Parthenium alpinum var. alpinum

(Alpine Fever-Few)

Habitat: Dry upland sites in sparse grasslands or shrublands, especially mountain-mahogany (*Cerocarpus* spp.) shrublands. Often on limestone; occasionally on shale. 4,900-7,200 ft elevation (NatureServe, 2009).

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Flowering/Fruiting Period: May

Diagnostic Characteristics: A perennial herb that forms a ground-hugging mat less than 4 cm in height. Flower heads are extremely inconspicuous: tiny, green, and mostly covered by the foliage (NatureServe, 2009).

No line drawing available

Phacelia splendens (Patch Scorpion-weed)

Habitat: Barren clay slopes in West central and Southwestern Colorado and extreme Northwest New Mexico (Cronquist et al, 1984).

Flowering/Fruiting Period: Unavailable

Diagnostic Characteristics: Seeds are conspicuously excavated on one or usually both sides of the prominent ventral ridge; plants annual to biennial; leaves strongly toothed to more often pinnately lobed or dissected; leaves less dissected, only the lower (or none) of the sinuses reaching the midrib; corolla-lobes entire or nearly so; seeds deeply excavated on both sides of the ventral ridge; filaments evidently exerted (to 2 mm or usually much more); flowers on short, stout pedicels up to about 1-1.5 mm long, or virtually sessile; leaves glaborous or nearly so, except sometimes along the petiole and the proximal part of the rachis.

No line drawing available

Phlox cluteana (Navajo Mountain Phlox)

Habitat: Light to heavy shade on sandy soils in ponderosa pine forest; 6,000-10,000 ft.

Flowering/Fruiting Period: Flowers June to July.

Diagnostic Characteristics: Perennial with slender, creeping rhizomes; stems mostly 8-10 cm long, sparsely to densely glandular pubescent; leaves evergreen, 1-4 cm long, entire, linear to narrowly lanceolate or elliptic, glabrous to ciliate or sometimes pubescent like the stems; inflorescence of short, terminal cymes; pedicels 3-15 mm long; flowers large and showy, light pink to purple; calyx 6-8 mm long; corolla tube 8-18 mm long, the lobes 8-10 mm long and nearly as wide, rounded at the apex; stamens included or slightly exserted.

Photograph by Steve O'Kane.
http://nmrareplants.unm.edu/rarelist_single_photo.php?SpeciesID=

Source: Arizona Rare Plant Field Guide, 2011; M. Sharp

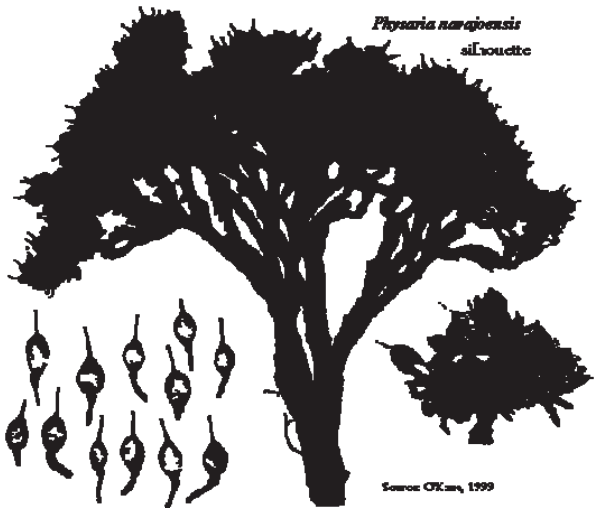
Physaria navajoensis (Navajo Bladderpod)

Habitat: Mesa rims of Todilto limestone in sparse pinyon-juniper woodland; 7,200-7,600 ft.

Flowering/Fruiting Period: Flowers in May.

Diagnostic Characteristics: Perennial herb forming low, cushion-shaped clumps from an intricately branching, subterranean caudex; herbage silvery-gray, covered with a crust of flattened, stellate hairs; hairs usually with 5 main rays, each twice bifurcate into 20 tips, rays somewhat fused near the center by a thin, narrow webbing; stems crowded, buried among and not exceeding the leaves; leaves linear-oblanceolate, 3-8(occasionally up to 13) mm long, 0.7-1.4 mm wide; flowers and fruits in dense, few-flowered racemes, not or barely exceeding the leaves; pedicels straight to slightly sigmoid; sepals 4, yellow-green, 3.7-4.8 mm long; petals 4, deep yellow, spatulate, 5.2-6.5 mm long; fruits slightly inflated silicles, ovate, glabrous, reddish at maturity; styles 1.8-3 mm long in fruit; seeds suborbicular-ovoid, 1.5-2.4 mm long, 1.3-1.9 mm wide, strongly mucilaginous when wetted.

Photograph by Steve O'Kane.
http://nmrareplants.unm.edu/rarelist_single_photo.php?SpeciesID=112



Psorothamnus scoparius (Broom Pea)

Habitat: Open sunny areas in dunes and sandy arroyo bottoms (Cartron et al, 2008).

Flowering/Fruiting Period: Flowers June to September (Cartron et al, 2008).

Diagnostic Characteristics: Shrub to 3 ft tall; stems many branched, gray-green; herbage glandular dotted; leaves small, linear, 8-10 mm long; flowers small, clustered at the tips of stems, papilionaceous, fragrant, dark purple. It is a highly xerophytic shrub that is nearly leafless and covered in gray hairs (Cartron et al, 2008).

http://plants.usda.gov/gallery/standard/dasc7_1h.jpg

No line drawing available

Puccinellia parishii (Parish's Alkali Grass)

Habitat: Alkaline springs, seeps, and seasonally wet areas that occur at the heads of drainages or on gentle slopes at 2,600-7,200 ft range-wide. The species requires continuously damp soils during its late winter to spring growing period.

Flowering/Fruiting Period: Flowers May to June.

Diagnostic Characteristics: Dwarf annual with 1 to many stems; leaf blades about 1 mm broad, flat or involute, short; culms mostly 5-15 cm tall; panicle narrow, few-flowered, the branches erect-appressed; spikelets 4-6 mm long; glumes shorter than the first floret, broad, strongly nerved, scarious-margined; florets 4-6 per spikelet, disarticulating above the glumes; lemmas about 2 mm long, obtuse to truncate, scarious and somewhat erose at the tip, pubescent on the mid and lateral nerves nearly to the apex, and on the intermediate nerves about half way.

Photograph by Robert Sivinski.
http://nmrareplants.unm.edu/rarelist_single_photo.php?SpeciesID=156

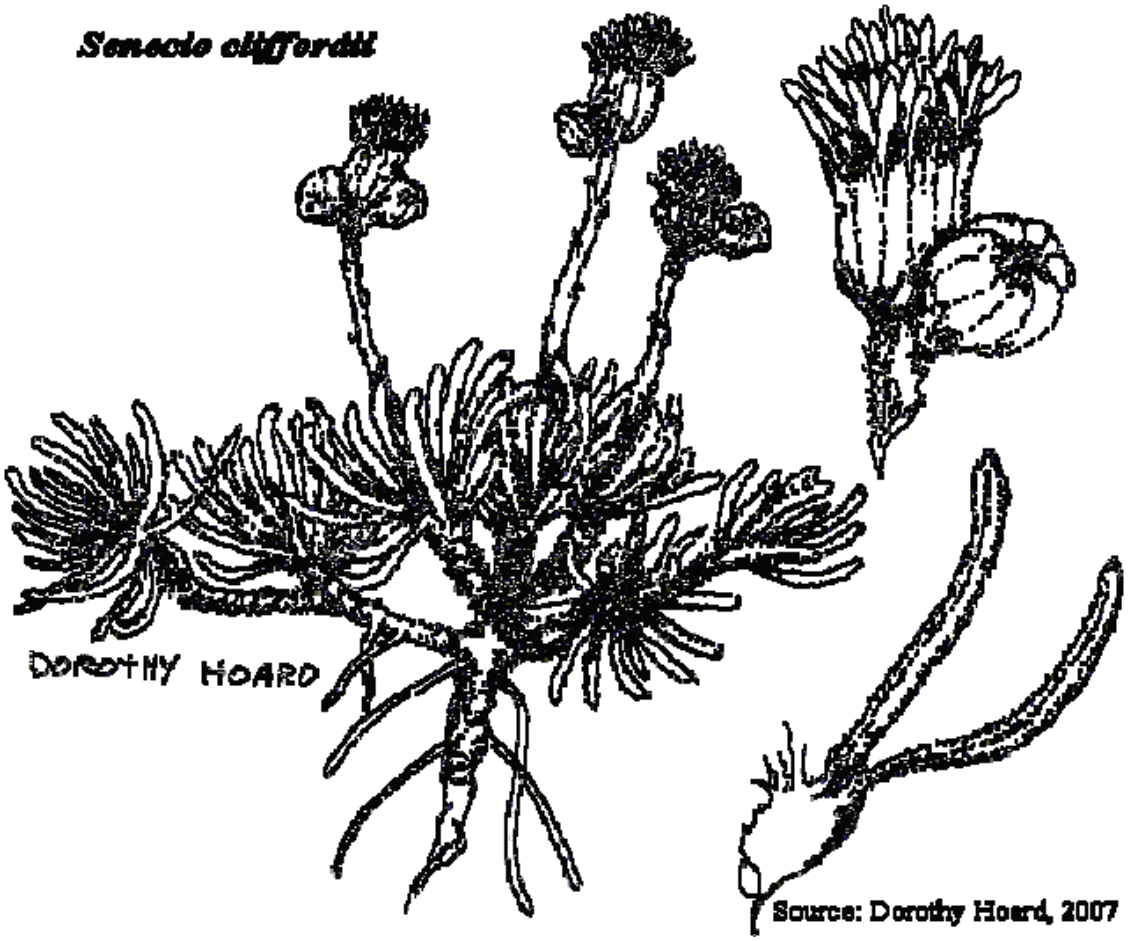
Senecio cliffordii (Clifford's Groundsel)

Habitat: Limy mudstones or sandy soils in pinyon-juniper woodland up to mixed conifer forest; 7,380-7,700 ft.

Flowering/Fruiting Period: Flowers April and early May.

Diagnostic Characteristics: Tufted perennial, 4-15 cm tall, forming clumps up to 2 dm across, covered with white, felty or woolly tomentum; basal leaves linear or linear-oblanceolate, 2-4 cm long, 1-3 mm wide, flat or with margins rolled inwards; stem leaves reduced to small scales; flower stems taller than basal leaves and terminated by one or three heads; flower heads about 10 mm long, involucral bracts in one or two series, green or becoming purplish at maturity; disk flowers yellow, ray flowers absent; achenes sparsely short-hairy along the longitudinal angles; pappus of white capillary bristles.

Photograph by Robert Sivinski.
http://nmrareplants.unm.edu/rarelist_single_photo.php?SpeciesID=217



Source: Dorothy Hoard, 2007

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Appendix C

Field Guide to Sensitive Mammal, Bird, and Reptile Species

Potentially Found in the Region of the Northeast Church Rock Mine

Sensitive Mammal, Bird, and Reptile Species Field Guide

A list of rare and sensitive animal species believed to occur within or near the Navajo Nation was acquired for the determination of potential species that may occur in the vicinity of the Northeast Church Rock Mine (NECR). A total of 70 species were indicated on the list with an additional two species added because they had been identified as rare. The list of 70 was reduced to 17 potential species based on incompatibility of habitat requisites with conditions that exist in the project area. The additional two species that were identified in the field brings the list to 19 potential sensitive animal species that have some potential to be encountered in the vicinity of the NECR project area (see table below).

Scientific Name	Common Name	Global Status	Federal Status	State Status	Navajo Nation
Mammals					
Puma concolor	Mountain lion	G5	-	S4	-
Sorex merriami	Merriam's Shrew	G5	Sensitive	S2	-
Birds					
Buteo swainsoni	Swainson's Hawk	G4	Sensitive	S4	G2
Callipepla squamata	Scaled Quail	G5	-	S5	-
Circus cyaneus	Northern Harrier	G5	-	S4	-
Geococcyx californianus	Greater Roadrunner	G5	-	S5	-
Haliaeetus leucocephalus	Bald Eagle	G4	T	T	G3
Hirundo rustica	Barn Swallow	G5	-	S5	-
Myadestes townsendi	Townsend's Solitaire	G5	-	S5	-
Progne subis	Purple Martin	G5	Sensitive	S4	-
Regulus satrapa	Golden-crowned Kinglet	G5	-	S4	-
Vireo vicinior	Gray Vireo	G5	Sensitive	S3	-
Reptiles					
Aspidoscelis tigris	Western Whiptail	G5	-	S3	-
Aspidoscelis inornatus	Little Striped Whiptail	G5	-	S5	-
Crotalus viridis abyssus	Grand Canyon Rattlesnake	G5	-	S5	-
Diadophis punctatus	Ringneck Snake	G5	-	S4	-
Eumeces multivirgatus	Many-lined Skink	G5	-	S5	-
Hypsiglena torquata	Night Snake	G5	-	S5	-
Sceloporus graciosus graciosus	Northern Sagebrush Lizard	G5	-	S4	-

Description of Status Table Codes

Global

G3 Vulnerable - Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.

G4 Apparently Secure - Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals.

G5 Secure - Common, widespread, and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Federal

T – "Threatened" - A species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Sensitive - A species that is likely to occur or have habitat on National Forest Service System lands and that has been identified by the Regional Forester as of concern for reduction in population viability as evidenced by: significant current or predicted downward trends in population numbers or density, or; significant current or predicted downward trends in habitat capability that would reduce the species' distribution.

State

S3 Vulnerable - Vulnerable in NM either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals.

S4 Apparently Secure - Uncommon but not rare, and usually widespread in NM. Possible cause of long-term concern. Usually more than 100 occurrences and more than 10,000 individuals.

S5 Secure - Common, widespread, and abundant in NM. Essentially ineradicable under present conditions. Typically with considerably more than 100 occurrences and more than 10,000 individuals.

Navajo Nation

G2 - A species or subspecies whose prospects of survival or recruitment are in jeopardy.

G3 - A species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future.

MAMMALS

Puma concolor (Mountain lion)

Description: Excepting size, mountain lions appear similar to a short-haired house cat, with a relatively small head, shortened face, small and rounded ears, elongated body, and long neck and tail. Males are about eight to as much as nine feet from the nose to the tip of its tail, and females, about 6 to 7 feet long. Both sexes range from 2 – 2 1/2 feet in height. Males usually weigh between 125 to 160 pounds and females between 80 to 100 pounds. Mountain lion have a variety of color from tawny to rufous to buff to bluish gray along the back and sides with a lighter colored belly, throat and inner legs and with a black-bracketed nose and a dark-tipped tail (Sharp, 1996).

Habitat: Lions tend to choose vegetated ridges, rocky cliffs and ledges, and other solid covers in inland areas found in the Southwest desert basin and mountain range country (Sharp, 1996).

Diet: Mountain lions often favor white-tail and mule deer, but will prey on any animal it can catch, including anything from elk, moose and bighorn sheep to rodents, reptiles and birds. Some even eat insects (Sharp, 1996).

Ecology: It is a solitary, nocturnal animal that is active throughout the year, although it may migrate up into the higher elevations in the summer and down into lower elevations in winter (Sharp, 1996).

Sorex merriami (Merriam's Shrew)

http://www.wordinfo.info/words/images/shrew-desert.gif

Description: Merriam's shrew is brownish-gray or gray above with whitish undersides. Its tail is distinctly bi-colored. It is smaller than the dusky and masked shrew and it is very difficult to identify. Only close, microscopic examination of the teeth will allow experts to identify it with certainty. Its total length is 88 to 107 mm, tail length is 33 to 42 mm and it weighs 4 to 7 grams (Streubel, 2000).

Habitat: It is found at elevations of 650-9500 ft (200-2900 m), primarily in grasses in shrub steppe or pinyon-juniper habitat (recorded in spruce-aspen grove in New Mexico). It seems to prefer drier habitats than other shrews. (Streubel, 2000).

Diet: Feeds primarily on insects and other small invertebrates. Caterpillars are most common summer food item (Streubel, 2000).

Ecology: It is active throughout the year and it may utilize burrows and runways of other animals (Streubel, 2000).

BIRDS

Buteo swainsoni (Swainson's Hawk)

Description: Swainson's hawk is a medium-sized bird with a stout body and broad wings. It has a white face with dark flight feathers that contrast with a pale inner wing, a dark chest band and a medium-long rounded tail that is light with multiple thin dark bands, one darker and broader near the tail tip. The juveniles have a similar underwing to the adults, but the underparts are streaked with large spotting on the breast (England et al, 1997).

Habitat: These hawks are locally uncommon in riparian woodland to fairly common in pinyon-juniper and adjacent riparian habitats (Schmitt, 1976).

Ecology: Swainson's hawk is a migratory species that breeds in North America and is mostly seen in McKinley County only during the summer months. It winters in South America. This species has had declining numbers throughout much of its range. It is susceptible to pesticides, especially on its wintering grounds. The use of pesticides in Argentina was responsible for the deaths of nearly 6,000 Swainson's Hawks in 1995 and 1996 (CLO, 2009a). *Buteo swainsoni* was listed under the Navajo Endangered Species List "G2" ("Endangered" - Any species or subspecies which is in danger of being eliminated from all or a significant portion of its range on the Navajo Nation) (NESL, 1994). However, globally *Buteo swainsoni* was listed under the Natural Heritage Global Rank "G4" ("G4" = "Apparently Secure") (AGFD, 1995).

Callipepla squamata (Scaled Quail)

Description: Scaled quail is medium-sized and pale gray overall. It has a bushy white chest and finely scaled pattern over neck, chest, and belly. The juveniles are similar to the adult, but start out without the scaling (Schemnitz, 1994). The cotton-top crest is often visible from some distance, and generally the grayish coloration of this species sets it apart from all other quail in the arid habitat where it occurs. Females may be distinguished from adult males by their less conspicuous crests and by the dark brown streaks on the sides of the face and throat (males have unstreaked pearly gray to white coloration in this area). The birds are usually reluctant to fly, preferring to run rather than remain hidden. The distinctive "pey-cos" location calls (stronger in males) often reveal the presence of scaled quail in the area (Johnsgard, 1975).

Habitat: The species seem to survive best where there is a combination of annual weeds, some shrubby or spiny ground cover, and available surface water. In the northern part of its natural range it is especially associated with sandy soils and sand sagebrush vegetation. A source of midday shade and loafing cover is important during summer, but it must not be so thick as to prevent escape by running (Johnsgard, 1975).

Ecology: Scaled quail are residents almost statewide and are considered rare to common. They are local in much of the central-western, extreme northwest and extreme central-northern areas. They exist casually at elevations above 7000 feet (Hubbard, 1978).

Circus cyaneus (Northern Harrier)

Description: Northern harriers are medium-sized hawks with long, slender, rounded wings with a white rump and long tail. It flies low, with wings held up in a slight "V". It is one of the few raptors in which the sexes look quite different. The head, back, and upper chest of the male is light gray. The chest and belly are white with some rusty markings extending onto the flanks. Its underwings are white with black wingtips and a line of black on the rear of the wings. The tail is darkish gray above and whitish below with some barring. The back of the female is dark brown with many feathers edged with tawny. The female's face is streaked brown and whitish and outlined by a white facial disk. Its chest and belly are streaked dirty white and tan. The upper sides of the wings are brown and the lower sides are barred white and dark brown. The tail is brown with dark bars. The juveniles are similar to the adult female, but with rusty wash across mostly unstreaked underparts.

Habitat: Common winter resident in the Southwestern lowlands. It occupies open country and glides low over grasslands close to water, over freshwater or saltwater marshes, or hovers over wet meadows (Davis, 1997).

Ecology: Typically perches on the ground rather than in trees. Nest is on the ground (Cartron et al, 2008).

Geococcyx californianus

(Greater Roadrunner)

Description: Eyelids lashed; bill curved; feathers of crest and neck bristly, whole plumage coarse and harsh; tail long, graduated; wings very short; feet large and strong. Upperparts conspicuously streaked with brown and white, crest and foreparts of back glossed with steel-blue changing on lower back to lustrous bronzy green; upper tail coverts and middle tail feathers bronzy olive, glossed with purplish; outer tail feathers blue-black and green, tipped with white thumb marks; throat and belly whitish, chest streaked with black; iris yellow to orange, bare orbital space light blue anteriorly passing into bluish white beneath and behind the eye, the posterior portion deep orange or orange-red; bill horn color, legs and feet pale bluish (Bailey, 1928).

Habitat: The Greater Roadrunner can be found in cactus deserts or in dry, open country with various types of brush for cover (Davis, 1997).

Ecology: Rarely flies; typically is seen running rapidly and in zigzags with tail trailing on the ground (Carton et al, 2003). It's a common, permanent resident and is the state bird of New Mexico. It is demonstrably secure (G5) (BISON-M, 2009a).

Haliaeetus leucocephalus (Bald Eagle)


http://www.nearfamous.com/Pages/BaldEagles.html

Description: Head, neck, and tail pure white, body blackish or dark brown with feathers of the leg not reaching the foot; iris usually pale yellow or whitish; bill, cere, legs, and feet corn yellow (Bailey, 1928). Juveniles are variably patterned with dark brown and white; takes five years to acquire full adult plumage. White not restricted to well defined areas, but appearing scattered throughout body, usually with brown mottling in same area. White in wings primarily in linings and not flight feathers. Bill and cere blackish gray. Eyes dark brown. Feet and lower legs yellow (CLO, 2009b).

Habitat: Bald eagles seem to prefer timbered areas along coasts, large lakes, and rivers, but they also occupy other areas (O'Gara, 1994). They exhibit casual use of Juniper Savannahs and Great Basin sage areas (BISON-M, 2009b).

Comment: It is unlikely that the Bald Eagle would be present at this site, unless migrating through, given the need for large bodies of water for its forage, but due to the status of this bird (threatened), and that it could be a migrant, it is included.

Hirundo rustica (Barn Swallow)

Description: Dark blue above; orange below with deeply forked tail (Rappole, 2000).

Habitat: Savanna, prairie, open areas near water (Rappole, 2000).

Ecology: It seldom nests away from human-made structures. Barn swallows often nest in colonies where they have access to various kinds of structures such as barns, bridges, culverts, outbuildings, or eaves of houses, to which they attach their nests (Davis, 1997).

Myadestes townsendi (Townsend's Solitaire)

Description: Gray body; black, notched tail with white outer tail feathers; buff wing patches; white eyering (Rappole, 2000).

Habitat: Shrubby under story of montane coniferous forest; juniper, arid and semi-arid thorn forest in winter (Rappole, 2000). In summer, frequents mountainous coniferious forests around 3,000 feet below treeline; in winter, descends to canyons with open juniper forests on lower slopes (Alsop, 2001).

Ecology: As a breeder, the Townsend Solitaire is rather rare in New Mexico, and is confined during the summer to the higher parts of the mountains (Bailey, 1928).

Progne subis (Purple Martin)

Description: The adult male is glossy blue-black both above and below. The head reflects violet coloration in full sunlight with the forked tail and wings showing dull black. It is the only dark-bellied swallow. The female is light bellied with a smoky-gray throat and breast, and often has a very light collar (Davis, 1997).

Habitat: It is found in open or semi-open country where it can find nesting sites in saguaro cacti or hollow trees (Davis, 1997). Nests in colonies, originally in trees, now often in specially constructed martin houses (Rappole, 2000).

Ecology: Uncommon to rare and local summer resident in the lowlands and foothills of Western New Mexico (Rappole, 2000).

Regulus satrapa (Golden-Crowned Kinglet)

http://www.discoverlife.org/mp/20q?search=Regulus+satrapa

Description: Greenish above, whitish below; white wing bars, white eyering; male has orange crown bordered by yellow and black; female has yellow crown bordered in black (Rappole, 2000).

Habitat: Breeds in boreal zone mature spruce-fir and pine forest, especially red and douglas firs, sugar and ponderosa pines; a variety of woodland habitats in winter (Rappole, 2000).

Ecology: Seasonal migrant; vulnerable to habitat loss caused by logging, especially of mature coniferous forests (Alsop, 2001).

Vireo vicinior (Gray Vireo)

Photo by Mark Watson http://www.bison-m.org/booklet.aspx?id=042200

Description: Gray above, whitish below with narrow white eyering and single, faint wingbar (Rappole, 2000).

Habitat: Desert thorn scrub, oak-pinyon-juniper woodlands (Rappole, 2000).

Ecology: The Gray Vireo is a threatened species in New Mexico (BISON-M, 2009c).

REPTILES

Aspidoscelis tigris (Western Whiptail)

Description: 2 3/8 – 5 in. Back and sides with spots, bars, or network of dusky or black markings on background of gray, brown, yellowish, or tan. Light stripes may be present but often fade on lower back and base of tail. Ground color gray-brown, yellowish brown, yellowish, or olive. Tail becomes dark brown, dusky, or bluish toward tip. Usually cream-colored or yellowish below, with scattered spots of blackish, especially on chest and throat. In extreme darkening, the throat, chest, underside of front legs and belly are black; orange or pink on throat may be reduced to a few tan flecks. Rust-colored patches often present on sides of belly. Scales in front of gular fold only slightly enlarged and grading gradually into small granules of fold. Postantebrachials not enlarged. Supraorbital semicircles extend far forward. 68 – 114 dorsal granules. The young are spotted, marbled, or striped with black above; black fields alternating with narrow orange-yellow ones. Tails bright blue (Stebbins, 2003).

Habitat: Deserts and semiarid habitats, usually where plants are sparse and there are open areas for running. Ranges from deserts to montane pine forests (below sea level to around 7,000 ft) where it prefers warmer, drier areas. Avoids dense grassland and thick growth of shrubs. Ground may be firm soil, sandy, or rocky (Stebbins, 2003). This species is often associated with greasewood shrubs and pinyon-juniper woodlands (McCoy, 1965).

Breeding Period: One to two (perhaps 3) clutches usually with 1 – 4 (rarely 8) eggs, laid in April – Aug. Single clutches usually laid in cooler environments (Stebbins, 2003).

Ecology: The western whiptail appears to be limited to areas with 150 or more frost free days per year and requires sufficient soil moisture to prevent egg desiccation (McCoy, 1965).

Aspidoscelis inornatus (Little Striped Whiptail)

Description: 2 – 3 2/5 in. 6 – 8 (usually 7) pale yellowish, gray, to whitish stripes; mid-dorsal stripe sometimes faint or absent. Dark field between stripes blackish, brown, or brownish green to gray, without light spots; dark field becomes lighter with age. Tail blue to purplish blue towards the tip. Usually bluish white to blue below (brightest in males). Postantebrachials and scales in front of gular fold only slightly enlarged or not at all. Supraorbital semicircles normal. 52 – 79 dorsal granules. Usually 3 enlarged, rounded scales in front of vent. The young are less blue below than adult. The male's chin and belly are more bluish than the female's. Both sexes have more vivid blue on the underside of tail than on remaining underparts (Stebbins, 2003).

Habitat: Chiefly a prairie grassland species, but ranges into grassy areas of shrubby desert, chaparral, the pinyon-juniper zone, and in the northwestern part of its range into open ponderosa pine forests. Frequents sandy or silty, sometimes gravelly ground of elevated plains or lowlands. Seldom found in rocky or very barren areas or in mesquite habitats occupied by Desert Grassland Whiptails. Elevation ranges generally from 1,000 – 5,500 ft, but have been found up to 7,000 ft (Stebbins, 2003).

Breeding Period: Clutch of 1 – 3 eggs, laid May – June, perhaps as late as August (Stebbins, 2003).

Ecology: Species in apparent decline in many areas, perhaps due to over-grazing and other human disturbances (Stebbins, 2003).

Crotalus viridis abyssus

(Grand Canyon Rattlesnake)

Description: 16-64 inches. Size and color vary greatly. Brownish blotches down midline of back, generally edged with dark brown or black and often surrounded by light border; begin as oval, squarish, diamondlike, or hexagonal markings and tend to narrow into inconspicuous crossbands near tail. More than 2 internasal scales touch rostral scale. Scales keeled, in 25-27 rows (eNature, 2007a).

Habitat: Frequents a great variety of habitats, from shrub-covered coastal sand dunes to timberline and from prairies and desert-edge habitats of mesquite scrublands to pinyon-juniper woodland and montane forests. Rocky outcrops, talus slopes, rocky stream courses, and ledges are favorite haunts; in cooler areas (more northerly parts of its range and at higher elevations) it may den in mammal burrows, rock crevices, or caves, sometimes in large numbers (Stebbins, 2003).

Breeding Period: Live bearing ranging from 1 – 25 (often 4-12) young, born Aug – Oct (Stebbins, 2003).

Ecology: They are widespread, common and are venomous and aggressive if disturbed (Carton et al, 2008).

Diadophis punctatus (Ringneck Snake)

Description: 10-30 inches. A small slender snake, with a yellow, cream, or orange neck ring and bright yellow, orange, or red belly. Back gray, olive, brownish, or black; belly frequently marked with black spots. Neck ring may be interrupted, obscure, or occasionally absent. Loreal scale present. Scales smooth, in 15-17 rows. Anal plate divided (eNature, 2007b).

Habitat: Moist situations in varied habitat; forest, grassland, rocky wooded hillsides, chaparral, into upland desert along streams; sea level to ca. 7,000 ft (eNature, 2007b).

Breeding Period: Ringneck snakes mate in spring or fall. Clutches of 1-10 elongate white or yellowish eggs, 1 inch long, are laid June to July in communal nesting sites. Young hatch in about 8 weeks, at 4-6 inches; mature in 2-3 years. (eNature, 2007b).

Ecology: Some species have enlarged rear teeth and possibly toxic saliva, but are no threat to people. In other parts of the range 80 to 95 percent of individuals coil their tails to expose the bright red underside. This defense behavior is often reinforced by a discharge of musk. Adult males are less likely to tail-coil than juveniles and females (Fitch, 1975; Gehlbach, 1974; Smith, 1974).

Eumeces multivirgatus (Many-lined Skink)

Description: 5 - 7 5/8 inches. Long-bodied, with many alternating light and dark stripes, including dorsolateral light stripe along 3rd scale row counting from middle of back. Back striping faded or absent in some populations. Tail tapers so gradually it appears swollen. Young have bright blue tail (eNature, 2007c).

Habitat: Little is known about the environmental requirements of this species but it is most often encountered in areas with rocks, under which they shelter (Hahn, 1968). Many-lined Skinks have been found in areas of rocks and small brush in open grassy plains, sand hills, and desert; mountainous wooded areas to 8,200 ft (eNature, 2007c).

Breeding Period: Lays clutch of 5 eggs, but there is uncertainty as to the timing (eNature, 2007c).

Ecology: They are active during the day, especially during the morning. They are seasonally active beginning in April extending through September, although May and June appear to the period of peak activity (Hahn, 1968).

Hypsiglena torquata (Night Snake)


Photo by Karl H. Switak.
http://www.enature.com/fieldguides/enlarged.asp?imageID=19119

Description: 12-26 inches. Slender and cylindrical-bodied; beige, yellowish, or gray, patterned with numerous dark brown or gray blotches on back and side. Large blotch on each side of neck; a third spot may be present on nape or lateral blotches may be fused at midline. Eyes with vertical pupils. Dark bar behind eye; upper lip scales white. Belly cream or white, unpatterned. Scales smooth, in 19-21 rows. Anal plate divided (eNature, 2007d).

Habitat: A habitat generalist, the night snake is found in rocky areas of grassland, chaparral, desertscrub, woodland, moist mountain meadows, and thornscrub from sea level to 8,700 feet (ASDM, 2009).

Breeding Period: Habits poorly known. Clutches of 4-6 eggs, 7/8-1 ¼ inches long, have been deposited late April to early July. Incubation takes 7-8 weeks (eNature, 2007d).

Ecology: Seldom encountered during the day, this nocturnal snake is often seen crossing roads at night. The night snake preys upon lizards, small snakes, frogs, salamanders, and small mice, which it subdues with its mild venom; this venom poses no threat to humans. Young night snakes feed upon insects. If disturbed, the night snake raises its head and weaves, hisses, and flattens its neck in threat (ASDM, 2009).

Sceloporus graciosus graciosus

(Common Sagebrush lizard)

Description: 5 - 6 3/16 inches. A spiny lizard. Granular scales do not overlap on rear of thigh. Grayish-green to brown; some darker spots and crossbars. Faint light dorsolateral stripes. Sides reddish-orange behind forelegs. Males have light-blue mottling (not patches) on throat and darker blue belly patches. Females have pinkish orange on sides and neck (eNature, 2007e).

Habitat: Primarily areas of sagebrush and gravelly soils or fine-sand dunes. Never far from shelter such as stony piles, crevices, animal burrows (eNature, 2007e). Sagebrush lizards range up from 5,000 - 8,500 ft (Douglas, 1966).

Breeding Period: Single clutch of 2-7 eggs is laid June to July, hatches July to August (eNature, 2007e).

Ecology: Diurnal. Primarily terrestrial, these lizards occasionally climb trees or bushes in pursuit of insect prey (eNature, 2007e). They retreat into burrows or rock crevices at high or low temperatures and the availability of shade is important. During winter, they must be deep enough to avoid freezing (Douglas, 1966). The average home range for males was 85.7 square meters and 49 square meters for females (Turner, 1974).

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Appendix D

Growth Media Analysis / Revegetation Recommendation

MEMO

To: Jed Thompson, Lance Hauer
Re: Growth Media Analysis / Revegetation Recommendation
From: Steve Viert – Cedar Creek Associates, Inc.

Review of growth media sample data from the step-out area, background (reference) area, and growth media stockpile (see Table S and associated Charts) reveals several pertinent observations. First, with regard to revegetation potential, all samples exhibit reasonably favorable textural classes, especially those that indicate sandy clay loam. (Sample #10 is listed as "clay" but should correctly be listed as "clay loam".) Second, organic matter (%) is within the realm of expectation (low) for the reference and borrow areas, and somewhat above expectation for the step-out area. It was expected that organic matter would be very low (<0.3) in the step-out area, but was actually 0.4 to 1.2 (generally low). Third, electrical conductivity is indicative of "non-saline" soils, although some levels (e.g., #3, #4, and #6) could be somewhat restricting for emergence from seed for certain species unless mitigated. Fourth, lime ($CaCO_3$) is elevated in all samples from the step-out area indicating calcareous soils (values above 2%) as well as the borrow source which shows identical numbers. However, values from the step-out area are lower than expected. Had excavations reached the "C" horizon of the soil solum, values would have been higher. Fifth, pH is within expectation for all samples and cation elements (Calcium, Magnesium, and Sodium) do not appear to be overly problematic (elevated on samples #3, #4, and #6 – hence the modestly elevated EC values). Finally, SAR values are indicative of non-problematic circumstances for all samples.

Given this review of results, especially the charts indicated with Table S, it can be stated with reasonable certainty that the borrow source growth media (samples #1 and #2) is effectively no different than the in-situ material within the step-out area (samples #3 - #8), except for a slight decrease in salinity in non-saline soils. Therefore, there would be little or no benefit to revegetation potential with placement of this material over any portion of the disturbance area. As such, Cedar Creek recommends that use of this growth media be eliminated from consideration for reclamation.

Given the aforementioned finding, two options remain: 1) seeding directly into the in-situ material, or 2) amending the in-situ material to improve overall potential for seed emergence. As indicated above, calcareous soils and modestly elevated saline conditions of the lower soil solum in-situ materials will have some impact on seed germination. The extent of this impact would not be overly problematic, but would be notable, and would be manifested by preclusion of a notable proportion of non-saline tolerant species germination. Saline tolerant species may be somewhat restricted from germination, but once growing would no longer be impacted.

MEMO

To: Jed Thompson, Lance Hauer
Re: Growth Media Analysis / Revegetation Recommendation
From: Steve Viert – Cedar Creek Associates, Inc.

To maximize potential for revegetation success, it would be most prudent to amend the in-situ soil materials wherever appropriate (e.g., those circumstances that have a reasonable potential to remain without further disturbance). The best amendment for use in this circumstance would be sterile organic mulch (sterile cow manure) applied at approximately 4 tons per acre. Less tonnage would be acceptable, but less effective, and more tonnage would be redundant. It has been found on other arid-land revegetation trials and investigations that 4 tons / acre seems to provide the optimum benefit. Benefits of sterile organic mulch with regard to the in-situ soils of the project area include: 1) increasing the organic matter content of in-situ soils thereby improving water holding capacity which translates to a notable improvement in seedling emergence potential, especially given the high sand content of area soils (organic matter content of area soils is still diminutive); 2) elevating organic matter will help to reduce the $CaCO_3$ impact on germination and growth; 3) elevating organic matter will reduce pH (because of point #2 above) and will have additional soil chemistry benefits like reduction of soil salinity; 4) elevating organic matter will help with reducing excess calcium, magnesium, and sodium cations; and 5) there are non-adverse levels, and/or forms, of nitrogen, potassium, and phosphorus in sterile organic mulch that will have desirable effects on planted perennial species without overly benefiting undesirable annual invaders.

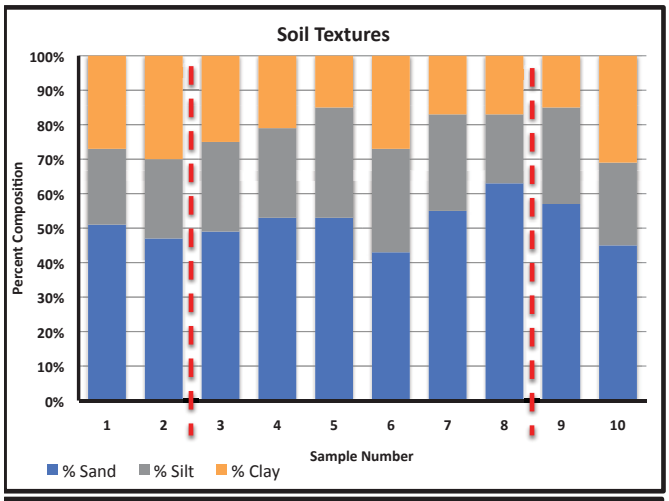
Given this analysis, it is Cedar Creek's recommendation to apply 4 tons / acre of sterile organic mulch to all areas designated by the engineers where an improvement to revegetation potential would be desirable or potentially permanent. If there is significant potential for future disturbance, the addition of sterile organic mulch is probably not worth the expense at this time. The mulch should be applied (by whatever means deemed appropriate by the seeding contractor) as the first step in the revegetation process. Following application, the mulch should be incorporated into the soil during the disking process. As previously indicated in our report, disking is followed by seeding, and if necessary, harrowing would be last. If the shrub / forb seed is broadcast prior to grass seed being drilled, the harrowing step can be eliminated.

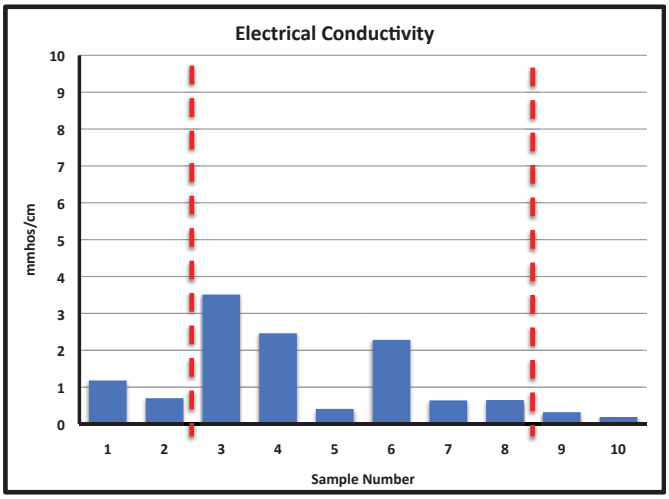
Table S, associated charts, and the map of soil sample locations is provided with this submittal.

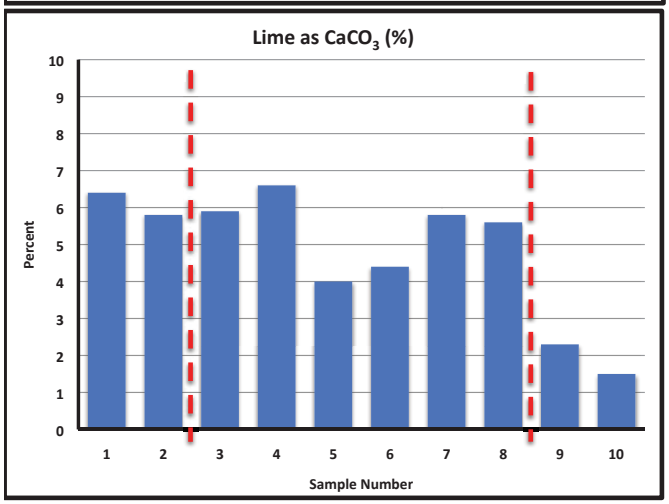
Table S - Growth Media Physical / Chemical Analyses - IRA at NECR

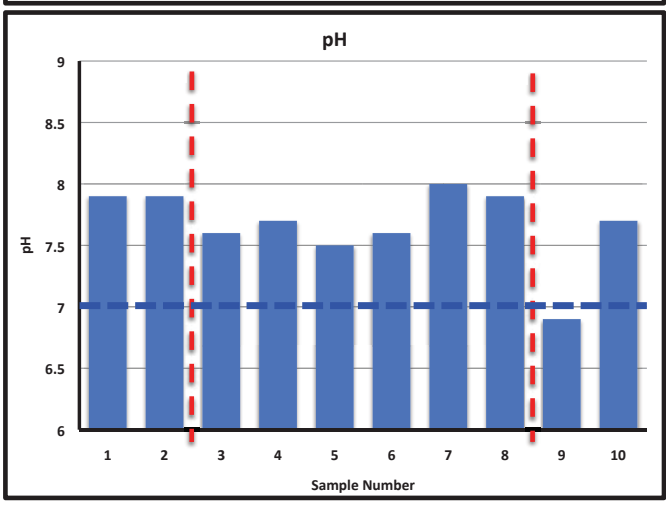
Sample No.	Sample Loc.	% Sand	% Silt	% Clay	Texture	Organic Mat (%)	EC	Lime as CaCO3 (%)	pH	Calcium	Magnesium	Sodium	SAR
1	Soil Borrow Source	51	22	27	Sandy Clay Loam	0.6	1.18	6.4	7.9	3.2	2.9	6.4	3.65
2	Soil Borrow Source	47	23	30	Sandy Clay Loam	0.5	0.7	5.8	7.9	2.9	2.5	1.2	0.73
3	Step Out - West*	49	26	25	Sandy Clay Loam	0.4	3.51	5.9	7.6	25.6	13.3	7.2	1.62
4	Step Out - West	53	26	21	Sandy Clay Loam	0.9	2.46	6.6	7.7	19.5	7.6	3.8	1.04
5	Step Out - East	53	32	15	Sandy Loam	1.2	0.41	4.0	7.5	3.0	0.9	0.3	0.24
6	Step Out - Central	43	30	27	Clay Loam	0.5	2.28	4.4	7.6	14.0	6.7	5.3	1.65
7	Step Out - North**	55	28	17	Sandy Loam	0.6	0.64	5.8	8.0	3.2	1.4	1.8	1.16
8	Step Out - North/Central	63	20	17	Sandy Loam	0.6	0.65	5.6	7.9	3.9	1.3	0.9	0.55
9	Ref Area Near # 10	57	28	15	Sandy Loam	0.9	0.32	2.3	6.9	2.3	0.8	0.2	0.18
10	Ref Area Near # 9	45	24	31	Clay	1.4	0.19	1.5	7.7	0.9	0.4	0.5	0.58
	Thresholds --> Interpretation -->					>1 Desirable	>4 Saline	>2 Calcareous	6.5-7.5 Ideal >8.4=Sodium problem				>13 Problematic

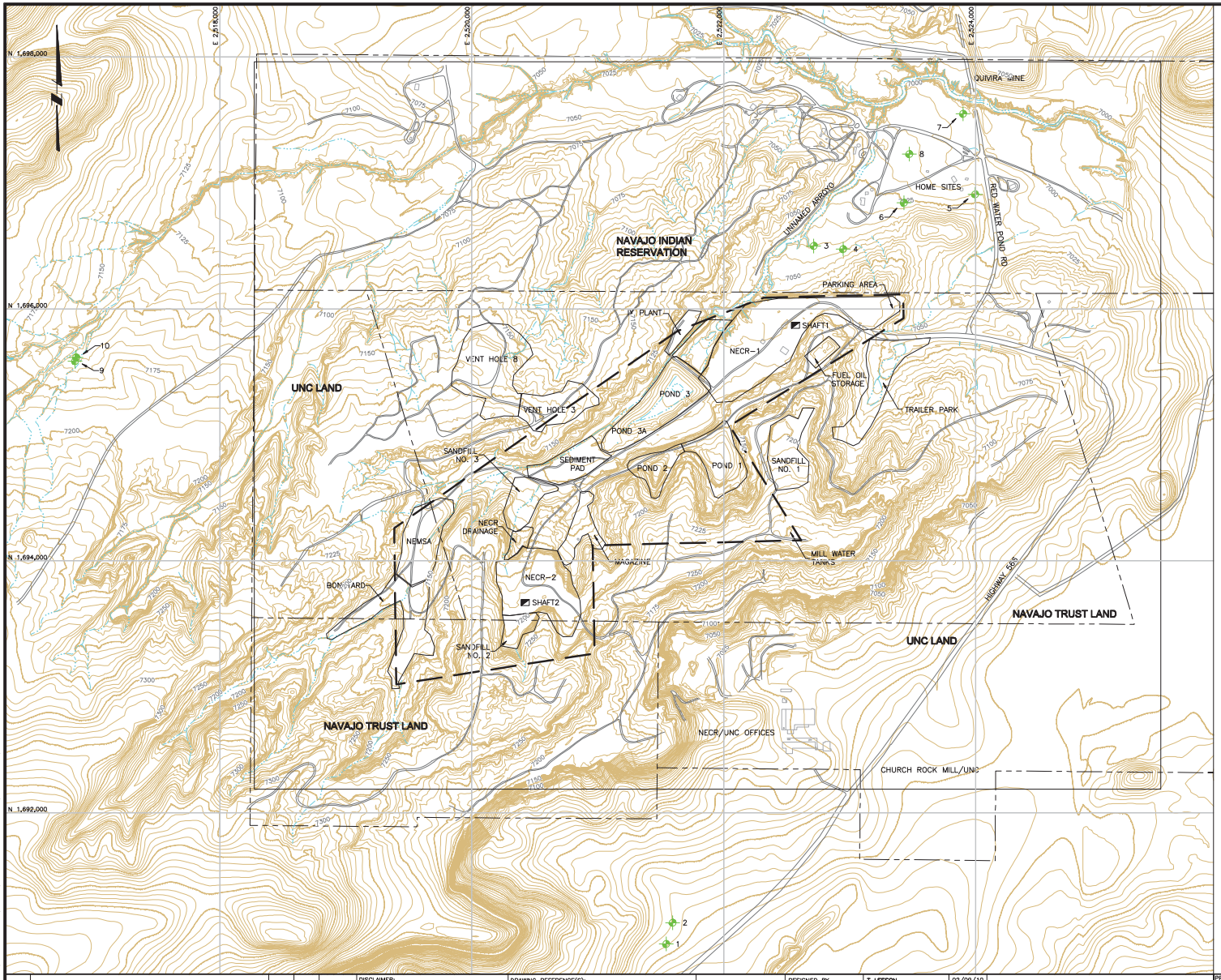
* Borrow Material ** May be borrow material











LEGEND:

- EXISTING GROUND SURFACE CONTOUR & ELEVATION, FEET
- PERMIT BOUNDARY
- FACILITY BOUNDARY
- APPROXIMATE OWNERSHIP BOUNDARY
- ROADS
- NATURAL DRAINAGE
- PHYSICAL STRUCTURE
- SHAFT LOCATION
- AGRONOMIC SAMPLES

SCALE
400 0 400 800 FEET
CONTOUR INTERVAL = 5 FEET

ISSUE REV	DESCRIPTION			
0	FINAL	CHF	RTL	02/09/10
		TECH	ENG	DATE

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DRAWING REFERENCE(S):
SURFACE TOPOGRAPHY GENERATED FROM AERIAL PHOTOGRAPHS DATED MAY 2007 BY COOPER AERIAL SURVEYS CO. AND USGS 10m DIGITAL ELEVATION MODELS (DEM).
PROJECTION:
STATE PLANE COORADINATES
ZONE:
NEW MEXICO WEST
DATUM:
NAD 83
UNITS:
US FEET

DESIGNED BY	T LEESON	02/09/10
DRAWN BY	C FOWLER	02/09/10
CHECKED BY	E MARKS	02/09/10
APPROVED BY	J THOMPSON	02/09/10
PROJECT MANAGER	T LEESON	02/09/10
CLIENT APPROVAL		
CLIENT REFERENCE NO.		

P.O. BOX 3077
Gallup, New Mexico 87305-3077

PROJECT LOCATION
NORTHEAST CHURCH ROCK MINE
PROJECT
INTERIM REMOVAL ACTION
TITLE
LOCATIONS OF IRA AGRONOMIC SAMPLES

MWH

FIGURE 1
REVISION 0
FILE NAME 1007552D017

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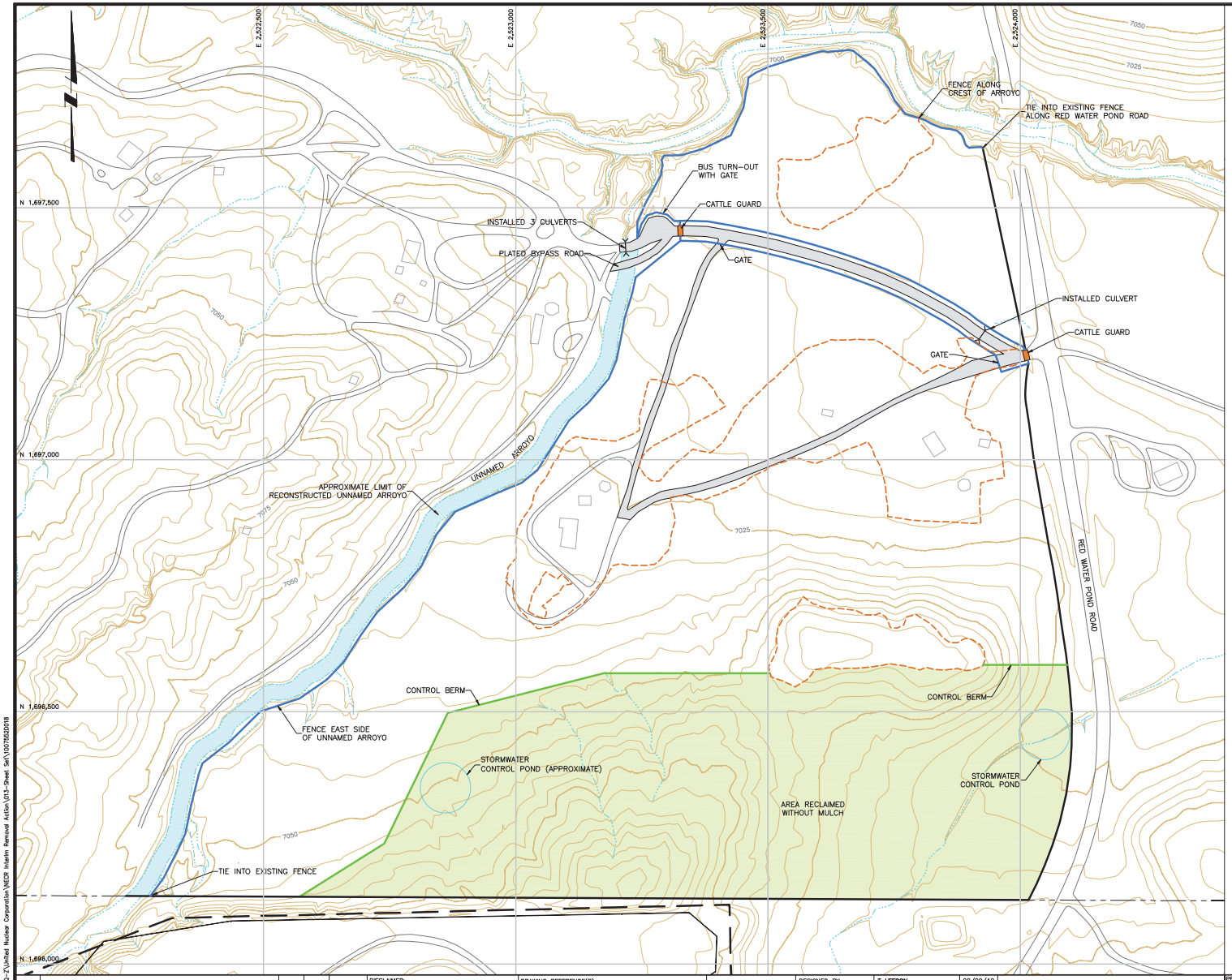

LEGEND:

- EXISTING GROUND SURFACE CONTOUR & ELEVATION, FEET
- PERMIT BOUNDARY
- APPROXIMATE OWNERSHIP BOUNDARY
- ROADS
- NATURAL DRAINAGE
- INTERIM REMOVAL ACTION EXCAVATION BOUNDARY – STEP OUT AREAS
- EXISTING FENCE
- APPROXIMATE LIMIT OF RECONSTRUCTED UNNAMED ARROYO
- AREA RECLAIMED WITHOUT TOPSOIL
- ROAD TO BE PLATED WITH 6" OF GRAVEL OR ROAD BASE
- PHYSICAL STRUCTURE
- NEW CULVERT

SCALE
100 0 100 200 FEET
CONTOUR INTERVAL = 5 FEET

REV	DESCRIPTION			
		TECH	ENG	DATE
0	FINAL	CHL	RTL	02/09/10

DISCLAIMER:
THIS DRAWING WAS DEVELOPED THROUGH THE APPLICATION OF PROFESSIONAL ENGINEERING SKILL AND PROPRIETARY METHODOLOGIES, PROCESSES, AND KNOW-HOW OF MWH AS AUTHOR. ALL PURSUANT TO THE TERMS OF A CONTRACTUAL SCOPE OF WORK GOVERNING ITS PREPARATION. ANY USE OF THIS DRAWING THAT IS NOT MODIFIED OTHERWISE THAN IN STRICT ACCORDANCE WITH THE TERMS OF THE GOVERNING CONTRACT AND SCOPE OF WORK OR OTHERWISE ABSENT THE INVOLVEMENT AND CONSENT OF THE AUTHOR, ANY ALTERATION OR ADAPTATION OF THIS DRAWING SHALL BE CONSISTENT WITH THE AUTHOR'S CONTRACTUAL AND PROPRIETARY RIGHTS AND BE AT USER'S SOLE RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY OF MWH.

DRAWING REFERENCE(S):
SURFACE TOPOGRAPHY GENERATED FROM AERIAL PHOTOGRAPHS DATED MAY 2007 BY COOPER AERIAL SURVEYS CO. AND USGS 10m DIGITAL ELEVATION MODELS (DEM).

PROJECTION:
STATE PLANE COORADINATES

ZONE:
NEW MEXICO WEST

DATUM:
NAD 83

UNITS:
US FEET

DESIGNED BY	T LEESON	02/09/10
DRAWN BY	C FOWLER	02/09/10
CHECKED BY	E MARKS	02/09/10
APPROVED BY	J THOMPSON	02/09/10
PROJECT MANAGER	T LEESON	02/09/10
CLIENT APPROVAL		
CLIENT REFERENCE NO.		

unc
P.O. BOX 3077
Gallup, New Mexico 87305-3077

PROJECT LOCATION: NORTHEAST CHURCH ROCK MINE
PROJECT: INTERIM REMOVAL ACTION
TITLE: FENCING PLAN

MWH

FIGURE: 2
REVISION: 0
FILE NAME: 1007552D018

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APPENDIX A6.2

BASELINE VEGETATION SURVEY

EASTERN DRAINAGE

MWH, 2012

United Nuclear Corporation (UNC)

2012 Eastern Drainage Baseline Vegetation Evaluation

NORTHEAST CHURCH ROCK MINE

NOVEMBER, 2012

CEDAR CREEK ASSOCIATES, INC.
5586 Overhill Dr.
Fort Collins, Colorado 80526
(970) 223-0775
www.cedarcreekassociatesinc.com

Table of Contents

In Text Tables, Charts, Maps, Plates, Exhibits, and Figures

Appendix A - Raw Data Tables

CEDAR CREEK ASSOCIATES, INC.

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www.cedarcreekassociatesinc.com

United Nuclear Corporation (UNC)

Northeast Church Rock Mine

EASTERN DRAINAGE VEGETATION EVALUATION AND REFERENCE AREA VALIDATION

1.0 INTRODUCTION

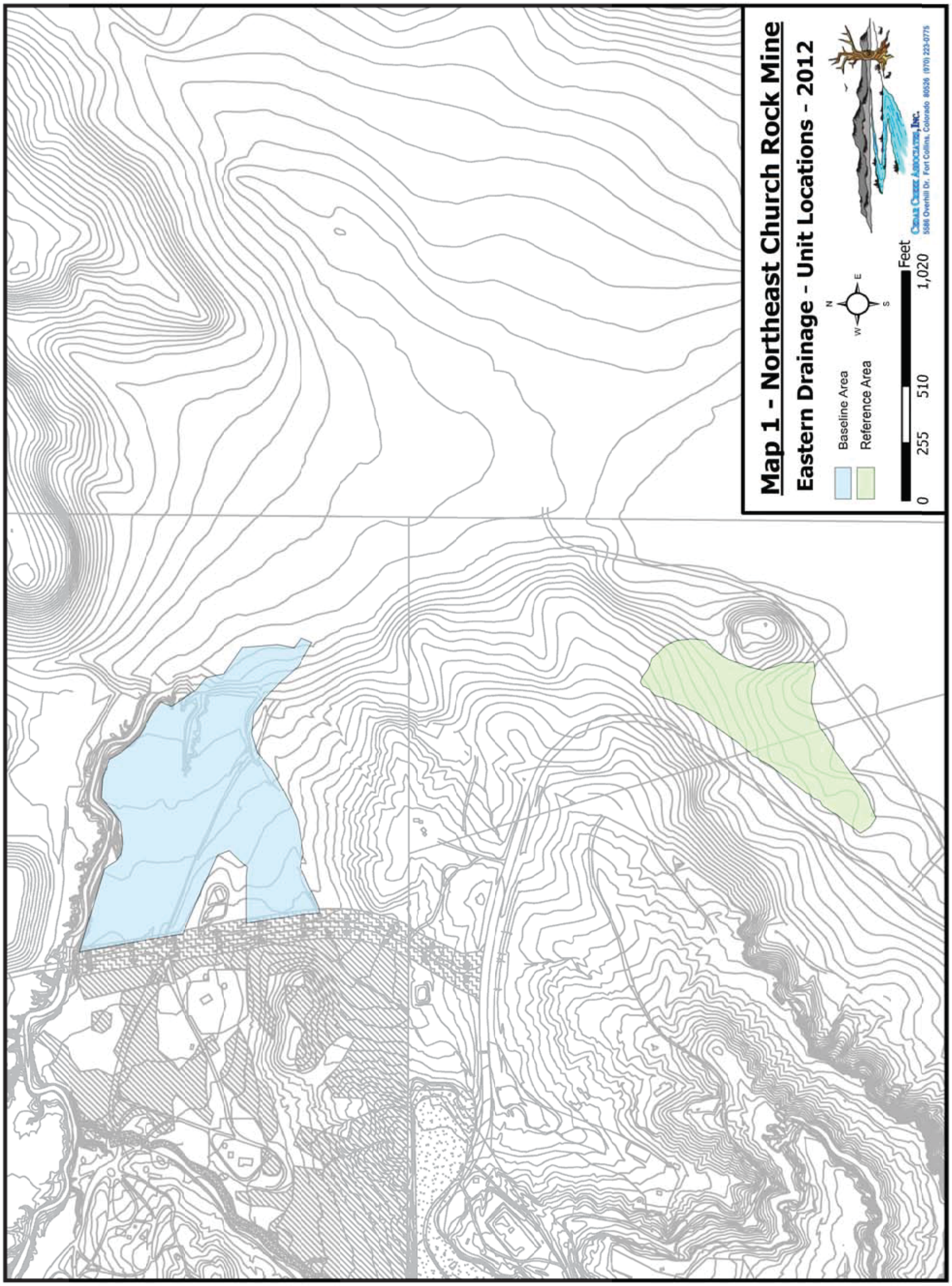
1.1 General

Cedar Creek Associates, Inc. (Cedar Creek) has been contracted in 2012 to implement a work plan specific to development of a baseline vegetation evaluation in support of the Eastern Drainage Removal Action (EDRA) for United Nuclear Corporation's (UNC) Northeast Church Rock Mine (NECR). This work plan requires identification of methods and protocols for vegetation evaluations responsive to the interim action pursuant to mandates of the US Environmental Protection Agency (EPA) – Region 9. In addition to baseline evaluation of the project area, establishment of an additional (site-appropriate) vegetation reference area was necessary to provide a suitable comparison for eventual reclamation and revegetation of Eastern Drainage. Therefore, the purpose of the effort documented herein is presentation of a methodology designed to facilitate a determination of current floral conditions extant in the vicinity of the project area.

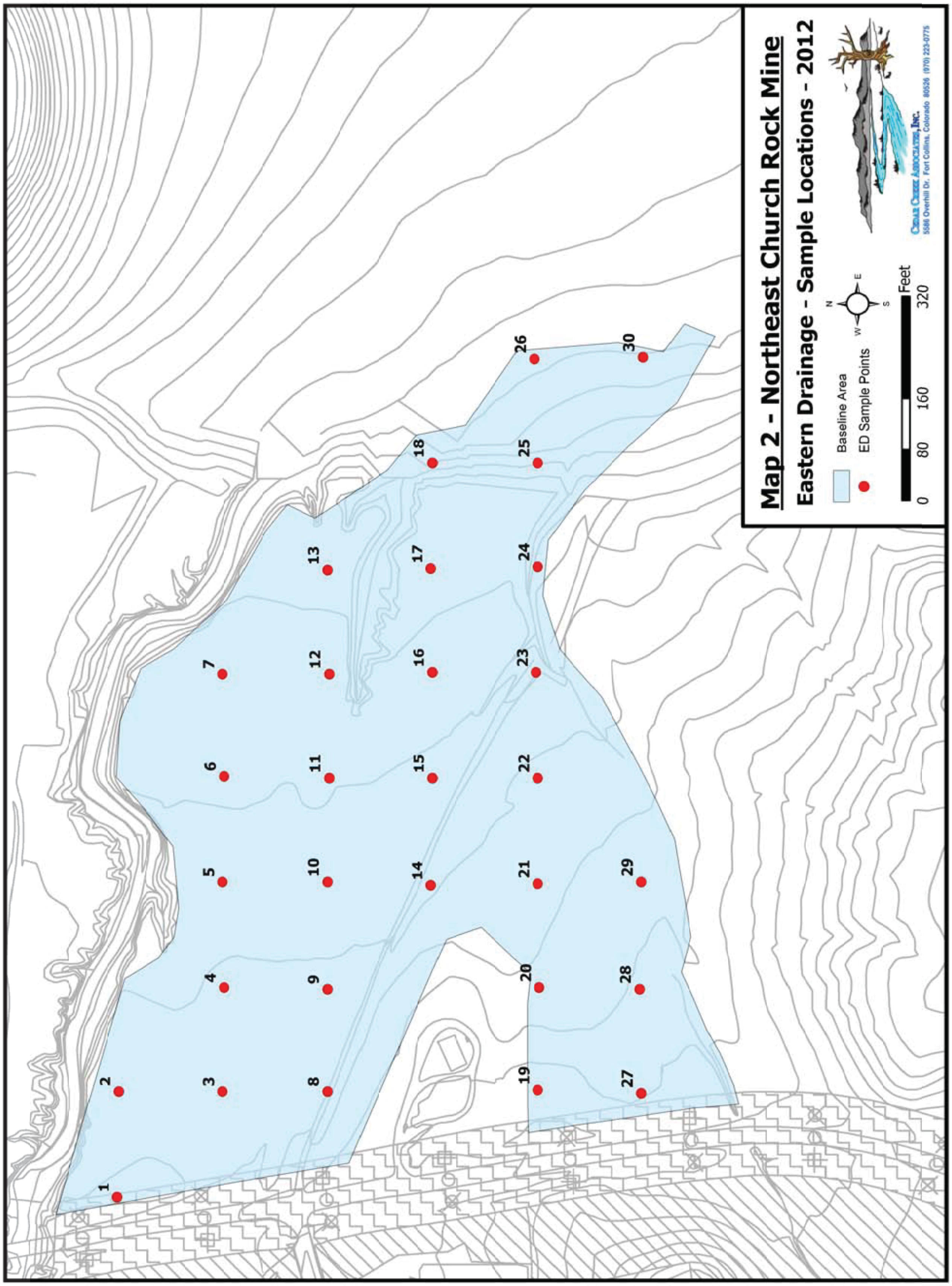
Floral surveys were conducted August 15th and 16th 2012 by or under the direct supervision of Cedar Creek Ecologist Mr. Jesse H. Dillon. Mr. Dillon will also serve as the Project Manager for Cedar Creek.

1.2 Site Description

NECR is located approximately 16 miles northeast of Gallup, New Mexico, at an elevation ranging between 7,000 and 7,200 feet above mean sea level. Eastern Drainage Project Area is within Step-out Area No. 2 immediately east of Red Water Pond Road. Based on field reconnaissance by Cedar Creek biologists, there is one distinct vegetation community within the project area, grassland. Grassland is dominated by perennial sod-forming "short" grasses and forbs which can be seasonally dominant, in addition occasional saltbush and rabbitbrush are found in the shrub stratum.



Map 1 - Northeast Church Rock Mine
Eastern Drainage - Unit Locations - 2012
Baseline Area
Reference Area
N
E
S
W
0
255
510
1,020
Feet
Cedar Creek Associates, Inc.
5586 Overhill Dr. Fort Collins, Colorado 80526 (970) 223-0775



Map 2 - Northeast Church Rock Mine
Eastern Drainage - Sample Locations - 2012
Baseline Area
ED Sample Points
N
E
S
W
0 80 160 320
Feet
1
2
3
4
5
6
7
8
9
10
11
12
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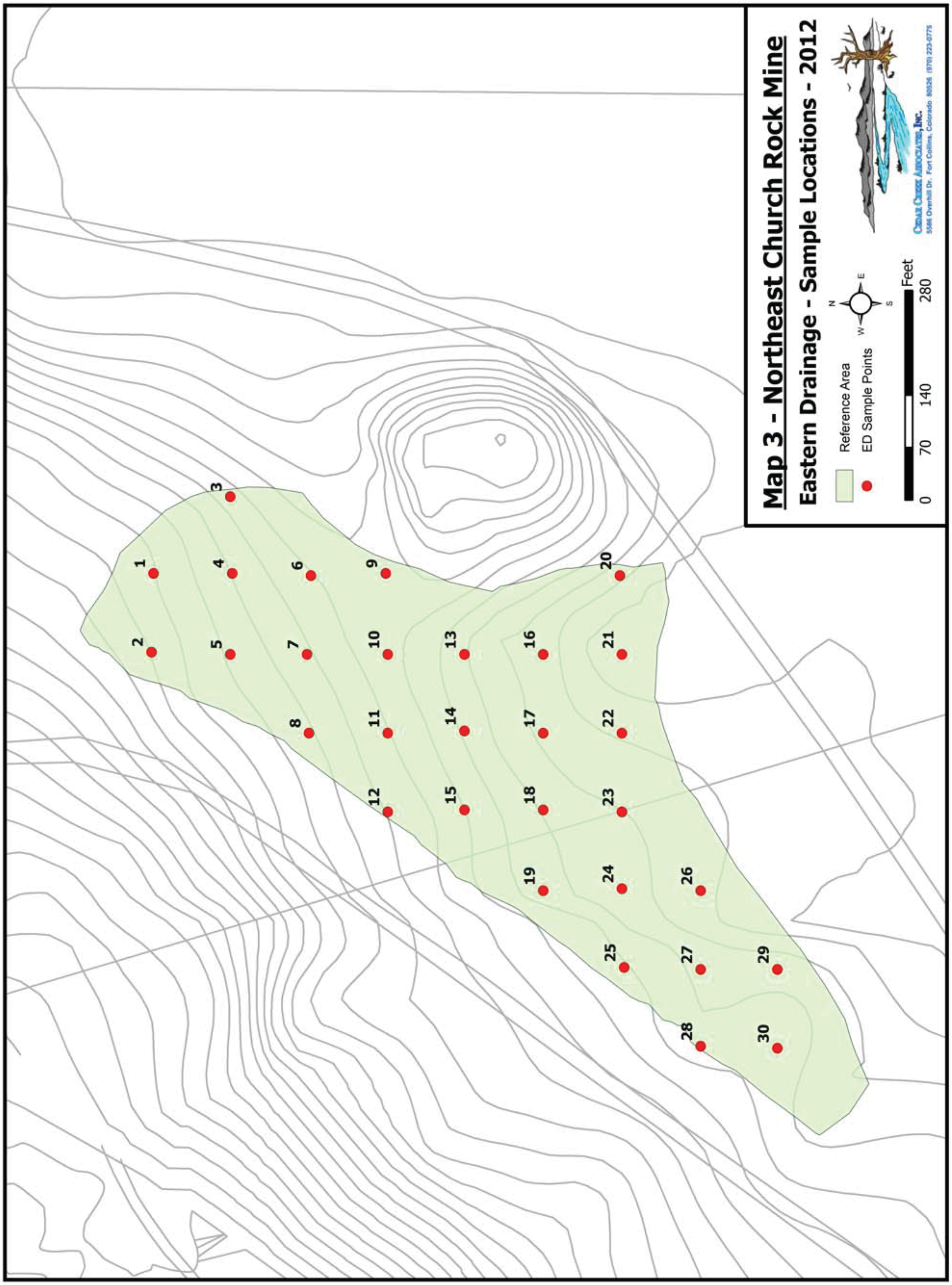
29
30


Map 3 - Northeast Church Rock Mine
Eastern Drainage - Sample Locations - 2012
Reference Area
ED Sample Points
N
E
S
W
0
70
140
280
Feet
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
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19
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2.0 REFERENCE AREA SELECTION

The reference area(s) to be used for final revegetation success comparison was selected from undisturbed areas in the vicinity of the project area. Preferred reference areas can be characterized as "ecologically and topographically similar" to the rehabilitated landform, surrounding areas, and/or areas representing the desired post mining land use (PMLU), and are based on five main considerations, as follows:

1. The reference area(s) is representative of the desired PMLU or vegetation community supporting the PMLU (grazing land in the case of the NECR Eastern Drainage area).

2. The reference area(s) occupy topography and aspects that are representative of the majority of reclaimed areas, especially with regard to slopes that may be subject to erosion.

3. The reference area(s) exhibit similar physical soil conditions as reclaimed areas and therefore, should be an "approximate ecological equivalent".

4. Excepting managed pasturelands and/or occasional invasive weeds, the reference area(s) support native tree/shrub/grass plant communities similar in structure to what can be obtained on reclaimed areas in the short term.

5. The plant communities selected for comparison provide an appropriate and logical target for reclamation efforts.

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3.0 SAMPLING METHODS

Cedar Creek's vegetation sampling protocols involve an emphasis upon ground cover* primarily to maintain validity in future statistical comparisons among evaluation, among other reasons. In brief, concentration on a single variable of plant ecology promotes improved comprehension and comparability over time and among treatment scenarios. Second, ground cover data, especially when determined using a very precise method such as the point-intercept procedure, provides some of the most important information regarding community variability that ecologists can evaluate. Such data facilitate the determination of true species composition, relative health (condition), and successional status of the sampled area. Furthermore, the same data can be utilized to develop the corresponding variables of frequency and species composition if desired. Third, strong inferences can be developed with other correlated variables such as production with species composition as a component of the analysis. Fourth, ground cover is a preferred variable for revegetation monitoring because cover data can be readily obtained in a statistically adequate and cost-effective manner (using the proper procedures), has broad application for evaluation (including erosion control modeling), precisely reflects species' dominance of a given area, and when collected using bias-free techniques such as the point-intercept procedure is one of the most repeatable variables among independent observers.

In addition to ground cover evaluations, Cedar Creek recommends evaluation of woody plant density and current annual vegetative production to facilitate a broader analysis. In this regard, it was determined most appropriate to document woody plant populations (for wildlife habitat considerations) by utilizing long quadrats or belts as detailed below. The most appropriate method for measuring current annual herbaceous production is use of long rectangular quadrats. Since sampling adequacy is not required (nor recommended) for woody plant density or vegetative production samples, one density belt

* To avoid confusion, the term "ground cover" is utilized to indicate the variable of non-overlapping foliar cover (the percent of the ground occupied by all above ground plant material) in addition to the ground surface covered by litter or rock. Non-overlapping means that only that cover which would be wetted by a light mist would be counted as opposed to that plant material which would not get wet due to overshadowing plant material. In this manner, total ground cover cannot exceed 100%. Other forms of "cover" would include: basal cover (the percent of the ground surface occupied by the living base of plants), crown or canopy cover (the percent of the ground occupied by the canopies of plants), or overlapping foliar cover (the percent of the ground occupied by all plant material allowing for overlapping vegetation - i.e., such cover can exceed 100%). Non-overlapping foliar cover is preferred because of its inherent repeatability among observers, resulting data are directly applicable to erosion control modeling efforts, and significant precedent has already been set in the mining industry. In contrast, the determination of the live portion of the base of a plant (as necessary for basal cover) becomes increasingly difficult and subjective given life forms such as certain bunch grasses and sod-formers.

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and one production quadrat will be co-located with each ground cover transect evaluated. Resulting data are then considered reasonable for the evaluation purposes intended.

3.1 Sample Site Selection / Location

The primary field effort for vegetation calls for sampling of Eastern Drainage Area and the establishment and sampling of a corresponding reference area. The reference area was selected and established during floral evaluations in September. The systematic procedure for determination of sample locations occurs in the following stepwise manner: First, a fixed point of reference is selected for the entire area to facilitate location of the systematic grid in the field. Second, a systematic grid of appropriate dimensions (i.e., 150' X 150') is selected by Cedar Creek to provide a minimum number of coordinate intersections (~30 in the baseline area and ~30 in the reference area) within the vegetative unit that could then be used for the initial set of sample sites. Third, a scaled representation of the grid is overlain on field maps extending parallel to major compass points to facilitate field location. Fourth, unbiased placement of this grid is controlled by selection of two random numbers between 0 and 150 (used as coordinates). Fifth, utilizing a handheld compass and pacing techniques or a GPS, all 30 of the initial sample points are located in the field. If the initial 30 systematic samples are not sufficient to provide an adequate ground cover sample, an "intergrid" would be selected to provide additional systematically determined sample points.

3.2 Determination of Ground Cover

Ground cover at each sampling site is determined utilizing the point-intercept methodology (Bonham 1989) as illustrated on Figure 1. This methodology has been utilized for range studies for over eighty (80) years, however, Cedar Creek utilizes state-of-the-art instrumentation that it has pioneered to allow for rapid and accurate collection of data. Implementation of the technique for the sampling effort occurs as follows: First, a transect of 10 meters length is extended from the starting point of each sample site toward the direction of the next site to be sampled. Then, at each one-meter intervals along the transect, a "laser point bar" is situated vertically above the ground surface, and a set of 10 readings recorded as to hits on vegetation (by species), litter, rock (>2mm), or bare soil. Hits are determined at each meter interval by activating a battery of 10 specialized lasers situated along the bar at 10 centimeter intervals and recording the variable intercepted by each of the narrow (0.02") focused beams (see Figure 1). In this manner, a total of 100 intercepts per transect are recorded resulting in 1 percent cover per intercept. This methodology and instrumentation facilitates the collection of the most unbiased, repeatable, precise, and cost-effective ground cover data possible. Furthermore, the point-

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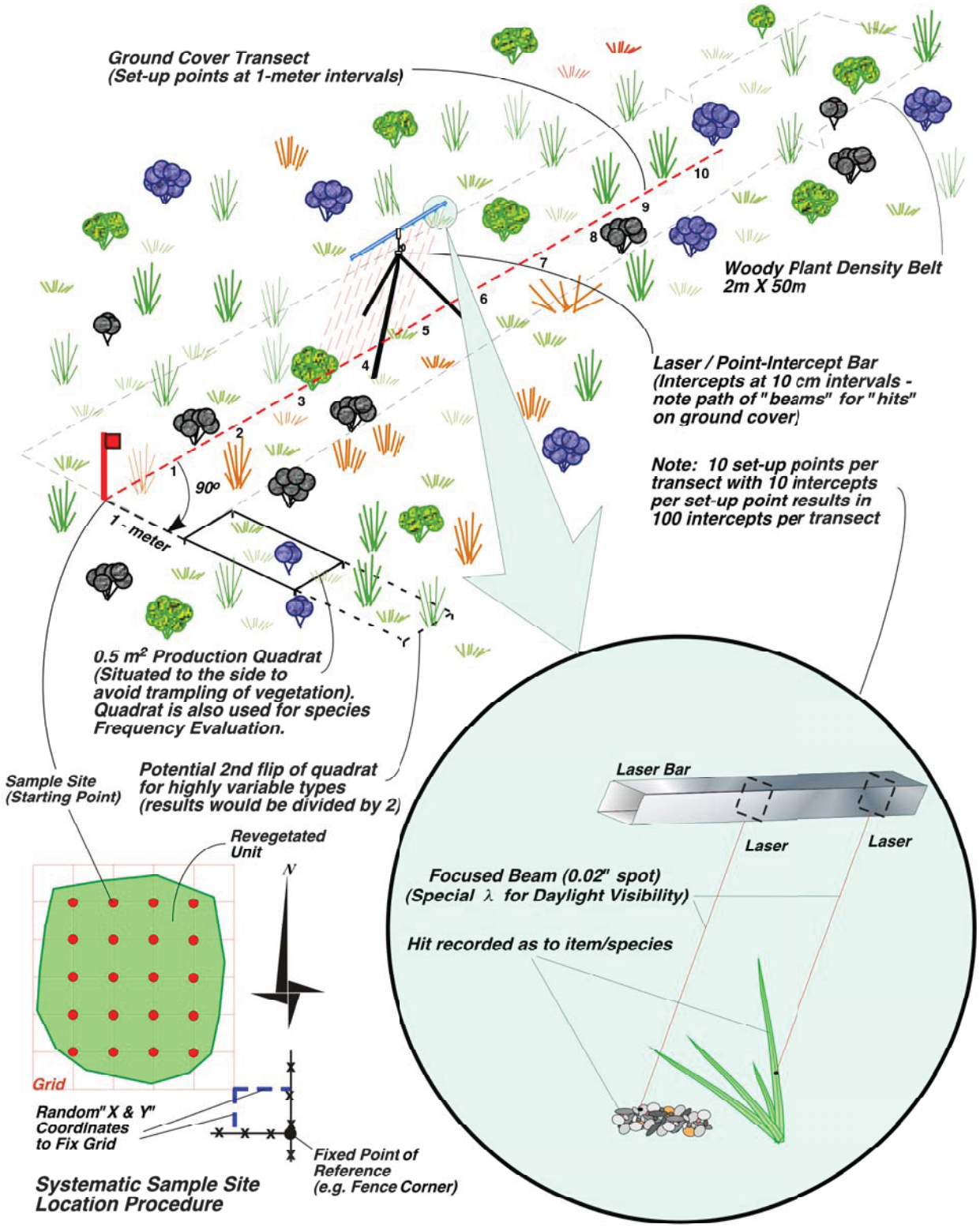

Figure - 1

Sampling Procedure at a Systematic Sample Site Location

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intercept procedure has been widely accepted in the scientific community as the protocol of choice for vegetation monitoring and is used within the mining industry in connection with bond release determinations.

3.3 Determination of Woody Plant Density

Woody plant density at each sampling site is determined using fixed length / width belt transects oriented parallel to, and co-located with, each ground cover transect. Each belt is 2 meters in width and extended from the beginning of the sample point for a distance of 50 meters (see Figure 1). All shrubs, succulents, and trees rooted within the boundaries of these belts are counted and classified according to species (sub-shrubs are not counted). Entire plants rather than stems are counted to provide a more accurate representation of actual woody plant density.

3.4 Determination of Vegetative Production

At each sample site, current annual production is collected from a $^1/_2$ m^2 quadrat frame at each sampling location. The quadrat is initially placed one meter and 90º to the right (clockwise) of the ground cover transect to avoid vegetation trampled by investigators during sample site location (see Figure 1). From within each quadrat, all above ground current annual vegetation within the vertical boundaries of the frame is clipped and bagged separately by life form as follows:

Native Perennial Grass
Introduced Perennial Grass
Annual Grass
Sub-Shrub
Shrub
Native Perennial Forb
Annual / Biennial Forb
Introduced Perennial Forb
Noxious Weed

All production samples are returned to the lab for drying and weighing. Drying will occur at 105º C until a stable weight is achieved (24 hours). Samples are then re-weighed to the nearest 0.1 gram.

3.5 Sample Adequacy Determination

Ground cover sampling is conducted to a minimum of 30 initial ground cover transects for the baseline area and a minimum of 30 initial ground cover transects for the reference area. Production and woody plant density samples are co-located with each ground cover transect but are not subject to a determination of sampling adequacy. From these preliminary efforts for ground cover, a sample mean and standard deviation for total non-overlapping vegetation ground cover is calculated. These parameters are calculated in the field to ensure collection of an adequate sample and once again by

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computer during final data analyses for each area. Sampling continues until an adequate ground cover sample, $\mathbf{n_{min}}$, has been collected in accordance with the Cochran formula (below) for determining sample adequacy, whereby the population would be estimated to within 10% of the true mean (μ) with 90% confidence. Sampling to these limits facilitates a very strong estimate of target populations.

When the inequality ($\mathbf{n_{min}} \leq \mathbf{n}$) is true, sampling is adequate and $\mathbf{n_{min}}$ is determined as follows:

$$\mathbf{n_{min} = (t^2 s^2) / (0.1\ \bar{x}\ )^2}$$

where: n = the number of actual samples collected (initial size = 30)

t = the value from the one-tailed t distribution for 90% confidence with n-1 degrees of freedom;

s^2 = the variance of the estimate as calculated from the initial samples;

$\bar{x}$ = the mean of the estimate as calculated from the initial samples.

If the initial 30 ground cover samples from each area does not provide a suitable estimate of the mean (i.e., the inequality is false), additional samples would be collected until the inequality ($\mathbf{n_{min}} \leq \mathbf{n}$) becomes true.

3.6 Threatened, Endangered, and Rare Plant Species

A list of rare and endangered plant and animal species that are known to occur within McKinley County and the grassland ecotype, which contains the study area, will be developed from several sources including New Mexico Natural Heritage Program, New Mexico Rare Plant Website, and Navajo Nation EPA before baseline evaluation.

Prior to implementation of fieldwork, taxonomic descriptions and botanical drawings of these target species were compiled into a field guide. Actual fieldwork involved search patterns in all portions of appropriate habitat within the project area. Search procedures involves slow implementation of qualitative pedestrian transects and careful visual scanning of the ground surface for any of the target plant species. The compiled field guide was used to determine whether encountered plants are species of concern.

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4.0 RESULTS

As indicated, statistically adequate ground cover data were collected from both Eastern Drainage Baseline Area and Reference Area. Woody plant density and production data were also collected from samples co-located with the ground cover samples. All sampled variables and analyzed parameters are summarized and presented in various formats either within the main text or at the rear of this document (Appendix A). Furthermore, four photos were collected (Plates 1-4) to document conditions of the sampled area at the time of sampling in September, 2012.

Floristic surveys of the baseline and reference area resulted in the identification of a total of 29 taxa, including: 6 grass-like species, 12 forbs, and 11 trees, shrubs, sub-shrubs, or succulents. Of these 29, 24 were of sufficient distribution as to be intercepted by sampling metrics as indicated on Tables 1 and 3. Species which were observed but not encountered during sampling included: Rocky Mountain beeplant (*Cleome serrulata)*, redstem stork's bill (*Erodium cicutarium)*, hoary tansyaster (*Machaeranthera canescens)*, threadleaf ragwort (*Senecio flaccidus*) and desert globemallow (*Sphaeralcea ambigua)*.

4.1 Baseline Area

The Baseline Area was evaluated with 30 samples, with each sample consisting of a 10-meter ground cover transect, as well as a co-located woody plant density belt (2m x 50m) and ½ m^2 production quadrat (Figure 1 and Map 2). Perusal of Table 1 and Chart 1 indicated that total plant cover was 22.3% with an average perennial cover of 19.7%, while rock, litter, and bare ground exposure were 0.1%, 21.9%, and 55.7% respectively. Grasses provided the majority of the cover (14.5%), followed by shrubs, sub-shrubs, cacti, and trees (5.0%), and then forbs (2.9%). Dominant taxa were blue grama (*Bouteloua gracilis*), threadleaf snakeweed (*Gutierrezia microcephala*), and little hogweed (*Portulaca oleracea*) with 14%, 2.4%, and 1.5% cover, respectively. The relative cover values (composition) of observed flora are presented on Table 2 and Chart 2. Review of Table 3 and Chart 3 reveals that woody plant density in this area averaged 152 woody plants per acre with an average of 144 shrubs per acre, 5 succulents per acre, and 3 trees per acre. The dominant woody plants were rubber rabbitbrush (*Chrysothamnus nauseosus*) with 73 plants per acre and four wing saltbush (*Atriplex canescens*) with 67 plants per acre. Table 4 and Chart 4 exhibit the current annual production of the Baseline Area with 117.9 pounds per acre of total production; of which, 102.1 pounds per acre was perennial production. Dominant life form categories in terms of production were native perennial grass, sub-shrub, and perennial forbs with an average of 51.7, 22.3, and 17.4 pounds per acre, respectively.

According to the New Mexico Rare Plants database, none of the identified species of concern have historically been found in the immediate vicinity of the project area. The taxa of primary concern and their habitats are indicated in Appendix B of this report. Site-specific field efforts have verified that no

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rare, threatened or endangered plant species occur on or near the project area. All taxa were searched for, but with negative results.

The baseline area (Map 2) contains several small pockets of trees contained within the project area. These trees were entirely enumerated by species for informational purposes. Locations of these trees were recorded with GPS and are displayed on Map 4. A total of 23 trees were counted within the project area, 17 juniper (*Juniperus monosperma*) and 6 pinon pines (*Pinus edulis*).

4.2 Reference Area

The Reference Area was also evaluated with 30 samples, with each sample consisting of a 10 meter ground cover transect, as well as a co-located woody plant density belt (2m x 50m) and a 1/2m^2 production quadrat (Figure 1 and Map 3). Perusal of Table 1 and Chart 1 indicate that total plant cover was 22.9% with an average perennial cover of 22.3%, while rock. Litter, and bare ground exposure were 1.6%, 25.4%, and 50.1%, respectively. Grasses provided the majority of cover (18.5%), followed by shrubs, sub-shrubs, cacti and trees (3.7%) and forbs (0.7%). Dominant taxa were blue grama and threadleaf snakeweed with 17.3% and 2.4%, respectively. The relative cover values of observed flora are presented on Table 2 and Chart 2. Review of Table 3 and Chart 3 revealed woody plant density in the area averaged 166 woody plants per acre with an average 161 shrubs per acre, 3 succulents per acre, and 3 trees per acre. The dominant woody plant was rubber rabbitbrush with 132 plants per acre. Table 4 and Chart 4 exhibit the current annual production of the reference Area with 166.0 pounds per acre of total production with 159.0 pounds per acre of perennial production. Dominant life form categories in terms of production are native perennial grass, sub-shrub, and shrub with an average of 89.9, 47.2, and 20.7 pounds per acre, respectively.

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Chart 1
Eastern Drainage Average Ground Cover by Lifeform - 2012

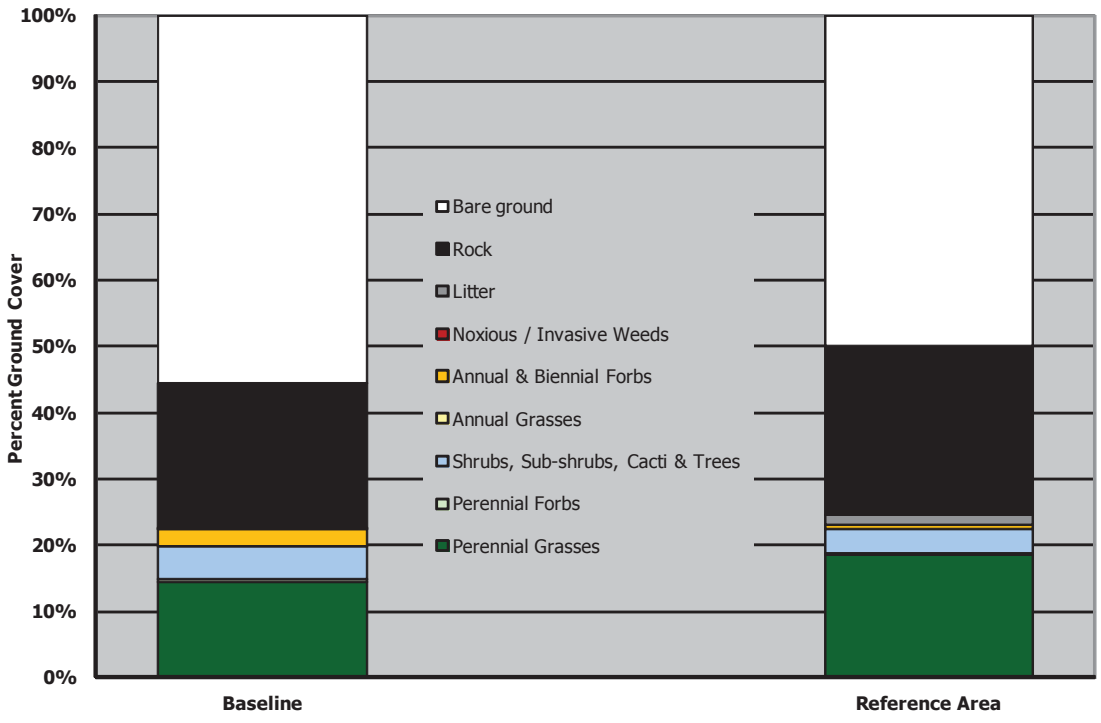

Chart 2
Eastern Drainage Relative Ground Cover (Composition) by Lifeform -2012

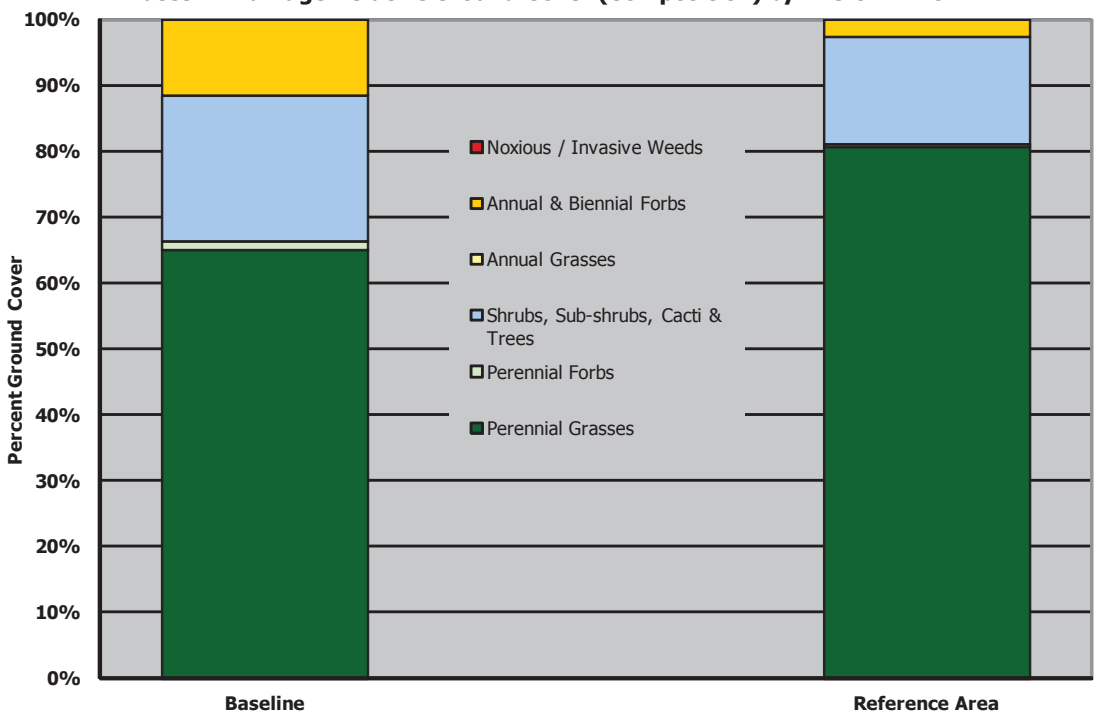

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Table 1 NECR - Vegetation Cover - 2012

Eastern Drainage Average Cover Summary

Percent Ground Cover Based on Point-Intercept Sampling

				Area ——>	Baseline	Reference Area
Grasses						
N	P	*Agropyron smthii*	Western Wheatgrass		0.40	0.03
N	P	*Aristida purpurea*	Purple Three-awn		-	0.13
N	P	*Bouteloua gracilis*	Blue Grama		14.00	17.27
N	P	*Hilaria jamesii*	Galleta		-	0.90
N	P	*Oryzopsis hymenoides*	Indian Ricegrass		-	0.13
N	P	*Sitanion hystrix*	Bottlebrush Squirreltail		0.07	0.03
Forbs						
N	P	*Astragalus tenellus*	Looseflower Milkvetch		-	0.07
N	P	*Euphorbia brachycera*	Horned Spurge		-	0.03
N	B	*Grindelia squarrosa*	Curlycup Gumweed		0.63	-
N	P	*Heterotheca villosa*	Hairy Golden Aster		0.27	-
I	A	*Kochia scoparia*	Burningbush		0.17	0.03
I	A	*Portulaca oleracea*	Little Hogweed		1.50	0.57
I	A	*Salsola tragus*	Russian Thistle		0.27	0.03
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow		0.03	-
Shrubs, Sub-shrubs, Cacti & Trees						
N	P	*Artemisia tridentata*	Big Sagebrush		-	0.10
N	P	*Atriplex canescens*	Fourwing Saltbush		1.40	0.10
N	P	*Chyrsothamnus nauseosus*	Rabbitbrush		0.77	0.87
N	P	*Escobaria vivipara*	Spinystar		0.03	-
N	P	*Gutierrezia microcephala*	Threadleaf Snakeweed		2.43	2.40
N	P	*Gutierrezia sarothrae*	Broom Snakeweed		0.33	0.20
N	P	*Opuntia polyacantha*	Plains Pricklypear		-	0.03
				Total Plant Cover	**22.30**	**22.93**
				Rock	0.07	1.57
				Litter	21.97	25.40
				Bare ground	55.67	50.10
				Total Non-Exotic Vegetative Cover	**20.37**	**22.30**
				Total Perennial Cover	**19.73**	**22.30**
Summary by Lifeform:						
				Perennial Grasses (P)	**14.47**	**18.50**
				Annual Grasses (A)	-	-
				Perennial Forbs (P)	**0.30**	**0.10**
				Annual & Biennial Forbs (A / B)	2.57	0.63
				Noxious / Invasive Weeds (NW / IW)	-	-
				Shrubs, Sub-shrubs, Cacti & Trees	**4.97**	**3.70**
Sample Adequacy Calculations:						
				Mean =	22.30	22.93
				Variance =	58.148	22.409
				n =	30	30
				n_{min} =	**20.11**	**7.33**

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Table 2 NECR - Vegetation Cover - 2012

Eastern Drainage Relative Cover Summary

Percent Ground Cover Based on Point-Intercept Sampling

			Area ——>	Baseline	Reference Area
Grasses					
N	P	*Agropyron smthii*	Western Wheatgrass	1.79	0.15
N	P	*Aristida purpurea*	Purple Three-awn	-	0.58
N	P	*Bouteloua gracilis*	Blue Grama	62.78	75.29
N	P	*Hilaria jamesii*	Galleta	-	3.92
N	P	*Oryzopsis hymenoides*	Indian Ricegrass	-	0.58
N	P	*Sitanion hystrix*	Bottlebrush Squirreltail	0.30	0.15
Forbs					
N	P	*Astragalus tenellus*	Looseflower Milkvetch	-	0.29
N	P	*Euphorbia brachycera*	Horned Spurge	-	0.15
N	B	*Grindelia squarrosa*	Curlycup Gumweed	2.84	-
N	P	*Heterotheca villosa*	Hairy Golden Aster	1.20	-
I	A	*Kochia scoparia*	Burningbush	0.75	0.15
I	A	*Portulaca oleracea*	Little Hogweed	6.73	2.47
I	A	*Salsola tragus*	Russian Thistle	1.20	0.15
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow	0.15	-
Shrubs, Sub-shrubs, Cacti & Trees					
N	P	*Artemisia tridentata*	Big Sagebrush	-	0.44
N	P	*Atriplex canescens*	Fourwing Saltbush	6.28	0.44
N	P	*Chyrsothamnus nauseosus*	Rabbitbrush	3.44	3.78
N	P	*Escobaria vivipara*	Spinystar	0.15	-
N	P	*Gutierrezia microcephala*	Threadleaf Snakeweed	10.91	10.47
N	P	*Gutierrezia sarothrae*	Broom Snakeweed	1.49	0.87
N	P	*Opuntia polyacantha*	Plains Pricklypear	-	0.15
Summary by Lifeform:					
			Perennial Grasses (P)	**64.87**	**80.67**
			Annual Grasses (A)	-	-
			Perennial Forbs (P)	**1.35**	**0.44**
			Annual & Biennial Forbs (A / B)	11.51	2.76
			Noxious / Invasive Weeds (NW / IW)	-	-
			Shrubs, Sub-shrubs, Cacti & Trees	**22.27**	**16.13**

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Table 3 Northeast Church Rock - Woody Plant Density - 2012

Summary of Eastern Drainage Woody Plant Density

Woody Plants per Acre

Lifeform	Scientific name	Area Sampled --> Common Name	Baseline	Reference
S	*Artemisia tridentata*	Big Sagebrush	4.0	14.8
S	*Atriplex canescens*	Four Wing Sagebrush	67.4	13.5
S	*Chrysothamnus nauseosus*	Rubber Rabbitbrush	72.8	132.2
T	*Juniperus monosperma*	One-seeded Juniper	2.7	1.3
Su	*Opuntia polyacantha*	Plains Pricklypear	5.4	2.7
T	*Pinus edulis*	Two-needle Pinyon	-	1.3
Life Form		**Shrub (S)**	**144.3**	**160.5**
		Succulent (Su)	**5.4**	**2.7**
		Tree (T)	**2.7**	**2.7**
Total Woody Plants per Acre			**152.4**	**165.9**

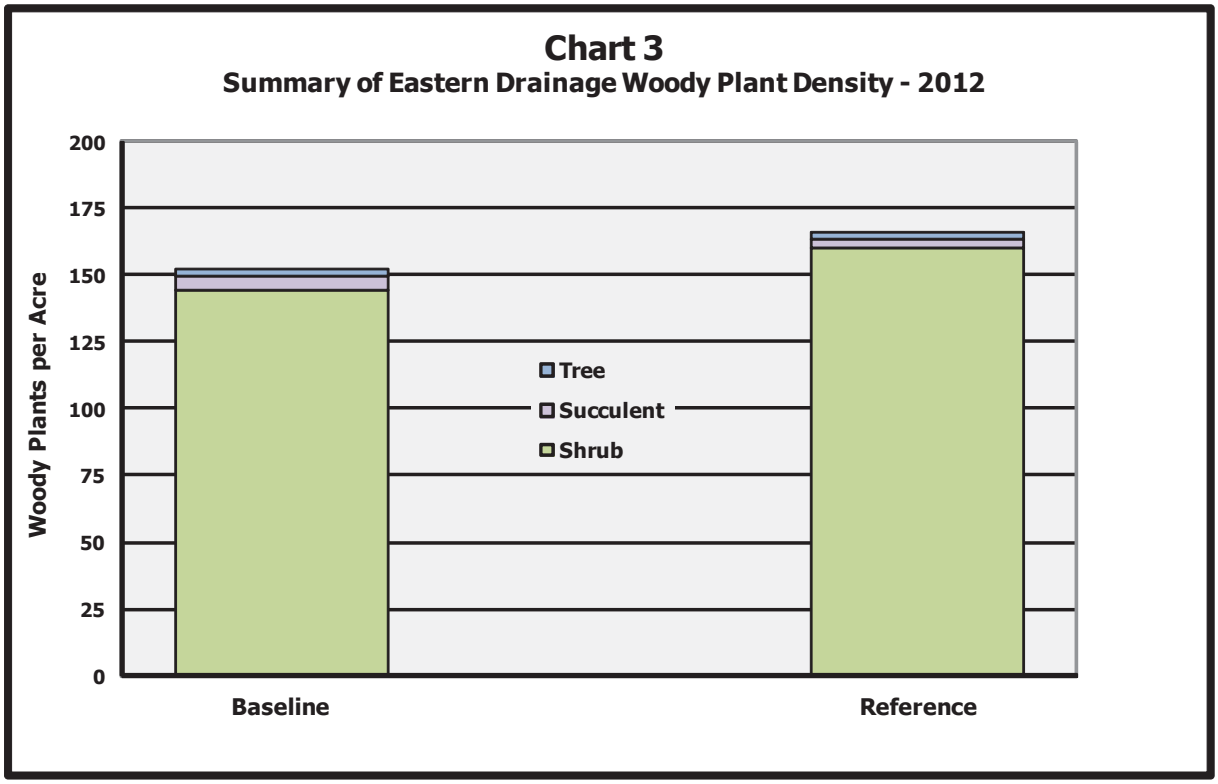

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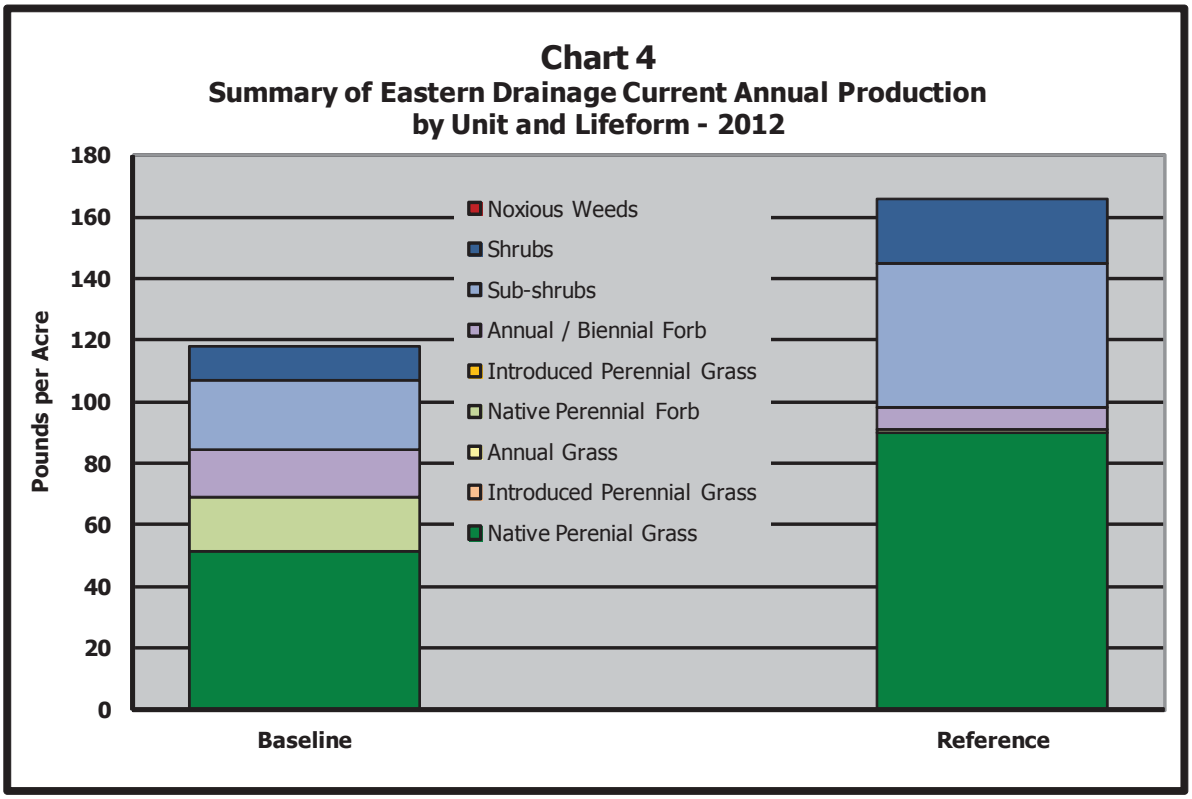
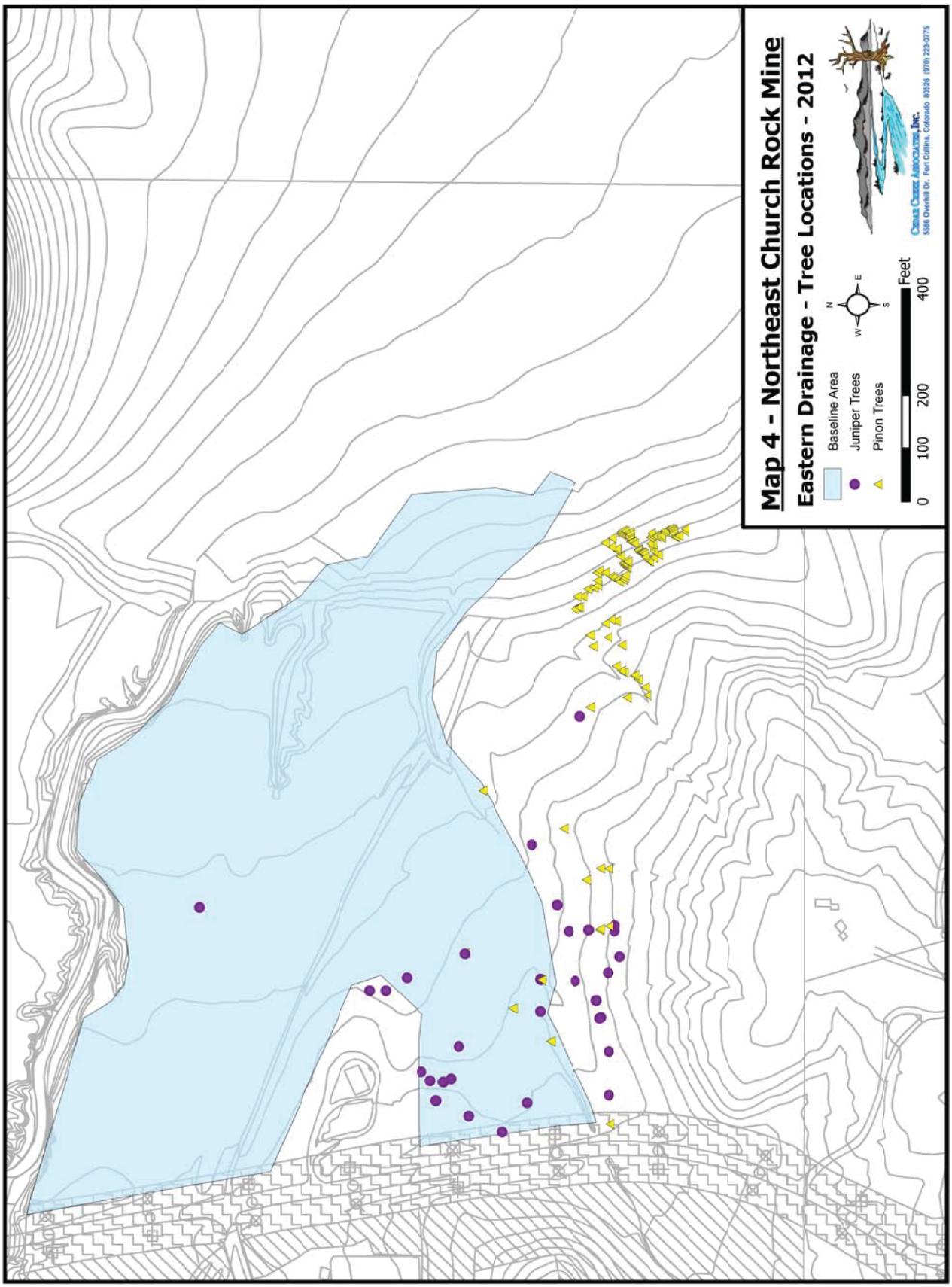
Table 4 Northeast Church Rock - Vegetation Production - 2012

Eastern Drainage Production Summary

Pounds per Acre

Area	Grasses			Forbs			Sub-shrubs	Shrubs	Noxious Weeds	All Perennial	Total
	Perennial		Annual	Perennial		Annual / Biennial					
	Native	Introduced		Native	Introduced						
Baseline	51.7	-	-	17.4	-	15.8	22.3	10.7	-	**102.1**	**117.9**
Reference	89.9	-	-	1.2	-	7.0	47.2	20.7	-	**159.0**	**166.0**




Map 4 - Northeast Church Rock Mine
Eastern Drainage - Tree Locations - 2012
Baseline Area
Juniper Trees
Pinon Trees
N
E
W
S
0
100
200
400
Feet
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5.0 DISCUSSION

A standard students "t" test comparison of the means (baseline vs. reference area) with regard to the three variables measured (ground cover, production, and woody plant density) indicates that these two areas can be considered to be from the same population with regard to ground cover and woody plant density. Therefore, the reference area can be considered representative for future testing of reclamation in this regard. Since the reference area production is greater than the baseline area, the reference area will still suffice as an adequate comparator for future testing of reclamation for this variable even though it does not pass a "t" test comparison.

Table 5 NECR - 2012

Eastern Drainage Statistical Comparison

	Reference Area	Baseline	PASS/ FAIL
Total Cover			
Estimated Mean (% cover)	22.93	22.30	PASS
Sample Variance	22.41	58.15	
Sample Size Collected	30	30	
Pooled Variance	1.34	1.34	
Calculated t-statistic (t*)	0.3865		
Tabular Value for t (0.95,n1+n2-2)	2.0017		
Production			
Estimated Mean (lbs/acre)	166.00	117.89	FAIL
Sample Variance	9038.22	7659.14	
Sample Size Collected	30	30	
Pooled Variance	278.29	278.29	
Calculated t-statistic (t*)	2.0396		
Tabular Value for t (0.95,n1+n2-2)	2.0017		
Woody Plant Density			
Estimated Mean (% cover)	165.89	152.40	PASS
Sample Variance	20248.14	24462.97	
Sample Size Collected	30	30	
Pooled Variance	745.19	745.19	
Calculated t-statistic (t*)	0.3493		
Tabular Value for t (0.95,n1+n2-2)	2.0017		

Plate 1 – Baseline Area

Plate 2 – Baseline Area – Close-up

Plate 3 – Baseline Area

Plate 4 – Baseline Area - Close-up

Plate 5 – Reference Area

Plate 6 – Reference Area – Close-up

Plate 7 – Reference Area

Plate 8 – Reference Area – Close-up

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Bonham, Charles D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. 338 pp.

Appendix A

Raw Data Tables

Appendix A - Raw Data Tables

Table A1 NECR - Vegetation Cover - 2012

Eastern Drainage Baseline Area

Raw Data

Percent Ground Cover Based on Point-Intercept Sampling

				Transect No.—>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Average Cover	Relative Cover	Freq.
Grasses																																				
N	P	*Agropyron smithii*	Western Wheatgrass									5	3	4																				**0.40**	**1.79**	**10**
N	P	*Bouteloua gracilis*	Blue Grama	6	11	13	10	15	14	10	17	28	24	12	15	18	14	13	15	14	10	15	12	15	9	13	17	11	10	13	18	12	16	**14.00**	**62.78**	**100**
N	P	*Sitanion hystrix*	Bottlebrush Squirreltail																	1	1													**0.07**	**0.30**	**7**
Forbs																																				
N	B	*Grindelia squarrosa*	Curlycup Gumweed									9	7												3									**0.63**	**2.84**	**10**
N	P	*Heterotheca villosa*	Hairy Golden Aster									4	2												2									**0.27**	**1.20**	**10**
I	A	*Kochia scoparia*	Burningbush																									4				1		**0.17**	**0.75**	**7**
I	A	*Portulaca oleracea*	Little Hogweed				6	5	2			5			1					1	2						1		5	11				6	**1.50**	**6.73**	**37**
I	A	*Salsola tragus*	Russian Thistle							3																		2	2				1	**0.27**	**1.20**	**13**
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow		1																													**0.03**	**0.15**	**3**
Shrubs, Sub-shrubs, Cacti & Trees																																				
N	P	*Atriplex canescens*	Fourwing Saltbush	21			17											4															4	**1.40**	**6.28**	**10**
N	P	*Chyrsothamnus nauseosus*	Rabbitbrush										2				4								5	4				5	3			**0.77**	**3.44**	**20**
N	P	*Escobaria vivipara*	Spinystar																	1														**0.03**	**0.15**	**3**
N	P	*Gutierrezia microcephala*	Threadleaf Snakeweed	3	4						4						4			5	4	1	6	6	7	3	3	12			4	6	1	**2.43**	**10.91**	**53**
N	P	*Gutierrezia sarothrae*	Broom Snakeweed																				3	2				5						**0.33**	**1.49**	**10**
																																		Mean	
				Total Plant Cover	**30**	**16**	**19**	**32**	**17**	**14**	**13**	**26**	**46**	**38**	**16**	**16**	**18**	**22**	**13**	**20**	**21**	**14**	**24**	**20**	**22**	**22**	**21**	**34**	**22**	**23**	**18**	**25**	**19**	**28**	**22.30**	
				Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**0.07**	
				Litter	17	18	27	30	23	41	11	18	24	28	31	26	23	22	15	26	30	6	9	20	20	23	28	16	18	33	25	24	18	9	**21.97**	
				Bare ground	53	66	54	38	60	45	76	56	30	34	53	58	59	56	72	54	49	80	67	60	58	55	51	48	60	44	57	51	63	63	**55.67**	
#				**Total Non-Exotic Vegetative Cover**	**30**	**16**	**13**	**27**	**15**	**14**	**10**	**21**	**46**	**38**	**16**	**15**	**18**	**22**	**13**	**20**	**20**	**12**	**24**	**20**	**22**	**22**	**20**	**34**	**11**	**10**	**18**	**25**	**18**	**21**	**20.37**	
	#			**Total Perennial Cover**	**30**	**16**	**13**	**27**	**15**	**14**	**10**	**21**	**37**	**31**	**16**	**15**	**18**	**22**	**13**	**20**	**20**	**12**	**24**	**20**	**22**	**19**	**20**	**34**	**11**	**10**	**18**	**25**	**18**	**21**	**19.73**	

Sample Adequacy Calculations	Plant Cover Mean = 22.30	t= 1.31	n = 30
	Variance = 58.15		n_{min} = 20.11

Table A2 NECR - Vegetation Cover - 2012

Eastern Drainage Reference Area

Raw Data

Percent Ground Cover Based on Point-Intercept Sampling

				Transect No.——>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Average Cover	Relative Cover	Freq.
Grasses																																					
N	P	*Agropyron smithii*	Western Wheatgrass		1																													**0.03**	**0.15**	**3**
N	P	*Aristida purpurea*	Purple Three-awn																						4									**0.13**	**0.58**	**3**
N	P	*Bouteloua gracilis*	Blue Grama	22	16	13	19	17	16	23	11	8	9	15	22	16	22	21	19	9	15	26	9	23	13	22	24	15	22	17	5	20	29	**17.27**	**75.29**	**100**
N	P	*Hilaria jamesii*	Galleta						6		3	7	6	1						3													1	**0.90**	**3.92**	**23**
N	P	*Oryzopsis hymenoides*	Indian Ricegrass									2		2																				**0.13**	**0.58**	**7**
N	P	*Sitanion hystrix*	Bottlebrush Squirreltail			1																												**0.03**	**0.15**	**3**
Forbs																																				
N	P	*Astragalus tenellus*	Looseflower Milkvetch						2																									**0.07**	**0.29**	**3**
N	P	*Euphorbia brachycera*	Horned Spurge		1																													**0.03**	**0.15**	**3**
I	A	*Kochia scoparia*	Burningbush		1																													**0.03**	**0.15**	**3**
I	A	*Portulaca oleracea*	Little Hogweed			7																								5	5			**0.57**	**2.47**	**10**
I	A	*Salsola tragus*	Russian Thistle																1															**0.03**	**0.15**	**3**
Shrubs, Sub-shrubs, Cacti & Trees																																				
N	P	*Artemisia tridentata*	Big Sagebrush								3																							**0.10**	**0.44**	**3**
N	P	*Atriplex canescens*	Fourwing Saltbush			2																	1											**0.10**	**0.44**	**7**
N	P	*Chrysothamnus nauseosus*	Rabbitbrush		5				1		4	2	3						2		5				4									**0.87**	**3.78**	**27**
N	P	*Gutierrezia microcephala*	Threadleaf Snakeweed	5		1	6	3	1	4	3	1				5	3	3	5		6		1	2			5	8	2		8			**2.40**	**10.47**	**63**
N	P	*Gutierrezia sarothrae*	Broom Snakeweed						2											4														**0.20**	**0.87**	**7**
N	P	*Opuntia polyacantha*	Plains Pricklypear										1																					**0.03**	**0.15**	**3**
																																		Mean		
			Total Plant Cover	**27**	**24**	**24**	**25**	**20**	**28**	**27**	**24**	**20**	**19**	**18**	**22**	**21**	**25**	**24**	**27**	**16**	**26**	**26**	**11**	**25**	**21**	**22**	**29**	**23**	**24**	**22**	**10**	**28**	**30**	**22.93**		
			Rock	0	0	0	3	2	0	4	0	5	7	4	0	0	0	0	2	17	0	0	0	0	0	0	0	0	3	0	0	0	0	**1.57**		
			Litter	24	32	37	27	13	18	27	30	23	20	13	24	21	21	28	27	8	20	19	43	26	34	42	20	29	16	34	43	20	23	**25.40**		
			Bare ground	49	44	39	45	65	54	42	46	52	54	65	54	58	54	48	44	59	54	55	46	49	45	36	51	48	57	44	47	52	47	**50.10**		
			Total Non-Exotic Vegetative Cover	**27**	**23**	**17**	**25**	**20**	**28**	**27**	**24**	**20**	**19**	**18**	**22**	**21**	**25**	**24**	**26**	**16**	**26**	**26**	**11**	**25**	**21**	**22**	**29**	**23**	**24**	**17**	**5**	**28**	**30**	**22.30**		
			Total Perennial Cover	**27**	**23**	**17**	**25**	**20**	**28**	**27**	**24**	**20**	**19**	**18**	**22**	**21**	**25**	**24**	**26**	**16**	**26**	**26**	**11**	**25**	**21**	**22**	**29**	**23**	**24**	**17**	**5**	**28**	**30**	**22.30**		

Sample Adequacy Calculations	Plant Cover Mean = 22.93	t= 1.31	n = 30
	Variance = 22.41		n_{min} = 7.33

Table A3 Northeast Church Rock - Woody Plant Density - 2012

Eastern Drainage Baseline Area

Raw Data

Sampling Method: 2m x 50m Belt Transects

	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S	*Artemisia tridentata*																				
S	*Atriplex canescens*	12		1	6	1		15										2		2	6
S	*Chrysothamnus nauseosus*				1	2	1	1	7	2	4	7			1				1		
T	*Juniperus monosperma*																			1	1
Su	*Opuntia polyacantha*																2	1			
	Total	**12**	**0**	**1**	**7**	**3**	**1**	**16**	**7**	**2**	**4**	**7**	**0**	**0**	**1**	**0**	**2**	**3**	**1**	**3**	**7**

	Species	21	22	23	24	25	26	27	28	29	30	Total Count	Per Acre
S	*Artemisia tridentata*			1		2						**3**	**4.0**
S	*Atriplex canescens*		2				3					**50**	**67.4**
S	*Chrysothamnus nauseosus*	5			3	4	4	3	8			**54**	**72.8**
T	*Juniperus monosperma*											**2**	**2.7**
Su	*Opuntia polyacantha*	1										**4**	**5.4**
	Total	**6**	**2**	**1**	**3**	**6**	**7**	**3**	**8**	**0**	**0**	**113**	**152.4**

Sample Adequancy Calc.	t = 1.310	mean = 3.77	var. = 14.9	nmin = 180.9

Table A4 Northeast Church Rock - Woody Plant Density - 2012

Eastern Drainage Reference Area

Raw Data

Sampling Method: 2m x 50m Belt Transects

	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
S	*Artemisia tridentata*					1			1							5	2	2			
S	*Atriplex canescens*		5										1			1					2
S	*Chrysothamnus nauseosus*	3	1		3	5		1	7	10	11	3	2	4	7	3	6	5	4	3	
T	*Juniperus monosperma*										1										
Su	*Opuntia polyacantha*							1		1											
T	*Pinus edulis*				1																
	Total	**3**	**6**	**0**	**4**	**6**	**0**	**2**	**8**	**11**	**12**	**3**	**3**	**4**	**7**	**9**	**8**	**7**	**4**	**3**	**2**

	Species	21	22	23	24	25	26	27	28	29	30	Total Count	Per Acre
S	*Artemisia tridentata*											**11**	**14.8**
S	*Atriplex canescens*			1								**10**	**13.5**
S	*Chrysothamnus nauseosus*	2		2		3	10	1			2	**98**	**132.2**
T	*Juniperus monosperma*											**1**	**1.3**
Su	*Opuntia polyacantha*											**2**	**2.7**
T	*Pinus edulis*											**1**	**1.3**
	Total	**2**	**0**	**3**	**0**	**3**	**10**	**1**	**0**	**0**	**2**	**123**	**165.9**

Sample Adequancy Calc. **t = 1.310** **mean = 4.10** **var. = 12.4** **nmin = 126.4**

Table A5 Northeast Church Rock - Vegetation Production - 2012

Eastern Drainage Baseline Area

Raw Data

Oven Dry Weight (grams per 0.5 square meter)

Sample No.	Grasses			Forbs			Sub-shrubs	Shrubs	Noxious Weeds	PERENNIAL		TOTAL	
	Perennial		Annual	Perennial		Annual / Biennial				grams / 0.5 m^2	lbs./ac.	grams / 0.5 m^2	lbs./ac.
	Native	Intro-duced		Native	Intro-duced								
1	1.5					0.9	2.2			3.7	**66.0**	4.6	**82.1**
2	1.5			0.1				1.3		2.9	**51.7**	2.9	**51.7**
3	0.4					0.3	2.2			2.6	**46.4**	2.9	**51.7**
4	0.1					0.3		2.9		3.0	**53.5**	3.3	**58.9**
5	6.0					0.7				6.0	**107.1**	6.7	**119.6**
6	7.2					0.1				7.2	**128.5**	7.3	**130.3**
7	2.4					0.1				2.4	**42.8**	2.5	**44.6**
8	3.6			0.6		1.5				4.2	**74.9**	5.7	**101.7**
9	7.8			13.6		2.5	0.6			22.0	**392.6**	24.5	**437.2**
10	4.1			0.3		4.9		0.2		4.6	**82.1**	9.5	**169.5**
11	2.1							0.6		2.7	**48.2**	2.7	**48.2**
12	6.1					0.8				6.1	**108.8**	6.9	**123.1**
13	3.3					0.1	1.1			4.4	**78.5**	4.5	**80.3**
14	2.0							8.5		10.5	**187.4**	10.5	**187.4**
15	1.2			0.6			2.2			4.0	**71.4**	4.0	**71.4**
16	1.2			0.3		0.1	4.9			6.4	**114.2**	6.5	**116.0**
17	1.3			1.6		0.3	1.6			4.5	**80.3**	4.8	**85.6**
18	1.8			0.5		0.2				2.3	**41.0**	2.5	**44.6**
19	2.2						2.2			4.4	**78.5**	4.4	**78.5**
20	0.9					0.2	2.0			2.9	**51.7**	3.1	**55.3**
21	1.8					0.1	1.0			2.8	**50.0**	2.9	**51.7**
22	4.6						2.4			7.0	**124.9**	7.0	**124.9**
23	4.3			11.6		0.4	0.4	0.6		16.9	**301.6**	17.3	**308.7**
24	3.3						7.4			10.7	**190.9**	10.7	**190.9**
25	3.0					4.7				3.0	**53.5**	7.7	**137.4**
26	1.8					5.4				1.8	**32.1**	7.2	**128.5**
27	2.2					0.1	0.2			2.4	**42.8**	2.5	**44.6**
28	7.4						2.8	3.9		14.1	**251.6**	14.1	**251.6**
29	0.4					0.6	2.8			3.2	**57.1**	3.8	**67.8**
30	1.5					2.2	1.5			3.0	**53.5**	5.2	**92.8**
Average	**2.9**	**0.0**	**0.0**	**1.0**	**0.0**	**0.9**	**1.3**	**0.6**	**0.0**	**5.7**	**102.1**	**6.6**	**117.9**

Sampling Adequacy	**t = 1.311**	**Variance = 7659.1**	**n= 30**
	Mean = 117.9		**n_{min} = 94.787**

Table A6 Northeast Church Rock - Vegetation Production - 2012

Eastern Drainage Reference Area

Raw Data

Oven Dry Weight (grams per 0.5 square meter)

Sample No.	Grasses			Forbs			Sub-shrubs	Shrubs	Noxious Weeds	PERENNIAL		TOTAL	
	Perennial		Annual	Perennial		Annual / Biennial				grams / 0.5 m^2	lbs./ac.	grams / 0.5 m^2	lbs./ac.
	Native	Introduced		Native	Introduced								
1	3.6						2.7			6.3	**112.4**	6.3	**112.4**
2	4.6									4.6	**82.1**	4.6	**82.1**
3	4.2						2.5			6.7	**119.6**	6.7	**119.6**
4	0.2					8.4				0.2	**3.6**	8.6	**153.5**
5	18.6									18.6	**331.9**	18.6	**331.9**
6	1.2					1.1	4.4			5.6	**99.9**	6.7	**119.6**
7	7.9						4.3			12.2	**217.7**	12.2	**217.7**
8	2.1			0.2			2.6			4.9	**87.4**	4.9	**87.4**
9	7.6			0.1			3.1			10.8	**192.7**	10.8	**192.7**
10	8.8			0.6				8.5		17.9	**319.4**	17.9	**319.4**
11	7.4									7.4	**132.0**	7.4	**132.0**
12	4.9						3.0	8.9		16.8	**299.8**	16.8	**299.8**
13	15.3			0.5			2.0			17.8	**317.6**	17.8	**317.6**
14	1.1						10.2			11.3	**201.6**	11.3	**201.6**
15	9.6			0.7			6.5			16.8	**299.8**	16.8	**299.8**
16	5.0									5.0	**89.2**	5.0	**89.2**
17	5.9						0.6	5.0		11.5	**205.2**	11.5	**205.2**
18	2.1									2.1	**37.5**	2.1	**37.5**
19	4.5						8.3			12.8	**228.4**	12.8	**228.4**
20	1.5						0.8	10.3		12.6	**224.8**	12.6	**224.8**
21	1.7						15.7			17.4	**310.5**	17.4	**310.5**
22	0.8						9.5	2.1		12.4	**221.3**	12.4	**221.3**
23	4.4									4.4	**78.5**	4.4	**78.5**
24	3.9					1.2				3.9	**69.6**	5.1	**91.0**
25	2.5					0.8				2.5	**44.6**	3.3	**58.9**
26	2.0									2.0	**35.7**	2.0	**35.7**
27	2.7					0.2	3.1			5.8	**103.5**	6.0	**107.1**
28	10.9									10.9	**194.5**	10.9	**194.5**
29	3.6									3.6	**64.2**	3.6	**64.2**
30	2.6									2.6	**46.4**	2.6	**46.4**
Average	**5.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.4**	**2.6**	**1.2**	**0.0**	**8.9**	**159.0**	**9.3**	**166.0**

Sampling Adequacy			
	t = 1.311	**Variance = 9038.2**	**n= 30**
	Mean = 166.0		**n_{min} = 56.408**