



CITY OF SURPRISE
Planning and Zoning Commission Agenda
16000 N. Civic Center Plaza
Surprise, AZ 85374

Thursday, June 2, 2011 @ 6:00 PM
 16000 N. Civic Center Parkway, Surprise, AZ. 85374

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CALL TO ORDER.

- A. Roll Call
- B. Pledge of Allegiance
- C. Current Events and Reports – Pursuant to A.R.S. §38-431.02(k) the chief administrator, presiding officer or a member of a public body may present a brief summary of current events without listing in the agenda the specific matters to be summarized, provided that 1) The summary is listed on the agenda; and 2) The public body does not propose, discuss, deliberate or take legal action at that meeting on any matter in the summary unless the specific matter is properly noticed for legal action.
- D. Staff Reports

Planning and Zoning Commission Agenda:

CALL TO THE PUBLIC:

INSTRUCTIONS: In order to address the Board\Commission, you will need to fill out a Call to the Public Form available at the front counter, and then turn it in to the Secretary before the meeting begins.

Note: A.R.S. 38-431.01(H) - During this time members of the public may address the Board\Commission on any item not on the agenda. At the conclusion of the open call, the Board\Commission may respond to criticism, may ask staff to review the matter or may ask that the matter be put on a future agenda. No discussion or action shall take place on any item raised.

- E. Approval of items on the Consent Agenda – all items with an asterisk (*) are considered to be routine matters and will be enacted by one motion and one roll call vote to the Board\Commission. There will be no separate discussion on these items unless a board member or commissioner requests, in which event the item will be removed from the consent agenda and considered in its normal sequence on the agenda.

CONSENT AGENDA:

REGULAR AGENDA ITEM - PUBLIC HEARING:

ITEM #	DISTRICT #	ITEM DESCRIPTION	STAFF RECOMMENDATION/ PRESENTED BY
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- | | | | |
|----|-------------------|---|--|
| #1 | District 3 | <u>Consideration and action on FS11-127, a conditional use permit for Imagine Prep at Surprise.</u> | Approve
Hobart Wingard,
Community &
Economic
Development |
| #2 | District 6 | <u>Consideration and action on FS11-096, a conditional use permit for All Greens Medical Marijuana Dispensary.</u> | Approve
Hobart Wingard,
Community &
Economic
Development |
| #3 | District Citywide | <u>Consideration and action on FS11-008, a city initiated major amendment to the City of Surprise 2030 General Plan to add the wildlife linkages map and ancillary information to the general plan.</u> | Approve
Vineetha
Karthi,
Community &
Economic
Development |

OTHER BUSINESS:

ADJOURNMENT:

SHERRY ANN AGUILAR, CITY CLERK, CMC

POSTED: May 26, 2011 Posted at 9:30 a.m.

SPECIAL NOTE: PERSONS WITH SPECIAL ACCESSIBILITY NEEDS, INCLUDING LARGE PRINT MATERIALS OR INTERPRETER, SHOULD CONTACT THE CITY CLERK'S OFFICE @ 623.222.1200 OR TTY 623.222.1002, BY NO LATER THAN 24 HOURS IN ADVANCE OF THE REGULAR SCHEDULED MEETING TIME.



CITY OF SURPRISE
Boards and Commissions

June 2, 2011 @ 6:00:00 PM

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Board Meeting Date:	June 2, 2011	Contact Person:	Hobart Wingard, Community & Economic Development
Submitting Department:	Planning & Zoning	District:	3
Staff Recommendations:	Approve		

Consent	Regular	Public Hearing	x	Report/Discussion
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Agenda Wording:

Consideration and action on FS11-127, a conditional use permit for Imagine Prep at Surprise.

Motion:

I move to approve FS11-127, a conditional use permit for Imagine Prep at Surprise and to adopt staffs findings and conditions a through e.

Background:

The request is to expand the allowable grade range of the school to accommodate sixth through twelfth grades. The original conditional use permit allowed the facility to provide for seventh through twelfth grades.

Financial Impact Statement:

The net financial impact to the City of Surprise is negligible.

ATTACHMENTS:

Click to download

☐ [Staff Report](#)

☐ [Vicinty Map](#)

External Attachment Links:

Meeting Requirements:

Powerpoint	x	Video	White Board	Other	x
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Presentation Speaker Names (spelling and titles for TV captions):

Hobart Wingard, Planner, Community & Economic Development



COMMUNITY AND ECONOMIC DEVELOPMENT DEPARTMENT

Date: June 2, 2011

To: Planning and Zoning Commission

From: Jeffrey J. Mihelich, Community and Economic Development Director
Hobart Wingard, Planner
623.222.3156, hobart.wingard@surpriseaz.gov

Re: FS11-127, Imagine Prep School

Application Summary

The applicant is requesting to modify a condition of the existing Conditional Use Permit.

Location

The existing school site is located at 14850 North 156th Avenue.

History

- On September 10, 1998, the subject property was annexed into the City of Surprise.
- On January 24, 2008, the Imagine Charter School CUP was approved by the Board of Adjustment.

Project Summary

The existing Imagine Prep School provides educational services for students attending seventh (7th) through twelfth (12th) grades. To balance attendance with it's fully occupied elementary campus, Imagine School at Rosefield, the applicant requests to allow students from the sixth (6th) grade to attend the Imagine Prep School campus. The overall enrollment limit, currently set at 650 students, would not be affected.

Citizen Review Meeting

A Citizen Review Meeting was held on May 17, 2011.

Economic Impact Analysis

The net financial impact to the City of Surprise is negligible.

Department Review

All departments involved in the subject review are recommending the project for approval subject to all conditions.

Staff Findings

1. Staff finds that the proposed project complies with the Surprise Municipal Code.
2. Staff finds that the proposed project complies with the General Plan.

Recommendation

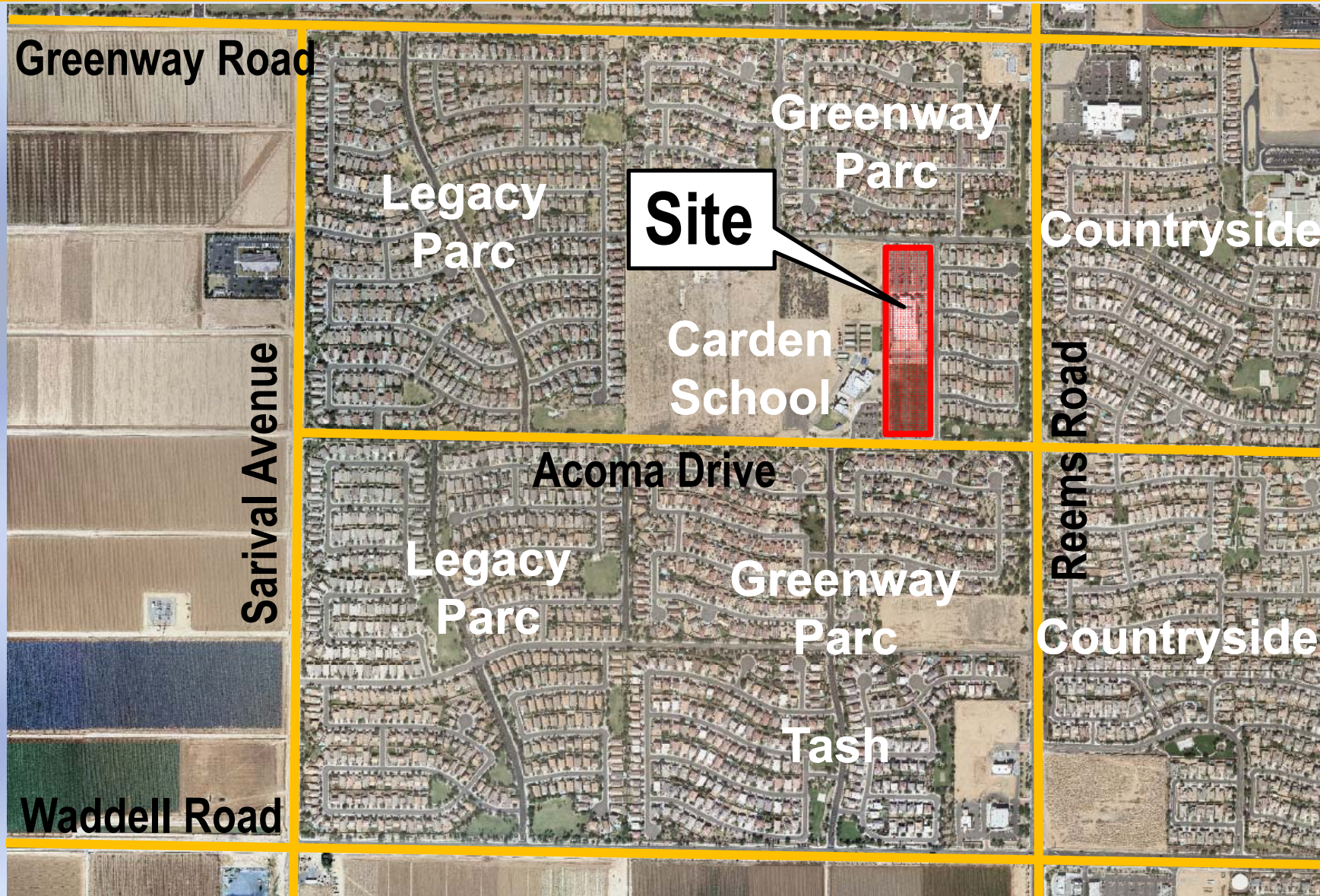
Staff recommends approval of the project, subject to the following conditions:

- a. Major changes to this Conditional Use Permit with regards to use and intensity will be processed as a revised application with approval by the Planning and Zoning Commission. Minor changes may be administratively approved by the Community and Economic Development Director.
- b. Educational services will be provided to no more than 650 students at this location.
- c. Educational services will only be provided for students attending sixth through twelfth grade.
- d. Open space will only be used for recreational purposes.
- e. School start and dismissal times will not occur within 30 minutes of the start and dismissal times of the adjacent school.

Attached

Citizen Review Meeting Summary and Vicinity Map.

LOCATION MAP – IMAGINE SCHOOL





CITY OF SURPRISE
Boards and Commissions

June 2, 2011 @ 6:00:00 PM

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Board Meeting Date:	June 2, 2011	Contact Person:	Hobart Wingard, Community & Economic Development
Submitting Department:	CD Boards and Commissions	District:	6
Staff Recommendations:	Approve		

Consent	Regular	Public Hearing	x	Report/Discussion
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Agenda Wording:

Consideration and action on FS11-096, a conditional use permit for All Greens Medical Marijuana Dispensary.

Motion:

I move to approve FS11-096, a conditional use permit for All Greens Medical Marijuana Dispensary and to adopt staffs findings and condition a.

Background:

The request is to allow for the operation of a medical marijuana dispensary.

Financial Impact Statement:

Because of the not-for-profit status of the proposed facility, the net financial impact to the City of Surprise is negligible.

ATTACHMENTS:

Click to download

- ☐ [STAFF REPORT](#)
 - ☐ [Vicinity Map](#)
 - ☐ [Site Plan](#)
 - ☐ [Photos](#)
-

External Attachment Links:

Meeting Requirements:

Powerpoint x Video White Board Other x

Presentation Speaker Names (spelling and titles for TV captions):



COMMUNITY AND ECONOMIC DEVELOPMENT DEPARTMENT

Date: June 2, 2011

To: Planning and Zoning Commission

From: Jeffrey J. Mihelich, Community and Economic Development Director
Hobart Wingard, Planner
623.222.3156, hobart.wingard@surpriseaz.gov

Re: FS11-096, All Greens Medical Marijuana Dispensary

Application Summary

The applicant is requesting to operate a 2,352-square-foot medical marijuana dispensary.

Location

The medical marijuana dispensary is proposed to be located at 13431 West Westgate Drive, Suite 103, immediately north of the intersection of Bell Road and Grand Avenue.

History

- On May 23, 1996, the subject property was annexed into the City of Surprise.
- On December 7, 2004, a site plan for a vehicle repair facility and shell building for the subject parcel was approved by the Planning and Zoning Commission.
- On November 2, 2010, Arizona voters passed proposition 203 which allows for the cultivation, distribution, and use of marijuana for medicinal purposes.
- On February 8, 2011, the Mayor and City Council approved a zoning text amendment to regulate medical marijuana facilities within the City of Surprise.

Project Summary

The proposed project will provide a 2,352-square-foot medical marijuana facility within an existing shell building located on land zoned CR (Community Commercial). The dispensary will cultivate clones, and distribute marijuana cultivated from an offsite facility for medicinal purposes.

Primary access to the facility exists from Westgate Drive to the North. Westgate Drive is reached from Bell Road, the nearest arterial road, via 134th Avenue to the east.

The security plan for the facility includes a locked and manned entry, monitored alarm system, exterior and interior video surveillance and recording, and full time security personnel. Additional building security measures include steel grating on the interior of all garage type doors and concrete landscape planters to prevent vehicle ramming of the facility.

As required by the Surprise Municipal Code, medical marijuana facilities are to be separated from other incompatible uses. Separation distances are as shown below:

Use	Required Distance	Distance from Subject Facility
School	1,500	5,800
Residence	500	1,220
Worship Facility	500	603
Park	1,500	8,660
Sexually Oriented Business	3,000	49,000

Citizen Review Meeting

A Citizen Review Meeting was held on May 18, 2011.

Economic Impact Analysis

Because of the not-for-profit status of the proposed facility, the net financial impact to the City of Surprise is negligible.

Department Review

All departments involved in the subject review are recommending the project for approval subject to all conditions.

Staff Findings

1. Staff finds that the proposed project complies with the Surprise Municipal Code.
2. Staff finds that the proposed project complies with the General Plan.

Recommendation

Staff recommends approval of the project, subject to the following conditions:

- a) This Conditional Use Permit will become effective upon issuance of the Dispensary Registration Certificate and written approval to operate a medical marijuana dispensary from the State of Arizona Department of Health Services.
- b) Any operations at this facility will not commence prior to the Conditional Use Permit being effective.
- c) Hour of operation will be limited to 8 am to 7 pm Monday through Friday, and 8 am to 6 pm on Saturday. The facility will be closed on Sunday.
- d) Prior to harvesting marijuana plants at this facility, new building plan submittals will be required based on the change in occupancy as defined by the adopted building codes.
- e) A security guard will be assigned exclusively to the exterior premises of the dispensary during operational hours.

Attached

Vicinity map, site plan, citizen review summary, and facility images.

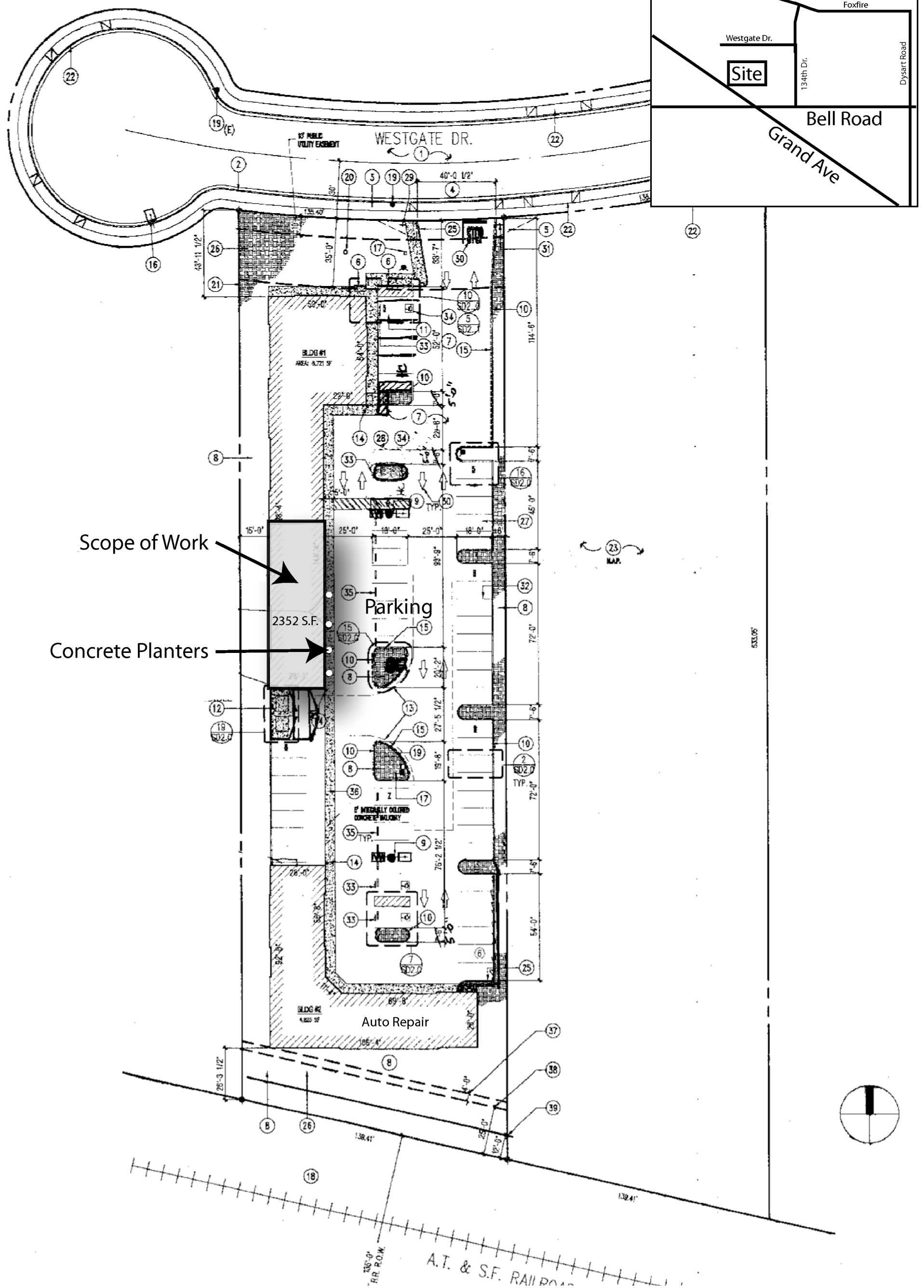
LOCATION MAP – ALL GREENS



LOCATION MAP – ALL GREENS



All Greens Medical Marijuana Dispensary











CITY OF SURPRISE
Boards and Commissions

June 2, 2011 @ 6:00:00 PM

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Board Meeting Date:	June 2, 2011	Contact Person:	Vineetha Kartha, Community & Economic Development
Submitting Department:	CD Boards and Commissions	District:	Citywide
Staff Recommendations:	Approve		

Consent	Regular	Public Hearing	x	Report/Discussion
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Agenda Wording:

Consideration and action on FS11-008, a city initiated major amendment to the City of Surprise 2030 General Plan to add the wildlife linkages map and ancillary information to the general plan.

Motion:

I move to recommend approval to the Mayor and City Council case FS11-008, major amendment to the City of Surprise 2030 General Plan to add the wildlife linkages map and other ancillary information.

Background:

The 2011 amendment to the General Plan is to consider the addition of a wildlife linkages map and ancillary information to the General Plan. Per Arizona Game and Fish Department, wildlife movement research and computer modeling techniques indicate the Trilby and Iona washes and their major tributaries, the CAP Canal, the McMicken Dam and the Beardsley Canal as areas important for conservation as wildlife linkages. These areas have been identified for conservation as wildlife linkages in the proposed wildlife linkages map.

Financial Impact Statement:

Approval of the major amendment will have no direct affect on the city budget. Any future activities related to the new general plan element that have budget implications would need to be considered by the Mayor and City Council at the time of proposal. There are no proposed activities at this time.

ATTACHMENTS:

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☐ [STAFF REPORT](#)

- ☐ [APPENDIX A](#)
- ☐ [APPENDIX B](#)
- ☐ [Appendix C](#)
- ☐ [Appendix D](#)
- ☐ [Appendix E](#)
- ☐ [APPENDIX F](#)

External Attachment Links:

Meeting Requirements:

Powerpoint x Video White Board Other x

Presentation Speaker Names (spelling and titles for TV captions):

Vineetha Kartha, Planner, Community & Economic Development



COMMUNITY & ECONOMIC DEVELOPMENT DEPARTMENT

Date: June 2, 2011

To: Planning and Zoning Commissioners

From: Jeffrey J. Mihelich, Community & Economic Development Director
Vineetha Kartha, Planner, 623-222-3155
vineetha.kartha@surpriseaz.gov

Re: **FS11-008 Major Amendment to the General Plan to add the Wildlife Linkages Information**

Application Summary

The major amendment this year is to amend the general plan to add the wildlife linkages map. Per Arizona Revised Statutes (ARS), the City of Surprise Planning and Zoning Commission is required to hold two public hearings on a major general plan amendment. The meetings are required to be held in different locations to promote citizen participation. The first required public hearing was held on May 19, 2011 at the AZ Techcelerator to meet this requirement. This is the second required public hearing.

History

- A presentation on wildlife linkages in partnership with Arizona Game and Fish Department (AZGFD) was made to the Planning & Zoning Commission on October 5, 2010
- A presentation on wildlife linkages in partnership with AZGFD was made to the City Council on May 27, 2010.

Background

Wildlife movement corridors are under threat from recent land use conversions for development and associated infrastructure. Continuing development consumes substantial amounts of acreage leading to further fragmentation and elimination of habitat. In addition there are existing barriers to wildlife movement within the Surprise Planning Area - US-60, SR 74, Sun Valley Parkway, BNSF railroad and the CAP Canal. Lack of connectivity deprives animals of biological resources, prevents animals from re-colonizing areas where extirpations have occurred, and ultimately disables the animals from contributing to various ecosystem functions. Fragmentation of wildlife corridors effectively isolates the local wildlife population thereby increasing the probability of localized extirpation of the species.

AZGFD has identified the following focal species¹ to model wild life linkages in the Surprise planning area: tiger rattlesnake, lyre snake, kit fox, blacktailed jackrabbit, javelina, mule deer, mountain lion, desert tortoise, and gila monster. These species are sensitive to habitat loss and fragmentation including those that are unable to cross barriers (mountain lion, mule deer, desert tortoise) and special status species (desert tortoise) while others like javelina are common but still need gene flow among populations. Crucial habitats for these species include a natural desert habitat with a distinctive biotic community.

On a local level, remnant populations of mountain lions, mule deer and desert tortoise will be lost if habitat fragmentation continues unchecked. Per a study on mule deer conducted by AZGFD in 2008, current levels of wildlife connectivity will diminish in the absence of connectivity planning, with potentially deadly consequences for the White Tanks mule deer herd as well as other species inhabiting the range or living within the project area boundary. Large habitat blocks connected by linkage corridors can serve critical functions by allowing wildlife to move, migrate, disperse, reproduce and access important habitats within a large landscape context thereby mitigating the challenges discussed above.

AZGFD has conducted wildlife movement research and utilized computer modeling techniques on the suite of focal species to identify areas important for conservation as wildlife linkages in the Surprise Planning Area. These areas have been identified for conservation as the wildlife linkages in the proposed wildlife linkages map. The areas proposed as wildlife linkages primarily includes those areas of the Trilby and the Iona washes and major tributaries south of CAP canal, as well as the CAP canal itself, McMicken Dam and Beardsley canal.

Future Steps

If the general plan amendment is approved, the city intends to take forward a text amendment to the Surprise Unified Development Code (SUDC) to preserve an undisturbed area of 100 feet measured from the edge of the high water mark or the floodway, whichever is greater to be preserved as a wildlife linkage. In order for wildlife corridors to be successful, the text amendment will also require that the wildlife linkage, including the floodway of the wash measure a minimum of 500 feet within areas identified as wildlife habitat corridor. Wildlife friendly development standards (no fences, low lighting, and native vegetation etc.) shall be required within an area of 900 feet or more measured from the edge of the “wildlife linkage.” A graphic of the proposed wildlife linkage and the buffer is provided as Appendix D.

Public Outreach

Pursuant to A.R.S. 9-461.05(D), the plan was transmitted to all the required agencies and interested parties.

The following comments were received as a result of the sixty-day agency review:

¹ Focal species such as these were chosen since they represent the needs of all wildlife species in the linkage planning area.

1. The Maricopa County Flood Control District (district) has indicated that while the priority land use function for the district properties is flood control, a secondary use could be for use as a wildlife corridor and other beneficial functions currently identified in the amendment. The district has therefore indicated that the McMicken Dam, outlet channel and the associated impoundment area include a special notation that clearly indicates that the primary use of these facilities is for flood control. The district has also requested that the wildlife corridor be removed from about 180 acres of the district property adjacent to US-60. The wildlife linkages map has been modified to satisfy the district comments.
2. Jorden Bischoff & Hiser, P.L.C, representing the Northwest Regional Landfill has commented on the proposed amendment to add the wildlife linkages map. The letter makes a reference to the Northwest Regional Planned Unit Development regarding the proposed amendment. Section 7.B. Development Standards notes that pursuant to Sections 122-1C and 122-68(a) of the Surprise Unified Development Code (the SUDC”) the SUDC and any amendments to the SUDC shall not apply to the Northwest Regional PUD.” Thus any future amendment to the SUDC arising from the adoption of ordinance provisions to implement the wildlife linkages plan amendment will not be applicable to the Northwest Regional Landfill. The letter also points out that notwithstanding the wildlife linkages map amendment, the Northwest Regional Landfill provides substantial protection to the wildlife corridor through the Trilby Wash. The City of Surprise acknowledges and understands that the Northwest Regional Landfill is an existing, grandfathered use and the wildlife linkages plan amendment if enacted and any subsequent change to the SUDC that implements the plan amendment will not apply to the Northwest Regional Landfill.
3. Comments received from Arizona State Lands Department suggested that the widths for the wildlife corridors be revised for tributaries and certain terminologies defined. The map has been revised to satisfy these comments.
4. The Arizona Game and Fish Department and the City of Glendale have sent a letter of support. AZGFD has suggested minor technical changes to the text amendment. Maricopa Water District has sent a letter of no objections to the proposed amendment.
5. The letters received during the 60-day agency review is attached to this staff report under Appendix C.

Public outreach meetings were held on March 30, 2011 at the Willow Canyon High School and on March 31, 2011 at the Northwest Regional Library. The meetings were held in an open house format to allow residents a larger window to visit the meeting sites. A total of 15 people attended these meetings. There were no negative comments on the Wildlife Linkages map. Comments received during these meetings have been attached under Appendix D.

Planning and Zoning Commission Consideration

The Planning and Zoning Commission held a public hearing at an offsite meeting location on May 19, 2011. Meeting minutes from the May 19th Planning and Zoning Commission minutes are provided below:

- **Item 4: FS11-008 – Discussion Only – 2011 Major General Plan Amendment**

Planner Vineetha Kartha presented the project to the commission.

There were questions and discussions regarding:

- Feedback from other municipalities
- Northwest Regional Landfill comment letter
- 900-foot buffer area
- Compatibility with Regional Trail

Vice Chair Somers opened the call to the public.

Dana Warnecke, Arizona Game and Fish Department, stated that the department is working on wildlife linkage planning across the State. The recommendations that have been provided are based on the biology of the species. The success across the State will be based on the communities' willingness to incorporate these goals.

Hearing no further comments, Vice Chair Somers closed the call to the public.

In response to Commissioner Hallin, Planner Kartha stated that the study area did not go north of Grand Avenue.

Staff Review

Investing in wildlife is not only advantageous to wild populations, but also provides direct benefit to humans. Wildlife and wildlife related recreation also provide economic benefits to local communities and natural environments that attract residents to communities. With careful planning and design, wildlife linkages can help reduce the negative effects of habitat fragmentation by allowing dispersal of wildlife between habitats. It is important for Surprise to use a proactive approach to identify, conserve and restore wildlife habitats by providing appropriate and reasonable controls for the development of such lands.

Recommendation

Staff recommends that the Planning and Zoning Commission move to recommend approval to the Mayor and City Council, case FS11-008, a major amendment to the General Plan to add the wildlife linkages map and other ancillary information.

Attachments

Exhibit A - Proposed Wildlife Linkages Map

Exhibit B - Text Amendment to the General Plan

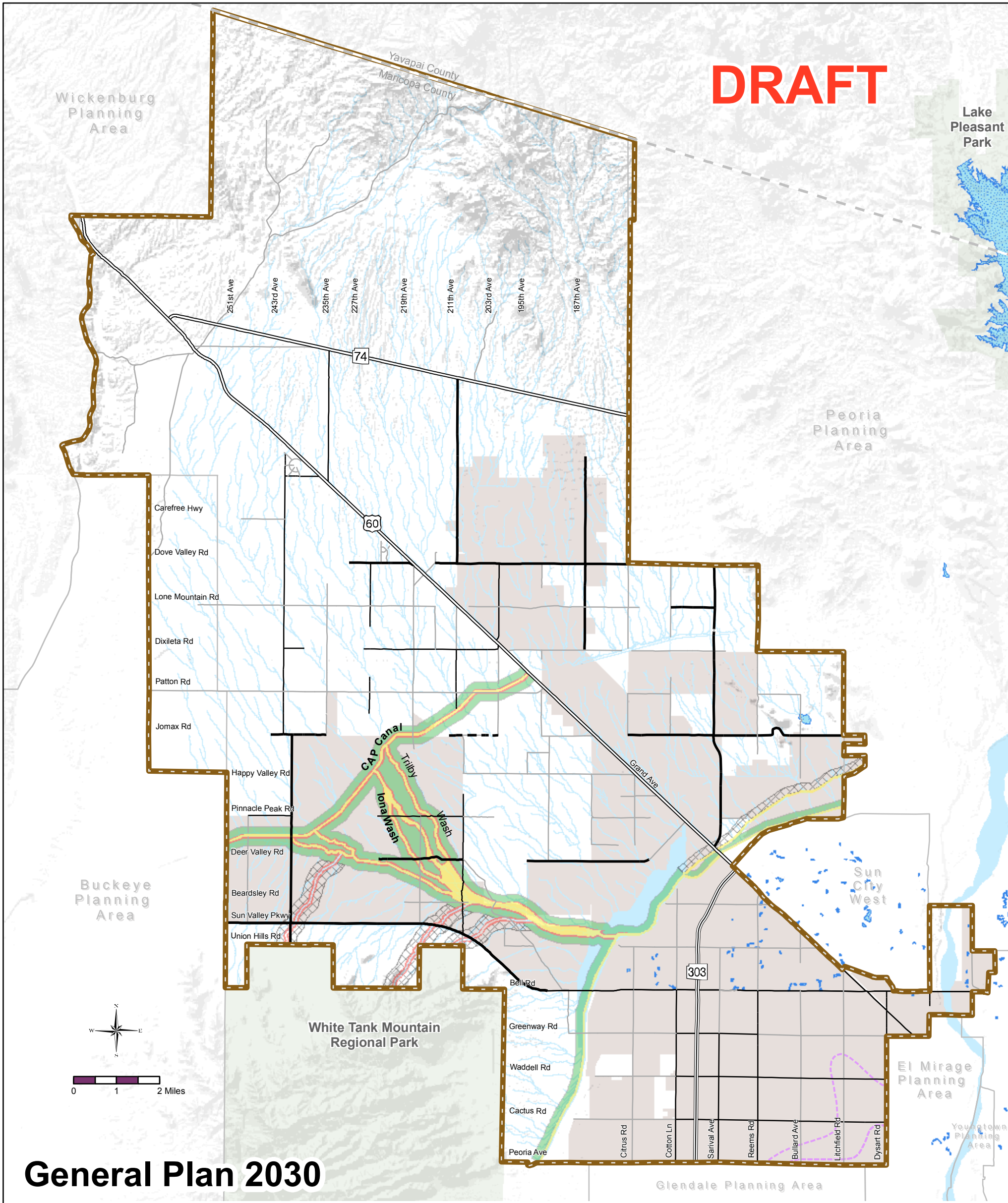
Exhibit C - Agency Comment Letters

1. Arizona Game & Fish Department
2. Maricopa County Flood Control District
3. Maricopa Water District
4. Jorden, Bischoff & Hiser PLC
5. City of Glendale
6. Arizona State Lands Department

Exhibit D – Public outreach sign in sheet and comments

Exhibit E – Graphic for wildlife linkages & buffers

Planning and Zoning Commission Minutes from May 19, 2011



Wildlife Linkage Corridors

- Wildlife Corridor, Wash or Floodway
- 100 Foot Buffer
- 900 Foot Wildlife Friendly Regulations
- Wildlife Friendly Regulations *
- Lakes
- Washes
- Parks

* Wildlife friendly development regulations for this area will be determined at the time of the development

Flood Control Note: The priority land use function for Flood Control District property is for flood control. A secondary use, if compatible with the flood control function, could be for use as a wildlife corridor and other beneficial functions as identified in the amendment.

Map Features

Roadways

- Freeway
- Expressway
- Parkways
- Major Arterials
- Minor Arterials

Boundaries

- City Limits
- Planning Area
- County

60 US Highway

303 State Freeway

74 State Highway

Map 6.2D - Wildlife Linkages

Map prepared by the City of Surprise: December, 2010
Adopted by City Council: Date



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The City recognizes the need to contribute to the protection of native plants and animals, and their habitats before their populations are so low that they must be listed as threatened or endangered under the State and Federal Endangered species acts and will provide protection to special status species.

In addition, the Arizona Game and Fish Department (AZGFD) has conducted wildlife movement research and utilized computer modeling techniques to identify areas important for conservation as wildlife linkages in the Surprise Planning Area. A suite of focal species are used to represent the movement needs of all wildlife species in the planning area and include: tiger rattlesnake, lyre snake, kit fox, blacktailed jackrabbit, javelina, mule deer, mountain lion, desert tortoise, and gila monster. These species are sensitive to habitat loss and fragmentation; they may require large blocks of barrier free habitat(mule deer, mountain lion), have specialized habitat requirements to persist(gila monster, lyre snake, kit fox) or are a special status species(desert tortoise). Others may be common prey species important to the ecosystem as a whole (blacktailed jackrabbit) or economically important game species that need gene flow among populations to persist regionally. Wildlife movement corridors for these species as well as others are under threat from recent land use conversions for development and associated infrastructure. Fragmentation of wildlife habitat effectively isolates the local wildlife populations, thereby increasing the probability of localized extirpation of some species. The wildlife corridors recommended for the City of Surprise Planning Area identified in map 6.2D.

B. Geological Resources

The city of Surprise is located within the Salt River Valley, exhibiting very little topographical change in the range of 0-2 percent slope (Map 6.2A). A two percent slope indicates that for every 100 feet horizontal distance, the land rises or drops two feet. The existing slope drains to the southeast. A slope of two percent allows virtually unrestricted development for agricultural, rural, or urban land uses.

Geologically Surprise lies within the Basin and Range province (Fig 6.2A). Tectonic stretching of the North American continental crust during the last 25 million years has yielded a broad rift called the Basin and Range province, so named because topographically, it consists of long linear mountain ranges separated from one another by flat plains (basins) of alluvium. The range in the general area of Surprise contains Proterozoic metamorphic, and igneous rocks and the aquifers here are formed of volcanic and carbonate rocks and unconsolidated to consolidated basin-fill deposits. The basin fill deposits form the most productive aquifers and are generally in individual alluvial basins that are drained internally and separated by low mountains. The geology of the area plays a large role in the soils, drainage patterns, and other physiographic features of the region.

Green Building - Development that minimizes energy consumption and minimizes pollution and the generation of wastes, while maximizing the re-use of materials and creating healthful indoor environments.

Habitat – The natural environment in which an organism lives.

Habitat Block – A relatively large and unfragmented area of land capable of sustaining healthy populations of wildlife into the foreseeable future.

Habitat Connectivity – The extent to which an area of the landscape facilitates ecological processes such as unrestricted movement of wildlife. Habitat connectivity is reduced by habitat fragmentation.

Habitat Fragmentation – The process through which previously intact areas of wildlife habitat are divided into smaller disconnected areas by roads, urbanization, or other barriers.

Incorporated: Territory included under City of Surprise jurisdiction

Ldn – the Day Night Average Level, is a 24-hour average level with a 10 dbA weighting added to noise during the hours of 10:00 PM to 7:00 AM to account for noise sensitivity.

Lifecycle housing – Housing that entails a range of housing options that meet people's preferences and circumstances at all of life's stages.

Metropolitan Area – The area which is located in a relatively large core city or cities and the adjacent geographic areas.

Multi-modal – Accommodating various modes of transportation including bicycles, pedestrians, transit vehicles, ferries, trains and personal vehicles.

Municipal Planning Area

Neotropical – The biogeographic region including tropical Mexico, Central America, South America and the West Indies.

Noise Contours

Noise contours are a series of lines superimposed on a map of the airport's environs. These lines represent various DNL levels. DNL noise contours are used for several purposes.

- Noise contours highlight existing or potential areas of significant aircraft noise exposure
- Noise contours are used to assess the relative aircraft noise exposure levels of different runway and/or flight corridor alternatives
- Noise contours provide guidance to political jurisdictions in the development of land use control measures. These measures include zoning ordinances, subdivision regulations, building codes and airport overlay zones.

New Urbanism - An approach to urban planning that advocates integrating housing, workplaces, shopping, and recreation areas into compact, pedestrian-friendly, *mixed-use*



neighborhoods linked by transit and bikeways. New urbanist development is characterized by buildings placed directly along relatively narrow streets, with parking and driveways located to the rear, complemented by pedestrian-oriented amenities such as front porches and sidewalk cafes.

Ordinance – A law or regulation set forth and adopted by a governmental authority, usually a city or county.

Ordinary High Water Mark: The Ordinary High Water Mark(OHWM) is a defining element used to identify the lateral limits of non-wetland. Federal jurisdiction over a non-wetland Waters of the United States extends to the OHWM, defined in 33 CFR Part 328.3 as the line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of the soil, destruction of terrestrial vegetation, or the presence of litter and debris.

Point Source of Pollution – Discrete conveyances, such as pipes or man made ditches that discharge pollutants into water of the United States. This includes not only discharges from municipal sewage plants and industrial facilities, but also collected storm drainage from larger urban areas and collected runoff from many construction sites.

Preservation – An action to reserve, protect or safeguard a portion of the natural environment from unnatural disturbance.

Recharge - A process by which water is added to a zone of saturation, usually by percolation from the soil surface.

Renewable – Energy obtained from sources that are essentially inexhaustible.

Ruderal – Vegetation that grows along roadsides or in disturbed or abandoned farmland.

Safe Yield – The amount of water that can be taken from a source or supply over a period of years without depleting that source beyond its ability to be recharged.

Shrink-swell – Identifies the capacity of a soil to expand or shrink as the moisture content is increased or decreased. Soils with a high percentage of clay tend to have a high shrink-swell capacity which can contribute to structural problems for buildings and roads.

Subsidence – The process of sinking or settling of a land surface because of natural or artificial causes.

Surprise Economic Positioning Framework- A study that identifies the economic opportunities that have the greatest potential based on the established economic foundations of the region and the unique, place-based assets found in the region and Surprise.

Sustainability – A concept of meeting the needs of the present without compromising

the ability of future generations to meet their needs. Planning for sustainability promotes responsible development - not anti-development. It requires a democratic process of planning to achieve the greatest common good for all segments of our population, protect the health of the environment and assure future generations of the resources they will need to survive and progress.

Streetwall – Technique where buildings are used to border and enclose space to make walking along the street safer and more comfortable and to ensure that the streetscape is visually interesting.

Transit- Transit comprises all transport systems that transport members of the general public, usually charging set fares. It generally includes rail, bus services, ferries, taxicab services etc.

Urban Design - Urban design concerns the arrangement, appearance and functionality of towns and cities, and in particular the shaping and uses of urban public space. It has traditionally been regarded as a disciplinary subset of urban planning, landscape architecture, or architecture. Urban design theory deals primarily with the design and management of public space (i.e. the 'public environment', 'public realm' or 'public domain'), and the way public places are experienced and used.

Urban Interface – Heavily vegetated areas where wildlands meet urban development.

Viewshed – A viewshed is an area of land, water and other environmental elements that is visible from a fixed vantage point.

Visitability – An international movement to change home construction practices so that virtually all new homes whether or not designated for residents, who currently have mobility impairments, offer specific accessibility features.

Wildlife Corridor – This term is often used interchangeably with “wildlife linkage” as we do in this report. Some biologists define the term “corridor” more narrowly to represent features such as canyons, ridgelines, riparian areas, and other landscape features that constrain or “funnel” wildlife movements in more restricted paths.

Wildlife Friendly Development Standards/Regulations – The wildlife friendly development standards will address fencing, lighting and vegetation and general development in the area.

Fencing: *Generally fencing designs should consider the potential impacts to the wildlife inhabiting the area. Fencing should not be hazardous to wildlife and should not restrict their movement.*

Lighting: *Generally the goal in a wildlife friendly development will be to provide no light, low light or at least very directed light that doesn't necessarily shed to the surrounding area.*

Storm water management systems: *Design multi use stormwater management systems rather than isolated stormwater stalags.*



Wildlife Linkage - An area of land used by wildlife to move between or within habitat blocks in order to complete activities necessary for survival and reproduction. Also referred to as a “wildlife movement area” or wildlife corridor.”

Xeriscape – Quality, low-maintenance landscaping that conserves water and is based on sound horticultural practices.



THE STATE OF ARIZONA
GAME AND FISH DEPARTMENT

5000 W. CAREFREE HIGHWAY
PHOENIX, AZ 85086-5000
(602) 942-3000 • WWW.AZGFD.GOV

REGION VI, 7200 E. UNIVERSITY DRIVE, MESA, AZ 85207

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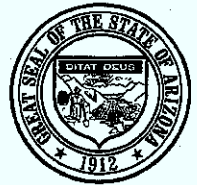
DIRECTOR

LARRY D. VOYLES

DEPUTY DIRECTORS

GARY R. HOVATTER

BOB BROSCHEID



April 15, 2011

Ms. Vineetha Kartha
Planner II, City of Surprise
Community Development Dept.
16000 N. Civic Center Plaza
Surprise, AZ 85374-7470

Re: Surprise Major General Plan Amendment- Wildlife Linkages

Dear Ms. Kartha:

The Arizona Game and Fish Department (Department) appreciates the opportunity to work with the City of Surprise towards future conservation of wildlife habitat linkages for the benefit of the White Tank Mountains ecosystem. Future plans for development within the jurisdictions of Surprise and Buckeye will effectively isolate the White Tanks from surrounding undeveloped lands (public and private). The Department anticipates that the long term consequences of habitat loss and fragmentation will be decreased local biodiversity, small population sizes, low genetic diversity, and eventually local extirpation of some wildlife species. The Department is actively developing partnerships and solutions across the state to address wildlife habitat loss and fragmentation. We applaud the City's commitment to address this growing Arizona issue at the local level.

As you know, the Department has been working closely with the City on the Village III planning effort to incorporate wildlife habitat connectivity goals into the future development plans for this area. We understand the City proposes a major general plan amendment to update the General Plan with a wildlife linkage map. The Department believes an effective approach to linkage design is through wildlife habitat modeling and wildlife movement study to locate and describe natural corridors and animal movement patterns across the landscape. We have applied both methodologies to inform our recommendations to the City for the White Tank Mountain area. We support the proposed recommendation for plan amendment illustrated in *Map 6.2D - Wildlife Linkages*. We offer a few technical edits to the proposed linkage map and the *Text Amendment for Section 6.2.2.A* for your consideration in the Attachment.

On behalf of the Department, I want to thank you for your interest and time as we continue to collaborate on community development solutions that benefit wildlife. If you have any questions regarding our information please contact me at (480) 324-3547 or dwarnecke@azgfd.gov.

Ms. Vineetha Kartha

April 15, 2011

Page 2

Sincerely,

A handwritten signature in cursive script that reads "Dana Warnecke".

Dana Warnecke
Habitat Specialist

DW:dw

Cc: Rod Lucas, Region VI Supervisor
Josh Avey, Habitat Branch Chief
Kelly Wollf-Krauter, Habitat Program Manager
Ray Schweinsburg, Contract Funded Research Program Supervisor

Attachment

Attachment

AGFD comments on Major General Plan Amendment Supporting Documentation

Map 6.2D- Wildlife Linkages:

At this time we recommend inclusion of the McMicken Dam and outflow channel (including County Right of Way lands) as a component of the linkage plan. We recognize that future planning and decisions for the rehabilitation of McMicken Dam by Maricopa County Flood Control District may eliminate this area as suitable for multiuse including wildlife habitat linkages. The suitability of these areas as wildlife linkages is dependent on extensive habitat enhancements to restore natural vegetation compositions and buffer from surrounding urban development. We believe with enhancement some native wildlife could benefit, but not all. We do not believe the Beardsley canal and any associated right-of-way is adequate for wildlife connectivity goals as a sole solution. However, conserving lands upstream of the canal right-of-way where hydrology has contributed to dense vegetation in addition to the McMicken Dam areas may create another linear opportunity for habitat connectivity in the area.

Text Amendment Section 6.2.2.A:

Text currently reads as-

In addition, the Arizona Game and Fish Department (AZGFD) has identified the following focal species to model wildlife linkages in the Surprise Planning Area: tiger rattlesnake, lyre snake, kit fox, blacktailed jackrabbit, javelina, mule deer, mountain lion, desert tortoise, and gila monster. These species are sensitive to habitat loss and fragmentation including those that are unable to cross barriers (mountain lion, mule deer and desert tortoise) and special status species (desert tortoise) while others like javelina are common but still need gene flow among populations. Wildlife movement corridors for these species and others are under threat from recent land use conversions for development and associated infrastructure. Fragmentation of wildlife corridors effectively isolates the local wildlife population thereby increasing the probability of localized extirpation of the species. The wildlife corridors recommended for the City of Surprise Planning area are identified in Map 6.2D.

Recommended edits to text-

In addition, the Arizona Game and Fish Department (AZGFD) has conducted wildlife movement research and utilized computer modeling techniques to identify areas important for conservation as wildlife linkages in the Surprise Planning Area. A suite of focal species are used to represent the movement needs of all wildlife species in the planning area and include: tiger rattlesnake, lyre snake, kit fox, blacktailed jackrabbit, javelina, mule deer, mountain lion, desert tortoise, and gila monster. These species are sensitive to habitat loss and fragmentation; they may require large blocks of barrier free habitat (mule deer, mountain lion), have specialized habitat requirements to persist (gila monster, lyre snake, kit fox) or are a special status species (desert tortoise). Others may be common prey species important to the ecosystem as a whole (blacktailed jackrabbit) or economically important game species (javelina, mule deer) that need gene flow among populations to persist regionally. Wildlife movement corridors for these species

Ms. Vineetha Kartha

April 15, 2011

Page 4

as well as others are under threat from recent land use conversions for development and associated infrastructure. Fragmentation of wildlife habitat effectively isolates the local wildlife populations, thereby increasing the probability of localized extirpation of some species. The wildlife corridors recommended for the City of Surprise Planning area are identified in Map 6.2D.

Date: April 1, 2011

Vineetha Kartha
Planner II, City of Surprise
16000 N. Civic Center Plaza,
Surprise, AZ 85374-7470

RE: Major Plan Amendment 60-day Agency Review

Dear Ms. Kartha:

The District has reviewed the proposed plan amendment and has the following concerns:

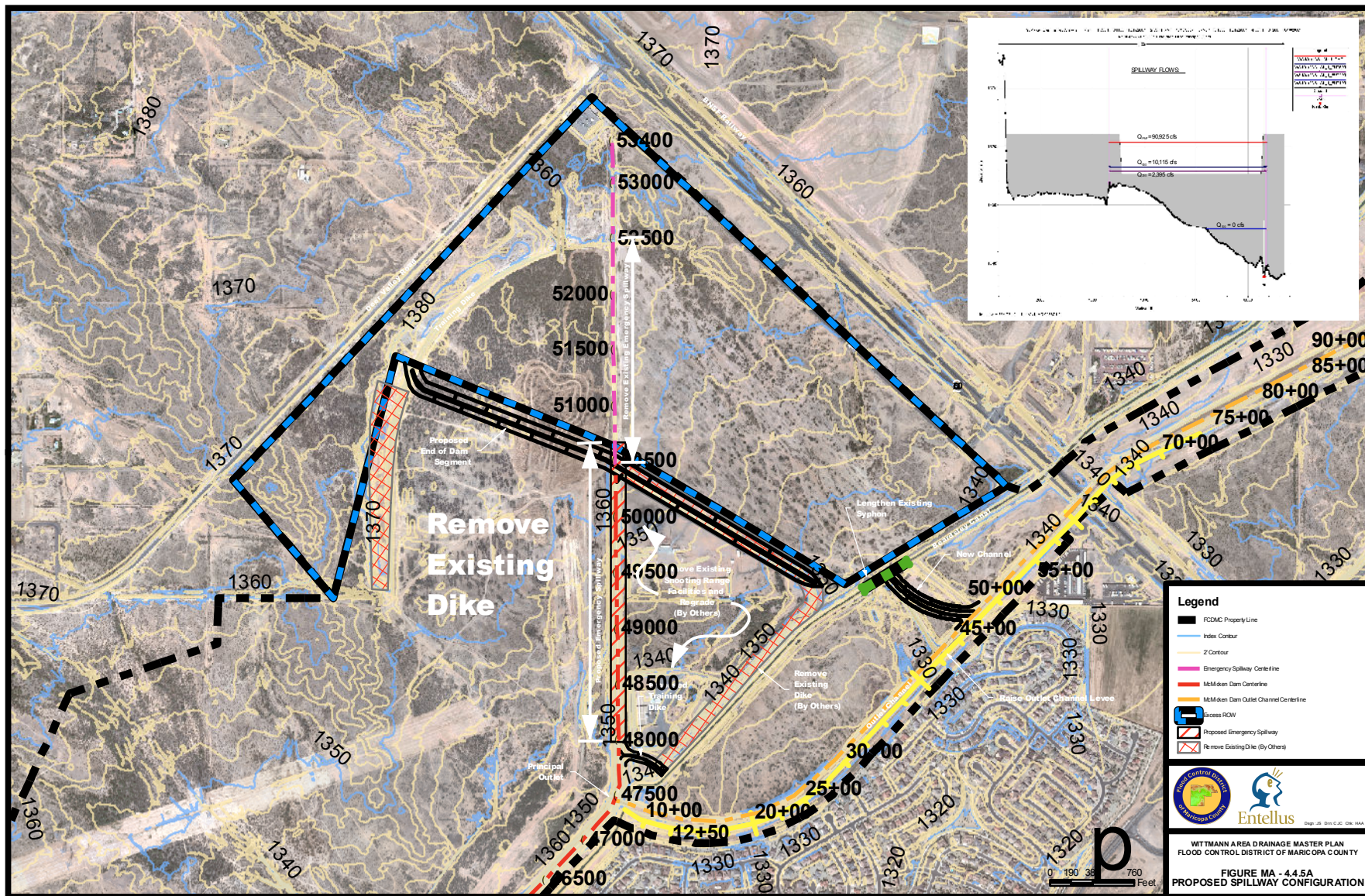
1. The priority land use function for Flood Control District property is for flood control. A secondary use, if compatible with the flood control function, could be for use as a wildlife corridor and other beneficial functions that are currently being identified in the Amendment. The location and extent of these secondary beneficial functions will be dependent upon the flood control facility requirements associated with the primary function of the property. Therefore, the District requests that the Amendment indicate that the McMicken Dam, outlet channel and associated impoundment area include a special notation that clearly indicates that the primary use of these facilities is for flood control.
2. The District and the City have been in discussions to up-zone approximately 180 acres of District property adjacent to US 60 to mixed use. This property likely will be identified as excess land if the current preliminary plans for the re-alignment of the spillway structure of McMicken Dam are implemented. The District has included a map of the spillway area and requests that the wildlife corridor overlay be adjusted and removed from this potential excess District property.

If there you require further clarifications or if you need further information on this subject matter please contact Mr. Farhad Tavassoli of my staff at 602-506-8773

Sincerely,

Timothy S Philips, P.E.
Chief Engineer & General Manager
Flood Control District of Maricopa County

Enclosure: Map of Potential Excess District Property





March 17, 2010

SENT VIA U.S. MAIL
& FACSIMILE

Ms. Vineetha Kartha
Community Development Department
City of Surprise
16000 N. Civic Center Plaza
Surprise, AZ 85374

**RE: CITY OF SURPRISE 2011 MAJOR GENERAL PLAN UPDATE -
WILDLIFE LINKAGE CORRIDORS (FS11-008)**

Dear Ms. Kartha:

Thank you again for meeting with Dave Maguire and me on March 9, 2011 to discuss the above referenced project. Based on our meeting, it is the understanding of the Maricopa Water District ("MWD") that the proposed Wildlife Corridors do not include or encroach upon the MWD Beardsley Canal. Therefore, MWD has no objection to the proposed Wildlife Corridors update to the 2011 General Plan.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Ogden", written in a cursive style.

Jennie Ogden
Property & Contracts Specialist

cc: KoKo Kvistad, MWD
James R. Sweeney, MWD
Dave Maguire, Land Solutions



LAW OFFICES

JORDEN BISCHOFF

& HISER, P.L.C.

7272 E. INDIAN SCHOOL ROAD, SUITE 360
SCOTTSDALE, ARIZONA 85251
TELEPHONE: 480-505-3900
FACSIMILE: 480-505-3901

DOUGLAS A. JORDEN

DIRECT LINE: 480-505-3909
e-mail: djorden@jordenbischoff.com

March 15, 2011

Vineetha Kartha
City of Surprise
16000 N. Civic Center Plaza
Surprise, AZ 85374

Re: Northwest Regional Landfill
Northwest Regional Planned Unit Development PRJ09-18; CR09-182; PS09-276
Major General Plan Amendment FS11-008

Dear Vineetha:

As you know, we represent Waste Management Arizona Landfills, Inc. ("Waste Management"), the owner and operator of the Northwest Regional Landfill. This letter pertains to pending Major General Plan Amendment FS11-008 relating to the addition of a Wildlife Linkages Map and related text to the Surprise General Plan (the "Wildlife Linkages Plan Amendment" or "Plan Amendment").

Waste Management purchased the Northwest Regional Landfill (which is situated on approximately 1200 acres) from Maricopa County in 1996; the landfill had been operated by Maricopa County for a number of years prior to 1996. All of the various approvals and permits for the site have consistently shown those portions of the 1200 acres will be used for landfill and related uses. In 2009, the property was annexed into the City of Surprise and a Planned Unit Development was approved for the property. The documents approved by the City in 2009 likewise depicted those portions of the property that would be used for the landfill and related uses.

Based on materials we have reviewed relating to the Wildlife Linkages Plan Amendment, the City intends to amend the Surprise Unified Development Code to implement the Plan Amendment. The changes to the Surprise Unified Development Code, if adopted as envisioned by the Plan Amendment, will impact the Northwest Regional Landfill.

The Northwest Regional Planned Unit Development recognized that this type of situation might arise in the future and included provisions relating to future ordinance changes. Specifically, Section 7. B. Development Standards notes (at the bottom of page 5) that "[p]ursuant to Sections 122-1(c) and 122-68(a) of the Surprise Unified Development Code (the "SUDC"), the SUDC and any amendment(s) to the SUDC shall not apply to the Northwest

Vineetha Kartha
Northwest Regional Landfill
March 8, 2011
Page 2

Regional PUD.” Thus, any future amendment to the SUDC arising from the adoption of ordinance provisions to implement the Wildlife Linkages Plan Amendment will not be applicable to the Northwest Regional Landfill.

Regardless of whether the new ordinance provisions apply to the Northwest Regional Landfill, it is important to note that the approved PUD provides substantial protection to the wildlife corridor through the Trilby Wash. As has been the case since the landfill was first sited in the 1980's and in deference to Trilby Wash, no development is contemplated or shown on the approved PUD for the southwestern corner of the 1200 acres. Thus, much of the protection of the wildlife corridor contemplated by the Wildlife Linkages Plan Amendment is already in place.

It would be most appreciated if you would confirm our understanding that the Wildlife Linkages Plan Amendment and any subsequent change to the SUDC that implements the Plan Amendment will not apply to the Northwest Regional Landfill based on the express language of the Northwest Regional Planned Unit Development. If any further information is needed to assist you in fulfilling this request, please let me know.

Sincerely,

A handwritten signature in black ink, appearing to read "D. Jorden", written over a faint rectangular box.

Douglas A. Jorden

DAJ/cbm

cc: Mark Snedecor, Waste Management
Len Butler, Waste Management



March 9, 2011

Ms. Vineetha Kartha
Planner II
Community Development Department
16000 North Civic Center Plaza
Surprise, AZ 85374

RE: 60-day Review for Proposed 2010 Major Amendment (FS11-008) to the City of Surprise General Plan

Dear Ms. Kartha:

The City of Glendale has reviewed the proposed City of Surprise Major General Plan Amendment. The City of Glendale supports FS11-008 Major Amendment to the General Plan to add information on Wildlife Linkages.

The proposed Major General Plan Amendment furthers the Implementation Program of the City of Glendale General Plan, specifically the following items:

Open Space Policies

4. Connectivity of Open Space

Work cooperatively with other jurisdictions and locally to prepare a program to develop connections between regional open space preserves.

6. Habitat Conservation

Inventory habitats and prepare conservation strategies.

Environmental Planning Policies

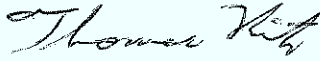
1. Protect Threatened and Endangered Species

Adopt a logical, locally attuned endangered and threatened species policy.

The City of Glendale has no further comments.

Please call me at (623) 930-2588 if you have any questions or would like to discuss these comments.

Sincerely,

A handwritten signature in cursive script, appearing to read "Thomas Ritz".

Thomas Ritz, AICP
Senior Planner
Planning Department

TR:mc

cc: Deborah Mazoyer, Assistant Deputy City Manager
Jon M. Froke, AICP, Planning Director
Brent Stoddard, Intergovernmental Programs Director
Bob Dubsky, Planner, Luke AFB, Community Initiatives Team

March 16, 2011

Vineetha Kartha, Planner II
City of Surprise
16000 N. Civic Center Plaza
Surprise, Arizona 85374-7470

Subject: City of Surprise Major General Plan Amendment 2011

Ms. Kartha,

The Arizona State Land Department (the Department) has reviewed the City of Surprise major General Plan Amendment (GPA) for 2011. The Department appreciates the opportunity to provide comments.

The Department is not opposed to the establishment of wildlife linkage corridors for the movement and gathering of wildlife. The Department does have comments and concerns about the major GPA as outlined below:

1. It would be helpful to know the Arizona Game and Fish Department's definitions for these types of linkages.
2. The total area proposed to be preserved is extensive. The 100 foot buffer on both sides of the washes seems justifiable, but the minimum width of 500 feet (wildlife linkage including floodway) plus the 900 foot wildlife friendly regulations buffer which is shown on both sides of the washes and tributaries seems excessive especially for the tributaries.
3. Tributaries are being treated the same as the main washes and they should not be. The tributaries are movement areas into the main wildlife wash gathering areas. The proposals may be appropriate for the main washes and the CAP, but not for the tributaries.
4. Many items are discussed in the Application Narrative, but not in the actual major GPA text. There is not a full disclosure of the proposed regulations in the major GPA.
5. Is the Application Narrative a draft of what will be in the text amendment to the Unified Development Code?

6. There needs to be a better definition of the 900 foot wildlife friendly regulations buffer. The uses that are to be allowed need to be defined. Is development to be allowed? Are golf courses, hiking trails and buildings to be allowed? There needs to be allowed uses that are consistent with the General Plan (resort and residential) land use designations. The State Trust lands on the north boundary of the White Tanks are great residential and resort areas. With sensitive design, uses such as these can be compatible with wildlife linkage corridors and will be an asset to the community.

Sincerely,



Victoria Carella, AICP
Arizona State Land Department

cc: Ed Dietrich, Arizona State Land Department

[illegible]

Sign In Sheet

General Plan Outreach
03/31/11

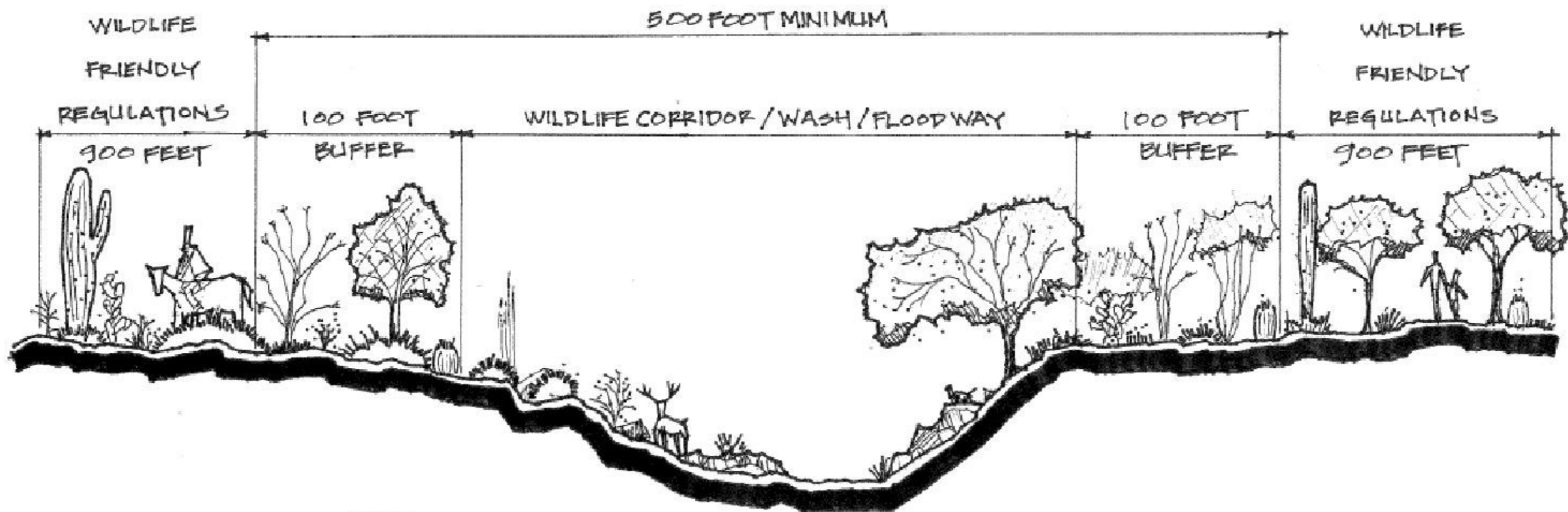
Name	Email (optional)	Would you like to be on the General Plan mailing list?
MARTHA BAILS	mbails2@aol.com	
Nancy Collins	NancyCollins@Q.com	Yes
MIKE WOODARD		
DAVID HILSDORF	DHILSDORF@AOL.COM	Yes
Andy Cepan	getsurprised@cox.net	Yes
James Truman	jstruman@msn.com	Yes
C.S. Tan Nery		Yes
William Campbell		No
Tyler Feigler	tylerzeigler@yahoo.com	Yes
Miguel Quiroz	Miguel.gre@gmail.com	interest in wild life preservation
Dwaine Higginson	dwahigginson@cox.net	no
D BREVINUS		

It makes sense to plan for better wildlife space for their good "roaming" habits – CST

I really think that this would not only help the habitat for the future, but also for our children in the future

Strongly support the city's efforts ..Should have started 2 decades ago. Must gain municipal support from all cities in this region and work as a cohesive unit. Need to develop/build a nature center N or NE adjacent to the White Tanks to anchor protection of sensitive areas.

I have noticed bats feeding at football games lately and honestly I would love to see a conservation club especially involving the school's help. I am happy that if I can as a teenager, to help with it.



NOTES:

An undisturbed area of 100 feet measured from the edge of the high water mark or the floodway, whichever is greater to be preserved as a "wildlife linkage."

In order for wildlife corridors to be successful, it is necessary that the wildlife linkage, including the floodway of the wash must measure a minimum of 500 feet within areas identified as wildlife habitat corridor.

Wildlife friendly development standards (no fences, low lighting, and native vegetation etc) are required within an area of 900 feet or more measured from the edge of the "wildlife linkage."

Wildlife Linkage Corridor Guideline

Drawn by Hobart Wingard
Prepared by the City of Surprise: September 2010
Adopted by City Council:



www.surpriseaz.gov

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White Tank Mountain Linkage Planning

Within the Surprise Planning Area

For the Surprise Planning area the focal species¹ include: desert tortoise, gila monster, lyre snake, mule deer, mountain lion, javelina, blacktailed jackrabbit, kit fox, tiger rattlesnake.

The wildlife linkages map has been proposed to ensure passage areas that provide concealment, food, water and dispersal along corridors free of barriers. Per the Game and Fish study on mule deer, the minimum corridor width may coincide with the minimum widths of home ranges. The minimum home range for the mule deer in this study was 0.72 miles. The following table shows the ideal home range sizes, the width proposed by the wildlife linkages map and whether the corridor needs are met for each species:

<i>Species</i>	<i>Ave. home range Size(data provided by AZ Game & Fish)</i>	<i>Proposed corridor widths in Surprise</i>	<i>Species Needs met?</i>
Mule Deer	> 1-2.2 sq miles in desert veg	Wash corridor + 100 ft buffer + 900 ft wildlife friendly stds ²	No
Mountain Lion	Varies; 27 sq. mi ave female 74 sq mi ave male		No
Javelina	0.73-2 sq miles		Yes
Sonoran desert Tortoise	17-57 acres (1/10 th sq mi)		Yes
Gila Monster	32-172 acres (1/3 sq mi)		Yes
Kit Fox	3.8-4.7 sq miles		Yes
Black-tailed Jackrabbit	0.38-1.5 sq miles		Yes
Gila Monster	32-173 acres; 1.8-2.5 miles long		Yes
Lyre Snake	5-10 acres		Yes
Tiger Rattlesnake	Female 2.4-12; Male 12-62 acres		Yes

²The proposed wildlife linkages map designates Trilby and Iona washes, the CAP Canal, McMicken dam and the Beardsley canal as wildlife corridor. These washes are proposed to be preserved in addition to a 100 ft buffer on either side of the washes. To ensure neighboring development does not harm the area, a 900 ft wide swath of land is proposed to be built per wildlife standards which impose regulations on vegetation, fencing and lighting.

¹Focal Species

A group of species that:

- Collectively serve as an umbrella for all species and ecological processes
- Area sensitive
- Habitat Specialists
- Dispersal limited
- Sensitive to barriers

- Otherwise ecologically important
- Endemic to the matrix but not the blocks

Species that need the corridor—Passage species need concealment cover, food and water for movement and dispersal along corridors that are free of barriers within a linkage area.

Species the corridor needs – Corridor dwellers contribute to the ecological integrity of a linkage and need core habitat requirements to support breeding (individual and population) and use corridors for movement and dispersal through multiple generations.

- Desert Tortoise – Susceptible to fragmentation & need connectivity for genetic diversity; dominant model criteria – vegetation & topography; rocky outcrops for burrows; herbivore
- Gila Monster – State sensitive species; susceptible fragmentation; dominant model criteria elevation & topography; rocky outcrops/boulders, mid-bajada flats during wet periods, wide ranging and long bouts of exercise; eggs reptiles/ birds, nesting birds and mammals, small lizards and carrion.
- Lyre Snake – Susceptible to fragmentation; dominant model criteria – topography; use all vegetation types and live on mountain slopes; prey is lizards, small mammals, bats, birds
- Mule Deer – important prey/economically important; sensitive to barriers; dominant model criteria – vegetation
- Mountain Lion – requires large areas of habitat/occurrence in low densities/habitat generalist; dominant model criteria – vegetation; associated with mountainous habitats, rocky cliffs and bluffs. Important predator species that prefers mule deer but preys on a wide range of wildlife.
- Javelina – prey for carnivores, need contiguous patches of dense vegetation, economically important; dominant model criteria – vegetation; have wide elevational distribution; herbivore of many desert cacti
- Blacktailed jackrabbit – seed dispersers and prey for raptors and mammals, common in wide variety of vegetation types
- Kit fox – habitat loss and fragmentation; dominant model criteria – vegetation (desert grasslands/scrub and sandy soils typically mid to low bajadas including creosote flats); large home range requirements; prey are small mammals, birds, lizards
- Tiger rattlesnake – rare in AZ and move across wide elevational range & habitats/seasonal elevational migrations (xeroriparian washes to rock outcrops); sensitive to barriers; dominant model criteria – elevation & topography strongly associated with rock outcroppings; genetic data supports movements between mountain ranges; prey is lizards and small mammals.

<i>Species</i>	<i>Ave. home range Size</i>	<i>Minimum patch habitat</i>	<i>Max dispersal distances</i>
Mule Deer	> 1-2.2 sq miles in desert veg	3.5 sq miles	Adult 60-135 mi
Mountain Lion	Varies; 27 sq. mi ave female 74 sq mi ave male	27 sq miles	64/22 mi male/female ave

Javelina	0.73-2 sq miles	0.17 sq miles	Up to several miles
Sonoran desert Tortoise	17-57 acres (1/10 th sq mi)	0.06 sq miles	~19 miles
Gila Monster	32-172 acres (1/3 sq mi)	0.38 sq miles	~5 miles
Kit Fox	3.8-4.7 sq miles	1.00 sq miles	No data
Black-tailed Jackrabbit	0.38-1.5 sq miles	248 acres	10 mile foraging
Gila Monster	32-173 acres; 1.8-2.5 miles long		5 miles
Lyre Snake	5-10 acres		2-3 miles
Tiger Rattlesnake	Female 2.4-12; Male 12-62 acres		

Corridor Widths

Individual species corridors are modeled using habitat suitability maps to calculate well-connected pixels (habitat areas) that together create the lowest cumulative resistance (COST DISTANCE) for a species to move between habitat blocks. The modeling produces a nested set of slices that become increasingly more costly for a species to move through the landscape; the 0.1% slice representing the lowest cost distance (0.1% slice to 10% slice). The goal is to determine which slice represents the minimum amount of space required for a species to move across the landscape, taking into account edge effects from adjacent urban development, as well as overlapping land uses for the linkage open space, or species home range/territory sizes, and dispersal distances the species will move between habitat patches or population cores. There is no discreet definition and the biology of the species has to be taken into account. The decision making also has to consider the realistic costs of land conservation and balance species needs with political and economic realities.

Research

Mountain lion telemetry – ongoing

Mule deer Movement Study – telemetry data collected March to October 2007

Modeling

White Tanks to Belmont/Bighorn Mtns

White Tanks to Vulture/Heiroglyphic Mtns

Land Use Planning

Wittmann ADMP

City of Surprise Village Planning

ADOT/MCDOT Transportation Plans

MCFD-Buckeye FRS1 Dam Rehab Plans

MCFD/ACOE – Trilby Wash feasibility Study (includes McMicken dam)

Modeled Linkages

Key Linkage Plan Components

Wittmann ADMP wildlife/multi-use corridors – Trilby/Iona Wash, Padelford wash

McMicken dam and MCFD properties

Agua Fria & Hassayampa River corridors

CAP Corridors

Open Space within modeled linkages

Floodway corridors in the Sun Valley ADMP planning area

Hassayampa River Water Course Master Plan

Mule Deer Movements in the White Tank Mountain Regional Park and Sun Valley Parkway Corridor, Maricopa County, AZ: Final Report

David D. Grandmaison and Ray E. Schweinsburg
Arizona Game and Fish Department
Research Branch
5000 W. Carefree Highway
Phoenix, Arizona 85086



February 2008

RECOMMENDED CITATION

Grandmaison, D.D., and R.E. Schweinsburg. 2008. Mule deer movements in the White Tank Mountain Regional Park and Sun Valley Parkway corridor, Maricopa County, AZ: final report. Arizona Game and Fish Department, Research Branch, Phoenix, Arizona.

ACKNOWLEDGEMENTS

Michael Ingraldi directed project development, both financial and intellectual. Shawn Lowery provided logistical support. Renee Wilcox provided administrative assistance. Chantal O'Brien, Leonard Ordway, and Brian Wakeling helped move the project forward. Thanks to Michael Ingraldi, Jim Heffelfinger, Scott Blackman and Jon Hanna for suggestions and comments for manuscript revision. Mark Shelton, Jonathan Rowe, and Lisa Shelton from Pathfinder Helicopters, Inc. conducted helicopter net-gun captures. Special thanks go to Wildlife Manager Mark Stewart for his enthusiastic support of this research and his helpful collaboration in the field. Pilots Bill David, Eddie Cash, and Steve DuBois played a crucial role in helping collect telemetry data. Scott Sprague provided training on the use of spread spectrum equipment and Jeff Gagnon provided technical advice on mule deer capture techniques. Todd Atwood contributed insightful conversation regarding random-effects modeling. Sue Boe contributed GIS assistance. Scott Sprague and Ron Mixan assisted with data collection. Thanks also to the staff at the White Tank Mountains Regional Park – especially Don Harris, Raymond Schell, and Bill “Doc” Talboys – for their support of this study and their eagerness to provide assistance.

PROJECT FUNDING

Project funding was provided by the Landowners West of the White Tank Mountains under Cooperative Agreement #4 with the Arizona Game and Fish Department as well as special mule deer tags raised by the Arizona Deer Association and Mule Deer Foundation through the Habitat Partnership Committee process.

The Arizona Game and Fish Department prohibits discrimination on the basis of race, color, sex, national origin, age and disability in its programs and activities. If anyone believes they have been discriminated against in any of AGFD's programs or activities, including its employment practices, the individual may file a complaint alleging discrimination directly with AGFD Deputy Director, 5000 W. Carefree Highway, Phx, AZ 85086, (623) 236-7290 or US Fish and Wildlife Service, 4040 N. Fairfax Dr., Ste. 130, Arlington, VA 22203.

Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, or this document in an alternative format, by contacting the AGFD Deputy Director, 5000 W. Carefree Highway, Phx, AZ 85086, (623) 236-7290 or by calling TTY at 1-800-367-8939. Requests should be made as early as possible to allow sufficient time to arrange for accommodation.

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INTRODUCTION

The inevitable result of continuing development in the greater Phoenix Area is loss and fragmentation of wildlife habitat. Habitat loss can be thought of as the conversion of habitat to an unusable state, relative to wildlife resources. Similarly, habitat fragmentation occurs as remaining usable habitats are broken into smaller, isolated parcels, ultimately making them unusable to certain species of wildlife, including mule deer. It is widely recognized that habitat loss and fragmentation are major threats to biological diversity and population viability (Soulé and Terborgh 1999). Isolated habitat patches can be viewed within the framework of island biogeography as “islands” of natural habitat in a “sea” of human development (MacArthur and Wilson 1967). The classic model of island biogeography depicts the number of individuals inhabiting an “island” as a dynamic balance between the opposing processes of extinction and colonization. Extinction and colonization rates are influenced by “island” size, distance from sources of dispersing individuals (i.e., the mainland), and barriers to animal movement. Population isolation through the processes of habitat loss and fragmentation will result in decreased colonization, small population size, low genetic diversity, and even local extirpation.

However, remaining non-developed habitat within the urban matrix (and the wildlife it supports) need not be isolated from larger open spaces beyond the metro area. Carefully planned linkages between isolated habitat patches and larger wildlands may accommodate normal patterns of wildlife movement, thereby allowing for population persistence in an increasingly developed landscape. When exchange rates between these “islands” are sufficiently high, the probability of extirpation and the problems associated with small population size (e.g., inbreeding, demographic and environmental stochasticity) can be ameliorated. Harrison (1992) suggests that an effective approach to corridor design is to locate and describe natural corridors and animal movement patterns across the landscape.

The White Tank Mountains are located to the west of the greater Phoenix metropolitan area and are highly accessible to residents with multiple recreational persuasions. In addition, master planned community developments within the region threaten to isolate wildlife populations within the White Tank Mountains. Given an awareness of the planned developments’ potential impacts on wildlife connectivity between the White Tank Mountains and secured open space to the west, our objective was to identify key mule deer movement corridors within the planned Sun Valley Development. Our goal was to provide data on mule deer movements within the development corridor in order to inform context-specific connectivity planning. Ultimately, this information should be used to guide the development of movement corridors that allow for mule deer movement between the White Tank Mountains Regional Park and the Hassayampa River in an effort to ensure long-term population viability of mule deer in the White Tank Mountains.

STUDY AREA

This study was conducted in, and adjacent to, the White Tank Mountains, approximately 40 miles (65 km) west of Phoenix, Arizona. Regional topography includes mountainous terrain ranging from 1,400 to 4,000 feet (427 to 1,219 m) above sea level and a gradient across bajada and alluvial flat habitats in the surrounding landscape. Vegetation within the study area is characteristic of the Arizona Upland subdivision of the Sonoran Desert scrub biome (Turner and Brown 1982). Bajada vegetation is dominated by a paloverde (*Parkinsonia* spp.)-mixed cacti association while vegetation on the alluvial flats consists of a creosotebush (*Larrea tridentata*)-white bursage (*Ambrosia deltoidea*) association (Turner and Brown 1982). Core mule deer habitat within the range falls inside the boundaries of Maricopa County's White Tank Mountains Regional Park (WTMRP). At nearly 47 mi² (121 km²), the WTMRP is the largest regional park in Maricopa County. Historically, the WTMRP provided high quality habitat to a healthy mule deer population and mule deer densities in WTMRP are thought to be higher than many deer populations in southern Arizona (J. Heffelfinger, AGFD, *pers. comm.*). Until recently, high quality habitats within the WTMRP have been accessible to immigrating mule deer from the Hassayampa River corridor and points west of the river. However, recent land use conversion for exurban development and associated transportation infrastructure threatens to sever mule deer movement corridors, effectively isolating the White Tanks mule deer herd and increasing the probability of localized extirpation.

The planned Sun Valley Development (hereafter Project Area) encompasses approximately 183 mi² (474 km²) between the White Tank Mountains and the Hassayampa River along the Sun Valley Parkway (SVP) within the Town of Buckeye, Arizona (Figure 1). The SVP is an approximately 28 mile (45 km) roadway that wraps around the western and northern extent of the mountains, connecting I-10 with Bell Road at the Beardsley Canal. The current alignment consists of a 4-lane divided roadway with paved shoulders and a 16 ft (5 m) wide raised median. Development plans along the SVP include low density (1-3 dwelling units/acre) and high density (10-15 dwelling units/acre) residential as well as commercial development (Town of Buckeye General Master Plan 2007). Current levels of wildlife connectivity will diminish in the absence of connectivity planning, with potentially deleterious consequences for the White Tanks mule deer herd as well as other species inhabiting the range or living within the Project Area boundary.

The Wildlife Linkages Workgroup (sponsored by the Arizona Department of Transportation and the Arizona Game and Fish Department) has identified the Sun Valley area as the key corridor linking the White Tank Mountains to the Hassayampa Plain and the Hummingbird Springs and Big Horn Mountain Wilderness areas west of the Hassayampa River (Nordhaugen et al. 2006). It is within this context that the Arizona Game and Fish Department, Landowners West of the White Tanks, and the Habitat Partnership Committee determined that a movement study was needed to inform decisions regarding the preservation of functional open space for mule deer.

METHODS

Mule Deer Capture and Movement Patterns

We captured 12 male mule deer using aerial net gunning techniques (Webb et al. 2008). We chose to collar males because they exhibit dispersed movements during post-rut periods (Relyea and Demarais 1994) and utilize non-mountainous habitat more than females (Ordway and Krausman 1986). We instrumented male mule deer with TGW-3590 spread spectrum GPS collars (Telonics, Inc., Mesa, AZ) and ear tags for future identification. The collars were programmed to obtain 14 GPS locations (approximate ≤ 16 ft [5 m] accuracy) hourly during two intervals (0400 – 1100 and 1800 – 2300) each day. Location data were stored on the collars until a command was given to transfer the information across a data link. Each collar was equipped with a VHF beacon, mortality sensor, and release mechanism to aid in recovery. We conducted telemetry flights at two week intervals from 7 March 2007 to 31 October 2007 to retrieve data and monitor mule deer movements and mortality. The GPS collars were programmed to drop from the deer on 1 November 2007. Collars were recovered using standard radio-telemetry techniques to home in on the VHF beacon within the collar.

Habitat Use

We defined habitat availability by creating a minimum convex polygon (MCP) encompassing 100% of the location estimates for each individual. The measure of availability was therefore unique to each animal and corresponded to an analysis of third-order habitat selection (Johnson 1980); that is, the selection of habitat components within an individual's home range.

Habitat variables were measured for each mule deer location and an equal number of random points located within the animals' MCP. Habitat characteristics were queried from a geographic information system (GIS). These variables included elevation, and proximity to the nearest road, nearest wash, and nearest permanent water source. We did not include vegetation as a variable because the desert scrub vegetation within the study area was relatively homogenous. We believed that fine-scale differences in vegetation would be largely explained by elevation.

We used random-effects logistic regression (Hosmer and Lemeshow 2000) to estimate seasonal mule deer resource selection function models (RSF; Manly et al. 2002). Seasons were delineated by patterns in temperature and precipitation (Ordway and Krausman 1986, Rautenstrauch and Krausman 1989). We defined spring as occurring 20 February to 30 April, early summer as 1 May to 15 July, and late summer as 16 July to 31 October. Because collars dropped on 1 November, we did not collect data during the winter season. We evaluated models separately for each season to examine temporal differences in resource selection. We used random-effects logistic regression (Hosmer and Lemeshow 2000) due to its ability to explicitly model individual variation as a random effect (Thomas and Taylor 2006). Standard fixed-effects logistic regression approaches have been used extensively for modeling RSF models but have come under criticism for their inability to meet the assumption of independence among observations (Morrison 2001). Generally, this assumption cannot be met due to the correlated nature of repeated

observations (i.e., locations) within each group (i.e., collared individual). Violation of this assumption leads to incorrect variance estimates (Otis and White 1999) and increased Type I error rates (Leban et al. 2001). Including a random-effect coefficient allowed us to account for individual variability in resource selection and inference could then be extended to the entire White Tanks herd (Thomas and Taylor 2006). In addition, random-effects models can be constructed with a random intercept to control for an unbalanced number of observations among individuals (Bennington and Thayne 1994), a common occurrence in telemetry studies. Random-effects logistic regression analysis was conducted using the LME4 Package for R (Bates 2007). We estimated RSF models for each habitat variable under three modeling scenarios: first with a random intercept, then with a random coefficient, and finally a combination of random intercept and a random coefficient. We then compared seasonal models by examining the log-likelihoods, parameter estimates, and their standard errors (Gillies et al. 2006).

We evaluated bed-site selection assuming that mule deer bedded during the midday when thermoregulatory conditions were most extreme (Tull et al. 2001). We examined the same RSF models used in our seasonal habitat analysis using random-effects logistic regression to compare used bed-sites to available habitat within the home range. We evaluated models separately for each season to examine temporal differences in bed-site resource selection.

Sun Valley Parkway Crossing Characteristics

We used ArcGIS Version 9.2 (ESRI, Redlands, California) to divide the Sun Valley Parkway into 268 segments 525 ft (0.16 km) in length following the methodology designed by Dodd et al. (2007). Segment lengths were chosen based on the units used by ADOT for tracking wildlife-vehicle collision and highway maintenance data. We quantified mule deer passage rates within a 820 ft (0.25 km) buffer zone of each segment (hereafter buffer segment), which corresponds to the road-effect zone that Rost and Bailey (1979) estimated for mule deer. Successive GPS fixes within the buffer segment were considered a single approach unless the animal crossed the parkway, stayed within the buffer segment, and crossed a second time. We calculated passage rates for each mule deer as the proportion of highway crossings to approaches (Dodd et al. 2007).

We examined the influence of adjacent land cover, and proximity to washes and permanent water sources on mule deer crossing locations using standard logistic regression (Hosmer and Lemeshow 2000) to identify differences in habitat characteristics between crossing segments and random segments. Adjacent land cover was described as the percentage of each land cover type within the segment buffer. Two major land cover classes from the Southwest Regional GAP Analysis Project (Lowry et al. 2007) were included: Sonoran palo verde-mixed cacti desert scrub and Sonora-Mojave creosote bush-white bursage desert scrub. We calculated distance to wash and permanent water sources by measuring the straight line distance from the center point of the road segment to the nearest wash or water feature using ArcGIS. We used logistic regression to evaluate differences in these habitat variables between crossing segments and an equal number of randomly selected segments.

RESULTS

Mule Deer Capture and GPS Collars

We instrumented 12 male mule deer with GPS collars on 20 February 2007. All 12 deer were captured at high elevation sites within the WTMRP despite surveying both high and low elevation sites adjacent to the park boundary during capture operations. A total of 38,771 fixes were acquired between 20 February and 31 October 2007 with a mean of 3,321 fixes per individual (range: 1,636-3,506 fixes/individual; Table 1). Approximately 99% of acquisition attempts were successful.

Mule Deer Movements and Mortality

There were no differences in home range size among seasons ($F_{2,31}=0.075$, $p = 0.928$; Table 2) largely due to the high variability in home range sizes. The mean overall home range size was 25.65 mi² (66.44 km²). The mean radius of mule deer home ranges was 2.86 mi (4.6 km). The mean minimum home range width, excluding straight-line movements, was approximately 0.72 mi (1.16 km).

Eleven of the 12 collared mule deer utilized lower elevation habitat outside the boundaries of the WTMRP (see Appendix A for individual maps). Shortly after GPS collars were deployed, the mean daily elevation of mule deer locations began to decline (Figure 2). Three travel routes were used by deer when moving from higher elevations within the park to lowland bajadas to the west (Figure 3). The seven deer that utilized habitat in the Project Area traveled these routes to access the development corridor from their activity areas inside the park.

Collared mule deer spent the summer dry season at low elevations with the mean daily elevation not exceeding 2,000 ft (610 m; Figure 2). Collared mule deer began utilizing low elevation perennial waters during this time (inferred from proximity of mule deer locations to permanent water sources). However, the higher elevation water sources in the southeast portion of the study area were not visited by any of the twelve deer that we monitored. Field visits to these structures indicated that they were being utilized by uncollared mule deer.

Movement patterns during the summer wet season were less well defined. The first precipitation event occurred on 16 July, signaling the beginning of the summer wet season. Shortly after the rains hit, collared mule deer moved into the mid-elevation habitat until 29 August when they moved back into the low-elevation habitat (Figure 2). With the exception of one individual, all the collars were recovered at low elevation sites.

Two mule deer died during the course of this study. Mule deer 104 was found dead on the west side of the WTMRP near a water catchment on 8 August. The carcass had been scavenged and evidence regarding the cause of mortality was unclear. All that remained was the skull, the spinal column and the GPS collar. Examination of the skeletal remains did not indicate mountain lion predation (generally mountain lions will attack from behind the animal and inflict damage to the spinal column). No fresh lion sign was detected at the kill site although there had been documented lion presence at the water

catchment earlier in the month. A second individual, mule deer 108, died on 20 June. Movement data indicated that this deer visited the water catchment on the north end of the White Tank Mountains on 18 June. Upon leaving the catchment, this individual moved north of its main activity area and crossed the SVP. The deer spent one day along the CAP Canal and the next day bedded down under a mesquite tree adjacent to the CAP fencing and died. Investigation by Mark Stewart, AGFD, Wildlife Manager, turned up a broken arrow shaft and broadhead lodged inside the animal's lung. This indicated that the deer was killed illegally out of season.

Habitat Use

Random-effects RSF models that included a random intercept and a random coefficient generally provided the best fit to the data (Table 3). In addition, the importance of habitat variables examined in this study varied with season (Table 3). Spring habitat use was influenced by distance to road ($p = 0.005$). Mule deer selected habitat farther from roads during this time. During the summer dry season, elevation ($p < 0.001$) had the greatest impact on habitat use with mule deer selecting habitat at lower elevations. During the summer wet season, mule deer selected habitat farther from permanent water sources ($p < 0.001$).

Bed-site selection differed slightly from overall habitat use (Table 4). The elevation model with a random slope was the best predictor of bed-site location during the spring ($p < 0.001$). Mule deer bedded at higher elevation than available within their home range. During the summer dry season, mule deer bedded at lower elevation ($p < 0.001$) and farther from water sources ($p < 0.001$) than available. For the summer dry season, random coefficient models provided a better fit than random intercept models. Random intercept-random coefficient models did not provide any improvement in model fit (Table 4). All variables, with the exception of elevation, were significant during the summer wet season. The random intercept-random coefficient model for distance to water provided the best fit to the data ($p < 0.001$); mule deer bedded farther from water sources than available. Mule deer also bedded farther from washes ($p = 0.014$) and roads ($p = 0.007$) during this time.

Sun Valley Parkway Crossing Characteristics

Seven of the collared mule deer approached within 820 ft (0.25 km) of the SVP a total of 173 times. These deer crossed the parkway a total of 111 times with a mean of 15.86 (± 5.59 SE) crossings per deer (range: 1-36 crossings/deer). The mean passage rate was 0.64 (± 0.09 SE) crossings per approach (range: 0.33-1.00 crossings/approach; Table 5).

Mule deer crossed 51 of the 268 road segments (19%). Animals did not appear to cross the Sun Valley Parkway at random. Instead, crossings exhibited an aggregated pattern (Figure 4). The greatest crossing frequency occurred at the eastern end of the SVP near Crozier Road where deer moved across the roadway to access Trilby Wash. A second spike in crossing frequency occurred south of Wagner Wash (Figure 5). A third crossing area, with a lower crossing frequency, was identified between N. Canyon Springs Blvd. and 243rd Ave. Logistic regression analysis indicated that neither land cover nor distance to wash had an influence on the location of mule deer crossings (Table 6). Instead, the

likelihood of crossing the road was influenced by the distance to permanent water source ($p = 0.013$). Crossing segments were closer to permanent water sources than random segments.

DISCUSSION

Shortly after the rut, male mule deer began to move from the high elevation habitat within the WTMRP to low elevation habitat within the Project Area where they spent the summer dry season. Fox and Krausman (1994) have demonstrated that pregnant females remain in high elevation habitat to take advantage of higher quality food resources due to their increased physiological demands during pregnancy and lactation while males move to lower elevation habitat perhaps to reduce their competition for food resources with does (Bowyer 1984, Barboza and Bowyer 2000). Our data indicates that males spent the summer dry season at low elevation, which would partially corroborate the gastrocentric sexual segregation hypothesis (Barboza and Bowyer 2000, Bowyer 2004), given that females generally avoid low-elevation creosote flats during fawning (Fox and Krausman 1994). If does are utilizing desert habitat differently than bucks, it is important to identify female habitat use for a more complete understanding of the impacts that development in the surrounding landscape will have on the White Tanks herd.

While at lower elevations, male home ranges generally included one or more permanent water sources and location data suggests that during the summer dry season, these water sources were utilized. Mule deer situated home ranges near water sources, but exhibited dispersed movements that were not concentrated near any single water source. Bed-site selection during the summer dry season occurred farther from permanent water sources than expected, possibly as a result of dispersed forage availability or as a strategy to avoid predation during a period in which predators are also attracted to permanent water resources (DeStefano et al. 2000). Evidence of mountain lion predation from other parts of the WTMRP suggests that lions may be utilizing water sources as reliable hunting grounds.

Almost immediately after the first rains began in July, male mule deer moved back into the mid- to high-elevation habitats within the park, possibly to take advantage of the green-up of food resources triggered by the precipitation. Towards the end of the monitoring period average daily elevation declined again as the bucks moved back into the low-elevation portions of their home ranges. Mule deer were located farther from permanent water sources during this period, possibly as a result of increased water or food availability in other parts of their home range (Elder 1956). Bed-site selection during this time was farther from permanent water sources, roads, and washes. The relationship between bed-site selection and distance to washes was unexpected. Marshall et al. (2006) identified a similar pattern and suggested that their approach to digitizing the washes from GIS imagery may have been insufficient for identifying small washes (< 5 m is width). This may have been the case in the current study and the distance to wash data may actually reflect the distance to large washes (Marshall et al. 2006). Thus, bed-

site selection may have been a result of avoidance of large washes rather than washes in general.

While approximately 62% of seasonal MCP home ranges contained at least one permanent water source, our analysis indicated that deer were only influenced by permanent water sources during the summer wet season or when selecting bed-sites during the summer dry season. In both cases, the relationship between distance to permanent water and habitat selection was positive; mule deer utilized habitat farther from water sources than expected. These results conflict with those of Ordway and Krausman (1986), Hervert and Krausman (1986), and Rautenstrauch and Krausman (1989) where mule deer were found closer to permanent water sources during the summer dry season. However, Hervert and Krausman (1986) found bucks farther from water than does during two summers of observation with a mean distance during July estimated at 0.84 and 1.73 mi (1.35 and 2.79 km) in 1981 and 1982, respectively. Prior to the first rainfall on 16 July, the mean distance to water during the summer dry season in the current study was 1.92 mi (3.09 km). Bucks visit catchments less frequently than does (Hervert and Krausman 1986) which is likely the result of greater water requirements for does during their last trimester of pregnancy. Nicholson et al. (1997) also found that bucks used areas farther from water in summer than expected. Marshal et al. (2006) found that terrain characteristics (i.e., slope and elevation) and forage quality were important in determining mule deer distribution in the Sonoran Desert whereas water catchments played a minor role. If applicable to the current study, the pattern observed by Marshal et al. (2006) might indicate that mule deer in the White Tanks were more strongly influenced by dispersed food resources than by permanent water sources within the study area. In the Sonoran Desert, males generally occupy more open habitat with lower quality forage than females during the post-rut period (Ordway and Krausman 1986). Differences between male and female habitat selection in relation to water resources (Hervert and Krausman 1986, Nicholson et al. 1997) warrant further examination of female habitat requirements within the Project Area.

Our analysis indicated that the SVP poses a significant barrier to mule deer movement. In addition to selecting habitat farther from roads during the spring, our analysis suggests that crossing the SVP is problematic for mule deer. Despite currently low levels of traffic volume along the SVP, passage rates indicated reluctance by deer to cross the road. Few studies have calculated passage rates to estimate permeability (Forman et al. 2003). Passage rates estimated for wolves (Paquet and Callaghan 1996) and elk (Dodd et al. 2007) ranged from 0.06-0.93 and 0.43-0.88 crossings per approach, respectively. Traffic volume accounted for the variability in wolf passage rates (Paquet and Callaghan 1996); as traffic volume increased, passage rates declined. The magnitude of the barrier-effect imposed by a roadway can be expected to increase with traffic volume. For example, Gagnon et al. (2007) found that increased traffic volume led to a reduction in the probability of road crossing by elk. In addition, wildlife-vehicle collisions are often correlated with increased traffic volume (Allen and McCullough 1976, Groot Bruinderink and Hazebroek 1996, Romin and Bissonette 1996). The current level of permeability across the SVP (0.64 ± 0.09 SE) can be expected to decline as traffic volume increases

with future development in the area, thereby increasing the isolation of the White Tanks herd.

Despite relatively low levels of permeability, mule deer did cross the SVP. This begs the question: why and where did the mule deer cross the road? Crossing locations were not distributed randomly along the alignment and were influenced by the distance to permanent water sources. The majority of road crossings occurred within two distinct crossing areas (Figure 5). The first, at the eastern end of the Sun Valley Parkway near Crozier Road allowed deer to access Trilby Wash. The second crossing area was located south of Wagner Wash where deer moved across the SVP to access the wash near its confluence with the Hassayampa River. Our results suggest that while deer do not necessarily cross the road at wash crossings, they did cross the road to access washes and water sources on either side.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

Corridor Design

Harrison (1992) suggests that minimum corridor width may coincide with the minimum widths of home ranges. However, the minimum width may also depend on corridor length such that narrower corridors may be used if the corridor length is short relative to home range estimates (Beier and Loe 1992). Approximately 6 mi (9 km) must be traveled from the boundary of the WTMRP to the Hassayampa River, 3 mi (5 km) of which are within the boundaries of the Project Area. Relative to the average radius of home ranges estimated in the current study (2.86 mi [4.6 km]), mule deer movement across the Project Area is feasible. Identifying the appropriate corridor width is more problematic. Minimum home range width was approximately 0.72 mi (1.16 km) in the currently undeveloped landscape. Width requirements could be wider or narrower as the landscape is developed. For this reason, we suggest that multiple corridor widths be implemented and monitored to identify the appropriate width for mule deer movement corridors in the region.

Seven major drainages off the west slope of the White Tank Mountains connect with the Hassayampa River and have potential as major components in mule deer movement corridors. Three of these drainages are associated with the two northern travel routes identified at the western boundary of the WTMRP and run into the SVP at the primary crossing area identified in our analysis. We recommend that this area and the drainages therein be the focus of connectivity planning efforts. A fourth drainage to the south was utilized by mule deer as they moved out of the WTMRP into the low elevation habitat via the southern most travel route. This could function as an additional corridor leading to the Hassayampa River and should also be given consideration during planning efforts.

Permanent water sources are biologically significant for the survival of wildlife in arid environments and construction of wildlife water catchments remains an important tool for wildlife management. Strategically placed water catchments have potential for attracting desert wildlife, such as mule deer, to corridors and may be used to manipulate wildlife

movements through corridors in an effort to maintain connectivity. This hypothesis has not yet been tested, but warrants future examination.

Road Crossing Structures

Mule deer have been shown to use wildlife underpasses (Reed 1981, Gordon and Anderson 2003), although few observed crossings have been documented in the arid southwest. Much of the existing research on mule deer road crossing has been conducted on migratory populations that move considerable distances between breeding and non-breeding activity areas (Reed et al. 1975a, Reed et al. 1975b) and therefore have a high level of motivation to cross roadways in their path. Desert mule deer, especially those on the edges of urban areas, may not have the same incentive to make large-scale movements given the availability of water (e.g., irrigation systems, golf courses, wildlife water catchments, cattle tanks) and food resources (e.g., gardens, lawns, landscape plants, agriculture) associated with human development. The impacts of this behavioral shift on population structure have yet to be addressed. Regardless, crossing structure requirements for desert mule deer may be different than for deer in other regions.

Mule deer are more likely to use large underpasses versus small underpasses and bridge-type underpasses versus culverts (Reed 1981). In Wyoming, Gordon and Anderson (2003) identified a minimum underpass size threshold (8 ft tall x 20 ft wide), below which mule deer reluctance increased. Reed et al. (1975a) recommended underpasses with at least 14 ft x 14 ft dimensions. Studies have also shown width may be more important than height (Foster and Humphrey 1995, Clevenger and Waltho 2000). We recommend a minimum size of 10 ft tall x 20 ft wide be used for desert mule deer crossing structures. Additionally, the presence of suitable habitat on either side of the crossing structure is critical to its use (Ng et al. 2004). Furthermore, if mule deer can see the horizon through the underpass, they may be more willing to use it (Foster and Humphrey 1995). Roadways in flat terrain, such as the SVP, may be best traversed by wildlife using overpass structures.

Strategically placed crossing structures combined with wildlife mitigation fencing are effective in reducing wildlife-vehicle collisions (Clevenger et al. 2001) whereas crossing structures alone are ineffective at reducing collision rates (Feldhammer et al. 1986). We recommend that crossing structures (e.g., underpasses and/or overpasses and associated fencing) be placed along the SVP at high frequency crossing areas. Placing crossing structures at known crossing locations may increase the likelihood of use. Ungulate proof fencing should be approximately 8 ft to prevent animals from jumping or climbing over (Clevenger et al. 2001) and include one-way gates to allow animals trapped on the roadway to move away from the roadway (Reed et al. 1975b). An additional consideration should be made regarding human activity at the crossing structure. For example, Clevenger and Waltho (2000) found that human activity was a significant factor determining deer use of underpasses in Banff National Park. Additionally, off-highway vehicle and pedestrian traffic through the crossing structure may impact its effectiveness.

Habitat Considerations

Mule deer have been shown to avoid human developments (Vogel 1989, Nicholson et al. 1997) and may be an indicator species for connectivity planning in arid ecosystems due to their sensitivity to development. Currently, the landscape west of the White Tank Mountains is relatively undeveloped. As housing density increases, there is a high likelihood that the number of deer supported by existing habitats will decrease as their habitat is fragmented (Vogel 1989). The current study can be viewed as a pre-treatment (i.e., build-out with movement corridors) estimate of movement and habitat use within the Project Area slated for development. The development of movement corridors through the Project Area is critical for ameliorating the negative effects of habitat fragmentation. Using the current study as a baseline for evaluating the success of such corridors will greatly inform future management for connectivity conservation. Therefore, we recommend that mule deer movement corridors and road crossing structures be implemented and monitored to assess their effectiveness in maintaining connectivity between the White Tank Mountains and the Hassayampa River as development progresses.

Vogel (1989) suggested that habitat patches within developed landscapes be closer together and connected by travel corridors. Vogel (1989) also asserted that new construction would have less of an impact on deer movement if it were located away from vegetated riparian areas that are used as travel corridors. If extended to the desert, this approach of conserving xeroriparian areas may be a useful management tool for maintaining connectivity. Although our analysis did not indicate a relationship between proximity to washes and habitat selection, Krausman et al. (1993) found use of washes to increase during warm, dry periods. Ordway and Krausman (1986) observed preferences for washes by males for each season with the exception of early summer when it was thought that the deer took advantage of the high abundance of forbs in areas between washes. The implications of the current study are that both xeroriparian and upland areas will be important components of successful mule deer movement corridors. Maintaining productive and diverse vegetation to allow mule deer access to high quality food resources (Krausman et al. 1997, Popowski and Krausman 2002) within corridors may increase their likelihood of use and aid in the long-term persistence of the White Tanks herd.

It should also be noted that the duration of the monitoring period for this study was nine months. Annual variability in rainfall patterns and food availability could lead to similar or divergent movement and habitat use patterns during subsequent years of study. For this reason, we recommend that additional movement and habitat use data be collected prior to corridor implementation and that female mule deer be considered for future study.

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TABLES AND FIGURES

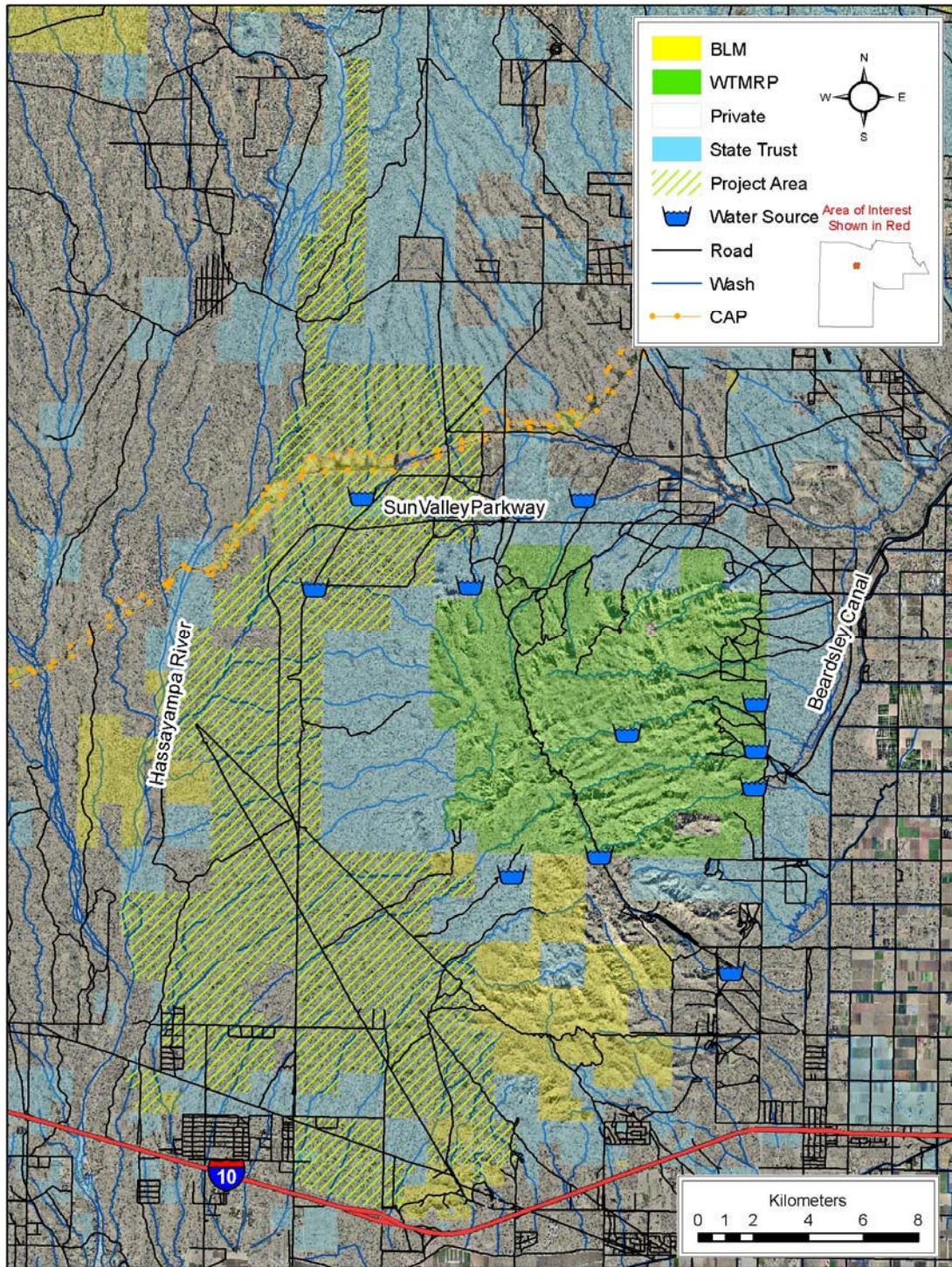


Figure 1. Overview map of Project Area and the WTMP in Maricopa County, Arizona.

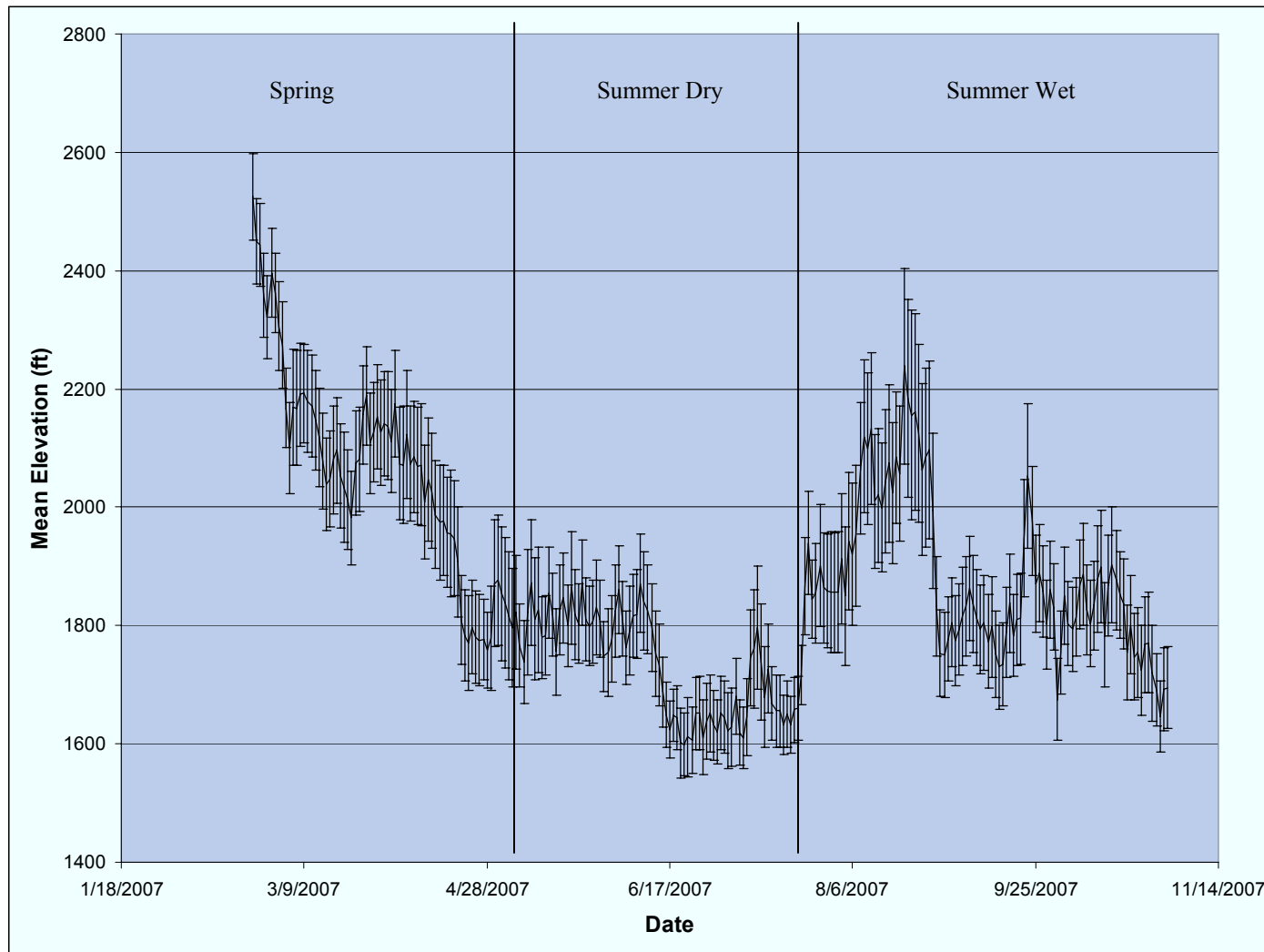


Figure 2. Mean daily elevation ($\pm$ SE) of male mule deer locations from 20 February to 31 October 2007 in the White Tank Mountains and surrounding area, Maricopa County, Arizona.

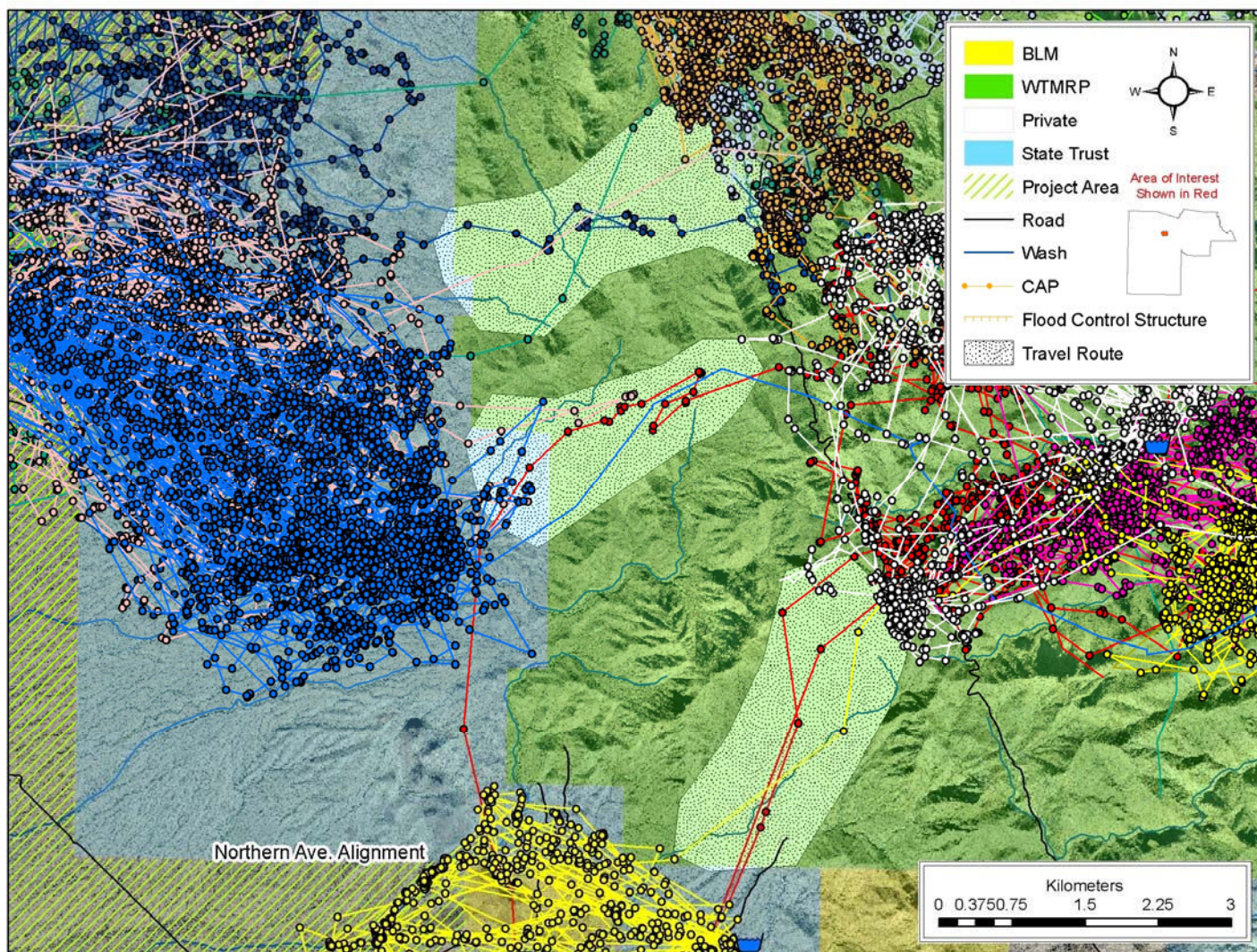


Figure 3. Travel routes used by seven mule deer when moving from high elevation habitat within the WTMRP to low elevation habitat within the Project Area.

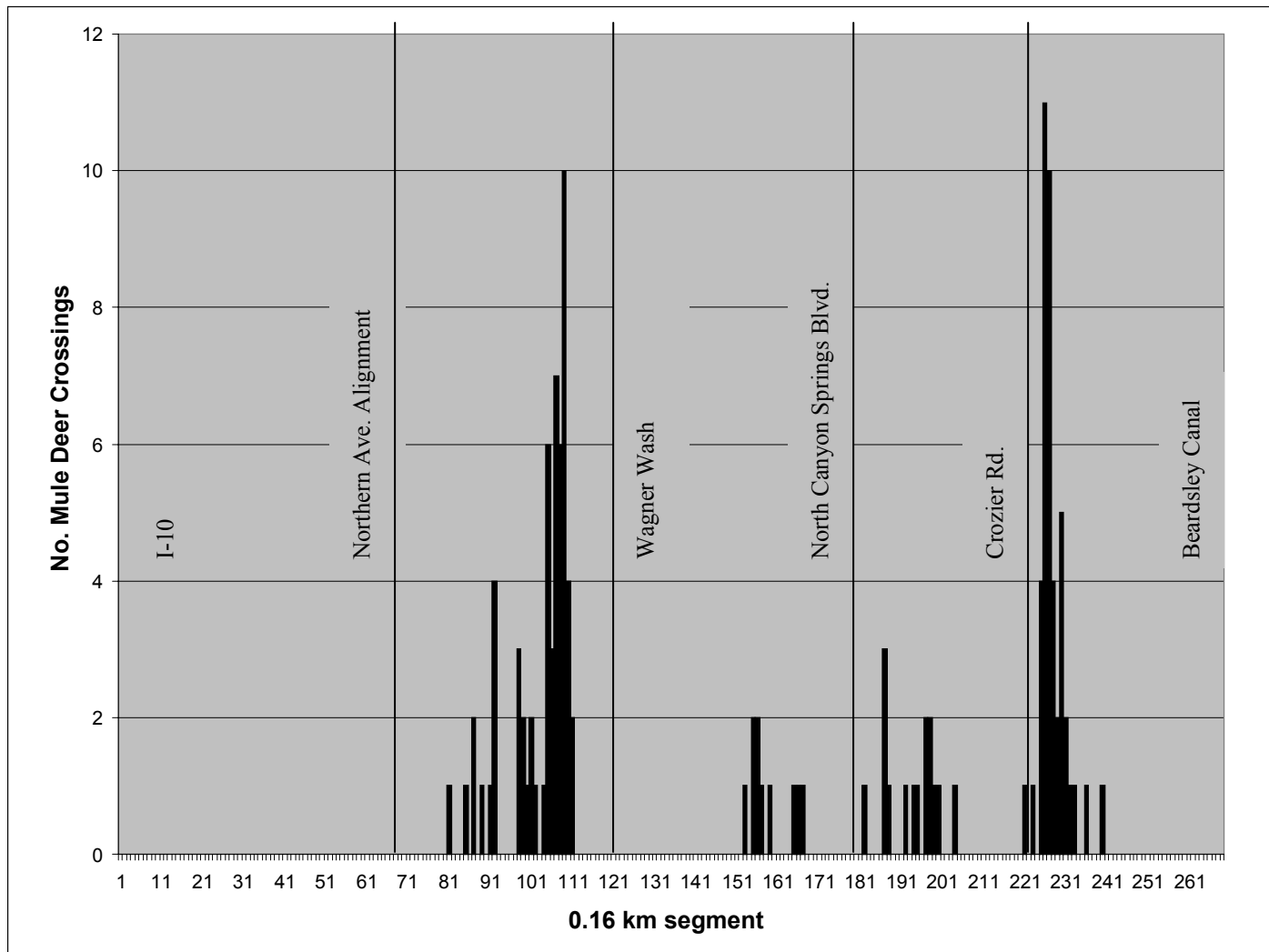


Figure 4. Distribution of mule deer crossings along the Sun Valley Parkway from 20 February 31 October, Maricopa County, Arizona.

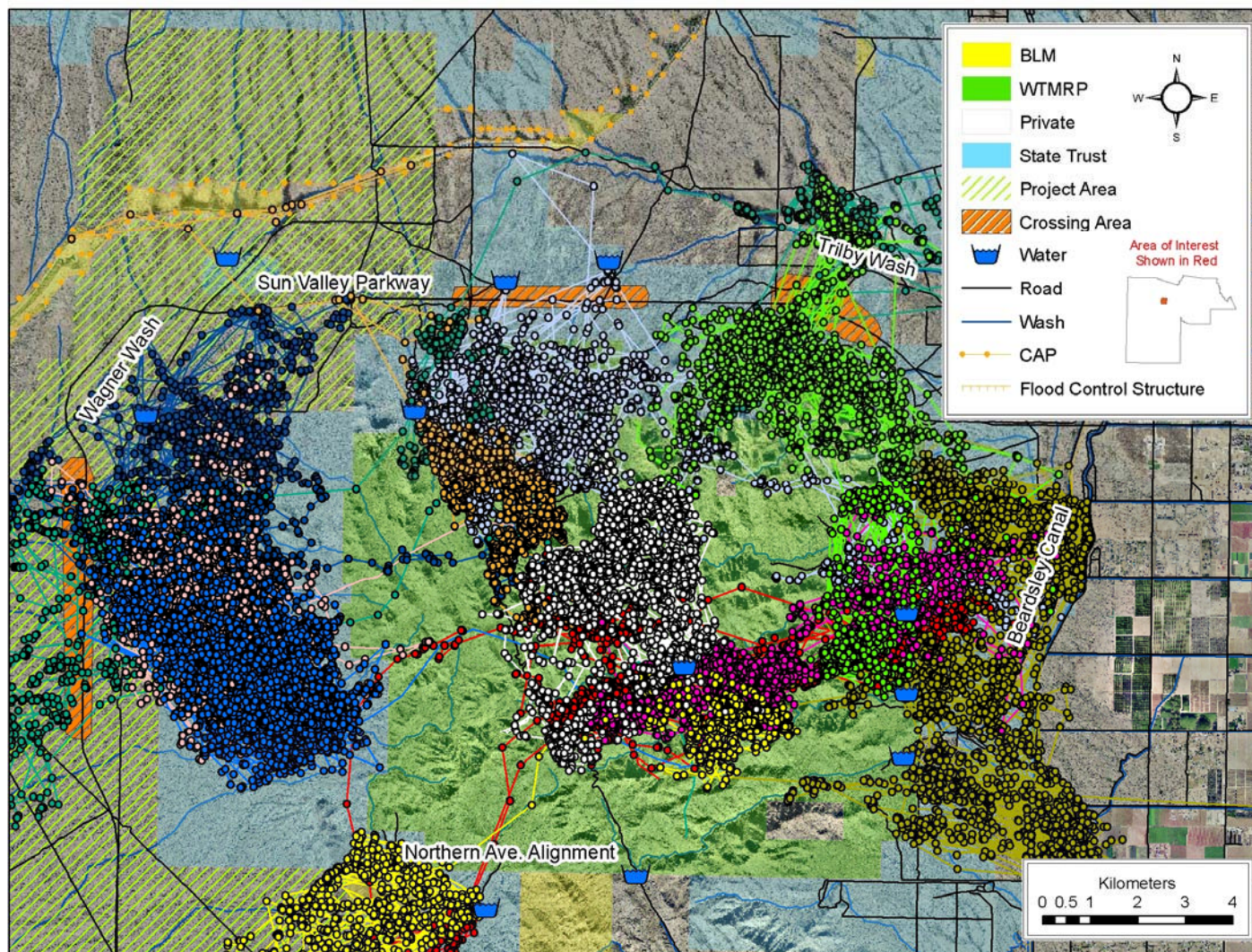


Figure 5. Mule deer crossing areas along the Sun Valley Parkway in Maricopa, County.

Table 1. Seasonal number of fixes acquired on 12 male mule deer in the White Tank Mountains Regional Park and surrounding area between 20 February and 31 October 2007.

Mule Deer ID	Spring	Summer Dry	Summer Wet	Total Fixes
101	930	1059	1499	3488
102	937	1057	1498	3492
103	934	1062	1510	3506
104	930	1052	276	2258
105	930	1060	1505	3495
106	933	1059	1498	3490
107	938	1064	1504	3506
108	929	707	0	1636
109	935	1055	1481	3471
110	936	1035	1488	3459
111	934	1055	1496	3485
112	935	1055	1495	3485

Table 2. Mean seasonal and overall minimum convex polygon home range estimates (km^2) and standard error (SE) of desert mule deer in the White Tank Mountains Regional Park and surrounding area, Maricopa County, Arizona. Two mule deer died during the summer wet season and were therefore censored from the home range estimate for that season.

Season	Mean (km^2)	SE	No. Deer
Spring	32.066	24.402	12
Summer Dry	36.059	34.294	12
Summer Wet	34.724	24.902	10
Overall	66.440	14.049	12

Table 3. Seasonal male mule deer RSF models with parameter estimates (β_i), standard errors (SE) and associated p values. Log-likelihood values reflect model fit. Higher log-likelihoods indicate better fit relative to the other models. We defined spring as occurring from 20 February to 30 April, early summer as 1 May to 15 July, and late summer as 16 July to 31 October.

Spring	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-15531	-15474	-15351	-15350	-15127	-14163	-15459	-15342	-14137	-15245	-15112	-14544
β_i	-2.9E-05	-0.00013	-0.000125	0.00039	0.000152	-0.10988	9.2E-05	5.49E-05	0.000152	0.00174	0.00335	0.001054
SE	4.6E-05	0.000101	0.0002906	2.2E-05	0.00319	0.03923	8.6E-06	3.36E-05	0.0002732	8.7E-05	0.0002	0.006217
p	0.514	0.203	0.667	<0.001	0.962	0.005	<0.001	0.103	0.578	<0.001	<0.001	0.865
Summer Dry	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-17043	-16959	-16812	-17015	-16905	-464183	-16932	-16908	-16181	-16716	-16368	-15427
β_i	0.00037	-0.00041	-0.0003851	-0.0002	-0.00051	-0.0001086	0.00012	0.000114	-0.0001567	-0.0021	-0.0051	-0.009139
SE	4.2E-05	0.000114	0.0003117	2.2E-05	0.002255	0.0022156	8.1E-06	1.96E-05	0.0009975	9.3E-05	0.00319	0.002639
p	<0.001	<0.001	0.217	<0.001	0.822	0.961	<0.001	<0.001	0.875	<0.001	0.108	<0.001
Summer Wet	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-21134	-21070	-20905	-21141	-21065	-20863	-20988	-20937	-20643	-21132	-21061	-19780
β_i	0.00017	8.86E-05	0.00004983	4.4E-05	-0.00013	-0.0002125	0.00011	0.000102	0.0001757	-0.0003	-0.0012	-0.006408
SE	3.8E-05	0.00012	0.0003637	1.9E-05	0.002355	0.000211	6.9E-06	1.87E-05	0.00005252	7.7E-05	0.00015	0.00479
p	<0.001	0.461	0.891	0.022	0.956	0.314	<0.001	<0.001	<0.001	<0.001	<0.001	0.181

Table 4. Bed-site RSF models with parameter estimates (β_i), standard errors (SE), and associated p values. Log-likelihood values reflect model fit. Higher log-likelihoods indicate better fit relative to the other models. We defined spring as occurring from 20 February to 30 April, early summer as 1 May to 15 July, and late summer as 16 July to 31 October.

Spring	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-1102	-1099	-1102	-1082	-1075	-1043	-1095	-1093	-1057	-1073	-1070	-1073
β_i	0.00017	0.000171	0.0001576	0.00049	0.000431	0.0004286	0.00011	0.000103	0.0002422	0.00213	0.00333	0.0020912
SE	0.00017	0.000168	0.0001831	7.9E-05	0.000133	0.000357	3.3E-05	3.6E-05	0.0003019	0.00034	0.00043	0.0003654
p	0.303	0.308	0.389	0.000	0.001	0.230	0.001	0.004	0.423	0.000	0.000	0.000
Summer Dry	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-1192	-1182	-1176	-1192	-1188	-1188	-1176	-1176	-1176	-1167	-1155	-1155
β_i	0.00017	-0.00027	-0.0002716	-9E-05	-8.7E-05	-0.0001519	0.00016	0.000158	0.0001664	-0.0021	-0.0043	-0.0042946
SE	0.00015	0.000215	0.0004225	8.5E-05	9.93E-05	0.000104	3.1E-05	3.09E-05	0.00003326	0.00036	0.00053	0.0005378
p	0.246	0.211	0.520	0.283	0.380	0.144	0.000	0.000	0.000	0.000	0.000	0.000
Summer Wet	Distance to Wash			Distance to Road			Distance to Water			Elevation		
	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i	Random Intercept	Random x_i	Random Intercept and Random x_i
Log-likelihood	-1482	-1478	-1479	-1482	-1482	-1482	-1479	-1478	-1477	-1486	-1483	-1483
β_i	0.0004	0.000399	0.00038	0.00019	0.000193	0.000183	8.8E-05	6.9E-05	0.00008245	-7E-06	-6E-05	-0.00006556
SE	0.00014	0.000162	0.000192	7.2E-05	7.22E-05	0.00008456	2.7E-05	2.71E-05	0.00003072	0.0003	0.00026	0.0002649
p	0.005	0.014	0.048	0.007	0.007	0.031	0.001	0.011	0.007	0.824	0.809	0.805

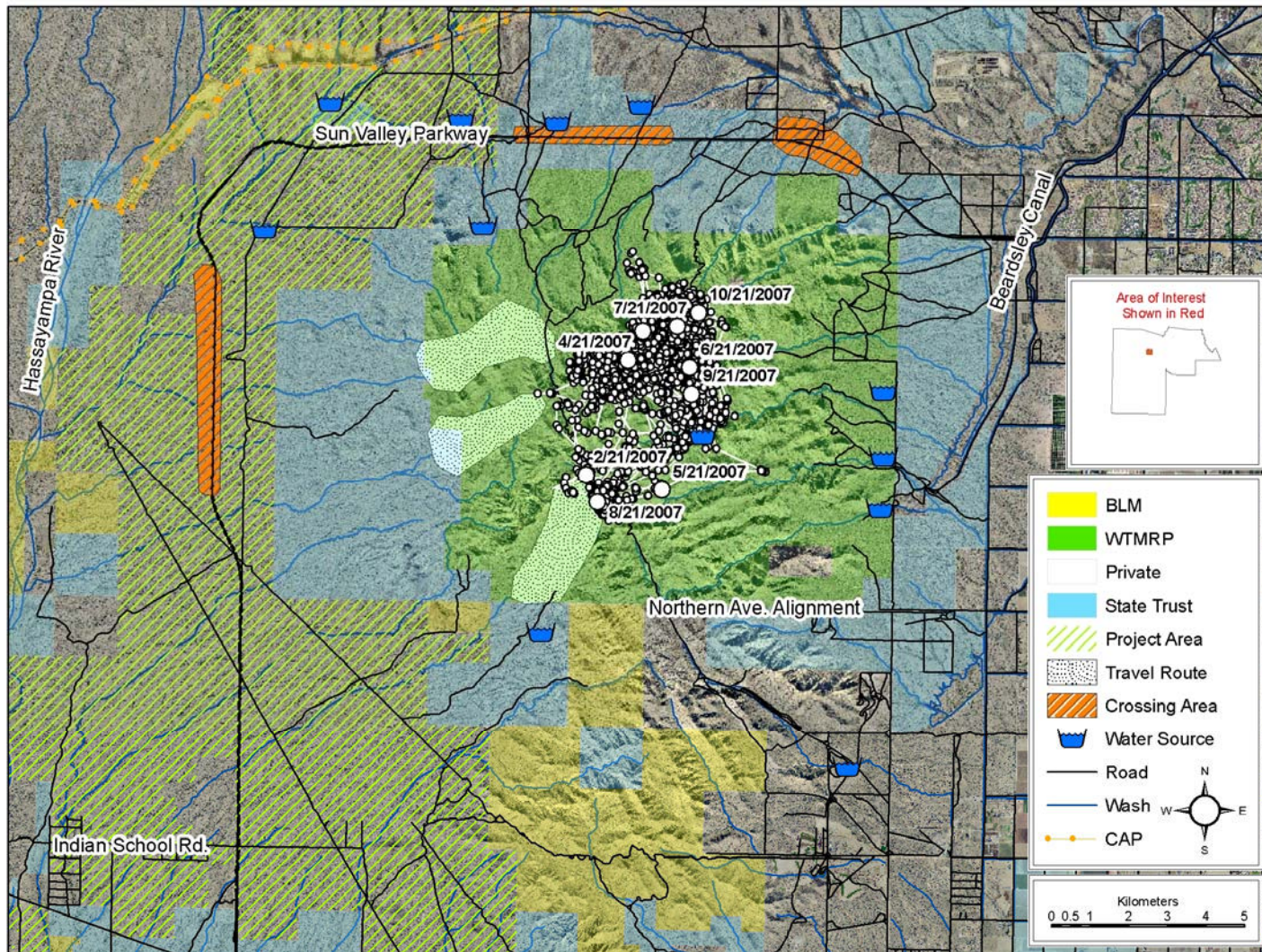
Table 5. Passage rates (approaches / crossings) for 7 male mule deer moving across the Sun Valley Parkway, Maricopa County, AZ.

Mule Deer	No. Approaches	No. Crossings	Passage Rate
102	3	1	0.33
103	54	36	0.67
107	8	3	0.38
108	3	3	1.00
110	47	26	0.55
111	12	11	0.92
112	49	31	0.63
Total	176	111	
Mean	25.14	15.86	0.64
SE	8.90	5.59	0.09

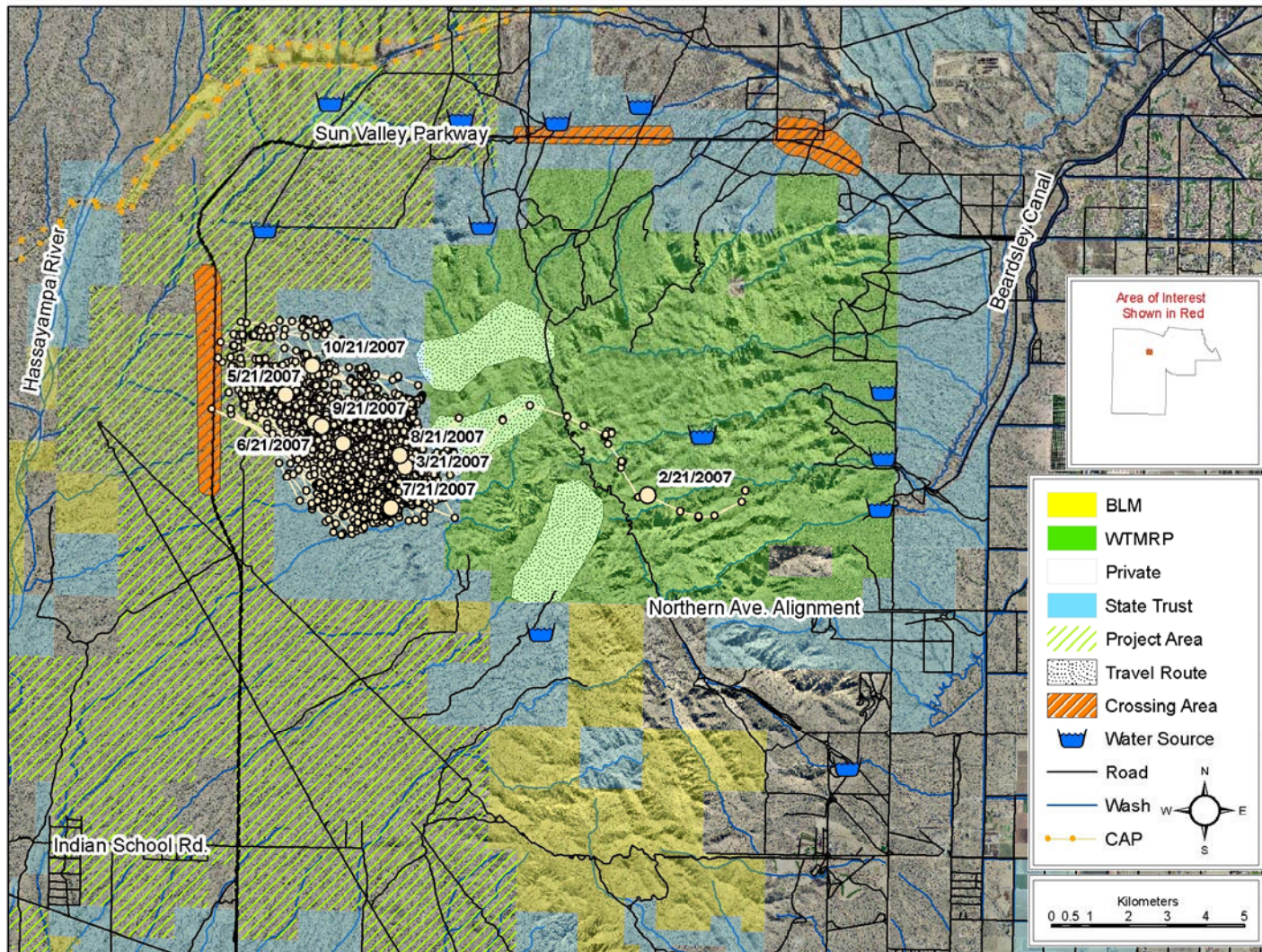
Table 6. Logistic regression analysis results comparing crossing segments to random segments along the Sun Valley Parkway, Maricopa County, AZ. Land cover data was taken from the Southwest Regional Gap Analysis Project land cover dataset (Lowry et al. 2007). Mcacti and Creosote indicate land cover types Sonoran Paloverde-Mixed Cacti and Sonoran-Mohave Creosotebush-White Bursage Desert Scrub, respectively. Values represent parameter estimates (β_i), standard errors (SE) and p values.

	Distance to Wash	Distance to Water	Mcacti	Creosote
β_i	0.00073	-0.00021	-0.867	0.908
SE	0.00062	0.00009	1.190	1.194
p	0.240	0.013	0.470	0.450

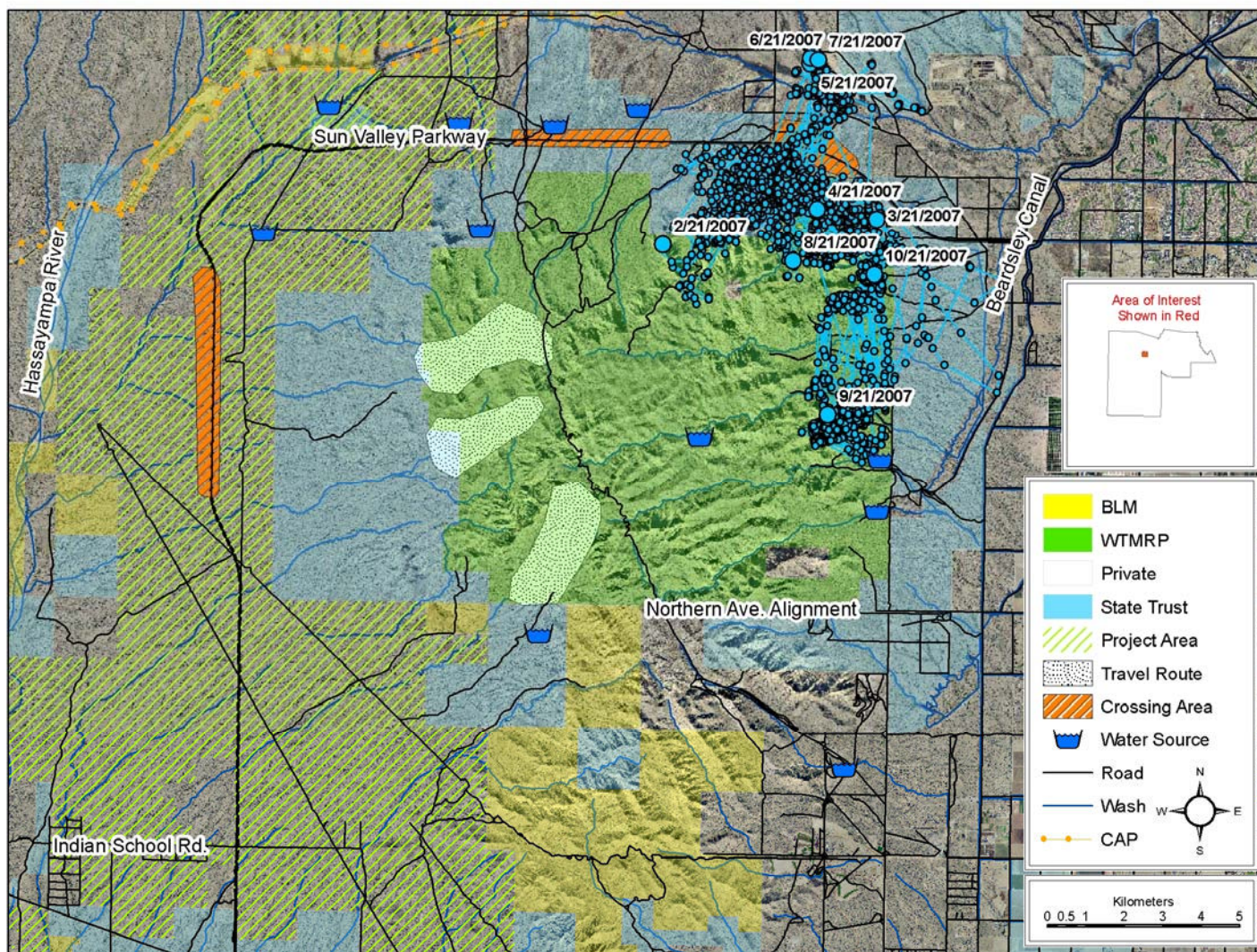
APPENDIX A



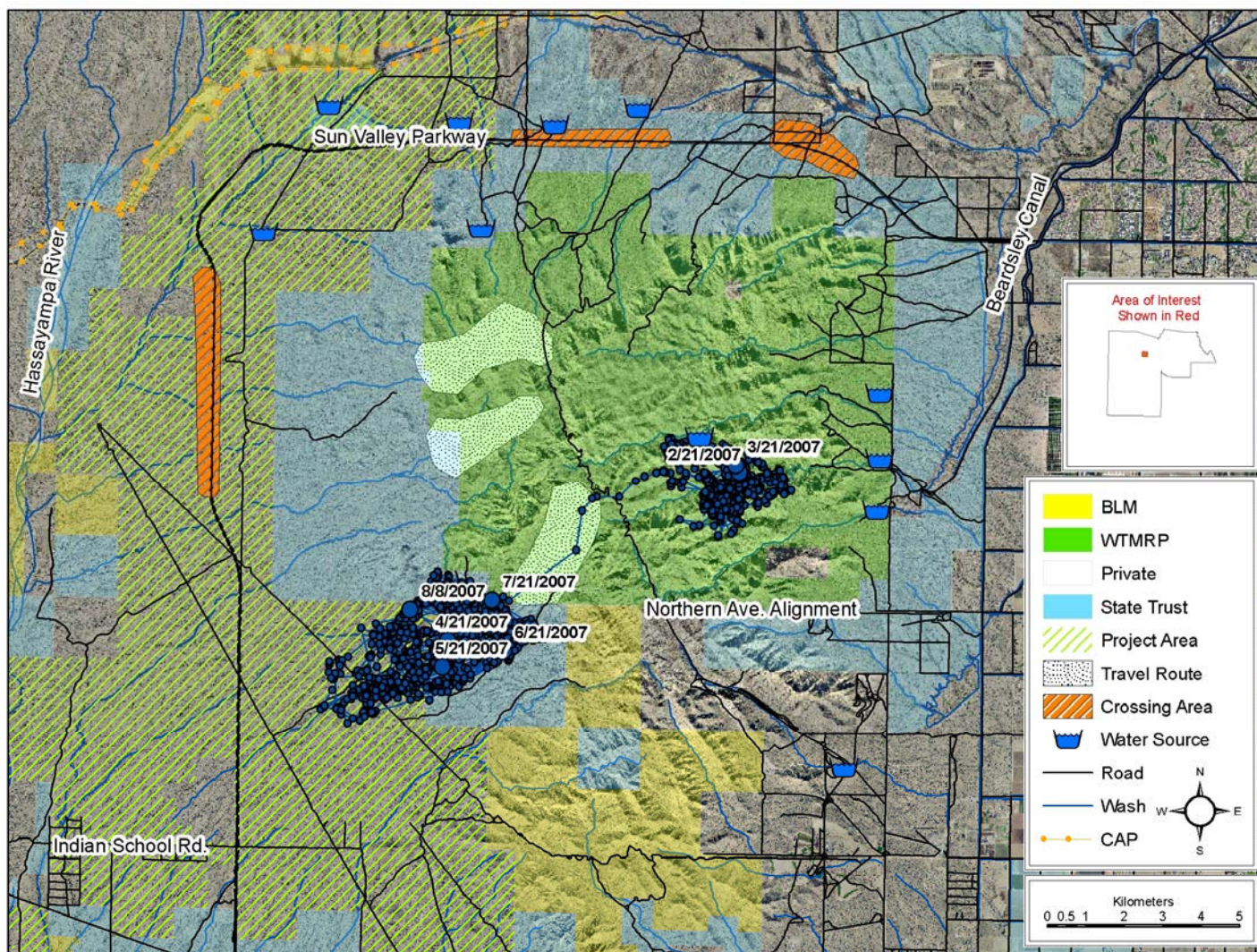
Mule deer 101 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



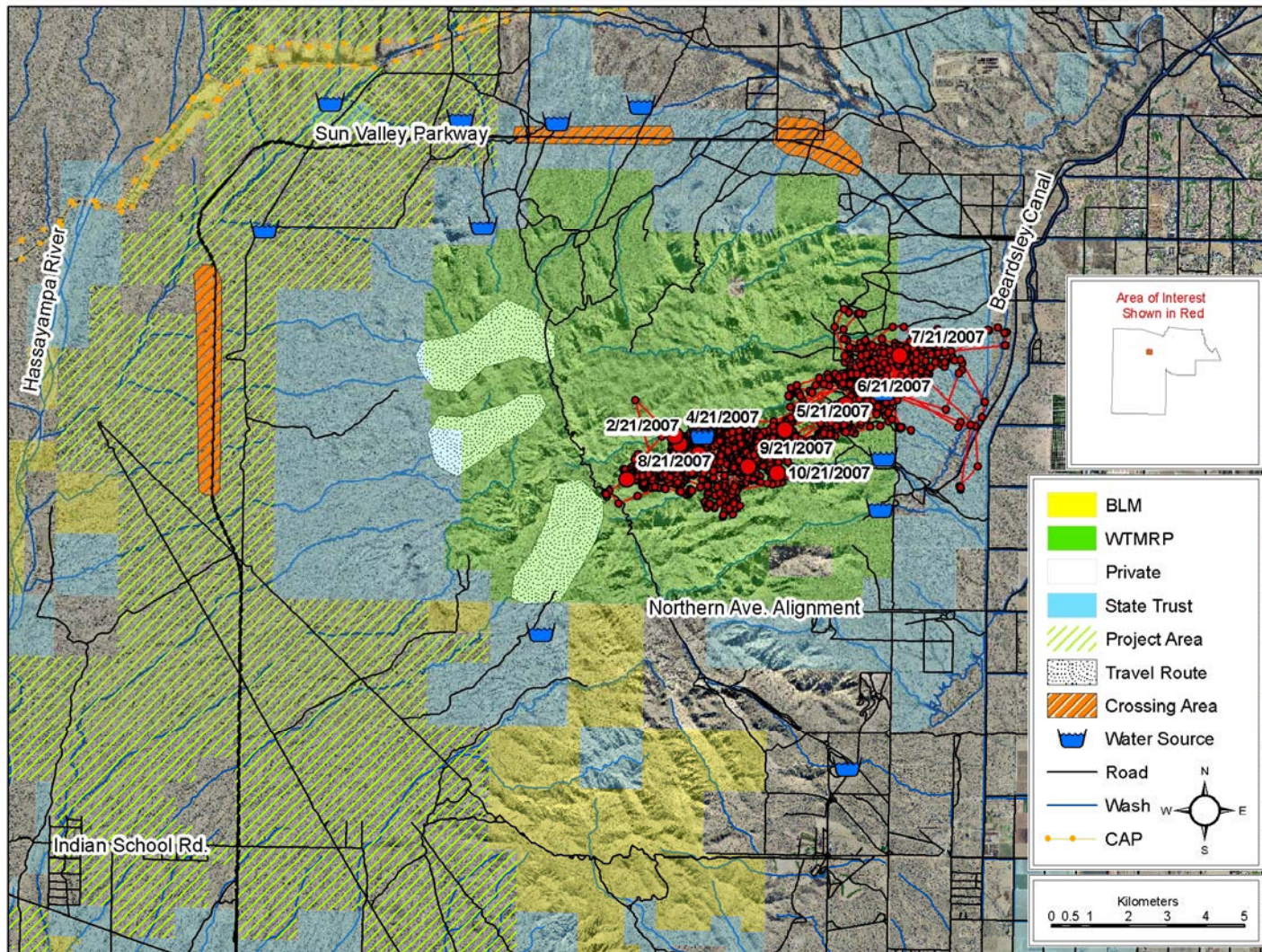
Mule deer 102 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



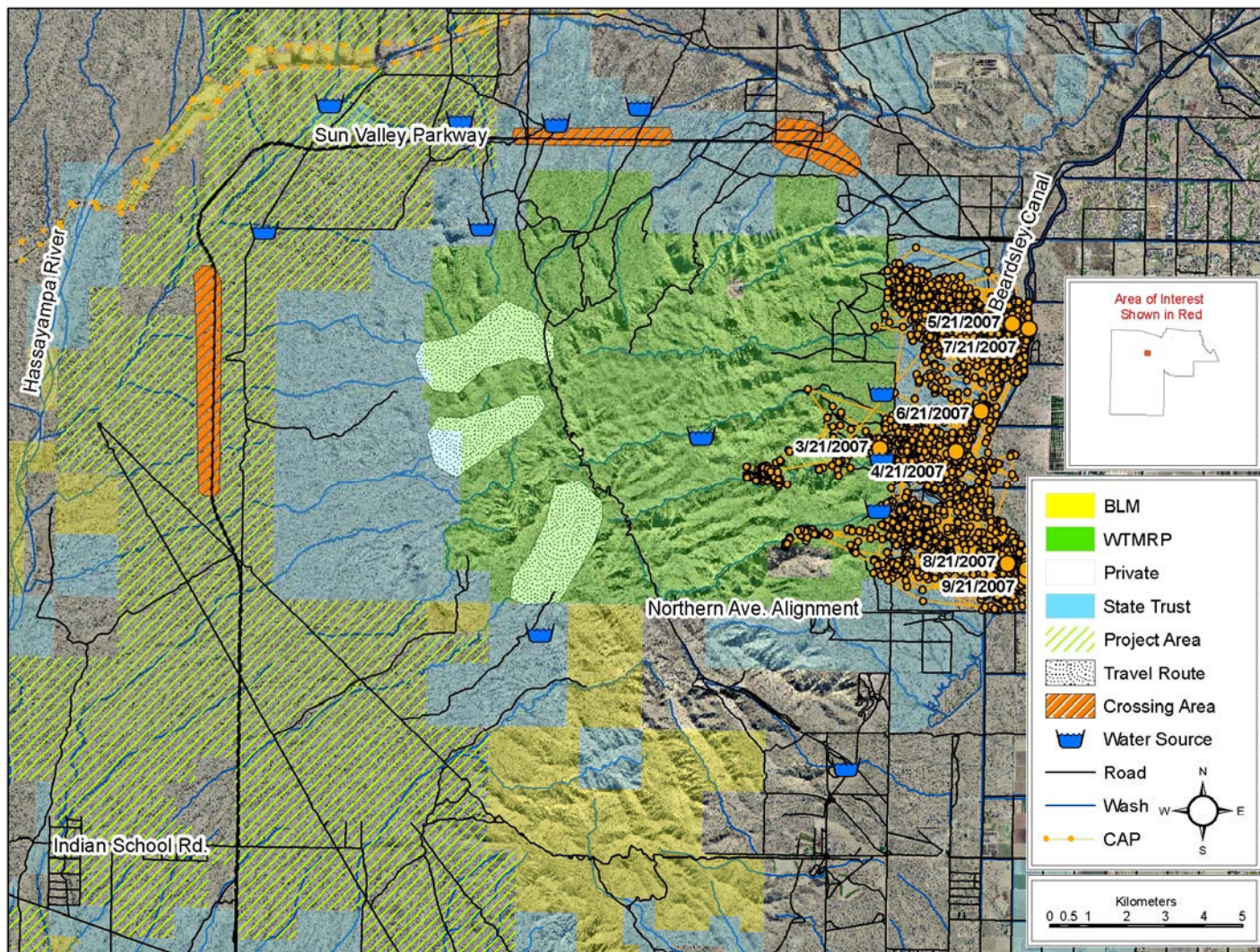
Mule deer 103 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



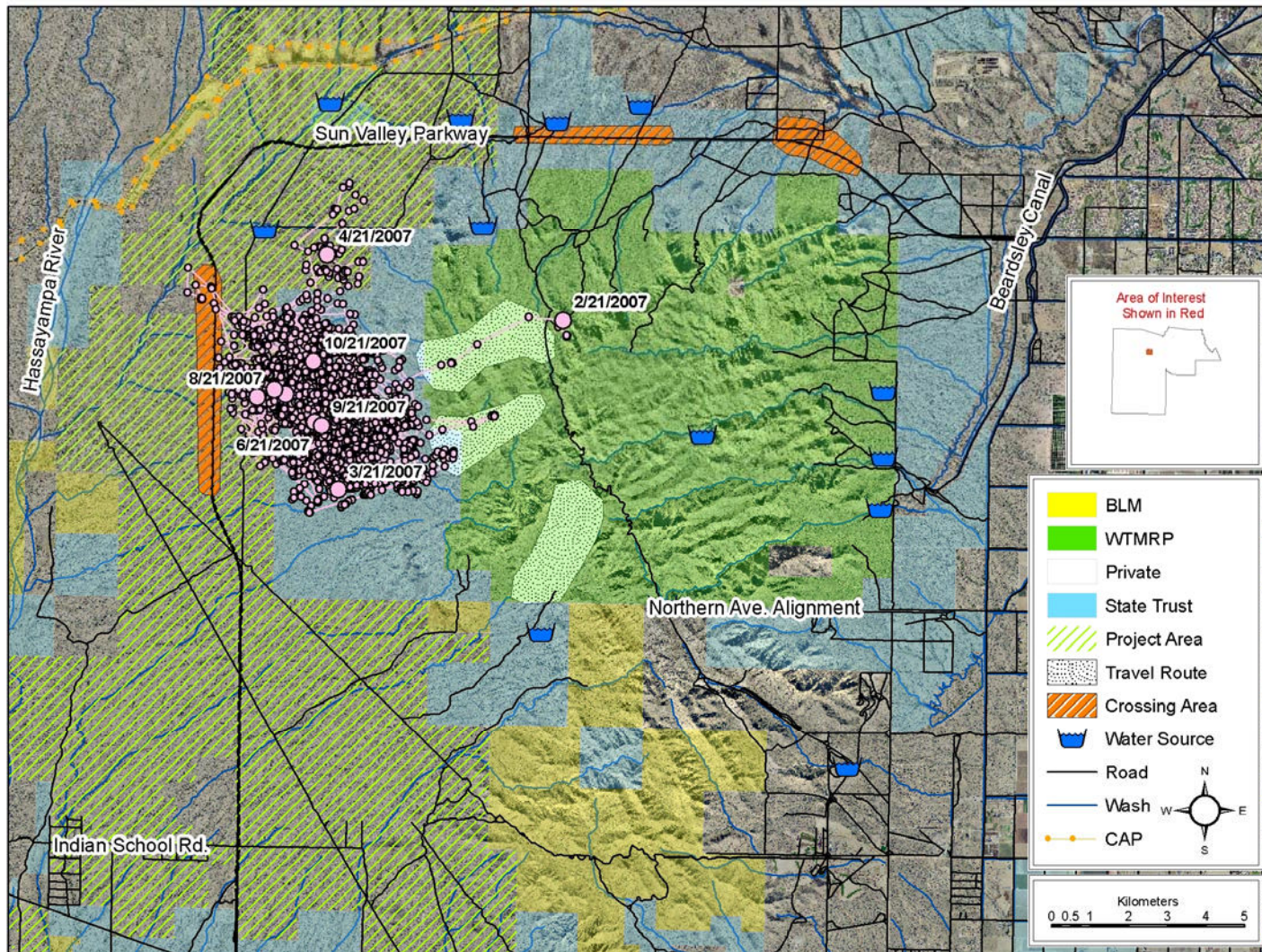
Mule deer 104 movements in the White Tank Mountains and surrounding area between 20 February and 8 August 2007.



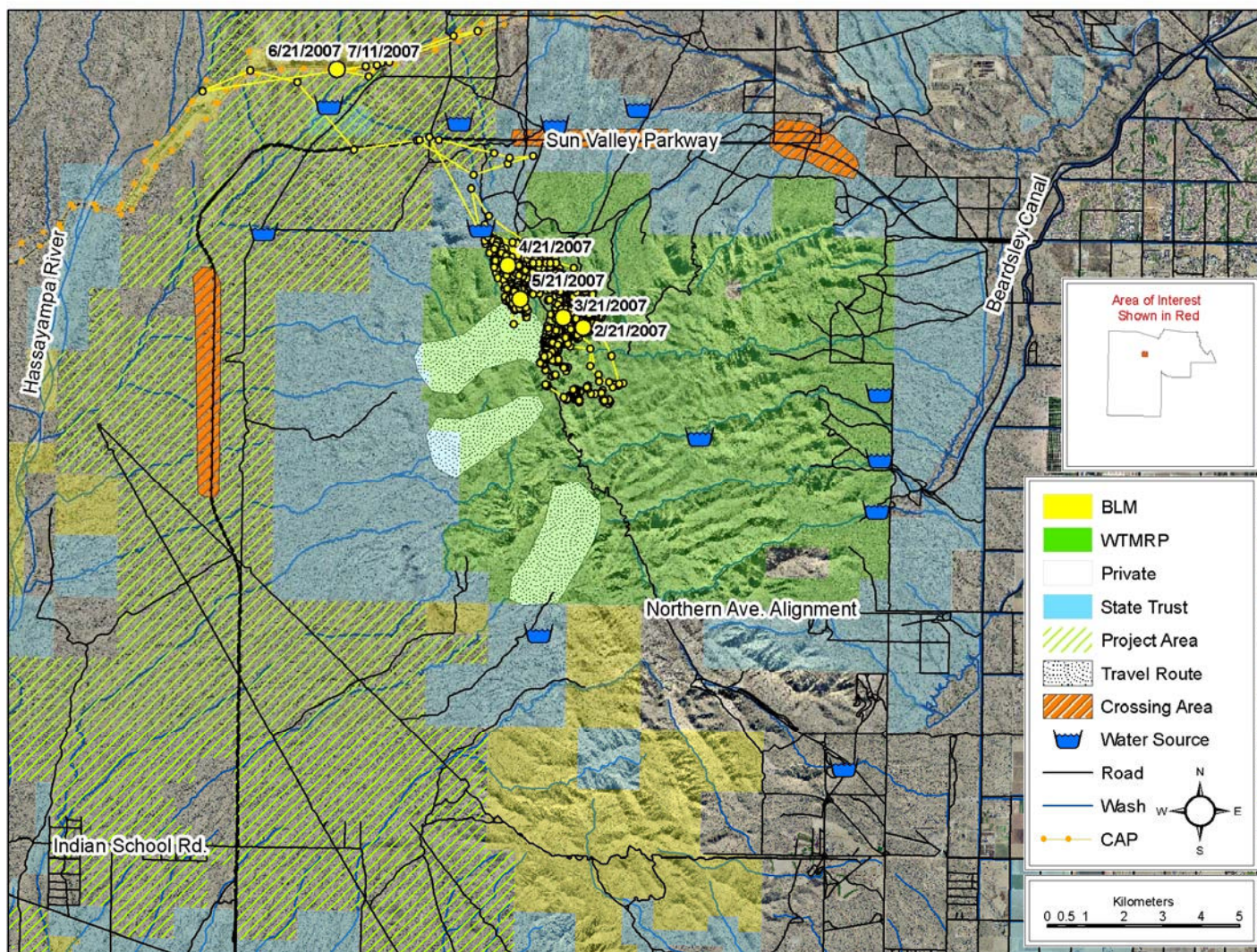
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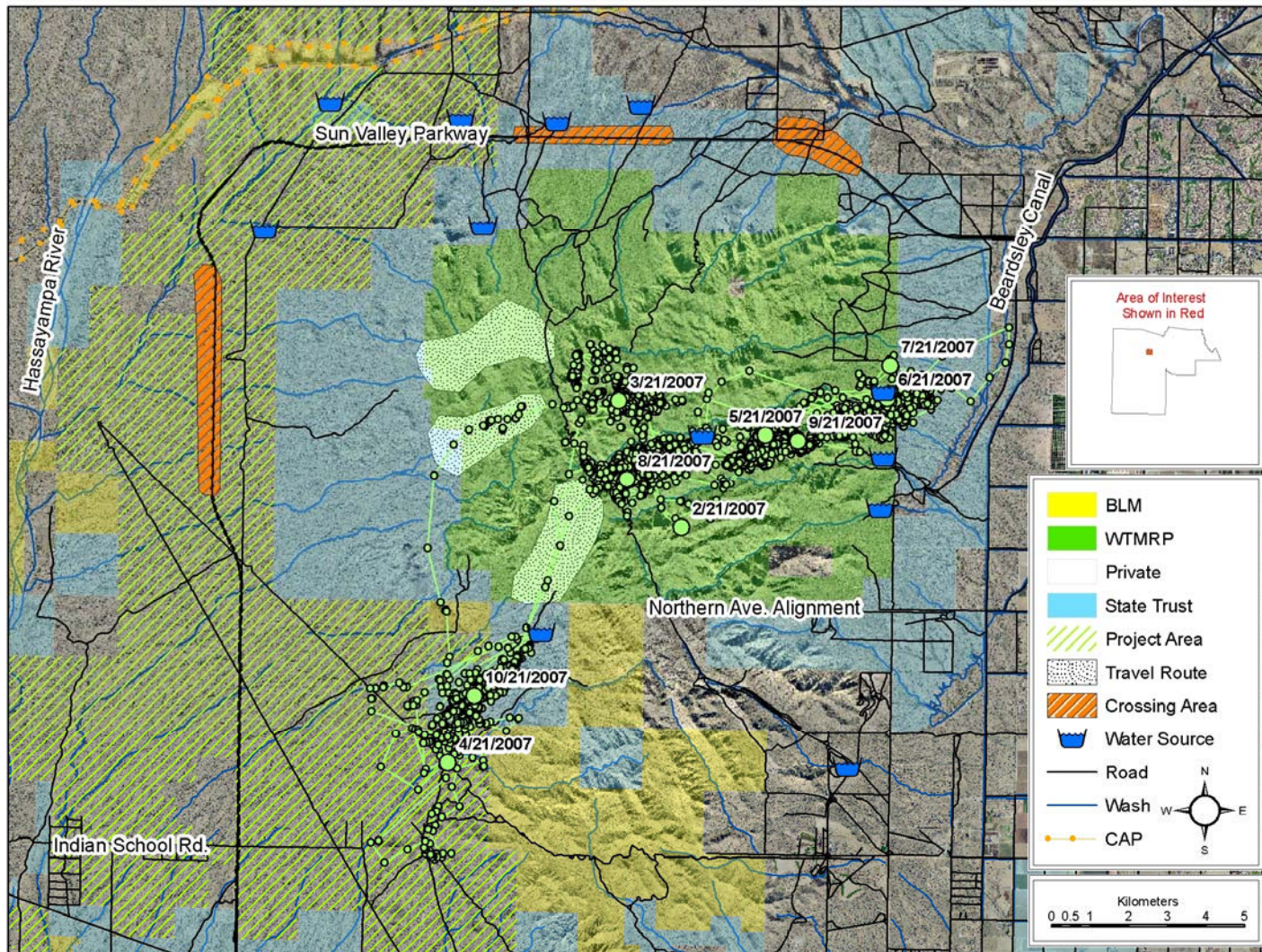
Mule deer 106 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



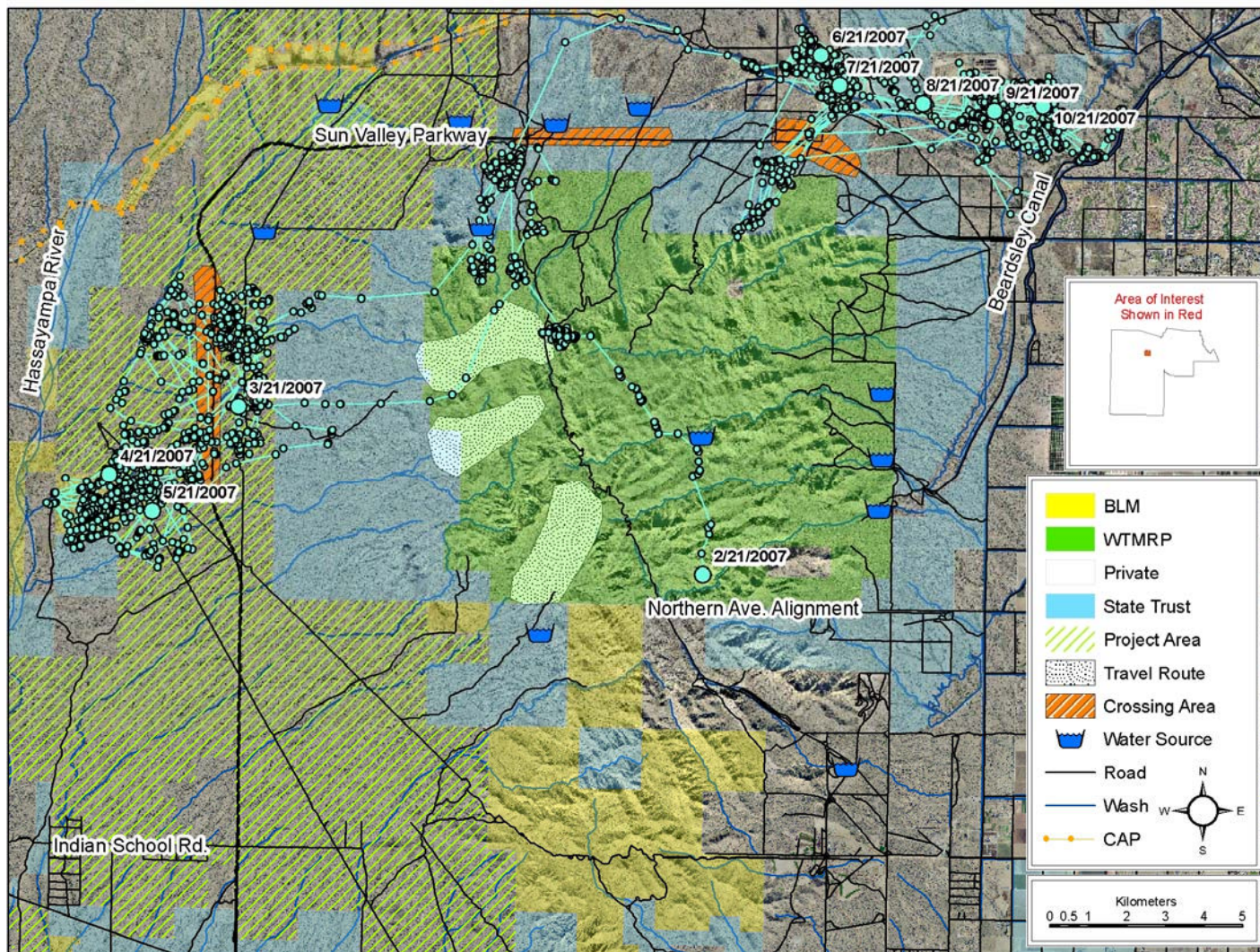
Mule deer 107 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



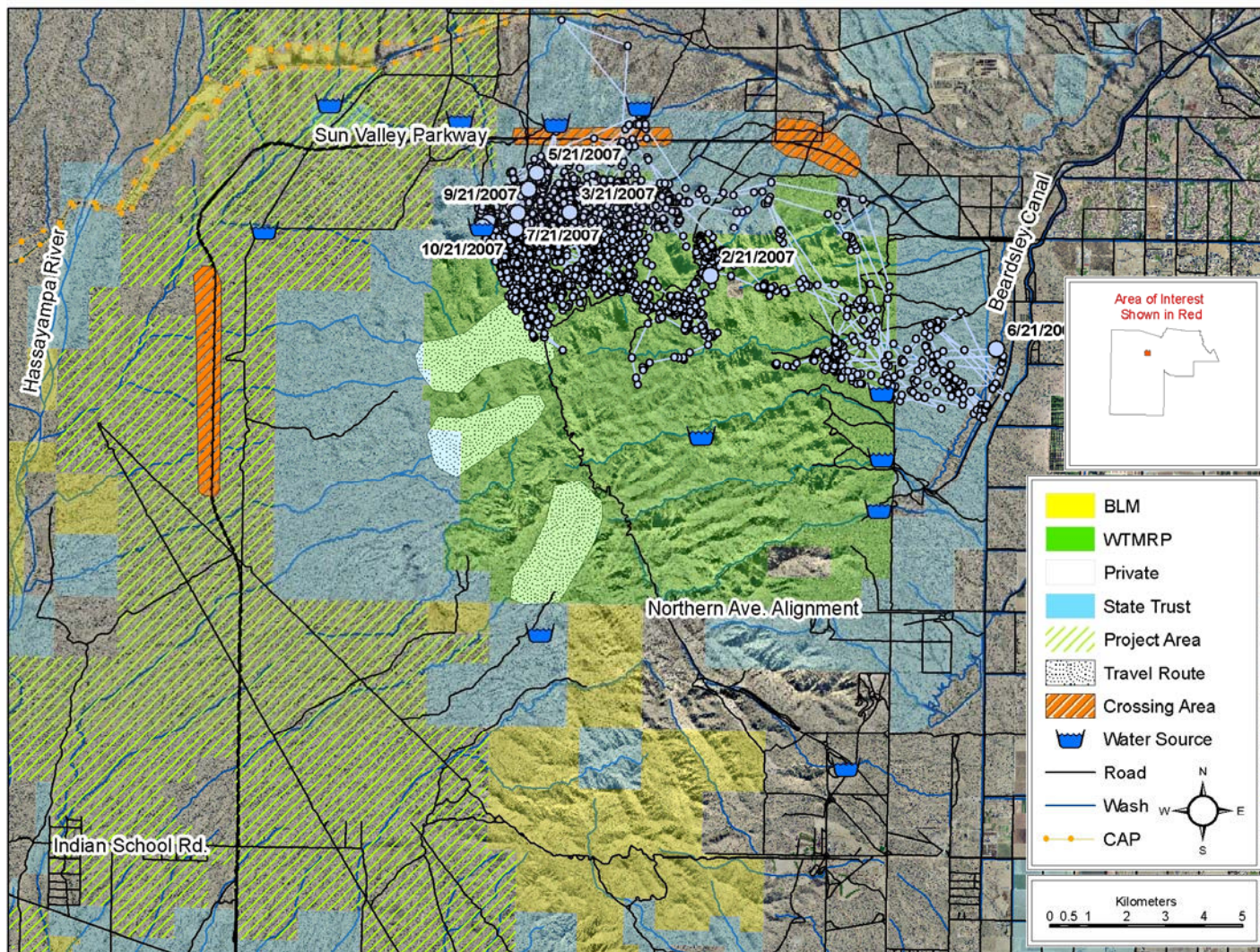
Mule deer 108 movements in the White Tank Mountains and surrounding area between 20 February and 20 June 2007.



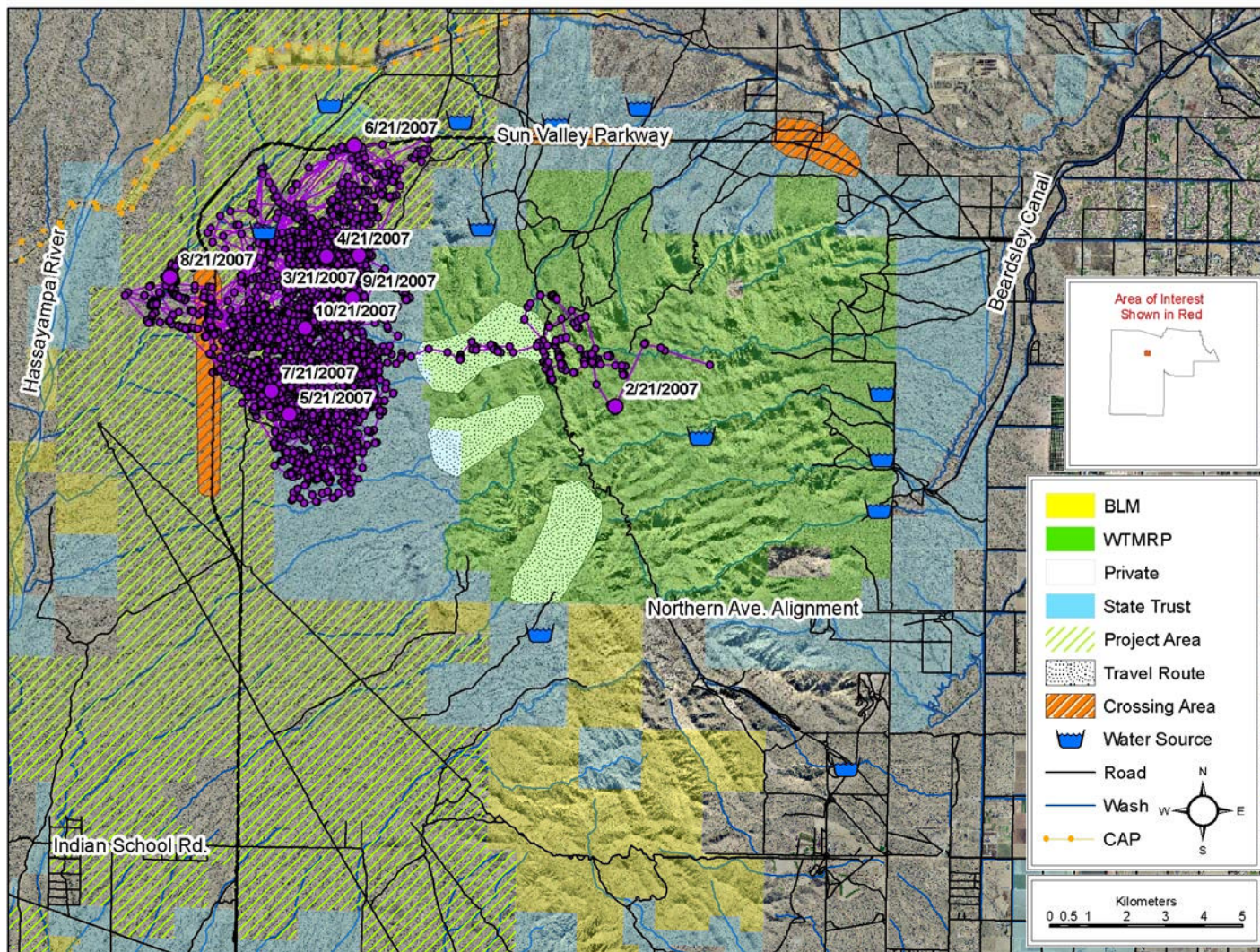
Mule deer 109 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



Mule deer 110 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



Mule deer 111 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.



Mule deer 112 movements in the White Tank Mountains and surrounding area between 20 February and 31 October 2007.