



BUILDING BRIGHTER FUTURES

**Design and Reclamation of Postmining Playas in the Powder River Basin.
Successful Examples from the North Antelope Rochelle Mine, (NARM)
Campbell County, Wyoming**

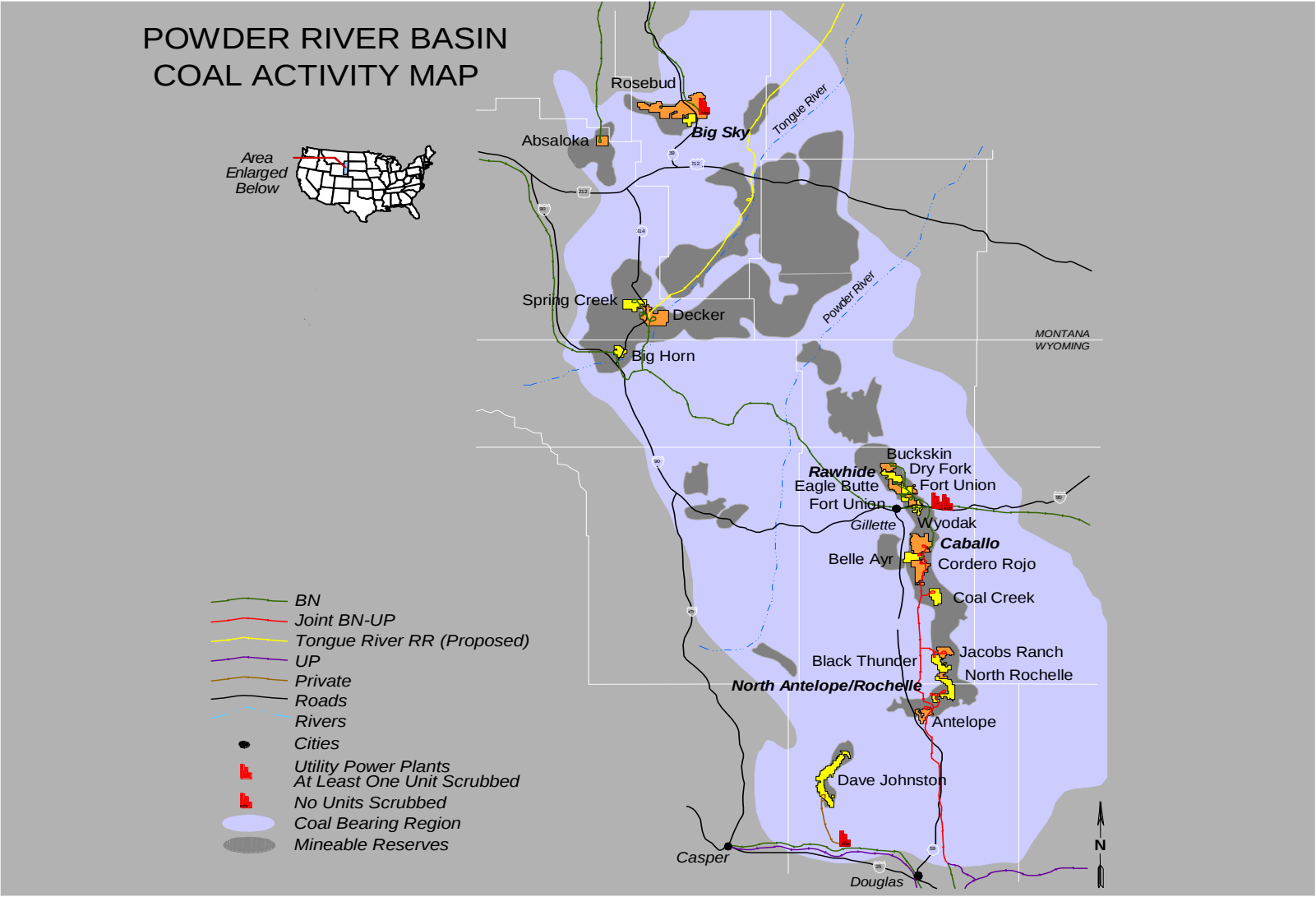
Philip A. Murphree – Manager, Hydrology | June 8, 2026

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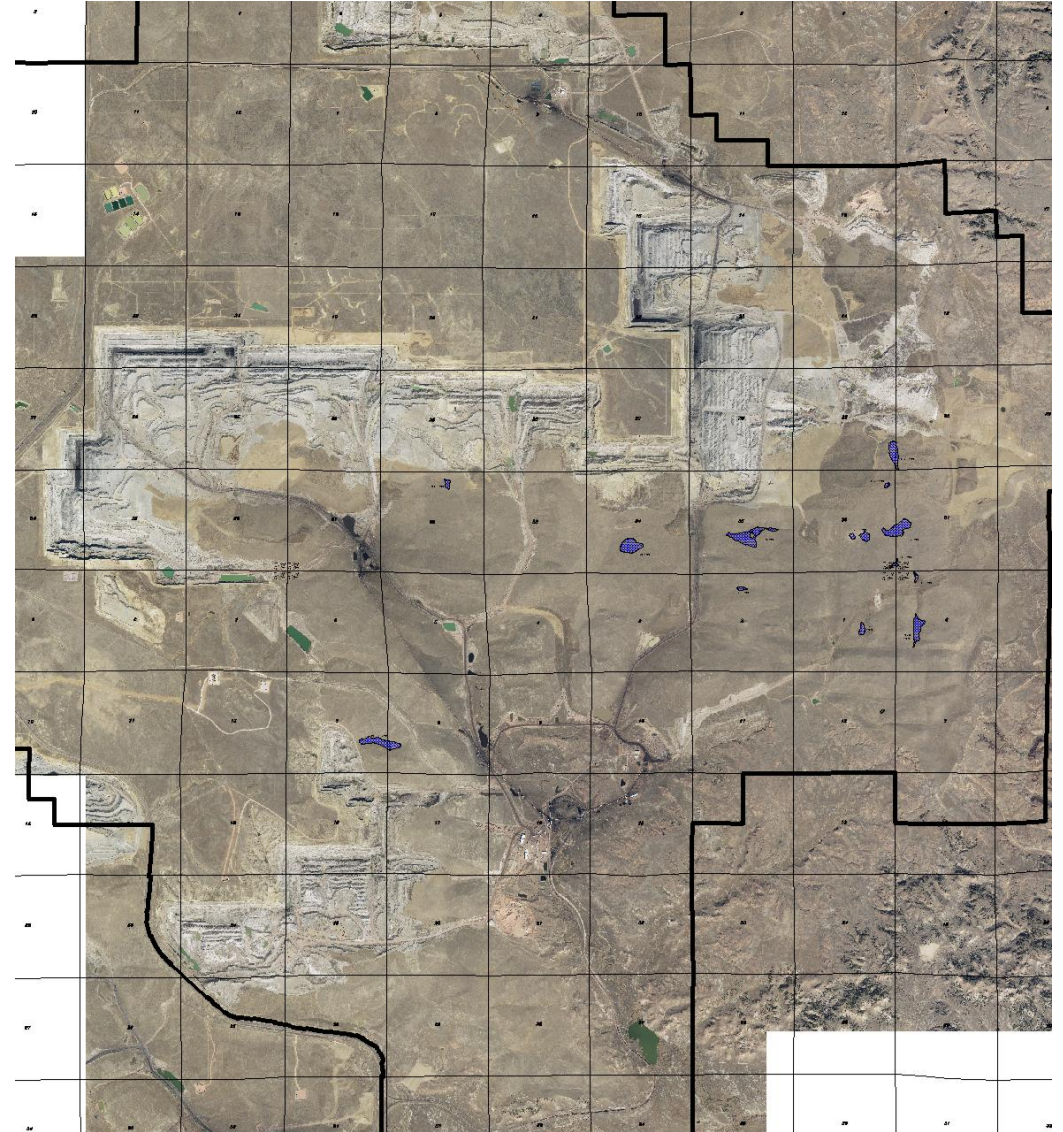




2025 NARM Overview

- NARM is the Largest Coal Mine in the USA
- Permit Area: 65,805 Acres
- Coal Production in 2025: 65,031,905 Tons
- Reclaimed Area: 15,622 Acres
- Phase 1 Released: 13,541 Acres
- Phase 2 Released: 12,762 Acres
- Phase 3 Released: 7,522 Acres
- Phase 1 Pending: 2,010 Acres
- Phase 2 Pending: 1,398 Acres

Photo: NARM in March 2026 showing constructed postmining playas in blue.



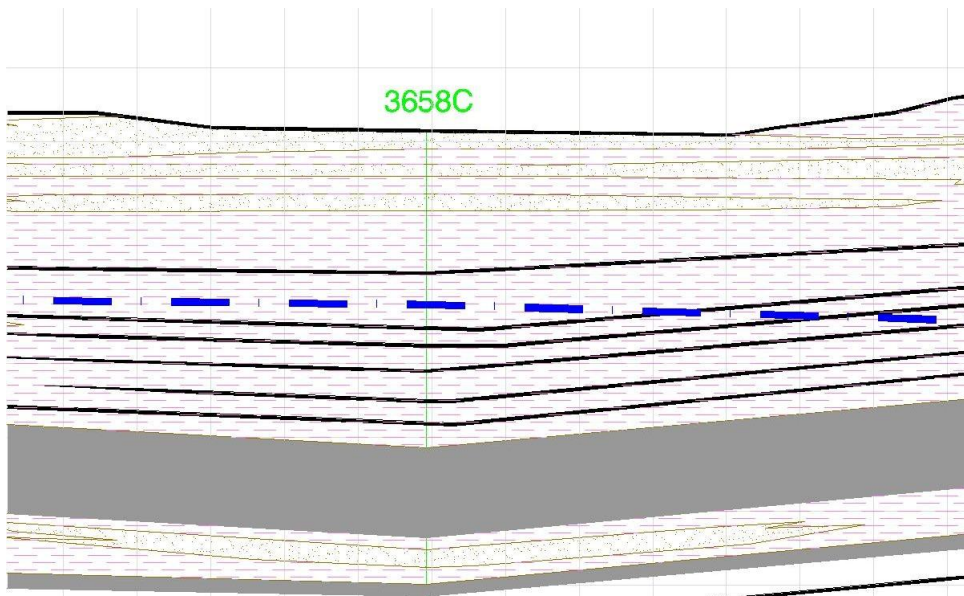
Climate and Setting

- Topography is generally flat with most surface drainages flowing into ephemeral streams. The mine is located in the transition area from a subdued upland topography to extensive badlands.
- Permit area elevation ranges from 4,494 ft to 1,525 m 5,000 feet
- Climate is generally cool and semi-arid
 - Mean annual precipitation is approximately 12-15 inches and predicted ET is 25 inches



Native Playas in the Powder River Basin and at NARM

- Playas are common in the Powder River Basin of Wyoming.
- The playas typically form due to subsurface structural troughs where precipitation is insufficient to allow surface drainage from the low area of the playa.
- Large playas exist in flatter areas. Some very small playas exist in burn areas where historic natural coal burning has resulted in volume reductions and subsidence.
- The pools generally have depths of around 2 ft. With evaporation and seepage generally in the range of 1 ft/mo, the playas generally don't hold water for more than a couple of months at a time.



Native Playas in the Powder River Basin and at NARM (continued)

- At NARM, there were seventeen separate native playas and playa complexes located in the permit area. The drainage areas ranged in size from 45 ac to 1,453 ac and the pool areas ranged from 1.2 ac to 109.6 ac.
- At NARM, some of the native playa drainage areas were reduced by erosion from headcutting of native stream channels prior to mining and some playas were abandoned by erosion.
- Due to erosion into the pool areas over time, the playa soils are generally fine grain clays and silts.
- The vegetation in the playa pool areas generally consisted of grasslands along with some wetland species, especially where ranchers had constructed dugouts prior to mining. Common species were Western wheatgrass, Common spikerush, and foxtail barley. The premining playas were usually surrounded by sagebrush grasslands.
- The margins of shrub dominated areas relative to the playa grasslands may change over time due to climatic variation.

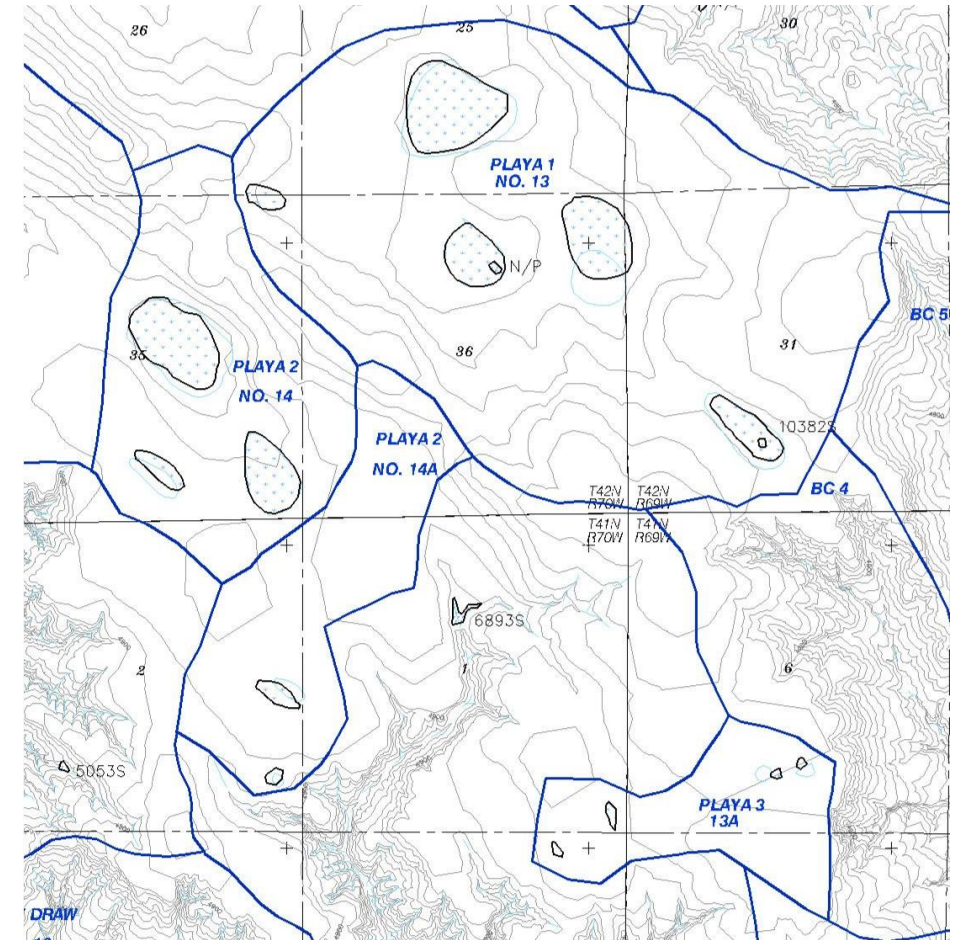


Figure: Native Playas at NARM Surrounded by Badlands to South, West, and East.

Hydrology of Playas and Wetlands Within Playas

- Generally, the playas will fill to a shallow depth during runoff events and combined evapotranspiration and seepage means the playas will typically hold water for a couple of months or so. During wet periods, the playas may hold some water for a whole year.
- Locally important recharge occurs from playas as shown by groundwater level monitoring.
- Due to infiltrating water carrying salts downward, the surface water quality in the playas was often the best at the mine with TDS ranging from 88 to 518 mg/L and trace metals below detection at one of the major playas. Most surface water features had much higher TDS from 100 to 4,500 mg/L depending on season and retention time.
- In the early mine wetlands delineations between 1992 and 1998, there were 79.8 acres jurisdictional playa / depressional wetlands requiring replacement in kind, but the 2001 U.S. Supreme Court decision in Solid Waste Agency of Northern Cook County (SWNCC) vs US Army Corps of Engineers meant that the playas are outside of US Army Corps of Engineers jurisdiction.



Previous Studies

- In 1997, there were three studies of 59 playas in the PRB, including two of the playas at NARM, conducted by University of Wyoming graduate students for M.S. thesis projects.
- Some findings relevant to our work are the differences between recharge playas located above the water table like those at NARM that have superior water quality and soils, and discharge playas located below the water table such as a number of examples near Gillette, that tend to be saline.
- Some of the conclusions of the studies I would disagree with at least for the playas at NARM and the Caballo Mine near Gillette since we do see local recharge and no increase of salinity over time due to significant infiltration. The fine-grained soils in the pools are a result of slow flow over time towards the centers of the playas but are not particularly clay-rich. Trace metal concentrations are extremely low in the playa soils at the two mines.
- In addition, the playas did not form due to aeolian processes but probably were shaped by them after being formed due to trough formation.



Development of Design Criteria for Postmining Playas

- In the early 1990's, there was debate within WDEQ/LQD as to whether to allow playa reclamation. Some at WDEQ/LQD believed they would be trace metal sinks.
- One consulting firm marketed a complicated playa design model with many required inputs, but when used at NARM, few of the native playa pools and wetlands should have existed.
- Use of a simple range of pool area relative to drainage area proved to be much more reliable. This has proven to be reliable at different mines because the pool areas and wetlands are probably related to the soils and precipitation differences at each site.
- The first large postmining playas were permitted at NARM in the mid-1990's for wetland mitigation, but design started earlier. NARM's first playa reclamation occurred soon after. Based on permitting at the Caballo Mine, the NARM playa reclamation language was revised later.
- We agreed with WDEQ/LQD to keep the playas a minimum of 30-40 feet above the postmining potentiometric surface to ensure there won't be salt accumulation. This conservative approach has proven to be successful.
- WDEQ/LQD Guideline 17 allows playa reclamation with up to 110 percent of total premining drainage area to limit effect on downstream water rights and within 25 percent of premining pool area.
- Drainage basin depth is not a key factor as long as the other factors are met. Due to the playa being designed to hold large runoff events at a shallow depth, there is no spill depth consideration.

Development of Design Criteria for Postmining Playas (continued)

- Summary NARM Permit table for premining and postmining playa comparison
- There were 17 premining playas and playa complexes.
- Currently, there are 27 postmining playas planned. 14 of these have been constructed to date.

Site I.D. or Location	Drainage Area (acres)	Pool Area (acres) +	Ratio of Pool Area to Drainage Area
PREMINING			
Playa 1 (Draw 13)	1453	105.46	0.073
Playa 2 (Draw 14 and 14A)	793	64.69	0.082
Playa 3 (Draw 13A)	160	2.68	0.017
Bailey's Playa	422	1.23	0.003
POSTMINING			
Amalie Playa	681	28.42	0.042
Angela Playa	304	10.11	0.033
Bailey's Playa	286	8.28	0.029
Brunhilde Playa	43	4.58	0.107
Elke Playa	166	3.13	0.019
PREMINING / POSTMINING			
Total Premining Playa	6866	401	0.058
Total Postmining Playa	7198	243	0.034
Difference (Post/Pre) (%)	4.83%	39.47 %	---

Reclamation of Postmining Playas

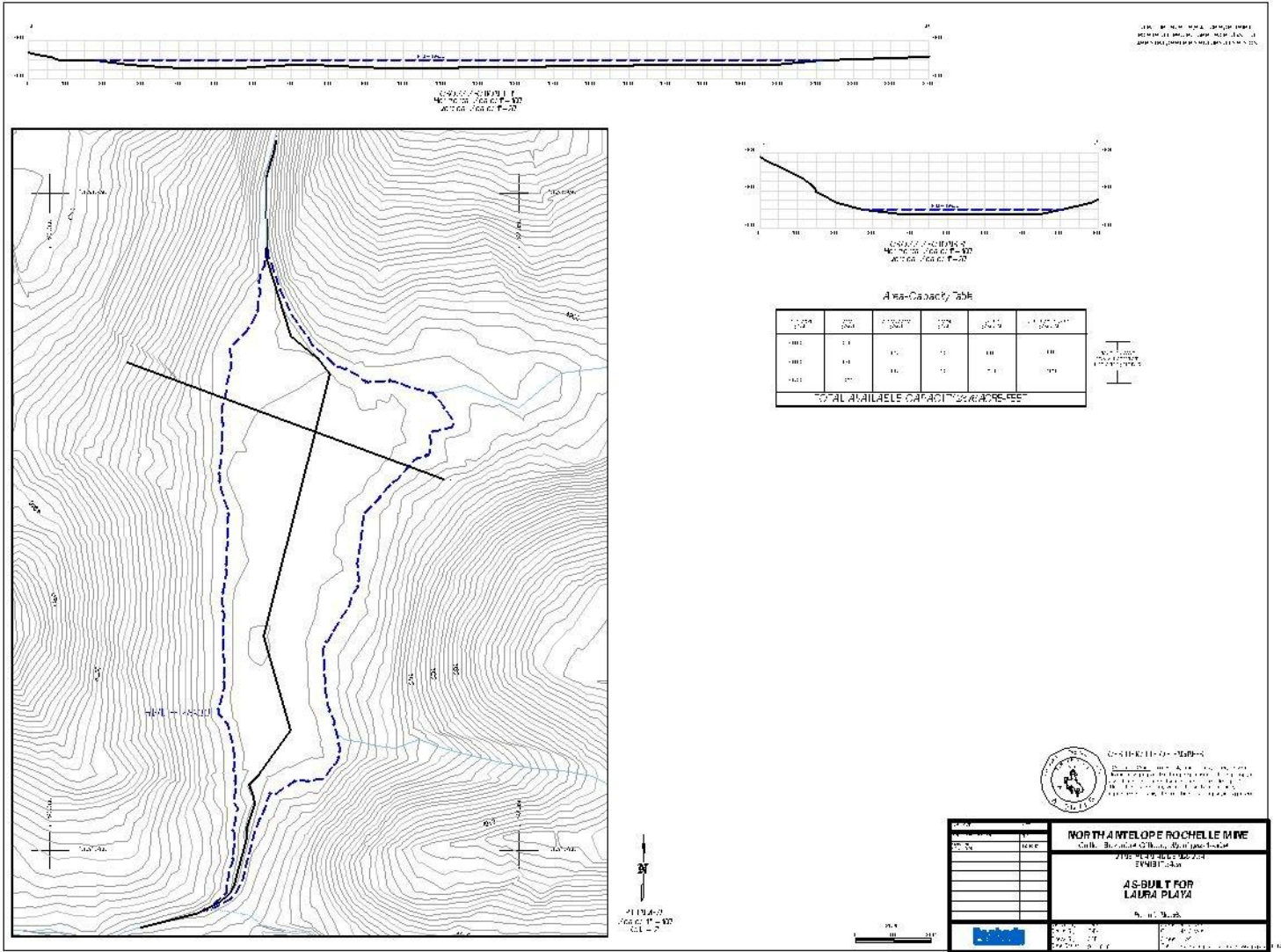
- Our goal is not to necessarily replace the appearance of the premining playas, but to replace the function of the playas while taking advantage of the positioning in the postmining topography to develop beneficial microclimates and sheltered areas in addition to pools and functional wetlands.
- During reclamation of playas, the playas are going to be lower areas of the backfill. Slopes are graded down from a maximum of 5H:1V and flattening downward to the pool area.
- Care must be taken in the very flat pool area since a small elevation difference can result in a very different pool area.
- The pools are designed to fill somewhere between the 10-year 24-hour and 100-year 24-hour event.
- The topsoil placed on the playa should either be native playa soil or other fine-grained topsoil to recreate premining conditions.
- The flatter area around the playa and the pool area are planted with the playa seed mix consisting of Western wheatgrass, Slender wheatgrass, and big bluegrass.



Reclamation of Postmining Playas (continued)

- Some native wetlands soils may be placed in the pool area, and some wetland plugs may also be added and seeding conducted, but many of the wetlands have formed naturally.
- The 14 constructed playas have a total drainage area of 3,500 acres and combined pool area of 118 acres. 9 of these playas have received Phase 3 bond release, and four more have Phase 2 or Phase 1 release.
- The playas have proven to be some of the best and most productive features on the mine reclamation and their replacement should be encouraged. Playa enhancement areas might be more beneficial in some areas versus more uplands when water rights are not an issue.
- Although not required, we included playa wetlands in a 2021 total reclamation delineation required for USACE reauthorization and found 37.5 acres of functional wetlands in the postmining playas.
- Wildlife, including large herds of Elk, Deer, and Pronghorn Antelope, as well as songbirds, and waterfowl have been observed at the postmining playas.





Examples of Postmining Playas



Laura Playa with Wetland



Leoni Playa with Cattle

Examples of Postmining Playas (continued)



Helga Playa with Wetland



Bailey's Playa with Wetland

Examples of Postmining Playas (continued)



Irene Playa



Jewel Denial Playa with Wetlands and Shrubs

The End



Questions?



Thank You!

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