Management Area and Conservation Measure Recommendations for *Eriogonum ovalifolium* var. *williamsiae*, Steamboat buckwheat

Cover photo: *Eriogonum ovalifolium* var. *williamsiae* in flower. Steamboat Hills, Washoe Co., NV. Photo: J. McClinton, NDNH. May 30, 2023.

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Summary

Steamboat buckwheat, *Eriogonum ovalifolium* var. *williamsiae*, is a federally Endangered and State-protected (NAC 527.010) and critically endangered rare plant that has been declared by Nevada to be threatened with extinction (NRS 527.270). Per NRS 527.260(b), "the people of the State of Nevada have an obligation to conserve and protect the various species of flora which are threatened with extinction."

Steamboat buckwheat forms mats or mounds of gray-green leaves haloed by tiny white to pink flowers. The global distribution of this species is limited to the Steamboat Hills near south Reno, Nevada, where plants inhabit unique soils developed from sinter outcrops deposited by hot springs and geysers. The specific habitat and small geographic range of this plant make it highly vulnerable to random natural and human-caused disturbances. The inherent vulnerability of this species is compounded by threats posed by development pressure and other human impacts in a rapidly growing city, which further increase its risk of extinction.

There is no known threshold of habitat loss, plant take, and population decline that can be tolerated in rare soil specialists such as Steamboat buckwheat without causing potentially significant and irreversible declines in abundance or losses of genetic diversity that could compromise survival of the species. Previous efforts to transplant Steamboat buckwheat away from development sites within its habitat (Knight 1997) lack data to show that these efforts were successful; therefore, it must be assumed that future efforts may result in losses of those individuals. The same may also be true for other mitigation strategies since there is no comprehensive demographic data for the species that can be used to measure population trends. Considering the vulnerability of this species and intense pressures upon its habitat, the Nevada Division of Natural Heritage Botany Program recommends that a Management Area, as defined in NAC 527.100, be established to protect Steamboat buckwheat. This management area would serve to protect and restore Steamboat buckwheat habitat, prevent indirect impacts to the species from incompatible land uses, and preserve existing evolutionary potential to maximize long-term viability of the species. It is recommended that the Nevada Division of Forestry and all of its permittees, cooperators, stakeholders, and itself as a habitat and plant landowner, use the recommendations herein to guide all actions and decisions authorized by the agency that have a nexus with Steamboat buckwheat habitat and plants.

While this recommendation contains a robust set of conservation measures that may be employed to achieve the goals of the management area, these recommendations will be updated as new information becomes available to ensure that adaptive management is responsive to more effective ways to protect Steamboat buckwheat.

Background

Taxon description (non-technical):

Steamboat buckwheat is a low, mat- or mound- forming perennial plant up to approximately 45 cm (17.7 in) wide and 25 cm (9.8 in) tall. Plants are covered with rosettes of rounded gray-green leaves topped by dense, spherical heads of white to pink flowers on the ends of short, leafless stalks. Flowers bloom between May and July. Each tiny flower produces nine stamens with pink anthers that protrude from the rest of the flower.

Current legal and formal status designations:

Steamboat buckwheat was added to the Nevada List of Fully Protected Native Flora (NAC 527.010) in 1982 and was listed as endangered under the federal Endangered Species Act of 1973, as amended in 1986. It is also listed as a BLM-Sensitive species and is ranked as critically imperiled at the state (S1) and global (G5T1) level by the Nevada Division of Natural Heritage and NatureServe.

Habitat

Soils/substrate

Steamboat buckwheat plants occupy open areas of moderately deep to shallow soils formed from high-silica sinter bedrock deposited by hot springs and geysers in the Steamboat hills. This geothermal activity began approximately 2.5 million years ago (USFWS 1995, Minor *et al.* 1997). The sinter deposits consist of a complex mix of mineral and crystal types that vary within the habitat area of Steamboat buckwheat (Lynne 2008, Williams 1982). Steamboat buckwheat habitat differs from surrounding alluvial, floodplain, and other soils due to the geothermal processes by which it was created.

New habitat formation is expected to be limited, as most historical geysers and hot springs in the Steamboat Hills no longer flow above the surface to create additional sinter bedrock (Sorey and Colvard 1992). Unoccupied areas of solid sinter bedrock may weather over time to become suitable habitat (Pavlik *et al.* 2005), and there is evidence of plant establishment in some areas where sinter soils have washed down on top of surrounding alluvial soils. An early effort by D. Johnson (2000) to correlate soil physical and chemical properties to plant distribution was unsuccessful; however, this study included soil surface and subsurface samples from only eleven sample sites (5 sites each along two transects and 1 standalone sample). Additional studies with higher sample sizes, especially in combination with greenhouse studies examining plant growth in habitat and other local soil types, may be more successful in describing an envelope of suitable soil characteristics.

Associated species

Steamboat buckwheat occurs in sparse vegetative communities with total cover between zero to approximately 30% on average, although some plants have been observed to occupy areas with vegetative cover as high as 70%. Associated native species include big sagebrush (*Artemisia tridentata), ricegrass (Achnatherum sp.),* Pursh's milkvetch *(Astragalus purshii var. tinctus),* shadscale *(Atriplex confertifolia),* Douglas' dustymaiden *(Chaenactis douglasii),* yellow rabbitbrush *(Chrysothamnus viscidiflorus),* redstem springbeauty *(Claytonia rubra ssp. depressa),* pinnate tansy-mustard *(Descurania pinnata),* Steamboat monkeyflower *(Diplacus ovatus),* saltgrass *(Distichlis spicata var. stricta),* slender wild rye *(Elymus trachycaulus),* green Mormon-tea *(Ephedra viridis),* doveweed *(Eremocarpus setigerus),* rubber rabbitbrush *(Ericameria nauseosa),* Rayless Shaggy Fleabane *(Erigeron aphanactus),* Bailey's buckwheat *(Eriogonum baileyi),* altered andesite buckwheat *(Eriogonum robustum),* Wright's buckwheat *(Eriogonum wrightii var. scaposum),* Washoe wallflower *(Erysimum capitatum var. washoensis),* flat-spine bursage *(Ambrosia acanthicarpa),* broom snakeweed *(Gutierrezia sarothrae),* Baltic rush *(Juncus balticus),* Great Basin wildrye *(Leymus cinereus),* hoary tansy-aster *(Dieteria*

canescens), smooth-stem blazingstar *(Mentzelia laevicaulis),* Nevada bluegrass *(Poa nevadensis),* Sandberg bluegrass *(Poa secunda),* desert almond *(Prunus fasciculata),* goldenweed *(Pyrrocoma sp.),* and greasewood *(Sarcobatus vermiculatus);* non-native associated species include cheatgrass *(Bromus tectorum),* redstem filaree *(Erodium cicutarium),* and clasping pepperweed (*Lepidium perfoliatum*), among others (Pavlik *et al*. 2005, NDNH 2024a).

Other endangered, threatened, and sensitive species

Steamboat buckwheat co-occurs with two other rare plant species, Steamboat monkeyflower, (*Diplacus ovatus*), and altered andesite buckwheat (*Eriogonum robustum*). Both plants are ranked S2 (imperiled) by the Nevada Division of Natural Heritage (NDNH), are endemic to Nevada, and are present on the 2023 Bureau of Land Management Special Status Species list.

Geographic distribution and land management

Steamboat buckwheat plants occupy approximately 254,952 m^2 (63 acres) of land within approximately 1.15 km^2 (285 acres) of potential habitat in the Steamboat Hills, south of the intersection of Old US-395 and Mt. Rose Highway (S.R. 431) in Reno, Nevada. Approximately 67.7% of the habitat occupied by this species is under private ownership, with the remainder managed by the Bureau of Land Management (21.7%) and State of Nevada (10.6%). On the parcels owned by the Towne Development Group, ORMAT leases geothermal drilling rights along with 15 acres of surface occupancy.

Biology and ecology

Steamboat buckwheat is a perennial plant. Flower and seed production occurs May – July. This species has a gynodioecious breeding system, meaning that plants can be either strictly female (flowers contain only whole pollen-receiving structures, the gynoecium), or hermaphroditic (flowers contain both the gynoecium and pollen-producing structures, the androecium). This breeding system promotes outcrossing, which means seeds are produced using pollen from a genetically different individual from the plant producing the seed. This is generally considered promising in conservation because it can contribute to relatively high and evenly distributed levels of genetic diversity, which has been observed within the Steamboat buckwheat population (Archibald *et al.* 2001). Maintenance of a large contiguous population has been noted as an important strategy to maintain that diversity and the evolutionary potential it represents.

Maintenance of an intact pollinator community is also likely to be important for supporting sexual reproduction and associated genetic diversity. Steamboat buckwheat flowers require pollination to produce seeds (Tepedino *et al.* 2000). The most common flower visitors observed on Steamboat buckwheat plants are bees and flies (Tepedino *et al.* 2000; Burls and Scholl 2021). Some bee species have been observed to gather nectar from Steamboat buckwheat and pollen from nearby plants in the primrose family (Onagraceae), suggesting that Steamboat buckwheat also serves as a food source for native bees that interact with plants in the surrounding area. The glaucon blue butterfly, *Euphilotes glaucon glaucon*, uses Steamboat buckwheat as a larval host plant and primary nectar source at locations studied by Burls and Scholl (2021).

Each flower can produce up to 3 achenes, totaling up to 15-24 seeds per head (Pavlik *et al.* 2005). The number of flowerheads per plant varies widely, from one to >200, resulting in a wide range of variation in potential fecundity per individual. Seeds are likely primarily dispersed through wind and gravity. Despite abundant seed production under favorable conditions, establishment of new seedlings from seed appears rare. This may be due to high rates of seed predation (Hulme 1998), particularly by butterflies in the genus *Euphilotes* (Burls and Scholl 2021), low rates of viability (Archibald *et al.* 2001), rare occurrence of consistently favorable annual climatic conditions, or a combination of these factors (Solbreck and Knape 2017, Walck 2011, J. McClinton, pers. obs.).

Steamboat buckwheat has also frequently been observed to employ asexual reproduction, and clonal growth complicates abundance estimates, which have ranged from 10,000-15,000 plants (USFWS 1986), to approx. 85,000 plants (Knight 1997), 200,000 plants (Morefield 2001), and between 334,875 and 1,178,584 plants/clumps (NDNH 2024b) in the global population. In a genetic study, several clones were found to occupy areas <70 cm in diameter; however, the authors recommended additional sampling on a scale of 0-100 cm to determine the prevalence and average size of clones across the entire population (Archibald *et al.* 2001). To our knowledge, no estimates of total population size have been made that account for the presence of clones of any size.

Evidence of threats to survival

As a rare, highly specialized species with an extremely restricted global distribution, Steamboat buckwheat is particularly vulnerable to environmental stochasticity and anthropogenic impacts that might reduce its population size (Caicco 2012; Kaye *et al.* 2019; Staude 2020). Key threats to the species include commercial and residential development, drilling for geothermal exploration, habitat degradation due to off-highway vehicle (OHV) use and maintenance activities near roads and billboards, changes in moisture availability, and invasive species.

Current human impacts

A variety of human-caused disturbances directly and indirectly affect Steamboat buckwheat and its habitat. While some of these activities have been permitted by Nevada Division of Forestry (NDF) in consultation with NDNH and United States Fish and Wildlife Service (USFWS) to minimize or eliminate authorized take of habitat and plants, accidental and unauthorized take regularly occurs throughout the habitat.

Direct impacts include soil compaction and crushing of plants associated with unsanctioned vehicle/OHV use, as well as with billboard sign maintenance (NDNH site visits 2022, see photo 1 in Appendix). Additionally, the company ORMAT operates a geothermal energy complex that intersects with Steamboat buckwheat's range. Originally constructed in 1988, ORMAT's Steamboat complex consists of multiple powerplants, production wells, and injection wells connected by an extensive network of aboveground pipes (Applied Analysis 2019). The construction of this facility likely disturbed Steamboat buckwheat habitat and resulted in take of plants. When comparing historic extent (1986-2000) to currently mapped occupied habitat (NDNH 2023), 83 acres of habitat containing Steamboat buckwheat plants appear to have been lost to development. Of those, approximately 30 acres (36%) were in the

direct vicinity of ORMAT operations. Possible ongoing threats near this site may include drilling of additional test wells and inadvertent impacts from foot traffic or other routine operations within existing habitat.

Known indirect disturbance impacts to Steamboat buckwheat include altered drainage patterns, which have been identified as a threat since 1995 (USFWS). Recently, culverts around ORMAT have created a large new erosion channel through the northeastern edge of Steamboat buckwheat habitat (NDNH site visits, see photo 2A in Appendix). Where this channel formed, erosion undercut Steamboat buckwheat plants, which now cling to the edge of the wash with much of their roots exposed. Where the channels have completely washed away the shallow soil, several whole plants have been washed downstream (NDNH site visits, photos 2B and 2C in Appendix). While smaller washes may have been present historically, disturbance, human-built surfaces, and drainage management infrastructure are known to exacerbate water erosion in desert landscapes (Dotterweich 2013, Marticorena 1997). Habitat recovery after large erosion events is unlikely in the absence of ongoing sinter deposition.

Competition and habitat alteration by invasive species, often accidentally introduced by humans, may also negatively affect Steamboat buckwheat. Currently, cheatgrass (*Bromus tectorum*) and tall whitetop (*Lepidium latifolium*) are among the most abundant invasive plants found in Steamboat buckwheat habitat. The presence of these invasive species may alter fire regimes and change soil chemistry (Pilliod *et al.* 2017; Ehrenfeld 2003). Additionally, in areas where invasive weeds occur near Steamboat buckwheat plants, competition for water and nutrients may increase chances of Steamboat buckwheat mortality; however, additional research is needed to understand the prevalence and magnitude of this threat.

Future human impacts

High property values and urban growth in the vicinity of Steamboat buckwheat habitat has led to increasing pressure on the core areas of the habitat and plants as well as the frequency of activities that result in unauthorized take. Current zoning designations and growth strategies from the City of Reno (City of Reno 2023, City of Reno 2021), as well as steady population growth since 1970 and expectations of continued population growth (PNREAP 2023, Lawton 2022), suggest that development pressure in the Steamboat Hills and surrounding area is likely to increase. Steamboat buckwheat's core habitat (Fig. 1), on the southern edge of Reno's current city limits, has already been largely zoned for development. 66.5% (190 acres) is zoned for industrial use, 55.6% (19 acres) is zoned for open/green space, 8% (23 acres) is zoned for suburban mixed use, 4.7% (2 acres) is outside of Reno city limits and considered transition/ unincorporated area, and 12.5% (4 acres) is not zoned due to its proximity to the road (City of Reno 2023). Future development within and surrounding Steamboat buckwheat habitat could result in direct losses of plants and habitat and may also exacerbate indirect impacts, such as erosion from altered drainage patterns and loss of pollinator habitat in surrounding areas.

Other environmental threats

Wildfire, such as the Petrilla fire of 2021, has already affected portions of Steamboat buckwheat habitat and resulted in the loss of several plants (National Interagency Fire Center 2022, J. Johnson personal communication) and is likely to recur. Additionally, climate change may

worsen existing challenges to maintaining and growing the population of Steamboat buckwheat. For example, there is evidence that seed set in this species is very low (< 1% of flowers produce viable seeds; Archibald *et al*. 2001), and that recruitment events are rare (Pavlik *et al*. 2005; USFWS 2019; Walck 2011)— conditions that may be exacerbated by changes in precipitation and rising temperatures (Kaye *et al.* 2019). Long-term habitat integrity is also a concern; since surface geothermal activity and sinter deposition has ceased, there will be no new habitat formation and existing Steamboat buckwheat plants may eventually be outcompeted by other native and nonnative species as soil development progresses and existing sinter erodes away (USFWS 2019).

Management plan recommendations

Summary of recommendations

Considering this species' highly restricted global geographic distribution, special habitat requirements, and intensifying anthropogenic pressure, the Nevada Division of Natural Heritage Botany Program recommends that a Management Area, as defined in NAC 527.100, be established "for the conservation, protection, restoration and propagation" of Steamboat buckwheat (*Eriogonum ovalifolium* var. *williamsiae*). This Management Area should operate under guidance of a management plan and monitoring and evaluation program that supports adaptive management. The overarching goals of this Management Area should be to maintain a viable population of Steamboat buckwheat that is resistant and resilient to environmental change, disturbance, and other threats, to maximize the species' potential for long-term persistence, and to work toward accomplishing recovery criteria outlined in the Amended Recovery Plan published by USFWS (2019).

The Steamboat Buckwheat Habitat Management Area (SBHMA) should be managed as two sub-units: a transitional management zone designated as the Steamboat Hills Buffer Zone (SHBZ), and a smaller core of management designated as the Steamboat Buckwheat Core Habitat Area (SBCHA) (Fig. 1). Within the SHBZ, management should focus on measures that guide sustainable land use and protect the SBCHA from indirect impacts that may result in habitat degradation or otherwise pose a threat to the species, and on measures that promote pollinator abundance and diversity in the Steamboat Hills. Within the SBCHA, management should focus on measures that directly seek to understand, protect, and restore Steamboat buckwheat habitat and preserve or increase plant abundance.

Steamboat Buckwheat Habitat Management Area (SBHMA) Map

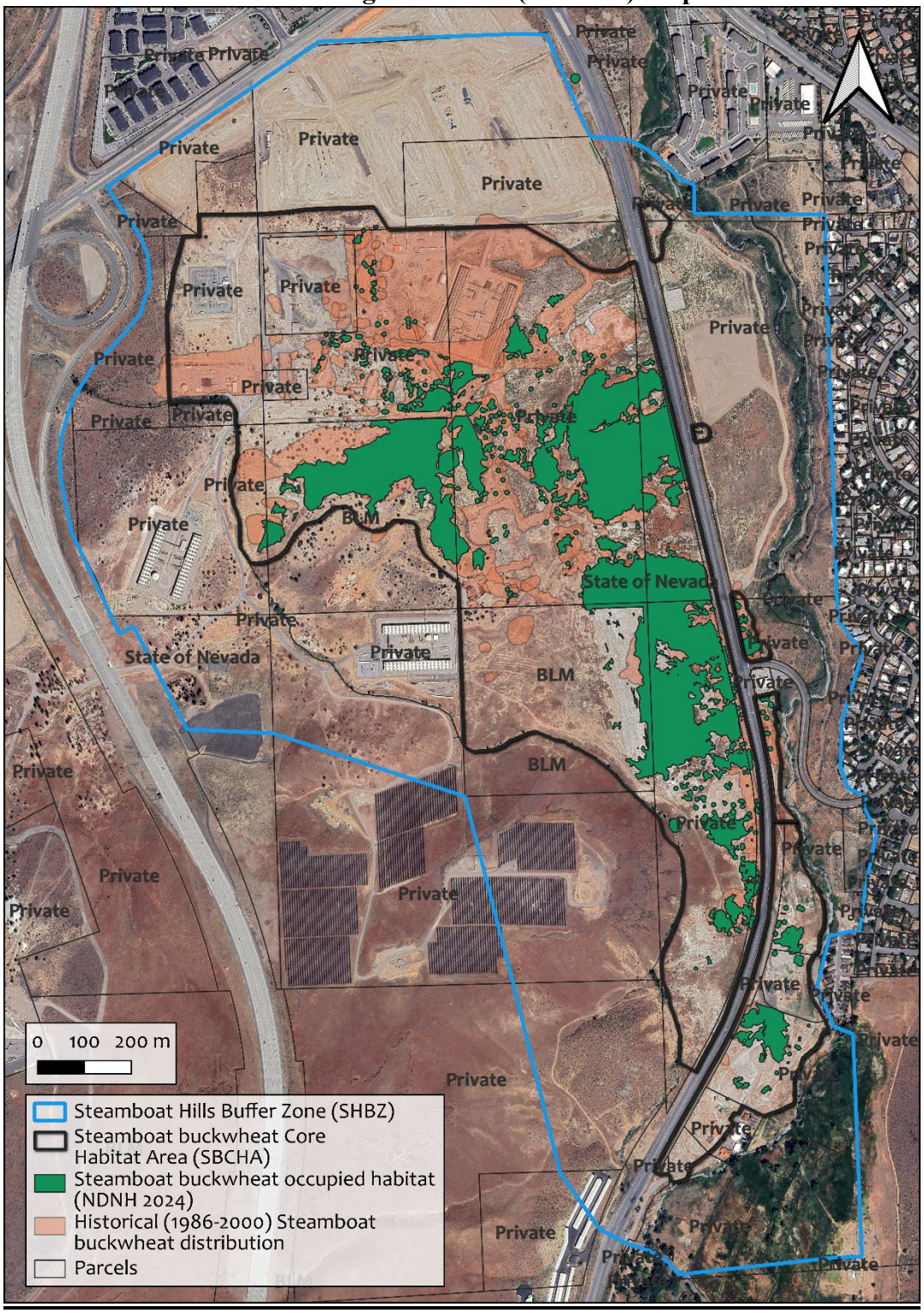

Figure 1. Recommended boundaries of the Steamboat Hills Buffer Zone (light blue line) and Steamboat Buckwheat Core Habitat Area (thick black line).

Steamboat Hills Buffer Zone (SHBZ)

SHBZ boundary development

The boundaries of the Steamboat Hills Buffer Zone (SHBZ) (Figure 1) were developed using a modified 500m buffer around currently occupied habitat in the NDNH database. This buffer distance was chosen to reflect the best available science on the foraging ranges of potential pollinators and beneficial insects found in Steamboat buckwheat habitat (BLM 2012, Cranmer *et al.* 2012, Senapathi *et al.* 2016). Boundaries were modified to follow parcel boundaries where practical. The SHBZ excludes the existing residential development east of Steamboat Creek because this area likely represents poor existing and potential native pollinator habitat.

Management area recommendations

Goals and objectives

The goals of the Steamboat Hills Buffer Zone are to guide sustainable land use and protect the SBCHA from indirect impacts that may result in habitat degradation or otherwise pose a threat to the species, and on measures that promote pollinator abundance and diversity in the Steamboat Hills. Implementation of special management practices in this zone will help to minimize "edge effects" within the SBCHA, a common problem in small reserves (Parker 2012).

Recommended actions

1. Minimize disturbance within the SHBZ to maintain essential ecosystem components needed to support Steamboat buckwheat and prevent harmful indirect effects within the SBCHA.

A. Require permits for ground-disturbing activities and long-term management plans for projects compatible with the goals of the SHBZ, including but not limited to:

- Stormwater management—no additional runoff as a result of land management or development activities should be permitted to enter the SBCHA. This is to prevent erosion and associated habitat loss, transport of non-native species, and deposition of sediment, fertilizer, herbicides, or oil/other road-related pollutants into Steamboat buckwheat habitat.
- Dust management plans during and after activities that minimize use of additives that could blow or be washed into occupied Steamboat buckwheat habitat. Plans should incorporate monitoring and reporting to measure dust deposition on Steamboat buckwheat plants and potential impacts to plant growth and reproduction and allow for adaptive management.
- Measures to prevent establishment and spread of non-native invasive plants that can colonize Steamboat buckwheat habitat, particularly cheatgrass (*Bromus tectorum)*, halogeton (*Halogeton glomeratus)*, and tall whitetop (*Lepidium latifolium).*
- Slope stabilization measures such as retaining walls to ensure that raised areas constructed during development will not collapse or erode and directly or indirectly impact the SBCHA.

B. Install fencing with rare plant habitat signage around developments in the SHBZ to prevent casual trespass into the core habitat area.

C. Install K-rail or other durable barriers along boundaries of occupied habitat along Old US-395/So. Virginia St. to prevent OHV intrusion into SBCHA and to facilitate road maintenance.
D. Ensure pollinators have enough resources to continue servicing the SBCHA:

- Mandate use of seed zone appropriate flowering species native to northwestern Nevada in landscaping to support pollinators (WWETAC 2024). Use of closely related wild buckwheat species should be avoided to prevent hybridization (this includes other varieties of *Eriogonum ovalifolium* and *Eriogonum strictum*). Use of more distantly related species of *Eriogonum* such as *Eriogonum umbellatum* is encouraged due to high value to pollinators.
- Avoid using herbicides that are documented to negatively impact pollinator survivability, such as nitroguanidine neonicotinoids, anywhere within the SBCHA or SHBZ, or that are likely to persist in soils for long time periods (Sondhia 2014).
- Apply herbicides only during appropriate phenological and weather windows (e.g. wind <10mph, in mornings/evenings or when cool temperatures reduce likelihood of evaporation, and outside of peak breeding and foraging times).
- Use backpack sprayers only and apply from the ground. Set nozzles low to operate just above plant height and calibrated to spray at low pressures (15-30 psi) to produce larger heavier droplets that are less likely to drift.

E. Quantify vegetation community types and distribution throughout the SHBZ, with a focus on potential Steamboat buckwheat pollinator habitat.
F. Continually monitor the SHBZ and develop thresholds for pollinator habitat impacts that, once reached, will trigger implementation of specific actions to reduce impacts and/or prevent further impacts.
G. Develop and implement a fire management plan to maintain and protect essential ecosystem components within the SHBZ needed to support Steamboat buckwheat and reduce potential future impacts to the SBCHA.

2. Provide public education opportunities to support long-term maintenance of SHBZ.
A. Post signage within the SHBZ with information about rare and protected species contained within the SBCHA to increase public knowledge and appreciation of the unique habitats and species therein.

Steamboat Buckwheat Core Habitat Area (SBCHA)

SBCHA boundary development

The boundaries of the Steamboat Buckwheat Core Habitat Area were developed using a combination of NDNH data on current and historical occupied habitat, aerial imagery, parcel data, and geologic and soils maps of the Steamboat Hills (UES 2024, NRCS 2023, CH2M Hill 1986). Boundaries encompass occupied and potential habitat, incorporate buffers of at least 15m from currently occupied habitat, and follow parcel lines where practical to facilitate management.

Management area recommendations

Goals and objectives

The goals of the SBCHA (Fig. 1) are to protect and restore existing and future Steamboat buckwheat habitat and preserve existing evolutionary potential to maximize long-term viability of the species. Development of a management plan for this area will help address the USFWS Amended Recovery Plan (2019) Downlisting criteria #3.

Recommended actions

We recommended 5 action areas to meet the goals and objectives listed above:

1. Halt and prevent further degradation of habitat.

A. Avoid ground-disturbing activities, except for permitted activities required for maintenance of existing facilities and installations.
   - Determine suitable buffer distances for ground-disturbing activities to protect habitat and individual plants. While final buffer distance requirements should consider local topography, construction, and final usage, NDNH recommends buffers of at least 3m away from habitat for low impact uses such as walking or occasional OHV use, and at least 15m for high intensity use areas such as driveways, buildings, sidewalks, and other paved areas (Davis and Birch 2011, Yemets *et al.* 2014, Zehetner *et al.* 2009). These distances are intended to minimize potential impacts to Steamboat buckwheat habitat from a variety of stressors including human intrusion, runoff, and vehicle exhaust.
   - Remove commercial signage within habitat where possible. Designate approved routes for maintenance access to properties and signage, including road maintenance by the NV Department of Transportation.

B. Prioritize fee or conservation easement acquisitions for portions of habitat situated on private land to address USFWS Amended Recovery Plan (2019) Downlisting criteria #1.

C. Establish cooperative agreements with the USFWS for long-term management on all federally and state-owned lands within the SBCHA to address USFWS Amended Recovery Plan (2019) Downlisting criteria #2.

D. Restrict public access to Steamboat buckwheat habitat until appropriate protective buffers can be determined, installed, and enforced.

E. Pursue permanent endowments necessary for long-term management to address USFWS Amended Recovery Plan (2019) Delisting criteria #1.

F. Develop and implement a fire management plan to minimize damage and disturbance within the SBCHA in the event of wildfire and and to maintain and protect essential ecosystem components needed to support Steamboat buckwheat.

2. Continue to study Steamboat buckwheat to understand its ongoing status and detect changes in the population.

A. Collect plant density, cover, and richness data, including existing floral resources within each of the three blooming periods – spring, summer, and fall – within the SBCHA to establish baselines and targets for restoration.

B. Implement long-term demographic monitoring for Steamboat buckwheat, including different microsites within the SBCHA (e.g. main terrace/rocky crevices, central drainage/deeper soils, and in areas surrounding ORMAT activities). Monitoring should be capable of addressing whether conditions listed in the USFWS Amended Recovery Plan (2019) Delisting Criteria #2 are being met.

C. Use monitoring results to facilitate adaptive management intended to allow Steamboat buckwheat to persist without substantial human intervention.

3. Maintain and study the SBCHA to better understand essential ecosystem components needed to support Steamboat buckwheat, including but not limited to the following:

A. Habitat requirements

- Further characterize habitat of Steamboat buckwheat, including areas occupied by Steamboat buckwheat and areas that may be suitable for plants in the future (e.g., after soil development).
    - Collect data on topography, soil properties, associated plant species, hydrology, and proximity of sinter bedrock to soil surface.
    - Consider appropriate buffers needed to protect Steamboat buckwheat (see Action 1)
- Develop guidelines for local-scale habitat delineation, using results of habitat characterization studies and refine SBCHA boundaries as appropriate.

B. Pollinators

- Quantify pollinator diversity, abundance and effectiveness and implement periodic monitoring to ensure that adequate pollination resources exist to support sexual reproduction in Steamboat buckwheat.
- Identify locations of bee overwintering sites within the SBCHA. Avoid ground disturbance and noise near overwintering sites, and during peak foraging and breeding times. (Liczner 2019).
- Avoid using herbicides with long residual toxicities and long-lived toxic nitroguanidine neonicotinoids anywhere within the SBCHA or SHBZ.
- Apply herbicides only during appropriate phenological and weather windows (e.g. wind < 10 mph, in mornings/evenings or when cool temperatures reduce likelihood of evaporation, and outside of peak breeding and foraging times).
- Use backpack sprayers only and apply from the ground. Set nozzles low to operate just above plant height and calibrated to spray at low pressures (15-30 psi) to produce larger heavier droplets that are less likely to drift.

C. Co-occurring plant and fungal species

- Study impacts of competition on Steamboat buckwheat, including both native plants and non-native invasive species.
- Consider and study plants and other organisms co-occurring with Steamboat buckwheat that may have beneficial or complimentary effects, such as biotic soil crusts and mycorrhizal fungi.

4. Conduct ecological restoration where needed.

A. Identify degraded Steamboat buckwheat habitat within the SBCHA and conduct habitat restoration using genetically appropriate seed collected from common native plant species within and surrounding the SBCHA.
   - Establish parameters for target species richness and cover and a monitoring program to track restoration outcomes.
   - Establish guidelines for monitoring results that would trigger additional action to improve outcomes.

B. Control non-native invasive plant species to prevent habitat degradation. Control invasive plant species using only hand pulling methods within 50 feet of occupied habitat (see Action 1).

5. Develop contingencies in case of loss of individuals or subpopulations of plants.

A. Maintain an ex-situ conservation collection of viable Steamboat buckwheat seeds at a qualified regional seedbank. (ex: Rae Selling Berry Seedbank and Plant Conservation Program). This addresses USFWS Amended Recovery Plan (2019) Delisting criteria #3.
   - Follow Center for Plant Conservation guidelines for seed collection and storage (no more than 10% of an individual or population in no more than 5 years out of 10).
   - Fund periodic seed viability and germination testing. Establish a minimum number of viable seeds in storage below which additional collection and accessions would be triggered, or conduct fresh collections every 10 years, whichever is sooner. The minimum acceptable number of seeds in storage should be informed by Center for Plant Conservation Best Practices.

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Appendix: Supplemental Photos

Photo 1: Presumed OHV tracks within Steamboat buckwheat habitat, with at least 3 dead Steamboat buckwheat individuals directly in tracks. J. Johnson, NDNH botanist, Nov 2022.

Photo 2a: Stream channel created by culvert near ORMAT operations. J. Johnson, NDNH botanist, May 13, 2022.

Photos 2b: Steamboat buckwheat plants clinging to the edge of a wash, roots exposed. J. Johnson, NDNH botanist, May 13, 2022.

Photos 2c: Entire Steamboat buckwheat plants washed downstream. J. Johnson, NDNH botanist, May 13, 2022.