.2.1.1 for the Caliente rail alignment and in Section F.2.1.2 for the Mina rail alignment.

For actions that would be located in a floodplain, DOE is required to describe the nature and extent of the flood hazard. DOE must determine if an action would be located within either a base-action floodplain or a critical-action floodplain, using the most authoritative information available about site conditions. The base floodplain is, at a minimum, the area inundated by a flood having a 1-percent chance of occurring in any given year (referred to as the 100-year floodplain). The critical-action floodplain is the area inundated by a flood having an 0.2-percent chance of occurring in any given year (referred to as the 500-year floodplain).

Critical action is defined as any activity for which even a slight chance of flooding would be too great. Such actions could include the storage of highly volatile, toxic, or water-reactive materials. DOE considered the critical action floodplain (500-year floodplain) in this assessment because petroleum, oil, lubricants, and other hazardous materials could be used during the construction and operation of the proposed railroad and because spent nuclear fuel and high-level radioactive waste would be transported on the rail line.

The spent nuclear fuel and high-level radioactive waste that DOE would transport to a repository at Yucca Mountain would be considered highly toxic, but when in transit or temporarily positioned at an associated facility, this material would be managed in shipping casks that meet U.S. Nuclear Regulatory Commission regulations. Commission regulations (10 CFR Part 71) are intended to ensure that the public will be protected both during normal transportation activities and in the event a shipment is involved in a transportation accident. These regulations state that each shipping cask must meet certain containment, radiation control, and criticality control requirements when it is subjected to specified normal transportation conditions and hypothetical accident conditions. The test conditions include a 9-meter (30-foot) free drop; a puncture test allowing the container to free fall 1 meter (3.3 feet) onto a steel rod 15 centimeters (6 inches) in diameter; a 30-minute, all-engulfing fire at 800°C (1,500°F); and an 8-hour immersion under 0.9 meter (3 feet) of water. Further, an undamaged package must be subjected to 1-hour immersion under 200 meters (655 feet) of water. These regulations define radiological criteria (that is, radioactivity release and radiation levels external to the cask) that must be achieved. These criteria require the cask structural integrity to be effectively unimpaired.

Shipping casks would never be opened during the transportation process and the potential for a release during any accident or flooding scenario would be extremely remote (DIRS 104774-Fischer et al. 1987, pp. 9-1 to 9-15). Hazardous materials that would be most susceptible to accidental spills and releases would be the fuels and other petroleum products required to support power and equipment needs during the railroad construction and operations phases. Storage of these materials would be according to normal environmental regulatory requirements (within secondary containment) and, as practicable, would be stored outside of floodplains.

### F.2.1.1 Caliente Rail Alignment

DOE analyzed floodplain data in accordance with 10 CFR Part 1022 for the Caliente rail alignment; the analysis is here and documented in the *Hydrologic and Drainage Evaluation Report for the Caliente Rail Corridor* (DIRS 182755-Parsons Brinckerhoff 2005, pp. 8 to 12).

FEMA has mapped floodplains on Flood Insurance Rate Maps for areas of Lincoln, Nye, and Clark Counties. In Lincoln County, applicable flood-map coverage was only available for the City of Caliente. FEMA provides these maps for use in community planning and development to adequately prepare for potential flood events. FEMA has mapped 500-year floodplains only within the city limits of Caliente. The FEMA flood-map coverage is shown on Figure F-1 and described in detail in Sections F.3.2.1 through F.3.2.12.

Overlaying the Caliente rail alignment on the FEMA maps allows for estimates of crossing distances (that is, the length of the rail alignment within the various floodplains). Table F-1 lists the floodplains identified along the Caliente rail alignment by alternative segments and common segments. Sections F.3.2.1 through F.3.2.12 describe the floodplains, where information is available, that would be encountered by each of the rail line segments.

In addition to the FEMA flood maps, DOE used two studies completed in support of the Rail Alignment EIS to provide additional information related to discharge rates and flood hazards. The *Hydrologic and Drainage Evaluation Report for the Caliente Rail Corridor* (DIRS 182755-Parsons Brinckerhoff 2005, all) included field reconnaissance of every drainage feature along the entire Caliente rail alignment and a review of all available streamflow and precipitation data sources. Also, an earlier study completed by Kennedy, Jenks, and Chilton in 1990 (DIRS 176903-De Leuw, Cather & Company 1992, Appendix H) provides approximate design discharge flow rates for portions of the alignment with drainage areas greater than 2.6 square kilometers (1 square mile) in size. The study also identifies locations along the Caliente rail alignment with significant and unusual flooding hazards, including sections of the alignment

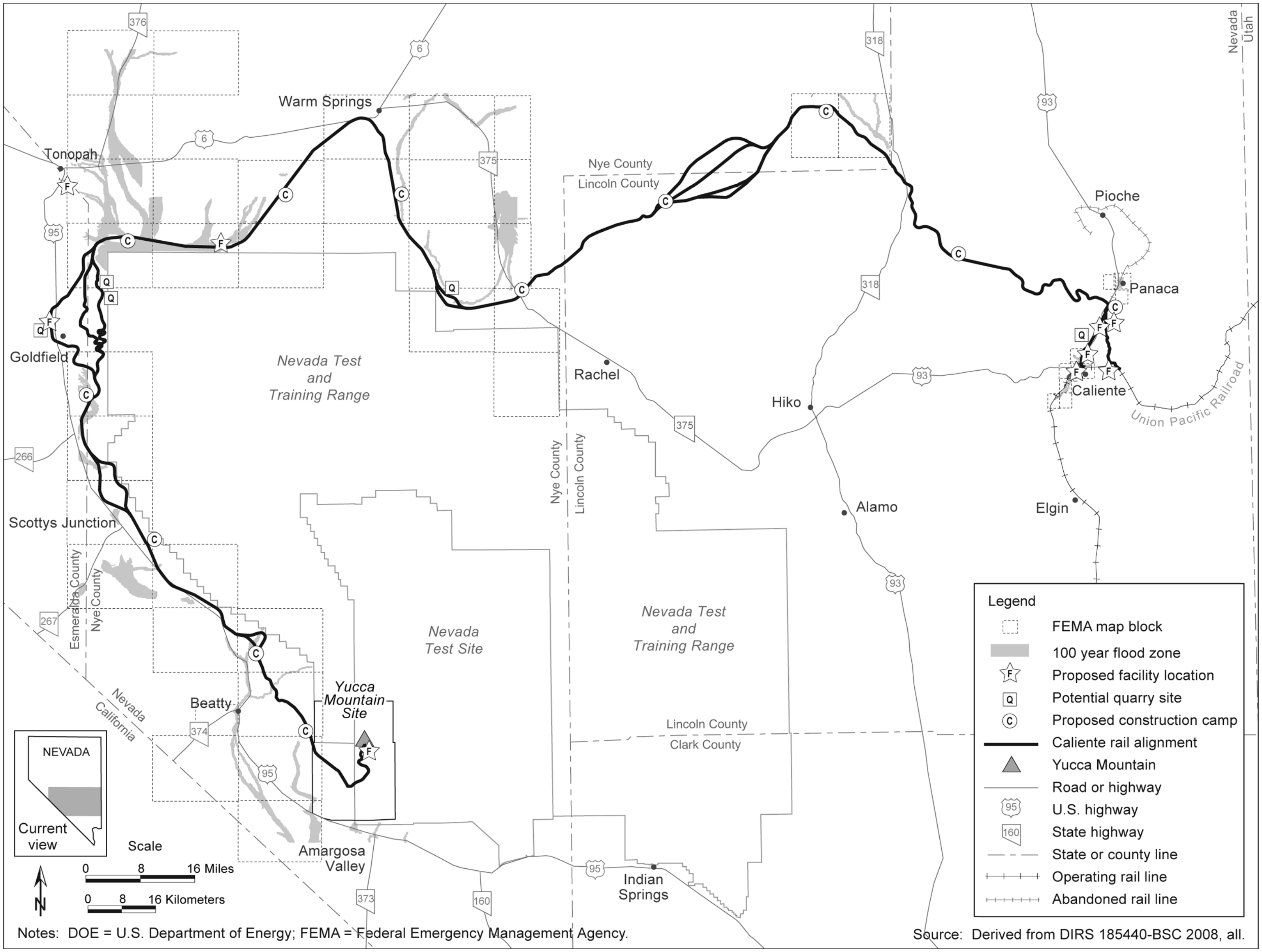


**Figure F-1.** FEMA floodplain map coverage for the Caliente rail alignment.

**Table F-1.** Floodplains the Caliente rail alignment would cross (page 1 of 2).

| Rail line segment | Portion covered by FEMA[a] maps (percent) | Floodplain crossing distance (miles)[b] | | Description of feature that would be crossed |
|---|---|---|---|---|
| | | Mapped | Additional estimated | |
| Caliente alternative segment | 28 | 1.6 | 1.6 | Starting from the southern end of the alignment with the Clover Creek Floodplain to its junction with the Meadow Valley Wash Floodplain and up the alignment approximately 4 kilometers (2.5 miles). No FEMA map available above Caliente city limit. Additional floodplain estimated by using shaded relief map and extending flood plain. Crossing distance for Meadow Valley Wash is based on the width of the flood zones farther south where there is flood map coverage. |
| Eccles alternative segment | 0 | 0 | 0.62 | FEMA map coverage is not available for the Eccles alternative segment. Crossing distance is estimated from the width of the 100-year flood zone along Clover Creek near its confluence with Meadow Valley Wash where there is flood zone map coverage. |
| Caliente common segment 1 | 14 | 0 | 1.2 | No floodplains identified. |
| Garden Valley alternative segment 1 | 0 | 0 | 2.4 | No FEMA map coverage; floodplain estimated as area adjacent to Coal Valley Playa. |
| Garden Valley alternative segment 2 | 0 | 0 | 5.9 | No FEMA map coverage; floodplain estimated as area adjacent to Coal Valley Playa. |
| Garden Valley alternative segment 3 | 0 | 0 | 2.4 | No FEMA map coverage; floodplain estimated as area adjacent to Coal Valley Playa. |
| Garden Valley alternative segment 8 | 0 | 0 | 5.9 | No FEMA map coverage; floodplain estimated as area adjacent to Coal Valley Playa. |
| Caliente common segment 2 | 26 | 0 | 0 | No floodplains identified. |
| South Reveille alternative segment 2 | 100 | 14 | 0 | Reveille Valley braided wash floodplain extending from Railroad Valley around southern tip of Reveille Range. |
| South Reveille alternative segment 3 | 100 | 0 | 0 | No floodplains identified. |
| Caliente common segment 3 | 79 | 17 | 0 | The floodplain extends from Mud Lake Playa up through Ralston Valley Wash, Saulsbury Wash, Willow Creek (also called Stone Cabin Creek), and a tributary of Willow Creek and a western tributary of Mud Lake Playa. There are no floodplain maps for parts of eastern common segment 3-west; however, the topography in that area suggests that it is not in a floodplain. |

**Table F-1.** Floodplains the Caliente rail alignment would cross (page 2 of 2).

| Rail line segment | Portion covered by FEMA[a] maps (percent) | Floodplain crossing distance (miles)[b] | | Description of feature that would be crossed |
|---|---|---|---|---|
| | | Mapped | Additional estimated | |
| Goldfield alternative segment 1 | 58 | 0.62 | 0 | Floodplains from Mud Lake Playa and Stonewall Flat extending up Mud Lake Playa minor tributaries and Jackson Wash and China Wash, respectively. |
| Goldfield alternative segment 3 | 55 | 0.62 | 0 | Floodplains from Mud Lake Playa and Stonewall Flat extending up Mud Lake Playa minor tributaries and Jackson Wash and China Wash, respectively. |
| Goldfield alternative segment 4 | 43 | 0.93 | 0 | Floodplains from Mud Lake Playa, Alkali Lake Playa, and Stonewall Flat extending up Mud Lake Playa minor tributaries, Big Wash tributaries, and Jackson Wash and China Wash tributaries, respectively. Alkali Lake Playa floodplain not mapped by FEMA. |
| Caliente common segment 4 | 100 | 0.81 | 0 | Floodplain extends downgradient of Stonewall Flat Playa to the Lida Valley Alkali Flat Playa. |
| Bonnie Claire alternative segment 2 | 30 | 0 | 0 | No floodplains identified. |
| Bonnie Claire alternative segment 3 | 78 | 1.2 | 0 | Floodplains extending up tributaries of the Lida Valley Alkali Flat Playa and up the Stonewall Pass wash from the Bonnie Claire Flat area of Sarcobatus Flat. |
| Common segment 5 | 74 | 0.19 | 0 | Floodplain extending from Sarcobatus Flat up to Tolicha Wash. |
| Oasis Valley alternative segment 1 | 100 | 0.68 | 0 | Floodplain of the Amargosa River within Thirsty Canyon. |
| Oasis Valley alternative segment 3 | 100 | 0.25 | 0 | Floodplain of the Amargosa River within Thirsty Canyon. |
| Common segment 6 | 55 | 0.06 | 0 | Beatty Wash Floodplain extending from Amargosa River Floodplain. |
| | | 0.14[c] | | Busted Butte Wash draining east side of Yucca Mountain to Fortymile Wash (wash and tributaries crossed). |

a. FEMA = Federal Emergency Management Agency.
b. To convert miles to kilometers, multiply by 1.6093.
c. There are no FEMA maps covering Busted Butte Wash on the eastern slope of Yucca Mountain. Estimates of flood zone crossings in this area are from DOE 2002 flood mapping efforts (DIRS 155970-DOE 2002, Figure 3-12).

affected by alluvial fans, closed-basin lakes, extremely high peak discharges, and wide shallow flow. Sections F.3.2.1 through F.3.2.12 summarize these studies.

DOE also contacted Bureau of Land Management (BLM) field offices having jurisdiction over the federally owned lands along the Caliente rail alignment to determine if they were aware of any floodplain data beyond that available from FEMA. None of the offices DOE contacted provided any floodplain data (DIRS 176303-Ong 2005, all; DIRS 176304-Ong 2005, all).

### F.2.1.2 Mina Rail Alignment

DOE analyzed floodplain data in accordance with 10 CFR Part 1022 for the Mina rail alignment. The analysis is summarized here and documented in the *Phase I Hydrologic and Drainage Evaluation Report for the Mina Rail Corridor* (DIRS 180885-Parsons Brinckerhoff 2007, pp. 8 to 11).

FEMA has mapped floodplains on Flood Insurance Rate Maps for areas of Lyon, Mineral, and Nye Counties. In Lyon County, applicable flood-map coverage is available for most of the county, which

includes areas north and west of the Mason Valley Wildlife Management Area, and approximately 20 percent of Nye County. FEMA has mapped floodplains only in the southernmost section of Walker Lake.

There are no FEMA flood maps for any part of Esmeralda County. The FEMA flood map coverage is shown on Figure F-2 and described in detail in Sections F.3.3.1 through F.3.3.12.

In the areas FEMA has mapped, flood insurance studies have been completed that include a hydraulic analysis and a computation of the floodway and/or flood zones. FEMA defines the floodway as "the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights." Minimum federal standards limit such increases to 0.3 meter (1 foot). The area of the floodplain between the floodway and the outer limit of the 100-year flood limit is defined as the floodway fringe. The floodway is identified to assist the community in management of the floodplains detailed in the flood insurance study.

In addition to the FEMA flood maps, DOE used three studies completed in support of the Rail Alignment EIS to provide additional information related to discharge rates and flood hazards. The *Phase I Hydrologic and Drainage Evaluation Report for the Mina Corridor* (DIRS 180885-Parsons Brinckerhoff 2007, all) and the *Hydrologic and Drainage Evaluation Report for the Caliente Corridor* (DIRS 182755-Parsons Brinckerhoff 2005, all) included field reconnaissance of every drainage feature along the entire Mina rail alignment and a review of all available streamflow and precipitation data sources. Also, an earlier study completed by Kennedy, Jenks, and Chilton in 1990 (DIRS 176903-De Leuw, Cather & Company 1992, Appendix H) provides approximate design discharge flow rates for portions of the alignment. The study also identifies locations along the Mina rail alignment with significant and unusual flooding hazards, including sections of the alignment affected by alluvial fans, closed-basin lakes, extremely high peak discharges, and wide shallow flow. Sections F.3.3.1 through F.3.3.12 summarize these studies.

Overlaying the Mina rail alignment on the FEMA maps allows for estimates of crossing distances (that is, the length of the rail alignment within the various floodplains). Table F-2 lists the floodplains identified along the Mina rail alignment by alternative segments and common segments. Sections F.3.3.1 through F.3.3.12 discuss the floodplains, where information is available, that would be encountered by each of the rail line segments.

DOE also contacted BLM field offices with jurisdiction over the federally owned lands along the Mina rail alignment to determine if they were aware of any floodplain data beyond that available from FEMA. None of the offices DOE contacted provided any floodplain data (DIRS 176303-Ong 2005, all; DIRS 176304-Ong 2005, all).

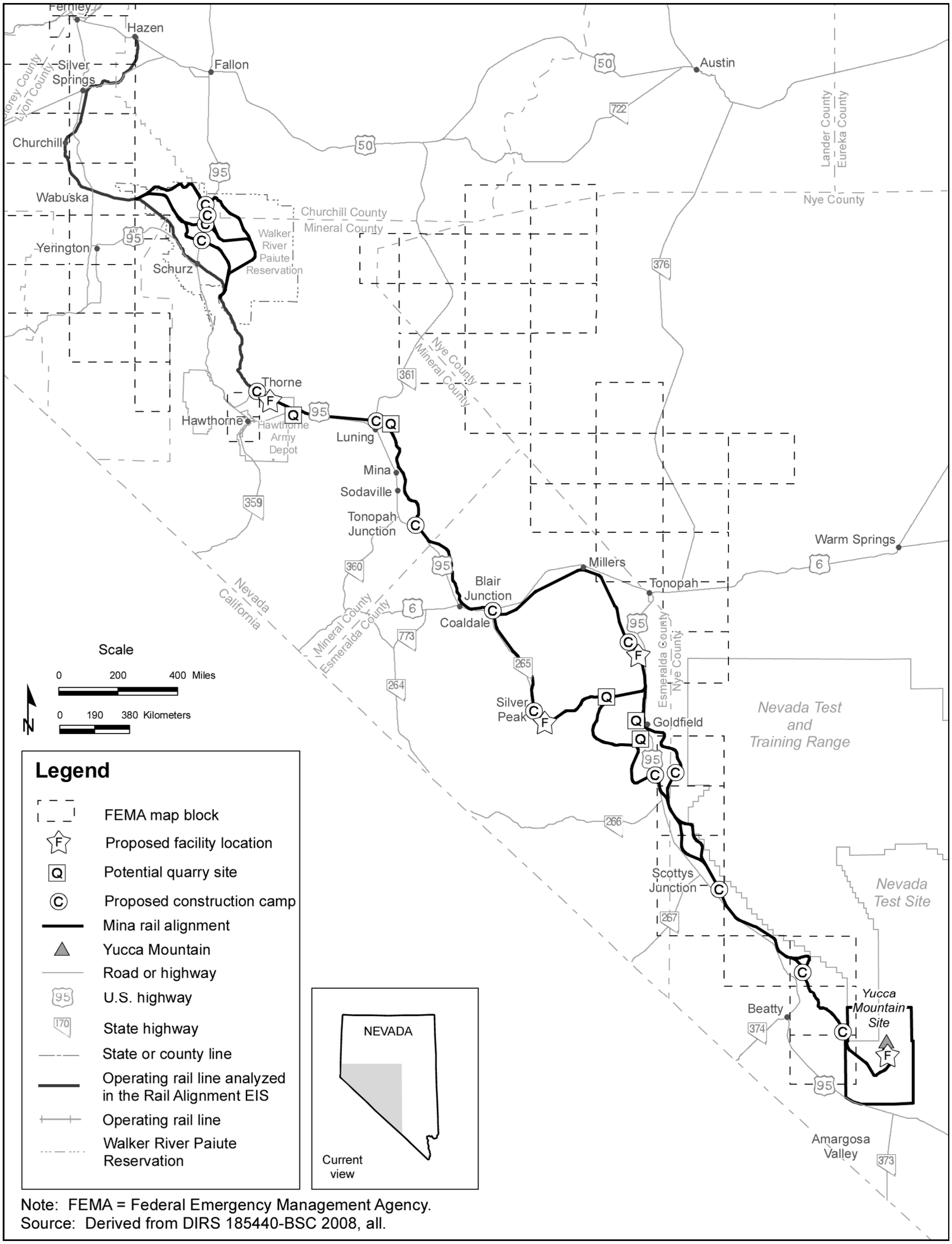


**Figure F-2.** FEMA floodplain map coverage for the Mina rail alignment.

**Table F-2.** Floodplains the Mina rail alignment would cross (page 1 of 2).

| Rail line segment | Portion covered by FEMA[a] maps (percent) | Floodplain crossing distance (miles)[b] | | Description of feature that would be crossed |
|---|---|---|---|---|
| | | Mapped | Additional estimated | |
| Union Pacific Railroad Hazen Branchline | - | - | - | - |
| Department of Defense Branchline North | - | - | - | - |
| Schurz alternative segment 1 | 0 | 0 | - | No floodplains mapped. |
| Schurz alternative segment 4 | 0 | 0 | - | No floodplains mapped. |
| Schurz alternative segment 5 | 0 | 0 | - | No floodplains mapped. |
| Schurz alternative segment 6 | 0 | 0 | - | No floodplains mapped. |
| Department of Defense Branchline South | - | - | - | - |
| Mina common segment 1 | 0 | 0 | 0 | No floodplains identified. |
| Montezuma alternative segment 1 | 0.10 | 0.0062 | 0 | Floodplain from Jackson Wash and Jackson Wash tributaries, respectively. Alkali Lake Playa floodplain not mapped by FEMA. |
| Montezuma alternative segment 2 | 10 | 1.2 | 0 | The floodplain is located between Stonewall Mountains and Cuprite Hills and is associated with Stonewall Flat. |
| Montezuma alternative segment 3 | 0.10 | 0.0062 | 0 | The very southern end of Montezuma 3 would cross a very small section of FEMA floodplains just before it joins with Mina common segment 2. |
| Mina common segment 2 | 100 | 0.81 | 0 | Floodplain extends downgradient of Stonewall Flat Playa to the Lida Valley Alkali Flat Playa. |
| Bonnie Claire alternative segment 2 | 30 | 0 | 0 | No floodplains identified. |
| Bonnie Claire alternative segment 3 | 78 | 1.2 | 0 | Floodplains extending up tributaries of the Lida Valley Alkali Flat Playa and up the Stonewall Pass wash from the Bonnie Claire Flat area of Sarcobatus Flat. |

**Table F-2.** Floodplains the Mina rail alignment would cross (page 2 of 2).

| Rail line segment | Portion covered by FEMA[a] maps (percent) | Floodplain crossing distance (miles)[b] Mapped | Additional estimated | Description of feature that would be crossed |
|---|---|---|---|---|
| Common segment 5 | 74 | 0.19 | 0 | Floodplain extending from Sarcobatus Flat up to Tolicha Wash. |
| Oasis Valley alternative segment 1 | 100 | 0.68 | 0 | Floodplain of the Amargosa River within Thirsty Canyon. |
| Oasis Valley alternative segment 3 | 100 | 0.25 | 0 | Floodplain of the Amargosa River within Thirsty Canyon. |
| Common segment 6 | 55 | 0.06 | 0 | Beatty Wash Floodplain extending from Amargosa River Floodplain. |
| | | 0.14[c] | | Busted Butte Wash draining east side of Yucca Mountain to Fortymile Wash (wash and tributaries crossed). |

a. FEMA = Federal Emergency Management Agency.
b. To convert miles to kilometers, multiply by 1.6093.
c. There are no FEMA maps covering Busted Butte Wash on the eastern slope of Yucca Mountain. Estimates of flood zone crossings in this area are from DOE flood mapping efforts (DIRS 155970-DOE 2002, Figure 3-12*)*.

## F.2.2 WETLAND DATA REVIEW

Title 10 CFR 1022.11 requires DOE to examine the following information to determine whether a proposed action would be located in a wetland, consistent with the most authoritative information available about site conditions:

- U.S. Army Corps of Engineers, *Wetlands Delineation Manual*
- U.S. Fish and Wildlife Service National Wetlands Inventory
- U.S. Department of Agriculture, Natural Resources Conservation Service local identification maps
- U.S. Geological Survey topographic maps
- DOE environmental documents

A **functional assessment** is used to evaluate current wetland functions and predict potential changes to a wetland's functions that may result from proposed activities. A wetland is compared to similar wetlands that are relatively unaltered.

**Hydrogeomorphic** relates to the form or surface features of the land.

DOE used these data sources to support the delineation of wetlands along the Caliente and Mina rail alignments. DOE conducted jurisdictional determinations of waters of the United States and adjacent wetlands as described in the *Waters of the U.S. Jurisdictional Determination Report for Yucca Mountain Project - Caliente Rail Corridor* (DIRS 183595-PBS&J 2006, all), and the *Waters of the U.S. Jurisdictional Determination Report for Yucca Mountain Project - Mina Rail Corridor* (DIRS 180889-PBS&J 2007, all). The jurisdictional determinations were conducted on public and accessible private lands pursuant to Section 404 of the Clean Water Act and Executive Order 11990, *Protection of Wetlands*, and in compliance with U.S. Army Corps of Engineers guidance.

The U.S. Army Corps of Engineers is responsible for determining whether drainages and wetlands along the rail alignment are regulated under Section 404; therefore, DOE's conclusions in this analysis about the classification of washes and wetlands as waters of the United States are tentative subject to the Army Corps of Engineers' determination. A delineation of wetlands along the proposed Caliente rail alignment was completed and submitted to the U.S. Army Corps of Engineers in October 2007 with a request that a jurisdictional determination be made to identify which waters are regulated under Section 404 of the Clean Water Act.

DOE's jurisdictional determinations were used to support the Rail Alignment EIS and compliance with Section 404 of the Clean Water Act (DIRS 183595-PBS&J 2006, all; DIRS 180889-PBS&J 2007, all). The Department identified and delineated all wetlands within 0.40 kilometer (0.25 mile) of the Caliente and Mina rail alignments, except for the southern portion of the Caliente alternative segment. The evaluation corridor was restricted to a 61-meter (200-foot) width in this area due to the presence of private property and the fact that DOE would construct the alignment within an area narrower than the 61-meter delineation corridor.

Wetlands typically must exhibit three general characteristics, including wetland hydrology, hydrophytic vegetation, and hydric soils, and there generally must be a positive indicator of each of these characteristics for a site to be classified as a wetland (DIRS 183595-PBS&J 2006, all; DIRS 180889-PBS&J 2007, all).

**Riverine:** Dominant water source is channel flow and bank overflow; dominant water direction is unidirectional for channels, and bidirectional for floodplains. Water flows visibly in most of site during most of wet season.

**Depressional:** Fed primarily by overland flows; dominant water direction is vertical (seepage). Located in topographic depressions.

**Slope:** Dominant water source is groundwater input; dominant water direction is unidirectional and horizontal. Slope wetlands may not have an apparent gradient and can appear quite flat. Lateral seepage from irrigation diversions can contribute hydrologically to slope wetlands.

### F.2.2.1 Functional Assessment of Wetlands

DOE conducted a functional assessment of the wetlands along the Caliente and Mina rail alignments in February 2008 to better characterize potential impacts (direct, indirect, and cumulative) to the functions served by wetlands in this area. Wetland functions are generally assessed to document functional losses that could occur due to a proposed impact. By assessing wetland functions, mitigation can be designed to provide wetland functions in a manner and capacity that offsets potential losses.

An assessment of wetland functions was conducted using a hydrogeomorphic-based wetland assessment procedure developed for the state of Oregon, *Hydrogeomorphic-based Assessment of Oregon Wetland and Riparian Sites* (DIRS 185293-Division of State Lands, Oregon 2001, all). This standard assessment procedure includes treatment of the Basin and Range landform, which the project exists within.

Nevada lacks a specific regionally-based assessment procedure of its own. Federal wetland regulatory agencies encourage the use of hydrogeomorphic-based wetland assessment methods to document existing wetland functions and provide a basis for analysis of potential modifications in wetland functions as a result of a proposed action. Potentially impacted wetland functions can then be considered during development of wetland mitigation goals and objectives. To ensure that the ecological value and importance of the relatively scarce wetlands that may be affected by the proposed action have been accurately assessed, DOE would compare the results of the functional assessment to a standard assessment procedure based on high-value wetlands in the area. This would be done during development of a compensatory mitigation plan to aid in determining the amount of mitigation required.

Application of a standard assessment procedure to wetlands within the project study area serves several purposes. Primary among these is to provide an objective framework for assessment of proposed impacts to wetlands that not only considers area-based impact (acreage), but potential alteration to wetland site functional capacity by direct and/or indirect mechanisms. An impact assessment that takes functional capacity into consideration can also be used to determine the relative priority of functions to support mitigation.

Wetlands within the study area that may be directly affected by the Proposed Action were classified using the hydrogeomorphic classification system selected by DOE. Wetlands were grouped into seven wetland assessment units. Assessment units consist of one or more wetlands grouped together based on proximity, common geomorphic setting, dominant hydrogeomorphic classification, similar vegetation, soils, and/or water source. Three hydrogeomorphic classes, riverine, depressional, and slope, were found within the study area. Wetlands along the Caliente alternative segment consist of five assessment units, Eccles alternative segment one assessment unit, and Mina rail alignment one assessment unit, as described in Sections F.3.2.1.1.2, F.3.2.1.2.2, and F.3.3.4, respectively.

Wetland functions are typically defined as the hydraulic, geochemical, and biological processes that a wetland within a specific hydrogeomorphic category performs. The hydrogeomorphic-based method for assessing wetland functions is designed for ease of use and repeatability of results. The method was used to evaluate the following wetland functions:

- Water Storage and Delay. Wetlands act as natural sponges, absorbing water during periods of high rainfall and releasing water when precipitation is scarce. For this reason, wetlands can mitigate the effects of flood or drought. Wetlands that provide high water storage and delay functions have soils that are able to absorb and hold water during periods of significant precipitation. Wetlands with the capacity for water storage and delay are typically large compared to the contributing watershed and generally have a depressional geomorphic setting, which allows water to be detained. Slope wetlands typically have low capacity for water storage.
- Sediment Stabilization and Phosphorus Retention. Densely vegetated wetlands can often support the stabilization of sediments, ion exchange, and algal and bacterial decomposition of naturally occurring phosphorous or phosphorous pollutants where these inputs may occur. Wetlands with the capacity to store and/or delay water and with the presence of well-developed vegetative root masses or woody debris able to trap newly deposited sediments tend to rate higher for this function. Sediment deposition can provide bank stabilization and slow water velocity.
- Nitrogen Removal. Wetlands have the capacity to purify water by removing organic and mineral particulate matter through physical, biological, and chemical processes. Nitrogen removal is an important function in areas exporting high amounts of nitrogen, such as agricultural areas. Wetlands with undisturbed, anaerobic soils and the ability to store and delay water have a higher capacity to remove nitrogen.
- Primary Production. Primary production of organic matter occurs where vascular plants and algae produce carbon through photosynthesis. Subsequently, animals may consume the carbon, and microbes decompose the carbon. Wetlands and riparian systems produce large amounts of organic material that provides a foundation for development of food webs. A well-developed vegetation community and seasonally ponded areas are typical of wetlands with capacity for this function.
- Thermoregulation. Some riverine wetlands have the capacity to maintain or reduce water temperature by providing shade and/or serving as a conduit and temporary holding area for discharging groundwater. Wetlands with deep, permanent water and a well-developed vegetation community, including shrub and tree strata, have a higher capacity for thermoregulation. Importance of this

function increases when elevated temperature is known to be a limiting factor for one or more aquatic species in downstream waters.

- Fish Habitat Support. Wetlands that provide the function of fish habitat support are assessed in appropriate cases. The resident fish habitat support function is assessed only if part of the site is permanently inundated and the subclass is riverine impounding. The anadromous fish habitat support function is assessed only if part of the site is accessible to anadromous fish during seasonal inundation, which is not the case for any wetlands surveyed. The capacity to support resident fish habitat is supported by wetlands along stream margins and backwater areas, especially the riverine-impounding hydrogeomorphic subclass. Sites with better thermoregulation ratings should provide better fish habitat. Greater summer water depth and/or greater duration of flooded connection to permanent surface water also increases the capacity of this function.
- Invertebrate Habitat Support. Wetlands that provide the function of invertebrate habitat support typically contain areas of seasonal or permanent inundation, undisturbed soils, and well-developed, undisturbed vegetation communities. Wetlands isolated in the landscape tend to have lower capacity for this function.
- Amphibian and Turtle Habitat. Wetlands that function high for amphibian and turtle habitat have ponded water, an abundance of food, shelter (either vegetation or woody debris) from predators, basking and calling sites, and undisturbed adjacent upland habitat. The capacity of wetlands to support this function is negatively correlated with contaminated water and lack of other wetlands in proximity.
- Breeding Waterbird Support/Wintering and Migratory Waterbird Support. Wetlands that provide the function of waterbird support have extensive ponded water, dense vegetation that can act as shelter from predators and extreme environmental conditions, lack of human disturbance, and are located in proximity to other wetlands. Slope headwater wetlands and wetlands that are small in size tend to have lower capacity for these functions.
- Songbird Habitat Support. Wetlands with the capacity to support songbirds typically contain breeding, roosting, feeding, and refuge areas. They typically contain a well-developed vegetative community with a woody overstory. They are situated in undeveloped (natural) settings, are well connected to upland areas, contain some year-round surface water, and are undisturbed by humans. Capacity for this function is negatively correlated with small size, disturbance by humans, and lack of vegetative structure and surface water.
- Support of Characteristic Vegetation. Plant communities influence local species diversity and contribute to regional biodiversity. Wetlands that function high for support of characteristic vegetation typically contain a diversity of native plant species and plant forms, large older trees, varied microtopography, moderate fluctuation in surface water, lack of human disturbance, and an undeveloped (natural) contributing watershed. Capacity for this function is negatively correlated with a dominance of non-native, invasive vegetative species onsite, developed surroundings, and frequent site disturbance.

All of the wetlands that would be directly impacted by the Mina and Caliente rail alignments were evaluated and scored based on their capacity to perform each function. A score was assigned to each function. Scores were based on a scale of 0.0 to 1.0 with the score of 0.0 indicating minimal capacity and 1.0 indicating highest capacity. For the functional assessment conducted by DOE, function scores between 0.1 and 0.3 are considered low, scores between 0.4 and 0.6 are moderate, and 0.7 to 1.0 are high.

Function assessment scores ranged from 0.2 to 0.7 for the wetlands surveyed in the Caliente and Mina rail alignments. Most individual functions within assessment units tended to cluster at a “moderate” function capacity, scoring in the general range of 0.4 to 0.6. All of the assessment units exhibit variability in relative level of wetland functioning both within and between assessment units. Variability in scores is based directly on site attributes upon which scores of functions are assigned. The moderate functional scores for these wetlands can be attributed to existing land uses, surface water conditions, and water management practices that decrease functional capacity. Examples include grazing effects on vegetation,stream bank incision, and irrigation inputs (DIRS 185340-URS 2008, all).

Sections F.3.2.1 through F.3.2.12 describe the wetland delineation and functional assessment for the Caliente rail alignment. Sections F.3.3.1 through F.3.3.12 describe the wetland delineation and functional assessment for the Mina rail alignment.

# F.3 Floodplain and Wetland Impacts

In accordance with 10 CFR 1022.13(a)(2), a floodplain assessment must discuss the positive and negative, direct and indirect, and long- and short-term effects of a proposed action on floodplains and wetlands. In addition, the effects on lives and property, and on natural and beneficial values of floodplains, must be evaluated. For actions taken in wetlands, the assessment should evaluate the effects of the proposed action on the survival, quality, and natural and beneficial values of the wetlands. DOE has identified and stated a preference for the least environmentally damaging practicable alternative with regards to impacts to floodplains and wetlands for the railroad alignment and its construction and operations.

For the purpose of assessing direct impacts to floodplains and wetlands, the region of influence for these resources is limited in most cases to the area of disturbance. DOE has defined the area of construction as the area within 150 meters (500 feet) on either side of the centerlines of the rail alignments (called the nominal width of the rail line construction right-of-way; see Section 2.2 of the Rail Alignment EIS). The goal of conceptual design and engineering is to limit impacts to this area to the maximum extent practicable. The area of disturbance would be limited to a smaller area along sections of the alignment where there are wetlands or private property. In areas requiring deep cuts or high fills, the area of disturbance could extend beyond the nominal width of the construction right-of-way.

**50-year flood** is a flood that has a 2-percent chance of being equaled or exceeded in any given year.

**100-year flood** is a flood that has a 1-percent chance of being equaled or exceeded in any given year. A base flood may also be referred to as a 100-year storm and the area inundated during the base flood is sometimes called the 100-year floodplain.

**500-year flood** is a flood that has a 0.2-percent chance of being equaled or exceeded in any given year.

The region of influence for surface-water resources would be limited in most cases to the nominal width of the rail line construction right-of-way. In places where surface-water flow patterns (including floodwaters) could be modified or surface-water drainage could carry eroded soil, sediment, or spills downstream, the region of influence extends beyond the construction right-of-way. Within the region of influence, there could be impacts to floodwaters such that they would back up on the upstream side of the rail line, while there could be impacts to water quality if pollutants traveled downstream during a storm event without precipitating out (soils from erosion) or becoming too dilute (petroleum-based lubricants or fuels) to detect.

DOE evaluated potential impacts to floodplains and wetlands based on a series of criteria, as listed in Table F-3. There would be an impact if railroad construction and operations would cause any of the conditions listed in Table F-3. To avoid or limit adverse impacts to floodplains and wetlands, the Department would comply with applicable laws, regulations, policies, standards, and directives, and implement best management practices (see Chapter 7 in the Rail Alignment EIS). Most importantly,

**Table F-3.** Impact assessment standards.

| Resource criteria | Basis for assessing adverse impact |
|---|---|
| Wetlands | • Cause filling of wetlands or otherwise alter drainage patterns such that wetlands or waters are adversely affected. |
| Floodplains | • Alter floodway or floodplain or otherwise impede or redirect flows such that human health, the environment, or personal property is adversely impacted.<br>• Conflict with applicable flood management plans or ordinances. |

careful pre-planning of construction and operations activities would allow the Department to assess and minimize potential impacts before they occur (see Section 2.2 in the Rail Alignment EIS).

The areas where surface-water impacts would be greatest and where DOE would implement direct controls (such as erosion and sedimentation controls) would be within the construction right-of-way. DOE would reduce impacts to floodplains and wetlands by avoiding these resources where practicable and reducing the footprint of impact where the alignment would cross floodplains or wetlands. The Department would minimize the filling of wetlands and, as practicable, would reduce the width of the construction footprint in areas where the rail line would intersect or abut wetlands to reduce adverse impacts to wetlands in these areas. Impacts are addressed in this section in relation to the impact assessment standards listed in Table F-3, including construction in floodplains, alterations to floodwater discharge, construction in wetlands, and water-quality degradation.

The presence of floodplains or wetlands in the areas of the Caliente and Mina rail alignments depends in large part on the meteorology and hydrology of the area. Central and southern Nevada is characterized by low precipitation and high annual evaporation rates typical of desert climates, as described in Sections 3.2.5 and 3.3.5 of the Rail Alignment EIS. Because of the climate and topography (which is mostly north-south trending, parallel mountain ranges with broad, intervening valleys) in this area, internal drainage is the predominant hydrologic feature. Important characteristics of this hydrologic system include ephemeral streams and playas. Ephemeral streams might be dry over multiple seasons or years during periods of drought, but could have multiple periods of flow or standing water during wet periods, as happened during the winter of 2004-2005.

Runoff in the area is the result of snowmelt and seasonal precipitation that occurs most commonly in winter and occasionally in fall and spring. Localized thunderstorms also occur in this area, primarily in the summer. Thunderstorms can be intense, creating runoff in one wash while an adjacent wash receives little or no rain. In rare cases, however, storm and runoff conditions can be extensive enough to result in flow being present throughout the drainage systems. Although flow in most washes is rare, the area is subject to flash flooding from intense summer thunderstorms or sustained winter precipitation. When it occurs, intense flooding can include mud and debris flows in addition to runoff. Much of the runoff quickly infiltrates into rock fractures or into the dry soils, some is carried down alluvial fans in arroyos, and some drains onto dry lakebeds where it might stand for weeks as a lake (DIRS 180885-Parsons Brinckerhoff 2007, p. 17).

Washes in the areas of the Caliente and Mina rail alignments typically terminate in playas and flats within enclosed basins, typical of the Great Basin hydrologic regime (DIRS 174207-NDWR [n.d.], Part 1, p. 4-1). The exception is Meadow Valley Wash at the eastern end of the Caliente rail alignment, which is part of the Colorado River drainage system. The Amargosa River drainage system terminates within an enclosed basin, but in this case, outside of the Nevada state boundary into the Death Valley area of California. Sections 3.2.5 and 3.3.5 of the Rail Alignment EIS includes a detailed discussion of all of the mapped surface-water features along the Caliente and Mina rail alignments, respectively.

The proposed rail alignments pass through numerous valleys and over or around numerous ranges, as described in Sections 3.2.5 and 3.3.5 of the Rail Alignment EIS. Physical limitations on the design of a rail line (for example, the need for relatively gentle gradients and wide turns) require that the alignments follow valley floors to go around ranges or parallel the mountain ranges in transition zones to gradually change elevation to reach, or descend from, passes. In the valley floors, the alignments parallel predominant drainage channels and cross through or near flats and playas. Closer to ranges, the alignments are laid out at a right angle to the predominant drainage (from topographic highs to inland basins). As a result, the proposed rail alignments would encounter a wide variety of surface drainage features.

## F.3.1 COMMON IMPACTS

### F.3.1.1 Floodplains

Many of the floodplains that would be encountered by the proposed rail line are associated with internally draining basins with few, if any, inhabitants or facilities, and where the floodwaters end up in playa areas. The floodplains assessed herein are primarily those areas of normally dry washes that are temporarily and infrequently inundated from runoff during 100-year or 500-year floods. The proposed rail alignments are in a region where flash flooding events are the primary concern. Although such flooding can be violent and hazardous, it is generally focused in its extent and duration, limiting the potential for extensive impacts associated with the proposed rail line; that is, any damage would be expected to be confined to a small portion of the rail line.

Construction of a rail line along the Caliente rail alignment or the Mina rail alignment would affect floodplains, either through direct alteration of the stream channel cross section that would affect the flow pattern of the stream, or through indirect changes in the amount of impervious surfaces and additional water volume added to the floodplain. In most of the areas along the proposed rail alignment, construction in a floodplain would not increase the risk of future flood damage or increase the impact of floods on human health and safety because there are very few human activities or facilities in the areas adjacent to the proposed alignments, with a few exceptions, such as the City of Caliente along the Caliente rail alignment and town of Mina along the Mina rail alignment. DOE expects that adverse impacts along the proposed rail alignments would be minimized because construction activities would adhere to design standards that limit the degree to which floodwaters would be allowed to rise. DOE would incorporate hydraulic modeling into the engineering design process to ensure that all crossings are designed in a manner that limits adverse impacts to nearby populations and resources; therefore, DOE expects that impacts associated with construction in floodplains would be small.

Except in areas where drainage structures cross a Federal Emergency Management Agency-designated 100-year floodplain, hydraulic design would be based upon typical Class 1 freight railroad standard design criteria. Class 1 freight railroad standard criteria require that the ***50-year flood*** should not come into contact with the top (crown) of the culvert or the lowest point of the bridge, whichever is applicable. For the ***100-year flood***, these criteria require that the floodwaters should not rise above the ***subgrade elevation*** at the structure. To conform to these standards, DOE would use circular culverts where flow rates would be small (less than 4 cubic meters per second [140 cubic feet per second]). For larger flows (up to 28 cubic meters per second [1,000 cubic feet per second]), DOE would use box culverts. The Department would construct bridges where flows were larger and where the rail surface would not be tall enough to accommodate a sufficiently sized

> **Subgrade elevation** of the rail line is the elevation of the top of the ***subballast***.
>
> **Subballast** is a layer of crushed gravel that is used to separate the ***ballast*** and roadbed for the purpose of load distribution and drainage.
>
> **Ballast** is crushed stone used to support the railroad ties and provide drainage.

culvert, and would install the culverts with ***riprap*** around the exposed ends to protect the fill material from erosion (DIRS 182824-Nevada Rail Partners 2007, p. ii). Bridge abutments and piers would be similarly protected. In some places, training dikes or ***berms*** would be required to redirect flow and ensure that the flow would be conveyed through the structure. In places, channel improvements might be necessary for a short distance upstream and downstream of the rail line to intercept and effectively redirect flows through drainage structures.

DOE would analyze crossings on a case-by-case basis and propose culverts whenever feasible. Where there would be very wide and shallow depths of flow during a 100-year flood, or the flow would be divided into multiple natural channels that would cross the rail line, the Department would use a series of multiple culverts, potentially in concert with small bridges to span the main flow channel. In locations where there were very high fill conditions, it would be more economical to use multiple culverts than to construct a bridge (DIRS 182824-Nevada Rail Partners 2007, p. ii). Because DOE would design stormwater-conveyance systems to safely convey design floods (50-year and 100-year) and would minimize concentration of flow to the greatest extent practicable, impacts associated with construction of the rail line on stormwater conveyance would be small.

DOE would design rail line features to accommodate 100-year floods, based on typical Class 1 freight railroad standard design criteria as described above. The final design process could also consider a range of flood frequencies and include a cost-benefit analysis in the selection of a design frequency in accordance with standard rail line design guidelines and practices (DIRS 106860-AREA 1997, Volume 1, Section 3.3.2.2c). In areas where drainage structures cross a Federal Emergency Management Agency-designated 100-year floodplain, the bridge would be designed to comply with Agency standards and appropriate county regulations. Federal Emergency Management Agency standards require that floodway surcharge (the difference between the 100-year flood elevation and the actual flood surface elevation) not exceed 0.3 meter (1 foot) at any location. These standards are designed to limit the impacts of floodwater impacts to structures built in or adjacent to floodplains (DIRS 182824-Nevada Rail Partners 2007, p. ii). By adhering to these standards, the Department would substantially limit the potential for adverse impacts to the population and resources located adjacent to floodplains.

The placement of a bridge may involve encroachment into the floodplain by the bridge abutments. This encroachment can have some impact on the height of floodwaters upstream of the bridge. Excessive encroachment can also result in increased scour potential at the abutments, piers, and the stream bottom, and through the bridge opening, due to increases in flow velocities. Based on the conceptual design for the proposed alternative segments, encroachments up to 30 percent of the floodplain width would be possible, which could result in an increase of 0.3 meter (1 foot) in the height of floodwaters at the upstream side of the proposed bridge where the floodplain is wide and shallow (DIRS 182824-Nevada Rail Partners 2007, p. ii).

DOE would reduce impacts to floodplains and the resources close to the floodplains by adhering to the design standards that limit the degree to which floodwaters would be allowed to rise. DOE would incorporate hydraulic modeling into the engineering design process to ensure that all crossings were designed to limit impacts to nearby populations and resources.

In general, construction-related impacts associated with the floodplains would be similar to those that could occur in any other identified drainage areas (in other words, the alteration of natural drainage patterns and possible changes in erosion and sedimentation rates or locations). Construction in washes or other flood-prone areas may reduce the area through which floodwaters naturally flow, which could cause water levels to rise at the upstream side of crossings. Sedimentation would be likely to occur on the upstream side of crossings in these areas where the flow of water is restricted to the point where ponding occurs. DOE would manage sedimentation of this type under a regular maintenance program

(DIRS 155970-DOE 2002, pp. 6 to 79). Impacts to floodplains resulting from restrictions in flow and resulting sedimentation are expected to be small due to the regular maintenance DOE would perform.

### F.3.1.2 Floodwater Discharge

Alterations to natural drainage, sedimentation, and erosion would be unlikely to increase future flood damage, increase the effect of floods on human health and safety, or cause significant harm to the natural and beneficial values of the floodplains. This is because of the relatively limited size of the disturbance that would be necessary to construct a rail line and because the rail line design would include appropriate water-conveyance structures or devices to accommodate flood flows.

Alterations to floodplains (such as cuts and fills) due to rail line construction could cause the alteration of natural drainage patterns and runoff rates that could affect downgradient resources. Construction activities that could alter surface drainage temporarily include moving large amounts of soil and rock to develop the track platform (or subgrade) and constructing temporary access roads to reach construction initiation points and major structures, such as bridges, and to allow movement of equipment to the construction initiation points. Permanent alterations to drainage would be limited to engineered drainage structures and grading and excavation activities. DOE would not expect alterations to floodplain drainage to adversely impact people and property downstream because DOE would use best management practices and standard engineering design and construction practices to minimize adverse impacts.

Depending on site-specific conditions, construction grading may be used to channel a number of minor drainage channels into a single culvert or under a single bridge, which would result in water flowing from a single location on the downstream side rather than across a broader area. As a result, some localized changes in drainage patterns would occur. However, these changes would be limited to areas where natural drainage channels were small; therefore, DOE would expect adverse impacts associated with altered drainage patterns to be small. The Department does not expect that any increase in the velocity of floodwaters caused from rechanneling or regrading would result in adverse impacts to downgradient resources because alterations to drainage would be limited to the area of construction and the associated facility locations.

### F.3.1.3 Wetlands

To the extent possible, wetland functions were used to support the assessment of impacts to wetlands (functional losses that could occur). Direct, indirect, and cumulative impacts to wetlands were evaluated. Direct impacts are caused by the action and occur at the same time and place as the proposed action. Indirect impacts occur later in time or farther removed in distance, but they are still reasonably foreseeable. Cumulative impacts, on the other hand, result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable actions, regardless of the agency or person initiating the other actions.

Direct impacts to wetlands associated with the rail alignment would result from temporary or permanent filling or draining of these resources. Wetland areas would be filled or disturbed as a result of construction of the proposed rail line. Direct alteration of wetlands (for example, by placement of fill) and indirect impacts to wetlands by nearby activities could result in the long-term loss of physical, ecological, and biogeochemical functions typically provided by the existing wetlands. The relative severity of impacts generally would be proportionate to the acreage of wetlands proposed to be directly impacted.

DOE would minimize filling of wetlands by incorporating avoidance into engineering and design of the rail line to the maximum extent practicable. DOE would also use the minimum practicable footprint when constructing in wetlands. This would be accomplished by increasing the slope of the roadbed or bridging across wetlands and not constructing access roads in wetlands. DOE would use best management practices during construction and operations that would minimize indirect impacts to wetlands. Direct impacts specific to the Caliente rail alignment are addressed in Section F.3.2. Direct impacts specific to the Mina rail alignment are addressed in Section F.3.3.

The construction and operation of the rail line and associated facilities could have indirect impacts to wetlands occurring nearby or downstream. Some of these impacts would be short term in nature. Potential short-term indirect impacts to wetland functions include impacts such as water-quality degradation associated with construction activities (such as erosion), and indirect impacts to habitat functions due to nearby construction. Impacts to habitat function are most relevant to sensitive species that utilize wetlands for all or a portion of their lives.

Long-term or permanent indirect impacts would occur during the operation of the railroad. Long-term indirect impacts would include changes to natural/pre-existing drainage patterns, particularly to surface water but potentially to shallow groundwater as well. This is inclusive of drainage interruption or the constriction of water from a broad area to a single location (such as new culverts at wash and stream crossings). DOE would design the railroad to maintain existing drainage patterns and minimize interruption and constriction of the flow of water when possible. For wetlands located within active stream channels (such as those found in Clover Creek), local hydrology (such as velocity, depth) could be indirectly affected by fill or excavation within non-wetland portions of the stream channel (for example, bridge piers). In addition, wetlands could receive increased surface flow due to soil compaction and/or new impermeable surfaces. Activities along the rail line could also contribute to potential water-quality degradation in wetlands along and downstream of the alignment. Water-quality degradation, and the methods that would be used to minimize impacts to water quality, are further addressed in Section F.3.1.4. Sections F.3.2.1 through F.3.2.12 further address indirect impacts to wetlands for the Caliente rail alignment. Sections F.3.3.1 through F.3.3.12 further address indirect impacts to wetlands for the Mina rail alignment.

Cumulative effects to wetlands and the functions served by those wetlands would be considered small. The total amount of area impacted and loss of functions would be a small incremental contribution to cumulative total wetland loss in the area of influence as described in Chapter 5 of the Rail Alignment EIS. Because DOE would mitigate these losses, the residual effect would be short term and minimized. Mitigation is further discussed in Section F.4.4.

### F.3.1.4 Water-Quality Degradation

Increased sediment loading as a result of cut, fill, and regrading operations during construction would be the most likely adverse impact to water quality associated with the Proposed Action. DOE would be required to identify the appropriate and applicable steps that would be taken during construction to minimize alteration of natural drainage patterns, erosion, and sediment loading. These steps would reduce potential for increased erosion and subsequent sedimentation and ensure that any downstream water did not experience increases in sediment loading or turbidity that would threaten the beneficial use of that water. Standard engineering design practices would be employed and hydraulic modeling would be incorporated into the final design process to ensure that crossings are properly engineered so that they would minimize impacts to surface-water resources, including wetlands, from erosion and sediment pollution. DOE would not expect adverse impacts to surface waters along the proposed rail alignment that would interfere with any beneficial use of the water, which is a primary criterion applied by the State of Nevada environmental standards (Nevada Administrative Code 445A.121).

Construction and operations activities associated with the Proposed Action would have the potential to degrade water quality and cause negative impacts to floodplains and wetlands due to the potential release and spread of contaminants (that is, materials potentially harmful to human health or the environment), which could be released through an accidental spill or discharge. These types of releases could be localized (in the event of a small spill) or widespread (in the case where precipitation or intermittent runoff carried contaminants away from the site of the spill). Sections 4.2.12 and 4.3.12 of the Rail Alignment EIS discuss hazardous materials in more detail, including petroleum products (such as fuels and lubricants) and coolants (such as antifreeze) for equipment operation. Other contaminants could include solvents used in cleaning or degreasing actions. The construction camps and some of the railroad operations support facilities would include some bulk storage of hazardous materials, and supply trucks would routinely bring new materials and remove used materials and wastes (such as lubricants and coolants) from the construction sites (see Sections 4.2.12 and 4.3.12 of the Rail Alignment EIS). These activities would present some potential for accidental spills and releases, the significance of which would greatly depend on the nature and volume of the material spilled and its location. A release or spill of contaminants to a stream or wash, or carrying of contaminants to such receptors by stormwater runoff, would have the greatest potential for adverse environmental impacts.

The potential for such impacts would be reduced because of the arid environment and lack of flowing water along either rail alignment. Also, construction contractors would be required to comply with regulatory requirements on spill prevention measures, report and remediate spills, and properly dispose or recycle used materials. Employees responsible for railroad operations and maintenance activities would also be required to comply with any regulatory requirements and best management practices applicable to the proper storage and use of oil or hazardous materials. A Spill Prevention, Control, and Countermeasure Plan would be required for all rail line operations. Common stormwater pollution control practices mandate that hazardous materials be stored inside facilities, or have secondary containment or other protective devices, and that spill control and containment equipment be stationed close to hazardous material (such as fuel) storage areas. Thus, the potential for an accidental release that would not be localized or contained would be very small. During construction activities, water sprayed to control dust and achieve soil compaction criteria would not be used in quantities large enough to support surface-water flow and contaminant transport.

During operation of the rail line, it would be extremely unlikely that a railcar carrying spent nuclear fuel or high-level radioactive waste would derail in a floodplain or wetland, or in one of the washes crossed by the proposed rail alignment that drains to a floodplain or wetland. If a railcar transporting a shipping cask containing radioactive waste were to derail, the chances of a radiation release would be remote. As described in Section F.2.1, the shipping casks are designed to withstand accident conditions and are subject to very stringent design and testing standards to ensure their structural integrity. Impacts to wetlands and floodplains resulting from a release of hazardous materials of any type would be expected to be very small because of the precautions that would be taken to avoid and respond to spills. Further, shipping casks would never be opened during the transportation process and the potential for a release to occur during any accident or flooding scenario is extremely remote (DIRS 104774-Fischer et al. 1987, pp. 9-1 to 9-15).

## F.3.2 SEGMENT-SPECIFIC IMPACTS FOR THE CALIENTE RAIL ALIGNMENT

### F.3.2.1 Interface with the Union Pacific Railroad Mainline – Caliente and Eccles Alternative Segments

Two alternative segments (Caliente and Eccles alternative segments) for connecting to the existing Union Pacific Railroad Mainline were analyzed. Facilities at the Interface with the Union Pacific Railroad Mainline include the Interchange Yard, the Staging Yard, a Satellite Maintenance-of-Way Facility, train crew facilities, and possibly the Nevada Railroad Control Center and National Transportation Operations Center.

#### *F.3.2.1.1 Caliente Alternative Segment*

**F.3.2.1.1.1 Floodplains – Caliente Alternative Segment.** FEMA has mapped flood zones only for the very southern portion of the Caliente alternative segment, as shown in Figures F-3 and F-4. From its starting point on the southern bank of Clover Creek, the alignment would cross 100-year and 500-year flood zones associated with both Clover Creek and Meadow Valley Wash. The Interchange Yard would be within 100-year and 500-year flood zones associated with Clover Creek. The alignment would remain in the 100-year floodplain associated with Meadow Valley Wash as it traveled north and left the area mapped by FEMA. Based on an analysis of the FEMA flood mapping and topographic contour data for the alignment, it appears that the Caliente alternative segment would be in a floodplain associated with Meadow Valley Wash from the time it left Caliente until it turned west just before joining Caliente common segment 1.

As listed in Table F-1, the alignment would cross a total of 2.6 kilometers (1.6 miles) of FEMA-mapped floodplains and approximately 2.6 kilometers of additional floodplains that FEMA has not mapped. It should be noted that the Caliente rail alignment would follow an existing abandoned Union Pacific rail roadbed from where it originates in Caliente for most of its length before joining common segment 1. Therefore, most rail line construction activities (except for operations support facilities) would be confined to the existing rail roadbed.

The Interchange Yard on the Caliente alternative segment would be located in the City of Caliente, directly across from the City of Caliente administrative complex, which houses city offices, a public library, College of Southern Nevada classrooms, meeting rooms, and a senior center. FEMA floodplain maps for this area show that a 240-meter (790-foot) section of the Interchange Yard would be in a 100-year floodplain and the remainder would be in a 500-year floodplain. Floodwaters from Meadow Valley Wash flow through the center of Caliente to the south where they merge with the runoff from three dry washes that flow to the southwest. In the area where the Interchange Yard would intersect the 100-year floodplain, the floodwater depth was calculated to be 0.90 meter (3 feet) during the 100-year storm event (DIRS 176806-FEMA 1985, all). Because the interchange tracks would be in an area already occupied by an existing Union Pacific siding, the Interchange Yard would not be likely to obstruct the flow of floodwaters to the point that floodwater depths would increase.

Two of the three alternative locations being considered for the Staging Yard are along the Caliente alternative segment (Indian Cove and Upland). The southern portion of the Indian Cove Staging Yard would be constructed in the 100-year floodplain mapped by FEMA along Meadow Valley Wash. Based on the elevation of the meadow in which the Staging Yard would be constructed, it appears that the entire meadow could be considered floodplain. The Caliente-Upland optional location for the Staging Yard is also susceptible to flooding from Meadow Valley Wash; however, FEMA has not mapped floodplains in this area. One of the construction camps would be about 2.5 kilometers (1.6 miles) south of the Caliente alternative segment junction with Caliente common segment 1. This construction camp would not

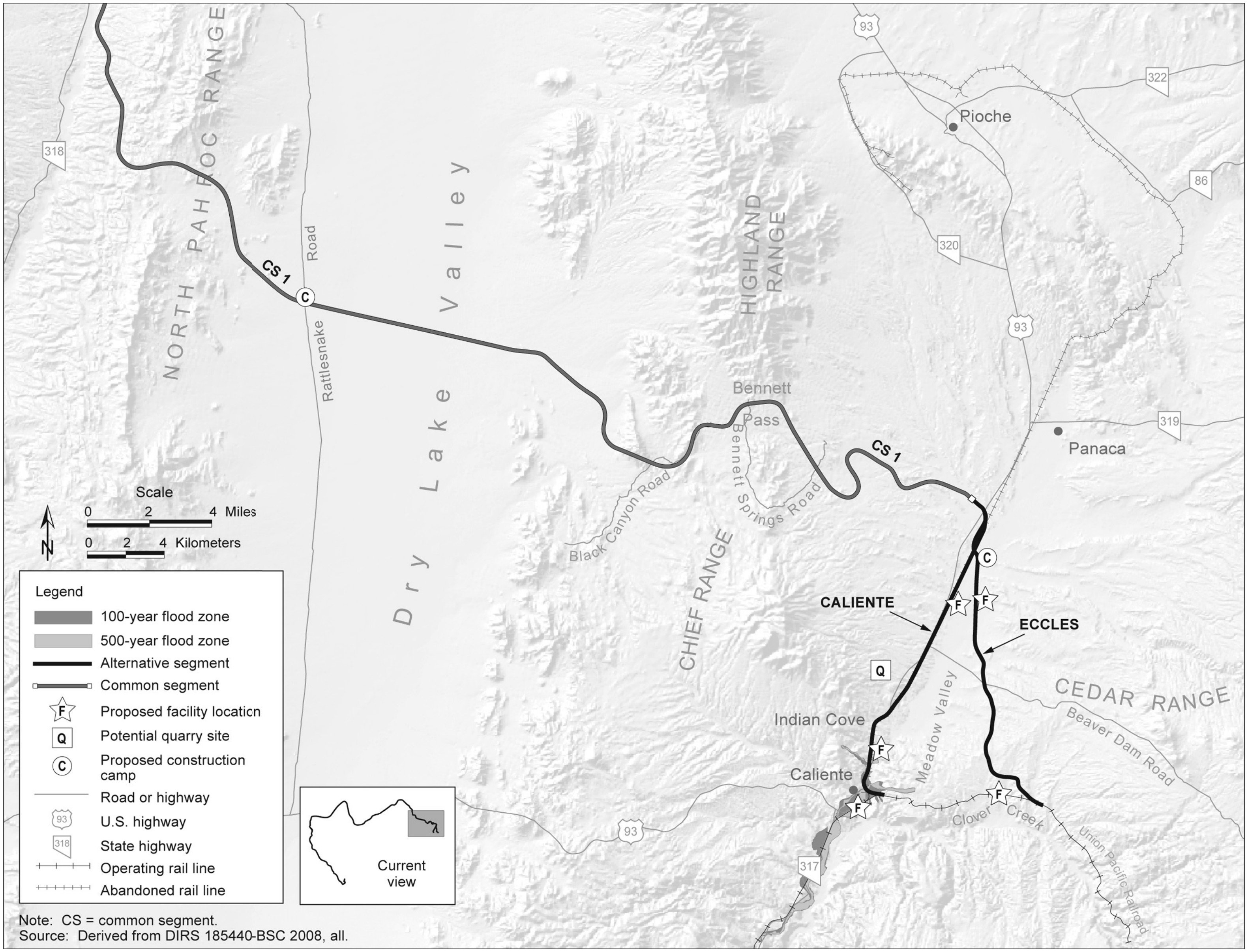


**Figure F-3.** FEMA floodplain map for map area 1 of the Caliente rail alignment.

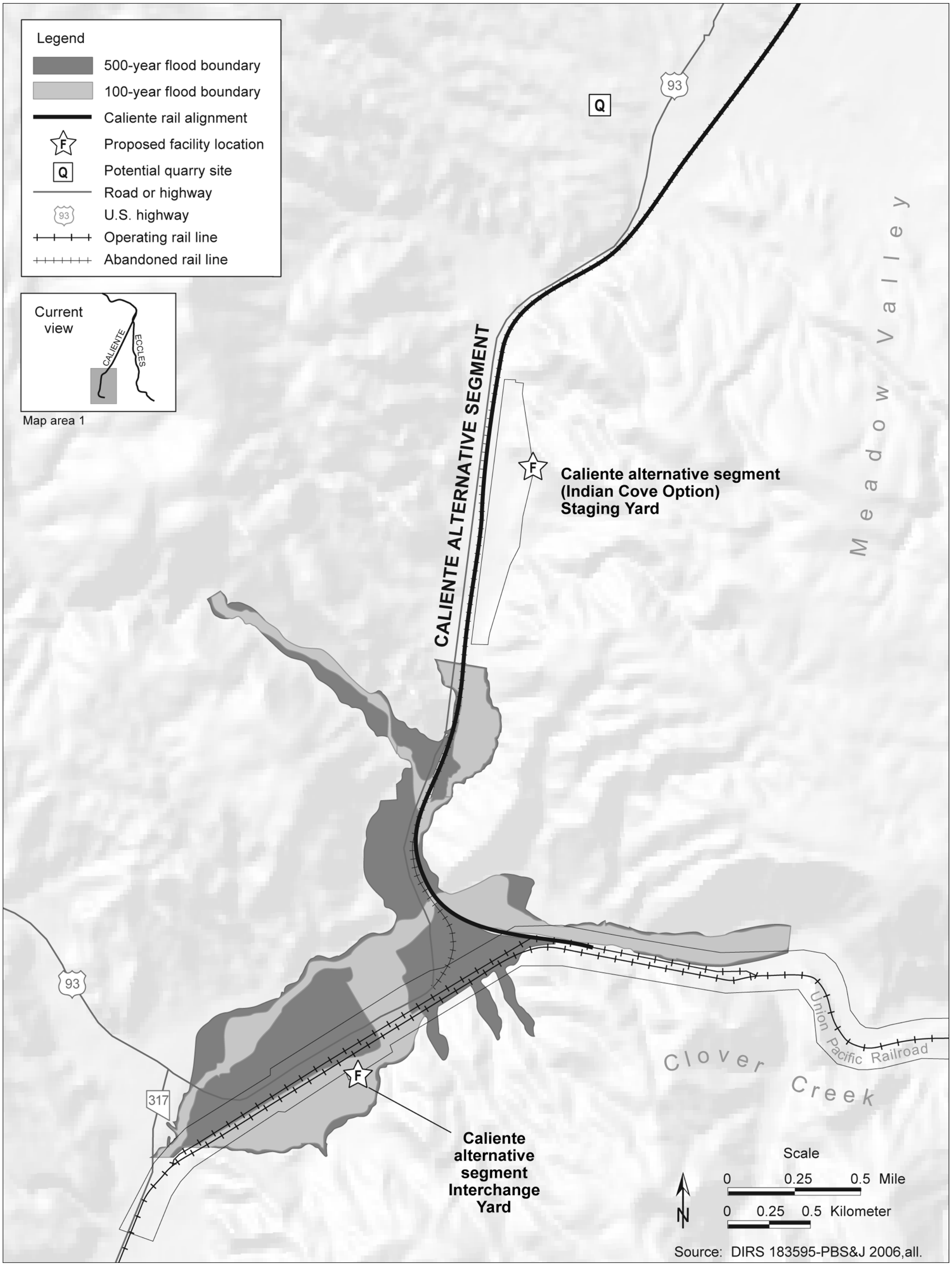


**Figure F-4.** FEMA floodplain map for the Caliente alternative segment.

intersect floodplains or wetlands. Section F.3.1 addresses the common impacts to floodplains the Caliente alternative segment and its associated facilities would cross.

**F.3.2.1.1.2 Wetlands – Caliente Alternative Segment.** DOE delineated wetlands within 30 meters (100 feet) of the Caliente alternative segment (see Figures F-5 and F-6) in a field survey completed in support of the Rail Alignment EIS (see Figures F-5 and F-6) (DIRS 183595-PBS&J 2006, Figures 4A to 4T). That delineation was submitted to the U.S. Army Corps of Engineers in October 2007 with a request that a jurisdictional determination be made to identify areas along the Caliente rail alignment that are regulated pursuant to Section 404 of the Clean Water Act (DIRS 185487-Larson 2007, all).

DOE conducted a functional assessment of these wetlands in February 2008 to better characterize potential impacts (direct, indirect, and cumulative) to the functions served by wetlands in this area (DIRS 185340-URS 2008, all). The functional assessment identified five types of wetlands along the Caliente alternative segment with similar functional characteristics, such as proximity, common setting (landforms, typography), hydrology, vegetation, and soils. These wetland types, also called assessment units, are summarized in Table F-4 and expanded upon in the impact discussion that follows.

Each of these assessment units were evaluated and scored based on their capacity to perform wetland functions. See Section F.2.2.1 for further details on the functions evaluated during the functional assessment. Scores were based on a scale of 0.0 to 1.0 with the score of 0.0 indicating minimal capacity and 1.0 indicating highest capacity. For the functional assessment conducted by DOE, function scores between 0.1 and 0.3 are considered low, scores between 0.4 and 0.6 are moderate, and 0.7 to 1.0 are high. The function scores for the wetlands along the Caliente rail alignment are summarized in Table F-5. Wetlands were also classified based on the hydrogeomorphic class. For the Caliente rail alignment, the relevant classes include riverine, depressional, and slope (DIRS 185340-URS 2008, all).

As shown in Table F-5, many of the function capacities had “moderate” scores. The most likely justification for the strong tendency toward moderate functional scores throughout the study area is related to the existing land use and water management practices, which tend to limit higher existing function capacity. Although scores trend toward moderate, they vary between assessment units in terms of which functions perform at relatively higher or lower capacity, as well as consistency of scoring across a suite of functions. Ultimately none of the functions can be identified as more important than the others, while these may sometimes be determined from a policy standpoint on the basis of regulatory policies or regional issues (for example, flood control needs would value “water storage and delay” function capacity highly). By evaluating baseline functional characteristics of wetlands within the study area, however, an assessment of what types and levels of function may be impacted by the proposed project can be articulated and carried through to mitigation goals and objectives (DIRS 185340-URS 2008, all).

**F.3.2.1.1.2.1 Caliente Alternative Segment Roadbed** The Department has concluded that it would not be possible to construct a rail line heading north from Caliente into Meadow Valley that would avoid wetlands (see Section F.4.1.2 for further discussion of alternatives analysis). The only possible rail route north from Caliente is adjacent to Meadow Valley Wash and U.S. Highway 93 through Indian Cove. There is no possibility of designing an alignment in this area that would avoid all wetlands because the Indian Cove area and extreme southern Meadow Valley are narrow, surrounded by impassible terrain, and almost entirely covered with wetland and riparian habitat in some areas. As described below, the Department has developed a route and selected design options that would minimize the amount of wetlands filled along the Caliente alternative segment. DOE would minimize filling of wetlands by incorporating avoidance into engineering and design of the rail line to the maximum extent practicable.

**Table F-4.** Wetland assessment units along the Caliente alternative segment[a].

| Assessment unit | Wetlands within AU[b] | Description |
|---|---|---|
| AU-1 | WT-5, WT-6 | Assessment unit 1 is classified as riverine under the hydrogeomorphic framework, and includes wetlands located within the incised portion of the Meadow Valley Wash. Wetland hydrology is directly associated with Meadow Valley Wash. Beaver are active in this area and have constructed three or more beaver dams within the assessment unit. This has resulted in a complex of pools and glides that are highly dynamic. This unit is characterized by generally moderate functional capacity. Only two scores were at or below 0.3. |
| AU-2 | CC: 1, 7, 9, 10, 13, 17 (portion), 19, 20, 21 (majority of), 24, 25, 26 | Assessment unit 2 is classified as slope under the hydrogeomorphic framework, and includes gently sloping wetland pastures located throughout the Caliente alternative segment. Wetland hydrology is characterized by dominance of horizontal water movement toward the southern portion of the valley. Natural springs, irrigation diversions, and Meadow Valley Wash provide hydrology sources for these wetlands. Active grazing occurs on most if not all of AU-2 wetlands. This unit is characterized by generally moderate functional capacity. Only two scores were at or below 0.3. |
| AU-3 | CC: 17 (portion); PWT: 1, 2; WT: 1, 2, 3, 4 | Assessment unit 3 is classified as riverine and includes all of the wetlands located within the active floodplain of Meadow Valley Wash. The majority of this assessment unit along the alignment is isolated from cattle. These wetlands are generally inundated or saturated during high stream flows on an annual basis, and exhibit visibly flowing water during (at minimum) the wet season. These wetlands are often well-connected to the adjacent floodplain. Vegetation in this assessment unit is fairly well-established and characterized by a diverse assemblage of native wetland forbs. This assessment unit is characterized by generally moderate functional capacity. Only one score was at or below 0.3. |
| AU-4 | CC: 2, 3, 4, 4A, 4B, 5, 6, 8, 14, 14A, 15, 16, 18, 23A | Assessment unit 4 includes several linear wetland fragments, classified as slope under the hydrogeomorphic framework, that are generally located along the base of the abandoned Union Pacific Railroad roadbed and U.S. Highway 93. Prior to original construction of the abandoned roadbed and U.S. Highway 93, many of these wetlands were likely to have been contiguous with wetlands classified as AU-2. Unique to these narrow, linear wetland fragments, they are likely augmented by an additional surface sheet-flow component due to being linear, narrow, and often having gently sloped upland boundaries. Wetlands in this assessment unit appear generally degraded due to the fragmentation effects and encroachment by more non-native, ruderal species. This assessment unit is characterized by a generally low functional capacity (many scores of 0.3) relative to the other assessment units. |
| AU-5 | CC: 12, 17 (portion), 21 (portion) | Assessment unit 5 includes wetlands associated with deeper water, basin topography that was classified as depressional under the hydrogeomorphic framework. These wetlands are generally perennial in character, but occasionally dry out, thus they exhibit a semi-permanent hydrologic regime typified by 1.5 to 3 feet water depth (during wet season). Cattle have little impact on these wetlands except around the edges, thus these wetlands typically support a less degraded vegetation community. Hardstem bulrush is dominant in these wetlands, and wetland pasture species occur in drier areas. This assessment unit is characterized by a strongly moderate functional capacity with function scores ranging between 0.5 and 0.7. It therefore exhibits the ability to perform a variety of functions at a moderately strong capacity. |

a. Source: DIRS 185340-URS 2008, all.
b. AU = assessment unit.

**Table F-5.** Functional assessment scoring – Caliente alternative segment.[a]

| Assessment unit | Wetlands within assessment unit | Wetland function sources[b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Water storage and delay | Sediment stabilization and phosphorus retention | Nitrogen removal | Primary production | Thermoregulation | Resident fish habitat support | Invertebrate habitat support | Amphibian and turtle habitat support | Breeding waterbird support | Wintering and migratory waterbird support | Songbird habitat support | Support of characteristic vegetation |
| AU-1 | WT-5, WT-6 | 0.6 | 0.5 | 0.5 | 0.6 | 0.6 | 0.5 | 0.4 | 0.3 | 0.3 | 0.5 | 0.6 | 0.5 |
| AU-2 | CC: 1, 7, 9, 10, 13, 17[c], 19, 20, 21[d], 24, 25, 26 | 0.5 | 0.4 | 0.5 | 0.4 | NA[e] | NA | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 |
| AU-3 | CC: 17[c]; PWT: 1, 2; WT: 1, 2, 3, 4 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.7 | 0.5 | 0.4 | 0.4 | 0.4 | 0.6 | 0.5 |
| AU-4 | CC: 2, 3, 4, 4A, 4B, 5, 6, 8, 14, 14A, 15, 16, 18, 23A | 0.3 | 0.3 | 0.3 | 0.4 | NA | NA | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| AU-5 | CC: 12, 17[c], 21[c] | 0.7 | 0.5 | 0.6 | 0.5 | NA | NA | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

a. Source: DIRS 185340-URS 2008, all.
b. Scores were based on a scale of 0.0 to 1.0 with the score of 0.0 indicating minimal capacity and 1.0 indicating highest capacity. For the functional assessment conducted by DOE, function scores between 0.1 and 0.3 are considered low, scores between 0.4 and 0.6 are moderate, and 0.7 to 1.0 are high.
c. Indicates that a portion of this wetland has been categorized as this assessment unit.
d. Indicates that a majority of this wetland has been categorized as this assessment unit.
e. NA = not applicable.

The construction right-of-way along the Caliente alternative segment would be 30 meters (100 feet) wide, narrower than along most of the remainder of the Caliente rail alignment, to minimize impacts to private property and surface waters (see Figure 2-3). Along the entire length of the Caliente alternative segment, there is 0.096 square kilometer (23.8 acres) of wetlands within the proposed construction right-of-way. A majority (0.094 square kilometer [23.3 acres]) of these wetlands are believed to be jurisdictional based on the wetland delineation completed by DOE.

***F.3.2.1.1.2.1.1 Wetlands That Would Be Avoided Along Roadbed:*** Of the 0.096 square kilometer (23.8 acres) of wetlands within the proposed construction right-of-way, 0.01 square kilometer (2.6 acres) would be avoided in two areas where the abandoned Union Pacific Railroad roadbed is immediately adjacent to Meadow Valley Wash (see wetlands WT-5/WT-6, and WT-1/PWT-1 shown in

Figures F-5 and F-6) and one location where it is adjacent to Bennett Springs Wash (see wetlands PWT-2/WT-4 shown in Figure F-6). In those areas, the washes are incised 3 to 12 meters (10 to 40 feet) below the existing roadbed and have narrow bands of palustrine emergent or palustrine scrub-shrub wetlands adjacent to the stream channels (DIRS 183595-PBS&J 2006, all). These wetlands are within assessment units 1 and 3 as described in Table F-4. All of these wetlands would be avoided by shifting the location of the roadbed away from the edge of the washes.

The Caliente alternative segment would cross washes with adjacent wetlands at five locations, including three crossings of the perennial Meadow Valley Wash (see wetlands WT5 at two locations and wetlands CC13/CC14 at one location shown in Figure F-5), and one crossing each of the intermittent or ephemeral Clover Creek Wash (see wetland WT-5 shown in Figure F-5) and Bennett Springs Wash (see wetland WT-2 shown in Figure F-6). There currently are old railroad bridges at each of these wash crossings that would be replaced with steel or precast concrete bridges. These new bridges would span the stream channels and avoid the adjacent wetlands. These wetlands are within assessment units 1, 2, 3, and 4 as described in Table F-4.

Although these wetlands would be avoided, construction activity (for example, pier placement) could cause direct impacts as a result of bridge placement over washes containing fringe/interspersed wetlands. The design goal, however, is to avoid direct wetland impacts to the maximum extent practicable in placement of bridge abutments and/or piers at such stream crossing points. Impacts are summarized in Table F-6.

***F.3.2.1.1.2.1.2 Wetlands That Cannot Be Avoided Along Roadbed:*** All of the remaining wetlands within the construction right-of-way of the Caliente alternative segment are along the first 8 kilometers (5 miles) of the alternative segment in and near Indian Cove (a canyon through which Meadow Valley Wash flows from southern Meadow Valley toward the City of Caliente) and southern Meadow Valley (see Figures F-5 and F-6). Approximately 0.027 square kilometer (6.7 acres) of those wetlands are located in a pasture at the south end of Indian Cove (see wetlands CC1 through CC9 shown in Figure F-5) and have been classified as assessment units 2 and 4. The other 0.057 square kilometer (14 acres) of wetlands within the construction right-of-way is adjacent to the abandoned Union Pacific Railroad roadbed in Indian Cove and southern Meadow Valley (see wetlands CC10 through CC26 shown in Figure F-5).

Assessment unit 2 includes all of the wetland pastures located throughout the Caliente alternative segment. Portions of the wetlands in this assessment unit may be flooded by Meadow Valley Wash during flood events, but the majority of the area consists of gently sloping pastures that receive water from natural springs and irrigation diversions (from Meadow Valley Wash). Because of the lack of field indications of past inundation, this assessment unit appears to have prominent (that is, contiguous across the surface of pastures) surface flooding greater than a few inches in depth less than once in every 2 years. These wetlands are likely more consistently saturated and/or ponded (for example, "puddles") in winter and spring than in summer and fall. However, due to high variation in regional precipitation regime, there are exceptions including observations of saturation and surface sheetflow during mid-summer.

Wetlands in this assessment unit are characterized by active grazing management. Vegetation is generally grazed to within a few inches of the ground surface. Vegetation is typically a mixture of inland saltgrass (*Distichlis spicata*), common spikerush (*Eleocharis palustris*), and Baltic rush (*Juncus balticus*). Little to no tree or shrub vegetation exists within this assessment unit. This unit is characterized by generally moderate functional capacity (see Table F-5). Only two functions (invertebrate habitat support and support of characteristic vegetation) were scored as low and two functions (thermoregulation and

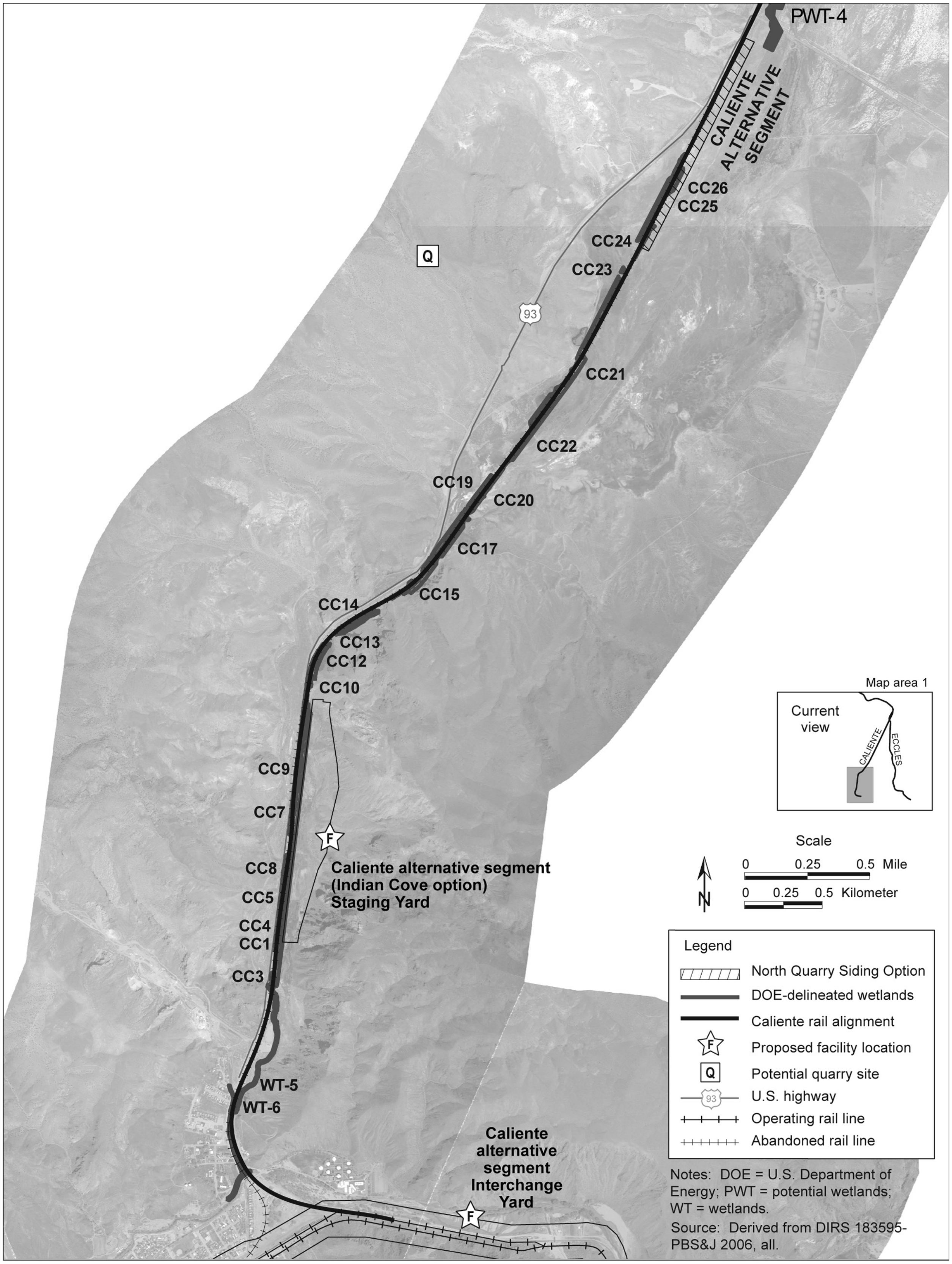


**Figure F-5.** Wetlands along southern portion of the Caliente alternative segment.

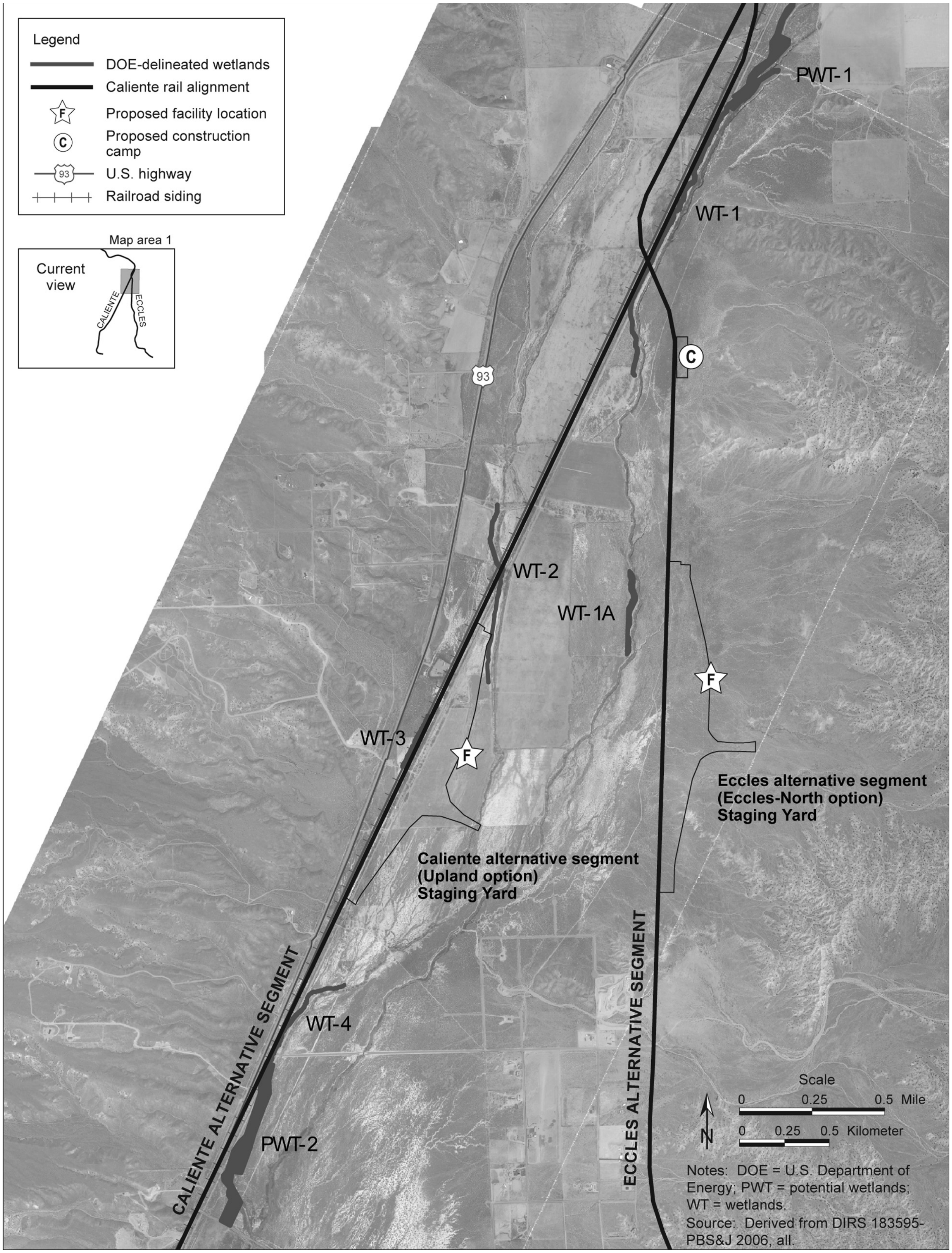


**Figure F-6.** Wetlands along northern portion of the Caliente alternative segment.

**Table F-6.** Summary of impacts to wetlands – Caliente alternative segment.

| Construction activity | Direct impacts to assessment units (acres)[a] | Potential indirect impacts | Primary wetland functions affected |
|---|---|---|---|
| Roadbed construction | AU-2 (5.4)<br>AU-3 (0.8)<br>AU-4 (0.4)<br>AU-5 (0.5) | *Short-term impacts:*<br>• Water quality<br>o Mitigate with best management practices and control of irrigation water timing (low/no flow).<br>o More manageable for AU-2 and AU-4 because less open water.<br>• Wildlife habitat support – from construction activity and noise<br>*Long-term impacts:*<br>• Potential minor impact to sediment stabilization, which new bridge/hydraulic design of bridge would mitigate. | *Long-term impacts:*<br>• Majority of impacts to pasture (slope) wetlands, thus:<br>o Water storage and delay<br>o Nitrogen removal<br>o Sediment stabilization and phosphorus retention<br>o Low to moderate impacts to wildlife and vegetation functions by lessening area<br>*Short- and long-term impacts:*<br>• AU-1 and AU-3 (RFT)[b] – none to very minor direct bridge construction impacts (for example, pier placement), minor impact to habitat functions such as fish, invertebrate, and songbird support. |
| Interchange Yard | None | None | None |
| *Staging Yard for the Caliente alternative segment (one of these two options would be constructed):* | | | |
| Indian Cove Staging Yard | AU-2 (47.0) | *Short-term impacts:*<br>• Water quality<br>o Mitigate with best management practices and suggested irrigation water timing (low/no flow).<br>• Wildlife habitat support – from construction activity and noise. | *Long-term impacts:*<br>• Entirely pasture (slope) wetlands:<br>o Water storage and delay<br>o Nitrogen removal<br>o Sediment stabilization and phosphorus retention<br>• Low to moderate wildlife and vegetation functions by lessening area |
| Upland Staging Yard and north quarry siding | AU-2 (1.5)[c] | *Short-term impacts:*<br>• Water quality<br>o Mitigate with best management practices and suggested irrigation water timing (low/no flow).<br>• Wildlife habitat support – from construction activity and noise. | *Long-term impacts:*<br>• Entirely pasture (slope) wetlands:<br>o Water storage and delay<br>o Nitrogen removal<br>o Sediment stabilization and phosphorus retention<br>• Low to moderate wildlife and vegetation functions by lessening area |

a. To convert acres to square kilometers, multiply by 0.0040469.
b. RFT = riverine flow-through hydrogeomorphic wetland class.
c. This assessment unit is located at the north quarry siding. All direct and indirect impacts for the Upland Staging Yard option are due to wetlands located within the north quarry siding. No wetlands are located within the Upland Staging Yard site.

resident fish habitat support) are non-applicable. Site-specific conditions that tend to support higher function capacity scores include the following:

- High proportion of wetlands saturated or inundated at least seasonally within the gently sloping pasture setting; example of function supported – nitrogen removal.
- Shallow, slow-moving water typically present during spring season; example of functions supported – amphibian and turtle habitat, wintering and migratory waterbird support.
- Although impacted by grazing, fairly consistent vegetation cover by vascular plants, mostly grasses, sedges and rushes; example of function supported – primary production.

Site-specific conditions that tend to support lower function capacity scores:

- Lack of trees/shrubs, grazed pasture grasses in many areas; example of function negatively impacted – support of characteristic vegetation.
- Lack of diverse plant species and plant morphological forms, generally speaking. Certain areas/patches within assessment unit 2 provide exceptions; for example, areas containing a mixture of bulrush, sedge, grasses, and seasonally ponded water. A greater proportion of assessment unit 2 consists of less vegetatively diverse, grazed pastures; example of function negatively impacted – invertebrate habitat support.

To minimize impacts of roadbed construction on wetlands along the Caliente alternative segment, DOE would construct the rail line on the abandoned Union Pacific Railroad roadbed. That roadbed is an upland feature that generally is about 1 meter (3 feet) above the surrounding terrain and 8 to 14 meters (25 to 45 feet) wide (DIRS 183595-PBS&J 2006, p. 13 and Figure 4). In addition, where the alignment crosses wetlands, the new rail roadbed would be constructed with a 2:1 slope and without a permanent service road. That roadbed would have a maximum width of about 17 meters (55 feet). Constructing this narrow roadbed would reduce the amount of wetlands permanently filled from a total of about 0.096 square kilometer (23.8 acres) within the construction right-of-way in this area to 0.029 square kilometer (7.1 acres), 0.028 square kilometer (6.9 acres) of which are assumed to be jurisdictional. Those wetlands are all located along a continuous 6.4 kilometer (4 mile) stretch of the alignment starting at the south end of the pasture south of Indian Cove and ending approximately 0.9 kilometer (0.6 mile) south of Beaver Dam Road (see Figure F-5). Impacts are summarized in Table F-6.

Roadbed construction would directly impact 0.029 square kilometer (7.1 acres) of wetlands, approximately 0.022 square kilometer (approximately 5.4 acres) of which were categorized as assessment unit 2, while the remaining 0.007 square kilometer (1.7 acres) were classified as assessment units 3, 4, and 5. Assessment unit 2 wetlands consist of wetland pasture that is heavily grazed, generally to within a few inches of ground surface. Primary direct impacts to existing wetlands function associated with wetland fill in assessment unit 2 and 4 wetlands (totally 0.024 square kilometer [5.8 acres]) may include a reduction of the wetlands' ability to store and delay stormwater and subsequent ability to perform flood abatement due to the reduction in area of the active floodplain. Filling these wetlands would also result in the reduction of wetlands capable of supporting nitrogen removal; sediment stabilization and phosphorus retention; amphibian habitat support; songbird habitat support; and breeding, migratory and wintering waterfowl habitat support (Table F-6) (DIRS 185340-URS 2008, all).

There are extensive wetland and riparian habitats in southern Meadow Valley. For example, there are about 9.8 square kilometers (about 2,400 acres) of North American Arid West Emergent Marsh habitat and 4.5 square kilometers (1,100 acres) of Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland habitat within 8 kilometers (5 miles) of the Caliente alternative segment (Table 3-52). Much of the wetland and riparian habitat is in southern Meadow Valley and the Indian Cove area (Figure

3-91). Given that the amount of wetlands that would be filled (0.03 square kilometer [7.1 acres]) is small relative to the remaining wetlands in Indian Cove and southern Meadow Valley, it is expected that these impacts would have a small overall impact to the wetland functions served by these wetlands. Flood abatement impacts would be small because of the small area of wetlands filled and because in most cases the roadbed would run parallel with the primary floodwater flow direction. Impacts to the other functions served by these wetlands would be small as well, primarily due to the small area of wetlands that would be permanently filled.

The long-term (permanent) direct impacts to wetlands would be mitigated through onsite or off-site mitigation as described in detail in Section F.4.4.3.2.1.3.1. DOE would develop a compensatory mitigation and monitoring plan for unavoidable impacts as part of its compliance with Section 404 of the Clean Water Act in coordination with the U.S. Army Corp of Engineers, U.S. Environmental Protection Agency, and applicable land-management agencies such as the BLM. The plan would be designed to replace the functions lost by the filling of the wetlands. Because of the compensatory mitigation that DOE would complete, long-term direct impacts to wetlands and the functions served by those wetlands would be negligible.

Short-term (temporary) indirect impacts would occur to the wetlands adjacent to and downstream of the rail roadbed during construction. Temporary (short-term) impacts as a result of construction would include vegetation trampling, soil compaction, and soil erosion. Construction activity could also cause indirect impacts to the habitat functions served by these wetlands, such as fish, invertebrate, and songbird support. Wildlife affected by the Caliente alternative segment would be temporarily displaced and may utilize nearby habitats. Over time, some wildlife species would return to affected areas, especially if lost habitat was reestablished. Long-term indirect impacts from the construction and operation of the rail line could include impacts to the sediment stabilization functions served by the wetlands in these areas. Removal of vegetation along the Caliente rail alignment would reduce the flood alteration capacity, and result in increased sedimentation, particularly during rain events. In some areas, an influx of sediments related to disturbances could produce an accreting environment on the streambed and result in decreased flood storage capacities

These impacts would be minimized by following best management practices and mitigated by post-construction site restoration measures. Best management practices would include:

- Erosion-control measures to minimize bare and exposed soils and to reduce transport of sediments to receiving water bodies, including wetlands
- Installation of temporary stormwater facilities to control pollutants associated with construction
- Staging in uplands where possible
- Limited access construction routes
- Use of mats when heavy machinery must operate from within wetlands

Best management practices are further discussed in Section F.4.4.2. Site restoration typically involves soil improvements, where necessary due to compaction, and revegetation using a native wetland seed mix (or woody plantings if such is impacted). Best management practices would also be included in the erosion-control plans and construction drawings for the project. Proper maintenance and cleaning of construction vehicles before leaving the site would also help to reduce the amount of sediments or fuels and lubricants from reaching water bodies and help to limit the spread of non-native plant materials.

Because DOE would require best management practices to be used during construction and site restoration to occur at the conclusion of construction activities, temporary impacts to wetlands adjacent to and downstream of the rail roadbed are expected to be small. These same actions would also reduce long-term indirect impacts such as impacts to sediment stabilization functions resulting from bridge pier construction. In addition, hydraulic modeling would be used to design bridges and bridge piers that would have the minimum impact on stream hydrology; thus, long-term indirect impacts from the presence of bridges and bridge piers are expected to be small.

DOE evaluated methods to further decrease the width of the rail roadbed to reduce the amount of wetlands filled in the Indian Cove area and southern Meadow Valley. The roadbed could be reduced to a width of approximately 9.1 meters (30 feet) by constructing vertical retaining walls along part or all of the 6.4 kilometer (4 mile) stretch of the alignment that crosses wetlands. The retaining walls would consist of sheet pilings, mechanically stabilized earth, or conventional cast-in-place concrete construction. About 0.006 square kilometer (1.6 acres) of wetlands would be permanently filled to construct a 9.1-meter-wide (30-foot-wide) roadbed. The cost of constructing a roadbed with vertical retaining walls is approximately 8.8 million dollars more per kilometer (14 million dollars more per mile) than the cost of constructing a conventional roadbed with a 2:1 slope. Thus, the cost of reducing the amount of wetlands filled from 0.03 square kilometer (6.9 acres) to 0.006 square kilometer (1.6 acres) by constructing vertical walls along the 6.4 kilometer (4 mile) section of the alignment would be about 56 million dollars, or 25.9 million dollars per 0.01 square kilometer of wetlands avoided (10.5 million dollars per acre). Therefore, DOE has determined that this method is not practicable for reasons of cost. DOE also considered constructing a continuous bridge over the wetlands but has concluded that method also is not practicable because it would cost approximately twice as much as constructing vertical walls (DIRS 180916-Nevada Rail Partners 2007, Appendix F).

**F.3.2.1.1.2.2 Interchange Yard** The Interchange Yard for the Caliente alternative segment would be located in the City of Caliente, directly across from the Caliente City Hall (see Figure 2-44). That facility would include a wye track that would allow access to the alignment from both the east and west. There are no wetlands in this area.

**F.3.2.1.1.2.3 Staging Yard** DOE is considering two optional locations for the Staging Yard along the Caliente alternative segment (Indian Cove and Upland). The Indian Cove Staging Yard would be constructed in a pasture north of the City of Caliente (see Figure 2-45). Most of the pasture is covered with palustrine emergent wetlands that are frequently grazed by cattle. Those wetlands are supported by water diverted from Meadow Valley Wash to irrigate the pasture and possibly from groundwater flow from north of the pasture (DIRS 183595-PBS&J 2006, all). Construction of the Staging Yard in this area would require the wetlands to be filled above the level of the floodplain. It might also require an active drainage system and a channel around the eastern edge of the site to keep the area dry and in a stable condition. Construction of the Staging Yard in Indian Cove would require filling up to 0.19 square kilometer (47 acres) of wetlands, all of which have been categorized as assessment unit 2 wetlands.

Primary direct impacts to existing wetland functions associated with wetland fill in these wetlands would be the same as those discussed in Section F.3.2.1.1.2.1 for wetlands categorized as assessment unit 2. Based on the large area of fill within a localized setting, the relative impact to function of assessment unit 2 wetlands would likely be much more substantial than that incurred by smaller amounts of roadbed fill over a longer linear distance as described for the roadbed component of the Caliente alternative segment.

The Upland site of the Staging Yard is within and adjacent to an agricultural field in Meadow Valley (see Figure 2-46). One or more sets of tracks at the north end of this yard would cross Bennett Springs Wash, a water of the United States. A bridge would be constructed at that crossing and no fill would be placed in the wash. There is an isolated wetland immediately to the west of the Upland site, in a swale adjacent to the abandoned rail roadbed. That wetland is confined to the lower part of the swale where water ponds and it has no apparent surface connection to Meadow Valley Wash or its tributaries (DIRS 183595-

PBS&J 2006, Table 6). Nonetheless, DOE would avoid filling this wetland by constructing the Staging Yard to the west of the abandoned rail roadbed; therefore, no fill of wetlands or other waters of the United States would be required to construct the Staging Yard at the Upland site.

DOE also examined possible sites for the staging yard south of Caliente near the wastewater-treatment facility and found that the slope in the area is too steep for construction of the yard. A potential location for the Staging Yard within Dry Lake Valley was not considered in the Rail Alignment EIS because the site would be located too far away from both the Caliente alternative segment and the Union Pacific Railroad Mainline to be feasible.

**F.3.2.1.1.2.4 Quarry Siding** DOE has identified two possible locations where ballast from quarry CA-8B may be loaded onto ballast trains (DIRS 180922-Nevada Rail Partners 2007, p. 3-6), which are dependent upon the location of the Staging Yard. If DOE were to select the Indian Cove Staging Yard, ballast would be loaded at that yard; therefore, wetland impacts are already addressed for the Indian Cove Staging Yard. If DOE were to select the Upland Staging Yard, it would construct a quarry siding immediately south of Beaver Dam Road and to the east of the mainline track (see Figure F-5). The siding would be 1,500 meters (5,000 feet) long and 61 meters (200 feet) wide.

DOE delineated a total of 0.005 square kilometers (1.24 acres) of wetlands in the western 100 feet of this proposed location (DIRS 183595-PBS&J 2006, p. 11). DOE conducted additional field studies in January and February 2008 at the proposed siding location and mapped potential wetlands in the eastern half of the site. A total of 0.001 square kilometer (0.35 acre) of wetlands were mapped; thus, the total area of wetlands within the site is estimated to be 0.006 square kilometer (1.59 acres). The wetland mapping that DOE completed in 2008 should not be considered a formal delineation of wetlands conducted in accordance with methods approved by the U.S. Army Corps of Engineers.

The 0.006 square kilometer (1.59 acres) of wetlands that would be filled to construct the quarry siding were categorized as assessment unit 2. Primary direct impacts to existing wetland functions associated with wetland fill in these wetlands would be the same as those discussed in Section F.3.2.1.1.2.1 for wetlands categorized as assessment unit 2 along the roadbed.

Alternative locations for the quarry siding north and south of the selected site were considered but eliminated because they could have greater impacts on wetlands, land use, or operation of the railroad. Moving the siding north 610 meters (2,000 feet) to avoid the wetlands at the proposed site would require blocking Beaver Dam Road for long periods while ballast trains are being loaded. Constructing the siding immediately north of Beaver Dam Road would require channelizing a portion of Meadow Valley Wash and filling more than 0.0081 square kilometer (2 acres) of wetlands adjacent to that wash. Moving the siding farther north to avoid all wetlands and streams in the area would interfere with operations at the Upland Staging Yard. Locating the siding south of the proposed location would require filling more than 0.02 square kilometer (5 acres) of wetlands in the large complex of wet meadows at the south end of Meadow Valley (DIRS 185097-Rautenstrauch 2008, all).

**F.3.2.1.1.2.5 Wetland Summary – Caliente Alternative Segment** The total amount of wetlands that would be permanently filled to construct the rail roadbed and the Upland Staging Yard option would be approximately 0.035 square kilometer (8.7 acres), 0.034 square kilometer (8.5 acres) of which are likely regulated pursuant to Section 404 of the Clean Water Act. Approximately 0.22 square kilometer (54.1 acres) of wetlands would be filled to construct the rail roadbed and the Indian Cove Staging Yard option. Table F-7 provides the amount of wetlands and stream crossings DOE identified as waters of the United States requiring fill along the Caliente alternative segment for both the Upland and Indian Cove Staging Yard options. For purposes of comparison, wetlands and stream crossings identified as waters of the United States requiring fill along the Eccles alternative segment are also provided in Table F-7.

#### *F.3.2.1.2 Eccles Alternative Segment*

The Eccles alternative segment would begin along Clover Creek about 8 kilometers (5 miles) east of Caliente and trend generally north to enter Meadow Valley from the southeast (see Figure 2-5). This alternative segment would then cross U.S. Highway 93 about 5 kilometers (3 miles) southwest of Panaca and connect to Caliente common segment 1 about 1 kilometer (0.6 mile) northwest of U.S. Highway 93 and 18 kilometers (11 miles) south of Pioche. The Eccles alternative segment would be about 19 kilometers (12 miles) long (DIRS 180916-Nevada Rail Partners 2007, p. E-4).

If DOE were to select the Eccles alternative segment, an Interchange Yard and Staging Yard would be constructed along the alignment (see Section 2.2.4.1.1 of the Rail Alignment EIS). There are no suitable ballast quarry locations along the Eccles alternative segment; therefore, no quarry siding would be required. The Department would have to obtain ballast from an existing commercial quarry if this alternative segment were selected.

A wye track would be needed at or near the Interchange Yard to allow trains and locomotives to safely turn around. The topography along Clover Creek precludes construction of that track at the Interchange Yard. The wye track at the Staging Yard, 13 kilometers (8 miles) to the north, would have to be used for this purpose. This makes operation of the Eccles alternative segment a much less practicable alternative than the Caliente alternative.

**F.3.2.1.2.1 Floodplains – Eccles Alternative Segment.** There are no FEMA flood maps for the area of the Eccles alternative segment; however, it is reasonable to assume that the floodplain mapped for Clover Creek in the area of Caliente extends to the east, upstream to the starting point of this alternative segment (see Figure F-3). Clover Creek is a tributary of Meadow Valley Wash. The place where the Eccles alternative segment would cross Meadow Valley Wash is also a likely floodplain. Section F.3.1 addresses the common impacts to floodplains that would be crossed by and adjacent to the Eccles alternative segment.

**F.3.2.1.2.2 Wetlands – Eccles Alternative Segment.** DOE delineated wetlands within 200 meters (1,300 feet) of the Eccles alternative segment in a field survey completed in support of the Rail Alignment EIS (DIRS 183595-PBS&J 2006, Figures 4A to 4R). That delineation was submitted to the U.S. Army Corps of Engineers in October 2007 with a request that a jurisdictional determination be made to identify which waters along the Caliente rail alignment are regulated under Section 404 of the Clean Water Act (DIRS 185487-Larson 2007, all).

**F.3.2.1.2.2.1 Eccles Alternative Segment Roadbed** The only wetlands located along the Eccles segment are in northern Meadow Valley where the rail line would cross Meadow Valley Wash (see wetland WT-1 shown in Figure F-6). This wetland was categorized as assessment unit 3 (see Table F-8) in the wetland functional assessment completed by DOE. A bridge would be constructed over that stream that would span the stream channel and avoid the adjacent wetlands. Minor direct impacts to these riverine flow-through wetlands could occur as a result of bridge placement over Meadow Valley Wash, which contains fringe/interspersed wetlands. The design goal, however, is to avoid direct wetland impacts to the maximum extent practicable in placement of bridge abutments and/or piers at such stream crossing points. Primary direct impacts to existing wetland functions associated with potential minor wetland fill in these wetlands include both short-term and long-term minor reduction in wetland habitat support, including resident fish, invertebrate, and songbird (DIRS 185340-URS 2008, all).

**Table F-7.** Summary of wetlands and waters of the United States – Caliente and Eccles alternative segments.[a]

| Construction activity | Waters of the United States crossings[b] | Waters of the United States fill area (acres)[c] | Waters of the United States fill volume (cubic feet)[d] | Wetlands fill area (acres) |
|---|---|---|---|---|
| *Caliente alternative segment* | | | | |
| Upland Staging Yard option | | | | |
| Roadbed construction | 5 | 0.01 | 99 | 7.1 |
| Interchange Yard | 0 | 0 | 0 | 0 |
| Staging Yard | 1 (bridged) | 0 | 0 | 0 |
| North quarry siding | 0 | 0 | 0 | 1.6 |
| Quarry | 0 | 0 | 0 | 0 |
| ***Totals*** | 6 | 0.01 | 99 | 8.7 |
| Indian Cove Staging Yard option | | | | |
| Roadbed construction | 5 | 0.01 | 99 | 7.1 |
| Interchange Yard | 0 | 0 | 0 | 0 |
| Staging Yard | 1 (bridged) | 0 | 0 | 47 |
| Quarry | 0 | 0 | 0 | 0 |
| ***Totals*** | 6 | 0.01 | 99 | 54.1 |
| *Eccles alternative segment* | | | | |
| Roadbed construction | 11 | 0.21 | 1400 | 0 |
| Interchange Yard | 1 | 11[e] | 459,000[e] | 0 |
| Staging Yard (Eccles-North) | 4 | 0.03 | 390 | 0 |
| ***Totals*** | 16 | 11.2 | 461,000 | 0 |

a. Source: DIRS 183595-PBS&J 2006, Figures 3A to 3C.
b. Any water of the United States within 12 meters (40 feet) of the construction footprint is considered to be crossed.
c. To convert acres to square kilometers, multiply by 0.0040469.
d. To convert cubic feet to cubic meters, multiply by 0.028317.
e. The total area to be filled in Clover Creek for construction of the siding would range from approximately 0.033 to 0.043 square kilometer (8.2 to 11 acres). Additional fill within Clover Creek would also be required to create dikes to protect the Interchange Yard from flooding.

**F.3.2.1.2.2.2 Eccles Alternative Interchange Yard** The Interchange Yard at Eccles would be approximately 8 kilometers (5 miles) east of the City of Caliente. It would be constructed immediately north of the Union Pacific Railroad Mainline within the confines of Clover Creek (see Figure F-7). Clover Creek drains an area of about 970 square kilometers (240,000 acres) east of the site. Drainage through the site is from east to west, toward Meadow Valley and Caliente. Construction of this yard would require dikes and riprap in Clover Creek to provide the necessary embankment, maintain stream bed characteristics, properly direct water, and protect the siding (DIRS 180919-Nevada Rail Partners 2007, p. 4-2).

Portions of the south bank of Clover Creek would be filled to a height of 2 meters (6 feet) or more to elevate the site out of the floodplain to the height of the existing tracks. For construction of the interchange tracks, the fill would extend approximately 15 to 23 meters (50 to 75 feet) into the creek for a length of approximately 1,400 meters (4,600 feet) along the creek. For construction of the interchange siding, the fill would extend approximately 7.6 meters (25 feet) into the ephemeral creek bed for a length of approximately 900 meters (3,000 feet) on the east end and 600 meters (2,000 feet) on the west end of

**Table F-8.** Functional assessment scoring – Eccles alternative segment.[a]

| Assessment unit | Wetlands within assessment unit | Wetland function sources[b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Water storage and delay | Sediment stabilization and phosphorus retention | Nitrogen removal | Primary production | Thermoregulation | Resident fish habitat support | Invertebrate habitat support | Amphibian and turtle habitat support | Breeding waterbird support | Wintering and migratory waterbird support | Songbird habitat support | Support of characteristic vegetation |
| AU-3 | WT-1 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.7 | 0.5 | 0.4 | 0.4 | 0.4 | 0.6 | 0.5 |
| AU-6 | WT-9, WT-10 | 0.2 | 0.3 | 0.2 | 0.4 | 0.3 | 0.5 | 0.4 | 0.4 | 0.4 | 0.5 | 0.6 | 0.6 |

a. Source: DIRS 185340-URS 2008, all.
b. Scores were based on a scale of 0.0 to 1.0 with the score of 0.0 indicating minimal capacity and 1.0 indicating highest capacity. For the functional assessment conducted by DOE, function scores between 0.1 and 0.3 are considered low, scores between 0.4 and 0.6 are moderate, and 0.7 to 1.0 are high.

the interchange tracks. The total area to be filled in Clover Creek for construction of the siding would be approximately 0.033 to 0.043 square kilometer (8.2 to 11 acres) depending on the width of the fill. Clover Creek is classified as a water of the United States under Section 404 of the Clean Water Act. The total area and volume of permanent fill of waters of the United States required for constructing the Eccles alternative segment is provided in Table F-7.

The active stream channel along this portion of Clover Creek is approximately 0.3 meter (1 foot) deep (DIRS 183595-PBS&J 2006, Table 3). The volume of fill placed in the stream floodplain would be approximately 10,000 to 13,000 cubic meters (13,000 to 17,000 cubic yards) and the total volume of fill required to extend and raise the south bank of Clover Creek 2 meters (6 feet) or more to the height of the existing track would be about 65,000 to 87,000 cubic meters (85,000 to 110,000 cubic yards). Additional fill within the jurisdictional channel of Clover Creek would also be required to create dikes to protect the siding from flood waters.

There are five small wetlands along the section of Clover Creek where the Interchange Yard would be constructed (see Figure F-7). DOE categorized the riverine flow-through wetlands within the active and highly dynamic Clover Creek floodplain (WT-9 and WT-10) as assessment unit 6. Clover Creek has seasonal flow, with a widely meandering low-flow channel containing pockets of wetland formed on low terraces adjacent to the channel.

The presence and extent of wetlands within Clover Creek and its floodplain are likely dynamic from year to year. These wetlands are characterized by shrub and tree saplings. The non-native invasive saltcedar (*Tamarix ramosissima*) is a dominant species in some of the wetlands in this area. Soils are comprised of recent flood deposits and are of a coarse granular texture with little development. These wetlands have a distinct hydrogeomorphic character within their setting in the dynamic active floodplain of Clover Creek. This assessment unit scored moderately (see Table F-8), the functions that scored highest were related to habitat support for vegetation, fish, and wildlife. Scores for these functions ranged between 0.4 and 0.6. This is based on attributes such as the interspersion of vegetative habitat features and dynamism and landscape variety of hydrologic regime across the wash. Functions more dependent on variables related to soil development, sediment stability, and the ability to detain water did not score as highly for this assessment unit, which is justifiable given the dynamic floodplain setting with active soil alluvial deposition, occasional high-velocity flow events and areas of substantial erosion.

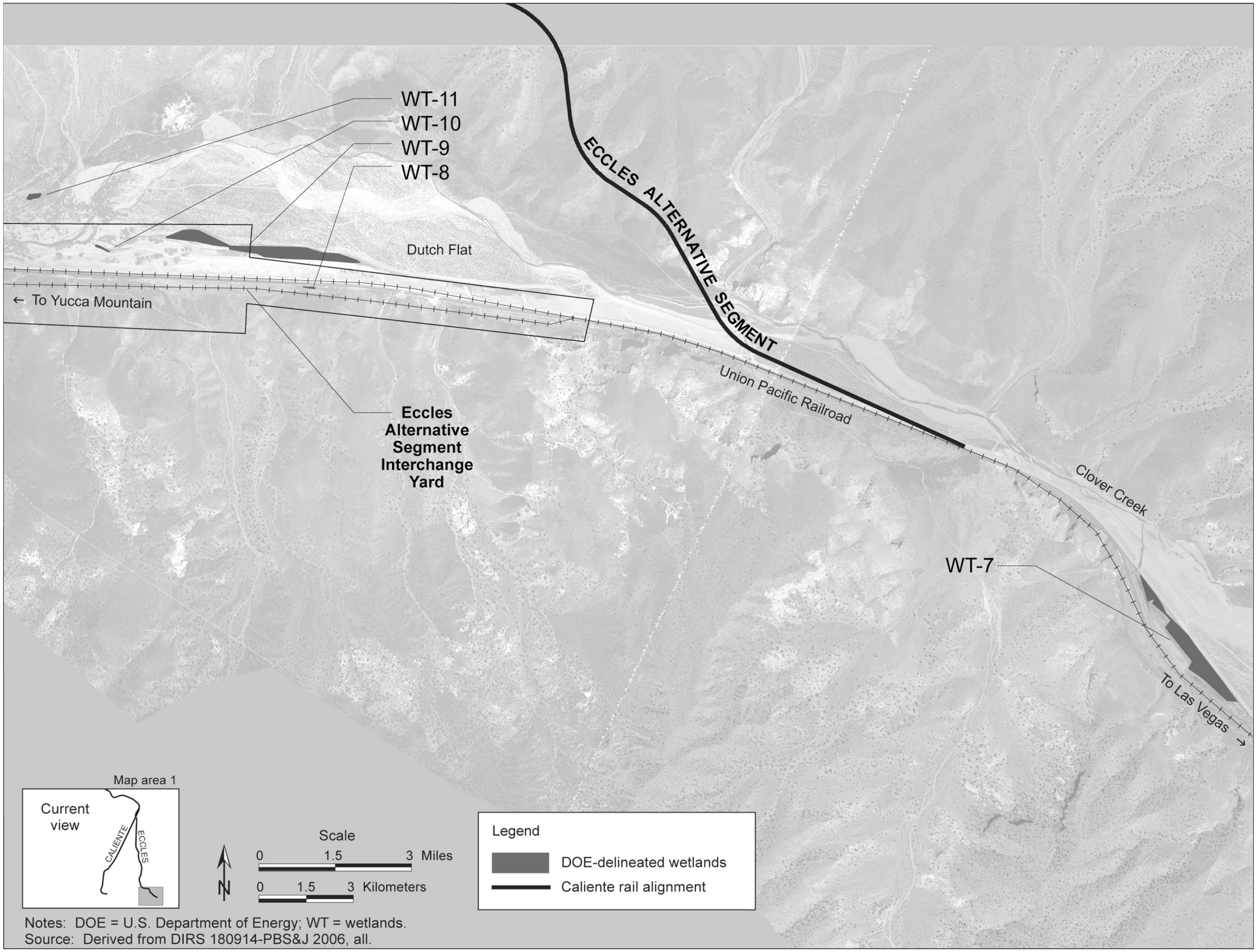


**Figure F-7.** Wetlands in vicinity of Eccles Interchange Yard.

None of the wetlands would be permanently filled to construct the Interchange Yard; however, three of these wetlands are adjacent to or downstream of the section of Clover Creek that would have to be filled to construct the yard. No direct impacts are expected to these wetlands; however, Clover Creek and its floodplain would be directly impacted. Wetland impacts are summarized in Table F-9.

There is a stand of riparian vegetation west of the proposed location of the Eccles Interchange Yard along Clover Creek, outside the construction right-of-way, which could be suitable for migrating and non-nesting southwestern willow flycatchers, which are federally protected. This area of riparian vegetation would not be disturbed during construction of the Eccles Interchange Yard. The riparian area continues downstream (toward the west) and consists of mature riparian forest. The BLM has proposed designating portions of Clover Creek and Meadow Valley Wash as the Lower Meadow Valley Wash Area of Critical Environmental Concern for the protection of federally endangered, threatened, and candidate species such as the southwestern willow flycatcher (endangered) and western yellow-billed cuckoo (candidate), and sensitive species such as the Meadow Valley Wash desert sucker, Meadow Valley Wash speckled dace, and Arizona southwestern toad. The portion of Clover Creek where the Eccles Interchange Yard would be constructed and the downstream riparian areas managed by the BLM are within this proposed Area of Critical Environmental Concern (DIRS 185340-URS 2008, p. 21). See Section 4.2.7.2.2.2 for a discussion of the potential impacts of the interchange yard on these species.

Fill material placed within the floodplain of Clover Creek to construct the Interchange Yard could have indirect impacts to Dutch Flat and to the downstream riparian areas and associated wetlands, including those within the Lower Meadow Valley Wash Area of Critical Environmental Concern. Indirect impacts would be due to alterations in hydraulic properties that would occur as a result of placing fill in the active floodplain of Clover Creek. The velocity of flows in Clover Creek could be increased, which would cause erosion adjacent to the filled areas and subsequent deposition downstream of the filled area. In addition, placing fill, including dikes, in Clover Creek could cause the active channel to shift to the north, resulting in erosive flows through Dutch Flat (see Figure F-7) and an additional increase in the downstream sedimentation. The additional downstream sedimentation, which would otherwise not occur, would alter the downstream riparian habitat (which are shown in Figure 3-91). Shifting the location of the active channel at the Interchange Yard could also cause changes in the location and other characteristics of that channel downstream, possibly resulting in less surface-water flow through some riparian areas.

The Environmental Protection Agency recently issued an Administrative Order requiring the Union Pacific Railroad to remove a series of dikes in the Dutch Flat areas of Clover Creek and to restore the conveyance capacity of that creek for floodwaters. The embankment for the Interchange Yard and its rip-rap protection and dikes would be placed in the same location as Union Pacific's restoration work. Monitoring and inspections of that restoration would likely extend years into the future and overlap with construction activities proposed by DOE. While the amount of fill to be placed by DOE is less than the amount placed and removed by Union Pacific, the types of indirect impacts to Dutch Flat and downstream riparian areas would be similar to the impacts caused by the Union Pacific actions. Thus, constructing the Eccles Interchange Yard would disrupt efforts to restore Clover Creek required by that Administrative Order and may complicate the Department's ability to comply with Section 404 of the Clean Water Act.

Quantifying the degree of modification to hydrologic conditions in Clover Creek cannot be addressed without hydraulic modeling. Several variables would affect the degree of indirect impacts, including timing and velocity of peak flows in Clover Creek, proportion of floodplain filled, depth and total volume of fill, substrate conditions, and the condition of the side channel after restoration and monitoring has been completed by the Union Pacific Railroad to the requirements of the Environmental Protection Agency.

**Table F-9.** Summary of impacts to wetlands – Eccles alternative segment.

| Construction activity | Direct impacts to assessment units (acres)[a] | Potential indirect impacts | Primary wetland functions affected |
|---|---|---|---|
| Roadbed construction | None | *Short-term impacts:*<br>• Water quality<br>o Mitigate with best management practices and in-water timing (low/no flow).<br>*Long-term impacts:*<br>• Potential minor impact to sediment stabilization, which new bridge/hydraulic design of bridge would mitigate. | *Short- and long-term impacts:*<br>• None to very minor direct bridge construction impacts (for example, pier placement) at WT-1 (AU-3, an RFT[b] wetland), minor impact to habitat functions such as fish, invertebrate, and songbird support. |
| Interchange Yard | None | *Short-term impacts:*<br>• Water quality<br>• Mitigate with best management practices and in-water timing (low/no flow).<br>*Long-term impacts:*<br>• Water storage and delay – could decrease due to alteration of localized hydraulic conditions from fill in Clover Creek wash; would need modeling to quantify.<br>• Sediment stabilization – potential increase to flow velocity could increase erosion during high-flow events; would need modeling to quantify.<br>• Primary production and invertebrate support – may decrease due to potential for higher velocity flow; less conducive conditions for algae/plants. | None |
| Staging Yard | None | None | None |

a. To convert acres to square kilometers, multiply by 0.0040469.
b. RFT = riverine flow-through hydrogeomorphic wetland class.

The strong dynamism of the active Clover Creek floodplain also indicates that accurate predictions from modeling would benefit from inclusion of dynamic geomorphic processes. For example, higher velocity flows could increase erosional processes in certain areas of the floodplain and prevent germination or establishment of in-stream wetland vegetation; the counteracting physical process is sediment deposition. It would be difficult to predict where the sediment resulting from increased erosion would be redeposited and whether such deposition would encourage origination or continued establishment of downstream wetlands (DIRS 185340-URS 2008, all).

**F.3.2.1.2.2.3 Eccles Alternative Staging Yard** The Staging Yard for the Eccles alternative segment would be located in Meadow Valley about 910 meters (3,000 feet) east of U.S. Highway 95. One ephemeral water of the United States would be crossed by this Staging Yard and three would be crossed by the access road to the site. A total of 560 square meters (0.14 acres) of waters of the United States would be filled to construct this yard. There is no alternative location for this yard along the Eccles segment in Meadow Valley that would not cross at least one water of the United States.

## F.3.2.2 Caliente Common Segment 1

FEMA has published only one flood map that covers a small section of the area crossed by Caliente common segment 1. This flood map covers a portion of land in White River Valley and the adjacent north end of the Seaman Range, as shown in Figure F-8. Common segment 1 would not cross any FEMA floodplains shown in the area on this single map. Common segment 1 would run 1.4 kilometers (0.87 mile) north of an unnamed playa that is 47 square kilometers (18 square miles) in size when crossing Dry Lake Valley. During periods of heavy rainfall, runoff from the Highland, Chief, North Pahroc, and Seaman Ranges can produce ephemeral lakes in these playas. One construction camp would be located along the common segment, but it would not intersect floodplains or wetlands. Common impacts to nearby playas and their associated floodplains are addressed in Section F.3.1.

In the North Pahroc Range pass (between White River Valley to the west and Dry Lake Valley to the east), Caliente common segment 1 would pass within 600 meters (2,000 feet) of a small group of three isolated wetlands (see Figure F-9). These isolated, nonjurisdictional (not regulated under Section 404 of the Clean Water Act) wetlands were delineated during the field survey conducted in support of the Rail Alignment EIS (DIRS 183595-PBS&J 2006, Figure 4S). These wetlands are labeled WT-12, WT-13, and WT-14 and are associated with an unnamed spring. A lack of wildlife habitat was observed in this area. The shoreline of the ponds lacks the vegetation that would provide food, shelter, or reproductive habitat for a variety of species (DIRS 183595-PBS&J 2006, Photos 50 and 51, pp. B-25 and B-26). Using the Cowardin (DIRS 178724-Cowardin et al. 1979, all) classification scheme, the stock watering pond (WT-12) is classified as a palustrine emergent/rock bottom/unconsolidated bottom wetland and the other areas (WT-13 and WT-14) as emergent wetlands (DIRS 183595-PBS&J 2006, p. 19).

The unnamed spring appears to have been created by excavating (or blasting) a hole into the soil and excavating a channel to convey water into a basin used as a stock watering pond. The spring head and excavated channel (WT-13) and the stock pond (WT-12) occupy less than 0.0081 square kilometer (2 acres). The channel was flowing from the spring head through the channel to the stock pond at the time of the field survey (DIRS 183595-PBS&J 2006, p. 13). These wetlands are uphill of and outside the rail line construction right-of-way; therefore, there would be no direct or indirect impacts to these wetlands as a result of the construction or operation of the proposed rail line.

## F.3.2.3 Garden Valley Alternative Segments

FEMA flood maps do not cover any of the Garden Valley alternative segments. However, it is likely that some areas in the valley experience periodic flooding. Garden Valley alternative segment 2 would cross

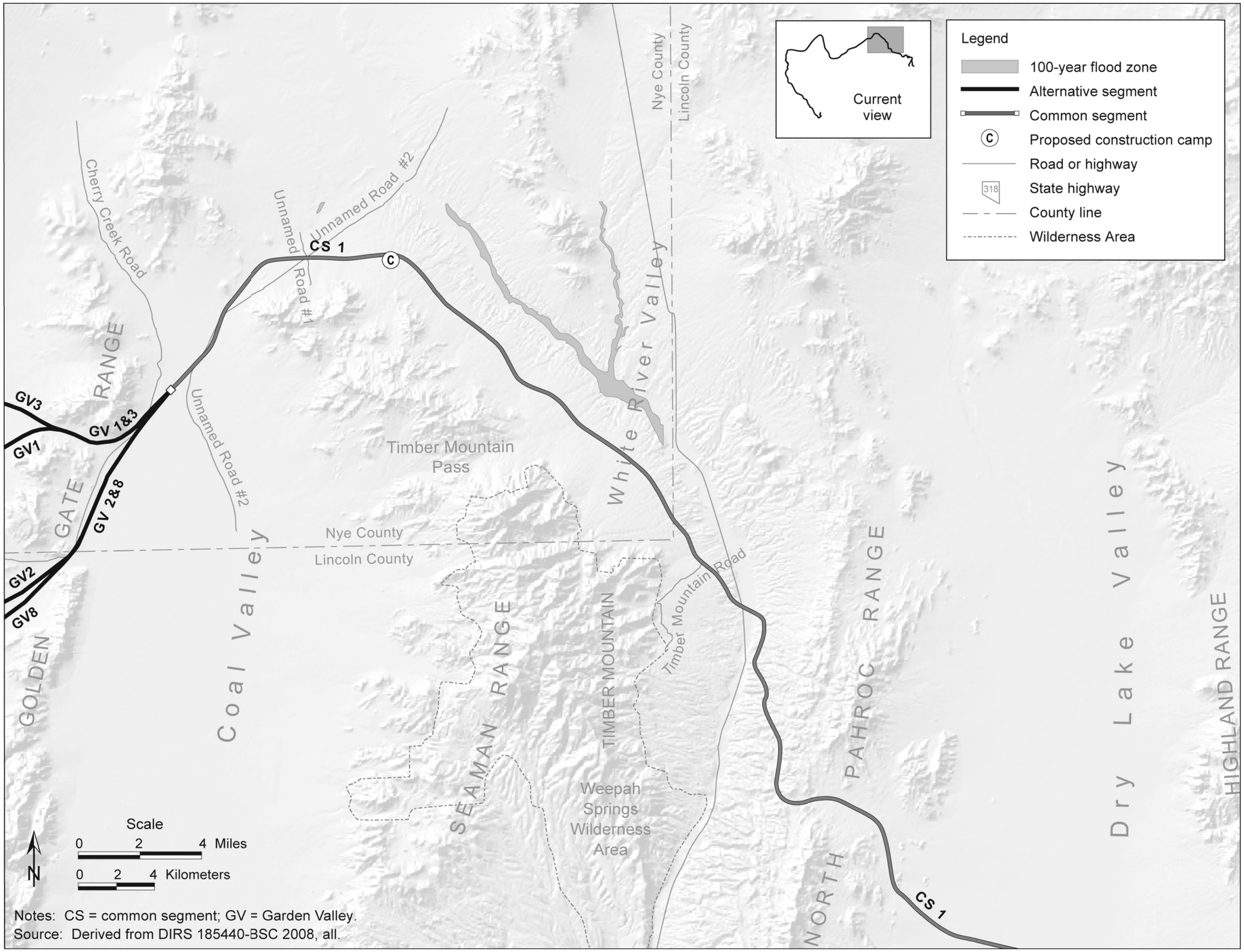


**Figure F-8.** FEMA floodplain map for map area 2 of the Caliente rail alignment.

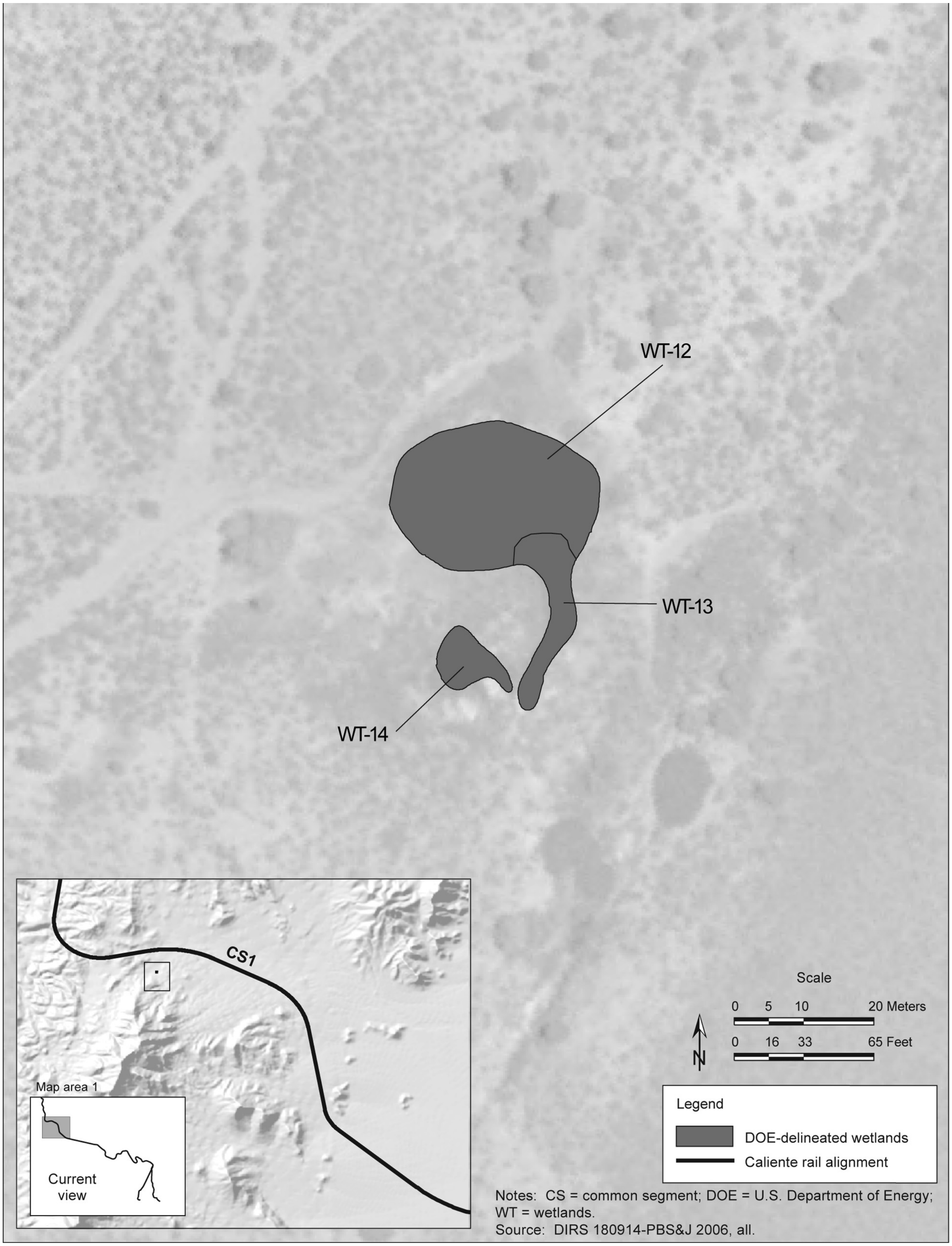


**Figure F-9.** Isolated wetlands south of Caliente common segment 1.

three of the same intermittent creeks and washes and the drainage feature designated as Water Gap, which is characterized as a topographically constricted area through which several small drainage channels run. Although the area is normally dry, Water Gap must be considered an area for flooding issues. Garden Valley alternative segment 2 would also skirt (within 1 kilometer [0.6 mile]) the Coal Valley playa, another area expected to be susceptible to flooding and standing water. Each alternative segment would have a construction camp located about 6 kilometers (3.7 miles) east of the junction with Caliente common segment 2. None of these three locations intersect floodplains. Common impacts to nearby floodplains are addressed in Section F.3.1.

Although the National Wetlands Inventory dataset identifies the Coal Valley playa as a lacustrine littoral unconsolidated shore wetland, DOE field studies in support of the Rail Alignment EIS confirmed that there are no hydric soils, plant species indicative of wetlands, or other indicators of wetlands on or adjacent to the playa near the alignment (DIRS 180696-Potomac-Hudson Engineering 2007, p. 3). No wetlands were identified along any of the Garden Valley alternative segments.

### F.3.2.4 Caliente Common Segment 2

The only portion of Caliente common segment 2 covered by FEMA flood maps is the west end in Railroad and Reveille Valleys, but common segment 2 would not cross any floodplains in this limited area, as shown in Figure F-10. Two washes in this area have associated floodplains. One of these washes originates in Reveille Valley and runs adjacent to the proposed rail alignment and the other originates in the hills to the south and would be crossed by the rail alignment. Both of these washes terminate in the Railroad Valley playa north of the rail alignment. The floodplain for the adjacent wash does not extend laterally as far as the proposed rail alignment and the floodplain associated with the wash that would be crossed does not extend as far south as the proposed rail alignment. In the eastern portion of common segment 2, where there is no flood map coverage, the proposed rail alignment would cross drainage features, including Davis Creek and Quinn Canyon Wash, both of which have the potential to be associated with floodplains that have not been mapped. Two construction camps would be located along common segment 2; however, neither intersects floodplains. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to Caliente common segment 2.

There are no wetlands identified along Caliente common segment 2 or its associated facilities.

### F.3.2.5 South Reveille Alternative Segments

FEMA flood maps encompassing the area of these two short alternative segments are shown in Figure F-10. South Reveille alternative segment 2 would cross a 3.1-kilometer (1.9-mile) stretch of the 100-year floodplain associated with five tributaries draining to the well-defined, unnamed braided wash. Two potential quarry sites are located near the origination of the alternative segments. The proposed sites for the quarry plants that would support quarry NN-9A are located within the same floodplain that South Reveille alternative segment 2 would cross. South Reveille alternative segment 3 lies farther away from the wash and would not cross any 100-year floodplains. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to the South Reveille alternative segments.

There are no wetlands identified along the South Reveille alternative segments or their associated facilities.

### F.3.2.6 Caliente Common Segment 3

Most of Caliente common segment 3 would cross land that has FEMA flood map coverage. According to the FEMA maps, the common segment would not cross 100-year floodplains until it nears the vicinity of

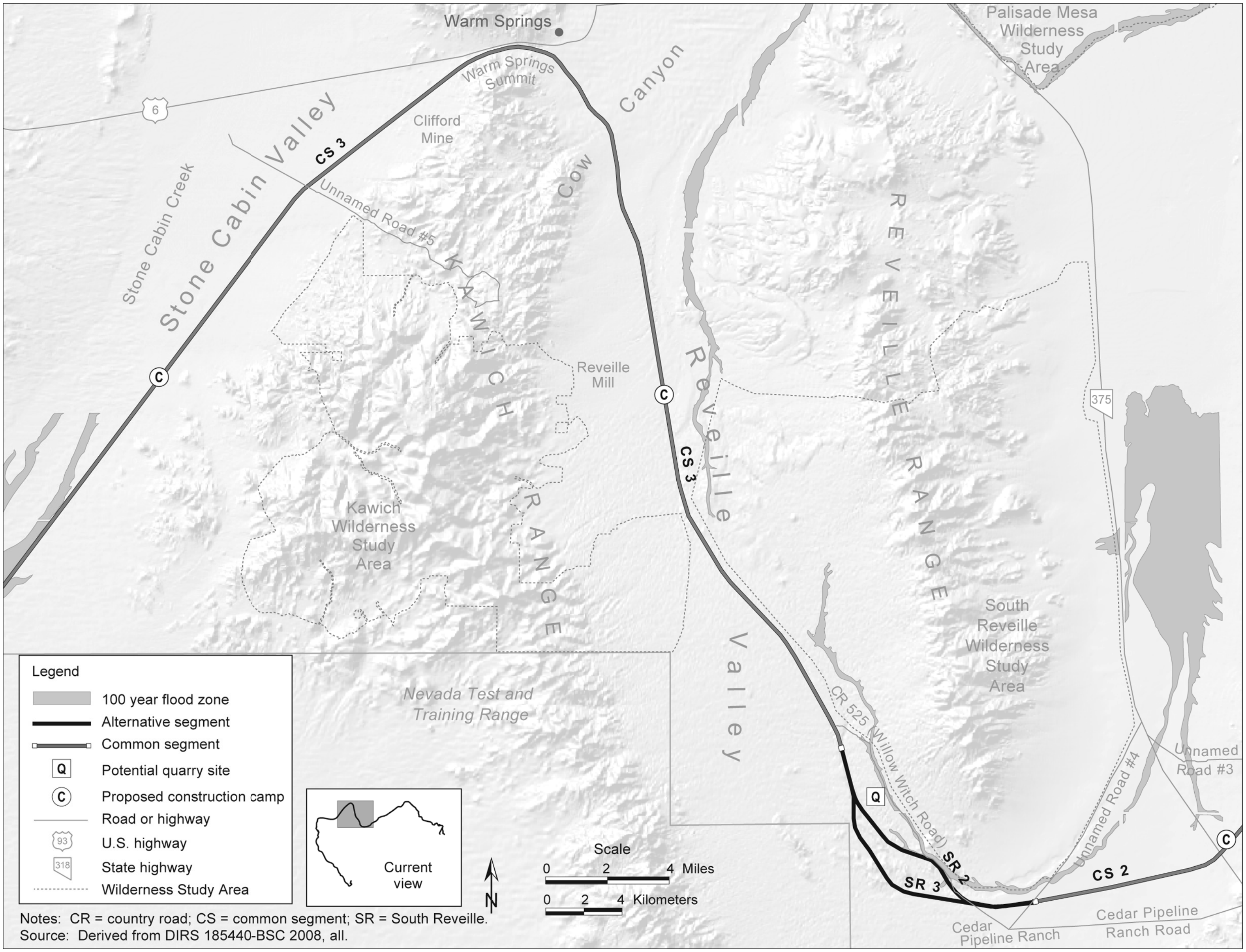


**Figure F-10.** FEMA floodplain map for map area 4 of the Caliente rail alignment.

Mud Lake Playa and its tributaries where the flood boundaries are fairly extensive, as shown in Figures F-10 and F-11. From the east, the rail alignment would first encounter floodplains associated with Stone Cabin Creek and Saulsbury Wash as they converge on Mud Lake Playa. The proposed rail alignment would then cross the floodplain of a wash draining the central Ralston Valley before it would cross through two legs of a drainage system draining the western Ralston Valley. The Mud Lake Playa area has by far the most extensive area of 100-year floodplains. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to Caliente common segment 3.

Three construction camps would be located along Caliente common segment 3 (see Figures F-10 and F-11), one of which would be constructed within a floodplain associated with Mud Lake Playa. DOE would construct the Maintenance-of-Way Trackside Facility (see Section 2.2.4.1.2.1) in the southwestern portion of Stone Cabin Valley (see Figure F-11) in floodplains associated with Stone Cabin Creek. Common impacts to floodplains in which these facilities would be constructed are addressed in Section F.3.1.

There are no wetlands identified along Caliente common segment 3 or its associated facilities.

### F.3.2.7 Goldfield Alternative Segments

FEMA flood maps cover the northern and southern portions of the Goldfield alternative segments, but not the central area that includes Goldfield, as shown on Figure F-11. According to FEMA flood maps, the alternative segments would cross a small portion of the floodplain associated with Mud Lake Playa, and each segment would cross a small portion of the floodplain associated with the drainage channel leading to Stonewall Flat Playa. There are three proposed quarry sites along the Goldfield alternative segments, two along Goldfield alternative segment 3, and one that would be accessible from Goldfield alternative segment 4; however, none of them intersect floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by or adjacent to the Goldfield alternative segments.

There are no wetlands identified along the Goldfield alternative segments.

### F.3.2.8 Caliente Common Segment 4

The FEMA flood maps provide coverage for almost all of Caliente common segment 4. The proposed rail alignment segment would skirt within 0.5 kilometer (0.31 mile) of Stonewall Flat Playa to the east and Alkali Flat Playa to the southwest and cross over the drainage path that connects the two areas. As shown in Figure F-11, the rail alignment would cross a 1.3-kilometer (0.81-mile) portion of the 100-year floodplain associated with the drainage between Stonewall Flat Playa and Alkali Flat Playa in Lida Valley. One construction camp would be located along common segment 4; however, it would not intersect any floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to Caliente common segment 4.

There are no wetlands within the region of influence for Caliente common segment 4. The Stonewall Flat Playa is classified by the National Wetlands Inventory dataset as a lacustrine littoral unconsolidated shore wetland system. DOE field studies in support of the Rail Alignment EIS confirmed that there are no hydric soils, plant species indicative of wetlands, or other indicators of wetlands on or adjacent to the playa near the alignment (DIRS 180696-Potomac-Hudson Engineering 2007, p. 6).

### F.3.2.9 Bonnie Claire Alternative Segments

FEMA flood maps cover most of the Bonnie Claire alternative segments, but do not include land east of the segments, which are shown on maps as an old boundary of the Nevada Test and Training Range.

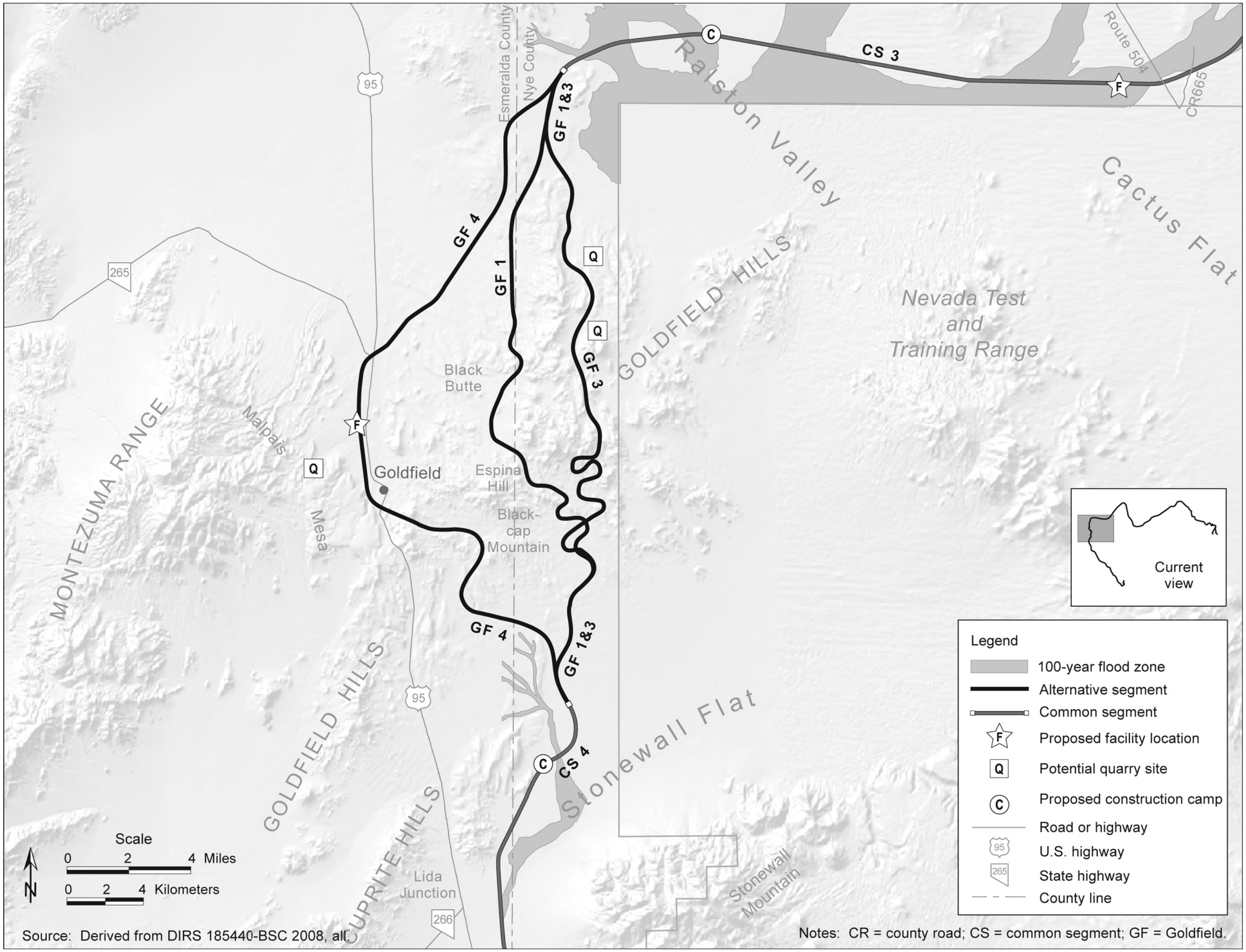


**Figure F-11.** FEMA floodplain map for map area 5 of the Caliente rail alignment.

Consequently, there is no floodplain mapping east of this boundary. Bonnie Claire alternative segment 3, the western alternative segment, has more extensive flood map coverage than Bonnie Claire alternative segment 2. As shown in Figure F-12, the northwest end of Bonnie Claire alternative segment 3 would cross a 100-year floodplain associated with the Alkali Flat playa. The flood maps also show a floodplain for an unnamed drainage channel from Pahute Mesa. This floodplain ends just south of Bonnie Claire alternative segment 3 at one of the old Test and Training Range boundaries.

The floodplain is sufficiently close to Bonnie Claire alternative segment 3 to assume it could have a similar width if floodplain mapping were extended upslope to where it would be crossed by Bonnie Claire alternative segment 3. It is possible this floodplain would extend far enough northeast to be encountered by Bonnie Claire alternative segment 2; however, the distance is too far to support such an assumption. In addition, Bonnie Claire alternative segment 2 would occur at higher elevations in the foothills where the wash would encounter fewer tributaries. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to the Bonnie Claire alternative segments.

There are no wetlands identified along the Bonnie Claire alternative segments.

### F.3.2.10 Common Segment 5

FEMA flood maps provide coverage for almost all of common segment 5 (see Figures F-12 and F-13) and indicate the proposed rail alignment would cross a 100-year floodplain associated with Tolicha Wash as it drains toward Sarcobatus Flat. FEMA has also identified a 100-year floodplain approximately 2 kilometers (1.2 miles) southwest of the alignment. This small floodplain is associated with two minor playas in Sarcobatus Flat. One construction camp would be located along common segment 5; however, it would not intersect floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to common segment 5.

There are no wetlands identified along common segment 5.

### F.3.2.11 Oasis Valley Alternative Segments

FEMA flood maps provide complete coverage for the Oasis Valley alternative segments, as shown in Figure F-13. The maps show both alternative segments would cross the Amargosa River 100-year floodplain. The linear distance required to cross the Amargosa River in Oasis Valley would be less for Oasis Valley alternative segment 3 because there are fewer braided channels upstream than there are downstream. One construction camp would be located along the alternative segments; however, it would not intersect floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to the Oasis Valley alternative segments.

DOE field surveys identified a small isolated wetland, WT-15, (74 square meters [0.018 acre]) just outside the construction right-of-way, approximately 160 meters (530 feet) north of Oasis Valley alternative segment 1 (see Figure F-14). This wetland occurs within a slight topographic depression and does not have a surface-water connection to any nearby washes and would be regarded as isolated, and thus considered nonjurisdictional (DIRS 183595-PBS&J 2006, Table 6 and Figure 4T). This wetland can be characterized as a shrub-shrub/emergent wetland complex with a moderately complex wildlife habitat structure (DIRS 183595-PBS&J 2006, Photos 52 and 53). There would be no direct impacts to this wetland during rail line construction because it is outside the construction right-of-way and it would be fenced or flagged. Indirect impacts such as sedimentation, erosion, and incidental spills would still be possible and are addressed in Section F.3.1.

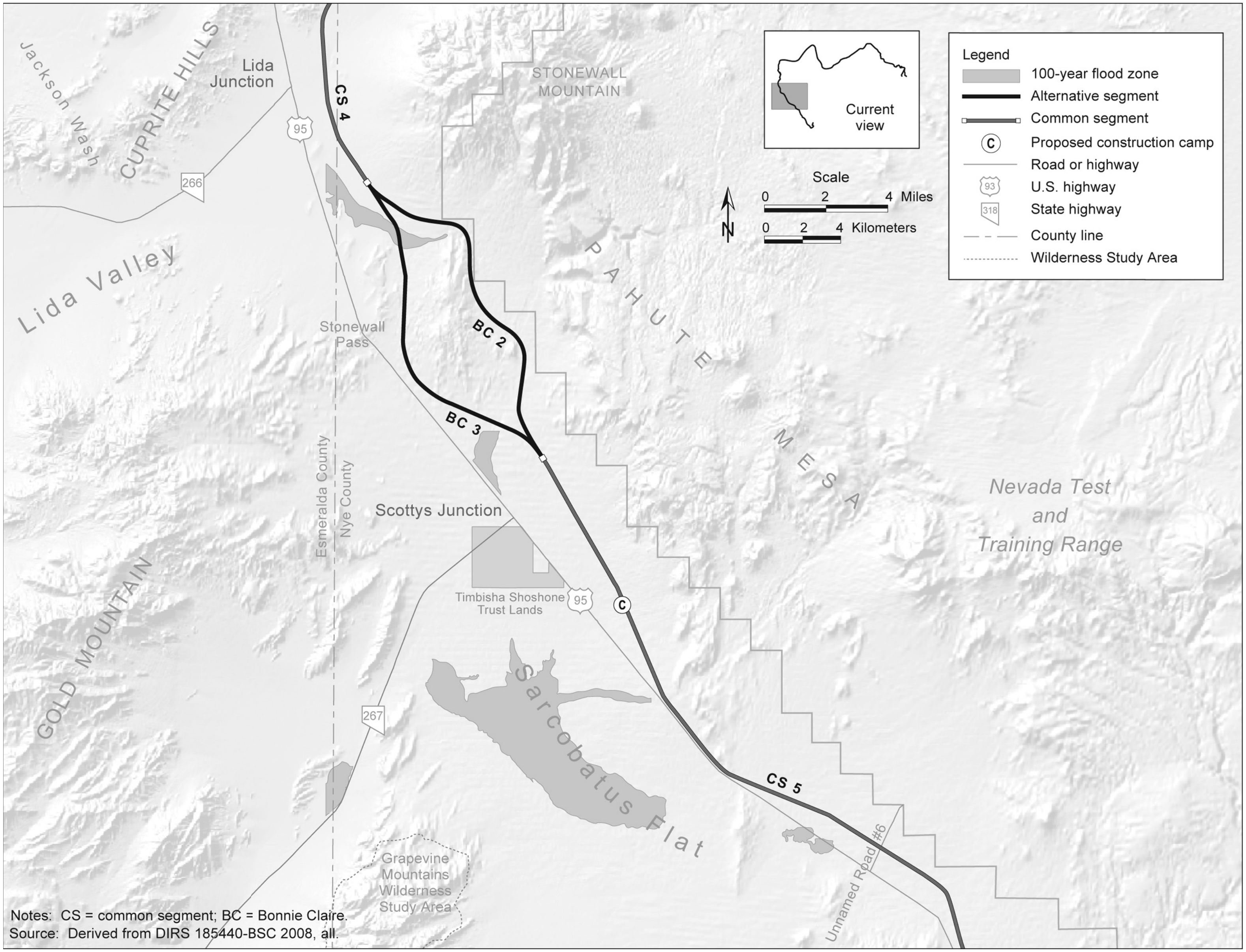


**Figure F-12.** FEMA floodplain map for map area 6 of the Caliente rail alignment.

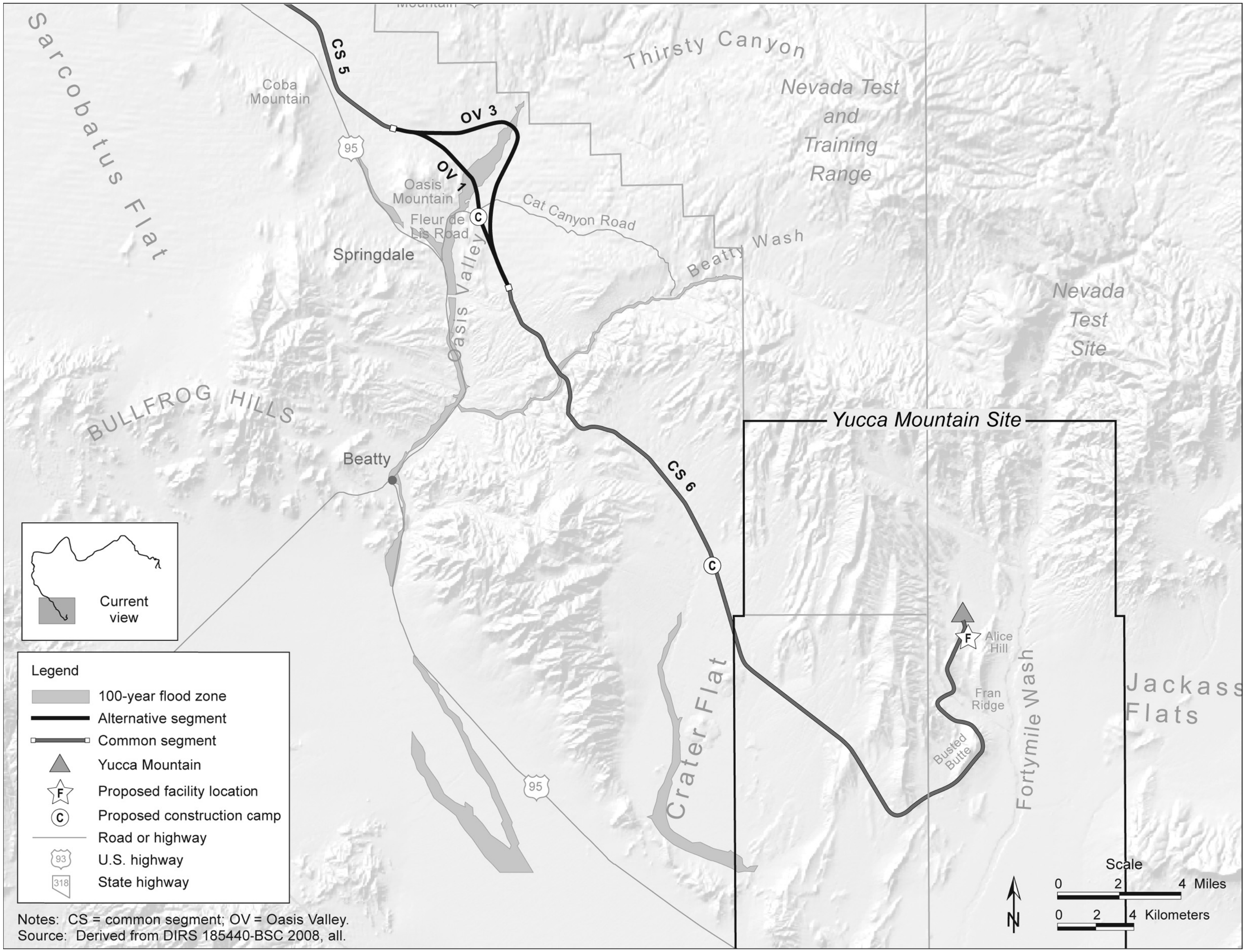


**Figure F-13.** FEMA floodplain map for map area 7 of the Caliente rail alignment.

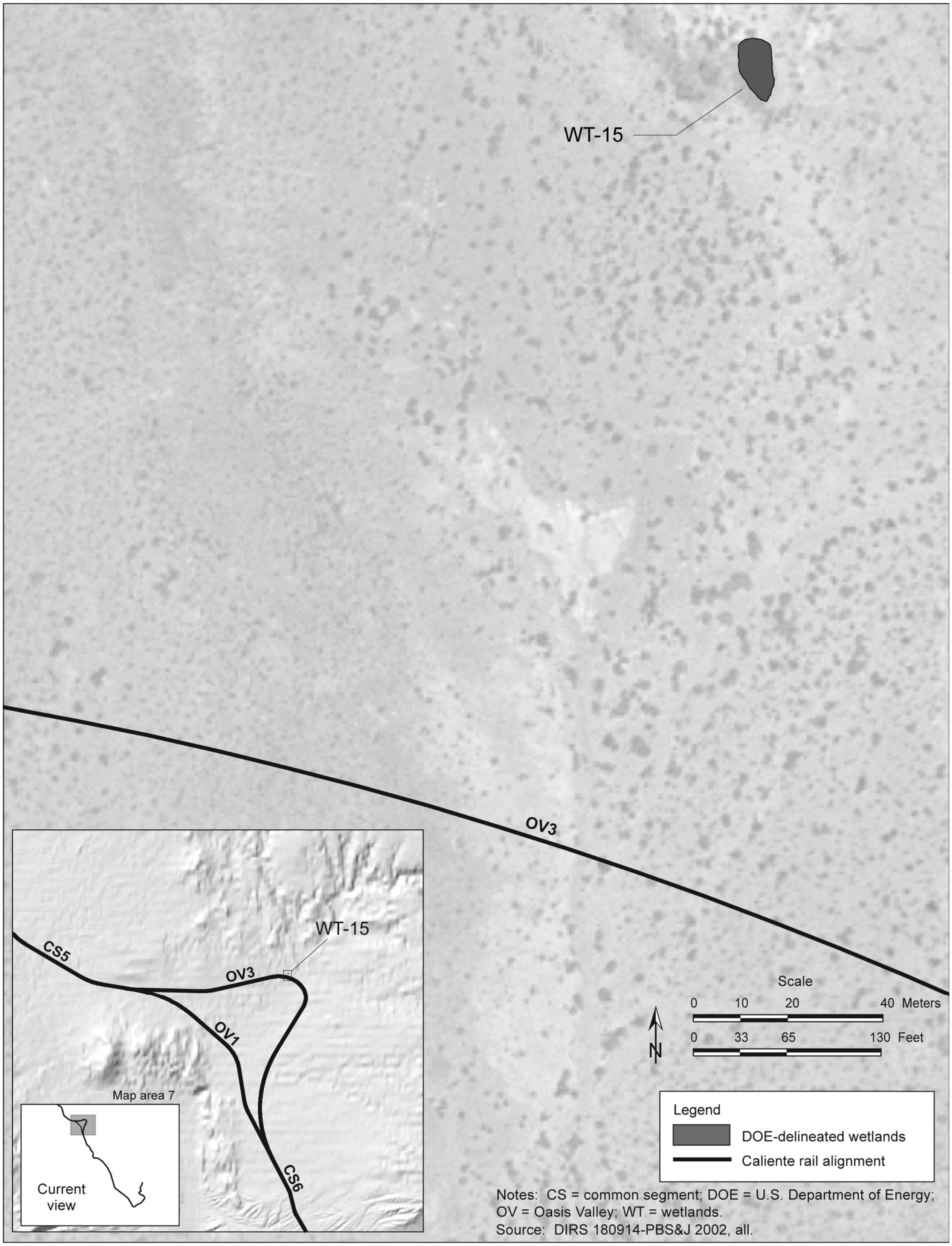


**Figure F-14.** Isolated wetland near Oasis Valley alternative segment 3.

### F.3.2.12 Common Segment 6

Slightly more than half of common segment 6 has coverage on FEMA flood maps. The coverage terminates at about the point where the proposed rail alignment reaches the repository land withdrawal area (see Figure F-13). Although the flood maps do not provide coverage for the area of the repository on the eastern side of Yucca Mountain, DOE has performed flood studies on several washes in that area, as addressed in the Yucca Mountain FEIS. An overlay of the proposed rail alignment with the Yucca Mountain FEIS (see Figure F-15) indicates that common segment 6 would cross short stretches of 100-year floodplains associated with Busted Butte Wash (also known as Dune Wash) and Drill Hole Wash (DIRS 155970-DOE 2002, pp. 3-38 and 3-39, and Figure 3-15).

As shown in Table F-1, common segment 6 would cross a 0.10-kilometer (0.06-mile) section of the Beatty Wash floodplain. The Beatty Wash Bridge has two piers that are in or near the floodway of this ephemeral streambed. Flood models would determine the flow of the 500-year storm during preliminary design. This would be the minimum return event for design of the foundations and protection against scour. The foundations would be founded in rock and armored in accordance with the American Railway Engineering and Maintenance-of-Way Association and Nevada Department of Transportation recommendations to prevent scour. The presence of a pier in the floodway would create a minor blockage and cause a slight detention of flow above the bridge. The bridge would have no negative impact on flooding below the bridge. A description of the study performed to investigate the 100-year peak flow for the structure crossing Beatty Wash on U.S. Highway 95 is provided in the *Phase 1 Hydrologic and Drainage Evaluation Report Mina, Rail Corridor* (DIRS 180885-Parsons Brinckerhoff 2007, pp. 1-16). This report also references the 500-year storm as a basis for design of bridges where scour may be an issue. The FEMA flood maps also show a floodplain associated with an unnamed wash in Crater Flat; however, the floodplain does not extend upstream to the point where it would be crossed by the proposed rail alignment.

Table F-10 lists peak discharges for estimated floods along the main washes at Yucca Mountain, including a value for the estimated regional maximum flood. In addition to the flood estimates listed in the table, DOE used another estimating method, the probable maximum flood methodology (based on American National Standards Institute and American Nuclear Society Standards for Nuclear Facilities) to generate another maximum flood value for washes adjacent to the existing facilities and operations at the repository north and south portals. The flood value this method generates, which includes a bulking factor to account for mud and debris (including boulder-size materials), is the most severe reasonably possible for the location under evaluation and is larger than the regional maximum flood. DOE used the probable maximum flood values to predict the areal extent of flooding in the area of the repository and to determine if facilities and operations at the repository could be at risk for flood damage.

During March 1995 and February 1998, Fortymile Wash and the Amargosa River flowed simultaneously through their primary channels to Death Valley. The 1995 event represented the first documented case of this flow condition. During the 1995 event, the peak flow near the location where the existing Yucca Mountain access road crosses Fortymile Wash was reported as approximately 100 cubic meters per second (3,500 cubic feet per second) (DIRS 182755-Parsons Brinckerhoff 2005, p. 18). The 1995 event was brought about by relatively short-term precipitation events at higher altitudes near Yucca Mountain; the 1998 flood was characterized by sustained regional precipitation over several days (DIRS 159895-Tanko and Glancy 2001, p. 3). One construction camp would be located along common segment 6; however, it would not intersect floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to common segment 6.

No wetlands were identified along common segment 6.

**Table F-10.** Estimated peak discharge along washes at the Yucca Mountain Repository.[a]

| Name | Drainage area, square kilometers (square miles) | Peak discharge 100-yr flood, cubic meters per second (cubic feet per second) | Peak discharge 500-yr flood, cubic meters per second (cubic feet per second) | Regional maximum flood, cubic meters per second (cubic feet per second) |
|---|---|---|---|---|
| Fortymile Wash | 810 | 340 | 1,600 | 15,000 |
| | (310) | (12,000) | (56,800) | (530,000) |
| Busted Butte Wash | 17 | 40 | 180 | 1,200 |
| | (6.6) | (1,400) | (6,400) | (42,000) |
| Drill Hole Wash | 40 | 65 | 280 | 2,400 |
| | (15) | (2300) | (9,900) | (85,000) |
| Yucca Wash | 43 | 68 | 310 | 2,600 |
| | (17) | (2,400) | (11,000) | (92,000) |

a. Source: DIRS 155970-DOE 2002, Table 3-9.

## F.3.3 SEGMENT-SPECIFIC IMPACTS FOR THE MINA RAIL ALIGNMENT

### F.3.3.1 Interface with the Union Pacific Railroad Hazen Branchline (Hazen to Wabuska)

DOE would not perform any construction activities along this portion of the Mina rail alignment. Therefore, there would be no impacts to floodplains or wetlands along the existing Union Pacific Railroad Hazen Branchline.

### F.3.3.2 Department of Defense Branchline North (Wabuska to the boundary of the Walker River Paiute Reservation)

DOE would not perform any construction activities along this portion of the Mina rail alignment. Therefore, there would be no impacts to floodplains or wetlands along the existing Department of Defense Branchline North (see Figure F-16).

### F.3.3.3 Department of Defense Branchline through Schurz

DOE would not perform any new construction activities along this portion of the Mina rail alignment. Therefore, there would be no impacts to floodplains or wetlands along the existing Department of Defense Branchline through Schurz (see Figure F-16).

### F.3.3.4 Schurz Alternative Segments

As shown in Figure F-2, FEMA flood maps do not cover any of the Schurz alternative segments. However, it is reasonable to assume that the floodplain mapped for the very southern portion of Walker Lake extends upstream to where the Schurz alternative segments would cross over the Walker River. Because the alternative segments would follow valley floors, utilize mountain gaps, and cross unnamed ephemeral playas, it is feasible that floodplains could exist in low-lying areas along the alternative segments. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to the Schurz alternative segments.

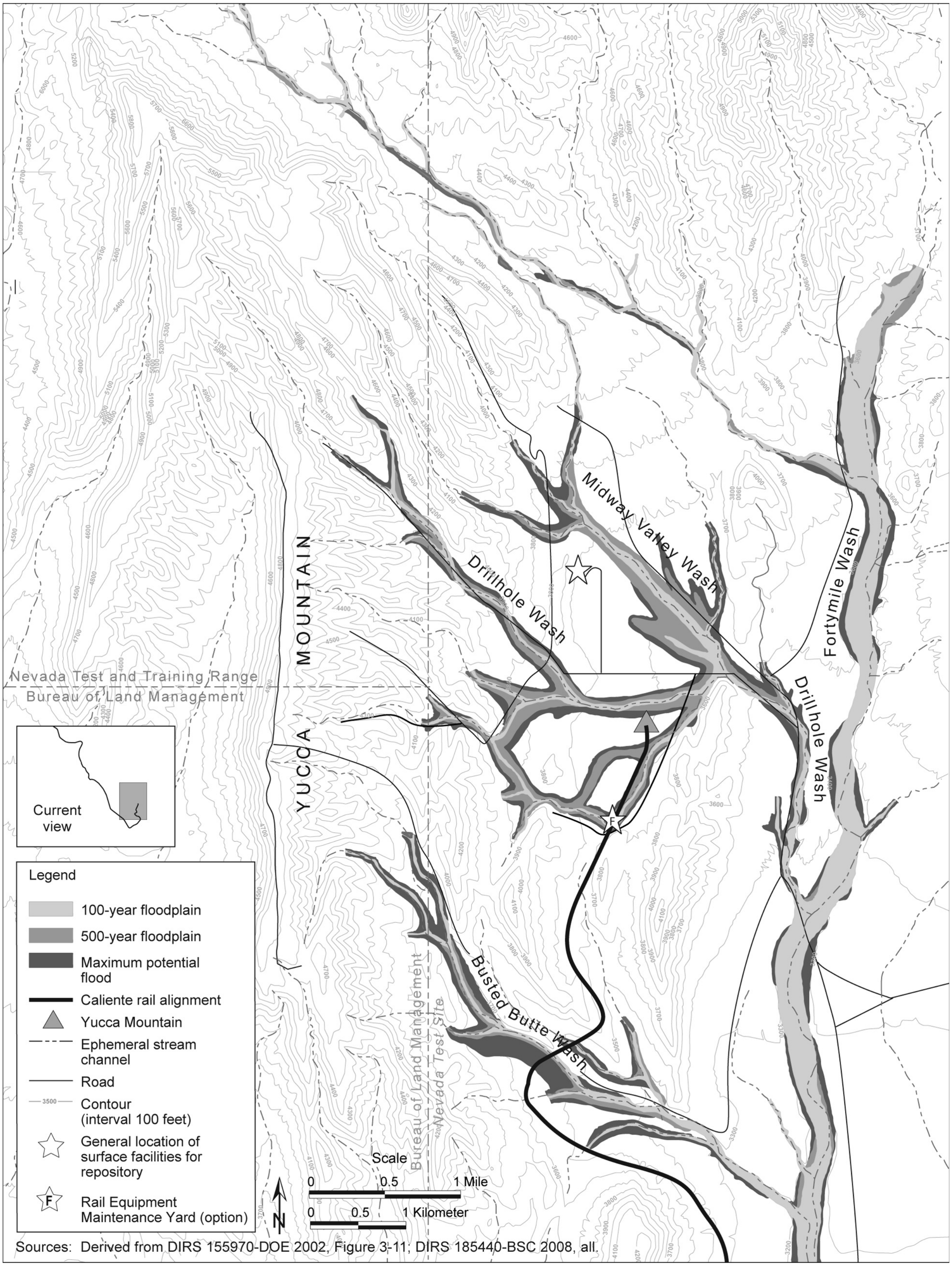


**Figure F-15.** DOE floodplain map for repository area.

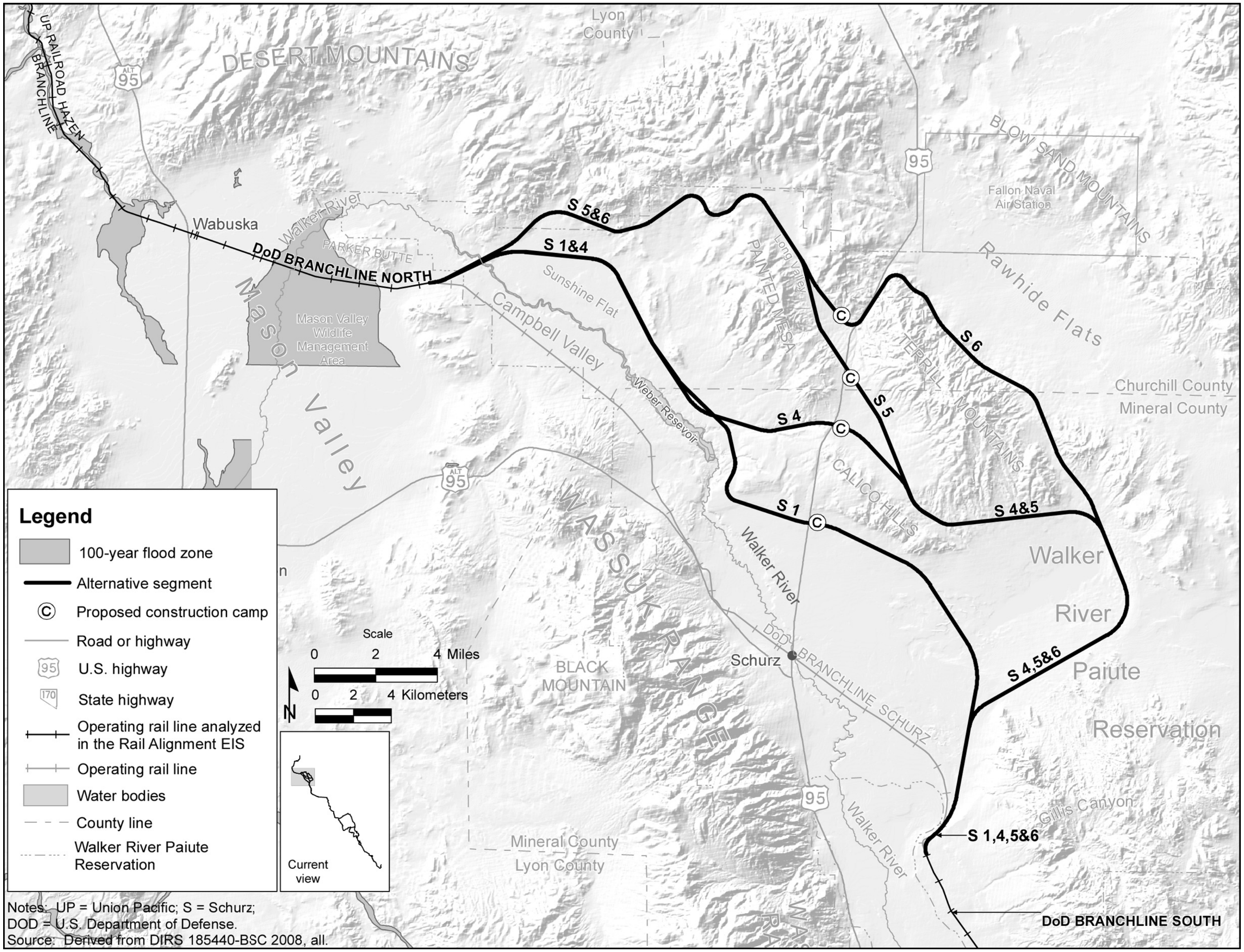


**Figure F-16.** FEMA floodplain map for map area 1 of the Mina rail alignment.

A survey for wetlands along the Mina rail alignment conducted by DOE in support of the Rail Alignment EIS identified emergent wetlands (WRN-1, WRN-2, WRN-3, and WRN-4) that would be crossed by the Schurz alternative segments (see Figure F-17). The total surface area for these wetlands is 0.065 square kilometer (16 acres). Emergent and scrub-shrub wetlands continue north and south beyond the region of influence. DOE classified these wetlands as assessment unit 7 in the functional assessment completed in February 2008. Assessment unit 7 includes the only wetland areas that would be permanently impacted by the Mina Implementing Alternative. This assessment unit is located along the banks of the Walker River in the northwestern portion of the Mina rail alignment. The wetlands are classified as riverine flow-through under the hydrogeomorphic framework, with primary hydrological influence associated with seasonal surface water, including bank overflow, and alluvial groundwater from the Walker River (DIRS 185340-URS 2008, all).

The hydrology of these wetlands is highly influenced by the Walker River hydrologic system, the flow of which is controlled to support irrigation of fields upstream of the wetlands. As such, flooding does not necessarily occur on the basis of natural seasonal cycles, but as a result of flow releases from upstream impoundments in high snowpack years in the Sierra Nevada. Off-channel wetlands within this assessment unit (WRN-3 and WRN-4) (see Figure F-17) would have even greater hydrologic variability than wetlands WRN-1 and WRN-2, which fringe the active channel of the Walker River. The off-channel wetlands are connected by topography and/or drainage channels (DIRS 180889-PBS&J 2007, Table 5) to the channel-fringing wetlands, resulting in a more complex habitat and hydrologic setting due to two subtypes of wetland landform setting.

This riverine flow-through wetland has a unique hydrogeomorphic character. The dynamic floodplain of the Walker River within which assessment unit 7 occurs tends to modulate the functions that are more dependent on stability and development of soil/substrate characteristics (see Table F-11). Habitat support-related functions scored between 0.4 and 0.6, which was supported by a variety of biotic and physical habitat features such as lack of nearby busy roads and complex water/vegetation interspersion.

A unique feature of assessment unit 7 is the seasonally flooded, off-channel wetland habitat. This type of habitat, landform, and hydrologic feature served to increase the score of several function capacities that lacking off-channel wetlands would have scored lower. Availability of seasonally flooded wetland areas outside of the main channel of the Walker River provides a suite of functional attributes including water storage, nutrient transformation, primary production, invertebrate, and resident fish habitat support (DIRS 185340-URS 2008, all).

DOE would minimize impacts by constructing a bridge over the Walker River and its associated wetlands. The double-cell bridge would be about 300 meters (1,000 feet) long with 12-meter (40-foot) pier spacing. The only permanent fill will be the concrete pilings required to support the bridge piers. Using these methods, the only permanent fill or loss of wetlands would be a total of about 20 square meters (0.005 acre) for emplacement of about 10 piers in wetlands for Schurz alternative segments 1 and 4, or 28 square meters (0.007 acre) for emplacement of about 14 piers for Schurz alternative segments 5 and 6. By maximizing avoidance in this way, DOE would avoid filling of wetlands to the maximum extent practicable.

Placement of piers and construction of the bridge in the active stream would occur during low flow (generally September through April). To provide access for cranes and other heavy equipment to the stream channel, which is about 12 meters (40 feet) wide in this area, heavy mats made of wood or other solid material would be sunk into the stream. There would be sufficient gaps between the mats to allow flow of water. No sand, gravel, or other loose fill would be placed in the stream channel. The mats would be removed from the channel after the bridge pilings are driven into ground and the concrete bridge sections are erected over the channel. DOE would also implement best management practices such

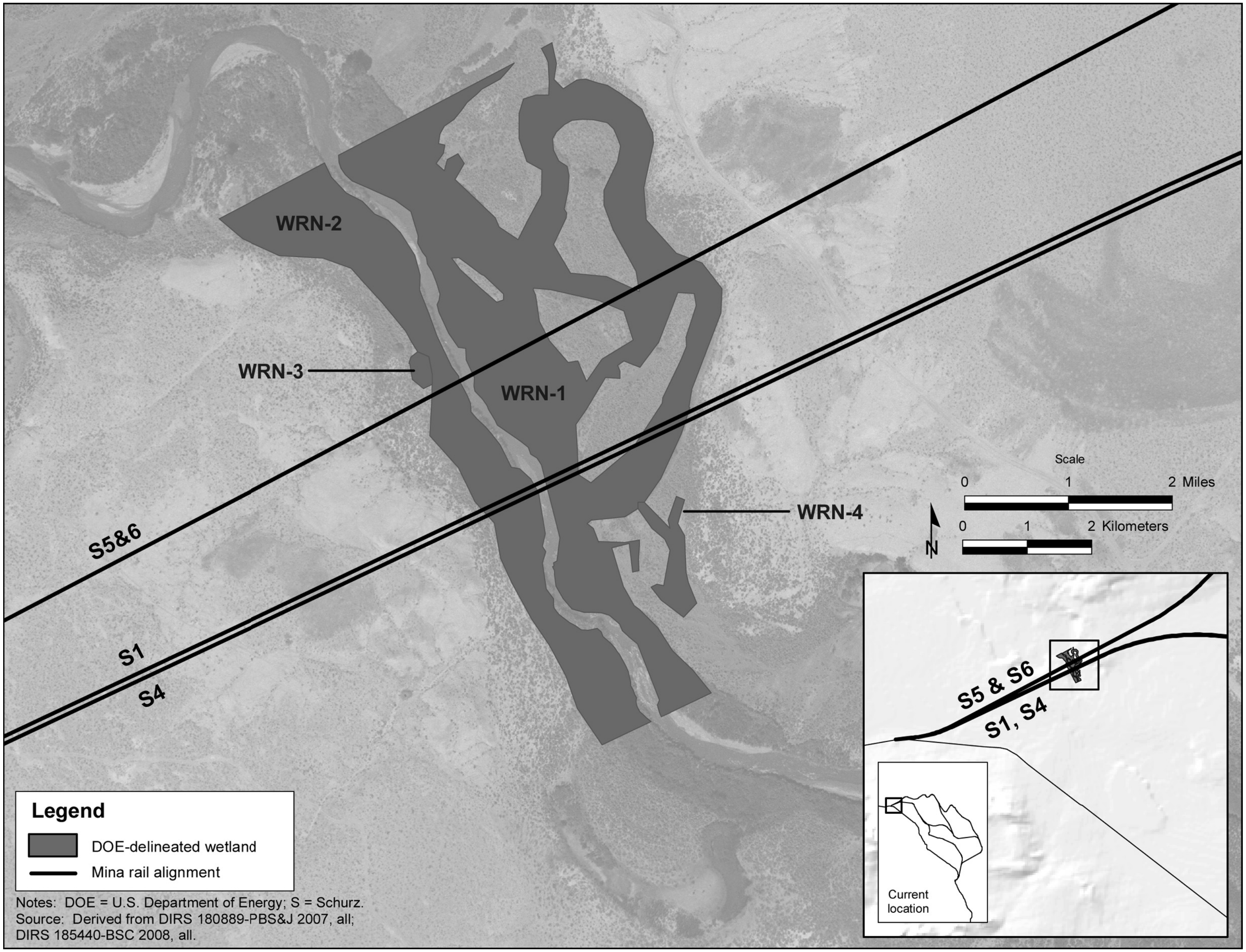


**Figure F-17.** Wetlands along Walker River (shows WRN-1 through WRN-4).

**Table F-11.** Functional assessment scoring – Schurz alternative segments.[a]

| Assessment unit | Wetlands within assessment unit | Wetland function sources[b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Water storage and delay | Sediment stabilization and phosphorus retention | Nitrogen removal | Primary production | Thermoregulation | Resident fish habitat support | Invertebrate habitat support | Amphibian and turtle habitat support | Breeding waterbird support | Wintering and migratory waterbird support | Songbird habitat support | Support of characteristic vegetation |
| AU-7 | WRN-1, WRN-2, WRN-3, WRN-4 | 0.2 | 0.3 | 0.3 | 0.4 | 0.2 | 0.4 | 0.4 | 0.5 | 0.4 | 0.5 | 0.6 | 0.6 |

a. Source: DIRS 185340-URS 2008, all.
b. Scores were based on a scale of 0.0 to 1.0 with the score of 0.0 indicating minimal capacity and 1.0 indicating highest capacity. For the functional assessment conducted by DOE, function scores between 0.1 and 0.3 are considered low, scores between 0.4 and 0.6 are moderate, and 0.7 to 1.0 are high.

as constructing sediment ponds and installing hay bales or silt fences, which would minimize potential impacts during construction.

Primary impacts to existing wetland functions associated with potential minor wetland fill in these wetlands include both short-term and long-term minor reduction in wetland habitat support, including resident fish, invertebrate, and songbird. Wildlife utilizing wetlands in the proposed disturbance areas would be temporarily displaced, but would continue to use the undisturbed adjacent areas; therefore, impacts to the wetlands in this area from the construction of the rail alignment are expected to be small. Wetland impacts are summarized in Table F-12.

**Table F-12.** Summary of impacts to wetlands – Mina rail alignment.

| Construction activity | Direct impacts to assessment units (acres)[a] | Potential indirect impacts | Primary wetland functions affected |
|---|---|---|---|
| Roadbed construction | AU-7 (0.007) | *Long-term impacts:*<br>• Potential minor impact to sediment stabilization, which new bridge/hydraulic design of bridge would mitigate. | *Short- and long-term impacts:*<br>• AU-7 (RFT)[b] – none to very minor direct bridge construction impacts (for example, pier placement); minor impact to habitat functions such as fish, invertebrate, and songbird support |

a. To convert acres to square kilometers, multiply by 0.0040469.
b. RFT = riverine flow-through hydrogeomorphic wetland class.

There are no practicable design or construction options that would allow DOE to completely avoid impacting wetlands along the Mina rail alignment. The Department of Defense Branchline is south of the Walker River west of the town of Schurz. All Schurz alternative segments must connect to that branchline west of Schurz and cross the river to avoid the town and proceed to the east of Walker Lake. The wetlands along this reach of the Walker River are too wide to be completely spanned and bridge piers therefore must be placed in the wetlands.

DOE would minimize impacts by constructing a bridge over the Walker River and its associated wetlands. Of the 0.065 square kilometer (16 acres) crossed in this area, only 28 square meters (300 square feet) would be permanently filled to facilitate the construction of the bridge. By maximizing avoidance in this way, DOE would minimize permanent impacts to the maximum extent practicable. DOE would also implement best management practices such as constructing sediment ponds and installing hay bales or silt fences, which would minimize potential impacts during construction. Wildlife utilizing wetlands in the proposed disturbance areas would be temporarily displaced, but would continue to use the undisturbed adjacent areas; therefore, impacts to the wetlands in this area from the construction of the rail alignment are expected to be small (see Table F-12).

### F.3.3.5 Department of Defense Branchline South (Hawthorne to Mina Common Segment 1)

Although Department of Defense Branchline South represents an existing railway, DOE would develop construction camp 17 on the southern portion of this rail alignment. The construction camp would not overlie any floodplains or wetlands. Aside from construction of this camp, DOE does not anticipate any other surface disturbances along this portion of the Mina rail alignment (see Figure F-18).

### F.3.3.6 Mina Common Segment 1 (Gillis Canyon to Blair Junction)

FEMA flood maps do not cover any part of Mina common segment 1. Because the proposed segment would follow valley floors, cross unnamed ephemeral washes and playas, or utilize mountain gaps, it is feasible that a floodplain could exist in low-lying areas along the common segment, especially in low-lying areas receiving seasonal water from ephemeral washes. The Staging Yard at Hawthorne, four construction camps, and two potential quarry sites would be located along common segment 1; however, none of these facilities intersect with floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to Mina common segment 1.

No wetlands were identified along Mina common segment 1. Although the National Wetlands Inventory dataset indicates Mina common segment 1 would cross through wetlands within Soda Springs Valley, field investigations conducted by DOE in support of the Rail Alignment EIS determined that surface water shown by the NWI dataset are absent from the region of influence (DIRS 180889-PBS&J 2007, Figures 5A and 5B, Photos 16 to 22). These areas are mostly unvegetated, barren landscapes that are more representative of ephemeral playas. A review of existing data indicates that areas shown as NWI wetlands actually correspond to unnamed ephemeral playas as identified by the National Hydrologic Dataset.

### F.3.3.7 Montezuma Alternative Segments

FEMA flood maps only cover a small portion of the Montezuma alternative segments, near their southern termination. Because the proposed alternative segments would follow valley floors, cross unnamed ephemeral washes and playas, or utilize mountain gaps, it is feasible that a floodplain could exist in low-lying areas along the alternative segments, especially in low-lying areas receiving seasonal water from ephemeral washes. As shown in Figure F-19, Montezuma alternative segment 2 would cross approximately 2 kilometers (1.2 miles) of floodplains associated with a drainage in Lida Valley and the Stonewall Flat playa. Two alternative locations for the Maintenance-of-Way Facility (Klondike option and Silver Peak option) would also be located along the alternative segments, as well as four proposed construction camp sites and three quarry sites. None of these facilities would intersect floodplains or wetlands. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to the Montezuma alternative segments.

No wetlands were identified along the Montezuma alternative segments. For Montezuma alternative segment 1, the National Wetland Inventory dataset identifies an unnamed pond near the Town of Silver Peak as wetlands; however, DOE field studies in support of the Rail Alignment EIS determined there are

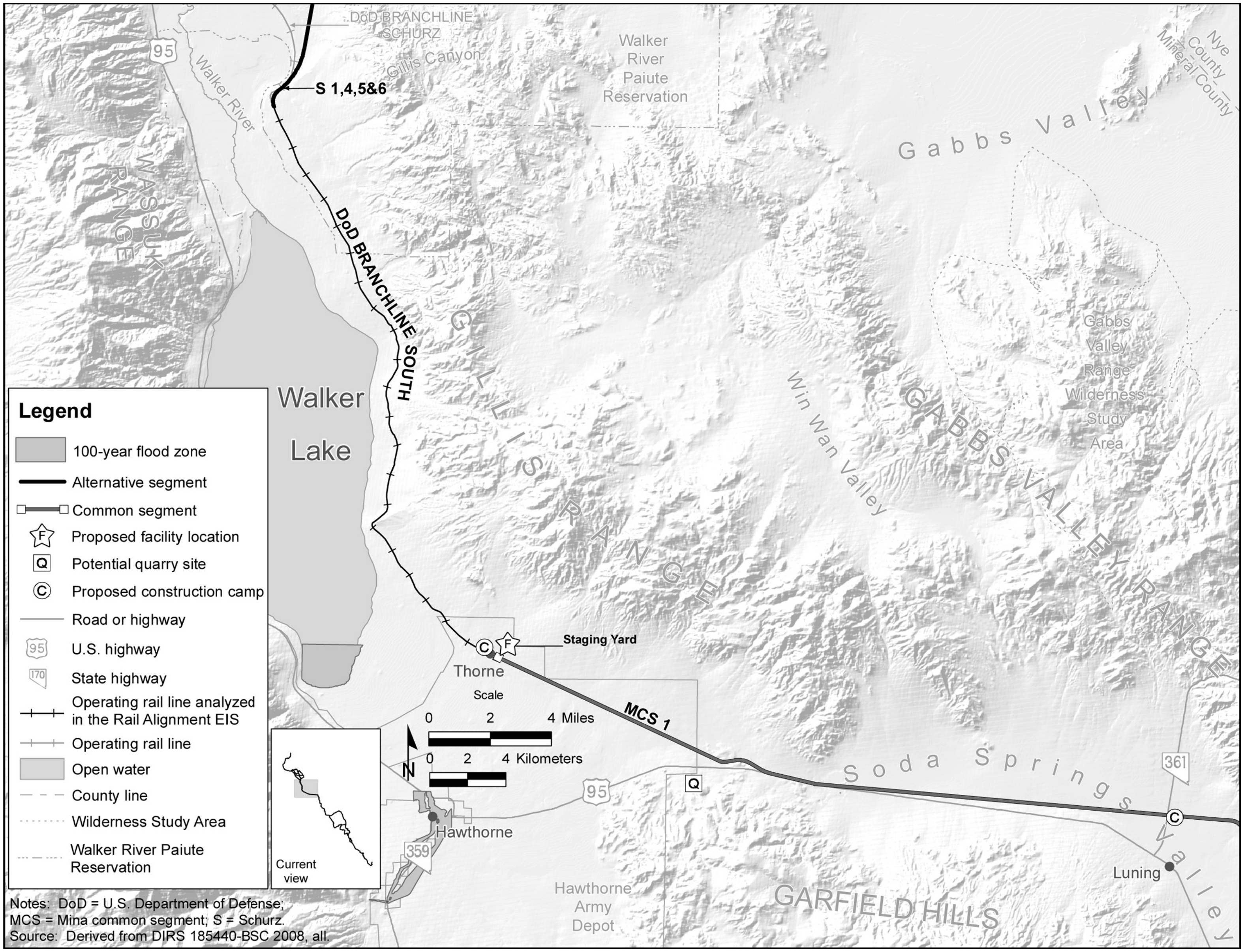


**Figure F-18.** FEMA floodplain map for map area 2 of the Mina rail alignment.

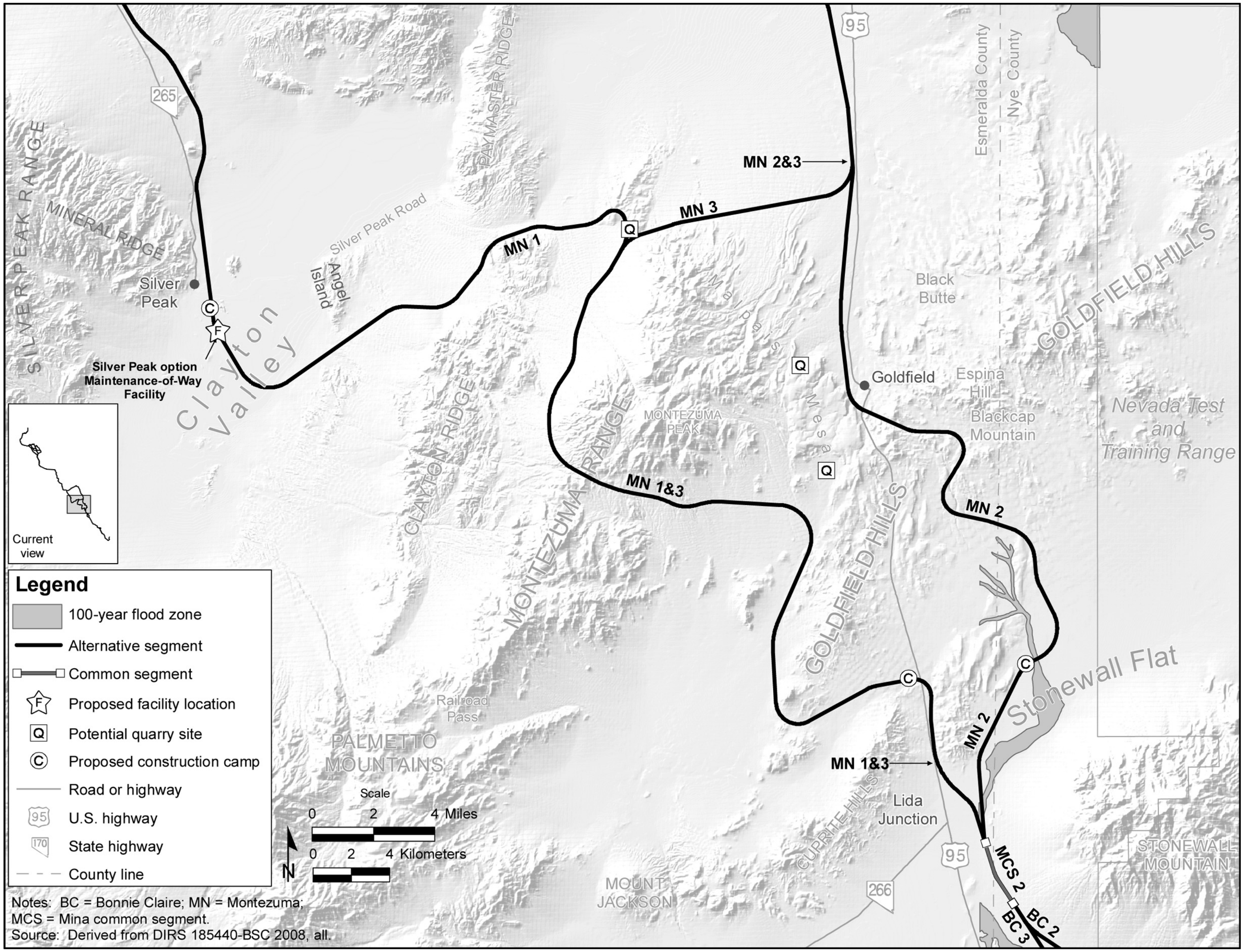


**Figure F-19.** FEMA floodplain map for map area 5 of the Mina rail alignment.

no wetlands in this area. For Montezuma alternative segments 2 and 3, the National Wetland Inventory dataset classifies the large playas in Big Smoky Valley and Stonewall Flat as wetlands; however, DOE field studies in support of the Rail Alignment EIS confirmed no wetlands exist within the region of influence (DIRS 180889-PBS&J 2007, Figure 5C, Photos 23 and 24).

### F.3.3.8 Mina Common Segment 2

As shown in Figure F-19, FEMA flood maps provide coverage for the entire length of Mina common segment 2; however, no floodplains are crossed by the segment. Because the proposed segment would follow valley floors, cross unnamed ephemeral washes and playas, or utilize mountain gaps, it is feasible that a floodplain could exist in low-lying areas along common segment 2, especially in low-lying areas receiving seasonal water from ephemeral washes. Section F.3.1 addresses common impacts to floodplains that would be crossed by and adjacent to Mina common segment 2.

No wetlands were identified along Mina common segment 2.

### F.3.3.9 Bonnie Claire Alternative Segments

Refer to Section F.3.2.9.

### F.3.3.10 Common Segment 5

Refer to Section F.3.2.10.

### F.3.3.11 Oasis Valley Alternative Segments

Refer to Section F.3.2.11.

### F.3.3.12 Common Segment 6

Refer to Section F.3.2.12.

## F.4 Alternatives

In accordance with 10 CFR 1022.13(a)(3), DOE must consider alternatives to the Proposed Action that would avoid adverse impacts and incompatible development in the floodplain or wetland, including alternative sites, alternative actions, and no action. Further, DOE must evaluate measures that mitigate the adverse impacts of actions in a floodplain or wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas.

As shown in Figure F-20, the Proposed Action includes two implementing alternatives, each with a ***Shared-Use Option***.

Under the Proposed Action Caliente Implementing Alternative, DOE would determine a rail alignment within the Caliente rail corridor and would construct and operate a railroad for the shipment of spent nuclear fuel, high-level radioactive waste, and other materials within Nevada. The proposed railroad would run from a site in or near the City of Caliente, Lincoln County, Nevada, to a geologic repository at Yucca Mountain, Nye County, Nevada. The Caliente Implementing Alternative is the DOE preferred alternative.

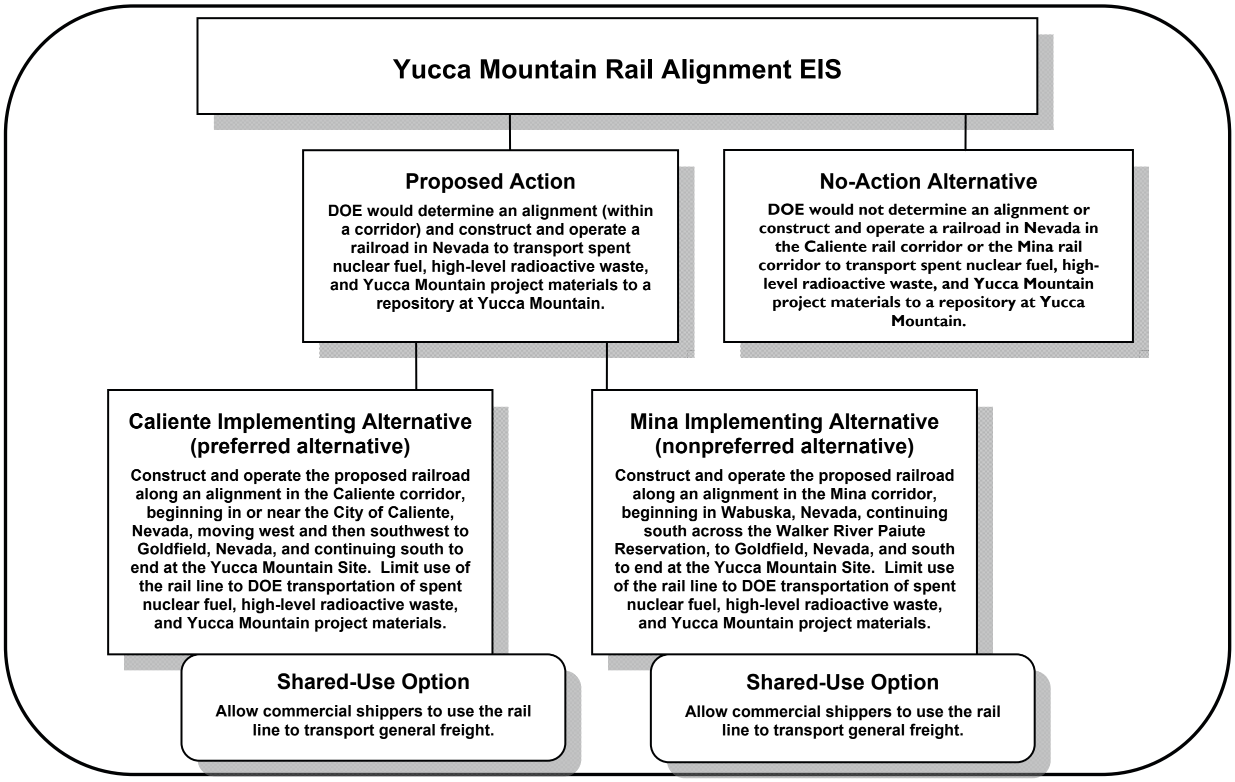


**Figure F-20.** Alternatives analyzed in the Rail Alignment EIS.

Under the Proposed Action Mina Implementing Alternative, DOE would determine a rail alignment within the Mina rail corridor and would construct and operate a railroad for the shipment of spent nuclear fuel, high-level radioactive waste, and other materials within Nevada. The proposed railroad would run from Wabuska, Lyon County, Nevada, to a geologic repository at Yucca Mountain, Nye County, Nevada. The Mina Implementing Alternative is the DOE nonpreferred alternative.

Along each of the rail alignments, DOE considered a range of alternative segments and a series of common segments, and eliminated some of the alternative segments from detailed analysis. Appendix C, Evolution of Alternative Segments and Common Segments, describes the elimination process.

Under either Proposed Action implementing alternative, the Shared-Use Option would allow commercial shippers to use the rail line. Under the Shared-Use Option, other organizations could construct commercial sidings and additional facilities that would allow commercial commodities (such as nonmetallic minerals or stone) to be transported on the rail line.

Under the ***No-Action Alternative***, DOE would not determine a rail alignment or construct and operate the proposed railroad within the Caliente rail corridor or the Mina rail corridor. As such, the No-Action Alternative provides a basis for comparison with the Proposed Action.

## F.4.1 PROPOSED ACTION

### F.4.1.1 Alternative Evaluations under the Proposed Action

Appendix C describes the process DOE used to evaluate and determine the reasonable range of alternative segments for the Caliente and Mina rail alignments considered in the Rail Alignment EIS, and the results of that process.

### F.4.1.2 Preferred Alignment

Council on Environmental Quality National Environmental Policy Act (NEPA) implementing regulations require an agency to identify its preferred alternative, if one or more exists (40 CFR 1502.14[e]). For the Rail Alignment EIS, the DOE preferred alternative is to construct and operate a railroad along the Caliente rail alignment and to implement the Shared-Use Option. DOE identified preferred alternative segments (Figure F-21) within the Caliente rail alignment based on an analysis of environmental impacts, engineering and cost factors, and regulatory compliance issues, including permit requirements and challenges, stakeholder preference, land-use conflicts, and uncertainties (see Table 2-30 of the Rail Alignment EIS).

The regulations that implement Section 404(b)(1) of the Clean Water Act (40 CFR Part 230) require a demonstration of the need to fill wetlands and other waters of the United States and a comparison among alternatives of the impacts to aquatic resources, so that the practicable alternative with the least impact to aquatic resources is selected. In addition, Executive Order 11990, *Protection of Wetlands*, requires federal agencies to avoid undertaking or providing assistance for new construction located in wetlands unless there is no practicable alternative to such construction and the proposed action includes all practicable measures to minimize harm to wetlands resulting from the proposed action.

The Mina Implementing Alternative would be environmentally preferable when compared to the Caliente Implementing Alternative. In general, the Mina Implementing Alternative would have fewer private-land conflicts, less surface disturbance, smaller wetlands impacts, and smaller air quality impacts than the Caliente Implementing Alternative. However, the Mina Implementing Alternative remains the nonpreferred alternative due to the objection of the Walker River Paiute Tribe to the transportation of spent nuclear fuel and high-level radioactive waste through its Reservation. DOE considered variations of the Mina rail corridor that would avoid the Walker River Paiute Reservation (DIRS 104792-YMP 1990, p. 17; DIRS 104795-CRWMS M&O 1995, p. 26), but excessive length of the route, land-use conflicts, and rugged terrain resulted in DOE eliminating this option from further study (DIRS 155970-DOE 2002, Section 2.3.3.1). Avoiding the Reservation would require the addition of 209.2 to 257.5 kilometers (130 to 160 miles) of track (to the approximately 321.9 kilometers [200 miles] of the Mina corridor) to avoid private lands and military installations and negotiate the terrain surrounding the Reservation. The route would have to pass between U.S. Navy bombing ranges, which the Navy plans to expand, and cross the rugged terrain of the Monte Cristo Mountains or the Gabbs Valley Range.

For the Caliente Implementing Alternative, the only wetlands that could be directly or indirectly affected for construction and operation of the Caliente rail alignment are along the beginning-of-line alternative segments; therefore, the following discussion focuses on that portion of the alignment. See Section 4.2.5.2.1.4 for a description of impacts to ephemeral streams that may be regulated under Section 404 of the Clean Water Act.

Section 2.4 of the Rail Alignment EIS describes the preferred alignment identified by the Department. A preference has been identified for the Caliente alternative segment and associated facility locations in part to minimize impacts to wetlands and other aquatic resources. One reason the Caliente alternative segment

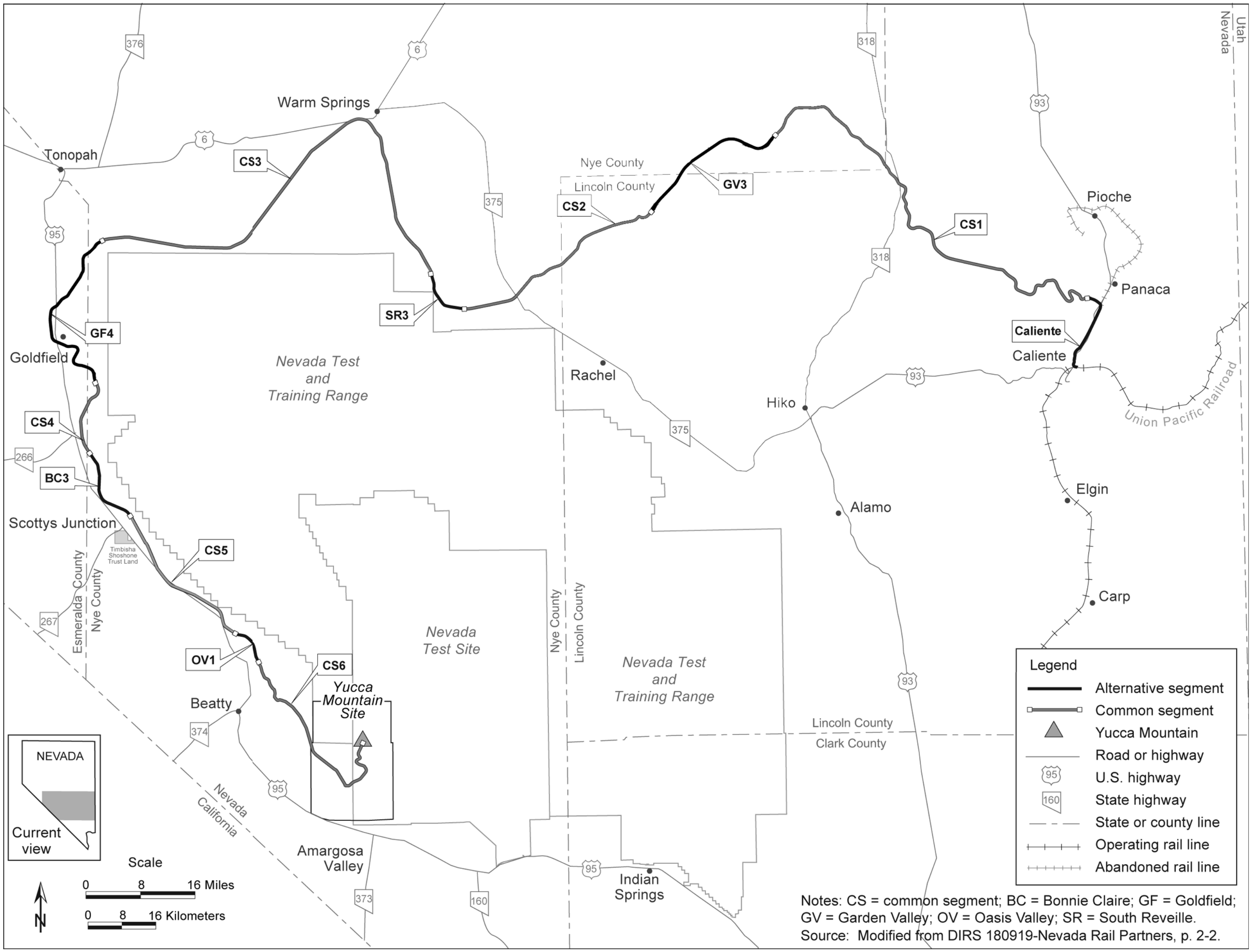


**Figure F-21.** Preferred Caliente rail alignment, combination of common segments and alternative segments.

was identified as preferred, rather than the Eccles alternative segment, was that construction of the Eccles Interchange Yard would require placing approximately 0.033 to 0.043 square kilometers (8 to 11 acres) of fill along about 2.9 kilometers (1.8 miles) of the south bank of Clover Creek (Section F.3.2.1.2). Additional fill would also be required if dikes must be placed in Clover Creek to direct the flow of water and maintain the track embankment. Channelizing the creek bank and filling of the creek bed would result in direct impacts to Clover Creek and its associated floodplain. It would also impact riparian restoration efforts in Clover Creek required by the Environmental Protection Agency. Indirect impacts would occur to the riparian areas and other aquatic resources downstream of the proposed Interchange Yard. The riparian areas that could be affected are within an Area of Critical Environmental Concern proposed by the BLM for protection of habitat for federally endangered, threatened, and candidate species such as the southwestern willow flycatcher (DIRS 185340-URS 2008, p. 21). The Eccles alternative segment also was not identified as preferred because operation of the railroad at that location is much less practicable than along the Caliente alternative segment because of the slope of the Eccles Interchange Yard, slope of the main track leaving the yard, lack of a wye track, and lack of a local source of ballast (see Section 2.4 of the Rail Alignment EIS).

Other beginning-of-line options for the Caliente rail corridor were examined to determine whether a practicable alternative exists that would not require filling of wetlands or otherwise impact aquatic resources in Meadow Valley Wash or Clover Creek. As described in Section C.4.1.1 of Appendix C, DOE considered but eliminated from detailed analysis two alternative segments, Crestline and Elgin, for the Interface with the Union Pacific Railroad Mainline (see Table C-3 of Appendix C). The required engineering criteria could not be met along the Crestline alternative because of rugged terrain and insufficient flat land for a rail yard and associated facilities at the Interface with the Union Pacific Railroad Mainline. The Eglin alternative was eliminated because it would exceed maximum allowable grade. An additional alternative segment, Garden Valley 6, was considered that would have tied into the Union Pacific Railroad Mainline at Caliente and extended west through the Delamar Mountains, avoiding Meadow Valley. That alternative was eliminated because it would have required extensive tunneling near Caliente and in the three mountain passes to the west (Table C-5 in Appendix C).

The Department also examined other locations in eastern Nevada to interface with the Union Pacific Railroad Mainline, such as existing sidings between the Utah border and Caliente, but could not find a practicable location with sufficient flat terrain to construct an interchange yard or an associated alignment that would not exceed the maximum allowable grade or other design requirements. The Union Pacific Railroad Mainline from the Utah border to Caliente generally follows Sheep Springs Draw and Clover Creek through the Chief Range. Any alignment in that area would have to exit the slopes of those drainages, which are steep in most locations, and traverse the rugged terrain of the Chief Range. Any alignment connecting to the Union Pacific Railroad Mainline south of Caliente would require construction of an interchange yard, and possibly a staging yard, in Meadow Valley Wash and would have to exit through the steep slopes of Rainbow Canyon.

Based on this analysis, DOE has concluded that the Caliente alternative segment is the practicable beginning-of-line alternative with the least adverse impacts to aquatic ecosystems. Construction of the rail roadbed for that alternative would result in the permanent filling of some wetlands in and near the Indian Cove area and southern Meadow Valley just north of the City of Caliente. There is no practicable alternative location for that alignment that would completely avoid those wetlands. Indian Cove and extreme southern Meadow Valley are narrow; surrounded by steep, impassible terrain; and almost entirely covered with wetlands and riparian habitat in some areas. Thus, any rail line extending north from Caliente into Meadow Valley would be restricted to the valley bottom adjacent to or near Meadow Valley Wash and U.S. Highway 93 and would have to cross some wetlands.

To avoid impacting wetlands during construction of facilities along the Caliente alternative segment, DOE has stated a preference for the Upland Staging Yard and has identified a new location for a ballast quarry siding that is just south of Beaver Dam Road. Construction of the Upland Staging Yard would not require filling of any wetlands, and would avoid filling about 0.18 square kilometer (44 acres) of wetlands for the Staging Yard at Indian Cove. The ballast quarry siding selected would require permanently filling about 0.0064 square kilometer (1.6 acres) of wetlands, much less than the 0.09 square kilometer (22 acres) needed for the original quarry siding location considered in the Draft Rail Alignment EIS. There is no practicable alternative quarry siding location close enough to the source of ballast that would result in lesser impacts to wetlands, avoid interference with the operation of the Upland Staging Yard, or avoid blocking access to Beaver Dam Road (Section F.3.2.1.1.2.5).

To further minimize loss of wetlands, DOE has identified the following design and construction alternatives that would minimize the amount of wetlands permanently filled to construct the Caliente alternative segment (Section F.3.2.1.1).

- Construct the rail line on the abandoned Union Pacific Railroad roadbed.
- Design bridges to span wetlands adjacent to washes that are crossed.
- Avoid wetlands in the bottom of incised washes adjacent to the roadbed by shifting the roadbed away from the edge of the washes.
- Construct the rail roadbed with a 2:1 slope.
- Do not construct a service road adjacent to the track through wetlands.

Implementing these design alternatives would reduce the amount of wetlands permanently filled from a total of about 0.096 square kilometer (23.8 acres) within the construction right-of-way to 0.029 square kilometer (7.1 acres) for construction of the rail roadbed. The total amount of wetlands that would be permanently filled to construct the Caliente alternative segment, including the quarry siding, would be about 0.035 square kilometer (8.7 acres), 0.034 square kilometer (8.5 acres) of which probably are regulated pursuant to Section 404 of the Clean Water Act. Table F-7 provides the amount of wetlands and stream crossings DOE identified as waters of the United States requiring fill along the Caliente alternative segment for both the Upland and Indian Cove Staging Yard options. For purposes of comparison, wetlands and stream crossings identified as waters of the United States requiring fill along the Eccles alternative segment are also provided in Table F-7.

DOE evaluated using vertical retaining walls and extensive bridging to further decrease the footprint of the rail roadbed and reduce the amount of wetlands filled in the Indian Cove area and southern Meadow Valley Wash. It was determined that those methods would not be practicable (see Section F.3.2.1.1).

By identifying the Caliente alternative segment and the associated Upland Staging Yard as preferred alternatives, and committing to design and construction methods that minimize impacts to wetlands, DOE has identified the practicable beginning-of-line alternative that has the minimum adverse impact on the aquatic ecosystem and has taken available steps to avoid and minimize the loss of wetlands. Section F.4.4 describes the best management practices and mitigation measures that would be implemented to minimize impacts from filling of wetlands that cannot be avoided. That section also describes the best management practices and conceptual mitigation measures that would be implemented along the preferred alignment to reduce the risk of flood damage; minimize the impacts of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

### F.4.2 SHARED-USE OPTION

The Shared-Use Option would involve the use of the DOE rail line for general freight such as mineral resources or oil that could be shipped by private companies. Construction-related impacts to floodplains and wetlands would be similar to those identified for the Proposed Action without shared use.

### F.4.3 NO-ACTION ALTERNATIVE

Council on Environmental Quality regulations (40 CFR 1502.14) require that the alternatives analysis in an EIS include the alternative of no action. Under the No-Action Alternative in the Rail Alignment EIS, DOE would not select a rail alignment within the Caliente or Mina rail corridors for the construction and operation of a railroad. As such, the No-Action Alternative provides a basis for comparison with the Proposed Action.

In the event that DOE were not to select a rail alignment in the Caliente or Mina rail corridors, the future course that it would pursue to meet its obligations under the Nuclear Waste Policy Act (NWPA) is uncertain. DOE recognizes that other possibilities could be pursued, including identifying and evaluating alignments in other corridors considered in the Yucca Mountain FEIS (DIRS 155970-DOE 2002, Chapter 6).

DOE would relinquish the public lands withdrawn from surface and mineral entry for purposes of evaluating the lands for the potential construction, operation, and maintenance of a railroad (70 *Federal Register* [*FR*] 76854, December 28, 2005). These lands would then become available for other uses as determined by the BLM once it amended or revoked the withdrawal.

### F.4.4 MITIGATION MEASURES

In accordance with 10 CFR 1022.13(a)(3), DOE must address measures to mitigate the adverse impacts of actions in a floodplain or wetlands, including but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas. Whenever possible, DOE would avoid disturbing floodplains and wetlands and would minimize impacts to the extent practicable, if avoidance was not possible. This section discusses the floodplain and wetland mitigation measures that would be considered in the vicinity of the proposed rail alignment and, where necessary and feasible, implemented during railroad construction, operations, and maintenance. In general, DOE would minimize impacts to floodplains and wetlands through the implementation of engineering design standards and best management practices.

DOE has identified several measures to help avoid, minimize, or mitigate potential adverse impacts to floodplains and wetlands under the Proposed Action and Shared-Use Option. DOE has designed the rail alignment segments to avoid direct and indirect impacts to water resources wherever practicable. Due to the nature of rail line design and the construction activities that would be required to implement the design, the rail line cannot avoid crossing floodplains or wetlands. The engineering design process would ensure that the engineered structures used to pass water runoff from one side of the rail line to the other would do so in a way that would minimize impacts to floodplains and wetlands. Such impacts would be limited mostly to the construction phase and would be subject to Clean Water Act regulations. In most cases DOE would minimize adverse impacts through the implementation of best management practices in concert with the permits and plans regulatory agencies would require. DOE would also develop a compensatory mitigation and monitoring plan for unavoidable impacts as part of its compliance with Section 404 of the Clean Water Act in coordination with the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and applicable land-management agencies such as the BLM.

### F.4.4.1 Engineering Design Standards

Before any construction could begin, DOE would require pre-construction surveys to ensure that the work would minimize impacts to floodplains and wetlands. In addition, the site's reclamation potential would be determined during these surveys. If the surveys indicate that construction would threaten these resources, and modification or relocation of the proposed rail line and associated roads would not be reasonable, DOE would develop mitigation measures. DOE would incorporate mitigation measures developed during the pre-construction surveys into the final design of the proposed rail line and associated facilities.

DOE would minimize the disturbance of surface areas and vegetation and would maintain natural contours to the maximum extent feasible. DOE would establish reclamation guidelines for site clearance, topsoil salvage, erosion and runoff control, recontouring, revegetation, siting of roads, and construction practices (see Section 2.2.2.10). DOE would stabilize slopes to minimize erosion and would avoid unnecessary off-road vehicle travel.

Although DOE would generally design rail line features to accommodate 100-year flows, the final design process may also consider a range of flood frequencies and include a cost-benefit analysis in the selection of a design frequency in accordance with standard rail line design guidelines and practices (DIRS 106860-AREA 1997, Volume 1, Section 3.3.2.2.c). DOE would analyze crossings on a case-by-case basis and propose culverts whenever feasible (DIRS 182824-Nevada Rail Partners 2007, p. ii). In areas where drainage structures would cross a FEMA Flood Zone A (such as a 100-year flood zone), DOE would design the bridge to comply with FEMA standards and appropriate county regulations. The FEMA standards require that floodway surcharge (the difference between the 100-year-flood elevation and the actual flood surface elevation) would not cause more than a 0.3-meter (1-foot) rise at any location. The FEMA standards have been designed to limit floodwater impacts to structures built in or adjacent to the floodplain (DIRS 182824-Nevada Rail Partners 2007, p. ii). By adhering to these standards, DOE would substantially limit the potential for adverse impacts to the population and resources located adjacent to floodplains.

Where very wide and shallow depths of flow occur during the 100-year event, or the flow is divided into multiple natural channels that would cross the alignment, DOE would use a series of multiple culverts, potentially in concert with small bridges, to span the main flow channel where practicable. In locations where there are very high fill conditions, multiple culverts would be more practical and economical than constructing a bridge (DIRS 182824-Nevada Rail Partners 2007, p. ii). DOE would install culverts with riprap around the exposed ends and use other measures, as necessary, to protect the fill material from erosion. DOE would take similar actions as needed for bridges to protect the structures and to ensure disturbed areas are not subject to increased erosion.

### F.4.4.2 Best Management Practices

A National Pollutant Discharge Elimination System General Construction Permit would be required for construction activities. In accordance with this permit, construction contractors would be required to prepare and submit a Stormwater Pollution Prevention Plan. The Stormwater Pollution Prevention Plan would be prepared consistent with State of Nevada and federal standards for construction activities and would detail the best management practices DOE would employ to minimize soil loss and degradation to nearby water resources. DOE would base the design of the best management practices program on practices listed in the *Best Management Practices Handbook* developed by the Nevada Division of Environmental Protection and the Nevada Division of Conservation Districts (DIRS 176309-NDEP 1994, all) and the *Storm Water Quality Manuals Construction Site Best Management Practices Manual* developed by the Nevada Department of Transportation (DIRS 176307-NDOT 2004, all). Table F-13

**Table F-13.** Best management practices (page 1 of 2).

| Practice | Description |
|---|---|
| *Road and construction site practices* | |
| Development site plan | A site plan identifies the physical features of the site, the location of proposed development, and the location of temporary and/or permanent best management practices. By utilizing a development site plan, the proposed development can be situated to minimize impact to natural resources and the land, and to enable water-quality protection measures and runoff conveyance measures to be properly located. |
| Grading seasons and practices | The grading season is determined by the local climate conditions. All grading, clearing, and excavation work should be conducted during this period to avoid climatic conditions that could increase the chances for erosion. Grading and construction activities should be coordinated such that bare and disturbed soil exposure is minimized during the winter snow and rainy seasons. |
| *Erosion and sediment controls* | |
| Erosion and sediment control structures | Properly designed, installed, and maintained, erosion and sediment control structures will effectively reduce the transport of sediments, minimize erosion and the degradation of water resources, and reduce negative impacts to natural resources (vegetation and wildlife). |
| Runoff interceptor trench or swale | Properly designed, installed, and maintained, a runoff interceptor trench or swale will effectively convey surface runoff, minimize soil erosion resulting from surface runoff, and reduce the degradation of receiving water resources. |
| Siltation or filter berms | Siltation or filter berms capture and retain runoff from construction sites and allow sediments to settle out, and direct runoff water through filter berms at outlets to stabilized drainage ways. |
| Filter or silt fence | Filter or silt fences are constructed to intercept and capture sediment by decreasing the velocity of surface runoff. |
| Sediment basins | Sediment basins are effective in reducing water pollution by trapping sediment originating from construction sites and by providing basins for deposition and storage of silt, sand, gravel, stone, and other debris. |
| *Soil stabilization practices* | |
| Rock and gravel mulches | The application of gravel or crushed rock as a mulch is used to stabilize soils during construction activities for erosion control on a variety of surface disturbance areas. |
| Wood chip, straw, and black mulches | Wood chips, straw, and bark mulches are used as mulch to protect the soil surface from raindrop and irrigation impacts, and decrease runoff. |
| Jute and synthetic netting | The primary purpose of nettings is to anchor mulch in place on varying topography or in wind-prone areas. Netting provides stability to surface disturbances and reduces the soil erosion potential. |
| *Slope stabilization practices* | |
| Slope shaping | Slope shaping is comprised of designing and modifying cut or fill slopes to reduce the soil erosion and runoff potential. Activities include predisturbance planning and design, terraces, benches, serrations, and steps. |

**Table F-13.** Best management practices (page 2 of 2).

| Practice | Description |
|---|---|
| *Slope stabilization practices (continued)* | |
| Retaining structures | Retaining structures are walls comprised of wood, rock, concrete, or other material, constructed at the toe of a slope in order to protect the slope face or toe from scour and erosion from storm runoff. |
| Rock riprap | Rock riprap is a layer of loose rock placed over an erodible soil or surface disturbance in order to protect the soil surface, to provide for slope stabilization on steep slopes, and to reduce soil erosion within a project area. |
| *Infiltration systems* | |
| Infiltration trench or basin | A shallow rock- or gravel-filled trench located at the drip line of roofs or adjacent to other impervious surfaces such as paved driveways and parking areas can percolate runoff from impervious surfaces and prevent erosion. |
| *Watershed management* | |
| Stream protection and stabilization | Stabilization of stream channels and stream banks is an effective treatment to reduce sediment loading and control erosion and land damage. |
| Floodwater retarding structure | Floodwater retarding structures are installed to reduce flood damage downstream by controlling the release rate from flood flows of predetermined frequencies. |
| Floodwater diversion | Floodwater diversions will protect the land, surface improvements, and the watershed by reducing erosion and sediment delivery to receiving waters. |
| *Mining (quarries)* | |
| Excavation stabilization | Excavation stabilization of mined surfaces may prevent erosion, sedimentation, and the degradation of surface and ground water quality through the discharge of sediments or other pollutants into stream channels, drainage ways, or waters of the state. |
| Surface runoff management | Stormwater runoff management practices when designed, installed, and maintained properly, are effective methods to treat nonpoint source pollution and minimize impacts to surface and ground water quality. |
| *Urban resource management* | |
| Street runoff collection | Street runoff collection prevents erosion of roadside shoulders and adjacent roadway slopes from surface runoff. |
| Storm drainage structures | Storm drainage structures include pipes, channels, drop inlets, slotted drains, grease and oil traps, or other facilities used to collect and/or convey surface runoff. Their effectiveness depends on keeping them free from debris or filled with sediment. |
| Landscaping | Proper landscaping can stabilize disturbed sites in a manner that controls surface drainage and soil erosion. |

lists many of the categories of best management practices that would be considered for the construction and operation of the proposed rail line.

Best management practices are structural and nonstructural controls that are used to control ***nonpoint source pollution*** such as sedimentation and stormwater runoff. Structural controls are best management practices that need to be constructed (such as detention or retention basins). Nonstructural controls refer to best management practices that typically do not require construction, such as planning, education, revegetation, or other similar measures. Sedimentation and stormwater runoff are typically addressed through the use of temporary and permanent best management practices. These include techniques such as grading that would induce positive drainage, installation of silt fences, and revegetation to minimize or prevent soil exposed during construction from becoming sediment to be carried offsite. DOE would implement, inspect, and maintain best management practices to minimize the potential for adversely affecting downstream water quality. Therefore, DOE expects impacts from erosion and sediment runoff associated with construction efforts to be small.

During large flood events, when water is held on the upstream side of the structure, it is possible that sediment could accumulate on the upstream side of the crossings. DOE would remove this material periodically so that future floods would have sufficient space to accumulate, rather than overflow the structures during successively smaller floods. Sediment removed from these areas would be removed by truck and disposed of appropriately or, depending on the location of the drainage channel, simply moved out of the drainage channel and left at the site. Under natural conditions this sediment would have continued downstream and been deposited as the floodwaters dispersed. Compared to the total amount of sediment that is moved by floodwater along the entire length of a wash, the amount deposited behind a crossing would be minor.

Storage of hazardous materials during the construction and operations periods would be in accordance with normal environmental regulatory requirements (for example, within secondary containment) and best management practices. As practicable, DOE would store hazardous materials outside of floodplains. Hazardous materials that would be most susceptible to accidental spills and releases would be the fuels and other petroleum products that would be required to support power and equipment needs for the construction and operation of the proposed rail line. A Spill Prevention, Control, and Countermeasure Plan would be required for all rail line construction and operations.

### F.4.4.3 Regulatory Mitigation

There are several actions DOE would take in accordance with regulatory requirements that would define mitigation measures during implementation of either the Proposed Action or the Shared-Use Option. These actions would include preparing plans, acquiring permits, and implementing mitigation, as identified as follows in Sections F.4.4.3.1 through F.4.4.3.4.

#### *F.4.4.3.1 Stormwater Discharge*

Sediment is the primary pollutant generated at construction sites. Runoff from construction and industrial activities has the potential to generate large quantities of sediment and other contaminants if not properly addressed. In response to this common cause of water-quality impairment, the Environmental Protection Agency promulgated regulations requiring the permitting of stormwater-generated pollution under the National Pollutant Discharge Elimination System (Section 402 of the Clean Water Act). The Nevada Division of Environmental Protection has been delegated the authority to administer these federal regulations and has adopted state regulations to administer a National Pollutant Discharge Elimination System Stormwater program. A National Pollutant Discharge Elimination System General Construction Permit would be required for construction activities associated with the Proposed Action or Shared-Use Option. In accordance with the National Pollutant Discharge Elimination System, DOE must do the following:

- Prepare a Stormwater Pollution Prevention Plan or Plans to address construction of the proposed rail line, including (but not limited to) quarry sites, borrow pits, associated facilities, and labor camps.

- Obtain stormwater National Pollutant Discharge Elimination System permit(s) from the Nevada Bureau of Water Pollution Control, which may involve general and individual permits.
- As part of the National Pollutant Discharge Elimination System permit application, identify proposed measures, including best management practices, to control pollutants in stormwater discharges during and after construction, such as diversion, detention, erosion control, sediment traps, gravel construction entrances, covered storage, spill response, and good housekeeping.

### *F.4.4.3.2 Discharge of Dredged or Fill Materials*

Jurisdictional waters of the United States, subject to regulation under Section 404 of the Clean Water Act, include interstate waters, intrastate waters with a nexus to interstate commerce, tributaries to such waters, and wetlands that are adjacent to waters of the United States. For purposes of this floodplain and wetlands assessment, DOE treated all wetlands equally whether or not they were jurisdictional or nonjurisdictional wetlands. The U.S. Army Corps of Engineers is responsible for determining whether drainages and wetlands along the rail alignment are regulated under Section 404; therefore, all conclusions in this analysis about the classification of washes and wetlands as waters of the United States are tentative. A delineation of wetlands along the proposed Caliente rail alignment was completed and submitted to the U.S. Army Corps of Engineers in October 2007 with a request that a jurisdictional determination be made to identify which waters are regulated under Section 404 of the Clean Water Act.

Section 404(b)(1) of the Clean Water Act (40 CFR Part 230) requires a demonstration of the need to fill waters of the United States and a comparison of the aquatic resource impacts of alternatives to filling, so that the practicable alternative with the least impact to aquatic resources is selected. DOE has demonstrated that no practicable alternatives to filling a water of the United States exist (see Section F.4.1.2), and that available steps have been taken to avoid, minimize, reduce, and mitigate the loss of that water as a result of the Proposed Action. A range of rail alignments have been investigated through the EIS process as documented in the Rail Alignment EIS. Waters of the United States were considered together with multiple other factors in deciding on the final alternatives considered in the Rail Alignment EIS. Upon selecting two implementing alternatives, the Caliente and Mina Rail Alternatives, the alternatives were further scrutinized in terms of avoidance and minimization.

When wetlands cannot be avoided in a proposed project area and efforts to minimize the project still result in unavoidable impacts, the implementing regulations of Section 404 of the Clean Water Act require compensatory mitigation be developed based on the quantity and type of impact(s), and the perceived (or quantified) adverse effects, both direct and indirect, to existing wetland functional capacity. Section 404 regulations require that the applicant replace the lost wetland's area and functions by restoring, preserving, enhancing, or creating wetlands at varying ratios of mitigation acreage to affected acreage.

For the proposed project, in general, the areas that score highest in terms of functional capacity would be avoided or impacts therein would be minimized to stream crossings (such as assessment unit 1, assessment unit 3, and assessment unit 5). The majority of wetland impacts throughout the Caliente alternative segment would occur to assessment unit 2 and assessment unit 4, which exhibited lower wetland function scores (see Section F.3.2.1.1.2) due to grazing of the degraded pastures and fragmented wetlands.

**F.4.4.3.2.1 Compensatory Mitigation Options.** This section addresses compensatory mitigation options for the placement of fill in wetlands. For the area of unavoidable impacts to wetlands and other waters proposed by either alternative, federal law (33 CFR Part 320.4 (r)) would require compensatory mitigation. To fully assess the mitigation opportunities for project alternatives and options, a design-level investigation of opportunities for mitigation would be necessary. This investigation would include an assessment of available properties with potential to provide mitigation; discussions with landowners; and input from state and federal regulatory agency representatives. DOE would use the design-level investigation to develop a compensatory mitigation and monitoring plan for unavoidable impacts as part of its compliance with Section 404 in coordination with the U.S. Army Corp of Engineers, U.S. Environmental Protection Agency, and applicable land-management agencies such as the BLM.

Temporary (short-term) impacts of construction, including vegetation trampling, soil compaction, and soil erosion, would be minimized by following best management practices, and would be mitigated by post-construction site restoration measures. Site restoration typically involves soil improvements, where necessary due to compaction, and revegetation using a native wetland seed mix (or woody plantings if such is impacted). In addition to the best management practices listed in Table F-13, DOE would stage equipment and supplies in upland areas and use construction mats or timber mats when heavy machinery must operate within wetlands.

**F.4.4.3.2.1.1 Functional Replacement** The majority of permanent direct wetland impacts would occur to pasture wetlands. More negligible impacts would occur at stream crossings if bridge piers cannot be designed outside of wetland riparian areas.

***F.4.4.3.2.1.1.1 Caliente Rail Alignment:*** Primary wetland functions that may be adversely impacted as a result of selecting the Caliente alternative segment include:

- Flood abatement (due to reduction of active floodplain)
- Nitrogen removal
- Sediment stabilization and phosphorus retention
- Amphibian habitat support (limited)
- Migratory and wintering waterfowl habitat support

Based on the reduction of these functions, mitigation should include vegetation and/or hydrological (that is, augmentation) enhancement consisting of dense, thin-stemmed emergent vegetation (such as bulrush) in an area(s) that receives annual inundation from stream flow during high water events. This type of action would result in functional lift for the suite of reduced functions listed above. Mitigation success would be enhanced by grading to provide microtopographic variation, such as grading for ponds and hummocks interspersed with flat to gently sloping gradients. Such “floodplain roughness” would benefit the mitigation site’s function capacities in water-quality management and habitat support for amphibians, invertebrates, and waterfowl.

Primary wetland functions that may be adversely impacted as a result of selecting the Eccles alternative segment include:

- Resident fish habitat support
- Wintering/migratory waterbird support
- Songbird habitat
- Support for native wetland/riparian plant communities

Mitigation for potential indirect wetland impacts associated with the Eccles alternative segment should include support of multi-strata, characteristic vegetation with a focus on restoring forested wetland to provide shade, primary production of organic materials (including woody debris), and placement of large woody debris or rock to influence the creation of shaded pools for resident fish. This second goal would also foster the development of habitat for wetland-dependent avian species. These goals can be accomplished by planting currently bare areas to obtain a palustrine thin-stemmed emergent class, palustrine scrub-shrub class, and palustrine forest class dominated by native vegetation. Areas currently dominated by non-native saltcedar could be enhanced through weed control and maintenance. Because the riparian area in this part of Clover Creek is designated as an Area of Critical Environmental Concern by the BLM, it is recommended that wetland mitigation include plantings that would benefit the southwestern willow flycatcher and other sensitive species in this area.

***F.4.4.3.2.1.1.2 Mina Rail Alignment:*** Primary wetland functions that may be adversely impacted as a result of selecting the Mina rail alignment are similar to those listed above for the Eccles alternative segment, with some additions due to the unique off-channel wetland habitat adjacent to the Walker River, including:

- Resident fish habitat support
- Wintering/migratory waterbird support
- Songbird habitat
- Support for native wetland/riparian plant communities
- Flood abatement (due to off-channel wetlands)
- Primary production

**F.4.4.3.2.1.2 Type of Mitigation Opportunities** A variety of mitigation options exist for compensating wetland impacts. These include the following:

- Onsite mitigation vs. off-site mitigation – Onsite mitigation refers to conducting compensatory mitigation projects on the same parcel(s) where wetland impacts would occur. This is frequently the easiest option and may be the best one for minimizing the adverse impacts of developments in a given area. For example, if localized flooding is a problem, it is important to maintain local flood storage capability. Sometimes, however, onsite mitigation is not practicable (for example, for small wetland impacts) or is not the best option for replacing wetland functions. Off-site mitigation is when the mitigation site is not part of the development site. Instead, the mitigation project is constructed at some other appropriate site. Generally, off-site mitigation is located within the same basin as the impacted area such that overall functional mitigation is provided to the affected watershed. Mitigation banks are large wetland mitigation projects constructed by a public entity or private party to compensate for future wetland impacts. However, wetland mitigation banks are not considered an option due to the lack of available wetland mitigation bank servicing in this area of Nevada.
- Restoration, creation, and enhancement – Restoration is the reestablishment of wetland and/or other aquatic resource characteristics and function(s) at a site where they have ceased to exist, or exist in a substantially degraded state. Restoration activities generally garner the best mitigation ratio (such as acres restored for acres impacted) relative to creation or enhancement activities. Creation is the establishment of a wetland or other aquatic resource where one did not formerly exist. Enhancement activities can be conducted in existing wetlands or other aquatic resources that increase one or more aquatic functions. Enhancement generally provides higher mitigation ratios (more mitigation acreage needed) than restoration or enhancement activities.

When wetland impacts cannot be avoided, DOE would need to mitigate the loss of impacted wetland functions and area. This is typically done by restoring, creating, or enhancing wetlands. A majority of the impacted wetlands along the Caliente rail alignment are located near a busy roadway (U.S. Highway 93), and are within irrigated cow pastures with a low diversity of plant species and vegetation strata. For this reason, off-site and/or out-of-kind mitigation may be more beneficial to watershed-level wetland functioning, both in terms of compensating for hydrologic functional characteristics (for example, water storage and delay) and habitat support functions (for example, songbird habitat support).

**F.4.4.3.2.1.3 Conceptual Mitigation Opportunities** DOE has several potential opportunities for wetland mitigation which are presented below in Section F.4.4.3.2.1.3.1 for the Caliente rail alignment and in Section F.4.4.3.2.1.3.2 for the Mina rail alignment.

***F.4.4.3.2.1.3.1 Caliente Rail Alignment:*** DOE is considering the following options for mitigation for the Caliente alternative segment.

- On-site Creation of Wetlands - New wetlands could be created along the edges of the wet meadows crossed by the alternative segment. Those wetlands would be created by excavating the adjacent uplands to channelize water into depressions and create microtopographic variation. Some areas along or near the rail alignment appear to have ample surface water flow to support creation of wetlands, especially at the extreme southern end of Meadow Valley near Indian Cove. The created wetlands would be seeded or planted with a variety of native plants found in adjacent wetland and riparian areas to create a diversity of plants higher than that found in the adjacent grazed meadows. This option may require access to additional private property outside of the construction right-of-way.

- On-site Enhancement of Wetlands by Excluding Cattle - Wetlands within or near the railroad right-of-way could be fenced to exclude cattle. Because the construction footprint is narrower than the construction right-of-way, this would enhance linear areas of wetlands adjacent to and parallel with the rail roadbed. The mitigation sites on each side of the roadbed would be approximately 25 feet wide by several thousand feet long. This enhancement action would allow development and diversification of native vegetation in the absence of grazing. As a result of this enhancement, it is likely that the enhanced wetlands, which are in Assessment Unit 2, would eventually be similar to the wetlands in Assessment Unit 3, which have a diversity of erect, thin-stemmed native herbaceous vegetation. Because the Caliente alternative segment would bisect spring-fed pastures that may be of high value for cattle grazing, fencing the right-of-way could affect the ranching operation in southern Meadow Valley. To minimize those effects, it may be prudent to fence and enhance other wetlands in the vicinity, such as those along the edge of the complex of wet meadows there. Decisions on what wetlands to enhance, or where to create wetlands would be made in coordination with local landowners and regulatory authorities such as the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency.

DOE may also consider on-site out-of-kind mitigation for the Caliente alternative segment by amending in-kind mitigation elsewhere onsite with riparian plantings along the Meadow Valley Wash, particularly within their right-of-way. Due to presence of beaver in Meadow Valley Wash, trees are consumed at a large rate, and additional tree stock would help with habitat structure and shading for the stream. These actions would add to the robustness of mitigated wetlands.

Another option for mitigation of wetlands along the Caliente alternative segment would be off-site, out-of-kind mitigation. In this case, wetland impacts may be mitigated at a watershed scale by such arrangements as a partnership with the BLM or other land-management agency to enhance riparian wetland habitat in the Rainbow Valley reach of Meadow Valley Wash. Public land in this area, located south of the City of Caliente, is managed primarily by the BLM and is designated as an Area of Critical Environmental Concern for the southwestern willow flycatcher. This area, although off-site, is within the same watershed as the project area. Opportunities to conduct enhancement in this area may include addressing areas susceptible to erosion (such as grading, bioengineering), planting riparian/wetland shrubs and trees targeting southwestern willow flycatcher habitat preferences, and enhancing in-stream habitat for resident fish, particularly the Meadow Valley Wash speckled dace and the Meadow Valley Wash desert sucker. Additional opportunities in this area may include fish passage barrier removals, in-stream debris removal, and native emergent wetland plantings (such as stream-side bench areas, off-channel wetland habitat).

For the Eccles alternative segment, on-site, in-kind mitigation could be achieved within the Clover Creek floodplain. DOE could grade areas susceptible to erosion, bioengineer streambanks, realign dirt roads and trails that currently cross the floodplain away from the floodplain, control populations of noxious weeds (such as saltcedar), and/or plant wetland shrubs and trees to enhance willow flycatcher habitat and in-stream habitat for resident fish. Additional opportunities in this area may include in-stream debris removal and emergent native wetland plantings. Because of the potential indirect impacts to wetlands located downstream of the proposed Eccles Interchange Yard, wetland enhancement activities located downstream of the project area may be considered onsite. This area has the benefit of being owned by the BLM and managed for conservation as per the Area of Critical Environmental Concern in this area.

It should be noted that the extent of the downstream indirect impacts caused by the filling of Clover Creek for the Interchange Yard will not be completely understood until additional engineering design work is completed to confirm the amount and location of fill, and the associated hydrologic and hydraulic modeling is completed. Likewise the feasibility of providing on-site, in-kind mitigation will not be known until such modeling is completed.

DOE could also conduct on-site, out-of-kind mitigation for the wetlands impacted by the Eccles alternative segment. DOE could provide wetland enhancement to wetland WT-7 (Figure F-7). This wetland is surrounded by railroad embankments on both sides but is reported to have a surface-water connection to Clover Creek. By enhancing this wetland with microtopographic manipulations (to increase variation) and tree plantings, the wetland could provide amphibian habitat and potentially off-channel resident fish habitat.

Off-site mitigation opportunities described for the Caliente alternative segment would also provide mitigation for the Eccles alternative segment. However, for the Eccles segment, the Rainbow Valley Meadow Valley Wash enhancement activities would be considered in-kind.

***F.4.4.3.2.1.3.2 Mina Rail Alignment:*** Because wetland acreage impacts are negligible at the Walker River Crossing, and do not consist of proposed activities that would likely have major effects on the existing system (such as berm construction that could block or redirect major drainage patterns), it is assumed that impacts to existing wetland functions would be proportionally minimal. It is likely that mitigation for the Mina Implementing Alternative wetland impacts could be provided by conducting wetland and riparian enhancement inclusive of the following suite of activities:

- Bank stability enhancement (grading, bioengineering, erosion control)
- Noxious weed control (focused on existing saltcedar vegetation)
- Tree and shrub planting for both habitat support and shading properties
- Increasing microtopographic variation in the riparian and/or adjacent off-channel wetland areas
- Providing habitat structures for wetland birds, mammals, and amphibians
- Providing an area(s) of exclusion from cattle grazing within the riparian and/or off-channel wetland area(s)

### *F.4.4.3.3 Working in Waterways*

According to Nevada Revised Statute 445A.465, which discusses the prohibition on discharging pollutants into waters of the state without a permit, DOE would have to obtain a permit from the Nevada Division of Environmental Protection, Bureau of Water Pollution Control, to work in waterways. The application for this permit would have to include a description of best management practices DOE would propose to use in and along waterways to protect water quality; control erosion and sedimentation; protect and restore riparian areas; stabilize, protect, and rehabilitate stream banks; and control water pollution. In addition, DOE would have to perform construction activities when streambeds were at low flows or preferably dry, and preserve and restore existing drainage patterns to the extent practicable.

#### *F.4.4.3.4 Flood Hazard Control*

In areas where drainage structures would cross a FEMA Flood Zone A (that is, a 100-year flood zone), DOE would design the bridge to comply with FEMA standards and appropriate county regulations. The FEMA standards require that floodway surcharge (that is, the difference between the 100-year flood elevation and the actual flood surface elevation) not exceed 0.3 meter (1 foot) at any location. The FEMA standards have been designed to limit floodwater impacts to structures built in or adjacent to the floodplain (DIRS 182824-Nevada Rail Partners 2007, p. ii). By adhering to these standards, DOE would substantially limit the potential for adverse impacts to the population and resources located adjacent to floodplains. Other practices DOE would use to minimize impacts to floodplains include:

- Construct the proposed rail line in such a way as to maintain current drainage patterns to the extent practicable and not result in new drainage of wetland areas.
- Inspect all drainages, bridges, and culverts semi-annually, or more frequently, as seasonal flows dictate, for debris accumulation.
- Remove debris from drainage structures and properly dispose of debris in an upland area.
- Coordinate with the local floodplain administrators to ensure that new project-related stream and floodplain crossings were appropriately designed to minimize impacts.

## F.5 Compliance with Section 404(b)(1) of the Clean Water Act

This section summarizes the Department's conclusions about whether the Proposed Action would comply with the implementing regulations of Section 404(b)(1) of the Clean Water Act. This section also documents compliance with one of the requirements of Section 404(r) of the Clean Water Act, which states that "…information on the effects of such discharge, including consideration of the guidelines developed under subsection (b)(1) of this section, is included in an environmental impact statement for such project pursuant to the National Environmental Policy Act of 1969."

Section F.5.1 addresses compliance with restrictions on discharges identified in 40 CFR 230.10. Section F.5.2 summarizes the factual determinations on the potential short-term and long-term effects of the proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment, as outlined in 40 CFR 230.11 and Subparts C through F of 40 CFR 230. Section F.5.3 is the Department's finding of compliance with the restrictions of discharge required by 40 CFR 230.12. This analysis discusses only the preferred alignment described in Sections 2.4 and F.4.1.2 of the Rail Alignment EIS. The applicable analyses described in Subparts C through F of 40 CFR 230 are presented in Section 4.2.5 of the Rail Alignment EIS.

## F.5.1 RESTRICTIONS ON DISCHARGE (40 CFR 230.10)

### F.5.1.1 Least Environmentally Damaging Practicable Alternative (40 CFR 230.10(a))

As described in Section F.4.1.2, DOE has stated a preference for the set of alternative segments and facility locations that would have the least adverse impacts to aquatic ecosystems. The Department has clearly demonstrated that there is no practicable alternative that would meet the purpose and need of the project and avoid constructing a rail line through at least some wetlands in southern Meadow Valley. As stated in Section 4.2.5.2.1.4, there also is no practicable alternative to crossing some ephemeral streams in the Meadow Valley Wash and Amargosa River drainage systems that are waters of the United States. In addition, DOE has identified design and construction alternatives that would minimize to the extent practicable the amount of wetlands permanently filled to construct the Caliente alignment (see Chapter 7 and Section F.4.4).

### F.5.1.2 Statutory Requirements (40 CFR 230.10(b))

#### *F.5.1.2.1 State Water-Quality Standards*

As analyzed in Section 4.2.5, impacts to surface-water quality from constructing and operating the rail line would be small and would not result in violations of applicable State of Nevada water-quality standards. Construction contractors would be required to comply with regulatory requirements for stormwater control, spill prevention, and proper use and disposal of hazardous materials. Tables F-13 and 7-1 list the types of best management practices that would be used to minimize potential effects on water quality.

#### *F.5.1.2.2 Toxic Effluent Standards*

Toxic effluent standards deal with pretreatment requirements for discharge to publicly owned treatment works and, therefore, are not applicable to the Proposed Action.

#### *F.5.1.2.3 Endangered Species Act*

The U.S. Fish and Wildlife Service identified three species currently classified as threatened or endangered species that may occur in or near the vicinity of the Caliente alignment (DIRS 181055-Williams 2007, all): desert tortoise, southwestern willow flycatcher, and Ute ladies'-tresses. As described in Section 4.2.7, impacts to these species would be small and no designated critical habitat would be crossed. DOE has entered consultation with the U.S. Fish and Wildlife Service as required by Section 7 of the Endangered Species Act, and anticipates receiving a nonjeopardy biological opinion from that agency some time in 2008.

#### *F.5.1.2.4 Protection of Marine Sanctuaries*

There are no marine sanctuaries near the Caliente alignment; therefore, this section does not apply.

### F.5.1.3 Significant Degradation Analysis (40 CFR 230.10(c))

The Department has concluded that placement of fill material into wetlands and other waters of the United States along the Caliente alignment will not cause or contribute to significant degradation of the waters of the United States. This conclusion is based on the analyses presented in Section 4.2.5 of the Rail Alignment EIS and the summary of factual determinations presented in Section F.5.2.

### F.5.1.4 Minimization of Adverse Impacts (40 CFR 230.10(c))

DOE has identified and will implement the appropriate and practicable steps to minimize adverse impacts of the discharge of fill material on the aquatic ecosystem, as required under Section 40 CFR 230.10(c). As described in Section F.4.1.2, DOE has stated a preference for alignment segments and facility locations that have the minimum practicable impact on aquatic resources. DOE has identified design alternatives and construction methods that would minimize to the extent practicable the discharge of fill materials into wetlands. The Department has stated a commitment in Section F.4.4 to mitigate impacts to wetlands that cannot be avoided. DOE would develop a detailed compensatory mitigation and monitoring plan prior to construction of the railroad. That plan would be developed in coordination with the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and applicable land-management agencies such as the BLM.

## F.5.2 FACTUAL DETERMINATIONS (40 CFR 230.11)

This section summarizes the potential short-term and long-term effects of discharges of fill material into wetlands and other waters of the United States on the physical, chemical, and biological components of the aquatic environment.

### F.5.2.1 Physical Substrate Determinations

To construct the rail roadbed and quarry siding, the substrate within about 0.035 square kilometer (8.7 acres) of wetlands in southern Meadow Valley will be replaced with clean fill from nearby cuts or borrow areas. At 39 crossings of ephemeral or perennial streams that may be classified as waters of the United States, the wash substrate would be replaced with concrete or metal culverts, or with concrete or wooden pilings at bridge crossings (Section 4.2.5.2.1.4). There would be little change in the surrounding substrate because the fill would be compacted and protected as necessary with rip-rap or other materials to resist erosion, slumping, or lateral discharge. Benthic organisms present within and near wetland fill sites will be displaced during construction, but should return to adjacent sites after construction is completed. Best management practices, such as those listed in Tables F-13 and 7-1, would be used to minimize compaction of the surrounding substrate, reduce erosion, and stabilize soil.

### F.5.2.2 Water Circulation, Fluctuation, and Salinity Determinations

Impacts of constructing the rail line on the chemical and physical characteristics of water would be small (Section 4.2.5.2.1.2). Fill materials would consist of poured or precast concrete, corrugated metal pipes, and excavated materials from nearby cuts or borrow areas. Placement of these materials in wetlands and washes would not introduce contaminants, nutrients, or organic matter, other than suspended particulates that would affect the quality of water (see Section F.5.2.3).

Impacts on water circulation from constructing the rail line would be small (see Sections 4.2.5.2.1.6 and F.3.1.1). Increasing the height and width of the abandoned rail roadbed to construct the track along the Caliente alternative segment will not affect water flow in the wetlands in Indian Cove and southern Meadow Valley. Bridges or culverts will be placed at existing flow channels to maintain the flow patterns and surface-water connections between wetlands and streams in the area.

Bridges or culverts would be placed at most existing flow channels along the alignment to maintain current stormwater flow patterns and to prevent the backup of water. DOE would employ standard engineering design practices to size and place culverts and bridges so that water would effectively move under the tracks.

Cut and fill operations during rail line construction would cause the alteration of natural drainage patterns in some areas. Construction could include regrading to redirect flow from a number of minor drainage channels into a single culvert or bridge, resulting in stormwater flowing from a single location on the downstream side rather than across broader areas. As a result, there would be localized changes in drainage patterns in those areas.

Impacts on normal water fluctuations from construction of the rail line, including facilities, also would be small (see Sections 4.2.5.2.1.6 and F.3.1.1). Construction in washes and other flood-prone areas could reduce the area through which floodwaters would naturally flow, which could cause water levels to rise on the upstream side of the crossing and temporarily alter flood flows downstream of the crossing. DOE would generally design rail line features to accommodate 100-year floods, based on typical Class 1 freight railroad standard design criteria. In areas where drainage structures would cross a Federal Emergency Management Agency-designated 100-year floodplain, DOE would design crossings to comply with Agency standards and appropriate county regulations. By adhering to these standards, the Department would substantially limit the potential for adverse impacts on normal water fluctuations during storm events and to the population and resources located adjacent to floodplains.

As described in 40 CFR 230.25, "salinity gradients form where salt water from the ocean meets and mixes with fresh water from land." Waters with salinity gradients do not occur along the Caliente rail alignment.

### F.5.2.3 Suspended Particulate/Turbidity Determinations

Construction activities could adversely impact surface-water quality due to increased sedimentation because rail line construction activities would result in the potential for erosion and sediment during precipitation events. Sediment would be contained through the use of best management practices, including erosion- and sedimentation-control measures. Fill material placed in wetlands and other waters of the United States would be compacted and protected as necessary with rip-rap or other materials to resist erosion. Stormwater Pollution Prevention Plans would be prepared and implemented consistent with state and federal standards for construction activities and would detail the best management practices that would be employed to minimize soil loss and degradation to nearby water resources. Design of the best management practices program would be based on methods listed in the *Best Management Practices Handbook* developed by the Nevada Division of Environmental Protection and the Nevada Division of Conservation Districts (DIRS 176309-NDEP 1994, all) and the *Storm Water Quality Manuals Construction Site Best Management Practices Manual* developed by the Nevada Department of Transportation (DIRS 176307-NDOT 2004, all). Therefore, the potential for impacts to surface waters from increased sediment loads would be small (see Section 4.2.5.2.1.2).

### F.5.2.4 Contaminant Determinations

Fill materials placed in wetlands and other waters of the United States would consist of poured or precast concrete, corrugated metal pipes, and excavated materials from nearby cuts or borrow areas. Placement of these materials in wetlands and washes would not introduce contaminants, nutrients, or organic matter, other than suspended particulates that would affect the quality of water (see Section F.5.2.3).

### F.5.2.5 Aquatic Ecosystem and Organism Determinations

Fill of wetlands and other waters of the United States to construct the railroad along the Caliente alignment will have minimal effects on the structure and function of the aquatic ecosystem. There would be no long-term changes in water quality or flow patterns that would affect the aquatic ecosystem. Construction of bridges over streams and filling of wetlands that flow into Meadow Valley Wash could result in a short-term increase in sediment load in the habitat of the Meadow Valley speckled dace and Meadow Valley Wash desert sucker (see Section 4.2.7.2.2.1). Construction in these areas could also have a small impact on southwestern toads and other aquatic organisms in Meadow Valley Wash (see Section 4.2.7.2.2.1). As stated in Section F.5.2.3, potential for impacts to surface water from increased sediment loads would be small because sediment would be contained onsite using appropriate best management practices. Construction within and near wetlands and the active stream channel of Meadow Valley Wash may also result in the temporary displacement of aquatic organisms living adjacent to the construction sites. Those organisms would return to the area after construction is completed.

Impacts to threatened and endangered species from construction and operation of the rail line would be small, as described in Section 4.2.7. Impacts to wildlife from construction of the Caliente rail alignment are summarized in Section 4.2.7.4. It is concluded that, although there could be impacts to wildlife habitats and individual populations as a result of rail line construction, impacts would be small and would not affect the continued existence of any wildlife species.

The only special aquatic sites that would be impacted are the wetlands along the Caliente alternative segment in Indian Cove and southern Meadow Valley. Those wetlands, and the potential impacts to their values and functions, are described in detail in Section F.3.2.1.1.2. There are no sanctuaries or refuges along or near the Caliente rail alignment that would be affected. There are no mud flats, vegetated shallows, coral reefs, or riffle or pool complexes along the alignment.

### F.5.2.6 Proposed Disposal Site Determinations

The wetlands and other waters of the United States where fill material would be placed are identified in Sections 4.2.5 and F.3.2.1.1.2. Because those wetlands and washes are either normally dry or have very shallow surface water, the surface-water column would be shallow within which fill material would mix, and dispersion of fill material will not occur or will be restricted to immediately adjacent areas.

Placement of fill material in wetlands and other waters of the United States would have minimal impacts on human-use characteristics of the surrounding areas. Municipal and private water supplies along the alignment come from underground water sources (DIRS 182821-Converse Consultants 2005, all). Construction of the railroad would not affect the quality of these water supplies (see Section 4.2.6.2.1). Potential impacts on groundwater resources resulting from physical disturbance of the ground surface, such as placement of fill material into regulated washes, would be small. Proposed groundwater withdrawals would locally affect groundwater flow patterns and groundwater availability. Impacts on downgradient groundwater basins (hydrographic areas) due to the proposed groundwater withdrawals would be small. Impacts on groundwater resources due to groundwater withdrawals at proposed quarry locations and rail facility locations would also be small. DOE would implement best management practices as part of the Proposed Action to avoid, minimize, or otherwise reduce impacts to groundwater resources. Chapter 7 identifies best management practices and potential mitigation measures (also see Section 4.2.6).

There are no recreational or commercial fisheries within the waters to be filled and no water-related recreation would be affected by construction of the railroad.

Impacts on aesthetic resources from construction and operation of the Caliente alignment are described in Section 4.2.3.5. It is concluded that contrast that would be caused by the rail line and support facilities would remain consistent with BLM visual resource management objectives during the operations phase, but would be inconsistent in certain locations during the construction phase. Construction and use of a rock conveyor across the highway to bring ballast from potential quarry site CA-8B to the Indian Cove Staging Yard would cause a strong contrast against the surrounding Class II BLM-administered lands north of the Staging Yard. If DOE selected the Caliente-Upland option (see Figure D-9 in Appendix D) for the Staging Yard, the conveyor would cross the highway farther north, near key observation point 4; construction and use of a conveyor there would cause a strong contrast, but against Class III lands (see Section 4.2.3.2.2.1). Contrast ratings of strong would mean that construction activity would not meet BLM management objectives for the Class II lands in the Indian Cove area, nor Class III lands in the Upland area.

Construction and operation of the Caliente rail alignment would not affect parks, national and historical monuments, national seashores, Wilderness Areas, research sites, or similar preserves (see Section 4.2.2).

### F.5.2.7 Determination of Cumulative Effects on the Aquatic Ecosystem

The cumulative effects on surface-water resources of the Proposed Action and other reasonably foreseeable future actions and continuing actions along and near the Caliente alignment are described in Section 5.2.2.5. It is concluded that potential cumulative impacts on surface-water resources would be small and localized.

### F.5.2.8 Determination of Secondary Effects on the Aquatic Ecosystem

There will be minimal secondary effects on the aquatic ecosystem as a result of the placement of fill material in wetlands and other waters of the United States along the Caliente alignment. The Department would implement best management practices during construction and operations to minimize secondary effects associated with the placement of fill material. For example, spill prevention plans would be developed and implemented at facilities near water resources, such as the Upland Staging Yard and associated quarry siding, to prevent the release of hazardous materials into surface waters. A weed management plan would be developed to prevent the spread of noxious and other invasive weeds into aquatic and other habitats. Other best management practices that would be implemented to minimize the secondary effects of the Proposed Action on surface-water resources are described in Table 7-1.

## F.5.3 FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE (40 CFR 230.12)

On the basis of the guidelines in Subparts C through G of 40 CFR 230 and the information presented above, the Department has reached the following findings of compliance with the restrictions on discharge:

1. No practicable alternative exists which meets the purpose and need of the project that does not involve the discharge of fill material into waters of the United States.

2. The set of alignment segments and facility locations for which the Department has stated a preference in Section 2.4 are the alternatives that would have the least adverse impacts to aquatic ecosystems.

3. The discharge of fill materials into wetlands and other waters of the United States would not cause or contribute to violations of any state water-quality standards. The discharge would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

4. Construction of the railroad along the Caliente alignment would not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act.

5. The placement of fill material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity; productivity and stability; and recreation, aesthetic, and economic values would not occur.

6. Appropriate steps would be taken to minimize the adverse environmental impact of the Proposed Action. DOE would develop and implement a detailed compensatory mitigation and monitoring plan prior to construction of the railroad. That plan would be developed in coordination with the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and applicable land-management agencies, such as the BLM.

On the basis of the above conclusions, the proposed discharge of fill materials into wetlands and other waters of the United States are specified as complying with the requirements of the guidelines of 40 CFR 230.

## F.6 Glossary

| | |
|---|---|
| 100-year flood | A flood event of such magnitude that it occurs, on average, every 100 years; this equates to a 1-percent chance of its occurring in a given year. A base flood may also be referred to as a 100-year storm. The area inundated during the base flood is sometimes called the 100-year floodplain. |
| 50-year flood | A flood event of such magnitude that it occurs, on average, every 50 years; this equates to a 2-percent chance of its occurring in a given year. |
| accessible environment | For this ***environmental impact statement*** (EIS), all points on Earth outside the surface and subsurface area controlled over the long term for the ***repository***, including the atmosphere above the controlled area. |
| accident | An unplanned sequence of events that results in undesirable consequences. Examples in the Rail Alignment EIS include an inadvertent release of ***radiation*** from the ***casks*** or hazardous materials from their containers; train derailments; vehicular accidents; and construction-related accidents that could affect workers. |
| air quality | A measure of the concentrations of pollutants, measured individually, in the air. |
| alpha particle | A positively charged particle ejected spontaneously from the nuclei of some ***radioactive*** elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). See ***ionizing radiation.*** |

alternative — One of two or more actions, processes, or propositions, from which a decisionmaker will determine the course to be followed. The National Environmental Policy Act, as amended, states that in preparing an EIS, an agency "shall … (s)tudy, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources" [42 U.S.C. 4321, Title I, Section 102(E)]. The regulations of the Council on Environmental Quality that implement the National Environmental Policy Act indicate that the alternatives section is "the heart of the environmental impact statement" (40 CFR 1502.14), and include rules for presentation of the alternatives, including no action, and their estimated impacts.

The Nevada Rail Corridor SEIS analyzes one alternative to the ***Proposed Action***, the ***No-Action Alternative***. Under the Nevada Rail Corridor SEIS No-Action Alternative, the U.S. Department of Energy (DOE or the Department) would not select a rail alignment within the Mina rail corridor for the construction and operation of a railroad. As such, the No-Action Alternative provides a basis for comparison to the Proposed Action.

The Rail Alignment EIS analyzes one alternative to the Proposed Action – the No-Action Alternative – and two implementing alternatives under the Proposed Action – the Caliente Implementing Alternative and the Mina Implementing Alternative – for constructing, operating, and possibly abandoning a ***railroad*** for the shipment of ***spent nuclear fuel*** and ***high-level radioactive waste*** for long-term ***disposal*** in a ***geologic repository*** at Yucca Mountain. Under the No-Action Alternative, DOE would not construct the proposed railroad along the Caliente ***rail alignment*** or the Mina rail alignment.

alternative segments — Geographic region of the ***rail alignment*** for which multiple routes for the ***rail line*** have been identified. In the Rail Alignment EIS, there are different alignments identified within the Caliente ***rail corridor*** and the Mina rail corridor that could minimize or avoid environmental ***impacts*** and reduce construction complexities.

atomic mass — The mass of a neutral atom, based on a relative scale, usually expressed in atomic mass units. See ***atomic weight.***

atomic nucleus — See ***nucleus***.

atomic number — The number of ***protons*** in an atom's ***nucleus***.

atomic weight — The relative mass of an atom based on a scale in which a specific carbon atom (carbon-12) is assigned a mass value of 12. Also known as relative ***atomic mass***.

ballast — The coarse rock that is placed under the ***railroad*** tracks to support the railroad ties and improve drainage along the ***rail line***.

barrier — Any material, structure, or condition (as a thermal barrier) that prevents or substantially delays the movement of water or ***radionuclides***.

berm — A mound or wall of earth.

beta particle — A negatively charged ***electron*** or positively charged positron emitted from a ***nucleus*** during ***decay***. Beta decay usually refers to a ***radioactive*** transformation of a ***nuclide*** by electron emission, in which the ***atomic number*** increases by 1 and the mass number remains unchanged. In positron emission, the atomic number decreases by 1 and the mass number remains unchanged. See ***ionizing radiation.***

boiling-water reactor (BWR) — A ***nuclear reactor*** that uses boiling water to produce steam to drive a turbine.

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| canister | An unshielded metal container used as: (1) a pour mold in which molten vitrified ***high-level radioactive waste*** can solidify and cool; (2) the container in which DOE and electric utilities place intact ***spent nuclear fuel***, loose rods, or nonfuel components for shipping or ***storage***; or (3) in general, a container used to provide ***radionuclide confinement***. Canisters are used in combination with specialized overpacks that provide structural support, ***shielding*** or confinement for storage, transportation, and ***emplacement***. Overpacks used for transportation are usually referred to as transportation ***casks***; those used for emplacement in a ***repository*** are referred to as ***waste packages***. |
| cask | A heavily shielded container that meets applicable regulatory requirements used to ship ***spent nuclear fuel*** or ***high-level radioactive waste***. |
| common segment | Geographic region of the ***rail alignments*** for which a single route for the ***rail line*** has been identified. |
| confinement | As it pertains to ***radioactivity***, the retention of ***radioactive*** material within some specified bounds. Confinement differs from containment in that there is no absolute physical ***barrier*** in the former. |
| decay (radioactive) | The process in which one ***radionuclide*** spontaneously transforms into one or more different radionuclides called decay products. |
| disposal (of spent nuclear fuel and high-level radioactive waste) | The ***emplacement*** in a ***repository*** of ***spent nuclear fuel***, ***high-level radioactive waste***, or other highly ***radioactive*** material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste, and the ***isolation*** of such waste from the ***accessible environment***. |
| dose (radioactive) | The amount of ***radioactive*** energy taken into (absorbed by) living tissues. See ***effective dose equivalent***. |
| effective dose equivalent | Often referred to simply as ***dose***, it is an expression of the ***radiation*** dose received by an individual from external radiation and from ***radionuclides*** internally deposited in the body. |
| electron | A stable elementary particle that is the negatively charged constituent of ordinary matter. |
| environment | (1) Includes water, air, and land and all plants and humans and other animals living therein, and the interrelationship existing among these. (2) The sum of all external conditions affecting the life, development, and survival of an organism. |
| emplacement | The placement and positioning of ***waste packages*** in the ***repository***. |
| environmental impact statement (EIS) | A detailed written statement that describes:<br>"...the environmental impact of the ***proposed action***; any adverse environmental effects which cannot be avoided should the proposal be implemented; ***alternatives*** to the proposed action; the relationship between local short-term uses of man's ***environment*** and the maintenance and enhancement of long-term productivity; and any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."<br>Preparation of an EIS requires a public process that includes public meetings, reviews, and comments, as well as agency responses to the public comments. |

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| exposure (to radiation) | The condition of being subject to the effects of or potentially acquiring a ***dose*** of ***radiation***. The incidence of radiation on living or inanimate material by ***accident*** or intent. Background exposure is the exposure to natural ***ionizing radiation***. Occupational exposure is the exposure to ionizing radiation that occurs during a person's working hours. Population exposure is the exposure to a number of persons who inhabit an area. |
| fission | The splitting of a ***nucleus*** into at least two other nuclei, resulting in the release of two or three ***neutrons*** and a relatively large amount of energy. |
| fission products | ***Radioactive*** or nonradioactive atoms produced by the ***fission*** of heavy atoms, such as uranium. |
| fuel assembly | A number of fuel elements held together by structural materials, used in a ***nuclear reactor***; sometimes called a fuel bundle. |
| gamma ray | The most penetrating type of radiant nuclear energy. It does not contain particles and can be stopped by dense materials such as concrete or lead. See ***ionizing radiation.*** |
| geologic repository | A system for the ***disposal*** of ***radioactive*** waste in excavated geologic media, including surface and subsurface areas of operation, and the adjacent part of the geologic setting that provides ***isolation*** of the radioactive waste in a controlled area. |
| high-level radioactive waste | (1) The highly ***radioactive*** material that resulted from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing, and any solid material derived from such liquid waste that contains ***fission products*** in sufficient concentrations. |
| impact | For an EIS, the positive or negative effect of an action (past, present, or future) on the natural ***environment*** (land use, ***air quality***, water resources, geological resources, ecological resources, aesthetic and scenic resources) and the human environment (***infrastructure***, economics, social, and cultural). |
| infrastructure | Basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communication systems. |
| ionizing radiation | (1) ***Alpha particles***, ***beta particles***, ***gamma rays***, ***X-rays***, ***neutrons***, high-speed ***electrons***, high-speed ***protons***, and other particles capable of producing ions. (2) Any ***radiation*** capable of displacing electrons from an atom or molecule, thereby producing ions. |
| irradiation | ***Exposure*** to ***radiation***. |
| isolation | Inhibiting the transport of ***radioactive*** material so that the amounts and concentrations of this material entering the ***accessible environment*** stay within prescribed limits. |
| neutron | An atomic particle with no charge and an ***atomic mass*** of 1; a component of all atoms except hydrogen; frequently released as ***radiation***. |
| No-Action Alternative | Under the No-Action Alternative in the Nevada Rail Corridor SEIS, DOE would not construct and operate a ***railroad*** within the Mina ***rail corridor*** from Wabuska to Yucca Mountain.<br><br>Under the No-Action Alternative in the Rail Alignment EIS, DOE would not implement the ***Proposed Action*** in the Caliente rail corridor or the Mina rail corridor. |

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| nonpoint source pollution | Pollution does not come from a single source but from many unidentifiable sources. An example of nonpoint source pollution would be urban runoff of items like oil, fertilizers, and lawn chemicals. As rainfall or snowmelt moves over and through the ground, it picks up and carries away natural and human-made pollutants. These pollutants are eventually deposited into natural bodies of water, such as lakes, rivers, wetlands, coastal waters, and underground sources of drinking water. |
| nuclear reactor | A device in which a nuclear ***fission*** chain reaction can be initiated, sustained, and controlled to generate heat or to produce useful ***radiation***. |
| nucleus | The central, positively charged, dense portion of an atom. Also known as ***atomic nucleus***. |
| nuclide | An atomic ***nucleus*** specified by its ***atomic weight***, ***atomic number***, and energy state; a ***radionuclide*** is a ***radioactive*** nuclide. |
| pressurized-water reactor (PWR) | A nuclear power ***reactor*** that uses water under pressure as a coolant. The water boiled to generate steam is in a separate system. |
| Proposed Action | The activity proposed to accomplish a federal agency's purpose and need. An EIS analyzes the environmental ***impacts*** of a proposed action, which includes the project and its related support activities.<br>The Proposed Action in the Nevada Rail Corridor SEIS, is to construct and operate a ***railroad*** to connect the Yucca Mountain ***repository*** to an existing ***rail line*** near Wabuska, Nevada (the Mina ***rail corridor***).<br>The Proposed Action in the Rail Alignment EIS is to determine an alignment (within a corridor) and construct and operate a railroad in Nevada to transport ***spent nuclear fuel***, ***high-level radioactive waste***, and other Yucca Mountain project materials to a repository at Yucca Mountain. |
| proton | An elementary particle that is the positively charged component of ordinary matter and, together with the ***neutron***, is a building block of all atomic nuclei. |
| radiation | Energy traveling through space. Radiation can be non-ionizing, like radio waves, ultraviolet radiation, or visible light, or ionizing, depending on its effect on atomic matter. As used in the Rail Alignment EIS, "radiation" refers to ***ionizing radiation***. Ionizing radiation has enough energy to ionize atoms or molecules while non-ionizing radiation does not. ***Radioactive*** material is a physical material that emits ionizing radiation. |
| radioactive | Emitting ***radioactivity***. |
| radioactivity | (1) The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ***ionizing radiation*** (such as ***alpha***, ***beta***, or ***gamma rays***). (2) The property of unstable nuclei in certain atoms (of elements such as uranium) to spontaneously emit ionizing radiation during nuclear transformations. |
| radionuclide | See ***nuclide***. |
| rail alignment | An engineered refinement of a ***rail corridor*** in which DOE would identify the location of a ***rail line***. A rail alignment is comprised of ***common segments*** and ***alternative segments***. |
| rail corridor | As used in the Rail Alignment EIS, a strip of land 400 meters (0.25 mile) wide through which DOE would identify an alignment (***rail alignment***) for the construction of a ***rail line*** in Nevada to a ***geologic repository*** at Yucca Mountain. |

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| rail line | An engineered feature incorporating the track, ties, ***ballast***, and ***subballast*** at a specific location. |
| railroad | A transportation system incorporating the ***rail line***, operations support facilities, railcars, locomotives, and other related property and infrastructure. |
| reactor | See ***nuclear reactor***. |
| repository | See ***geologic repository***. |
| riprap | Broken rocks or chunks of concrete used as foundation material or to protect embankments and gullies to control water flow or prevent erosion. |
| roadbed | The earthwork foundation upon which the track, ties, ***ballast***, and ***subballast*** of a ***rail line*** are lain. |
| Shared-Use Option | An option under the ***Proposed Action***. DOE would allow commercial and other shippers to use the ***rail line*** for general freight shipments. General freight would include stone and other nonmetallic minerals, petrochemicals, waste materials (nonradioactive), or other commodities that private companies would ship or receive. |
| shielding | Any material that provides ***radiation*** protection. |
| spent nuclear fuel | Fuel that has been withdrawn from a ***nuclear reactor*** following ***irradiation***, the component elements of which have not been separated by reprocessing. For this project, this refers to (1) intact, nondefective ***fuel assemblies***, (2) failed fuel assemblies in ***canisters***, (3) fuel assemblies in canisters, (4) consolidated fuel rods in canisters, (5) nonfuel assembly hardware inserted in ***pressurized-water reactor*** fuel assemblies, (6) fuel channels attached to ***boiling-water reactor*** fuel assemblies, and (7) nonfuel assembly hardware and structural parts of assemblies resulting from consolidation in canisters. |
| storage | The collection and containment of waste or ***spent nuclear fuel*** in a way that does not constitute ***disposal*** of the waste or spent nuclear fuel for the purposes of awaiting treatment or disposal capacity. |
| subballast | A layer of crushed gravel that is used to separate the ***ballast*** and ***roadbed*** for the purpose of load distribution and drainage. |
| subgrade elevation | The elevation of the top of the ***subballast*** in the ***rail line***. |
| waste packages | Two thick metal cylinders, one nested within the other. The inner cylinder would be made of stainless steel to provide structural strength. The outer cylinder would be made of a nickel alloy that is highly resistant to corrosion. |
| X-rays | Penetrating electromagnetic ***radiation*** having a wavelength much shorter than that of visible light. X-rays are identical to ***gamma rays*** but originate outside the ***nucleus***, either when the inner orbital ***electrons*** of an excited atom return to their normal state or when a metal target is bombarded with high-speed electrons. |

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# APPENDIX G

# METHODOLOGY FOR ASSESSING IMPACTS TO GROUNDWATER

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| DIRS | Document Input Reference System |
| DTN | Data Tracking Number |
| DOE | U.S. Department of Energy |
| DEIS | Draft Environmental Impact Statement |
| GIS | Geographic Information System |
| GNIS | Geographic Names Information System |
| NDWR | Nevada Division of Water Resources |
| NWIS | National Water Information System |
| USGS | U.S. Geological Survey |

# APPENDIX G

# METHODOLOGY FOR ASSESSING IMPACTS TO GROUNDWATER

This appendix provides detailed information on the methods DOE used to assess potential impacts to groundwater provided in Sections 4.2.6 and 4.3.6 of the Rail Alignment EIS (DOE/EIS-0369).

Section G.3 defines terms shown in ***bold italics***.

This appendix describes:

- The general approach and assumptions the U.S. Department of Energy (DOE or the Department) used to identify existing groundwater resources and to assess potential impacts to those groundwater resources from the proposed groundwater withdrawal for construction and operation of the proposed rail line
- The methodology for determining the impact to the aquifer (at an existing groundwater resource feature) due to pumping at a specific well location or the location of a group of wells
- The aquifer types considered and the corresponding calculations employed for the proposed well locations where an assessment was performed

Section G.1 describes the methods DOE used to assess impacts to groundwater from railroad construction along either the Caliente rail alignment or the Mina rail alignment; Section G.1.3 describes the methods for determining potential impacts from railroad operations along either alignment. DOE used the same methods to assess potential impacts to groundwater resources under the Shared-Use Option for each alignment as described in Section G.2.

DOE performed calculations to quantitatively evaluate potential impacts to existing water wells and springs from withdrawing groundwater from proposed new wells that would support construction and operation of the proposed rail line. DOE has proposed many locations along the Caliente and Mina rail alignments for water wells. Each set of calculations evaluates impacts on the host aquifer from pumping of these wells. DOE has categorized wells into construction wells (Section G.1.2), which would be temporary, and operations wells (Section G.1.3), which would be permanent. DOE further categorized construction wells into: (1) construction water wells which would provide water during construction of the rail roadbed and to support water needs at construction camps (Section G.1.2), and to support water needs associated with construction of rail facilities (Section G.1.2.3); and (2) quarry wells (Section G.1.2.5), which would provide water to specific quarry sites. The evaluation of construction impacts includes a sensitivity analysis for locations along the Caliente rail alignment (Section G.1.2.4), which DOE conducted to identify favorable locations where increased productivity rates would not impact existing groundwater uses.

## G.1 Construction Impacts Assessment

### G.1.1 OVERVIEW OF GROUNDWATER ASSESSMENT METHODOLOGY AND ASSUMPTIONS

For assessing potential impacts to groundwater resources, DOE assumed the total duration of the construction phase would be 4 years, the shortest construction period being considered. Actual construction would occur during about the first 3 years, with the final year allocated to installation and testing of signal and communications equipment, and putting the rail line into service. DOE assumed this 4-year construction duration because it would require higher or the same groundwater withdrawal rates from the new proposed water wells than if a longer duration were assumed. This analysis approach is conservative and any impacts identified would include impacts under a longer (up to 10 years) construction duration.

DOE assumed that all of the water required for the Proposed Action would be obtained from the proposed new water wells. DOE also assumed that all of the groundwater required for rail roadbed construction activities within each hydrographic area that the Caliente rail alignment or Mina rail alignment would cross would be acquired within a 9-month period (DIRS 182822-Converse Consultants 2006, Section 2.1; DIRS 180888-Converse Consultants 2007, Section 2.1).

The construction impacts assessment involved calculating the approximate ***radius of influence*** of the ***cone of depression*** surrounding each proposed new water-supply well located in an area with existing wells or any known springs that could potentially be impacted. Section G.1.2.1 provides details regarding the approach that was used for identifying existing wells and known springs that could be located within the radius of influence of the cone of depression surrounding each proposed new water-supply well. The cone of depression generated by pumping groundwater from a well increases (approximately radially) in relation to its areal extent, and the magnitude of the drawdowns contained within it increase during the initial, transient period of operation. As the system approaches steady state, both the size of the cone of depression and the magnitude of drawdowns would be expected to expand to reach maximum (equilibrium) values within the specified pumping time frame (in this case, 9 months), unless there were barriers to flow that could affect the generally radial flow behavior surrounding a pumping well and these barriers were located within the radius of influence of that pumping well. The maximum impact of a well on the aquifer is achieved once steady-state conditions have developed. Therefore, DOE performed the impact evaluations using steady-state well formulae so that the likely maximum impacts could be assessed.

Vertical flow can also occur between aquifers. If a well is ***screened*** in a ***leaky aquifer***, part of the flow is derived from the horizontal flow in that aquifer, and part from the vertical flow from underlying or overlying aquifers, located below or above the aquifer in question. DOE neglected this phenomenon in the quantitative impact analyses because additional flow originating from other aquifers would decrease the calculated drawdown in the aquifer of interest. Therefore, for purposes of conducting quantitative impacts analysis calculations to determine the radius of influence created around pumping wells, the combination of assumptions that all required water would be obtained from new wells and that no contribution to flow in the wells would be provided by vertical flow, leads to a conservative estimation of the radius of influence of pumping wells on the water-bearing zone.

DOE also evaluated the potential for impacts to occur to the affected environment due to vertical flow between aquifers or between different zones within multiple units within an aquifer. A discussion of the potential impacts due to vertical flow is presented at the end of this section.

DOE determined and evaluated a range of potential aquifer conditions. At several locations, DOE completed more than one calculation of the radius of influence to reflect different potential aquifer conditions (confined aquifer versus unconfined aquifer; alluvial aquifer versus fractured volcanic rock aquifer, etc.; see Section G.1.2.2) that might occur at the pumping location.

If a calculated radius of influence equaled or exceeded the distance separating the proposed well location and an existing well or spring, then DOE assumed there would be a hydrogeologic impact on that existing well or spring. The *Hydrogeologic DEIS Analysis Report, REV. 0, April 10, 2006* (DIRS 182822-Converse Consultants 2006, all) describes the locations and characteristics of wells proposed for supplying water needed for rail roadbed earthwork compaction along the Caliente rail alignment. The *Hydrogeologic DEIS Analysis Report, REV. 0, April 27, 2007* (DIRS 180888-Converse Consultants 2007, all) describes the locations and characteristics of wells proposed for supplying water needed for rail roadbed earthwork compaction along the Mina rail alignment.

As described above, for the impact analysis calculations, vertical flow was not considered when calculating a maximum radius of influence for the aquifer of interest. This approach is conservative in this application, because additional flow originating from other aquifers would decrease the calculated drawdown in the aquifer of interest, and it results in the largest possible horizontal radius of influence for the cone of depression induced by pumping.

It is recognized that pumping groundwater from a well that has a perforated interval (screened zone) that vertically spans an aquifer zone or extends vertically across portions of two vertically distinct aquifer units could induce water to flow vertically within the aquifer or between different aquifer units, or, if sufficient pressure head exists, potentially into the open environment (that is, to the ground surface). In such instances, if a water-bearing zone or aquifer unit having poor-quality (for example, highly mineralized or currently contaminated) water is intercepted by the well's perforated zone, the potential exists for poor-quality flow to move vertically to either a different portion of the aquifer, a different aquifer zone that currently contains better-quality water, or to the ground surface.

To further evaluate the potential for such impacts to occur along the Caliente and/or Mina rail alignments, published information regarding groundwater-quality conditions underlying areas that would be crossed by the proposed Caliente and Mina rail alignments was researched and compared to the proposed locations of groundwater-supply wells. Key published reports and maps reviewed in this capacity include DIRS 182821-Converse Consultants 2005, all; DIRS 176502-Rush 1964, all; DIRS 176646-Eakin 1963, all; DIRS 176883-Brothers, Katzer, and Johnson 1996, all; DIRS 176852-Drici, Garey, and Buqo 1993, all; DIRS 103136-Prudic, Harrill, and Burbey 1993, all; and DIRS 149377-Harrill and Prudic 1998, all text and Figure 22 for the proposed Caliente rail alignment; and DIRS 180887-Converse Consultants 2007, all; DIRS 180888-Converse Consultants 2007, all; DIRS 180760-Albers and Stewart 1981, all; DIRS 180759-Van Denburgh and Glancy 1970, all; DIRS 103136-Prudic, Harrill, and Burbey 1993, all; and DIRS 172905-USGS 1995, all text and Figure 70 for the proposed Mina rail alignment.

The characteristics of the proposed new wells (total well depth and range of screened intervals) were also reviewed. This information was used to: (1) determine whether areas of poorer-quality groundwater currently exist that could be intercepted by newly proposed wells; and (2) assess, if such conditions were found to exist, the likelihood of such vertical movement occurring of poorer-quality water to other better-quality portions of an aquifer or different aquifer units, and/or to the ground surface.

## G.1.2 CONSTRUCTION WATER-SUPPLY WELLS

DOE performed calculations to evaluate the potential impacts of groundwater withdrawals from individual wells or groups of wells on nearby existing wells and springs. DOE varied the analytical methods used for the impacts analyses at the various locations to reflect the different aquifer conditions inferred to be present at each pumping site. The impacts analyses consisted of:

- Identifying the average and peak proposed withdrawal rates of each proposed well or group of wells
- Evaluating potential hydrogeologic conditions that could be present at each location and identifying an appropriate calculation methodology for each potential condition

- Calculating the extent and magnitude of drawdowns that would be generated by the proposed well or an equivalent single well for a well cluster pumping at the specified average withdrawal rate (under the range of potential hydrogeologic conditions postulated)
- Identifying the location and characteristics of existing water wells, springs, seeps, or other surface-water-right locations that might be impacted by the drawdown generated by the proposed groundwater withdrawals
- Estimating the potential for a reduction in well capacity or discharge to a spring, seep, or other surface-water-right location, if any, that could occur as a result of the proposed groundwater withdrawals

### G.1.2.1 Hydrogeologic Impacts Analysis Approach

DOE used the following approach to evaluate potential impacts on existing wells and springs from the proposed groundwater withdrawals from new water wells:

- Review the specified data regarding the proposed well locations, well construction details, estimated groundwater depths, and proposed groundwater withdrawal rates and timeframes. The references containing these data for the Caliente rail alignment include DIRS 182822-Converse Consultants 2006, all; DIRS 180919-Nevada Rail Partners 2007, Section 3.1.5; DIRS 180922-Nevada Rail Partners 2007, Section 3.1.5; DIRS 180922-Nevada Rail Partners 2007, Section 4.4; DIRS 180875-Nevada Rail Partners 2007, Section 4.4; and DIRS 180919-Nevada Rail Partners 2007, Section 3.1.5. The references containing these data for the Mina rail alignment include DIRS 180888-Converse Consultants 2007, all; DIRS 180873-Nevada Rail Partners 2007, Section 2.1.5; and DIRS 180875-Nevada Rail Partners 2007, Section 4.4.
- Identify all the existing wells, springs, seeps, or other surface-water-right locations in proximity to the proposed pumping well locations and their characteristics, use category, and permit status using report information (such as DIRS 182821-Converse Consultants 2005, all; DIRS 180887-Converse Consultants 2007, all; DIRS 185060-Converse Consultants 2008, all; DIRS 184642-SNWA 2007, all) and information from online sources, including the Nevada Division of Water Resources (NDWR) water-rights and well-log databases, the U.S. Department of the Interior, U.S. Geological Survey (USGS), and National Water Information System (NWIS) (DIRS 176325-USGS 2006, all). Water rights associated with wells, springs, and other surface-water-right locations are included in the NDWR water-rights database, which provides the best available source of information pertaining to water rights in Nevada. NDWR water-rights data included in the impacts analysis include data for water rights associated with wells, springs, and a category listed as “other surface water (OSW)” in the NDWR water-rights database. DOE used the following Geographic Information System (GIS) datasets in the analyses:
  - GNIS-Nevada Springs. Data Tracking Number (DTN) MO0605GOISGNISN.000 (DIRS 176979)
  - USGS Existing Wells Location Information for the State of Nevada. DTN MO0607USGSWNVD.000 (DIRS 177294)
  - Two New Existing Wells within Dry Lake Valley. DTN MO0607PWMAR06D.000 (DIRS 177293)
  - National Hydrological Dataset Point Information for the State of Nevada 2006. DTN MO0607NHDPOINT.000 (DIRS 177712)
  - National Hydrological Dataset Waterbody Information for the State of Nevada 2006. DTN MO0607NHDWBDYD.000 (DIRS 177710)
  - Converse Consultants 2007 (DIRS 182759)
  - Luellen 2007, all (DIRS 183990)

– Luellen 2007, all (DIRS 183991)
– Luellen 2007, all (DIRS 183992)
– Luellen 2007, all (DIRS 184045)

The (location) coordinates assumed for most of these existing wells are based on the center of the 40-acre Quarter Quarter Section description provided in the water-rights database maintained by the NDWR. Therefore, these wells could actually be anywhere within each described 40-acre Quarter Quarter Section of land.

- For initial screening purposes, if DOE identified an existing well, spring, seep, or other surface-water-right location within a 1.6-kilometer (1-mile) radius (buffer distance) of a proposed new water well, DOE selected that proposed well location as a candidate for conducting a groundwater hydrogeologic impacts evaluation. If DOE found no existing well, spring, seep, or other surface-water-right location within this initial search radius, it extended the search distance outward from the proposed well location to identify the nearest spring or existing well and determined its hydrogeologic and construction characteristics (for the existing wells). If the nearest existing well, spring, seep, or other surface-water-right location was farther away than the initial search distance of 1.6 kilometers, an impacts analysis was still performed if one was deemed appropriate for that location, provided the nearest existing well, spring, seep, or other surface-water-right location was found to be within a distance of 2.8 kilometers (1.75 miles) of the proposed pumping well location. The analysis was done taking into account the withdrawal rate at the proposed new well location and the annual duty for the nearest existing well, if applicable, if it had a formal appropriated water right. DOE searched the NDWR water-rights database and well-log databases to confirm the identity, use, water-rights status, if any, and appropriated annual duty and diversion rate, if applicable, associated with each existing well (or spring) within the final searched buffer distance.
- Existing wells and known springs, seeps, or other surface-water-right locations were deemed significant, even if there was not an active water right associated with the well (provided that the well has a use that is listed as being other than the uses listed in the next item immediately below) or the spring. In addition to possibly being a source of water for human use, springs provide a water source for wildlife and form unique habitats within the desert ecosystem.
- DOE did not analyze impacts on existing wells that were found to have no productive use based on use category or status (that is, were confirmed to be groundwater exploration or test wells, thermal gradient test wells, or were dry). For example, DOE excluded from the list of wells of potential concern several existing wells cataloged in the USGS NWIS database that were confirmed to be either monitoring wells, thermal gradient or oil and gas testing wells, or hydrogeologic investigation wells and that have no associated productive (beneficial) use other than their potential future use as monitoring wells.
- Wells for which water-rights applications have been submitted to the State Engineer and that have been assigned a status of "Ready for Action (RFA)" or "Ready for Action, Protested (RFP)" by the State Engineer were also considered when evaluating the potential for cumulative groundwater resource impacts. Specifically, DOE analyzed the potential for cumulative impacts to groundwater resources to occur as a result of combined impacts from pumping in proposed new rail alignment-related wells and from RFA and RFP wells, if they were to be approved by the State Engineer and installed and put into operation at the same time as the proposed new rail alignment-related wells.
- The impacts assessment also included identifying other surface-water rights located within a 2.8-kilometer (1.75-mile) radius around each proposed new well location and within a 9.7-kilometer (6-mile) radius around each new potential fault-zone well location, based on review of the Nevada Division of Water Resources (NDWR) on-line water-rights database.

- DOE included wells with a designation of Domestic. The State of Nevada does not require a water-rights application or permit (formal appropriation) to drill a well for domestic purposes. However, DOE considered domestic wells in the impacts analyses.
- DOE reviewed available geologic and hydrogeologic information for known and potential aquifers in areas where existing wells or springs near proposed new pumping wells indicated that a quantitative analysis of hydrogeologic impacts was warranted. Information and data reviewed included well-log data (total well depth, lithologic units, depth to groundwater, pumping-test data, appropriated duty balance, and diversion rate data, if applicable) for existing wells near proposed new well locations, published geologic and hydrogeologic reports, and groundwater resource appraisal reports. DOE used this information to identify appropriate analytical methods for quantitatively evaluating the drawdown effects from the proposed groundwater withdrawals on the aquifer in which the wells would be installed. The following references containing available geologic and hydrogeologic information for the study area were reviewed:

**Caliente Rail Alignment**

- DIRS 177524-Anning and Konieczki 2005
- DIRS 173179-Belcher 2004
- DIRS 176851-Brothers, Buqo, and Tracy 1993
- DIRS 176883-Brothers, Katzer, and Johnson 1996
- DIRS 176852-Drici, Garey, and Buqo 1993
- DIRS 116801-Driscoll 1986
- DIRS 176818-Eakin 1962
- DIRS 181909-Fridrich et al. 2007, all
- DIRS 129721-Geldon et al. 1998
- DIRS 106094-Harrill, Gates, and Thomas 1988
- DIRS 180775-Lopes et al. 2006
- DIRS 106695-Malmberg and Eakin 1962
- DIRS 103136-Prudic, Harrill, and Burbey 1993
- DIRS 169384-Reiner et al. 2002
- DIRS 176519-Rowley and Shroba 1991
- DIRS 176947-Rowley et al. 1994
- DIRS 176502-Rush 1964
- DIRS 176849-Rush 1968
- DIRS 176950-Rush and Everett 1966
- DIRS 174643-Seaber, Kapinos, and Knapp 1994
- DIRS 183639-Shannon & Wilson 2007
- DIRS 182854-Shannon & Wilson 2006
- DIRS 150228-Slate et al. 2000
- DIRS 184642-SNWA 2007
- DIRS 176488-State of Nevada 2006
- DIRS 184816-Swadley and Simonds 1994
- DIRS 147766-Thiel 1999
- DIRS 172905-USGS 1995
- DIRS 176325-USGS 2006
- DIRS 176848-Van Denburgh and Rush 1974

**Mina Rail Alignment**

- DIRS 180760-Albers and Stewart 1981
- DIRS 177524-Anning and Konieczki 2005

- DIRS 173179-Belcher 2004
- DIRS 181394-Everett and Rush 1967
- DIRS 181909-Fridrich et al. 2007, all
- DIRS 129721-Geldon et al. 1998
- DIRS 106094-Harrill, Gates and Thomas 1988
- DIRS 180697-Huxel and Harris 1969
- DIRS 180775-Lopes et al. 2006
- DIRS 106695-Malmberg and Eakin 1962
- DIRS 180777-Mauer et al. 2004
- DIRS 103136-Prudic, Harrill, and Burbey 1993
- DIRS 169384-Reiner et al. 2002
- DIRS 176849-Rush 1968
- DIRS 180754-Rush et al. 1971
- DIRS 174643-Seaber, Kapinos, and Knapp 1994
- DIRS 180881-Shannon & Wilson 2007
- DIRS 183639-Shannon & Wilson 2007
- DIRS 182854-Shannon & Wilson 2006
- DIRS 183636-Shannon & Wilson 2007
- DIRS 150228-Slate et al. 2000
- DIRS 176488-State of Nevada 2006
- DIRS 180975-Stewart, Carlson, and Johannessen 1982
- DIRS 181896-Bhark, Ruskauff, and Kelley 2005
- DIRS 147766-Thiel 1999
- DIRS 172905-USGS 1995
- DIRS 176325-USGS 2006
- DIRS 180759-Van Denburgh and Glancy 1970

- DOE completed quantitative analyses to calculate the estimated lateral extent of the drawdown cone of depression that would be induced in the aquifer surrounding each proposed new water-well location (or well cluster) during pumping at the water-well location(s) at the prescribed withdrawal rate. DOE performed quantitative analyses using one or more sets of analytical equations to correspond to one or more sets of assumptions. The analyses were designed to cover the range of possible aquifer conditions that might be encountered at the proposed well locations. For those proposed new well locations that were evaluated due to the presence of a nearby existing well with a water right, results of these analyses were combined with an analysis undertaken to quantitatively evaluate the radius of influence that might be induced by pumping at that existing well. DOE compared the results of the radius-of-influence calculations for both the proposed new location and the existing well to determine whether the drawdown cones of depression from the two well locations could contact each other. Analytical results demonstrated that such conditions (that is, that the radii of influence would intersect each other, based on the assumptions made for analysis) would occur only in a few cases. These cases of likely impact to existing groundwater were a result of high average groundwater withdrawal rates prescribed at a proposed new well location (see the sensitivity analysis cases described in Section G.1.2.4), unfavorable hydrogeologic conditions in the area, the proximity of the nearest existing well to the proposed well location, or a very large appropriated annual duty for the existing well. Sections G.1.2.2 and G.1.2.4 provide details regarding the calculation methods and assumptions.

Tables G-1 and G-2 list proposed new well locations for the Caliente and Mina rail alignments for which DOE performed hydrogeologic impact analyses.

**Table G-1.** Proposed new well locations pumped at specified average (base-case) groundwater withdrawal rates for which DOE performed groundwater impacts analyses – Caliente rail alignment (page 1 of 2).

| Proposed new well/ aquifer type[a] | Hydrographic area number | Hydrographic area name | Alternative segment/common segment |
|---|---|---|---|
| ClV1/AVF | 204 | Clover Valley | Eccles/Caliente common segment 1 |
| ClV2/AVF | 204 | Clover Valley | Eccles/Caliente common segment 1 |
| PanV1/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV4/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV23/AVF and VRA | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV2/PanV24/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV6/PanV3/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV25/PanV26/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/Caliente common segment 1 |
| PanV7/PanV8/AVF and OTH | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/Caliente common segment 1 |
| PanV13/PanV9/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/Caliente common segment 1 |
| DLV3/AVF and CRA | 181 | Dry Lake Valley | Caliente common segment 1 |
| DLV4/AVF and CRA | 181 | Dry Lake Valley | Caliente common segment 1 |
| PahV1/PahV2/PahV3/CRA | 208 | Pahroc Valley | Caliente common segment 1 |
| PahV7/PahV8/PahV9/CRA | 208 | Pahroc Valley | Caliente common segment 1 |
| GV2/AVF | 172 | Garden Valley | Garden Valley 2 |
| GV10/AVF | 172 | Garden Valley | Garden Valley 1 |
| RrV2/AVF | 173A | Railroad Valley South | Caliente comment segment 2/South Reveille 3/Caliente common segment 3 |
| RrV6/RrV11/AVF | 173A | Railroad Valley South | Caliente common segment 2/ South Reveille 2/Caliente common segment 3<br>Caliente common segment 2/ South Reveille 3/Caliente common segment 3 |
| RrV8/AVF | 173A | Railroad Valley South | Caliente common segment 2/South Reveille 3/Caliente common segment 3 |
| HC4/AVF | 156 | Hot Creek Valley | Caliente common segment 3 |
| HC5/HC7/AVF and VRA | 156 | Hot Creek Valley | Caliente common segment 3 |
| SCV3/AVF | 149 | Stone Cabin Valley | Caliente common segment 3 |
| ASV6/VRA | 142 | Alkali Spring Valley | Goldfield 4 |
| SaF4/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5 |
| SaF5/SaF9/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5<br>Bonnie Claire 2/common segment 5 |
| SaF7/SaF11/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5<br>Bonnie Claire 2/common segment 5 |
| OV9/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV24/OV25/OV26/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |

**Table G-1.** Proposed new well locations pumped at specified average (base-case) groundwater withdrawal rates for which DOE performed groundwater impacts analyses – Caliente rail alignment (page 2 of 2).

| Proposed new well/ aquifer type[a] | Hydrographic area number | Hydrographic area name | Alternative segment/common segment |
|---|---|---|---|
| OV12/OV18/OV19/OV20/ OV21/AVF and OTH | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |
| OV3/OV4/OV5/OV13/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6<br>Common segment 5/Oasis Valley 3/ common segment 6 |
| OV14/OV16/OV6/OV8/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV17/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |

a. Aquifer types are abbreviated as follows: AVF = alluvial valley fill; VRA = volcanic rock aquifer; CRA = carbonate rock aquifer; OTH = other: includes fluvial-lacustrine deposits (stream-lakebed derived), Cenozoic bedrock unit, or other consolidated rock unit (for example, limestone/dolomite, conglomerate, mudstone, and others).

**Table G-2.** Proposed new well locations pumped at the maximum groundwater withdrawal rates for which DOE performed groundwater impacts analyses – Mina rail alignment (page 1 of 2).

| Proposed new well/ aquifer type[a] | Hydrographic area number | Hydrographic area name | Alternative segment/common segment |
|---|---|---|---|
| WLa-2c/AVF | 110A | Walker Lake Valley-Schurz | Department of Defense Branchline North/ Schurz alternative segments 5 and 6/ Department of Defense Branchline South |
| WLa-3a/AVF | 110A | Walker Lake Valley-Schurz | Department of Defense Branchline North/ Schurz alternative segment 1/Department of Defense Branchline South |
| WLc-2a/AVF | 110C | Walker Lake Valley-Whiskey Flat-Hawthorne | Department of Defense Branchline South/ Mina common segment 1 |
| CSM-2a/AVF | 118 | Columbus Salt Marsh | Mina common segment 1 |
| CSM-3a/AVF | 118 | Columbus Salt Marsh | Mina common segment 1 |
| SSa-2/AVF | 121A | Soda Springs Valley East | Mina common segment 1 |
| SSa-3AVF | 121A | Soda Springs Valley East | Mina common segment 1 |
| SSa-4/AVF | 121A | Soda Springs Valley East | Mina common segment 1 |
| SSb-2/AVF | 121B | Soda Springs Valley West | Mina common segment 1 |
| BSa-1a/AVF | 137A | Big Smoky Valley-Tonopah Flat | Mina common segment 1/Montezuma alternative segment 1;<br>Mina common segment 1/Montezuma alternative segment 2 |

**Table G-2.** Proposed new well locations pumped at the maximum groundwater withdrawal rates for which DOE performed groundwater impacts analyses – Mina rail alignment (page 2 of 2).

| Proposed new well/ aquifer type[a] | Hydrographic area number | Hydrographic area name | Alternative segment/common segment |
|---|---|---|---|
| BSa-2a/AVF | 137A | Big Smoky Valley-Tonopah Flat | Mina common segment 1/Montezuma alternative segment 2 |
| BSa-3a/AVF | 137A | Big Smoky Valley-Tonopah Flat | Mina common segment 1/Montezuma alternative segment 2 |
| AS-1b/AVF | 142 | Alkali Spring Valley | Montezuma alternative segment 2 |
| AS-2b/AVF | 142 | Alkali Spring Valley | Montezuma alternative segment 2 |
| Cl-1a/AVF | 143 | Clayton Valley | Montezuma alternative segment 1 |
| Cl-8a/AVF | 143 | Clayton Valley | Montezuma alternative segment 1 |
| Cl-9a/AVF | 143 | Clayton Valley | Montezuma alternative segment 1 |
| Li-3a/AVF | 144 | Lida Valley | Montezuma alternative segment 1 |
| SaF4/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5 |
| SaF5/SaF9/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5, Bonnie Claire 2/common segment 5 |
| SaF7/SaF11/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5, Bonnie Claire 2/common segment 5 |
| OV24/OV25/OV26/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV12/OV18/OV19/OV20/ OV21/AVF and OTH | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |
| OV3/OV4/OV5/OV13/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6, common segment 5/ Oasis Valley 3, common segment 6 |
| OV9/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV14/OV16/OV6/OV8/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV17/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |

a. Aquifer types are abbreviated as follows: AVF = alluvial valley fill; VRA = volcanic rock aquifer; CRA = carbonate rock aquifer; OTH = other: includes fluvial-lacustrine deposits (stream-lakebed derived), Cenozoic bedrock unit, or other consolidated rock unit (for example, limestone/dolomite, conglomerate, mudstone, and others).

### G.1.2.2 Hydrogeologic Impacts Calculation Methods

DOE performed calculations using one or more sets of analytical equations reflecting one or more sets of assumptions made regarding the hydrogeologic conditions present at the analysis location. These calculations were designed to cover the range of possible aquifer conditions that might be encountered at the proposed new well locations. Applicable aquifer conditions varied according to well location, proposed well depth, and the available geologic and hydrogeologic information for each area. Types of aquifers considered for the various proposed locations included alluvial valley-fill aquifers, alluvial valley-fill aquifers with transecting faults, and faulted and/or fractured consolidated rock aquifers. Types of aquifer conditions assumed to exist at the various well locations for either the Caliente or the Mina rail alignment included:

- Infinite-extent unconfined aquifer
- Infinite-extent confined aquifer
- Semi-infinite-extent unconfined aquifer
- Semi-infinite-extent confined aquifer
- Carbonate and volcanic rock aquifers
- Limited-extent unconfined aquifer
- Limited-extent confined aquifer

A particular pumping well location could have calculations for more than one type of aquifer condition depending on the assumptions made due to varying geologic information from different reports. A particular pumping well location could have calculations for more than one type of aquifer condition depending on the assumptions made due to varying geologic information from different reports. Estimates of some aquifer parameters, such as aquifer thickness, alluvial materials present, and estimates of unconfined vs. confined aquifer conditions, were obtained from review of available well logs and numerous published geologic and hydrogeologic/groundwater resource appraisal reports (see references at the end of this appendix). With respect to aquifer hydraulic parameters assumed for completing the calculations, the calculation methodology used is based on the assumption that the host aquifer in each well would have the lowest value of saturated hydraulic conductivity or transmissivity that would be able to produce the average pumping rate required at that location. This approach results in the largest possible amount of drawdown and the largest possible horizontal radius of influence for the cone of depression induced at each pumping location and therefore provides a conservative measure of the potential impacts caused by the proposed well pumping. As part of each calculation package, the hydraulic conductivity or transmissivity values derived for each aquifer case considered in the calculation package were compared to published estimates (for example, DIRS 103136-Prudic, Harrill, and Burbey 1993, Table 3; DIRS 173179-Belcher 2004, Tables F-11 and F-12, together with DIRS 176852-Drici, Garey, and Buqo 1993, Table 2, and several published groundwater resource appraisal reports) of saturated hydraulic conductivity and transmissivity for the same aquifer or same type of aquifer in the area and/or region surrounding the proposed well location to assess the reasonableness and representativeness of the impact analysis results. For these locations with more than one potential type of aquifer condition, the results from the calculations for the different types of aquifer conditions served to identify the range and extent of possible impacts to the aquifer as a result of pumping groundwater. Sections G.1.2.2.1 through G.1.2.2.7 describe the analytical methods DOE utilized.

Hydrogeologic impacts analysis calculations were generally performed for those proposed construction wells that are intended to supply water for rail roadbed construction; development and operation of construction camps; and development and operation of potential quarries. Water consumption rates during the period of use of construction camps during the peak output year have been estimated at approximately 76 liters (20 gallons) per minute, which is equivalent to approximately 110,000 liters (28,800 gallons) per day (DIRS 180888-Converse Consultants 2007, Table 2-4). Methodologies and approaches used for evaluating impacts from wells intended to support the first two of these activities are provided in Sections G.1.2.2.1 through G.1.2.2.7 and Section G.1.2.4. Section G.1.2.3 provides a discussion of the approach used for evaluating potential impacts from groundwater withdrawals for wells used to support construction of rail facilities. Section G.1.2.5 provides a discussion of the approach used for evaluating potential impacts from groundwater withdrawals for wells used to support development and operation of proposed quarries.

Analysis of impacts from pumping of proposed new wells was based on calculations performed assuming one pumping well at each location. In cases where up to two wells were postulated to be installed on the same drilling pad (a number of proposed well sites along the Caliente rail alignment fall into this category), the calculations assumed one "equivalent" pumping well at the drill pad location. Although the use of only one equivalent well in the calculations represents an analytical simplification, a number of conservative assumptions were incorporated into the impacts analysis calculations including: (1) the targeted water-bearing zone was assumed to have the greatest possible saturated zone thickness based on the specified ranges of possible total well depths and estimated depths to the potentiometric surface (analysis results indicate that a thicker saturated zone thickness results in a greater impact (a larger radius of the cone of depression); (2) in cases where a suite of different well locations (one to two wells each on multiple well pads) were proposed to collectively provide the total water demands at a given rail alignment construction station, the single equivalent pumping well location selected from among that suite of well locations for use in the impacts analysis calculations was the one located closest to the nearest groundwater resource feature (well, spring, or seep); and (3) in each such multiple well pad case, the impacts analysis was based on the assumption that the total required groundwater pumping rate needed for meeting the total water demand at that station was applied to the (equivalent) well on the well pad located nearest the groundwater resource in question.

#### *G.1.2.2.1 Infinite-Extent Unconfined Aquifer*

For the case of an unconfined aquifer, the governing equation describing the relationship between the withdrawal rate of a well and the hydraulic head in the aquifer is (DIRS 105038-Bear 1979, eq. 8-24):

$$H_0^{\,2} - h^2 = \frac{Q_w}{\pi K} \ln\left(\frac{R}{r}\right)$$

The terms are:

$H_0$ undisturbed saturated thickness, [Distance or Length (L)],

h saturated thickness at distance "r" from the well, [L],

K hydraulic conductivity, [Length/Time (L/T)], where T is time

$Q_w$ withdrawal rate, [Volume ($L^3$)/T],

R radius of influence of the well, [L], and

r radial distance from the well, [L].

The saturated thickness (h) at distance "r" from the well, or h(r), is calculated as follows (DIRS 105038-Bear 1979, eq. 8-4 and Figure 8-4):

$$h(r) = \sqrt{H_0^{\,2} - \frac{Q_w}{\pi K} \ln\left(\frac{R}{r}\right)}$$

The drawdown "s" at distance "r" from the well (DIRS 105038-Bear 1979, Figure 8-4), or s(r), is calculated using the expression for h(r),

$$s(r) = H_0 - h(r) = H_0 - \sqrt{H_0^{\,2} - \frac{Q_w}{\pi K} \ln\left(\frac{R}{r}\right)}$$

When the hydraulic head at the face of the well is set to a given value ($h(r=r_w) = h_w$), the well capacity is obtained from the following relationship (DIRS 105038-Bear 1979, eq. 8-23):

$$H_0^{\ 2} - h_w^{\ 2} = \frac{Q_w}{\pi K} \ln\left(\frac{R}{r_w}\right) \qquad \text{or} \qquad Q_w = \frac{\pi K (H_0^{\ 2} - h_w^{\ 2})}{\ln\left(\frac{R}{r_w}\right)}$$

The drawdown "$s_w$" at the face of a well is a factor in both the capacity of the well and the extent of the well's radius of influence. This drawdown is generally not equal to the drawdown observed within the casing of the pumping well because of various head losses that take place near the well and within the well screened interval (perforated interval in well casing) and the sand pack (interval in the well bore annular space backfilled with sand). The magnitude of these losses depends mostly on the quality of well construction and characteristics of the water in the aquifer, and is difficult to estimate beforehand. Examples discussed in the literature (such as DIRS 116801-Driscoll 1986, pp. 244 and 245 and pp. 554 to 579) specify aggregate well and head losses for typical wells resulting in effective well efficiencies from on the order of 50 to more than 80 percent. It was assumed (conservatively) for these calculations that the useful drawdown, that is the drawdown at the face of the well, is equal to 85 percent of the maximum drawdown that can occur within the well casing. The selection of an 85 percent well efficiency results in a larger calculated radius of influence than would a lower efficiency value. This is deemed to be conservative but still a realistic assumption because, in general, carefully engineered, constructed, and developed wells could be expected to achieve efficiencies in the range of 70 to 80 percent (DIRS 116801-Driscoll 1986, p. 555). The 85 percent efficiency assumption is therefore based on conservative engineering judgment, and the published guidance provided in Driscoll 1986 (DIRS 116801, pp. 244 and 245 and pp. 554 to 579). For an unconfined aquifer, the theoretical maximum drawdown within a well is equal to the undisturbed saturated thickness minus the length of the well screen ($s_{max} = H_0 – L$), assuming that the bottom of the screen is located at the bottom of the aquifer and that the screen is not exposed during well operation (these are typical practices when a well is screened in an unconfined aquifer). It is also assumed that the screen is long enough to accommodate the pump. The maximum useful drawdown (at the well face) is then:

$$s_w = 0.85\ (H_0 – L)$$

The radius of influence is defined as the distance from the well where the drawdown becomes insignificant and can be neglected. For wells deriving most of their groundwater flow from water from recharge in the area immediately surrounding the well, this radius of influence can be estimated based on mass balance considerations. However, this scenario is likely not applicable in much of the study area, where ***evapotranspiration*** rates generally exceed precipitation rates and/or recharge rates to aquifers are very low (in lower-elevation valley bottom areas) (DIRS 176502-Rush 1964, Table 10; DIRS 103136-Prudic, Harrill, and Burbey 1993, p. 2; DIRS 180759-Van Denburgh and Glancy 1970, p. 17 and Table 6; DIRS 169384-Reiner et al. 2002, Table 5). For wells assumed to derive most of their flow from the horizontal movement of water within the aquifer, as is typically the case in this analysis, empirical formulae were developed to estimate the radius of influence. Two such formulae are presented (DIRS 105038-Bear 1979, eqns. 8-11 and 8-12); note that units are meters and seconds and that $s_w$ is the drawdown at the face of withdrawal well ($s_w = H_0 - h_w$):

$$R = 3{,}000\ s_w\ K^{1/2} \qquad \text{and} \qquad R = 575\ s_w\ (H_0\ K)^{1/2}$$

DOE used the second of these two formulae in this analysis, because it is expressed in terms of aquifer transmissivity "$H_0$ K" and can be directly applied to cases involving both confined and unconfined aquifers. The first formula uses the hydraulic conductivity, which in the case of a confined aquifer, would have to be calculated by assuming a given thickness of the permeable zone, which may be unknown.

An example of a proposed water-supply area where an infinite-extent, unconfined alluvial aquifer case was assumed is well location SCV3 in the Stone Cabin Valley hydrographic area along proposed Caliente common segment 3. The SCV3 location lies in an area underlain by alluvial valley fill. The nearest mapped rock units are at least several miles from the proposed well site; therefore, an infinite-extent, alluvial aquifer is assumed.

Another example of a proposed water-supply well location where an infinite-extent unconfined aquifer was assumed is the proposed well location Cl-1A southwest of the community of Silver Peak in hydrographic area 143 (Clayton Valley) along the Mina rail alignment. This well location would be southwest of an existing well field that services Silver Peak. This well location and the corresponding analysis is a special case in that the proposed withdrawal rate at the Cl-1A well location is approximately 1,300 liters (350 gallons) per minute (gpm) or less. This withdrawal rate is higher than the anticipated withdrawal rate for other proposed new water-supply wells along the Mina rail alignment because groundwater underlying much of Clayton Valley is extremely brackish (DIRS 180760-Albers and Stewart 1972, p. 2). Therefore, locations that could serve as sources of better-quality groundwater for use in rail roadbed construction and for supplying water for a proposed construction camp in this vicinity are very limited in this area.

#### *G.1.2.2.2 Infinite-Extent Confined Aquifer*

If the producing zone in the host aquifer occurs below a relatively thick, impermeable layer, such as a layer of clay, then the system could behave as a confined aquifer. For a confined aquifer, the relationship between the withdrawal rate of a well and the hydraulic head in the aquifer can be written as follows (DIRS 105038-Bear 1979, eq. 8-6):

$$s = \frac{Q_w}{2\pi T} \ln\left(\frac{R}{r}\right)$$

where the terms are:

T transmissivity T = $H_0$ K (undisturbed saturated thickness times the hydraulic conductivity) [$L^2$/T; where T is time].

s drawdown, [L],

$Q_w$ withdrawal rate, [$L^3$/T],

R radius of influence of the well, [L], and

r radial distance from the well, [L].

For drawdown at the well face, the expression for well capacity becomes (DIRS 105038-Bear 1979, eq. 8-4):

$$Q_w = \frac{s_w 2\pi T}{\ln\left(\frac{R}{r_w}\right)}$$, where T is transmissivity

The formula for the radius of influence used in these calculations for a confined aquifer is the same as that used for the unconfined case. As for the case of an unconfined aquifer, it was assumed for these calculations that the useful drawdown (that is, the drawdown at the face of the well) would be equal to 85 percent of the maximum drawdown that could occur within the well casing. In the confined case, the theoretical maximum drawdown within the well is the distance between the static hydraulic head to the top of the permeable zone ($s_{max} = \varphi_0 - EL_{top}$). The maximum useful drawdown is then:

$$s_w = 0.85\ (\varphi_0 - EL_{top})$$

An example of a proposed water-supply area where an infinite-extent confined alluvial aquifer case was assumed consists of the proposed set of new well locations HC5 and HC7 in the Hot Creek Valley hydrographic area along the Caliente rail alignment. The proposed well locations are considered infinite-extent confined because location HC5/HC7 is described as being on mapped alluvial valley-fill materials, the estimated total depth of the wells is 150 meters (500 feet), and it was considered possible that a relatively impermeable geologic layer, such as a clay unit, might be present above the targeted aquifer, which could lead to confined conditions.

### *G.1.2.2.3 Semi-Infinite-Extent Unconfined Aquifer*

DOE assumed a semi-infinite-extent confined alluvial aquifer case for some proposed well locations where a single (linear) geologic boundary exists adjacent to the proposed well location(s) and assumed that this boundary might act as a no-groundwater-flow feature (flow barrier) that could affect groundwater flow characteristics in the aquifer surrounding the pumping well location(s). Geologic boundaries considered as representing potential no-flow boundaries include faults offsetting a geologic unit of likely low permeability (low hydraulic conductivity) from a geologic unit of likely higher permeability (higher hydraulic conductivity) or an unfaulted geologic contact between two such different geologic units. For these cases, the relationship between the withdrawal rate of a well and the hydraulic head in the aquifer can be calculated using the same formulae as for the infinite-extent unconfined aquifer described in Section G.1.2.2.1. However, in these cases, to account for this assumed adjacent no-flow boundary, the system is modeled by increasing the withdrawal rate in the pumping well by a factor of two to simulate the adjacent boundary. The "method of images" is used in this case to account for the possible no-flow boundary adjacent to the proposed well (DIRS 105038-Bear 1979, p. 356).

To simulate a no-flow boundary, an image pumping well is placed opposite the real pumping well on the other side of the boundary. The system simulating the pumping well and the boundary therefore consists of the real well and an image well, both equal in strength. Strictly speaking, a semi-infinite aquifer has two boundaries, and the far boundary should be treated in the same way. However, in most cases, this far boundary would be a great enough distance from the proposed well (in other words, the far boundary would lie beyond the radius of influence for the proposed pumping well) that the effects of this far boundary on the proposed pumping well would be negligible and can be ignored. Because the proposed well location is adjacent to one boundary and far enough away from the other boundary, a semi-infinite aquifer is considered. One can assume that in relation to the adjacent boundary, the proposed well is close enough to this no-flow boundary that the distance between it and its reflection (image well) across that boundary is negligible. Recall that the image well is equal in strength to the real well. Therefore, the system can be approximated by keeping only the real pumping well and increasing its extraction rate by a factor of two, which is the same as placing the image well right at the same location of the real well.

For the case of an idealized no-flow boundary where a potential no-flow boundary lies within the radius of influence of the proposed pumping well, the relationship between the pumping rate of a well and the hydraulic head in the aquifer can be calculated using the same formulae as for an infinite-extent aquifer, but with the effects of the adjacent potential no-flow boundary taken into account using the method of images (DIRS 105038-Bear 1979, pp. 356 to 367). The method of images is used to simulate the potential effects of the adjacent boundary (assumed to act as a no-flow barrier) on groundwater flow behavior within the region of influence surrounding the proposed pumping well. To simulate the effect of an adjacent assumed no-flow boundary, an image pumping well is placed opposite the real well an equal distance away from, and on the opposite side of, the boundary with respect to the real well. In theory, the process of placing image wells should be repeated to infinity, with each new image well located progressively farther from the real well on the opposite side of a simulated parallel and more distant boundary. However, after a certain number of image wells is introduced, their distance to the real well increases to such an extent that their contribution to drawdown at the real well becomes negligible. The series can thus be truncated and still result in a reasonably good approximation of drawdown.

Using the principle of superposition, the drawdown at any observation point located within the calculated region of influence surrounding the pumping well can then be approximated by summing the drawdown determined for the real well and the drawdowns for the associated simulated image wells, where the real well and the image wells are all assumed to be operating in a simulated infinite-extent aquifer (DIRS 105038-Bear 1979, pp. 356 to 367).

To solve for the radius of influence, the infinite-extent aquifer formula, unconfined in this case, can be used, but the pumping rate substituted in the equation must equal the actual pumping rate multiplied by two. Note that assuming an impervious boundary is conservative. In reality, geological boundaries would not be completely impervious and would provide some flow. This is especially true for cases where a fault occurs in alluvial valley-fill deposits. In such cases, the faulted zone/fault boundaries would not likely be completely impermeable to flow. This flow across the boundary would lessen the impact of the proposed well on the aquifer. Therefore, the assumption that such faults would act as completely impermeable barriers to flow is conservative; that is, this assumption would result in the determination of a greater amount of impact than might actually occur.

An example of a new well location where DOE assumed a semi-infinite-extent unconfined alluvial aquifer case is proposed new well location RrV8 (a quarry well) in the Railroad Valley South hydrographic area along the Caliente rail alignment. The proposed well location is situated in a valley-fill alluvial aquifer adjacent to mapped volcanic rock units. Section G.1.2.5 describes the methodology and approach used in the hydrogeologic impacts calculation performed for this location.

#### *G.1.2.2.4 Semi-Infinite-Extent Confined Aquifer*

DOE assumed a semi-infinite-extent confined alluvial aquifer case for some proposed new well locations where the same conditions occur that are described in Section G.1.2.2.3 except that the host aquifer is assumed to be confined rather than unconfined in nature. For the case of a semi-infinite-extent confined aquifer, the relationship between the withdrawal rate of a well and the hydraulic head in the aquifer can be calculated using the same formulae as for the infinite-extent confined aquifer described in Section G.1.2.2.2. However, as in the semi-infinite-extent unconfined aquifer case, DOE assumed that a (linear) no-flow boundary exists and that this no-groundwater flow feature lies adjacent to the proposed withdrawal well. To simulate the no-flow boundary, the "method of images" is used (DIRS 105038-Bear 1979, p. 356). Section G.1.2.2.3 provides a more detailed explanation concerning the use of "method of images" for a semi-infinite aquifer case. Because the no-flow boundary is adjacent to the pumping well location, the system is approximated by a real well and an image well, both at the same location and extracting groundwater at the same rate. Therefore, the formula for an infinite-extent confined aquifer is applicable, provided the pumping rate used in the formula is double the actual pumping rate (to account for the image well).

An example of a new well location where DOE assumed a semi-infinite-extent confined alluvial aquifer case is proposed new location PanV6/PanV3 in the Panaca Valley hydrographic area. The proposed well location is mapped in alluvial valley fill, and is adjacent to rock units variously characterized as "tuffaceous sedimentary rocks" or lakebed deposits (Panaca Formation). The lithologic makeup of these rock materials and available published information suggest that these rock materials might be either relatively permeable or relatively impermeable, depending on location. Based on this condition and the existing available hydrogeologic information for the area surrounding the proposed PanV6/PanV3 location, DOE assumed the host aquifer for well location PanV3/PanV6 to be a horizontal alluvial aquifer, semi-infinite in extent, and confined.

#### *G.1.2.2.5 Carbonate and Volcanic Rock Aquifers*

The hydrogeologic characteristics of carbonate rock aquifers and volcanic rock aquifers vary depending on their location within the areas that either the Caliente rail alignment or the Mina rail alignment would cross. Depending on factors such as the degree of fracturing or faulting, and degree of welding, volcanic rocks along the proposed rail alignments might be either relatively permeable to relatively impermeable, or even moderately permeable (transmissive) with respect to groundwater flow. Carbonate rock aquifers present within some areas of the proposed rail alignments are generally assumed to be relatively permeable due to fracturing and openings caused by dissolution (see DIRS 103136-Prudic, Harrill, and Burbey 1993, p. 13). In the hydrogeologic impact calculations, for those cases where the aquifer was assumed to be comprised of carbonate rock or permeable volcanic rock, DOE treated the aquifer as an equivalent porous media and used the same formulae as for the infinite-extent unconfined or confined aquifer cases (Sections G.1.2.2.1 and G.1.2.2.2 above).

DOE assumed a volcanic rock aquifer case at proposed new well location ASV6 in the Alkali Spring Valley hydrographic area. This proposed well location is in an area of mapped volcanic rock units and alluvial fan deposits with the target aquifer being a fractured volcanic rock unit, assumed to be overlain by a layer of alluvial fan materials (DIRS 182822-Converse Consultants 2007, Appendix B). An example of a new well location where DOE assumed a carbonate rock aquifer is proposed new location DLV4 for the Caliente rail alignment in the Dry Lake Valley hydrographic area. The proposed well location is in an area underlain by alluvial valley fill; however, a carbonate rock aquifer underlying the alluvial materials is assumed to be host aquifer for the well based on the characteristics of other wells installed in this area (DIRS 182822-Converse Consultants 2007, Appendix B).

#### *G.1.2.2.6 Limited-Extent Unconfined and Confined Aquifers*

DOE assumed a limited-extent unconfined aquifer case for some locations where multiple potential no-flow boundaries are located adjacent to the proposed new well location(s). A limited-extent aquifer case was assumed for proposed new well locations OV3, 4, 5, and 13 in the Oasis Valley hydrographic area (area 228). The Oasis Valley hydrographic area calculations assumed a wedge-shaped alluvial aquifer of limited extent because of the presence of different rock units along the sides of the wedge-shaped alluvium. In this case, it was assumed that the two lateral boundaries of the alluvial aquifer could represent geologic contacts with relatively impermeable volcanic rocks. At Oasis Valley, the source of water to Upper Oasis Valley Ranch Springs downgradient of the proposed well locations was assumed to be groundwater underflow derived from upgradient areas, possibly with some vertical inflow component.

Another example location where this type of analysis was performed is the proposed well at location WLa-2c for the Mina alignment. For this location, adjacent no-flow boundaries might exist to the north and south of the proposed well site, and, to some extent, possibly also to the east of the well site. In this case, the geometric configuration of the system including the potential nearby boundaries around the proposed pumping well could be roughly approximated by a system comprised of an alluvial aquifer occupying a quadrant of a vertical circular cylinder (see DIRS 105038-Bear 1979, Figure 8-26). By applying the concepts used for the case of a semi-infinite aquifer, this system of potential no-flow boundaries could be simulated by assuming a pumping rate equal to four times the simulated pumping rate in the formula for an infinite, confined aquifer, which is equivalent to including three images wells in the analysis (that is, using a simulated pumping rate at the proposed well site equal to the actual required pumping rate multiplied by four). Thus, the simulated pumping rate assumed for the new well at the WLa-2c location is four times the actual required pumping rate at that well location, resulting in a conservative assessment of potential pumping-induced impacts.

DOE intended the approach taken in the limited-extent unconfined aquifer calculations to be very conservative, because the lateral boundaries likely are not true no-flow boundaries. Available information suggests that at both locations there is likely to be some hydraulic connection between the alluvium and adjacent rock units, which would support an assumption that at least some groundwater underflow from adjacent rock units to the alluvial aquifer would occur (see DIRS 169384-Reiner et al. 2002, pp. 8 to 10 for the case of the Oasis Valley calculations).

At Oasis Valley, DOE assumed an upper-bound limiting pumping rate at the proposed wells that would not affect discharge rates at existing springs downgradient of the proposed new well locations. To evaluate the potential impact of such pumping on existing spring discharges, two criteria must be considered: the radius of influence and the relative percentage of the withdrawal rate to total aquifer discharge. In this evaluation, DOE assumed the total discharge from springs to be similar to the aquifer discharge, which is a conservative assumption because the total spring discharge would represent the lowest possible aquifer discharge (given that evapotranspiration is a significant component of aquifer discharge). Because DOE assumed a limited-extent aquifer, it was necessary to establish an upper bound for the pumping rate to ensure that the proposed groundwater withdrawal would not impact aquifer conditions enough to alter water levels throughout the aquifer. In this calculation, DOE estimated that the maximum pumping rate at the proposed groundwater pumping wells should be at least an order of magnitude (a factor of 10) lower than the total discharge from the limited-extent aquifer (assumed to be the total discharge rate from the springs in the alluvium). With this constraint, DOE then calculated a radius of influence for each proposed new well location and compared these calculated radii of influence to the distances separating each proposed new well location and the nearest existing spring to show that these calculated radii of influence would be valid and representative indicators of the extent of impact at each proposed pumping location, and demonstrate that existing springs should not be affected by the proposed groundwater withdrawals.

#### *G.1.2.2.7 Treatment of Faults and Major Fracture Systems*

For a selected set of new groundwater withdrawal well locations, the proposed new well was determined to be located in the vicinity of one or more faults or extensive fracture systems or was found to be specifically targeted for installation directly within a major fault zone or an extensive fracture zone (DIRS 182822-Converse Consultants 2007, Appendix B). For such cases, additional evaluations of hydrogeologic data and/or additional analyses were performed.

In cases where a proposed well was determined to be oriented lateral to a mapped fault trace or fracture zone trace, the fault or fracture zone was treated as a potential no-flow barrier if it was located sufficiently close to the proposed new well to be within the region of influence from pumping at that well location. In such cases, the calculations included a specific method (method of images as described in Section G.1.2.2.3) to simulate the potential effects of the fault or fracture zone on groundwater flow behavior.

Hydraulic tests performed in faulted and fractured consolidated rock aquifers at a few wells in the region of the Nevada Test Site and Yucca Mountain indicate that high-permeability zones associated with faults are capable of acting as conduits for transmitting hydraulic responses from pumping wells over larger-scale (on the order of kilometers) distances if the pumping well draws its water from the fault zone. These flow conduit effects have been observed for both faulted and fractured volcanic rock and faulted and fractured carbonate rock aquifers (DIRS 181896-Bhark, Ruskauff, and Kelley 2005, Section 2.0; DIRS 129721-Geldon et al. 1998, pp. 23 to 24 and p. 31). Results from pump tests conducted at these wells often indicate that very complex hydrogeologic conditions, including heterogeneous hydraulic rock properties, the presence of complex structural systems controlling flow, and other non-isotropic conditions, exist at these test sites. For these reasons, where a proposed new well was initially identified as targeting a specific fault or fracture system that might be capable of acting as a high-permeability conduit, DOE identified the locations of existing wells, springs, seeps, or other surface-water-right locations up to 9.7 kilometers (6 miles) away from each such proposed well. In these cases, DOE reviewed available data on existing wells and springs and locations of known (mapped) fault and fracture zone traces within the 9.7-kilometer radius surrounding each new well location and compared these with the locations of the proposed well to estimate the likelihood of a hydraulic connection occurring between the proposed well and existing wells, springs, seeps, or other surface-water-right locations beyond a distance of 2.8 kilometers (1.75 miles) but within the approximately 9.7-kilometer distance. If sufficient evidence was found that a proposed new well would likely intercept a fault/fault zone, and that an existing well, spring, seep, or other surface-water-right location within the 9.7-kilometer search distance could likely be hydraulically connected to the proposed withdrawal well withdrawal zone, potential impacts to the nearest such well or spring caused as a result of the proposed withdrawal were assessed. Tables G-3 and G-4 summarize those proposed new well locations for the Caliente and Mina rail alignments, respectively, where a fault or fault zone was initially targeted as a potential water-bearing zone for a new well.

**Table G-3.** Proposed new well locations where a fault or fault zone was initially identified as a targeted water-bearing zone – Caliente rail alignment.

| Well location identification | Rail line segment |
|---|---|
| PanV14/PanV16 | Caliente common segment 1 |
| DLV2, DLV3, DLV4, and DLV6 | Caliente common segment 1 |
| PahV1 and PahV2 | Caliente common segment 1 |
| PahV5 and PahV8 | Caliente common segment 1 |
| HC5/HC7 | Common segment 3 |
| StF10 | Goldfield alternative segments |
| LV5/LV13 | Goldfield alternative segments |
| LV8/LV19 | Goldfield alternative segments |
| OV7/OV15 | Common segment 6 |
| OV22/OV23 | Common segment 6 |

**Table G-4.** Proposed new well locations where a fault or fault zone was initially identified as a targeted water-bearing zone – Mina rail alignment.

| Well location identification | Rail line segment |
|---|---|
| BSa-3a | Mina common segment 1/Montezuma alternative segments 2 and 3 |
| WLa-1c | Department of Defense Branchline North/Schurz alternative segment 4/Department of Defense Branchline South |
| CSM-2a | Mina common segment 1 |
| As-2a and AS-3a | Montezuma alternative segment 1 |
| OV7/OV15 | Common segment 6 |
| OV22/OV23 | Common segment 6 |

### G.1.2.3 Groundwater Withdrawals for Construction of Rail Facilities and Sidings

Water needs and required groundwater well withdrawal rates associated with construction of rail facilities and sidings are small compared to the amount of water required to support construction of the rail line. Construction of the Cask Maintenance Facility would require approximately 4,400 cubic meters (approximately 3.6 acre-feet, or 1.176 million gallons) of water, with construction estimated to occur over approximately 2 years (DIRS 104508-CRWMS M&O 1999, Table III-2). The amount of water needed to construct the other facilities (Staging Yard, Maintenance-of-Way Facilities, and the Rail Equipment Maintenance Yard) would range from approximately 14,000 to 200,000 cubic meters, which is equivalent to 11.5 to 161.1 acre-feet, or 3.75 to 52.5 million gallons (DIRS 180873-Nevada Rail Partners 2007, Table 2-2; DIRS 180919-Nevada Rail Partners 2007, Section 3.1.5). When compared to the total amount of water needed for railroad construction, and compared to existing groundwater resources in the respective hydrographic areas where the facilities would be constructed, the direct short-term impacts to groundwater resources in the respective hydrographic areas due to water withdrawals associated with construction of facilities and sidings would be small and long term. Direct and indirect impacts on groundwater resources also would be small. For this reason, DOE did not perform quantitative impact analyses for water wells that would be used (for example, at proposed base-case withdrawal rate) solely to support construction of these facilities and sidings (DIRS 182822-Converse Consultants 2006, Appendices A and B; DIRS 180888-Converse Consultants 2007, Appendices A through X).

### G.1.2.4 Sensitivity Analysis

#### *G.1.2.4.1 Caliente Rail Alignment*

The productivity of the proposed wells would vary depending on a number of variables, including aquifer depth, aquifer lithology, permeability, well efficiency, degree of cementing or fracturing present in the host aquifer, the presence or absence of nearby faults or flow boundaries, or other factors. Therefore, it might be necessary to use one or more highly productive wells rather than all proposed wells within each hydrographic area. Higher withdrawal rates at one or more highly productive wells could help fulfill more of the required water demand within a hydrographic area if other wells had lower-than-expected productivities. It should be noted that the temporary nature of the construction water wells would require that short-term higher withdrawal rates be only temporarily imposed. This factor would help reduce potential long-term impacts of increased withdrawal at the applicable higher-productivity locations.

To allow for possible uncertainties in future well productivities and withdrawal rates, DOE considered the possibility of using more highly productive wells and performed sensitivity analyses to evaluate the degree of increased impacts expected to result from the imposition of higher (in other words, higher short-term or peak) withdrawal rates at such more productive water-well locations. For planning purposes, DOE assumed that a maximum withdrawal rate of 0.014 cubic meter (0.5 cubic foot) per second (approximately 852 liters [225 gallons] per minute) might, at least in theory, be imposed at any of the proposed new well locations (with the exception of proposed quarry wells, as described in Section G.1.2.5). Table G-5 lists the proposed new well locations where DOE performed sensitivity analysis calculations. The methodologies and analytical equations used for completing these sensitivity analyses are the same as described in Section G.1.2.2.

**Table G-5.** Proposed new well locations pumped at higher groundwater withdrawal rates (sensitivity analysis) for which DOE performed groundwater impacts analyses – Caliente rail alignment.

| Name of proposed well/ aquifer type[a] | Hydrographic area number | Hydrographic area name | Alternative segment/common segment |
|---|---|---|---|
| PanV1/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV4/AVF | 203 | Panaca Valley | Caliente/Caliente common segment 1 |
| PanV5/AVF | 203 | Panaca Valley | Caliente/Caliente common segment 1 |
| PanV2/PanV24/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV6/PanV3/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1 |
| PanV25/PanV26/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/Caliente common segment 1 |
| PanV7/PanV8/AVF and OTH | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/Caliente common segment 1 |
| PanV13/PanV9/AVF | 203 | Panaca Valley | Eccles/Caliente common segment 1<br>Caliente/common segment 1 |
| DLV3/AVF and CRA | 181 | Dry Lake Valley | Caliente common segment 1 |
| DLV4/AVF and CRA | 181 | Dry Lake Valley | Caliente common segment 1 |
| PahV1/PahV2/PahV3/CRA | 208 | Pahroc Valley | Caliente common segment 1 |
| PahV7/PahV8/PahV9/CRA | 208 | Pahroc Valley | Caliente common segment 1 |
| GV2/AVF | 172 | Garden Valley | Garden Valley 2 |
| GV10/AVF | 172 | Garden Valley | Garden Valley 1 |
| RrV2/AVF | 173A | Railroad Valley South | Caliente common segment 2/South Reveille 2/Caliente common segment 3 |
| RrV6/RrV11/AVF | 173A | Railroad Valley South | Caliente common segment 2/South Reveille 2/South Reveille 3/Caliente common segment 3 |
| HC4/AVF | 156 | Hot Creek Valley | Caliente common segment 3 |
| HC5/HC7/AVF and VRA | 156 | Hot Creek Valley | Caliente common segment 3 |
| SCV3/AVF | 149 | Stone Cabin Valley | Caliente common segment 3 |
| SaF4/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5 |
| SaF5/SaF9/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5,<br>Bonnie Claire 2/common segment 5 |
| SaF7/SaF11/AVF | 146 | Sarcobatus Flat | Bonnie Claire 3/common segment 5,<br>Bonnie Claire 2/common segment 5 |
| OV9/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV24/OV25/OV26/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV12/OV18/OV19/OV20/ OV21/AVF and OTH | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |
| OV14/OV16/OV6/OV8/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 1/ common segment 6 |
| OV17/AVF | 228 | Oasis Valley | Common segment 5/Oasis Valley 3/ common segment 6 |

a. Aquifer types are abbreviated as follows: AVF = alluvial valley fill; VRA = volcanic rock aquifer; CRA = carbonate rock aquifer; OTH = other: includes fluvial-lacustrine deposits (stream-lakebed derived), Cenozoic bedrock unit, or other consolidated rock unit (for example, limestone/dolomite, conglomerate, mudstone, and others).

DOE evaluated potential impacts on existing wells and existing springs, seeps, or other surface-water right locations caused by these higher-withdrawal-rate wells by evaluating the size of the radius of influence induced by pumping at the hypothetical higher withdrawal rate. DOE applied the same types of equations to the nearest existing well with a water right located nearest to each higher-withdrawal-rate well to calculate the estimated radius of influence induced by pumping at the existing well. The geology and hydrogeology associated with existing and proposed wells were evaluated to identify the appropriate flow equations in the same manner as described in Sections G.1.2.2.1 and G.1.2.2.2. In these sensitivity analysis calculations, pumping-rate assumptions used for existing wells were derived from annual duty (appropriated annual duty) and diversion rate data contained in the NDWR Water Rights Database.

#### *G.1.2.4.2 Mina Rail Alignment*

Sensitivity analyses were not required for well locations proposed for the Mina rail alignment. Calculations performed for evaluating groundwater impacts for the proposed Mina well locations initially assumed a maximum pumping rate expected to be applied at each location, approximately 852 liters (225 gallons) per minute, which is identical (with the exception of proposed new well location Cl-1a, where a withdrawal rate of approximately 1,300 liters [350 gallons] per minute or less was assumed) to the potentially higher-withdrawal-rate value used in each sensitivity analysis calculation completed for the Caliente alignment well locations.

### G.1.2.5 Quarry Water Wells

#### *G.1.2.5.1 Caliente Rail Alignment*

The construction impacts assessments also included the evaluation of the potential impacts from pumping at new water wells proposed to support quarry operations along the Caliente rail alignment. DOE considered the potential for impacts to occur resulting from proposed groundwater withdrawals from the proposed quarry water well locations for both the Caliente and Mina rail alignments. Based on the review of the available information, DOE completed impacts analysis calculations for the following proposed quarry well locations:

- One water well (PanV23) associated with a potential quarry northwest of the community of Caliente in hydrographic area 203 in Lincoln County
- Up to two water wells (RrV8 and RrV10) associated with a potential quarry northeast of South Reveille alternative segments 2 and 3 in hydrographic area 173A in Nye County
- Up to two water wells (AsV6 and AsV7) associated with a potential quarry in hydrographic area 142 in Nye County

Each quarry would operate for approximately 2 years following an initial startup period. Water consumption rates during the period of use of quarries have been estimated at approximately 90.8 liters (24 gallons) per minute, which is equivalent to approximately 131,000 liters (34,560 gallons) per day (DIRS 180888-Converse Consultants 2007, Table 2-4). The *Hydrogeologic DEIS Analysis Report, REV. 3, April 27, 2007* (DIRS 182822-Converse Consultants 2006, all) provides details pertaining to the characteristics and use of the water wells that would be associated with these potential quarry sites. DOE performed impacts analysis calculations for potential quarry wells PanV23, RrV8, and AsV6. An example of the methodology used for a quarry well impact calculation (for proposed well RrV8) is summarized below.

For proposed well site RrV8, DOE proposes a 90- to 120-meter (300- to 400-foot)-deep quarry well and anticipates that this well would be used to supply water at a withdrawal rate of 91 liters (24 gallons) per minute over approximately a 2-year period following an initial startup period (DIRS 182822-Converse

Consultants 2006, Appendix A). Based on geologic information for this area, the well would likely be screened in an alluvial aquifer adjacent to volcanic rock units. Available published information suggests that the volcanic rock materials might be either relatively permeable or relatively impermeable, depending on location. DOE assumed a semi-infinite-extent unconfined alluvial aquifer wherein the adjacent volcanic unit (lava-flow unit) was assumed to be an essentially impermeable rock unit. Based on hydrogeologic information for the area surrounding the proposed RrV8 well location, the host aquifer for the well location RrV8 was assumed to be a horizontal alluvial aquifer and unconfined. The semi-infinite aquifer case is considered to be conservative because the adjacent volcanic rock unit is not likely to be completely impermeable.

Because the potential quarry sites are typically located in bedrock-dominated terrain, a groundwater well installed at these locations would be unlikely to have the capacity to supply any extra water beyond that required (approximately 91 liters [24 gallons] per minute) for quarry operations. Therefore, DOE did not perform additional sensitivity analyses for the quarry water wells to assess any increased impacts that might result from imposing higher withdrawal rates at these well sites.

#### *G.1.2.5.2 Mina Rail Alignment*

The construction impacts assessments also included the evaluation of the potential impacts from pumping at new water wells proposed to support quarry operations along the Mina rail alignment. DOE evaluated impacts from one proposed quarry water well, WLc-2a, associated with a potential quarry in Garfield Hills in hydrographic area 110C in Mineral County. Each quarry used to support construction of the Mina alignment would operate for approximately 2 years following an initial startup period. The *Hydrogeologic DEIS Analysis Report, REV. 3, April 27, 2007* (DIRS 182822-Converse Consultants 2006, all) provides details pertaining to the characteristics and use of the water wells that would be associated with these potential quarry sites. Section G.1.2.5.1 provides an example of the methodology used for a quarry well impact calculation (for a proposed quarry well at location RrV8 along the Caliente rail alignment).

## G.1.3 OPERATIONS IMPACTS ASSESSMENT

### G.1.3.1 Caliente Rail Alignment

#### *G.1.3.1.1 Overview*

The operations impacts assessment included estimating groundwater-supply impacts associated with operation of the rail line and railroad construction and operations support facilities.

#### *G.1.3.1.2 Facility Operations*

Permanent facilities considered include the Staging Yard, the Maintenance-of-Way Facility, the Maintenance-of-Way Headquarters Facility, the Rail Equipment Maintenance Yard, the Cask Maintenance Facility, Facilities at the Interface with the Union Pacific Railroad Mainline, and rail sidings. These would be permanent facilities corresponding to an assumed railroad operations phase of up to 50 years.

#### *G.1.3.1.3 Evaluation of Potential Hydrogeologic Impacts*

Details on the water requirements activity and groundwater impacts at the rail operations facilities are provided in the *Facilities–Design Analysis Report Caliente Rail Corridor, Task 10: Facilities, Rev. 03* (DIRS 180919-Nevada Rail Partners 2007, Section 3.1.5). These facilities would require only limited amounts of water, with water required for operations estimated to range from approximately 9,500 to 23,000 liters (2,500 to 6,000 gallons) per day at the facilities, which is equivalent to approximately 6 to

16 liters (1.7 to 4.2 gallons) per minute. Operations water requirements were derived from estimated staffing and shift projections, a 190-liter per day (50-gallon per day) per capita use ratio, estimated shop process needs, and a multiplier of 1.5 to account for miscellaneous water needs (DIRS 180873-Nevada Rail Partners 2007, Section 3.1.5; DIRS 180919-Nevada Rail Partners 2007, Section 3.1.5). Water needed for meeting emergency water storage capacity requirements (for fire safety) are estimated to range from approximately 379,000 to 833,000 liters (100,000 to 220,000 gallons). Water needs for meeting water storage requirements at each facility could be readily met using a new low-productivity well. Because the well withdrawal rates (approximately 16 liters [4.2 gallons] per minute or less) required to support operation of these railroad operations support facilities are relatively low (DIRS 180919-Nevada Rail Partners 2007, Table 3-B), the magnitude of impacts on the host aquifers for the individual facility water-supply wells would be expected to be small. For this reason, DOE did not perform quantitative impacts analyses for water wells that would be used (for example, at proposed base-case withdrawal rate) solely to support operation of these facilities.

### G.1.3.2 Mina Rail Alignment

#### *G.1.3.2.1 Overview*

The operations impacts assessment included estimating groundwater-supply impacts associated with operation of the rail line and railroad construction and operations support facilities.

#### *G.1.3.2.2 Facility Operations*

Permanent facilities considered include the Staging Yard at Hawthorne in hydrographic area 110C, the Maintenance-of-Way Facility at either Silver Peak in hydrographic area 143 or Klondike in hydrographic area 142, the Rail Equipment Maintenance Yard in hydrographic area 227A, and proposed sidings in several hydrographic areas. These would be permanent facilities corresponding to an assumed railroad operations period of up to 50 years.

#### *G.1.3.2.3 Evaluation of Potential Hydrogeologic Impacts*

Similar to the case for the Caliente rail alignment, DOE did not perform quantitative impact analyses for water wells that would support facilities operations or sidings. The reason for not performing quantitative analyses is the same as for the Caliente alignment – because required well withdrawal rates for wells supporting operation of facilities and sidings are very small, the magnitude of short-term or long-term impacts on the host aquifer for the individual facility water wells would be small.

# G.2 Shared-Use Option

## G.2.1 CONSTRUCTION IMPACTS ASSESSMENT – CALIENTE RAIL ALIGNMENT

Under the Shared-Use Option, additional commercial access sidings would be constructed as a third track alongside passing sidings. However, the total length of the additional sidings would be relatively short in comparison to the total length of the rail line. The water requirement for construction of the rail line under the Shared-Use Option would only increase by approximately 150,000 cubic meters (122 acre-feet), or approximately 2 percent, compared to the total estimated likely water demand of 7.52 million cubic meters (6,100 acre-feet) for construction of the rail line without shared use.

For purposes of this analysis, DOE assumed that the commercial access sidings would be in the same hydrographic areas the Caliente rail alignment would cross. Therefore, additional impacts to groundwater features in these areas would likely be small, given that the additional water requirement under the Shared-Use Option represents only a small portion of the total water demand for construction of the rail line without shared use. The overall impacts to groundwater resources in these areas would be similar to the impacts described in Section G.1.2.3.

Commercial-use facilities under the Shared-Use Option would likely be constructed close to the DOE-owned and -operated rail facilities and so would likely overlie the same hydrographic areas as the DOE facilities. Therefore, additional impacts to groundwater features in these areas as a result of construction of facilities under the Shared-Use Option would also be small. The overall impacts would be similar to the impacts described in Section G.1.2.3.

## G.2.2 OPERATIONS IMPACTS ASSESSMENT – CALIENTE RAIL ALIGNMENT

Groundwater impacts for railroad operations along the Caliente rail alignment under the Shared-Use Option would be similar to those identified in Sections G.1.3.1 and G.1.3.2. Impacts to groundwater from operation of additional sidings would be small. There would be no continued need for water along the additional sidings, and possible changes to recharge, if any, would be the same as those at the completion of construction.

Commercial-only facilities would require water for daily operations. Water demand to operate these facilities has not yet been identified, but DOE assumes it would be small. Therefore, additional impacts to groundwater features would likely be small, and the overall impacts would be similar to those described in Section G.1.3.

## G.2.3 CONSTRUCTION IMPACTS ASSESSMENT – MINA RAIL ALIGNMENT

Under the Shared-Use Option, additional commercial access sidings would be constructed as a third track alongside passing sidings. However, the total length of the additional sidings would be relatively short in comparison to the total length of the rail line. The water requirement for the construction of the rail line under the Shared-Use Option would only increase by approximately 147,000 cubic meters (119 acre-feet), or approximately 2 percent, compared to the total estimated likely water demand of 7.34 million cubic meters (5,950 acre-feet) for construction of the rail line without shared use.

For purposes of this analysis, DOE assumed that the commercial access sidings would be in the same hydrographic areas the Mina rail alignment would cross. Therefore, additional impacts to groundwater features in these areas would likely be low, given that the additional water requirement under the Shared-Use Option represents only a small portion of the total water demand for construction of the rail line without shared use. The overall impacts to groundwater resources in these areas would be similar to the impacts described in Section G.1.2.3.

Commercial-use facilities under the Shared-Use Option would likely be constructed close to the DOE-owned and -operated rail facilities and would likely overlie the same hydrographic areas as the DOE facilities. Therefore, additional impacts to groundwater features in these areas would also be small. The overall impacts would be similar to the impacts described in Section G.1.2.3.

## G.2.4 OPERATIONS IMPACTS ASSESSMENT – MINA RAIL ALIGNMENT

Groundwater impacts for railroad operations along the Mina rail alignment under the Shared-Use Option would be similar to those identified in Sections G.1.3.1 and G.1.3.2. Impacts to groundwater from operation of additional sidings would be small. There would be no continued need for water along the additional sidings, and possible changes to recharge, if any, would be the same as those at the completion of construction.

Commercial-only facilities would require water for daily operations. Water demand to operate these facilities has not yet been identified, but DOE assumes it would be small. Therefore, additional impacts to groundwater features would likely be small, and the overall impacts would be similar to those described in Section G.1.3.

## G.3 Glossary

| | |
|---|---|
| aquitard | A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores groundwater. |
| cone of depression | The lowering of the water table in a cone-shaped depression around a pumped well. |
| evapotranspiration | The combined process of evaporation and transpiration. Evaporation is water loss to the atmosphere from sources such as soil, canopy interception, and water bodies; transpiration refers to the movement of water vapor from a plant to the air through the plant's stomata or leaves. |
| leaky aquifer | An aquifer that has an ***aquitard*** either above or below that allows water to leak into or out of the aquifer depending on the direction of the hydraulic gradient. |
| radius of influence | The distance from the well where the drawdown becomes insignificant and can be neglected. |
| screened | The portion of a well that is screened is the interval in the well where the casing contains slots to let in the water from the primary (most productive) water-bearing zone or zones. |

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**DATA**


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|---|---|---|
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# APPENDIX H

# BIOLOGICAL RESOURCES

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BLM | Bureau of Land Management |
| DOE | U.S. Department of Energy |
| FWS | U.S. Fish and Wildlife Service |
| GPS | Global Positioning System |
| NDOW | Nevada Department of Wildlife |
| NNHP | Nevada Natural Heritage Program |
| HMA | herd management area |

# APPENDIX H

# BIOLOGICAL RESOURCES

This appendix supports the descriptions of the affected environment for biological resources in Chapter 3 and the impacts analyses in Chapter 4 of the Rail Alignment EIS (DOE/EIS-0369). It describes the field survey methods and other technical data that support the biological resource analysis described in those chapters.

## H.1 Introduction

Sections H.2 through H.5 of this appendix summarize the research and field methods the U.S. Department of Energy (DOE) used to compile information necessary to assess potential impacts on biological resources from implementation of the Proposed Action along either the Caliente rail alignment or the Mina rail alignment, and presents the information resulting from those varied efforts. Generally, this information is organized by biological resource.

This appendix summarizes information from previous studies and documents such as the *Environmental Baseline File for Biological Resources* (DIRS 104593-CRWMS M&O 1999, all), applicable BLM resource management plans, conservation plans for various species or communities, and other similar documents. Additionally, the appendix summarizes information obtained from BLM institutional knowledge (such as noxious and invasive weed locations and wild horse and burro herd management areas), Nevada Department of Wildlife institutional knowledge (including big game species distributions and habitat requirements), Nevada Natural Heritage Program occurrence database (DIRS 185440-BSC 2008, all) of protected and sensitive species, the Southwest Regional Gap Analysis Project (SWReGAP) data of land cover (DIRS 174324-NatureServe 2004, all), and other similar data. The appendix also includes descriptions of the methods DOE used during field observations for vegetation, special status species, game species, and wild horses and burros. Figure H-1 shows survey locations along the Caliente rail alignment; Figure H-2 shows field observation points along the Mina rail alignment.

## H.2 Vegetation

### H.2.1 METHODS

#### H.2.1.1 Research

Prior to field surveys, DOE identified existing information regarding the occurrence and distribution of plant communities within the Caliente rail alignment and Mina rail alignment study areas (8 kilometers [5 miles] on either side of the centerline of the proposed rail alignment; a total width of 16 kilometers [10 miles]). This effort included literature searches and consultations with federal and state agencies including the U.S. Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (FWS), the Nevada Natural Heritage Program (NNHP), the Nevada Department of Wildlife (NDOW), and the Nevada Division of Forestry.

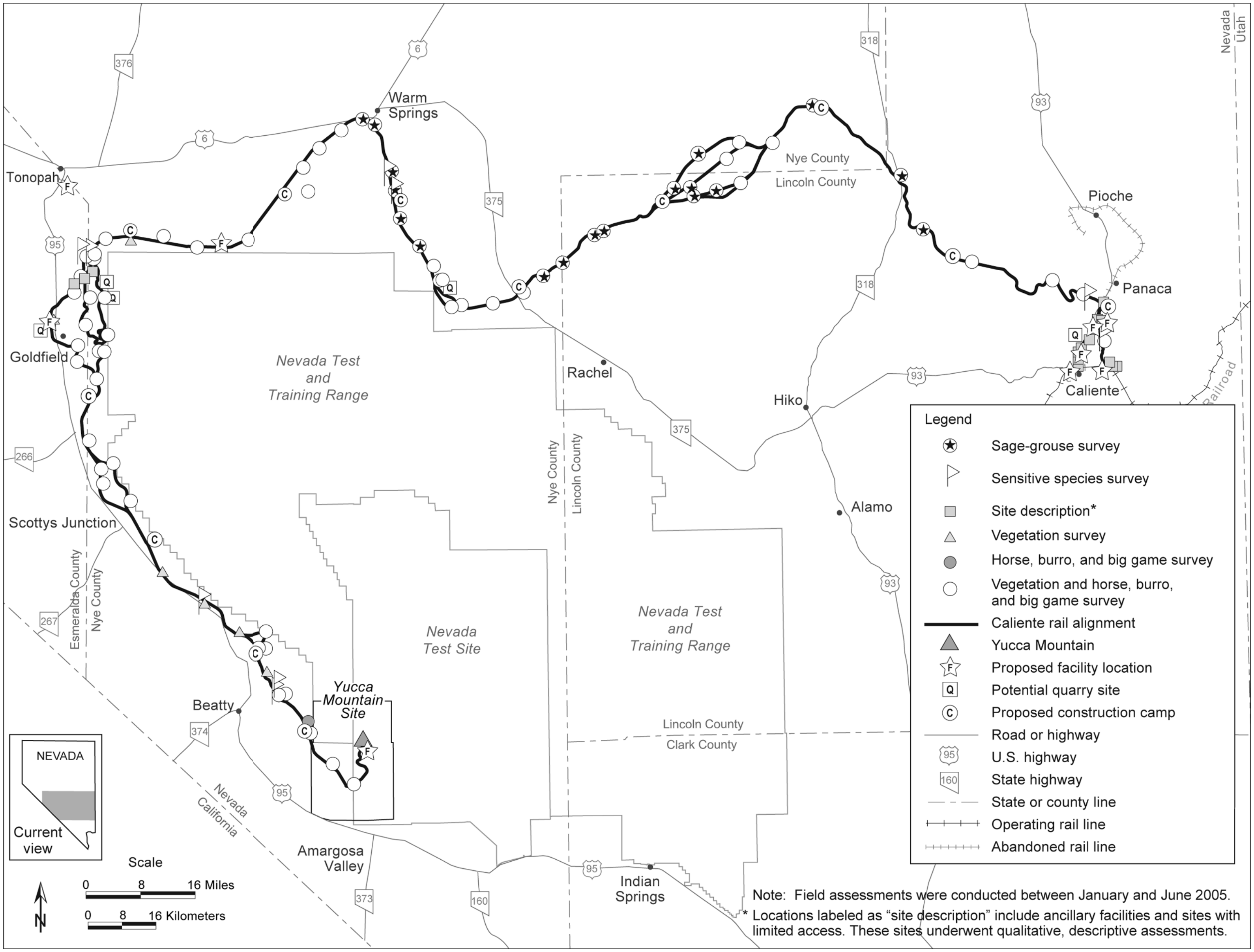


**Figure H-1.** Survey locations for biological resources along the Caliente rail alignment.

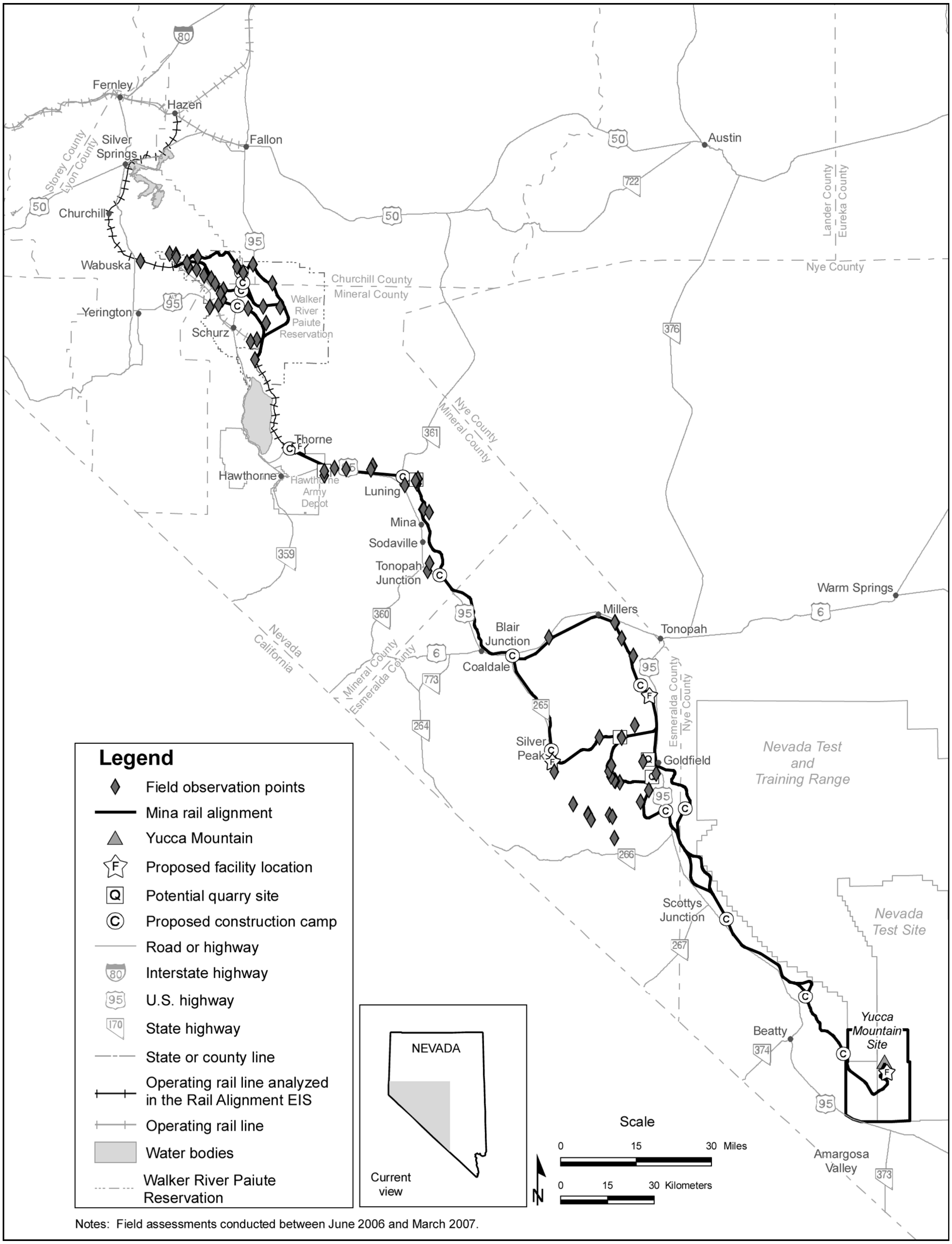


**Figure H-2.** Field observation points for biological resources along the Mina rail alignment.

DOE also obtained spatial data, in digital and print form, from the BLM, the Nevada Department of Wildlife, the Nevada Natural Heritage Program, the University of Nevada, Reno, and other sources, for computer-based and paper-based evaluation of biological resources within the study area. DOE assessed plant communities within the study area of the rail alignments and rail line construction and operations support facilities using the 2004 SWReGAP (DIRS 174324-NatureServe 2004,all). The SWReGap is a multi-institutional cooperative mapping and assessment of biodiversity within Arizona, Utah, Nevada, New Mexico, and Colorado and provides digital land-cover maps that contain plant community distribution data. This dataset also provides information about the existing natural vegetation to the level of dominant or codominant plant species, public and private land ownership, and management and conservation land status. DOE overlaid this information, in conjunction with digital, orthographically corrected, aerial photos (DIRS 174497-Keck Library 2004, all), onto maps of the two rail alignments and associated facilities and used to it identify unique vegetation communities within the study area (such as sagebrush and riparian), and identified areas where there could be sensitive species.

DOE then conducted field surveys in the study area along the proposed Caliente and Mina rail alignments to characterize the existing SWReGAP (DIRS 174324-NatureServe 2004,all) land-cover analyses in locations that closely represent the land-cover types. DOE also surveyed areas that are considered unique relative to the region, such as riparian habitat, playas, and sand dunes. Locations were also chosen to provide a relatively consistent survey among alternative segments, in order to adequately compare the alternative segments for the impact analysis.

### H.2.1.2 Field Surveys

***Caliente Rail Alignment***

Field surveys for the proposed Caliente alignment included 72, 200-meter (660-foot)-long vegetation transects in which plant species were formally identified and the composition of plant communities was quantitatively assessed. The vegetation transects were located at various intervals along the entire proposed Caliente rail alignment, including all common segments and all alternative segments.

In addition to quantitative assessments, qualitative field observations were made at many of the sites where formal transect-based surveys were conducted and at other locations where no transects were established, including areas where limitations such as private property prevented access. These qualitative site descriptions typically consisted of a visual assessment of vegetation, landform, land use and level of disturbance, physical relationship to the proposed rail alignment, and the presence of water or evidence of the influence of water on the habitat.

DOE performed vegetation surveys along the proposed Caliente rail alignment from February 4 through March 11, 2005, from May 5 through May 7, 2005, on June 7 and 8, 2005, and from January 23 through January 27, 2006. Before conducting the 2005 vegetation surveys, and periodically throughout the course of the 2005 field surveys, Dr. Kent Ostler, an expert in regional plant ecology, provided survey personnel with guidance in the field regarding regional plant ecology and identification (DIRS 174634-Thebeau and Huenfeld 2005, p. 2). Surveys conducted in 2006 were performed by a qualified biologist following the same research methods and field survey protocols as outlined in this appendix.

DOE conducted vegetation sampling along a transect or straight line of 200 meters (660 feet) parallel to the proposed location of the rail alignment. The bearing or direction of each transect was determined using a geographic positioning system receiver or a compass. After establishing the starting point and the bearing of a transect, a 1-square-meter (11-square-foot) plot was sampled every 20 meters (66 feet), resulting in 10 sample plots or quadrats. In most cases, a wooden stake was driven into the ground to semi-permanently mark the location of the start and end of a transect. Photos and geographic positioning system location surveys were taken at the beginning and end of each transect.

Field personnel recorded vegetation survey data on the two-page data sheet used for vegetation assessments shown in Figure H-3. Trees, shrubs, cacti, invasive and noxious plants, and most grasses were identified by genus or species, whereas non-weed forb species were recorded as forbs, and lumped together. For each species identified within the quadrat, field personnel estimated the percent of the quadrat covered by that species and recorded that information on data sheets. Field personnel also recorded the percent cover for dead plant material, mosses, rock, and cryptobiotic soil crust (a crust formed by cyanobacteria, lichens, and mosses over the surface of the soils). The total percent cover in a quadrat could add to more than 100 due to overlap. Field personnel collected samples and took photographs of unrecognized plant species for subsequent identification. General descriptions of the landform, the slope, aspect, land use of the site (grazing, mining, wilderness), and the type of plant community present on the site were also recorded. The general description was used to identify the presence of indicator or key species present but occurring scattered and outside of transects. Such species included Joshua tree (*Yucca brevifolia*), Utah juniper (*Juniperus osteosperma*), and singleaf pinyon (*Pinus monophylla*).

***Mina Rail Alignment***

DOE performed field surveys along the proposed Mina rail alignment and associated facility and quarry locations during three separate field visits: June 12 through 15, 2006; December 11 through 13, 2006; and March 26-29, 2007. Surveys consisted of a visual assessment of vegetation, land use, disturbance, water resources, and potential habitat for wildlife and special status species within the study area.

General field observation points were taken at locations along the alignment where there was an obvious change in the landscape and/or land-cover type, and at “micro-site” locations. Micro-sites are small vegetative or physically dissimilar areas that occur within a larger continuous community type (such as rock outcrops, playas, vegetated sand dunes [Figure H-2]).

A list of special status species was provided by the Nevada Natural Heritage Program Database (DIRS 185440-BSC 2008, all). These historical occurrences were overlaid on topographic maps of the project area and assessed in the field for the potential occurrence of special status species. Habitat assessment points were documented using Global Positioning System (GPS), photography, and data forms.

The assessment included identifying all plant species present and determining community type based on primary and secondary composition of plant species. In addition, the assessment used general observations of the landscape, including slope, aspect, elevation, land use, and any wildlife observations.

Special status species and any areas determined to be micro-sites were used to establish the specific survey locations along the proposed rail alignment and quarry sites.

### H.2.1.3 Impact Analysis

DOE assessed potential adverse impacts on vegetation communities as a result of the Proposed Action described in Chapter 2 of the Rail Alignment EIS, which were based on the review of SWReGAP data and field observations. Direct long-term impacts include the loss of vegetation and fragmentation of vegetation communities and were assessed using Geographic Information System vegetation and construction datasets, and a Geographic Information System process called Intersect was used to quantify the amount of specific land-cover types that would be removed in relation to rail line, facility, and quarry footprints. Indirect short-term impacts were assessed using the same methods, however calculations for

| TRANSECT ID: | DATE (mm/dd/yy): | RECORDER: | OBSERVERS: | LOCATION: | TRANSECT BEARING: |
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| | | | | | |

| | GPS FILENAME - START: | | | | | |
|---|---|---|---|---|---|---|
| Coordinates | WAYPOINT | UTM N | UTM E | PDOP | WAAS USED? | ELEVATION |
| START TRANSECT | | | | | yes / no | |
| END TRANSECT | | | | | yes / no | |
| | GPS FILENAME - END (if different): | | | | | |

| TRANSECT START PHOTO: | TRANSECT END PHOTO: |
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| SLOPE: | ASPECT: | LANDFORM (elaborate in Notes section): Valley Flat Toe Slope/Alluvuial Fan Slope Cliff/Scarp Other | LAND USE: Wilderness Mining Recreation Grazing Transportation Plowed Fields Urban/Developed Other |
|---|---|---|---|

| SW REGAP CLASS: |
|---|
| ESTIMATED DOMINANT SPECIES: |

| | NAME/CODE | EXTENT* | WAYPOINT | UTM N | UTM E | PDOP | WAAS | ELEVATION |
|---|---|---|---|---|---|---|---|---|
| Sensitive Species 1 | | | | | | | yes / no | |
| Sensitive Species 2 | | | | | | | yes / no | |
| Sensitive Species 3 | | | | | | | yes / no | |
| * Categories for sens spp and inv/nox spp extent: Solitary, Few Clumped, Few Scattered, Many Clumped, Many Scattered, Dense, Other | | | | | | | | |
| Invasive/Nox Species 1 | | | | | | | yes / no | |
| Invasive/Nox Species 2 | | | | | | | yes / no | |
| Invasive/Nox Species 3 | | | | | | | yes / no | |

| NOTES: |
|---|
| |

**Figure H-3.** Vegetation data sheet (page 1 of 2).

| TRANSECT ID: | DATE (mm/dd/yy): | RECORDER: | LOCATION: | TRANSECT BEARING: |
|---|---|---|---|---|
| | | | | |

| QUADRAT NUMBER | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | NOTES/PHOTOS |
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| SPECIES | | | | | | | | | | | |
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| Forbs | | | | | | | | | | | |
| Litter | | | | | | | | | | | |
| Crypto | | | | | | | | | | | |
| Bare | | | | | | | | | | | |

NOTES:

**Figure H-3.** Vegetation data sheet (page 2 of 2).

short-term impacts included the area from the toe of slope to the edge of the construction right-of-way and is outside of the rail line, facility, and quarry footprints. They are considered short-term impacts because DOE would minimize disturbance within the construction right-of-way and would mitigate or restore disturbed areas not used during the operations phase.

The magnitude of impact was determined based on the SWReGAP dataset. A small impact to vegetation would neither destabilize nor noticeably alter a specified land-cover type and would not affect the overall function or viability of the plant community. A moderate impact would noticeably alter a specific land-cover type, but not destabilize or affect important attributes of that land-cover type. An indication of a moderate impact pertains to a land-cover type that is uncommon within the Mojave and Great Basin Deserts, such as riparian vegetation. A large impact would significantly alter or destabilize the land-cover type. However, no large impacts were found to occur in the analysis.

## H.2.2 VEGETATION COMMUNITIES

The vegetation communities present along the Caliente and Mina rail alignments are indicative of the Great Basin and the Mojave Deserts. Table H-1 lists the land-cover types and vegetation communities identified as potentially occurring within the Caliente rail alignment and Mina rail alignment regions of influence as described in the Southwest Regional Gap Analysis Project databases and confirmed by field surveys.

**Table H-1.** Southwest Regional Gap Analysis Project land-cover types within the Caliente rail alignment and Mina rail alignment study areas[a,b,c] (page 1 of 5).

| Land-cover type | Characteristic plant species and distribution |
|---|---|
| Agriculture | This land-cover type includes row crops, irrigated pasture and hay fields, and dry farm crops. |
| Barren | This land-cover type includes barren soil or rock with less than 5 percent vegetative cover. |
| Developed, Medium - High Intensity | Developed, Medium Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50 to 79 percent of the total cover. These areas most commonly include single-family housing units. Developed, High Intensity: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover. |
| Developed, Open Space - Low Intensity | Open Space: Includes areas with a mixture of some construction materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Developed, Low Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20 to 49 percent of total cover. These areas most commonly include single-family housing units. |
| Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland | This land-cover type occurs in mountain ranges from about 1,220 to more than 2,135 meters (4,000 to more than 7,000 feet). This type often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. The variety of plant associations connected to this type reflects elevation, stream gradient, floodplain width, and flooding events. Dominant trees may include white fir, thinleaf alder, water birch, narrowleaf cottonwood, balsam poplar, Fremont cottonwood, red willow, Gooding's willow, and Douglas fir. Dominant shrubs include silver sagebrush, Redosier dogwood, narrowleaf willow, arroyo willow, Lemmon's willow, or yellow willow. |

**Table H-1.** Southwest Regional Gap Analysis Project land-cover types within the Caliente rail alignment and Mina rail alignment study areas[a,b,c] (page 2 of 5).

| Land-cover type | Characteristic plant species and distribution |
|---|---|
| Great Basin Pinyon-Juniper Woodland | This land-cover type occurs on dry mountain ranges and is typically found at lower elevations ranging from 1,600 to 2,600 meters (5,200 to 8,500 feet). These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Woodlands dominated by a mix of singleleaf pinyon and Utah juniper, and woodlands dominated solely by either species comprise this land-cover type. Associated species include shrubs such as desert mahogany, green manzanita, low sagebrush, black sagebrush, Great Basin sagebrush, mountain mahogany, littleleaf mountain mahogany, blackbrush, Gambel oak, scrub oak, bunch grasses needle-and-thread, Idaho fescue, bluebunch wheatgrass, Great Basin wild rye, and mutton grass. |
| Great Basin Xeric Mixed Sagebrush Shrubland | This land-cover type occurs in the Great Basin on dry flats and plains, alluvial fans, rolling hills, rocky hill slopes, saddles, and ridges at elevations between 1,000 to 2,600 meters (3,300 to 8,500 feet). Sites are dry, often exposed to desiccating winds, with typically shallow, rocky, non-saline soils. Shrublands are dominated by black sagebrush (mid and low elevations), low sagebrush (higher elevation), and may be codominated by Wyoming big sagebrush or yellow rabbitbrush. |
| Inter-Mountain Basins Big Sagebrush Shrubland | This widespread land-cover type occurs throughout much of the intermountain west and is found at slightly higher elevations farther south. Soils are typically deep with minimal salt, and often with a microphytic crust. This system is dominated by perennial grasses and forbs (greater than 25 percent cover) with big basin sagebrush, big sagebrush, Wyoming big sagebrush, threetip sagebrush, and/or antelope bitterbrush dominating or codominating the open to moderately dense (10 to 40 percent cover) shrub layer. |
| Inter-Mountain Basins Big Sagebrush Steppe | This land-cover type occurs throughout much of the Columbia Plateau and northern Great Basin and Wyoming, and is found at slightly higher elevations farther south. Soils are typically deep and non-saline, often with a microphytic crust. This shrub-steppe is dominated by perennial grasses and forbs with basin big sagebrush, big sagebrush, Wyoming big sagebrush, threetip sagebrush, and/or desert bitterbrush dominating or codominating the open to moderately dense shrub layer. Shadscale saltbush, yellow rabbitbrush, rubber rabbitbrush, horsebrush, or prairie sagewort may be common, especially in disturbed stands. Associated grasses include Indian ricegrass, plains reedgrass, thickspike wheatgrass, Idaho fescue, rough fescue, prairie junegrass, Sandberg bluegrass, and bluebunch wheatgrass. Common forbs are spiny phlox, sandworts, and milkvetches. |
| Inter-Mountain Basins Cliff and Canyon | This land-cover type is found from foothills to subalpine elevations and includes barren and sparsely vegetated landscapes of steep cliff faces, narrow canyons, and smaller rock outcrops of various bedrock types. Also included are unstable slopes with accumulations of broken rock (known as talus or scree) that typically occur below cliff faces. Widely scattered trees and shrubs may include white fir, twoneedle pinyon, limber pine, singleleaf pinyon, Juniper, big sagebrush, desert bitterbrush, curl-leaf mountain mahogany, Mormon tea, oceanspray, and other species often common in adjacent plant communities. |
| Inter-Mountain Basins Greasewood Flats | This land-cover type occurs throughout much of the western United States in intermountain basins. It typically occurs near drainages on stream terraces and flats or may form rings around playas. Sites typically have saline or salty soils, a shallow water table, and may flood intermittently, but remain dry for most growing seasons. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by greasewood. Fourwing saltbush, shadescale saltbush, or winterfat may be present to codominant. |

**Table H-1.** Southwest Regional Gap Analysis Project land-cover types within the Caliente rail alignment and Mina rail alignment study areas[a,b,c] (page 3 of 5).

| Land-cover type | Characteristic plant species and distribution |
|---|---|
| Inter-Mountain Basins Mixed Salt Desert Scrub | Includes shrublands of typically saline basins, lower mountain slopes, and plains across the intermountain western United States. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more saltbush (*Atriplex*) species such as shadescale saltbush, fourwing saltbush, cattle saltbush, or spinescale saltbush. |
| Inter-Mountain Basins Playa | This ecological system is composed of barren and sparsely vegetated playas (generally less than 10 percent plant cover) found in the intermountain western United States. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from filtering through the soil by an impermeable soil layer and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. Characteristic species may include iodinebush, greasewood, spiny hopsage, Lemon's alkaligrass, basin wildrye, saltgrass, and saltbush. |
| Inter-Mountain Basins Semi-Desert Grassland | This widespread land-cover type occurs throughout the intermountain western United States on dry plains and mesas, at approximately 1,450 to 2,320 meters (4,800 to 7,600 feet) in elevation. These grasslands occur in a wide range of landscape locations and on varied soil types. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. These grasslands are typically dominated or codominated by Indian ricegrass, three-awns, blue grama, needle-and-thread grass, Torrey's muhly, or James's galleta, and may include scattered shrubs and dwarf-shrubs of species of sagebrush, saltbush, blackbrush, jointfir, snakeweed, or winterfat. |
| Inter-Mountain Basins Semi-Desert Shrub Steppe | This land-cover type occurs throughout the intermountain western United States, typically at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by grasses (greater than 25 percent cover) with an open shrub layer, but includes sparse mixed shrublands without a strong grass layer. Characteristic grasses include Indian ricegrass, blue grama, inland saltgrass, needle-and-thread grass, James's galleta, Sandberg bluegrass, and alkali sacaton. The shrub layer is often a mixture of shrubs and dwarf-shrubs including fourwing saltbush, sand sagebrush, Greene's rabbitbrush, yellow rabbitbrush, jointfir, rabbitbrush, broom snakeweed, and winterfat. |
| Inter-Mountain Basins Wash | This barren and sparsely vegetated (generally less than 10 percent plant cover) land-cover type is restricted to intermittently flooded streambeds and banks that are often lined with *Sarcobatus vermiculatus*, rabbitbrush, Apache plume and/or silver sagebrush (in more northern and wetter stands). Spiny hopsage may also dominate in the Great Basin. Shrubs often form a continuous or intermittent linear canopy in and along drainages but do not extend out into flats. |
| Invasive Annual and Biennial Forbland | This land-cover type occurs in areas dominated by invasive thistles (*Salsola* spp.), Mexican fireweed (*Kochia scoparia*), and halogeton (*Halogeton glomeratum*). |
| Invasive Annual Grassland | This land-cover type occurs in areas dominated by species of oats (*Avena* spp.), brome (*Bromus* spp.), and Mediterranean grasses (*Schismus* spp.). |
| Mojave Mid-Elevation Mixed Desert Scrub | This land-cover type represents the extensive desert scrub in the transition zone above creosote-burrobush desert scrub and below the lower montane woodlands (700 to 1,800 meters [2,300 to 5,900 feet] elevations) that occurs in the eastern and central Mojave Desert, around elevations of 700 to 1,800 meters. It is also common on lower slopes in the transition zone into the southern Great Basin. The vegetation in this land-cover type is quite variable. Codominant species include blackbrush, Eastern Mohave buckwheat, Nevada jointfir, spiny hopsage, spiny menodora, beargrass, buckhorn cholla, Mexican bladdersage, Parish's goldeneye, Joshua tree, or Mohave yucca. |

**Table H-1.** Southwest Regional Gap Analysis Project land-cover types within the Caliente rail alignment and Mina rail alignment study areas[a,b,c] (page 4 of 5).

| Land-cover type | Characteristic plant species and distribution |
|---|---|
| North American Arid West Emergent Marsh | This land-cover type is found throughout much of the arid and semi-arid regions of western North America. Natural marshes may occur in depressions in the landscape (ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 meters (6.6 feet). Water levels may be stable, or may fluctuate 1 meter (3.3 feet) or more over the course of the growing season. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils. The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of bulrush, cattail, rush, pondweed, knotweed, pond-lily, and canarygrass. This system may also include areas of relatively deep water with floating-leaved plants and submergent and floating plants. |
| North American Warm Desert Bedrock Cliff and Outcrop | This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally less than 10 percent plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur below cliff faces. Species present are diverse and may include elephant tree, ocotillo, Bigelow's nolina, teddybear cholla, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 0.02 square kilometer (5 acres) in size from adjacent areas. |
| North American Warm Desert Lower Montane Riparian Woodland and Shrubland | This ecological system occurs in mountain canyons and valleys of southern Arizona, New Mexico, and adjacent Mexico and consists of mid- to low-elevation (1,100 to 1,800 meters [3,300 to 5,900 feet]) riparian corridors along perennial and seasonally intermittent streams. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include narrowleaf cottonwood, Rio Grande cottonwood, Fremont cottonwood, Arizona sycamore, Arizona walnut, velvet ash, and wingleaf soapberry. Shrub dominants include narrowleaf willow, plum, Arizona alder, and mule's fat. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and annual rise in the water table for growth and reproduction. |
| North American Warm Desert Playa | This land-cover type is composed of barren and sparsely vegetated dry lakes (generally less than 10 percent plant cover) found across the warm deserts of North America. Playas form with intermittent flooding, followed by evaporation, leaving behind a saline or salty residue. Salt crusts are common, with small saltgrass beds present in depressions and sparse salt-tolerant shrubs around the margins. Soils often include an impermeable layer of clay. Large desert playas tend to be defined by vegetation rings formed in response to salinity. Given their common location in wind-swept desert basins, dune fields often form downwind of large playas. Species may include iodinebrush, seepweed, inland saltgrass, common spikerush, ricegrass, dropseed, crinklemat, or saltbush. |
| Sonora-Mojave Creosotebush-White Bursage Desert Scrub | This land-cover type forms the vegetation matrix in broad valleys, lower bajadas (masses of gravel and sand deposited by streams as they emerge from narrow mountain valleys), plains, and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2 to 50 percent cover) of small-leaved, drought-tolerant, and broad-leaved shrubs. Creosote and burrobush are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may be present or form typically sparse understories. |

**Table H-1.** Southwest Regional Gap Analysis Project land cover types within the Caliente rail alignment and Mina rail alignment study areas[a,b,c] (page 5 of 5).

| Land-cover type | Characteristic plant species and distribution |
|---|---|
| Sonora-Mojave Mixed Salt Desert Scrub | This land-cover type includes extensive open-canopied shrublands of typically salty basins in the Mojave and Sonoran deserts. Stands often occur around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more saltbush species such as fourwing saltbush or cattle saltbush along with other species of saltbush. Species of iodinebush, pickleweed, seepweed, or other salt-loving plants are often present to codominant. Grasses may include alkali sacaton or inland saltgrass at varying densities. |

a. Species and distribution description are derived from DIRS 174324-NatureServe 2004, all, and field studies.
b. Sources: DIRS 174399-MO9901COV97208.000; DIRS 174324-NatureServe 2004, all; DIRS 174324-NatureServe 2004, all.

## H.2.3 NOXIOUS WEEDS AND INVASIVE SPECIES

There are numerous species considered to be noxious weeds or invasive species present in the region. Table H-2 lists such species, including their scientific name and general habitat requirements. Several of these species have been designated by the State of Nevada as noxious. For these species, the table displays the Nevada Department of Agriculture noxious weed category, and discusses primary habitat characteristics associated with each species. These categories are defined as follows:

- Category A, weeds not found or that are limited throughout the state and are controlled wherever they are found
- Category B, weeds in scattered populations in some counties in Nevada and that are actively excluded where possible
- Category C, weeds that are widespread in many counties in Nevada

**Table H-2.** Noxious weeds and invasive species[a] (page 1 of 4).

| Common name(s) | Scientific name | Noxious weed category[b] | Habitat[c] |
|---|---|---|---|
| African mustard | *Malcolmia africana* | -- | Found in disturbed areas and desert shrubland at elevations between 1,250 and 2,000 meters (4,100 to 6,600 feet). |
| Asian mustard | *Brassica tournefortii* | -- | Found along roadsides and washes and in open areas below 800 meters (2,600 feet) in elevation. It is likely that the species will be designated as noxious by the state of Nevada in the near future. |
| Common crupina | *Crupina vulgaris* | A | Prefers well-drained, sandy, or loamy soils, and southern slopes on steep canyon grasslands. Also, it commonly grows along field edges, and in improved pastures, hayfields, and grass seed fields. It frequently infests gravel pits, roadsides, railroad embankments, and other rights-of-way. No information has been found that indicates it is or is not in Nevada. |
| Dalmation toadflax | *Linaria dalmatica* | A | Commonly found in cultivated fields, roadsides, railways, waste areas, clearcuts, overgrazed pastures and rangeland, and in plant communities that are typically open or disturbed. Neither Dalmation nor yellow toadflax (*Linaria vulgaris*) occur as frequently in intact wild lands and natural areas. |

**Table H-2.** Noxious weeds and invasive species[a] (page 2 of 4).

| Common name(s) | Scientific name | Noxious weed category[b] | Habitat[c] |
|---|---|---|---|
| Downy brome/ cheatgrass | *Bromus tectorum* | -- | Grows in many climatic conditions. It is found primarily in locations that receive 15 to 56 centimeters (6 to 22 inches) of precipitation. Cheatgrass will grow in almost any type of soil. Research shows that it is most often found on coarse-textured soils and does not grow well on heavy, dry, or saline soils. Cheatgrass has been found growing in eroded soil areas and areas low in nitrogen. It grows in a narrow range of soil temperatures. It has been found in Nye and Esmeralda Counties (DIRS 174674-Carpenter and Murray [n.d.], all). |
| Dyer's woad | *Isatis tinctoria* | A | Found on disturbed and undisturbed sites, roadsides, railroad rights-of-way, fields, pastures, grain and alfalfa fields, forests, and rangeland. The species can grow on dry, rocky, or sandy soils. |
| Hoary cress/ whitetop | *Cardaria draba* | C | Grows well in many environments, but they commonly grow in disturbed, alkaline soils with moderate moisture or acidic soils with limited moisture. They grow well in sub-irrigated pastures, hay fields (especially alfalfa), rangeland meadows, along roadsides, ditch banks, and in many other unshaded disturbed areas. They are aggressive invaders in much of Nevada because their seeds germinate and plants grow in moderately salty soils. |
| Halogeton | *Halogeton glomeratus* | -- | An annual that is often found along rail roadbeds, roads, trails, and other places where the soil has been disturbed, in areas that have been overgrazed or burned over, and on dry lake beds. It can tolerate very saline soils. It cannot effectively compete with healthy native vegetation, but can form dense stands where native vegetation is sparse (DIRS 174505-Torell, Young, and Kvasnicka 2005, p. 1-3). |
| Houndstongue | *Cynoglossum officinale* | A | Can survive hot, dry summers, as well as cold winters. It is found on a variety of soils from well-drained, relatively coarse, alkaline soils to clay subsoil. It is tolerant of shade and prospers in wetter grasslands. It is found on roadsides, meadows, and disturbed places. Houndstongue has been found in Elko County, Nevada and can quickly spread to other areas of the state. |
| Klamath weed/ common St. Johnswort/ goatweed | *Hypericum perforatum* | A | A large, bushy plant that prefers dry, sandy, or gravelly soils and open, sunlit areas. It can be found in pastures, pinyon-juniper woodlands, foothill forests, waste places, and along roadsides. It may dominate a site as a monoculture. Klamath weed spreads by seed and by creeping horizontal stems that root when they touch the ground (DIRS 174671-Graham and Johnson [n.d.], all). |
| London rocket/ Tumbling mustard | *Sisymbrium irio* | -- | Is common in irrigated cropland and orchards, and disturbed areas such as roadsides, fence lines, and ditches below 800 meters (2,600 feet) elevation. |

**Table H-2.** Noxious weeds and invasive species[a] (page 3 of 4).

| Common name(s) | Scientific name | Noxious weed category[b] | Habitat[c] |
|---|---|---|---|
| Medusahead | *Taeniatherum caput-medusae* | B | Invades grasslands, oak savannah, oak woodland, and chaparral communities. It grows in a wide range of climatic conditions. Clay or clay-loam soils with at least 25.4 centimeters (10 inches) of rainfall annually are most susceptible to invasion. However, medusahead has been found on coarse-textured soils, as well. |
| Musk thistle | *Carduus nutans* | B | Musk thistle is found in saline soils in low valleys to acidic soils at 3,048 meters (1,000 feet). It prefers moisture and sunlight, and it often grows in pastures, construction sites, ditches, and rangeland (DIRS 174670-Kadrmas and Johnson [n.d.], all). |
| Perennial pepperweed/tall whitetop | *Lepidium latifolium* | C | Infests wet sites along streams, rivers, and wetlands. It is found in riparian areas of the entire western United States. Tall whitetop is very tolerant of salty soils and adapts well to many sites under adverse conditions. It is found in native hay meadows, abandoned agricultural lands, pastures, hayfields, residential areas, and along roadsides. |
| Purple loosestrife | *Lythrum salicaria* | A | Moist soils, especially on the fringes of water bodies and is potentially found around Meadow Valley Wash and the Amargosa River areas. |
| Red brome | *Bromus rubens* | -- | A cool-season annual bunchgrass that commonly grows in open, disturbed areas below 1,524 meters (5,000 feet) elevation. It is less frost-tolerant than the closely related cheatgrass, and is more common in the Mojave region that in the Great Basin. It can form extensive monocultures, which, as the fine textured plants dry in the summer, dramatically increases the frequency of wildfires (DIRS 174673-Newman 1992, all). |
| Russian knapweed | *Acroptilon repens* | B | Common along roadsides, riverbanks, irrigation ditches, pastures, waste places, clearcuts, and croplands. Russian knapweed does not establish readily in healthy, natural habitats. It typically invades disturbed areas, forming dense single-species stands. Once established, Russian knapweed inhibits the growth of nearby plants to spread outward into undisturbed areas. Specimens have been found in Nye, Clark, and Esmeralda Counties. |
| Russian olive | *Elaeagnus angustifolia* | -- | Invasive in many states and typically inhabits disturbed areas. It fixes nitrogen and can therefore persist in poor soils. It is drought and salt tolerant. In the Great Basin it grows at elevations of 240 to 600 meters (790 to 2,000 feet). It has been found in Meadow Valley Wash. |

**Table H-2.** Noxious weeds and invasive species[a] (page 4 of 4).

| Common name(s) | Scientific name | Noxious weed category[b] | Habitat[c] |
|---|---|---|---|
| Russian thistle | *Salsola spp.* | -- | An annual that grows along fence lines, crop margins, and roadsides, in areas that have been overgrazed, and other places where the native vegetation has been disrupted. Its seeds are spread when the plant dies in the autumn and breaks free from its roots, allowing it to tumble freely in the wind (hence, the common name, "tumble weed"). Like halogeton, it can not effectively compete with intact communities of native vegetation (DIRS 174498-Taylor 1992, p. 66). |
| Saltcedar | *Tamarix ramosissima* | C | Requires a large amount of groundwater, and is most common in riparian areas and areas with a seasonally high water table. The amount of water used by the species can lower the water table that supplies springs and shallow wells. It is extremely salt tolerant and accumulate salts in its deciduous leaves, which, when dropped, create soil conditions beneath the plant that are too salty for most other species to grow. |
| Scotch thistle | *Onopordum acanthium* | B | An invasive weed that infests disturbed and neglected lands. It prefers sites near ditch banks and rivers but also infests pastureland, crops, rangeland, and roadsides. Although scotch thistle prefers disturbed areas with high soil moisture, drier areas do not limit its invasive nature. It commonly invades overgrazed lands, rangeland, pastures, roadsides, and construction sites. |
| Spotted knapweed | *Centaurea maculosa* | A | Found in rangelands that have disturbed soils and that receive less than 20 centimeters (7.9 inches) of precipitation annually. Spotted knapweed is believed to produce a substance that retards the growth of other nearby species (DIRS 174672-Graham and Johnson [n.d.], all). |
| Yellow starthistle | *Centaurea solstitalis* | A | Found in rangelands that receive less than 38 centimeters (15 inches) of annual precipitation, grows in disturbed areas such as roadside ditches and construction areas, and is also found on rangelands and hay pastures. It has been observed in Clark County (DIRS 174669-Johnson et al. [n.d.], all). |
| Yellow toadflax/ Butter-n-eggs | *Linaria vulgaris* | A | Commonly found in cultivated fields, roadsides, railways, waste areas, clearcuts, overgrazed pastures and rangeland, and in plant communities that are typically open or disturbed. It is not found as frequently in intact wild lands and natural areas. |

a. Source: DIRS 130301-Hickman 1993, all.
b. Nevada Department of Agriculture noxious weed category definitions: A = weeds not found or limited in distribution throughout the state, controlled wherever found; B = weeds established in scattered populations in some counties of the state, actively excluded where possible; C = weeds currently established and generally widespread in many counties of the state (DIRS 174543-NDOA 2005, all).

# H.3 Wildlife

## H.3.1 METHODS

### H.3.1.1 Research

DOE gathered information regarding wildlife potentially found within the study area of the Caliente rail alignment and Mina rail alignment from reviews of BLM resource management plans, field guides, NatureServe database, discussion with and acquisition of GIS data from federal and state agencies (BLM, NDOW), and field observations. Using the information gathered from these sources, DOE developed general descriptions and locations of the wildlife communities relative to the proposed alignments, including sage-grouse habitat and mule deer, elk, and antelope winter and summer range.

### H.3.1.2 Field Surveys

DOE did not perform field surveys specifically to characterize the wildlife communities along the Caliente and Mina rail alignments. Wildlife observed during the surveys discussed in Section H.2.1.2 were documented and included in the field notes and data sheets. All surveys were conducted during daylight hours; therefore, field personnel would not have observed species that are exclusively nocturnal, but they recorded signs or other indicators of the presence of these species.

#### *H.3.1.2.1 Sage-Grouse Habitat Quality Surveys*

DOE performed field surveys in habitat for greater sage-grouse (*Cetrocercus urophasianus*) and other sage-dependent species. To assess the quality of sagebrush (*Artemisia* ssp.) habitat, the percentage of sagebrush cover and sagebrush height were measured along 18, 50-meter (160-feet) transects along the rail alignments within sage-grouse population management units. DOE performed assessments of sagebrush habitat for potential suitability as winter habitat for sage-grouse from February 27, 2005 through March 9, 2005, along the Caliente rail alignment.

At sites predetermined for sage-grouse habitat surveys, a sage-grouse habitat transect was set up as an extension of the previously completed vegetation survey, in the same direction and along the same bearing. A 50-meter (160-foot) tape measure was staked and stretched out along the alignment from the predetermined transect start point. A digital photo was taken, Universal Transverse Mercator coordinates collected and recorded, and a wooden stake driven into the ground at the beginning and end of transects. On data sheets, a sample of which is presented in Figure H-4, sagebrush canopy cover (by species of sagebrush, *Artemisia* spp.) was recorded using the line-intercept method that required measuring the amount of live sagebrush that occurs along the line created by the tape measure. Gaps in live canopy of less than 5 centimeters (2 inches) were ignored. Additionally, at each 5-meter (16-foot) increment along the tape, starting at the 5-meter (16-foot) point, the height and species of the nearest sagebrush plant were recorded.

Sage-grouse habitat quality surveys were not performed for the Mina alignment since there is no designated sage-grouse habitat within the study area.

#### *H.3.1.2.2 Big Game Surveys*

For big game surveys, the appropriate BLM or Nevada Department of Wildlife management unit was identified and overlain on the proposed rail alignment study area. DOE conducted big game surveys in areas where the proposed rail alignment and documented big game habitat would intersect. Field study included the survey of 66, 800-meter (2,600-foot) transects along the length of the proposed rail alignment to identify signs of habitat use by big game species. An 2,600 foot transect was chosen to take

| TRANSECT ID: | DATE (mm/dd/yy): | RECORDER: | OBSERVERS: | | LOCATION: | TRANSECT BEARING: |
|---|---|---|---|---|---|---|
| | GPS FILENAME - START: | | | | | |
| Coordinates | WAYPOINT | UTM N | UTM E | PDOP | WAAS USED? | ELEVATION |
| START TRANSECT | | | | | yes / no | |
| END TRANSECT | | | | | yes / no | |
| | GPS FILENAME - END (if different): | | | | | |
| TRANSECT START PHOTO: | | | TRANSECT END PHOTO: | | | |
| SLOPE: | ASPECT: | LANDFORM (elaborate in Notes section): Valley Flat Toe Slope/Alluvuial Fan Slope Cliff/Scarp Other | | LAND USE: Wilderness Mining Recreation Grazing Transportation Plowed Fields Urban/Developed Other | | |
| SW REGAP CLASS: | | | | | | |
| ESTIMATED DOMINANT SPECIES: | | | | | | |

| Big sagebrush intercepts (include units) | Total | % Cover |
|---|---|---|
| | | |

| Big Sagebrush Height at: (ARTRT) | 5m | 10m | 15m | 20m | 25m | 30m | 35m | 40m | 45m | 50m |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

| Other sagebrush spp. intercepts (include units) | Total | % Cover |
|---|---|---|
| | | |

| Other Sagebrush Height at: | 5m | 10m | 15m | 20m | 25m | 30m | 35m | 40m | 45m | 50m |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

**Figure H-4.** Data sheet for assessing sage-grouse habitat quality.

into consideration indirect impacts, which is 500 meters (1,640 feet) beyond the 300-meter (1,000-foot)-wide proposed construction right-of-way. Rather than attempt to describe population sizes or habitat quality, these field surveys were designed specifically to determine use of the areas near the proposed rail alignment by game species. DOE conducted field surveys, which included track and pellet counts, to verify use of the area and identify important migration corridors. Section H.5 provides additional information on the big game surveys (methods and equipment).

## H.3.2 WILDLIFE COMMUNITIES

Sections 3.2.7 and 3.3.7 of the Rail Alignment EIS describe the wildlife species potentially occurring within the Caliente and Mina rail alignments regions of influence, respectively. However, in several cases, the list of species in several groups of wildlife were too numerous and the data too extensive to include in those sections. Therefore, the information is included in this appendix.

Table H-3 lists the game species identified in the Nevada Administrative Code Sections 503.020, 503.045, 503.060 and their occurrence in the biological resources study area for the Caliente and Mina rail alignments. Table H-4 lists bird species and their occurrence within the study area for the Caliente and Mina rail alignments. Table H-5 lists the protection status, a description of preferred habitat, and the probability of occurrence for 23 bat species potentially found along the Caliente and Mina rail alignments. Table H-6 lists amphibians and reptiles potentially found along the Caliente and Mina rail alignments, including their protection status and a description of preferred habitat.

## H.3.3 IMPACT ANALYSIS

DOE assessed potential adverse impacts on wildlife as a result of the Proposed Action described in Chapter 2 of the Rail Alignment EIS, based on the review of Nevada Department of Wildlife datasets, review of BLM resource management plans, and field observations. Direct long-term impacts include the loss of and fragmentation of habitat and potential death of individuals. Indirect short-term impacts include avoidance, change in movement patterns, and potential contamination of water resources in the event of derailment. The potential for impacts on game species, including mule deer, elk, antelope, and sage-grouse, were determined based on the location of the rail line, facilities, and quarries in relation to their identified habitat range. In addition, DOE used the SWReGAP data and field observations to determine the likelihood of an occurrence of a particular species based on its known preferred habitat and the vegetation community present.

The magnitude of impact was determined based on the type of habitat (such as crucial winter range, yearlong, migratory corridor) through which the rail line would pass. A small impact to wildlife would neither destabilize nor noticeably alter the species' habitat or population. A moderate impact would noticeably alter a species' habitat or population, but would not destabilize it. A large impact would significantly alter or destabilize a species' habitat and population. However, no large impacts were found to occur in the analysis.

**Table H-3.** Nevada game species[a] and their occurrence in the biological resources study areas for the Caliente and Mina rail alignments (page 1 of 2).

| Common name | Scientific name | Occurrence within the study area[b] Caliente rail alignment | Mina rail alignment |
|---|---|---|---|
| *Game mammals* | | | |
| Pronghorn antelope | *Antilocapra americana* | Present | Present |
| Black bear | *Ursus americanus* | Absent | Absent |
| Mule deer | *Odocoileus hemionus* | Present | Present |
| Mountain goat | *Oreamnos americanus* | Absent | Absent |
| Mountain lion | *Felis concolor* | Present | Present |
| Moose | *Alces alces* | Absent | Absent |
| Peccary | *Pecari angulatus* | Absent | Absent |
| Cottontail rabbit | *Sylvilagus* spp. | Present | Present |
| Pygmy rabbit | *Sylvilagus idahoensis* | Present | Absent |
| Snowshoe rabbit | *Lepus americanus* | Absent | Absent |
| Black-tailed jackrabbit | *Lepus californicus* | Present | Present |
| Kit Fox | *Vulpes velox* | Present | Present |
| Bobcat | *Lynx rufus* | Present | Present |
| Bighorn sheep | *Ovis canadensis* | Present | Present |
| Elk | *Cervus elaphus* | Present | Present |
| *Upland and migratory game birds* | | | |
| Blue grouse | *Dendragapus obscurus* | Absent | Absent |
| Ruffed grouse | *Bonasa umbellus* | Absent | Absent |
| Sage-grouse | *Centrocercus urophasianus* | Potentially present | Potentially present |
| Sharp-tailed grouse | *Tympanuchus phasianellus* | Absent | Absent |
| Chukar | *Alectoris chukar* | Present | Present |
| Gray (Hungarian) partridge | *Perdix perdix* | Absent | Absent |
| Snow partridge | *Tetrogallus himalayensis* | Absent | Absent |
| Ring-necked pheasant | *Phasianus colchicus* | Present | Present |
| White-wing pheasant | *Phasianus colchicus* | Absent | Absent |
| Northern bobwhite quail | *Colinus virginianus* | Absent | Absent |
| California quail | *Callipepla californicus* | Absent | Absent |
| Gambel's quail | *Callipepla gambelii* | Present | Present |
| Mountain quail | *Oreortyx pictus* | Absent | Absent |
| Scaled quail | *Callipepla squamata* | Absent | Absent |
| Wild turkey | *Meleagris gallopavo* | Present | Present |
| American crow | *Corvus brachyrhynchos* | Present | Present |
| Ducks, geese, and swans | Family *Anatidae* | Present only in wetland/marsh areas | Present only in wetland/marsh areas |
| Wild doves and pigeons | Family *Columbidae* | Present | Present |
| Cranes | Family *Gruidae* | Present only in wetland/marsh areas | Present only in wetland/marsh areas |
| Rails, coots, and gallinules | Family *Rallidae* | Present only in wetland/marsh areas | Present only in wetland/marsh areas |

**Table H-3.** Nevada game species[a] and their occurrence in the biological resources study areas for the Caliente and Mina rail alignments (page 2 of 2).

| | | Occurrence within the study area[b] | |
|---|---|---|---|
| Common name | Scientific name | Caliente rail alignment | Mina rail alignment |
| *Upland and migratory game birds* (continued) | | | |
| Woodcocks and snipes | Family *Scolopacidae* | Present only in wetland/marsh areas | Present only in wetland/marsh areas |
| *Game fish* | | | |
| Bonneville cutthroat trout | *Oncorhynchus clarki utah* | Absent | Absent |
| Lahontan cutthroat trout | *Oncorhynchus clarki henshawi* | Absent | Present |
| Snake River cutthroat trout | *Oncorhynchus clarki bouvieri* | Absent | Absent |
| Salmon | *Oncorhynchus* ssp. | Absent | Absent |
| Atlantic salmon | *Salmo salar* | Absent | Absent |
| Brook trout | *Salvelinus fontinalis* | Absent | Absent |
| Brown trout | *Salmo trutta* | Absent | Present |
| Bull trout | *Salvelinus confluentis* | Absent | Absent |
| Lake trout | *Salvelinus namyaycush* | Absent | Absent |
| Rainbow trout | *Oncorhynchus mykiss* | Absent | Present |
| Redband trout | *Oncorhynchus mykiss gibbsi* | Absent | Absent |
| Mountain whitefish | *Prosopium williamsoni* | Absent | Present |
| Black bullhead | *Ameiurus melas* | Absent | Absent |
| Brown bullhead | *Ameiurus nebulosus* | Absent | Absent |
| Channel catfish | *Ictalurus punctatus* | Absent | Present |
| White catfish | *Ameiurus catus* | Absent | Present |
| Striped bass | *Morone saxatilis* | Absent | Absent |
| White bass | *Morone chrysops* | Absent | Present |
| Largemouth black bass | *Micropterus salmoides* | Absent | Present |
| Smallmouth black bass | *Micropterus dolomieu* | Absent | Absent |
| Spotted bass | *Micropterus punctulatus* | Absent | Present |
| Black crappie | *Pomoxis nigromaculatus* | Absent | Absent |
| White crappie | *Pomoxis annularis* | Absent | Present |
| Sacramento perch | *Archoplites interruptus* | Absent | Absent |
| Yellow perch | *Perca flavescens* | Absent | Present |
| Bluegill sunfish | *Lepomis macrochirus* | Absent | Present |
| Green sunfish | *Lepomis cyanellus* | Absent | Absent |
| Redear sunfish | *Lepomis microlophus* | Absent | Absent |
| Walleye | *Stizostedion vitreum* | Absent | Present |

a. Source: Nevada Administrative Code Sections 503.020, 503.045, and 503.060.
b. Sources: DOE field surveys; DIRS 185440-BSC 2007, all; BLM resource management plans (DIRS 174518-BLM 2005, all; DIRS 103079-BLM 1998, all; DIRS 173224-BLM 1997, all; DIRS 179560-BLM 2001, all).

**Table H-4.** Non-game bird species and their potential occurrence in the biological resources study areas for the Caliente and Mina rail alignments[a] (page 1 of 3).

| Common name | Scientific name | Description | Potential occurrence Caliente | Potential occurrence Mina |
|---|---|---|---|---|
| Northern goshawk | *Accipiter gentilis* | Feeds on small mammals, nests in large tree limbs or crotch of tree. | Low | Low |
| Tricolored blackbird | *Agelaius tricolor* | Found in riparian habitat and grasslands; nests in marsh thickets. | None | None |
| Sage sparrow | *Amphispiza belli* | Prefers sagebrush or shadscale scrub; nests in depression on ground or in shrub. | High | High |
| Golden eagle | *Aquila chrysaetos* | Found in high deserts shrub habitat and montane; feeds on small mammals, birds, fish, and insects; nests usually in tall trees or cliffs. | Low | Low |
| Long-eared owl | *Asio otus* | Nests in woodlands and hunts in open grasslands. | Low | Low |
| Western burrowing owl | *Athene cunicularia hypugaea* | Found in grassy shrub-steppe and juniper-pinyon woodlands; feeds on small mammals, frogs, and birds; nests in abandoned burrows on ground. | Moderate | Low |
| Juniper titmouse | *Baeolophus griseus* | Found in pinyon-juniper woodlands; nests in tree cavities. | None | Low |
| Ferruginous hawk | *Buteo regalis* | Prefers open grassland and shrub-steppe communities; nests in various sites including trees, cliffs, power poles, and hillsides. | Moderate | Moderate |
| Red-tailed hawk | *Buteo jamaicensis* | Found in open shrub-steppe and montane; feeds on small mammals, birds, reptiles, and insects; nests in tree branches. | High | High |
| Swainson's hawk | *Buteo swainsoni* | Feeds on reptiles, rodents, birds, insects; nests in tree or bush, power pole or cliff. | High | High |
| Western snowy plover | *Charadrius alexandrinus nivosus* | Found in sandy areas, salt flats, and shorelines; eats insects and aquatic invertebrates. | Low | High |
| Mountain plover | *Charadrius montanus* | Prefers grasslands, plowed fields, and sandy deserts; nests on ground in short grass or bare ground. | Low | Low |
| Black tern | *Chlidonia niger* | Found in desert marshlands. | Low | Low |
| Western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | Found in thick riparian habitats or forests; nests in cottonwood trees. | Low | Low |
| Yellow warbler | *Dendroica petechia* | Found in riparian communities; nests in tree or shrub branches. | Low | Low |
| Southwestern willow flycatcher | *Empidonax traillii extimus* | Found in thick riparian areas with mature willow. | Low | Low |

**Table H-4.** Non-game bird species and their potential occurrence in the biological resources study areas for the Caliente and Mina rail alignments[a] (page 2 of 3).

| Common name | Scientific name | Description | Potential occurrence Caliente | Potential occurrence Mina |
|---|---|---|---|---|
| Prairie falcon | *Falco mexicanus* | Found in grasslands, alkali meadows, and lower elevation montane; feeds on mammals, birds, and insects; nests in high ledges. | Moderate | Moderate |
| Peregrine falcon | *Falco peregrinus* | Nests in high cliffs near water; feeds on mostly fish and waterfowl. | None | Low |
| Common loon | *Gavia immer* | Lakes with deep and shallow areas. | None | None |
| Common yellowthroat | *Geothlypis trichas* | Found in marshes, riparian areas; nests in cattails, brush, or grasses near water. | None | Low |
| Greater sandhill crane | *Grus Canadensis tabida* | Marsh areas or agricultural fields. | None | None |
| Pinyon jay | *Gymnorhinus cyanocephalus* | Prefers pinyon-juniper woodlands; nests in colonies. | None | Low |
| Bald eagle | *Haliaeetus leucocephahis* | Feeds on fish, small mammals, and birds; nests near rivers and lakes in tall trees. | None | Low |
| Harlequin duck | *Histriontcus histrionicus* | Lakes. | None | None |
| Yellow-breasted chat | *Icteria virens* | Found in woodlands, scrub, and fence rows; nests in bushes or trees in dense vegetation. | None | Low |
| Loggerhead shrike | *Lanius ludovicianus* | Found in shrub-steppe and pinyon-juniper woodlands; nests in bush or tree. | High | High |
| Long-billed curlew | *Numenius americanus* | Found in grasslands and wet meadows; nests on ground in short grasslands. | Moderate | Low |
| Macgillivray's warbler | *Oporornis tolmiei* | Prefers shrubby riparian woodlands; nests on ground. | None | Low |
| Flammulated owl | *Otus flammeolus* | Found in pinyon-juniper woodlands; feeds on insects. | Low | Moderate |
| Osprey | *Pandion haliaetus* | Near lakes and rivers with fish; nests in tall trees, power poles, and towers. | None | Low |
| American white pelican | *Pelicanus erythrorhynchos* | Rivers, lakes, and reservoirs. | None | None |
| Vesper sparrow | *Pooecetes gramineus* | Found in prairies, dry shrublands, sagebrush communities; nests on ground. | Moderate | Moderate |
| White-faced ibis | *Plegadis chihi* | Marshes, ponds, and rivers; nests in low trees, bulrushes, or on a floating mat. | None | Low |
| Phainopepla | *Phainopepla nitens* | Found in pinyon-juniper or shadscale scrub; feeds on insects or berries. | Low | Low |
| Yuma clapper rail | *Rallus longirostris yumaensis* | Freshwater habitats with bulrushes and cattails. | None | Low |
| Red-naped sapsucker | *Sphyarpicus nuchalis* | Found mostly in montane forests or riparian woodlands; nests in dead trees. | Low | Low |

**Table H-4.** Non-game bird species and their potential occurrence in the biological resources study areas for the Caliente and Mina rail alignments[a] (page 3 of 3).

| Common name | Scientific name | Description | Potential occurrence Caliente | Potential occurrence Mina |
|---|---|---|---|---|
| Sage thrasher | *Oreoscoptes montanus* | Found in sagebrush shrub communities; feeds on insects on the ground; nests in sagebrush or on ground in concealed nests. | High | High |
| Crissal thrasher | *Toxostoma crissale* | Found in desert scrub, tall riparian brush or chaparral; nests in low tree or shrub. | Low | Low |
| Orange-crowned warbler | *Vermivora celata* | Found in low elevation shrub communities; nests on ground. | Low | Low |
| Lucy's warbler | *Vermivora luciae* | Found in deserts or riparian woodlands; nests in tree cavity. | Low | Low |
| Gray vireo | *Vireo vivinior* | Found in shrub-steppe and pinyon-juniper woodlands. | Moderate | Moderate |
| Wilson's warbler | *Wilsonia pusilla* | Prefers open areas in moist woodlands or thickets; nests on ground at base of shrub. | Low | Low |

a. Sources: DIRS 185440-BSC 2007, all; DIRS 181899-USAF 2007, p. 40; DIRS 174518-BLM 2005, p. 3.6-10; DIRS 103079-BLM 1998, all; DIRS 182067-Brune 2007, all; DIRS 174412-Ryser 1985, all.

**Table H-5.** Bat species' protection status and occurrence along the Caliente and Mina rail alignments[a] (page 1 of 4).

| Scientific name | Common name | Protection status | Description | Probability of occurrence along Caliente rail alignment | Probability of occurrence along Mina rail alignment |
|---|---|---|---|---|---|
| *Antrouzous pallidus* | Pallid bat | Nevada protected, BLM-sensitive | Statewide, year-round resident; records in vicinity of alignment, especially around the Yucca Mountain repository area. | High | High |
| *Choeronycteris mexicana* | Mexican long-tongued bat | Unprotected | Known only from one individual found in Las Vegas. Extreme northern edge of range. Prefers desert canyons with riparian vegetation. | Low | None |
| *Corynorhinus townsendii* | Townsend's big-eared bat | Nevada sensitive, BLM-sensitive | Statewide, year-round resident; highly dependent on caverns and mines, susceptible to disturbance. | High | High |
| *Eptesicus fuscus* | Big brown bat | BLM-sensitive | Statewide, year-round resident; tolerant of and uses human-built structures. | High | None |

**Table H-5.** Bat species' protection status and occurrence along the Caliente and Mina rail alignments[a] (page 2 of 4).

| Scientific name | Common name | Protection status | Description | Probability of occurrence along Caliente rail alignment | Probability of occurrence along Mina rail alignment |
|---|---|---|---|---|---|
| *Euderma maculatum* | Spotted bat | Nevada threatened, BLM-sensitive | Scattered across Nevada, typically at higher elevations; roosts in cliff faces. Only Nevada mammal classified as threatened. | Moderate | Moderate |
| *Eumops perotis californicus* | Greater western mastiff bat | Nevada sensitive, BLM-sensitive | Only one dead specimen found in Las Vegas; occurs in various habitats ranging from desert scrub to montane coniferous forests; typically roosts in cliff crevices and boulder cracks; does not appear to hibernate. | Low | None |
| *Idionycteris phyllotis* | Allen's lappet-browed bat | Nevada protected, BLM-sensitive | Recorded only in Clark County, but may occur as far north as southern Lincoln and Nye Counties. Probable resident that migrates from higher summer elevations to lower winter elevations; typically roosts in tree cavities, but has been observed in mines and caverns. | Low | Low |
| *Lasionycteris noctivagans* | Silver-haired bat | BLM-sensitive | A forest-associated species, more common in mature forests; found primarily at higher latitudes and altitudes in coniferous and mixed deciduous/coniferous forests of pinyon-juniper, subalpine fir, white fir, limber pine, aspen, cottonwood, and willow. Probably a transient spring and fall migrant. | Low | Low |
| *Lasiurus blossevillii* | Western red bat | Nevada sensitive, BLM-sensitive | Forest-dwelling, thought to be a transient; very rare in Nevada, only two records until 1999 and development of acoustic detecting equipment. Three acoustical records have occurred since. | Low | Low |
| *Lasiurus cinereus* | Hoary bat | BLM-sensitive | Rare in Nevada, thought to be primarily a summer migrant; tree roosting. | Low | Low |
| *Lasiurus xanthinus* | Western yellow bat | Unprotected | Closely associated with fan-palms, found in palm groves in upper Moapa Valley. May be expanding its range due to use of palms in urban landscaping. | Low | None |
| *Macrotus californicus* | California leaf-nosed bat | Nevada sensitive, BLM-sensitive | No observations have occurred north of Clark County. | Low | None |

**Table H-5.** Bat species' protection status and occurrence along the Caliente and Mina rail alignments[a] (page 3 of 4).

| Scientific name | Common name | Protection status | Description | Probability of occurrence along Caliente rail alignment | Probability of occurrence along Mina rail alignment |
|---|---|---|---|---|---|
| *Myotis califorincus* | California myotis | BLM-sensitive | Resident throughout Nevada, widespread and locally common; will roost anywhere from caves to buildings to exfoliating tree bark. Found in habitats from desert scrub to forests. | High | High |
| *Myotis ciliolabrum* | Small-footed myotis | BLM-sensitive | Statewide resident; tends to prefer mid to high elevations in southern Nevada. Roosts in trees, mines, and caves. Inhabits a variety of habitats including desert scrub, grasslands, sagebrush steppe, blackbrush, greasewood, pinyon-juniper woodlands, pine-fir forests, agriculture, and urban areas. | High | High |
| *Myotis evotis* | Long-eared myotis | BLM-sensitive | Year-round, high elevation forest-dwelling resident. In southern part of Nevada found only in ponderosa forests. Roosts in hollow trees, under exfoliating bark, crevices in small rock outcrops, and occasionally in mines, caves, buildings, and bridges. | Low | Low |
| *Myotis lucifugus* | Little brown myotis | BLM-sensitive | Probably a year-round resident, found in the northern part of Nevada in high elevation coniferous forests. Must be close to water; day roosts in hollow trees, rock outcrops, buildings, and occasionally mines and caves. One of the species most commonly found in human structures. | Low | Low |
| *Myotis thysanodes* | Fringed myotis | Nevada protected, BLM-sensitive | Year-round resident of southern and central Nevada. Widespread but rare. Roost and nursery areas are easily disturbed; roosts in mines, caves, trees, and buildings. | Moderate (historic occurrence in Beatty area) | Moderate (historic occurrence in Beatty area) |
| *Myotis velifer* | Cave myotis | BLM-sensitive | Only recorded in one location in extreme southern Nevada at the Lake Mead National Recreational Area. Typically roosts in caves and bridges, commonly observed using swallow nests. | Low | None |

**Table H-5.** Bat species' protection status and occurrence along the Caliente and Mina rail alignments[a] (page 4 of 4).

| Scientific name | Common name | Protection status | Description | Probability of occurrence along Caliente rail alignment | Probability of occurrence along Mina rail alignment |
|---|---|---|---|---|---|
| *Myotis volans* | Long-legged myotis | BLM-sensitive | Probable resident found throughout Nevada, but more commonly in the north and central portions. Appears to prefer pinyon-juniper, Joshua tree woodlands, and montane coniferous forest habitats. Not found in low desert. Roosts in hollow trees and hibernates in caves and mines, but also uses rock crevices, caves, mines, and buildings. | Moderate (historic occurrence in Beatty area) | Moderate (historic occurrence in Beatty area) |
| *Myotis yumanensis* | Yuma myotis | BLM-sensitive | Tends to occur in the western and southern portions of Nevada, but recent records from eastern Nevada indicate it might be more widespread. Inhabits various habitats including sagebrush, salt desert scrub, agriculture, playa, and riparian habitats. One of few bat species that thrive in urban environments. | Low | Low |
| *Nyctinomops macrotis* | Big free-tailed bat | BLM-sensitive | Observed only in Clark County. Appears to be a transient, but has been commonly seen in the fall along the Muddy River basin. | Low | Low |
| *Pipestrellus hesperus* | Western pipistrelle | BLM-sensitive | Resident found throughout Nevada but is more prevalent in the south and west areas of the state. Prefers desert habitats of blackbrush, creosote, salt desert shrub, and sagebrush. In the summer, roosts in crevices, snags, under rocks, or in buildings. Hibernates in caves and mines in the winter. | High | High |
| *Tadarida braziliensis* | Brazilian free-tailed bat | Nevada protected, BLM-sensitive | A summer resident scattered across Nevada but commonly found in the southern portion. A ubiquitous colonial rooster, will use cliff faces, mines, caves, buildings, bridges, and hollow trees. Some summer colonies have up to 100,000 bats. | High | High |

a. Source: DIRS 181865-Bradley et al. 2006, all.

**Table H-6.** Reptile and amphibian species occurrence along the Caliente and Mina rail alignments.[a]

| Scientific name | Common name | Protection status | Description |
|---|---|---|---|
| *Amphibians* | | | |
| *Ambystoma tigrinum* | Tiger salamander | None | Found in ponds, reservoirs, streams, and stock ponds in deserts, sagebrush areas, grasslands, and mountain meadows. |
| *Bufo boreas nelsoni* | Amargosa toad | BLM-sensitive | Found in or near springs and wet meadows. Takes shelter under shrubs, woody material, and rocks, and may be found in rodent burrows. |
| *Bufo cognatus* | Great Plains toad | None | Found in streams, marshes, irrigation ditches, flooded fields, and adjacent creosote bush desert or sagebrush areas. |
| *Bufo microscaphus* | Southwestern toad | BLM-sensitive | May be found in cottonwood-willow associations, creeks, pools, irrigation ditches, flooded fields, and reservoirs. |
| *Bufo punctatus* | Red-spotted toad | None | Found in rocky, desert streams and adjacent open grassland and scrubland. |
| *Bufo woodhousei* | Woodhouse's toad | None | Found in grasslands, floodplains, and sagebrush flats and sandy areas near streams, marshes, and irrigation ditches. |
| *Rana catesbeiana* | Bullfrog | None | Found in ponds or slow-moving streams with thick aquatic vegetation. |
| *Rana pipiens* [b] | Northern leopard frog | Nevada protected | Found in banks and shallow portions of marshes, ponds, lakes, reservoirs, beaver ponds, streams, and other bodies of permanent water. Also found in irrigation ditches and wet meadows. |
| *Hyla regilla* | Pacific treefrog | None | Found in grasslands, woodlands, farmlands, and desert areas in ponded wetlands, reservoirs, roadside ditches, and slow streams. |
| *Scaphiopus intermontanus* | Great Basin spadefood | None | Found in wet areas within pinion-juniper woods and sagebrush flats. |
| *Reptiles* | | | |
| *Gopherus agassizii* | Desert tortoise | Threatened | Found in desert shrubland habitat in the Mojave Desert. |
| *Sauromalus obesus* [b] | Common chuckwalla | None[c] | Found in rocky areas (rocky outcrops, lava flows, and rocky hillsides) within the Great Basin, Mohave, and Sonoran Deserts. |

a. Source: DIRS 174414-Stebbins 2003, pp. 152, 204, 209, 211 to 215, 223, and 241.
b. Recorded only along the Mina rail alignment.
c. Being considered for a status change to "species of concern" in Nevada.

# H.4 Special Status Species

## H.4.1 METHODS

### H.4.1.1 Research

DOE obtained information on federally and state-protected species from the Nevada Natural Heritage Program (DIRS 185440-BSC 2008, all), an element occurrence database that maintains an inventory on he locations, biology, and conservation status of all threatened, endangered, sensitive, and at-risk species and biological communities in the state. DOE obtained additional information through discussions with resource management agencies and reviewing BLM resource management plans and similar documents. DOE consultation with the FWS provided a list of species protected under the Endangered Species Act that could occur along the Caliente and Mina rail alignments. Using the information gathered from these sources, DOE mapped species locations within the study area, and used the information for on-site verification investigations in 2005 (Caliente rail alignment) and 2007 (Mina rail alignment) and for the assessment of potential impacts.

### H.4.1.2 Field Surveys

DOE conducted field surveys for sensitive plant species, sage-grouse habitat quality, and big game habitat use along the Caliente rail alignment in 2005 and along the Mina rail alignment in 2007 to support the evaluations of potential impacts of the proposed project on these resources. Section H.4.1.2.1 describes the methods DOE used for these surveys.

#### *H.4.1.2.1 Sensitive Plant Species Surveys*

DOE performed surveys for sensitive plant species along the Caliente rail alignment from May 6 through May 16, 2005 and along the Mina rail alignment during the field surveys described in Section H.2.1.2. DOE used the same field equipment described for the previous vegetation surveys for the sensitive plant species surveys. Field personnel used a datasheet to record the data gathered during these surveys (see Figure H-5).

Transects were centered along the rail alignments at the point closest to the known sensitive species location, as documented by the Nevada Natural Heritage Program element occurrence database (DIRS 185440-BSC 2007, all). Locations of the start and end of the transect were recorded using a geographic positioning system unit, and the transect was photographed and staked. Two teams of two biologists examined the area for presence of the species in question; the two teams went in opposite directions with each team member walking 30 meters (100 feet) from the rail alignment centerline for 1 kilometer (0.6 mile). They covered a total distance of 2 kilometers (1.2 miles) in search of the target species or indicative habitat or sign. After reaching the end point of the transect, the biologists spread out an additional 100 feet from their original line and walked the transect back to the starting point. This approach resulted in a 2-kilometer (1.2-mile)-long, 180-meter (590-foot)-wide transect being inspected. When target species were located, the habitat and associated plant community surrounding the target species were documented to evaluate for uniqueness. The locations of locally rare or sparsely distributed species were determined and recorded using a geographic positioning system receiver, and photographed. For species that were locally common, individual plants were counted and their distribution was assessed and recorded on the data sheets shown in Figure H-3.

### H.4.1.3 Impact Analysis

Potential adverse impacts on special status species as a result of the proposed actions provided in Chapter 2 were assessed based on the review of the NNHP dataset, review of BLM resource management plans, and field observations. Direct long-term impacts include the loss of and fragmentation of special status species suitable habitat and potential death of individuals. Indirect impacts include potential avoidance and/or displacement of animal species during construction and disturbance from passing trains. The potential for impacts on special status species was determined based on the location of the documented occurrence within the study area and in relation to the rail line, facilities, and quarries. In addition, DOE used the SWReGAP data and field observations to determine the likelihood of an occurrence of a particular species based on its known preferred habitat and the vegetation community present.

| TRANSECT ID: | DATE (mm/dd/yy): | RECORDER: | OBSERVERS: | LOCATION: | TRANSECT BEARING: |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| | GPS FILENAME - START: | | | | | |
| Coordinates | WAYPOINT | UTM N | UTM E | PDOP | WAAS USED? | ELEVATION |
| START TRANSECT | | | | | yes / no | |
| END TRANSECT | | | | | yes / no | |
| | GPS FILENAME - END (if different): | | | | | |

| | |
|---|---|
| TRANSECT START PHOTO: | TRANSECT END PHOTO: |

| SLOPE: | ASPECT: | LANDFORM (elaborate in Notes section): Valley Flat Toe Slope/Alluvuial Fan Slope Cliff/Scarp Other | LAND USE: Wilderness Mining Recreation Grazing Transportation Plowed Fields Urban/Developed Other |
|---|---|---|---|

SW REGAP CLASS:

ESTIMATED DOMINANT SPECIES:

| | NAME/CODE | EXTENT* | WAYPOINT | UTM N | UTM E | PDOP | WAAS | ELEVATION |
|---|---|---|---|---|---|---|---|---|
| Sensitive Species 1 | | | | | | | yes / no | |
| Sensitive Species 2 | | | | | | | yes / no | |
| Sensitive Species 3 | | | | | | | yes / no | |
| Sensitive Species 4 | | | | | | | yes / no | |
| Sensitive Species 5 | | | | | | | yes / no | |
| Sensitive Species 6 | | | | | | | yes / no | |
| Sensitive Species 7 | | | | | | | yes / no | |
| Sensitive Species 8 | | | | | | | yes / no | |
| * Categories for sens spp and inv/nox spp extent: Solitary, Few Clumped, Few Scattered, Many Clumped, Many Scattered, Dense, Other | | | | | | | | |
| Invasive/Nox Species 1 | | | | | | | yes / no | |
| Invasive/Nox Species 2 | | | | | | | yes / no | |
| Invasive/Nox Species 3 | | | | | | | yes / no | |

NOTES:

**Figure H-5.** Data sheet for sensitive plant species survey.

The magnitude of impact was determined based on the type of habitat. A small impact to a special status species would neither destabilize nor noticeably alter the species' habitat or population. A moderate impact would noticeably alter a species' habitat or population, but would not destabilize it. A large impact would significantly alter or destabilize a species' habitat and population. However, no large impacts were found to occur in the analysis.

## H.5 Wild Horses, Burros, and Big Game Species

### H.5.1 METHODS

#### H.5.1.1 Research

Before beginning fieldwork, DOE identified any existing information regarding the occurrence and distribution of herd management areas and big game habitats within the region of influence of the proposed rail alignment. These efforts included literature searches and consultations with land-management agencies and authorities, including the BLM and the Nevada Department of Wildlife.

#### H.5.1.2 Field Surveys

DOE performed surveys along the Caliente rail alignment from February 4 through March 11, 2005, from May 5 through May 10, 2005, and on June 7 and 8, 2005, to assess relative use of areas by horses, burros, and big game. DOE performed surveys along the Mina rail alignment during the field surveys described in Section H.2.1.2.

DOE performed observational sampling along linear transects. Transect dimensions were 800 meters (2,600 feet) long, unless blocked by terrain, by 120 meters (390 feet) wide. The sampling interval was continuous, with three observers spaced 30 meters (100 feet) apart. At the beginning of each transect, the type of BLM or Nevada Department of Wildlife management unit (for example, wild horse and burro herd management area, game habitat) potentially affected was determined, the locations of the start and end of the transect were recorded using a geographic positioning system receiver, and the transect was photographed and staked as described above. Field notes concerning the surrounding terrain and special habitat features, such as water sources or fences, were recorded on the data sheets for horse and burro and big game habitat use surveys shown in Figure H-6.

The bearing of the transect was determined as described for vegetation surveys in Section H.2.1.2. Transects were walked by teams of three biologists, one walking along the center line of the proposed rail alignment, with each of the others 30 meters (100 feet) to either side. When only two biologists were available for surveys, this fact was noted on the data sheet and resultant data were interpreted to adjust for the decrease in area covered. Observers documented the presence of any visible large ungulates, wild horses, or burros, and their estimated distance from the transect. Notes were also recorded regarding the presence of small or non-game wildlife species, including birds, rabbits, foxes, coyotes, badgers, reptiles, and amphibians, or evidence of habitat use by these species, such as scat, owl pellets, or burrows.

Track counts were conducted in which discrete sets of mule deer, pronghorn antelope, bighorn sheep, wild horse, or burro tracks were identified and counted. Sets of animal tracks that crossed the path of more than one observer were counted only once. Areas of high track density were noted and roughly delineated using waypoints identified by a geographic positioning system to assist in determining migration routes and forage areas.

| | | | | | | |
|---|---|---|---|---|---|---|
| TRANSECT ID: | DATE (mm/dd/yy): | RECORDER: | OBSERVERS: | | LOCATION: | TRANSECT BEARING: |
| | GPS FILENAME - START: | | | | | |
| Coordinates | WAYPOINT | UTM N | UTM E | PDOP | WAAS USED? | ELEVATION |
| START TRANSECT | | | | | yes / no | |
| END TRANSECT | | | | | yes / no | |
| | GPS FILENAME - END (if different): | | TRANSECT LENGTH: meters | | | |
| SLOPE: | ASPECT: | LANDFORM (elaborate in Notes sec ion): Valley Flat Toe Slope/Alluvial Fan Slope Cliff/Scarp Other | | LAND USE: Wilderness Mining Recreation Grazing Transportation Plowed Fields Urban/Developed Other | | |
| ESTIMATED PLANT COMMUNITY: | | | | MANAGEMENT UNIT (if applicable): | | |
| | STALLION PELLET | MARE PELLET | TRACK COUNT | | | |
| HORSE | | | | | | |
| | PELLET COUNT | | | | | |
| BURRO | | | | | | |
| MULE DEER | | | | | | |
| BIGHORN | | | | | | |
| PRONGHORN | | | | | | |
| Wildlife observed/distance from transect: | | | | | | |
| Notes: | | | | | | |
| Photo, transect start: | | | | | | |
| Photo, transect end: | | | | | | |
| Photo, supplemental 1: | | | | | | |
| Photo, supplemental 2: | | | | | | |

**Figure H-6.** Data sheet for assessing horse, burro, and big game habitat use.

Pellet counts were conducted in which individual piles of large ungulate, wild horse, or burro scat that appeared to be less than 3 months old (based on degree of weathering), were identified and counted. Bighorn sheep, pronghorn antelope, and mule deer scat were sometimes difficult to differentiate by appearance alone. In these cases, the species was determined by examining other evidence (habitat, terrain, tracks, known distribution information). In the case of wild horses, stallion piles, which consist of two or more depositions of scat, were counted separately from single depositions resulting from mares and subordinate stallions. In some cases, burro scat was difficult to differentiate from foal and yearling horses and a determination of species was based on other evidence, such as the presence of other horse scat or tracks. Evidence of commercial sheep grazing activities was noted where present, because these operations can hinder the assessment of deer and antelope tracks and pellets.

## H.5.2 HERD MANAGEMENT AREAS (HMAs)

The Caliente rail alignment and the Mina rail alignment each would cross a number of herd management areas. Section H.5.2.1 describes herd management areas the Caliente rail alignment would cross; Section H.5.2.2 describes herd management areas the Mina rail alignment would cross. The primary sources for information about each area listed are the BLM Draft Ely District Resource Management Plan (DIRS 174518-BLM 2005, all) and additional information DOE gathered from herd management plans and evaluations, as indicated in the descriptions.

### H.5.2.1 Caliente Rail Alignment

#### *H.5.2.1.1 Miller Flat and Little Mountain Herd Management Areas*

The Miller Flat HMA and Little Mountain HMA are in Lincoln County, Nevada, approximately 3.2 kilometers (2 miles) northeast of the City of Caliente and, combined, are approximately 580 square kilometers (140,000 acres) in size. Both the Caliente and the Eccles alternative segments would cross the Little Mountain HMA. Each herd management area has an appropriate management level of nine to 15 horses. A 2004 census (DIRS 174047-Bennet 2005, p. 2) indicates that there are 40 horses in the Little Mountain HMA and 35 horses in the Miller Flat HMA. The herds move from Miller Flat to Little Mountain in the winter and move back to Miller Flat during the summer. The 2005 Draft Ely District Resource Management Plan (DIRS 174518-BLM 2005, p. 3.8-6) indicates that forage, water, space, and habitat in these herd management areas are inadequate and recommends removing the horses and eliminating the HMA status. Permanent water sources consist of nine small springs on both private and public lands primarily in the Miller Flat HMA, Clover Creek, and water troughs installed for livestock. Only two small springs are available to horses and burros within the Little Mountain HMA, so the resident horses and burros are forced to travel to the Miller Flat HMA for water (DIRS 173057-BLM [n.d.], all).

#### *H.5.2.1.2 Highland Peak Herd Management Area*

Caliente common segment 2 would cross the Highland Peak HMA, which covers 550 square kilometers (140,000 acres) to the west of Panaca. The primary water source is in the central portion of the HMA at Bennett Springs, but several small springs are also found on the Highland Peak Range (DIRS 173059-BLM [n.d.], all). The appropriate management level for the Highland Peak HMA is 364 horses; however, the current population (2007) is approximately 150 horses (DIRS 174047-Bennet 2005, p. 2). Field observations from the winter of 2005 suggest that the eastern end of common segment 1 also supports a very high level of use by horses, and the portion of the segment at Bennett Pass shows evidence of seasonal horse use, which was confirmed during the May 2005 field effort, during which 35 horses were counted in the pass. The Draft Ely District Resource Management Plan (DIRS 174518-BLM 2005, p. 3.8-6) lists the habitat of this HMA as inadequate in the winter and does not rate the forage, space, and genetic viability of the HMA; the Plan recommends that this HMA be combined with the Dry Lake and Rattlesnake HMAs.

#### H.5.2.1.3 Rattlesnake Herd Management Area

The Rattlesnake HMA, covering approximately 290 square kilometers (71,000 acres), is approximately 27 kilometers (17 miles) west of the City of Caliente in the Dry Lake Valley. Caliente common segment 1 would cross a small portion of the northeast corner of the HMA. The HMA has an appropriate management level of one horse to account for incidental use by wild horses from the Dry Lake HMA to the north during years with exceptionally high snowfall. The primary water sources include three springs, small ephemeral reservoirs, and cattle troughs. The 2003 census found no resident horses (DIRS 174332-BLM [n.d.], all; DIRS 174047-Bennet 2005, p. 2). The 2005 Draft Ely District Resource Management Plan (DIRS 174518-BLM 2005, p. 3.8-7) lists the habitat as inadequate during the summer months and does not rate the forage, water, space, and genetic viability of the HMA. The Draft Ely District Resource Management Plan recommends that this HMA be combined with the Dry Lake and Highland Peak HMAs.

#### H.5.2.1.4 Dry Lake Herd Management Area

The Dry Lake HMA is in Lincoln County west of the town of Pioche and encompasses approximately 2,000 square kilometers (490,000 acres). Common segment 1 would cross the Dry Lake HMA in Dry Lake Valley and in the North Pahroc Range. The appropriate management level for this HMA is 94 horses. In August 2003, 23 horses were removed from the HMA, and the BLM population estimate is 72 horses. Primary water sources for the HMA are artesian springs and freshwater seeps in the Schell Creek, Pahroc, Bristol, and Fairview Mountain Ranges (DIRS 182069-BLM [n.d.], all; DIRS 174047-Bennet 2005, all). The 2005 Draft Ely District Resource Management Plan (DIRS 174518-BLM 2005, p. 3.8-6) rates forage, water, space, habitat, and genetic viability as adequate, and recommends that this HMA be combined with the Rattlesnake and Highland Peak HMAs.

#### H.5.2.1.5 Seaman Herd Management Area

Common segment 1 would cross the Seaman HMA, which is approximately 56 kilometers (35 miles) south of Lund in both Nye and Lincoln Counties. It encompasses approximately 1,350 square kilometers (338,400 acres) and is currently being managed for a target population of 159 horses (DIRS 174333-BLM [n.d.], all). A 2004 population estimate indicates that there are 99 horses using the HMA (DIRS 174047-Bennet 2005, p. 2). The resident horses' summer range is in the Seaman and Grant Mountains in the western portion of the herd management area, and their winter range is in the Coal and White River Valleys. Water sources are very limited (rated as marginal in the 2005 Draft Ely District Resource Management Plan) and emergency removal of horses is anticipated in dry years (DIRS 174333-BLM [n.d.], all). Space is rated as adequate, but habitat is rated as inadequate due to the lack of summer habitat. Forage and genetic viability is unrated in the 2005 Draft Ely District Resource Management Plan, but the Plan recommends removing the herd and eliminating the herd management area status of the land (DIRS 174518-BLM 2005, p. 3.8-7).

#### H.5.2.1.6 Reveille Herd Management Area

The Reveille HMA is 80 kilometers (50 miles) east of Tonopah and 19 kilometers (12 miles) south of Warm Springs. Common segment 3 would cross this HMA. The HMA covers 510 square kilometers (130,000 acres) and is currently managed for a target population of 138 horses. The 2006 BLM census flight located 78 wild burros in the area (DIRS 182310-Dwyer 2007, all). A significant portion of the Reveille herd has established residency outside the boundaries of the HMA, suggesting that the current target population might not be appropriate for the available habitat (DIRS 173060-BLM [n.d.], all; DIRS 174046-Bennet 2005, all).

#### H.5.2.1.7 Stone Cabin Herd Management Area

The Stone Cabin HMA is 45 kilometers (28 miles) east of Tonopah and encompasses approximately 1,600 square kilometers (404,000 acres). Caliente common segment 3 would cross this HMA, which is of historic significance to wild horse management. The first wild horse roundup approved by the U.S. Congress occurred here after the passage of the Wild Free-Roaming Horse and Burro Act of 1971 (Public Law 92-195). It is also the historic home of the "Stone Cabin Grey" wild horse type; however, recent horse gathers and drought have reduced the number of horses with "Stone Cabin Grey" characteristics to only a few individuals (DIRS 174330-BLM [n.d.], all). The appropriate management level is 364 horses, and the current population as of 2007 is approximately 150 horses (DIRS 182310-Dwyer 2007, all). DOE field personnel observed evidence of a high level of use by horses during the 2005 field surveys near common segment 3 in the northern portion of Stone Cabin Valley. Personnel observed a herd of at least 12 horses several times from U.S. Highway 6 in Stone Cabin Valley within approximately 3 kilometers (1.9 miles) of the Caliente rail alignment. Personnel also observed 12 horses approximately 1 kilometer (0.62 mile) south of the Caliente rail alignment in this area.

#### H.5.2.1.8 Saulsbury Herd Management Area

The Saulsbury HMA is 26 kilometers (16 miles) east of Tonopah and is separated into two parcels totaling 570 square kilometers (140,000 acres), with an interconnecting segment of U.S. Forest Service land. Common segment 3 would cross the southern extent of this HMA. The area was intended to be managed under a Memorandum of Understanding between the U.S. Forest Service and the BLM, but it is currently managed as smaller individual units by the agency of jurisdiction. The appropriate management level is 40 horses, and the population as of 2007 is approximately 30 horses (DIRS 182310-Dwyer 2007, all). The resident horses spend their time in both administrative areas (DIRS 174329-BLM [n.d.], all; DIRS 174046-Bennett 2005, all).

#### H.5.2.1.9 Goldfield Herd Management Area

The Goldfield HMA is east of the community of Goldfield in Nye and Esmeralda Counties. Goldfield alternative segments 1, 3, and 4 along the Caliente rail alignment would cross this HMA. There is a potential quarry site in the northeastern portion of the HMA, adjacent to Goldfield alternative segment 3. The area encompasses 260 square kilometers (64,000 acres) and is in a transitional zone between the Mojave and Great Basin Deserts vegetation types. It provides suitable habitat only for burros, although the appropriate management level is 125 horses and 50 burros. The 2004 population estimate was 15 burros, although unofficial sightings suggest as many as 20. The BLM gathered and removed all resident wild horses in 1995, 1996, and 1997 (DIRS 173062-BLM [n.d.], all; DIRS 174046-Bennet 2005, p. 2). During the 2005 surveys, one burro was observed and evidence of habitat use by burros was noted near the northern end of Caliente common segment 4.

#### H.5.2.1.10 Montezuma Peak Herd Management Area

Goldfield alternative segment 4 would cross the Montezuma Peak HMA, which is west of the community of Goldfield. There is a potential quarry site in the eastern portion of the HMA, adjacent to Goldfield 4. The Montezuma Peak HMA encompasses 305 square kilometers (75,500 acres). The appropriate management level is 157 horses. The 2006 BLM census flight located 58 horses, 18 burros, and 3 mules (DIRS 182310-Dwyer 2007, all; DIRS 173061-BLM [n.d.], all; DIRS 174046-Bennet 2005, all).

#### *H.5.2.1.11 Stonewall Herd Management Area*

The Stonewall HMA is west of Lida Junction and south of Goldfield in Nye County. Caliente common segment 4 and both the Bonnie Claire alternative segments would cross the HMA, which encompasses 100 square kilometers (25,000 acres) and provides suitable habitat only for burros, although the appropriate management level is for 50 horses and 25 burros (DIRS 182310-Dwyer 2007, all). A 2006 partial BLM census flight located 17 burros around the Stonewall Falls area. Other sightings have indicated that some of the 34 resident burros from the adjoining Goldfield HMA wander through the Stonewall HMA (DIRS 173063-BLM [n.d.], all; DIRS 174046-Bennet 2005, p. 2). Observations made during the 2005 field surveys along Bonnie Claire alternative segment 2 suggest that burros occasionally use the area. Along Bonnie Claire alternative segment 3, within the Stonewall HMA, field observations suggest a relatively high level of past and present use of this area by burros. Field personnel noted signs of limited use of the area by horses near the northern end of Bonnie Claire 3, and noted evidence of habitat use by burros near the southern end of common segment 4.

#### *H.5.2.1.12 Bullfrog Herd Management Area*

The Bullfrog HMA surrounds the town of Beatty in Nye County. Common segment 6 would cross this HMA, which encompasses 520 square kilometers (130,000 acres) and is suitable habitat only for wild burros. Only a portion of the HMA has had an appropriate management level established, which was for 183 burros and 12 horses. The 2006 BLM census flight located 32 burros, though the population is estimated to be approximately 70 (DIRS 182310-Dwyer 2007, all). The burro population in the area is estimated to be 34. Unofficial sightings suggest the presence of wild horses and additional burros (DIRS 173064-BLM 2007, all; DIRS 174046-Bennett 2005, all). During the 2005 field surveys, personnel observed several herds of approximately 13 burros each near common segment 6 in the Crater Flat area. Field personnel noted evidence of burros consistently along common segment 6 south of Beatty Wash, with higher levels of use within the Bullfrog HMA.

### H.5.2.2 Mina Rail Alignment

#### *H.5.2.2.1 Horse Mountain Herd Management Area*

The Horse Mountain HMA is located at the northern boundary of the Walker River Paiute Reservation in Lyon and Churchill counties. Schurz alternative segment 6 would run adjacent to the southern periphery of the HMA, but would not intersect. The Horse Mountain HMA encompasses approximately 193 square kilometers (47,691 acres). In 2000, there was an estimated population of 95 wild horses in this area and no burros (DIRS 182310-Dwyer 2007, all). Currently, there are no known herds that occupy the Horse Mountain HMA, due to modifications or diversions of water resources that once supported herds (DIRS 181843-Westover 2007, all).

#### *H.5.2.2.2 Pilot Mountain Herd Management Area*

The Pilot Mountain HMA is located in Mineral and Esmeralda Counties, extending from the Monte Cristo mountain range in the southern boundary of the HMA, and continuing northwest along the Pilot Mountain range to the Gabbs Valley Range. The Pilot Mountain HMA is large, encompassing 1,937 square kilometers (478,641 acres). Mina common segment 1 follows the southwestern boundary of the HMA, but would not intersect any of the designated wild horse and burro habitat. The 2006 estimated population of Pilot Mountain HMA is approximately 286 horses (DIRS 182310-Dwyer 2007, all). There are no known burros (DIRS 181843-Westover 2007, all).

#### *H.5.2.2.3 Silver Peak Herd Management Area*

The Silver Peak HMA is located in Esmeralda County, directly west of Silver Peak and Montezuma alternative segment 1. The proposed rail alignment would not intersect the designated Silver Peak HMA, but would occur adjacent to the eastern boundary. The Silver Peak HMA is approximately 970 square kilometers (239,691 acres). In 2006, all horses were removed from the HMA due to recurrent drought, starvation, and genetics issues (DIRS 182310-Dwyer 2007, all).

#### *H.5.2.2.4 Goldfield Herd Management Area*

The Goldfield HMA is located in Esmeralda and Nye Counties, east of the town of Goldfield. Montezuma alternative segment 2 would intersect this HMA. A 2006 BLM census flight located six horses and no burros; however, burro tracks and scat are evident throughout the HMA. Numbers fluctuate dramatically due to burro movement into the Nevada Test Site. There is an estimated population of about 20 to 30 burros in the Goldfield HMA (DIRS 182310-Dwyer 2007, all).

#### *H.5.2.2.5 Montezuma Peak Herd Management Area*

The Montezuma Peak HMA is within the Montezuma Range and borders the Goldfield HMA to the east and the Palmetto HMA to the southwest. Montezuma alternative segments 1, 2, and 3 would intersect or run adjacent to the designated HMA. The Montezuma Peak HMA is about 310 square kilometers (76,602 acres) with an estimated 146 wild horses and 10 burros (DIRS 181843-Westover 2007, all). However, a 2006 BLM census flight located 58 horses and 18 burros (DIRS 182310-Dwyer 2007, all). During the December 2006 and March 2007 field surveys, several wild horses were observed in the area near the proposed North Clayton quarry site on the west-facing side of the Montezuma Range.

#### *H.5.2.2.6 Stonewall Herd Management Area*

The Stonewall HMA is west of Lida Junction and south of Goldfield in Nye County. Both the Bonnie Claire alternative segments would cross the HMA, which encompasses 100 square kilometers (25,000 acres) and provides suitable habitat only for burros, although the appropriate management level is for 50 horses and 25 burros. Annual counts have not recorded any resident animals, but subsequent sightings have indicated that some of the 34 resident burros from the adjoining Goldfield HMA wander through the Stonewall HMA (DIRS 173063-BLM [n.d.], all; DIRS 174048-Bennet and Thebeau 2005, all). Observations made during the 2005 field surveys along Bonnie Claire alternative segment 2 suggest that burros occasionally use the area. A partial 2006 census flight located 17 burros in the area around Stonewall Fall. Along Bonnie Claire alternative segment 3, within the Stonewall HMA, field observations suggest a relatively high level of past and present use of this area by burros. Field personnel noted signs of limited use of the area by horses near the northern end of Bonnie Claire 3.

#### *H.5.2.2.7 Bullfrog Herd Management Area*

The Bullfrog HMA surrounds the town of Beatty in Nye County. Common segment 6 would cross this HMA, which encompasses 520 square kilometers (130,000 acres) and is suitable habitat only for wild burros. Only a portion of the HMA has had an appropriate management level established, which was for 183 burros and 12 horses. The burro population in the area is estimated to be 34. A 2006 BLM census flight located 17 burros around the Stonewall Falls area (DIRS 182310-Dwyer 2007, all). Unofficial sightings suggest the presence of wild horses and additional burros (DIRS 173064-BLM 2007, all; DIRS 174046-Bennet 2005, all). During the 2005 field surveys, personnel observed several herds of approximately 13 burros each near common segment 6 in the Crater Flat area. Field personnel noted evidence of burros consistently along common segment 6 south of Beatty Wash, with higher levels of use within the Bullfrog HMA.

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