The driving mission of the Desert Preservation Initiative is to restore native ecosystems using science-based methods to create a sustainable future for the health and beauty of our shared environment.

September 29, 2023

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Dear General Manager, Zach Renstrom; Ivins City Mayor, Chris Hart; and Ivins City Council (Lance Anderson, Jenny Johnson, Dennis Mehr, Adel Murphy, and Mike Scott),

It is with a vision of the welfare of our city of Ivins that the directors of the Desert Preservation Initiative (DPI), a 501(c)(3) non-profit recognized by the state of Utah, provide to you this letter — a letter reporting a summary of our insights, field-experiences, and knowledgebase on invasive plants that suggest WCWCD and Ivins City reconsider the proposed site (Kayenta) for the Dry Wash Reservoir.

One of the most successful non-native tree species to replace native riparian woodlands in the western United States is Tamarisk. Tamarisk (also known as Saltcedar; *Tamarix* spp.; Tamaricaceae) is now ranked as the third most abundant woody species across riparian habitats in our western landscape. This Asian native occurs throughout many Kayenta washes, where some of the populations are so large and thick that they are nearly impenetrable. DPI has invested a tremendous amount of monies and resources, as well as a vast amount of volunteer hours, during 2022 to eradicate Tamarisk from some of the primary, secondary, and tertiary washes. To date, we believe that the DPI volunteer team has removed around 10% of the Tamarisk within Kayenta.

Presently, large extensive populations of Tamarisk occur directly to the north, west, and south of the proposed Dry Wash Reservoir Kayenta site. These existing Tamarisk populations will continually invade, via hundreds of air-borne seeds, the shoreline of the proposed reservoir for many years to come. The resulting plants will have a significant ongoing impact on future financial and resource demands in an attempt for you to meet the objectives of the Dry Wash Reservoir project. If WCWCD and Ivins City move forward with the Dry Wash Reservoir project, DPI's Directors firmly believe that the result will:

- dramatically increase woody invasives throughout ravines, washes, canals, and agriculture areas within Ivins and the county,
- not be able to provide the water that is proposed to be delivered since Tamarisk at some point in the future will make use of large quantities of water to sustain itself and Tamarisk will increase the salinity of the available water making it difficult to use for agriculture purposes,
- require annual monies year in and year out to manage the invasion by large populations of Tamarisk that are presently neighboring three sides of the proposed site, and
- greatly increase fire risk to Ivins' structures and hardscape as Tamarisk increases in number and geographic coverage within our city.

The management of WCWCD and Ivins City will ultimately be responsible for the Dry Wash Reservoir becoming a significant stepping-stone for Tamarisk to invade all other moist ravines, washes, canals, and ponds within Ivins City, Santa Clara, and Shivwits Homeland. Based on our past scientific studies and our own field experiences with Tamarisk, this will happen. We cannot stress enough that the Dry Wash Reservoir will require extensive and increasing demands on your resources, staffing, and annual budget in an attempt to manage within the Dry Wash Reservoir the never-ending invasion of one of the world's worst riparian ecosystem destroyers.

While non-native, woody, riparian species (e.g., Russian Olive, Tamarisk, Siberian Elm) have expanded in range and increased in dominance over the last century, native riparian woodland species, such as Cottonwood and Willow, have sharply declined in distribution and number. Tamarisk has won the number 3 slot due to: its highly successful life-history strategies: 1) having a vertical tap root down to the water table; 2) being a facultative phreatophyte (able to extract water from unsaturated soil layers) by having an expansive lateral root system; 3) being able to send up new shoots from the lateral root system when the plant above dies; 4) having a high tolerance to an amazing array of saline conditions; 5) being able to survive, as well as often to flourish, when the level of water in its riparian habitat fluctuate dramatically for extended periods of time; 6) producing a prolific amount of seed throughout an entire region's growing season; 7) having immediate germination and growth of its seeds upon contact with moist soil; 8) being able to live for 100 years or more; 9) having the ability to continually develop/manipulate its habitat to support further expansion of its population while reducing the competitive advantages of the existing native species to sustain themselves. Once Tamarisk successfully invades a riparian site, this species immediately begins impacting a number of hydrological and ecological changes, including reductions in plant and animal biodiversity, replacement of native riparian trees, and altering bank structure and geomorphological processes of the stream flow or body of water. Further details on why Tamarisk is so successful in artificial bodies of water, as well as further explanations and details of why the DPI Directors believe that the Dry Wash Reservoir should not happen are presented in Appendix 1.

Those individuals within the WCWCD and Ivins City who feel the Dry Wash Reservoir plan has value, even after reading about Tamarisk in this letter and the further details in Appendix 1, might consider getting into a kayak and paddling around the non-managed riparian shorelines of Gunlock Reservoir. They will immediately see Tamarisk's success in invading and colonizing this artificially created

impounded water body. Large and thick Tamarisk thickets can be viewed along the north and west shores of the non-managed/not maintained shoreline of Gunlock. While kayaking the shoreline, they will also be able to note that the only areas lacking Tamarisk are: 1) the spillway, along the southern border, which has non-controlled rather intensive flooding for washing away any Tamarisk seeds, seedlings, and young plants within the spillway, as well as having a vertical dam structure in place that does not support the development of a riparian habitat area and 2) the continually managed and maintained sandy beaches and boat ramp on the east side.

DPI's Board of Directors looks forward to receiving your input concerning the above issues concerning Tamarisk as it relates to the proposed Kayenta Dry Wash Reservoir. The Directors would welcome the opportunity to show you the impact Tamarisk already has had on the health of Ivins' washes, as well as the increased fire risk associated with this species and the significant impact Tamarisk has had on our native flora and fauna in these washes. We firmly believe that providing you both with a tour through some of the Tamarisk forested washes in Kayenta will allow you to visualize what will likely occur if the reservoir is constructed in Kayenta's Dry Wash. Please note below, the email address for communications with Ivins' DPI Board of Directors for scheduling a tour of Kayenta's Tamarisk forested washes to the north and east of the proposed site.

With our best regards,

Desert Preservation Initiative Board of Directors

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APPENDIX 1
Further Insights by DPI on the Proposed Ivins City Site for a New County Reservoir

Tamarisk's impact on regional economies, environments, agriculture, and biodiversity
Tamarisk continues to have tremendous impacts on a region's economy, environment, agriculture, and biodiversity, especially in the arid areas of the southwestern U.S. The most significant impact on economics is related to the large and ever-increasing losses of stream flow and groundwater. It has been shown that just 1 acre of Tamarisk can consume over 950,000 gallons of water within a one-year time period. Another economic impact is the increased risk, frequency, and intensity of wildfires caused by Tamarisk. Washington County, Santa Clara, and Ivins firefighting department managers continue to promote and encourage the removal of Tamarisk that are close to structures due to the plant's quick ignition and the thick layer of flammable debris for sustaining a fire. Economic losses have also been documented showing the reduced utilization of reservoirs, parks, and natural areas when Tamarisk has invaded a site.

Especially in the southwestern U.S., non-native trees, such as Tamarisk, are targets of large-scale chemical, physical, and biological control efforts costing agencies and organizations millions of dollars each year. The primary reasons for attempting to control Tamarisk are to increase water yield, improve wildlife habitat, restore native vegetation, improve the health and sustainability of the riparian ecosystem, and decrease riparian wildfire frequency and severity. In many cases, these objectives are extremely difficult to achieve.

The environmental impact of Tamarisk causes increased sedimentation, bank aggradation, narrowing and deepening of channels, filling in backwaters, modification of riffle structure, overgrowth of sand and gravel bars, and changes in turbidity and temperature of the water. Tamarisk is probably the greatest user of scarce groundwater in infested desert ecosystems. Tamarisk increases the natural salinity levels by absorbing saline groundwater, then concentrating the salts in its leaves, and finally either excreting the excess salts through leaf glands or dropping its leaves. The saline litter and soil under the trees do not support the germination of growth of most riparian shrubs and trees. Dry foliage and twigs quickly accumulate under the deciduous Tamarisk. This debris is highly flammable. Tamarisk thickets burn more intensely and more frequently than native riparian plant communities. Those problems are further compounded when humans alter hydrologic cycles, preventing the natural spring floods from washing away the accumulated, salty, and forever increasing leaf litter in Tamarisk communities.

Tamarisk has also become a significant threat to agriculture due to: 1) its high use of water, 2) the ease with which it has invaded and colonized channels and moist areas associated with agriculture in the desert, and, finally, 3) how it increases salinity of agricultural lands and their water sources. Millions of dollars are spent each year to remove Tamarisk from agricultural water channels to slow down the loss of water, reduce fire risk, reduce sedimentation and channeling of waterways, and stop invasion into other agricultural areas,

The most significant direct negative impact of any Tamarisk invasion is the displacement of biologically diverse native riparian plant communities by dense thickets of solely Tamarisk. The most seriously affected species by this invasion are the woody shrubs and trees. These native species, usually Cottonwood, Willow, Mesquite, and Baccharis are obligate phreatophytes (plants that must be supplied with surface water and require their roots to be constantly in touch with moisture). These four native woody species are the dominant woody species in Ivins' riparian areas that have not been colonized by Tamarisk. A walk through the extensive Tamarisk thicket just east of Kwavasa Drive in the Kayenta Wash (note this is just east of the Dry Wash Reservoir site) shows that Cottonwoods and Willows are on a significant decline with little to no replacement plants being generated. Mesquite trees are barely hanging on in this area as they get shaded out and outcompeted by increasing numbers of Tamarisk plants. Tamarisk plants can live up to one hundred years far outliving both Mesquite and Willow. Once again, we are not seeing any young plants of Mesquite in this area. In the southwestern U.S., the loss of native riparian vegetation has been directly linked to a significant decline in many riparian wildlife populations such as migratory birds.

Once Tamarisk invades a healthy, diverse riparian habitat, on-site colonization occurs quickly by both vegetative and reproductive strategies. New plants can be generated through rhizomes. Stems that have become buried post-inundation can sprout roots and go on to produce new plants. Water and air-dispersed seeds allow this species to spread over short and long distances. Seeds are tiny, easily dispersed, and remain viable for a few days. Prolific flowering and seed production occurs throughout the entire growing season to ensure that at some point in time, some seeds land in a sunny moist spot. Seeds germinate almost immediately upon coming in contact with soil moisture and then grow extremely quickly by sending down a taproot and developing lateral roots. The majority of riparian native wood species typically release seeds during only a small fraction of the growing season and during this short period of time; the seeds must either land around the mother tree or be dispersed by water to a moist sunny spot to germinate. Native woody riparian seeds are slow to germinate and slow to grow. They require available moisture at all times during the germination and initial growth stages. As the size of the Tamarisk colony increases, the plants are concentrating any available soil salts into their leaves. Leaves drop continuously from plants throughout the year creating an amazing thick layer of leaf debris containing concentrated salts. The leaf debris and the increasing saline levels of the soil decrease the ability of any native riparian species to be able to germinate around the Tamarisk plants. Once again, the area in the Kayenta Wash just east of Kwavasa Drive provides an excellent visual example of the successful colonization of Tamarisk and the ongoing decline and lack of regeneration of the original native riparian woody species of Cottonwoods, Willows, Mesquites, and Baccharis.

Tamarisk - a nationally listed invasive species
Tamarisk is listed on the USDA's National Invasive Species List. In most western States, Tamarisk is listed as invasive and prohibited from being sold or propagated. In Utah, Tamarisk is listed as a Class III Weed – populations of this species should be contained to halt their spread. These plants are not allowed to enter the state via commercial channels. Construction of the Dry Wash Reservoir, without plans for extensive ongoing shoreline management for invasives, will definitely support the propagation and spread of Tamarisk within the city and county.

Tamarisk and the Desert Preservation Initiative
The primary directive of the Desert Preservation Initiative (DPI), a Federal 501(c) (3) non-profit organization in Ivins City is "to restore native ecosystems using science-based methods to create a sustainable future for the health and beauty of our shared environment". The Board of Directors and our 60+ volunteers have focused, over the past 20 months, on restoring native riparian habitats within the city that have been impacted by the invasives Tamarisk and Russian olive. Tamarisk populations can be found throughout the city in many of the city's washes and the artificially created body of water (Ivins Reservoir) and its associated inflow and outflow drainage channels. Some of the larger washes, such as the Kayenta Wash from Taviawk Drive west to Kwavasa Drive, have extensive, rather tall thickets of impenetrable walls of Tamarisk. One highly visible and accessible area of an extensive impenetrable thicket of Tamarisk is directly east of Kwavasa Drive in the Kayenta Wash. Note that this extensive population of large reproducing Tamarisk is directly east of the eastern border of the proposed Dry Wash Reservoir, as well as draining into the area for the proposed reservoir.

During DPI's first 12-month season removing Tamarisk and Russian olive, over 1,500 volunteer hours were invested in cutting, disposing, and killing Tamarisk on 15 properties. From January to May of 2023, DPI volunteers conducted at least three Tamarisk and Russian olive removal sessions each week. Even with so many volunteers and donors supporting invasive removal each and every week, DPI has probably removed maybe 10% of the previously surveyed Tamarisk within the community of Kayenta. DPI is well aware that it will need to continually seek grants, donations, and contributions to be able not just to continue killing and clearing Tamarisk from Ivins' washes, but also to be able to increase our available resources and monies to 1) monitor regrowth for both past, recent, and future removal sites (at least a year for each site), 2) eradicate new invasives entering the newly cleared disturbed site, and 3) support the possible planting and maintenance of native species in case the surrounding native species are not able to regenerate the site due to extreme changes and modifications of the site's conditions due to having Tamarisk growing for an extended period of time and, possible if the site has a gradient making it difficult for seeds to get a foothold.

Tamarisk's strategy for invading and colonizing new impounded bodies of water (i.e., reservoirs)
In a recent comparative research project of natural lakes and human-made reservoirs, reservoirs were up to 300 times more likely than lakes to harbor invasive species, according to a study's results published in the journal *Frontiers in Ecology and the Environment*. The study also demonstrated that higher non-native invasion risk was related to high levels of human use, which is usually seen at reservoirs. In addition, the study found that reservoirs typically contain young, highly vulnerable, less established ecological communities along their borders that tend to support invasive species gaining a foothold faster than the surrounding native vegetation. Another study of reservoirs and invasives demonstrates that reservoirs have been and are facilitating the spread of invasive species into natural hydrological riparian and water systems. The reservoirs increase the invasion risk of natural bodies of water through what is called a "stepping stone" effect -- favorable conditions at a reservoir give invasive species an entry point into the landscape from which they can more easily spread to nearby

natural bodies. This scenario has been frequently observed for reservoirs, especially in the southwestern U.S.

Natural occurring riparian zones occur at the interface between terrestrial zones and bodies of water. Water bodies can be natural such as streams, rivers, or lakes, or they can be human-created such as ditches, canals, ponds, or reservoirs. With the creation of a reservoir, a riparian zone is created along the entire circumference except for border edges that have a vertical structure such as a wall to stop erosion or a dam to control water. Reservoirs are artificial as are the riparian zone that is created and, therefore, the body of water and the riparian zone are unstable habitats (no historical natural evolution for long-term stability), analogous to disturbed terrestrial habitats. Disturbed terrestrial habitats tend to be colonized by species adapted to disturbances, usually weedy, naturalized, and invasive species. So it is not a surprise that Tamarisk, and other riparian invasives, have a distinct advantage in invading a new riparian zone.

Water level is and will always be controlled when a reservoir is completed and functioning as planned. Natural flooding and natural drying will not occur along its borders. For purposes of this discussion, we will consider the reservoir to be initially functioning when the height of the water has reached the level of water stated in the construction plans. This level will be referred to as the “full pool”. At this maintained level, the borders will be ready to accept and support the growth and germination of Tamarisk seeds dispersed by air from neighboring populations. Remember that Tamarisk plants release seeds throughout the growing year so timing is not an issue for when Tamarisk can begin the invasion. The border typically remains stable (“full pool”) for reservoirs during the initial years to allow the completed system to be tested. This period allows Tamarisk seeds and young plants to have stable soil moisture, no inundation, and no soil drying (these factors can impede growth in young Tamarisk plants until the root systems are developed). Keep in mind that Tamarisk young plants grow quickly compared to native species, so they are able to withstand above “full pool” levels and drawdowns “below full pool” leaves sooner than the native young plants trying to also get established in the riparian border.

Tamarisks are almost always able to get a jump on getting seedlings started on the reservoir ravine border before natives have an opportunity to provide seeds to the habitat when there are neighboring populations that can air disperse hundreds if not thousands of seeds throughout the region's growing season. Native species are at such a disadvantage for newly created riparian habitats: 1) they release seeds only during a short time of the year, 2) they use water for seed dispersal, and 3) germination and growth of seedlings is slow and requires moist soil at all times. However, in human-controlled water systems, native seeds from natural upstream water systems are usually not able to make it to the border due to how reservoirs are typically constructed. For the proposed Dry Water Reservoir site, large populations of reproductive Tamarisk occur to the north, to the south, and presently to the west giving a very high probability of Tamarisk invading these new borders once water is put into the reservoir. Note that seed sources for native wood species (Cottonwoods, Willows, Baccharis, etc.), are a good distance to the north and south of the reservoir site and are few in number due to colonization by Tamarisk in Kayenta’s washes. The Dry Wash Reservoir will be primed and ready to begin accepting Tamarisk seedlings (the “invasion” begins) the moment it has reached the full pool and is not positioned to support or encourage the introduction of native species.

As time evolves with the ongoing management of reservoirs, these types of water bodies go through repeated cycles of inundation (above “full pool”) and drawdown (below “full pool”) based on climate fluctuations, ongoing climate change, availability of water to maintain the “full pool” level and human and agricultural demands for the water. It is at this point where any native seedlings and plants that

have been able to get established along the border will likely die due to lack of oxygen (inundation – above “full pool”) and/or water (“full pool” drawdown) as humans attempt to control the level. Tamarisk has some truly amazing strategies to stay alive, once it has invaded a site, during cycles of inundation (above “full pool”) and drying out (“full pool” drawdown). When groundwater is not available on the surface (drawdown of the level), Tamarisk has a vertical tap root down at the water table. Also, if water is scarce at both the ground level and in the water table, Tamarisk just drops its leaves and sits and waits to start growing again when humans allow the reservoir to fill. Tamarisk is known to be able to survive a few months when completely inundated. Most native species cannot survive long periods of inundation. If above-ground parts of Tamarisk die from long-term inundation, then draw down to “full pool” or below does occur in the reservoir, Tamarisk’s horizontal underground rhizomes will send up new shoots. Note that as Tamarisk is growing and dropping its leaves, it is increasing the salt concentration in the border habitat to continually dissuade any native species from getting a foothold in any of the prime riparian habitats. Since the process of “flooding” of natural riparian habitat to wash debris and salt away downstream does not occur in artificial bodies of water, Tamarisk debris accumulates quickly developing an increasingly poorer quality site for native seed germination through time. Seedlings and young plants of native wood riparian species do not have the life history strategies for surviving in the riparian border of artificial bodies of water that always go through inundation (above “full pool”) and draw down (below “full pool”) cycles. The inevitable inundation and draw-down cycles of southwestern U.S. reservoirs ensure the continued colonization and eventual monoculture of Tamarisk in these bodies of water unless immediate and continued management of the borders are put into place to control the invasive and manage the border on a regular basis for the long-term.