APPENDIX G

WEED MANAGEMENT PLAN

FOR THE OVERTON POWER 9-YEAR PLAN
CLARK COUNTY, NEVADA

FOR

BUREAU OF LAND MANAGEMENT
BUREAU OF RECLAMATION
OVERTON POWER DISTRICT #5

Prepared by

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February 7, 2014

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1.0 INTRODUCTION

1.1 Background

Knight and Leavitt Associates (K&LA) has been retained by the Power District to complete a noxious weed inventory of the project area and to prepare the Weed Management Plan. Nevada Revised Statutes (NRS) 555.005-201 characterizes noxious weeds as plants that have been defined as pests by law or regulation. Noxious weeds are typically those plants considered as being detrimental to agriculture, wildlife, or public health. As discussed herein, noxious weeds are specifically defined as those plant species listed on the State of Nevada Noxious Weed List (Nevada Department of Agriculture, 2006) provided in **Appendix B**. Additional non-native plant species, which are not currently listed as noxious weeds, also occur in the project area. These plants have been introduced into the region and although they are not listed specifically as noxious weeds, they do have the potential to significantly reduce habitat quality in the areas where they occur. All non-native plants (see Ryan, 2005) can be thought of as invasive species and may be considered for control under the Weed Management Plan.

The purpose of this Weed Management Plan is to provide steps which will limit the effects of weeds within the project area and adjacent lands as a result of the Proposed Action. The plan proposes activities which are to be completed before, during, and after construction.

The Power District is ultimately responsible for the implementation of the Weed Management Plan; however, all contractors and sub-contractors involved in the project should be familiar with the stipulations of the plan.

Since the majority of lands within and surrounding the project area are administered by the BLM, BLM guidelines have been used in the development of the Weed Management Plan described herein. This Weed Management Plan has been developed in consultation with Nora Caplette, the former BLM LVFO Weed Management Specialist. The BLM LVFO has prepared the LVFO Weed Plan (Bartz, 2006) that provides guidance for an active integrated weed management program using best management practices (BMPs). The BMPs originated from a cooperative effort between BLM and other Federal agencies which produced the document, Partners Against Weeds (BLM, 1996).

The management of weeds is further guided by the Las Vegas Resource Management Plan (BLM, 1998) which identifies two objectives for resource management involving weeds:

1) RP-1-f states; “Use integrated weed management techniques to control and eradicate tamarisk, such as burning, chemical, biological or mechanical treatments, where potential for treatment is good. Rehabilitate the area with native species to help reduce the potential for tamarisk re-establishment and improve ecosystem health.”

2) VG1 states; “Maintain or improve the condition of the vegetation on public lands to a Desired Plant Community or to a Potential Natural Community.” Meeting these objectives will help to insure that the Proposed Action will not lead to a deterioration of the habitat quality in and surrounding the action area.

1.2 Goals and Objectives

Weeds are seen as a major threat to ecosystem health in southern Nevada. The presence of weeds in any landscape increases the inter-specific competition for resources. In most situations weeds out-compete native plants and displace them.

The goal of weed management is to implement early detection, containment, and control leading to eradication of noxious and invasive weeds during and following construction. The objective of the Weed Management Plan is to prevent the spread of noxious and invasive weeds in and adjacent to the project area, and to maintain noxious weed populations by restricting them to their current size or smaller.

Noxious and invasive weeds are opportunistic plants which grow quickly in disturbed areas and have the potential to spread into natural areas where they compete with for natural resources and may even displace native plants. Noxious weeds have the potential to significantly alter the habitats in which they grow. For instance, the abundance of non-native grasses, including red brome (*Bromus rubens*), cheatgrass (*B. tectorum*), and Mediterranean grass (*Schismus* spp.), which are well established in the project area, may increase as a result of construction activities. Once established, these grasses flourish increasing the potential for fire. Fire events lead to increased disturbance further enhancing the threat posed by invasive plants. As native plants are displaced, reliable food sources for native animal populations diminish further disrupting the natural balance of the ecosystem.

Monitoring and maintenance, during and following construction, involves the identification of potential noxious/invasive weeds in areas within and adjacent to the construction project. Of primary concern are those weed species not well established in the project area. It is also critical to keep those weeds which are well established from spreading to new areas. The Weed Management Plan focuses on preventive measures aimed at reducing the threat of a weed infestation, and on proactive measures aimed at controlling populations of noxious weeds once they are observed. Weed infestations noted during and following construction may be controlled primarily using mechanical means (such as by pulling or using hand tools) and require regular monitoring to insure successful control. All equipment and vehicles entering the project area need to be clean and free of weeds which may be brought onto the job-site. Likewise, weed wash stations can be implemented at key exit points to prevent weed parts and seeds from leaving currently infested areas. Further, all workers can be educated in the importance of weed management and the need to eliminate the spread of noxious and invasive weeds.

Table G-1. Noxious Weeds and Other Non-Native Plant Species Observed in the Overton Power 9-Year Plan Project Area.

SCIENTIFIC NAME	COMMON NAME	USDA CODE*
Noxious Weeds		
Brassica tournefortii	Sahara mustard	BRTO
Centaurea melitensis	Malta star thistle	CEME2
Sorghum halepense	Johnson grass	SOHA
Tamarix aphylla	Athel tamarisk	TAAP
Tamarix chinensis	saltcedar	TACH2
Other Non-native Plants		
Amaranthus albus	tumbleweed	AMAL
Avena fatua	wild oat	AVFA
Bassia (*Kochia*) *scoparia*	burningbush	BASC5
Bromus diandrus	ripgut brome	BRDI3
Bromus rubens	red brome	BRRU2
Bromus tectorum	cheatgrass	BRTE
Convolvulus arvensis	bindweed	COAR4
Cycloloma atriplicifolium	winged pigweed	CYAT
Cynodon dactylon	Bermuda grass	CYDA
Descurainia sophia	herb sophia	DESO2
Erodium cicutarium	redstem storksbill, filaree	ERCI6
Helianthus annuus	common sunflower	HEAN3
Herniaria hirsuta	hairy rupturewort	HEHI7
Hordeum spp.	barley grasses	HORDE
Lactuca serriola	wild lettuce	LASE
Malcolmia africana	African mustard	MAAF
Melilotus indicus	sourclover	MEIN2
Morus alba	white mulberry	MOAL
Opuntia engelmannii var. *linguiformis*	cactus apple	OPENL2
Parkinsonia aculeata	Jerusalem thorn	PAAC3
Physalis angulata var. *lanceifolia*	cutleaf groundcherry	PHANL2
Plantago major	common plantain	PLMA2
Polypogon monspeliensis	annual rabbitsfoot grass	POMO5
Salsola sp.	Russian thistle	SALSO
Schismus sp.	Mediterranean grass	SCHIS
Sisymbrium altissimum	tumble mustard	SIAL2
Sisymbrium irio	London rocket	SIIR
Sonchus asper	sow-thistle	SOAS
Xanthium strumarium	cocklebur	XAST

USDA, NRCS. 2012. The PLANTS Database (http://plants.usda.gov, 3 January 2012). National Plant Data Team, Greensboro, NC.

2.0 WEED INVENTORY

Visits to the project area began in the fall of 2007 to identify habitat and map existing power line rights-of-way. Botanical surveys of the project area began in the spring of 2009 and continued into summer 2011. Methods used to identify noxious and invasive weeds and results of the surveys are included in the botanical report of the project area (K&LA, 2011). Weed observations were made during each phase of the botanical surveys (cactus surveys, rare plant surveys, etc.). The entire length of the project ROW was observed, including all access roads. GPS points were specifically taken for all State of Nevada noxious weeds observed during the botanical surveys except for Sahara mustard (*Brassica tournefortii*), which was widespread in the project area. GPS points were recorded using a Garmin 12-channel GPS unit. GPS points were also taken at locations where Sahara mustard was particularly abundant.

Maps showing the specific locations of noxious weeds and the general locations of other non-native plant species observed during the botanical surveys are included in **Appendix A** (**Maps A-2 to A-35**). In all, five noxious weeds and 29 additional non-native plant species were recorded. Table **G-1** provides a list of the non-native plants which were observed during the survey period.

2.1 Noxious Weeds

Five State of Nevada noxious weeds were observed in the project area and are listed on Table 1. These were Sahara mustard, Saltcedar (*Tamarix chinensis*/*ramosissima*), Athel tamarisk (*Tamarix aphylla*), Malta star thistle (*Centaurea melitensis*), and Johnsongrass (*Sorghum halepense*). The State of Nevada Noxious Weed List in **Appendix B** indicates the current designation of each of these weed species. A fact sheet, produced by the University of Nevada Cooperative Extension (UNCE), on each of these species, is also located in **Appendix B**.

Sahara mustard (**Figure G-1**) is widely scattered throughout the project area in both disturbed and native locations. The distribution of Sahara mustard is shown on **Map A-2 in Appendix A**. Sahara mustard is most abundant in sandy habitats and has formed dense populations in several areas, especially near roadways. This is an especially aggressive weed which has spread quickly through the region over the past decade. **Map A-3 in Appendix A** shows areas of high density Sahara mustard in the project area where concentrations of this weed were noted as being particularly high.


Figure G-1. Sahara Mustard. *This noxious weed is common in the project area, especially in sandy soils. It was most abundant near roadways where it was frequently observed forming dense populations.*

Saltcedar is common in riparian habitats, forming dense thickets along the Virgin and Muddy Rivers, in Meadow Valley Wash, and adjacent to Bowman Reservoir. **Figure G-2** shows the density of saltcedar within the Muddy River floodplain south of Overton. Saltcedar was also observed in scattered populations throughout the project area where water has been available long enough for it to become established. Athel tamarisk is another species of tamarisk which is generally much larger than saltcedar. In the project area it was located adjacent to SR-169 near the Simplot Silica Sand Operation. Athel tamarisk can be seen as the large tree in **Figure G-3** where it is growing within the existing power line ROW. **Map A-4 in Appendix A** shows the distribution of tamarisk species in the project area.

Figure G-2. A dense thicket of saltcedar within the Muddy River floodplain south of Overton. *The road in the center left portion of the image is Lewis Avenue which is within the proposed ROW.*

Figure G-3. A large Athel tamarisk *(at right in above photo) was observed along SR-169 near the Simplot Silica Sand Operation. Saltcedar was also common in the area.*

The distribution of **Malta star thistle** (**Figure G-4**) is shown on **Map A-5 in Appendix A**. Malta star thistle was observed at multiple locations on Mormon Mesa along both sides of the Arrowhead Highway, the old highway (US-91) which was replaced by and parallels I-15 in the area. It was primarily noted in somewhat barren, clay soils in low lying areas where water tends to collect following rain events. Malta star thistle was also noted on Lewis Avenue adjacent to the Muddy River and south of Overton along SR-169. **Figure G-4** shows one particularly large population of dry plants observed south of Lamar Avenue on the east side of the highway.

Figure G-4. A dense population of dry Malta star thistle along SR-169 south of Overton. *Additional groups of Malta star thistle as well as other non-native plants were observed along this stretch of highway between Overton and the Simplot Silica Sand Operation. Saltcedar can also be observed along both sides of the highway in the photo. The inset shows a picture of the flower head of Malta star thistle from a small population observed along the Arrowhead highway, also within the ROW.*

The **Johnsongrass** seen in **Figure G-5** was another species of noxious weed which was observed in the project area along the road shoulders of SR-169. It was also noted near the intersection of SR-169 and Lewis Avenue in Overton. This is a common noxious weed found near agricultural fields throughout the Moapa Valley. It appears to grow best in areas with relatively moist soils and is probably not a considerable threat in most portions of the project ROW. The distribution of Johnsongrass in the project area is shown on **Map A-6 in Appendix A**.

Other State of Nevada noxious weeds, which were not observed during the project surveys, are common in the rural communities near the project area. Russian knapweed (*Acroptilon repens*), Scotch thistle (*Onopordum acanthium*), white horse-nettle (*Solanum elaeagnifolium*), and puncture vine (*Tribulus terrestris*) have all been noted (Swearingen 1981, Powell 2001, personal observations). All noxious weeds are capable of growing and spreading quickly under favorable circumstances and they could easily be transported into or out of the action area by persons or construction vehicles and equipment. The utmost care should be taken by all employees to prevent the further spread of these invasive plants.

Figure G-5. Johnsongrass observed south of Overton along the shoulders of SR-169. *Tamarisk can also be seen in the upper right hand corner of the photo.*

2.2 Additional Non-Native Plants

Twenty-nine additional non-native plant species were recorded during the plant surveys and are listed in **Table G-1. Maps A-7 to A-35 in Appendix A** show the general distribution of each of these weeds in the survey area. The maps are arranged alphabetically by scientific name.

Russian thistles (probably both *Salsola tragus* and *S. paulsenii*), African mustard (*Malcolmia africana*), red brome, Mediterranean grass, and filaree (*Erodium cicutarium*) are all invasive, non-native species which are problematic, well established, and common throughout the project area. Less common weeds which are still well established in specific locations and are also of particular concern include cheatgrass, barley grasses (*Hordeum* spp.), London rocket (*Sisymbrium irio*), and cocklebur (*Xanthium strumarium*). Several species were observed, fairly close to developed areas, which are familiar weeds in urban/agricultural areas, but do not yet appear to be invading native habitats. These included wild oats (*Avena fatua*), burningbush (*Kochia scoparia*), bindweed (*Convolvulus arvensis*), Bermuda grass (*Cynodon dactylon*), common sunflower (*Helianthus annuus*), and wild lettuce (*Lactuca serriola*). The remaining non-native species which were noted do not appear to be either widespread or particularly troublesome at this time.

A few observations, however, are of some interest. **Hairy rupturewort** (*Herniaria hirsuta*, **Figure G-6**) was noted on Mormon Mesa east of the Carp/Elgin exit. This is a small prostrate annual species which grows to about 8 inches in length. This non-native plant was quite common in disturbed areas with silty to clay soils between the Arrowhead Highway and I-15. Hairy rupturewort is not listed in any of the local resources consulted during this inventory and it may be the first recorded sighting of this non-native plant in southern Nevada. Its potential as an

invasive weed in the region is yet to be determined. It is not listed as a noxious weed in either California or Arizona, where it is also known to occur, but it is at times listed as an invasive plant (see Bowers, Bean, & Turner, 2006).

Figure G-6. Hairy rupturewort in clay and silty soils northeast of the Carp/Elgin exit along the old Arrowhead Highway. *This non-native species does not appear to be well documented in Southern Nevada.*

Cactus apple (*Opuntia engelmannii* var. *linguiformis*) is a non-native cactus which is commonly grown as an ornamental landscaping plant. On two occasions, this non-native cactus was observed in discarded landscaping debris and was growing in the areas in which it had been left in the desert as can be seen in **Figure G-7**. These observations were made near the proposed Dugway substation near the Mormon Mesa Road and adjacent to an access road near SR-169 between the Simplot Silica Operation and "Snowbird" Mesa. It is unclear as to the threat that this may pose to the eventual distribution of this non-native plant. Presently it does not appear that cactus apple is capable of becoming established in native habitats in the area, however, its ability to easily grow from discarded yard clippings is somewhat alarming. This is a situation which may be worth further review.

Figure G-7. Cactus apple, a common ornamental cactus, observed twice along the ROW in discarded landscaping debris. *In both instances, sections of the discarded cactus were rooted in the soil and developing new growth. It is uncertain as to the potential for cactus apple to survive for longer periods or to spread in the area.*

Winged pigweed (*Cycloloma atriplicifolium*) does not appear to be common in the area, but was noted at several locations in sandy soils east of Logandale. Swearingen describes this plant as being infrequent at disturbed locations in her 1981 *Flora of the Muddy Mountains*. Our observations were all from undisturbed soils adjacent to sandy washes. Winged pigweed is not listed in the Checklist of Non-Native Plants of Southern Nevada (Ryan, 2005). This may be due to the fact that it is native to the central United States. Its distribution is described as expanding (see Flora of North America Editorial Committee, 1993+). Swearingen (1981) and Baldwin et al. (2002) both list this plant as non-native. It does not appear that this species poses a particular threat to native habitats at this time; however, its distribution is worth noting for future reference.

Many non-native and invasive plants occur in the communities and along the roadways surrounding the project area which further increases the potential for introduction of new or additional weeds into native habitats. Swearingen listed 80 non-native species in her *Vascular Flora of the Muddy Mountains, Clark County Nevada* (1981). Many of these were identified from the rural areas surrounding Logandale and Overton. The plant checklist for Lake Mead National Recreation Area (Powell, 2001) includes over 110 species of non-native plants. Overall, the risk for transport of weeds, weed seeds, and weedy plant materials into and within the project area is high.

2.3 Weed Hot Spots

Weeds were most common along roadways and in areas with visible disturbances. As noted (**Map A-3 in Appendix A**), Sahara mustard is very common in several areas. The portions of the project area adjacent to I-15 were especially overgrown with mustard. Dense populations

were also recorded in Toquop wash (including the terraces to the west), along Mormon Mesa Road, and near the Sandhill Substation. Two additional locations were also noted as being particularly weedy. These were near the utilities corridor west of Glendale and adjacent to SR-169 south of Overton. Both areas had a wide variety and a high concentration of non-native species.

Several projects including power lines and pipelines have been constructed along the utilities corridor and the area has been heavily accessed by the general public. Weeds here included Russian thistles, brome grasses (*Bromus* spp.), barley grasses (*Hordeum* spp.), Mediterranean grass, Sahara mustard, African mustard, filaree, herb sophia (*Descurainia sophia*), and London rocket. Some species native to the region at large, but not native here, have also been introduced, perhaps during recent seeding efforts. California poppy (*Eschscholzia californica*) and desertbells (*Phacelia campanularia*) were specifically noted.

The roadsides of SR-169 south of Overton are also very weedy. Long term public use; development, including roads, buildings, and a rail line to the Simplot Mining Operation; and exposure to a fairly consistent water source are all factors influencing weeds in this area. Standing water was noted on multiple visits and a reliable water source was further evidenced in the presence of weeds such as saltcedar, Johnsongrass, cocklebur, common sunflower, and cutleaf groundcherry (*Physalis angulata* var. *lanceifolia*). Malta star thistle, Russian thistle, red brome, barley grass, Mediterranean grass, African mustard, London Rocket, wild oats (*Avena fatua*), burningbush (*Bassia scoparia*), bindweed (*Convolvulus arvensis*), Bermuda grass (*Cynodon dactylon*), wild lettuce (*Lactuca serriola*), Jerusalem thorn (*Parkinsonia aculeata*), and common plantain (*Plantago major*) were also found in this area. In the fall, large numbers of the native alkali goldenbush (*Isocoma acradenia* var. *eremophila*) line both sides of the roadway. The road shoulders appear to be regularly graded (personal observations), but weeds are persistent and even flourish.

3.0 WEED MANAGEMENT

3.1 Pre-Construction Actions

The Power District will provide information to all contractors and subcontractors regarding noxious weed management and identification. All personnel should be provided with weed training to educate them on the effects of noxious and invasive weeds and basic measures each worker should follow to prevent the spread of weeds. Since the project area is located within the range of the federally threatened desert tortoise (*Gopherus agassizii*), all weed personnel are to complete desert tortoise training to educate them on responsibilities of working in desert tortoise habitat.

Prior to beginning construction, all populations of Malta star thistle, Russian knapweed (if observed), and hairy rupturewort occurring in the project area, are to be treated using approved methods. Sahara mustard, common cocklebur, and Johnson grass will also be treated if noted in areas that will be disturbed or driven through. Mechanical treatment methods are preferred over herbicides due to unresolved risks of pesticide use in desert tortoise habitat. However, species such as Russian knapweed has a creeping root system so mechanical removal can actually propagate the population. Also, populations of other weeds that are too large to treat mechanically should be treated with herbicide. Weed parts may be left in place after mechanical removal as long as seeds have not developed; otherwise all plant material should be bagged and disposed in and approved landfill. All herbicide treatments are to be coordinated with the BLM LVFO Weed Management Specialist (702-515-5000). If herbicides are used, a Pesticide

Use Proposal Form (PUP) is to be submitted to the BLM LVFO Weed Management Specialist prior to application and a Pesticide Application Report (PAR) is to be submitted to the BLM LVFO Weed Management Specialist following application. Blank PUP and PAR forms are provided in **Appendix C**.

Prior to beginning work and during all phases of construction, areas regarded as high risk for the spread of noxious weeds will be cordoned off or flagged by the Power District to prevent access until weed management control efforts have been implemented.

3.2 Preventive Measures

In accordance with the LVFO Weed Plan approved December 2006, the following preventive management measures are mandatory for this project.

a) The Weed Risk Assessment and the Weed Management Plan, when approved and signed by the BLM LVFO Weed Management Specialist, shall be submitted concurrently and included in the NEPA documentation. These documents provide specific information about the types of weed surveys to be conducted and the methods of weed treatments and weed prevention schedules for the management of weeds on the project footprint. This will identify the level of noxious weed management necessary. The weeds that are of greatest concern are those weeds listed on the State of Nevada Noxious Weed List. The recent introduction of hairy rupturewort into the area is also of concern and is to be considered as a potential threat. It is important during the project to prevent weed species which presently occur in the project area from spreading into new areas. Several invasive weed species, including Malta star thistle, cheatgrass, Bermuda grass, and cocklebur, presently occur within the project area in relatively low densities. Additional noxious weeds including Russian knapweed, Scotch thistle, white horse-nettle, and puncture vine have been observed near the project area. Containment of these species is a primary goal of the Weed Management Plan.

b) The Power District shall coordinate project activities with the BLM Weed Management Specialist (702-515-5000) regarding any proposed herbicide treatment. The Power District shall prepare, submit, obtain and maintain a pesticide use proposal (PUP) for the use of any herbicides in the project area.

c) Before ground-disturbing activities begin, the Power District shall review the weed risk assessment and this Weed Management Plan which inventories and prioritizes weed infestations for treatment within the project foot print. Should weeds spread beyond the project foot print then these will be treated as a part of the project. This is to include all access routes.

d) The Power District shall limit the size of any vegetation and/or ground disturbance to the absolute minimum necessary to perform work activities safely and as designed. The Power District will avoid creating soil conditions that promote weed germination and establishment.

e) The Power District shall begin project operations in weed free areas whenever feasible before operating in weed-infested areas.

f) The Power District shall locate equipment storage, machine and vehicle parking or any other area needed for the temporary placement of people, vehicles, machinery and supplies in areas that are relatively weed-free. The Power District shall avoid or minimize all types of travel through weed-infested areas or restrict major activities to periods of time when the spread of seed or plant parts are least likely.

g) The Power District is responsible for ensuring that all project related vehicles and equipment arriving at the site do not transport noxious weeds into the project area. The operator shall ensure that all such vehicles and equipment that will be traveling off constructed and maintained roads or parking areas within the project area have been power washed, including the undercarriage, since their last off road use and prior to off road use on the project. When beginning off road use on the project, such vehicles and equipment shall not harbor soil, mud, or plant parts from another locale.

h) The Power District will be required to have on-site wash areas identified and readily available for equipment and vehicles leaving the project area. All equipment and vehicles traveling through weed infested areas shall be power washed (**this especially includes the nooks and crannies of undercarriages**) prior to leaving the site, at established, identified wash areas. Wash water and sediment shall be contained in a catchment basin. Seeds and plant parts will be collected, bagged and deposited in dumpsters destined for local landfills. Cleaning areas shall be inspected regularly for the presence of undesirable weed species. If observed, these are to be appropriately controlled.

i) Project workers shall inspect, remove, and dispose of weed seed and plant parts found on their clothing and personal equipment, bag the product and dispose of such in a dumpster for deposit in local landfills.

j) The Power District shall evaluate options, including area closures, to regulate the flow of traffic on sites where native vegetation needs to be established.

k) The Power District will insure that all straw or hay bales used during the project, such as for sediment barriers or for mulch distribution, are from state cleared sources and are certified weed free.

l) When removing topsoil from weed infested areas, the Power District shall stockpile all infested soil adjacent to areas from which it was removed. No infested topsoil will be moved to new locations or will be transported off of the jobsite.

m) Reclamation work will proceed immediately following construction as outlined in the reclamation plan. The Power District will insure that all topsoil and vegetative material which was removed from infested sites is returned to the areas from which it was stripped.

3.3 Treatment Methods

The Power District will rely primarily on mechanical treatment methods to control identified weed infestations. These methods will primarily involve the use of pulling and/or hand tools to remove weeds from infested sites. Mowing or mulching may be used to control populations in previously disturbed areas and is recommended only when the potential to distribute weed seed is minimal. Seeding of native vegetation, as approved by the BLM Weed Management Specialist, may be required for areas where heavy equipment is used to mow or mulch weed populations. The use of herbicides is to be implemented only as approved by the BLM Weed Management Specialist and requires submitting, obtaining, and maintaining a PUP prior to application and completing a PAR following application (PUP and PAR forms are included in **Appendix D**).

All treated areas are to be monitored following treatment based on the project guidelines for weed monitoring provided below.

4.0 WEED MONITORING

During construction activities and for three years following site restoration, the project footprint shall be inspected for the presence of noxious and invasive weed infestations by a qualified weed specialist approved by the BLM. Of particular concern are those invasive and non-native species not known to be well established in the project area. All treated areas are to be revisited and photo documented during each monitoring period. All observed infestations are to be recorded, photographed, and submitted to the BLM. Infestations are to be promptly and aggressively treated using the control measures discussed under treatment methods should the weed populations become larger than baseline. Inspections are to be completed at least three times annually in the early spring (prior to April 1), mid-spring (prior to May 15), and following the monsoon season in late summer or early fall (prior to September 30). A brief summary of each survey shall be prepared and submitted to the BLM.

Weed infestations which are noted by project personnel or are reported to the Power District will be promptly evaluated to determine the severity and need for control measures. These evaluations will be summarized and submitted to the BLM.

5.0 SUMMARY

It is imperative during and following construction to prevent the spread of existing weed populations. It is also of concern to prevent new species of weeds from being introduced into the construction area and vicinity. Regular monitoring for weed species allows for timely intervention and may prevent the establishment of new or existing species. The State of Nevada maintains an official Noxious Weed List (Nevada Department of Agriculture, 2006) identifying potentially threatening plant species. All plant species identified from the Nevada Noxious

Weed List are to be included for monitoring and control on the project. An additional guide to assist in identifying potentially invasive plants is the *Checklist of the Non-native Plants of Southern Nevada* produced by the UNCE (Ryan, 2005).

The Weed Management Plan provides stipulations aimed at controlling the spread of invasive weed species in the project area and vicinity. Whereas known weeds species have been identified in the project area and the project area is adjacent to undisturbed habitat, it is important that appropriate measures be applied proceeding, during, and following construction to control their spread. Furthermore, care should be taken not to introduce new species of plants into the area. Many plant species spread when seeds or plant parts are transported from one infected area into a new one. These new infestations reduce the capacity of the land to maintain healthy native plant and animal populations thus reducing the overall quality of the ecosystem at large. It is the responsibility of all individuals and companies working in Southern Nevada to maintain natural areas which provide sustainable habitats for the all persons, plants, and animals who reside here.

6.0 QUALIFICATIONS

This Weed Management Plan was completed by DeVon Ekenstam, K&LA Senior Botanist. Mr. Ekenstam has a Bachelor's of Science, in Botany, from Weber State University and a Master's of Science, in Botany, from Arizona State University. He has worked as a field biologist in the Mojave Desert since December, 2001 and has served as the lead botanist at K&LA since June, 2006. Mr. Ekenstam has worked on numerous plant surveys throughout Southern Nevada,

including a recent survey of the proposed Pahrump Valley Airport in Nye County, NV, and the proposed City of Henderson/Boulder City Regional Training and Shooting Facility.

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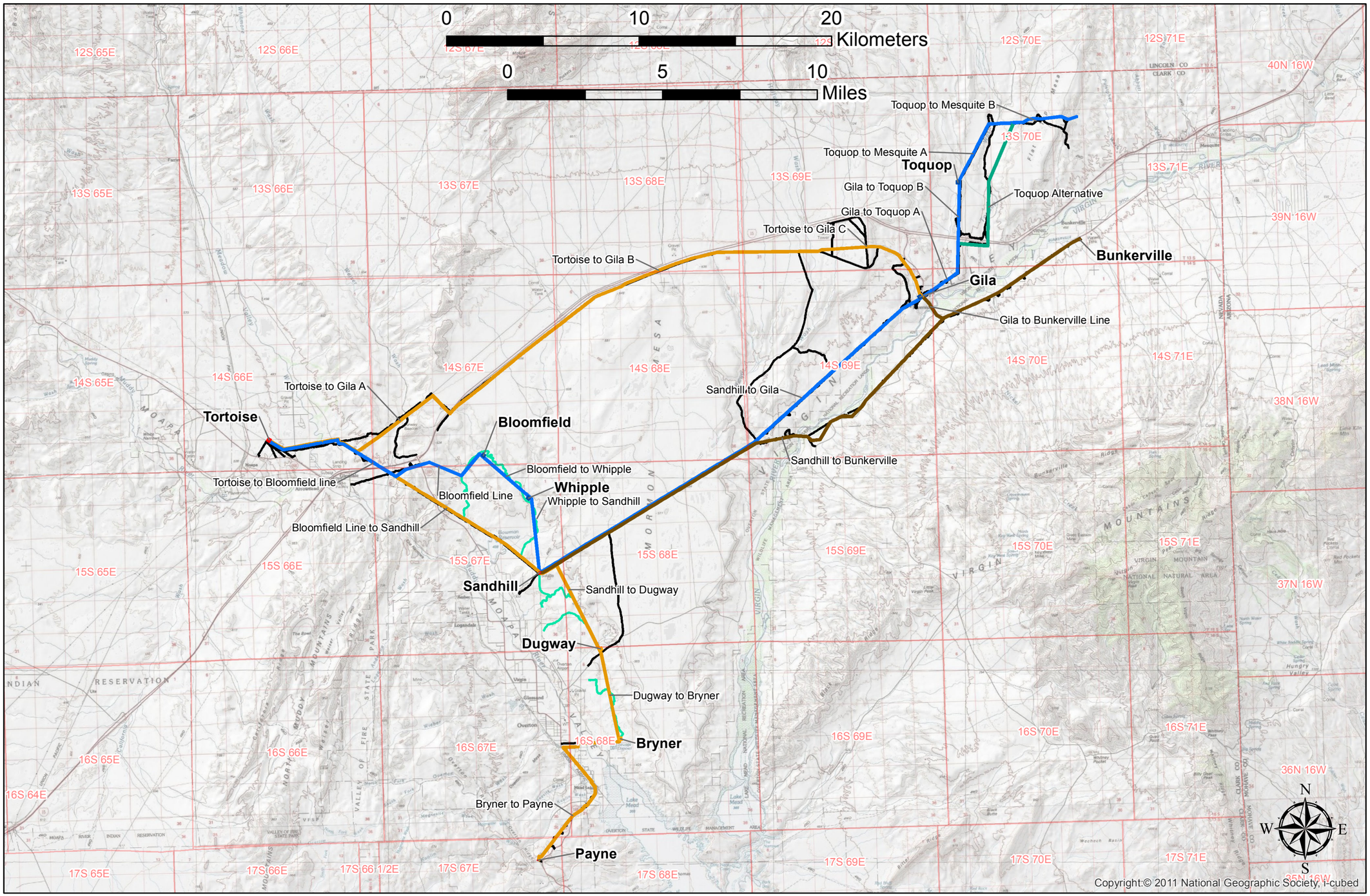
ATTACHMENT A. PROJECT AREA AND WEED DISTRIBUTION MAPS

Overton Power District #5 Transmission Line Upgrades

Project Overview Map

Base Maps: USGS 15' Series
Overton, NV (1983)
Lake Mead, NV (1983)



Legend

Substations

- 3 Year
- 9 Year
- Existing

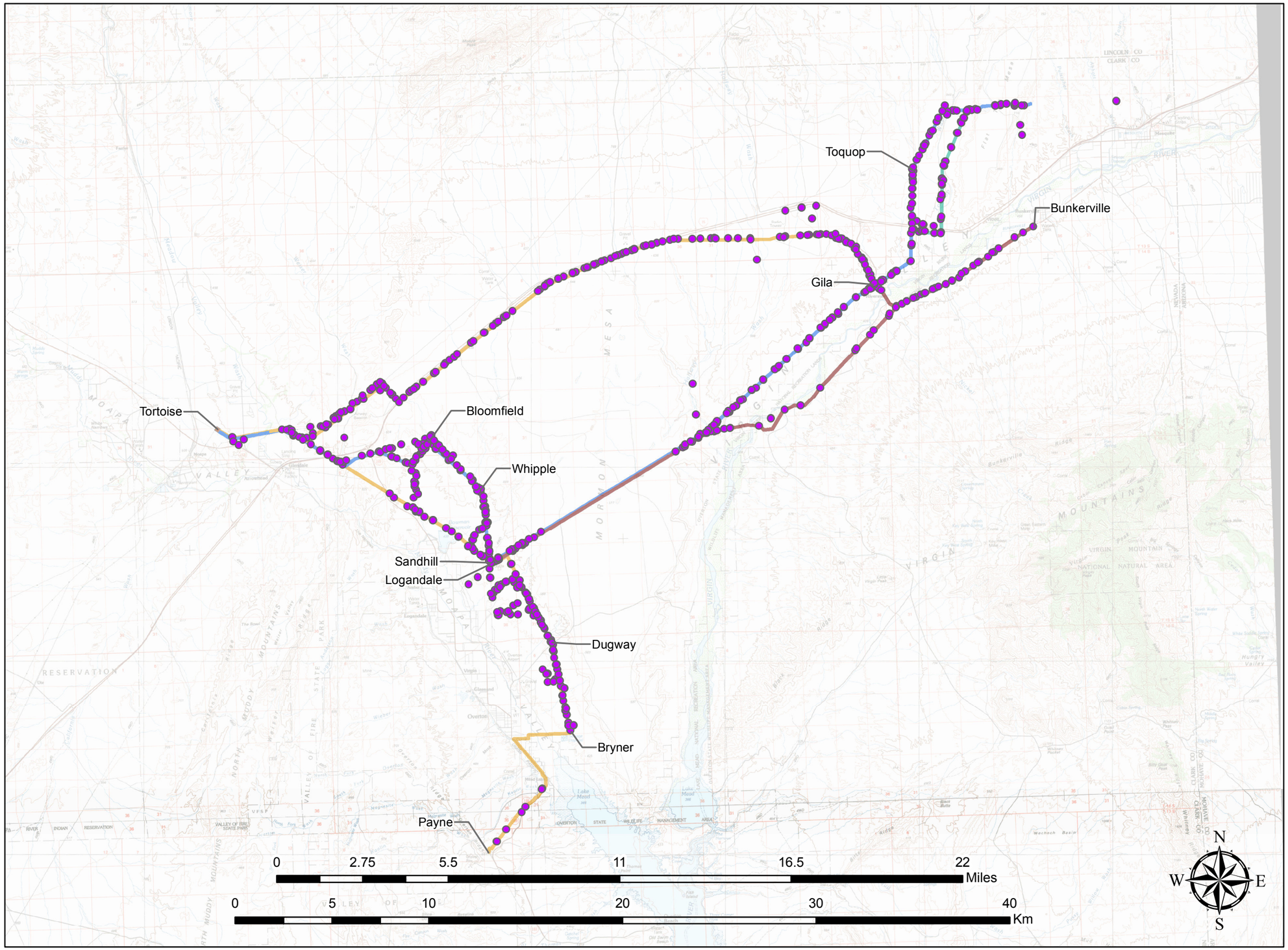
Right of Way

- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES RESEARCH SERVICES

Overton Power District #5
Planned System Upgrades
Noxious Weed
Observations

SAHARA MUSTARD
Brassica tournefortii
BRTO



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

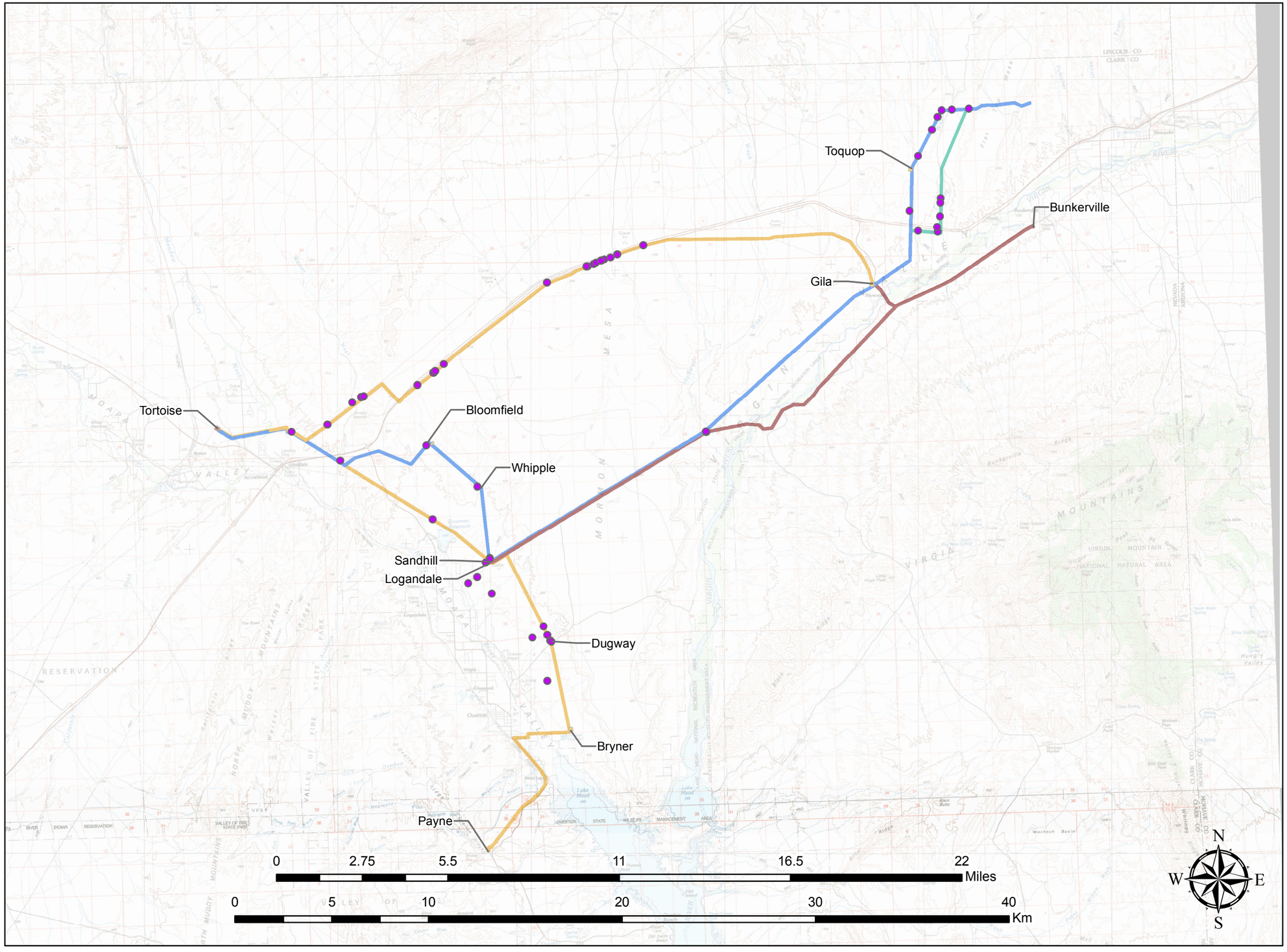
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Noxious Weed Observations

HIGH DENSITY SAHARA MUSTARD
Brassica tournefortii
BRTO



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

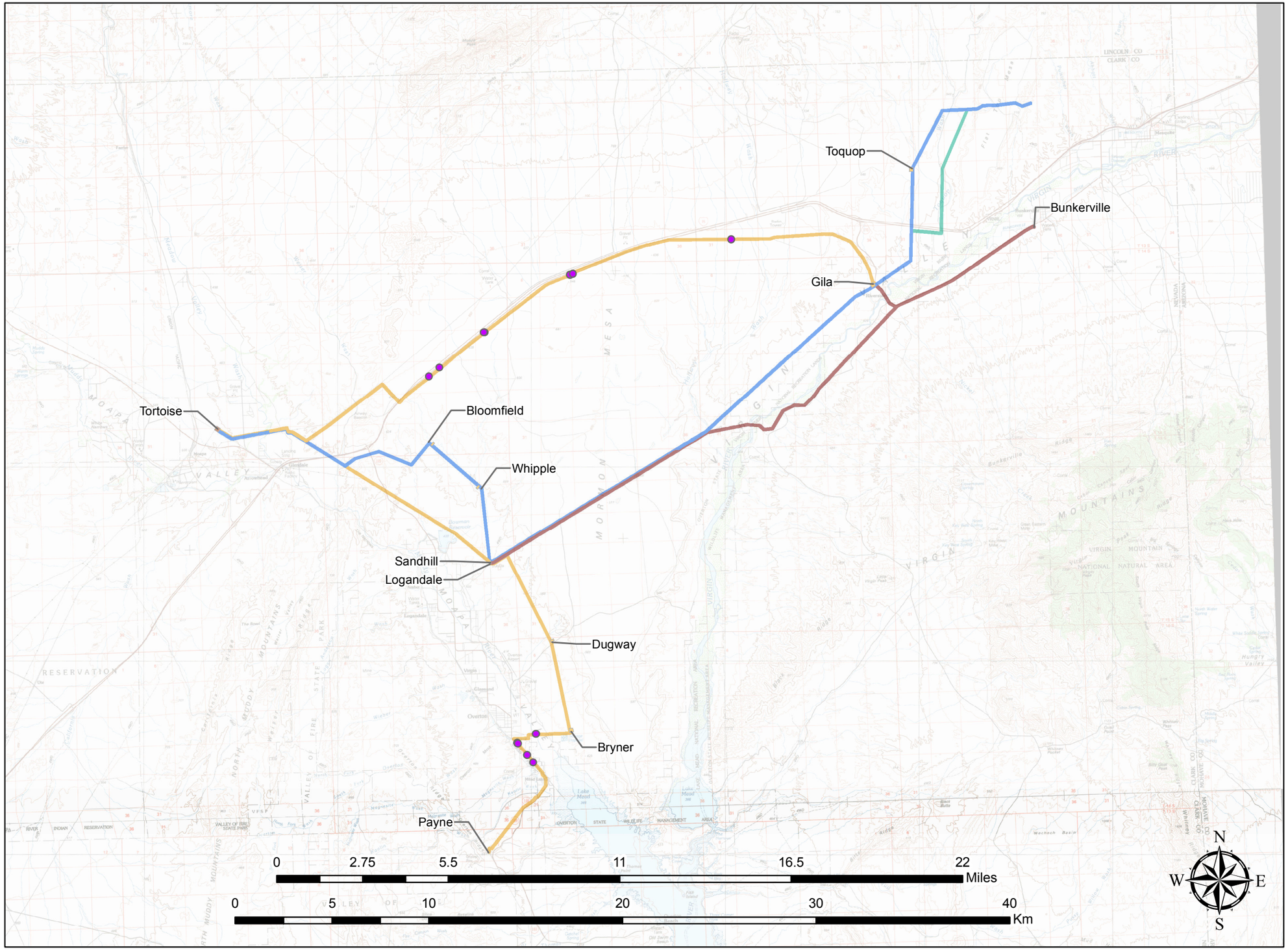
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Noxious Weed Observations

MALTA STAR THISTLE
Centaurea melitensis
CEME2



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

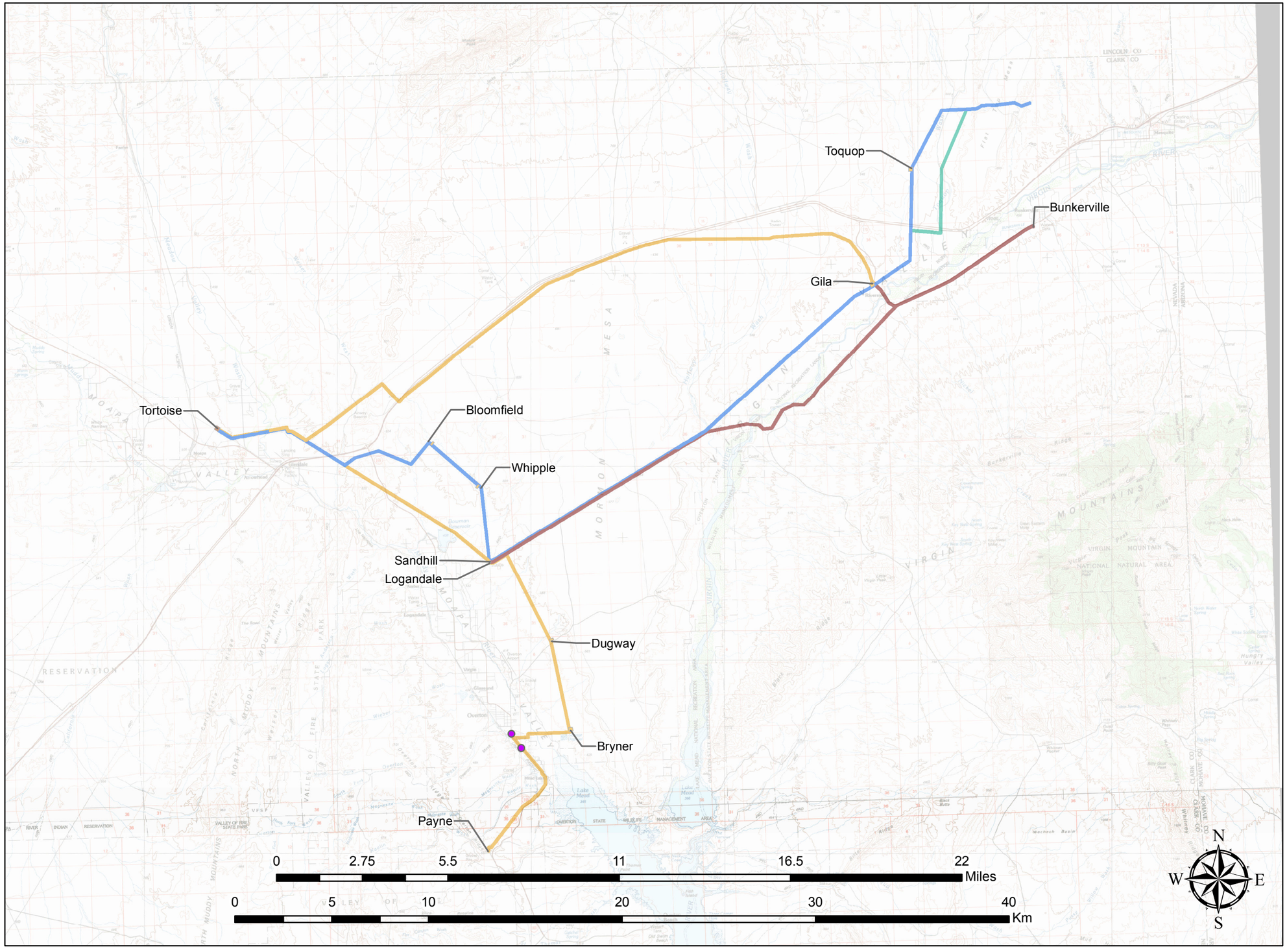
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Noxious Weed Observations

JOHNSON GRASS
Sorghum halepense
SOHA



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

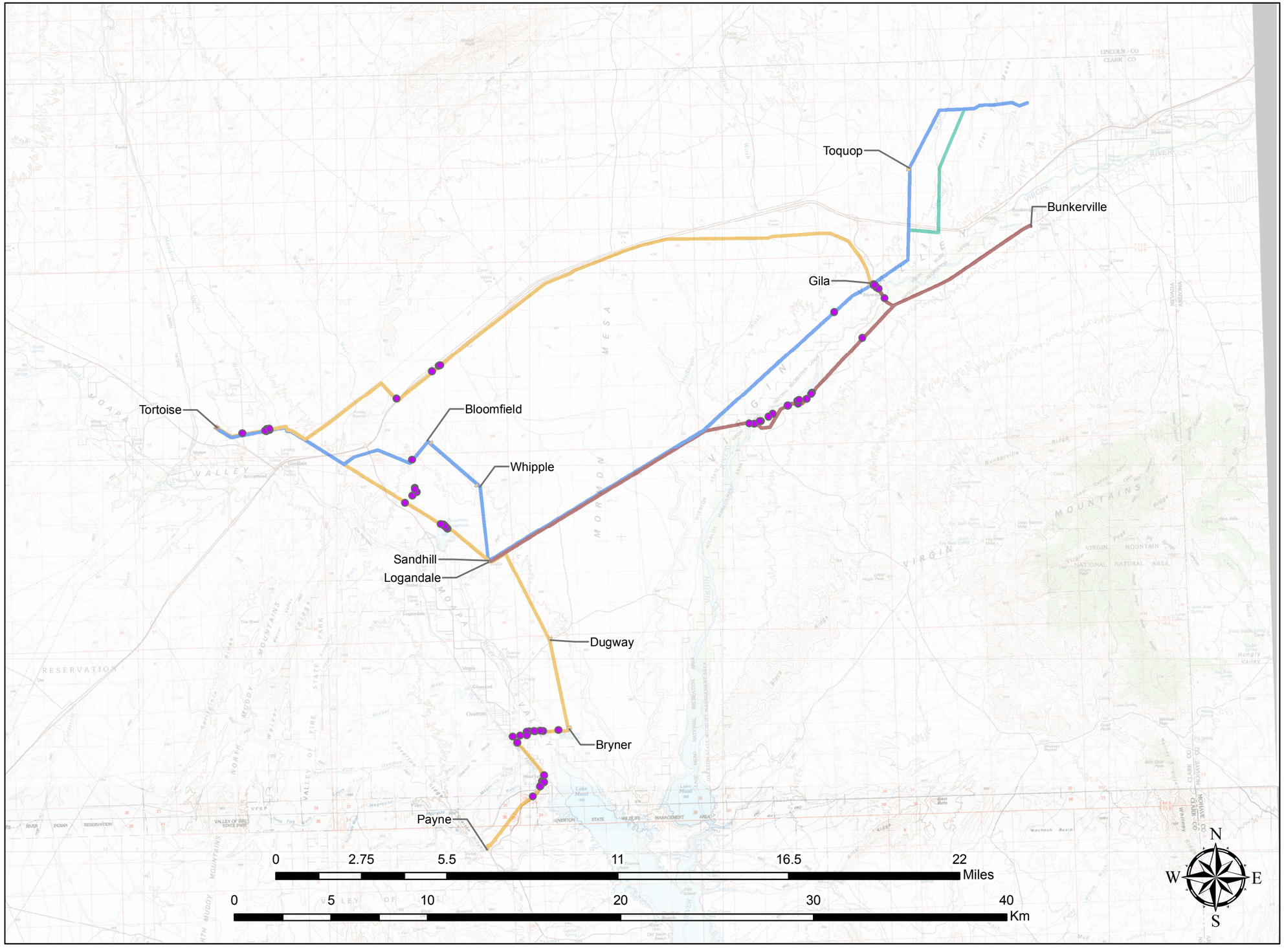
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Noxious Weed Observations

SALTCEDAR
Tamarix spp.
TAMAR2



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

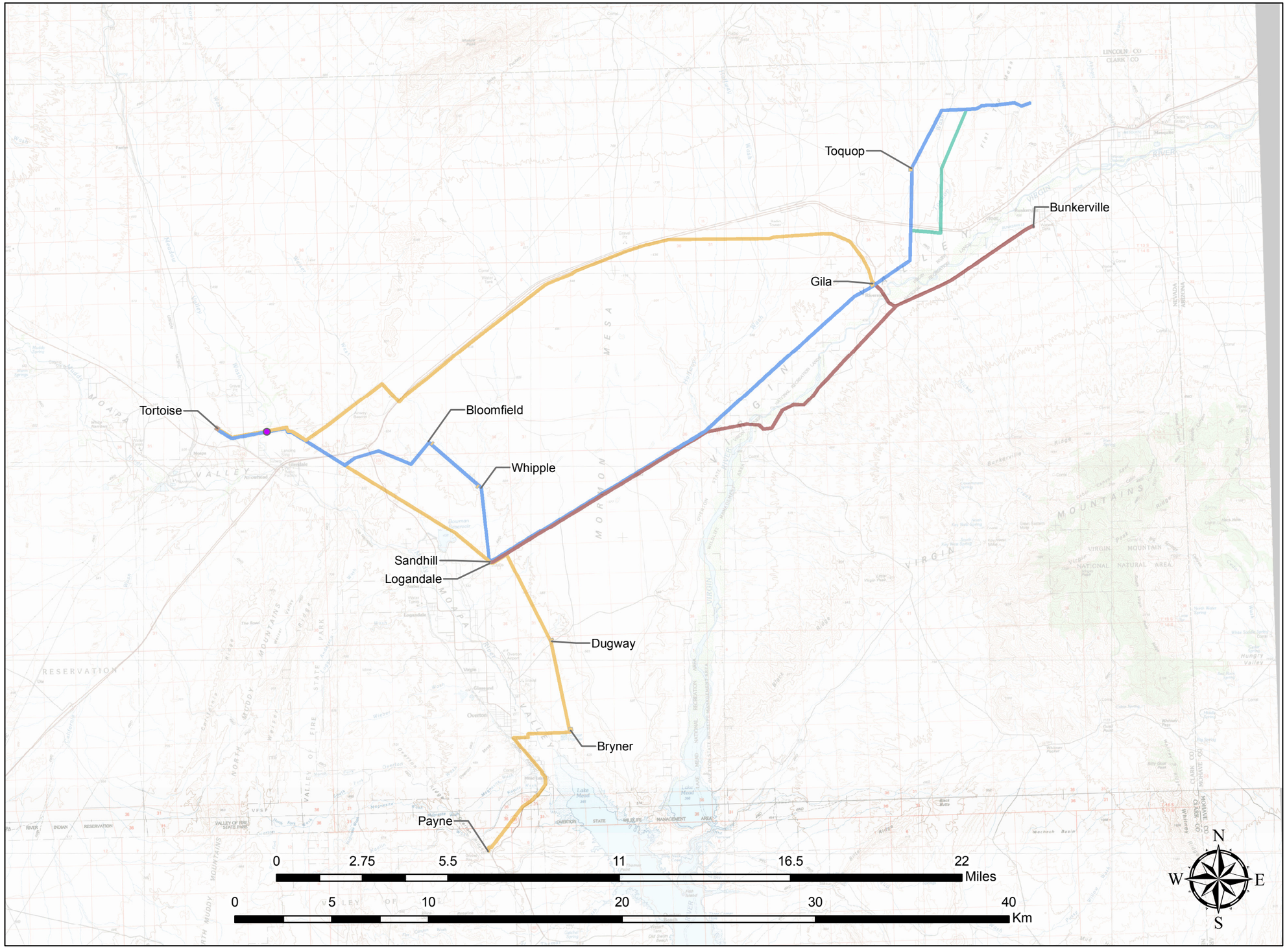
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

TUMBLEWEED
Amaranthus albus
AMAL



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

- 3 Year
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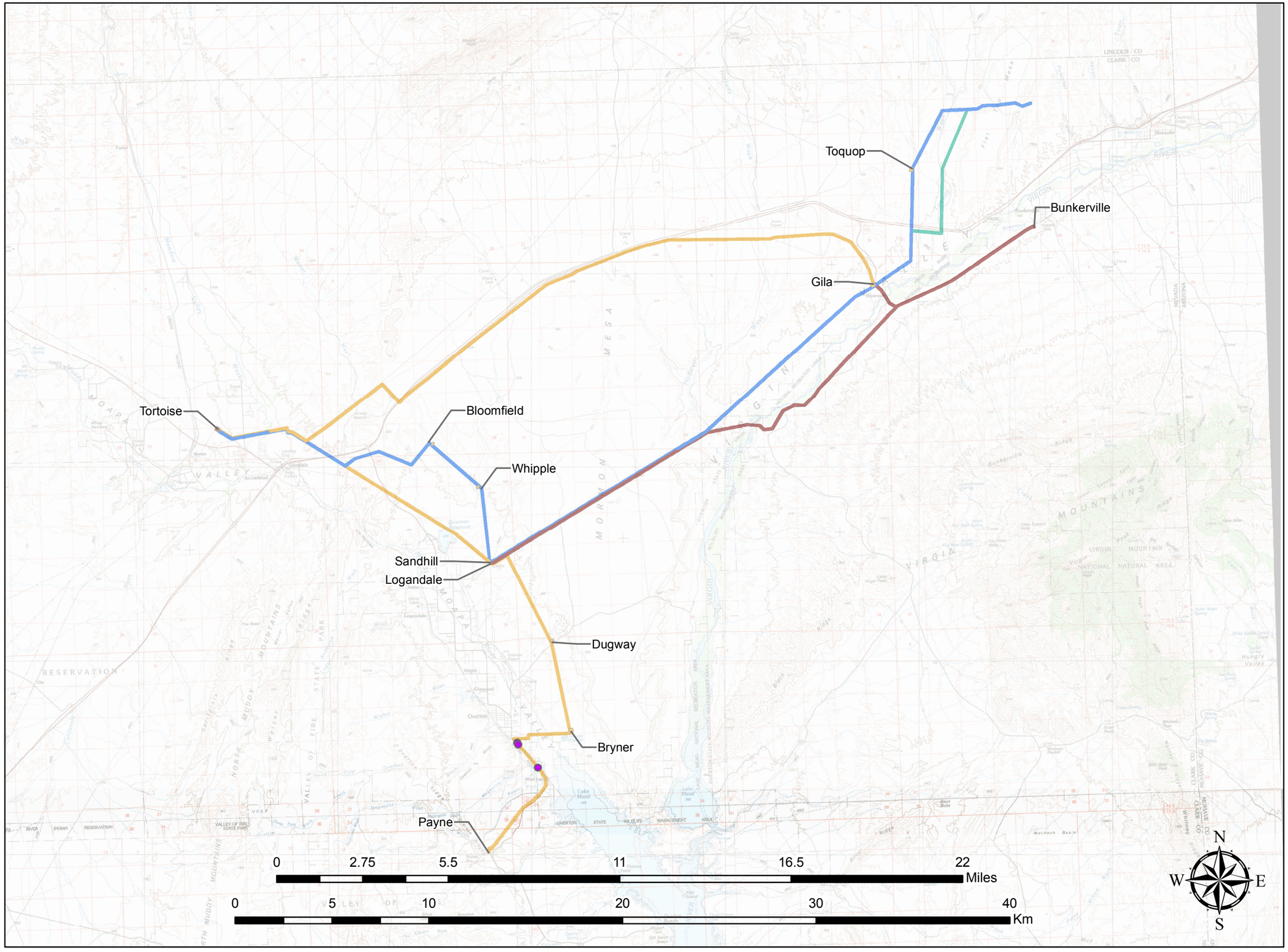
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

WILD OAT
Avena fatua
AVFA



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

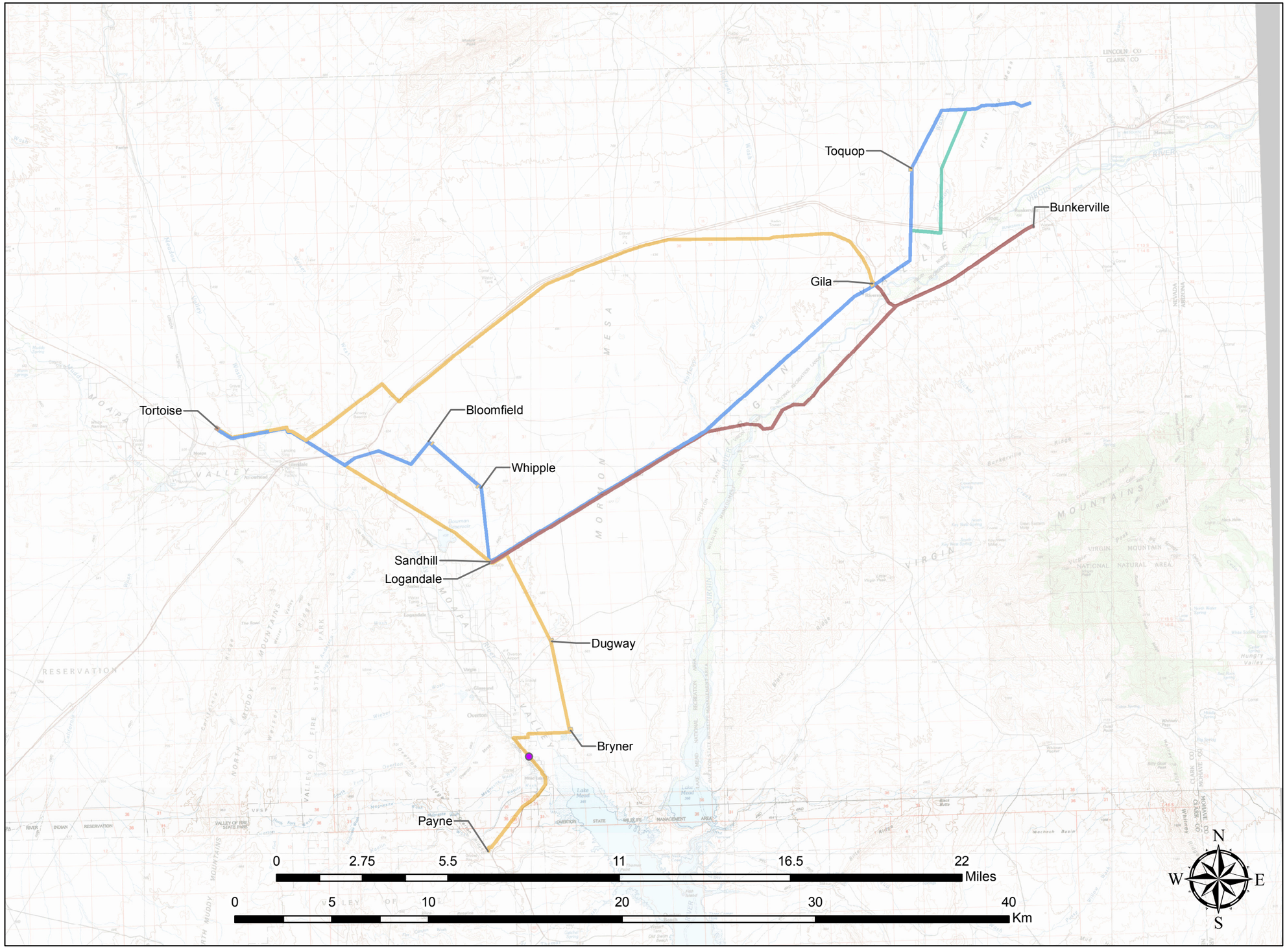
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

BURNINGBUSH
Bassia (Kochia) scoparia
BASC5



Legend

- Observations

Substations

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- Existing

Proposed ROW

- 3 Year
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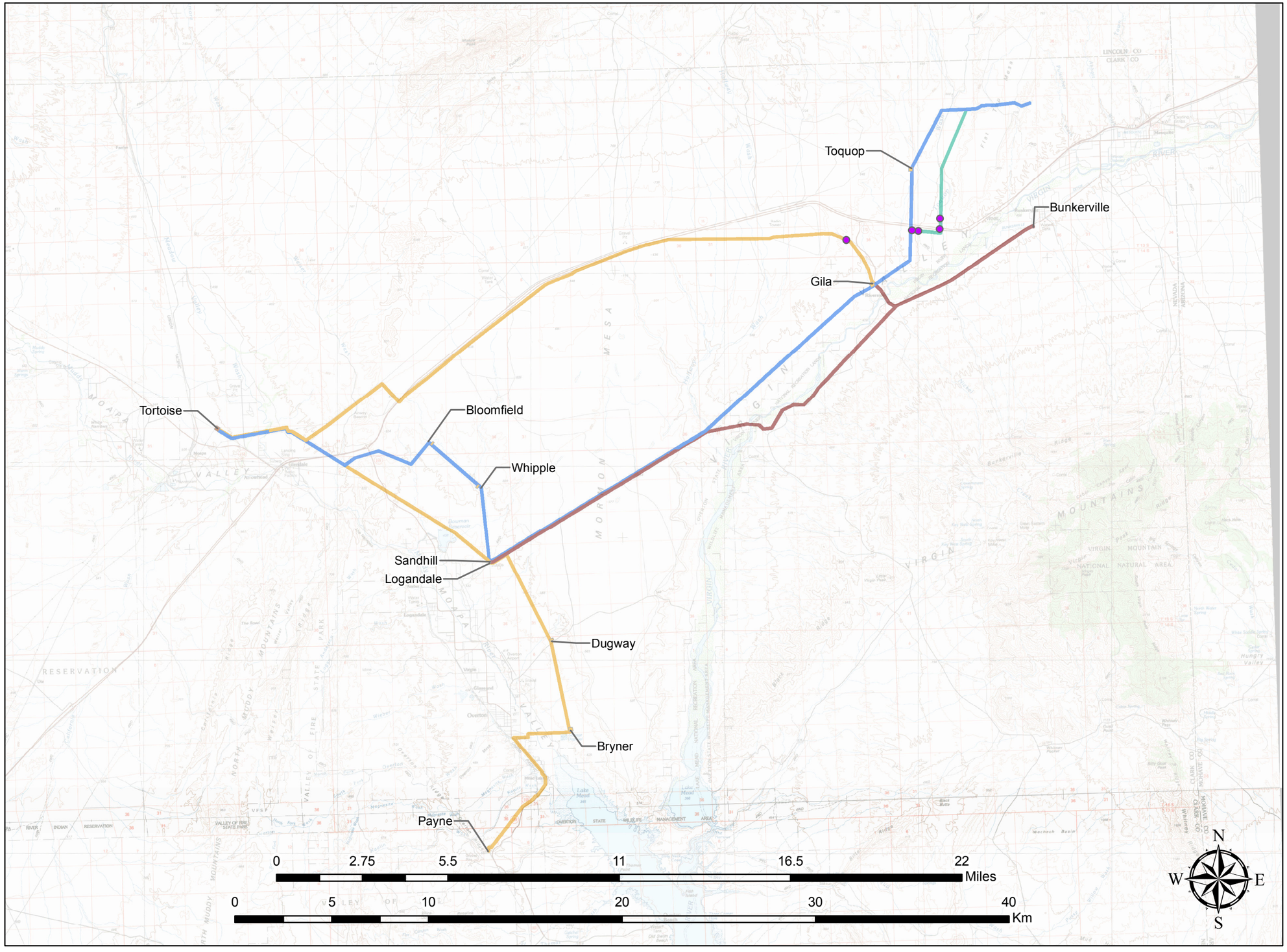
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

RIPGUT BROME
Bromus diandrus
BRDI3



Legend

- Observations

Substations

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- Existing

Proposed ROW

- 3 Year
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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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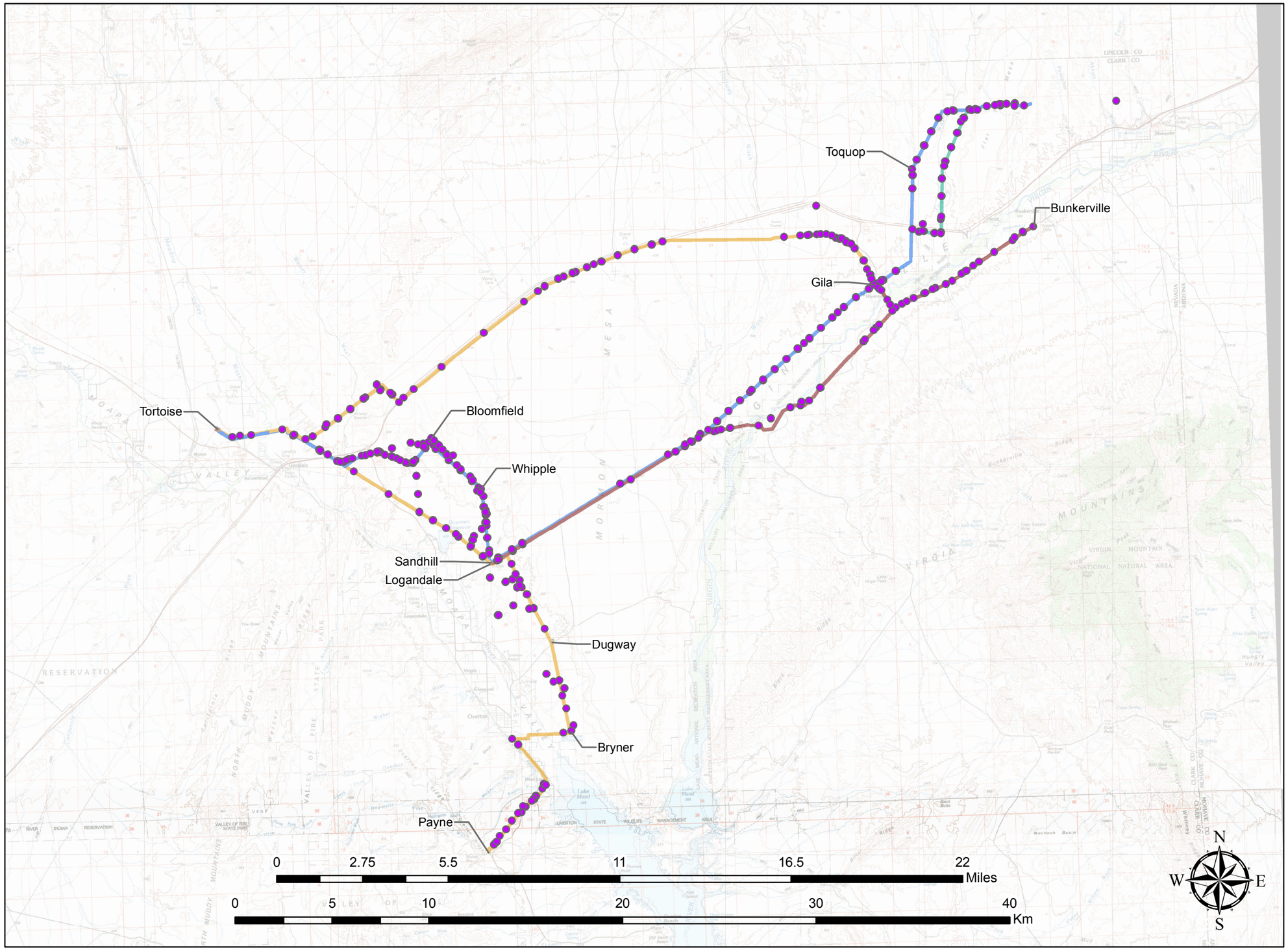
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

RED BROME
Bromus rubens
BRRU2



Legend

- Observations

Substations

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Proposed ROW

- 3 Year
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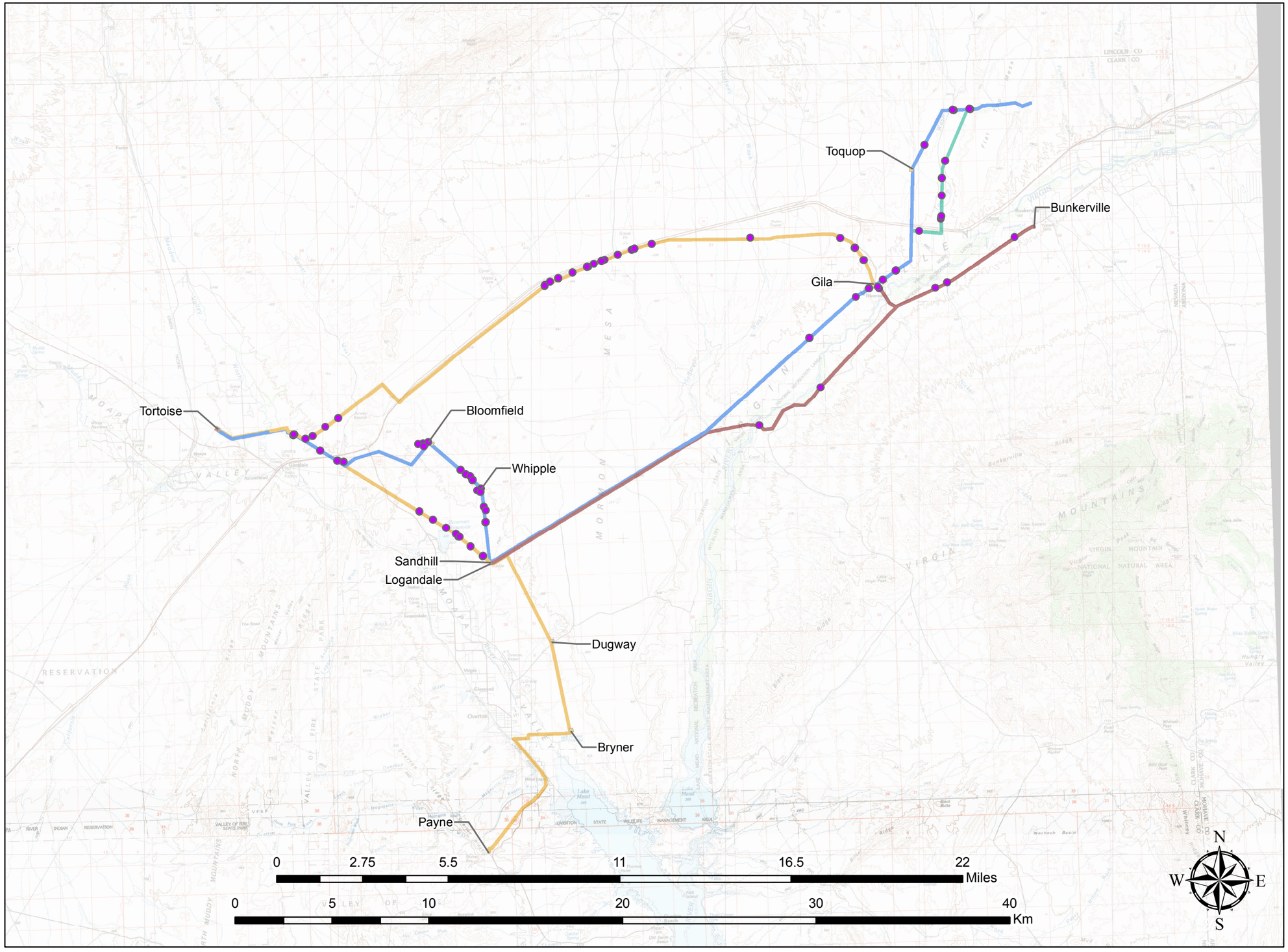
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

CHEATGRASS
Bromus tectorum
BRTE



Legend

- Observations

Substations

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Proposed ROW

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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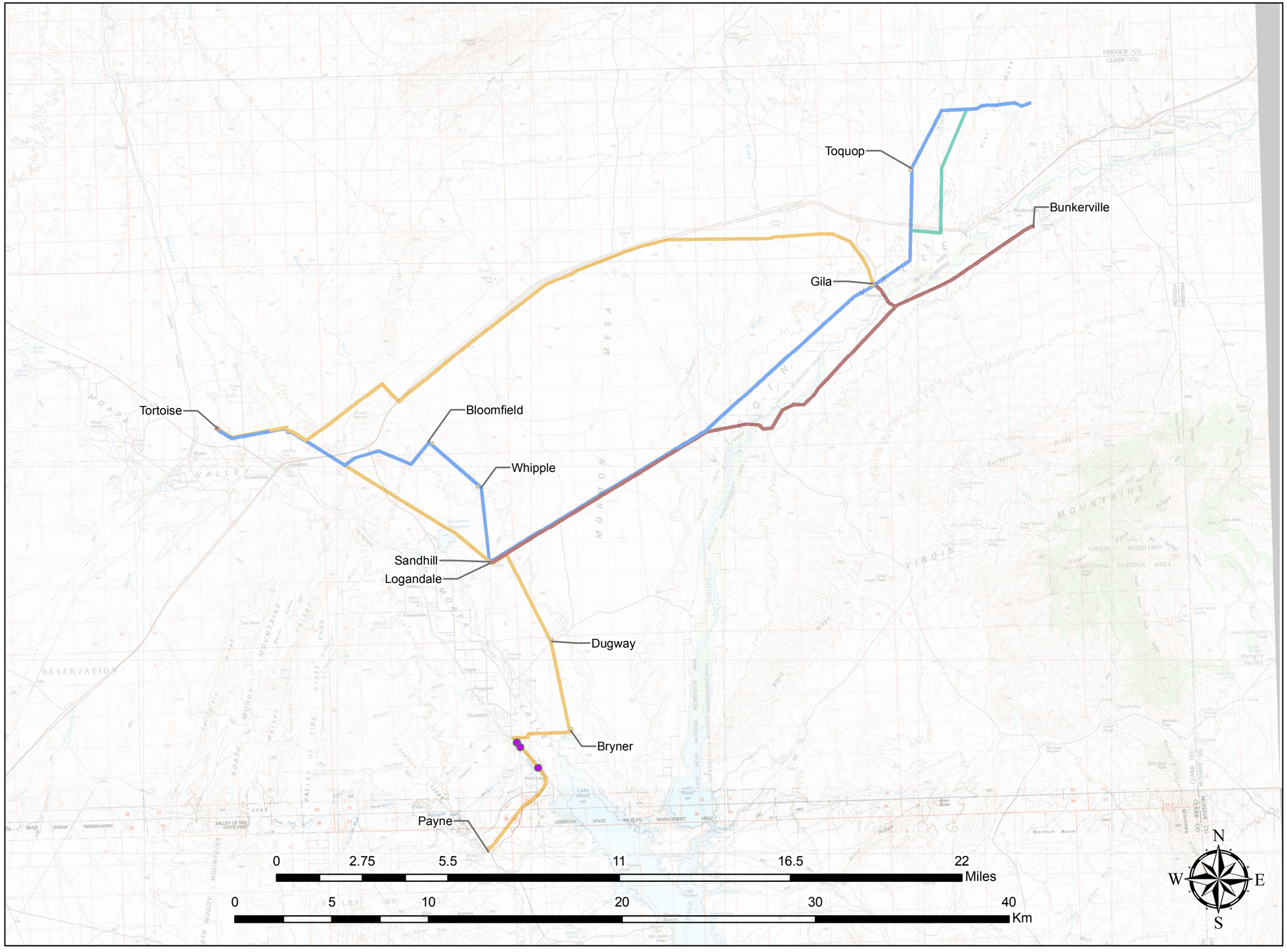
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

BINDWEED
Convolvulus arvensis
COAR4



Legend

- Observations

Substations

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Proposed ROW

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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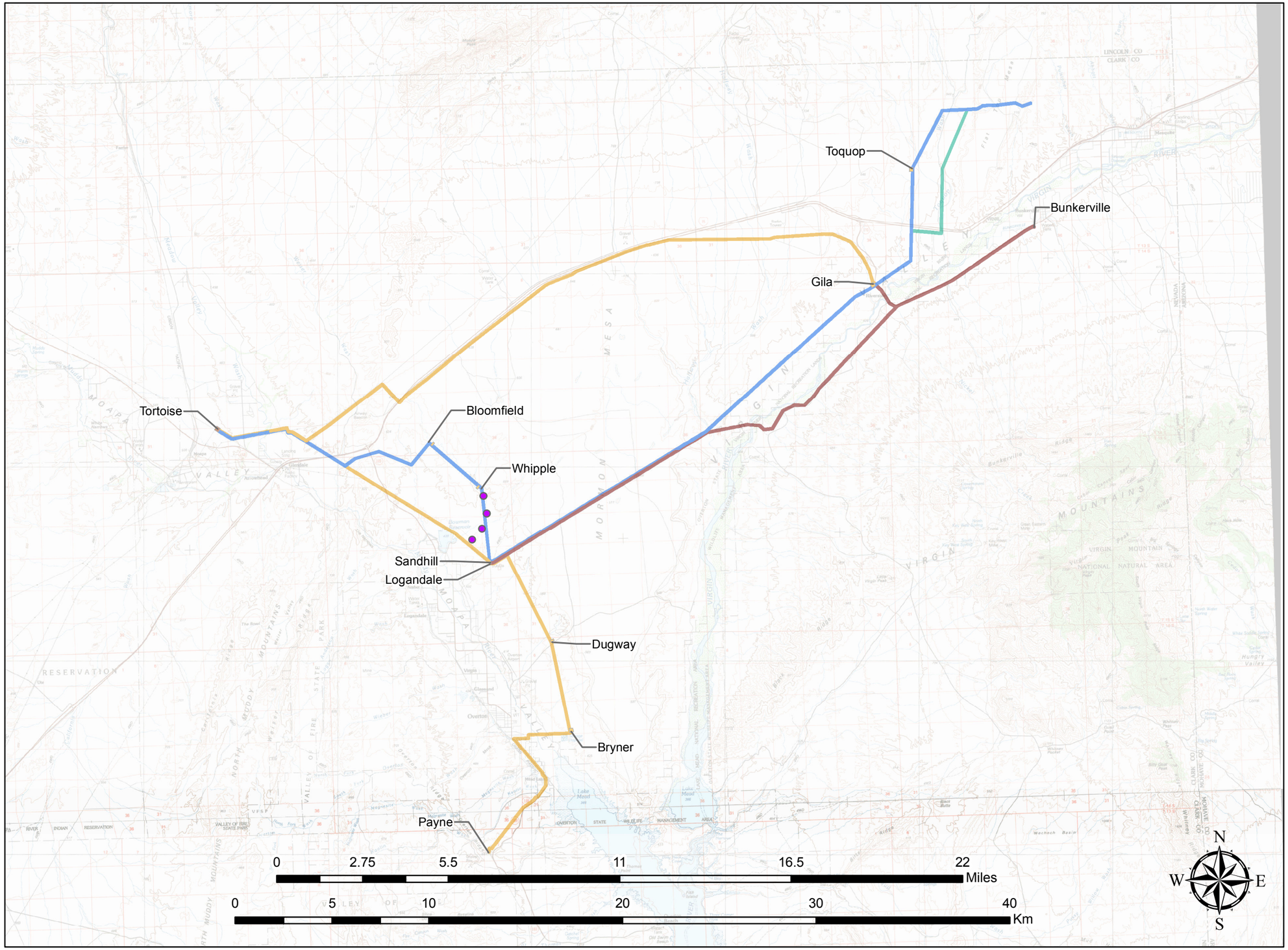
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

WINGED PIGWEED
Cycloloma atriplicifolium
CYAT



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

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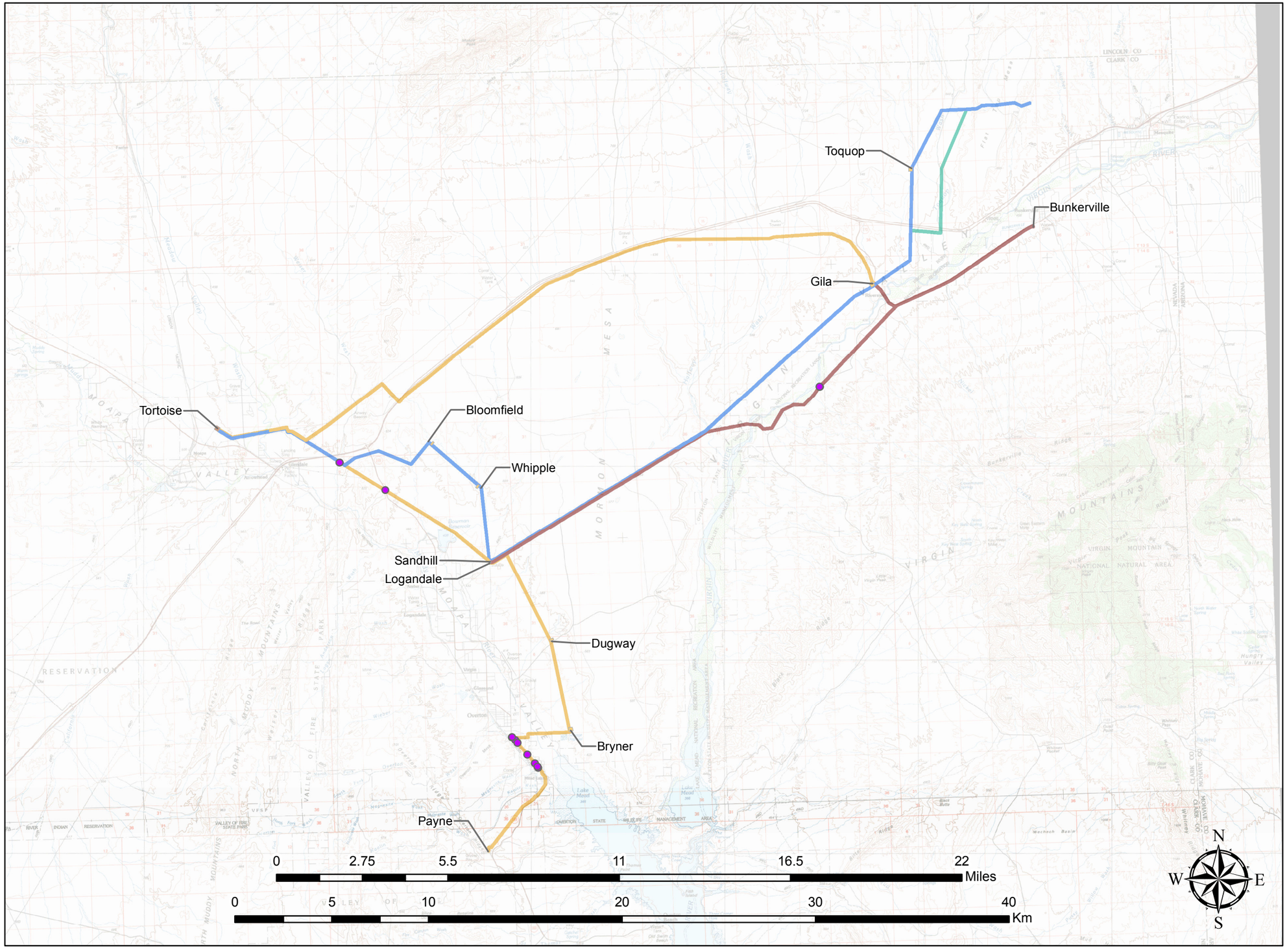
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

BERMUDA GRASS
Cynodon dactylon
CYDA



Legend

- Observations

Substations

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Proposed ROW

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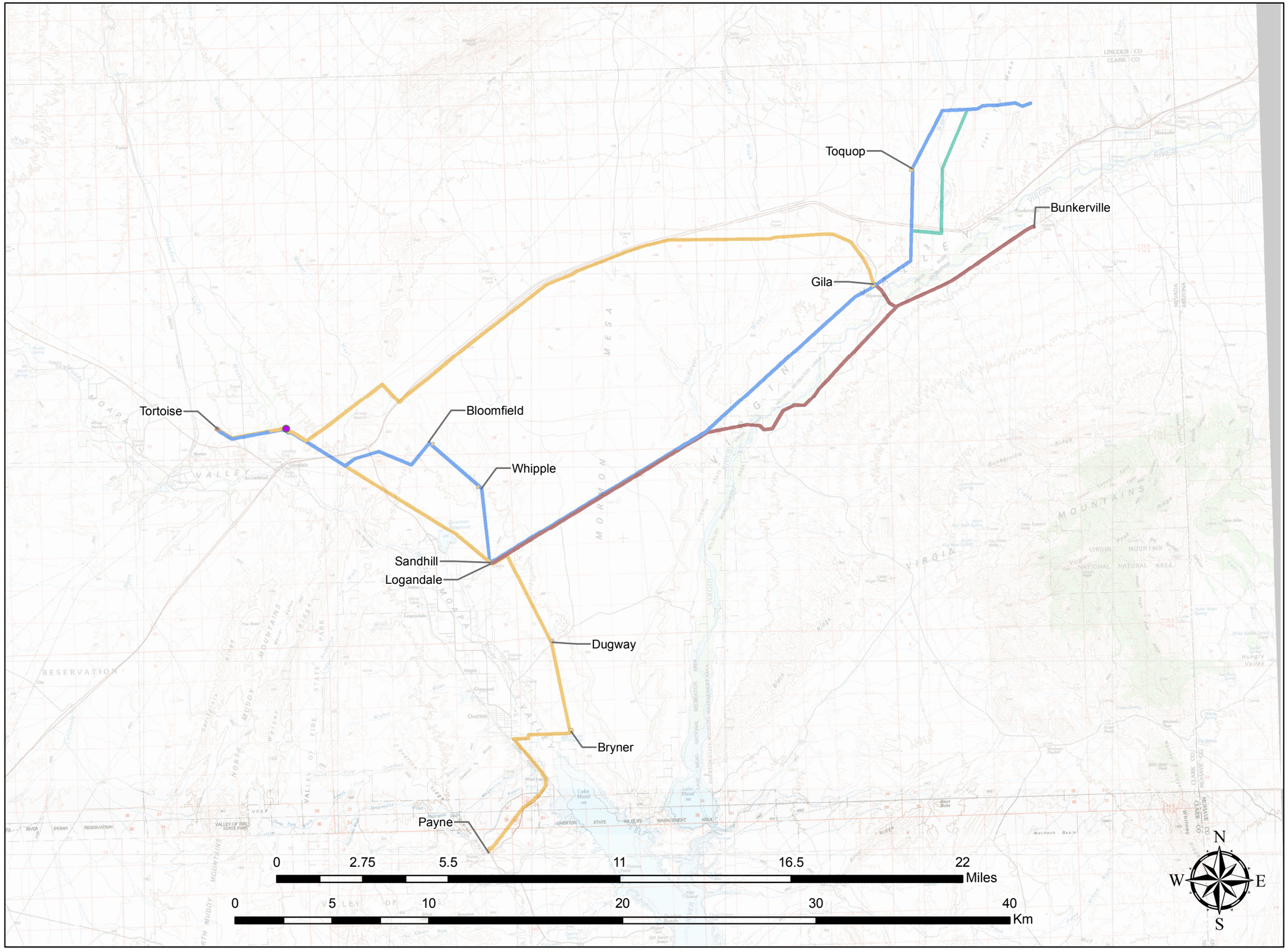
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

HERB SOPHIA
Descurainia sophia
DESO2



Legend

- Observations

Substations

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Proposed ROW

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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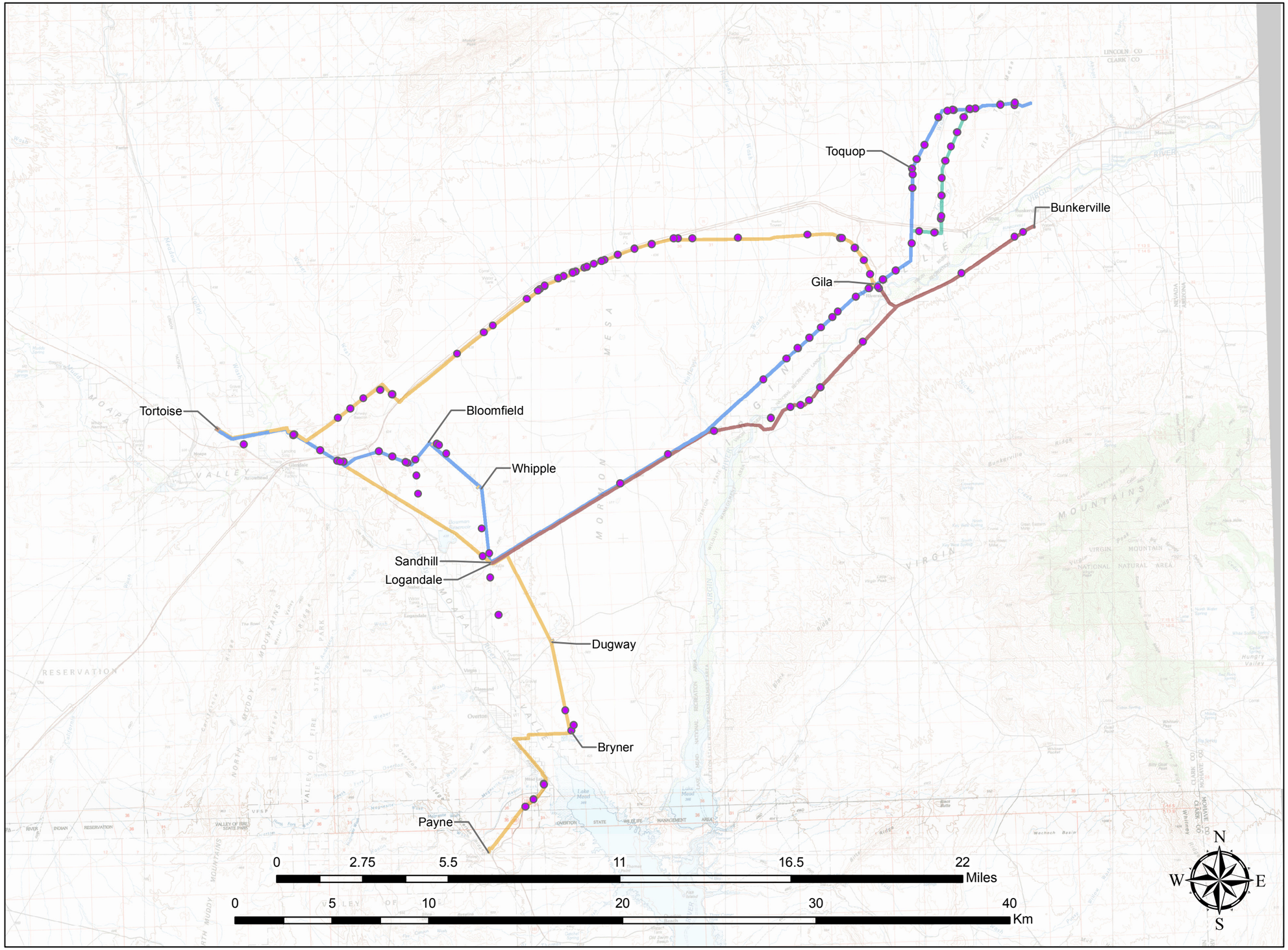
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

REDSTEM STORKSBILL, FILAREE
Erodium cicutarium
ERCI6



Legend

- Observations

Substations

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Proposed ROW

- 3 Year
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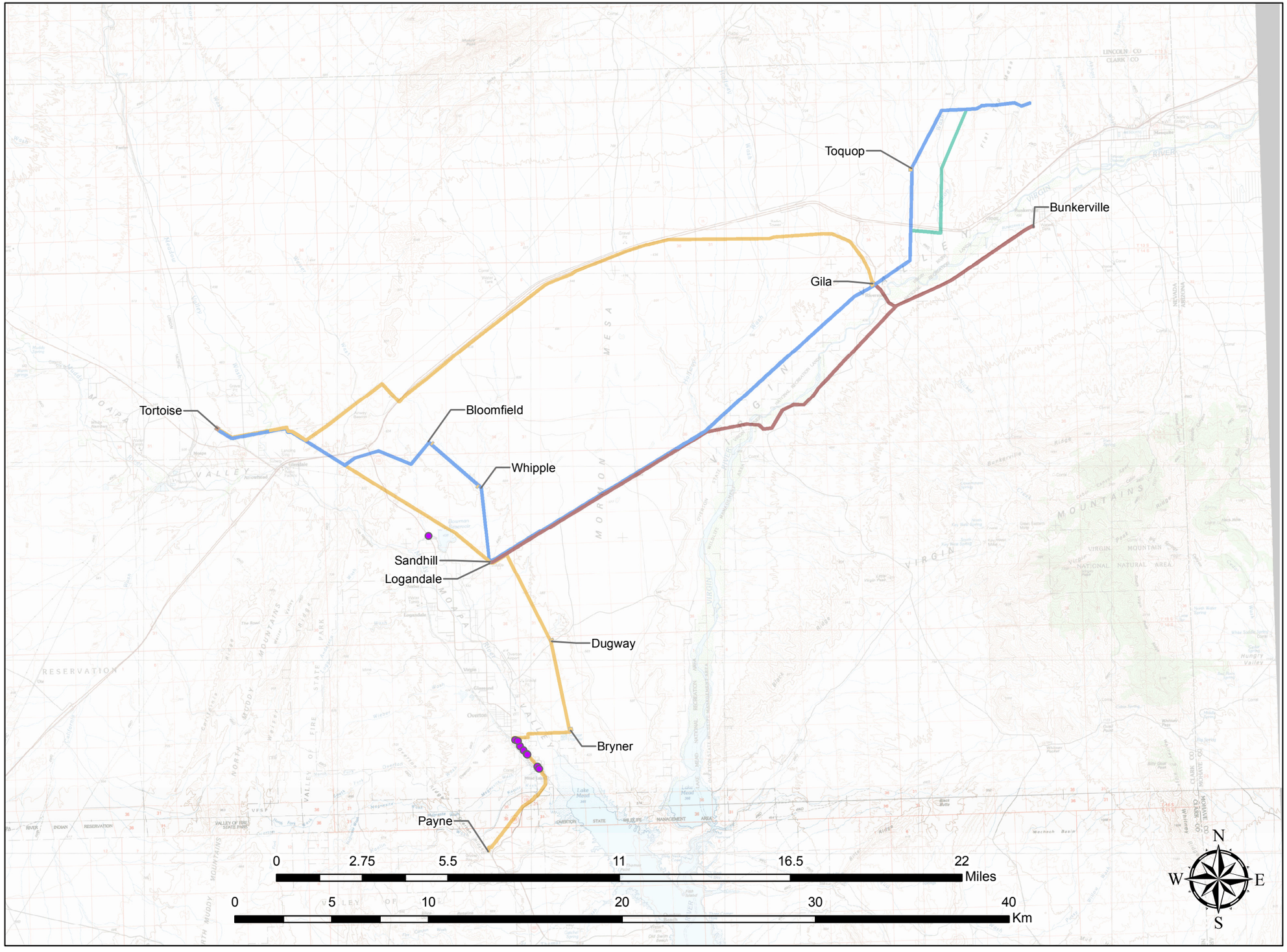
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

COMMON SUNFLOWER
Helianthus annuus
HEAN3



Legend

- Observations

Substations

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- Existing

Proposed ROW

- 3 Year
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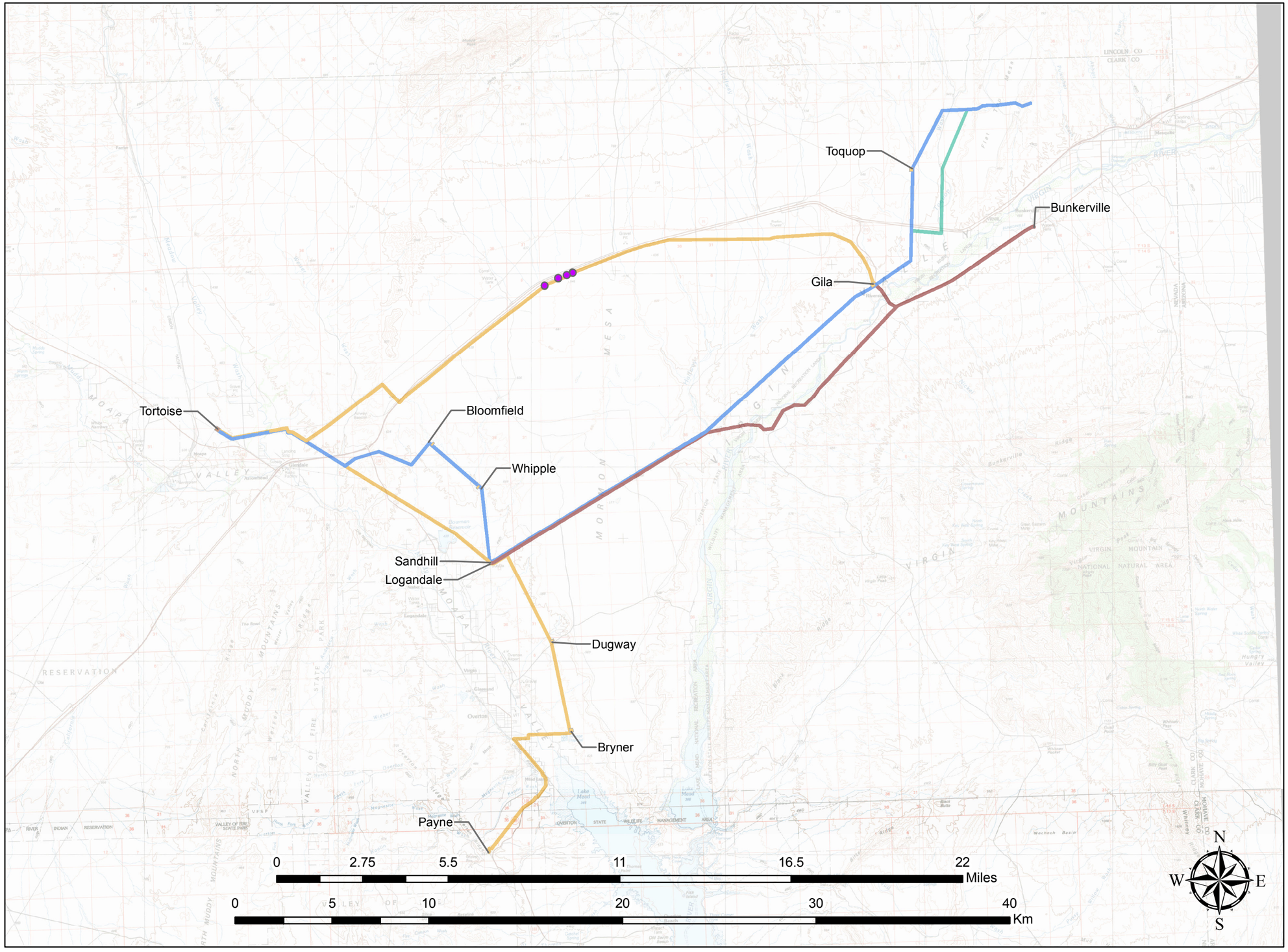
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

HAIRY RUPTUREWORT
Herniaria hirsuta
HEHI7



Legend

- Observations

Substations

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- Existing

Proposed ROW

- 3 Year
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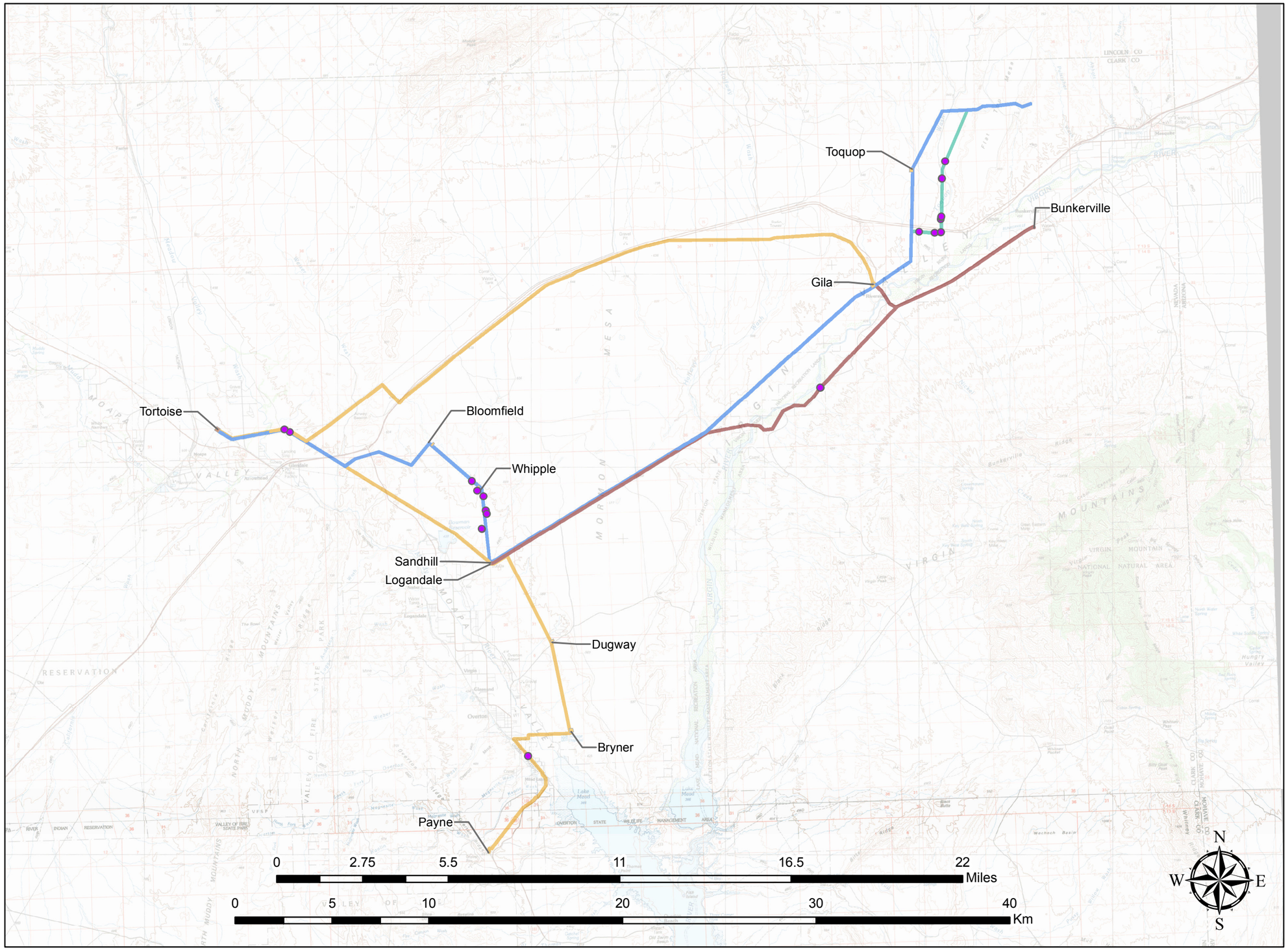
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

BARLEY GRASSES
Hordeum spp.
HORDE



Legend

- Observations

Substations

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Proposed ROW

- 3 Year
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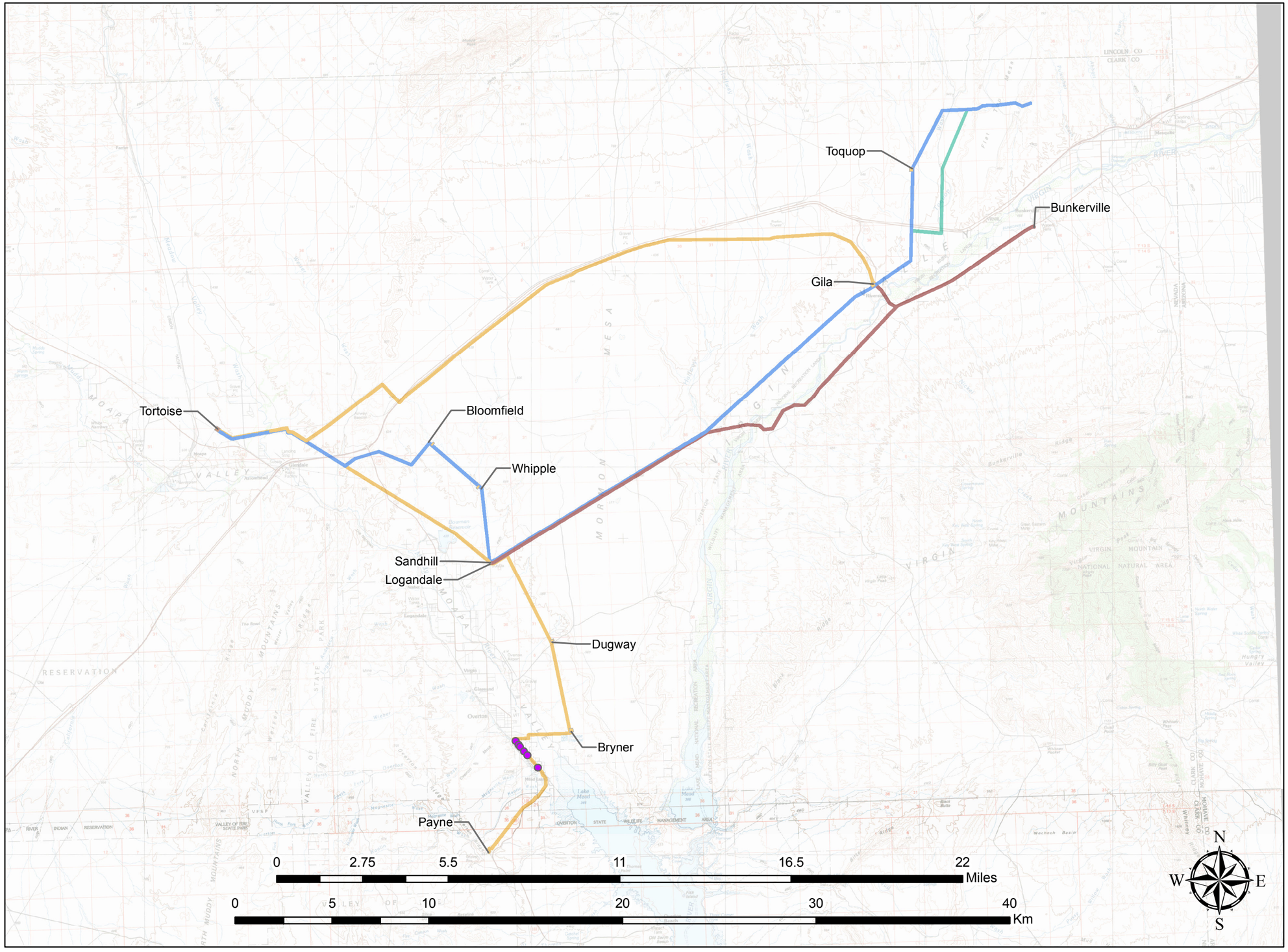
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

WILD LETTUCE
Lactuca serriola
LASE



Legend

- Observations

Substations

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Proposed ROW

- 3 Year
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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

AFRICAN MUSTARD
Malcolmia africana
MAAF

Toquop
Bunkerville
Gila
Tortoise
Bloomfield
Whipple
Sandhill
Logandale
Dugway
Bryner
Payne

0 2.75 5.5 11 16.5 22 Miles
0 5 10 20 30 40 Km

N
W E
S

Legend

- Observations

Substations
- New
- Existing

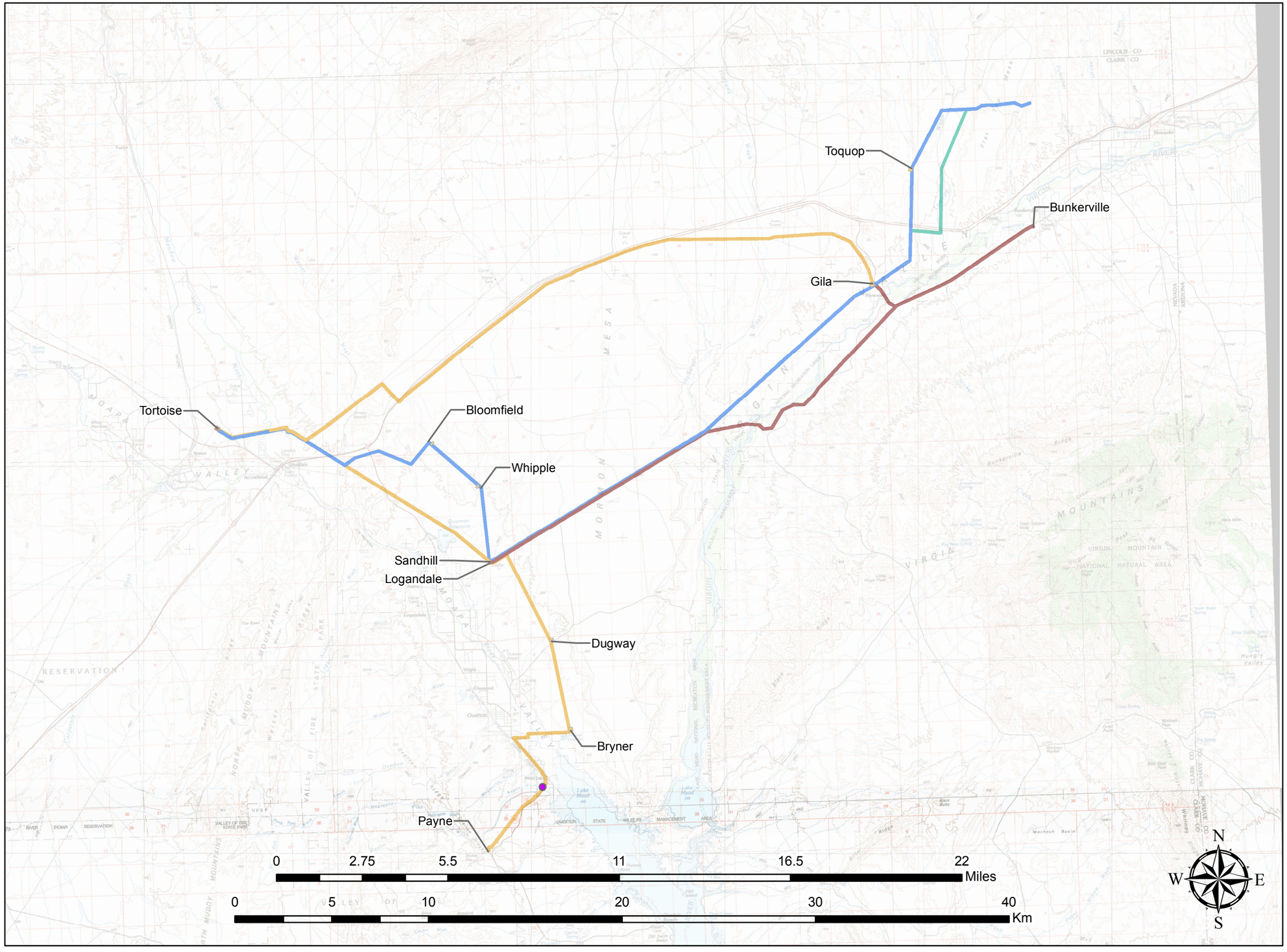
Proposed ROW
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

SOURCLOVER
Melilotus indicus
MEIN2



Legend

- Observations

Substations

- New
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Proposed ROW

- 3 Year
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- 7 Year
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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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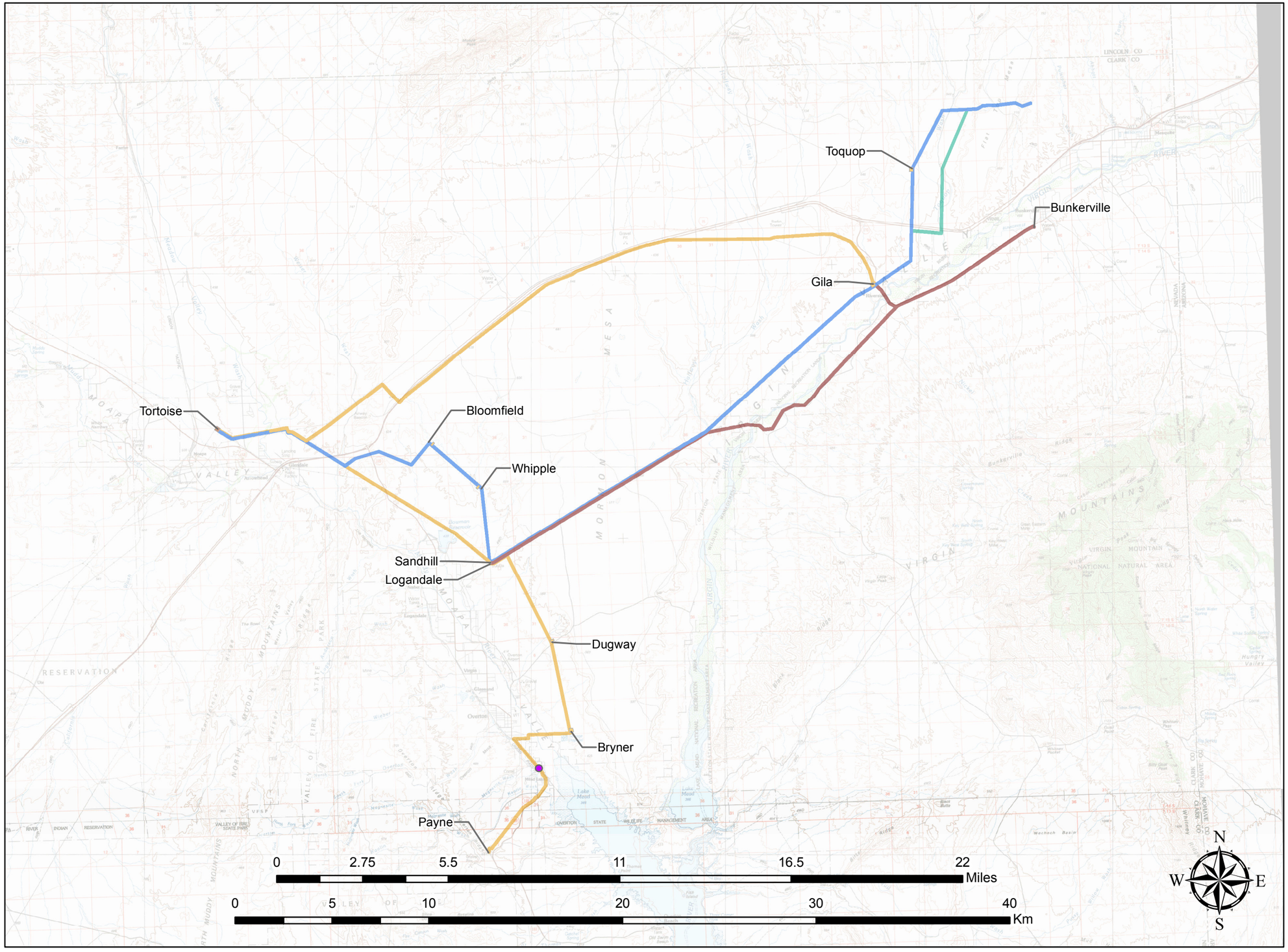
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

WHITE MULBERRY
Morus alba
MOAL



Legend

- Observations

Substations

- New
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Proposed ROW

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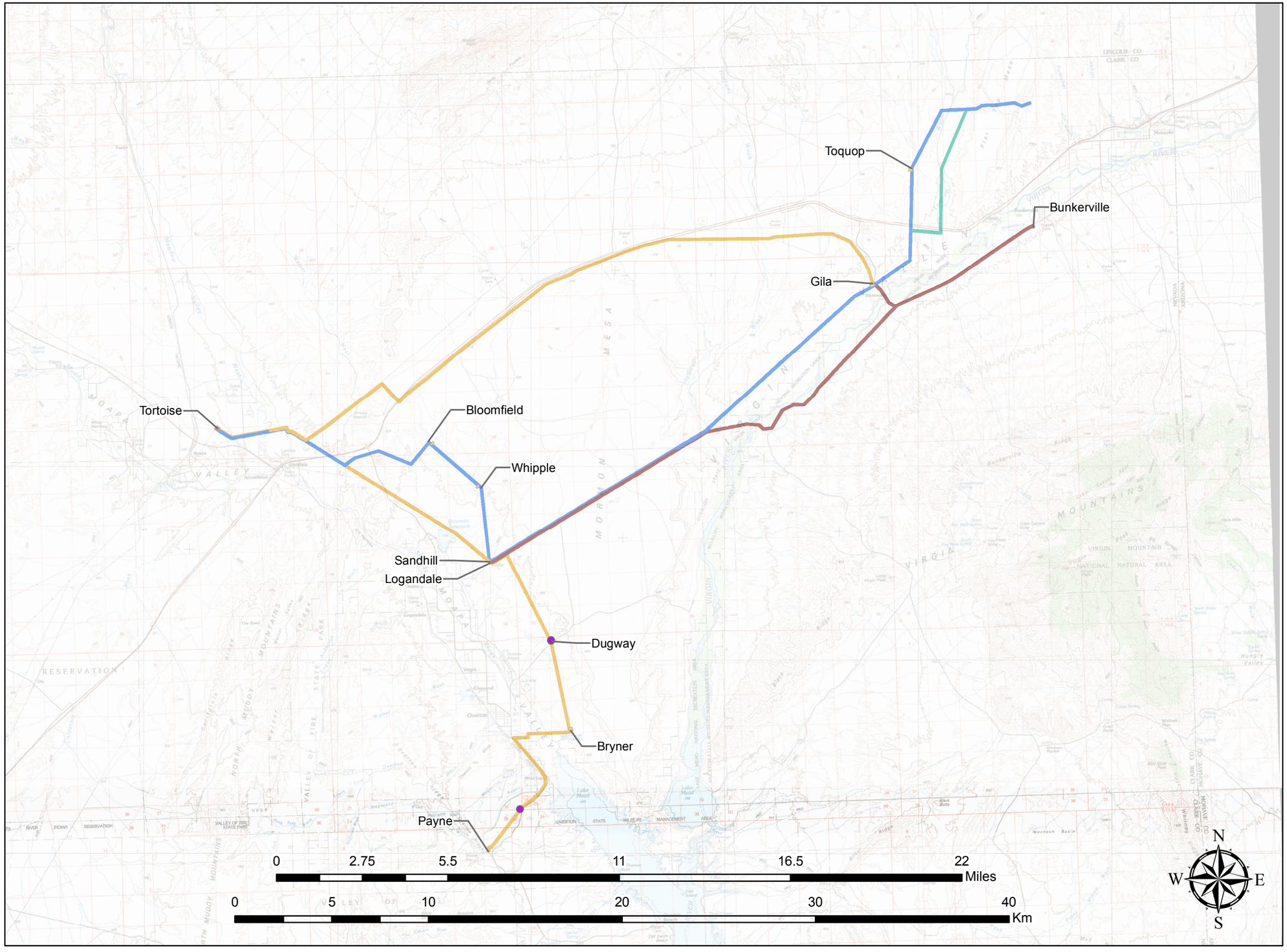
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

CACTUS APPLE
Opuntia engelmannii var. linguiformis
OPENL2



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

- 3 Year
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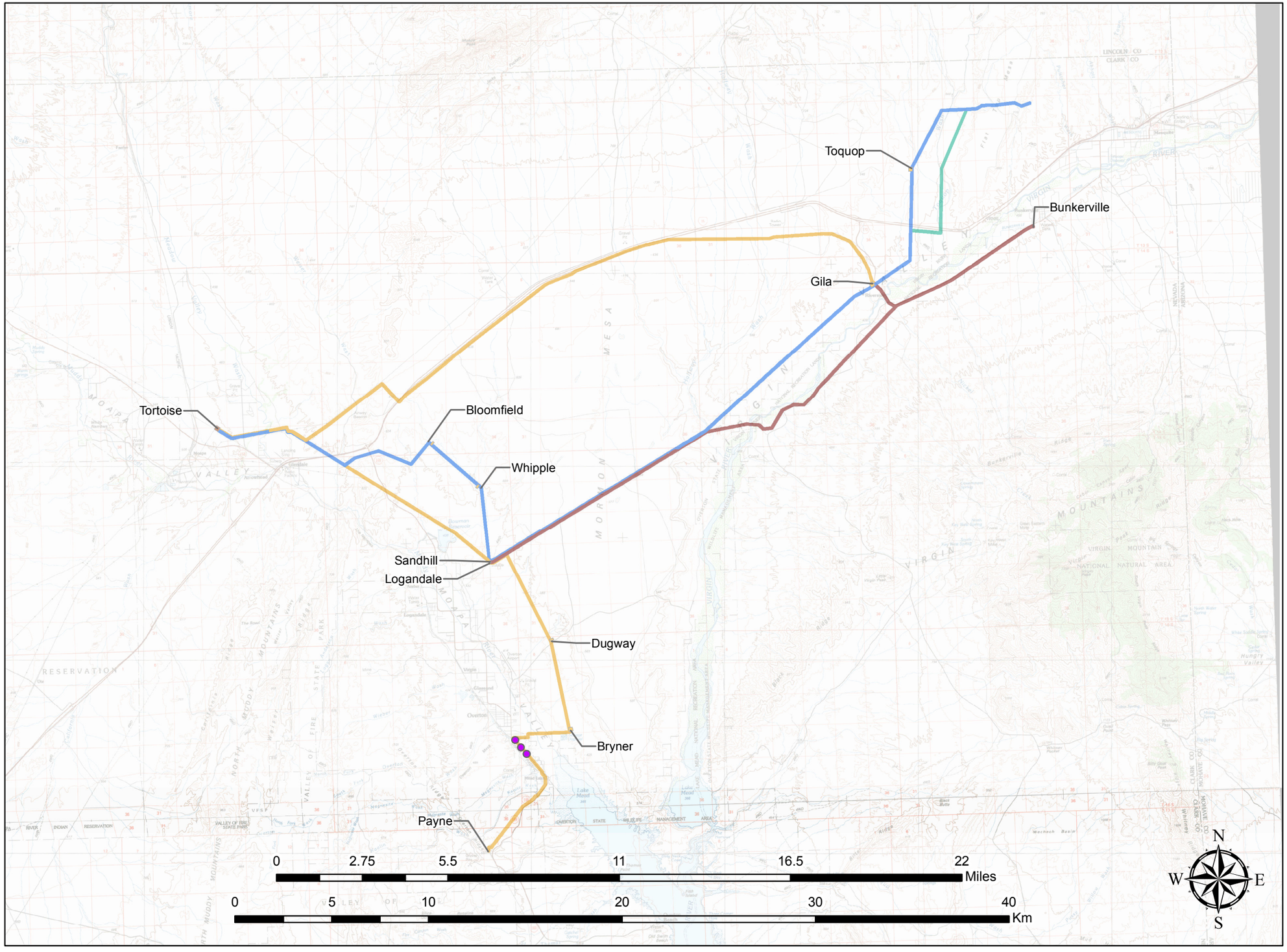
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

JERUSALEM THORN
Parkinsonia aculeata
PAAC3



Legend

- Observations

Substations

- New
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Proposed ROW

- 3 Year
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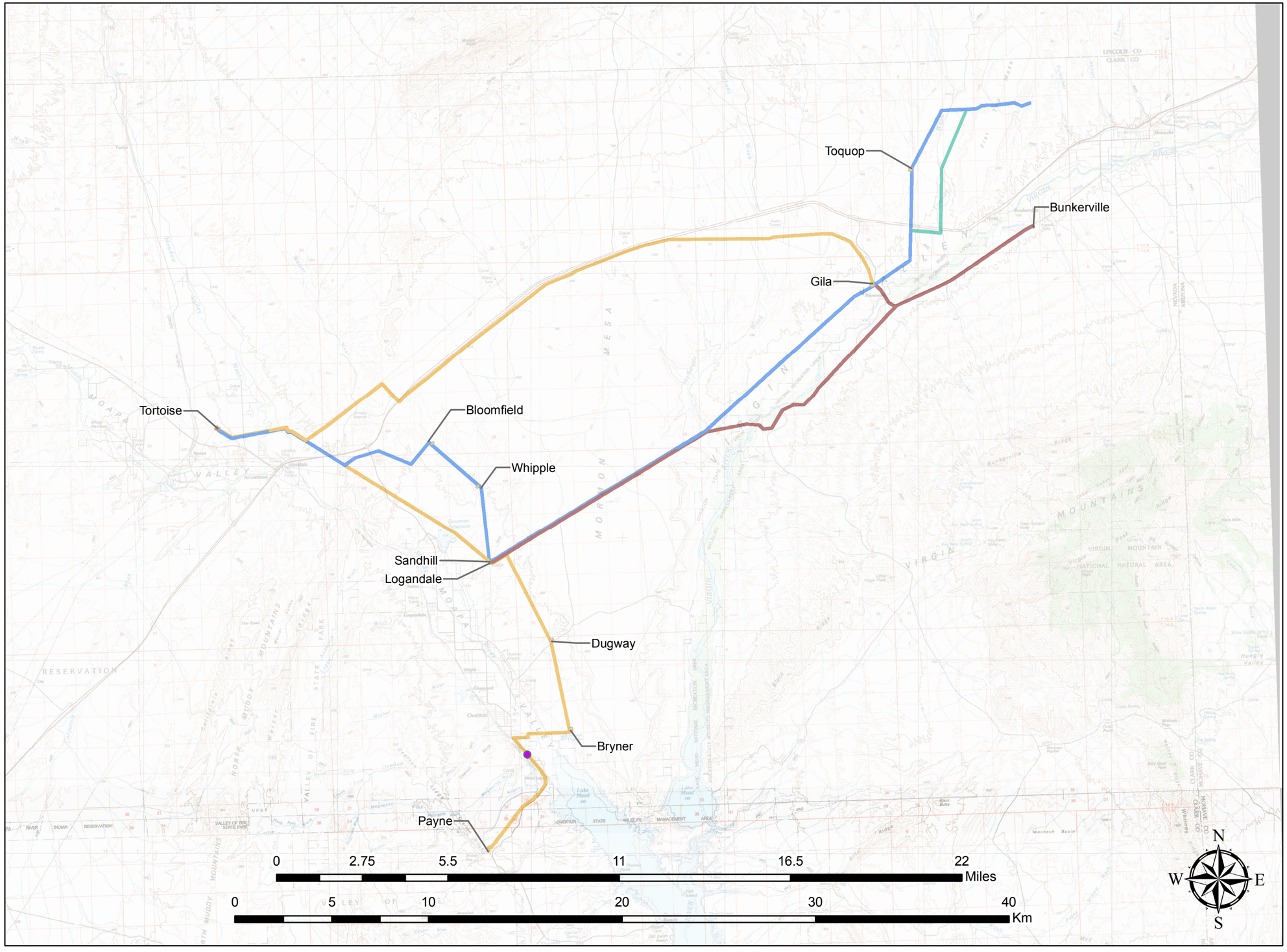
KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

CUTLEAF GROUNDCHERRY
Physalis angulata var. lanceifolia
PHANL2



Legend

- Observations

Substations

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Proposed ROW

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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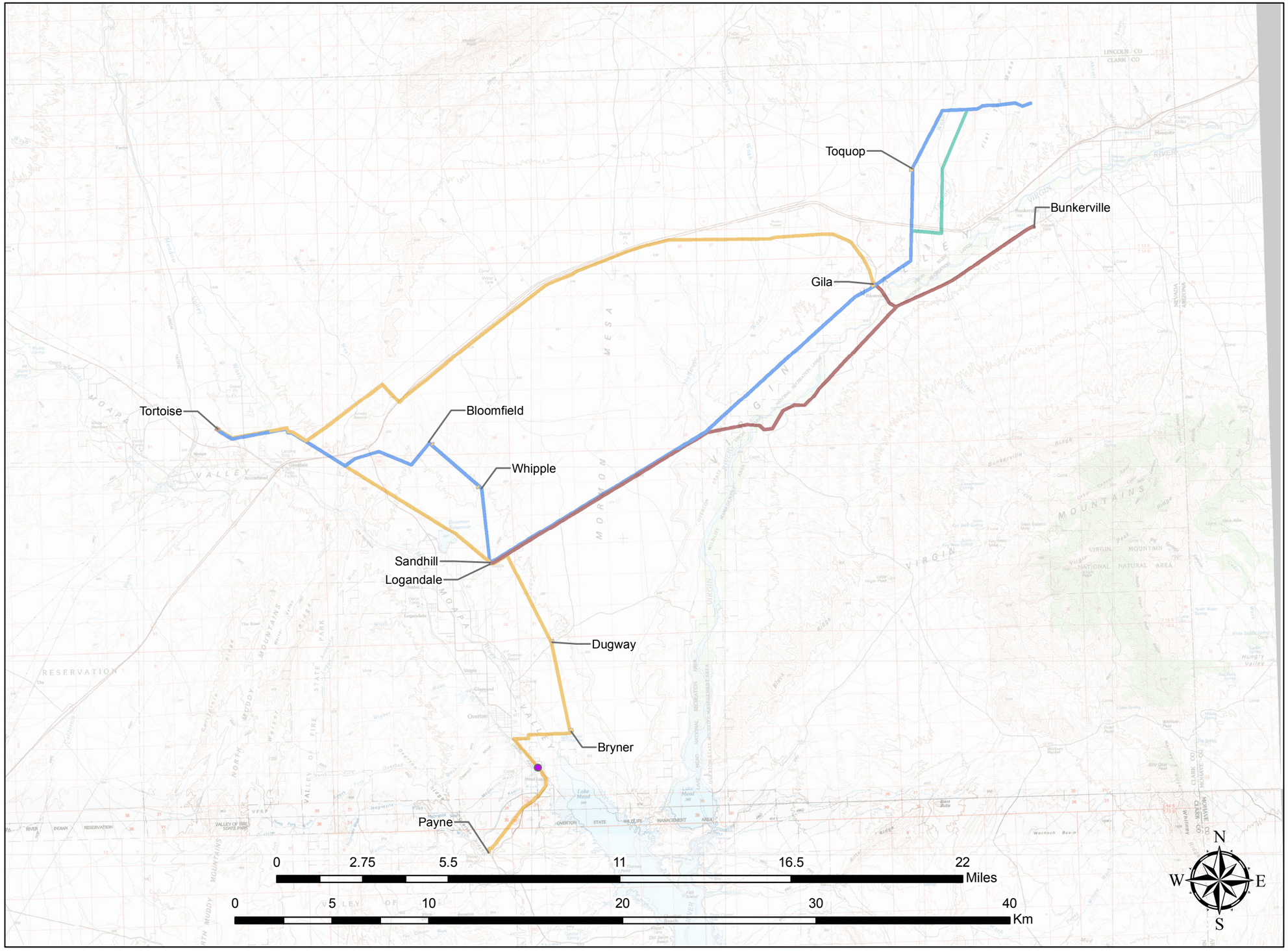
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

COMMON PLANTAIN
Plantago major
PLMA2



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

- 3 Year
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- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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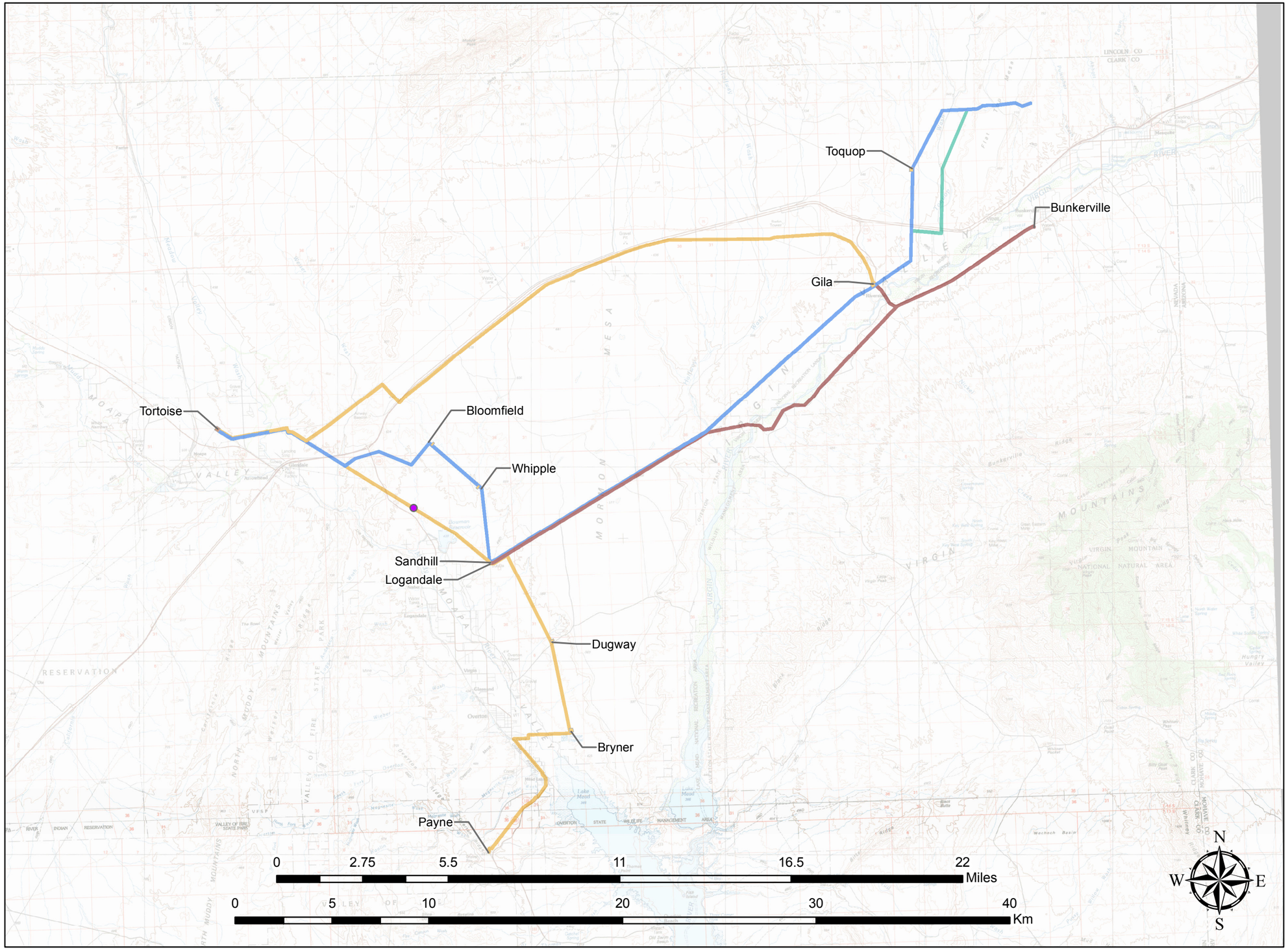
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

ANNUAL RABBITSFOOT GRASS
Polypogon monspeliensis
POMO5



Legend

- Observations

Substations

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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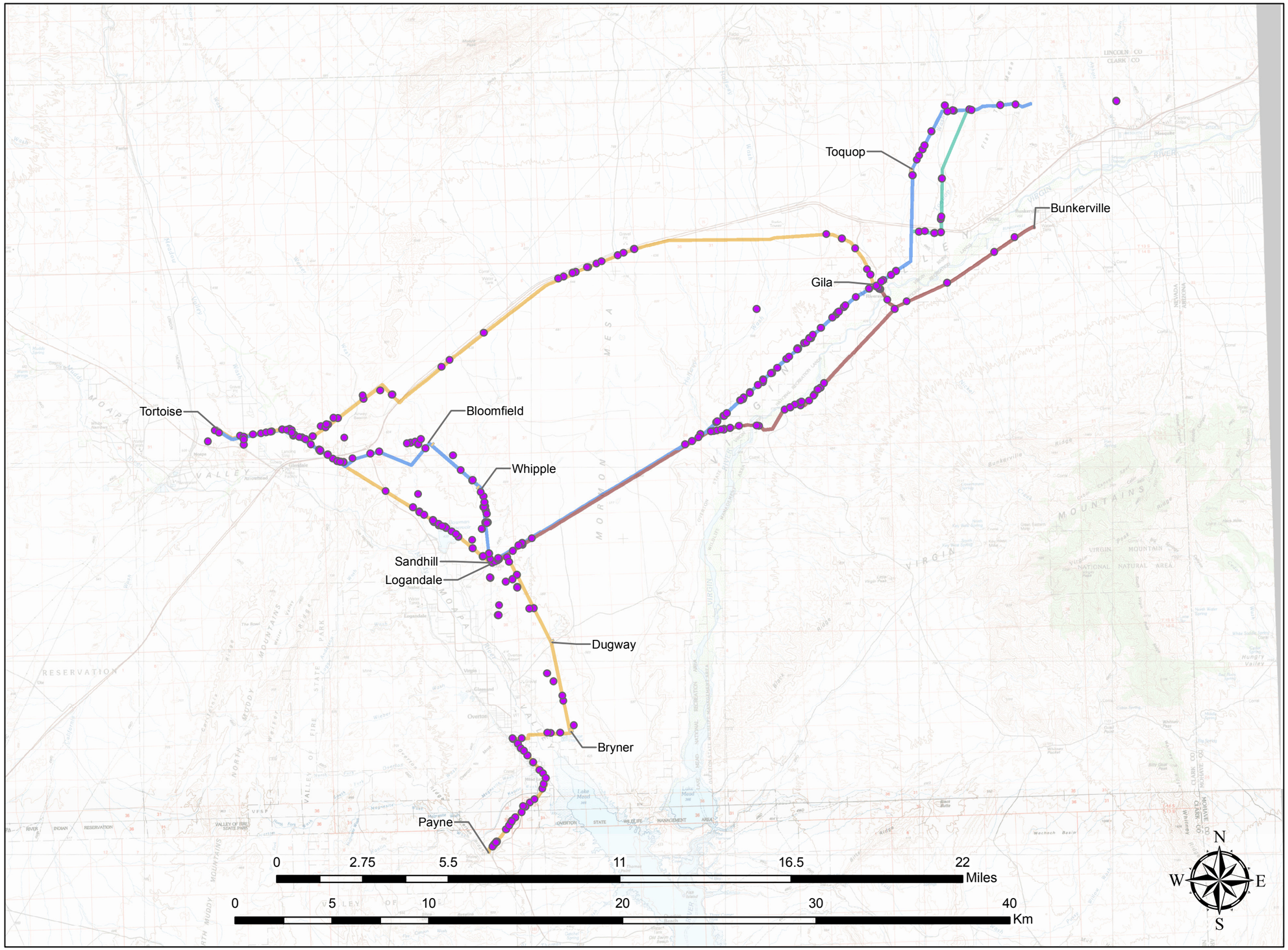
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

RUSSIAN THISTLE
Salsola sp.
SALSO



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

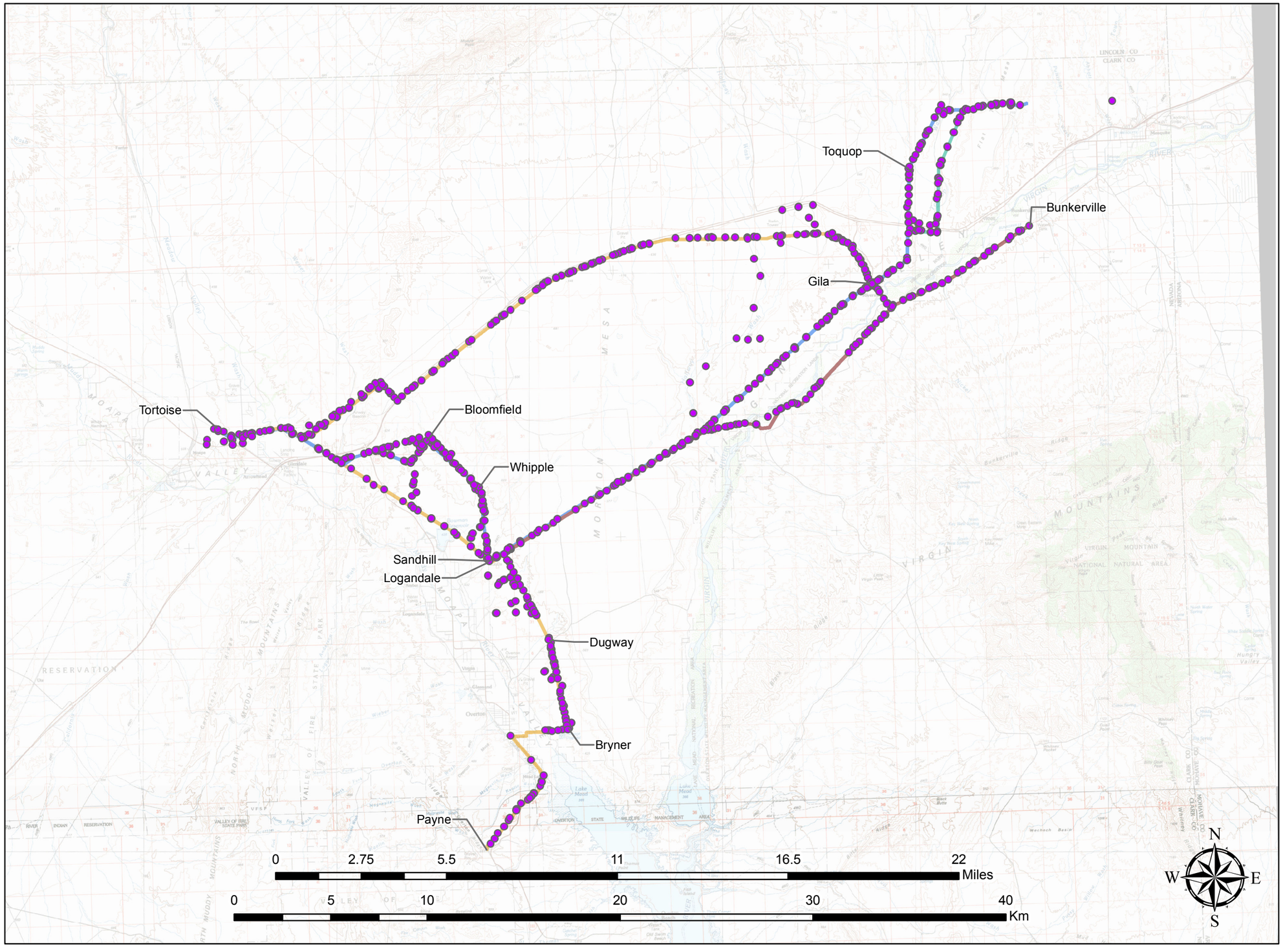
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

MEDITERRANEAN GRASS
Schismus sp.
SCHIS



Legend

- Observations

Substations

- New
- Existing

Proposed ROW

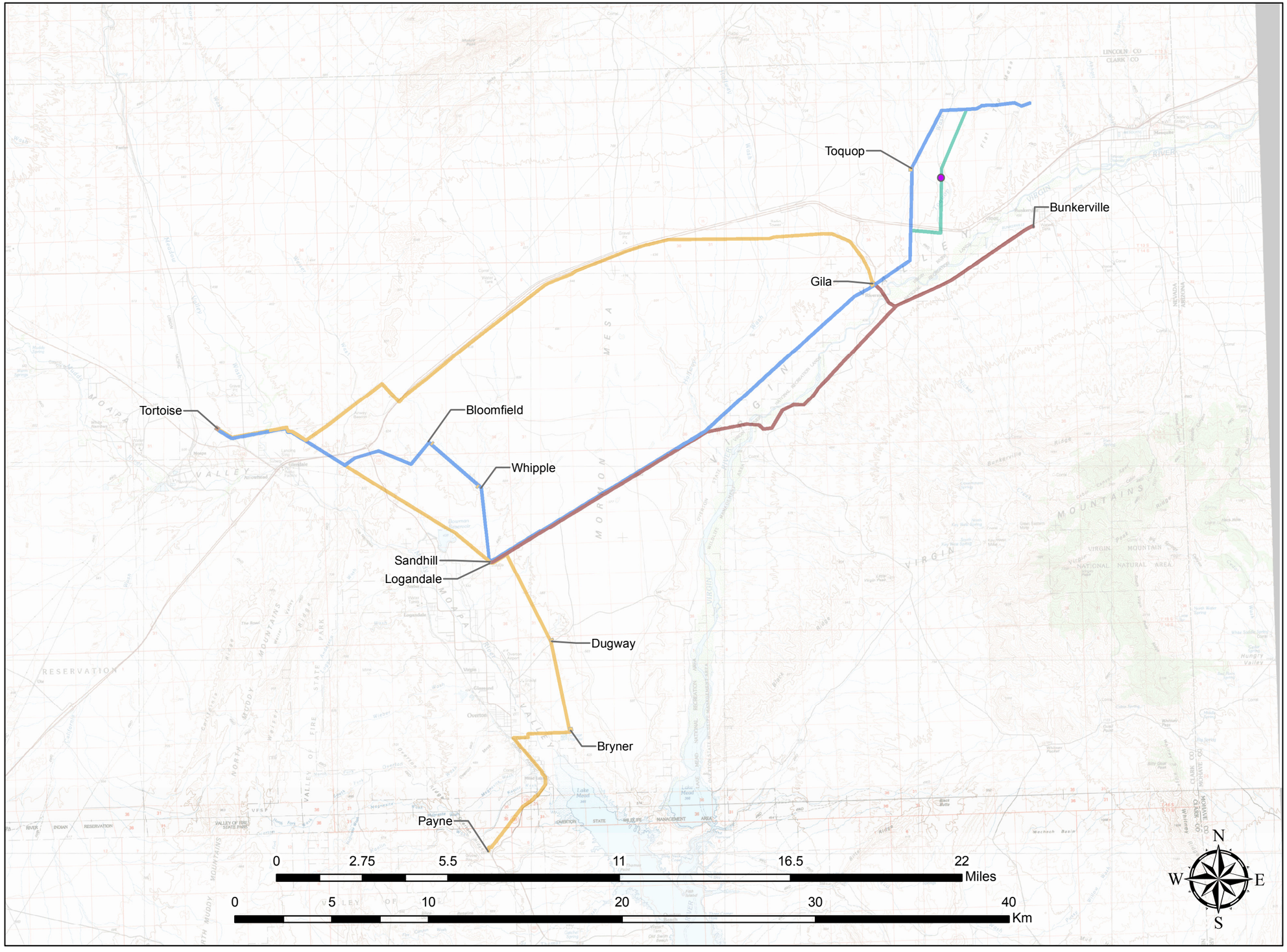
- 3 Year
- 3 Year Alternative
- 7 Year
- 9 Year

KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

Base Maps: Based on
USGS 15' Series
Lake Mead, NV (1987)
Overton, NV (1987)

Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

TUMBLE MUSTARD
Sisymbrium altissimum
SIAL2



Legend

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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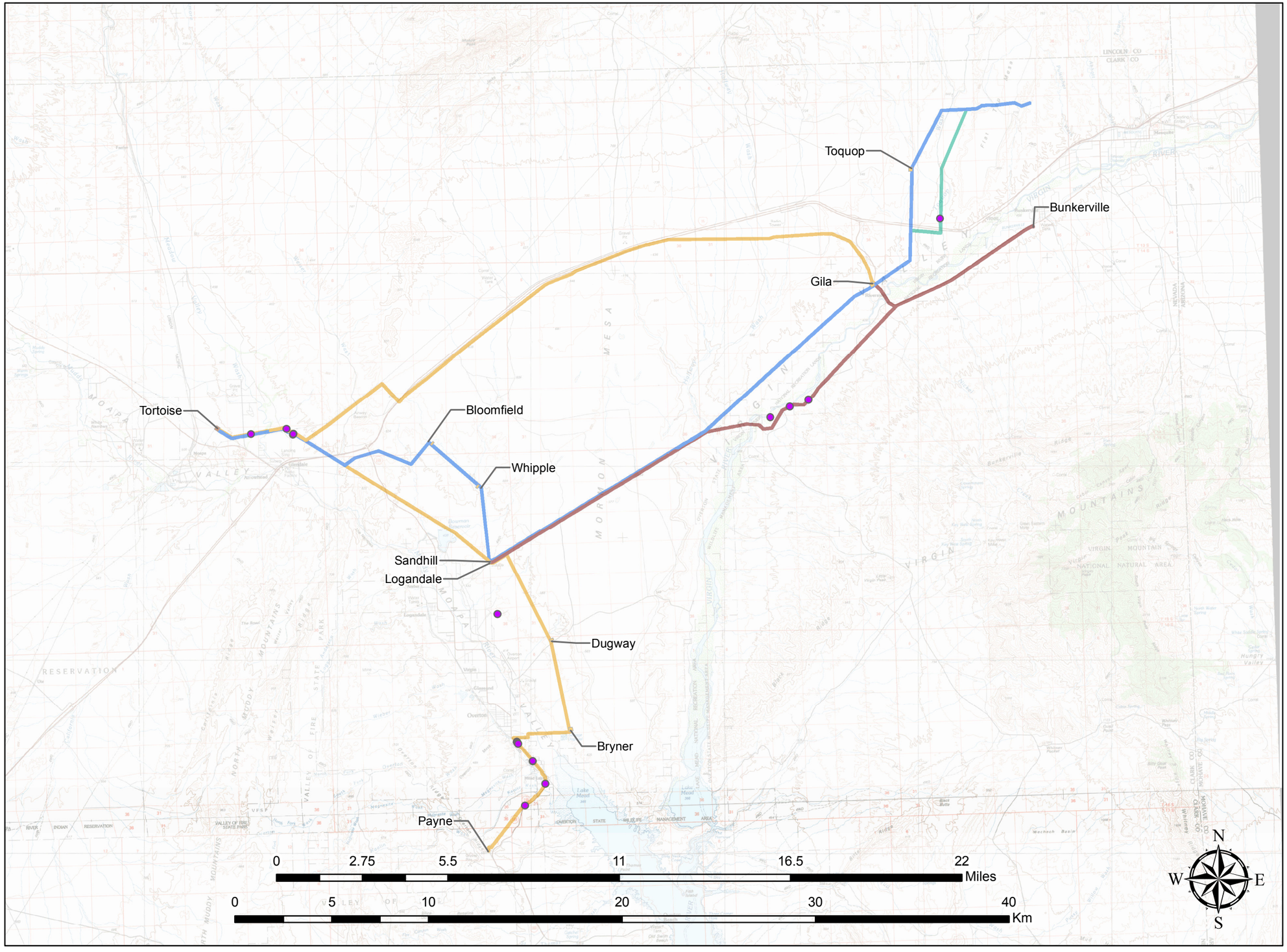
Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

LONDON ROCKET
Sisymbrium irio
SIIR



Legend

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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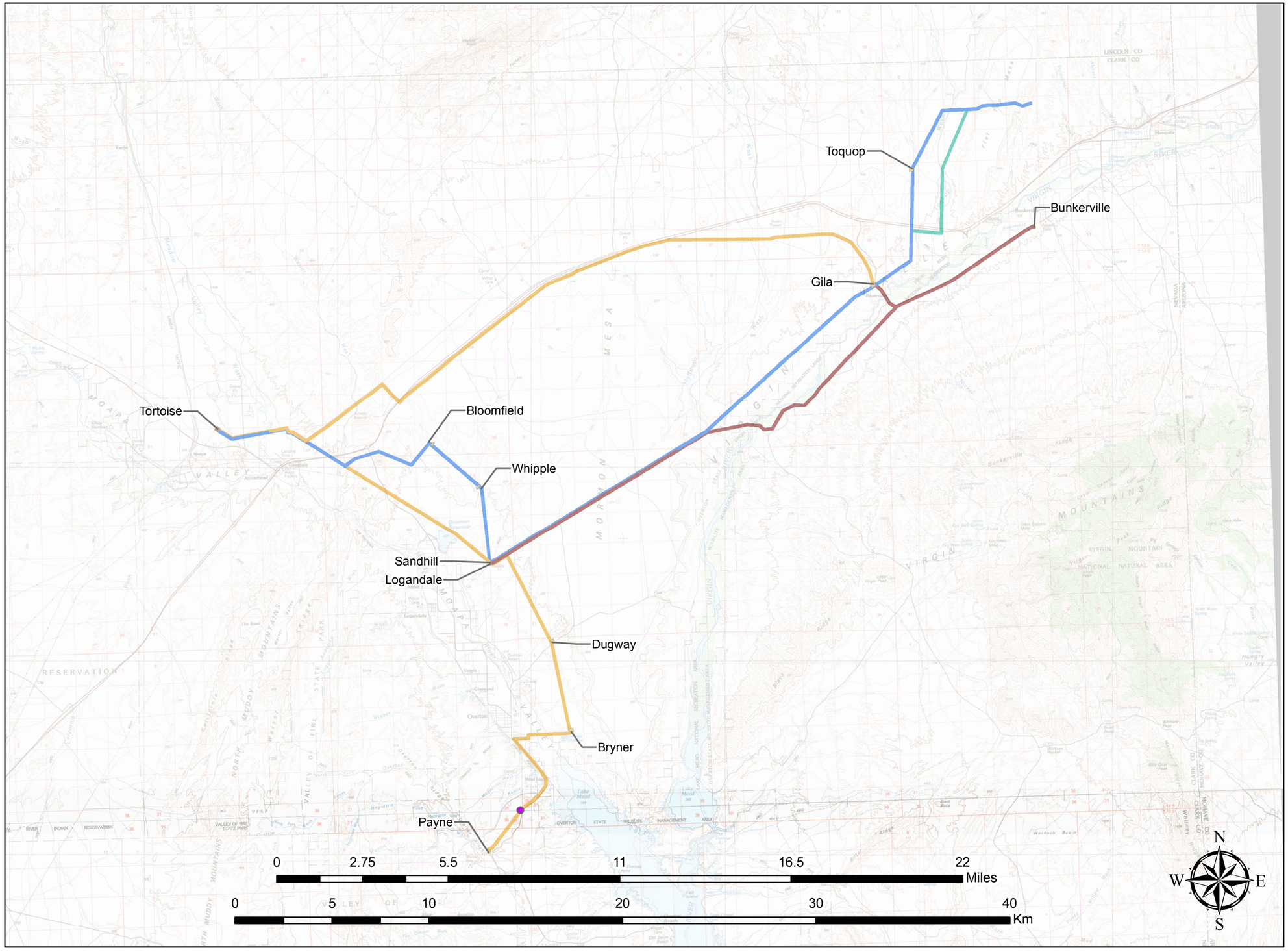
Overton, NV (1987)

Overton Power District #5
Planned System Upgrades
Non-Native Plant Observations

SOW-THISTLE
Sonchus asper
SOAS



Legend

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KNIGHT LEAVITT ASSOCIATES
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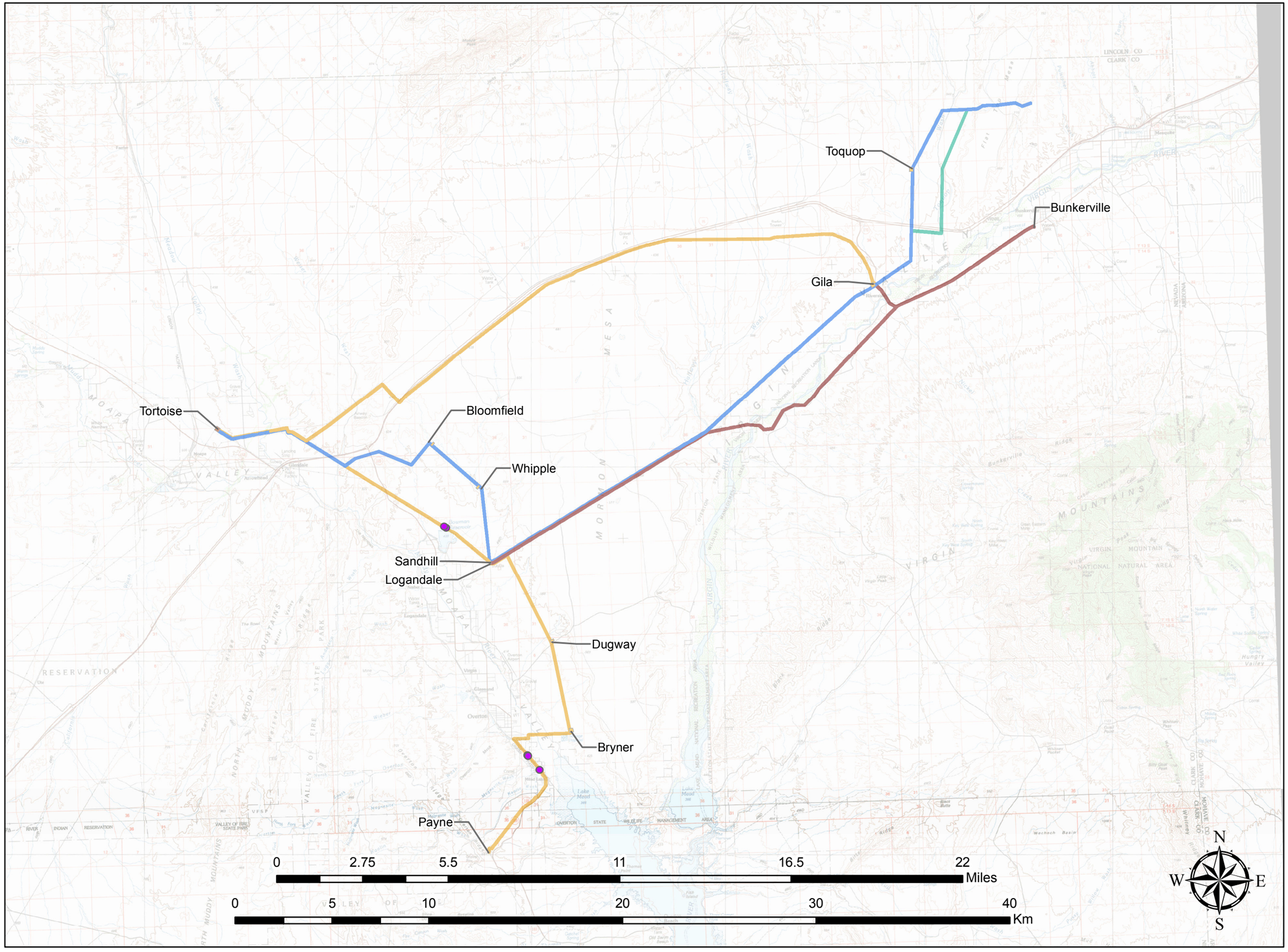
Overton Power District #5 Planned System Upgrades Non-Native Plant Observations

COCKLEBUR
Xanthium strumarium
XAST



Legend

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KNIGHT LEAVITT ASSOCIATES
RESEARCH SERVICES

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Lake Mead, NV (1987)
Overton, NV (1987)

ATTACHMENT B. NOXIOUS WEED INFORMATION

Nevada Department of Agriculture, Plant Industry Division

Noxious Weed List

Definitions

Category ”A”: Weeds not found or limited in distribution throughout the state; actively excluded from the state and actively eradicated wherever found; actively eradicated from nursery stock dealer premises; control required by the state in all infestations

Category "B": Weeds established in scattered populations in some counties of the state; actively excluded where possible, actively eradicated from nursery stock dealer premises; control required by the state in areas where populations are not well established or previously unknown to occur

Category "C": Weeds currently established and generally widespread in many counties of the state; actively eradicated from nursery stock dealer premises; abatement at the discretion of the state quarantine officer

COMMON NAME	SCIENTIFIC NAME
Category A Weeds:	
African Rue	*Peganum harmala*
Austrian fieldcress	*Rorippa austriaca*
Austrian peaweed	*Sphaerophysa salsula / Swainsona salsula*
Black henbane	*Hyoscyamus niger*
Camelthorn	*Alhagi camelorum*
Common crupina	*Crupina vulgaris*
Dalmation Toadflax	*Linaria dalmatica*
Dyer’s woad	*Isatis tinctoria*
Eurasian water-milfoil	*Myriophyllum spicatum*
Giant Reed	*Arundo donax*
Giant Salvinia	*Salvinia molesta*
Goats rue	*Galega officinalis*
Green Fountain grass	*Pennisetum setaceum*
Houndstongue	*Cynoglossum officinale*
Hydrilla	*Hydrilla verticillata*
Iberian Starthistle	*Centaurea iberica*
Klamath weed	*Hypericum perforatum*
Malta Star thistle	*Centaurea melitensis*
Mayweed chamomile	*Anthemis cotula*
Mediterranean sage	*Salvia aethiopis*
Purple loosestrife	*Lythrum salicaria, L.virgatum and their cultivars*
Purple Star thistle	*Centaurea calcitrapa*
Rush skeletonweed	*Chondrilla juncea*
Sow Thistle	*Sonchus arvensis*
Spotted Knapweed	*Centaurea masculosa*
Squarrose knapweed	*Centaurea virgata*
Sulfur cinquefoil	*Potentilla recta*
Syrian Bean Caper	*Zygophyllum fabago*
Yellow Starthistle	*Centaurea solstiltialis*
Yellow Toadflax	*Linria vulgaris*

COMMON NAME	SCIENTIFIC NAME
Category B Weeds:	
Carolina Horse-nettle	*Solanum carolinense*
Diffuse Knapweed	*Centaurea diffusa*
Leafy spurge	*Euphorbia esula*
Medusahead	*Taeniatherum caput-medusae*
Musk Thistle	*Carduus nutans*
Russian Knapweed	*Acroptilon repens*
Sahara Mustard	*Brassica tournefortii*
Scotch Thistle	*Onopordum acanthium*
White Horse-nettle	*Solanum elaeagnifolium*
Category C Weeds:	
Canada Thistle	*Cirsium arvense*
Hoary cress	*Cardaria draba*
Johnson grass	*Sorghum halepense*
Perennial pepperweed	*Lepidium latifolium*
Poison Hemlock	*Conium maculatum*
Puncture vine	*Tribulus terrestris*
Salt cedar (tamarisk)	*Tamarix* spp
Water Hemlock	*Cicuta maculata*

Source: Department of Agriculture, No. 55.11, eff.5-25-62; A 5-1-68]--(NAC A by St. Quarantine Officer, 8-9-94; R191-99, 8-7-2000; R097-01m 5-1-2002; R003-03, 9-24-2003

UNIVERSITY OF NEVADA •Reno

COOPERATIVE EXTENSION

Bringing the University to You

Fact Sheet-05-02

Identifying and Managing Sahara Mustard

Jessica Graham, Undergraduate Research Assistant, University of Nevada, Reno
Wayne S Johnson; Associate Professor, Department of Resource Economics, College of Agriculture Biotechnology and Natural Resources; IPM Specialist, University of Nevada Cooperative Extension
Elizabeth Powell, Ph.D., Botanist, Lake Mead National Recreation Area

Sahara mustard (*Brassica tournefortii* Gouan) is native to North Africa, the Middle East, and Mediterranean lands of southern Europe. It was first collected in the United States in California in 1927. It is now found in southern Nevada, southern California, Arizona, New Mexico, and west Texas. A large number of these plants began appearing around Lake Mead National Recreation Area in Arizona and Nevada in 2000. It is imperative that further establishment of this invasive weed be prevented and that existing plants be eliminated.

Identification

Sahara mustard, also commonly known as wild turnip, African mustard, and Asian mustard, is a member of the mustard family (*Brassicaceae*). It is an erect annual herb that can grow from four to forty inches tall, or rarely more (Fig. 1). The stems branch from the base of the plant and have rough, stinging hairs that make them painful to touch. The plants smell of cabbage or turnips when crushed.

The basal rosette of leaves grows up to three feet in diameter in favorable environments. The basal leaves can be three to twelve inches long. The lower leaves are arranged in a rose-like cluster and have lobes with rounded tips. The stem leaves are much smaller and have bristly, stiff hairs on both sides. They are oblong or linear with entire or toothed margins. Leaves are pinnately divided with an enlarged terminal lobe and smaller lateral lobes. Leaves, which are mostly basal, decrease in size further up the stem.

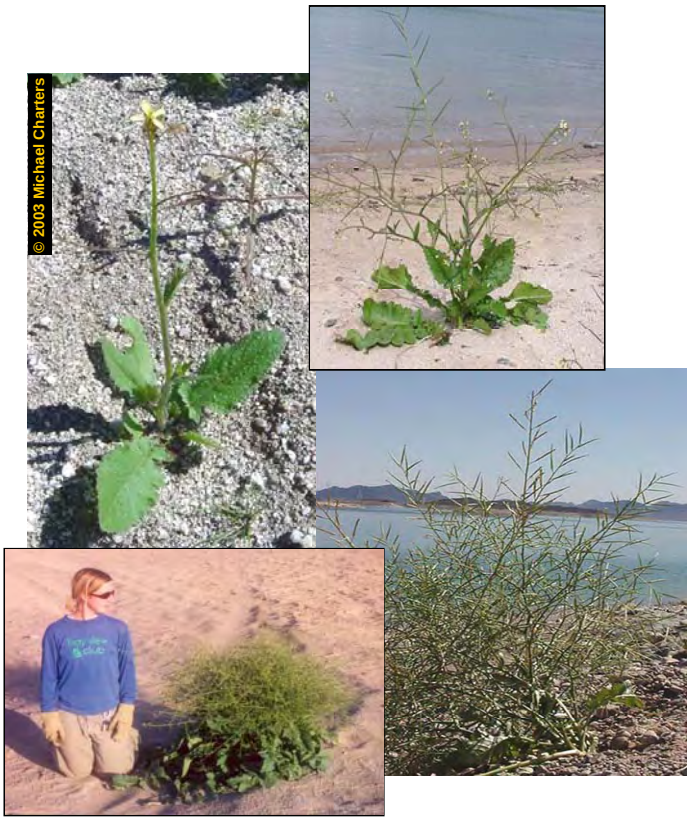

Figure 1. Various sized Sahara mustard plants.

Sahara mustard's flowers are small, less than one-quater inch, with four oblong, pale yellow petals arranged in the shape of an X (Fig. 2). They are bractless with smooth or lightly hairy sepals. The flower petals are longer than the sepals and spread away from the stem. The plant's flowers or fruits may appear as early as December or January. As a winter annual in southern Nevada, most plants have fruited and are dead by April or May.

Figure 2. Although showy in this photograph, Sahara mustard flowers are small and pale yellow. © Michael Charters

Sahara mustard fruits are narrow seed capsules (siliques) that break open when mature (dehiscent) and disperse seed, Fig. 3. Each silique has a noticeable beak at its tip. The seeds are only 0.04 inch (1 mm) in diameter, the smallest of any *Brassica* species. They are reddish brown, spherical, and ribbed. The mucilaginous coating of the seeds, makes them both very sticky when wet and waterproof when swollen by water, which allows them to survive in a dormant condition for up to two months in or under water and facilitates their spread during rainy conditions.

Well developed plants may produce between 750 and 9,000 seeds. Seed of other *Brassica* species remain viable for several years, although it is not known whether this is true of Sahara mustard seed. However, seed kept for three years under room temperatures in the lab were able to germinate. Sahara mustard may be self-fertile because fruit set is nearly 100 percent on most plants.

In the laboratory, 90 to 99 percent of Sahara mustard seeds tested germinated within 48 hours after being wetted. Seeds germinated at temperatures between 61 °F (15 °C) and 90°F (32 °C) in the laboratory. Tests of seeds wetted and maintained at temperatures lower and higher than these did not germinate. Germination was 90% or greater at temperatures between 61 °F (16 °C) and 82 °F (28 °C). Consequently, germination should be expected in the field following rain when daily temperature occurs within this range. Optimal germination should typically occur from February to April in southern Nevada, from April to June in northwestern Nevada, and May through early summer in northern Nevada. In southern Nevada, seeds have germinated repeatedly in the same area following rains when temperatures have been in this range. Germination has not been observed to occur after rainfall during hot summer months in southern Nevada. Germination during the hot summer months may be inhibited by light (long day length), high temperatures, and/or lack of persistent moisture.

Habitat

Sahara mustard typically inhabits areas of low elevation, but it has been found as high as 3,300 feet at Lake Mead National Recreation Area. This weed has spread across deserts in southwestern North America, including southern Nevada. It particularly thrives in sandy or gravelly soils in disturbed and undisturbed areas. It often forms almost pure stands on sandy fields, beaches, and dunes. It is most common in wind-blown sand deposits and in disturbed sites, such as roadsides and abandoned fields. Sahara mustard is scarce on alluvial fans and rocky hillsides as of yet, but it is becoming more common and is capable of growing in these areas.

Figure 3. A fruit and a wet seed surrounded by a sticky, mucilaginous gel.

Impact

Sahara mustard is particularly threatening because it does not require soil disturbance to be invasive. Sahara mustard plants growing early in

the season may dominate available soil moisture. This may adversely affect native annuals starting growth a little later in the season.

Sahara mustard is thought to increase fuel loads and fire hazard in desert scrub and coastal sage scrub. In addition, it may establish from a soil seed bank after fire, but this is yet to be determined.

Rodents cache seeds and may be capable of moving seeds up to 100 meters from their source. Uneaten caches are capable of germinating, thus spreading the plants. These caches are often found in washes, wash banks, berms, and sandy areas. Seeds can also be spread by water and wind. Dry plants can break off at ground level and tumble across the landscape in the wind, spreading seed and infesting new areas.

Sahara mustard seed may be dispersed long distances during wet weather. The mucilaginous gel that forms on seeds in contact with water can cause seeds to stick to many surfaces, such as animals, vehicles, and people. This could facilitate spread. Plants can be blown into water bodies, such as lakes and rivers, and can float on water to new areas. Seeds have been shown to be capable of germinating after being in or under water for up to two months.

Sahara mustard can form dense stands and potentially crowd out native annuals. The density of plants per square foot may fluctuate with annual climate, soil type, available soil moisture, and fire history. Because Sahara mustard is drought tolerant, long, dry periods that may kill other plants, might allow Sahara mustard to increase its stand. This may or may not have been the case during a drought in Riverside County from 1989 to 1991 when red brome cover on a dry southern exposure declined, and the population of Sahara mustard increased by nearly 35 times. Conversely, hot spells or fires may decrease Sahara mustard density by causing the plants to flower and fruit early. Densities equivalent to as high as three million plants per acre have been recorded at Lake Mead National Recreation Area.

Currently, it appears that most birds and mammals do not forage on this plant. The highly nutritious and caloric seeds, however, are eaten by rodents and some birds.

Management Methods

Experiments to find effective methods of Sahara mustard control are ongoing. Plants may be controlled if quick action is taken before a seed bank in the soil is established.

Prevention: The best control method for any invasive plant is prevention. People must be made aware and given the tools for early identification in order to prevent the ingress and establishment of alien species in new areas. If Sahara mustard is found, eliminate it immediately. Do not allow it to go to flower and produce seed. Minimize soil disturbance by vehicles, equipment, or other activities to prevent its spread by these vectors. This plant spreads by seed, so do not drive vehicles, move animals, or walk through infested areas, especially following a rain. It is particularly important to avoid moving mud and soils from infested areas. Contaminated equipment used to fight wildland fires, construct and maintain utility lines, build and maintain roads—any equipment, along with recreational vehicles (SUVs, ATVs, dirt bikes, etc.) may be put on trailers and moved great distances. Unless the equipment and trailer are properly cleaned before moving from infested lands, they may transport Sahara mustard seed hundreds of miles to infest new areas.

Unfortunately, rodent caching of Sahara mustard seed into disturbed areas may be a significant way this plant is spread, over which there are not many management options. Controlling the animals may or may not be possible or desirable. Of course, monitoring the area for caches and then treating them accordingly is important.

Mechanical Control: Hand pulling plants is effective in reducing the population, especially if done before a seed bank has been established. For best results, return to the site several times over the season, especially if there have been repeated rainfall events, and eliminate any new plants.

Hand hoeing is also very effective in large stands of plants if done when the plants are in the rosette or early stages of flowering, particularly on sandy or gravelly sites. Weed whipping and mowing alone are not recommended because the plants will simply regrow flower and fruit stalks.

Planned burning will probably not be effective due to Sahara mustard's ability to survive long periods of harsh conditions in soil seed banks. Fires do cause high seed losses; however, plants grow back rapidly following fire. Furthermore, fire in desert environments may harm native plants,

seed banks, and soil organisms, and increase the spread of alien grasses.

Cultural Control: Grazing is not expected to contain the spread of Sahara mustard because as yet, animals do not appear to readily eat it and the plants can establish rapidly from the seed bank. It is possible that goats could be trained to eat Sahara mustard, but to our knowledge this has not been done. Burros do eat the plant, but not enough to make a difference. Experiments need to be undertaken in order to determine the effects of grazing.

The effect of revegetation on the stand density of Sahara mustard also needs to be investigated. A dense cover of annual or perennial grasses may restrain Sahara mustard germination, establishment and long term persistence in an area.

Biological Control: There are currently no biological control agents for Sahara mustard. Due to the plant's close relationship to many significant crops in the mustard family, such as broccoli, cauliflower, brussel sprouts, and canola, it will be difficult to find an agent that will control Sahara mustard without damaging these crops.

Chemical Control: Early applications of chemicals may control Sahara mustard due to its extremely early development. Applications should be particularly effective if started before native species have begun to develop. Applying Remedy® or Garlon® (triclopyr) at a 2% concentration killed plants in the rosette and early flowering stage at Lake Mead National Recreation Area However, if the plants have already produced fruits, it is wise to hand-pull and remove them from the site. Green fruits may be capable of ripening in the field from uprooted and /or chemically treated plants to produce viable seed. It is unknown if treatment with triclopyr prevents seed ripening in green fruits or decreases the viability of already ripened or potentially ripened seed.

Tests are currently being conducted to determine whether other chemicals will effectively control Sahara mustard. So far, tests have shown that applications of Roundup® (glyphosate) are inconclusive. However, weed whipping followed by applications of glyphosate effectively kills plants.

In Australia, Sahara mustard is considered resistant to Group B herbicides, which includes chemicals such as chlorsulfuron, imazethapyr, and flumetsulam. These herbicides inhibit acetolactate synthase (ALS), and are powerful inhibitors of root growth. They are usually applied pre- and post-emergence. These herbicides do not effectively control Sahara mustard plants in Australia, but their effectiveness in the United States has not been determined.

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UNIVERSITY OF NEVADA •Reno

COOPERATIVE EXTENSION

Bringing the University to You

Fact Sheet FS-02-93

(Replaces Fact Sheet FS 95-15)

Managing Saltcedar

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Saltcedars (*Tamarix chinensis, T. ramosissima,* and *T. parvifolia*) are invasive, shrubby trees that are rapidly colonizing riparian areas in Nevada. *Tamarix ramosissima* is the principle invader. They were introduced into the United States in the early 1800's as ornamentals and to prevent soil erosion along streams. These trees have escaped cultivation and are spreading rapidly throughout the desert southwest, Rocky Mountains and Great Basin. A fourth species, Athel (*T. aphylla*) is a very tall single-trunked, evergreen that is invasive in Southern Nevada. Less hardy than the others, it grows in Clark and southern Nye Counties.

In Nevada, saltcedar occupies Baltic rush meadows along the Walker River, saltgrass communities or former croplands at Stillwater and the Humboldt Sink, and arroyos in the upper pinyon/juniper zone of the Stillwater Range at Fence Maker Pass. The Colorado, Muddy and Virgin Rivers are heavily infested in southern Nevada. Native plant communities surrounding springs, seeps, streams and lakes are also threatened. Even isolated arroyos are being occupied by saltcedar throughout Nevada.

DESCRIPTION AND HABITAT

Saltcedar (*T. ramosissima*) is a deciduous shrub or small tree that grows 20 to 25 feet tall. Its gray-green leaves and wispy limbs give it a feathery appearance. The striking, small, pink to white flowers cover the upper branches in spring with occasional sparse flowering over the season (Fig. 1). It profusely produces tiny seeds each year that are spread by wind, water and animals.

Unlike native willows and cottonwoods that produce seeds for a short period in the spring, saltcedar

Figure 1. Wispy saltcedar limbs in bloom.

produces seeds over the entire summer as long as soil moisture is available. Spring-produced saltcedar seed has near 100 percent germination over a wide range of constant or alternating temperatures. Seed produced later has less viability. Each plant can produce 500,000 or more seeds. One hundred seeds per square inch have been produced within a saltcedar forest. Once wetted, embedded in soil or not, saltcedar seeds germinate in 24 hours. If the soil dries rapidly, the seedlings die. For establishment, the soil must dry slowly enough for the roots to grow into moisture deeper in the soil profile.

Saltcedar also reproduces vegetatively from the stems, crown and roots. New growth occurs readily when young plants are grazed or mowed, or the trunk or shoots are removed or killed by fire or severe drought.

Saltcedar uses more water than native cottonwoods, poplars and willows. It grows best in riparian sites such as stream banks, saline meadows, seasonally saturated washes, and lands that have seasonally high

water tables. It is classified as a phreatophyte, meaning it uses very large amounts of groundwater. Therefore, it lowers the water table that supplies springs and shallow wells. Dried up springs in Nevada have recovered after the surrounding saltcedar has been removed.

Saltcedar is able to use salty water. It does this by absorbing the salts through cell membranes. It avoids the toxic effects by using special glands to excrete the salts and by dropping salt-filled leaves. The leaves dropped each fall accumulate to a considerable depth under the canopy. Through this process, saltcedar acts as a salt pump concentrating salts from deep in the ground onto the soil surface. Over time, salts in the mulch layer kill existing plants and prevent others, especially desirable forage species, from becoming established. As a result, the ground under a saltcedar or within a saltcedar boscage is void of plants except, on occasion, another salt tolerant species.

SALTCEDAR ASSOCIATED PROBLEMS

Studies in New Mexico and Utah show saltcedar uses four to thirteen acre-feet of water a year; much more water than native trees and shrubs. It has an extensive, deep root system that absorbs water from the surrounding soil lowering the water table and killing most native plants. Competition for water resources in the west is growing yearly, especially where large saltcedar communities exist.

A normally functioning, healthy river (Fig. 2) has a

Figure 2. A variety of plants contribute to a healthy, functioning, beautiful river or stream.

narrow, deep, meandering flow. Saltcedar reduces a river's flow of water. It uses soil moisture that would usually contribute to the stream and traps sediment along the banks and in the river. This increases the size of the flood plain spreading water over a larger area, which increases evaporation and water use by plants (often extensive saltcedar woods). When infested with saltcedar, a healthy river becomes an impenetrable, unproductive saltcedar forest that may use one third more water from the river than a similar stand of native trees (Fig. 3). A saltcedar-dominated stream functions poorly, is unattractive, changes native habitats, supports less wildlife, spoils recreational uses and affects water quality.

Cattle, sheep and goats will graze saltcedar but it is nutritionally poor forage for both livestock and wildlife. They prefer not to eat it and only do so when little else is available. Cattle eat only the young sprouts early in the year. Aggressive grazing by sheep may provide some control, but overgrazing stimulates suckering and speeds the area's conversion to a pure saltcedar stand.

Saltcedar provides cover for wildlife, but animal and plant diversity is reduced. The impenetrable stands make recreational access almost impossible on foot, horse or vehicle. Hunting and fishing are greatly restricted. Rounding up livestock hiding in a thicket is a chore.

CONTROL STRATEGIES

Effective management requires determination and a

Figure 3. Saltcedar stands along the Muddy River at Glendale, NV prevent fishing.

multi-year commitment. Efforts should be taken to prevent site disturbances by fire, overgrazing, and mechanical damage, that leave the site open for saltcedar invasion. Elimination of upstream infestations is required to effectively control saltcedar in a watershed. Eradication of the plant immediately after discovery is best before saltcedar becomes well established. After saltcedar is removed, it is requisite that a competitive stand of desirable plants be established to prevent reinvasion of the area by saltcedar.

BIOLOGICAL CONTROL

Biological control applies natural enemies to weeds. Insects, disease causing organisms, and livestock have all been used in successful biological control efforts on a variety of invasive weeds.

Two insects, a mealy bug (*Trabutina mannipara*) and leaf beetle (*Diorhabda elongata*), have been released in the United States to attack saltcedar. The

mealy bug is not adapted to colder, drier environments and was released outside Nevada. The leaf beetle was released at Schurz, Stillwater, and Lovelock, Nevada after it was established that it eats only saltcedar and not valuable natives, ornamentals or crops. Research continues on its adaptability, reproductive ecology and predation of saltcedar in Nevada.

MECHANICAL CONTROL

Plowing, cutting, mowing, chaining and burning have been attempted to control saltcedar. All have failed on large-scale projects because saltcedar resprouts profusely following mechanical treatments. Success has been achieved after a fire when the root crowns are removed before the next growing season and all new growth is removed as it occurs.

Flooding saltcedar for one or two years is effective. Small plants, if completely covered, easily succumb. The root crown and most of the shoots must be covered completely for months to successfully kill larger plants.

CHEMICAL CONTROL

Only two herbicides effectively control saltcedar, triclopyr (Garlon 4) and imazapyr (Arsenal). After applying either product, do not disturb the saltcedar for two years. This allows the herbicide time to move throughout the entire plant, especially the root system, and kill it. Applying 2,4-D, picloram, or glyphosate to saltcedar does not control it.

Saltcedar usually produces a multi-stemmed shrubby tree. In the Walker River Delta, there are 60,000 stems per acre, many of them less than one inch in diameter. This makes navigating the area and applying chemicals difficult, even hazardous. Exercise care in handling herbicides while moving among the stems to avoid spilling it on yourself, others, or contaminating the area.

Cut saltcedar stems off at ground level and immediately paint the cut surface with full strength Garlon 4, the ester formulation of triclopyr. (Specific instructions limit the use of triclopyr near water and in wetlands.) Apply the herbicide with a brush within ten minutes, sooner is better. Triclopyr can also be applied as a basal stem treatment mixed with metylated seed oil as a carrier (see the label for directions on mixing the two). Stems must be treated all the way around, which can be difficult in heavy stands. Stem treatments can be used on stems up to three inches in diameter. This requires less labor than painting the cut surface of stems. Both applications use large amounts of herbicide per acre, are labor intensive, and time consuming.

The only effective foliar-applied herbicide for saltcedar is imazapyr. Follow the label instructions regarding application rates, use of an oil carrier, and the types of application equipment to use. Again, do not disturb saltcedar treated with imazapyr for two years or burn the treated stand after it has dried. For additional insights see Table 1.

When applying herbicides, always follow the directions on the label. Failure to do so violates the law. Following the instructions protects the applicator, other workers, non-target plants and animals, and our environment. It also reduces liability for any damages incurred.

SUSTAINABLE MANAGEMENT

Treated areas should be revegetated and properly managed. Successful saltcedar control and revegetation is difficult for these reasons:

- The accumulation of salt on the soil's surface hinders the establishment of desirable plants.
- The understory species in many saltcedar infestations is desert saltgrass, which is damaged or killed by imazapyr. The area has to be tilled to break up the saltgrass sod and turn the salts under before seed of other species can be broadcast or drilled.
- Removal of the limbs and roots of saltcedar is difficult and expensive. If the trees are large, chainsaws and a caterpillar are used to remove the biomass and deep rip the roots.
- Burning the treated area results in sprouting from the roots. Two growing seasons must elapse for the herbicide to kill the roots so that the saltcedar will not regrow when the shots are removed or burned.

Other aspects must be considered when controlling and removing saltcedar. The plant plays an important part in bank stabilization on Nevada's desert river systems. Loss of stabilization must be compensated for in any control program. Control of saltcedar in the Walker River Delta and the Virgin River Valley may result in additional erosion of highly salt-affected soils, increasing the salt content of nearby waters.

Along the Carson, Humboldt, Muddy, Truckee, Walker and Virgin Rivers or other riparian communities where saltcedar is established, selective control is necessary. Reestablishment of native woody vegetation may prove difficult requiring changes in management of the riparian woodlands to prevent pollution of nearby waters and re-establishment of saltcedar.

Table 1. Considerations for effective chemical treatments to control saltcedar.

Considerations	Treatment Methods		
	Cut-stump Surface	**Basal Bark**	**Foliar Spray**
Plant Stage	All stages, triclopyr in summer and fall.	All stages, but most effective applied to stems less than 3" in diameter treated when dormant compared to spring or summer applications.	Best results occur with an aerial application of imazapyr in the late summer to early fall (August – September). Stop when fall dormancy begins.
Treatment Process	Paint the cut stumps immediately with triclopyr; within 10 minutes, sooner is better. Use a water-soluble dye to track the treated plants.	Spray the lower uncut 15" of the plant with triclopyr in an oil carrier. Be sure to spray the entire bark surface of the stem.	Herbicide and wetting agent are applied via spray devices. Ground based sprayers (ATV's or trucks) and aircraft are effective.
Herbicide Application	Thoroughly treat each stump, especially the cambium layer just inside the bark. Stumps must be wetted completely for good control.	Low-volume application: mix 25 to 30 gallons Garlon 4* with oil to make a 100-gallon mixture. Apply to plants with stems less than 3" in diameter. Inconsistent results.	Apply Arsenal* (Imazapyr) with the proper surfactant until the saltcedar is wet, but not dripping. Do not disturb the crown and roots of large trees for 2 years to allow imazapyr to move throughout the tree to prevent re-sprouting from the roots.
Effectiveness	Most popular and effective in areas unsuitable for aerial or ground rig applications. Use near water to avoid drift and contamination of water.	Retreatment of the stems that were not killed is difficult compared with the cut stump treatment. Use where it is very rocky or labor is not available for treating cut stumps.	Effective on large stands with few non-target plants growing among the saltcedar. The shoots normally die within one year, the roots within two years.
Retreatment	Is necessary to clean up missed stumps.	May need to retreat the following year.	If necessary.

*Trade or common names have been used to simplify information; no endorsement by the University of Nevada Cooperative Extension is intended nor implied. Likewise criticism of products not listed is neither implied nor intended.

Be cautious when using chemicals. Be careful not to treat irrigation ditches, non-target plants, or surface waters. For more information contact your local University of Nevada Cooperative Extension office.

BENEFITS OF SALTCEDAR CONTROL

Controlling saltcedar and revegetating the land improves riparian habitats and increases biodiversity. Using the woody biomasss of saltcedar for value added manufacturing in rural Nevada may be a viable option. Conversion of saltcedar woodlands to more water efficient plants allows water in a watershed to be utilized for more beneficial uses. Until alternative vegetation becomes established on the infested land, actual measurements cannot be taken to determine whether or not water is conserved and available. Control of saltcedar also improves grazing, wildlife habitat, and recreational uses along waterways.

ADDITIONAL RESOURCES

1) Ball, D., P.J.S. Hutchinson, T.L. Miller, D.W. Morishita, R. Parker, R.D. William and J.P. Yenish. 2001 Pacific Northwest Weed Management Handbook. Oregon State University. Corvallis, OR. pp. 184-203.
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COOPERATIVE EXTENSION

Bringing the University to You

Fact Sheet FS-04-36

Managing Johnsongrass

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Now a significant pest throughout most of the United States, Johnsongrass (*Sorghum halepense*) is a perennial plant that was introduced as a hay or forage crop. In addition to spreading rapidly and crowding out desirable species, when stressed or injured Johnsongrass is potentially toxic to grazing livestock. It is considered one of the ten most noxious weeds in the world.

Identification

This member of the Poaceae (grass) family produces stems two to eight feet tall that are solid with prominent nodes. The smooth leaf blades are one-half to one inch wide, have noticeable white midveins, and are arranged alternately along the stems. The ligules (the tissue at the junction of the stalk and leaf blade – pull the blade away from the stalk to see it) are short and membranous, with a terminal fringe of fine hairs.

The flowers, which occur from July through September, are large, open, pyramid-shaped panicles. Shiny, reddish to purple spikelets are found in pairs at the lower end of the flowering stalk, and in threes at the upper end (Fig. 1). A pair consists of one sterile spikelet with male

Figure 1. Purplish spikelets are shiny and awn-tipped.

Figure 2. Johnsongrass spreads rapidly by large fleshy rhizomes.

flowers and short stalks, and one fertile, stalkless spikelet with female flowers. When found in threes, only one of the spikelets is fertile. Most of the spikelets have bent, needle-like awns. The knob-shaped tip of the seed stalk distinguishes Johnsongrass from other closely related species.

The reddish brown seeds are glossy and 1/8 to 3/16 inch long. Seeds are scattered great distances by wind, water, animals, and agricultural activities. One plant may produce more than 80,000 seeds and 275 feet of rhizomes in a single growing season. Seeds can remain viable in the soil for over ten years, and may endure ingestion by birds and mammals.

In addition to spreading by seed, this plant also has fibrous roots and extensive, creeping rhizomes. The thick, fleshy rhizomes are initially white, but become chestnut brown over the winter (Fig. 2).

There are several species similar to Johnsongrass, but they can easily be distinguished. Those often confused with Johnsongrass include the following large grasses. Shattercane is an annual grass that does not produce rhizomes. In addition, the leaf

blades of shattercane are usually much wider than those of Johnsongrass. Eastern gamagrass (*Tripsacum* dactyloides) has flowers in a spike rather than a panicle. Switchgrass (*Panicum virgatum*) has a greenish-yellow seed head and no white veins in the leaves. Big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*) both have more narrow leaves than Johnsongrass.

Figure 3. Johnsongrass is a vigorous perennial that grows two to eight feet tall.

Habitat

Introduced from the Mediterranean, Johnsongrass was originally considered a warm season grass. It has adapted and is now found in a variety of environments, although, it prefers fertile, moist soils in warm-temperate regions.

It grows in crop fields, pastures, abandoned fields, rights-of-way, forest edges, and along stream banks. It thrives in open, disturbed, rich, bottom ground, particularly in cultivated fields. Johnsongrass has infested these areas in Lincoln, Nye, and Clark Counties in Nevada. This weed is found in California's Central Valley, the foothills of the Cascade Range, the Sierra Nevada mountains, and many agricultural areas in the western U.S. where moisture is available.

Threat

Once lands are infested with this extremely aggressive grass, it is very difficult to eradicate. Johnsongrass is a serious problem in all annual agricultural crops, orchards, vineyards, ditches, roadsides, and fencerows. Its rapid spread by seed and strong rhizomes allows it to easily develop colonies, crowd out native species, and slow natural succession in native plant communities.

In situations where Johnsongrass is stressed by drought or frost, or injured by trampling or herbicides, hydrocyanic acid is produced. This acid may be present in all parts of the plant and is poisonous to grazing livestock. Young plants are more toxic than mature ones, and disruption of growth is likely to increase its toxicity. Symptoms of poisoning include: a bluish coloration of mucous membranes, rapid and deep breathing, muscle twitching, staggering, a weak abnormal pulse, and death. Abrupt death without displaying signs of poisoning is common.

Weed Management Options

Prevention: As with all invasive plants, prevention is the best control option for Johnsongrass. Education and early identification will prevent its establishment in new areas. Its ability to spread in several ways makes Johnsongrass difficult to eradicate once it is established. Therefore, it is imperative that the weed be controlled before it spreads over an entire area.

Thoroughly clean equipment after using it in uninfested areas, especially if the equipment has been used in an area with Johnsongrass. It may be necessary to confine livestock for about a week and give them weed-free forage to purge their system of the weed seed if they had contact with the plant. Check for seed on clothing, animals, and vehicles before leaving an infested area. Monitor public and private land for Johnsongrass and eliminate it where it is found immediately. Revisit the site each year to make sure there were no escapes. Agricultural seed, hay, and livestock feeds may become contaminated with Johnsongrass seed. Always select and plant weed-free forage seed.

Mechanical Control: Hand-pulling small infestations of Johnsongrass can be effective. All parts of the plant must be removed and

safely discarded. Make sure there are no stem or root fragments left behind. Areas of infestation may need to be hand-pulled several times to obtain control. Mature plants are more difficult to remove, and hand removal is not practical for large infestations.

Repeated, intensive tillage every few weeks can be an effective control method if done in the winter or summer, and may even prevent rhizome development. If done moderately, however, tillage will break and spread rhizomes, thus helping the weed flourish. Plowing in late fall exposes the rhizomes to harsh winter temperatures and noticeably reduces the stand, especially where repeated freezing, thawing, and dehydration occur.

Fields cultivated every four to five weeks will provide results. Use one tool to cut the rhizomes into small sections and another to bring the fragments to the soil surface.

Continual close mowing kills the seedlings, prevents seed production, and reduces rhizome growth, but will not eliminate established plants.

Cultural Control: Rotating winter crops and crops planted in the late summer will disrupt the environment, provide competition, reduce seed production, and slow the development of rhizomes. Alfalfa can compete with Johnsongrass for a while, but will weaken in the long run. Mowing a mixture of alfalfa and Johnsongrass repeatedly will prevent Johnsongrass from producing seed and slow down rhizome growth.

Burning the plants in the spring is not recommended because fire encourages regrowth from the rhizomes.

Biological Control: There are no known biological control agents available for Johnsongrass. Livestock grazing may reduce the plant's strength, but has several negative effects as grazing increases the likelihood that other weeds will be introduced, desirable species may be selectively eaten or damaged, the soil compacted, and the trampling of the Johnsongrass may produce hydrocyanic acid, making the grass toxic to animals.

Chemical Control: Single herbicide applications will probably not eliminate Johnsongrass from an area. Spraying the foliage of dense patches with 2% Roundup® during June just before maturity can provide control. Roundup® is a nonselective herbicide, however, so it may also kill desired plants if not applied carefully.

Spot-treatment of individual plants in small infestations is very effective. If repeated for several years it will probably prevent further establishment of Johnsongrass. Combining herbicides with other control methods, such as tillage and crop rotation, will produce the best results.

References

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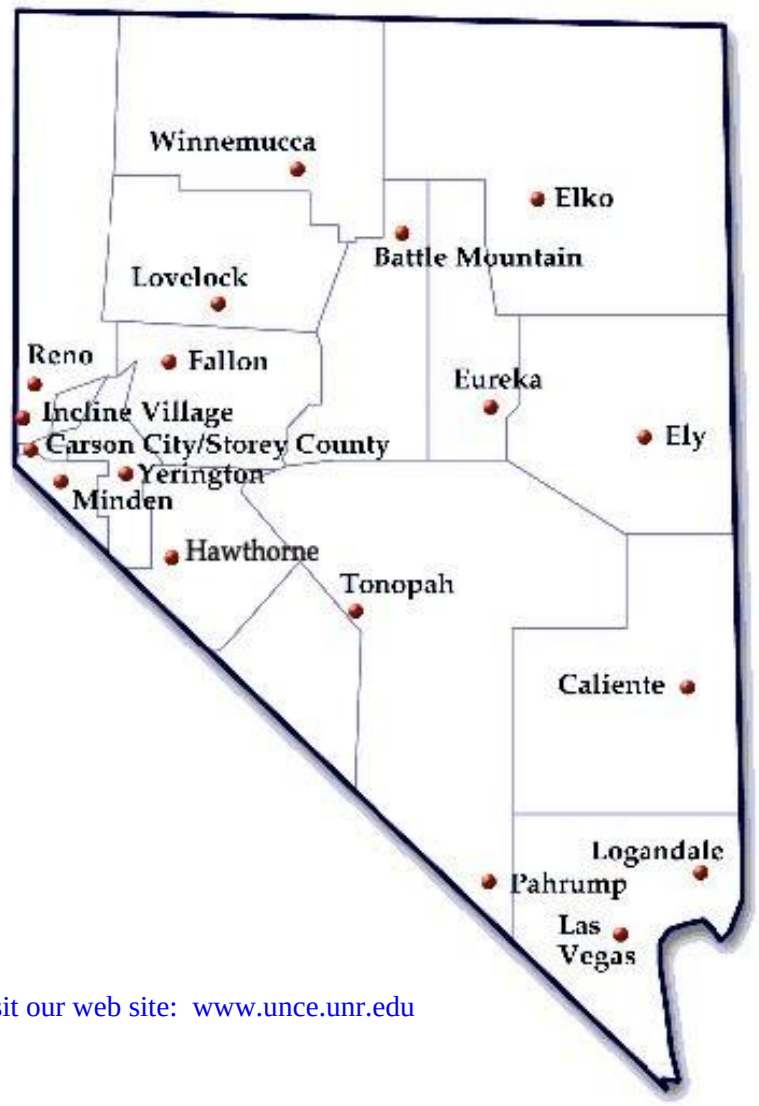
2. Hutchinson, Max. *Vegetation Management Guideline Johnson grass (Sorghum halepense)*. Illinois Nature Preserves Commission. 9 June 2003. <www.inhs.uiuc.edu/chf/outreach/VMG/johngrass.html>.
3. Johnson, Bill, Andy Kendig, Reid Smeda, Fred Fishel. *Johnsongrass Control*. Department of Agronomy, University of Missouri-Columbia. 9 June 2003. <muextension.Missouri.edu/xplor/agguides/crops/g04872.htm>.
4. *Washington's Noxious Weed List Written Findings*. Washington State Noxious Weed Control Board. 9 June 2003. <www.nwcb.wa.gov/weed_info/johnsongrass.html>.

Photographs are courtesy of *Weeds of the West*.

Cooperative Extension Office Locations



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ATTACHMENT C. FORMS

Blank Document **NEVADA BLM PESTICIDE USE PROPOSAL**

PROPOSAL NUMBER: _____
REFERENCE NUMBER of EA:

FIELD OFFICE: **COUNTY:**

LOCATION:

DURATION OF PROPOSAL:

I. PESTICIDE APPLICATION (including mixtures and surfactants):

	Trade Names:	Common Names:	EPA Registration No.	Manufactures:	Fomulations (Liquid or Granular)	Method of Application
1						
2						
3						

MAXIMUM RATE OF APPLICATION:	
USE UNIT ON LABEL:	**POUNDS ACID EQUILIVENT/ACRE:**
1.	1.
2.	2.

INTENDED RATE OF APPLICATION:

APPLICATION DATES:

NUMBER OF APPLICATIONS:

II. PEST (List specific pest(s) and reason(s) for application):

III. MAJOR DESIRED PLANT SPECIES PRESENT:

IV. **TREATMENT SITE:** (Describe land type or use, size, stage of growth of target species, slope and soil type).

ESTIMATED ACRES

V. SENSITIVE ASPECTS AND PRECAUTIONS: (Describe sensitive areas [e.g., marsh, endangered, threatened, candidate and sensitive species habitat] and distance to treatment site. List measures taken to avoid impact to sensitive areas).

VI. NON TARGET VEGETATION: (Describe the impacts, cumulative impacts, and mitigations to non target vegetation that will be lost as a result of this chemical application).

VII. INTEGRATED PEST MANAGEMENT: (Describe how this chemical application fits into your overall integrated pest management program for the treatment area.)

Originator: Date:
Company Name:
Phone:

SIGNATURES:
Certified Pesticide Applicator: (may be unknown at this time)

_____ Date: _____

Field Office Pesticide/Noxious Weed Coordinator

_____ Date: _____
Lauren Brown
Weeds Management Specialist

District Office Authorized Officer

_____ Date: _____
Mary Jo Rugwell
SNDO District Manager

APPROVALS (State Office Use Only):

_____ Date: _____
Mark Coca
BLM State Pesticide Coordinator

_____ Date: _____
Deputy State Director,
Natural Resources, Lands and Planning

___ CONCUR OR APPROVED
___ NOT CONCUR OR DISAPPROVED
___ CONCUR OR APPROVED WITH MODIFICATIONS

Bureau of Land Management PESTICIDE APPLICATION RECORD

This Record is required and must be completed for monitoring within 24 hours after completion of application of pesticides. This record must be maintained for a minimum of 10 years. One form for each pesticide used (unless combined together).

1. Project Name: _____

   Pesticide Use Proposal Number: _____

2. Name of Applicator and License(s) Applying the Pesticide:

   _____ _____

3. Date(s) of Application: _____ Time of Application: _____
   (MONTH, DAY, YEAR)

4. Location of Application: County, Township and Section or Road and Mile Markers .

   _____

5. Type of Equipment Used to Apply Pesticide: _____

6. Pesticide (s) Used: a. Company or Manufacturer's Name: _____

   b. Trade Name: _____

   c. Type of Formulation: Liquid _____/ Granular _____/

7. Rate of Application Used: track for each herbicide if combined.

   a. Active Ingredient per acre: _____

   b. Other ingredients in formulation used: _____

   _____

   c. Mix Ratio: _____

   d. Total Active Ingredient Used Each (gallons/oz): _____

   e. Total Volume of Formulation (gallons/oz): _____

   f. Acres Treated: _____

   g. Total Project Acres (if known): _____

8. Primary Target Plant(s): _____

9. Start Conditions: a. Wind Direction: _____ b. Wind velocity: _____ c. Temp._____

   End Conditions: a. Wind Direction: _____ b. Wind velocity: _____ c. Temp._____

10. Form Completed By:

    _____ _____
    Printed Name Signature