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Nestle Project Application Review: Potential Impacts of the Nestle Project to Natural Resources in the Area

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Please note that all highlighting and underlining are by a Chaffee County resident for informational purposes

I accepted the task to assess validity of the analysis given in the Nestle Water North America (Nwana) report and whether or not the analysis and report fully addresses the requirements in Chaffee County's 1041 Regulations.

I. Summary of Comments

A. This report is based on the results of the analysis presented by the applicant. The hydrological review and methodology are being completed by others. If the hydrology review results in a change to the data, this report may require revision. When the withdrawal project is viewed in the context of the entire hydrogeological system including the impacts of a changing climate, Nwana's conclusions, regarding sustainability of the proposed pumping rates and no negative impact to the aquifer, springs or stream flows and associated wetland vegetation, may not be supported.

B. Terrestrial and aquatic animals and habitat: Nwana conclusions, regarding no impact to wildlife and their habitat are not supported by the evidence. Nwana data has not considered the entire documented native wildlife community. Although Colorado Division Of Wildlife's (CDOW) analysis regarding no impact to elk, mule deer, bighorn and non-game mammal species are supported by existing data, other wildlife species documented to occur in the area were not included in the report. Several State Listed Bird Species of Concern have been recently reported in nearby, comparable habitat and could potentially use the Site area for breeding or foraging habitat, were not considered in the Nwana proposal.

Wetland habitats in arid ecosystems are especially critical to both upland and wetland wildlife species and wetland alteration or loss could impact species' survivability.

C. Terrestrial and aquatic plant life: When the Site is viewed in the context of the overall ecological system, including climate and surrounding geology, Nwana's conclusions, regarding "no detrimental impact" to wetland communities, are not supported.

Nwana project calculations of the percent drawdown is predicated on current aquifer recharge and spring flow characteristics – current climate trends, as documented by the Intergovernmental Panel on Climate Change (IPCC) (Ray et al, 2008), clearly show a decline in runoff with correspondingly reduced stream

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flows and aquifer recharge. Thus the percentage of drawdown from pumping will likely increase in a warming climate scenario, and thereby increases the potential for aquifer dewatering and related impacts to wetland habitat.

II. Specific Comments

A. Floodplains, wetlands and riparian areas.

Numerous small wetlands emerge on the alluvial outwash terrace at the interface between the Mosquito Range (Arkansas Hills) and the Arkansas River. These wetlands are uniquely located and are a stark contrast between xeric upland and surrounding valley floor habitat. As such they are an important component of the natural history of Chaffee County and provide potentially critical habitat for a diversity of native wildlife.

1. As reported in the NRNA project proposal, the amount of available water in the aquifer at the site is approximately 12,488 acre-feet. The proposed withdrawal would be approximately equivalent to 1.6% of the available amount of water and would be equal to 1.4% to 2.1% of the average annual recharge to the aquifer (Appendix I, Groundwater Investigation, Section 2 and Executive Summary).

a. The cumulative amount withdrawn from the aquifer is a critical factor in determining impacts on native ecosystems. Within the 890-acre site area, NRNA has identified 7 wells and 30 users that may be withdrawing from the site aquifer (Appendix I, Groundwater Executive Summary, Section 9). Although the proposed amount to be withdrawn by NRNA may not by itself negatively impact the aquifer, the cumulative withdrawal may exceed the sustainability of the aquifer thereby impacting wetland ecosystems that the aquifer supports.

b. Additionally, agricultural and domestic withdrawals are mostly return flows to the stream and do not ultimately deficit the system whereas none of the NRNA project withdrawal is returned and contributes to a water deficit.

2. NRNA indicates that withdrawals would not exceed 10% of average total spring/seep flow (Final Application text Page 5) and that the total water to be extracted annually would be approximately 200 acre-feet (= 124 gpm). A key consideration is whether or not the NRNA withdrawal would be adjusted to actual flow rates or if the proposed withdrawals would be keyed to a long-term average flow rate.

a. In a drought situation, spring/seep flows could be much less than average and the NRNA drawdown of 124 gpm could then actually be much greater than 10%.

b. Seasonal variation in spring/seep flows is dramatic (Final Application, Figure 1) and year-to-year variation can also be highly variable

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(Groundwater Executive Summary, section 5), so that again, a drawdown of 124 gpm could effectively be much greater than 10%.

c. NWNA states that seasonal withdrawal amounts may vary upon demand with higher demand occurring in summer months compared to winter months when demand is lower (Appendix H, Surface water investigation, section 1); and that although the total average yearly withdrawal will not exceed 124 gpm during peak demand, withdrawal could increase to 170 gpm during “demand” season.

Pumping tests demonstrated that a withdrawal of 170 gpm from the Ruby Mountain site during the May low-flow season is currently sustainable (Phase I, Hydrogeological report, p. 4-10) and that a portion of the withdrawal is to come from the Bighorn site (Appendix H, Surface Water Investigation, section 1). However, increased demand-based withdrawals would occur at a time of the year when flows are actually near a seasonal low or are recovering (Final Application, figure 1). So that withdrawal percent could actually increase substantially during “demand” season if NWNA projected spring/seep flows are less than average.

In my opinion test pumping data indicates that there is the potential for substantial dewatering of the aquifer with a commensurate reduction in spring/seep flows in an extended drought and/or reduced recharge scenario. Hydrogeological data indicate that at just slightly higher pumping rates the aquifer (upper portion of the screened interval) could potentially become dewatered under a 180-day no-recharge scenario (Phase I, Hydrogeological report, p. 4-10). In such a dewatering scenario impacts to wetland vegetation and habitat would likely be negative and significant.

d. As identified by NWNA, a high degree of fluctuation in seasonal flow rates characterizes spring/seep flow (Final application, Page 6, Figure 1) which, in my opinion, indicates that the alluvium at the spring sites is thinner and that spring/seep flows are closely tied to recharge at the surface. Indeed, in the area where the springs are located, the NWNA groundwater report (section 2) describes a narrowing of the Site due to an outcrop of rhyolite and a thinning of the aquifer due to the Site being underlain by rhyolite. The hydrogeologic report identifies recharge as primarily by infiltration of stream flows from side creeks and by direct precipitation (Phase I, Hydrogeologic report p 1-1,1-2).

Characteristics of the aquifer create a situation in which the aquifer is especially sensitive and responds rapidly to changes in streamflow and precipitation. Streamflows are also highly variable due to geologic characteristics. The surrounding bedrock uplands have less storage capacity, which confers less system resiliency and results in more

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fluctuation in the overall hydrologic system; flashy upland stream flows quickly run off and are not stored in surrounding soils where they would otherwise supply a more steady discharge to maintain more consistent stream flows.

~~Due to these watershed characteristics, drawdowns during even short-term drought situations, in my opinion, may put the aquifer and springs/seeps at significant risk.~~

Additionally, the adjacent Mosquito range and the upper Arkansas valley, of which the Ruby Mountain and Big Horn springs sites are part, is naturally arid due to a rain-shadow effect. Wetland and riparian habitats in this arid ecosystem are unique and especially valuable to wildlife. Due to geologic and climatic characteristics these springs, seeps and riparian areas are also especially sensitive and less resilient to hydrologic alteration. Low-flow/dry season conditions are an especially critical time of year to the survivability of natural communities and wetland ecosystems. Drawdowns that exacerbate already low-flow environmental conditions may stress the community and its inhabitants beyond the capacity for recovery and survivability.

3. Global Climate Change

NWNA indicates that aquifer recharge comes from three primary sources, direct precipitation, infiltration from drainage runoff (especially Trout Creek and Arnold Gulch) and infiltration from irrigation return flows (Appendix I, Groundwater Executive Summary, Section 3). NWNA project data indicate that spring/seep discharge quantity is heavily dependent on sustained recharge to the aquifer: they calculate that their withdrawal of 200 acre-feet/year would be equal to 1.4% -2.1% of estimated annual recharge in a normal year and as much as 5.5% in a drought year *assuming precipitation and irrigation are similar to the past 10 years* (Appendix I, Groundwater Executive Summary, section 3 and 11).

Data from the IPCC (Ray et al, 2008) clearly show that our Colorado climate will not be the same as it has been in the past ten years. Climate trends in the upper Arkansas River valley show a clear and dramatic temperature increase. Climate trends are toward warmer winters and springs with snowmelt occurring 5 to 14 days earlier in the West, including the Arkansas River basin (USGS, 2008).

Because climate, precipitation and streamflows are linked, consideration of Colorado's changing climate is essential to any decisions regarding allocation of water resources. In the upper Arkansas River basin since 1945 there been a clear, statistically significant trend toward earlier streamflow, which is attributed to winter and spring warming (USGS,

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2008). The report from the USGS (2008) also states that if trends continue many mountain landscapes will endure increasingly severe summer-drought conditions.

Climate change predictions for Colorado from the IPCC (Ray et al, 2008) indicate that precipitation patterns and corresponding infiltration, recharge and discharge patterns and seasonal stream flow rate patterns will also change. Their primary conclusions based on IPCC data are: 1)

Temperatures are increasing and will continue to increase; 2) there is uncertainty with regard to precipitation projections; 3) Even with no change in precipitation, temperature increases alone will lead to a decline in runoff for most of Colorado's river basins by the mid 21st century; 4) Synthesis of findings suggests a reduction in total water availability by the mid 21st century; and that 5) a warming climate increases the risk to Colorado's water supply even if precipitation remains at historical levels.

Climate models project Colorado will warm by 2.5°F by 2025, relative to the 1950–99 baseline, and 4°F by 2050. The projections show summers warming more (+5°F) than winters (+3°F) and suggest that typical summer temperatures in 2050 will be as warm as or warmer than the hottest 10% of summers that occurred between 1950 and 1999; from 1957 to 2006 the average year-round temperatures in the upper Arkansas River basin have increased by 2° F (Ray et al, 2008).

4. Spring/aquifer connection. Nwana hydrogeologic research documents a direct physical connection between the springs that supply water to the wetlands and the underlying aquifer (Phase I, Hydrogeologic report, p. 4-4, 5-2, and 6-3); both the Ruby Mountain and Bighorn Springs showed a clear response to pumping. Their observations suggested to them that the host aquifer for Ruby Mountain and Bighorn Springs is the alluvial-outwash aquifer (Phase I, Hydrogeologic report, p. 5-2).

a. Nwana research documents that the aquifer, from which these springs emanate, is primarily recharged by infiltration of stream flow from side creeks as they spill onto the valley floor and that these streams are sourced from bedrock uplands and mountains (Phase I, Hydrogeologic report, pp. 1-1, 1-2, and 2-2). Additionally, their report indicates that direct precipitation, including snowmelt, as well as irrigation return flows are also important sources of aquifer recharge (Phase I, Hydrogeologic Report, p. 5-2).

Climate trends will alter stream flows and aquifer recharge rendering predictions about pumping sustainability unsupported and inconclusive.

b. Shallow alluvial aquifers, such as this one, transmit a reduction in groundwater levels quickly with a result that can include cessation of

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spring flows: when Trout Creek was dammed recharge to the aquifer was diminished and spring discharge on the Hagen property on the valley floor was significantly reduced or in some locations ceased (Phase 1 Hydrogeologic report, p. 2-3). As indicated by the NRNA report, this condition was likely exacerbated by the existing drought.

The watershed that supplies the streams and aquifer is relatively small and in the Site area the aquifer is relatively shallow (Appendix I, Groundwater Executive Summary, section 2). Additionally, the watershed's geologic characteristics result in rapid runoff and reduced storage in surface soils. **In my assessment these factors indicate that the stream and associated wetland and riparian systems are less resilient to environmental changes and less able to moderate perturbations.** Geologic characteristic of the watershed result in stream flows that are highly responsive to precipitation events – with little storage capacity to absorb flows and discharge energy that would otherwise moderate flow fluctuations.

Viewed as a system the Site is highly sensitive to changes in the flow regime. Even small drawdowns could dewater the aquifer in times of extended drought.

B. Terrestrial and Aquatic Animals and Habitat

Wetland habitats are necessary for the survival of a disproportionately high percentage of wildlife species in the Rocky Mountain West. Although only 3 % of Colorado's landscape are wetland habitats approximately 40% of plant species, 75% of the birds and 80% of mammals live in or migrate through these areas (Huggins, 2004). **NRNA's proposal has not taken into consideration the several documented species of special concern that occur in adjacent and comparable upland and wetland habitats.** Although no federally listed species have been observed, with the exception of the Gunnison's prairie dog (*Cynomys gunnisoni*) which is being considered for listing, numerous 'ranked' species have been recently observed in nearby areas with similar habitat and resources. Species 'ranking' indicates that populations are at risk, primarily because of habitat loss or alteration, rarity or degree of imperilment. Thus their occurrence indicates the presence of habitat that is essential to survivability. **This remaining habitat is especially valuable and essential to the long-term survivability of those ranked species.**

Upland habitat. Active Gunnison prairie dog (GUPD) colonies are documented by the Colorado Division of Wildlife (CDOW) in Chaffee County near Nathrop on both sides of the Arkansas River and directly adjacent to the proposed NRNA pipeline route (Figures 1 and 2) (CDOW 2009). As corroborated by the NRNA report (Terrestrial and aquatic species and habitat appendix, p.3), two active GUPD colonies are present immediately adjacent to the proposed pipeline route. The colonies are located in upland habitat east of the Bighorn Springs wetland site. (Figure 1).

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In central Colorado, GUPDs inhabit mountain parks at sites ranging in elevation from 5,997 – 11,998 feet (CDOW 2008). In these high elevation sites GUPDs occupy grasslands and mesic shrublands on open, flat to gently rolling terrain with deep, well-drained soils for burrow development (Fitzgerald et al. 1994, CDOW, 2009)). GUPD diet consists mostly of grasses but forage requirements vary with the season and they switch among plant species as they become available during the growing season; sagebrush is browsed during early spring, forbs in the summer as they become available and finally grasses, sedges and rushes are consumed as they ripen in the late summer (Fitzgerald et al. 1994 and Seglund et al. 2005).

GUPDs play an essential role in maintaining ecosystem integrity. Prairie dog burrowing activity creates an oasis of species diversity that has resulted in their being considered keystone species. Burrowing activity creates an ecosystem that favors plant diversity and promotes the growth of perennial grasses and forbs favored by livestock and native ungulates; their burrows are refugia for numerous small mammals, burrowing owls and reptiles and amphibians; they are an important prey for predators such as eagles and hawks; and their burrowing activity enriches primary productivity, soil structure and soil chemistry (Miller et al. 1996, CDOW 2009).

Vegetation, soil and topographic characteristics on upland portions of the NWNA property provide the habitat conditions necessary for GUPDs. Upland vegetation, as described in the NWNA vegetation report (Appendix M, pg. 2 and 5) consists of grassland and shrubland/forestland types; grasslands primarily consist of herbaceous species such as blue grama (*Bouteloua gracilis*) and wheatgrass (*Agropyron spp.*) and several woody and cacti species including rabbitbrush (*Chrysothamnus nauseosus*) and prickly pear (*Opuntia polyacantha*).

GUPD colonies throughout the Basin are fragmented (CDOW 2009, USFWS, 2009). Fragmentation and isolation puts prairie dogs at higher risk of extinction and disrupts the function of the entire system putting both the prairie dog and associated species at risk (Miller et al 1996, CDOW 2009, USFWS 2009). Possible direct adverse impacts to prairie dogs associated with pipeline development include 1) clearing and crushing of vegetation; 2) reduction in available habitat; 3) fragmentation of available habitat; 4) prairie dog displacement and mortality; 5) increased soil compaction; and 6) increased exposure to shooting-induced mortality.

Gunnison's prairie dog is being considered for Federal listing and Prairie dog burrowing activity provides essential habitat for numerous wildlife species including the burrowing owl (*Athene cunicularia*), which is listed by the CDOW as a State threatened species. Although burrowing owls have not been observed in Chaffee county, suitable habitat is present near the Site at the GUPD colonies and they have been recently observed in Gunnison County in comparable habitat and at comparable elevation (Jason Beason, 2009). Although the NWNA assessment suggests that the probability of the occurrence of burrowing owls is low (Terrestrial and aquatic species and habitat report, p. 5), their recent sighting in Gunnison County in combination with the presence of active prairie dog colonies suggests that burrowing owls may indeed be present in Chaffee County at

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GUPD colonies. Any activity that impacts prairie dogs, upon which owls are totally dependent for burrows, also has a negative impact on burrowing owls PIF, 2009).

If Chaffee County approves this project I would recommend that the County consider requiring prairie dog conservation measures such as those identified by the BLM in their Vernal Draft Management Plan available at http://www.blm.gov/ut/st/en/fo/vernal/planning/rmp/draft_rmp_eis/draft_rmp_eis.html. Additional management recommendations follow in III. B.

Wetland and adjacent upland habitat. Numerous bird species have been observed in the area in close proximity to the Site that were not included in the bird list submitted by NWNA (Terrestrial and Aquatic species and habitat, Table 1). Although none of these observed birds are currently federally listed (peregrine falcon was removed from the federal register but is now a State listed species of special concern) many are tracked as species of special concern and some of these have been documented as breeding. Tracked birds recently observed near the NWNA Site include; peregrine falcon observed near Nathrop and possibly nesting; loggerhead shrike (Partners in Flight ranking) and juniper titmouse (USFS ranking) observed on the West side of the Arkansas River near the confluence with Dry Creek; Brewer's sparrow (Audubon, PIF and USFS ranking) possibly nesting and northern pygmy owl (CNHP watchlist) both observed on the western side of the base of Ruby Mountain, Virginia's warbler (Audubon ranking) confirmed nesting and pygmy nuthatch (USFS ranking) both observed near Nathrop, and cordilleran flycatcher (PIF ranking) in riparian habitat on the Arkansas near Buena Vista. Species accounts are from Colorado Natural Heritage Program, Rocky Mountain Bird Observatory and Colorado Breeding Bird Atlas 2008 and 2009 data records.

Numerous other non-tracked bird species have also been observed in nearby, comparable habitat. Although these species are not tracked they are, nonetheless, an important part of the natural history of Chaffee County and many of these species are indicators of habitat condition. In my experience the following bird species are typical in the surrounding landscape and are important indicator species. A casual count of (non-tracked) bird species observed in 2008 included; near Ruby Mountain at the Arkansas River gray flycatcher, green-tailed towhee, black-throated gray warbler, cedar waxwing, Townsend's solitaire, bush tit and western wood-peewee; at Dry Creek and the Arkansas River western tanager and fox sparrow; further upstream near Buena Vista in riparian habitat on the Arkansas River Wilson's warbler and blue-gray gnatcatcher; and upstream of Buena Vista in riparian habitat near the confluence of 4-mile Creek and the Arkansas black-headed grosbeak, gray catbird, spotted towhee, and song sparrow.

Bird species can also be especially good indicators of wetland function. The quality and function of riparian habitat is in large part determined by vegetation characteristics. Breeding birds select nesting habitat based on a suite of environmental variables including the quality, quantity and structure of vegetation. Bird surveys conducted by NWNA were inadequate to provide either a basic census of the breeding bird community or to give any indication of habitat function.

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Historical accounts of bird species near Salida include Colorado rare species such as Golden-crowned night heron and Willow flycatcher (Warren, 1910) and numerous other ranked species that were then common including loggerhead shrike and MacGillivray's warbler. Habitat loss is the major cause for the decline of species. Wherever a sufficient amount of suitable habitat exists there is the potential for the occurrence of these species.

C. Terrestrial and Aquatic Plant Life.

Wetland habitat and vegetation wholly depends on a sufficient and reliable water source. As identified in the NRNA proposal a clear and direct connection exists between the aquifer and both the Ruby Mountain and Bighorn springs/seeps and supports Site wetlands. Hydrology is probably the single most important determinant of the establishment and maintenance of wetlands and even small changes in hydrology can result in significant biotic changes (Mitsch and Gosselink, 2000). Drawdowns as proposed by the NRNA project will reduce flows and may alter wetland hydroperiod. Climate change-induced reductions in runoff, streamflow and aquifer recharge may then actually increase the percent of withdrawal.

Maintenance of wetland function and structure are dependent on hydrologic conditions, which affects species composition and richness, primary productivity, organic accumulation and nutrient cycling in wetlands (Mitsch and Gosselink, 2000). The water source that sustains both palustrine and riparian wetlands at the Site are the springs and the underlying aquifer.

1. Palustrine wetlands. Generally speaking palustrine wetlands are non-tidal wetlands that are supported by shallow groundwater discharge; all of the wetlands in the project area are in this category. Riparian wetlands are those palustrine wetlands adjacent to a flowing body of water that are, at least periodically, influenced by flooding; riparian wetlands in this project are riverine wetlands in terms of their water source but are also very likely supported by ground water discharge and so dependent on both river flooding and shallow groundwater discharge. NRNA describes two "low-quality" palustrine wetlands at the Ruby Mountain Site, and at the Bighorn site one high-quality wetland, 12 moderate-quality and three low-quality wetlands: They go on to say that heavy grazing has modified and is responsible for reducing wetland quality (Appendix M, Wetland/riparian areas, p. 3) and provide a list of wetland communities and dominant plant species in table 1 (Appendix M, Final wetlands table). The wetland report also states that from information provided by several agencies, populations of Federally listed species or their habitat are not known to occur in the study area (Appendix M, Final wetlands, p. 6).

a. In my opinion wetland "quality" is best assessed by first identifying a natural wetland that is functioning at potential and that is located in a similar environmental setting that can be used as a baseline criterion. This wetland can then be used as a yardstick with which to compare other wetlands. Quality is then based on whether or not the wetland is functioning at potential.

b. My personal bias is that there are no low-quality wetlands, rather wetlands that are functioning at potential or those that are not. Frequently

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functioning below potential is a result of unsustainable management practices. Wetland function can often be restored with the cessation of unsustainable management practices if there is a sufficient and reliable water source with a natural hydroperiod.

c. In my estimation documentation given in the NRNA report does not provide sufficiently detailed information over an adequate period of time to make a determination as to whether or not the Site wetlands are functioning at potential, particularly at the Bighorn Springs area; however, the Ruby site has been severely altered by human development which has clearly diminished wetland function and potential. Wetland hydroperiod is a key determinant of wetland function while vegetation and wildlife community composition and structure are key indicators of function. Baseline data regarding these characteristics is essential to making a determination regarding wetland function. Neither has been sufficiently assessed to enable a determination regarding sustainability of the proposed drawdown.

d. Vegetation surveys were conducted throughout Chaffee County in 2008 by the CNHP. Although the NRNA project site was not included in the CNHP survey, other nearby, comparable habitats were surveyed.

Although no federally listed species or communities were observed by CNHP, tracked plant communities were documented. These communities were often structurally complex with a species-rich plant community that supported a rich and abundant bird community. Additionally the Colorado natural Areas Program has documented the occurrence of a tracked plant species in nearby upland habitat comparable to upland habitat at the Site.

2. Impacts to Palustrine Wetlands. Source water for palustrine wetland habitat is identified primarily as subsurface and ephemeral flows (Appendix M, Executive summary, p. 4), which the hydrogeological and groundwater reports tie to the underlying aquifer. At the Bighorn site potential impacts to wetlands from pumping are identified as a decrease in size or loss of three "low-quality" wetlands within close proximity of the well (#s 3,4 and 5), and also that the margins of one moderate quality (#6) and one high-quality wetland (#2) may be affected by drawdown (Appendix M, Executive summary pp. 3,4,5). Additionally, the report states that "these wetlands may decrease in size or transition into upland vegetation ...if a substantial amount of subsurface water flow is affected by drawdown" (Appendix M, p. 4). NRNA is proposing a monitoring plan to assess the potential impacts of pumping at the Bighorn site, although they also state that the majority of wetland #2 is not likely to be affected by withdrawals (Appendix M, Executive summary, p. 4)

a. NRNA reports have indicated that maximum withdrawals would be a relatively small percentage of total available spring/seep flows and that NRNA maximum withdrawals would occur during summer months. Summer is a season of the year when water is critical to vegetation maintenance and growth and to the wildlife that depends on wetland

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resources for breeding, foraging and cover. Summer is also the season of the year that is likely to be most affected by climate change with warming-induced reduction in aquifer recharge and spring/seep flows reduced.

b. Nwana's conclusion that the majority of wetland # 2 is "not likely to be affected by withdrawals" may not be valid. When viewed in the context of the entire system, drawdown impacts to the wetland may be greater than suggested. The underlying aquifer is relatively shallow in this location and water storage is thus reduced. Also, due to surrounding geology in combination with the local climatic rain-shadow conditions aquifer recharge is highly variable and tenuous. Consequently the system has reduced reserves and is less resilient and thus more susceptible to degradation by even small flow alteration. Even short-lived alterations in stream flows that recharge the aquifer have been shown to produce dramatic changes in spring/seep flows as evidenced by the temporary cessation of spring/seep flows corresponding to the damming of Trout Creek and filling of the reservoir. Longer term drawdowns may have an even greater impact and ultimately alter wetland vegetation and function.

Additionally, given the documented trend toward climate warming in the Arkansas River valley and throughout the West with corresponding changes in aquifer recharge and spring/seep flows, actual withdrawal percentage may be much greater than anticipated.

c. Proposed withdrawals will also affect the wetland natural hydroperiod which can affect wetland stability. Wetland hydroperiod is the wetlands' signature – the seasonal pattern of the water level of a wetland and is an integration of the inflows and outflows of water, surrounding topography and soil and groundwater condition. (Mitsch and Gosselink, 2000).

d. The report states that wetlands 3,4, and 5 may be affected by drawdown and then states that they are "low quality" and have been heavily grazed (appendix M). Even "low-quality" wetlands can recover and sustain biota but for correctable habitat conditions. In the case of the "low-quality" wetlands sustainable grazing practices in combination with sufficient and reliable water sources with a natural hydroperiod would likely restore these sites to a more functional condition.

e. From the Nwana wetland report the areal extent of proposed monitoring is not clear. Will monitoring be conducted on only wetland 2 or will monitoring include all wetlands in the Site area? Vegetation composition and structure is a key determinant of habitat quality. Will monitoring include a thorough vegetation assessment beginning with baseline conditions?

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f. In my view, monitoring should be an integral aspect of the project. Monitoring should use a landscape focus and begin with establishing wetland potential by first identifying reference wetlands in similar environments that are functioning at potential and then using these as a yardstick by which to compare other wetlands. The reference wetland can also be used to set goals for mitigation. Specifically a monitoring plan should be structured for adaptive management and include:

- 1) Identification of reference wetlands
- 2) Determination of the normal hydroperiod in the reference and site wetlands.
- 3) Establishment of vegetation monitoring plots to quantitatively measure in detail vegetation cover, structure and species composition.
- 4) Establishment and conduction of breeding bird censuses during appropriate times of the year using point-count surveys and nest searches.
- 5) Ongoing collection and synthesis of data to determine and mitigate any impacts to the wetland system.

3. Impacts to riparian wetlands. Riparian wetlands have been identified along the Arkansas River, Bighorn channel, Arnold Gulch, and the Hatchery ditch. The wetland report (Appendix M, p. 5) suggests that riparian areas in the Bighorn Springs and Arnold Gulch area would not be affected by drawdown since willows have deep roots and subsurface and surface flows would not be substantially affected by drawdown; and that riparian vegetation along the Arkansas would not be affected by drawdown since associated vegetation is supported by water from the river. NWNA reports also indicate that drawdowns would reduce flows in the Bighorn springs channel by 8% to 16% and would reduce the wetted width of the channel by 6% to 10% (Surface water executive summary p. 10).

Riparian vegetation relies on flowing water for moisture and nutrients and also to remove metabolic waste. Reducing flows in the spring channels and the amount of the channel that is filled with water would diminish both out-of-bank flows and associated functions and may well impact wetland vegetation and habitat. With regard to riparian vegetation along the Arkansas River: the groundwater report (p.7) suggests that a considerable amount of groundwater likely discharges directly into the Arkansas where the aquifer is incised by the river. In my opinion, riparian vegetation along this stretch of river, similar to other reaches in the area, may be dependent on both water from the river (during high flow season) and shallow groundwater discharge (during low flow season) for sufficient year-round moisture. Reduction in either may negatively impact riparian vegetation.

4. Floodplain vegetation and impacts to terrestrial and aquatic plant life. According to the NWNA wetland report (Appendix M, p. 6) populations of federally listed species or the potential habitat are not known to occur in the study area. However, surveys by CNHP and Colorado Natural Areas Program have identified tracked plant communities in nearby comparable upland and wetland

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habitat. (Brian Kurzel, 2009).

III. Management Recommendations

A. Wetland management recommendations

1. Reduce and manage grazing pressure; depending on vegetation assessment some limited grazing may be desirable for maintenance of certain plant communities.
2. Determine natural hydroperiod and baseline conditions: Monitor water level in reference and Site wetlands throughout the year.
3. Maintain sufficient groundwater flow to wetlands.
4. Eradicate/manage noxious weeds and non-native plant species.
5. Revegetate with native plant species using the reference wetlands as models of natural species diversity.
6. Locate any recreational trails away from and out of wetland and riparian zones; establish and harden specific fishing ingress/egress trails; install educational signage.

B. Gunnison prairie dog habitat management (Adapted from the Prairie Dog Coalition, 2009)

1. Inventory prairie dog habitat on a regular basis; include vegetation, bird and mammal surveys.
2. Ensure that development does not fragment prairie dog habitat or leave it in isolated condition.
3. Impose restrictions on the shooting, poisoning and bulldozing of prairie dogs
4. Utilize non-lethal methods of managing prairie dogs on public lands, and require landowners to utilize non-lethal methods, such as properly installed vinyl and metal barriers or native vegetation deterrents to prevent prairie dog colonization of their land.
5. Require developers to design their projects in a way that will preserve prairie dog colonies on their land. On-site mitigation should be a priority.
6. Educate the public regarding the prairie dog's positive influence on its environment.

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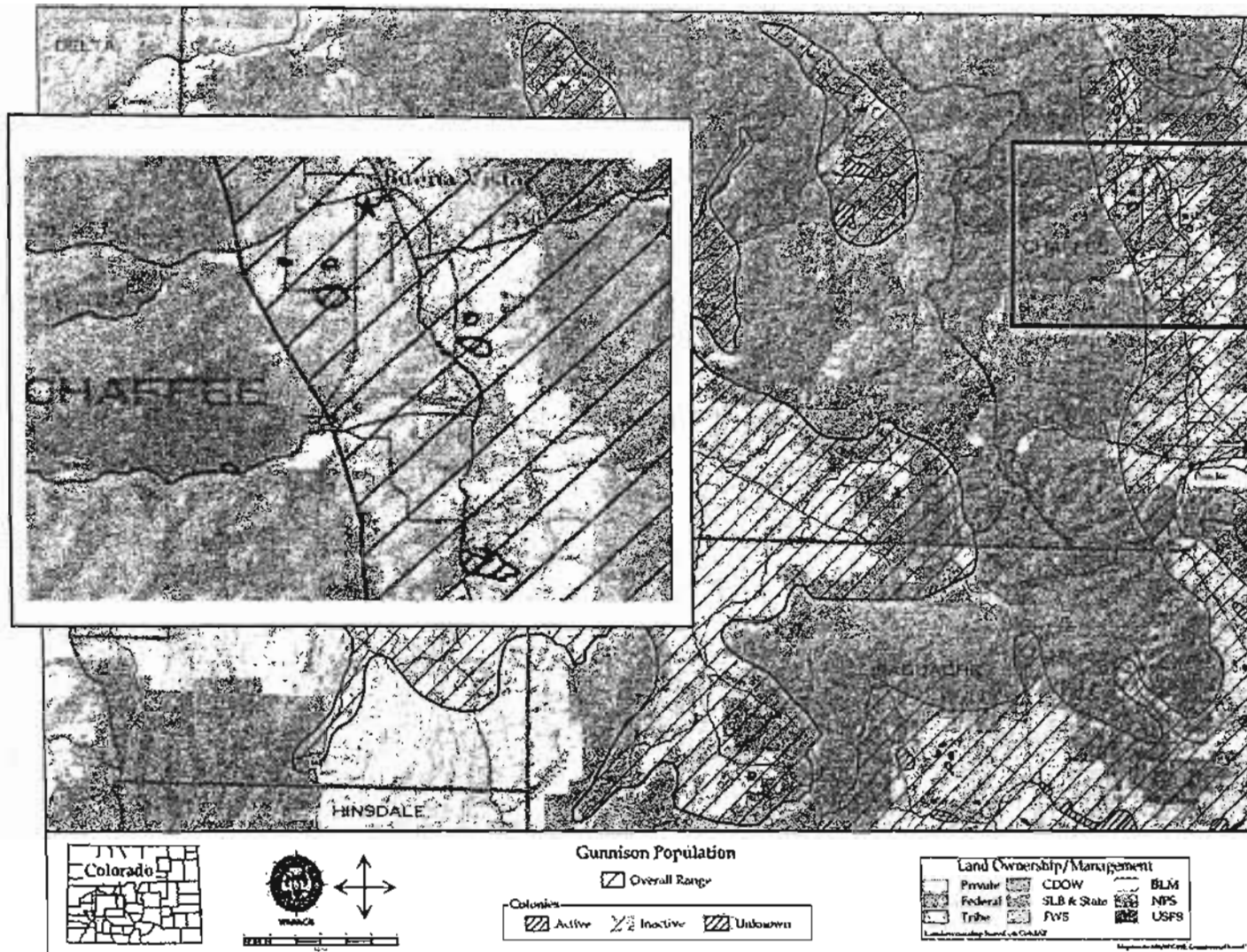


Figure 1: GUPD Distribution in Central Colorado; Inset shows location of colonies at NWNA site (CDOW, 2009)