United States Department of Agriculture

DRAFT Environmental Impact Statement
Resolution Copper Project and Land Exchange

Volume 3

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Front Cover photo captions:
Top: Oak Flat Federal Parcel;
Bottom Left: Oak Flat Federal Parcel;
Bottom Right: Headframe of Shaft 10 at East Plant Site

Back Cover photo captions:
Top left: Shaft 9 and 10 at East Plant Site;
Top center: MARRCO corridor;
Top right: Picket Post mountain;
Bottom left: Oak Flat Federal Parcel ;
Bottom right: Overlooking West Plant Site, Town of Superior and Picket Post mountain

TABLE OF CONTENTS

VOLUME 3

Appendix A Section 3003 of the NDAA

Appendix B Existing Conditions of Offered Lands

Appendix C Draft Practicability Analysis in Support of Clean Water Act 404(B)(1) Alternatives Analysis

Appendix D Draft Resolution Copper Project Clean Water Act Section 404 Conceptual Compensatory Mitigation Plan

Appendix E Alternatives Impact Summary

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APPENDIX A. SECTION 3003 OF THE NDAA

NDAA Section 3003

Sec. 3003 Southeast Arizona Land Exchange and Conservation.

(a) PURPOSE. – The purpose of this section is to authorize, direct, facilitate, and expedite the exchange of land between Resolution Copper and the United States.

(b) DEFINITIONS. – In this section:

(1) APACHE LEAP. – The term “Apache Leap” means the approximately 807 acres of land depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Apache Leap” and dated March 2011.

(2) FEDERAL LAND. – The term “Federal land” means the approximately 2,422 acres of land located in Pinal County, Arizona, depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Federal Parcel-Oak Flat” and dated March 2011.

(3) INDIAN TRIBE. – The term “Indian tribe” has the meaning given the term in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450b).

(4) NON-FEDERAL LAND. – The term “non-Federal land” means the parcels of land owned by Resolution Copper that are described in subsection (d)(1) and, if necessary to equalize the land exchange under subsection (c), subsection (c)(5)(B)(i)(I).

(5) OAK FLAT CAMPGROUND. – The term “Oak Flat Campground” means the approximately 50 acres of land comprising approximately 16 developed campsites depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-0ak Flat Campground” and dated March 2011.

(6) OAK FLAT WITHDRAWAL AREA. – The term “Oak Flat Withdrawal Area” means the approximately 760 acres of land depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-0ak Flat Withdrawal Area” and dated March 2011.

(7) RESOLUTION COPPER. – The term “Resolution Copper” means Resolution Copper Mining, LLC, a Delaware limited liability company, including any successor, assign, affiliate, member, or joint venturer of Resolution Copper Mining, LLC.

(8) SECRETARY. – The term “Secretary” means Secretary of Agriculture.

(9) STATE. – The term “State” means the State of Arizona.

(10) TOWN. – The term “Town” means the incorporated town of Superior, Arizona.

(11) RESOLUTION MINE PLAN OF OPERATIONS. – The term “Resolution mine plan of operations” means the mine plan of operations submitted to the Secretary by Resolution Copper in November, 2013, including any amendments or supplements.

(c) LAND EXCHANGE. –

(1) IN GENERAL. – Subject to the provisions of this section, if Resolution Copper offers to convey to the United States all right, title, and interest of Resolution Copper in and to the non-Federal land, the Secretary is authorized and directed to convey to Resolution Copper, all right, title, and interest of the United States in and to the Federal land.

(2) CONDITIONS ON ACCEPTANCE. – Title to any non-Federal land conveyed by Resolution Copper to the United States under this section shall be in a form that-

A. is acceptable to the Secretary, for land to be administered by the Forest Service and the Secretary of the Interior, for land to be administered by the Bureau of Land Management; and

B. conforms to the title approval standards of the Attorney General of the United States applicable to land acquisitions by the Federal Government.

(3) CONSULTATION WITH INDIAN TRIBES. –

A. IN GENERAL. – The Secretary shall engage government-to-government consultation with affected Indian Tribes concerning issues of concern to the affected Indian tribes related to the land exchange.

B. IMPLEMENTATION. – Following the consultations under paragraph (A), the Secretary shall consult with Resolution Copper and seek to find mutually acceptable measures to-

i. address the concerns of the affect Indian tribes; and

ii. minimize adverse effects on the affected Indian tribes resulting from mining and related activities on the Federal land conveyed to Resolution Copper under this section.

(4) APPRAISALS. –

A. IN GENERAL. – As soon as practicable after the date of enactment of this Act, the Secretary and Resolution Copper shall select an appraiser to conduct appraisals of the Federal land and non-Federal land in compliance with the requirements of section 254.9 of title 36, Code of Federal Regulations.

B. REQUIREMENTS. –

i. IN GENERAL. – Except as provided in clause (ii), an appraisal prepared under this paragraph shall be conducted in accordance with national recognized appraisal standards, including –

I. the Uniform Appraisals Standards for Federal Land Acquisitions; and

II. the Uniform Standards of Professional Appraisal Practice.

ii. FINAL APPRAISED VALUE. – After the final appraised values of the Federal land and non-Federal land are determined and approved by the Secretary, Secretary shall not be required to reappraise or update the final appraised value –

I. for a period of 3 years beginning on the date of the approval by the Secretary of the final appraised value; or

II. at all, in accordance with section 254.14 of title 36, Code of Federal Regulations (or a successor regulation), after an exchange agreement is entered into by Resolution Copper and the Secretary.

iii. IMPROVEMENTS. – Any improvements made by Resolution Copper prior to entering an exchange agreement shall not be included in the appraised value of the Federal land.

iv. PUBLIC REVIEW. – Before consummating the land exchange under this section, the Secretary shall make the appraisals of the land to be exchange (or a summary thereof) available for public review.

C. APPRAISAL INFORMATON. – The appraisal prepared under this paragraph shall include a detailed income capitalization approach analysis of the market value of the Federal land which may be utilized, as appropriate, to determine the value of the Federal land, and shall be the basis for calculation of any payment under subsection (e).

(5) EQUAL VALUE LAND EXCHANGE. –

A. IN GENERAL. – The value of the Federal land and non-Federal land to be exchanged under this section shall be equal or shall be equalized in accordance with this paragraph.

B. SURPLUS OF FEDERAL LAND VALUE. –

i. IN GENERAL. – If the final appraised value of the Federal land exceeds the value of the non-Federal land, Resolution Copper shall –

I. convey additional non-Federal land in the State to the Secretary or the Secretary of the Interior, consistent with the requirements of this section and subject to the approval of the applicable Secretary;

II. make a cash payment to the United States; or

III. use a combination of the methods described in subclauses (I) and (II), as agreed to by Resolution Copper, the Secretary, and the Secretary of the Interior.

ii. AMOUNT OF PAYMENT. – The Secretary may accept a payment in excess of 25 percent of the total value of the land or interests conveyed, notwithstanding section 206(b) of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1716(b)).

iii. DISPOSITION AND USE OF PROCEEDS. – Any amounts received by the United States under this subparagraph shall be deposited in the fund established under Public Law 90-171 (commonly known as the “Sisk Act” 16 U.S.C. 484a) and shall be made available to the Secretary for the acquisition of land or interests in land in Region 3 of the Forest Service.

C. SURPLUS OF NON-FEDERAL LAND. – If the final appraised value of the non-Federal land exceeds the value of the Federal land –

i. the United States shall not make a payment to Resolution Copper to equalize the value; and

ii. except as provided in subsection (h), the surplus value of the non-Federal land shall be considered to be a donation by Resolution Copper to the United States.

(6) OAK FLAT WITHDRAWAL AREA. –

A. PERMITS. – Subject to the provisions of this paragraph and notwithstanding any withdrawal of the Oak Flat Withdrawal Area from the mining, mineral leasing, or public land laws, the Secretary, upon enactment of this Act, shall issue to Resolution Copper-

i. if so requested by Resolution Copper, within 30 days of such request, a special use permit to carry out mineral exploration activities under the Oak Flat Withdrawal Area from existing drill pads located outside the Area, if the activities would not disturb the surface of the Area; and

ii. if so requested by Resolution Copper, within 90 days of such request, a special use permit to carry out mineral exploration activities within the Oak Flat Withdrawal Area (but not within the Oak Flat Camp- ground), if the activities are conducted from a single exploratory drill pad which is located to reasonably minimize visual and noise impacts on the Campground.

B. CONDITIONS. – Any activities undertaken in accordance with this paragraph shall be subject to such reason- able terms and conditions as the Secretary may require.

C. TERMINATION. – The authorization for Resolution Copper to undertake mineral exploration activities under this paragraph shall remain in effect until the Oak Flat Withdrawal Area land is conveyed to Resolution Copper in accordance with this section.

(7) COSTS. – As a condition of the land exchange under this section, Resolution Copper shall agree to pay, without compensation, all costs that are –

A. associated with the land exchange and any environ- mental review document under paragraph (9); and

B. agreed to by the Secretary.

(8) USE OF FEDERAL LAND. – The Federal land to be conveyed to Resolution Copper under this section shall be available to Resolution Copper for mining and related activities subject to and in accordance with applicable Federal, State, and local laws pertaining to mining and related activities on land in private ownership.

(9) ENVIRONMENTAL COMPLIANCE. –

A. IN GENERAL. – Except as otherwise provided in this section, the Secretary shall carry out the land exchange in accordance with the requirements of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

B. ENVIRONMENTAL ANALYSIS. – Prior to conveying Federal land under this section, the Secretary shall prepare a single environmental impact statement under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.), which shall be used as the basis for all decisions under Federal law related to the proposed mine and the Resolution mine plan of operations and any related major Federal actions significantly affecting the quality of the human environment, including the granting of any permits, rights-of-way, or approvals for the construction of associated power, water, transportation, processing, tailings, waste disposal, or other ancillary facilities.

C. IMPACTS ON CULTURAL AND ARCHAEOLOGICAL RESOURCES. – The environmental impact statement prepared under subparagraph (b) shall –

i. assess the effects of the mining and related activities on the Federal land conveyed to Resolution Copper under this section on the cultural and archeological resources that may be located on the Federal land; and

ii. identify measures that may be taken, to the extent practicable, to minimize potential adverse impacts on those resources, if any.

D. EFFECT. – Nothing in this paragraph precludes the Secretary from using separate environmental review documents prepared in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) or other applicable laws for exploration or other activities not involving –

i. the land exchange; or

ii. the extraction of minerals in commercial quantities by Resolution Copper on or under the Federal land.

(10) TITLE TRANSER. – Not later than 60 days after the date of publication of the final environmental impact statement, the Secretary shall convey all right, title, and interest of the United States in and to the Federal land to Resolution Copper.

(d) CONVEYANCE AND MANAGEMENT OF NON-FEDERAL LAND. –

(1) CONVEYANCE. – On receipt of title to the Federal land, Resolution Copper shall simultaneously convey-

A. to the Secretary, all right, title, and interest that the Secretary determines to be acceptable in and to –

i. the approximately 147 acres of land located in Gila County, Arizona, depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Turkey Creek” and dated March 2011;

ii. the approximately 148 acres of land located in Yavapai County, Arizona, depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Tangle Creek” and dated March 2011;

iii. the approximately 149 acres of land located in Maricopa County, Arizona, depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Cave Creek” and dated March 2011;

iv. the approximately 640 acres of land located in Coconino County, Arizona, depicted on the map entitled “Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-East Clear Creek” and dated March 2011; and

v. the approximately 110 acres of land located in Pinal County, Arizona, depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Apache Leap South End" and dated March 2011; and

B. to the Secretary of Interior, all rights, title, and interest that the Secretary of Interior determines to be acceptable in and to –

i. the approximately 3,050 acres of land located in Pinal County, Arizona, identified as "Lands to DOI" as generally depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011- Non-Federal Parcel-Lower San Pedro River" and dated July 6, 2011;

ii. the approximately 160 acres of land located in Gila and Pinal Counties, Arizona, identified as "Lands to DOI" as generally depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Dripping Springs" and dated. July 6, 2011; and

iii. the approximately 940 acres of land located in Santa Cruz County Arizona identified as "Lands to DOI" as generally 'depicted' on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Non-Federal Parcel-Appleton Ranch" and dated July 6, 2011.

(2) MANAGEMENT OF ACQUIRED LAND. –

A. LAND ACQUIRED BY THE SECRETARY. –

i. IN GENERAL. – Land acquired by the Secretary under this section shall –

I. become part of the national forest in which the land is located; and

II. be administered in accordance with laws applicable to the National Forest System.

ii. BOUNDARY REVISION. – On the acquisition of land by the Secretary under this section, the boundaries of the national forest shall be modified to reflect the inclusion of the acquired land.

iii. LAND AND WATER CONSERVATION FUND.–For purposes of section 7 of the Land and Water Conservation Fund Act of 1965 (16 U.S.C. 4601-9), the boundaries of a national forest in which land acquired by the Secretary is located shall be deemed to be the boundaries of that forest as in existence on January 1, 1965.

B. LAND ACQUIRED BY THE SECRETARY OF INTERIOR. –

i. SAN PEDRO NATIONAL CONSERVATION AREA. –

I. IN GENERAL. – The land acquired by the Secretary of the Interior under paragraph (1)(B)(i) shall be added to, and administered as part of, the San Pedro National Conservation Area in accordance with the laws (including regulations) applicable to the Conservation Area.

II. MANAGEMENT PLAN. – Not later than 2 years after the date on which the land is acquired, the Secretary of the Interior shall update the management plan for the San Pedro National Conservation Area to reflect the management requirements of the acquired land.

ii. DRIPPING SPRINGS. – Land acquired by the Secretary of the Interior under paragraph (1)(B)(ii) shall be managed in accordance with the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.) and applicable land use plans.

iii. LAS CIENEGAS NATIONAL CONSERVATION AREA. – Land acquired by the Secretary of the Interior under paragraph (1)(B)(iii) shall be added to, and administered as part of, the Las Cienegas National Conservation Area in accordance with the laws (including regulations) applicable to the Conservation Area.

(e) VALUE ADJUSTMENT PAYMENT TO UNITED STATES. –

(1) ANNUAL PRODUCTION REPORTING. –

A. REPORT REQUIRED. – As a condition of the land exchange under this section, Resolution Copper shall submit to the Secretary of the Interior an annual report indicating the quantity of locatable minerals produced during the preceding calendar year in commercial quantities from the Federal land conveyed to Resolution Copper under subsection (c). The first report is required to be submitted not later than February 15 of the first calendar year beginning after the date of commencement of production of valuable locatable minerals in commercial quantities from such Federal land. The reports shall be submitted February 15 of each calendar year thereafter.

B. SHARING REPORTS WITH STATE. – The Secretary shall make each report received under subparagraph (A) available to the State.

C. REPORT CONTENTS. – The reports under subparagraph (A) shall comply with any recordkeeping and reporting requirements prescribed by the Secretary or required by applicable Federal laws in effect at the time of production.

(2) PAYMENT OF PRODUCTION. – If the cumulative production of valuable locatable minerals produced in commercial quantities from the Federal land conveyed to Resolution Copper under subsection (c) exceeds the quantity of production of locatable minerals from the Federal land used in the income capitalization approach analysis prepared under subsection (c)(4)(C), Resolution Copper shall pay to the United States, by not later than March 15 of each applicable calendar year, a value adjustment payment for the quantity of excess production at the same rate assumed for the income capitalization approach analysis prepared under subsection (c)(4)(C).

(3) STATE LAW UNAFFECTED. – Nothing in this subsection modifies, expands, diminishes, amends, or otherwise affects any State law relating to the imposition, application, timing, or collection of a State excise or severance tax.

(4) USE OF FUNDS. –

A. SEPARATE FUNDS. – All funds paid to the United States under this subsection shall be deposited in a special fund established in the 'treasury and shall be available, in such amounts as are provided in advance in appropriation Acts, to the Secretary and the Secretary of the Interior only for the purposes authorized by subparagraph (B).

B. AUTHORIZED USES. – Amounts in the special fund established pursuant to subparagraph (A) shall be used for maintenance, repair, and rehabilitation projects for Forest Service and Bureau of Land Management assets.

(f) WITHDRAWAL. – Subject to valid existing rights, Apache Leap and any land acquired by the United States under this section are withdrawn from all forms of –

(1) entry, appropriation, or disposal under the public land laws;

(2) location, entry, and patent under the mining laws;

(3) disposition under the mineral leasing, mineral materials, and geothermal leasing laws.

(g) APACHE LEAP SPECIAL MANAGEMENT AREA. –

(1) DESIGNATION. – To further the purpose of this section, the Secretary shall establish a special management area consisting of Apache Leap, which shall be known as the "Apache Leap Special Management Area" (referred to in this subsection as the "special management area").

(2) PURPOSE. – The purposes of the special management area are-

A. to preserve the natural character of Apache Leap;

B. to allow for traditional uses of the area by Native American people; and

C. to protect and conserve the cultural and archeological resources of the area.

(3) SURRENDER OF MINING AND EXTRACTION RIGHTS. – As a condition of the land exchange under subsection (c), Resolution Copper shall surrender to the United States, without compensation, all rights held under the mining laws and any other law to commercially extract minerals under Apache Leap.

(4) MANAGEMENT. –

A. IN GENERAL. – The Secretary shall manage the special management area in a manner that furthers the purposes described in paragraph (2).

B. AUTHORIZED ACTIVITIES. – The activities that are authorized in the special management area are –

i. installation of seismic monitoring equipment on the surface and subsurface to protect the resources located within the special management area;

ii. installation of fences, signs, or other measures necessary to protect the health and safety of the public; and

iii. operation of an underground tunnel and associated workings, as described in the Resolution mine plan of operations, subject to any terms and conditions the Secretary may reasonably require.

(5) PLAN. –

A. IN GENERAL. – Not later than 3 years after the date of enactment of this Act, the Secretary, in consultation with affected Indian tribes, the Town, Resolution Copper, and other interested members of the public, shall prepare a management plan for the Apache Leap Special Management Area.

B. CONSIDERATIONS. – In preparing the plan under subparagraph (A), the Secretary shall consider whether additional measures are necessary to –

i. protect the cultural, archaeological, or historical resources of Apache Leap, including permanent or seasonal closures of all or a portion of Apache Leap; and

ii. provide access for recreation.

(6) MINING ACTIVITIES. – The provisions of this subsection shall not impose additional restrictions on mining activities carried out by Resolution Copper adjacent to, or outside of, the Apache Leap area beyond those otherwise applicable to mining activities on privately owned land under Federal, State, and local laws, rules and regulations.

(h) CONVEYANCES TO TOWN OF SUPERIOR, ARIZONA. –

(1) CONVEYANCES. – On request from the Town and subject to the provisions of this subsection, the Secretary shall convey to the Town the following:

A. Approximately 30 acres of land as depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Federal Parcel-Fairview Cemetery" and dated March 2011.

B. The reversionary interest and any reserved mineral interest of the United States in the approximately 265 acres of land located in Pinal County, Arizona, as depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Federal Reversionary Interest-Superior Airport" and dated March 2011.

C. The approximately 250 acres of land located in Pinal County, Arizona, as depicted on the map entitled "Southeast Arizona Land Exchange and Conservation Act of 2011-Federal Parcel-Superior Airport Contiguous Parcels" and dated March 2011.

(2) PAYMENT. – The Town shall pay to the Secretary the market value for each parcel of land or interest in land acquired under this subsection, as determined by appraisals conducted in accordance with subsection (c)(4).

(3) SISK ACT. – Any payment received by the Secretary from the Town under this subsection shall be deposited in the fund established under Public Law 90-171 (commonly known as the "Sisk Act") (16 U.S.C. 484a) and shall be made available to the Secretary for the acquisition of land or interests in land in Region 3 of the Forest Service.

(4) TERMS AND CONDITIONS. – The conveyances under this subsection shall be subject to such terms and conditions as the Secretary may require.

(i) MISCELLANEOUS PROVISIONS. –

(1) REVOCATION OF ORDERS; WITHDRAWAL. –

A. REVOCATION OF ORDERS. – Any public land order that withdraws the Federal land from appropriation or disposal under a public land law shall be revoked to the extent necessary to permit disposal of the land.

B. WITHDRAWAL. – On the date of enactment of this Act, if the Federal land or any Federal interest in the non-Federal land to be exchanged under subsection (c) is not withdrawn or segregated from entry and appropriation under a public land law (including mining and mineral leasing laws and the Geothermal Steam Act of 1970 (30 U.S.C. 1001 et seq.)), the land or interest shall be withdrawn, without further action required by the Secretary concerned, from entry and appropriation. The withdrawal shall be terminated-

   i. on the date of consummation of the land exchange; or

   ii. if Resolution Copper notifies the Secretary in writing that it has elected to withdraw from the land exchange pursuant to section 206(d) of the Federal Land Policy and Management Act of 1976, as amended (43 U.S.C. 1716(d)).

C. RIGHTS OF RESOLUTION COPPER. – Nothing in this section shall interfere with, limit, or otherwise impair, the unpatented mining claims or rights currently held by Resolution Copper on the Federal land, nor in any way change, diminish, qualify, or otherwise impact Resolution Copper's right- and ability to conduct activities on the Federal land under such unpatented mining claims and the general mining laws of the United States, including the permitting or authorization of such activities.

(2) MAPS, ESTIMATES, AND DESCRIPTIONS. –

A. MINOR ERRORS. – The Secretary concerned and Resolution Copper may correct, by mutual agreement, any minor errors in any map, acreage estimate, or description of any land conveyed or exchanged under this section.

B. CONFLICT. – If there is a conflict between a map, an acreage estimate, or a description of land in this section, the map shall control unless the Secretary concerned and Resolution Copper mutually agree otherwise.

C. AVAILABILITY. – On the date of enactment of this Act, the Secretary shall file and make available for public inspection in the Office of the Supervisor, Tonto National Forest, each map referred to in this section.

(3) PUBLIC ACCESS IN AND AROUND OAK FLAT CAMPGROUND. – As a condition of conveyance of the Federal land, Resolution Copper shall agree to provide access to the surface of the Oak Flat Campground to members of the public, including Indian tribes, to the maximum extent practicable, consistent with health and safety requirements, until such time as the operation of the mine precludes continued public access for safety reasons, as determined by Resolution Copper.

APPENDIX B. EXISTING CONDITIONS OF OFFERED LANDS

Existing Conditions of Offered Lands

Overview of Land Exchange

Section 3003 of the Carl Levin and Howard P. ‘Buck’ McKeon National Defense Authorization Act for Fiscal Year 2015 (NDAA) directs the conveyance of approximately 2,422 acres of specified National Forest System (NFS) lands to Resolution Copper Mining, LLC (Resolution Copper) if Resolution Copper offers to convey approximately 5,374 acres of private lands to the United States, which Resolution Copper has done. Table B-1 provides a brief summary of the land exchange parcels. A detailed description of the land exchange can be found in section 2.2.1.1 of the draft environmental impact statement (DEIS). The complete Section 3003 of the NDAA is provided in appendix A of the DEIS.

Table B-1. Summary of land exchange parcels

Parcel Landownership	Description of Parcels to Be Exchanged
Parcels transferred from the United States to Resolution Copper	• 2,422 acres near Superior in Pinal County, Arizona, known as the **Oak Flat Federal Parcel**, to become private lands
Parcels transferred from Resolution Copper to the United States, to be included in the NFS	• 140 acres* near Superior in Pinal County, Arizona, known as the **Apache Leap South End Parcel**, to be administered by the Tonto National Forest • 148 acres in Yavapai County, Arizona, known as the **Tangle Creek Parcel**, to be administered by the Tonto National Forest • 147 acres in Gila County, Arizona, known as the **Turkey Creek Parcel**, to be administered by the Tonto National Forest • 149 acres near Cave Creek in Maricopa County, Arizona, known as the **Cave Creek Parcel**, to be administered by the Tonto National Forest • 640 acres north of Payson in Coconino County, Arizona, known as the **East Clear Creek Parcel**, to be administered by the Coconino National Forest
Parcels transferred from Resolution Copper to the U.S. Department of the Interior	• 3,050 acres near Mammoth in Pinal County, Arizona, known as the **Lower San Pedro River Parcel**, to be administered by the U.S. Department of the Interior Bureau of Land Management (BLM) as part of the San Pedro Riparian National Conservation Area • 940 acres south of Elgin in Santa Cruz County, Arizona, known as the **Appleton Ranch Parcel**, to be administered by the BLM as part of the Las Cienegas National Conservation Area • 160 acres near Kearny in Gila and Pinal Counties, Arizona, known as the **Dripping Springs Parcel**, to be administered by the BLM
If requested by the Town of Superior, Arizona, land would be transferred from the United States to the Town of Superior	• 30 acres associated with the Fairview Cemetery • 250 acres associated with parcels contiguous to the Superior Airport • 265 acres of Federal reversionary interest associated with the Superior Airport

* Using updated survey information provided by Resolution Copper, the U.S. Forest Service revised the Apache Leap South End Parcel from 110 acres (as presented in the NDAA) to 140 acres. Acreage of all other parcels is subject to revision upon completion of all survey work by the BLM.

Offered Lands – Forest Service

The offered lands include 5,374 acres of Resolution Copper private land on eight parcels located throughout Arizona. The parcels of offered lands would be transferred to the United States, for administration by either the U.S. Department of Agriculture Forest Service (Forest Service) or the U.S. Department of the Interior Bureau of Land Management (BLM).

Details of the private parcels that would be transferred to the United States with management by the Forest Service are in the following text. Additional details regarding the special status species present on the offered lands being transferred to the Tonto National Forest, Coconino National Forest, and BLM are summarized in tables B-2, B-3, and B-4, respectively, at the end of this appendix.

APACHE LEAP SOUTH END PARCELS

As noted later in this section, the Apache Leap South End Parcels would become part of the Apache Leap Special Management Area (SMA), administered by the Tonto National Forest, Globe Ranger District. The NDAA required completion of a management plan for the Apache Leap SMA. Preparation of the management plan was conducted through a separate National Environmental Policy Act (NEPA) process, which resulted in an environmental assessment (August 2017) and the final management plan (December 2017). Substantial information about the Apache Leap South End Parcels can be found in that environmental assessment (see “Key Documents Describing Apache Leap South End Parcels” later in this section). The Apache Leap management plan would exclude future grazing leases and limit construction and motorized vehicles to protect the natural character of the area.

Parcel Description

The Apache Leap South End Parcels consist of three parcels that total 140 acres, located near the eastern edge of the town of Superior in Pinal County, Arizona (figures B-1 and B-2). The Apache Leap South End Parcels are surrounded by NFS lands and would become part of the Apache Leap SMA, administered by the Tonto National Forest, Globe Ranger District. Upon completion of the land exchange, Resolution Copper would surrender all mining claims and interests to the parcels. Portions of the parcels are accessible by unimproved roads and trails from below Apache Leap via Ray Road/Apache Leap Road from Arizona State Route 177, or from above Apache Leap via NFS Road 315 via Magma Mine Road.

Figure B-1. Photograph of Apache Leap South parcels

The parcels include lands located above and below Apache Leap, an escarpment of sheer cliff faces, hoodoos, and buttresses that forms the scenic backdrop to the town of Superior. Current land uses on the parcels include livestock grazing and informal recreation such as hiking, rock climbing, nature viewing, and hunting. Additionally, there are multiple historical mining features and remnants of old mining-related roads located throughout the parcels, including small open cuts, shafts, tunnels, raises, crosscuts, and more extensive underground workings. The major underground mines in this area were principally known as the Grand Pacific and Belmont mines. Entrances to these mines are found on portions of the parcels and appear to date to the early 1900s, with evidence of having been explored historically for the presence of economic minerals. In a few instances, this exploration led to mineral development and exploitation.

Geological Setting

This area lies in a transitional zone on the northeastern edge of the Basin and Range physiographic province. The western edge of this area is generally very steep, with the cliffs of the Apache Leap escarpment rising abruptly above the town of Superior. There is roughly up to 1,970 feet of vertical displacement along the escarpment and Superior is in a down-dropped fault basin. The Tertiary-aged Apache Leap Tuff, the youngest consolidated formation in the area, forms the Apache Leap escarpment, and the underlying Paleozoic sedimentary rocks and Precambrian sedimentary rocks are exposed at the foot of the escarpment. Tertiary-aged Whitetail Conglomerate is present, with limited exposure at the toe of the slope on the western side of Apache Leap. A Quaternary alluvial deposit overlies the Apache Leap Tuff in a small area in the southwestern portion of the parcels.

Biological and Water Resources

Major biotic communities within the Apache Leap South Parcels include the Arizona Upland subdivision – Sonoran Desertscrub vegetation community in lower elevations and Interior Chaparral along the top of the Apache Leap escarpment (Brown 1994). Interior Chaparral species also occur on north-facing slopes in lower elevations west of the Apache Leap escarpment.

Vegetation found in the Arizona Upland subdivision typically consists of shrubs, cacti, and leguminous trees such as foothill paloverde, saguaro, and velvet mesquite. Additional species common to this area include goldenflower century plant, Mormon tea, fairyduster, barrel cactus, catclaw mimosa, jojoba, catclaw acacia, wolfberry, brittlebush, teddybear cholla, buckhorn cholla, cactus apple, Engelmann’s hedgehog, shrubby buckwheat, flattop buckwheat, Louisiana sagewort, desert marigold, Coues’ cassia, desert globemallow, and purple three-awn.

The Interior Chaparral vegetation type is characterized by dense stands of woody evergreens and shrubs. A common (diagnostic) species of Interior Chaparral in central Arizona is scrub live oak. In the Apache Leap SMA, this community is best represented by scrub live oak, pointleaf manzanita, red barberry, alderleaf mountain mahogany, deerbrush, and sugar sumac. Other common species include crucifixion thorn, hopbush, Wright’s silktassel, and broom snakeweed.

Three special status plant species have the potential to occur within the parcels: Arizona hedgehog cactus, Pima Indian mallow, and mapleleaf false snapdragon. All may occur but are not known to occur. There is suitable habitat for Arizona hedgehog cactus in the northern portion of the parcels, and the parcels are near known populations of the species. However, the species’ presence was not confirmed during site visits or during informal surveys specifically searching for the species by Forest Service biologists over the past several years.

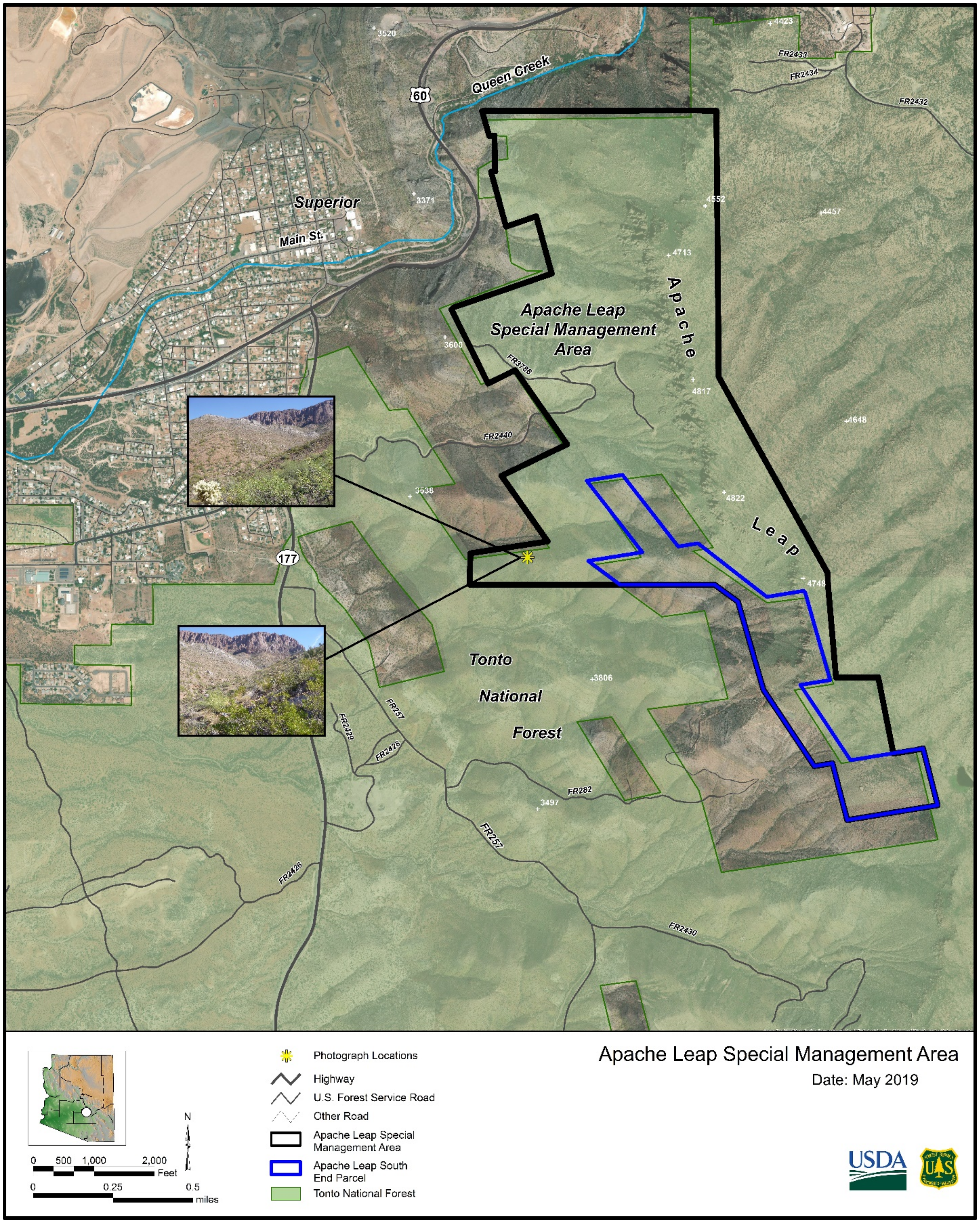

Figure B-2. Apache Leap Special Management Area and land exchange parcel

Drainages within the project area do not contain permanent surface water features and do not support riparian vegetation. Instead, the drainages generally contain greater densities of the same species that are present in the adjacent uplands. Additionally, no known springs occur within the Apache Leap South End Parcels.

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in August 2015, and identified no recognized environmental conditions (RECs) on the property. Historic-era mine features were noted during the work, but while there is potential for the historic mine features to impact groundwater or produce acid mine drainage, no discoloration or distressed vegetation was noted around the existing features. In addition, potential for impacts on surface or groundwater by contact with mineralized rock is not considered likely. Most adits are closed for human safety while allowing continued bat use.

Cultural Resources

The parcels are generally characterized as undeveloped open space with no evidence of human occupation. A Class III cultural resources inventory was performed in 2016 and found three archaeological sites, two of which were new discoveries. Of these, one site was considered eligible for the National Register of Historic Places (NRHP). Additionally, numerous cultural resources inventories have identified sites representing Prehistoric, Protohistoric, and Historic Native American occupations and activities spanning several thousand years in the areas surrounding the parcels. Historic Euro-American activities have also been identified, including ranching, transportation, and utilities in combination with mining operations; these date to the late nineteenth century through the middle twentieth century.

Key Documents Describing Apache Leap South End Parcels

- SWCA Environmental Consultants. 2017. “Apache Leap Special Management Area Management Plan: Heritage Resources Report.” August 1, 2017 (Tremblay 2017)
- SWCA Environmental Consultants. 2017. “Apache Leap Special Management Area Wildlife and Vegetation Specialist Report.” August 1, 2017 (Dugan 2017)
- SWCA Environmental Consultants. 2017. “Apache Leap Special Management Area Biological Evaluation.” August 1, 2017 (Campbell and Dugan 2017)
- U.S. Forest Service. 2014. Tonto National Forest’s Nomination of *Chi'chil Biłdagoteel*, commonly known as Oak Flat and Apache Leap, to the National Register of Historic Places as an Apache Traditional Cultural Property. October 31, 2014 (Nez 2014)
- U.S. Forest Service. 2017. “Apache Leap Special Management Area Management Plan: Environmental Assessment and Finding of No Significant Impact.” August 1, 2017 (U.S. Forest Service 2017a)
- U.S. Forest Service. 2017. “Apache Leap Special Management Area: Management Plan.” December 1, 2017 (U.S. Forest Service 2017c)
- U.S. Forest Service. 2017. “Apache Leap Special Management Area Management Plan: Errata to Final Environmental Assessment.” December 1, 2017 (U.S. Forest Service 2017b)
- WestLand Resources Inc. 2015. “Phase I Environmental Site Assessment Apache Leap South End [Phase I Environmental Assessment Non-Federal Parcel Apache Leap South End Gila County, Arizona].” August 13, 2015 (WestLand Resources Inc. 2015b)

- WestLand Resources Inc. 2016. "A Cultural Resources Inventory of 106 Acres Along the South End of Apache Leap for Resolution Copper Mining, LLC, Pinal County, Arizona." June 23, 2016 (Daughtrey 2016)

TANGLE CREEK PARCEL

Parcel Description

Located in Yavapai County, Arizona, approximately 35 miles north of the towns of Cave Creek and Carefree, the Tangle Creek Parcel is a 148-acre private inholding within the Tonto National Forest (figures B-3 and B-4). The parcel would be administered by the Tonto National Forest, Cave Creek Ranger District. The Tangle Creek parcel lies within the Central Highlands physiographic province, a transition zone between the Basin and Range and the Colorado River provinces.

Figure B-3. Photograph of Tangle Creek parcel

The Tangle Creek Parcel is located near the center of a broad valley known as Bloody Basin, a rugged and scenic basin in central Arizona with abundant hiking, camping, and hunting opportunities. The parcel lies adjacent to Seven Springs Recreation Area, Cave Creek Campground and Trailhead, and Civilian Conservation Corps Campground, with known recreational uses that include fishing, boating, swimming, nature viewing, outdoor learning, and picnicking; however, no boating, fishing, or swimming occur on the Tangle Creek Parcel. The parcel was homesteaded in the 1890s by the Babbitt family and used for livestock grazing and farming through the 1990s. Developed features within the parcel are limited; the only remaining associated improvements include an overgrown dirt road, remnants of a concrete dam/revetment structure, water pipelines, a small concrete foundation, water troughs, and wells. The historically cultivated farm fields are in the process of reverting to open woodlands and thickets of hackberry, mesquite, and catclaw acacia. Resolution Copper does not use the parcel for any specific purpose. Several unimproved roads provide public access to the area and are likely used for recreational, grazing, and agricultural purposes. The parcel is within a grazing allotment that includes surrounding lands in all directions. The parcel also contains a power line transmission corridor. No active mining claims exist within the parcel.

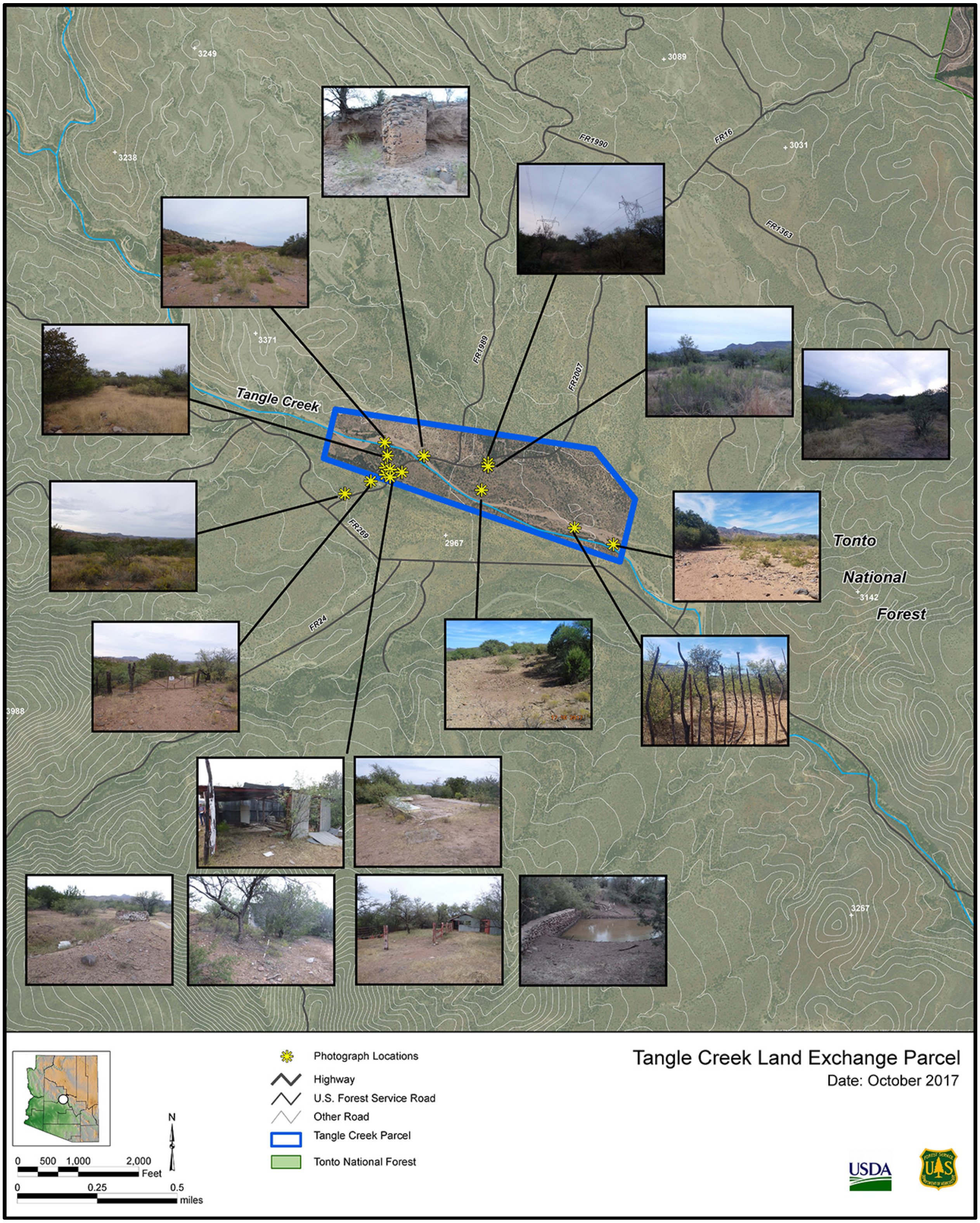

Figure B-4. Tangle Creek land exchange parcel

The parcel can be accessed from the west via Bloody Basin Road (NFS Road 269) from Interstate 17 or by traveling north from Carefree along Cave Creek Road (NFS Road 24).

Geological Setting

This parcel is located along Tangle Creek in Bloody Basin, which is in the Central Highlands physiographic province, a transitional zone between the Basin and Range and the Colorado Plateau. The Bloody Basin area is a graben, bounded to the west by Cooks Mesa and to the east by the Mazatzal Mountains. It is mapped as Tertiary-aged deposits.

Biological and Water Resources

Upland vegetation of the parcel is mapped as Great Basin Conifer Woodland; however, vegetation characteristic of the Arizona Upland Subdivision of the Sonoran Desertscrub, the Semi-Desert Grassland, and Sonoran Deciduous Riparian Forest biotic communities were also observed during field reconnaissance. Common plant species include one-seed juniper, oats grama, saguaro, sycamores, ash, and desert willow.

Features of the Tangle Creek Parcel include Tangle Creek, a spatially intermittent to perennial stream that bisects the parcel and acts as a substantial tributary to the Verde River (located approximately 10 miles downstream) and associated riparian habitat, as well as mature netleaf hackberry, mesquite, ash, and sycamore trees, which provide habitat for migratory birds and nesting songbirds. No aquatic biology surveys have been conducted. One spring, LX Spring, exists outside the parcel and water from this spring was conveyed to the parcel by pipeline. The water right for LX Spring water use at the Tangle Creek parcel is no longer active.

No critical habitats exist within the parcel. The 2004 ecological overview identified three special status species (under the Endangered Species Act [ESA]) with some potential to occur within the property: Arizona agave (endangered), Arizona cliffrose (endangered), and bald eagle (now delisted, but still protected under the Bald and Golden Eagle Protection Act [BGEPA]). More recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a Tonto National Forest sensitive species):

- ESA: western yellow-billed cuckoo (threatened); southwestern willow fly-catcher (endangered); Gila chub (endangered); spikedace (endangered)
- BGEPA: golden eagle
- Tonto National Forest sensitive species: lowland leopard frog; peregrine falcon; desert sucker; headwater chub; roundtail chub; pale Townsend’s big-eared bat; spotted bat; Allen’s lappet-browed or big-eared bat; western red bat; Sonoran desert tortoise; Parker’s cylloepus riffle beetle

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in October 2016, and identified no RECs on the property. A prior Phase 1 environmental site assessment in 2004 had identified numerous potential environmental conditions associated with a building, but it was subsequently determined that the building was not on the parcel itself. In 2016, the only item noted was a drum that did not appear to contain more than traces of fluid and was not observed to be leaking. Resolution Copper undertook a substantial cleanup of the Tangle Creek parcel in 2018 to remove trash and other materials.

Cultural Resources

A Class III cultural resources inventory was performed in 2016, recording 10 previously undiscovered archaeological sites, of which seven were recommended eligible for inclusion in the NRHP. In addition, 22 archaeological sites had been previously discovered within the vicinity of the parcel, many of which are indicative of substantial Formative period occupation.

Key Documents Describing Tangle Creek Parcel

- WestLand Resources Inc. 2004. “Ecological Overview LX Bar Ranch Parcel, Yavapai County Arizona.” March 8, 2004 (WestLand Resources Inc. 2004d)
- WestLand Resources Inc. 2016. “A Cultural Resources Inventory of the 148-Acre Tangle Creek Parcel, Yavapai County, Arizona: Resolution Copper.” September 28, 2016 (Charest 2016b)
- WestLand Resources Inc. 2016. “Phase I Environmental Assessment Non-Federal Parcel, Tangle Creek (LX Bar Ranch) Yavapai County, Arizona, Resolution Copper.” October 1, 2016 (WestLand Resources Inc. 2016c)

TURKEY CREEK PARCEL

Parcel Description

The Turkey Creek Parcel is a 147-acre parcel located approximately 8 miles southeast of the community of Pleasant Valley in Gila County, Arizona (figures B-5 and B-6). Also known as JX Ranch, the Turkey Creek Parcel is a private inholding within the Tonto National Forest and would be administered by the Tonto National Forest, Pleasant Valley Ranger District. It is located within the streambed and adjacent upland areas along Turkey Creek and Rock Creek in the Sierra Ancha Mountains within the Central Highlands physiographic province, a transitional zone between the Basin and Range and the Colorado Plateau provinces.

The parcel was formerly homesteaded in the 1880s and associated with Elmer D. Boody. Development includes a series of buildings and property improvements such as a house, barn, kitchen, storehouse, tool house, shop, well, and cultivated area. The parcel also includes remains of a trail, a small apple orchard, and a scattering of historical artifacts. A dry-laid masonry well that appears to have been filled in almost entirely by sediment or possibly trash was observed on the former homestead location. The Boody homestead would eventually become known as JX Ranch. Under Resolution Copper ownership, the parcel is not used for any purpose; however, there is evidence of dispersed recreation including hunting, nature viewing, hiking, picnicking, camping, and off-highway vehicle use. Overall, the parcel is characterized as mainly vacant open space that appears to have been used in the past for historical homesteading and grazing. Currently there are no active mining claims within the parcel.

The parcel can be accessed by going east and north approximately 22 miles from State Route 188 along multiple NFS Roads (71, 609, 416, and 2768).

Figure B-5. Photograph of Turkey Creek parcel

Geological Setting

This parcel is located in the Sierra Ancha Mountains, which are in the Central Highlands physiographic province, a transitional zone between the Basin and Range and the Colorado Plateau. The parcel has middle Tertiary-aged conglomerate on the canyon's upper slopes, Precambrian-aged (middle Proterozoic) Dripping Springs Quartzite exposed in cliff faces adjacent to the stream bed, and Quaternary alluvium within the valley floor along Turkey Creek and Rock Creek.

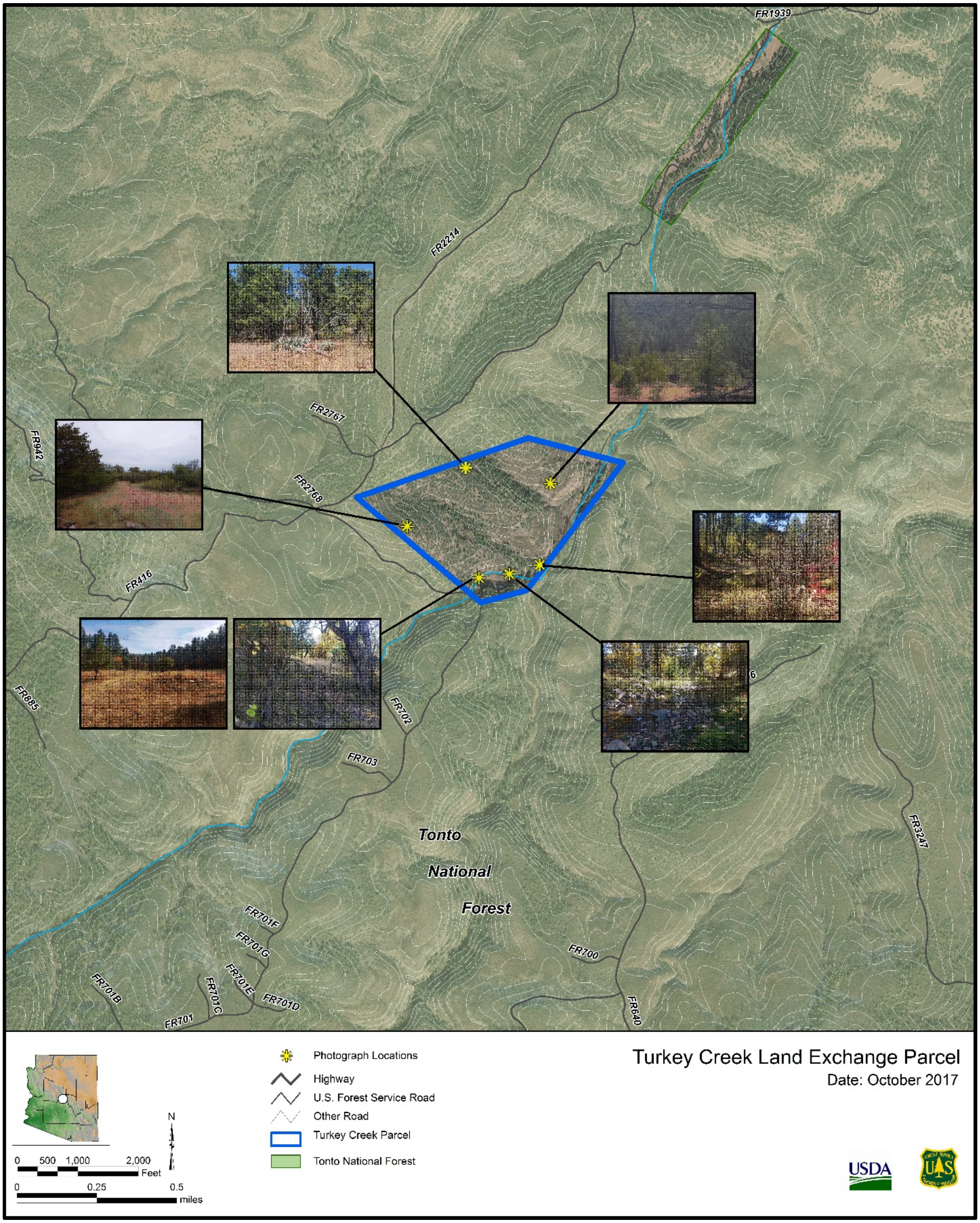

Figure B-6. Turkey Creek land exchange parcel

Biological and Water Resources

Four biotic communities were observed during field reconnaissance: Petran Montane Conifer Forest, Madrean Evergreen Woodland, Interior Chaparral, and Great Basin Conifer Woodland; however, the upland vegetation on the parcel is only mapped as Great Basin Conifer Woodland biotic community. Common plants include ponderosa pine on north-facing slopes and alligator juniper, manzanita, and grasses on south-facing slopes. Riparian vegetation such as narrowleaf cottonwood, New Mexico locust, Arizona sycamore, and Gambel oak are present along Turkey Creek. Approximately one-third of the vegetation within the parcel was impacted by fires in the early 2000s, with some areas burning intensely, resulting in losses of entire stands of juniper, ponderosa pine, and manzanita. Natural vegetation is reestablishing, however. Within the parcel there is habitat for elk, mule deer, and native fish.

Additionally, the parcel is within Forest Service lands that contain Mexican spotted owl critical habitat, as well as two Mexican spotted owl protected activity centers. The 2004 ecological overview identified three special status species with some potential to occur within the property: Arizona agave (endangered), Chiricahua leopard frog (threatened), and bald eagle (now delisted, but still protected under the BGEPA). More recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a Tonto National Forest sensitive species):

- ESA: western yellow-billed cuckoo (threatened); southwestern willow fly-catcher (endangered); Chiricahua leopard frog (threatened); Mexican spotted owl (threatened); Gila chub (endangered); spikedace (endangered); northern Mexican gartersnake (threatened); narrow-headed gartersnake (threatened)
- BGEPA: golden eagle
- Tonto National Forest sensitive species: lowland leopard frog; peregrine falcon; northern goshawk; Sonora sucker; desert sucker; headwater chub; roundtail chub; pale Townsend’s big-eared bat; spotted bat; Allen’s lappet-browed or big-eared bat; western red bat

Turkey Creek is the dominant drainage feature in the parcel and has intermittent to perennial flow. Surface water features comprise ephemeral channels that are tributary to Turkey Creek in the Salt River’s watershed.

Wildfires in the area in 2018 may have affected the property and surrounding lands.

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in October 2016, and identified no RECs on the property.

Cultural Resources

A Class III cultural resources inventory of the parcel was performed in 2016 and found six previously undiscovered archaeological sites, with five of the sites recommended eligible for inclusion in the NRHP. Sites were dated to the Late Formative period (over a range of 1,000 years) and the Late Historic period.

Key Documents Describing Turkey Creek Parcel

- WestLand Resources Inc. 2004. “Ecological Overview JX Ranch Parcel, Gila County, Arizona.” March 31, 2004 (WestLand Resources Inc. 2004c)

- WestLand Resources Inc. 2016. “A Cultural Resources Inventory of the 146.78-Acre Turkey Creek Parcel, Gila County, Arizona: Resolution Copper.” September 28, 2016 (Charest 2016b)
- WestLand Resources Inc. 2016. “Phase I Environmental Site Assessment Non-Federal Parcel, Turkey Creek (JX Bar Ranch) Gila County, Arizona.” October 1, 2016 (WestLand Resources Inc. 2016f)

CAVE CREEK PARCEL

Parcel Description

The Cave Creek Parcel is a 149-acre parcel located approximately 7 miles north of Cave Creek in Maricopa County, Arizona, known also as 6L Ranch (figures B-7 and B-8). The Cave Creek Parcel is a private inholding surrounded by Tonto National Forest lands. Upon completion of the land exchange, the parcel would be administered by the Tonto National Forest, Cave Creek Ranger District. The parcel lies along the canyon floor and adjacent upland areas of Cave Creek in the Central Highlands physiographic province.

Figure B-7. Photograph of Cave Creek parcel

The Cave Creek parcel is located north of the Spur Cross Ranch Conservation Area, used for dispersed recreation activities such as hunting, camping, nature viewing, and hiking. The parcel was initially settled in the 1880s and used as a residence until the 1920s. Livestock grazing occurred on the parcel through 2001. Several ranching features were observed through field reconnaissance and include development such as a concrete watering trough, pipes, a steel cistern, a well, a collapsed dry-laid masonry outbuilding with tin roof, a wooden cattle chute, and a corral area. The parcel is largely devoid of development, and there is no evidence of recent human occupation within the parcel. The Cave Creek parcel can be accessed via Cave Creek Road and Spur Cross road to Forest Trail 4, on which a 40-minute walk on foot is required to reach the parcel. Drivable access is limited at the Maricopa County Spur Cross Ranch Conservation Fence. No active mining claims exist within the parcel.

Geological Setting

This parcel is located along Cave Creek, which drains the southern portion of the New River Mountains, a rugged range defining the eastern portion of the Agua Fria River valley. Notable peaks around this parcel are Skull Mesa to the east, Sugarloaf Mountain to the southwest, and Black Mesa to the west and north. The parcel lies in the Central Highlands physiographic province. The New River Mountains comprise Quaternary- and Tertiary-aged basalt-covered tablelands cut by streams through Precambrian-aged metavolcanic rocks. Most of the parcel is mapped as volcanic and sedimentary rock dated from the middle Miocene to Oligocene. Small portions of the northern and southern ends of the parcel are mapped as Early Proterozoic Metavolcanic rocks.

Biological and Water Resources

Three biotic communities have been observed within the parcel: Interior Chaparral, Arizona Upland Subdivision of Sonoran Desertscrub, and Deciduous Riparian Forest along Cave Creek. Common plant species include saguaro, foothill paloverde, ironwood, barberry, buckbrush, Arizona sycamore, velvet ash, and Goodding's willow. Wildlife habitat for migratory songbirds, raptors, amphibians, javelina, mule deer, and coyotes has been identified within the parcel. No aquatic species surveys have been conducted within the parcel.

The 2004 ecological overview identified three special status species with some potential to occur within the property: bald eagle (now delisted, but still protected under the BGEPA), Gila topminnow (endangered), and cactus ferruginous pygmy owl (now delisted).

More recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a Tonto National Forest sensitive species):

- ESA: western yellow-billed cuckoo (threatened); southwestern willow fly-catcher (endangered); lesser long-nosed bat (since delisted)
- BGEPA: golden eagle
- Tonto National Forest sensitive species: lowland leopard frog; peregrine falcon; pale Townsend's big-eared bat; spotted bat; Allen's lappet-browed or big-eared bat; western red bat; Sonoran desert tortoise; Parker's cylloepus riffle beetle

Surface water features include Cave Creek, which originally flowed south toward the Salt River in Phoenix; however, the flow is now intercepted by the Cave Creek Dam in the northern Phoenix metropolitan area and the canal system in Phoenix, which diverts the stream to discharge to the Agua Fria River. The Cave Creek riparian corridor runs through the center of the parcel and drains the southern portion of the New River Mountains. It is ephemeral to intermittent with some perennial reaches in the vicinity of the parcel.

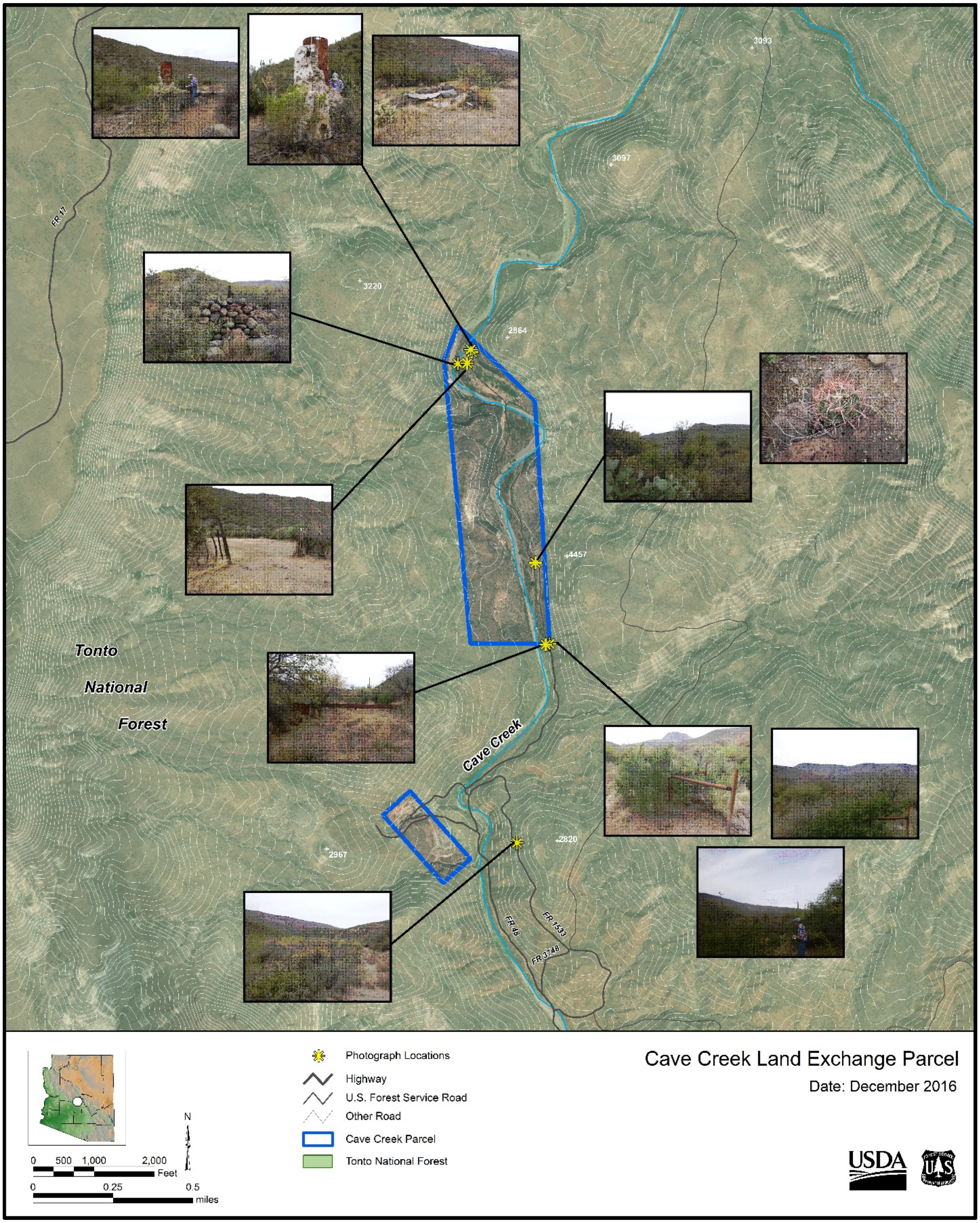

Figure B-8. Cave Creek land exchange parcel

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in September 2016, and identified no RECs on the property.

Cultural Resources

Prehistorically, the parcel and area were extensively used and occupied by indigenous cultures. A Class III cultural resource inventory was performed in 2016, and identified six archaeological sites including four that were previously undiscovered. All six sites were recommended for inclusion in the NRHP. The sites date to the Late Archaic and Early to Middle, Middle, and Late Formative periods, as well as the Late Historic period, and include prehistoric petroglyphs. Additionally, stone structures, grinding areas, and more petroglyphs have been found in areas surrounding the parcel.

Key Documents Describing Cave Creek Parcel

- WestLand Resources Inc. 2004. “Ecological Overview: 6L Ranch Parcel, Yavapai County, Arizona.” July 19, 2004 (WestLand Resources Inc. 2004a)
- WestLand Resources Inc. 2016. “Phase I Environmental Site Assessment Non-Federal Parcel, Cave Creek (6L Ranch) Maricopa County, Arizona, Resolution Copper.” September 1, 2016 (WestLand Resources Inc. 2016e)
- WestLand Resources Inc. 2016. “A Cultural Resources Inventory of the 149.18-Acre Cave Creek Parcel, Maricopa County, Arizona: Resolution Copper.” September 28, 2016 (Charest and Francis 2016)

EAST CLEAR CREEK PARCEL

Parcel Description

The East Clear Creek Parcel is a 640-acre private inholding within the Coconino National Forest, located north of Payson in Coconino County, Arizona (figures B-9 and B-10). The parcel would be administered by the Mogollon Rim Ranger District. The East Clear Creek Parcel is located along the canyon floor and adjacent upland areas of East Clear Creek in the Colorado Plateau physiographic province, a transitional zone between the upper plateau and riparian ecosystems on the Mogollon Rim.

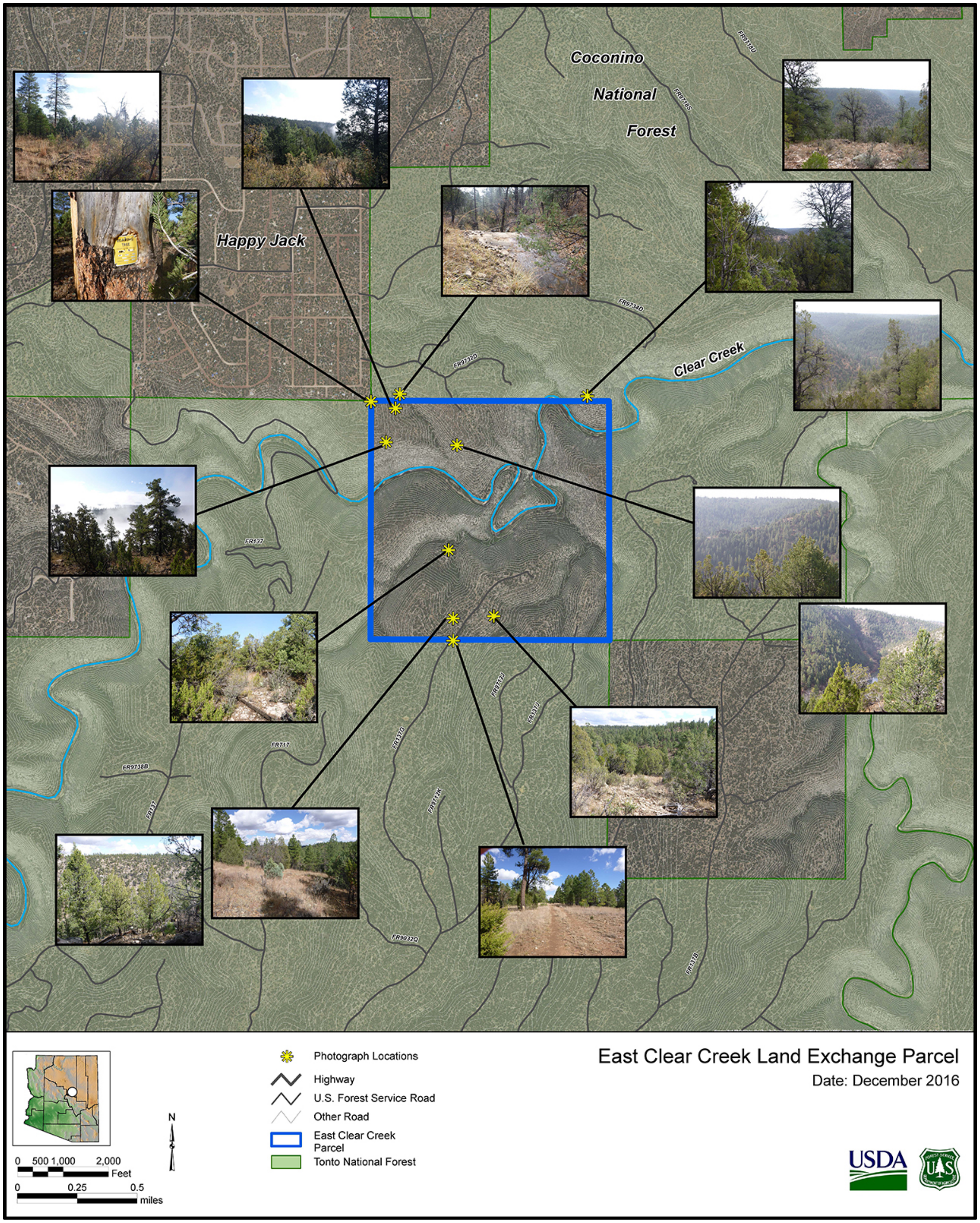

Figure B-9. East Clear Creek land exchange parcel

The only known current and historical uses of the area are recreation and logging. Designated pack trails are present on Forest Service land south and east of the parcel. Hiking, fishing, nature viewing, hunting, and camping are available on the public lands surrounding the parcel. The parcel is surrounded by the T Bar grazing allotment; however, Resolution Copper does not manage this grazing lease. BLM records show a Record of Patent for the parcel to the Santa Fe Pacific Railroad Company for the purpose of constructing a railroad and telegraph line from Missouri and Arkansas to the Pacific Coast; however, there is no evidence within the parcel or adjoining areas that the railroad was ever developed. Logging has historically been conducted in the vicinity of the parcel, with the most recent timber sale occurring in the late 1980s. There is a stock tank near the southern boundary of the parcel, suggesting livestock grazing as a potential historical land use, although not within at least the last 10 years. There is no recent development on the parcel. Dirt roads are the only developed, formal use. No active mining claims exist within the parcel.

Figure B-10. Photograph of East Clear Creek parcel

The parcel can be accessed from the south via State Route 87 and traveling approximately 12 miles to the east and north. There is no designated access into the property from the north, but it is adjacent to the Starlight Pines subdivision.

Geological Setting

This parcel is located in the canyon floor and adjacent uplands along East Clear Creek. The East Clear Creek parcel is in the Colorado Plateau physiographic province, which is bounded on the south by the Mogollon Rim and is characterized by nearly horizontal, stratified sedimentary rocks that have been eroded into numerous canyons, plateaus, and scarps. The canyon walls are steep adjacent to East Clear Creek and upland areas are rugged. The entire parcel is mapped as Permian-aged sedimentary rocks.

Biological and Water Resources

The upland vegetation on the East Clear Creek parcel has one recorded biotic community: Petran Montane Conifer Forest, although field reconnaissance also observed Interior Riparian Deciduous Forest and Great Basin Conifer Woodland biotic communities. The upland vegetation is dominated by second-growth ponderosa pine with Gambel oak and New Mexico locust on north-facing slopes, while south-facing slopes are generally scrub live oak woodland with juniper and pinyon pine. Riparian habitat includes species such as boxelder, cottonwood, Arizona alder, and Bonpland willow. Riparian wildlife habitat and raptor nesting and roosting sites are present within the parcel.

The 2017 ecological overview and more recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a Coconino National Forest sensitive species):

- ESA: Little Colorado spinedace (threatened); Mexican spotted owl (threatened); Chiricahua leopard frog (threatened)
- BGEPA: bald eagle; golden eagle
- Coconino National Forest sensitive species: peregrine falcon; Little Colorado sucker; northern goshawk; rock fleabane; roundtail chub; Arizona toad

The dominant surface water feature on the parcel is East Clear Creek, a substantial perennial tributary of the Little Colorado River located approximately 71 river miles downstream (northeast) of the parcel. Analytical results from water quality sampling in 1976 suggest that all chemical constituents in East Clear Creek are within acceptable water quality standards for the support of cold-water fisheries habitat. More recent data from the U.S. Environmental Protection Agency suggest that water quality in East Clear Creek is fully supportive of agricultural use; fish, shellfish, and wildlife protection and propagation; and primary-contact recreation. Other surface water features include minor tributaries that are likely ephemeral to intermittent. Active registered instream flow surface water rights in the Little Colorado watershed sourced from East Clear Creek exist in the parcel as well. In 1993, preliminary analysis was conducted to document a 25-mile portion of East Clear Creek as being eligible with a scenic designation under the Wild and Scenic Rivers Act (U.S. Forest Service 1993). The outstanding remarkable values of this segment include scenic resources and threatened and endangered fish species habitat. The East Clear Creek parcel is within the proposed eligible section. As of 2019, the segment has not been officially designated.

Wildfires in the area in 2018 may have affected the property and surrounding lands.

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in September 2016, and identified no RECs on the property.

Cultural Resources

A Class III cultural resources inventory performed in 2016 identified three newly recorded archaeological sites, all of which were recommended for inclusion in the NRHP. These archaeological sites point to use by Native Americans and Late Historic period Euro-American uses. In addition, one historical feature was identified just outside the boundary of the parcel.

Key Documents Describing East Clear Creek Parcel

- WestLand Resources Inc. 2016. "Phase I Environmental Assessment Non-Federal Parcel, East Clear Creek, Coconino County, Arizona, Resolution Copper." September 1, 2016 (WestLand Resources Inc. 2016b)
- WestLand Resources Inc. 2016. "A Cultural Resources Inventory of the 633.88-Acre East Clear Creek Parcel, Coconino County, Arizona." September 28, 2016 (Charest 2016c)
- WestLand Resources Inc. 2017. "Ecological Overview for East Clear Creek Parcel, Coconino County, Arizona, Resolution Copper." January 24, 2017 (WestLand Resources Inc. 2017b)

Offered Parcels – Bureau of Land Management

Parcels to be transferred from Resolution Copper to the United States and administered by the BLM are detailed in the following text. Additional details regarding the special status species present on the offered lands being transferred to the BLM are summarized in table B-4 at the end of this appendix.

LOWER SAN PEDRO RIVER PARCEL

Parcel Description

The Lower San Pedro River Parcel is an approximately 3,050-acre parcel located near Mammoth in Pinal County, Arizona (figures B-11 and B-12). It lies within the Basin and Range physiographic province, characterized by mountain ranges trending northwest-southeast, separated by broad alluvial valleys.
The parcel is located within one of these valleys, with the Galiuro Mountains to the east and the Santa Catalina Mountains to the south. In November 1988, Congress designated 40 miles and 58,000 acres of the upper San Pedro corridor as the San Pedro Riparian National Conservation Area. The parcel would be administered by the BLM Gila District, Tucson Field Office. The parcel is patented private land for which Swift Land and Cattle, LLC, a subsidiary of Resolution Copper, holds active mining claims.

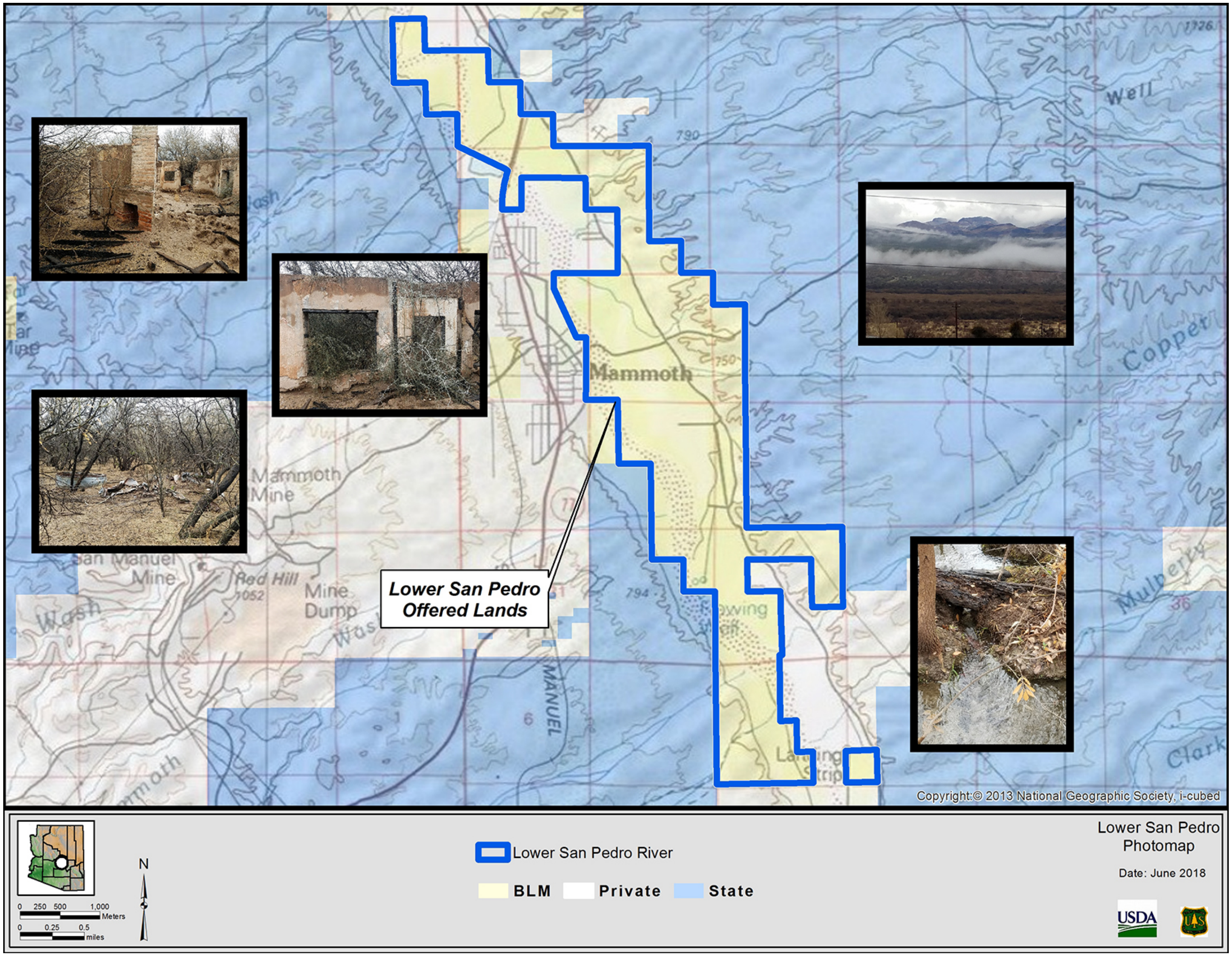

Figure B-11. Lower San Pedro River land exchange parcel

Figure B-12. Photograph of Lower San Pedro River parcel

The Lower San Pedro River Parcel is mostly undeveloped, and the parcel is surrounded by undeveloped land. The developed areas have been primarily used, either currently or historically, for grazing, other agricultural, former residential, or research uses, as seen from abandoned structures, corrals, and farm fields. Approximately 15 percent of the parcel has been cleared of native vegetation. Other known uses of the Lower San Pedro River Parcel are primarily recreational: off-road vehicle use, hunting, and a town park which includes baseball and picnicking facilities. A 1.2-mile-long trail for public access is located within the parcel south of Copper Creek Road. Transfer of the Lower San Pedro River Parcel would render the area unavailable for future housing development.

Portions of the parcel were cultivated from at least 1945 until at least the 1950s when lead and arsenate pesticides and defoliants were historically used on certain crops in Arizona, leading to the possible presence of pesticide residuals in the formerly cultivated soils within the parcel. The parcel is currently managed as an open space by The Nature Conservancy on behalf of Resolution Copper. An on-site storage unit is used for the property manager’s gear.

Geological Setting

This parcel is located within the Basin and Range physiographic province, which is characterized by elongated mountain ranges trending northwest-southeast, separated by broad alluvial valleys. The parcel is in a broad alluvial valley with the Galiuro Mountains to the east and the Santa Catalina Mountains to the south. Most of the surface geology of the parcel is Holocene-aged river alluvium. An upland area in the eastern portion of the parcel is mapped as deposits from the Pliocene to Middle Miocene, and the extreme southwestern corner of the parcel is mapped as Quaternary-aged surficial deposits.

Biological and Water Resources

Vegetation on the Lower San Pedro River Parcel includes the Arizona Uplands Subdivision of Sonoran Desertscrub and Sonoran Deciduous Riparian Forest biotic communities. Plant species commonly occurring within the parcel include saguaro, velvet mesquite, creosote bush, several species of cholla cacti, and foothill paloverde. The riparian corridor in the parcel includes more than 800 acres of mesquite woodland that features a wetland fed by a flowing thermal artesian well. The parcel's riparian areas and woodlands provide habitat for a wide variety of wildlife, including many migratory bird species, lowland leopard frogs, and native fish. Other riparian species present include desert willow, Goodding's willow, graythorn, Fremont cottonwood, and the non-native tamarisk.

The 2003 ecological overview identified three special status species with some potential to occur within the property: cactus ferruginous pygmy owl (now delisted); southwestern willow fly-catcher (endangered); and western yellow-billed cuckoo (threatened). More recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a BLM sensitive species):

- ESA: Gila chub (endangered); jaguar (endangered); ocelot (endangered)
- BGEPA: bald eagle; golden eagle
- BLM Gila District sensitive species with known or potential occurrence: peregrine falcon; lowland leopard frog; Arizona grasshopper sparrow; ferruginous hawk; gilded flicker; desert purple martin; Gila longfin dace; desert sucker; Sonora sucker; roundtail chub; monarch butterfly; pale Townsend's big-eared bat; greater western mastiff bat; Allen's lappet-browed or big-eared bat; lesser long-nosed bat; California leaf-nosed bat; cave myotis; Sonoran desert tortoise; desert ornate box turtle

Several large washes exist on the parcel, including Cooper, Mammoth, and Turtle Washes, all tributary to the San Pedro River. The San Pedro River is ephemeral to intermittent along the approximately 53,800-foot reach through the parcel; an uncapped artesian well supports a wetland adjacent to the river channel. The San Pedro River is unique as it is one of only two major rivers that flow north out of Mexico into the United States and is one of the few remaining free-flowing rivers in the Southwest. The unique qualities of the San Pedro River ecosystem have earned this riverine system The Nature Conservancy's designation as one of the "Last Great Places on Earth" and it is one of the more important riparian habitats in the Sonoran and Chihuahuan Deserts.

The parcel contains registered wells that indicate that water levels are generally shallow, at less than 60 feet below the ground surface. Two wells on-site that are monitored by The Nature Conservancy of Arizona indicate that groundwater levels are less than 35 feet below the ground surface. Active surface water rights exist for diverting water for wildlife use on the parcels.

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in November 2017, and identified several RECs on the property. These include two known fuel releases near the property boundaries (but not within the property), the Town of Mammoth wastewater treatment plant that has permits to discharge pollutants to both the aquifer and surface water upstream of the property, a nearby dry-cleaning operation, and informal dumping. In addition, the former cultivation of the land from at least 1945 until at least the 1950s was noted, as lead and arsenate (arsenic) pesticides and defoliants were historically used on certain crops in Arizona. It is unknown if routine agricultural application of pesticides has occurred on the property, therefore, it is possible that pesticide residuals (chlorinated pesticides, arsenic, and lead) may be present in the formerly cultivated soils on the property. RECS are not indications that contamination actually exists; these are typically noted so further investigation can take place.

Several cleanups have taken place on the property; additional cleanups are planned in conjunction with the BLM to identify the structures and features desired to remain after completion of the land exchange.

Cultural Resources

A Class III cultural resources inventory performed in 2017 identified 59 archaeological sites within the parcel; 37 of these sites had not been previously identified. Forty sites are recommended eligible for inclusion in the NRHP and one site has been determined eligible. The sites cover a wide range of Prehistoric and Historic periods.

Key Documents Describing Lower San Pedro River Parcel

- The Nature Conservancy. 2016. “7B Ranch Management Plan.” October 1, 2016 (Nature Conservancy 2016)
- Tucson Audubon Society. 2010. “Avian surveys conducted by Audubon Arizona IBA Program at 7B Ranch, Lower San Pedro River, Mammoth, Arizona, 2006–2010.” January 1, 2010 (Wilbor 2010)
- WestLand Resources Inc. 2003. “Ecological Overview: San Pedro River Parcel, Pinal County, Arizona.” September 10, 2003 (WestLand Resources Inc. 2003)
- WestLand Resources Inc. 2017. “A Cultural Resources Inventory of 3,125 Acres of Private Land Along the Lower San Pedro River Near Mammoth, Pinal County, Arizona, Resolution Copper.” April 11, 2017 (Gruner 2017)
- WestLand Resources Inc. 2017. “Phase I Environmental Site Assessment Non-Federal Parcel, Lower San Pedro River, Pinal County, Arizona, Resolution Copper.” November 1, 2017 (WestLand Resources Inc. 2017d)

APPLETON RANCH PARCEL

Parcel Description

The Appleton Ranch Parcel includes approximately 940 acres of non-contiguous private lands south of Elgin in Santa Cruz County, Arizona (figures B-13 and B-14). The parcels are within the Appleton-Whittell Research Ranch and Las Cienegas National Conservation Area. The parcels are to be administered by the BLM Gila District, Tucson Field Office, as part of the Las Cienegas National Conservation Area. The Las Cienegas National Conservation Area, established in 2000, is a 45,000-acre conservation area containing cottonwood-willow riparian forests and marshlands associated with Cienega Creek, rolling grasslands, and woodlands. Established in 1969 by the Appleton family in partnership with the National Audubon Society, Forest Service, and BLM, the Appleton-Whittell Research Ranch is a sanctuary for native plants and animals and a research facility for the study of grassland ecosystems. The ranch is currently managed by the National Audubon Society.

Figure B-13. Photograph of Appleton Ranch parcel

The Appleton Ranch Parcels are unpatented private land and have no active mining claims. Federal and State lands surrounding the area are used principally for livestock grazing as well as dispersed recreational activities including hunting, camping, off-road vehicle use, and hiking. Grazing operations were the primary use until 1969, when the property owner ceased ranching operations to enter into agreements with the BLM, Forest Service, and Audubon Society to use the Research Ranch to study grassland ecology. Although technically not part of the Research Ranch, management on the parcels has been essentially the same: no livestock grazing or other ranching operations, limited residential use, and low-impact ecological study.

Remaining structures within the parcel include a few windmills, wells, and numerous small earthen-bermed reservoirs. These features are accessible via primitive dirt roads from the Research Ranch primitive road network. Additionally, one area was used for residential purposes from the 1980s until 2002 when it was destroyed by a fire. The fire debris was disposed of off-site, leaving only the house foundation and septic system.

Geological Setting

These parcels are located along the streambeds and adjacent upland areas of Post, Vaughn, and O’Donnell Canyons. The upland areas drained by the three on-site streams are known as the Canelo Hills, rolling terrain that include the Appleton Ranch parcels. The Canelo Hills are in the southern Basin and Range physiographic province and are composed of volcanic and sedimentary rocks. A veneer of soil overlies the bedrock on the upland areas, and eroded material from these uplands has accumulated as alluvium in canyon bottoms. The easternmost parcel's surface geology is mapped as surficial deposits that are predominantly from the Early Pleistocene to Late Pliocene; the western portion is mapped as deposits dating from the Pliocene to Middle Miocene; and the southeastern corner is mapped as sedimentary rocks from the Middle Miocene to Oligocene. The other two parcels are mapped as deposits from the Pliocene to Middle Miocene.

Biological and Water Resources

The ranch contains more than 90 species of native grass and 480 native plant species and is used by more than 200 species of birds for wintering, breeding, or migratory habitat.

Biotic communities within the parcels include Semidesert Grassland and Madrean Evergreen Oak Woodland. Grasslands are much more extensive than are the oak woodlands. The grassland varies markedly in species composition, density, and structure in the northern part of the Appleton Ranch Parcel, with short-grass grasslands found on south-facing slopes, medium-sized grass stands in swales and north-facing ridges, and tall-grass stands of sacaton in the broader floodplains along several of the washes. Woody vegetation is present in some upland areas as juniper woodlands, and along watercourses as mesquite bosques with very limited stands of cottonwood and desert willow. Transfer of the parcels to public ownership would ensure seamless management of the surrounding ecological preserve and contribute to its continued protected status. Primary values of the surrounding Research Ranch that would become extended to Appleton Ranch through acquisition include the following: to provide a wildlife sanctuary that is ungrazed by cattle, conduct or promote ecological research, and to provide education about sustainable land management. Large mammals such as pronghorn, deer, peccaries, and coyotes are present within the parcel and pass through often.

The 2004 ecological overview identified 13 special status species with some potential to occur within the property: Huachuca water umbel (endangered); Canelo Hills ladies’ tresses (endangered); Gila chub (endangered); Gila topminnow (endangered); desert pupfish (endangered); Chiricahua leopard frog (threatened); Mexican spotted owl (threatened); bald eagle (since delisted but still protected under the BGEPA); western yellow-billed cuckoo (threatened); ocelot (endangered); jaguar (endangered); lesser long-nosed bat (since delisted); and Huachuca springsnail (candidate species, not listed). More recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a BLM sensitive species):

- ESA: northern Mexican gartersnake (threatened)
- BGEPA: bald eagle; golden eagle
- BLM Gila District sensitive species with known or potential occurrence: peregrine falcon; lowland leopard frog; Arizona grasshopper sparrow; ferruginous hawk; gilded flicker; Gila longfin dace; desert sucker; Sonora sucker; roundtail chub; monarch butterfly; pale Townsend’s big-eared bat; greater western mastiff bat; Allen’s lappet-browed or big-eared bat; lesser long-nosed bat; California leaf-nosed bat; cave myotis; Sonoran desert tortoise; desert ornate box turtle; western burrowing owl

The Appleton Ranch parcels are located along streambeds and adjacent upland areas of Post, Vaughn, and O’Donnell Canyons, all of which flow north-northeast toward the Babocomari River approximately 1.5 miles north of the closest parcel boundaries. The Babocomari River is an ephemeral to perennial tributary to the perennial San Pedro River, which flows north and northwest to join the Gila River, eventually flowing westward across Arizona to the Colorado River.

Groundwater levels on or near the property appear at relatively shallow depths (i.e., generally less than 100 feet below surface). Surface water rights exist for stock ponds and erosion-control structures on the Appleton Ranch parcels.

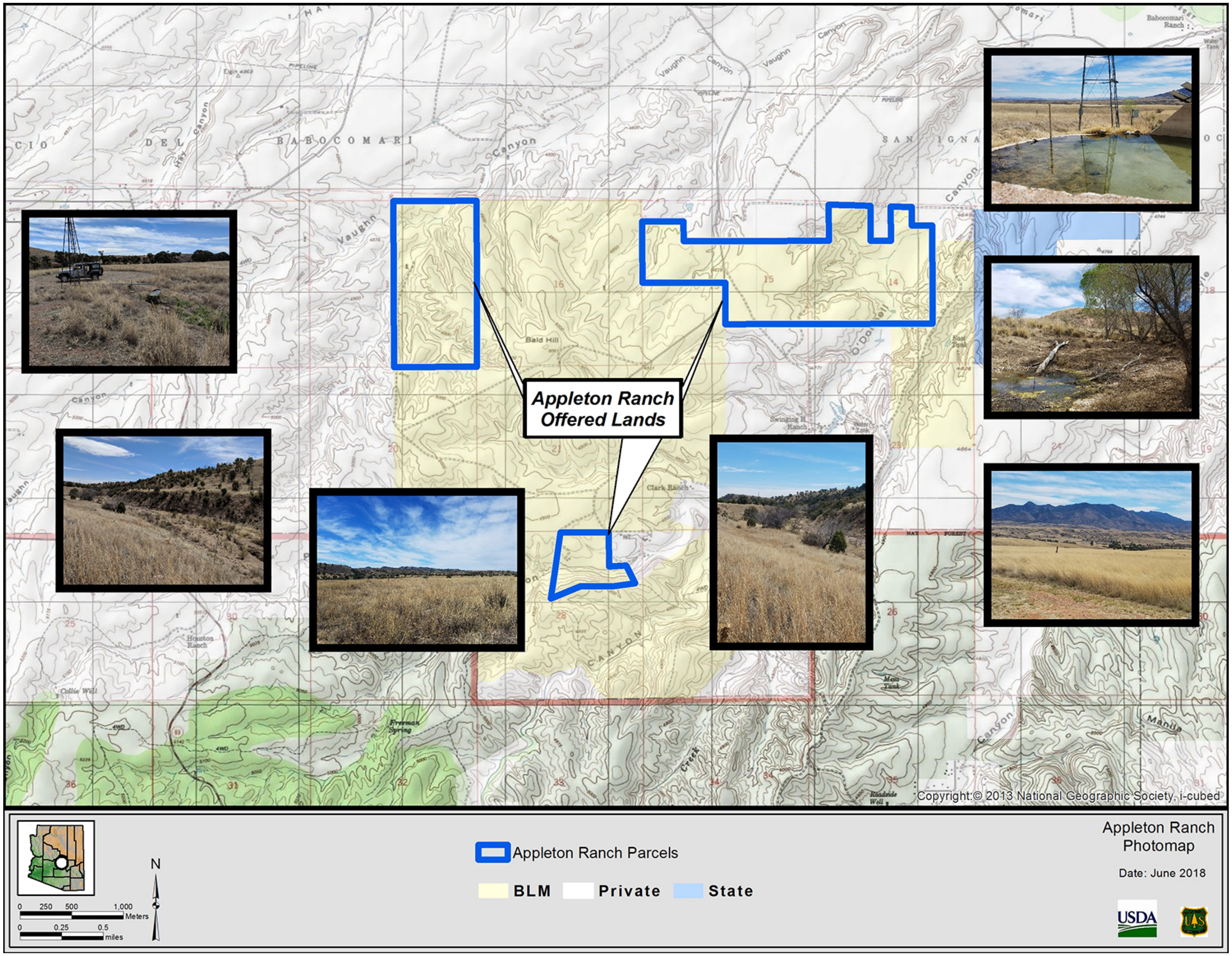

Figure B-14. Appleton Ranch land exchange parcels

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in September 2016, and identified no RECs on the property.

Cultural Resources

A Class III cultural resources inventory performed in 2015 identified three archaeological sites within the parcel, related to Native American resource procurement and processing activities and historic-era ranching. Two sites were recommended eligible for inclusion in the NRHP.

Key Documents Describing Appleton Ranch Parcels

- Breckenfeld, D.J., and D. Robinett, Natural Resources Conservation Service. 2001. "Soil and Range Resource Inventory of the National Audubon Society Appleton-Whittell Research Ranch, Santa Cruz County, Arizona." April 1, 2001 (Breckenfeld and Robinett 2001)
- Cogan, R.C., Conservation Coordinator, Appleton-Whittell Research Ranch, National Audubon Society. 2012. "Herpetofauna of the Appleton-Whittell Research Ranch." November 1, 2012 (Cogan 2012)
- McLaughlin, S.P., E.L. Geiger, and J.E. Bowers. 2001. "Flora of the Appleton-Whittell Research Ranch, northeastern Santa Cruz County, Arizona." January 1, 2001 (McLaughlin et al. 2001)
- WestLand Resources Inc. 2004. "Ecological Overview Appleton Ranch Parcel, Santa Cruz County, Arizona." May 26, 2004 (WestLand Resources Inc. 2004b)
- WestLand Resources Inc. 2015. "A Cultural Resources Inventory of 940 Acres Within the Appleton-Whittell Research Ranch for Resolution Copper Mining, LLC." December 1, 2015 (Daughtrey 2015)
- WestLand Resources Inc. 2016. "Phase I Environmental Site Assessment Non-Federal Parcel, Appleton Ranch, Santa Cruz County, Arizona Resolution Copper." September 1, 2016 (WestLand Resources Inc. 2016d)

DRIPPING SPRINGS PARCEL

Parcel Description

The Dripping Springs Parcel is a 160-acre parcel located northeast of Kearny in Gila and Pinal Counties, Arizona, in the Basin and Range physiographic province (figures B-15 and B-16). It lies within a rugged upland area northeast of the Gila River, which is the main drainage feature for the area. The parcel, situated in the Dripping Spring Mountains near Tam O'Shanter Peak and Steamboat Mountain, is almost completely surrounded by BLM-administered lands, with some adjacent Arizona State Land Department–administered State Trust land. The parcel would be administered by the BLM Gila District, Tucson Field Office. The parcel is unpatented private land and has no active mining claims.

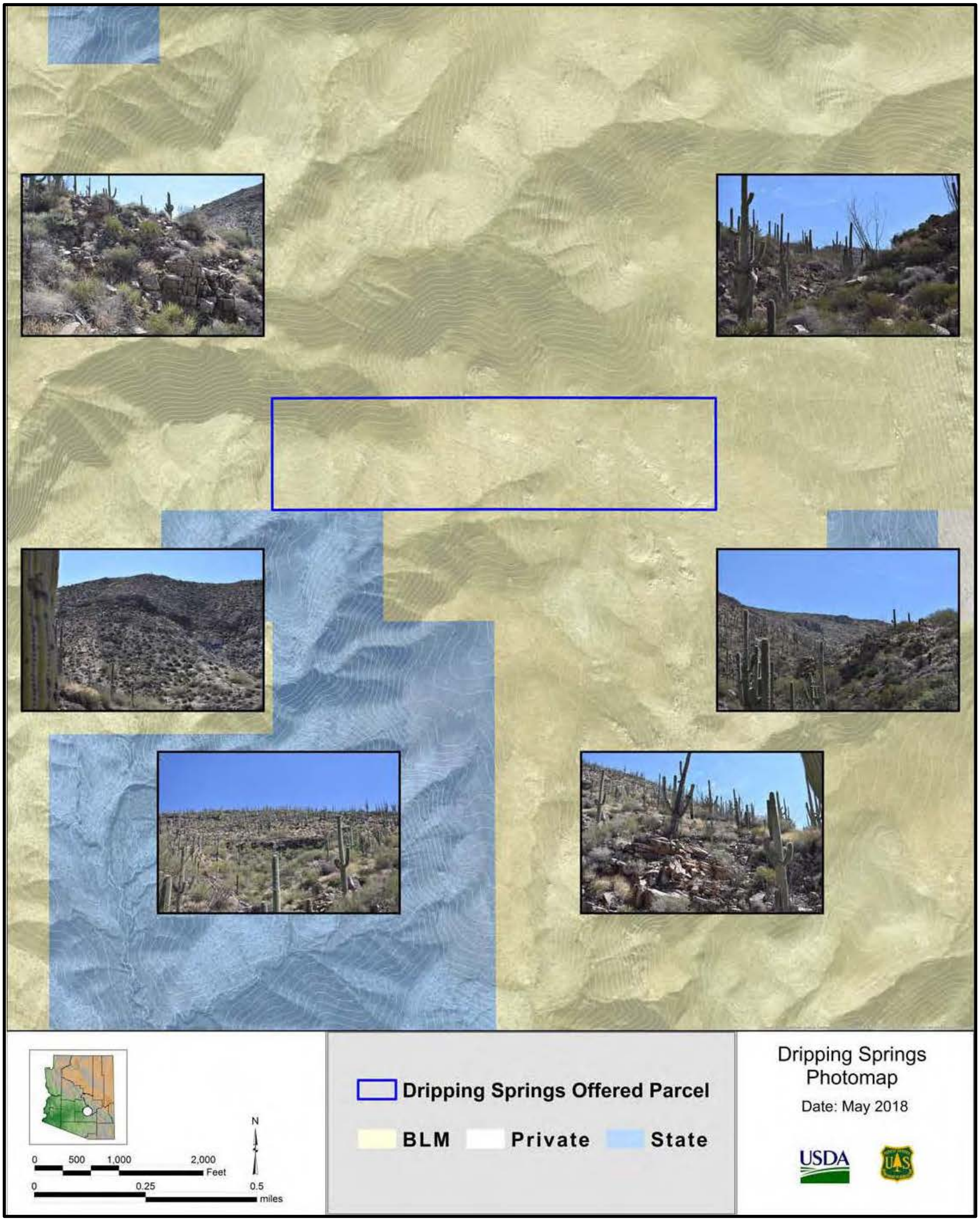

Figure B-15. Dripping Springs land exchange parcel

Figure B-16. Photograph of Dripping Springs parcel

The parcel's abundant rock formations are known for offering recreational rock-climbing opportunities. The Arizona State Parks Board, recognizing the value of this climbing resource, has taken preliminary steps toward the creation of a state park in this location. Hunting is also a permitted recreational activity in the area. Historically the areas surrounding the parcel were the focus of prospecting, mining, and settlement during the Historic period; however, limited homesites, mines, or other features have been found within the Dripping Springs Parcel. In general, the parcel is characterized as undeveloped open space, with past land use limited to small-scale mine exploration, intermittent hunting and recreational shooting, and possibly hiking. Land use in the surrounding areas appears to be similar to the Dripping Springs Parcel but may also include livestock grazing. Vehicular access to the parcel is unavailable as no road accesses the area. Because the property is only accessible by overland hiking across rugged terrain, the parcel has been effectively isolated from human use and has not been subjected to overuse by hikers, off-road vehicle use, hunters, miners, or ranchers. Transfer of management of the Dripping Springs Parcel to the BLM would require a permit to perform recreational and resource use activities generating significant noise, light, and dust disturbances.

Geological Setting

This parcel is in the Dripping Spring Mountains northeast of Kearny, which is a rugged upland area northeast of the Gila River, the main drainage feature for the region. Notable peaks are Steamboat Mountain to the west and Tam O'Shanter Peak to the southeast. This parcel is within the Basin and Range physiographic province and the Dripping Spring Mountains have extensive and complex fault systems composed of tilted fault blocks. The surface geology of the parcel is predominantly sedimentary rocks of Precambrian age (Middle Proterozoic). A fault bisects the parcel and defines the boundary between two tilted fault blocks. The western portion of the parcel is mapped as sedimentary rocks from the Mississippian, Devonian, and Cambrian.

Biological and Water Resources

Vegetation on the parcel encompasses two biotic communities: Arizona Upland Subdivision of the Sonoran Desertscrub and Semi-desert Grassland. The western portion of the parcel includes both biotic communities, whereas the eastern portion is entirely grasslands. Commonly found plant species within the Dripping Springs Parcel include saguaro, paloverde, jojoba, velvet mesquite, desert hackberry, hopbush, brittlebush, cholla, and prickly pear cacti. Grassland species found include desert spoon, Palmer's agave, catclaw acacia, scrub live oak, beargrass, one-seed juniper, threeawn grasses, sideoats grama grass, black grama grass, curly mesquite grass, bullgrass, and broom snakeweed. Groupings of limestone endemics were also noted within the parcel including sandpaper bush, Mariola, crucifixion thorn, desert zinnia, and beebush. The xeric washes on the parcel support dense velvet mesquite and catclaw mimosa.

The 2016 ecological overview and more recent screening identified a number of other special status species with some potential to occur within the property (either under the ESA, BGEPA, or identified as a BLM sensitive species):

- ESA: western yellow-billed cuckoo (threatened); ocelot (endangered); jaguar (endangered); southwestern willow fly-catcher (endangered)
- BGEPA: bald eagle; golden eagle
- BLM Gila District sensitive species with known or potential occurrence: peregrine falcon; gilded flicker; monarch butterfly; pale Townsend's big-eared bat; greater western mastiff bat; Allen's lappet-browed or big-eared bat; lesser long-nosed bat; California leaf-nosed bat; cave myotis; Sonoran desert tortoise; pinyon jay; desert purple martin

No surface water features appear to be present within the Dripping Springs Parcel, with the exception of very minor ephemeral headwater drainage features that are tributary to the Gila River.

Hazardous Materials

A Phase 1 environmental site assessment was completed for the property in June 2015, and identified no RECs on the property. Historical mine features were noted during the work, but while there is potential for these mine features to impact groundwater or produce acid mine drainage, no discoloration or distressed vegetation was noted around the existing features. In addition, potential for impacts on surface or groundwater by contact with mineralized rock is not considered likely.

Cultural Resources

A Class III cultural resources inventory performed in 2016 identified four newly recorded archaeological sites, two of which were recommended for inclusion in the NRHP. These archaeological sites point to use by Native Americans, and Late Historic period Euro-American uses.

Key Documents Describing Dripping Springs Parcel

- WestLand Resources Inc. 2015. "Phase I Site Assessment Non-Federal Parcel - Dripping Springs Gila County, Arizona." June 1, 2015 (WestLand Resources Inc. 2015a)

- WestLand Resources Inc. 2016. “A Cultural Resources Inventory of the 159.64-Acre Dripping Spring Parcel, Gila and Pinal Counties, Arizona.” September 28, 2016 (Charest 2016a)
- WestLand Resources Inc. 2016. “Ecological Overview Dripping Springs Parcel Gila and Pinal Counties, Arizona: Resolution Copper.” December 1, 2016 (WestLand Resources Inc. 2016a)

Town of Superior Lands

PARCEL DESCRIPTION

If requested by the Town of Superior, Section 3003 additionally authorizes and directs the transfer of 545 acres of NFS lands to the Town of Superior (figure B-17). At this time, the Town of Superior has not requested the transfer.

Figure B-17. Photograph of Town of Superior parcel

The Forest Service–administered lands to be conveyed to the Town of Superior include a 30-acre parcel known as Fairview Cemetery and 250 acres contained in four parcels known as the Superior Airport Contiguous Parcels. In addition, the Town of Superior lands include a Federal reversionary interest to a 265-acre Superior Airport parcel. The Superior Airport parcel was originally owned by the Federal Government, then deeded to Pinal County, and subsequently conveyed to the Town of Superior with the condition that it could only be used as an airstrip. Any other use would cause the property to revert to Federal land (the reversionary interest). As part of the land exchange, the Federal reversionary interest would be removed, after which time the parcel could be used for non-airport purposes.

Wildlife Species Occurrence on Offered Lands

The following tables contain analysis of which special status species occur on lands managed by either Tonto National Forest (see table B-2), Coconino National Forest (see table B-3), or BLM (see table B-4). Each of these administrative jurisdictions has a separate list of species that are considered to have special status.

Plant Species Occurrence on Offered Lands

Special status plants also occur on the various parcels and are listed in table B-5. Each of these administrative jurisdictions has a separate list of species that are considered to have special status. The jurisdictions are also concerned with noxious weeds and their presence for management goals. The likelihood of occurrence for the noxious and invasive weeds are shown in table B-6.

Table B-2. Special status wildlife species for offered lands under Tonto National Forest jurisdiction

Unless otherwise noted, range or habitat information is from the following sources: Arizona Heritage Data Management System (Arizona Game and Fish Department 2018a); USFWS Arizona Ecological Services Field Office (U.S. Fish and Wildlife Service 2016b); Tonto National Forest Final Assessment (U.S. Forest Service 2017d); Tonto National Forest Threatened, Endangered and Sensitive Species Abstracts (Tonto National Forest 2000); NatureServe (NatureServe 2018); Reptiles and Amphibians of Arizona (Brennan 2008); eBird (2018)

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Parcels
Amphibians							
Western barking frog (*Craugastor augusti cactorum*)	TNF: S	No	No	No	Species prefers outcrops or cave on rocky slopes in oak/pine-oak associations; elevational range of 4,200–6,200 feet above mean sea level (amsl)	Occurs in rocky outcrops in Cochise and southern Pima and Santa Cruz Counties, in the Quinlan, Santa Rita, Patagonia, Huachuca, and Pajarito mountain ranges	Unlikely to occur
Chiricahua leopard frog (*Lithobates chiricahuensis*)	ESA: T (Gila, Pinal, Yavapai Counties)	No	No	No	Species is known from mid-elevation wetland communities such as tanks, lakes, reservoirs, streams, and rivers; often surrounded by an arid environment. Elevational range of 3,281–8,890 feet.	Occurs along the Mogollon Rim and in mountainous areas of southeastern Arizona	Possible site: Turkey Creek
Northern leopard frog (*Lithobates pipiens*)	TNF: S	No	No	No	Range of habitats that includes grasslands, brush land, and forests, usually in permanent water; elevational range of 2,640–9,155 feet amsl	Found in northern and central Arizona	Unlikely to occur
Lowland leopard frog (*Lithobates yavapaiensis*)	TNF: S	No	No	No	Aquatic systems in elevations ranging from 480–6,200 feet amsl; species is found using a variety of habitats both natural and human-made	Occurs in central and southeastern Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek, Turkey Creek
Birds							
Northern goshawk (*Accipiter gentilis*)	TNF: S	Yes, Turkey Creek	No	No	Species is found in wide variety of forest associations including deciduous, coniferous and mixed forests; prefers mature forests for breeding in elevations ranging from 4,750–9,120 feet amsl	Occurs throughout Arizona	Possible site: Turkey Creek
Golden eagle (*Aquila chrysaetos*)	BGEPA: Yes	No	Yes, Apache Leap (WestLand Resources Inc. 2017c)	eBird	Species prefers mountainous areas, nesting occurs at elevations between 4,000–10,000 feet amsl	Occurs throughout Arizona	Known site: Cave Creek; possible sites: Apache Leap, Tangle Creek, Turkey Creek
Western yellow-billed cuckoo (DPS) (*Coccyzus americanus*)	ESA: T (All Arizona counties)	Yes, Apache Leap, Tangle Creek	No	eBird	Typically found in riparian woodland vegetation (cottonwood [*Populus* spp.], willow [*Salix* spp.], or saltcedar [*Tamarix* spp.) at elevations below 6,600 feet amsl. Dense understory foliage appears to be an important factor in nest site selection.	Occurs throughout Arizona	Known site: Cave Creek; possible sites: Tangle Creek, Turkey Creek,
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: E (All counties except Navajo County)	No	No	No	Found in dense riparian habitats along streams, rivers, and other wetlands where cottonwood (*Populus* spp.), willow (*Salix* spp.), boxelder (*Acer negundo*), saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), buttonbush (*Cephalanthus* spp.), and arrowweed (*Pluchea sericea*) are present. Nests are found in thickets of trees and shrubs, primarily those that are 13 to 23 feet tall, among dense, homogeneous foliage. Habitat occurs at elevations below 8,500 feet amsl.	Occurs throughout Arizona	Possible sites: Cave Creek, Tangle Creek, Turkey Creek
American peregrine falcon (*Falco peregrinus anatum*)	TNF: S	No	Yes, Apache Leap South (WestLand Resources Inc. 2017c)	eBird: Cave Creek, Apache Leap	Species is found near cliffs overlooking habitats that support large numbers of birds; elevational range from 400–9,000 feet amsl	Occurs throughout Arizona	Known sites: Cave Creek, Apache Leap; possible sites: Tangle Creek, Turkey Creek
Yellow-eyed junco (*Junco phaeonotus*)	TNF: S	No	No	No	Habitat consists of open coniferous forest and pine-oak associations	Occurs in central and southeastern Arizona	Unlikely to occur
Sulphur-bellied flycatcher (*Myiodynastes luteiventris*)	TNF: S	No	No	No	Preferred habitat includes sycamore-walnut canyons; species only present during breeding season	Occurs in southeast and central Arizona	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Parcels
Yuma Ridgeway's rail (*Rallus longirostris yumanensis*)	ESA: E (Gila, La Paz, Maricopa, Mohave, Pinal, and Yuma Counties)	No	No	No	In Arizona, found at elevations below 4,500 feet amsl in freshwater marshes, which are often dominated by cattails (*Typha* spp.), bulrushes (*Isolepis* spp.), and sedges (*Carex* spp.).	Occurs in western and central Arizona	Unlikely to occur
Mexican spotted owl (*Strix occidentalis lucida*)	ESA: T (All counties except La Paz and Yuma Counties)	No	No	No	Found in mature montane forests and woodlands and steep, shady, wooded canyons. Can also be found in mixed-conifer and pine-oak vegetation types; generally nests in older forests of mixed conifers or ponderosa pine–Gambel oak. Nests in live trees on natural platforms (e.g., dwarf mistletoe [*Arceuthobium* spp.] brooms), snags, and canyon walls at elevations between 4,100 and 9,000 feet amsl.	Occurs throughout Arizona, except La Paz and Yuma Counties	Possible site: Turkey Creek
Fish							
Desert sucker (*Catostomus clarki*)	TNF: S	Yes, Apache Leap, Cave Creek, Tangle Creek, Turkey Creek	No	No	Species is found in flowing pools of streams and rivers with a gravel substrate; elevational range of 480–8,840 feet amsl	Occurs in central, southern, and southeastern Arizona	Possible sites: Tangle Creek, Turkey Creek
Sonora sucker (*Catostomus insignis*)	TNF: S	Yes, Apache Leap, Cave Creek, Tangle Creek, Turkey Creek	No	No	Found in a variety of habitats from warm rivers to cool streams, prefers gravelly or rocky pools in elevations ranging from 1,210–8,730 feet amsl	Occurs in central, southern, and southeastern Arizona	Possible sites: Turkey Creek
Desert pupfish (*Cyprinodon macularius*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Santa Cruz, and Yavapai Counties)	No	No	No	Found in shallow waters of springs, marshes and small streams, prefers soft substrates and clear water; elevational range of 1,200–3,450 feet amsl	Occurs in Cochise, Gila, Graham, Maricopa, Pima, Santa Cruz, and Yavapai Counties	Unlikely to occur
Gila chub (*Gila intermedia*)	ESA: E (Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai Counties)	No	No	No	Normally found in smaller headwater streams, cienegas, and springs or marshes of the Gila River Basin at elevations between 2,720 and 5,420 feet amsl.	Occurs in Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai Counties	Possible sites: Tangle Creek, Turkey Creek
Headwater chub (*Gila nigra*)	TNF: S	No	No	No	Species is found in the middle to headwater reaches of medium-sized streams with large pools and cover; elevational range of 92–2,000 feet amsl	Occurs in Gila, Graham, and Yavapai Counties	Possible sites: Tangle Creek, Turkey Creek
Roundtail chub (*Gila robusta*)	TNF: S	No	No	No	Species prefers cool to warm water in mid-elevation streams and rivers with pools up to 6.6 feet deep near flowing water. Cover consists of boulders, tree roots, deep water and submerged vegetation. Elevational range of 1,210–7,220 feet amsl	Occurs in Apache, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pinal, and Yavapai Counties	Possible sites: Tangle Creek, Turkey Creek
Spikedace (*Meda fulgida*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pinal, and Yavapai Counties)	No	No	No	Found in medium-sized to large perennial streams, where it inhabits moderate-velocity to fast waters over gravel and rubble substrates, typically at elevations below 6,000 feet amsl.	Occurs in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pinal, and Yavapai Counties	Possible sites: Tangle Creek, Turkey Creek
Gila topminnow (incl. Yaqui) (*Poeciliopsis occidentalis*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai Counties)	No	No	No	Occurs in small streams, springs, and cienegas at elevations below 4,500 feet amsl, primarily in shallow areas with aquatic vegetation and debris for cover	Occurs in Cochise, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai Counties	Unlikely to occur
Colorado pikeminnow (*Ptychocheilus lucius*)	ESA: E (Gila, Maricopa, and Yavapai Counties)	No	No	No	Juveniles prefer slackwater, backwater and side channels with little or no flow and silty substrates; adults utilize turbid, deep and fast flowing waters. Species was reintroduced at an elevation of 1,960 feet amsl.	Occurs in Gila, Maricopa, and Yavapai Counties	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Parcels
Loach minnow (*Tiaroga cobitis*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Pinal, and Yavapai Counties)	No	No	No	Found in small to large perennial creeks and rivers, typically in shallow, turbulent riffles with cobble substrate, swift currents, and filamentous algae at elevations below 8,000 feet amsl	Occurs in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Pinal, and Yavapai Counties	Unlikely to occur
Razorback sucker (*Xyrauchen texanus*)	ESA: E (Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, and Yuma Counties)	No	No	No	Found in backwaters, flooded bottomlands, pools, side channels, and other slower moving habitats at elevations below 6,000 feet amsl	Occurs in Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, and Yuma Counties	Unlikely to occur
Invertebrates							
Netwing midge (*Agathon arizonicus*)	TNF: S	No	No	No	Confined to areas in the immediate vicinity of rapidly flowing streams	Occurs in Gila County in Arizona	Unlikely to occur
Parker's cylloepus riffle beetle (*Cylloepus parkeri*)	TNF: S	No	No	No	Habitat consists of small, rocky streams	Occurs in Yavapai County, Arizona	Possible sites: Cave Creek, Tangle Creek
A mayfly (*Fallceon eatoni*)	TNF: S	No	No	No		Occurs in Gila County, Arizona	Unlikely to occur
Fossil springsnail (*Pyrgulopsis simplex*)	TNF: S	No	No	No	Habitat is only present at headsprings and upper section of the outflow, generally found on rocks or aquatic macrophytes in moderate current	Occurs in Gila and Yavapai Counties, Arizona	Unlikely to occur
A caddisfly (*Wormaldia planae*)	TNF: S	No	No	No		Occurs in Gila and Yavapai Counties	Unlikely to occur
Mammals							
Sonoran pronghorn (*Antilocapra americana sonoriensis*)	ESA: ENE (La Paz, Maricopa, Pima, Pinal, Santa Cruz and Yuma Counties)	No	No	No	Found in Sonoran desertscrub within broad, intermountain, alluvial valleys with creosote (*Larrea tridentata*)–bursage (*Ambrosia* spp.) and palo verde–mixed cacti associations at elevations between 2,000 and 4,000 feet amsl.	Occurs in southwestern Arizona	Unlikely to occur
Mexican gray wolf (*Canis lupus baileyi*)	ESA: E (Apache and Greenlee Counties)	No	No	No	Vegetation type not important, species mostly needs sufficient prey such as deer and elk. Reintroduction areas are typically rugged lands in coniferous forest. Elevational range of 3,000–12,000 feet amsl.	Occurs in Apache and Greenlee Counties, reintroductions are occurring in Apache County. All packs are currently located on the Apache-Sitgreaves National Forests (AGFD 2018a).	Unlikely to occur
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	TNF: S	Yes, Apache Leap, Cave Creek, Tangle Creek, Turkey Creek	No	No	In summer the species is found in caves and mines in elevations ranging from 550–7,520 feet amsl; in winter the species is found in cold caves, lava tubes, and mines in higher elevations than summer	Occurs throughout Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek, Turkey Creek
Spotted bat (*Euderma maculatum*)	TNF: S	No	No	No	Habitat can vary widely from dry deserts to conifer forest, prefer to roost in crevices and cracks in cliff faces; elevational range of 110–8,670 feet amsl	Occurs in Yuma and Maricopa Counties, and eastern Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek, Turkey Creek
Allen's lappet-browed or big-eared bat (*Idionycteris phyllotis*)	TNF: S	No	No	No	Found in ponderosa pine, pinyon-juniper, Mexican woodland and riparian areas with cottonwoods, sycamores and willows, also have records from desertscrub and white fir habitats; elevational range of 1,320–9,800 feet amsl	Occurs throughout Arizona except for deserts in southwestern Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek, Turkey Creek
Western red bat (*Lasiurus blossevillii*)	TNF: S	No	No	No	Habitat consists of riparian and wooded areas, typically roosts in cottonwood trees; elevational range of 1,900–7,200 feet amsl	Occurs south-central to southern and southeastern Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek, Turkey Creek

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Parcels
Ocelot (*Leopardus [Felis] pardalis*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Pinal, and Santa Cruz Counties)	No	No	No	In Arizona, this species has typically been observed in subtropical thorn forest, thornscrub, and dense, brushy thickets at elevations below 8,000 feet amsl and is often found in riparian bottomlands. The critical habitat component is probably dense cover near the ground and complete avoidance of open country.	Occurs in Cochise, Gila, Graham, Maricopa, Pima, Pinal, and Santa Cruz Counties	Unlikely to occur
Jaguar (*Panthera once*)	ESA: E (Cochise, Pima, and Santa Cruz Counties)	No	No	No	Variety of habitats, prefers lowland wet habitats but also occurs in drier habitats such as oak-pine woodlands; elevational range of sightings in Arizona were from 5,200–5,700 feet amsl	Occurs in Cochise, Pima, and Santa Cruz Counties	Unlikely to occur
Reptiles							
Sonoran Desert tortoise (*Gopherus morafkai*)	TNF: S	No	No	No	Habitat includes Mojave desert scrub to semidesert grassland and interior chaparral; elevational range of 510–5,300 feet amsl	Occurs in the southern and southwest part of Arizona	Possible sites: Apache Leap, Cave Creek, Tangle Creek
Northern Mexican gartersnake (*Thamnophis eques megalops*)	ESA: T (All counties except Maricopa and Yuma Counties)	No	No	No	Species prefers cienegas, streams and rivers in habitats ranging from upland Sonoran desertscrub to montane coniferous forests; elevational range of 1,000–6,700 feet amsl	Occurs throughout Arizona except Maricopa and Yuma Counties	Possible site: Turkey Creek
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)	ESA: T (Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties)	No	No	No	Species prefers pinyon-juniper and pine-oak woodlands, ranging into ponderosa pine at elevations between 2,440–8,080 feet amsl; species needs permanent water source	Occurs in Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties	Possible site: Turkey Creek
Bezy's night lizard (*Xantusia bezyi*)	TNF: S	No	No	No	Species prefers rocky slopes in upland Sonoran desertscrub and chaparral vegetation types; elevational range of 2,400–5,800 feet amsl	Occurs in Gila, Pinal, and Maricopa Counties	Possible site: Apache Leap

*Status Definitions

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = Threatened. Threatened species are those that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

ENE = Reintroduced populations designated as Experimental – Nonessential, under ESA.

Tonto National Forest (TNF):

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by: a. significant current or predicted downward trends in population number or density. B. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Bald and Golden Eagle Protection Act (BGEPA):

Yes = A species protected by a United States Federal statute that protects two species of eagle.

Table B-3. Special status wildlife species for offered lands under Coconino National Forest jurisdiction

Unless otherwise noted, range or habitat information is from the following sources: Arizona Heritage Data Management System (Arizona Game and Fish Department 2018a); USFWS Arizona Ecological Services Field Office (U.S. Fish and Wildlife Service 2016b); Tonto National Forest Final Assessment (U.S. Forest Service 2017d); Tonto National Forest Threatened, Endangered and Sensitive Species Abstracts (Tonto National Forest 2000); NatureServe (NatureServe 2018); Reptiles and Amphibians of Arizona (Brennan 2008); eBird (2018)

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands
Amphibians							
Arizona toad (*Anaxyrus microscaphus*)	CNF: S	Yes	No	Reptiles of Arizona	Species prefers rocky stream and canyons in pine-oak associations and in lower deserts. Elevation ranges from sea level to 8,000 feet above mean sea level (amsl)	Found in canyons and floodplains south of the Mogollon Rim	Known to occur: East Clear Creek
Chiricahua leopard frog (*Lithobates chiricahuensis*)	ESA: T (All Arizona counties except La Paz, Mohave, Pinal, Yuma)	Yes	No	No	Species is known from mid-elevation wetland communities such as tanks, lakes, reservoirs, streams, and rivers; often surrounded by an arid environment. Elevational range of 3,281–8,890 feet amsl.	Species occurs along the Mogollon Rim and in mountainous areas of southeastern Arizona	Known to occur: East Clear Creek
Northern leopard frog (*Lithobates pipiens*)	CNF: S	Yes	No	Reptiles of Arizona	Range of habitats that includes grasslands, brush land, and forests, usually in permanent water; elevational range of 2,640–9,155 feet amsl	Found in northern and central Arizona	Known to occur: East Clear Creek
Lowland leopard frog (*Lithobates yavapaiensis*)	CNF: S	No	No	No	Aquatic systems in elevations ranging from 480–6,200 feet amsl; species is found using a variety of habitats both natural and human-made	Species occurs in central and southeastern Arizona	Unlikely to occur
Birds							
Northern goshawk (*Accipiter gentilis*)	CNF: S	Yes	Yes (WestLand Resources Inc. 2017c)	eBird	Species is found in wide variety of forest associations including deciduous, coniferous and mixed forests; prefers mature forests for breeding in elevations ranging from 4,750–9,120 feet amsl	Species is found statewide in tall, forested mountains	Known to occur: East Clear Creek
Clark's grebe (*Aechmophorus clarkii*)	CNF: S	No	No	No	Requires large, deep bodies of water for fishing	Species is present on large reservoirs and along the Colorado River	Unlikely to occur
Golden eagle (*Aquila chrysaetos*)	BGEPA: Yes	No	No	No	Species prefers mountainous areas, nesting occurs at elevations between 4,000–10,000 feet amsl	Species is found throughout Arizona	Possible to occur: East Clear Creek
Western burrowing owl (*Athene cunicularia hypugaea*)	CNF: S	No	No	No	Species is found in open, dry grasslands, deserts, and agricultural lands; elevation ranges from 650–6,140 feet amsl	Species is found in southern Arizona and in agricultural areas in Maricopa and Pinal Counties	Unlikely to occur
Ferruginous hawk (*Buteo regalis*)	CNF: S	No	No	No	Species is found in open grasslands, scrublands, and woodlands in winter; ranges in elevation from 3,500 to 6,000 feet amsl	Species is found throughout the state in winter, breeds on Colorado Plateau	Unlikely to occur
Common black hawk (*Buteogallus anthracinus*)	CNF: S	Yes	No	eBird	Species only present during breeding season; riparian obligate found along streams between 1,750–7,080 feet amsl	Breeding range is along streams draining the Mogollon Rim; species can be found throughout the state during migration	Known to occur: East Clear Creek
Western yellow-billed cuckoo (DPS) (*Coccyzus americanus occidentalis*)	ESA: T (all Arizona counties) CNF: S	No	No	No	Typically found in riparian woodland vegetation—cottonwood (*Populus* spp.), willow (*Salix* spp.), or saltcedar (*Tamarix* spp.)—at elevations below 6,600 feet amsl. Dense understory foliage appears to be an important factor in nest site selection.	Species occurs at its highest concentrations in Arizona are along the Agua Fria, San Pedro, upper Santa Cruz, and Verde River drainages and Cienega and Sonoita Creeks.	Unlikely to occur
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: E (all Arizona counties except Navajo County)	No	No	No	Found in dense riparian habitats along streams, rivers, and other wetlands where cottonwood (*Populus* spp.), willow (*Salix* spp.), boxelder (*Acer negundo*), saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), buttonbush (*Cephalanthus* spp.), and arrowweed (*Pluchea sericea*) are present. Nests are found in thickets of trees and shrubs, primarily those that are 13 to 23 feet tall, among dense, homogeneous foliage. Habitat occurs at elevations below 8,500 feet amsl.	Species breeds very locally along the middle Gila, Salt, Verde, middle to lower San Pedro, and upper San Francisco Rivers; also, locally around Colorado River near the mouth of the Little Colorado River, the headwaters of the Little Colorado and locations south of Yuma; species can be found in a variety of habitat types during migration	Unlikely to occur

Common Name (*Scientific Name*)	**Status***	**HDMS Records within 2 miles**	**Baseline Data Records**	**Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)**	**Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)**	**Geographical Range in Arizona**	**Likelihood of Occurrence in Offered Lands**
American peregrine falcon (*Falco peregrinus anatum*)	CNF: S	Yes	(WestLand Resources Inc. 2017c)	No	Species is found near cliffs overlooking habitats that support large numbers of birds; range in elevations from 400–9,000 feet amsl	Species breeds throughout state only on cliffs near abundant prey items	Known to occur: East Clear Creek
California condor (*Gymnogyps californianus*)	ESA: ENE (Apache, Coconino, Mohave, Navajo and Yavapai Counties)	No	No	No	Roosts and nest in steep terrain with rock outcroppings, cliffs, and caves. High perches are necessary to create the strong updrafts the bird requires to lift into flight, and open grasslands or savannahs are essential for searching for food	Occurs mostly along the Grand Canyon and Kaibab Plateau in northern Arizona	Unlikely to occur
Bald eagle (*Haliaeetus leucocephalus*)	CNF: S BGEPA: Yes	Yes	(WestLand Resources Inc. 2017c)	eBird	Habitat components include large bodies of water with lots of coastline and tall perches above water to allow for hunting	Found throughout much of the central and northern parts of Arizona, near large bodies of water	Known to occur: East Clear Creek
Abert's towhee (*Melozone aberti*)	CNF: S	No	No	No	Habitat includes woodlands and thickets usually near water, occurs in riparian woods, exotic vegetation such as salt cedar, along agricultural fields and in suburban areas	Species is found in lower elevation areas of central, southern and western Arizona	Unlikely to occur
Mexican spotted owl (*Strix occidentalis lucida*)	ESA: T (All counties except La Paz and Yuma Counties)	Yes	(WestLand Resources Inc. 2017c)	No	Found in mature montane forests and woodlands and steep, shady, wooded canyons. Can also be found in mixed-conifer and pine-oak vegetation types; generally nests in older forests of mixed conifers or ponderosa pine (*Pinus ponderosa*)–Gambel oak (*Quercus gambelii*). Nests in live trees on natural platforms (e.g., dwarf mistletoe [*Arceuthobium* spp.] brooms), snags, and canyon walls at elevations between 4,100 and 9,000 feet amsl.	Found throughout the state in summer in forested mountains with steep canyons; found in almost all counties of Arizona; recently species has been found wintering in lower riparian areas such as Tonto Creek and Sabino Canyon	Known to occur: East Clear Creek
Fish							
Longfin dace (*Agosia chrysogaster*)	CNF: S	No	No	No	Habitat varies from intermittent hot low-desert stream to clear, cool streams at higher elevations; prefers medium- to small-sized streams with sandy/gravely bottoms and pools with some cover. Species is normally found below 4,900 feet amsl.	Occurs in central, southern, and southeastern Arizona	Unlikely to occur
California floater (*Anodonta californiensis*)	CNF: S	Yes	No	No	Species prefers shallow areas, less than 2 meters deep in unpolluted lakes, reservoirs, and perennial streams with relatively stable water levels of low velocity flow regimes; elevational range of 4,000–8,670 feet amsl	Occurs in Apache and Greenlee Counties, found in the Black River part of the Gila River Basin System	Known to occur: East Clear Creek
Desert sucker (*Catostomus clarki*)	CNF: S	No	No	No	Species is found in flowing pools of streams and rivers with a gravel substrate; elevational range of 480–8,840 feet amsl	Found throughout the Gila River basin and in tributaries to the Bill Williams River	Possible to occur: East Clear Creek
Bluehead sucker (*Catostomus discobolus discobolus*)	CNF: S	No	No	No	Species occurs in a variety of habitats from small streams to large rivers ranging from cold clear streams to warm, turbid rivers; elevational range of 2,001-6,759 feet amsl	Occurs in the Colorado River mainstem and Grand Canyon tributaries	Unlikely to occur
Sonora sucker (*Catostomus insignis*)	CNF: S	No	No	No	Found in a variety of habitats from warm rivers to cool streams, prefers gravelly or rocky pools in elevations ranging from 1,210–8,730 feet amsl	Found in the Gila and Bill Williams river basins	Possible to occur: East Clear Creek
Little Colorado sucker (*Catostomus* sp.)	CNF: S	Yes	(WestLand Resources Inc. 2017c)	No	Species prefers creeks, small to medium rivers and impoundments most often with abundant cover; elevational range of 2,200–7,100 feet amsl	Species is endemic to the upper portion of the Little Colorado River and some of its north-flowing tributaries	Known to occur: East Clear Creek
Gila chub (*Gila intermedia*)	ESA: E (Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai Counties)	No	No	No	Normally found in smaller headwater streams, cienegas, and springs or marshes of the Gila River Basin at elevations below 2,720 and 5,420 feet amsl.	Currently found in the following drainages: Santa Cruz River, Middle Gila River, San Pedro River, Agua Fria River and Verde River	Possible to occur: East Clear Creek

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands
Headwater chub (*Gila nigra*)	CNF: S	No	No	No	Species is found in the middle to headwater reaches of medium-sized streams with large pools and cover; elevational range of 925–2,000 feet amsl	Current range includes streams in the Verde River basin, Tonto Creek subbasin and San Carlos River basin in Yavapai, Gila and Graham Counties	Unlikely to occur
Roundtail chub (*Gila robusta*)	CNF: S	No	(WestLand Resources Inc. 2017c)	No	Species prefers cool to warm water in mid-elevation streams and rivers with pools up to 6.6 feet deep near flowing water. Cover consists of boulders, tree roots, deep water and submerged vegetation. Elevational range of 1,210–7,220 feet amsl.	Occurs in tributaries to the Little Colorado River, tributaries to the Bill Williams River basin, the Salt River and its tributaries, the Verde River and its tributaries, Aravaipa Creek and Eagle Creek	Known to occur: East Clear Creek
Little Colorado spinedace (*Lepidomeda vittata*)	ESA: T (Apache, Coconino, and Navajo Counties)	Yes	(WestLand Resources Inc. 2017c)	No	Habitat consists of medium to small streams and is characteristically found in pools with water flowing over fine gravel and silt-mud substrates; elevational range of 4,000–8,000 feet amsl	Found in East Clear Creek and its tributaries, Chevelon and Silver Creeks, and Nutrioso Creek and the Little Colorado River	Known to occur: East Clear Creek
Spikedace (*Meda fulgida*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pinal, and Yavapai Counties)	No	No	No	Found in medium-sized to large perennial streams, where it inhabits moderate-velocity to fast waters over gravel and rubble substrates, typically at elevations below 6,000 feet amsl	In Arizona, populations are found in the middle Gila, and Verde Rivers and Aravaipa and Eagle Creeks.	Unlikely to occur
Gila trout (*Oncorhynchus gilae gilae*)	ESA: T (Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties)	No	No	No	Species is found in small mountain headwater streams, which are generally narrow and shallow, and rarely exceed 70 degrees Fahrenheit. Siltation is usually low and cobble is the predominant substrate; Elevational range of 5,446-9,220 feet amsl.	Historically found in Verde and Agua Fria drainages. Species has been introduced to Gap Creek and Dude Creek, but those populations are in jeopardy or have been extirpated. Species could still be present in tributaries to the Verde River such as Oak Creek and West Clear Creek.	Unlikely to occur
Gila topminnow (*Poeciliopsis occidentalis occidentalis*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai Counties)	No	No	No	Occurs in small streams, springs, and cienegas at elevations below 4,500 feet amsl, primarily in shallow areas with aquatic vegetation and debris for cover	In Arizona, most of the remaining native populations are in the Santa Cruz River system.	Unlikely to occur
Colorado pikeminnow (*Ptychocheilus lucius*)	ESA: E, ENE (Gila, Maricopa, and Yavapai Counties)	No	No	No	Juveniles prefer slackwater, backwater and side channels with little or no flow and silty substrates; adults utilize turbid, deep and fast flowing waters. Species was reintroduced at an elevation of 1,960 feet amsl.	Considered extirpated from the state, two experimental populations have been stocked into Salt and Verde River drainages	Unlikely to occur
Loach minnow (*Tiaroga cobitis*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Pinal, and Yavapai Counties)	No	No	No	Found in small to large perennial creeks and rivers, typically in shallow, turbulent riffles with cobble substrate, swift currents, and filamentous algae at elevations below 8,000 feet amsl	Its range in Arizona is limited to reaches in the East Fork of the White River (Navajo County); Aravaipa, Deer, and Turkey Creeks (Graham and Pinal Counties); San Francisco and Blue Rivers; and Eagle, Campbell Blue, and Little Blue Creeks (Greenlee County). A population was discovered in the Black River in 1996.	Unlikely to occur
Razorback sucker (*Xyrauchen texanus*)	ESA: E (Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, and Yuma Counties)	No	No	No	Found in backwaters, flooded bottomlands, pools, side channels, and other slower-moving habitats at elevations below 6,000 feet amsl	In Arizona, populations are restricted to Lakes Mohave and Mead and the lower Colorado River below Havasu in the Lower Basin. In the Upper Basin, small remnant populations are found in the Green, Yampa, and main stem Colorado Rivers.	Unlikely to occur
Invertebrates							
A mayfly (*Homoleptohyphes quercus*)	CNF: S	No	No	No	Habitat is primarily lotic depositional, some lentic littoral. Larvae are common in flowing waters ranging from small streams to large rivers, but they occur in areas of slow current. Preferred substrates include silt, fine sand, gravel, woody debris, moss and other plant growth on stones, exposed roots of terrestrial plants, and at the base of rooted aquatic vegetation.	Occurs in Coconino and Pinal Counties	Possible to occur: East Clear Creek

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands
Four-spotted skipperling (*Piruna polingii*)	CNF: S	No	No	No	Habitat includes moist woodland openings with lush vegetation, meadows, ravines and streamsides in the mountains	Occurs from central Arizona south to Mexico	Possible to occur: East Clear Creek
Page springsnail (*Pyrgulopsis morrisoni*)	CNF: S	No	No	No	Occurs on firm substrates such as rocks, vegetation, floating algal mats and submerged woody debris in association with slow to moderate flows of head springs, seeps and lateral runs; elevational range of 3,300–3,600 feet amsl	Occurs in several springs along Oak Creek in the Bubbling Springs complex, the Page Springs complex, and on private land in the Verde Valley	Unlikely to occur
Fossil springsnail (*Pyrgulopsis simplex*)	CNF: S	No	No	No	Habitat is only present at headsprings and upper section of the outflow, generally found on rocks or aquatic macrophytes in moderate current	Occurs in Gila and Yavapai Counties, Arizona	Unlikely to occur
Nitocris fritillary (*Speyeria nokomis nitocris*)	CNF: S	No	No	No	Occurs in alpine meadows, the species' host plant is *Viola nephrophylla*	Occurs in eastern Arizona	Unlikely to occur
Nokomis fritillary (*Speyeria nokomis nokomis*)	CNF: S	No	No	No	Occurs in streamside meadows and open seepage areas with an abundance of violets in generally desert landscapes	Occurs in eastern Arizona	Unlikely to occur
Mammals							
Mexican gray wolf (*Canis lupus baileyi*)	ESA: E (Apache and Greenlee Counties)	No	No	No	Vegetation type not important, species mostly needs sufficient prey such as deer and elk. Reintroduction areas are typically rugged lands in coniferous forest. Elevational range of 3,000–12,000 feet amsl	Occurs in Apache and Greenlee Counties, reintroductions are occurring in Apache County. All packs are currently located on the Apache-Sitgreaves National Forest (AGFD 2018a).	Unlikely to occur
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	CNF: S	No	No	No	In summer the species is found in caves and mines in elevations ranging from 550–7,520 feet amsl; in winter the species is found in cold caves, lava tubes, and mines in higher elevations than summer	Widespread, documented in almost all counties	Possible to occur: East Clear Creek
Spotted bat (*Euderma maculatum*)	CNF: S	No	No	No	Habitat can vary widely from dry deserts to conifer forest, prefer to roost in crevices and cracks in cliff faces; elevational range of 110–8,670 feet amsl	Not well known, records from Yuma County, Maricopa County, Kaibab Plateau and some heard only records from eastern Arizona	Possible to occur: East Clear Creek
Greater western mastiff bat (*Eumops perotis californicus*)	CNF: S	No	No	No	Species prefers lower and upper Sonoran desertscrub near cliffs with lots of crevices; elevational range of 240–8,475 feet amsl	Year-round and widespread in the state	Possible to occur: East Clear Creek
Allen's lappet-browed or big-eared bat (*Idionycteris phyllotis*)	CNF: S	No	No	No	Found in ponderosa pine, pinyon-juniper, Mexican woodland and riparian areas with cottonwoods, sycamores and willows, also have records from desertscrub and white fir habitats; elevational range of 1,320–9,800 feet amsl	Widespread in Arizona except for deserts in southwestern Arizona, most records from southern Colorado Plateau, Mogollon Rim and adjacent mountain ranges	Possible to occur: East Clear Creek
Western red bat (*Lasiurus blossevillii*)	CNF: S	No	No	No	Habitat consists of riparian and wooded areas, typically roosts in cottonwood trees; elevational range of 1,900–7,200 feet amsl	South-central to southern and southeastern Arizona, summer resident only; historic records from Sierra Ancha Mountains and Queen Creek	Possible to occur: East Clear Creek
Long-tailed vole (*Microtus longicaudus*)	CNF: S	No	No	No	Occurs in various habitats ranging from dense coniferous forests to rocky alpine tundra, sagebrush semidesert, moist meadows, marshes, and forest-edge habitat; elevational range of sea level to 11,975 feet amsl	Found in northern and central Arizona	Unlikely to occur
Navajo Mogollon vole (*Microtus mogollonensis navaho*)	CNF: S	No	No	No	Species prefers clear-cut pine flat that is growing back as grassland with scattered oaks, rocky slopes with open uncut ponderosa forest with openings, and pinyon juniper with scattered ponderosa pine stands	Occurs in Apache and Coconino Counties, in the Little Colorado headwaters, Canyon Diablo, Lower Little Colorado, and Upper Verde watersheds	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Records (eBird, SWCA, or Forest Service Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands
Black-footed ferret (*Mustela nigripes*)	ESA: ENE (Coconino and Yavapai Counties)	No	No	No	Occurs in arid prairies, characterized as Plains and Great Basin Grassland community; elevational range of 5,250–6,234 feet amsl	Species is reintroduced into the Aubrey Valley in Coconino County	Unlikely to occur
Wupatki Arizona pocket mouse (*Perognathus amplus cineris*)	CNF: S	No	No	No	Found in various types of desert scrub habitats and in some scrub oak habitats; elevational range of 3,900–5,420 feet amsl	Found only from Echo Cliffs in the north, south and east to the Colorado River and to the Little Colorado River, south of Wupatki National Monument	Unlikely to occur
Plains harvest mouse (*Reithrodontomys montanus*)	CNF: S	No	No	No	Occurs in well-developed grasslands in areas with less than 50 percent bare soil; elevational range of 275–6,300 feet amsl	Species occurs in southeastern Arizona	Unlikely to occur
Merriam's shrew (*Sorex merriami leucogenys*)	CNF: S	No	No	No	Sagebrush steppe	Northeastern Arizona	Unlikely to occur
Dwarf shrew (*Sorex nanus*)	CNF: S	No	No	No	Occupies numerous habitats including rocky areas in alpine tundra and partly into subalpine coniferous forest, other types of rocky slopes, sedge marsh, subalpine meadow, dry brushy slopes, arid shortgrass prairie, dry stubble fields, and pinyon-juniper woodland	Occurs along the Kaibab Plateau, San Francisco Peaks, and White Mountains	Unlikely to occur
Reptiles							
Reticulate Gila monster (*Heloderma suspectum suspectum*)	CNF: S	No	No	No	Occurs in Sonoran Desert and extreme western edge of Mohave Desert, less frequent in desert-grassland and rare in oak woodland; most common in undulating rocky foothills, bajadas, and canyons	Occurs in the western and southwestern portion of the state	Unlikely to occur
Northern Mexican gartersnake (*Thamnophis eques megalops*)	ESA: T (All counties except Maricopa and Yuma Counties) CNF: S	No	No	No	Species prefers cienegas, streams, and rivers in habitats ranging from upland Sonoran desertscrub to montane coniferous forests; elevational range of 1,000–6,700 feet amsl	Species is found along the Mogollon Rim and a few isolated populations in south-central Arizona	Unlikely to occur
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)	ESA: T (Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties) CNF: S	No	No	No	Species prefers pinyon-juniper and pine-oak woodlands, ranging into ponderosa pine at elevations between 2,440–8,080 feet amsl; species needs permanent water source	Species is found along the Mogollon Rim	Unlikely to occur

* Status Definitions

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = Threatened. Threatened species are those that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

ENE = Reintroduced populations designated as Experimental – Nonessential, under ESA.

Coconino National Forest (CNF):

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by: a. significant current or predicted downward trends in population number or density. B. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Bald and Golden Eagle Protection Act (BGEPA):

Yes = A species protected by a United States Federal statute that protects two species of eagle.

Table B-4. Special status wildlife species for offered lands under BLM jurisdiction

Unless otherwise noted, range or habitat information is from the following sources: Arizona Heritage Data Management System (Arizona Game and Fish Department 2018a); USFWS Arizona Ecological Services Field Office (U.S. Fish and Wildlife Service 2016b); Tonto National Forest Threatened, Endangered and Sensitive Species Abstracts (Tonto National Forest 2000); NatureServe (NatureServe 2018); Reptiles of Arizona (Brennan 2008); eBird (2018)

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (eBird, SWCA or BLM Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in BLM Offered Lands
Amphibians							
Arizona toad (*Anaxyrus microscaphus*)	BLM: S	No	No	No	Species prefers rocky stream and canyons in pine-oak associations and in lower deserts; elevational range from sea level to 8,000 feet amsl	Found in canyons and floodplains south of the Mogollon Rim	Possible to occur: Dripping Springs
Sonoran green toad (*Anaxyrus retiformis*)	BLM: S	No	No	No	Species is found in rain pools, wash bottoms, and areas near water in semi-arid mesquite-grassland, creosote desert and upland saguaro-paloverde desert; elevational range of 500–3,225 feet amsl	Found in south-central Arizona, from Organ Pipe Cactus National Monument to 9 miles north of Pima/Pinal county line in Santa Rosa Valley	Unlikely to occur
Great Plains narrow-mouthed toad (*Gastrophryne olivacea*)	BLM: S	No	No	No	Found in mesquite semi-desert grassland to oak woodland near streams, springs, and rain pools; elevational range of sea level to 4,100 feet amsl	Found from Santa Cruz County north to Maricopa County and west to near Ajo, in Pima County	Unlikely to occur
Plains leopard frog (*Lithobates blairi*)	BLM: S	No	No	No	Found near stream, ponds, reservoirs, marshes, or irrigation ditches in prairies and desert grasslands; elevational range of 4,060–5,880 feet amsl	Isolated population located on the western side of the Chiricahua Mountains, Cochise County, Arizona	Unlikely to occur
Chiricahua leopard frog (*Lithobates chiricahuensis*)	ESA: T (All Arizona counties except La Paz, Mohave, Pinal, Yuma) BLM: S	Yes, Appleton Ranch	No	Reptiles of Arizona	Species is known from mid-elevation wetland communities such as tanks, lakes, reservoirs, streams, and rivers; often surrounded by an arid environment. Elevational range of 3,281–8,890 feet amsl.	Species occurs along the Mogollon Rim and in mountainous areas of southeastern Arizona	Possible to occur: Appleton Ranch
Northern leopard frog (*Lithobates pipiens*)	BLM: S	No	No	No	Range of habitats that includes grasslands, brush land, and forests, usually in permanent water; elevational range of 2,640–9,155 feet amsl	Found in northern and central Arizona	Unlikely to occur
Lowland leopard frog (*Lithobates yavapaiensis*)	BLM: S	Yes, Dripping Springs, Lower San Pedro River	No	Reptiles of Arizona	Aquatic systems in elevations ranging from 480–6,200 feet amsl; species is found using a variety of habitats both natural and human-made	Species occurs in central and southeastern Arizona	Known to occur: Lower San Pedro River, Dripping Springs; possible site: Appleton Ranch
Birds							
Northern goshawk (*Accipiter gentilis*)	BLM: S	No	No	No	Species is found in wide variety of forest associations including deciduous, coniferous, and mixed forests; prefers mature forests for breeding in elevations ranging from 4,750–9120 feet amsl	Species is found statewide in tall, forested mountains	Unlikely to occur
Arizona grasshopper sparrow (*Ammodramus savannarum ammolegus*)	BLM: S	Yes, Appleton Ranch, Dripping Springs	No	eBird: Appleton Ranch, Dripping Springs, Lower San Pedro River	Species preferred habitat is open grasslands with some shrubs between 3,800–5,300 feet amsl	Species is found in southern Arizona year-round	Known to occur: Appleton Ranch, Dripping Springs, Lower San Pedro River
Golden eagle (*Aquila chrysaetos*)	BLM: S BGEPA: Yes	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	eBird: Appleton Ranch, Dripping Springs, Lower San Pedro River	Species prefers mountainous areas, nesting occurs at elevations between 4,000–10,000 feet amsl	Species is found throughout Arizona	Known to occur: Appleton Ranch, Dripping Springs, Lower San Pedro River
Western burrowing owl (*Athene cunicularia hypugaea*)	BLM: S	Yes, Appleton Ranch	No	eBird: Appleton Ranch	Species is found in open, dry grasslands, deserts, and agricultural lands; elevation ranges from 650–6,140 feet amsl	Species is found in southern Arizona and in agricultural areas in Maricopa and Pinal Counties	Known to occur: Appleton Ranch
Ferruginous hawk (*Buteo regalis*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	eBird: Appleton Ranch, Dripping Springs, Lower San Pedro River	Species is found in open grasslands, scrublands, and woodlands in winter; ranges in elevation from 3,500 to 6,000 feet amsl	Species is found throughout the state in winter, breeds on Colorado Plateau	Known to occur: Appleton Ranch, Dripping Springs, Lower San Pedro River

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (eBird, SWCA or BLM Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in BLM Offered Lands
Western yellow-billed cuckoo (DPS) (*Coccyzus americanus*)	ESA: T (all Arizona counties) BLM: S	Yes, Appleton Ranch, Lower San Pedro River	Yes, Lower San Pedro River (Wilbor 2010)	eBird: Appleton Ranch, Lower San Pedro River	Typically found in riparian woodland vegetation (cottonwood, willow, or saltcedar) at elevations below 6,600 feet amsl. Dense understory foliage appears to be an important factor in nest site selection.	Species occurs at its highest concentrations in Arizona along the Agua Fria, San Pedro, upper Santa Cruz, and Verde River drainages and in Cienega and Sonoita Creeks.	Known to occur: Appleton Ranch, Lower San Pedro River
Gilded flicker (*Colaptes chrysoides*)	BLM: S	Yes, Dripping Springs, Lower San Pedro River	No	eBird: Appleton Ranch, Lower San Pedro River	Habitat includes stands of large saguaros, Joshua trees, and low-elevation riparian groves	Species is restricted to the Sonoran Desert	Known to occur: Appleton Ranch, Lower San Pedro River; possible site: Dripping Springs
Southwestern willow flycatcher (*Empidonax traillii extimus*)	ESA: E (all Arizona counties except Navajo County) BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	eBird: Lower San Pedro River	Found in dense riparian habitats along streams, rivers, and other wetlands where cottonwood (*Populus* spp.), willow (*Salix* spp.), boxelder (*Acer negundo*), saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), buttonbush (*Cephalanthus* spp.), and arrowweed (*Pluchea sericea*) are present. Nests are found in thickets of trees and shrubs, primarily those that are 13 to 23 feet tall, among dense, homogeneous foliage. Habitat occurs at elevations below 8,500 feet amsl.	Species breeds very locally along the middle Gila, Salt, Verde, middle to lower San Pedro, and upper San Francisco Rivers; also, locally around Colorado River near the mouth of the Little Colorado River, the headwaters of the Little Colorado and locations south of Yuma; species can be found in a variety of habitat types during migration	Possible to occur: Lower San Pedro River
American peregrine falcon (*Falco peregrinus anatum*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	eBird: Appleton Ranch	Species is found near cliffs overlooking habitats that support large numbers of birds; range in elevations from 400–9,000 feet amsl	Species breeds throughout state only on cliffs near abundant prey items	Known to occur: Appleton Ranch; possible sites: Lower San Pedro River, Dripping Springs
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	BLM: S	No	No	No	Species prefers streamside cottonwoods and willows near mesquite bosques; can also be found in dry washes with large mesquite, paloverde, ironwood, and saguaro	Occurs in Organ Pipe Cactus National Monument and suburban Tucson	Possible to occur: Lower San Pedro River
California condor (*Gymnogyps californianus*)	ESA: ENE (Apache, Coconino, Mohave, Navajo and Yavapai Counties) BLM: S	No	No	No	Roosts and nest in steep terrain with rock outcroppings, cliffs, and caves. High perches are necessary to create the strong updrafts the bird requires to lift into flight, and open grasslands or savannahs are essential for searching for food	Occurs mostly along the Grand Canyon and Kaibab Plateau in northern Arizona	Unlikely to occur
Pinyon jay (*Gymnorhinus cyanocephalus*)	BLM: S	No	No	No	Habitat consists of pinyon-juniper woodland, sometimes found in pine forests and in scrub oak or sagebrush areas	Species is found along and above the Mogollon Rim in northern Arizona	Possible to occur: Dripping Springs
Bald eagle (*Haliaeetus leucocephalus*)	BLM: S BGEPA: Yes	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Habitat components include large bodies of water with lots of coastline and tall perches above water to allow for hunting	Found throughout much of the central and northern parts of Arizona, near large bodies of water	Unlikely to occur
California black rail (*Laterallus jamaicensis coturniculus*)	BLM: S	No	No	No	Habitat in Arizona consists of shallow water habitat with emergent and shoreline vegetation. Prefers areas where water levels do not fluctuate.	Occurs only in southwestern part of state along the Colorado River in Yuma County	Unlikely to occur
Arizona Botteri's sparrow (*Peucaea botterii arizonae*)	BLM: S	Yes, Appleton Ranch	No	eBird: Appleton Ranch	Species is found in grasslands with scattered mesquite trees	Occurs in southeastern Arizona	Known to occur: Appleton Ranch
Desert purple martin (*Progne subis hesperia*)	BLM: S	Yes, Dripping Springs, Lower San Pedro River	No	eBird: Lower San Pedro River	Habitat consists of Sonoran Desert with many large saguaros proximal to water	Species is found in southern and central Arizona	Known to occur: Lower San Pedro River; possible site: Dripping Springs
Yuma Ridgeway's rail (*Rallus longirostris yumanensis*)	ESA: E (Gila, La Paz, Maricopa, Mohave, Pinal, and Yuma Counties) BLM: S	No	No	No	In Arizona, found at elevations below 4,500 feet amsl in freshwater marshes, which are often dominated by cattails (*Typha* spp.), bulrushes (*Isolepis* spp.), and sedges (*Carex* spp.).	Range includes the Colorado River from Lake Mead to Mexico; the Gila and Salt Rivers upstream to the area of the Verde confluence; Picacho Reservoir; and the Tonto Creek arm of Roosevelt Lake. This species may be expanding into other suitable marsh habitats in western and central Arizona.	Unlikely to occur
California least tern (*Sternula antillarum browni*)	BLM: S	No	No	No	Habitat includes seacoasts, beaches, bays, estuaries, lagoons, lakes, and rivers	Species is rarely found in the state, one breeding record occurred in 2009 in Maricopa County but the species has not bred in the state since.	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (eBird, SWCA or BLM Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in BLM Offered Lands
Mexican spotted owl (*Strix occidentalis lucida*)	ESA: T (All counties except La Paz and Yuma Counties) BLM: S	Yes, Appleton Ranch	No	No	Found in mature montane forests and woodlands and steep, shady, wooded canyons. Can also be found in mixed-conifer and pine-oak vegetation types; generally nests in older forests of mixed conifers or ponderosa pine (*Pinus ponderosa*)–Gambel oak (*Quercus gambelii*). Nests in live trees on natural platforms (e.g., dwarf mistletoe [*Arceuthobium* spp.] brooms), snags, and canyon walls at elevations between 4,100 and 9,000 feet amsl.	Found throughout the state in summer in forested mountains with steep canyons; found in almost all counties of Arizona; recently species has been found wintering in lower riparian areas such as Tonto Creek and Sabino Canyon	Unlikely to occur
Le Conte's thrasher (*Toxostoma lecontei*)	BLM: S	Yes, Dripping Springs	No	No	Flat, open saltbush deserts with a few scattered mesquites or creosote present	Species is found in the low deserts of southwestern Arizona	Unlikely to occur
Fish							
Gila longfin dace (*Agosia chrysogaster*)	BLM: S	Yes, Appleton Ranch, Lower San Pedro River	No	No	Habitat varies from intermittent hot low-desert stream to clear, cool streams at higher elevations; prefers medium- to small-sized streams with sandy/gravely bottoms and pools with some cover. Species is normally found below 4,900 feet amsl.	Occurs in central, southern, and southeastern Arizona	Possible to occur: Appleton Ranch, Lower San Pedro River
Desert sucker (*Catostomus clarki*)	BLM: S	Yes, Appleton Ranch	No	No	Species is found in flowing pools of streams and rivers with a gravel substrate; elevational range of 480–8,840 feet amsl	Found throughout the Gila River basin and in tributaries to the Bill Williams River	Possible to occur: Appleton Ranch, Lower San Pedro River
Sonora sucker (*Catostomus insignis*)	BLM: S	Yes, Appleton Ranch	No	No	Found in a variety of habitats from warm rivers to cool streams, prefers gravelly or rocky pools in elevations ranging from 1,210–8,730 feet amsl	Found in the Gila and Bill Williams river basins	Possible to occur: Appleton Ranch, Lower San Pedro River
Desert pupfish (*Cyprinodon macularius*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Santa Cruz, and Yavapai Counties) BLM: S	Yes, Appleton Ranch	Yes, Appleton Ranch (WestLand Resources Inc. 2004b)	No	Found in shallow waters of springs, marshes and small streams, prefers soft substrates and clear water; elevational range of 1,200–3,450 feet amsl	No natural populations remaining; populations were reintroduced at sites in Graham, Yavapai, and Santa Cruz Counties	Unlikely to occur
Gila chub (*Gila intermedia*)	ESA: E (Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai Counties) BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Normally found in smaller headwater streams, cienegas, and springs or marshes of the Gila River Basin at elevations below 2,720 and 5,420 feet amsl	Currently found in the following drainages: Santa Cruz River, Middle Gila River, San Pedro River, Agua Fria River, and Verde River	Possible to occur: Appleton Ranch, Lower San Pedro River
Headwater chub (*Gila nigra*)	BLM: S	No	No	No	Species is found in the middle to headwater reaches of medium-sized streams with large pools and cover; elevational range of 925–2,000 feet amsl	Current range includes streams in the Verde River basin, Tonto Creek subbasin and San Carlos River basin in Yavapai, Gila, and Graham Counties	Unlikely to occur
Roundtail chub (*Gila robusta*)	BLM: S	No	No	No	Species prefers cool to warm water in mid-elevation streams and rivers with pools up to 6.6 feet deep near flowing water. Cover consists of boulders, tree roots, deep water and submerged vegetation. Elevational range of 1,210–7,220 feet amsl.	Occurs in tributaries to the Little Colorado River, tributaries to the Bill Williams River basin, the Salt River and its tributaries, the Verde River and its tributaries, Aravaipa Creek and Eagle Creek	Possible to occur: Appleton Ranch, Lower San Pedro River
Little Colorado spinedace (*Lepidomeda vittata*)	ESA: T (Apache, Coconino and Navajo Counties) BLM: S	No	No	No	Habitat consists of medium to small streams and is characteristically found in pools with water flowing over fine gravel and silt-mud substrates; elevational range of 4,000–8,000 feet amsl	Found in East Clear Creek and its tributaries, Chevelon and Silver Creeks, and Nutrioso Creek and the Little Colorado River	Unlikely to occur
Spikedace (*Meda fulgida*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pinal, and Yavapai Counties) BLM: S	No	No	No	Found in medium-sized to large perennial streams, where it inhabits moderate-velocity to fast waters over gravel and rubble substrates, typically at elevations below 6,000 feet amsl	In Arizona, populations are found in the middle Gila, and Verde Rivers and Aravaipa and Eagle Creeks.	Unlikely to occur

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Gila topminnow (incl. Yaqui) (*Poeciliopsis occidentalis*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai Counties) BLM: S	Yes, Appleton Ranch	No	No	Occurs in small streams, springs, and cienegas at elevations below 4,500 feet amsl, primarily in shallow areas with aquatic vegetation and debris for cover	In Arizona, most of the remaining native populations are in the Santa Cruz River system	Unlikely to occur
Colorado pikeminnow (*Ptychocheilus lucius*)	ESA: E, ENE (Gila, Maricopa, and Yavapai Counties)	No	No	No	Juveniles prefer slackwater, backwater and side channels with little or no flow and silty substrates; adults utilize turbid, deep and fast-flowing waters. Species was reintroduced at an elevation of 1,960 feet amsl.	Considered extirpated from the state, two experimental populations have been stocked into Salt and Verde River drainages	Unlikely to occur
Speckled dace (*Rhinichthys ocsulus*)	BLM: S	No	No	No	Species prefers rocky areas of riffles, runs, pools, creeks, and small to medium rivers	Occurs in the Colorado, Bill Williams, and Gila River drainages	Possible to occur: Lower San Pedro River
Loach minnow (*Tiaroga cobitis*)	ESA: E (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Pinal, and Yavapai Counties) BLM: S	No	No	No	Found in small to large perennial creeks and rivers, typically in shallow, turbulent riffles with cobble substrate, swift currents, and filamentous algae at elevations below 8,000 feet amsl	Its range in Arizona is limited to reaches in the East Fork of the White River (Navajo County); Aravaipa, Deer, and Turkey Creeks (Graham and Pinal Counties); San Francisco and Blue Rivers; and Eagle, Campbell Blue, and Little Blue Creeks (Greenlee County). A population was discovered in the Black River in 1996.	Unlikely to occur
Razorback sucker (*Xyrauchen texanus*)	ESA: E (Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pinal, Yavapai, and Yuma Counties) BLM: S	No	No	No	Found in backwaters, flooded bottomlands, pools, side channels, and other slower-moving habitats at elevations below 6,000 feet amsl	In Arizona, populations are restricted to Lakes Mohave and Mead and the lower Colorado River below Havasu in the Lower Basin. In the Upper Basin, small remnant populations are found in the Green, Yampa, and main stem Colorado Rivers.	Unlikely to occur
Invertebrates							
Monarch butterfly (*Danaus plexippus* pop. 1)	BLM: S	No	No	No	Species present during spring and summer, rarely during winter at varying elevations around the state; prefers riparian habitats with milkweeds present	Species is present throughout the state	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Bylas springsnail (*Pyrgulopsis arizonae*)	BLM: S	No	No	No	Species is found in springs ranging from 26–32 degrees Celsius with submergent vegetation	Found in three springs along the Gila River between Bylas and Pima in Graham County, Arizona	Unlikely to occur
Sonoran talussnail (*Sonorella magdalenensis*)	BLM: S	No	No	No	Species prefers talus slopes of coarse broken rock; elevational range of 2,750–6,000 feet amsl	Occurs in Pima and Santa Cruz Counties, Arizona	Unlikely to occur
Arizona cave amphipod (*Stygobromus arizonensis*)	BLM: S	No	No	No	Species prefers aquatic habitat in subterranean caves and mines; found at elevations of 5,245 feet amsl	Found only at two locations in Cochise County, Arizona	Unlikely to occur
Gila tryonia (*Tryonia gilae*)	BLM: S	No	No	No	Species is found in mildly thermal springs with submergent vegetation; elevational range of 2,600–2,800 feet amsl	Found in an unnamed spring north of Bylas, also in Cold Springs and Porter Wash in Graham County, Arizona	Unlikely to occur
Mammals							
Sonoran pronghorn (*Antilocapra americana sonoriensis*)	ESA: ENE (La Paz, Maricopa, Pima, Pinal, Santa Cruz and Yuma Counties) BLM: S	No	No	No	Found in Sonoran desertscrub within broad, intermountain, alluvial valleys with creosote (*Larrea tridentata*)–bursage (*Ambrosia* spp.) and palo verde–mixed cacti associations at elevations between 2,000 and 4,000 feet amsl	The only extant U.S. population is in southwestern Arizona	Unlikely to occur
Mexican gray wolf (*Canis lupus baileyi*)	ESA: E (Apache and Greenlee Counties) BLM: S	No	No	No	Vegetation type not important, species mostly needs sufficient prey such as deer and elk. Reintroduction areas are typically rugged lands in coniferous forest. Elevational range of 3,000–12,000 feet amsl.	Occurs in Apache and Greenlee Counties, reintroductions are occurring in Apache County. All packs are currently located on the Apache-Sitgreaves National Forests (AGFD 2018a).	Unlikely to occur

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Mexican long-tongued bat (*Choeronycteris mexicana*)	BLM: S	No	No	No	Habitat includes mesic areas in canyons of mixed oak-conifer forests in mountains rising from the desert. Roosts in daytime in caves, abandoned mines, and rockshelters; occasionally in palo verde-saguaro areas. Typically at elevations of 2,540–7,320 feet amsl.	Occurs in southeast Arizona from the Chiricahua Mountains west to the Baboquivari Mountains and as far north as the Santa Catalina Mountains. HDMS unpublished records from Pinal, Pima, Graham, Santa Cruz and Cochise Counties.	Possible to occur: Appleton Ranch
Pale Townsend's big-eared bat (*Corynorhinus townsendii*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	In summer the species is found in caves and mines in elevations ranging from 550–7,520 feet amsl; in winter the species is found in cold caves, lava tubes, and mines in higher elevations than summer.	Occurs throughout Arizona	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Gunnison's prairie dog (*Cynomys gunnisoni*)	BLM: S	No	No	No	Species prefers high mountain valleys and plateaus; elevational range of 6,000–12,000 feet amsl	Occurs in north-central and northeastern Arizona	Unlikely to occur
Black-tailed prairie dog (*Cynomys ludovicianus*)	BLM: S	Yes, Appleton Ranch	No	No	Habitat is dry, flat, open plains and desert grasslands; elevational range of 2,300–7,200 feet amsl	Occurs in southeast Arizona where they are reintroduced to the Las Cienegas National Conservation Area	Unlikely to occur
Banner-tailed kangaroo rat (*Dipodomys spectabilis*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Habitat is Great Basin desertscrub, desert grasslands with mesquite, junipers or shrubs; elevational range of 3,500–4,000 feet amsl	Occurs in Apache County	Unlikely to occur
Spotted bat (*Euderma maculatum*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Habitat can vary widely from dry deserts to conifer forest, prefer to roost in crevices and cracks in cliff faces; elevational range of 110–8,670 feet amsl	Not well known, records from Yuma, Roll, Maricopa County, Kaibab Plateau, and some heard-only records from eastern Arizona	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Greater western mastiff bat (*Eumops perotis californicus*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Species prefers lower and upper Sonoran desertscrub near cliffs with lots of crevices; elevational range of 240–8,475 feet amsl	Occurs year-round and is widespread throughout the state	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Allen's lappet-browed or big-eared bat (*Idionycteris phyllotis*)	BLM: S	No	No	No	Found in ponderosa pine, pinyon-juniper, Mexican woodland, and riparian areas with cottonwoods, sycamores, and willows; also have records from desertscrub and white fir habitats; elevational range of 1,320–9,800 feet amsl	Widespread in Arizona except for deserts in southwestern Arizona, most records from southern Colorado Plateau, Mogollon Rim, and adjacent mountain ranges	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Ocelot (*Leopardus* (*Felis*) *pardalis*)	ESA: E (Cochise, Gila, Graham, Maricopa, Pima, Pinal, and Santa Cruz Counties) BLM: S	No	No	No	In Arizona, this species has typically been observed in subtropical thorn forest, thornscrub, and dense, brushy thickets at elevations below 8,000 feet amsl and is often found in riparian bottomlands. The critical habitat component is probably dense cover near the ground and complete avoidance of open country.	In Arizona, there are five recent confirmed sightings of ocelot in Cochise County (2009), the Huachuca Mountains (2011 and 2012), one near Globe (2010), Santa Rita Mountains (2014), and unconfirmed sightings in the Chiricahua and Peloncillo Mountains.	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	Yes, Appleton Ranch (WestLand Resources Inc. 2004b)	Forage plants noted during site visits at Dripping Springs, Lower San Pedro River, and Appleton Ranch	Habitat consists of desert grasslands and shrublands in elevations ranging from 1,190–7,320 feet amsl; present only in summer	Species ranges from the Picacho Mountains south to the Agua Dulce Mountains, then east to the Chiricahua Mountains. Two records from the Phoenix area.	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
California leaf-nosed bat (*Macrotus californicus*)	BLM: S	Yes, Dripping Springs, Lower San Pedro River	No	No	Species prefers Sonoran desertscrub, roosts in mines, caves and rockshelters that have large areas of ceiling and flying space; elevational range of 160–3,980 feet amsl	Typically found south of the Colorado Plateau, year-round resident	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Arizona myotis (*Myotis occultus*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Found in ponderosa pine and oak-pine woodlands near water, can also be found in riparian forests along the lower Colorado and Verde rivers; elevational ranges of 150–1,000 feet amsl (lower Colorado River) and 3,200–8,620 feet amsl	Found in higher elevations of central and eastern counties of Arizona as well as the lower Colorado River Valley	Possible to occur: Appleton Ranch, Lower San Pedro, Dripping Springs
Cave myotis (*Myotis velifer*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	No	Habitat consist of creosote, brittlebush, palo verde, and cacti; roosts in caves, tunnels, mineshafts, under bridges and sometimes in buildings. Elevational range of 300–5,000 feet amsl.	Range is south of the Mogollon Plateau to Mexico, mostly summer resident except for a few that winter in southeastern Arizona	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (eBird, SWCA or BLM Site Visits, Reptiles of Arizona)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in BLM Offered Lands
Jaguar (*Panthera onca*)	ESA: E (Cochise, Pima, and Santa Cruz Counties) BLM: S	No	No	No	Variety of habitats, prefers lowland wet habitats but also occurs in drier habitats such as oak-pine woodlands; elevational range of sightings in Arizona were from 5,200–5,700 feet amsl	All documented sightings have been from southeastern Arizona	Possible to occur: Appleton Ranch, Lower San Pedro River
Reptiles							
Arizona striped whiptail (*Aspidoscelis arizonae*)	BLM: S	No	Yes, Appleton Ranch (Cogan 2012)	Reptiles of Arizona	Species prefers Semi-desert Grasslands in low valleys and sandy flats	Species only occurs near Willcox in Cochise County and in Whitlock Valley, Graham County	Unlikely to occur
New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscurus*)	ESA: T (Cochise County) BLM: S	No	No	No	Habitat includes rocks, bunchgrass, and leaf litter in steep rocky canyons in the pine-oak and pine-fir belts at elevations of 5,600–9,000 feet amsl	Occurs only in the Pelloncillo Mountains of Cochise County	Unlikely to occur
Sonoran Desert tortoise (*Gopherus morafkai*)	BLM: S	Yes, Dripping Springs, Lower San Pedro River	No	Reptiles of Arizona	Habitat includes Mojave desert scrub to semidesert grassland and interior chaparral; elevational range of 510–5,300 feet amsl	Species occurs across much of the southern and southwest part of the state, ranging from Kingman to Yuma to Tucson	Possible to occur: Appleton Ranch, Lower San Pedro River, Dripping Springs
Sonora mud turtle (*Kinosternon sonoriense sonoriense*)	BLM: S	Yes, Appleton Ranch, Dripping Springs, Lower San Pedro River	No	Reptiles of Arizona	Species prefers rocky stream, creeks, rivers, ponds, cattle tanks, and ditches in habitats ranging from Sonoran desertscrub to woodlands; elevational range of sea level to 6,500 feet amsl	Occurs in southeastern Arizona and along and below the Mogollon Rim	Possible to occur: Appleton Ranch, Lower San Pedro River
Slevin's bunchgrass lizard (*Sceloporus slevini*)	BLM: S	Yes, Appleton Ranch	Yes, Appleton Ranch (Cogan 2012)	Reptiles of Arizona	Species prefers coniferous forests around bunchgrass in open sunny areas; elevational range of 4,300–9,480 feet amsl	Found only in the mountains of extreme southeast Arizona	Possible to occur: Appleton Ranch
Desert massasauga (*Sistrurus catenatus edwardsii*)	BLM: S	No	No	No	Species prefers tobosa grasslands in sloping bajadas with surface rocks; elevational range of 4,400–4,700 feet amsl	Occurs in extreme southeastern Arizona in San Bernardino and Sulphur Springs Valley	Unlikely to occur
Desert ornate box turtle (*Terrapene ornata*)	BLM: S	No	No	Reptiles of Arizona	Species prefers low valleys, plains, and bajadas in semi-desert grassland and Chihuahuan desertscrub habitat types; elevational range of 2,000–7,100 feet amsl	Species is found in southeast Arizona, ranging as far north as Winkelman	Possible to occur: Appleton Ranch, Lower San Pedro River
Northern Mexican gartersnake (*Thamnophis eques megalops*)	ESA: T (All counties except Maricopa and Yuma Counties) BLM: S	Yes, Appleton Ranch	Yes, Appleton Ranch (Cogan 2012)	Reptiles of Arizona	Species prefers cienegas, streams, and rivers in habitats ranging from upland Sonoran desertscrub to montane coniferous forests; elevational range of 1,000–6,700 feet amsl	Species is found along the Mogollon Rim and a few isolated populations in south-central Arizona	Possible to occur: Appleton Ranch
Narrow-headed gartersnake (*Thamnophis rufipunctatus*)	ESA: T (Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties) BLM: S	No	No	No	Species prefers pinyon-juniper and pine-oak woodlands, ranging into ponderosa pine at elevations between 2,440–8,080 feet amsl; species needs permanent water source	Species is found along the Mogollon Rim	Unlikely to occur

* Status Definitions

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = Threatened. Threatened species are those that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

ENE = Reintroduced populations designated as Experimental – Nonessential, under ESA.

Bureau of Land Management (BLM):

S = Sensitive. Species that could easily become endangered or extinct in the state.

Bald and Golden Eagle Protection Act (BGEPA):

Yes = A species protected by a United States Federal statute that protects two species of eagle.

Table B-5. Special status plant species analyzed for the offered lands parcels

Unless otherwise noted, range or habitat information is from the following sources: Arizona Heritage Data Management System (Arizona Game and Fish Department 2018a); USFWS Arizona Ecological Services Field Office (U.S. Fish and Wildlife Service 2016b); Tonto National Forest Final Assessment (U.S. Forest Service 2017d); Tonto National Forest Threatened, Endangered and Sensitive Species Abstracts (Tonto National Forest 2000); NatureServe (NatureServe 2018); Bureau of Land Management (Bureau of Land Management 2017b); Reptiles of Arizona (Brennan 2008); eBird (2018); (SEINet 2018)

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (SEINet, NatureServe)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Analysis Area
Acuna cactus (*Echinomastus erectocentrus* var. *acunensis*)	ESA: E (Maricopa, Pima, and Pinal Counties) BLM: S	No	No	No	Occurs in valleys and on small knolls and gravel ridges of up to 30 percent slope in the Palo Verde-Saguaro Association of the Arizona Upland subdivision of the Sonoran Desert scrub. Elevation 1,190–3,773 feet amsl.	Found in Maricopa, western Pima, and Pinal Counties	Unlikely to occur
Alcove bog orchid (*Platanthera zothecina*)	CNF: S	No	No	No	Found at bases of alcove face-walls with flowing drip-line or with seepage down wall, shaded seeps, in dense vegetation or under rock debris, and in shaded sites along streams; elevation 3,950–6,400 feet amsl	Apache, Coconino, and Navajo Counties	Unlikely to occur
Aravaipa woodfern (*Thelypteris puberula* var. *sonorensis*)	TNF: S BLM: S	No	No	No	Meadows and seeps, wetland-riparian	Coconino, Graham, Pima, Pinal, and Yavapai Counties	Unlikely to occur
Arizona bugbane (*Actaea arizonica*)	CNF: S TNF: S	No	No	No	Mixed conifer and high-elevation riparian deciduous forests in deep shade and moist soils with high humus content, near perennial or intermittent streams or seeps, especially along bottoms and lower slopes of steep, narrow canyons; elevation 5,300–8,300 feet amsl	Coconino, Kaibab, and Tonto National Forests in central Arizona	Possible to occur: East Clear Creek
Arizona cliffrose (*Purshia subintegra*)	ESA: E (Graham, Maricopa, Mohave and Yavapai Counties)	No	No	No	Occurs at four widely separated areas across central Arizona, these sights differ slightly in elevation and associated vegetation. All sites have limestone soils derived from Tertiary lacustrine (lakebed) deposits.	Graham, Maricopa, Mohave, and Yavapai Counties	Unlikely to occur
Arizona eryngo (*Eryngium sparganophyllum*)	BLM: S	No	No	No	Riparian zones and marshes within pinyon-Juniper woodland and Madrean evergreen woodland. Elevation between 3,000–8,000+ feet amsl.	Cochise and Pima Counties	Unlikely to occur
Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*)	ESA: E (Maricopa, Pinal, and Gila Counties) BLM: S	Yes, Apache Leap	No	No	Found on dacite or granite bedrock, open slopes, in narrow cracks, between boulders, and in the understory of shrubs in the ecotone between Madrean evergreen woodland and Interior Chaparral. Elevation 3,200–5,200 feet amsl.	In Gila and Pinal Counties of central Arizona. Exact locations are not provided because illegal collecting threatens the species.	Known to occur: Apache Leap South
Arizona leatherflower (*Clematis Hirsutissima* var. *arizonica*)	CNF: S	No	No	No	Limestone-derived soils within ponderosa pine and pinyon pine, and Rocky Mountain juniper communities	Apache and Coconino Counties	Unlikely to occur
Arizona phlox (*Phlox amabilis*)	CNF: S TNF: S	No	No	Yes	Open, exposed, limestone-rocky slopes within pinyon-juniper woodlands and ponderosa pine-Gambel oak communities	Coconino, Gila, Graham, and Yavapai Counties	Possible to occur: Tangle Creek
Arizona rabbitbrush (*Chrysothamnus molestus*)	CNF: S	No	No	No	Rocky soils, mostly on limestone pinyon-juniper woodlands. Elevation between 5,905–7,875 feet amsl.	Only known from Coconino County.	Unlikely to occur
Arizona sneezeweed (*Helenium arizonicum*)	CNF: S	No	No	Yes	Roadsides and clearings in ponderosa forests and in regions of pine forests, especially around wet places such as bogs, ponds, lakes, and roadside ditches	Known almost exclusively from Coconino County, but also found in southern Apache, Gila, and possibly Navajo Counties	Possible to occur: East Clear Creek, Tangle Creek
Arizona Sonoran rosewood (*Vauquelinia californica* ssp. *sonorensis*)	BLM: S	No	No	Yes	Woodland or forest at base of cliffs, along canyon bottoms and on moderate to steep slopes of the Ajo Mountains. Elevation 2,300–4,800 feet amsl.	Cochise, Gila, Maricopa, Pima, and Pinal Counties	Known to occur: Apache Leap South
Arizona sunflower (*Helianthus arizonensis*)	CNF: S	No	No	No	Open pine woodlands. Elevation 3,935–6,885 feet amsl.	Apache, Coconino, Navajo, and Yavapai Counties	Unlikely to occur
Bartram stonecrop (*Graptopetalum bartramii*)	BLM: S	No	No	No	Sky island species growing on rocky outcrops along arroyos and canyons, often in shade and litter with Madrean evergreen woodland. Elevation 3,900–6,700 feet amsl.	Cochise, Pima, and Santa Cruz Counties	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (SEINet, NatureServe)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Analysis Area
Bebb's willow (*Salix bebbiana*)	CNF: S	No	No	No	Along stream channels, on the edges of drainages, along seeps, and in perched sites that appear to be receiving little water	Apache, Coconino, Navajo, and Yavapai Counties	Unlikely to occur
Blumer's dock (*Rumex orthoneurus*)	CNF: S TNF: S	No	No	Yes	Near perennial springs in unshaded meadows or along stream sides in canyons. In organic, moist soils. Elevation 6,490–9,030 feet amsl.	Apache, Coconino, Cochise, Gila, and Graham Counties	Known to occur: East Clear Creek
Chihuahua breadroot aka scurfpea (*Pediomelum pentaphyllum*)	BLM: S	No	No	No	Sandy, loamy soils	Cochise and Graham Counties	Unlikely to occur
Chihuahuan sedge (*Carex chihuahuensis*)	TNF: S	No	No	No	Stream banks, springs, and seeps. Elevation 1,100–8,000 feet amsl.	Cochise, Gila, Graham, Pima, and Santa Cruz Counties. Tonto National Forest: only found along Reynolds Creek.	Unlikely to occur
Chiricahua Mountain alumroot (*Heuchera glomerulata*)	TNF: S	No	No	No	Found on north-facing shaded rocky slopes, near seeps, springs and riparian areas, often in humus soil. Elevation 4,000–9,000 feet amsl.	Apache, Cochise, Greenlee, Gila, Graham, and Navajo Counties. Tonto National Forest: only found in Pinal Mountains	Unlikely to occur
Clifton rock daisy (*Perityle ambrosiifolia*)	BLM: S	No	No	No	Occurs in fissures and crevices in conglomerate rock near seeps and waterfalls; high desert above and riparian below	Species occurs on cliffs above Eagle Creek and San Francisco River in Greenlee County	Unlikely to occur
Cochise sedge (*Carex ultra*); also (*Carex spissa* var. *ultra*)	CNF: S TNF: S BLM: S	No	No	No	Stream banks, wet seeps, sometimes on serpentine. Elevation lower than 1,970 feet amsl.	Apache, Cochise, Graham, Pima, Pinal, Santa Cruz and Yavapai Counties	Unlikely to occur
Countess Dalhousie's spleenwort (*Asplenium dalhousiae*)	BLM: S	No	No	No	Moist, rocky ravines, terrestrial among and at bases of rocks. Elevation 4,260–6,570 feet amsl.	Cochise and Pima Counties Only found in the Mule, Huachuca, and Baboquivari Mountains of southern Arizona	Unlikely to occur
Crenulate moonwort (*Botrychium crenulatum*)	CNF: S	No	No	No	Wet, marshy, and springy areas, including marshy meadows, edges of marshes, saturated soils of seeps, bottoms and stabilized margins of small streams. Sites partly to heavily shaded and usually have dense vegetation cover. Elevation 3,930–8,210 feet amsl.	Native, no county data	Unlikely to occur
Eastwood alum root (*Heuchera eastwoodiae*)	CNF: S TNF: S	No	No	No	Shaded, rocky slopes. Elevation 4,920–6,250 feet amsl.	Coconino, Gila, Maricopa, and Yavapai Counties	Unlikely to occur
Fickeisen plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*)	ESA: E (Coconino, Mohave, and Navajo Counties) BLM: S	No	No	No	Occurs on gravelly soils of alkaline desert scrub and desert grasslands; elevational range of 3,985–5,940 feet amsl.	Endemic to northern Arizona, found in Coconino, Mohave, and Navajo Counties	Unlikely to occur
Fish Creek fleabane (*Erigeron piscaticus*)	TNF: S BLM: S	No	No	No	Gravelly and sandy washes. Elevation 2,290–3,940 feet amsl.	Maricopa and Graham Counties	Unlikely to occur
Fish Creek rockdaisy (*Perityle saxicola*)	TNF: S	No	No	No	Cracks and crevices on very steep cliff faces, large boulders and rocky outcrops in canyons, and on buttes. Steep cliffs with generally east and northeast exposures, with slopes from 50 to 100 percent. Elevational range of 2,000–3,500 feet amsl.	Gila and Maricopa Counties. On Tonto National Forest occurs near Roosevelt Lake Dam and in Sierra Ancha Mountains, suspected to be in Superstition Mountains	Unlikely to occur
Flagstaff beardtongue (*Penstemon nudiflorus*)	CNF: S	No	No	No	Dry ponderosa pine forests in mountainous regions south of the Grand Canyon. Elevation 4,490–6,990 feet amsl.	Coconino, Navajo, and Yavapai Counties	Unlikely to occur
Flagstaff false pennyroyal (*Hedeoma diffusum*)	CNF: S	No	No	No	Rocky pavement, cliff, and limestone break habitats in the ponderosa pine vegetation type. Elevation 6,000–7,000 feet amsl.	Coconino, Navajo, and Yavapai Counties	Unlikely to occur
Galiuro aka Aravaipa sage (*Salvia amissa*)	TNF: S BLM: S	No	No	No	Stream banks and moist meadows in full sun or light shade. Elevation 1,509–3,010 feet amsl.	Cochise, Gila, and Graham Counties	Unlikely to occur
Gentry's indigobush (*Dalea tentaculoides*)	BLM: S	No	No	No	Canyon bottoms on cobble terraces subject to occasional flooding, in sandy, gravelly loam Rhyolite parent material. Elevation 3,600–4,600 feet amsl.	Pima, Cochise, and Santa Cruz Counties	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (SEINet, NatureServe)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Analysis Area
Grand Canyon century plant aka Phillip's agave (*Agave phillipsiana*)	CNF: S	No	No	No	Sandy to gravelly places with desert scrub. Elevation 2,290–3,610 feet amsl.	Known only from four sites within Grand Canyon National Park	Unlikely to occur
Heathleaf wild buckwheat (*Eriogonum ericifolium* var. *ericifolium*)	CNF: S	No	No	No	Gravelly or rocky slopes of lacustrine silt, mixed grasslands, chaparral and oak-woodlands. Elevation 2,950–3,610 feet amsl.	Coconino, Pima, and Yavapai Counties	Unlikely to occur
Hohokam agave aka. Murphey agave (*Agave murpheyi*)	TNF: S BLM: S	No	No	No	Mountainous slopes in dry chaparral and desert areas. Near drainage systems in desert scrub. Elevation 1,310–3,280 feet amsl.	Gila, Maricopa, Pinal, and Yavapai Counties	Possible to occur: Apache Leap South, Cave Creek
Huachuca golden aster (*Heterotheca rutteri*)	BLM: S	No	No	No	Grasslands with mesquite, grassy understory in oak woodlands, grassy floodplains, sandy, loamy soils. Elevation 3,280–4,920 feet amsl.	Cochise, Santa Cruz, and Pima Counties	Possible to occur: Appleton Ranch
Huachuca Mountain milkvetch (*Astragalus hypoxylus*)	BLM: S	No	No	No	Oak woodland with south to southwest exposures. Elevation 5,300–5,500 feet amsl.	Santa Cruz and Cochise Counties	Unlikely to occur
Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*)	ESA: E (Cochise, Pima, and Santa Cruz Counties) BLM: S	No	Appleton Ranch (WestLand Resources Inc. 2004b)	No	The majority of this species occur along the San Pedro River, in the Huachuca Mountains, and along Cienega Creek in the San Pedro River and Santa Cruz River watersheds	Occurs on lands administered by the U.S. Army Fort Huachuca, the Forest Service, the BLM, the U.S. Fish and Wildlife Service, Arizona Parks, Pima County, The Nature Conservancy, and private landowners	Unlikely to occur
Kearney's blue star (*Amsonia kearneyana*)	BLM: S	No	No	No	Stable alluvial deposits of small boulders and cobbles along a dry wash. Grows in full sun or partial shade in riparian vegetation zone surrounded by Sonoran Desert Scrub.	Found only in Pima County	Unlikely to occur
Lace-leaf rockdaisy (*Perityle ambrosiifolia*)	BLM: S	No	No	No	In fissures and crevices of north- or east-facing cliffs and canyon walls; conglomerate, sandstone, or rhyolite rock, often near seeps and waterfalls. Found within pinyon-juniper grassland communities. Elevation 1,640–4930 feet amsl.	Greenlee County	Unlikely to occur
Lyngholm's cliffbrake (*Pellaea lyngholmii*)	CNF: S	No	No	No	Rocky slopes and ledges, usually on sandstone. Elevation 3,935–5905 feet amsl.	Coconino and Yavapai Counties	Unlikely to occur
Mapleleaf false snapdragon (*Mabrya acerifolia*)	TNF: S	No	No	No	Occurs on rock overhangs and in bare rock/talus/scree, cliff, and desert habitats. Elevation around 2,000 feet amsl.	Maricopa and Pinal Counties; all localities occur in the Mesa Ranger District	Unlikely to occur
Mearns' bird-foot trefoil aka horseshoe deer vetch (*Lotus mearnsii* var. *equisolensis*)	TNF: S	No	No	No	Desert scrub growing on late Tertiary lacustrine deposits at an elevation of 2,100 feet amsl	Known only from Horseshoe Reservoir, Maricopa County	Unlikely to occur
Metcalfe's tick-trefoil (*Desmodium metcalfei*)	CNF: S	No	No	No	Rocky slopes and canyons in grasslands, oak-pinyon-juniper woodlands, and riparian forests. Elevation between 4,000–6,500 feet amsl.	Cochise, Coconino, Gila, Pinal, Santa Cruz and Yavapai Counties	Unlikely to occur
Mogollon thistle (*Cirsium parryi* ssp. *mogollonicum*)	CNF: S	No	No	No	Moist to very moist soils in riparian understory of perennial stream with ponderosa pine, Douglas-fir, and white fir. Elevation 7,200 feet amsl.	Endemic to <1 square mine in Dane Canyon in Coconino County	Unlikely to occur
Mt. Dellenbaugh sandwort (*Arenaria aberrans*)	CNF: S	No	No	No	Oak and pine forests, mixed forests/woodland	Gila and Yavapai Counties	Unlikely to occur
Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*)	ESA: E (Maricopa, Pima, and Pinal Counties) BLM: S	No	No	No	Found on limestone substrates along dissected alluvial fans, inclined terraces and saddles, bajadas, and debris flow. It grows in open areas and partially to shaded areas underneath the canopy of shrubs and trees, or sheltered next to rocks on steep slopes and within limestone outcrops. Occurs within the Upland Division of Sonoran Desert scrub on 0 to 30 percent slopes with north-, west-, and south-facing exposure. Elevation 2,400–4,000 feet amsl.	Endemic to the Sonoran Desert and occurs on isolated mountain ranges within south-central Arizona in Pima and Pinal Counties	Unlikely to occur

Common Name (*Scientific Name*)	Status*	HDMS Records within 2 miles	Baseline Data Records	Other Occurrence Records (SEINet, NatureServe)	Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence in Offered Lands Analysis Area
Page Springs agave (*Agave yavapaiensis*)	CNF: S	No	No	No	Rocky, clayey-loamy igneous derived soils, less frequently on limestone soils in semi-arid desert grassland to pinyon-juniper woodland	Known only from 10 populations occurring near habitation and agricultural and archaeological sites associated with pre-Columbian cultures	Unlikely to occur
Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*)	ESA: E (Navajo County) BLM: S	No	No	No	Weakly alkaline, gravelly soils where the host gravel can occur on a variety of substrates. Elevation between 5,400 and 5,600 feet amsl.	Central Navajo County, near Holbrook, Arizona	Unlikely to occur
Parish's Indian mallow (*Abutilon parishii*)	TNF: S BLM: S	No	No	No	Mountain slopes and desert scrublands. Elevation is 3,280 feet amsl.	Found in Maricopa, Gila, Graham, Pima, Pinal, and Yavapai Counties	Possible to occur: Apache Leap South, Dripping Springs
Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*)	BLM: S	No	No	No	Alluvial valleys, mesas, and hillsides in desert, desert grassland, or southwestern oak woodlands. Soils range from shallow to deep, and silty to rocky, with a preference for silty to gravelly deep alluvial soils. Elevation 2,290–4,920 feet amsl.	Pima and Santa Cruz Counties	Unlikely to occur
Ripley's wild buckwheat (*Eriogonum ripleyi*)	CNF: S TNF: S	No	No	No	Sandy clay flats and slopes on edges of sandstone outcrops, oak-juniper woodlands. Elevation 3,280–6,235 feet amsl.	Known only from two areas in Arizona: one near Frazier's Well in Coconino County and a second in the Verde Valley area of southeastern Yavapai and extreme northwestern Maricopa County	Unlikely to occur
Rock fleabane (*Erigeron saxatilis*)	CNF: S	No	No	Yes	Shaded canyon walls, moist north-facing slopes, and steep rock outcrops and boulders in the stream beds of shady canyons. Elevation 4,390–6,990 feet amsl.	Coconino, Gila, and Yavapai Counties	Known to occur: East Clear Creek
Round dunebroom (*Errazurizia rotundata*)	BLM: S	No	No	No	Sandy areas or in crevices of rock on rocky hilltops and ledges.	Coconino and Navajo Counties	Unlikely to occur
Rusby's milk-vetch (*Astragalus rusbyi*)	CNF: S	No	No	No	Meadows in yellow pine forest or edge of thickets and aspen groves, in dry or temporarily moist basaltic soils; elevational range of 5,400–8,000 feet amsl.	Occurs in the Flagstaff area and the lower slopes of the San Francisco Peaks descending into Oak Creek Canyon, in Coconino County	Unlikely to occur
Rusby's milkwort (*Polygala rusbyi*)	CNF: S TNF: S	No	No	No	Desert grasslands and juniper woodlands. Elevation 3,000–5,000 feet amsl.	Maricopa, Mohave, and Yavapai Counties	Unlikely to occur
Salt River rock daisy (*Perityle gilensis* var. *salensis*)	TNF: S	No	No	No	Crevices on cliff faces, ledges, and rock outcrops in Mojave Sonoran desert scrub, semi-desert grassland, juniper grass, and interior chaparral associations	Only two known sites, located along the Salt River Canyon.	Unlikely to occur
San Francisco Peaks groundsel (*Packera franciscana*)	ESA: T (Coconino County)	No	No	No	Talus slopes, rock crevices, above timberline. Elevation 10,500–12,470 feet amsl.	Known only from above timberline in the San Francisco Peaks	Unlikely to occur
San Pedro River wild buckwheat (*Eriogonum terrenatum*)	BLM: S	No	No	No	Clayey slopes and flat, creosote bush communities. Elevation 3,280–3,940 feet amsl.	Pima and Cochise Counties	Unlikely to occur
Sierra Ancha fleabane (*Erigeron anchana*)	TNF: S	No	No	No	Rock crevices and ledges on boulders or on vertical cliff faces, usually in canyons. Granite cliff faces, chaparral through pine forests.	Found in Gila County in the Sierra Ancha, Mazatzal, and Mescal Mountains as well as Pine Creek	Unlikely to occur
Sunset Crater beardtongue (*Penstemon clutei*)	CNF: S	No	No	No	Volcanic cinder cones, either in open areas or under ponderosa pines in spots without leaf litter. Elevation is 6,988 feet amsl.	Near Sunset Crater in Coconino County	Unlikely to occur
Texas purple-spike (*Hexalectris warnockii*)	BLM: S	No	No	No	Shaded slopes and dry, rocky creek beds in canyons, in leaf mold in oak-juniper-pinyon pine woodlands. Elevation 1,965–6,565 feet amsl.	Found in Cochise County	Unlikely to occur
Tonto Basin agave (*Agave delamateri*)	CNF: S TNF: S	No	No	No	Gravelly places with desert scrub, rarely in chaparral or pinyon-juniper woodlands. Elevation 2,295–5,250 feet amsl.	Gila, Maricopa, and Yavapai Counties	Possible to occur: Turkey Creek
Toumey's groundsel (*Packera neomexicana* var. *toumeyi*)	TNF: S	No	No	No	Found in oak chaparral and occasionally pine forest; elevational range of 3,000–9,000 feet amsl.	Cochise and Gila Counties, on Tonto National Forest found in the Pinal Mountains	Unlikely to occur

Common Name (*Scientific Name*)	**Status***	**HDMS Records within 2 miles**	**Baseline Data Records**	**Other Occurrence Records (SEINet, NatureServe)**	**Habitat Components (Elevation, Soils, Vegetation Association, Slope, Aspect, etc.)**	**Geographical Range in Arizona**	**Likelihood of Occurrence in Offered Lands Analysis Area**
Tumamoc globeberry (*Tumamoca macdougalii*)	BLM: S	No	No	No	Semidesert grasslands, sandy washes and gullies, Sonoran desert scrub	Maricopa, Pima, and Pinal Counties	Unlikely to occur
Verde breadroot (*Pediomelum verdiense*)	TNF: S	No	No	No	Sonoran desert scrub or scattered juniper communities on Verde limestone or compacted roadsides	Yavapai County	Unlikely to occur
Verde Valley sage (*Salvia dorrii* ssp. *mearnsii*)	CNF: S	No	No	No	Sandy, rocky, or limestone soil on dry open slopes, and on flats or foothills. Elevation 960–9,800 feet amsl.	Coconino and Yavapai Counties	Unlikely to occur

* Status Definitions

Endangered Species Act (ESA):

E = Endangered. Endangered species are those in imminent jeopardy of extinction. The ESA specifically prohibits the take of a species listed as endangered. Take is defined by the ESA as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to engage in any such conduct.

T = Threatened. Threatened species are those that are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Tonto National Forest (TNF):

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by: a. significant current or predicted downward trends in population number or density. B. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Coronado National Forest (CNF):

S = Sensitive. Species identified by a Regional Forester for which population viability is a concern, as evidenced by: a. significant current or predicted downward trends in population number or density. B. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Bureau of Land Management (BLM): Sensitive species were included from the Gila District Office

S = Sensitive. Species that could easily become endangered or extinct in the state.

Table B-6. Noxious and invasive weed species analyzed for the offered lands parcels

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
African rue	*Peganum harmala*	TNF Arizona Department of Agriculture (ADA)	Favors disturbed and barren areas with moist soil such as roadsides, riparian corridors, and irrigation ditches; will grow in alkaline soils and high saline soils (U.S. Forest Service 2014a). Typically occurs below 4,500 feet amsl elevation; and seeds can germinate under fairly saline conditions (White 2013).	Maricopa County (Natural Resources Conservation Service 2018a). Also has been observed in Pima County along Interstate 10 near Vail, but not on Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur (all). All distant to known occurrences (SEINet 2018; Tonto National Forest 2018).
African sumac	*Rhus lancea*	TNF	Occurs in well-drained sites in woodlands, grassland margins, and riparian communities; occurs in disturbed, degraded, or cultivated sites, typically below 2,000 feet amsl (White 2013).	The USDA PLANTS database indicates that there are no records in Arizona (Natural Resources Conservation Service 2018a). No records on Tonto National Forest (Tonto National Forest 2018). However, a recent record occurs in Cave Creek approximately 3 miles downstream of the Cave Creek parcel (SEINet 2018).	May occur • Cave Creek Nearest occurrence is within 3 miles (SEINet 2018) and suitable habitat may occur. Unlikely to occur • Tangle Creek • Turkey Creek • Apache Leap South Sites more than 15 miles from known occurrences (SEINet 2018).
Alligator weed	*Alternanthera philoxeroides*	ADA	Occurs in both aquatic and terrestrial habitats, often where aquatic and terrestrial habitat interface; occurs in riparian areas, canals, rivers, ditches, wetter pastures, and irrigated crops; can tolerate cold winters but cannot withstand prolonged freezing temperatures; prefers eutrophic conditions, but can survive in areas with low nutrient availability (CABI 2018).	No record in Arizona (CABI 2018; Natural Resources Conservation Service 2018a)	Unlikely to occur (all). This species is not known to occur in Arizona.
Anchored water hyacinth	*Eichhornia azurea*	Federal ADA	Freshwater, perennial, aquatic plant found in permanent water bodies, prefers open, slow-moving water environments (CABI 2018).	No record in Arizona (Natural Resources Conservation Service 2018a)	Unlikely to occur (all). This species is not known to occur in Arizona.
Arabian schismus	*Schismus arabicus*	TNF	Occurs in disturbed, degraded, or cultivated sites in desert and semidesert grassland communities and along roadsides, typically below 4,500 feet amsl (White 2013).	Has occurrence records in Cochise, Maricopa, Mojave, Pima, and Pinal Counties (Natural Resources Conservation Service 2018a)	Unlikely to occur (all). Turkey Creek occurs above the typical elevational range of this species. Cave Creek, Tangle Creek, and Apache Leap South are all distant from known occurrences (SEINet 2018) and do not occur in areas with high disturbance levels or along roads.
Asian mustard [Sahara mustard]	*Brassica tournefortii*	TNF	Occurs in areas with windblown sediments and disturbed areas within desert grasslands, desert scrub, and roadsides at elevations typically below 2,600 feet amsl (White 2013).	Has occurrence records in Maricopa, Pima, Pinal, and Yuma Counties (Natural Resources Conservation Service 2018a). Widespread throughout Tonto National Forest (Tonto National Forest 2018).	May occur • Cave Creek • Tangle Creek Contains suitable grassland or desertscrub habitat, has occurrences in vicinity (SEINet 2018), and is within or just above elevational range Unlikely to occur • Turkey Creek Does not contain suitable habitat and is above typical elevational range. Unlikely to occur • Apache Leap South Does not contain disturbed areas or roadsides and is well above typical elevational range.
Austrian fieldcress [Austrian yellowcress]	*Rorippa austriaca*	ADA	Perennial that occurs in wet soil, on disturbed and cultivated sites including roadsides, fields, and mud flats; prefers soils that are wet 6–8 months of the year (University of Nevada Reno 2004).	No records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Black mustard	*Brassica nigra*	TNF	Occurs in dry disturbed sites such as along roadsides, railroad rights-of-way, pastures, and waste places at elevations below 7,000 feet amsl (White 2013).	Has occurrence records in Cochise, Coconino, Maricopa, Pima, and Pinal Counties (Natural Resources Conservation Service 2018a). Occurs along State Route 188 through Tonto Basin, and along State Route 87 within Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Apache Leap South • Turkey Creek These sites do not contain suitable disturbed areas, and recent occurrences in the project vicinity occur on roadsides (SEINet 2018).

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Blue mustard	*Chorispora tenella*	TNF	Occurs in disturbed sites including waste places, pastures, roadsides, and railroad rights-of-way, typically below 7,500 feet amsl (White 2013).	Has occurrence records in Apache, Coconino, Maricopa, Navajo, and Yavapai Counties (Natural Resources Conservation Service 2018a). Has been found outside of the Tonto National Forest along State Route 69 between Cordes Junction and Prescott; in Prescott; and north of Holbrook (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Apache Leap South • Turkey Creek These sites do not contain suitable disturbed areas, and occurrences are distant to project areas (SEINet 2018).
Branched broomrape [hemp broomrape]	*Orobanche ramosa*	Federal ADA	Requires relatively high temperatures for optimum germination and growth and occurs mainly in irrigated crops grown under summer conditions in tropical and sub-tropical climates. Adapted to soils of generally high PH and are associated with the crops they attack (CABI 2018).	No record in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Buffelgrass	*Pennisetum ciliare*	TNF ADA	Alkaline soils and within arid areas with high nutrients and moisture (Allen 2017). Extremely drought tolerant and reestablishes quickly and expands infestation following fire (Tonto National Forest 2018).	Has occurrence records in Maricopa, Pima, Pinal, and Yuma Counties (Natural Resources Conservation Service 2018a). Common in Phoenix, and spreading onto Tonto National Forest along State Routes 60 and 87, Pima Road in Scottsdale, Cave Creek Road, and others (Tonto National Forest 2018).	May occur • Cave Creek • San Pedro River Near known occurrences and/or are in close proximity to a main road which may serve as a vector for this species or close to a known occurrence (SEINet 2018; Tonto National Forest 2018) Unlikely to occur • Tangle Creek • East Clear Creek • Turkey Creek • Apache Leap South • Dripping Springs Distant from main roads that could serve as a vector for this species. Unlikely to occur • Appleton Ranch parcels No records in vicinity (SEINet 2018).
Bull thistle	*Cirsium vulgare*	TNF	Occurs most often in areas that have been recently or repeatedly disturbed (e.g., overgrazed rangelands, recently burned forests, clear-cuts, and along roads and ditches); prefers soil of intermediate moisture (U.S. Forest Service 2018d). Typically occurs at elevations between 4,500 and 9,100 feet amsl (White 2013).	Has occurrence records in Apache, Cochise, Coconino, and Navajo Counties (Natural Resources Conservation Service 2018a). Common from Flagstaff to south of Mogollon Rim (Tonto National Forest 2018).	Unlikely to occur • Tangle Creek • Turkey Creek • Apache Leap South • Dripping Springs • East Clear Creek At least 10 miles from known occurrences (SEINet 2018). No recent burns, or repeatedly disturbed areas occur in the parcels.
Burclover	*Medicago polymorpha*	ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within meadows, grasslands, woodlands, and forest communities, typically between 4,000 and 8,000 feet amsl (White 2013).	Has occurrence records in Apache, Cochise, Gila, Maricopa, Pima, Pinal, and Yavapai Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur • East Clear Creek • Turkey Creek • Apache Leap South • Appleton Ranch • Dripping Springs Distant from known records (SEINet 2018). Unlikely to occur • Cave Creek • San Pedro River • Tangle Creek Recent records in vicinity (SEINet 2018) but well below typical elevational range.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Camelthorn	*Alhagi maurorum*	TNF ADA	Occurs in moist sites that are cultivated, disturbed or degraded; typically found at 4,500–5,000 feet amsl within meadows, grasslands, and riparian communities (White 2013).	Has occurrence records in Apache, Coconino, Gila, Maricopa, and Navajo Counties (Natural Resources Conservation Service 2018a). Heavy infestations in northeastern part of state; near Painted Rock Dam; southwest of Phoenix; west of Phoenix near Loop 101; Chandler; Highway 60 just north of Globe; Highway 60 north of the Salt River; but, not yet on Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur (all). All sites are distant from known occurrence records (SEINet 2018; Tonto National Forest 2018). Does not occur in grassland or meadow habitat; outside of typical elevation range: • Cave Creek • Tangle Creek • Dripping Springs • San Pedro River Do not contain suitable degraded moist habitat: • Apache Leap South • Appleton Ranch parcels Outside typical elevation; habitat not degraded, disturbed, or cultivated: • Turkey Creek • East Clear Creek
Canada thistle	*Cirsium arvense*	TNF ADA	Occurs most commonly in disturbed upland areas (e.g., barrens, meadows, fields, pastures), but can also invade wet areas with fluctuating water levels (U.S. Forest Service 2018d). Typically occurs at elevations 4,200–8,300 feet amsl (White 2013).	Has occurrence records in Apache, Coconino, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurs in northeast part of state, and near the OW Ranch, west of Canyon Creek on the Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Apache Leap South • Turkey Creek • Dripping Springs • San Pedro River • Appleton Ranch Parcels distant from known locations (SEINet 2018; Tonto National Forest 2018). Unlikely to occur • Turkey Creek • East Clear Creek Known occurrence about 10 miles southwest of parcel (SEINet 2018); however, site not disturbed.
Carolina horsenettle	*Solanum carolinense*	ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland and woodland communities; prefers sandy, well-drained soils at elevations from 4,000 to 5,000 feet amsl (White 2013).	In Arizona, known only one site along Queen Creek (SEINet 2018).	Unlikely to occur (all). Sites are distant from only known occurrence in Arizona (SEINet 2018).
Common purslane [little hogweed]	*Portulaca oleracea*	ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within meadows, grassland, woodland, and forest communities; can be found in soil containing loam, sand, or gravelly material at elevations from 4,000 to 8,500 feet amsl; can tolerate heat and drought (White 2013).	Observed in all Arizona counties except La Paz, Pinal, and Yuma (Natural Resources Conservation Service 2018a).	Known to occur on Appleton Ranch NE parcel (SEINet 2018). May occur • Tangle Creek Despite being distant to known occurrences, this parcel contains well-used roads and is within typical elevational range: Unlikely to occur • San Pedro River It contains suitable disturbed habitat and is within 10 miles of documented occurrences (SEINet 2018); however, it is found within Sonoran desertscrub biotic community and is well below the typical elevation for this species. Unlikely to occur • Cave Creek • East Clear Creek • Turkey Creek • Apache Leap South • Dripping Springs Parcels do not contain suitable disturbed or degraded habitat, and roads within or near the parcel appear to be minor and seldom used.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Common teasel [Fuller's teasel]	*Dipsacus fullonum*	TNF	Prefers open, sunny habitats and commonly occurs in disturbed areas including roadsides and pastures; grows in both moist and arid soils, but more commonly found in mesic soils (U.S. Forest Service 2014b). Typically occurs at elevations ranging from 4,700 to 8,700 feet amsl (White 2013).	Has occurrence records in Coconino County (Natural Resources Conservation Service 2018a). Occurs at Watson Woods on Granite Creek near Prescott; at Shumway Millsite, south of Payson and at Sharp Creek Campground on Tonto National Forest (Tonto National Forest 2018).	May occur • Turkey Creek Is within the typical elevational range and is approximately 7 miles north of the nearest occurrence (SEINet 2018). Unlikely to occur • Cave Creek • Tangle Creek • Apache Leap South • East Clear Creek These sites do not contain suitable disturbed roadsides or pastures, and are distant from recent occurrences (SEINet 2018).
Creeping wart cress [Greater swinecress]	*Coronopus squamatus*	ADA	Occurs in disturbed areas, including agricultural fields, orchards, turf, roadsides, banks of ditches; tolerates saline soil (Winston et al. 2014).	No records in Arizona (CABI 2018; Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Dalmatian toadflax	*Linaria dalmatica*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within meadows, grassland, woodland, and riparian communities at elevations ranging from 4,400 to 10,000 feet amsl (White 2013).	Has occurrence records in Coconino and Yavapai Counties (Natural Resources Conservation Service 2018a). Common around Flagstaff; widespread in ponderosa pine forests on Kaibab, Coconino, and Prescott National Forests; on Tonto National Forest, grows at Hot Shot Base, along State Route 87 between Payson and Rye, and near the Verde River 1 mile downstream of Childs (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Dripping Springs • San Pedro River Well below elevational range Unlikely to occur • Apache Leap South • East Clear Creek • Appleton Ranch parcels Known occurrences are at least 15 miles from parcels (SEINet 2018; Tonto National Forest 2018).
Diffuse knapweed	*Centaurea diffusa*	TNF ADA	Prefers well-drained soils within cultivated, disturbed, or degraded sites along roadsides or within meadows, grassland, woodland, and forest communities at elevations typically below 7,200 feet amsl (White 2013).	Has occurrence records in Apache County (Natural Resources Conservation Service 2018a). Common on private lands in Young; on Tonto National Forest occurs at Pleasant Valley airport; Pleasant Valley Ranger Station, along Cherry Creek, and along Highway 288 at Board Tree Saddle (south of Young) (Tonto National Forest 2018).	Unlikely to occur. Cave Creek • Tangle Creek • East Clear Creek • South Apache Leap • San Pedro River • Appleton Ranch parcels • Dripping Springs Distant from known occurrences (SEINet 2018; Tonto National Forest 2018). Unlikely to occur • Turkey Creek Site is approximately 12 miles southwest of the nearest occurrences, and does not contain suitable disturbed or degraded habitat.
Dodder	*Cuscuta* spp. (except for natives)	Federal ADA	Alluvium, sandy soils, desert shrub community (NatureServe 2018). Parasitic annual plant species, some of which infest crops, and some that infest salty marshes, flats, or ponds (University of California Statewide Integrated Pest Management Program 2017).	Has occurrence records in all counties except Apache, Graham, and Greenlee (Natural Resources Conservation Service 2018a).	May occur (all). *Cuscuta* spp. is widespread and species inhabit a wide variety of habitats, and have occurrence records throughout Arizona (SEINet 2018). Unlikely to occur • East Clear Creek
Downy brome [cheatgrass]	*Bromus tectorum*	TNF	Occurs from valley bottoms to high mountainous areas; quickly invades disturbed sites. Prefers well-drained soils of any texture but is not well adapted to saline or sodic soil conditions or wet soil (Natural Resources Conservation Service 2018a).	Has occurrence records in all counties except Cochise, Greenlee, La Paz, Pinal, Santa Cruz, and Yuma (Natural Resources Conservation Service 2018a).	May occur. • Cave Creek • Apache Leap South • Turkey Creek • Tangle Creek • East Clear Creek This species is widespread and does not appear to be limited to paved roadsides or extremely disturbed areas (SEINet 2018).

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Dryer's woad	*Isatis tinctoria*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland or woodland communities; prefers dry rocky or sandy soils at elevations from 4,300 to 7,000 feet amsl (White 2013).	No records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Dudaim melon [cantaloupe]	*Cucumis melo*	ADA	Occurs in disturbed areas with abundant moisture, including fields, roadsides, and ditches (Winston et al. 2014).	No records in Arizona (Natural Resources Conservation Service 2018a; Winston et al. 2014).	Unlikely to occur (all). This species is not known to occur in Arizona.
Field bindweed	*Convolvulus arvensis*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland, chaparral, woodland, forest, and riparian communities at elevations ranging from 3,500 to 10,000 feet amsl (White 2013).	Has occurrence records in all Arizona counties (Natural Resources Conservation Service 2018a).	May occur • San Pedro River • Appleton Ranch parcels • Tangle Creek • Turkey Creek Although some parcels below typical elevational range, they contain suitable disturbed habitat, and there are occurrence records nearby (SEINet 2018). Unlikely to occur • Cave Creek • East Clear Creek • Apache Leap South • Dripping Springs Distant from known occurrences (SEINet 2018) and minimal disturbed habitat.
Field sandbur	*Cenchrus spinifex [incertus]*	TNF ADA	Prefers sandy or gravelly sites that have been disturbed, or degraded sites at elevations between 3,500 and 5,000 feet amsl (White 2013).	Has occurrence records in all counties except La Paz, Pinal, and Yuma (Natural Resources Conservation Service 2018a). Occurs east of Tonto National Forest on the Fort Apache Reservation along the right-of-way for Highway 60 east; Occurs on Tonto National Forest on right-of-way of State Route 188, a few miles north of Globe, Arizona (Tonto National Forest 2018).	May occur • Appleton Ranch parcels May contain suitable degraded sandy or gravelly sites, and there are known occurrences approximately 3.5 miles north of the parcels (SEINet 2018). Unlikely to occur • Tangle Creek • Cave Creek • East Clear Creek • Apache Leap South • Turkey Creek • San Pedro River • Dripping Springs Distant from known occurrences (SEINet 2018; Tonto National Forest 2018).
Five-stamen tamarisk	*Tamarix chinensis*	TNF	Desert riparian habitats, including seeps, springs, and roadsides; may tolerate saline soil (CABI 2018).	Has occurrence records in all Arizona counties except Greenlee, La Paz, Pinal, and Yuma (Natural Resources Conservation Service 2018a). On Tonto National Forest, saltcedar occurs along the Verde River and its tributaries; along much of the Salt River; and along Salt and Verde River reservoirs (Tonto National Forest 2018).	May occur • Cave Creek • Tangle Creek • Turkey Creek This species occurs in Cave Creek approximately 3 miles south of the parcel (SEINet 2018), and may occur at Tangle Creek and Turkey Creek, if sufficient water occurs. Unlikely to occur • Apache Leap South • East Clear Creek Lacks riparian habitat or roadsides.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Fountain grass	*Pennisetum setaceum*	TNF	Usually found along roadways or in rangelands. Prefers arid to semi-arid conditions, but can occur in mesic environments; usually occurs in areas with mild winters and summer moisture; prefers open, sunny areas with well-drained soils (CABI 2018).	Has occurrence records in Cochise, Maricopa, Pima, and Santa Cruz Counties (Natural Resources Conservation Service 2018a). Documented in all desert districts within the Tonto National Forest; very abundant along Highway 60 between Superior and mountain tunnel; also occurs along State Route 87, along the road to Bartlett and Horseshoe Reservoirs, and in the Salt River Recreation Area (Tonto National Forest 2018).	May occur • Apache Leap South • Cave Creek Contain suitable habitat and have occurrence records within approximately 2 miles (SEINet 2018). Unlikely to occur • Tangle Creek • Turkey Creek • East Clear Creek These sites are distant from known occurrences, and do not contain suitable habitat (SEINet 2018).
Floating water hyacinth	*Eichhornia crassipes*	ADA	Aquatic, floating plant that occurs in tropical and subtropical freshwater lakes and rivers (CABI 2018).	Has occurrence records in Maricopa County (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). Cave Creek does not contain perennial aquatic habitat. The nearest known occurrence is approximately 14 miles northwest of the Cave Creek Parcel, in the Agua Fria River (SEINet 2018).
Giant reed	*Arundo donax*	TNF	Occurs in moist areas including ditches, stream and riverbanks, and floodplains; prefers well-drained soils with abundant moisture; will tolerate a wide variety of conditions, including high salinity; will tolerate a wide range of soil types from clay to sand; typically occurs below 4,000 feet amsl (White 2013).	Has occurrence records in Cochise, Maricopa, and Navajo Counties (Natural Resources Conservation Service 2018a). Occurs upstream of Tonto National Forest on the Upper Verde, with potential to invade in a large river scouring event (Tonto National Forest 2018).	May occur • Cave Creek If sufficient moisture occurs, as there are occurrence records 3 miles downstream (SEINet 2018). Unlikely to occur • Apache Leap South • Turkey Creek • Tangle Creek • East Clear Creek Sites are at least 30 miles from the nearest known occurrence (SEINet 2018; Tonto National Forest 2018) and Apache Leap South does not contain suitable moist habitat.
Giant salvinia	*Salvinia molesta*	Federal ADA	Prefers warm, fresh water in temperate and subtropical climates (Chambers and Hawkins 2002).	Found in slow-moving water or still-water canals, ponds, rivers, lakes, and reservoirs (Chambers and Hawkins 2002). Occurrence records from the southwest portion of Arizona, in and near the Colorado River (SEINet 2018).	Unlikely to occur (all). All parcels are distant from nearest known location in the Colorado River (SEINet 2018).
Globe chamomile [stinknet]	*Oncosiphon piluliferum*	TNF	Occurs in disturbed areas including waste places, pastures, and along roadsides; typically found below 3,500 feet amsl elevation; this annual is a pioneer species within disturbed sites (White 2013).	Has occurrence records in Maricopa, Pinal, and Yavapai Counties (Natural Resources Conservation Service 2018a). Documented along I-17 north of Phoenix, near Skunk Tank Ridge south of Cave Creek on the Cave Creek Ranger District, at the Cave Creek Ranger Station, at the Sonora Desert National Monument, Pinal City near Superior, along State Route 84 west of Casa Grande, Extension Service Demonstration Garden (east Broadway in Phoenix), on Carefree Highway 4 miles east of I-17, and growing in cultivation at the Desert Botanical Garden and Boyce Thompson Arboretum (Tonto National Forest 2018).	May occur • Cave Creek Occurrence records less than 3 miles south of the site (SEINet 2018). Unlikely to occur • Apache Leap South • Tangle Creek • Turkey Creek • East Clear Creek Known occurrences are more than 10 miles from these sites (SEINet 2018), and these sites do not contain typical disturbed habitats.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Globe-podded hoary cress [whitetop]	*Cardaria draba*	TNF ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides or within meadows, grassland, chaparral, woodland, forest, and riparian communities; prefers alkaline to saline soils, but will tolerate a wide variety of soil and moisture conditions; typically found between 3,000 and 8,000 feet amsl (White 2013).	Has occurrence records in Navajo, Santa Cruz, and Yavapai Counties (Natural Resources Conservation Service 2018a). *Cardaria* spp. has been recorded in Prescott, Camp Verde, Flagstaff, and Cottonwood, and on the upper Verde River near Perkinsville; on the Tonto National Forest, occurs on the Pleasant Valley Ranger District (Tonto National Forest 2018).	May occur • Appleton Ranch parcels • East Clear Creek • Turkey Creek Known occurrences nearby (SEINet 2018; Tonto National Forest 2018) and suitable moist habitat may be present. Unlikely to occur • Cave Creek • Tangle Creek Distant from known occurrences (SEINet 2018; Tonto National Forest 2018). Unlikely to occur • Dripping Springs • Apache Leap South Distant from known occurrences (SEINet 2018; Tonto National Forest 2018). Unlikely to occur • San Pedro River Distant from known occurrences (SEINet 2018) and parcel is below usual elevational range.
Hairy white-top	*Cardaria pubescens*	TNF ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides or within meadows, grassland, chaparral, woodland, forest, and riparian communities; prefers alkaline to saline soils, but can tolerate a wide range of soils and moisture conditions; typical elevation is 3,000 to 8,000 feet amsl (White 2013).	*Cardaria* spp. has been recorded in Prescott, Camp Verde, Flagstaff, and Cottonwood, and on the upper Verde River near Perkinsville; on the Tonto National Forest, occurs on the Pleasant Valley Ranger District (Tonto National Forest 2018).	May occur • East Clear Creek • Turkey Creek Known occurrences nearby (SEINet 2018; Tonto National Forest 2018) and suitable moist habitat may be present. Unlikely to occur • Cave Creek • Tangle Creek • Appleton Ranch parcels Distant from known occurrences (SEINet 2018; Tonto National Forest 2018) Unlikely to occur • Dripping Springs • Apache Leap South Distant from known occurrences (SEINet 2018; Tonto National Forest 2018) and does not contain disturbed or degraded moist sites: Unlikely to occur • San Pedro River Distant from known occurrences (SEINet 2018) and parcel is below usual elevational range.
Halogeton [saltlover]	*Halogeton glomeratus*	ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides or within grassland or woodland communities; prefers open areas and alkaline and saline soils, generally at elevations ranging from 4,000 to 6,500 feel amsl (White 2013).	Has occurrence records in Apache, Navajo, and Mohave Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). • San Pedro River • Cave Creek • Tangle Creek Distant from known occurrences (SEINet 2018) and below typical elevational range. • Appleton Ranch parcels • Turkey Creek • Dripping Springs • Apache Leap South • East Cave Creek Distant from known occurrences (SEINet 2018)

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Hydrilla [waterthyme]	*Hydrilla verticillata*	Federal ADA	Found mainly in freshwater aquatic systems but can tolerate low salinity. Sometimes found in upper reaches of estuaries. Found in shallow water, but in clear water can survive down to 49 feet (Chambers and Hawkins 2002).	Has occurrence records in Maricopa County (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). There are known occurrences in the Phoenix metropolitan area (SEINet 2018), but none in proximity to any parcels.
Iberian starthistle [Iberian knapweed]	*Centaurea iberica*	ADA	Occurs along banks of watercourses and other moist sites, typically below 3,200 feet amsl elevation (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Japanese brome	*Bromus japonicus*	TNF	Occurs in cultivated, disturbed, or degraded sites along roadsides and within semidesert grassland and wooded communities at elevations ranging from 4,500 to 7,200 feet amsl (White 2013).	Has occurrence records in Apache, Cochise, Coconino, Gila, Greenlee, Maricopa, Pima, and Navajo Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur. • Cave Creek • Tangle Creek • Apache Leap South • Turkey Creek All Tonto National Forest sites are at least 12 miles from a known occurrence (SEINet 2018), all except Turkey Creek occur below typical elevation, and Turkey Creek contains only minor disturbances.
Japanese knotweed	*Polygonum cuspidatum*	TNF	Riparian areas, including along streams and rivers, low-lying areas, utility rights-of-way; it rapidly colonizes scoured areas and can survive severe floods; can tolerate full shade, high temperatures, high salinity, and drought (U.S. Forest Service 2018d).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a),and is not known from Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur as does not occur in Arizona: • Cave Creek • Turkey Creek • Tangle Creek • Apache Leap South
Jointed goatgrass	*Aegilops cylindrica*	TNF ADA	Occurs above 4,000 feet amsl, occurs in disturbed areas. Occurs in dry sites in grassland or wooded communities and roadsides at elevations ranging from 5,300 to 7,000 feet amsl (White 2013).	Has occurrence records in Apache, Cochise, Coconino, Navajo, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurs along State Route 87 from Payson to Strawberry, and in the Young area (Tonto National Forest 2018).	May occur • East Clear Creek Site may contain suitable habitat and is situated near State Route 87. Unlikely to occur • Cave Creek • Tangle Creek • San Pedro River Distant from known occurrences (SEINet 2018; Tonto National Forest 2018) and below usual elevational range. Unlikely to occur • Turkey Creek • Apache Leap South • Dripping Springs • Appleton Ranch parcels Distant from known occurrences (SEINet 2018; Tonto National Forest 2018).
Karoo bush [African sheepbush]	*Pentzia incana*	TNF	Occurs in dry, disturbed sites including waste places, pastures, and along roadsides within desert, semidesert, grassland, chaparral oak scrub and pinyon-juniper woodland communities typically below 5,300 feet amsl elevation (White 2013).	Occurrence records in Graham County (Natural Resources Conservation Service 2018a). Has been documented at one site on Tonto National Forest, north of the Oak Flat Campground on the Globe Ranger District (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Oak Flat Known occurrences are more than 30 miles (SEINet 2018). Unlikely to occur • Apache Leap South Although the Oak Flat occurrence is within 4 miles of Apache Leap South (SEINet 2018; Tonto National Forest 2018), this parcel does not contain suitable disturbed habitat for this species.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Kochia	*Kochia scoparia [Bassia scoparia]*	TNF	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland and woodland communities in well-drained, uncompacted soil, below 8,500 feet amsl; thrives in warm, low rainfall environments; burns easily owing to plant structure (White 2013).	Has occurrence records in Apache, Cochise, Coconino, Navajo, and Pima Counties (Natural Resources Conservation Service 2018a).	May occur • Cave Creek Occurrence record approximately 3 miles south (SEINet 2018). Unlikely to occur • Tangle Creek • Turkey Creek • Apache Leap South Sites are minimally disturbed and are at least 10 miles from a known occurrence (SEINet 2018).
Leafy spurge	*Euphorbia esula*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within fields, pastures, rangeland, and riparian communities, typically between 4,600 and 9,500 feet amsl (White 2013).	Has occurrence records in Coconino County (Natural Resources Conservation Service 2018a). Has been documented in the Coconino National Forest but not on the Tonto National Forest (Tonto National Forest 2018).	Unlikely to occur (all). All are more than 25 miles from nearest known occurrence (SEINet 2018; Tonto National Forest 2018).
Lehmann's lovegrass	*Eragrostis lehmanniana*	TNF	Occurs in cultivated, disturbed, and degraded sites on sandy flats and on calcareous slopes within desert grassland, semidesert grassland, and woodland communities and roadsides, generally between 3,500 and 4,000 feet amsl elevation (White 2013).	Has occurrence records in Cochise, Coconino, Graham, Maricopa, and Pima Counties (Natural Resources Conservation Service 2018a). Within Tonto National Forest, seeded extensively along highways, power line corridors, and after fires (Tonto National Forest 2018).	May occur • Apache Leap South • Turkey Creek • Cave Creek • Tangle Creek Although several parcels are below the typical elevation, there are occurrence records within 5 miles (SEINet 2018) and suitable habitat may be present.
Lens podded hoary cress	*Cardaria chalepensis*	ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides and within meadows, grassland, chaparral, woodland, forest, and riparian communities; prefers alkaline to saline soils but can tolerate a wide variety of soils and moisture conditions; elevations typically range from 3,300 to 6,000 feet amsl (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a). One isolated record from 1992 occurs more than 30 miles east of the East Clear Creek Parcel (SEINet 2018).	Unlikely to occur (all). No current records from Arizona.
Lightningweed	*Drymaria arenarioides*	Federal ADA	Prefers dry areas, acidic soils, hills and plains, and stressed rangelands (Scher et al. 2015). It is well adapted to soils and climates within the *Bouteloua-Aristada* type (CABI 2018).	Invades rangeland, displacing desired vegetation and his highly toxic to livestock. This species has not been documented in the U.S., but is spreading northward, reportedly to within 1 mile of New Mexico (Scher et al. 2015). No records in the United States (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in the United States.
Malta starthistle	*Centaurea melitensis*	TNF	Occurs in cultivated, disturbed, or degraded sites along roadways and within grassland and woodland communities at elevations below 7,200 feet amsl; is a competitive and aggressive plant (White 2013).	Has occurrence records in Apache, Cochise, Graham, Maricopa, Mohave, Pima, Pinal, and Yavapai Counties (Natural Resources Conservation Service 2018a). Widespread on Tonto National Forest at low elevations below 3,000 feet (Tonto National Forest 2018).	May occur • Apache Leap South • Cave Creek • Turkey Creek • Tangle Creek Occurrence records are common on Tonto National Forest (SEINet 2018), not all of which are along roadways or below 3,000 feet amsl elevation.
Mediterranean grass	*Schismus barbatus*	TNF	Occurs in roadways and cultivated, disturbed, or degraded sites along roadways and in desert and semidesert grassland communities, generally below 5,000 feet amsl elevation (White 2013).	All Arizona counties except Apache, Cochise, Graham, Greenlee, and Navajo (Natural Resources Conservation Service 2018a).	May occur • Apache Leap South • Cave Creek Within 5 miles of the nearest known occurrence (SEINet 2018) and occur within the Sonoran desertscrub biome. Unlikely to occur • Turkey Creek • Tangle Creek These sites are at higher elevation than is typical for this species, and neither site contains desert or semidesert grassland communities; known occurrences are also more than 10 miles from these sites (SEINet 2018).

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Mediterranean sage	*Salvia aethiopis*	TNF	Occurs in roadways and cultivated, disturbed, or degraded sites along roadways and within meadows, grassland, woodland, and riparian communities; prefers well-drained soil; occurs at elevations typically below 8,500 feet amsl (White 2013).	Has occurrence records in Coconino and Yavapai Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur • Apache Leap South • Tangle Creek • Turkey Creek • Cave Creek These sites are all at least 50 miles away from the nearest known occurrence (SEINet 2018).
Mexican paloverde	*Parkinsonia aculeata*	TNF	On the Tonto National Forest, infestation occurred from a single ornamental planting in Camp Creek area; typically invades waste areas at low elevations (Tonto National Forest 2018). Invasive on degraded rangelands; tolerant of drought, waterlogging, and saline conditions (CABI 2018).	Has occurrence records in Gila, Graham Maricopa, Pima, Pinal, Santa Cruz, and Yuma Counties where it is a native species (Natural Resources Conservation Service 2018a). On Tonto National Forest, a 2-acre infestation occurs from areas burned in the Cave Creek Complex fire near Camp Creek (Tonto National Forest 2018).	May occur • Cave Creek This parcel is 3 miles north of a known recent occurrence (SEINet 2018). Unlikely to occur • Apache Leap South • Tangle Creek • Turkey Creek These sites are distant from known occurrences (SEINet 2018; Tonto National Forest 2018).
Morning-glory	*Ipomeoea* spp. [all except *I. carnea* and *I. aborescens*] *I. triloba* is a “restricted pest” according to ADA (see below)	ADA	Suitable habitat depends on species. For example *I. hederacea* and *I. purpurea* occur in disturbed areas, *I. tenuiloba* occurs in pinyon-juniper woodlands (SEINet 2018).	There are 69 species of *Ipomoea*, including native and introduced species, in the PLANTS database, 15 of which have occurrence records in Arizona (Natural Resources Conservation Service 2018a).	May occur (all). This genus is widespread in Arizona, and has occurrence records within 5 miles of each parcel (SEINet 2018). Disturbed areas occur within each parcel, and most parcels contain drainages or roadsides, which may contain suitable microclimates for many species within this genus.
Musk thistle	*Carduus nutans*	TNF	Grows from sea level up to 8,000 feet amsl in neutral to acidic soils; invades open areas (e.g., meadows or prairies) and spreads rapidly in areas of natural disturbance including landslides and flooding; does not grow well in conditions that are excessively wet, dry, or shady (U.S. Forest Service 2018d). Typically occurs between 4,200 and 8,100 feet amsl (White 2013).	Has occurrence records in Apache and Navajo Counties (Natural Resources Conservation Service 2018a). Grows on Coconino National Forest; found on the Tonto National Forest north and east of Payson in the area of the 1990 Dude Fire (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Turkey Creek • Apache Leap South There is no meadow or prairie habitat on any of the sites. Known occurrences are distant from the sites (SEINet 2018).
Oleander	*Nerium oleander*	TNF	On the Tonto National Forest, has naturalized in Camp Creek and near Boyce Thompson Arboretum; in California has been found in floodplain and riparian zones (Tonto National Forest 2018).	Has occurrence records in Maricopa County (Natural Resources Conservation Service 2018a). On Tonto National Forest, near Camp Creek and Boyce Thompson Arboretum (Tonto National Forest 2018).	Unlikely to occur • Cave Creek • Tangle Creek • Turkey Creek • Apache Leap South This species is only known from two locations on Tonto National Forest (SEINet 2018; Tonto National Forest 2018).
Onionweed	*Asphodelus fistulosus*	TNF Federal	In the Sonoran Desert region, it seems to do best at altitudes above the desert floor that receive moderate rainfall during winter. Tends to invade disturbed land leaving its potential threat to natural areas unclear (Animal and Plant Health Inspection Service 2019). Elevation is 2,000–4,500+ feet amsl (Animal and Plant Health Inspection Service 2019). Occurs in sandy or rocky disturbed sites, including roadsides, railroad rights-of-way, pastures, and waste places; typically occurs below 4,600 feet amsl; drought resistant (White 2013).	Known in the five southeastern counties (Pima, Pinal, Santa Cruz, Cochise, and Greenlee) and in an area near Sedona in Yavapai County (Animal and Plant Health Inspection Service 2019). Not known to occur on Tonto National Forest (Tonto National Forest 2018).	May occur • Appleton Ranch parcels Disturbance occurs, and there is an occurrence record less than 1 mile south of the northeast parcel (SEINet 2018). Unlikely to occur • San Pedro River • Dripping Springs • East Clear Creek Distant from known occurrences (SEINet 2018; Tonto National Forest 2018).
Oxeye daisy	*Leucanthemum vulgare*	TNF	Occurs in cultivated, disturbed, or degraded sites on well-drained but moist soils along roadsides and within meadows, grassland, woodland, and forest communities at elevations from 5,000 to 9,500 feet amsl (White 2013).	Has occurrence records in Apache, Coconino, Gila, and Navajo Counties (Natural Resources Conservation Service 2018a). Identified growing near Canyon Creek, Pleasant Valley Ranger District, Tonto National Forest; occurs in Flagstaff and Kachina Village, south of Flagstaff (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). All Tonto National Forest Parcels are at least 20 miles away from nearest known occurrence records (SEINet 2018). Only Turkey Creek is within the typical elevational range.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Perennial sowthistle	*Sonchus arvensis*	ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides and within grassland, woodland, and riparian communities; can be found in non-compacted, fine, rich, slightly alkaline to neutral soils at elevations ranging from 5,000 to 6,000 feet amsl (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Periwinkle	*Vinca major*	TNF	Occurs in highly disturbed areas including old homesteads, roadsides, and waste places; also occurs in riparian areas, forests, and grasslands; typically occurs below 7,500 feet amsl elevation (White 2013).	Has occurrence records in Cochise, Coconino, Maricopa, Pima, Santa Cruz, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurs on Tonto National Forest adjacent to private lands (e.g., Grantham Homestead off Highway 288) (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). No Tonto National Forest parcel contains highly disturbed areas, and all Tonto National Forest parcels except Apache Leap South are at least 5 miles from known occurrences (SEINet 2018; Tonto National Forest 2018).
Plumeless thistle	*Carduus acanthoides*	TNF ADA	Occurs in sites that are dry and well-drained; occurs in cultivated, disturbed, or degraded sites within meadows, grassland, chaparral, woodland, forest, and riparian communities or roadsides at elevations generally ranging from 4,200 to 8,800 feet amsl (White 2013).	While the PLANTS database shows no occurrence records in Arizona (Natural Resources Conservation Service 2018a), other sources indicate occurrence records in Petrified Forest National Park (Tonto National Forest 2018). SEINet (2018) shows no occurrences in Arizona.	Unlikely to occur (all). All parcels are distant to potential occurrences in Petrified Forest National Park.
Puna grass	*Stipa brachychaeta*	ADA	Disturbed soils along roadsides; streambanks, and waste places (Agriculture Victoria 2017).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Puncturevine	*Tribulus terrestris*	ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides and within grassland, woodland, and riparian communities; prefers dry, sandy soils but tolerates most soil types; found at elevations below 7,000 feet amsl (White 2013).	Has occurrence records in all Arizona counties (Natural Resources Conservation Service 2018a).	May occur • San Pedro River • Cave Creek Sites contain disturbance or roads and are near to known occurrences (SEINet 2018). Unlikely to occur • Appleton Ranch parcels • Tangle Creek Sites are distant from known occurrences (SEINet 2018). Unlikely to occur • Dripping springs • Turkey Creek • Apache Leap South • East Clear Creek Sites are distant from known occurrences (SEINet 2018) and have limited disturbance.
Purple loosestrife	*Lythrum salicaria*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites in perennial and seasonal wetlands; occurs along marsh and pond edges, streambanks, canals, and ditches at elevations generally from 4,500–6,800 feet amsl (White 2013).	While the PLANTS database and SEINet show no occurrence records in Arizona (Natural Resources Conservation Service 2018a; SEINet 2018), other sources indicate occurrence records in on the Apache-Sitgreaves National Forests (Tonto National Forest 2018).	Unlikely to occur (all). All parcels are distant to potential occurrences in Apache-Sitgreaves National Forests.
Purple starthistle	*Centaurea calcitrapa*	ADA	Occurs cultivated, disturbed, or degraded sites with fertile soil; occurs in meadows, grassland, woodland, and forest communities and along roadsides at elevations typically ranging from 3,300 to 8,000 feet amsl; germination occurs under a broad range of conditions with fewer viable seeds produced in dry years; plants seldom persist under shady conditions (White 2013).	Has occurrence records in Yuma County (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). All parcels are distant to known occurrence records (SEINet 2018) and do not occur in Yuma County.
Pyracantha	*Pyracantha* sp.	TNF	Not a common invasive in the desert Southwest; on the Tonto National Forest, occurred along Cave Creek (Tonto National Forest 2018). Drought resistant, common landscape plant; prefers dry soil and full sun (Dierking 1998).	Has occurrence records in Maricopa County (Natural Resources Conservation Service 2018a). On Tonto National Forest, occurred along Cave Creek (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). All Tonto National Forest parcels are distant from known occurrences (SEINet 2018; Tonto National Forest 2018) and this species is not a common invasive.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Quackgrass	*Elymus repens*	TNF ADA	Occurs in disturbed or degraded sites within grasslands, woodlands, forest communities, or along roadsides at elevations between 6,700 and 8,500 feet amsl; is extremely drought tolerant (White 2013).	Has occurrence records in Coconino, Gila, and Navajo Counties (Natural Resources Conservation Service 2018a). Documented near Flagstaff, in Grand Canyon National Park, and on one site in Tonto National Forest, on Pleasant Valley Ranger District (Tonto National Forest 2018).	May occur • East Clear Creek Occurs near known occurrence (SEINet 2018) and is close to the usual elevational range. Unlikely to occur • San Pedro River • Dripping Springs • Appleton Ranch • Turkey Creek • Apache Leap • Cave Creek • Tangle Creek Distant to known recent occurrences (SEINet 2018; Tonto National Forest 2018) and below typical elevational range.
Red brome	*Bromus rubens*	TNF	Occurs in cultivated, disturbed, or degraded sites along roadsides and in meadows, grassland, chaparral, woodland, and riparian communities, generally below 7,200 feet amsl elevation (White 2013). Red brome cannot withstand temperatures below freezing (Tonto National Forest 2018).	Has occurrence records in all Arizona counties, except Cochise, Greenlee, La Paz, Navajo, Santa Cruz, and Yuma (Natural Resources Conservation Service 2018a). Widespread on Tonto National Forest (Tonto National Forest 2018).	May occur (all Tonto National Forest parcels). This species is widespread, occurs in a wide variety of habitats, and occurs within 2.5 miles of Cave Creek, Tangle Creek, and Apache Leap South, and approximately 6.5 miles of Turkey Creek (SEINet 2018).
Rescuegrass	*Bromus catharticus*	TNF	Occurs in cultivated, disturbed, or degraded soils along roadsides or within desert or semidesert communities generally below 4,500 feet amsl elevation; can tolerate both cold temperatures and drought conditions (White 2013).	Has occurrence records in all Arizona counties except Pinal and Greenlee (Natural Resources Conservation Service 2018a). Likely grows on Tonto National Forest; occurs at Montezuma Castle National Monument and in the Tucson Mountains (Tonto National Forest 2018).	May occur • Cave Creek Unlikely to occur • Apache Leap South Is an occurrence within 3 miles of the (SEINet 2018) but disturbed areas do not occur. Unlikely to occur • Turkey Creek • Tangle Creek Sites do not contain desert or semidesert communities and are more than 15 miles from the nearest occurrence record (SEINet 2018).
Ripgut brome	*Bromus diandrus*	TNF	Occurs in cultivated, disturbed, or degraded sites along roadsides and within desert and semidesert communities, at elevations typically ranging from 3,200 to 4,600 feet amsl (White 2013).	Has occurrence records in Cochise, Coconino, Graham, Maricopa, Mohave, Pima, Pinal, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurs on National Monuments near Tonto National Forest, including Tuzigoot, Montezuma Castle, and Tonto National Monuments, and at the Hassayampa River Preserve; also occurs on the Verde where Highway 260 crosses, near the town of Strawberry, in the area of the Willow Fire of 2004 west of Rye, and at Sycamore Creek along the Beeline Highway (Tonto National Forest 2018).	May occur • Cave Creek Although below typical elevational range, it contains desert or semidesert conditions with some road disturbance, and occurs within 3 miles of the nearest occurrence record (SEINet 2018). Unlikely to occur • Apache Leap South There is an occurrence within 3 miles (SEINet 2018) but disturbed areas do not occur. Unlikely to occur • Turkey Creek • Tangle Creek Sites do not contain desert or semi-desert communities and are more than 6 miles from the nearest occurrence record (SEINet 2018).
Rush skeleton weed	*Chondrilla juncea*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland and woodland communities; prefers well-drained sandy or gravely soils below 5,500 feet amsl (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Russian knapweed	*Acroptilon repens*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within meadows, grassland, and riparian communities at elevations ranging from 3,000 to 8,000 feet amsl; found in variety of soil types; is a very competitive and aggressive species (White 2013).	Has occurrence records in Apache, Cochise, Greenlee, Maricopa, Navajo, Pima, and Yavapai Counties (Natural Resources Conservation Service 2018a). Documented in vicinity of Gordon Canyon on State Route 260 and at Shumway Millsite on Payson Ranger District, south of Payson (Tonto National Forest 2018).	May occur • Turkey Creek • East Clear Creek Sites are within the usual elevational range, contain some disturbance, and are in the vicinity of known occurrences (SEINet 2018; Tonto National Forest 2018). Unlikely to occur • Cave Creek • Tangle Creek • Apache Leap • Dripping Springs Sites are more than 20 miles from nearest known occurrence (SEINet 2018) and have minimal disturbance. Unlikely to occur • Appleton Ranch parcels • San Pedro River Nearest known infestation is at least 20 miles (SEINet 2018).
Russian olive	*Elaeagnus angustifolia*	TNF	Seedlings tolerant of shade, thrives in a variety of soil and moisture conditions, including bare mineral substrates; found in open areas, grasslands, streambanks, lakeshores, roadsides, and urban areas (U.S. Forest Service 2018d). Typically occurs at elevations ranging from 4,000 to 7,500 feet amsl; can dominate riparian vegetation where overstory cottonwood (*Populus* spp.) have died (White 2013).	Has occurrence records in Apache, Coconino, and Navajo Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur (all Tonto National Forest parcels). Distant from known occurrences (SEINet 2018). In addition, Tangle Creek and Cave Creek are below the typical elevational range, and Apache Leap South does not contain suitable habitat.
Russian thistle	*Salsola kali* and *S. tragus*	TNF	*Salsola* spp. occurs on cultivated, disturbed, or degraded sites along roadsides and within grassland and woodland communities; can occur on any type of well-drained uncompacted soil, but is most frequently found in alkaline or saline soil below 8,500 feet amsl; burns easily owing to plant structure (White 2013).	*Salsola* spp. has occurrence records in all Arizona counties (Natural Resources Conservation Service 2018a).	May occur • Cave Creek • Tangle Creek • Turkey Creek • Apache Leap South This species is widespread in the vicinity of the parcels (SEINet 2018).
Saltcedar	*Tamarix ramosissima*	TNF	*Tamarix* spp. occur in moist meadow and riparian communities, in drainage washes of both natural and artificial water bodies, and in other areas where seedlings can be exposed to extended periods of saturated soil conditions; can grow on saline soils with up to 15,000 ppm soluble salt; occurs below 7,500 feet amsl elevation (White 2013).	Has occurrence records in Mohave and Pima Counties (Natural Resources Conservation Service 2018a). On Tonto National Forest, saltcedar occurs along the Verde River and its tributaries; along much of the Salt River; and along Salt and Verde River reservoirs (Tonto National Forest 2018).	May occur • Cave Creek • Tangle Creek • Turkey Creek This species occurs approximately 3 miles south of the Cave Creek (SEINet 2018). May occur at Tangle Creek and Turkey Creek, if sufficient water occurs. Unlikely to occur • Apache Leap South Lacks riparian habitat or roadsides.
Scotch thistle	*Onopordum acanthium*	TNF ADA	Occurs in cultivated, disturbed, or degraded moist sites within meadows, grassland, woodland, and riparian communities, typically below 7,500 feet amsl; can germinate year-round (White 2013).	Has occurrence records in Apache, Navajo, and Yavapai Counties (Natural Resources Conservation Service 2018a). Common in Four Corners area, the Arizona Strip, and along Interstate system near Flagstaff; observed on Tonto National Forest growing in Strawberry at State Route 87 bridge (Tonto National Forest 2018).	May occur • East Clear Creek. This site is in the vicinity of known occurrences (SEINet 2018; Tonto National Forest 2018) and occurs along State Route 87, and contains riparian areas with some disturbance. Unlikely to occur. • Cave Creek • Tangle Creek • Turkey Creek • San Pedro River • Appleton Ranch • Apache Leap South • Dripping Springs Sites are distant to known occurrences of this species (SEINet 2018; Tonto National Forest 2018), and some parcels contain minimal disturbance.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Serrated tussock	*Nassella trichotoma*	Federal ADA	Grows in a wide range of climatic conditions and soil types, being able to tolerate floods, drought, exposure to salt and repeated frost (CABI 2018).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Siberian elm	*Ulmus pumila*	TNF	In Arizona, this species is found in forested areas and high elevations (U.S. Forest Service 2018d). Occurs in cultivated, disturbed, or degraded sites along roadsides and within meadow, grassland, woodland, and riparian communities in well-drained soils, typically below 8,100 feet amsl elevation (White 2013).	Has occurrence records in Apache, Maricopa, and Navajo Counties (Natural Resources Conservation Service 2018a). Isolated records from Coconino National Forest east of Flagstaff and in Verde River/Lynx Lake/Thumb Butte areas of Prescott National Forest (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). Nearest known occurrences are at least 20 miles from parcels (SEINet 2018).
Sicilian starthistle	*Centaurea sulphurea*	ADA	Occurs in cultivated, disturbed, or degraded sites along roadsides and within grassland and woodland communities at elevations typically below 3,300 feet amsl (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Smallflower tamarisk	*Tamarix parviflora*	TNF	Riparian habitats, along permanent or intermittent streams, lakes, and reservoirs; can grow in a wide variety of soils, and can tolerate salinity (CABI 2018).	Has occurrence records in Arizona but not county-specific records (Natural Resources Conservation Service 2018a). On Tonto National Forest, *Tamarix* spp. occur along the Verde River and its tributaries; along much of the Salt River; and along Salt and Verde River reservoirs (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). This species has no occurrence records in the vicinity of the parcels (SEINet 2018; Tonto National Forest 2018).
Southern sandbur	*Cenchrus echinatus*	TNF ADA	Occurs in cultivated, disturbed, or degraded sites that contain sandy or gravelly conditions; is an aggressive colonizer with rapid growth under moist conditions; usually occurs at elevations between 3,500 to 4,500 feet amsl (White 2013).	Has occurrence records in Cochise, Maricopa, Pima, and Yuma Counties (Natural Resources Conservation Service 2018a). Occurs east of Tonto National Forest on the Fort Apache Reservation along the right-of-way for Highway 60 east; occurs on Tonto National Forest on right-of-way of State Route 188, a few miles north of Globe, Arizona (Tonto National Forest 2018).	Unlikely to occur • Dripping Springs • Appleton Ranch parcels Distant from known occurrences (SEINet 2018). Unlikely to occur. • Cave Creek • Tangle Creek • East Clear Creek • Turkey Creek • Apache Leap South • San Pedro River Distant from known occurrences (SEINet 2018); and outside the typical elevational range.
Spotted knapweed	*Centaurea biebersteinii*	TNF	Found at elevations from sea level to 10,000 feet amsl in areas receiving 8 to 80 inches of rain a year; prefers well-drained light-textured soils that receive summer rain in a wide variety of open forest, prairie, and rangelands; disturbance promotes rapid establishment and spread (U.S. Forest Service 2018d).	While the PLANTS database shows occurrence records only in Santa Cruz County (Natural Resources Conservation Service 2018a), other sources indicate occurrence records along Highways 89A and 179 in Sedona, on Northern Arizona University campus, along Lake Mary Road and in the vicinity of Prescott; also north of Grand Canyon in the Arizona Strip, and north of Tonto National Forest above the Mogollon Rim; with an unconfirmed report on the Pleasant Valley Ranger District (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). All Tonto National Forest parcels are distant from known occurrences of this species (SEINet 2018; Tonto National Forest 2018).
Squarrose knapweed	*Centaurea squarrosa*	ADA	Found on cultivated, disturbed, or degraded rangelands and roadsides, typically below 8,000 feet amsl elevation; is an aggressive, competitive plant; germination can occur under a broad range of environmental conditions (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Sulfur cinquefoil	*Potentilla recta*	TNF	Associated with roadsides, disturbed areas, abandoned agricultural fields, and waste areas within grasslands, shrublands, and open-canopy forests; intolerant of complete shade (Zouhar 2003).	While the USDA PLANTS database shows no occurrence records in Arizona, other sources indicate occurrence records along the Rio de Flag and on the Lake Mary Road on Coconino National Forest (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). The nearest known occurrences are more than 30 miles from the parcels (SEINet 2018).
Swamp morning-glory	*Ipomoea aquatica*	Federal ADA	Occurs in moist, marshy, or inundated localities, in shallow pools, ditches, or wet rice fields at elevations between sea level and 3,200 feet amsl (CABI 2018).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Sweet resinbush	*Euryops subcarnosus*	TNF	In Arizona, occurs in semiarid grassland, desert grassland, desert shrub, and desert scrub communities below the Mogollon Rim (White 2013).	Has occurrence records in Graham, Pima, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurs on Fry Mesa south of Safford, on the Santa Rita Experimental Range, and several small patches south of the Globe Ranger Station; west of Highway 188 in Tonto Basin, north of Highway 60, north of the Miami cemetery; and east of cemetery and 2 miles down Bloody Tanks Wash toward Miami (Tonto National Forest 2018).	May occur • Apache Leap South • Tangle Creek • Cave Creek The sites are in the vicinity of known occurrences (Tonto National Forest 2018) and contain some desertscrub or semidesert grassland biotic communities. Unlikely to occur • Turkey Creek Does not contain suitable habitat.
Tansy ragwort [stinking willie]	*Senecio jacobaea*	ADA	Occurs in cultivated, disturbed, or degraded moist sites along roadsides or within meadows, grassland, woodland, and riparian communities; prefers light, well-drained soils at elevations typically below 4,900 feet amsl; this aggressive species is highly poisonous to livestock (White 2013).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Texas blueweed	*Helianthus ciliaris*	ADA	Occurs in cultivated, disturbed, or degraded moist open sites along roadsides and within meadows, grassland, woodland, forest, and riparian communities; prefers alkaline or saline soils at elevations ranging from 3,000 to 8,500 feet amsl; thrives in heavily disturbed and cultivated areas (White 2013).	Has occurrence records in Cochise, Gila, Graham, and Pinal Counties (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). All sites are at least 10 miles away from nearest known occurrence (SEINet 2018) and no site contains heavily disturbed areas except San Pedro River parcel, which is below the typical elevational range for this species.
Three-lobed morning-glory	*Ipomoea triloba*	ADA	Occurs in cultivated fields, sandy ground, and grassy swamp margins on hedges, in thickets; low to middle elevations (CABI 2018).	The PLANTS database shows no occurrence records in Arizona (Natural Resources Conservation Service 2018a). SEINet (2018) has two records from Arizona, in 1930.	Unlikely to occur (all). This species has no recent records in Arizona.
Torpedo grass	*Panicum repens*	ADA	Occurs in wet places, along the edges of rivers, irrigation channels, and lakes, but does not tolerate long-term submergence; can occur in a variety of soils, sandy to heavy (CABI 2018).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Tree of heaven	*Ailanthus altissima*	TNF	Widely distributed in fields, roadsides, fencerows, woodland edges, and forest openings (U.S. Forest Service 2018d). Generally, occurs below 6,200 feet amsl (White 2013).	Has occurrence records in Cochise, Coconino Gila, Greenlee, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai Counties (Natural Resources Conservation Service 2018a). Occurrences around Cottonwood, Camp Verde, and Jerome; on Coronado National Forest lands; in Tonto National Forest on Verde River near Childs; in Superior and Globe and on National Forest lands nearby; near confluence of Pinal Creek and Salt River; and Payson (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). These parcels are distant from known occurrences (SEINet 2018; Tonto National Forest 2018) and do not contain suitable open, disturbed habitat.
Tropical soda apple	*Solanum viarum*	Federal ADA	Occurs in areas that have been frequented by animals or that have received natural materials contaminated by seed, including pasturelands, roadsides, or cattle yards (U.S. Forest Service 2018d).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Water-chestnut	*Trapa natans*	ADA	Prefers full sun, and low-energy, nutrient-rich waters; prefers slightly acidic water (CABI 2018).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Weeping lovegrass	*Eragrostis curvula*	TNF	Occurs in cultivated, disturbed, or degraded areas along roadsides or within meadows, grasslands, and at the margins of chaparral, woodland, and forest communities, generally at elevations between 6,000 and 8,000 feet amsl; this species has high potential for establishment on burned sites (White 2013).	Has occurrence records in Cochise, Coconino, Gila, Graham, Maricopa, Pima, and Yavapai Counties (Natural Resources Conservation Service 2018a). Within Tonto National Forest, seeded extensively along highways, power line corridors, and after fires; seeded in Pinal Mountains after a fire (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). None of the parcels contain meadow, grassland, or roadside habitat, and none are above the 6,000 feet amsl elevation typical of this species.
White bietou	*Dimorphotheca cuneata*	TNF	On the Tonto National Forest, occurs in yards and canyons between Six Shooter Canyon and National Forest lands to the west; no other records of this species being invasive in the United States (Tonto National Forest 2018).	Occurs in an approximately 40-acre patch on the Tonto National Forest between Six Shooter Canyon and National Forest land to the west (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). The only known infestation of this species (SEINet 2018; Tonto National Forest 2018) is distant from all Tonto National Forest parcels.
Wild mustard	*Sinapis arvensis*	TNF	Occurs in dry, disturbed sites, including waste places, pastures, roadsides, and railroad rights-of-way, generally below 6,000 feet amsl elevation (White 2013).	Has occurrence records in Gila, Maricopa, Pima, and Pinal Counties (Natural Resources Conservation Service 2018a). Occurs along State Route 188 from Punkin Center to Roosevelt, on private lands; is common on Agua Fria National Monument, west of Perry Mesa tobosa grassland in Cave Creek Ranger District (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). The known occurrences of this species (SEINet 2018; Tonto National Forest 2018) are distant from all Tonto National Forest parcels.

Common Name	Scientific Name	Status	Habitat Components (Elevation, Soils, Veg Association, Slope, Aspect, etc.)	Geographical Range in Arizona	Likelihood of Occurrence
Wild oats	*Avena fatua*	TNF	Occurs in cultivated, disturbed, or degraded areas along roadsides and within desert, semidesert grasslands, and woodland communities, typically at elevations between 2,500 and 7,200 feet amsl (White 2013).	Has occurrence records in all Arizona counties except Graham, Greenlee, La Paz, Navajo, Santa Cruz, and Yuma (Natural Resources Conservation Service 2018a). Found along most highways in Tonto National Forest (Tonto National Forest 2018).	May occur (all Tonto National Forest parcels). Extremely widespread on the Tonto National Forest, and occurs in the vicinity of all Tonto National Forest parcels (SEINet 2018; Tonto National Forest 2018).
Witchweed	*Striga spp.*	Federal ADA	Parasitic plant that attacks agricultural crops (Natural Resources Conservation Service 2018a).	No occurrence records in Arizona (Natural Resources Conservation Service 2018a).	Unlikely to occur (all). This species is not known to occur in Arizona.
Yellow starthistle	*Centaurea solstitialis*	TNF ADA	Prefers full sunlight and deep, well-drained soils where rainfall is 10–60 inches per year; most commonly occurs in disturbed areas (U.S. Forest Service 2018d). Generally occurs below 8,200 feet amsl elevation (White 2013).	Although the USDA PLANTS database only shows occurrence records in Yuma County (Natural Resources Conservation Service 2018a), other sources indicate that this species has become established in central Arizona, within the communities of Flagstaff, Camp Verde, Payson, Star Valley, and Young; on Tonto National Forest, this species occurs mainly on the higher-elevation districts (Payson and Pleasant Valley) but has been documented in the Tonto Basin below 3,000 feet amsl elevation (Tonto National Forest 2018).	May occur • Clear Creek • Turkey Creek • Cave Creek • Tangle Creek Occurrences in the vicinity (SEINet 2018; Tonto National Forest 2018), disturbance from dirt roads on-site. Unlikely to occur • Apache Leap South • Dripping Springs Distant from nearest known occurrence (SEINet 2018; Tonto National Forest 2018), minimal disturbance on site. Unlikely to occur • Appleton Ranch parcels • San Pedro River Distant from nearest known occurrence (SEINet 2018; Tonto National Forest 2018).
Yellow sweetclover	*Melilotus officinalis*	TNF	Occurs in cultivated, disturbed, or degraded areas along roadsides and within meadows, grassland, woodland, and forest communities at elevations typically ranging from 5,000 to 10,500 feet amsl (White 2013).	Has occurrence records in all Arizona counties except Greenlee, La Paz, Mohave, and Yuma (Natural Resources Conservation Service 2018a). This species is widespread in Arizona, and very common in riparian zones of the Tonto National Forest along the Verde River and on the Cave Creek Ranger District (Tonto National Forest 2018).	Unlikely to occur (all Tonto National Forest parcels). Apache Leap South, Cave Creek, and Tangle Creek are below the typical elevational range of this species, and Turkey Creek contains minimal disturbance and is 7 miles northwest of the nearest occurrence record (SEINet 2018).
Yellow toadflax	*Linaria vulgaris*	TNF	Occurs in cultivated, disturbed, or degraded areas along roadsides and within meadows, grassland, woodland, and riparian communities at elevations typically ranging from 6,400 to 9,200 feet amsl; germination highest on open sites with compacted soils and little vegetation (White 2013).	Has occurrence records in Coconino County (Natural Resources Conservation Service 2018a).	Unlikely to occur (all Tonto National Forest parcels). Known records are distant from all Tonto National Forest parcels (SEINet 2018) and all of the sites are below the typical elevational range of this species.

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APPENDIX C. PRACTICABILITY ANALYSIS IN SUPPORT OF CLEAN WATER ACT 404(B)(I) ALTERNATIVES ANALYSIS

DRAFT

PRACTICABILITY ANALYSIS IN SUPPORT OF CLEAN WATER ACT 404(B)(1) ALTERNATIVES ANALYSIS

Resolution Copper

Prepared for:

United States Army Corps of Engineers

On Behalf of:

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TABLE OF CONTENTS

1. INTRODUCTION 1
2. PROJECT DESCRIPTION AND PURPOSE 2
   2.1. Project Description 2
   2.2. Purpose and Need for the Project 3
3. FORMULATION OF PROJECT ALTERNATIVES 3
   3.1. Geographic Scope for TSF Alternatives 4
      3.1.1. Brownfield Sites 4
      3.1.2. Multiple TSF Locations 6
      3.1.3. Initial TSF Alternative Screening 7
   3.2. Tailings Impoundment Design and Operations 8
      3.2.1. Tailings Embankment 8
      3.2.2. Tailings Processing and Placement Technologies 9
   3.3. Initial Alternatives Dismissed from Further Consideration 11
   3.4. Alternatives Considered in Detail 14
4. TSF ALTERNATIVES DESCRIPTION AND PRACTICABILITY DETERMINATION 14
   4.1. Project-Specific Practicability Criteria 14
   4.2. Detailed Evaluation of DEIS Alternatives 16
      4.2.1. Near West 'Wet' TSF Alternative 16
      4.2.2. Near West 'Dry' TSF Alternative 18
      4.2.3. Silver King TSF Alternative 19
      4.2.4. Peg Leg TSF Alternative 22
      4.2.5. Skunk Camp TSF Alternative 23
5. ENVIRONMENTAL EFFECTS OF PRACTICABLE ALTERNATIVES 27
   5.1. Near West 'Dry' TSF Alternative 28
      5.1.1. Impacts to the Aquatic Ecosystem and Surface Water Features 28
      5.1.2. Other Adverse Environmental Consequences 29
      5.1.3. Compliance with the Guidelines 31
   5.2. Skunk Camp TSF Alternative 32
      5.2.1. Impacts to the Aquatic Ecosystem and Surface Water Features 32
      5.2.2. Other Adverse Environmental Consequences 33
      5.2.3. Compliance with the Guidelines 34
6. SUMMARY AND CONCLUSIONS 36
7. REFERENCES 37

TABLES

Table 1. Brownfields Sites Investigated for Potential Tailings Storage (adapted from SWCA 2017) 5
Table 2. Initial Alternative TSF Locations Dismissed from Consideration (adapted from USFS 2019, Appendix B) 11
Table 3. TSF Alternative Practicability Analysis Results Summary 26
Table 4. Near West 'Dry' TSF Alternative Impacts to Aquatic Ecosystem and Surface Water Features 29
Table 5. Skunk Camp TSF Alternative Impacts to Aquatic Ecosystem and Surface Water Features 33

FIGURES

(follow text)

Figure 1. Overview of Proposed Mining Operation
Figure 2. Brownfield Tailings Storage Facility Locations
Figure 3. Initial Tailings Storage Facility Alternatives Dismissed from Further Consideration
Figure 4. Mineral Creek and Upper Dripping Springs Alternatives
Figure 5. Overview of Tailings Storage Facility Alternatives Locations Considered in Detail
Figure 6. Near West 'Dry' Impacts to Aquatic Ecosystems
Figure 7a. Skunk Camp Impacts to Aquatic Ecosystems Overview
Figure 7b. Skunk Camp Impacts to Aquatic Ecosystems

APPENDICES

Appendix A. *Resolution Copper Mining, LLC – Mine Plan of Operations and Land Exchange – USFS Alternatives Data Request #3-F, Information on Potential Tailings Alternatives*
Appendix B. Tables 3.1 – 3.7 Adapted from Klohn Crippen Berger (KCB) *Summary of DEIS Tailings Alternatives Seepage Control Levels* (February 22, 2019)

1. INTRODUCTION

Resolution Copper Mining, LLC (Resolution, or the Applicant) proposes to develop and operate an underground copper and molybdenum mine near Superior, Arizona. As proposed, the tailings storage facility (TSF), associated pipelines, and appurtenant infrastructure require the discharge of fill to surface water features that the U.S. Army Corps of Engineers (Corps) is anticipated to determine to be potentially jurisdictional waters of the United States (waters of the U.S.) pursuant to a preliminary jurisdictional determination (PJD). Based on the presumption that potentially jurisdictional waters of the U.S. will be impacted by discharges of dredged or fill material resulting from portions of Resolution's planned mine development, Resolution will need to make an application for a Clean Water Act (CWA) Section 404 permit for these discharges.

Because portions of Resolution's planned mine development occur on lands managed by the U.S. Forest Service (USFS) Tonto National Forest (TNF), Resolution submitted a General Plan of Operations (GPO) to the TNF in 2013 and subsequently amended it (Resolution 2016) to account for the USFS plan completeness review and the Southeast Arizona Land Exchange (land exchange) authorized in the National Defense Authorization Act (NDAA) for Fiscal Year 2015. The TNF deemed the GPO to be complete for the purpose of initiating review under the National Environmental Policy Act (NEPA) and has developed a draft of an Environmental Impact Statement (EIS) for the planned mine development and land exchange. Section 3003 of the NDAA authorized the exchange of lands between the federal government and Resolution and directed the USFS to prepare a single EIS as the basis for all decisions under federal law related to Resolution's proposed mine development. The NEPA analysis will ultimately lead to the issuance of a Record of Decision (ROD) by the USFS for Resolution's planned mining-related activities on National Forest System lands. The Corps is acting as a cooperating agency in the EIS process to meet its NEPA obligation triggered by Resolution's presumed need for a Section 404 permit authorizing the discharge of dredged or fill material to potential waters of the U.S.

Independent of the requirement to develop the EIS pursuant to NEPA and Section 3003 of the NDAA, an analysis of alternatives is required as part of Section 404 permitting in order to demonstrate compliance with guidelines established under CWA Section 404(b)(1) (40 CFR § Part 230; the Guidelines) for avoidance, minimization, and mitigation of impacts to waters of the U.S. A demonstration of compliance with the Guidelines is required before a Section 404 permit may be issued. The 404(b)(1) alternatives analysis is intended to ensure that no discharge be permitted "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR § 230.10(a)).

As discussed above, the Draft EIS (DEIS) analyzes the entirety of Resolution's planned mine development activities, as well as the congressionally authorized land exchange. Because only certain elements of Resolution's overall mine development activities involve a discharge of dredged or fill material into potential waters of the U.S. (i.e., the development of the TSF, associated pipelines, and auxiliary infrastructure), only those activities are required to be analyzed by the Corps under the Guidelines. This practicability analysis has been developed to support compliance with the Guidelines, identifies the basic and overall project purpose, describes the alternatives selected for detailed analysis, evaluates the practicability of each selected alternative, and discusses the environmental effects of each practicable alternative. Once finalized, the Corps will use this practicability analysis to complete its 404(b)(1) alternatives analysis, which will be used in the Corps permitting decision-making process.

2. PROJECT DESCRIPTION AND PURPOSE

2.1. PROJECT DESCRIPTION

Resolution's planned mine development is located near Superior in Pinal County, Arizona (**Figure 1**) in an area called the Copper Triangle and specifically within the Pioneer Mining District. Mine exploration and operations have been conducted in the area since the early 1860's, when the discovery of silver led to the development of the Silver King Mine. Magma Copper Company (Magma) took over the Silver King Mine and operated it as the Magma Mine from 1912 until the concentrator was finally shut down in 1996. After Magma's shutdown, the Resolution ore deposit was discovered 1.2 miles south of the existing Magma Mine and 7,000 feet below the ground surface.

Resolution was formed as a limited liability company in 2004 by Rio Tinto and BHP Billiton. Rio Tinto is the managing entity and possesses a 55-percent ownership stake in Resolution, while BHP Billiton maintains 45-percent ownership. Since 2004, Resolution has steadily worked to investigate and delineate the Resolution ore body, develop a mine design, prepare environmental and engineering studies to support the mine permitting and approvals effort, and conduct multiple community outreach efforts and public meetings to inform and involve the public as plans were developed. These efforts led to the submittal of the GPO to the USFS in November 2013.

Resolution proposes the development of the Resolution ore body using panel caving, a type of cave mining. The copper and molybdenum ore will be mined, undergo primary crushing underground, and then be sent to a concentrator facility to be constructed at the existing West Plant Site north of Superior. Concentrate produced here will be transported offsite for additional processing, while the resulting tailings will be transported via a pipeline to the proposed TSF location. Under the current proposed operating conditions and Life of Mine (LOM) planning parameters, the Resolution ore body is sufficient to support the concentrator operations for approximately 41 years. As currently configured, operations are anticipated to result in the mining of approximately 1.4 billion tons of copper and molybdenum ore and the production of approximately 1.37 billion tons of tailings. While the mining process in general, and the planned locations of the ore and processing facilities in particular, are described in the GPO, locations for the TSF, pipelines, and auxiliary infrastructure are the primary subject of the alternatives analysis in the NEPA DEIS and the sole focus of this practicability analysis document. As configured, only the development of the TSF, pipelines, and auxiliary infrastructure require a discharge of dredged or fill material into potential waters of the U.S. Discharge of fill for the development of these features, particularly the TSF, consists mostly of the levelling of existing topography through cut and fill of the natural ground surface. Materials to be discharged to potential waters of the U.S. during this process would consist primarily of native soil and rock taken from the footprint of the constructed features during the grading process.

Processing of the copper and molybdenum ore from the Resolution ore body will result in the production of two physically, mineralogically and geochemically distinct types of tailings: 1) the scavenger or non-potentially acid generating (NPAG) tailings, and 2) the pyrite or potentially acid generating (PAG) tailings. NPAG tailings contain less than 0.1 percent of pyrite by weight (Duke HydroChem 2016). NPAG tailings will account for approximately 84 percent, or approximately 1.15 billion tons, of the tailings produced during the LOM. In contrast, PAG tailings contain a much higher amount of pyrite (>20% by weight) and will account for 16 percent, or approximately 0.22 billion tons, of the tailings produced during the LOM (KCB 2018a). These two very distinct types of tailings, and the management requirements for each (especially the PAG tailings) informed the design and operation of the proposed TSF alternatives evaluated in both the DEIS and this document.

2.2. Purpose and Need for the Project

The Applicant's overall project purpose and need is to construct and operate a TSF and associated infrastructure capable of storing approximately 1.37 billion tons of tailings produced through milling copper and molybdenum ore from the Resolution ore body (plus approximately 12 million cubic yards of on-site borrow material used to construct the starter embankments), along with the pipelines and associated infrastructure needed to transport tailings to the TSF and recycled water from the TSF back to the concentrator facility. Capacity to deposit approximately 1.37 billion tons of tailings is required to allow for utilization of the Resolution ore body to the extent described in the GPO (mining of approximately 1.4 billion tons of ore). The Applicant's basic project purpose is mine tailings storage, which is not water-dependent. However, the proposed discharge will not affect a special aquatic site, so the rebuttable presumption in 40 C.F.R. § 230.10(a)(3) is not triggered.

3. FORMULATION OF PROJECT ALTERNATIVES

The USFS and cooperating agencies (including the Corps)[1] have evaluated a number of alternative TSF designs and locations for detailed analysis in the DEIS. This evaluation is contained in the DEIS and other documents cited herein but will be summarized in the balance of this **Section 3** to explain the selection of the alternatives analyzed in detail for compliance with the Guidelines. This practicability analysis document has been designed to be consistent with, and relies on, the detailed analysis of TSF alternatives contained in the DEIS and supporting documents. Most of these

1 Henceforth in this document, references to the USFS in the context of development of the DEIS should be understood to include the agencies cooperating in the development of that document, including (but not limited to) the Corps.

alternatives, and the methodology for identifying them, are discussed in detail in the *Resolution Copper Project and Land Exchange Environmental Impact Statement DRAFT Alternatives Evaluation Report, November 2017* (SWCA 2017). Subsequently, another alternative (Skunk Camp) was identified for detailed analysis in the DEIS (USFS 2019).

The USFS utilized information gathered from public scoping, government-to-government consultation with Native American groups, and alternatives workshops to identify public values and develop screening criteria for reviewing alternative TSF development scenarios. Some of the key public issues raised during this scoping analysis were public health and safety, proximity to existing communities, and protection of aquatic and wildlife habitat (SWCA 2017). With these issues in mind, the USFS began evaluating the regional landscape to identify potential alternative TSF locations to that TSF location proposed in the GPO. The USFS systematically evaluated dozens of potential tailings locations and technologies for both the full volume and partial volumes (split volume storage) of tailings.

3.1. Geographic Scope for TSF Alternatives

In practice, transport distance for tailings is a significant factor in the economic recovery of the copper and molybdenum ore from the Resolution ore body, and the placement of tailings is not functionally independent of the fixed locus of that ore body. The USFS evaluated the landscape surrounding the Resolution mine to identify initial potential alternative locations for the TSF. Factors considered in this evaluation included locations within a reasonable proximity to the Resolution mine site, favorable topography, sufficient storage capacity, and a configuration suitable for conventional tailings impoundment construction as described in the GPO. As a part of this evaluation, the potential for use of previously disturbed, or 'brownfield', sites for TSF development was also included.

3.1.1. Brownfield Sites

The USFS evaluated brownfield sites associated with other current and previous mining operations not under the ownership of Resolution in locations up to 200 miles from the Resolution ore deposit. This evaluation included 15 brownfield sites not under Rio Tinto or Resolution Copper ownership, as well as the future subsidence zone anticipated from mining the Resolution ore deposit itself, as potential areas for the storage of tailings that might be available and practicable as alternatives to the development of a new TSF in a previously undisturbed location (SWCA 2017). These sites are shown in **Figure 2.** The evaluation considered whether the brownfield site had ongoing or publicly stated planned future mining operations, had other ongoing site activities, and had the capacity to contain a necessary volume of tailings (factors relating to the availability of the site under the Guidelines). Included in the evaluation of capacity for tailings storage was an investigation of the use of multiple brownfield sites so site capacity was evaluated for both storage of the total volume of tailings and storage of only the total volume of PAG tailings. If sites were available and practicable under these initial screening factors, they were further evaluated to determine if they were within a reasonable distance for the pumping of tailings. The evaluated sites are listed in **Table 1**.

Table 1. Brownfields Sites Investigated for Potential Tailings Storage (adapted from SWCA 2017)

Site Name	Ownership	Mining Activity Status	Approximate Distance (miles)[1]
Ajo	Freeport-McMoRan	Copper mine, potential for future operation	120
Carlota	KGHM International Ltd.	Copper mine, current operation	10
Casa Grande	ASARCO LLC	Copper mine, closed operation	49
Copper Queen	Freeport-McMoRan	Copper mine, closed operation, tourism	145
Copperstone	Kerr Mines Incorporated	Gold mine, closed operation	190
Sierrita	Freeport-McMoRan	Copper mine, current operation	100
Johnson Camp	Excelsior Mining Corp.	Copper mine, potential for future operation	100
Miami and Inspiration	Freeport-McMoRan	Copper mine, closing	15
Miami Unit and Copper Cities	BHP Copper Inc.	Copper mine, closing	15
Pinto Valley Mine	Pinto Valley Mining Corp.	Copper mine, current operation	11
Ray Mine	ASARCO	Copper mine, current operation	11
Resolution Copper Subsidence Zone (potential future brownfield site)	Resolution Copper	Copper mine, potential for future operation	3
San Manuel	BHP Copper Inc.	Copper mine, closed operation	45
Tohono Cyprus	Freeport-McMoRan	Copper mine, potential for future operation	70
Twin Buttes	Freeport-McMoRan	Copper mine, potential for future operation	95
United Verde	Phelps Dodge Corporation	Copper mine, closed operation	115

1 Distances measured in aerial miles between Resolution ore body and brownfields facility. The total length to construct appropriate infrastructure (pipelines, etc.) would be considerably longer.

The initial evaluation of the brownfield sites indicated that almost none of the sites had the capacity to accommodate the total volume of tailings from the Resolution ore body and were, therefore, not practicable alternatives to the operation of a single TSF as described in the GPO. Nine of the alternatives either have current operations or proposed future operations that would make them unavailable for the storage of tailings from the Resolution ore body. The closed operations at Casa Grande, Copperstone, and United Verde lacked the capacity to completely contain even the PAG portion of the anticipated tailings and would require the operation of multiple TSFs solely for the PAG tailings (SWCA 2017). These operations were not practicable alternatives for the TSF and were dropped from further consideration. Copper Queen in Bisbee, Arizona is currently used for tourism and was considered unavailable as a potential tailings storage site. Additionally, this site would require an extensive pipeline traversing more than 145 straight-line miles and crossing multiple divisions of federal, state, tribal, and private lands such as to be technologically impracticable.

The Miami and Inspiration site, the Miami Unit and Copper Cities sites, and the San Manuel site were dismissed from consideration because of environmental considerations related to potential ground and surface water quality impacts associated with the storage of the PAG tailings (SWCA 2017). The Miami and Inspiration site and the Miami Unit and Copper Cities sites are located within the Pinal Creek Water Quality Assurance Revolving Fund (WQARF) site and are currently undergoing closure and remediation activities for impacts to groundwater. Similarly, storage of the PAG tailings in the San Manuel pit was determined to have the potential to deliver poor quality groundwater to the San Pedro River, given the characteristics of the PAG material and the pit's proximity to the river (SWCA 2017). As such, none of these three alternatives could be considered practicable alternatives for a TSF.

Use of the final brownfield site, the future subsidence zone anticipated from mining the Resolution ore deposit itself, was reviewed as a potential TSF location. The scenario included the placement of either conventional or dry stack tailings on the land above the mining panels, which would gradually become the subsidence pit. The subsidence pit would continue to be filled with tailings as mining continued and the subsidence expanded over time. Safety concerns to operations and personnel both aboveground and belowground from the deposition of tailings above the active panel caving operations (SWCA 2017) make this alternative impracticable and it was removed from further consideration.

It was ultimately determined that none of the brownfield sites were available, feasible, or reasonable alternatives for TSF locations and those sites were therefore dismissed from detailed analysis (SWCA 2017). As none of these sites meets the criteria for availability and/or practicability under the Guidelines, even using these limited screening criteria, they were also dismissed form further consideration in this practicability analysis.

3.1.2. Multiple TSF Locations

Although the potential for use of multiple sites for the storage for tailings was investigated by the USFS as part of the evaluation of brownfield TSF locations, the use of multiple TSFs was also considered in the development of the alternatives evaluated in this practicability analysis. In general, the use of multiple smaller sites for the storage of tailings is problematic from an operations and maintenance (as well as environmental) perspective, when compared to a single TSF site. Splitting the footprint of a TSF designed for a given capacity into multiple smaller TSFs designed to store that same capacity often results in a greater overall footprint, given the need to duplicate infrastructure.

Impoundment embankments, pipelines, seepage controls, and other auxiliary infrastructure (e.g., roads, power, pumping stations, buildings, vehicle storage/maintenance, and various environmental-management measures such as stormwater ponds, run-off collection, and run-on diversion structures) are required for the operation of a TSF of any size. All these structural components and appurtenant features would need to be constructed and operated at each of the smaller TSFs in a multiple TSF scenario. Starter dam, embankment, and capping materials would be required for each of the multiple

TSF locations. Separate tailings delivery and recycle water return pipelines would also be necessary for each TSF, further increasing the disturbance footprint. As described in **Section 3.2.2**, the transport of the two types of tailings, NPAG and PAG, will be through separate pipelines, further increasing the infrastructure needs associated with multiple TSFs. The duplicative infrastructure required for multiple TSF sites as compared to use of a single site would be expected to result in a larger combined footprint of impact for the multiple TSF over a single TSF of the same storage capacity.

In addition to the consideration of the physical footprint of a single TSF facility in one location versus multiple TSF footprints dispersed over a larger area, the use of multiple TSFs also spreads the potential for environmental effects to additional locations. Effects such as impacts to the aquatic ecosystem, visual impacts, land use compatibility, ground and surface water quality, and air quality would occur at multiple locations, rather than a single location. These effects would be spread over a much larger area when considering the separate facilities, as would the potential for impacts from process upsets, pipeline failures, or seepage. Operating multiple TSF sites when a single site with the necessary capacity exists increases both the operations and maintenance requirements and potential environmental impacts from process upsets.

Given the extensive infrastructure requirements for multiple TSFs and the potential spread of environmental effects to multiple locations, the use of multiple TSFs compared to a single TSF was not carried forward in this analysis.

3.1.3. Initial TSF Alternative Screening

After dismissal of the brownfield alternatives, 15 initial alternative TSF locations to that location proposed in the GPO were further evaluated (SWCA 2017, USFS 2019). The 15 initial locations (**Figure 3**) were screened and assessed using criteria developed from the public and agency scoping processes conducted by the USFS (SWCA 2017) as well as input from cooperating agencies and Resolution Copper. These general screening criteria included locations that were within approximately 20 miles of the West Plant Site, sites that avoided landscape barriers such as mountains or rivers, sites outside rugged terrain to steep for TSF development, and sites potentially near existing or historic mining operations. Resolution Copper's feedback was informed by input from the Resolution Copper Independent Tailings Review Board (ITRB), comprised of internationally recognized industry experts in the field of tailings, with involvement in post tailings failure reviews. Numerous aspects of TSF design and construction such as embankment type (e.g., upstream, centerline, modified centerline, and downstream embankments), foundation treatment and lining options, management of PAG tailings, and deposition methods (e.g., conventional thickened, high-density thickened, and filtered, or 'dry-stack') were assessed for use at these locations as described in the DEIS (USFS 2019). Pertinent portions of this analysis are discussed below in the context of the Guidelines.

3.2. Tailings Impoundment Design and Operations

Brief descriptions of the types of TSF embankment design and tailings placement technologies are provided as follows. Additional detail is available in the DEIS (USFS 2019).

3.2.1. Tailings Embankment

There are four main embankment types for constructing a raised TSF, which are known as upstream, centerline, modified centerline, and downstream. The names of the types refer to the direction of movement of the TSF embankment's centerline in relation to the starter dam initially constructed at the toe of the TSF impoundment. Filtered tailings stacks also require an outer structural zone to meet stability requirements, as discussed in **Section 3.2.1**. The differences in embankment design for each of the TSF alternatives are included in the TSF descriptions in **Section 4**.

Upstream Raised Embankment

For a TSF using an upstream raised embankment, the starter dam is constructed at the ultimate TSF toe and successive, or 'lifts,' are constructed with the crest of each berm offset towards the interior of the TSF or 'upstream' of the starter dam. This form of embankment is constructed of the tailings themselves and is generally considered the least robust and resilient embankment type as it relies on a well-drained shell and the strength of the tailings themselves for stability. The upstream method of embankment construction, which had been proposed in the GPO, was formally dismissed as part of the USFS alternatives analysis for the DEIS.

Downstream Raised Embankment

For a TSF using a downstream raised embankment, the starter dam is constructed within the ultimate impoundment and successive berms, or 'lifts,' are constructed with the crest of each berm offset towards the exterior of the TSF or 'downstream' of the starter dam. This form of embankment is typically constructed for containment of water for reservoirs or flood control. This can be a very robust and resilient embankment type because the embankment stability is not reliant on the strength of the tailings but generally requires the largest volume of material to construct. Due to the large volume required for this embankment type, it can present a challenge for three-sided embankments and areas where topography and land ownership constrains the TSF footprint. This embankment type is proposed for the secondary PAG tailings storage embankment within the larger Skunk Camp and Peg Leg TSFs.

Centerline Raised Embankment

For a TSF with a centerline raised embankment, the starter dam is constructed within the ultimate impoundment and successive berms, or 'lifts', are constructed with the crest of each berm directly above the starter dam and previous lift, the embankment crest not moving either towards or away from the TSF interior. As with the downstream embankment, this embankment type requires a relatively large volume of materials for construction and is a very robust and resilient embankment type. This embankment type is proposed for storage of the NPAG tailings embankments for the Peg Leg and Skunk Camp TSF alternatives.

Modified Centerline Embankment

Some of the TSF alternatives considered in detail in the DEIS and, therefore, in this practicability analysis document, utilize what are known as 'modified centerline' embankments. As described in Chapter 2 of the DEIS (USFS 2019), modified centerline embankments do move 'upstream' of the starter dam over time and involve some construction of embankments over tailings, but contain a more substantial structural zone as compared to an 'upstream' embankment design. The Near West 'Wet' and Near West 'Dry' TSF alternatives propose use of this embankment method.

3.2.2. Tailings Processing and Placement Technologies

The processing and placement method used for the deposition of tailings can be a determining factor in the design of the TSF and generally has a great effect on the delivery of tailings from the concentrator facility to the TSF for storage. Where differences in tailings placement methods are pertinent to the analysis of alternatives, this information is included in the TSF descriptions in **Section 4**. All TSF alternatives, included in Chapter 2 of the DEIS (USFS 2019), consist of separation and thickening of the NPAG and PAG tailings at the concentrator facility. Thickening tailings involves the mechanical process of removing some water from the tailings while still maintaining a concentration of water that allows the tailings to be transported via pipeline. The two types of tailings, NPAG and PAG, are transported to the TSF facility though separate pipelines within the same corridor. Brief descriptions of tailings placement technologies evaluated are provided as follows.

Sub-aqueous Deposition of PAG Tailings

In this method of tailings placement, PAG tailings are thickened at the concentrator to 50 to 55 percent solids and then transported to the TSF via pipeline. Sub-aqueous deposition of PAG tailings is a Best Management Practice (BMP) method used to prevent and minimize acid rock drainage (ARD). For all alternatives except Silver King (Filtered), the PAG tailings are discharged sub-aqueously into the reclaim pond from a barge in a separate area to the NPAG tailings deposition area. Near West 'Wet' includes the reclaim pond and PAG tailings area within the NPAG beach (not in a separate cell).

Near West 'Dry', Peg Leg and Skunk Camp alternatives all store PAG tailings in physically separate cells. However, Peg Leg PAG cells are separate from the NPAG impoundment, whereas, the Near West 'Dry' and Skunk Camp PAG cells would ultimately be encapsulated by the NPAG impoundment. As a result, the reclaim water pond would only overlie the PAG tailings, reduced in size from that typically needed for Near West 'Wet'. Limited and small low spots that accumulate water either released from the tailings or stormwater on the NPAG surface would also be directed to the PAG tailings cell.

Tailings Placement via Conventional Thickened Deposition

In this method of tailings placement, NPAG tailings are thickened at the concentrator facility to 60 to 65 percent solids and transported to the TSF via pipeline. At the TSF, the NPAG tailings are processed through hydrocyclones to produce a coarse particle tailings stream used to construct the embankment, and the finer particle tailings stream is deposited into the interior of the impoundment. Hydrocyclones require the input tailings stream to be between 30 to 40 percent solids, resulting in the finer particle tailings stream to have a high water content. Typically, the finer particle tailings stream is directly discharged into the facility with the high water content. Alternatively, the finer particle tailings stream can be thickened at the TSF site prior to discharge. This tailings placement technology is evaluated in the Near West 'Wet' TSF alternative with the finer particle tailings stream thickened to 50-percent solids.

Tailings Placement via High-density Thickened Deposition

Similar to conventional thickened deposition, tailings are transported to the TSF via pipeline after thickening at the concentrator facility. Additional thickeners located at the TSF facility remove and recycle water to further thicken the tailings prior to deposition. These tailings are deposited at between 60- to 70-percent solids. Like conventional thickened tailings, the NPAG tailings are processed through hydrocyclones to produce a coarse particle tailings stream used to construct the embankment, and a finer particle tailings stream that is placed into the interior of the impoundment. The high-density thickened deposition also involves, to the extent practicable, placement of tailings in thin layers, called "thin-lift," to further reduce entrained water through evaporation and thus reduce seepage. Alternatives that incorporate this type of tailings placement technology include the Near West 'Dry', Peg Leg, and Skunk Camp TSF alternatives.

Filtered Tailings ('Dry-Stack')

In this method of tailings placement, tailings are transported to the TSF via pipeline where they are filtered to reduce the moisture content to approximately 85-percent solids. This process reduces the moisture content to the point where transportation and placement via pipeline is no longer possible and placement of the dewatered tailings in the TSF must be accomplished via mechanical means, such as by truck or conveyor. Dry-stack impoundments can be constructed in horizontal lifts using of a structural outer shell that supports the non-structural zone upstream.

Key considerations when assessing the reasonableness, practicality, and benefits of a tailings management strategy are the precedents and lessons learned from case histories. Most dry-stack tailings facilities operate with throughput capacity between 2,000 and 10,000 tons per day (tpd) with dam heights of less than 200 feet. The current demonstrated industry maximum throughput capacity for operating dry-stack facilities at other mines is approximately 20,000 tpd to more recently approximately 40,000 tpd. The proposed concentrator facility for the Resolution Copper Project will have a throughput of approximately 132,000 tpd and a dam height of approximately 1000 feet for the Dry Stack alternative. To date, the maximum slope height of filtered tailings embankments achieved is approximately 200 feet (further detail can be found in **Appendix A**: *Resolution Copper Mining, LLC – Mine Plan of Operations and Land Exchange – USFS Alternatives Data Request #3-F, Information on Potential Tailings Alternatives*). While the dry-stack technology needed to meet the overall project purpose is unproven, this method was carried forward for further analysis in one TSF alternative to remain consistent with the analysis provided in the DEIS. This tailings placement technology is evaluated in the Silver King TSF alternative.

3.3. Initial Alternatives Dismissed from Further Consideration

The 15 initial alternative TSF locations to that location proposed in the GPO were analyzed for improvements upon key issues of concern identified in scoping by the public and agencies, and screened to identify potential environmental impacts that could result from the development of a TSF under that alternative. The 15 alternative locations, as well as the construction of a dry-stack impoundment at the proposed GPO TSF location, were included in this screening (**Figure 3**) using the screening criteria described in **Section 3.1**. These sites and their disposition are listed in **Table 2**.

Table 2. Initial Alternative TSF Locations Dismissed from Consideration (adapted from USFS 2019, Appendix B)

Alternative Location	Dismissed?	Rationale
BCG A	Yes	Closer to potential receptors and includes lands not available as described in the Far West alternative below. Dismissed from further consideration.
BCG B	Yes	Partially located on Bureau of Land Management (BLM) lands that are withdrawn from mineral entry by the Bureau of Reclamation (BOR) and therefore not available. Dismissed from further consideration.
BCG C	Yes; but became Peg Leg alternative	Partially located on BLM lands that are withdrawn from mineral entry by the BOR and therefore not available. Although dismissed from consideration another configuration of BCG C became the Peg Leg alternative.
BCG D	Yes	Partially located on BLM lands that are withdrawn from mineral entry by the BOR and therefore not available. Proximity to the Gila River presents challenges for seepage and therefore not technologically practicable. Dismissed from further consideration.
Dry-Stack at GPO	Yes; but became Near West alternatives	Water management issues and pipeline corridor are logistically impracticable. Although dismissed from consideration, configurations of conventional tailings and high-density thickened tailings at this location became the Near West 'Wet' and 'Dry' alternatives.
Far West	Yes	The USFS approached the Arizona State Land Department (ASLD) about the potential availability of these State Trust lands for a TSF. The ASLD plans to use these lands for residential development and expressed an unwillingness to sell them. They are therefore not available as an alternative. Dismissed from further consideration.

Table 2. Initial Alternative TSF Locations Dismissed from Consideration (adapted from USFS 2019, Appendix B)

Alternative Location	Dismissed?	Rationale
Hewitt Canyon	Yes	Location in proximity to Superstition Wilderness Class I airshed would prevent air permit compliance. Substantial watershed without a means to divert upper catchment around tailings and all runoff would have to be captured and contained within the TSF. Embankment would be approximately 1,000 feet in height, an unprecedented height for TSF embankments in North America, with a likely determination of extreme consequence based on dam classification. Considered not technologically or logistically practicable. Dismissed from further consideration.
Lower East	Yes	Location and configuration similar to impacts and challenges of Near West alternatives, but closer to sensitive receptors of Boyce Thompson Arboretum, residents, and U.S. 60. Extreme consequence of failure due to proximity to sensitive receptors and critical infrastructure. Dismissed from further consideration.
Silver King	Yes; but became Silver King Dry-Stack alternative	Conventional tailings deposition design at this location was not available because of historic cemetery and adverse mineral estate, and technologically impracticable because of historic mine workings. Although dismissed from consideration another configuration using dry-stack tailings is carried forward for analysis.
SWCA 1	Yes	Located adjacent to BLM lands withdrawn from mineral entry by the BOR. Seepage collection and other appurtenant infrastructure would need to be located on these withdrawn lands and therefore the alternative is not available. Proximity to the Gila River and terrain also present challenges for seepage and stormwater management. Dismissed from further consideration.
SWCA 2	Yes	Partially located on BLM lands that are withdrawn from mineral entry by the BOR; therefore, the alternative is not available. Proximity to the Gila River and terrain present challenges for seepage and stormwater management. Dismissed from further consideration.
SWCA 3	Yes	Location is on steep ridge crest and occupies portions of both the Queen Creek and Gila River watersheds. As such, it would require substantial engineering controls to minimize seepage from multiple locations that would be impracticable to implement. Rugged topography makes it unlikely to have available capacity for all tailings volume and presents substantial difficulties for infrastructure, structures, and equipment. Not in keeping with good engineering practices and technologically impracticable. Dismissed from further consideration.
SWCA 4	Yes	Partially located in Superstition Wilderness and therefore not available. Dismissed from further consideration.
Telegraph Canyon	Yes	Telegraph Canyon contains a perennial stream segment along with valuable riparian habitat identified as Important Bird Areas, as well as several springs, and may contain wetlands associated with the perennial flow. Dismissed from further consideration.

Table 2. Initial Alternative TSF Locations Dismissed from Consideration (adapted from USFS 2019, Appendix B)

Alternative Location	Dismissed?	Rationale
Upper Arnett	Yes	Alternative contains a perennial segment of Arnett Creek. This creek may support wetlands associated with the perennial flow. The location is also proximate to State Route 177 that constrains TSF design and the steep canyon sidewalls do not provide sufficient capacity for all the tailings volume. Dismissed from further consideration.
Whitford Canyon	Yes	Location in proximity to Superstition Wilderness Class II airshed would prevent air permit compliance. Substantial watershed without a means to divert upper catchment around tailings and all runoff would have to be captured and contained within the TSF. Embankment would be approximately 1,000 feet in height, an unprecedented height for TSF embankments in North America. Considered not technologically or logistically practicable. Dismissed from further consideration.

As none of the initial alternatives met the general screening criteria defined herein and the criteria for practicability under the Guidelines, they were dismissed from further consideration in the DEIS (SWCA 2017, USFS 2019) and this practicability analysis. The upstream method of tailings embankment construction was dismissed from further analysis, as well. This screening analysis did, however, identify four new TSF alternatives at three of the previously investigated locations. The Peg Leg Alternative resulted from a reconfiguration of the TSF proposed at BCG C, and the Near West 'Wet' and 'Dry' Alternatives resulted from the screening and analysis performed for the Dry-Stack at GPO Alternative. The Silver King location was identified for analysis as a potential dry-stack TSF. These four alternatives are described in **Section 3.4** and are considered in detail in both the DEIS and this practicability analysis document.

Two additional alternatives at locations not previously considered were brought forward for screening at this time. These alternatives, the Mineral Creek Headwaters Alternative and the Upper Dripping Springs Wash Alternative, are shown in **Figure 4**. Although the Mineral Creek Headwaters Alternative site may have sufficient capacity to store the total anticipated volume of tailings, it is located within a perennial segment of Mineral Creek (SWCA 2017) that is designated as critical habitat for the endangered Gila Chub (*Gila intermedia*) and may also support wetlands associated with the perennial flow. The Mineral Creek Headwaters Alternative was considered unavailable and dismissed from further review in both the DEIS and this practicability analysis document.

The initial screening of the Upper Dripping Springs Wash Alternative did not identify any high-level availability or practicability issues with this alternative location. The alternative footprint includes only ephemeral drainages, does not contain any potential wetlands, and avoids seeps and springs in the area. The alternative was renamed the Skunk Camp Alternative and carried forward for detailed review in both the DEIS and this practicability analysis document.

3.4. Alternatives Considered in Detail

Five TSF alternatives were considered for detailed analysis in the DEIS (USFS 2019), which included a mix of locations, embankment types, and tailings deposition and placement technologies. These same alternatives passed the general screening criteria described above and are carried forward for more detailed consideration in this practicability analysis. The alternatives for detailed analysis are as follows:

- Near West 'Wet' TSF (conventional thickened tailings)
- Near West 'Dry' TSF (ultra thickened tailings)
- Silver King TSF (dry-stack tailings)
- Peg Leg TSF (ultra thickened tailings)
- Skunk Camp TSF (ultra thickened tailings)

These final TSF alternatives are fully analyzed in the DEIS to disclose impacts to the natural and social environment. Per the Guidelines, the evaluation of these alternatives provided herein will focus on alternative practicability, impacts to the aquatic ecosystem, and other significant adverse environmental consequences.

4. TSF ALTERNATIVES DESCRIPTION AND PRACTICABILITY DETERMINATION

This section describes the five TSF alternatives (**Figure 5**) identified for detailed analysis by the USFS in the DEIS (USFS 2019) and provides description for each , including the acreages of impacted undisturbed land reported to the nearest whole acre. An alternative is to be deemed practicable, "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 CFR § 230.10(a)). The alternatives considered in this analysis have been evaluated for these elements of practicability. Details of each alternative are followed by a determination of the alternative's practicability based on the criteria defined in the Guidelines at 40 CFR §230.10(a)). One of the key practicability criteria applied to this analysis of TSF alternatives is discussed in **Section 4.1**.

4.1. Project-Specific Practicability Criteria

A critical element in determining the logistical and technological practicability of a TSF alternative is the ability (or lack thereof) to capture and control seepage from the TSF in a manner that reliably allows the facility to meet all applicable standards and obtain and operate in compliance with required environmental permits. Numerical models were developed for each TSF to predict the amount of uncollected seepage for each TSF alternative. These seepage models were developed based on the hydrogeological setting of each TSF site and represent steady-state conditions assuming operational conditions at full TSF build-out. Levels of engineering seepage controls were also developed for implementation at each TSF site and are described in detail in Section 3.7 of the DEIS (USFS 2019).

The levels of engineering control and estimated efficiency are based on Best Available Demonstrated Control Technology (BADCT) for seepage controls, as well as other discharge control technologies, as defined by the Arizona Department of Environmental Quality (ADEQ). Engineering controls to reduce seepage are characterized in the models by level, or efficiency, of control. These levels are generally specific to each alternative and location. Descriptions of each TSF alternative's levels are described in **Section 4.2** and tables taken from the *Resolution Copper Project Summary of DEIS Tailings Alternatives Seepage Control Levels* (KCB 2019) are included as **Appendix B** of this document. It should be noted that the seepage engineering controls included within each defined level are slightly different for each TSF alternative due to site-specific conditions. However, the greater the number of controls required in each level, and the presence of higher level controls, denote an increased degree of complexity in terms of those engineered controls.

The numerical models, described above and explained in detail in the DEIS, were used to estimate the uncaptured seepage in acre-feet per year (AF/yr). GoldSim models taking into account these engineered controls were then used to predict potential transport of any uncollected seepage through the aquifer to surface water receptors. In order to operate a TSF, Resolution must obtain an Aquifer Protection Permit (APP) from ADEQ, which requires the mine facility to demonstrate that it will not cause or contribute to an exceedance of Aquifer Water Quality Standards (AWQS) at the point of compliance, or, if, AWQS for a pollutant has been exceeded in an aquifer, that no additional degradation will occur [A.R.S. § 49-243(B)(2)-(3); AAC R18-9-A202(A)(8)(a)]. Seepage must also not contribute to the exceedance of any ADEQ surface water quality standards where groundwater may emerge and contribute to surface flow [AAC R18-11-405(b)].

The concentrations of regulated constituents in the seepage were modeled both with and without the background water quality. An analysis of the total predicted concentrations (modeled plus background) of pollutants was used to calculate the preliminary allowable seepage rate in AF/yr that would allow each TSF to operate over the LOM and post-closure (245 years) periods without exceeding water quality standards. The total predicted concentrations are compared to the ADEQ groundwater and surface water quality standards at the Points of Compliance (POC) downgradient of each TSF footprint (750 ft downgradient for groundwater; site-specific locations for surface water). The POC for Near West 'Wet' and 'Dry', and Silver King alternatives, is in the last groundwater cell nearest to Whitlow Ranch Dam, which provides the majority of surface flow at the dam. The POC for Peg Leg and Skunk Camp alternatives is located at the confluence of Gila River at Donnelly Wash and Dripping Springs Wash, respectively. The background water quality, surface water flow rate, and distance to the POC are critical in determining the potential seepage impacts to downstream surface water quality.

For each alternative, a maximum uncollected seepage rate was modeled that would allow compliance with surface water quality standards at the POCs noted above, as is necessary in order to secure an APP. If exhaustive and multiple seepage controls are installed and the TSF cannot meet standards and secure an APP, then it was determined that the TSF is technologically impracticable for the purposes of this assessment.

4.2. Detailed Evaluation of DEIS Alternatives

A description and discussion on the practicability of each TSF alternative is provided in the following sub-sections. The alternatives evaluated are as follows:

- Near West 'Wet' TSF
- Near West 'Dry' TSF
- Silver King TSF
- Peg Leg TSF
- Skunk Camp TSF

4.2.1. Near West 'Wet' TSF Alternative

4.2.1.1. Description

The Near West 'Wet' TSF Alternative (Alternative 2 in the DEIS) proposes the construction of a modified centerline embankment on USFS lands with approximately 1.37 billion tons of tailings storage capacity using conventional thickened tailings deposition as described in **Section 3.3**. The associated tailings transportation corridor would also be located on USFS and private lands owned by Resolution. This TSF alternative would be approximately 4,909 acres in size with an ultimate embankment crest reaching 520 feet in height.

The location of the Near West 'Wet' TSF is underlain by a mix of different age bedrock incised with narrow channels infilled with alluvial, colluvial and undifferentiated sediments (KCB 2018a). Gila Conglomerate makes up 55 percent of the Near West 'Wet' TSF overall foundation, while a mixture of limestones, sandstones and quartzites are located along the footprint of the NPAG's starter dam, the TSF embankment, and the northern portion of the TSF. The conglomerate, limestone, and sandstone sediments all possess a potential for reduced foundation strength, especially if exposed to long-term saturation and have potential to allow seepage into adjacent canyons (KCB 2018a).

The proposed Near West 'Wet' TSF is located near the center of Superior Basin, which drains ultimately into Queen Creek. Stormwater diversion channels would be required for this TSF alternative to redirect flow from the 4.91-square-mile upper watershed of Bear Tank Canyon to adjacent watershed of Roblas Canyon and Potts Canyon (SWCA 2018).

The Queen Creek aquifer in the vicinity of the Near West TSF location is relatively small with groundwater levels approximately 50 feet below ground surface and in relatively close proximity to the TSF footprint. As such, extensive seepage controls have been proposed for this alternative, including the following (KCB 2018a, 2019):

Level 0

- Underdrain system comprising a drainage blanket and finger drains beneath the entirety of the embankment to drain to seepage collection ponds

Level 0-1

- Extension of embankment underdrains beneath the entirety of the starter dam and into the impoundment under the entire NPAG tailings beach area
- In each drainage channel surrounding the TSF there will be a primary seepage collection system including lined seepage collection ponds, cutoff walls and pump back wells to return and recycle the collected seepage
  - A total of 12 cutoff walls will be excavated through alluvium, filled with compacted granular fill and grouted to competent bedrock

Level 1

- Further extension of the underdrain system an additional 200 feet into the impoundment beyond the beach area
- Lined channels downgradient of the embankment to direct captured seepage to the primary seepage collection system
- Foundation treatments and/or selective engineered low permeability layers in areas of the foundation where Gila Conglomerate not present
- Placement of an engineered low permeability layer for the PAG tailings starter facility
- Encapsulation of PAG into the low permeability NPAG tailings fines and sealing of the NPAG foundation with fines
- Addition of grout curtains extending to 100 feet below ground paired with each cutoff wall as part of the primary seepage collection system

Level 2

- Further extensions and deepening of the grout curtains described in Level 1 to target higher permeability zones and potential seepage pathways

Level 3

- Auxiliary seepage collection system downgradient of the primary seepage collection system in drainages surrounding the TSF facility comprising additional cutoff walls, seepage collection ponds, and wells to pump the collected and recycle water back to the TSF

Level 4

- Low permeability liners in areas of the foundation where Gila Conglomerate not present
- Engineered low permeability liner for the entire PAG cell
- Addition of an auxiliary grout curtain extending to 100 feet below ground paired with cutoff walls as part of the auxiliary seepage collection system; total of 7.5 miles in length
- Up to 21 pump back wells between the auxiliary seepage collection system and Queen Creek

Seepage modeling studies indicate that by using Levels 0 through 4 (KCB 2018a, 2019) of the engineered seepage controls detailed above, this facility would have uncollected seepage rates of 20.7 AF/yr and that the concentration of selenium will ultimately exceed state-established surface water quality standards. Montgomery (2019b) modeled a preliminary allowable maximum uncollected seepage rate of 3 AF/yr for compliance with surface water quality standards, well below the 20.7 AF/yr estimate. This allowable rate of uncollected seepage was based on the constituent that resulted in the lowest seepage flow rate prior to exceeding the regulatory threshold (selenium).

4.2.1.2. Practicability of Alternative

The Near West 'Wet' TSF Alternative is determined to be not practicable. While this alternative would meet the overall project purpose, the allowable seepage rate needed to avoid exceeding the aquatic and wildlife warm water quality standard for selenium is unachievable, even with extreme and extensive seepage controls. As such, it is unlikely that Resolution could secure the required APP from ADEQ. Therefore, this alternative is not technologically practicable and is not carried forward for further analysis.

As noted above, development of this alternative would result in concentrations of selenium above state-established surface water quality standards. In addition, seepage from this tailings facility would result in dissolved copper loading of Queen Creek, which has been determined to be impaired for copper by ADEQ. This alternative would increase the copper loading in Queen Creek by 7 to 22 percent, interfering with the state's efforts to reduce the loading in this impaired feature.

4.2.2. Near West 'Dry' TSF Alternative

4.2.2.1. Description

The Near West 'Dry' TSF Alternative also proposes the construction of a modified centerline embankment on USFS lands with approximately 1.37 billion tons of tailings storage capacity. The approximate TSF footprint is 4,909 acres in size with an ultimate embankment crest 510 feet in height. The tailings transportation corridor would also be located on USFS and private lands owned by Resolution (KCB 2018b). Compared to the 'Wet' Alternative, the Near West 'Dry' Alternative physically separates the PAG and NPAG tailings with a splitter berm and proposes ultra thickening of NPAG tailings. By isolating PAG tailings and ultra thickening the NPAG tailings, drier conditions are maintained, resulting in reduced seepage into the foundation.

The proposed Near West 'Dry' TSF Alternative is located within the same footprint as the Near West 'Wet' TSF Alternative and, therefore, possesses similar geologic and hydrologic conditions. This alternative would require upstream stormwater diversions and all the same Levels 0 through 4 of extensive engineered seepage controls as the Near West 'Wet' TSF Alternative described above. However, this configuration does allow the interior finger drain system to function more effectively for greater seepage capture. This more effective seepage capture, in combination with the Levels 0 through 4 seepage controls (KCB 2018a, 2019), the physical separation of PAG and NPAG tailings, and high-density thickening the NPAG tailings, is modeled to result in 2.7 AF/yr of uncollected seepage, which is slightly below the modeled allowable maximum seepage of 3 AF/yr (Montgomery 2019b) needed to meet surface water quality standards at the POC identified for this alternative. No chemical constituents are anticipated in concentrations above established surface and groundwater quality standards.

4.2.2.2. Practicability of Alternative

The Near West 'Dry' TSF Alternative is determined to be practicable, although it would require implementation of a degree of engineering control that is not typical of large-scale copper porphyry tailings facilities. Individually, the seepage control measures have been implemented at small, medium and large-scale projects, but the engineering controls described for this alternative combine a multitude of the available seepage controls and would be implemented on a larger scale than typical. The location of this alternative is currently available and has the capacity to meet the overall project purpose. Like the Near West 'Wet' TSF Alternative, this alternative would still require an extreme and extensive seepage control system, in comparison to the other TSF designs, in order to maintain ADEQ water quality standards. However, more extensive finger drains and thickening of tailings reduces overall seepage, allowing the engineered controls to capture enough seepage to meet water quality standards and potentially secure an APP from ADEQ. Based on the predicted uncollected seepage rates being so close to the allowable maximum rates to achieve compliance with water quality standards, this TSF alternative would need to consistently capture 99.5 percent of seepage. As noted in the DEIS (USFS 2019), "the high capture efficiency required of the engineered seepage controls could make meeting water quality standards under this alternative challenging. The number and types of engineered seepage controls represent significant economic and engineering challenges."

Seepage from this tailings facility would result in dissolved copper loading of Queen Creek, an impaired water. This alternative would increase the copper loading in Queen Creek by 1 to 2 percent, impeding the state's efforts to reduce the loading in this impaired feature.

Impacts to the aquatic ecosystem as well as other potential adverse environmental consequences of this alternative are described further in **Section 5**.

4.2.3. Silver King TSF Alternative

4.2.3.1. Description

The Silver King TSF Alternative proposes the construction of two separate impoundments using the dry-stack method, one with approximately 1.15 billion tons of NPAG tailing capacity and one with 0.22 billion tons of PAG tailing capacity. In contrast to the other TSF alternatives, the dry-stack TSF would not require an embankment, but rather the compacted zone of tailings around the perimeter of the dry-stack facility provides structural support (USFS 2019). Both the TSF and pipeline corridor would be located on USFS lands. Due to topography and land constraints, NPAG and PAG tailings would need to be placed in separate impoundments. The PAG tailings would be placed and maintained unsaturated, and would be exposed to continual wetting and drying cycles associated with natural precipitation (average of 18 inches per year). This TSF alternative would be approximately 5,661 acres in size, and the ultimate embankment crests for NPAG and PAG would reach 1,040 feet and 750 feet in height, respectively.

The location of the Silver King TSF sits across the Concentrator, Main, and Conley Springs faults. It is predominantly underlain by Quaternary deposits overlaying Pinal Schist bedrock. A complex geologic sequence of Pinal Schist, Tertiary Gila Conglomerate, Mescal Limestone, Apache Group, Bolsa Quartzite, Dripping Spring Quartzite, and Tertiary Tuff occur along the southwestern portion of the TSF with Quartz Diorite occurring along the northeastern corner, all of which is covered by Quaternary deposits and incised with alluvial filled channels. Additionally, the Pinal Schist unit is known to have reduced strength along foliations which appear at the southeastern portion of the TSF (KCB 2018c).

The proposed Silver King TSF is situated at the northeast edge of the Superior Basin, which drains into Queen Creek and Potts Canyon and ultimately to the Whitlow Ranch Dam. Due to the topography, land constraints, and large volume of tailings, large diversion dams, underground tunnels, and pipelines would be required to reroute surface water from large upstream drainage basins, particularly from Comstock Wash and Whitford Canyon, around the TSF.

The Queen Creek aquifer in this area is relatively small with groundwater levels approximately 100 to 300 feet below the surface of the TSF. The three faults beneath the TSF are likely leaky barriers to groundwater flow, causing higher groundwater levels to the northeast of the faults (KCB 2018c). Seepage controls proposed for this alternative include the following (KCB 2018a, 2019):

Level 0

- Dewatering of tailings to 85-percent solids prior to placement in a dry-stack
- Underdrain system comprising a drainage blanket beneath the entirety of the compacted structural zone of the dry-stacked tailings

Level 1

- Lined channels downgradient of the tailings facility to direct captured seepage to the primary seepage collection system
- Primary seepage collection system in drainages surrounding the TSF comprising multiple lined seepage collection ponds, cutoff walls and pump-back wells to return the collected seepage
  - Cutoff walls will be excavated through the small amount of alluvium present, filled with compacted granular fill and grouted to competent bedrock

Level 2

- Targeted grouting of fractures in the foundation
- Pump back wells down gradient of the primary seepage collection cutoff walls

Seepage modeling studies determined that Levels 0 to 2 controls (KCB 2018a, 2019) would only reach 90 percent efficiency, leading to uncollected seepage rates of 9 AF/yr with Level 2 controls, which exceeds the preliminary modeled maximum allowable seepage of 6 AF/yr (Montgomery 2019a) needed to meet surface water quality standards at the POC identified for this alternative. As such, selenium is modeled to exceed surface water quality standards beginning in model year 59 (USFS 2019).

4.2.3.2. Practicability of Alternative

The Silver King TSF Alternative is not logistically or technologically practicable. While the land for this alternative is available, the dry-stack technology is not proven at this scale and seepage quantities are modeled to result in exceedances of surface water quality standards in downstream surface waters.

The current proven maximum throughput capacity for operating dry-stack facilities is approximately 20,000 tpd (at the La Coipa mine in Chile), or approximately 15 percent of the Resolution Copper Project's anticipated initial operating capacity of approximately 132,000 tpd. Most filtered tailings capacities in operation are less than 10,000 tpd. Furthermore, with land constraints and capacity requirements, the Silver King TSF would reach heights of 750 and 1,040 feet, both unprecedented heights for existing TSFs, in which structural stability is unknown. The embankment heights for the other proposed TSF alternatives for the project range between 200 and 520 feet in height.

As noted above, development of this alternative would result in concentrations of selenium above state-established surface water quality standards. In addition, seepage from this tailings facility would result in dissolved copper loading of Queen Creek, which has been determined to be impaired for copper by ADEQ. This alternative would increase the copper loading in Queen Creek by 11 to 21 percent, interfering with the state's efforts to reduce the loading in this impaired feature.

Additionally, the filtered tailings are placed partially saturated and exposed to the natural elements, an approach that goes against current BMP for PAG tailings that are highly pyritic and acid generating. Such designs are more prone to wetting and drying cycles than typical TSF systems, resulting in low pH and an increase in Total Dissolved Solids (TDS), as well as elevated metals in seepage during the LOM. Only the dry-stack is as affected by the cyclical wetting and drying that leads to oxidation.

Given the lack of demonstrated dry-stack technology at the scale contemplated by the project and seepage control issues, this alternative would not be considered logistically or technologically practicable. This alternative is not carried forward for further analysis.

4.2.4. Peg Leg TSF Alternative

4.2.4.1. Description

The Peg Leg TSF Alternative proposes the construction of two separate impoundments with a dual-embankment approach, a centerline embankment for containment of approximately 1.15 billion tons of NPAG tailings and a downstream embankment for containment of approximately 0.22 billion tons of PAG tailings capacity. These impoundments would be located on a mix of public lands managed by the BLM and State Trust lands that would need to be purchased from the ASLD prior to construction and operation of the TSF. The transportation corridor would be located on a combination of lands owned by the USFS, BLM, Bureau of Reclamation, Department of Defense, ASLD, and Resolution. Similar to Near West 'Dry', PAG tailings would be discharged sub-aqueously into a separate impoundment, a BMP for PAG tailings. However, with the Peg Leg TSF Alternative, the PAG facility would be contained behind a separate downstream embankment and separated into smaller operating cells to reduce pond size, seepage, and water required during the LOM (Golder 2018). These two impoundments would total approximately 10,782 acres in size with the ultimate height of the NPAG and PAG impoundments reaching 310 and 200 feet in height, respectively.

The Peg Leg TSF is underlain by exposed granitic bedrock towards the eastern portion of the site with younger alluvial deposits over a gently sloping bedrock pediment within the western half of the footprint (Golder 2018). Ruin Granite and Tea Cup Granodiorite are the main bedrock units in the eastern portion. The thickness of the unit varies widely within the area and has been noted that decomposed and unsolidified granite makes up the first 90 feet of depth. The granite bedrock units possess both low permeability ratings and high strength characteristics. The NPAG footprint is mainly on a mix of alluvial deposits that reach depths of as much as 2,000 feet.

The proposed Peg Leg TSF is adjacent to Donnelly Wash which drains ultimately into the Gila River. Stormwater diversion channels would be required for this TSF alternative. The aquifer is relatively large, and groundwater tests in the area reveal water elevation ranging from 50 feet below ground surface in the fractured bedrock aquifers to several hundred feet near the center of Donnelly Wash basin (Golder 2018).

The site's geology and hydrology make the application of cutoff walls and grout curtain technically infeasible, requiring a higher number of pump-back wells than the other TSF alternatives. The following levels of controls would be implemented for the Peg Leg TSF alternative (Golder 2018, KCB 2019):

Level 0

- Underdrain system comprising a drainage blanket beneath the entity of the embankment

Level 1

- Lined channels downgradient of the tailings facility to direct captured seepage to lined seepage collection ponds with pump-back wells
- Extension of embankment underdrains with fingers drains extending beneath the impoundment under the entire NPAG tailings beach area
- HDPE lining of the recycled water pond area
- Engineered low permeability layers for the entire PAG cell
- Extensive network of pumpback wells down gradient of the lined channels and ponds to form a continuous cone of depression below the NPAG embankment

Level 2

- Engineered low permeability liner for the entire PAG cell
- Excavation and removal of alluvium above the bedrock below PAG cells
- Utilization of thin lift deposition beginning when sufficient operating area becomes available
- Adjustments and refinements to the network of pump-back wells for seepage capture

Seepage modeling studies indicate that by implementing the Levels 0 to 2 seepage controls, this facility can obtain uncollected seepage rates of 261 AF/yr, which is equal to the allowable seepage of 261 AF/yr (Montgomery 2019a) modeled as necessary to meet surface water quality standards at the POC identified for this alternative. Modeling does not indicate that any constituents will occur in concentrations above established water quality standards as a result of tailings seepage. Currently, this alternative meets the allowable uncollected seepage rates with the Levels 0 to 2 seepage controls, and additional controls could be added. The location, geology, and distance to the Gila River allows for flexibility in implementing additional seepage control measures, if necessary.

4.2.4.2. Practicability of Alternative

The Peg Leg TSF Alternative is not practicable. While this alternative has the capacity to meet the project's purpose and is logistically and technologically practicable, the site is not available. The ASLD has indicated that this site is more suitable for future residential development and that it is not available for the use of a TSF. The area is relatively flat and in the vicinity of the limits of the Town of Florence. Since no configuration of this TSF alternative is available without encroachment onto ASLD or BOR withdrawn lands, this alternative is not available and thus impracticable. It is not carried forward for further analysis.

4.2.5. Skunk Camp TSF Alternative

4.2.5.1. Description

The Skunk Camp TSF Alternative is very similar to the Peg Leg TSF, with a dual embankment incorporating a robust centerline embankment for the NPAG tailings, and a downstream embankment for the PAG tailings. The TSF alternative is located on a mix of private and ASLD-managed State Trust lands that would be purchased prior to construction and operation of the TSF. In contrast to the Peg Leg alternative, the ASLD has indicated that it is willing to consider the land at this location for development of a TSF. Two potential pipeline corridors are being analyzed for this TSF alternative: 1) the North Pipeline Corridor, and 2) the South Pipeline Corridor. Both would be located on USFS, private, and State Trust lands. The North Pipeline Corridor is currently the preferred corridor due to a smaller disturbance footprint, shorter length, lower required operating pressure, and lower pumping requirements. Impacts to the aquatic ecosystem and potential waters of the U.S. associated with the pipeline construction are anticipated to be largely temporary impacts and generally not material to the identification of the LEDPA.

The cross-valley design of the Skunk Camp TSF requires far less material to construct the embankment compared to three-sided ring-impoundment TSF designs needed at Near West and Peg Leg, thus reducing construction and operational complexity (KCB 2018d). Much like the Near West 'Dry' and Peg Leg TSF alternatives, the PAG tailings are physically isolated from the NPAG and are sub-aqueously placed into separate smaller operating cells located at the northern end of the NPAG tailings to reduce pond size, seepage, evaporative losses, and water required to maintain a water cover over the PAG tailings. The ultimate footprint would be approximately 4,002 acres in size with the ultimate height of the embankment crest reaching 490 feet in height.

The Skunk Camp TSF is situated along a north-trending normal fault and is underlain by a tertiary age Gila Conglomerate that is partially covered by Quaternary deposits, including alluvium in the base of the major valleys (KCB 2018d). There is some potential for relatively shallow Gila Conglomerate thickness west of the normal fault but greater depths along the eastern edge (Montgomery 2019a). Alluvial channels located throughout the site are considered pathways for groundwater flow and are noted to be less than 150 feet thick. Recent measurement of depth to groundwater taken within the alluvium and Gila Conglomerate, suggests that groundwater levels are approximately 70 feet below the ground surface in some locations (KCB 2018d).

This TSF alternative is located within the Dripping Spring Wash basin, which drains 13 miles to the southeast and discharges into the Gila River. Currently, several unnamed drainages report to Dripping Spring Wash. Stormwater diversion channels and dams are proposed on either side of the TSF, with one set of channels discharging into Dripping Spring Wash and the other set of channels diverting surface runoff into the upper reaches of Mineral Creek (SWCA 2018).

The site's geology and hydrology coupled with the overall design of the TSF allow for a less complex seepage collection system compared to the Near West 'Wet' and Near West 'Dry' TSF alternatives. The topography and geologic configuration of the site generally funnels seepage to one location, as compared to the topography and geologic configuration at Near West, which would allow seepage to move in multiple directions and thus require far more extensive engineering controls. This alternative would include only one cut-off wall, one grout curtain of far less length, and fewer pump-back wells.

For the Skunk Camp TSF, the differences in levels of seepage controls between Levels 1 and 3 are variations on the depth of the grout curtain and pump-back wells and not additional engineered controls. Seepage collection (KCB 2018d, 2019) for this TSF is summarized as follows:

Level 0

- Underdrain system comprising a drainage blanket beneath the entirety of the embankment

Level 1

- Extension of embankment underdrains beneath the entirety of the starter dam and into the impoundment between 100 and 200 feet under the NPAG tailings beach area
- Placement of an engineered low permeability layer for the PAG facility
- Seepage collection system including a lined seepage collection pond with a cutoff wall and pump-back wells to return and recycle the collected seepage
- Grout curtain to a depth of 70 feet
- Downgradient seepage pump-back wells to a depth of 20 feet

Level 2

- Extend Level 1 grout curtain to a depth of 100 feet
- Extend Level 1 downgradient seepage pump back wells to a depth of 70 feet

Level 3

- Extend Level 2 downgradient seepage pump back wells to a depth of 100 feet

Seepage modeling studies indicate that by using these Levels 0 to 3 seepage controls (KCB 2018d, 2019), this facility could obtain uncollected seepage rates of 65 to 178 AF/yr, which is well below the allowable maximum of 329 AF/yr (Montgomery 2019a) modeled as necessary to meet surface water quality standards at the POC identified for this alternative. No constituents were modeled to result in concentrations above established water quality standards.

4.2.5.2. *Practicability*

The Skunk Camp TSF Alternative is practicable. This alternative is available and both technically and logistically practicable. The ASLD has indicated that it is willing to sell this land to Resolution for the development of a TSF. The seepage collection system is simpler in design with a higher efficiency than the other TSF alternative designs, and there is substantial opportunity to implement additional seepage control measures for this alternative when compared to other alternatives. The design of the TSF under this alternative has the capacity to meet the overall project purpose.

Table 3. TSF Alternative Practicability Analysis Results Summary

TSF Alternative	Tailings Placement Method	Key Geologic and Hydrogeologic Characteristics	Available	Logistically Practicable	Technologically Practicable	Economically Practicable	Practicability Determination
Near West 'Wet'	Conventional thickened; modified centerline embankment.	Distance to Queen Creek is ~0.25 miles.	Yes	No	No – Significantly exceeds uncollected seepage maximums even with Level 4 controls.	Yes	**Not Practicable (technology and logistics)**
Near West 'Dry'	Ultra thickened NPAG; modified centerline embankment for NPAG; physically separated PAG cell using splitter berm.	Distance to Queen Creek is ~0.25 miles.	Yes	Yes	Yes – However, this TSF requires Level 4 seepage controls consistently operating at 99.5 percent efficiency. No known TSFs that use this degree of extensive seepage control technology to date.	Yes	**Practicable**
Silver King	Dry-stack NPAG and PAG; structural outer shell	Mix of diverse and complex geology with higher potential for weathering and fracturing. Requires extensive surface water diversion tunnels, dams, and channels.	Yes	No	No – Technology for dry-stack methodology at the scale needed to meet the project purpose has not been demonstrated, is at an unprecedented height, and lacks ability to meet water quality standards and secure an APP.	Yes	**Not Practicable (technology and logistics)**
Peg Leg	Ultra thickened NPAG; robust and resilient double embankment approach (full centerline for NPAG and downstream for PAG).	Geology is a mix of fractured bedrock for PAG and alluvial under NPAG. Distance to Gila River is ~2 miles.	No	Yes	Yes	Yes	**Not Practicable (not available)**
Skunk Camp	Ultra thickened NPAG; robust and resilient double embankment approach (full centerline for NPAG and downstream for PAG).	Geology is composed of Gila Conglomerate with thin alluvial cover. Distance to Gila River ~13 miles.	Yes	Yes	Yes	Yes	**Practicable**

5. ENVIRONMENTAL EFFECTS OF PRACTICABLE ALTERNATIVES

This section provides a comparative analysis of environmental impacts for those alternatives determined to be practicable in **Section 4**. This comparative analysis includes a discussion of impacts to the aquatic ecosystem and other anticipated adverse environmental consequences under each of the practicable alternatives. Identification of these other adverse environmental consequences is based on information contained in the baseline resource reports and DEIS prepared for Resolution's proposed mine development. Analyses of these other adverse environmental consequences are necessary to ensure that the Corps may identify the LEDPA, as required by the Guidelines (40 CFR § 230.10(a)).

The 404(b)(1) alternatives analysis is intended to ensure that no discharge be permitted "if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences" (40 CFR § 230.10(a)). The aquatic ecosystem, in turn, is defined as waters of the U.S., including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals (40 C.F.R. § 230.3(c)). In evaluating practicable alternatives, the Guidelines' preliminary focus is thus on assessing effects on waters of the U.S., but the analysis can extend to other adverse environmental consequences occurring outside of waters of the U.S.

The definition of "waters of the U.S." has been a source of considerable confusion for many years, particularly since the United States Supreme Court's 2006 decisions in *Rapanos v. United States and Carabell v. United States*. Following those decisions, the Environmental Protection Agency (EPA) and the Corps issued interpretive guidance, last modified in December 2008. In this 2008 CWA guidance document, entitled *Clean Water Act Jurisdiction Following the U.S. Supreme Court's Decision in Rapanos v. United States and Carabell v. United States* (the Guidebook), non-navigable tributaries that are not relatively permanent (which represent the majority of features present at all of the TSF alternatives) can be found jurisdictional only if they have a significant nexus with a Traditional Navigable Water (TNW). This represented a significant departure from the prior agency interpretation, which categorically regulated all tributaries, even ephemeral tributaries.

On June 29, 2015, the Corps and EPA adopted a new rule defining waters of the U.S. The new rule returned to a more categorical regulation of tributaries, including ephemeral tributaries. However, implementation of the 2015 rule is currently enjoined in 28 states, including Arizona, while being effective in 22 other states. That injunction is not permanent, and there is a chance that the 2015 rule could become effective in Arizona at some point.

Meanwhile, EPA and the Corps have proposed to repeal the 2015 rule, and separately proposed in early 2019 a new definition of waters of the U.S. that would exclude ephemeral features from regulation as waters of the U.S. Under the newly proposed definition, however, ephemeral features could serve as point sources if they conveyed pollutants to a regulated water, even if the ephemeral feature itself is not considered to be a water of the U.S.

In this analysis, identification of waters of the U.S. (or potential waters of the U.S.) is based on the 2008 Guidebook, which is still applicable in Arizona. Under the Guidebook, no waters of the U.S. exist in the footprint of the Near West alternatives (analyzed as Alternatives 2 and 3 in the DEIS), based on an approved jurisdictional determination issued by the Corps (SPL 2014-00064-MWL), but potential waters of the U.S. are believed to exist at the Skunk Camp alternative location (analyzed as Alternatives 6 in the DEIS), although no jurisdictional determination has yet been completed by the Corps. However, during the pendency of the Corps' review of Resolution's Section 404 permit application, the governing law on waters of the U.S. may change by the time the permit is issued. Were the 2015 rule to become effective in Arizona, ephemeral features at Near West and Skunk Camp would likely be considered jurisdictional; by contrast, if the 2019 proposed rule were adopted as proposed, neither site would likely contain any jurisdictional waters.

Given the uncertainty of whether ephemeral features within the footprints of the two practicable TSF alternatives could be considered jurisdictional waters of the U.S., the evaluation provided in this section focuses on impacts more broadly, informed by an evaluation completed by WestLand (2018) in support of the development of the DEIS. The evaluation that follows focuses on the extent of the OHWM in ephemeral systems (washes and ponds) and the location and extent of other aquatic features, such as seeps and springs. The identification of OHWM for the remaining practicable alternatives is based on a desktop review of high-quality, recent aerial photographs supplemented by field verification through collection of geolocated ground photography. The identification of seeps and springs was completed via review of U.S. Geological Survey topographic maps and other publicly available data, supplemented by full field inventory of the Near West (DEIS Alternatives 2 and 3) and Skunk Camp (DEIS Alternative 6) alternatives (Montgomery & WestLand 2017). Even if these features are not jurisdictional waters of the U.S. because they lack a "significant nexus" with a downstream TNW, they still provide wildlife habitat and other benefits (i.e., they still serve as "habitat for interrelated and interacting communities and populations of plants and animals"). Even if not waters of the U.S. (and thus not part of the "aquatic ecosystem" as defined in the Guidelines), impacts to these features can be considered other significant adverse environmental consequences, and thus may be considered in identifying the LEDPA.

5.1. Near West 'Dry' TSF Alternative

5.1.1. Impacts to the Aquatic Ecosystem and Surface Water Features

The estimated total impacts to surface water features and waters of the U.S. associated with this alternative (TSF footprint, pipelines, and associated facilities) are provided in **Table 4** and depicted in **Figure 6**.

Table 4. Near West 'Dry' TSF Alternative Impacts to Aquatic Ecosystem and Surface Water Features

Feature Type	Impact Area (ac)	
	Surface Water Features	Waters of the U.S.
Ephemeral features	36.89	0
Wetlands	0.2	0
Total Impacts	**36.89**	**0**

Aquatic Ecosystem and Surface Water Resources

The Near West 'Dry' TSF Alternative, located in the Queen Creek watershed, contains ephemeral drainages that possess an OHWM, but have been previously determined non-jurisdictional by the Corps. The ephemeral channels within the site and pipeline corridor contain functions and values typical of desert ephemeral systems. In addition to the ephemeral wash systems, three springs (Bear Tank Canyon, Benson, and Perlite springs) have been identified within the TSF footprint. While not jurisdictional, these features have wetland (i.e., special aquatic site) characteristics and have a cultural value to local tribes. Wetland features are particularly rare and valuable in arid areas.

5.1.2. Other Adverse Environmental Consequences

Identification of the other adverse environmental consequences of the development of Near West 'Dry' TSF Alternative is based on information contained in the baseline resource reports and DEIS. Focus is only on those resource effects which substantially distinguish one practicable alternative from the others. These adverse environmental consequences are compared to those of the other practicable TSF Alternatives to determine if selection of an alternative other than that identified as LEDPA is warranted (40 CFR §230.10(a)). As noted above, these other adverse environmental consequences include direct and indirect effects of the project on resources other than the aquatic ecosystem.

Environmentally damaging effects include the loss of surface water resources, including wetlands, within the footprint of Near West 'Dry' TSF Alternative, even if those resources do not constitute jurisdictional waters of the U.S. In addition, construction of the TSF under this alternative will directly affect approximately 3,308 acres of previously undisturbed National Forest System Lands.

Seepage Potential

This alternative is sited on a foundation comprised of bedrock incised with narrow channels infilled with alluvial, colluvial, and undifferentiated sediments. The relatively small Queen Creek alluvial aquifer lies approximately 50 feet below the surface, with Queen Creek less than 0.25 miles from the TSF. Whitlow Ranch Dam occurs approximately three miles downstream. The ring impoundment would produce seepage along all three sides. The extensive combined Levels 0 to 4 seepage controls, which go well beyond the typical copper porphyry TSF, would be required to meet ADEQ's surface water quality standards in Queen Creek and at Whitlow Ranch Dam. Uncaptured seepage would reach the ground surface at Queen Creek and travel downgradient to Whitlow Ranch Dam. Groundwater modeling studies for this location indicate a preliminary maximum allowable of uncaptured seepage rate of 3 AF/yr. By using the extensive Level 4 seepage control measures, modelled uncollected seepage rates are 2.7 AF/yr, just meeting the allowable uncaptured seepage rate, thereby requiring the extensive engineering controls to work at maximum efficiency with little to no room for error over the life of the mine and in post-closure.

Tailings Safety

As part of the evaluation of tailings alternatives, a failure modes analysis of each of the alternatives was conducted and included in the DEIS. For each failure mode, relevant protection measures and design features in line with best practice international standards and state and federal regulations were identified to prevent the failure. The USFS then completed an effects analysis of potential tailings dam failures using the Rico Empirical Method; see Section 3.10.1.2 of the DEIS (USFS 2019). This evaluation method represents a "worst case" scenario as it does not consider embankment type, design features used to address failure modes, foundation conditions, or operational approaches.

As noted above, the Near West 'Dry' TSF Alternative has been designed with a modified-centerline embankment, which is inherently more resilient than upstream-type embankments, but less resilient to any accumulated missteps or unforeseen events than true centerline-type embankments. For this alternative, the embankment is required to extend to three sides of the facility, is generally free-standing and not anchored to consolidated rock, and as such is the longest of the embankments proposed (10 miles). These design features are not inherently unsafe, but are potentially less resilient than a shorter, well-anchored embankment.

An estimated 600,000 people are in the modeled potential area of effect should a tailings dam failure occur at this alternative. Given the proximity of the community of Queen Valley to the alternative location, there would be relatively little time for an evacuation. An estimated eight water supply systems, serving approximately 700,000 people, would be adversely impacted by such a failure, as would significant agricultural irrigation and water supply infrastructure, such as the Central Arizona Project (CAP) and other canals. Impact to the CAP canal would have the potential to disrupt water supplies well beyond the tailings failure flow path, as the City of Tucson and other communities rely heavily on CAP water.

Visual Resources

This alternative would be visible from U.S. Highway 60, Superior, and Queen Creek, which are located 1.7 miles to the south, 4.5 miles to the southeast, and approximately 3 miles southwest of the TSF, respectively. Because this alternative has a more prominent dam height than the Skunk Camp TSF alternative, and it is located proximal to the public, it would have substantially greater visual impacts than the Skunk Camp TSF alternative.

Recreation

The Arizona National Scenic Trail (AZT), an 800-mile trail system that covers the length of the state, passes approximately 0.75 miles east of the Near West 'Dry' TSF alternative site, through Rice Water Canyon and Whitford Canyon. The pipeline corridor and access roads associated with the Near West 'Dry' alternative would cross the AZT, affecting the users experience and potential becoming a safety concern with mining vehicles crossing a remote hiking trail. Being National Forest System lands, this alternative's location also contains highly used public recreation areas, such as hiking, which would be impacted by the construction of this alternative.

5.1.3. Compliance with the Guidelines

As previously described, a demonstration of compliance with the Guidelines at 40 CFR § Part 230 is required before a Section 404 permit may be issued for a project. The analysis of alternatives included in this practicability analysis document and made final in the Corps's 404(b)(1) alternatives analysis document is intended to facilitate compliance with 40 CFR § Part 230.10(a) that no discharge of dredged or fill material be permitted if there is a practicable alternative to the proposed discharge that would have less impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. The information on the range of alternatives analyzed, the availability and/or practicability of analyzed alternatives, the impacts to the aquatic system of the practicable alternatives, and the other significant adverse environmental consequences of the practicable alternatives described herein is intended to provide the Corps with the information necessary to make this determination under 40 CFR § Part 230.10(a).

The Guidelines also contain three other independent requirements at 40 CFR § Parts 230.10(b), (c), and (d) that must be met prior to the decision by the Corps to issue a permit. The requirement at 40 CFR § Part 230.10(b) prohibits discharges that will result in a violation of water quality standards or toxic effluent standards, will jeopardize a threatened or endangered species, or violate requirements imposed to protect a marine sanctuary. Operation of the TSF under the Near West 'Dry' alternative will require that Resolution obtain an APP from ADEQ, which requires the mine facility to demonstrate that it will not cause or contribute to an exceedance of AWQS at the point of compliance, or, if AWQS for a pollutant has been exceeded in an aquifer at the time of permit issuance, that no additional degradation will occur [A.R.S. § 49-243(B)(2)-(3); AAC R18-9-A202(A)(8)(a)]. Seepage must also not contribute to the exceedance of any ADEQ surface water quality standards where groundwater may emerge and contribute to surface flow [AAC R18-11-405(b)]. The extensive seepage control measures and control efficiencies required to meet this standard for the Near West 'Dry' alternative are described above; as discussed therein, 99.5-percent seepage capture efficiency, a standard not seen at any known TSF, is required to avoid causing an exceedance of surface water quality standards in Queen Creek.

As described in the DEIS (USFS 2019), the Near West 'Dry' alternative is not anticipated to jeopardize the continued existence of species listed as threatened or endangered under the Endangered Species Act (ESA) or result in the destruction or adverse modification of such species' designated critical habitat. The Near West 'Dry' alternative also will not violate any requirement designed to protect a marine sanctuary.

The requirement at 40 CFR § Part 230.10(c) prohibits discharges that will cause or contribute to significant degradation of jurisdictional waters of the U.S. Although not jurisdictional waters of the U.S., the discharge of fill for the construction and operation of the TSF will result in the loss of the structure and aquatic function of the ephemeral drainages and groundwater-dependent wetland ecosystems within the footprint of fill. As described above, the extensive seepage control measures and control efficiencies necessary for the Near West TSF to meet AWQS under the APP are intended to prevent significant adverse effects from seepage.

Other indirect and cumulative effects from the discharge on the aquatic environment are anticipated to be minimal and will not cause significant degradation. There are not anticipated to be significantly adverse effects on human health or welfare, on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, or on aquatic ecosystem diversity, productivity and stability. There will be some indirect effect on recreational, aesthetic, and economic values of the lands surrounding the TSF as disclosed in the DEIS, but these effects are not significant adverse effects to or significant degradation of recreational, aesthetic, and economic values of the waters of the U.S. that result from the construction and operation of the TSF.

The requirement at 40 CFR § Part 230.10(d) prohibits discharges unless all appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. The development of the TSF design included a significant effort to avoid and minimize impacts to the ephemeral drainages and groundwater-dependent ecosystems in the area of the TSF. Although the area beneath the footprint of the TSF and its appurtenant features will no longer contribute runoff from precipitation to downstream drainage reaches, the TSF design minimizes impacts to downstream waters of the U.S. by diverting upstream stormwater flows around the facility. Similarly, the stormwater controls, run-on diversions, and engineering controls have been designed to maintain downstream stormwater flows while minimizing the risk of contaminant discharge to downstream surface water features to the maximum extent practicable.

5.2. Skunk Camp TSF Alternative

5.2.1. Impacts to the Aquatic Ecosystem and Surface Water Features

The estimated total impacts to surface water features and potential waters of the U.S. associated with this alternative (TSF footprint, pipelines, and associated facilities) are provided in **Table 5** and depicted in **Figures 7a and 7b**.

Table 5. Skunk Camp TSF Alternative Impacts to Aquatic Ecosystem and Surface Water Features

Feature Type	Impact Area (ac)	
	Surface Water Features	Potential Waters of the U.S.
Ephemeral Features	153.4	126.2
Wetlands	0	0
Total Impacts	**153.4**	**126.2**

Aquatic Ecosystem and Surface Water Resources

Potentially jurisdictional waters of the U.S. were mapped on the Skunk Camp TSF site using a recent ESRI Online aerial imagery analysis. Field reconnaissance and geolocated ground photography were used to further refine the delineation of OHWM characteristics. Potential waters identified within the site and pipeline corridor are dominated by both relatively confined and braided ephemeral channels with functions and values typical of desert ephemeral systems. No special aquatic sites (e.g., wetlands) or seeps and springs are located within the footprint of this TSF or either potential pipeline corridor.

5.2.2. Other Adverse Environmental Consequences

As indicated in **Section 5**, identification of the other adverse environmental consequences of the development of Skunk Camp TSF Alternative is based on information contained in the baseline resource reports and DEIS prepared for the proposed project.

Adverse direct effects include the loss of those resources within the footprint of Skunk Camp TSF Alternative. Construction of the TSF and associated infrastructure (including pipelines) under this alternative will directly affect approximately 4,002 acres of previously undisturbed private and state lands.

Seepage

This alternative's required seepage controls are much less extensive than the Near West 'Dry' TSF due to the foundation being located on less complex geology comprising Gila Conglomerate overlain with alluvial sediments. The cross-valley impoundment, located within a basin, allows for seepage to a singular point downgradient of the TSF. Groundwater modeling studies conducted indicate a preliminary maximum allowable of uncaptured seepage to be 329 AF/yr. Seepage control measure of a Level 3 indicate uncollected seepage rates of 65 to 178 AF/yr, which is below the maximum allowable by 46 to 80.3 percent.

Tailings Safety

A number of design and location considerations differentiate the Skunk Camp TSF Alternative from the Near West 'Dry' TSF Alternative. First, the embankment for the Skunk Camp TSF Alternative uses a cross-valley construction, which would have a single face instead of three faces and would be tied into consolidated rock on either end. In addition to being anchored to consolidated rock, the embankment face would be considerably shorter—3 linear miles compared to 10. While the embankments for both alternatives would be designed to the same safety standards, the simpler construction of the Skunk Camp TSF Alternative embankment, combined with the ability to implement a dual-embankment approach (a full centerline embankment for NPAG; downstream embankment for PAG) would be considered more resilient to any accumulated missteps or unforeseen events. The design for this tailings alternative also effectively isolates the PAG material with a downstream embankment, making it less likely that these materials would be released in the event of a tailings failure.

Downstream communities potentially affected by the modeled dam failure total approximately 3,000 people and the larger population centers (Winkelman, Hayden, and Kearney) are over 20 miles downstream of the TSF, allowing adequate time for evacuation, if necessary. Four water supply systems, serving approximately 3,000 people, are downstream of the TSF and would potentially be affected by a tailings failure.

Visual Resources

This alterative is not highly visible from towns, cities, or densely populated areas.

Recreation

The Skunk Camp TSF Alternative is relatively remote and would not include National Forest System lands within the TSF footprint. The location of this TSF sees less recreational use compared to the Near West 'Dry' TSF Alternative. No known hiking trails (including the AZT) or recreational areas would need to be relocated due to the construction of this TSF alternative.

5.2.3. Compliance with the Guidelines

The information on the range of alternatives analyzed, the availability and/or practicability of analyzed alternatives, the impacts to the aquatic system of the practicable alternatives, and the other significant adverse environmental consequences of the practicable alternatives described herein is intended to provide the Corps with the information necessary to make the determination of LEDPA under 40 CFR § Part 230.10(a). The following section is intended to demonstrate the compliance of the Skunk Camp TSF alternative with the other three independent requirements at 40 CFR § Parts 230.10(b), (c), and (d) that must be met prior to the decision by the Corps to issue a permit.

The requirement at 40 CFR § Part 230.10(b) prohibits discharges that will result in a violation of water quality standards or toxic effluent standards, will jeopardize a threatened or endangered species, or violate requirements imposed to protect a marine sanctuary. As with the Near West 'Dry' alternative, the Skunk Camp TSF alternative requires an APP from ADEQ to demonstrate that it will not cause or contribute to an exceedance of AWQS at the point of compliance, or, if, AWQS for a pollutant has been exceeded in an aquifer at the time of permit issuance, that no additional degradation will occur [A.R.S. § 49-243(B)(2)-(3); AAC R18-9-A202(A)(8)(a)]. Seepage must also not contribute to the exceedance of any ADEQ surface water quality standards where groundwater may emerge and contribute to surface flow [AAC R18-11-405(b)]. The seepage control measures and control efficiencies required to meet this standard for the Skunk Camp TSF alternative are described above. It is anticipated that seepage control using recognized technologies will be well above what is required to meet surface water quality standards.

As described in the DEIS (USFS 2019), the Skunk Camp TSF alternative is not anticipated to jeopardize the continued existence of species listed as threatened or endangered under the ESA or result in the destruction or adverse modification of such species' designated critical habitat. The Skunk Camp TSF alternative also will not violate any requirement designed to protect a marine sanctuary.

The requirement at 40 CFR § Part 230.10(c) prohibits discharges that will cause or contribute to significant degradation of jurisdictional waters of the U.S. The discharge of fill for the construction and operation of the TSF will result in the loss of the structure and aquatic function of the jurisdictional waters of the U.S., comprised entirely of ephemeral drainages, within the footprint of fill. Indirect and cumulative effects from the discharge on the aquatic environment are anticipated to be minimal and will not cause significant degradation. There are not anticipated to be significantly adverse effects on human health or welfare, on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, or on aquatic ecosystem diversity, productivity and stability. There will be some indirect effect on recreational, aesthetic, and economic values of the lands surrounding the TSF as disclosed in the DEIS, but these effects are not significant adverse effects to or significant degradation of recreational, aesthetic, and economic values of the waters of the U.S. that result from the construction and operation of the TSF.

The requirement at 40 CFR § Part 230.10(d) prohibits discharges unless all appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem. The development of the TSF design included a significant effort to avoid and minimize impacts to the ephemeral drainages and groundwater-dependent ecosystems in the area of the TSF. Although the area beneath the footprint of the TSF and its appurtenant features will no longer contribute runoff from precipitation to downstream drainage reaches, the TSF design minimizes impacts to downstream waters of the U.S. by diverting upstream stormwater flows around the facility. The Skunk Camp TSF has been located relatively high in the watershed of Dripping Spring Wash, minimizing the size of the upgradient watershed for which stormwater must be managed. Similarly, the stormwater controls, run-on diversions, and engineering controls have been designed to maintain downstream stormwater flows while minimizing the risk of contaminant discharge to downstream surface water features to the maximum extent practicable.

6. SUMMARY AND CONCLUSIONS

While the Skunk Camp TSF Alternative has impacts to currently jurisdictional waters of the U.S., and greater impacts to surface water (ephemeral wash) resources generally, the other practicable alternative, Near West 'Dry', would result in other significant adverse environmental consequences that must be factored into a LEDPA determination. First and foremost, seepage control under the Near West 'Dry' alternative would require the implementation of a level of engineering controls well beyond that which has been implemented and typical for copper porphyry TSFs, and would require those controls to work almost perfectly for long periods of time, in order for seepage from the TSF not to result in a violation of water quality standards. By contrast, the Skunk Camp alternative, due to less complex geology and topography, allows for use of significantly less complex engineering controls that can more reliably be expected to function effectively for long periods of time. The modeled seepage using these simpler and more reliable controls is significantly below that required to meet water quality standards. Skunk Camp is also located significantly further from any major surface water feature (approximately 13 miles from the Gila River, compared to Near West 'Dry' being only 0.25 miles from Queen Creek), allowing for substantial opportunity to incorporate additional engineering controls (e.g., cutoff walls, grout curtains, etc.), should any be necessary.

Other significant adverse environmental consequences of the Near West 'Dry' alternative in comparison to the Skunk Camp alternative are as follows: 1) Near West 'Dry' would result in the loss of surface water features with wetland (special aquatic site) characteristics (none are present at Skunk Camp); 2) Near West 'Dry' design and location present more challenges and far greater impacts affecting the potential for and consequences of tailings failure; 3) Near West 'Dry' would adversely impact existing recreational uses to a much greater degree; 4) Near West 'Dry' would require relocation of a portion of the Arizona Trail; 5) Near West 'Dry' would have significantly greater visual resource impacts due to its greater proximity to populated and traveled areas; and 6) Near West 'Dry' would impact over 3,000 acres of National Forest Service System land, whereas Skunk Camp would impact under 100 acres (solely in the pipeline corridor).

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FIGURES

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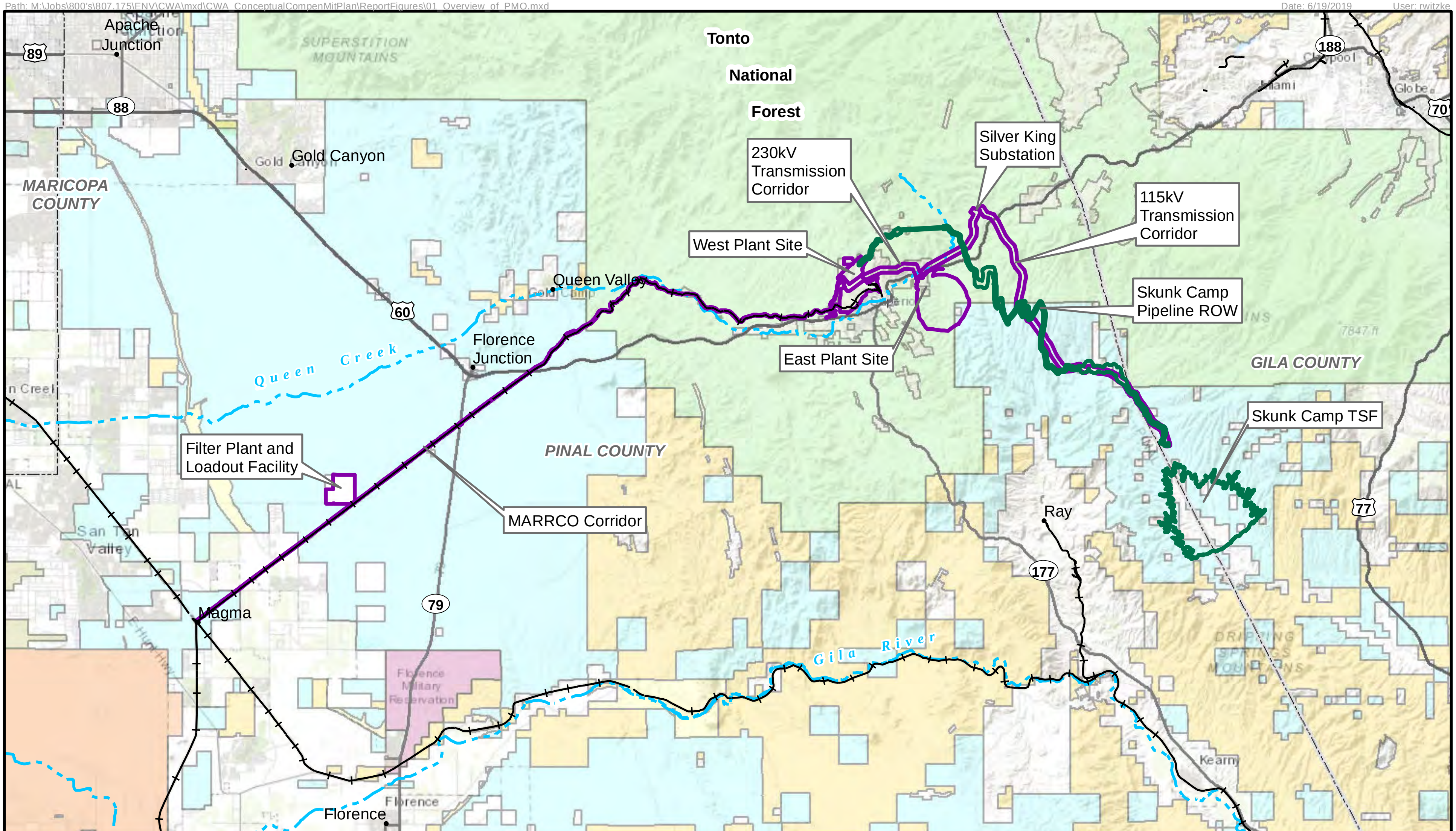

Pinal and Gila Counties, Arizona,
Data Source: BLM 2018, WRI Modified 2019,
ALRIS, SWCA, and USFS
Image Source: ArcGIS Online, World Topo Map

Legend

- Proposed Action
- GPO Mine Elements

Surface Management (BLM)

- County
- Indian Lands
- Local or State Parks
- Other
- State Trust Land
- Bureau of Land Management (BLM)
- Military
- Bureau of Reclamation
- Private Land
- US Forest Service (USFS)

N

0 2.5 5 Miles

0 4 8 Kilometers

WestLand Resources

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OVERVIEW OF
PROPOSED MINING OPERATION
Figure 1

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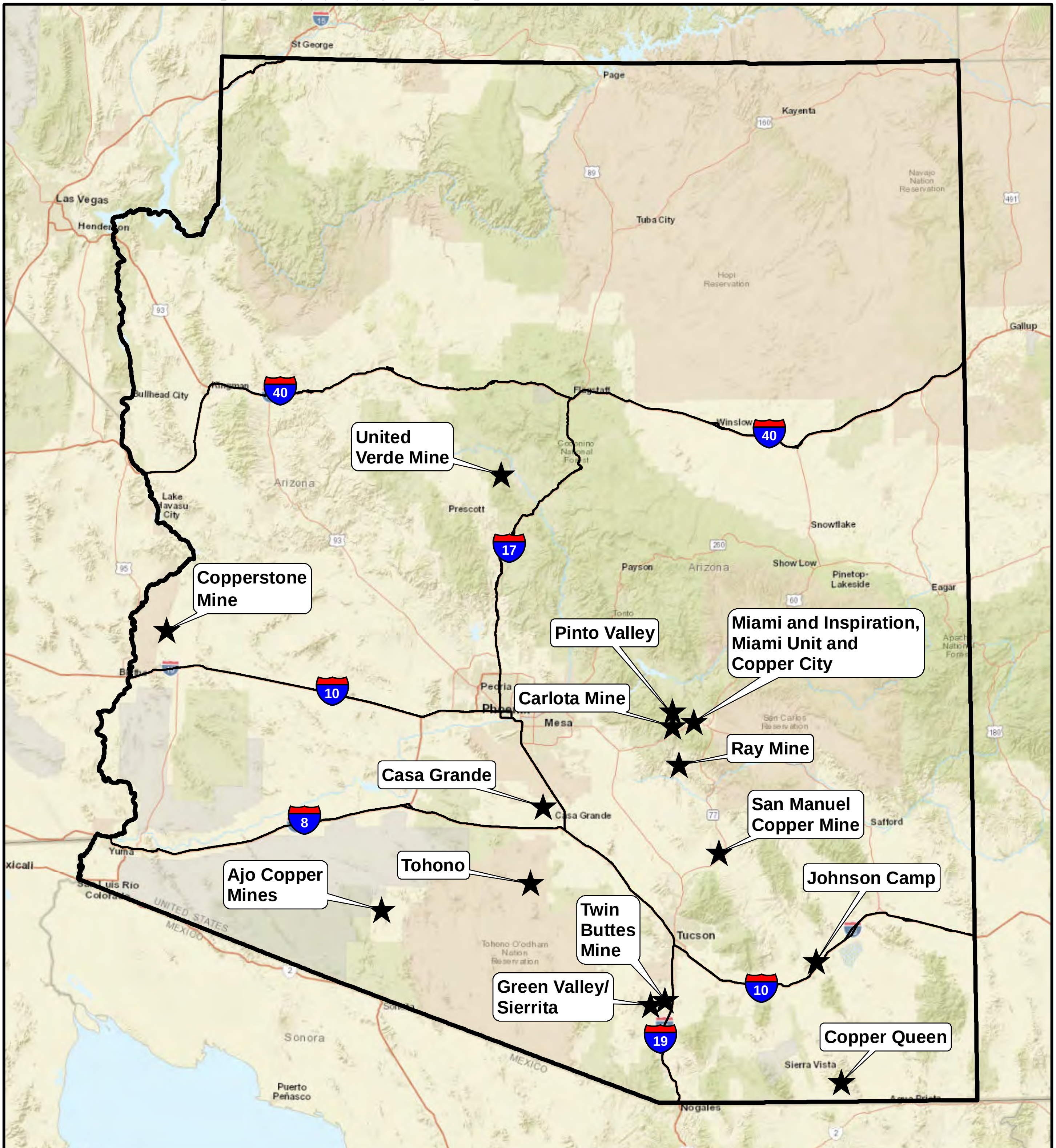

Data Source: ARLIS, USDA, USFS 11-1-2017
Image Source: ArcGIS Online World Street Map

Legend

★ Brownsfield Site
— Interstates (ALRIS)

N

0 25 50 Miles
0 50 100 Kilometers

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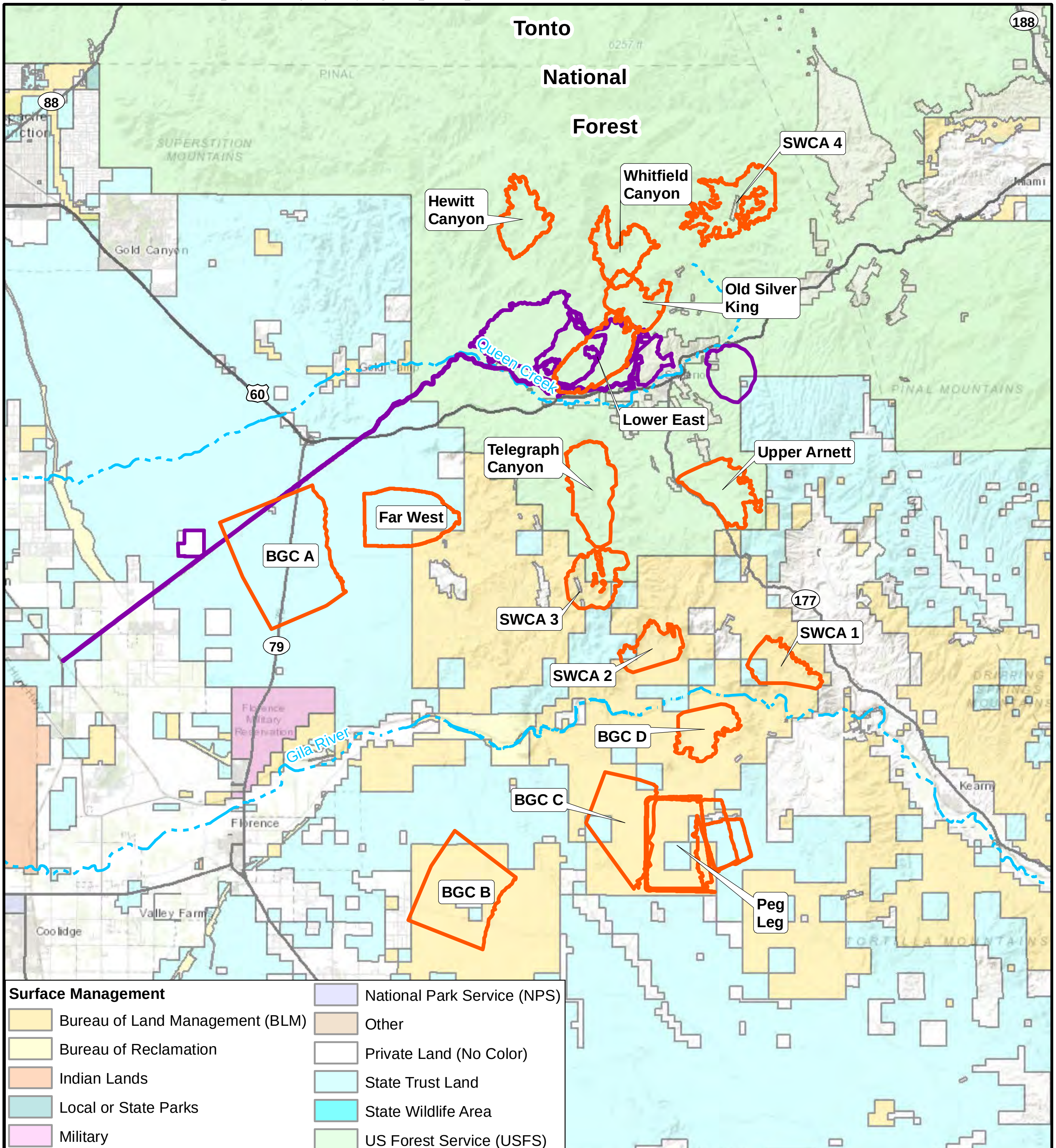
BROWNSFIELD TAILINGS STORAGE FACILITY LOCATIONS
Figure 2

WestLand Resources



Data Source: 08-17-2018
Image Source: ArcGIS Online World Topo Map

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Legend

Tailings Alternatives Dismissed
Proposed Action

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INITIAL TAILINGS STORAGEFACILITY ALTERNATIVES DISMISSED FROM FURTHER CONSIDERATION
Figure 3

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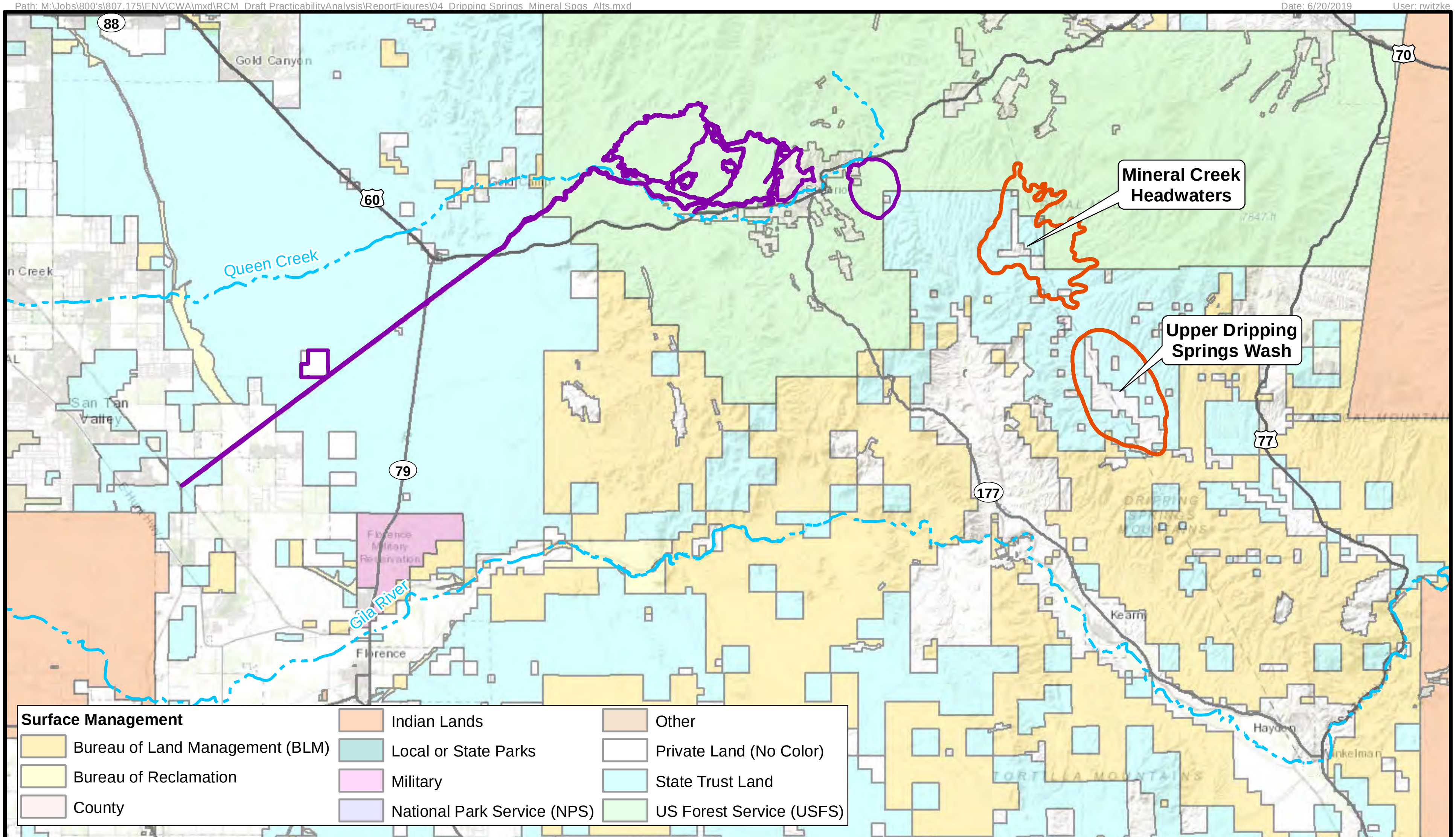

Data Source: 08-17-2018
Image Source: ArcGIS Online World Topo Map

0 2.5 5 Miles
0 5 10 Kilometers
N

WestLand Resources

Legend
Proposed Action

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MINERAL CREEK AND UPPER DRIPPING SPRINGS ALTERNATIVES
Figure 4

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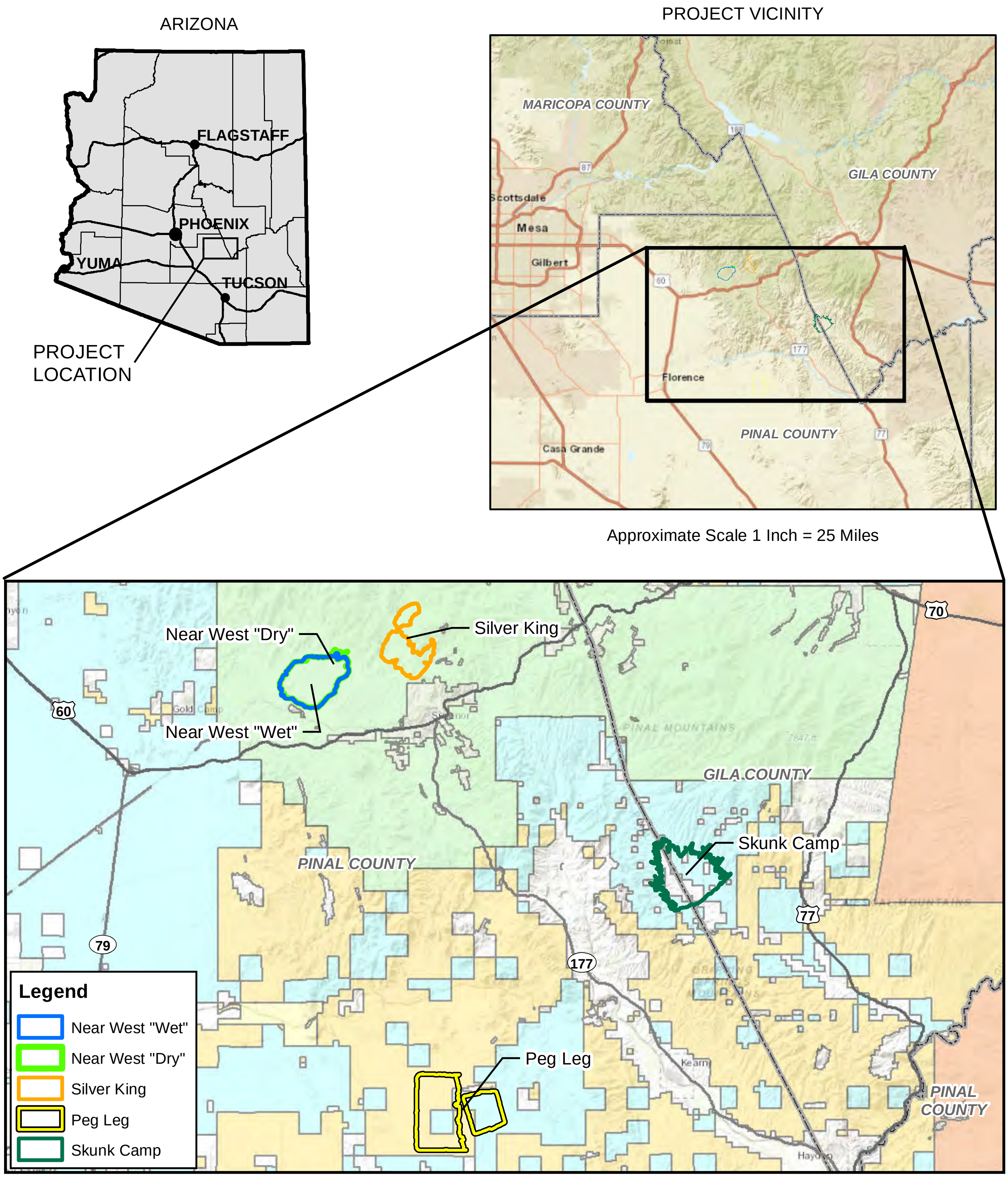

Portions of T1S R11 and 12E; T2S R14E; T3S R14E;
T4S R12 and 13E; and T5S R12 and 13E,
Pinal and Gila Counties, Arizona,
Image Source: ArcGIS Online, World Topo and World Street Maps

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OVERVIEW OF TAILINGS STORAGE FACILITY
ALTERNATIVES LOCATIONS CONSIDERED IN DETAIL

Figure 5

WestLand Resources

N

0 3 6 Miles

0 6 12 Kilometers

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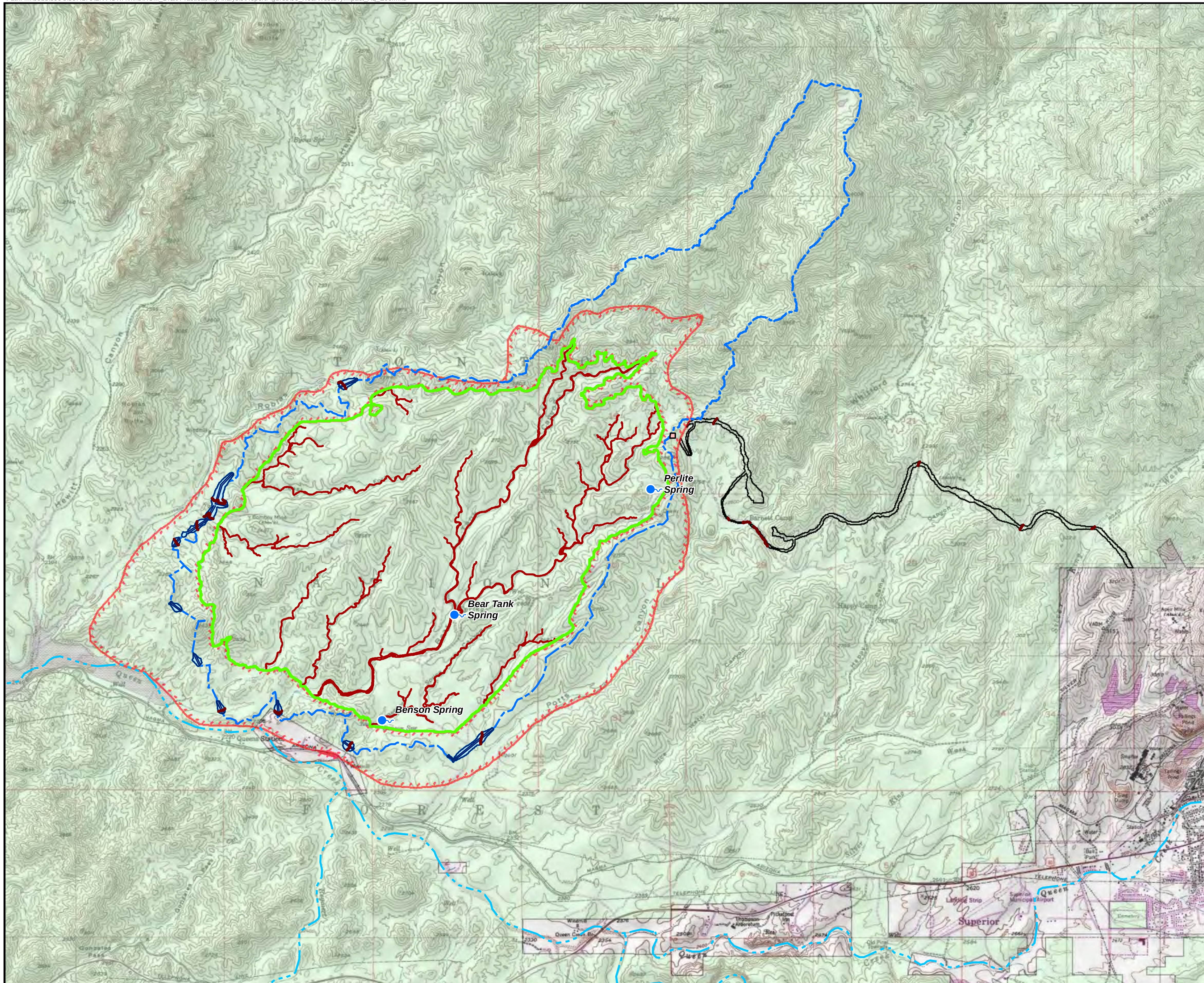

Near West 'Dry' TSF within:
T1S, R11E, Portions of Sections 23-27, 34-36,
T1S, R12E, Portions of Sections 18, 19, 30, and 31,
Pinal County, Arizona,
Picketpost Mountain USGS 7.5' Quadrangle
Data Source: SWCA and Golder
Surface Management: BLM 2018, WRI modified 2019

Legend

- Spring (Montogermey & Assoc. 6-4-2018)
- Near West Seepage Dams
- Near West Dams
- Cyclone Plant
- Near West Catchment
- Near West 'Dry' Impacted Ordinary High Water Mark
- Near West 'Dry' Tailings Storage Facility
- Near West 'Dry' Tailings Corridor
- Proposed Fenceline

Surface Management (BLM)

- Private Land (No Color)
- US Forest Service (USFS)

N

0 1,750 3,500 Feet

0 600 1,200 Meters

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NEAR WEST 'DRY' IMPACTS TO AQUATIC ECOSYSTEMS
Figure 6

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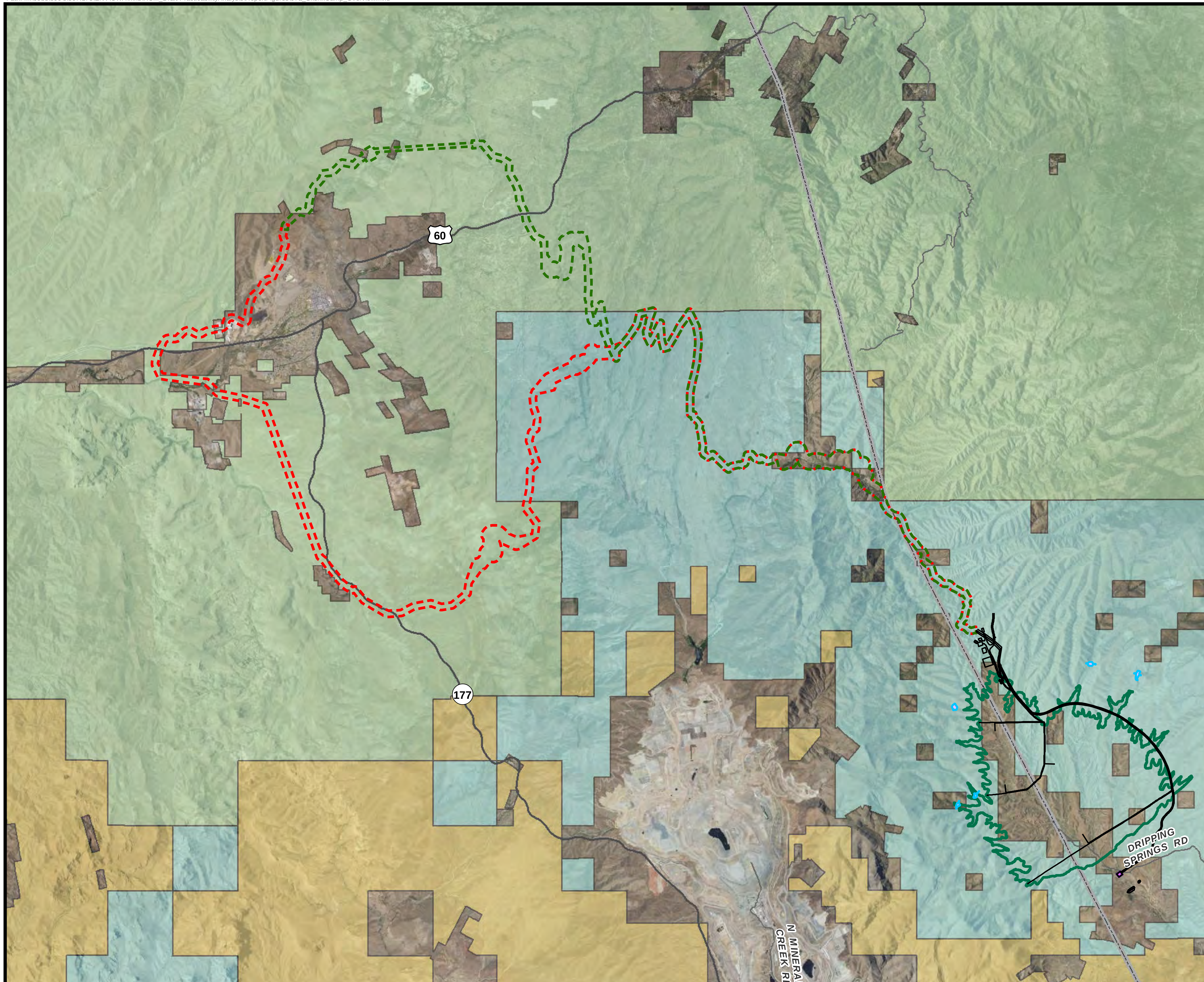

T1S, R12 and 13E, T2S, R12-14E, and T3S, R14E,
Gila and Pinal Counties, Arizona,
Data Sources: Golder and Associates, SWCA and RCM
Surface Management, BLM 2018, WRI modified 2019
Image Source: 2017 USDA NAIP Orthophoto

Legend

- Ancillary Facilities
- Skunk Camp Seepage Dam
- Skunk Camp Diversion Dyke
- Skunk Camp Toe Collection Pond
- Skunk Camp TSF
- North Skunk Camp 500 foot Pipeline ROW
- South Skunk Camp 500 foot Pipeline ROW

Surface Management

- Bureau of Land Management (BLM)
- Private Land (No Color)
- State Trust Land
- US Forest Service (USFS)

N

0 4,000 8,000 Feet

0 1,500 3,000 Meters

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SKUNK CAMP IMPACTS TO
AQUATIC ECOSYSTEMS OVERVIEW

Figure 7a

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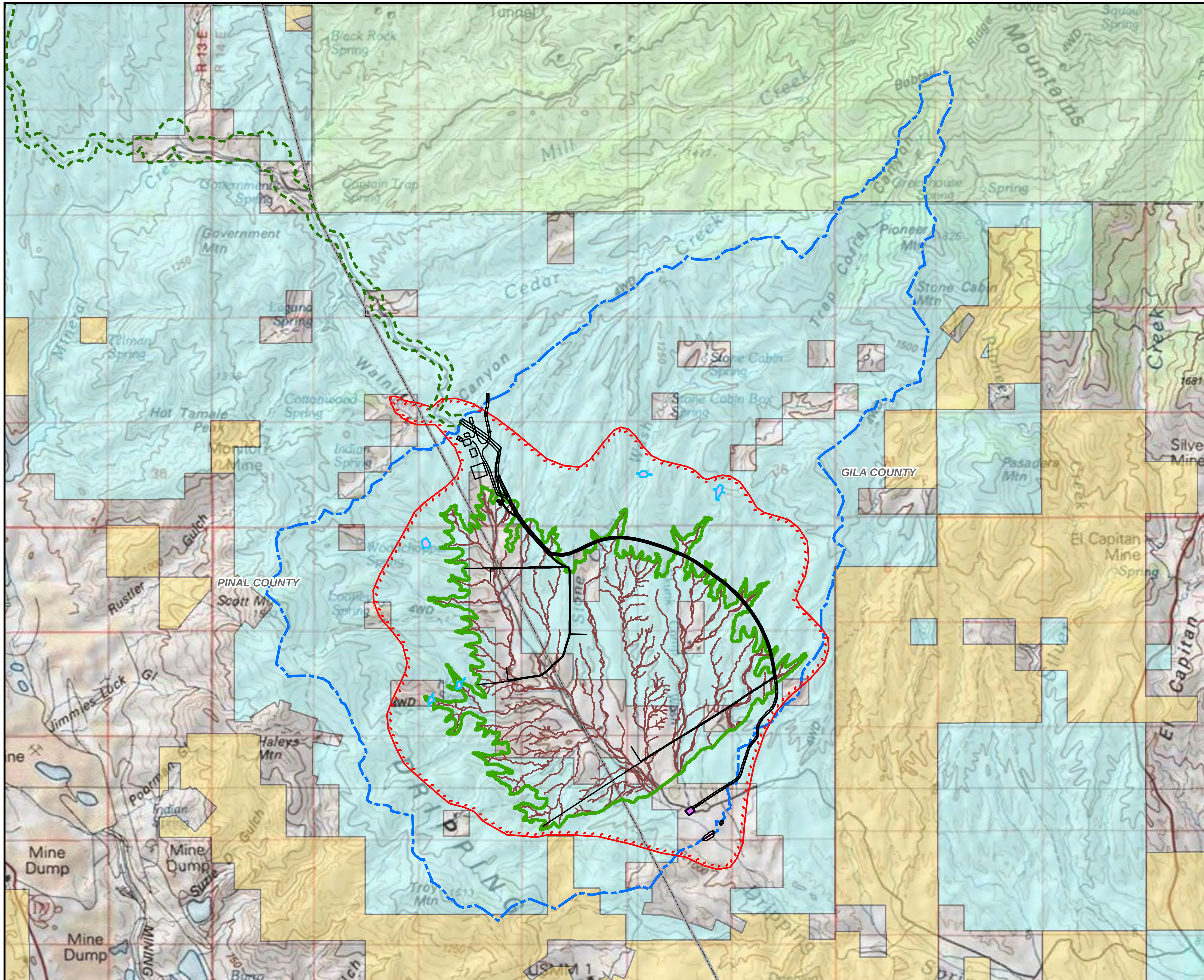

Skunk Camp TSF within:
T2S, R14E, Portions of Sections 33-35,
T3S, R14E, Portions of Sections 1-4, 9-12, and 14-16,
Pinal and Gila Counties, Arizona,
Globe USGS 1:100,000 USGS Quadrangle
Surface Management: BLM 2018, WRI Modified 2018,
Data Source: Golder and SWCA

Legend

- Ancillary Facilities
- Skunk Camp Seepage Dam
- Skunk Camp Diversion Dyke
- Skunk Camp Toe Collection Pond
- Skunk Camp Impacted Ordinary High Water Mark
- North Skunk Camp 500 foot Pipeline ROW
- Proposed Fenceline
- Skunk Camp Catchment
- Skunk Camp Tailings Storage Facility

Surface Management (BLM)

- Bureau of Land Management (BLM)
- Private Land
- State Trust Land
- US Forest Service (USFS)

N

0 2,500 5,000 Feet

0 1,000 2,000 Meters

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SKUNK CAMP IMPACTS TO
AQUATIC ECOSYSTEMS

Figure 7b

APPENDIX A

Resolution Copper Mining, LLC Mine Plan of Operations and Land Exchange USFS Alternatives Data Request #3-F, Information on Potential Tailings Alternatives

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August 30, 2017

Ms. Mary Rasmussen
US Forest Service
Supervisor's Office
2324 East McDowell Road
Phoenix, AZ 85006-2496

Subject: Resolution Copper Mining, LLC – Mine Plan of Operations and Land Exchange – USFS Alternatives Data Request #3-F, Information on Potential Tailings Alternatives

Dear Ms. Rasmussen,

In a letter Resolution Copper received from the USFS dated July 19, 2017 (Alternatives Data Request #3), the USFS requested Resolution Copper (RC) to provide information related to tailings storage facility concepts and locations. For your review and consideration, please find RC's response to item F of that request listed below.

USFS Item F*: The Forest may consider tailings alternatives that would involve filtered tailings, more commonly known as "dry-stack" tailings. The Forest requests that Resolution provide input on technical or logistical concerns of using filtered tailings. We request that these specific topics be considered:*

1. *What technical or logistical limitations does Resolution foresee regarding the ultimate height or footprint of a filtered tailings facility, or regarding the proposed disposal rate (tonnage per day)?*

2. *What technical or logistical limitations does Resolution foresee regarding the distance that filtered tailings could be reasonably conveyed? Alternatively if tailings were instead pumped via pipeline as a slurry to a tailings disposal facility and then filtered at that location prior to stacking, what is the potential acreage or infrastructure that would be needed for the filter equipment?*

3. *What potential concerns does Resolution foresee with respect to controlling acid rock drainage if scavenger and pyrite/cleaner tailings are disposed in a filtered tailings facility?*

Resolution Copper Response to F:

RC has studied filtered tailings as a tailings management strategy and found that filtered tailings are not a beneficial, reasonable or practicable tailings management strategy for the Resolution

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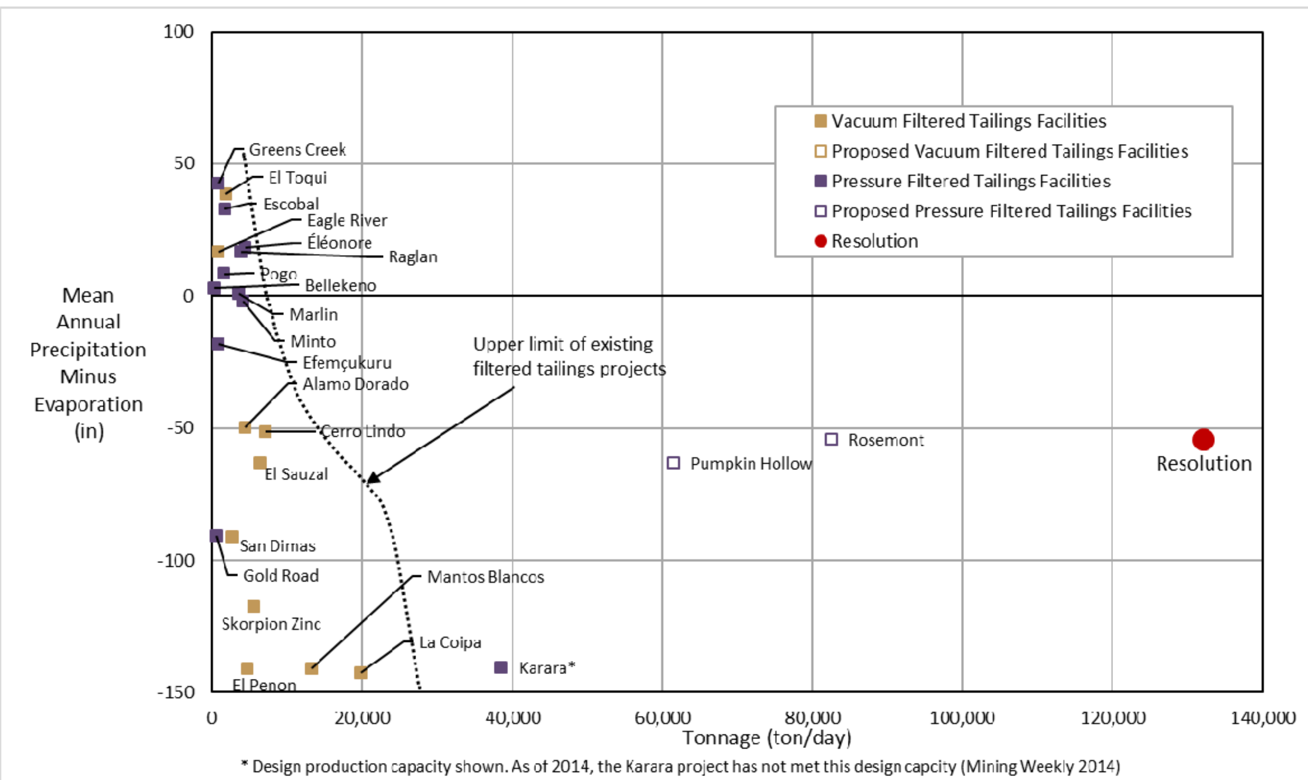
Project primarily because the scale is unprecedented and not demonstrated at an equivalent tonnage rate as well as other factors related to transportation, construction, water management and dust management challenges which are outlined herein.

RC has responded to each sub question of the Forest's item F separately below.

Resolution Copper Response to F-1: Technical and Logistical Limitations of Filtered Tailings for the Resolution Project

A key consideration when assessing the reasonableness, practicality and benefits of a tailings management strategy is precedents and lessons learned from case histories. A review of case histories was completed as part of the filtered tailings study, completed by RC's tailings engineer Klohn Crippen Berger, Ltd, whom have been involved with the Greens Creek filtered tailings facility for approximately 20 years and have been involved in several tailings technology reviews over recent years. An output from the review was a comparison of climate conditions to daily tailings production rate for operating mines and proposed projects, shown in Figure 1. The Resolution Project is also plotted on the figure for comparison.

Figure 1 Summary of Review Filtered Tailings Cases



Note: Net precipitation = mean annual precipitation minus mean annual evaporation. RC is in a semi-arid climate zone with low mean annual precipitation of 18 inches and high estimated mean annual potential evapotranspiration of 72 inches, for a mean annual precipitation minus evaporation of -54 inches per year.

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Based on the case history review of current and existing operations across the industry:

- Filtered tailings have never been applied at the production scale (130,000 ton per day) proposed for the Resolution Project or stored in a *dry-stack* pile of equivalent height.
    - Most filtered tailings are less than 10,000 tons per day. The La Coipa mine which is currently in care and maintenance did implement filtered tailings technology to a 20,000 tons per day operation. RC's estimated tailings production is 130,000 tons per day, 650% greater than La Copia.
    - Karara Mining Ltd. had proposed filtered tailings to manage a 40,000 ton per day operation, but returned to a conventional slurry facility after challenges with filtering and conveying limited production ramp-up.
    - To date, the maximum slope height of filtered embankments achieved is approximately 200 feet (La Coipa – from toe to crest, although maximum thickness of filtered tailings is approximately ~70 feet). A filtered tailings facility for the Resolution Project would be around 560 feet.

Given the vast differences between the tested and demonstrated limits of filtered tailings at the scale required for this project, RC will not consider this as a reasonable or practicable method for tailings management. In addition to precedents, additional key findings from RC's study of filtered tailings also are not in support of this tailings management strategy for this project, such as:

- Processing and Transportation
    - Most filtered tailings projects have reported challenges achieving target moisture contents and throughputs from filter plants on a reliable basis, especially at start-up. Conventional tailings facilities typically do not have this problem.
- Construction and Operations
    - Filtered tailings at the Near West site would be mechanically placed in rugged terrain which requires a significant construction fleet. The scale of the construction fleet for this operation would be much larger than a typical operation and be logistically challenging. See response to F-2 as well.
    - Due to potential upsets/unreliability of the filter plant and conveyor systems (i.e., mechanical break-downs, material produced at the filter plant that is too wet for transportation, flood events, wind events, etc.), multiple layers of back-up storage would be required (at the filter plant, at the filtered facility and potentially a separate back-up conventional tailings facility, like the Karara case history). At the Resolution Project's production rates, a back-up facility or stockpile would not be feasible within the current proposed disturbance footprints. Therefore, there would be significant additional disturbance on National Forest Service land.
- Water Management
    - Water management for filtered tailings for the Resolution Project would be complex. Runoff and seepage water would be managed in large external collection

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ponds rather than within the tailings impoundment as with conventional tailings facility. Therefore, there will be additional water retaining dams around the site, larger in size than those required for conventional slurry tailings options, and increased disturbance on National Forest Service land.

- Dust Management
  - Walking stacker conveyors for transporting and placement of filtered tailings would likely be required in a scenario for RC, a large active placement area is required, which cannot be progressively reclaimed. Therefore, there will be large areas requiring dust mitigation measures.
  - Unsaturated filtered tailings are prone to dusting and require active dust management if they can't be progressively reclaimed; requiring regular wetting, temporary covers, or some other measures to suppress dust (such as polymer suppressants).
  - Conventional slurry tailings facilities (as proposed in the mine plan of operations) would also have large exposed areas, but are more easily managed with multiple spigots to maintain a wet beach to reduce dust creation.
  - Due to the lower water content of the filtered tailings, more water (or other measures) would need to be used for dust mitigation than for conventional slurry. If water sprinklers are used as the dust management methodology, the make-up water benefits from using filtered tailings in comparison to conventional slurry tailings will be lessened significantly.

Resolution Copper Response to F-2: Transportation Logistics Considerations and Filter Plant Size

Due to the difficulty in transporting filtered tailings in comparison to slurry, it is not practical to have the filter plant at the WPS. The filter plant would be located at the tailings site, increasing the disturbance of National Forest Service lands. For this scale of operation, a filter plant would have a footprint of approximately 10 acres based on an estimate of the number of filter presses required. Once filtered, the tailings then require transportation to the tailings site and placement. Filter tailings can be transported via trucks or conveyors.

Many projects transport filtered tailings with trucks. The highest production mine reviewed that is using trucks as the primary method of filtered tailings transportation was Cerro Lindo at 7,100 tons per day. RC would need to place 130,000 tons per day. At 20 tons per load, RCM would require 6,500 dump truck loads per day to be moved from the filter plant to the tailings facility for placement. This method of placement would not be reasonable or practicable and therefore, walking stacker conveyors would be used for transportation, plus equipment to spread and compact the tailings. The rough terrain at the Near West site and at potential alternative locations would require the use of conveyors before valleys are filled, which is exceedingly difficult because walking stacker conveyors don't walk on rough rugged steep terrain and therefore re-handling of the tailings is likely required (additional earth-moving equipment). The substantial amount of

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heavy equipment would contribute significant amounts of noise and emissions above what is normal for conventional tailings facilities.

Resolution Copper Response to F-3: Acid Rock Drainage (ARD) Management

RC ore processing will generate two mineralogically and geochemically discrete tailings streams known as “scavenger” tailings and “cleaner” (or pyrite) tailings. Pyrite tailings are classified as Potentially Acid Generating (PAG). The management approach per the mine plan of operations for pyrite tailings involves subaqueous placement during operations (submerged beneath the reclaim pond) and then progressive covering with a thick sequence of scavenger tailings which would limit oxygen and thus minimize acid rock drainage.

If the pyrite tailings were filtered and stacked, they would be placed and kept in an unsaturated state. Thus, will oxidize under wetting and drying cycles from storm events, which would generate ARD and produce poorer water quality runoff compared to pyrite tailings stored in a saturated state (e.g. beneath a pond in a conventional facility). In a submittal to the USFS dated March 9, 2017 Resolution Copper provided a detailed technical report evaluating the chemistry of unsaturated pyrite tailings. The report is titled “*Geochemical Reactivity of Unsaturated Pyrite Tailings Technical Memorandum*” and included in Attachment 4 of this submittal.

As described in the response to F-1 above, external water management facilities are required to manage the water that can’t be stored on the tailings surface. These can be large depending on topography, operational water balance, and storm storage requirements. In the case of the proposed location in the mine plan of operations, a filtered tailings scenario would require external water management facilities containing poor quality contact storm water to be located closer to Queen Creek.

Should you have any questions or require further information please contact me.

Sincerely,

Vicky Peacey

Vicky Peacey,
Senior Manager, Permitting and Approvals; Resolution Copper Company, as Manager of Resolution Copper Mining, LLC

Cc: Ms. Mary Morissette, Senior Environmental Specialist; Resolution Copper Company
Mr. Andrew Luke, Metallurgical Engineer; Resolution Copper Company
Ms. Kate Patterson, P.Eng., M.Eng., PE, Associate, Tailings and Water Resources Engineer, Klohn Crippen Berger, Ltd

APPENDIX B

Tables 3.1 – 3.7 Adapted from Klohn Crippen Berger (KCB) 2019

APPENDIX B. TABLES 3.1 – 3.7 ADAPTED FROM KLOHN CRIPPEN BERGER
SUMMARY OF DEIS TAILINGS ALTERNATIVES SEEPAGE CONTROL LEVELS
(Section 3, Pages 2 – 11, February 22, 2019)

Table 3.1 TSF Alternatives References

TSF Alternative	Seepage Control Design for Draft EIS	Uncaptured Seepage Estimate
2 Near West ("wet")	KCB (2018a)	M&A (2018b, 2019)
3 Near West ("dry")	KCB (2018b)	M&A (2018b, 2019)
4 Silver King	KCB (2018c)	KCB (2019b)
5 Peg Leg	Golder (2018a, 2018b)	Golder (2019)
6 Skunk Camp	KCB (2018d)	KCB (2019a)

Table 3.2 Summary of TSF Alternatives Seepage Control Levels

Seepage Control Measures	Alternative 2 Near West – "wet"				Alternative 3 Near West – "dry"				Alternative 4 Silver King Filtered		Alternative 5 Peg Leg		Alternative 6 Skunk Camp		
Seepage Control Level:	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**1**	**2**	**1**	**2**	**3**
Discharge control systems to achieve BADCT for base metal TSFs (ADEQ 2005)															
Storm water and shallow aquifer intercepts	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Natural geologic features functioning as liners	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓			
Localized liners of geosynthetics and/or clay	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Fine Sealing	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Sub-drainage beneath the impoundment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Leachate collection systems (finger or blanket drains)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lining beneath main underdrains													✓	✓	✓
Centerline embankment construction	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Drains and reclaim water pump-back systems	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Free draining rockfill zones in the embankment															
Runoff water collection via channels and dikes or berms from embankment surface	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Engineered hydraulic barriers – grout curtains with pump-back wells	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓	✓
Engineered hydraulic barriers – reclaim wells and trench drains with clay or geomembrane				✓				✓					✓	✓	✓
Other seepage control measures															
Tailings thickening	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High-density thickening of tailings (and implementation of thin lift placement)					✓	✓	✓	✓				✓			
Dewatering (filtering)									✓	✓					
Downgradient pump-back wells			✓	✓			✓	✓		✓	✓	✓	✓	✓	✓
Extended engineered hydraulic barriers – grout curtains with pump-back wells		✓	✓	✓		✓	✓	✓						✓	✓
Additional downgradient pump-back wells				✓				✓						✓	✓

Table 3.3 Alternative 2 Near West Modified Proposed Action (Modified Centerline Embankment – "wet") Seepage Control Levels

Level of Seepage Control	Seepage Control Description (see KCB 2018a)	From M&A (2018b, 2019)				
		Average Seepage Capture Efficiency (%) (Note 1)	Average Scavenger (NPAG) Seepage (acre-ft/yr)	Average Pyrite (PAG) Seepage (acre-ft/yr)	Average Collection Pond Seepage (acre-ft/yr)	Average Uncaptured Seepage (acre-ft/yr)
0	Features required for stability and act as seepage control features include modified centerline-raised compacted cycloned sand embankments and an embankment underdrainage system.	*not explicitly modeled*				
Between 0 and 1 (Note 2)	Seepage control measures represented in the 2018 Alternative 2/3 steady-state model report[2] (M&A 2018) include: ▪ features for stability described above; ▪ embankment underdrains extend into the impoundment under the entire scavenger beach; and ▪ seepage collection ponds with cut-offs walls and pump-back wells.	91%	1,912	220	8	194
1	Seepage control measures as presented in the DEIS report (KCB 2018a) include: ▪ features for stability described above; ▪ embankment underdrains extend into the impoundment for 200 ft; ▪ foundation treatment or selective engineered low-permeability layers in areas that are not Gila Conglomerate; ▪ engineered low-permeability layers for the pyrite starter facility; ▪ encapsulation of pyrite tailings in the scavenger tailings fines; and ▪ seepage collection ponds with cut-offs, grout curtains and pump-back wells. Grout curtain would extend from the ground surface to 100 ft below ground.	*not explicitly modeled*				
2	To increase Level 1 seepage capture, Level 2 (as described in KCB 2018a) includes extending the grout curtain to target high-permeability zones and seepage pathways.	*not explicitly modeled*				
3	To increase Level 2 seepage capture, Level 3 (as described in KCB 2018a) includes adding additional seepage collection ponds/facilities downstream.	*not explicitly modeled*				

<table>
<tr><th rowspan="2">Level of Seepage Control</th><th rowspan="2">Seepage Control Description
(see KCB 2018a)</th><th colspan="5">From M&A (2018b, 2019)</th></tr>
<tr><th>Average Seepage Capture Efficiency (%) (Note 1)</th><th>Average Scavenger (NPAG) Seepage (acre-ft/yr)</th><th>Average Pyrite (PAG) Seepage (acre-ft/yr)</th><th>Average Collection Pond Seepage (acre-ft/yr)</th><th>Average Uncaptured Seepage (acre-ft/yr)</th></tr>
<tr><td>4</td><td>To increase Level 3 seepage capture, Level 4 (as described in KCB 2018a) includes additional pump-back wells and grout curtain/cut-off walls.

Seepage control measures represented in modified steady-state model report[2] (M&A 2019), in addition to the simulation described in M&A (2018), include:
▪ low-permeability liners in areas that are not Gila Conglomerate;
▪ engineered low-permeability liner for the entire pyrite cell;
▪ downgradient grout curtain extending from the ground surface to 100 ft below ground; and
▪ additional pump-back wells (see Note 3).</td><td>99%</td><td>1,910</td><td>223</td><td>0.6</td><td>21</td></tr>
</table>

Notes:

1. Seepage capture efficiency is calculated from the tailings seepage that enters the foundation, it does not account for dewatering (thickening/filtering) or climate effects.
2. Seepage control modeled by M&A were based on the seepage control measures described in KCB (2018a).
3. Pump back wells were added in the model by M&A in locations to maximize seepage capture.

Table 3.4 Alternative 3 Near West Modified Proposed Action (High-density thickened NPAG Scavenger and Segregated PAG Pyrite Cell) - Seepage Control Levels

Level of Seepage Control	Seepage Control Description (see KCB 2018b)	From M&A (2018b, 2019)				
		Average Seepage Capture Efficiency (%) (Note 1)	Average Scavenger (NPAG) Seepage (acre-ft/yr)	Average Pyrite (PAG) Seepage (acre-ft/yr)	Average Collection Pond Seepage (acre-ft/yr)	Average Uncaptured Seepage (acre-ft/yr)
0	Features required for stability and act as seepage control features include modified centerline-raised compacted cycloned sand embankments and an embankment underdrainage system.	*not explicitly modeled*				
Between 0 and 1 (Note 2)	Seepage control measures represented in the steady-state model report[2] (M&A 2018) include: ▪ embankment underdrains extend into the impoundment under the entire scavenger beach; and ▪ seepage collection ponds with cut-offs walls and pump-back wells.	84%	508	220	5	116
1	Seepage control measures as presented in the DEIS report (KCB 2018a) include: ▪ features for stability described above; ▪ embankment underdrains extend into the impoundment under the entire scavenger beach; ▪ foundation treatment or selective engineered low-permeability layers in areas that are not Gila Conglomerate; ▪ engineered low-permeability layers for the entire pyrite cell; and ▪ seepage collection ponds with cut-offs, grout curtains and pump-back wells. Grout curtain would extend from the ground surface to 100 ft below ground.	*not explicitly modeled*				
2	To increase Level 1 seepage capture, Level 2 (as described in KCB 2018b) includes extending the grout curtain to target high-permeability zones and seepage pathways.	*not explicitly modeled*				
3	To increase Level 2 seepage capture, Level 3 (as described in KCB 2018b) includes adding additional seepage collection ponds/facilities downstream.	*not explicitly modeled*				

Level of Seepage Control	Seepage Control Description (see KCB 2018b)	From M&A (2018b, 2019)				
		Average Seepage Capture Efficiency (%) (Note 1)	Average Scavenger (NPAG) Seepage (acre-ft/yr)	Average Pyrite (PAG) Seepage (acre-ft/yr)	Average Collection Pond Seepage (acre-ft/yr)	Average Uncaptured Seepage (acre-ft/yr)
4	To increase Level 3 seepage capture, Level 4 (as described in KCB 2018b) includes additional pump-back wells and grout curtain/cut-off walls. Seepage control measures as represented in modified steady-state model report (M&A 2019), in addition to the simulation described in M&A (2018), include: ▪ selective engineered low-permeability liners in areas that are not Gila Conglomerate; ▪ engineered low-permeability liners for the entire pyrite cell; ▪ grout curtain would extend from the ground surface to 100 ft below ground, extending to target high-permeability zones and seepage pathways; and ▪ additional pump-back wells (see Note 3).	99.5%	630	130	15	3

Notes:

1. Seepage capture efficiency is calculated from the tailings seepage that enters the foundation, it does not account for dewatering (thickening/filtering) or climate effects.
2. Seepage control modeled by M&A were based on the seepage control measures described in KCB (2018b).
3. Pump back wells were added in the model by M&A in locations to maximize seepage capture.

Table 3.5 Alternative 4 Silver King Seepage Control Levels

<table>
<tr><th>Level of Seepage Control</th><th>Seepage Control Description (see KCB 2018c, 2019b)</th><th>Average Seepage Capture Efficiency (%) (Note 1)</th><th>Average Scavenger (NPAG) Seepage (acre-ft/yr)</th><th>Average Pyrite (PAG) Seepage (acre-ft/yr)</th><th>Average Collection Pond Seepage (acre-ft/yr)</th><th>Average Uncaptured Seepage (acre-ft/yr)</th></tr>
<tr><td>0</td><td>Features required for stability and act as seepage control features include dewatered tailings, compacted structural zone with an underdrainage system.</td><td>n/a</td><td rowspan="3">77.5</td><td rowspan="3">1.9</td><td rowspan="3">0.6</td><td>n/a</td></tr>
<tr><td>1</td><td>In addition to the features for stability, seepage collection, as presented in the DEIS report (KCB 2018c), includes lined collection ditches and collection ponds that cut-off the alluvium. There is potential that a portion of the seepage would not be collected with this approach. A preliminary estimate of up to 80% capture is assumed because seepage can be collected in the underdrains and the alluvial channels will be cut-off.
There is a remaining risk that a large portion of the flow paths would bypass seepage collection.</td><td>less than 80%</td><td>greater than 17 acre-ft/yr</td></tr>
<tr><td>2</td><td>In addition to the features described for Level 1, additional seepage control measures would include targeted grouting of fractures (potential seepage pathways) in the foundation and pump-back wells for seepage return.
A preliminary estimate of up to 90% capture is assumed because of the uncertainty in the foundation conditions.
There is a remaining risk that a portion of the flow paths would bypass seepage collection.</td><td>up to 90%</td><td>greater than 9 acre-ft/yr</td></tr>
</table>

Notes:

1. Seepage capture efficiency is calculated from the tailings seepage that enters the foundation, it does not account for dewatering (thickening/filtering) or climate effects.

Table 3.6 Alternative 5 Peg Leg Seepage Control Levels

Level of Seepage Control	Seepage Control Description (see Golder 2018a, 2018b, 2019)	Average Seepage Capture Efficiency (%) (Note 1)	Average Scavenger (NPAG) Seepage (acre-ft/yr)	Average Pyrite (PAG) Seepage (acre-ft/yr)	Average Collection Pond Seepage (acre-ft/yr)	Average Uncaptured Seepage (acre-ft/yr)
0	Features required for stability and to act as seepage control features include modified centerline-raised compacted cycloned sand embankments and an embankment underdrainage system. Separate NPAG and PAG cells	n/a	2,660	1,270	<1	3,930
1	Seepage control measures as presented in the DEIS report (Golder 2019) include: ▪ features for stability described above; ▪ surface water diversions around the NPAG and PAG facilities to minimize run-on surface water; ▪ lined Seepage collection ponds and ditches; ▪ finger drains extending from the embankment underdrains below the impoundment beach and along the existing drainages; ▪ HDPE lining of reclaim pond area (300 acres) where reclaim pond is in contact with native materials; ▪ engineered low-permeability layers for the entire pyrite cell; and ▪ pump-back wells to form a continuous cone of depression (cut off) and collect surface seepage below the NPAG embankment.	65%	2,537	1,211	<1	1,317
2	Seepage control measures, as described above with the addition of: ▪ complete synthetic lining of PAG cells base and embankment; ▪ removal of alluvium and pervious sediments above bedrock below PAG cells; ▪ utilization of thin-lift deposition beginning in year 7 when sufficient operating area becomes available; and ▪ adjusting pump back wells to allow 261 acre-ft/yr to bypass system (requires less pumping than level 1).	84%	1,640	25	<1	261

Notes:

1. Seepage capture efficiency is calculated from the tailings seepage that enters the foundation, it does not account for dewatering (thickening/filtering) or climate effects.

Table 3.7 Alternative 6 Skunk Camp Seepage Control Levels

Level of Seepage Control	Seepage Control Description (see KCB 2018d, 2019a)	Average Seepage Capture Efficiency (%) (Note 1)	Average Scavenger (NPAG) Seepage (acre-ft/yr)	Average Pyrite (PAG) Seepage (acre-ft/yr)	Average Uncaptured Seepage (acre-ft/yr)
0	Features required for stability and also act as seepage control features include centerline-raised compacted cycloned sand embankments and an embankment underdrainage system.	n/a	1,820	50	n/a
1	Seepage control measures as presented in the DEIS report (KCB 2018d) include: ▪ features for stability described above; ▪ embankment underdrains extend into the impoundment for 100 ft to 200 ft; ▪ engineered low-permeability layers for the pyrite cells; ▪ seepage collection ponds with cut-offs, grout curtains and pump-back wells. Grout curtain would extend from the ground surface to 70 ft below ground and the seepage pump-back wells at 20 ft below ground level (estimated to be the base of the alluvium).	64%[1]	1,820	50	580-660
2	To increase Level 1 seepage capture, Level 2 (as described in KCB 2019) includes an extension of the grout curtain to 100 ft and the seepage pump-back wells installed at 70 ft below ground (estimated to be the base of the weathered Gila Conglomerate layer).	80%[1]	1,840	50	270-370
3	To increase Level 2 seepage capture, Level 3 (as described in KCB 2019) includes an installation of the seepage pump-back wells at 100 ft below ground, at the depth of the grout curtain.	90%[1]	1,840	50	70-180

Notes:

1. Seepage capture efficiency is calculated from the tailings seepage that enters the foundation, it does not account for dewatering (thickening/filtering) or climate effects.

APPENDIX D. RESOLUTION COPPER PROJECT CLEAN WATER ACT SECTION 404 CONCEPTUAL COMPENSATORY MITIGATION PLAN

DRAFT

RESOLUTION COPPER PROJECT CLEAN WATER ACT SECTION 404 CONCEPTUAL COMPENSATORY MITIGATION PLAN

Prepared for: Resolution Copper

Prepared by: WestLand Resources, Inc.

Date: June 21, 2019

Project No.: 807.175 03 03

TABLE OF CONTENTS

1. INTRODUCTION 2
2. PROJECT DESCRIPTION 2
3. AVOIDANCE AND MINIMIZATION 3
4. PROJECT IMPACTS TO WOTUS 4
5. MITIGATION OPPORTUNITIES 6
   5.1. Potential Mitigation Opportunities 7
      5.1.1. GRIC MAR-5 Recharge Project 7
      5.1.2. Lower San Pedro River Wildlife Area In-lieu Fee Project 8
      5.1.3. Olberg Road Restoration Site Project 8
      5.1.4. Queen Creek Project 9
      5.1.5. Arlington Wildlife Area In-lieu Fee Project 9
6. LONG-TERM SITE PROTECTION INSTRUMENTS 9
7. REFERENCES 11

TABLES

Table 1. Functions Evaluated for TSF Impacted Drainages 5

FIGURES

Figure 1. Overview of Proposed Mining Operation
Figure 2. Mitigation Opportunities
Figure 3. GRIC MAR-5 Project

APPENDICES

Appendix A. Gila River Indian Community MAR-5 2017 Vegetation Monitoring Report
Appendix B. Arizona Game and Fish Department Letter to Resolution Copper on the Lower San Pedro River Wildlife Area In-Lieu Fee Program (Dated April 15, 2019)

1. INTRODUCTION

Resolution Copper Mining, LLC (Resolution, or the Applicant) proposes to develop and operate an underground copper and molybdenum mine near Superior, Arizona. As proposed, the tailings storage facility (TSF), pipelines, and associated facilities require the discharge of fill to surface water features that the U.S. Army Corps of Engineers (Corps) is anticipated to determine to be potentially jurisdictional waters of the United States (waters of the U.S.) pursuant to a preliminary jurisdictional determination (PJD). Based on the presumption that potentially jurisdictional waters of the U.S. will be impacted by discharges of dredged or fill material resulting from portions of Resolution's planned mine development, Resolution will need to make an application for a Clean Water Act (CWA) Section 404 permit for these discharges.

In order to secure a CWA Section 404 permit, the Applicant is bound by the requirements of the Corps's and the U.S. Environmental Protection Agency's (EPA) "Final Rule for Compensatory Mitigation for Losses of Aquatic Resources" (33 C.F.R. Parts 325 and 332 and 40 C.F.R. Part 320; published in 73 Fed. Reg. 19594-19705) (Corps & EPA 2008), hereinafter referred to as the 2008 Mitigation Rule. The fundamental objective of the 2008 Mitigation Rule is to establish standardized compensatory mitigation criteria for all mitigation types to offset unavoidable impacts to waters of the U.S. authorized through the issuance of a CWA Section 404 permit. Compensatory mitigation is required after efforts to avoid and minimize impacts have been exhausted and impacts to waters of the U.S. would still occur. This conceptual compensatory mitigation plan introduces the suite of potential mitigation elements that Resolution will use to comply with the 2008 Mitigation Rule. A final conceptual mitigation plan will be developed once the extent of waters of the U.S. is confirmed and the magnitude of impacts (direct and indirect) have been refined. These mitigation measures will be evaluated as part of the National Environmental Policy Act (NEPA) evaluation being led by the U.S. Forest Service (USFS) with the Corps as a cooperating agency.

2. PROJECT DESCRIPTION

Resolution's planned mine development is located near Superior in Pinal County, Arizona (**Figure 1**) in an area called the Copper Triangle and specifically within the Pioneer Mining District. Mine exploration and operations have been conducted in the area since the early 1860's, when the discovery of silver led to the development of the Silver King Mine. Magma Copper Company (Magma) took over the Silver King Mine and operated it as the Magma Mine from 1912 until the concentrator was finally shut down in 1996. After Magma's shutdown, the Resolution ore deposit was discovered 1.2 miles south of the existing Magma Mine and 7,000 feet below the ground surface.

Resolution was formed as a limited liability company in 2004 by Rio Tinto and BHP Billiton. Rio Tinto is the managing entity and possesses a 55-percent ownership stake in Resolution, while BHP Billiton maintains 45-percent ownership. Since 2004, Resolution has steadily worked to investigate and delineate the Resolution ore body, develop a mine design, prepare environmental and engineering studies to support the mine permitting and approvals effort, and conduct multiple community outreach efforts and public meetings to inform and involve the public as plans were developed. These efforts led to the submittal of a General Plan of Operations (GPO) to the USFS in November 2013, and the subsequent NEPA evaluation by the Corps and the USFS.

Resolution proposes the development of the Resolution ore body using panel caving, a type of block cave mining. The copper and molybdenum ore will be mined, undergo primary crushing underground, and then be sent to a newly constructed concentrator facility to be located at the existing WPS north of Superior. Concentrate produced here will be transported offsite for additional processing, while the resulting tailings will be transported via a tailings pipeline to the proposed TSF location. Under the current proposed operating conditions and Life of Mine (LOM) planning parameters, the Resolution ore body is sufficient to support the concentrator operations for approximately 41 years. As currently configured, operations are anticipated to result in the mining of approximately 1.4 billion tons of copper and molybdenum ore and the production of approximately 1.37 billion tons of tailings.

Through the alternatives analysis process under NEPA, the U.S. Forest Service (USFS) evaluated numerous geographic locations for tailings storage within an approximately 200-mile radius around the mine. The USFS evaluated both singular TSFs, where pyrite and scavenger tailings were stored together, and separate scavenger and pyrite TSFs, depending on the geophysical and hydrogeological setting. Additional factors included favorable topography and sufficient storage capacity. This information is detailed in Section 2 and Appendix B of the *Resolution Copper Project and Land Exchange Draft Environmental Impact Statement* (USFS 2019). The final alternatives selected for detailed analysis were those TSF designs that addressed the widest range of issues identified during public scoping and had the potential to be selected as the least environmentally damaging practicable alternative (LEDPA). This conceptual compensatory mitigation plan has been developed based on the assumption that the Corps could ultimately identify, from the range of alternatives evaluated in the DEIS, a TSF alternative that has impacts to jurisdictional waters of the U.S. as the LEDPA for the Resolution Project (WestLand 2019). The suite of potential mitigation elements described within this plan would then be used to comply with the 2008 Mitigation Rule. However, the mitigation elements described herein would be applicable to all the alternatives carried forward for consideration in the DEIS (USFS 2019) and the practicability analysis (WestLand 2019).

3. AVOIDANCE AND MINIMIZATION

The development of alternatives for Resolution's proposed underground copper and molybdenum mine design included a significant effort to avoid and minimize impacts to potential waters of the U.S. to the extent practicable. As described above, only certain alternative locations for the TSF, pipelines, and associated facilities analyzed in the practicability analysis have impacts to potential waters of the U.S. An exhaustive evaluation of TSF alternatives was completed by the USFS and cooperating agencies, including the Corps. This evaluation of alternatives included other existing mine, or brownfields, sites in Arizona (USFS 2019). While the use of one of these brownfields sites would likely have avoided impacts to waters of the U.S., the agencies determined that none of the brownfields alternatives were available, feasible, or reasonable alternatives for TSF locations and those sites were therefore dismissed from detailed analysis. After dismissal of the brownfield alternatives, 15 initial alternative TSF locations to that location proposed in the GPO were screened and assessed using criteria developed from the public and agency scoping processes conducted by the USFS, as well as input from cooperating agencies and Resolution Copper (USFS 2019).

Numerous aspects of TSF design and construction such as embankment type (e.g., upstream, centerline, modified centerline, and downstream embankments), foundation treatment and lining options, management of PAG tailings, and deposition methods (e.g., conventional thickened, high-density thickened, and filtered, or 'dry-stack') were assessed for use at these locations as described in the DEIS (USFS 2019). Five TSF alternatives were ultimately considered for detailed analysis in the DEIS (USFS 2019) and practicability analysis (WestLand 2019), and included a mix of locations, embankment types, and tailings deposition and placement technologies. A number of onsite mitigation measures (referred to as "applicant committed environmental protection measures") were incorporated into the TSF designs to address impacts to the aquatic environment, including waters of the U.S., and water quality and quantity functions. Although the area beneath the footprint of the TSF and its appurtenant features will no longer contribute runoff from precipitation to downstream drainage reaches, the TSF design minimizes impacts to downstream waters of the U.S. by diverting upstream stormwater flows around the facility. Similarly, the stormwater controls, run-on diversions, and engineering controls have been designed to maintain downstream stormwater flows while minimizing the risk of contaminant discharge to downstream surface water features to the maximum extent practicable.

Given that the footprints of the practicable TSF alternatives contain ephemeral drainage channels and will be operated as part of an active copper mine, little opportunity exists for the development of onsite mitigation for unavoidable impacts to waters of the U.S. Aquatic habitat functions that will be lost through development of the TSF are anticipated to be mitigated offsite.

4. PROJECT IMPACTS TO WOTUS

As proposed, only the development of the TSF and associated infrastructure (including pipelines) may require a discharge of dredged or fill material into waters of the U.S. Discharge of fill for the development of these features, particularly the TSF, consists mostly of the levelling of existing topography through cut and fill of the natural ground surface. Materials to be discharged would consist of native soil and rock taken from the footprint of the constructed features during the grading process.

The aquatic resources at all of the TSF alternatives carried forward for evaluation in the DEIS (USFS 2019) and the practicability analysis (WestLand 2019) are comprised almost entirely of ephemeral washes. The ephemeral wash systems flow only in direct response to precipitation events and typically support some level of xeroriparian habitat. Two alternatives also include groundwater dependent ecosystems (e.g., seeps, springs) that support habitat more indicative of the hydric conditions. In general, these features exist in a largely unaltered state with primary land use within these footprints consisting of ranching or light recreational use.

The South Pacific Division of the Corps has developed the *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2015) for determining compensatory mitigation requirements for the processing of CWA Section 404 permits. The substantive component of this procedure is completion of the Mitigation Ratio-Setting Checklist (MRSC). The completed MRSC is intended to provide a ratio determining the amount of acreage necessary as compensatory mitigation to offset the acreage of authorized impacts, in compliance with the 2008 Mitigation Rule. Completion of the MRSC comprises a 10-step process that includes a functional analysis of impacted waters of the U.S. and proposed mitigation parcels, establishes baseline mitigation ratios, and authorizes adjustment of those ratios based on specified criteria.

Step 1 within the MRSC is the identification and classification of the aquatic resources present at and functions provided by the impact site and the proposed mitigation site. If a TSF alternative that has impacts to jurisdictional waters of the U.S. is identified by the Corps as the LEDPA, the aquatic resources at the impact site and mitigation site will be classified by their hydrologic, chemical, and biotic function. Step 2 of the MRSC is a qualitative assessment of the functions of the aquatic resources impacted and an assessment of the functional gain from the proposed mitigation actions. The assessed functions will be consistent with those hydrologic, chemical, and biotic functions identified in the South Pacific Division's *Standard Operating Procedure for the Determination of Mitigation Ratios* (Corps 2015). An example of 11 functions typically utilized for this purpose are listed in **Table 1**.

Table 1. Functions Evaluated for TSF Impacted Drainages

Evaluated Functions
HYDROLOGIC FUNCTIONS
Hydrologic Connectivity
Subsurface Flow and Groundwater Recharge
Energy Dissipation
Sediment Transport/Regulation
CHEMICAL FUNCTIONS
Elements, Compounds, and Particulate Cycling
Organic Carbon Export/Sequestration
BIOTIC FUNCTIONS
Aquatic Invertebrate Fauna
Presence of Fish and Fish Habitat Structure
Riparian/Wetland Vegetation Structure
Age Class Distribution of Wooded Riparian or Wetland Vegetation
Native/Non-native Plant Species

Evaluation of these eleven functions will be based on available data, published literature, aerial photography, general field observations, and field data collected from both the impact and proposed mitigation sites. It is anticipated that this effort will also include use of the *California Rapid Assessment*

Method (CRAM) *Episodic Riverine Field Book, version 2.0* (CWMW 2018), which was specifically developed to assess the functionality of ephemeral drainages based on relationships between condition and function. The functions of each identified drainage class will be scored qualitatively. The assessment of ephemeral drainages impacted will compare on-site aquatic features to normally functioning reference washes of the same class and similar flow regime. These functions will then be compared to those aquatic functions provided by the proposed mitigation activities to assess aquatic functions and values lost if the Project is permitted compared to aquatic functions and values gained through mitigation. Given the nature of the proposed mitigation sites, it is likely that this will require a functional comparison of services provided by ephemeral systems to services provided by perennial and intermittent systems (e.g., the Gila River). The assessment is not intended to make a value judgement between ephemeral and perennial systems; rather, the assessment fulfills the purposes of the MRSC to provide a comparative assessment of the functionality of the systems at the impact and mitigation sites and to develop a mitigation ratio that will ensure there is no net loss of aquatic functions and values. It is likely that this comparison will remove from the list of assessed functions factors such as 'Presence of Fish Habitat and Structure' not provided by ephemeral systems that would more heavily weight perennial or intermittent regimes.

To compensate for these unavoidable impacts and functional losses, five offsite mitigation opportunities have been identified that provide the potential for functional gains through implementation of active management, enhancement, restoration, and preservation activities.

5. MITIGATION OPPORTUNITIES

The 2008 Mitigation Rule identifies general classes of compensatory mitigation and identifies clear preferences among these classes, specifically noting that mitigation banks[1] and then in-lieu fee (ILF) mitigation are preferred over permittee-responsible onsite or offsite mitigation. As a general matter, in-kind mitigation is preferred over out-of-kind mitigation.

In accordance with the Corps's *Final 2015 Regional Compensatory Mitigation and Monitoring Guidelines* (2015), Resolution evaluated mitigation opportunities, based on the above hierarchy, within the Project watershed (Middle Gila Watershed [USGS HUC 15050100]) and adjacent watersheds. WestLand is not aware of any watershed planning efforts for the HUC-6 or HUC-8 watersheds within which the Project is located that identify specific restoration goals for aquatic resources. No onsite mitigation opportunities were identified.

Five offsite mitigation opportunities (**Figure 2**) have been identified as Potential Mitigation Opportunities (**Section 5.1**). The relative benefits of each mitigation opportunity are discussed based on WestLand's recent experience working within the framework of the 2008 Mitigation Rule on similar mining projects (WestLand 2017, 2018) and following Corps guidelines (Corps 2015). The mitigation opportunities include both permittee-responsible and ILF mitigation. Fulfillment of mitigation under

[1] There are currently no mitigation banks established in Arizona.

each opportunity would provide regional conservation benefits, though not all of the proposed mitigation measures will create xeroriparian habitat similar to the habitat that will be lost or impacted by the Project. Some of the opportunities entail preservation, enhancement, and restoration of high-value mesoriparian and hydroriparian habitats, which are rarer within the regional landscape and have higher productivity and wildlife values (Lowery, Stingelin, and Hofer 2016).

5.1. Potential Mitigation Opportunities

5.1.1. GRIC MAR-5 Recharge Project

The Gila River Indian Community (GRIC, the Community) MAR-5 Recharge Project is, to-date, a 3-year pilot study to evaluate the effectiveness of recharging a portion of the GRIC allotment of CAP water into the Gila River, on the Community's lands (**Appendix A**). Over the 3-year pilot study, CAP water was discharged at a single turnout near the Olberg Road Bridge in GRIC District 3. Water discharge at the site initiated in August 2015, and vegetation monitoring was conducted at the site each year from 2015 through 2017, including baseline data collection in June 2015. The pre-discharge vegetation of the area was described as a sparse collection of upland woody shrubs with desert forbs and Bermudagrass (*Cynodon dactylon*), along with the nonnative, invasive tamarisk (*Tamarix* spp.). The 2017 data show a five-fold increase in total vegetation volume and a six-fold increase in total herbaceous cover, and at the end of the pilot study the site was populated with desirable riparian species including cattails (*Typha* spp.) and Goodding's willow (*Salix gooddingii*). Tamarisk density at the site also increased substantially, from 11 plants per hectare in June 2015 to 352 plants per hectare in 2017 (**Appendix A**).

The instream discharge created an approximately 123-acre wetted area at the GRIC MAR-5 site (**Figure 3**), and it is anticipated that continued discharges would allow for significant ecological lift as riparian habitat in this area continues to develop, though Corps guidance (2015) indicates that mitigation credited towards this lift may be negatively-impacted by the presence and density of tamarisk. The GRIC Department of Environmental Quality has recently conducted limited tamarisk removal and native plant reseeding at the GRIC MAR-5 site and has identified a large tamarisk thicket directly upstream that is likely a major seed source contributing to the tamarisk colonization and proliferation at the GRIC MAR-5 site. Tamarisk removal and native reseeding efforts at the upstream tamarisk seed source are described in the Olberg Road Restoration Site Project mitigation option (**Section 5.1.3**).

The Corps places a high value on restoration projects (33 CFR 332.3(a)(2)), and the GRIC MAR-5 recharge project represents a significant restoration effort on one of Arizona's largest river systems. The Corps prefers that mitigation take place within the same watershed as the impacted site (33 CFR 332.3(b)), and the GRIC MAR-5 site occurs within the same HUC 8 watershed, the Middle Gila, as the Project (**Figure 2**). Additionally, the Community has indicated that the GRIC MAR-5 recharge project would restore a cultural resource (surface flows in the Gila River), which has significant traditional value to the Community.

5.1.2. Lower San Pedro River Wildlife Area In-lieu Fee Project

The ILF mitigation programs allow impacts to surface water features to be mitigated through funds paid to a governmental or non-profit natural resources management entity as a means to satisfy compensatory mitigation requirements (Corps & EPA 2008). These programs are a form of compensatory mitigation that can aid in larger restoration efforts, making ILF projects (along with mitigation banks) the Corps's preferred method of compensatory mitigation (Corps 2015).

The Arizona Game and Fish Department (AGFD) has developed an ILF mitigation project, the Lower San Pedro River Wildlife Area (LSPRWA) along the San Pedro River near Winkelman, Arizona. Although the LSPRWA ILF project is located within the Lower San Pedro (HUC 8) watershed adjacent to the Project area's watershed (**Figure 2**), the ILF project itself is located near the watershed boundary and has been used as mitigation for other projects located in the Middle Gila River HUC 8 watershed (WestLand 2018). The LSPRWA ILF project consists of converting over 100-acres of agricultural fields to native pasture grasses to reduce groundwater consumption and help restore base flows and riparian habitat (BFWS 2019). Additionally, the restoration project will involve substantial exotic species removal and subsequent plantings to establish native woody vegetation within the 2,116 acre site (Lowery, Stingelin, and Hofer 2016).

The AGFD has indicated in a letter to Resolution Copper (**Appendix B**) that all advanced credits available for purchase through the LSPRWA ILF project have been sold or obligated for sale. However, AGFD will expand the LSPRWA ILF project to make an additional 650 credits available for purchase through five future phases of development. Resolution may purchase as many LSPRWA ILF credits as necessary to meet the mitigation requirements needed to offset impacts resulting from the project. Given the lengthy mine construction period, tailings would not need to be placed for at least a decade. As such, additional credits are anticipated to be available well before impacts from TSF deposition.

The LSPRWA ILF project has previously been used as mitigation by Asarco in support of the proposed Ripsey Wash TSF project (Ripsey) (WestLand 2018). Ripsey is similar to the Project in that for both projects, all proposed impacted drainages are ephemeral. Mitigation ratios established using the LSPRWA ILF to offset impacts from Ripsey were set at 1:1 for both newly-established wetland habitat and restored riparian habitat (WestLand 2018). Due to the similar nature and functional value of the proposed impacted drainages between Ripsey and the Project, WestLand assumes that a mitigation ratio of 1:1 or similar would be used for the Project.

5.1.3. Olberg Road Restoration Site Project

The proposed 23-acre Olberg Road Restoration Site (ORRS) is located along the south bank of the Gila River just east of the Olberg Bridge in GRIC District 3, immediately upstream of the GRIC MAR-5 site (**Figure 3**). The conceptual mitigation strategy for the ORRS project consists of exotic tree species (principally tamarisk) removal and control, combined with native plant species reseeding. Nonnative, invasive tamarisk has shown substantial increase in cover at the GRIC MAR-5 site during the 3-year pilot study (**Appendix A**), prompting identification of the 23-acre ORRS as a major tamarisk seed source for the GRIC MAR-5 site. Exotic tree species removal and control combined with seeding of native plant species at the ORRS site would allow for the establishment and maintenance of a riparian habitat dominated by native tree species, and eliminate a large, local source of exotic tree species seed from that section of the Gila River.

The ORRS project is not expected to generate the same ecological lift and mitigation credit value as the GRIC MAR-5 site, as it provides fewer ecological benefits relative to restoring surface flows and high-value riparian vegetation. The mitigation actions associated with tamarisk removal and reseeding would be considered as restoration.

5.1.4. Queen Creek Project

Conceptual mitigation elements for the Queen Creek project consists of actions to improve the ecological condition of a stretch of Queen Creek near Superior, Arizona (**Figure 2**). The actions include the removal of tamarisk to allow riparian vegetation to return to its historic composition and structure and promote more natural stream functions. Additionally, a conservation easement would be established, covering approximately 150 acres along 1.8 miles of Queen Creek to restrict future development of the site and provide protected riparian and wildlife habitat. The 150-acre Queen Creek project area includes lands owned by Resolution and BHP Mineral Resources, Inc. (BHP).The Corps would likely categorize the Queen Creek project as an enhancement (lift of one or a few selected functions) project. However, important to note is that the Queen Creek project would be accessible and highly-visible from Superior (**Figure 2**), allowing a local community affected by the Project to be a major beneficiary of the mitigation.

5.1.5. Arlington Wildlife Area In-lieu Fee Project

The Arlington Wildlife Area (AWA), another AGFD ILF mitigation project, is a 1,500-acre wetland and riparian habitat restoration project along the west bank of the Gila River in Maricopa County, Arizona. The AWA is located within the Lower Gila (HUC 8) watershed, adjacent to the Project area's Middle Gila watershed (**Figure 2**). The AWA consists of agricultural lands, constructed wetlands, and riparian areas dominated by tamarisk and mixed native and non-native vegetation (AGFD 2019). Restoration actions at the AWA consist of streambank shaping, erosion control, and native revegetation. As an ILF project, the Corps places high value on this opportunity due to its potential to have a substantial impact on broader restoration efforts.

6. LONG-TERM SITE PROTECTION INSTRUMENTS

All of the permittee-sponsored mitigation opportunities (GRIC MAR-5 Recharge Project, ORRS Project, and the Queen Creek project) to the extent necessary will have a suitable site-protection instrument recorded in their respective counties or tribal government to provide long-term protection of the conservation objectives outlined here and to comply with the 2008 Mitigation Rule. The details of the site-protection instruments to be recorded at these mitigation sites have not been finalized at this time, though incompatible uses will be prohibited. Some low-impact public uses such as hiking and bird watching may be allowed in certain areas. The permittee would provide funds for the long-term management of the sites pursuant to the respective site-protection instrument.

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FIGURES

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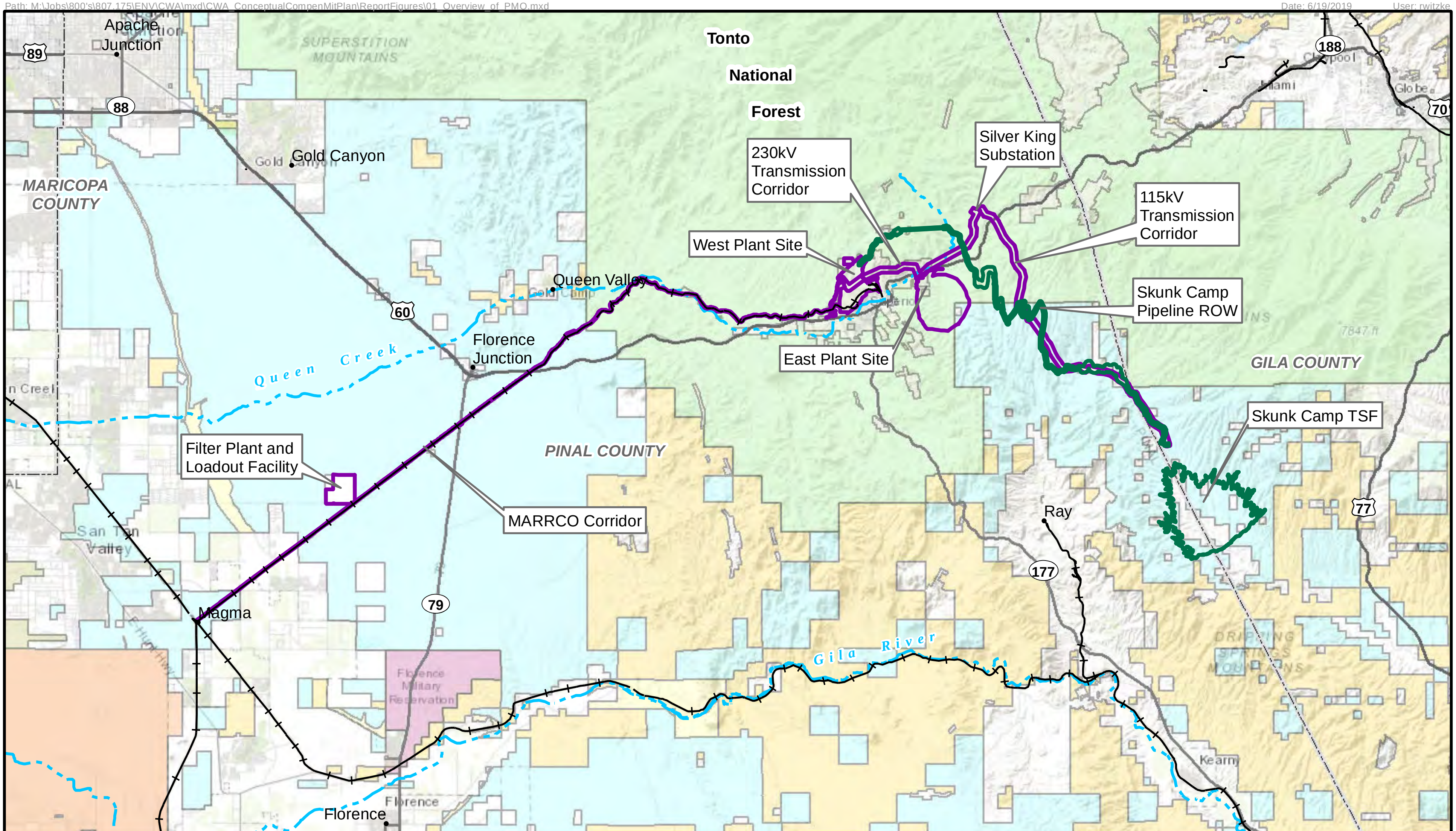

Pinal and Gila Counties, Arizona,
Data Source: BLM 2018, WRI Modified 2019,
ALRIS, SWCA, and USFS
Image Source: ArcGIS Online, World Topo Map

Legend

- Proposed Action
- GPO Mine Elements

Surface Management (BLM)

- County
- Indian Lands
- Local or State Parks
- Other
- State Trust Land
- Bureau of Land Management (BLM)
- Military
- Bureau of Reclamation
- Private Land
- US Forest Service (USFS)

N

0 2.5 5 Miles

0 4 8 Kilometers

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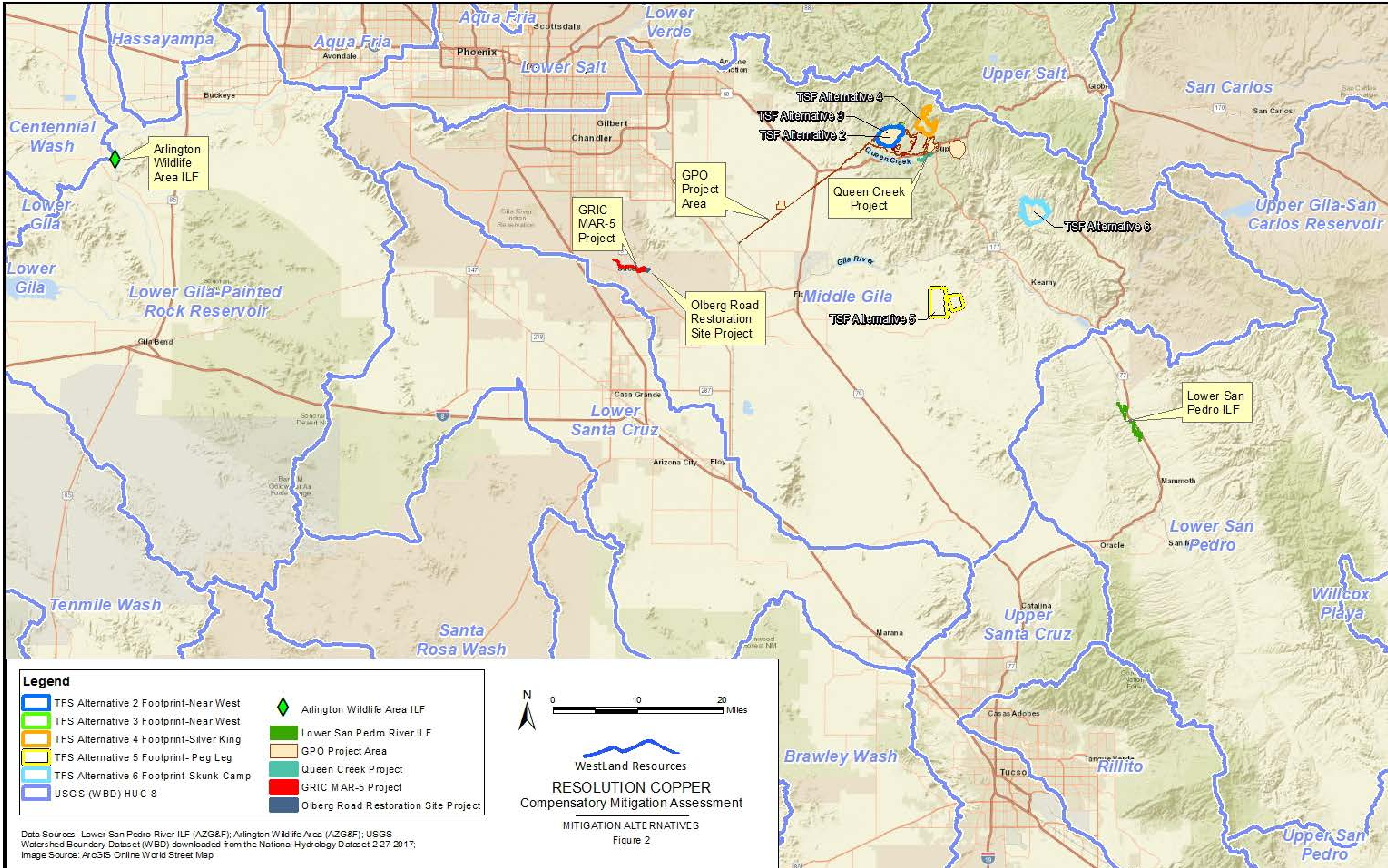
RESOLUTION COPPER
CWA Conceptual Compensatory Mitigation Plan

OVERVIEW OF
PROPOSED MINING OPERATION

Figure 1



Hassayampa
Aqua Fria
Aqua Fria
Scottsdale
Lower Verde
Phoenix
Avondale
Lower Salt
Upper Salt
San Carlos
Buckeye
Gilbert
Chandler
Centennial Wash
Arlington Wildlife Area ILF
TSF Alternative 4
TSF Alternative 3
TSF Alternative 2
Queen Creek
GPO Project Area
Queen Creek Project
GRIC MAR-5 Project
TSF Alternative 6
Upper Gila-San Carlos Reservoir
Lower Gila
Lower Gila
Gila River
Kearny
Lower Gila-Painted Rock Reservoir
Middle Gila
TSF Alternative 5
Olberg Road Restoration Site Project
Gila Bend
Casa Grande
Lower Santa Cruz
Lower San Pedro ILF
Arizona City
Eloy
Mammoth
Lower San Pedro
Oracle
Tenmile Wash
Santa Rosa Wash
Marana
Catalina
Upper Santa Cruz
Willcox Playa
Casas Adobes
Brawley Wash
Rillito
Tucson
Upper San Pedro
Legend
TFS Alternative 2 Footprint-Near West
TFS Alternative 3 Footprint-Near West
TFS Alternative 4 Footprint-Silver King
TFS Alternative 5 Footprint- Peg Leg
TFS Alternative 6 Footprint-Skunk Camp
USGS (WBD) HUC 8
Arlington Wildlife Area ILF
Lower San Pedro River ILF
GPO Project Area
Queen Creek Project
GRIC MAR-5 Project
Olberg Road Restoration Site Project
N
0
10
20
Miles
WestLand Resources
RESOLUTION COPPER
Compensatory Mitigation Assessment
MITIGATION ALTERNATIVES
Figure 2
Data Sources: Lower San Pedro River ILF (AZG&F); Arlington Wildlife Area (AZG&F); USGS
Watershed Boundary Dataset (WBD) downloaded from the National Hydrology Dataset 2-27-2017;
Image Source: ArcGIS Online World Street Map

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T4S, R6E, Portions of Sections 8 - 14,
Pinal County, Arizona.
Image Source: Pleiades Satellite Imagery 10/28/2017

0 800 1,600 Feet
0 250 500 Meters
N

Legend

Olberg Road Restoration Site Project
MAR-5 Wetted Area

RESOLUTION COPPER
CWA Conceptual Compensatory Mitigation Plan

GRIC MAR-5 PROJECT
Figure 3

WestLand Resources

APPENDIX A

Gila River Indian Community MAR-5 2017 Vegetation Monitoring Report

GILA RIVER INDIAN COMMUNITY MAR-5
2017 VEGETATION MONITORING REPORT
Resolution Copper

Prepared for:

RESOLUTION COPPER

102 Magma Heights – Superior, Arizona 85173
Project Number: 807.131 03 02
May 2019

WestLand Resources

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TABLE OF CONTENTS

1. INTRODUCTION AND BACKGROUND 1
2. METHODS 1
   2.1. Field Methods 2
      2.1.1. Total Vegetation Volume 2
      2.1.2. Percent Cover 3
      2.1.3. Belt Density 4
      2.1.4. Photopoints 5
      2.1.5. Hydrological Variables 5
   2.2. GIS Methods 6
   2.3. Data Entry and Analysis 6
3. RESULTS AND DISCUSSION 7
   3.1. Total Vegetation Volume 7
   3.2. Percent Cover 10
   3.3. Belt Density 12
   3.4. Invasive Species 14
   3.5. Hydrological variables 14
4. SUMMARY 16
5. REFERENCES 17

TABLES

Table 1. Total Vegetation Volume Index Summarized by Transect 8
Table 2. Total Vegetation Volume by Transect of Most Common Woody Species, June 2015, November-December 2015, November-December 2016, and November 2017 9
Table 3. Percent Cover of All Categories of Ground Cover Averaged Across All Sampled Transects; June 2015, November-December 2015, November-December 2016, and November 2017 10
Table 4. Percent Cover of Live Vegetation; June 2015, November-December 2015, November-December 2016, and November 2017; Summarized by Species and Averaged Across All Sampled Transects 11
Table 5. Total Woody Plant Density (Number of Plants >50 cm High Per Hectare) by Transect, June 2015, November-December 2015, November 2016, and November 2017 12
Table 6. Woody Plant Density (Plants >50 cm Height Per Hectare) of Most Common Species Averaged Across All Sampled Transects, June 2015, November-December 2015, November-December 2016, and November 2017 13
Table 7. Woody Plant Density (plants per hectare) by Height Class of Most Common Species Averaged across All Transects Sampled in November 2017 13
Table 8. Functional Capacity Index (FCI) Scores Averaged across All Sites and Functions, and FCU Values for the Entire Wetted Areas, Compared Across All Sampling Periods ... 14

FIGURES

(follow text)

Figure 1. Vicinity Map
Figure 2. Vegetation Monitoring Transects – June 2015
Figure 3. Vegetation Monitoring Transects – November 2016
Figure 4. Vegetation Monitoring Transects – November 2017

APPENDICES

Appendix A. Repeat Photographic Documentation of Vegetation Monitoring Transects
Appendix B. Table 2 from Tres Rios del Norte (Pima County, Arizona) Ecosystem Restoration Functional Assessment Using HGM, December 2003, Analyses, Results, and Documentation Draft Report
Appendix C. Functional Capacity Index (FCI) Scores of Functions Evaluated from November-December 2015, November 2016 and November 2017

1. INTRODUCTION AND BACKGROUND

WestLand Resources, Inc. (WestLand), was retained by Resolution to conduct vegetation monitoring of restoration efforts in partnership with the Gila River Indian Community (GRIC) through the discharge of Central Arizona Project (CAP) water to the Gila River as part of a Managed Aquifer Recharge (MAR) and riparian restoration pilot program.. Instream discharge of the GRIC CAP water allocation into the Gila River is currently conducted at a single turnout near the Olberg Road Bridge, referred to as MAR-5. The GRIC MAR-5 recharge study site is situated along the southern side of the Gila River, approximately 1 mile north of the town of Sacaton in Township 4 South, Range 30 East, Sections 9 through 11, 13, and 14 (the Project Area; **Figure 1**).

A 3-year pilot study to evaluate the effectiveness of the discharge at MAR-5 was initiated in 2015. Baseline vegetation data was collected in June 2015 before the initial discharge of water in July 2015. Additional vegetation data was collected in November and December 2015, November and December 2016, and November 2017.

This report presents the baseline vegetation data collected in June 2015 and provides a comparative analysis to the vegetation data collected in November-December 2015, November-December 2016, and November 2017 after instream discharge commenced at MAR-5. The report is presented in five sections: **Section 1**: Introduction, **Section 2**: Methods, **Section 3**: Results, **Section 4**: Discussion, and **Section 5**: References.

2. METHODS

Although the Corps has no approved wetlands functional assessment model for determining ecological restoration benefits in Arizona, WestLand used the Planning-based Wetland Functional Assessment Model developed by the Corps (Webb and Burks-Copes 2009) to establish an index of hydrological function of the MAR-5 recharge pilot study site, called its Functional Capacity Index (FCI). The FCI is a value ranging from 0 to 1 which reflects the quality of the evaluated wetland area relative to a hypothetical properly-functioning wetland. An index of "1" indicates that the wetland functions at a level equivalent to a wetland under reference standard conditions (Webb and Burks-Copes 2009), and an index at or above 0.50 indicates that the wetland has a moderate to high functional capacity (Burks-Copes and Webb 2003). The FCI is calculated by evaluating ten functions (e.g., channel dynamics, nutrient cycling, habitat structure), which in turn are calculated by formulas involving a total of 27 variables. Most of the variables are measured at the field sites; a few are evaluated using GIS. The Model converts measured variable values into a Variable Subindex (VSI) score for each variable, which ranges from 0 to 1. The VSI values comprise the variables within the formulas that calculate an FCI for each of the ten wetland functions. The FCI values of the 10 functions are averaged to produce an overall FCI for each sampled site. An overall average among all sites provides a single FCI for the entire study area. The FCI of the site is multiplied by the acreage of the represented area to calculate Functional Capacity Units (FCU). The value of the FCU reflects the quality and quantity of the wetland area, and can be compared among sites and over time for purposes of monitoring and mitigation.

2.1. Field Methods

The Model recognizes five types of wetlands (termed Partial Wetland Assessment Areas [PWAA]) in southern Arizona. All the study transects were in the Scrub-Shrubland PWAA, characterized by the presence of shrubs (defined as woody vegetation less than 3 inches in diameter at breast height), but lacking trees (>3 inches diameter at breast height). Also in the floodplain of the Gila River but outside of the channel wetted by discharge from MAR-5 are extensive areas of the Dry Riverbottom PWAA, characterized by a lack of woody vegetation (Webb and Burks-Copes 2009).

Prior to fieldwork, 38 study transects were selected by inspection of aerial imagery within the area predicted to be wetted from the discharges. Study transects were located perpendicular to the channel at intervals of approximately 200 meters (m). The lengths of the proposed transects varied in accordance with the width of the predicted wetted area (**Figure 2**). Throughout the four data collection periods, some transects were shortened, others were omitted, to better represent the wetted discharge channel and to omit non-wetted areas. Data was collected from 27 transects in June 2015, from 24 transects in November-December 2015, from 18 transects in November-December 2016, and from 24 transects in November 2017 (**Figure 3**). For transects that were shortened in November-December 2015 to include only wetted areas, the June data reported in **Section 3** was adjusted to correspond to the shortened transects, by deleting data points that were recorded in omitted sections of the transects.

At each transect, the following data were collected:

- Total Vegetation Volume (TVV)
- Percent Cover
- Belt Density of Woody Species
- Hydrological Variables
- Photographs

2.1.1. Total Vegetation Volume

The total vegetation volume (TVV) index is used to characterize community structure and composition of the vegetation and to provide an indication of overall productivity. This technique samples a series of one-decimeter (dm)-high by one-dm-radius cylinders (3.14 dm^3) from the ground surface through the top of the vegetation canopy at regular intervals along established transects. At each of the sample points per transect, a straight rod was held vertically; any live woody vegetation that occurred within a 10-centimeter (cm) radius cylinder centered on the vertical rod was recorded by species as "hits". Data was separated into 1-m vertical increments (ground-1 m, 1-2 m, 2-3 m, 3-4 m, 4-5 m, 5-6 m, 6-7 m, 7-8 m, and >8 m). Each vertical meter increment could have a maximum of 10 hits, corresponding to the number of 10-dm high x 10-cm radius cylinders occupied by live vegetation, within each vertical 1-m increment. For vegetation that occurred higher than 8 m, one hit was scored per species in the >8-m category.

The calculation procedure for computing vegetation volume data is provided below:

h_i = total number of hits (dm layers containing vegetation) at the i^{th} sample point

n = the total number of sample points within the transect

$\sum_{i=1}^{n} h_i$ = the sum of all hits within the transect

The sum of the hits can be used to calculate the volume of vegetation per dm^2 area for the transect:

$$\text{Vegetation volume per area (in decimeters)} = \frac{\sum_{i=1}^{n} h_i * 3.14dm^3}{n * 3.14dm^2}$$

The vegetation volume as cubic meters of vegetation per square meter, then, is calculated as:

$$\text{Vegetation volume per area (in meters)} = \frac{\sum_{i=1}^{n} h_i * 3.14dm^3}{n * 3.14dm^2} * \frac{1m^3}{1{,}000dm^3} * \frac{100dm^2}{1m^2}$$

This total vegetation volume per area can then be simplified and stated as an index value, TVV:

$$\text{TVV} = \frac{\sum_{i=1}^{n} h_i}{10n}$$

2.1.2. Percent Cover

Percent cover is defined as the proportion of the ground area that is covered by plant canopy, algae, water, or dead plant matter; the balance is bare ground. Plant canopy cover can be visualized as the outline projected to the ground resulting from draping a form-fitting sheet over the individual plant, i.e. ignoring small gaps in the canopy.

Percent cover was evaluated in June 2015, November-December 2016, and November 2017 with the line-intercept method, using the same transect lines established for TVV. Line-intercept essentially maps the transect in terms of the plants, litter, or bare ground that lie in a vertical plane defined by the transect. The observer begins at the 0-m mark on the transect tape and records the start and stop measures for each feature encountered along the line. For example, bare ground from 0 m to 13.75 m, mesquite canopy from 13.75 m to 20.30 m, etc., until the end of the transect is reached. Percent cover is calculated for each plant species and for litter and bare ground by summing the lengths for each feature and dividing by the total transect length. Adjustment of June data to the shortened November-December 2015 transects was accomplished by deleting any data points that occurred in portions of the transect that were later omitted. For example, Transect 3 was shortened from 250 m to 200 m; therefore, the June cover data that occurred in the last 50 m of the transect was deleted for comparison to later data.

In November-December 2015, plant cover was evaluated with the line-point method. Percent cover of a plant species or ground cover type is calculated as the percent of sample points in which the species occurred. The transect was sampled by identifying the plant species and ground cover that occurred at a series of points located at regular intervals. At each sample point, a vertical line was projected. The plant species and any dead plant matter that the vertical line intercepted was recorded. If more than one live plant species was intercepted, both species were recorded, as well as any dead plant matter. The cover of algae, algal remnants, or standing water was recorded. If there was neither live plant nor dead plant matter at the point, bare ground was recorded. Dead plant matter was recorded in one of these categories:

- LITTER (non-woody)
- FWD (Fine woody debris) ≤ 2.5 inches diameter
- CWD (Coarse woody debris) ≥ 2.5 inches diameter

2.1.3. Belt Density

Density is defined as the number of individual plants or plants of a given species per unit of area. Plant density monitoring occurred in June 2015 before the initiation of instream discharges to establish the baseline, and in November-December 2015, November-December 2016, and November 2017.

Plant density data was collected in 5-m-wide belt transects, which varied in length depending on the width of the channel (**Figure 3**). The belt transects were divided into 10-m by 5-m segments, and the number of individual perennial plants of each woody species that were more than 0.5 m in height was recorded within each segment. The ground rule for distinguishing conspecific individuals was a separation of at least 1 m between rooted stems. The division of the belt transects into segments enabled inter-year comparisons for transects that were shortened, by omitting the June 2015 data for any 10 m segments not later sampled. To document recruitment and establishment of seedlings, in November-December 2016 and November 2017, the woody plants were counted in these height classes: <20 cm, 21-50 cm, 51-100 cm, 101-200 cm and > 200 cm.

2.1.4. Photopoints

Photographs were taken from the endpoints of each of the transects, with views along the transects towards the other endpoint (**Appendix A**). Prints of the earlier photographs were taken into the field to ensure that the photos were matched (**Appendix A**).

2.1.5. Hydrological Variables

The following variables were evaluated in the field in November-December 2015, November-December 2017, and November 2017, using scores presented in the Model document (Webb and Burks-Copes 2009). Use of the Model was not implemented in time to collect data prior to discharge, thus there are no pre-discharge scores for these variables.

- DECAY: Presence of coarse woody debris in various stages of decomposition.
- FREQ: Frequency of inundation. This variable is intended to reflect the frequency of flood events necessary to inundate the site with perennial flow scored highest and 100-year flood return interval scored lowest.
- PORE: Soil pore space available for storing sub-surface water; depends on soil permeability. This variable was scored from 1 to 5, with a score of 1 indicating no restrictive layer and a score of 5 indicating a non-porous substrate.
- Q: This variable scores alterations of hydroregime by human activities, with no alterations scored highest and alterations with substantial changes to channel morphology scored lowest.
- SED: This variable scores the extent of sediment delivery to the wetland from human activity, with no human activity affecting sediment delivery scored highest, and site entirely filled with sediment from human sources scored lowest.
- SPECRICH: Species richness. A complete species list was made at each site on the same stream terrace and within 50 m upstream and downstream of each transect.
- SUBIN: Subsurface flow. This variable scores subsurface flow into the wetland either from adjacent lands or upstream sources, with subsurface flow evident scored highest and subsurface flow not evident scored lowest. Evidence of subsurface flow, in the absence of surface water, was marsh vegetation (cattails, bulrushes, reeds).
- SURFIN: Surface inflow from sheetflow. This variable was evaluated relative to an imaginary well-functioning reference area of the same PWAA in a similar hydrogeomorphic position. The variable scores surface inflow present and similar to pristine area highest, and no surface inflow with channelization scored lowest.
- TOPO: Macro- and microtopographic relief. Roughness and relief increase wetland function, by slowing and retaining water flow across the surface. Macrotopography refers to large-scale features such as bars and swales. Microtopography refers to small-scale features such as

pit-and-mound and hummock-and-hollow. This variable was scored from 1 to 5, with a score of 1 indicating complex macro and micro topographic relief and a score of 5 indicating steep banks and channelization, variable not recoverable.

- VEGSTRATA: Number of vegetation layers present. This variable has 14 categories from broad leaved tree to biotic soil crust. The more categories present, the higher the score.
- WIS: Wetland indicator score. This variable was evaluated after data entry, and was based on the plant species present. The Corps publishes an online list of species for the state of Arizona (Lichvar et al. 2016), with scores reflecting the degree to which a moist wetland habitat is necessary for the species. The lowest score (i.e. most indicative of wetland conditions) among the species present at each transect was used for the variable WIS.

  Scores are:

  1. Obligate
  2. Facultative wetland
  3. Facultative upland
  4. Upland

2.2. GIS Methods

The following variables were evaluated by inspection of Google Earth imagery:

- BUFFWIDTH (distance in meters to nearest human disturbance)
- CONTIG (cover of contiguous vegetation between wetlands and uplands)
- FPA (flood prone area)
- LANDBUFF (calculated from LANDUSE and BUFFWIDTH)
- LANDUSE (type of adjacent land use)
- TRIB (presence of connected tributaries)

2.3. Data Entry and Analysis

The field data was entered into an Excel™ workbook, and the Variable Subindex Score (VSI, a number between 0 and 1) for each variable was calculated. The VSI values populated the formulas that calculated the FCI values for the ten wetland functions:

- CHANNELDYN: maintenance of characteristic channel dynamics
- WATSTORENR: dynamic surface water storage/energy dissipation
- WATSTORLNG: long-term surface water storage
- WATSTORSUB: dynamic subsurface water storage
- NUTRIENT: nutrient cycling

- ELEMENTS: detention of imported elements and compounds
- DETPARTICL: detention of particles
- PLANTS: maintain characteristic plant communities
- HABSTRUCT: maintain spatial structure of habitat
- INTERSPERS: maintain interspersion and connectivity

More detailed descriptions of these functions are included in the Corps report (Webb and Burks-Copes 2009) and provided in **Appendix B**.

The Model requires a breakdown of plant canopy cover into herbaceous, shrub, and tree species, but only defines trees as greater than 3 inches in diameter at breast height (Webb and Burks-Copes 2009). Shrubs were classified as perennial woody plants with persistent single or multiple stems less than 3 inches in diameter at breast height, and herbaceous species as perennial or annual non-woody plants with single or multiple stems that do not persist.

A spreadsheet was created that lists every species found in all sites, with an indication for each species whether it is an herb, shrub, tree, invasive, and its WIS, if available. Species were counted as invasive and included in the variable INVAS if they appeared on the lists of:

1. Plant species listed as noxious weeds by the state of Arizona (Arizona Department of Agriculture 2005), and
2. Other non-native plant species considered invasive in Arizona (Northam et al. 2016).

While TVV data was collected in the field by recording each species' contribution separately in 1-m by 20-dm cylinders; the data required by the Model is a single number, so all hits on all species were summed for entry into the data spreadsheets.

3. RESULTS AND DISCUSSION

3.1. TOTAL VEGETATION VOLUME

Comparisons of TVV index values by transect for the four sample periods are presented in **Table 1**, showing baseline data from June 2015 and post-discharge data from November-December 2015, November-December 2016, and November 2017.

Table 1. Total Vegetation Volume Index Summarized by Transect

Transect Number	Total Vegetation Volume Index, m³/m²			
	June 2015	November - December 2015	November - December 2016	November 2017
1	0	*	*	0.27
2	0.025	0.071	0.23	0.035
3	0.016	0	0.18	0.01
4	0.025	0.100	0.65	0.09
5	0.005	0.020	*	0.215
6	0.02	0.013	*	0.01
7	0.05	0.165	*	0.15
8	0.01	0.035	*	0.005
9	0.012	0.150	*	0.225
12	0.012	0	*	0.015
13	0.014	0.004	0.04	0.01
14	0.040	0.004	0.11	0
15	0.024	0	0.23	0.035
17	0.020	0	0.03	0.025
19	0.004	0	0.08	0.12
22	0.020	0	0.07	0.03
24	0.032	0	0.05	0.085
25	0.008	0.010	0.01	*
27	0.024	*	0.26	0.29
28	0.016	0	0.15	0.16
31	0.004	0	0.24	0.19
33	0.020	0.020	0.17	0.13
35	0	0	0	0.01
36	0.020	0	0.05	0
37	0.010	0.015	0.22	0.025
Average	0.017	0.0264	0.154	0.089

* Denotes transects that were not sampled during data collection.

The TVV values by transect of the most common woody species for each sampling period are presented in **Table 2**. All the woody species increased in volume over the study period; the greatest increase was in saltcedar (*Tamarix chinensis*).

Table 2. Total Vegetation Volume by Transect of Most Common Woody Species, June 2015, November-December 2015, November-December 2016, and November 2017

Transect	1	2	3	4	5	6	7	8	9	12	13	14	15	17	19	22	24	25	27	28	31	33	35	36	37
June 2015																									
Atriplex canescens	0	0.015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baccharis sarothroides	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocoma pluriflora	0	0	0.008	0.005	0	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosopis velutina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0
Tamarix chinensis	0	0	0.008	0.005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.005	0
November-December 2015																									
Atriplex canescens	0	0.009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baccharis sarothroides	0	0.011	0	0.070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocoma pluriflora	0	0.011	0	0	0	0	0	0	0	0	0	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0
Prosopis velutina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.020	0	0	0.015
Tamarix chinensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
November-December 2016																									
Atriplex canescens	0	0.035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baccharis sarothroides	0	0.005	0	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isocoma pluriflora	0	0.065	0.065	0.125	0	0	0	0	0	0	0.015	0	0	0	0	0	0.015	0	0	0.065	0	0	0	0	0
Prosopis velutina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.065	0	0	0.1
Tamarix chinensis	0	0.01	0.025	0.17	0	0	0	0	0	0	0	0	0.115	0.015	0.04	0.035	0.01	0.005	0.13	0.01	0.12	0.02	0	0.025	0.01
November 2017																									
Atriplex canescens	0.155	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baccharis sarothroides	0.01	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0	0	0
Isocoma pluriflora	0	0.025	0.01	0	0.145	0.01	0.015	0.005	0	0	0	0	0.005	0	0	0	0.04	0	0	0.085	0	0	0	0	0
Prosopis velutina	0.04	0	0	0	0	0	0	0	0.21	0	0	0	0	0	0	0	0	0	0	0	0.03	0.095	0	0	0.005
Tamarix chinensis	0.065	0.01	0	0.02	0.07	0	0.105	0	0.015	0.015	0	0	0.03	0.025	0.12	0.03	0.045	0	0.27	0.075	0.13	0.035	0.01	0	0.02

3.2. PERCENT COVER

Comparisons of percent cover values of ground and plant cover categories averaged among transects during the four sample periods are presented in **Table 3**. There has been a decrease in bare ground, from 81.2 percent in June 2015 to 33.7 percent in November 2017. Herbaceous canopy cover has increased from 8.3 percent in June 2015 to 59.0 percent in November 2017, and shrub cover has increased from 3.3 percent to 10.5 percent.

Table 3. Percent Cover of All Categories of Ground Cover Averaged Across All Sampled Transects; June 2015, November-December 2015, November-December 2016, and November 2017

Ground Cover Categories	Average Percent Cover			
	June 2015	November - December 2015	November - December 2016	November 2017
Bare soil or rock	81.2	84.7	50.3	33.7
Litter	5.7	14.9	8.7	2.0
Herbaceous canopy	8.3	17.4	48.0	59.0
Shrub canopy	3.3	4.0	8.2	10.5

Comparisons of percent cover values of all plant species are presented in **Table 4**. The most notable changes, between June and November 2017 following the discharge of water in August 2015, were increases in herbaceous vegetation, mostly due to Bermudagrass (*Cynodon dactylon*), barnyard grass (*Echinochloa crus-galli),* and cattail (*Typha latifolia*). Cover of Bermudagrass averaged across all transects increased almost ten-fold, from 2.1 percent to 19.5 percent, and cover of barnyard grass increased from 0 to 17 percent (**Table 4**). The increase in cover of Bermudagrass and barnyard grass followed the discharge of water from MAR-5 and the summer rains. The increase in cattail cover, from 0 to 10 percent, can be directly attributed to the discharge from MAR-5, as it is an obligate wetland species (Lichvar et al. 2016) and is absent from the Gila River floodplain outside the discharge channel.

Table 4. Percent Cover of Live Vegetation; June 2015, November-December 2015, November-December 2016, and November 2017; Summarized by Species and Averaged Across All Sampled Transects

Species	Average Percent Cover			
	June 2015	November - December 2015	November - December 2016	November 2017
Ambrosia salsola	0	0.3	0.2	0.2
Amsinckia sp.	0	0.1	0	0
Atriplex canescens	0.3	0.2	0.2	0.4
Atriplex polycarpa	0.1	0.0	0.1	0
Atriplex rosea	4.3	0.0	11.0	0.9
Baccharis sarothroides	0.2	0.9	0.4	0.3
Bouteloua barbata	0	0.1	0.2	0
Brassica tournefortii	0	0.2	0	0
Camissonia sp.	0	0.3	0	0
Cynodon dactylon	2.1	11.4	13.4	19.5
Echinochloa crus-galli	0	0.3	5.2	16.9
Eclipta prostrata	0	0	0	4.2
Erodium cicutarium	0	0.3	0	0
Eriogonum sp.	0.1	0.0	2.5	0
Helianthus annuum	0	0	0	0.1
Heliotropium curassavicum	0	0	0.2	0
Isocoma pluriflora	1.1	1.2	2.8	2.3
Lactuca seriola	0	0	0	0.1
Leptochloa fulca	0	0	2.2	4.5
Pennisetum ciliaris	0	0.6	0.5	0.2
Prosopis velutina	0.6	1.0	0.3	1.6
Rumex sp.	0	0.0	1.7	0
Salsola tragus	1.6	1.3	7.0	1.5
Sonchus sp.	0	0.1	0	0
Sporobolus cryptandrus	0	0.1	0.3	0.1
Sphaeralcea sp.	0.1	0.1	0	0.1
Tamarix aphylla	0	0	0	0.1
Tamarix chinensis	1	0.3	4.2	5.6
Tidestromia lanuginosa	0	0.1	0	0.5
Tiquilia plicata	0.1	0.4	0.4	0.1
Typha latifolia	0	0	3.2	10.3
Unknown annual forb	0	0.2	0.1	0
Unknown annual grass	0	1.8	0	0

3.3. Belt Density

Comparisons of belt density of woody species by transect are presented in **Table 5**. To enable comparison across sampling periods, **Table 5** does not include shrubs less than 0.5 m high, as this data was only collected in November 2016 and 2017. Comparisons of belt density of woody species by species are presented in **Table 6**. Height class data for the seven most common woody species, averaged across all transects sampled in November 2017, is presented in **Table 7**.

Table 5. Total Woody Plant Density (Number of Plants >50 cm High Per Hectare) by Transect, June 2015, November-December 2015, November 2016, and November 2017

Transect	June 2015 *	Nov 2015	Nov 2016	Nov 2017
1	365	not sampled	not sampled	1050
2	1053	1093	3200	653
3	800	640	1490	750
4	914	900	1120	557
5	325	100	not sampled	1300
6	1286	1200	not sampled	457
7	320	1240	not sampled	1240
8	367	467	not sampled	267
9	100	250	not sampled	1200
10	100	0	not sampled	not sampled
11	0	0	not sampled	not sampled
12	171	114	not sampled	286
13	120	360	1160	40
14	0	280	not sampled	not sampled
15	0	0	6467	400
17	0	0	1333	267
19	0	0	1840	320
22	0	0	1750	700
24	0	100	7400	1000
25	0	200	1800	not sampled
27	0	0	6200	1600
28	100	0	1320	800
31	80	160	2560	640
33	0	0	800	700
35	400	0	400	533
36	100	100	1300	500
37	0	0	0	300

* June data was adjusted for any shortening of transects in November-December 2015 and November 2017.

Table 6. Woody Plant Density (Plants >50 cm Height Per Hectare) of Most Common Species Averaged Across All Sampled Transects, June 2015, November-December 2015, November-December 2016, and November 2017

Species	Belt Density (no. of plants per hectare)			
	June 2015 * (Baseline)	November - December 2015 (Post-discharge)	November - December 2016	November 2017
Ambrosia salsola	7	19	12	237
Atriplex canescens	18	20	20	95
Baccharis sarothroides	19	28	128	40
Isocoma pluriflora	158	207	524	149
Prosopis velutina	7	15	1	59
Salix gooddingii	0	0	87	12
Tamarix chinensis	11	6	1514	352
All woody species	244	300	2230	677

* June data was adjusted for any shortening of transects in November-December 2015 and November 2017.

From June 2015, before the initiation of MAR-5 discharge, to November-December 2015, all woody species increased in density, except for four-wing saltbush (*Atriplex canescens*) and saltcedar. In the period November 2015 to November 2016 desert broom (*Baccharis sarothroides*), jimmyweed (*Isocoma pluriflora*), Goodding's willow (*Salix gooddingii*), and saltcedar showed sharp increases in density, while mesquite showed a sharp decrease. The anomalously high-density data in 2016 may have been due to a mistaken sampling procedure: the rule of thumb for counting nearby plants as individuals was that each should be at least 1 m from a conspecific. This rule may not have been observed by the field crew in 2016, resulting in an overcount. The anomalous data for mesquite can be explained by the lack of data from transects that were not sampled in 2016 (transects 1, 5, 6, 7, 8, 9, and 12) in four of which mesquite had been present in 2015. Its large increase in 2017 was real, as it appeared for the first time in nine transects.

Table 7. Woody Plant Density (plants per hectare) by Height Class of Most Common Species Averaged across All Transects Sampled in November 2017

Species	Belt Density (no. of plants per hectare) by Height Class				
	< 20 cm	21-50 cm	51-100 cm	101-200 cm	>200 cm
Ambrosia salsola	0	2	18	13	1
Atriplex canescens	0	0	2	12	3
Baccharis sarothroides	0	3	14	19	3
Isocoma pluriflora	6	75	90	49	1
Prosopis velutina	9	24	10	5	11
Salix gooddingii	0	0	0	4	8
Tamarix chinensis	0	16	115	170	94

In the height class distribution shown in **Table 7**, a large proportion of plants of a given species in the smaller height classes (presumably younger individuals) indicates a growing population. Among these species, jimmyweed and mesquite show the most potential for population growth, with 37 percent and 57 percent respectively of their populations in the smaller two height classes. Goodding's willow, probably the most desirable tree species to become established in the wetted area (Webb and Burks-Copes 2009), has a low potential for increase given the small number of saplings present and the high cover of Bermuda grass in the wetter portions of the site as bare ground is required for willow recruitment (Stromberg 1993). Numerous willow saplings that had recently died were observed, probably a result of the fluctuations in ground water levels. Moist soils throughout the growing season are necessary for the establishment of willow recruits (Lite and Stromberg 2005, Stromberg 1993), and water stress effects are often most pronounced in the juveniles of a species (Lite and Stromberg 2005, Stromberg 1997).

3.4. INVASIVE SPECIES

Several species classified as non-native invasive plant to Arizona (Northam et al. 2016) occur in the GRIC MAR-5 study area, including buffelgrass (*Pennisetum ciliaris*), Sahara mustard (*Brassica tournefortii*), filaree (*Erodium cicutarium*), Bermudagrass, saltcedar, Athel tamarisk (*Tamarix aphylla*), Russian thistle, *Sonchus* sp., Mediterranean grass (*Schismus barbatus*), and barnyard grass. Bermudagrass, barnyard grass, and saltcedar have shown substantial increases in cover since the initiation of discharge in 2015 (**Table 5**).

3.5. HYDROLOGICAL VARIABLES

The field variables used in the Model were evaluated during fieldwork in November-December 2015, November-December 2016, and November 2017. The field and GIS variable values were converted to VSI scores and used to calculate the FCI scores for the three years. The overall averages of the FCI scores are presented in **Table 8**, as well as the FCU values (FCI multiplied by acreage). The slight increase in FCI score from 2015 to 2017 indicates that the site is approaching a moderate functional capacity (Burks-Copes and Webb 2003). Note that modifications to the MAR-5 discharge facility in 2017 resulted in an increased wetted area, which diverted water away from the established transects.

Table 8. Functional Capacity Index (FCI) Scores Averaged across All Sites and Functions, and FCU Values for the Entire Wetted Areas, Compared across All Sampling Periods

Category	November - December 2015	November - December 2016	November 2017
Overall Average FCI	0.44	0.61	0.47
Wetted acreage	53.9	53.9	123.4
FCU	23.7	32.9	58.0

The FCI scores for the hydrological functions evaluated at the transects in November-December 2015, November-December 2016, and November 2017 are provided in **Appendix C**. FCIs are scored from 0 to 1, with "1" considered a well-functioning wetland (riparian) site (Webb and Burks-Copes 2009). A comparison among years of FCI values for wetland functions averaged among all sample transects is provided in **Table 9**.

Table 9. Comparison Between Years of FCI Values Averaged across All Transects

Code	Name	2015	2016	2017
CHANNELDYN	Function 1: Maintenance of Characteristic Channel Dynamics	0.64	0.84	0.42
WATSTORENR	Function 2: Dynamic Surface Water Storage/Energy Dissipation	0.81	0.94	0.80
WATSTORLNG	Function 3: Long Term Surface Water Storage	0.51	0.92	0.66
WATSTORSUB	Function 4: Dynamic Subsurface Water Storage	0.50	0.50	0.50
NUTRIENT	Function 5: Nutrient Cycling	0.09	0.18	0.12
ELEMENTS	Function 6: Detention of Imported Elements and Compounds	0.32	0.51	0.41
DETPARTICL	Function 7: Detention of Particles	0.52	0.72	0.51
PLANTS	Function 8: Maintain Characteristic Plant Communities	0.17	0.50	0.47
HABSTRUCT	Function 9: Maintain Spatial Structure of Habitat	0.38	0.44	0.38
INTERSPERS	Function 10: Maintain Interspersion and Connectivity	0.40	0.51	0.40
	Average	**0.44**	**0.61**	**0.47**

The low FCI scores (less than 0.50) for most of the functions in **Table 9** indicate that, according to the Model, the GRIC MAR-5 site is presently not considered a well-functioning wetland (riparian) site. However, the site had just been recently tested with only 1 to 2 growing seasons, as such, it is expected that there would be significant potential for improvement. The water storage functions (Functions 2 - 4) will continue to improve with continued discharge from MAR-5. The CHANNELDYN, HABSTRUCT and INTERSPERS FCI scores will increase as more heterogenous habitats and contiguous areas of food and cover for wildlife develop with continued discharge of water into the channel. Likewise, the ELEMENT and NUTRIENT FCI scores will increase as plants colonize the wetted area and associated floodplain, and produce litter, fine and coarse woody debris, and increase the canopy and volume of vegetation.

The preponderance of invasive plants (see **Section 3.4**) will continue to depress FCI scores for the function PLANTS (maintenance of characteristic plant communities). However, with the implementation of an invasive species management plan the score would be likely to improve. Several functions involve the variable Flood Prone Area (FPA), which measures the degree to which the stream is confined within a man-made channel or gully. Eleven of the 24 study transects sampled in 2017 were scored as 4, defined as "FPA is confined and <1.5 bankfull width", indicating that the stream reach was confined in a gully. Discharge from MAR-5 has evidently scoured the channel in numerous areas, and continues to aggravate the gullying problem. However, the construction of a three-way flow splitter box in 2017 and subsequent distribution of water into a secondary channel and tertiary pond has markedly improved the channeling problem and distributed the flow over a larger area.

4. SUMMARY

The initiation of water discharge from MAR-5 into the Gila River in August 2015 created a strip of wetland, called the "wetted area", that varied in width and degree of saturation with the amount of discharge and distance from the source. The pre-discharge vegetation of the area was a sparse collection of upland woody shrubs (four-wing saltbush, mesquite, jimmyweed, desert broom) with desert forbs (*Atriplex rosea, Tiquilia plicata,* and Russian thistle) and Bermudagrass. Saltcedar and Athel Tamarix were present at low cover. There were no cattails. After a few months of discharge, the water was turned off and the area was re-sampled in late November-early December 2015, by which time the cover of Bermudagrass had increased almost ten-fold, barnyard grass had become common, and the woody shrubs had increased in cover and density.

The area was re-sampled a year later in November-December 2016. Bermudagrass and barnyard grass continued to increase in cover, while cattails and the grass Mexican sprangletop (*Leptochloa fusca*) became common. Russian thistle was very common, and had increased in cover from 1.6 percent before discharge to 7.0 percent. Jimmyweed and the invasive saltcedar increased in cover, density, and volume. Thousands of saltcedar recruits had appeared since the previous year.

The data recorded in November 2017 showed a continuation of these trends. The grasses Bermudagrass, barnyard grass, and Mexican sprangletop together with cattails contributed over 50-percent cover, as contrasted to the total herbaceous cover of 8.3 percent in June 2015. Shrub cover for most species was steady or had declined slightly, except for saltcedar. The density of saltcedars had increased from 11 to 352 per hectare over the period June 2015 to November 2017.

Vegetation cover decreases with distance downstream from the MAR-5 discharge site, from an average cover of 86 percent in the six transects closest to MAR-5 to 33 percent in the farthest six. The most distant transect (Transect 37) had only 11-percent vegetation cover in November 2017.

The modification to the MAR-5 discharge facility in 2017 resulted in an increase in the wetted area from 53.9 to 123.4 acres; however, the amount of discharge was not increased.

Future discharge of water will probably result in increased production of vegetation in the wetted area, especially of cattails, Bermudagrass, barnyard grass, saltcedar, and mesquite. Upland woody species, including jimmyweed, desert broom, and saltbush, may decline in the wetted area because they cannot tolerate frequent inundation (Stromberg 1993). More desirable species, such as Goodding's willow, may require a shorter dry period to become established and persist (Lite and Stromberg 2005, Stromberg 1997).

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FIGURES

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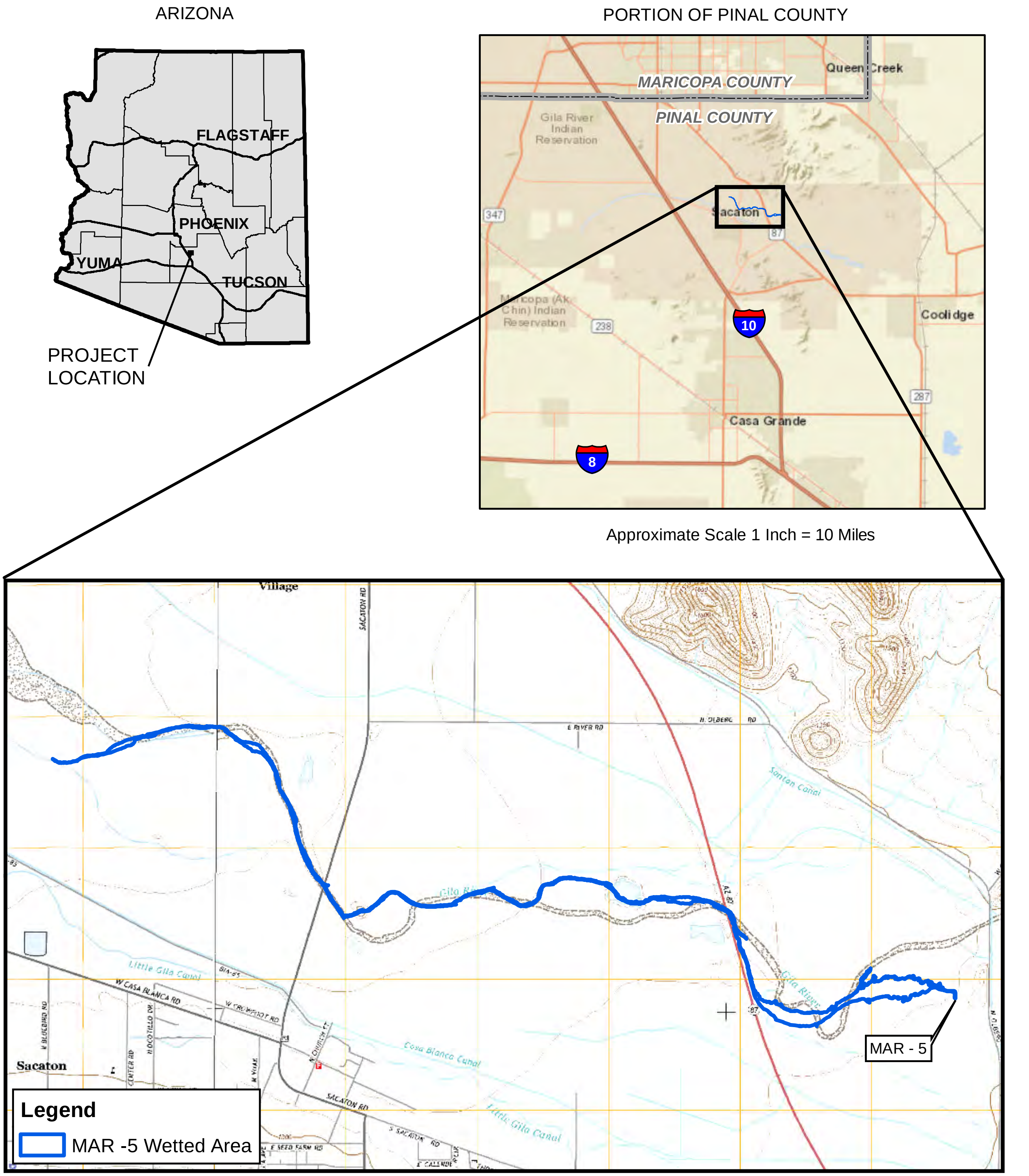

MAR-5 Wetted Area in
T4S, R6E, Portions of Sections 8-11, 13, and 14,
Pinal County, Arizona,
Sacaton and Gila Butte SE USGS 7.5' Quadrangles (2014)
Image Source: ArcGIS Online, World Street Map

RESOLUTION COPPER GRIC MAR-5

2017 Vegetation Monitoring Memo

VICINITY MAP

Figure 1

N

0 1,800 3,600 Feet

0 600 1,200 Meters

WestLand Resources

Legend

- Stake Locations
- Transect Locations
- MAR 5 100cfs Predicted Wetted Area

WestLand Resources

T4S, R6E, Portions of Sections 9-11, 13, and 14,
Pinal County, Arizona,
Gila Butte and Sacaton USGS 7.5' Quadrangles
Projection: UTM NAD83, Zone 12
Photo Source: ArcGIS Online

0 600 1,200 Feet
0 200 400 Meters

N

RESOLUTION COPPER GRIC MAR - 5
2017 Vegetation Monitoring Memo

VEGETATION MONITORING TRANSECTS - JUNE 2015
Figure 2

Path: M:\Jobs\800's\807.131\ENV\GRIC\Gric_MAR5_2017VegMonitoringMemo\MXD\Fig03_GRIC_MAR5_VegMonitoring.mxd

WestLand Resources

Wetted Area found within:
T4S, R6E, Portions of Sections 8-11, 13, and 14,
Pinal County, Arizona.
Image Source: 2015 USDA NAIP Orthophoto
Data Sources: BLM PLSS section data, GRIC BIA
Allotment data provided by Paul Shorthair, Land Use Ordinance Officer.
Department of Land Use Planning and Zoning, Gila River Indian Community.
We received 4 scanned images from Paul Shorhair. They were rectified to
the NAIP 2015 imagery and the red lines on these maps were delineated
as BIA Allotment Lines

N

0 800 1,600 Feet

0 0.25 0.5 Miles

Legend

- Access Point
- Transect Point 2016
- AccessRoute
- Transect Line 2016
- Approximate BIA Allotment Lines
- MAR -5 Wetted Area
- PLSSFirstDivision (Sections)

RESOLUTION COPPER GRIC MAR - 5
2017 Vegetation Monitoring Memo

VEGETATION MONITORING TRANSECTS - NOVEMBER 2016
Figure 3

Path: M:\Jobs\800's\807.131\ENV\GRIC\Gric_MAR5_2017VegMonitoringMemo\MXD\Fig04_GRIC_MAR_5_Vegetation_Monitoring.mxd Date: 3/21/2018 User: rwitzke

T4S, R6E, Portions of Sections 8 - 14,
Pinal County, Arizona.
Gila Butte SE and Sacaton USGS 7.5' Quadrangles
Image Source: Pleiades Satellite Imagery 10/28/2017

Legend

Transect Line
MAR-5 Wetted Area

WestLand Resources

0 750 1,500 Feet
0 250 500 Meters

N

RESOLUTION COPPER GRIC MAR-5
2017 Vegetation Monitoring Memo

VEGETATION MONITORING TRANSECTS - NOVEMBER 2017
Figure 4

APPENDIX A

Repeat Photographic Documentation of Vegetation Monitoring Transects

Photo 1. Transect 1a, 10 degrees. June 2015

Photo 2. Transect 1a, 90 degrees. November 2015

Photo 3. Transect 1a, 90 degrees. November/December 2016

Photo 4. Transect 1a, 10 degrees. November 2017

Photo 5. Transect 2a, 23 degrees. June 2015

Photo 6. Transect 2a, 23 degrees. November 2015

Photo 7. Transect 2a, 340 degrees. November 2016

Photo 8. Transect 2a, 345 degrees. November 2017

Photo 9. Transect 3a, 10 degrees. June 2015

Photo 10. Transect 3a, 10 degrees. November 2015

Photo 11. Transect 3a, 10 degrees. November 2016

Photo 12. Transect 3a, 10 degrees. November 2017

Photo 13. Transect 4a, 342 degrees. June 2015

Photo 15. Transect 4a, 340 degrees. November 2016

Photo 14. Transect 4a, 315 degrees. November 2015

Photo 16. Transect 4a, 315 degrees. November 2017

Photo 17. Transect 5a, 0 degrees. June 2015

Photo 19. Transect 5a, 0 degrees. November 2016

Photo 18. Transect 5a, 0 degrees. November 2015

Photo 20. Transect 5a, 330 degrees. November 2017

Photo 21. Transect 6a, 340 degrees. June 2015

Photo 23. Transect 6a, 340 degrees. November 2016

Photo 22. Transect 6a, 340 degrees. November 2016

Photo 24. Transect 6a, 340 degrees. November 2017

Photo 25. Transect 7a, 158 degrees. June 2015

Photo 26. Transect 7a, 158 degrees. November 2015

Photo 27. Transect 7a, 158 degrees. November 2016

Photo 28. Transect 7a, 158 degrees. November 2017

Photo 29. Transect 8a, 80 degrees. June 2015

Photo 30. Transect 8a, 80 degrees. November 2015

Photo 31. Transect 8a, 80 degrees. November 2016

Photo 32. Transect 8a, 30 degrees. November 2017

Photo 33. Transect 9a, 72 degrees. June 2015

Photo 34. Transect 9a, 72 degrees. November 2015

Photo 35. Transect 9a, 72 degrees. November 2016

Photo 36. Transect 9a, 60 degrees. November 2017

Photo 37. Transect 10a, 86 degrees. June 2015

Photo 38. Transect 10a, 90 degrees. November 2015

Photo 39. Transect 10a, 90 degrees. November 2016

Photo 40. Transect 11a, 82 degrees. June 2015

Photo 41. Transect 11a, 90 degrees. November 2015

Photo 42. Transect 11a, 90 degrees. November 2016

Photo 43. Transect 12a, 67 degrees. June 2015

Photo 45. Transect 12a, 67 degrees. November 2016

Photo 44. Transect 12a, 67 degrees. November 2015

Photo 46. Transect 12a, 67 degrees. November 2017

Photo 47. Transect 13a, 5 degrees. June 2015

Photo 48. Transect 13a, 5 degrees. November 2015

Photo 49. Transect 13a, 5 degrees. November 2016

Photo 50. Transect 13a, 5 degrees. November 2017

Photo 51. Transect 14a, 0 degrees. June 2015

Photo 52. Transect 14a, 0 degrees. November 2015

Photo 53. Transect 14a, 0 degrees. November 2016

Photo 54. Transect 14a, 340 degrees. November 2016

Photo 55. Transect 15a, 350 degrees. June 2015

Photo 56. Transect 15a, 350 degrees. November 2015

Photo 57. Transect 15a, 350 degrees. November 2016

Photo 58. Transect 15a, 340 degrees. November 2017

Photo 59. Transect 17a, 40 degrees. June 2015

Photo 60. Transect 17a, 40 degrees. November 2015

Photo 61. Transect 17a, 40 degrees. November 2016

Photo 62. Transect 17a, 10 degrees. November 2017

Photo 63. Transect 19a, 320 degrees. June 2015

Photo 64. Transect 19a, 320 degrees. November 2015

Photo 65. Transect 19a, 320 degrees. November 2016

Photo 66. Transect 19a, 305 degrees. November 2017

Photo 67. Transect 22a, 335 degrees. June 2015

Photo 69. Transect 22a, 335 degrees. November 2016

Photo 68. Transect 22a, 335 degrees. November 2015

Photo 70. Transect 22a, 310 degrees. November 2017

Photo 71. Transect 24a, 350 degrees. June 2015

Photo 72. Transect 24a, 350 degrees. November 2015

Photo 73. Transect 24a, 350 degrees. November 2016

Photo 74. Transect 24a, 340 degrees. November 2017

Photo 75. Transect 25a, 10 degrees. June 2015

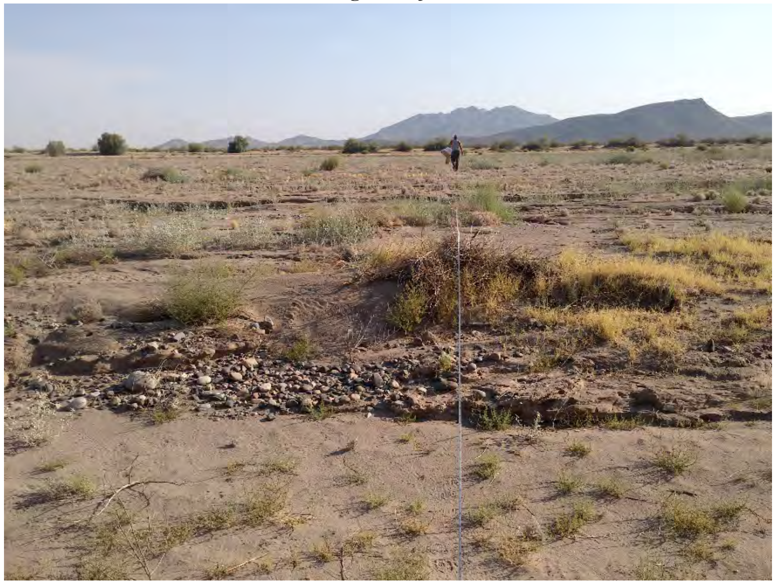

Photo 76. Transect 25a, 10 degrees. November 2015

Photo 77. Transect 25a, 10 degrees. November 2016

Photo 78. Transect 27a, 328 degrees. June 2015

Photo 79. Transect 27a, 328 degrees. November 2015

Photo 80. Transect 27a, 328 degrees. November 2016

Photo 81. Transect 27a, 320 degrees. November 2017

Photo 82. Transect 28a, 333 degrees. June 2015

Photo 83. Transect 28a, 333 degrees. November 2015

Photo 84. Transect 28a, 333 degrees. November 2016

Photo 85. Transect 28a, 340 degrees. November 2017

Photo 86. Transect 31a, 50 degrees. June 2015

Photo 87. Transect 31a, 50 degrees. November 2015

Photo 88. Transect 31a, 50 degrees. November 2016

Photo 89. Transect 31a, 60 degrees. November 2017

Photo 90. Transect 33a, 54 degrees. June 2015

Photo 91. Transect 33a, 54 degrees. November 2015

Photo 92. Transect 33a, 54 degrees. November 2016

Photo 93. Transect 33a, 60 degrees. November 2017

Photo 94. Transect 35a, 48 degrees. June 2015

Photo 96. Transect 35a, 48 degrees. November 2016

Photo 95. Transect 35a, 48 degrees. November 2015

Photo 97. Transect 35a, 40 degrees. November 2017

Photo 98. Transect 36a, 324 degrees, June 2015

Photo 99. Transect 36a, 324 degrees. November 2015

Photo 100. Transect 36a, 20 degrees. November 2016

Photo 101. Transect 36a, 20 degrees. November 2017

Photo 102. Transect 37a, 0 degrees. June 2015

Photo 104. Transect 37a, 0 degrees. November 2016

Photo 103. 37a, 0 degrees. November 2015

Photo 105. Transect 37a, 10 degrees. November 2017

APPENDIX B

Table 2 from Tres Rios del Norte (Pima County, Arizona) Ecosystem Restoration Functional Assessment Using HGM, December 2003, Analyses, Results, and Documentation Draft Report

Table 2. Functions in the Arizona Riverine HGM Model

Code	Name	Description
CHANNELDYN	Function 1: Maintenance of Characteristic Channel Dynamics	Physical processes and structural attributes that maintain characteristic channel dynamics. These include flow characteristics, bedload, in-channel coarse woody debris, and potential coarse woody debris inputs, channel dimensions, and other physical features (e.g. bank vegetation, slope).
WATSTORENR	Function 2: Dynamic Surface Water Storage/Energy Dissipation	Dynamic water storage and dissipation of energy at bankfull and greater discharges. These are a function of channel width, depth, bedload, bank roughness (coarse woody debris, vegetation, etc.), presence and number of in-channel coarse woody debris jams, and connectivity to off-channel pits, ponds, and secondary channels.
WATSTORLNG	Function 3: Long Term Surface Water Storage	The capability of a wetland to temporarily store (retain) surface water for long durations; associated with standing water not moving over the surface. Water sources may be overbank flow, overland flow, and/or channelized flow from uplands, or direct precipitation.
WATSTORSUB	Function 4: Dynamic Subsurface Water Storage	Availability of water storage beneath the wetland surface. Storage capacity becomes available due to periodic drawdown of water table.
NUTRIENT	Function 5: Nutrient Cycling	Abiotic and biotic processes that convert elements from one form to another; primarily recycling processes.
ELEMENTS	Function 6: Detention of Imported Elements and Compounds	The detention of imported nutrients, contaminants, and other elements or compounds.
DETPARTICL	Function 7: Detention of Particles	Deposition and detention of inorganic and organic particulates (>0.45 um) from the water column, primarily through physical processes.
PLANTS	Function 8: Maintain Characteristic Plant Communities	Species composition and physical characteristics of living plant biomass. The emphasis is on the dynamics and structure of the plant community as revealed by the species of TVVs, shrubs, seedlings, saplings, and herbs and by the physical characteristics of the vegetation.
HABSTRUCT	Function 9: Maintain Spatial Structure of Habitat	The capacity of a wetland to support animal populations and guilds by providing heterogeneous habitats.
INTERSPERS	Function 10: Maintain Interspersion and Connectivity	The capacity of the wetland to permit aquatic organisms to enter and leave the wetland via permanent of ephemeral surface channels, overbank flow, or unconfined hyporheic gravel aquifers. The capacity of the wetland to permit access of terrestrial or aerial organisms to contiguous areas of food and cover.

APPENDIX C

Functional Capacity Index (FCI) Scores of Functions Evaluated, for all Sampling Periods

Appendix C. Functional Capacity Index (FCI) Scores[1] of Functions Evaluated for all Sampling Periods[2]

Transect	CHANNELDYN	WATSTORENR	WATSTORLNG	WATSTORSUB	NUTRIENT	ELEMENTS	DETPARTICL	PLANTS	HABSTRUCT	INTERSPERS	Average
November-December 2015											
1	-	-	-	-	-	-	-	-	-	-	-
2	0.25	0.57	0.50	0.50	0.13	0.35	0.28	0.23	0.23	0.23	0.33
3	0.25	0.57	0.50	0.50	0.08	0.30	0.28	0.20	0.20	0.23	0.31
4	0.50	1.000	0.50	0.50	0.37	0.41	0.67	0.62	0.63	0.52	0.57
5	0.25	0.55	0.50	0.50	0.07	0.31	0.28	0.14	0.20	0.23	0.30
6	0.58	0.55	0.50	0.50	0.07	0.31	0.32	0.22	0.21	0.23	0.35
7	0.50	0.59	0.50	0.50	0.28	0.40	0.34	0.22	0.24	0.23	0.38
8	0.50	0.56	0.50	0.50	0.08	0.32	0.31	0.27	0.23	0.23	0.35
9	0.50	0.65	0.60	0.50	0.19	0.39	0.45	0.13	0.23	0.25	0.39
12	0.50	0.61	0.69	0.50	0.04	0.25	0.44	0.10	0.23	0.25	0.36
13	0.50	0.55	0.50	0.50	0.02	0.30	0.30	0.12	0.22	0.23	0.32
14	0.67	0.73	0.50	0.50	0.04	0.31	0.42	0.21	0.23	0.23	0.38
15	0.83	0.99	0.50	0.50	0.03	0.30	0.67	0.33	0.64	0.71	0.55
17	0.83	0.99	0.50	0.50	0.03	0.31	0.67	0.00	0.55	0.71	0.51
19	0.67	1.000	0.50	0.50	0.04	0.30	0.68	0.00	0.66	0.71	0.51
22	0.83	0.99	0.50	0.50	0.05	0.32	0.68	0.31	0.57	0.71	0.55
24	0.83	0.99	0.50	0.50	0.05	0.31	0.68	0.20	0.67	0.71	0.55
27	-	-	-	-	-	-	-	-	-	-	-
28	0.83	0.99	0.50	0.50	0.06	0.33	0.68	0.00	0.18	0.25	0.43
31	0.83	0.99	0.50	0.50	0.04	0.27	0.67	0.07	0.23	0.23	0.43
33	0.83	0.99	0.50	0.50	0.06	0.32	0.67	0.10	0.23	0.23	0.44
35	0.83	0.99	0.50	0.50	0.08	0.31	0.67	0.00	0.65	0.64	0.52
36	0.83	0.99	0.50	0.50	0.04	0.30	0.67	0.16	0.60	0.60	0.52
37	0.83	0.99	0.50	0.50	0.06	0.33	0.67	0.20	0.62	0.52	0.52
Average	**0.64**	**0.81**	**0.51**	**0.50**	**0.09**	**0.32**	**0.52**	**0.17**	**0.38**	**0.40**	**0.44**
November-December 2016											
1	-	-	-	-	-	-	-	-	-	-	-
2	0.58	0.66	0.84	0.50	0.30	0.53	0.45	0.30	0.23	0.25	0.46
3	0.58	0.65	0.84	0.50	0.22	0.46	0.44	0.29	0.23	0.25	0.45
4	0.58	0.72	0.84	0.50	0.57	0.68	0.48	0.32	0.23	0.25	0.52

Appendix C. Functional Capacity Index (FCI) Scores[1] of Functions Evaluated for all Sampling Periods[2]

Transect	CHANNELDYN	WATSTORENR	WATSTORLNG	WATSTORSUB	NUTRIENT	ELEMENTS	DETPARTICL	PLANTS	HABSTRUCT	INTERSPERS	Average
13	0.58	0.62	0.97	0.50	0.05	0.46	0.43	0.26	0.22	0.25	0.44
14	0.67	0.79	0.97	0.50	0.13	0.50	0.56	0.27	0.23	0.25	0.49
15	1.00	1.00	0.97	0.50	0.24	0.58	0.84	0.65	0.64	0.78	0.73
17	1.00	1.00	0.97	0.50	0.04	0.46	0.82	0.89	0.64	0.78	0.71
19	1.00	1.00	0.97	0.50	0.08	0.48	0.82	0.55	0.63	0.78	0.68
22	1.00	1.00	0.97	0.50	0.07	0.48	0.82	0.88	0.63	0.78	0.72
24	1.00	1.00	0.97	0.50	0.09	0.46	0.83	0.75	0.65	0.78	0.71
27	1.00	1.00	0.97	0.50	0.24	0.60	0.84	0.76	0.63	0.78	0.74
28	0.83	1.00	0.91	0.50	0.16	0.50	0.83	0.22	0.23	0.28	0.55
31	0.83	1.00	0.91	0.50	0.28	0.56	0.83	0.23	0.22	0.25	0.57
33	1.00	1.00	0.97	0.50	0.25	0.54	0.84	0.25	0.23	0.25	0.59
35	1.00	1.00	0.91	0.50	0.05	0.41	0.83	0.72	0.66	0.71	0.68
36	0.83	1.00	0.84	0.50	0.06	0.41	0.80	0.58	0.59	0.67	0.63
37	0.83	1.00	0.84	0.50	0.22	0.52	0.82	0.54	0.59	0.60	0.65
Average	**0.84**	**0.94**	**0.92**	**0.50**	**0.18**	**0.51**	**0.72**	**0.50**	**0.44**	**0.51**	**0.61**
November 2017											
1	0.25	0.67	0.77	0.50	0.31	0.52	0.45	0.31	0.24	0.25	0.43
2	0.25	0.56	0.65	0.50	0.15	0.37	0.29	0.29	0.24	0.23	0.35
3	0.25	0.55	0.65	0.50	0.05	0.36	0.28	0.31	0.23	0.23	0.34
4	0.25	0.57	0.65	0.50	0.15	0.41	0.30	0.30	0.24	0.23	0.36
5	0.42	0.60	0.77	0.50	0.22	0.54	0.32	0.31	0.22	0.23	0.41
6	0.50	0.55	0.65	0.50	0.04	0.36	0.30	0.31	0.23	0.23	0.37
7	0.50	0.58	0.65	0.50	0.21	0.45	0.32	0.31	0.23	0.23	0.40
8	0.50	0.55	0.65	0.50	0.08	0.35	0.31	0.27	0.23	0.23	0.37
9	0.25	0.60	0.65	0.50	0.22	0.49	0.29	0.29	0.22	0.23	0.38
12	0.25	0.55	0.65	0.50	0.01	0.36	0.27	0.31	0.22	0.23	0.34
13	0.25	0.55	0.65	0.50	0.05	0.36	0.28	0.29	0.23	0.23	0.34
14	0.50	0.72	0.65	0.50	0.00	0.35	0.39	0.27	0.22	0.23	0.38
15	0.50	0.99	0.65	0.50	0.07	0.37	0.65	0.89	0.65	0.71	0.60
17	0.50	0.99	0.65	0.50	0.04	0.37	0.65	0.85	0.64	0.71	0.59
19	0.50	1.00	0.65	0.50	0.14	0.43	0.66	0.75	0.64	0.71	0.60

Appendix C. Functional Capacity Index (FCI) Scores[1] of Functions Evaluated for all Sampling Periods[2]

Transect	CHANNELDYN	WATSTORENR	WATSTORLNG	WATSTORSUB	NUTRIENT	ELEMENTS	DETPARTICL	PLANTS	HABSTRUCT	INTERSPERS	Average
22	0.50	0.99	0.65	0.50	0.07	0.37	0.66	0.84	0.66	0.71	0.59
24	0.50	1.00	0.65	0.50	0.15	0.41	0.68	0.80	0.69	0.71	0.61
27	0.50	1.00	0.65	0.50	0.31	0.54	0.68	0.82	0.65	0.71	0.64
28	0.50	1.00	0.65	0.50	0.23	0.45	0.71	0.27	0.25	0.25	0.48
31	0.50	1.00	0.65	0.50	0.22	0.47	0.67	0.25	0.23	0.23	0.47
33	0.50	1.00	0.77	0.50	0.12	0.43	0.78	0.23	0.22	0.25	0.48
35	0.50	0.99	0.58	0.50	0.02	0.33	0.64	0.81	0.63	0.64	0.56
36	0.50	1.00	0.69	0.50	0.04	0.33	0.77	0.67	0.61	0.67	0.58
37	0.50	1.00	0.69	0.50	0.06	0.34	0.77	0.50	0.60	0.60	0.56
Average	**0.42**	**0.80**	**0.66**	**0.50**	**0.12**	**0.41**	**0.51**	**0.47**	**0.38**	**0.40**	**0.47**

1 Scores range from 0 to 1, based on similarity to well-functioning reference sites; see **Appendix B** for description of functions.

2 Rows with no scores were not sampled during that period.

APPENDIX B

AGFD Letter to Resolution Copper on the Lower San Pedro River Wildlife Area In-Lieu Fee Program

(Dated April 15, 2019)

April 15, 2019

Vicki Peacey
Senior Manager Permits & Approvals
Resolution Copper
102 Magma Heights
Superior, AZ 85173

Ms. Peacey,

The Department maintains an In-Lieu-Fee (ILF) program for Army Corps of Engineers (ACOE) 404 permit mitigation in an effort to facilitate economic development while ensuring conservation of Arizona's natural resources. One of the ILF programs maintained by the Department is located on the Lower San Pedro River Wildlife Area (LSPRWA). Your organization has expressed interest in purchasing mitigation credits within this ILF site. As we have discussed, all Advanced Credits at our LSPRWA ILF site have been sold or obligated for sale.

That said, the first set of Project Specific Credits will become available after the site has met established performance standards for the first 50 Advanced Credits and full approval of the Development Plan is obtained from the ACOE. At this time, we anticipate full sale of the Advanced Credits will be completed by the end of calendar 2019 with the Development Plan submitted the ACOE in calendar 2020. The full conservation of the LSPRWA site will be implemented in phases to ensure ecological performance standards are being met and ACOE approvals obtained for each phase. The Department's LSPRWA has five phases of 130 credits each accounting for a total of 650 credits. These credit releases will be available for purchase over time and will be available to anyone requiring mitigation credits.

I want to thank you and your staff for taking the time to make the Department's staff aware of your program development and look forward to a continued excellent relationship with Resolution. Further, as the Department's obligation for prior credit commitments are fully met, the Department will consider making future credits available to Resolution Copper and other entities in need of mitigation credits. Additionally, the Department would like to offer assistance in working with Resolution Copper to investigate other mitigation opportunities as a result of project implementation of your mining plan of development,

Again, thanks for your organization's positive working approach with the Department.

Sincerely,

Jim deVos
Assistant Director Wildlife Management Division

azgfd.gov | 602.942.3000

5000 W. CAREFREE HIGHWAY, PHOENIX AZ 85086

Cc:

Craig McMullen, Assistant Director Field Operations Division
Jay Cook, Regional Supervisor Mesa
Keith Knutson, Chief Wildlife Contracts
Clayton Crowder, Chief Habitat Branch

AGFD #M19-04014607

APPENDIX E. ALTERNATIVES IMPACT SUMMARY

Summary of Impacts

One of the core processes of any environmental impact statement (EIS)-level NEPA analysis is public outreach early in the project, which serves to inform the public, stakeholders, tribes, and other Federal, state, and municipal agencies of the nature of the proposed action and provides an opportunity for interested persons to ask questions of the lead Federal agency and to express thoughts or concerns they may have regarding the action. This process is referred to as “scoping” (40 CFR 1501.7).

The scoping process also serves as a means for the lead agency to gather initial ideas for alternative actions to the project that may accomplish the same overall purpose but possibly be less damaging to the environment. And, lastly, the public scoping process is essential to initially identifying potential effects on resources and other issues that will be analyzed in detail in the EIS.

The scoping process for this EIS is detailed in the “Resolution Copper Project and Land Exchange Environmental Impact Statement Scoping Report” (Scoping Report) available here: https://www.resolutionmineeis.us/documents/usfs-tonto-scoping-report.

The information gathered during the scoping process was subsequently analyzed by members of the project team and distilled into 14 major issues for consideration in the EIS. Nearly of these major issues include sub-issues to further focus the analysis, and all included specific “factors for analysis” as a means to gauge and compare effects. Details of how comments gathered during scoping were distilled into primary issues and sub-issues are documented in the “Resolution Copper Project and Land Exchange Environmental Impact Statement: Final Summary of Issues Identified Through Scoping” (Issues Report), available at https://www.resolutionmineeis.us/documents/usfs-tonto-issues-report-201711.

Table E-1 below provides a complete listing of primary issues and sub-issues that guided the effects analysis and a summary of impacts by project alternative. Please note that this table is organized by major issue as derived from the scoping process and the issues analysis, rather than by the section of the draft EIS (DEIS) in which that resource is addressed; the information in the left-most column points the reader to where in the DEIS the corresponding analysis may be found.

Impacts and differences between alternatives are highlighted at the end of chapter 2 at a high level. While appendix E also summarizes impacts, it is specifically intended to provide a crosswalk between the original issues/sub-issues and the actual results of the analysis, and to provide a more detailed yet succinct comparison between alternatives.

As documented in the footnotes to table E-1, during course of the impacts analysis certain sub-issues were modified or dismissed altogether for the specific reasons cited in each footnote.

Table E-1. Alternatives impact summary

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 1A: Tribal Values and Concerns – Disturbance to Tribal Values and Practices from Combined Resource Disturbance						
3.14.4.2 and 3.14.5	1A-1. Qualitative assessment of how cumulative resource disturbance impacts tribal values and spiritual practices.	Although under this alternative the Resolution Mine would not be developed, other ongoing or reasonably foreseeable transportation, utility, and other projects, and particularly large-scale mining operations such as the Pinto Valley Mine, the ASARCO Ripsey Wash tailings impoundment, and potential mine development in the Copper Butte area, would continue to be likely to adversely affect places and natural resources valued by Native Americans.	Development of the Resolution Mine under this or any other action alternative would directly and permanently damage the NRHP-listed *Chí'chil Biłdagoteel* Historic District TCP at the East Plant Site. In addition, as noted for the no action alternative, other large-scale mine development along with smaller transportation, utility, and private land development projects in the Superior region may adversely affect certain places and resources of value to Native Americans, including historic resource collection sites and culturally valued landforms and features.	Same as noted under Alternatives 1 and 2	Same as noted under Alternatives 1 and 2	Same as noted under Alternatives 1 and 2	Same as noted under Alternatives 1 and 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 1B: Tribal Values and Concerns – Impacts to Tribal Valued Resources at Oak Flat and Apache Leap						
3.7.1.4 and 3.14.4.2	1B-1. Quantitative assessment of number of sacred springs or other discrete sacred sites impacted.	Under the no action alternative most sacred sites would remain unaltered. However, Resolution Copper would continue dewatering activities at the East Plant Site. As described in DEIS Section 3.7.1, it is possible under the no action alternative that as many as six sacred springs could be adversely affected by drawdown due to continued mine dewatering.	In addition to impacts as under the no action alternative, water table drawdown caused by block caving is anticipated to impact two additional springs in the Superior area. Three additional springs would be buried beneath the tailings impoundment, and two additional springs would be within the subsidence area. A total of 13 sacred springs are anticipated to be lost under Alternative 2.	Same as Alternative 2	In addition to the springs in and around the town of Superior that would be adversely impacted by dewatering and block caving activities at the East Plant Site, under the Silver King Alternative one additional spring would be buried beneath the tailings impoundment. A total of 11 sacred springs are anticipated to be lost under Alternative 4.	Under this alternative, although springs in and around the town of Superior would be adversely impacted by dewatering and block caving activities at the East Plant Site, analysis shows no additional springs at the tailings location would be impacted. A total of 10 sacred springs are anticipated to be lost under Alternative 5.	Under this alternative, although springs in and around the town of Superior would be adversely impacted by dewatering and block caving activities at the East Plant Site, analysis shows no additional springs at the tailings location would be impacted. A total of 10 sacred springs are anticipated to be lost under Alternative 6.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.12.4.1 and 3.14.4.2	1B-2. Qualitative assessment of the impacts on Native Americans of the desecration of land, springs, burials, and sacred sites.	Same as above with respect to springs. Other effects to lands, burials, and other features and places of value to Native Americans would not occur under the no action alternative.	Development of the Resolution Mine under this or any other action alternative would directly and permanently damage the NRHP-listed *Chí'chil Biłdagoteel* Historic District TCP at the East Plant site. Similarly, under all action alternatives mine activity and the visual effects of subsidence would be perceptible from within the Apache Leap SMA. Under Alternative 2 the tailings storage facility would be fully in view from Picketpost Mountain, a mountain sacred to Western Apache bands, and the presence of the nearly 500-foot high tailings would constitute an adverse visual effect on the landscape. Numbers and locations of burials would not be known until such sites are detected as a result of mine-related activities. One large TEKP would be impacted by the tailings storage facility.	Same as Alternative 2	Same as Alternative 2, with the exception of TEKPs. With Alternative 4, three TEKPs would be impacted by the tailings storage facility.	Effects from the East Plant Site and subsidence area would be the same as under Alternative 2. For Alternative 5, three TEKPs would be impacted by the tailings storage facility.	Effects from the East Plant Site and subsidence area would be the same as under Alternative 2. For Alternative 6, at this time TEKPs have not been identified, but may be through additional surveys.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4, 3.12.4.2, and 3.14.4.2	1B-3. [REVISED][1] Qualitative assessment of traditional resource collection areas impacted.	No adverse effects to any traditional resource collection areas are foreseen. However, as noted in section 3.7.1, under the no action alternative six springs are anticipated to be impacted by continued dewatering, which may also adversely affect plant availability.	Under all action alternatives, one or more Emory oak groves at Oak Flat, used by tribal members for acorn collecting, will likely be lost. Other unspecified mineral and/or plant collecting locations are also likely to be affected; historically, medicinal and other plants are frequently gathered near springs and seeps, so drawdown of water at these locations may also adversely affect plant availability.	Same as Alternative 2	Impacts at the East Plant Site/Oak Flat would be the same as under Alternative 2. Other impacts to tribal values and concerns would be similar in context and intensity to those under Alternative 2; however, because the tailings storage facility would be in a different location, the specific impacts to potentially meaningful sites, resources, routes, and viewsheds would vary. See DEIS sections 3.11.4 (scenery), 3.12.4 (cultural resources), and 3.14.4 (tribal values) for detailed impact analyses specific Alternative 4.	Impacts at the East Plant Site/Oak Flat would be the same as under Alternative 2. Other impacts to tribal values and concerns would be similar in context and intensity to those under Alternative 2; however, because the tailings storage facility would be in a different location, the specific impacts to potentially meaningful sites, resources, routes, and viewsheds would vary. See DEIS sections 3.11.4 (scenery), 3.12.4 (cultural resources), and 3.14.4 (tribal values) for detailed impact analyses specific to Alternative 5.	Impacts at the East Plant Site/Oak Flat would be the same as under Alternative 2. Other impacts to tribal values and concerns would be similar in context and intensity to those under Alternative 2; however, because the tailings storage facility would be in a different location, the specific impacts to potentially meaningful sites, resources, routes, and viewsheds would vary. See DEIS sections 3.11.4 (scenery), 3.12.4 (cultural resources), and 3.14.4 (tribal values) for detailed impact analyses specific to Alternative 6.

[1] The original issue factor expected to be analyzed was: "Quantitative assessment of acres of traditional resource collection areas impacted." As locations for many traditional resource collection areas identified are sensitive, this was changed to a qualitative assessment rather than relying on acreage calculations.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 2A: Socioeconomics – Impacts to Municipal Infrastructure						
3.13.4.2	2A-1. Quantitative assessment of change in employment, labor earnings and economic output over time, including direct and indirect effects	No impacts anticipated.	On average, the mine is projected to directly employ 1,523 workers, pay about $134 million per year in total employee compensation, and purchase about $546 million per year in goods and services. Including direct and multiplier effects, the proposed mine is projected to increase average annual economic value added in Arizona by about $1.0 billion	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.13.4.2	2A-2. Quantitative assessment of change in tax revenues per year over time, including changes to payments in lieu of taxes (PILT)	No impacts anticipated.	The proposed mine is projected to generate an average of between $88 and $113 million per year in state and local tax revenues and would also produce substantial revenues for the Federal Government, estimated at over $200 million per year.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.13.4.2	2A-3. Quantitative assessment of change in demand and cost for local road maintenance over time	No impacts anticipated.	Construction and operations of the proposed mine could affect both the Town of Superior's costs to maintain its network of streets and roads as well as those of Pinal County. However, these impacts are difficult to predict as no precise figures have been available that break out road maintenance costs vs. total municipal expenditures. Based on projected changes in the effective population served by Pinal County, the proposed mine could increase the total costs of county service provisions (of which maintenance of County roads is one expenditure) by approximately \$3 million to \$6 million per year.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.13.4.2	2A-4. Qualitative assessment of change in demand and cost for emergency services over time	No impacts anticipated.	The Town of Superior anticipates that its costs of providing services related to public safety (police and fire protection) would increase by about 50% if and when the proposed mine becomes fully operational. Based on Superior's current expenditures to provide these services, this would represent an increase of about $375,000 per year in costs for the Town. Resolution Copper has entered into an agreement with the Town of Superior to provide $1.65 million to support emergency response services by the Town over the period from 2016 to 2021.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.13.4.2	2A-5. Quantitative assessment of change in tourism and recreation revenue over time	No impacts anticipated.	The effects of the proposed mine at the East Plant Site would reduce the number of hunting days per year by approximately 188, and result in a direct reduction of $10,510 annual wildlife-related recreation spending in the local economy, which would equal a nominal value of $630,480 over the 60-year life of the proposed mine. The Near West tailings alternative site would reduce the number of hunting days per year on the site by approximately 1,200, amounting to a reduction in direct wildlife-related recreation expenditures of $66,920 per year or $4.0 million over a 60-year mine life.	Same as Alternative 2.	Effects from East Plant Site are the same as Alternative 2. The Silver King alternative site would reduce the number of hunting days per year by approximately 1,078, and reduce the amount of direct wildlife-related recreation expenditures by about $60,368 per year or $3.6 million over a 60-year mine life.	Effects from East Plant Site are the same as Alternative 2. The Peg Leg alternative site would reduce the number of hunting days per year by approximately 219, and reduce the amount of direct wildlife-related recreation expenditures by about $12,254 per year or $735,269 over a 60-year mine life.	Effects from East Plant Site are the same as Alternative 2. The Skunk Camp alternative site would reduce the number of hunting days per year by approximately 1,269, and reduce the amount of direct wildlife-related recreation expenditures by about $70,554 per year or $4.2 million over a 60-year mine life.
	Issue 2B: Socioeconomics – Impacts to Property Values						
3.13.4.2	2B-1. Quantitative assessment of change in property values over time	No impacts anticipated.	Properties values within a 5-mile radius of the tailings storage facility would be reduced by approximately $3.1 million, a reduction of 4.1%.	Same as Alternative 2.	Property values within a 5-mile radius of the tailings storage facility would be reduced by approximately $5.5 million, a reduction of 10.6%.	Property values within a 5-mile radius of the tailings storage facility would be reduced by approximately $69,000, a reduction of 6.3%.	Property values within a 5-mile radius of the tailings storage facility would be reduced by $58,000, a reduction of 4.0%.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 2C: Socioeconomics – Impacts to Groundwater Availability/Usability						
3.7.1.4	2C-1. Qualitative assessment of effect of reduced groundwater availability on property values	No impacts anticipated.	While drawdown caused by mine dewatering and block-caving could impact wells at Top-of-the-World and Superior, Resolution Copper has committed to mitigation (replacement of water sources) that would result in no net loss of water supplies.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.7.2.4; Appendix M	2C-2. Qualitative assessment of effect of reduced groundwater quality on property values	No impacts anticipated.	While concentrations of metals and other constituents (sulfate, total dissolved solids) are expected to increase above background concentrations due to seepage from the tailings storage facility, no concentrations above Arizona Aquifer Water Quality Standards are anticipated that would render downgradient water supplies unusable.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 2D: Socioeconomics – Impacts to Local and Regional Living Standards						
3.13.5	2D-1. Qualitative assessment of the ability to meet rural landscape expectations as expressed by Federal, state and local plans	No impacts anticipated.	Large-scale mining projects such as the Resolution Mine may also adversely affect what are considered desirable but less tangible qualities of a rural setting and lifestyle. Applicant-committed environmental protection measures would be effective at expanding the economic base of the local community and improving resident quality of life, and could partially offset the expected impacts.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	2D-2. [DROPPED][2]						

[2] The original issue factor expected to be analyzed was: "Quantitative assessment of economic effects on amenity-based relocation." Based on the BBC Research and Consulting report titled *Socioeconomic Effects Technical Report: Resolution Copper Mine Environmental Impact Statement* (BBC 2018), amenity-based relocation in Pinal and Gila Counties was already low in comparison, for example, to Maricopa County. Development of the Resolution Mine is not expected to substantially alter existing conditions with respect to amenity-based resident populations or future relocations in these two counties.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.13.4.2	2D-3. Quantitative assessment of economic effects from change in visitor uses of Tonto National Forest and other public lands	No impacts anticipated.	The affected areas are used for a variety of activities, including OHV use, camping, and hunting, by visitors from outside Pinal County. AGFD estimates the East Plant Site and subsidence area would affect about 6 miles of public access motorized routes and eliminate 421 acres of dispersed camping. AGFD estimates that the Near West Tailings alternative would affect about 23 miles of public access motorized routes and eliminate 1,737 acres of dispersed camping	Same as Alternative 2.	Effects of the East Plant Site and subsidence area are the same as under Alternative 2. AGFD estimates that the Silver King tailings alternative would affect about 20 miles of public access motorized routes and eliminate 1,434 acres of dispersed camping.	Effects of the East Plant Site and subsidence area are the same as under Alternative 2. AGFD estimates that the Peg Leg tailings alternative would affect about 45 miles of public access motorized routes and eliminate 1,009 acres of dispersed camping (excluding pipeline corridors).	Effects of the East Plant Site and subsidence area are the same as under Alternative 2. AGFD estimates that the Skunk Camp tailings alternative would affect about 32 miles of public access motorized routes and eliminate 861 acres of dispersed camping (excluding pipeline corridors).
	Issue 3: Environmental Justice						
3.15.4.3	3-1. Quantitative assessment of economic effects on environmental justice communities and qualitative assessment of whether these effects are disproportionate.	Beneficial or adverse economic impacts to environmental justice populations would not occur, as the mine would not be developed and current land use would remain unchanged.	Overall, while both adverse and beneficial economic effects would impact environmental justice communities, they would not be disproportionately high or adverse.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.15.4.3 (*Continued*)	3-1. Quantitative assessment of economic effects on environmental justice communities and qualitative assessment of whether these effects are disproportionate. (*Continued*)		All environmental justice communities would experience socioeconomic benefits such as an increase in tax revenues and direct and indirect employment opportunities. There would also be negative socioeconomic effects. The expected influx of new workers may lead to shortages of housing and/or pressures on municipal infrastructure such as roads, schools, and medical facilities, and may be accompanied by price increases. Property values may be affected by the proximity of the tailings storage facility. Adverse or beneficial economic effects from the mine would be most apparent in the environmental justice community of the town of Superior. A number of applicant-committed measures would increase quality of life and opportunities within the town of Superior, offsetting some negative effects.				

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.15.4.3	3-2. Qualitative assessment of disproportionate effects of adverse resource impacts to environmental justice communities.	Disproportionate effects on environmental justice populations would not occur, as the mine would not be developed and current land use would remain unchanged.	The proposed East Plant Site, West Plant Site, area of subsidence, and auxiliary facilities would have disproportionately high and adverse impacts on the environmental justice community of the town of Superior for scenic resources and dark skies. In addition, impacts on cultural resources and tribal concerns and values would have a disproportionally adverse impact on Native American communities. Other environmental justice communities (with the exception of Native American communities) would not experience adverse impacts as a result of the proposed project because they would be located outside the geographic area of influence for most resources, or impacts are not disproportionately high or adverse on the community. For Alternative 2, the same impacts are true of the tailings storage facility.	Same as Alternative 2	Same as Alternative 2. For the Alternative 4 tailings storage facility, the scenic impacts from the Silver King alternative tailings storage would be felt most strongly in the town of Superior, due to the proximity and location of the facility.	Same as Alternative 2, but the Alternative 5 tailings storage facility would not impact any environmental justice communities.	Same as Alternative 2, but the Alternative 6 tailings storage facility would not impact any environmental justice communities.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 4: Impacts to Cultural Resources						
	4-1. [DROPPED][3]						
	4-2. [DROPPED][4]						
3.12.4	4-3. Quantitative assessment of number of NRHP-eligible historic properties, sacred sites, and other landscape-scale properties, to be buried, destroyed, or damaged.	If, under this alternative, the GPO is not approved but the land exchange occurs, 31 NRHP-eligible sites and one TCP would be adversely affected. If the GPO is not approved and the land exchange does not occur, there would be no effect.	101 NRHP-eligible and 31 sites of currently undetermined eligibility would be adversely affected. One TCP at the East Plant Site would also be adversely affected.	Same as Alternative 2	Impacts would be similar to Alternative 2; 122 NRHP-eligible sites and 15 currently undetermined sites would be directly and adversely impacted. About 72% of this area has been fully pedestrian surveyed for cultural resources.	Impacts would be similar to Alternative 2; 125 NRHP-eligible sites and 27 currently undetermined sites would be directly and adversely impacted for the east pipeline option, and 114 NRHP-eligible sites and 11 currently undetermined sites would be directly and adversely impacted for the west pipeline option. Between 74% to 78% of the area has been fully pedestrian surveyed for cultural resources, depending on pipeline route.	Impacts would be similar to Alternative 2; 343 NRHP-eligible sites and 17 currently undetermined sites would be directly and adversely impacted for the south pipeline option, and 318 NRHP-eligible sites and 5 currently undetermined sites would be directly and adversely impacted for the north pipeline option. About 96% of this area has been fully pedestrian surveyed for cultural resources.

[3] The original issue factor expected to be analyzed was: "Qualitative assessment of the impacts to places of traditional and cultural significance to Native Americans including natural resources." This is largely duplicated by issue factors 1B-1, 1B-2, and 1B-3.

[4] The original issue factor expected to be analyzed was: "Qualitative assessment of the impacts on other non-tribal communities in the region in terms of impacts on resources, such as historical townsites, cemeteries, mines, ranches, and homesteads." Any historical sites are already incorporated into the analysis described by issue factor 4-3.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.12.4	4-4. Quantitative assessment of number of NRHP-eligible historic properties expected to be visually impacted.	If, under this alternative, the GPO is not approved but the land exchange occurs, 31 NRHP-eligible sites and one TCP would be adversely affected. If the GPO is not approved and the land exchange does not occur, there would be no effect.	In addition to direct impacts, historic properties within the indirect analysis area and atmospheric analysis area could be impacted visually. This includes 29 historic properties within the indirect analysis area (2 NRHP-listed, 8 NRHP-eligible, and 19 unevaluated), and 48 sites within the atmospheric analysis area.	Same as Alternative 2	In addition to direct impacts, historic properties within the indirect analysis area and atmospheric analysis area could be impacted visually. This includes 25 historic properties within the indirect analysis area (2 NRHP-listed, 11 NRHP-eligible, and 12 unevaluated), and 48 sites within the atmospheric analysis area.	In addition to direct impacts, historic properties within the indirect analysis area and atmospheric analysis area could be impacted visually. For the eastern pipeline route, this includes 44 historic properties within the indirect analysis area (2 NRHP-listed, 23 NRHP-eligible, and 19 unevaluated), and 48 sites within the atmospheric analysis area. For the western pipeline route, this includes 29 historic properties within the indirect analysis area (1 NRHP-listed, 16 NRHP-eligible, 12 unevaluated), and 48 sites within the atmospheric analysis area.	In addition to direct impacts, historic properties within the indirect analysis area and atmospheric analysis area could be impacted visually. For the northern pipeline route, this includes 25 historic properties within the indirect analysis area (2 NRHP-listed, 12 NRHP-eligible, and 11 unevaluated), and 45 sites within the atmospheric analysis area. For the southern pipeline route, this includes 41 historic properties within the indirect analysis area (2 NRHP-listed, 19 NRHP-eligible, 20 unevaluated), and 45 sites within the atmospheric analysis area.
3.4.4	4-5. Qualitative assessment of potential for vibrations to damage cultural resources within and adjacent to the project areas.	If the GPO is not approved and the land exchange does not occur, there would be no effect.	The vibration analysis indicates that within given levels of explosive loading, neither blasting nor non-blasting vibrations exceed selected thresholds based on structural damage.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	4-6. [DROPPED][5]						.
3.14.4	4-7. [REVISED][6] Qualitative assessment of number of impacted sites known/likely to have human remains.	If the GPO is not approved and the land exchange does not occur, there would be no effect.	At this time, no sites have been determined to contain human remains; this would be determined during data recovery activities, and a burial plan would be in place to properly handle any human remains identified.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	4-8. [DROPPED][7]						
	Issue 5A: Public Health and Safety – Health Impacts						
	5A-1: [DROPPED][8]						
3.2.4	5A-2: [REVISED][9] Qualitative assessment of the public health risk from geologic hazards, including seismic activity.	If the GPO is not approved and the land exchange does not occur, there would be no effect.	Induced mine seismicity has been observed at other mines and is possible, but unlikely to be of sufficient magnitude to cause structural damage.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

[5] The original issue factor expected to be analyzed was: "Qualitative assessment of impacts to historic properties including visual impacts." Any historical sites are already incorporated into the analysis described by issue factor 4-3.

[6] The original issue factor expected to be analyzed was: "Quantitative assessment of number of impacted prehistoric sites known/likely to have human remains." The issue factor was modified to incorporate issue factor 4-8, and changed from a quantitative to a qualitative assessment.

[7] The original issue factor expected to be analyzed was: "Quantitative assessment of number of historic sites likely to have human remains." The issue factor was incorporated into issue factor 4-7.

[8] The original issue factor expected to be analyzed was: "Qualitative assessment of the public health risk from mine operations and facilities, including the potential for exposure to historically contaminated soil." The issue factor was generic and duplicative of more specific risks to human health analyzed by issue factors 5A-2, 5A-3, 5A-4, 5B-1, 5B-2, 5C-1, 5C-2, 5C-3, and 5C-4.

[9] This issue factor largely overlapped with issue factor 9A-3: "Qualitative assessment of the impact of the project to seismic activity." Issue factor 5A-2 has been modified to incorporate this aspect, and issue factor 9A-3 has been dropped.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.4.4	5A-3: Qualitative assessment of the public health risk from noise and vibrations.	If the GPO is not approved and the land exchange does not occur, there would be no effect.	Noise and vibration levels from mine construction and operation are expected to occasionally be perceptible to residents of the town of Superior and visitors to the immediate area of the East Plant Site, West Plant Site, filter plant and loadout facility, and this or other tailing storage facility location, particularly during construction phases, and from haul trucks during active operations, but mine-related noises and vibrations are not expected to represent either short- or long-term threats to public health and safety.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.4	5A-4: Quantitative assessment of the ability to meet air quality standards for human health.	No mine activities other than ongoing dewatering would occur; it is expected that current air quality standards would be met.	Air quality impacts from construction and operation of the Resolution Mine are not expected at any time to exceed NAAQS criteria pollutant thresholds, including those for particulates, and are therefore not anticipated to represent a threat to public health. A supplemental health impact analysis was conducted to assess the potential for both cancer risk and non-carcinogenic chronic health effects from exposure to airborne NPAG tailings. The analysis determined that Alternative 2 does not exceed selected thresholds for health risk.	Same as Alternative 2	Same as Alternative 2. The health impact analysis for Alternative 4 considered exposure to both NPAG and PAG airborne tailings. The analysis determined that Alternative 4 does not exceed selected thresholds for health risk.	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 5B: Public Health and Safety – Safety Concerns Related to Tailings Impoundment						
	5B-1: [REVISED][10] Qualitative assessment of the risk of failure of tailings dam or concentrate/ tailings pipelines and potential impacts downstream in the event of a failure.	No risk of failure, as no tailings facility or pipelines would be built.	Risk of failure is minimized by required adherence to National Dam Safety Program and APP standards, and applicant-committed environmental protection measures. Alternative 2 embankment is less resilient than Alternatives 5 and 6 due to: modified-centerline construction, long embankment (10 miles), freestanding structure	Alternative 3 embankment is less resilient than Alternatives 5 and 6 due to: modified-centerline construction, long embankment (10 miles), freestanding structure. Alternative 3 is more resilient than Alternative 2 due to ultrathickening.	Alternative 4 represents the least risk of all alternatives. Failure of filtered tailings would result in localized slump or landslide, not a long downstream runout.	Alternative 5 embankment is more resilient than Alternatives 2 and 3 due to: centerline construction, shorter embankment (7 miles). Double embankment for PAG using a downstream dam, and use of multiple PAG cells, reduces risk of PAG release.	Alternative 6 embankment is more resilient than Alternatives 2, 3, and 5 due to: centerline construction, shortest embankment (3 miles), cross-valley construction with tie-in to solid rock on each side. Double embankment for PAG using a downstream embankment, and use of multiple PAG cells, reduces risk of PAG release.
	5B-2: Quantitative assessment of the seismic stability of the tailings impoundment.	No tailings facility would be built.	The design earthquake meets the most stringent of all standards (Maximum Credible Earthquake), and static factor of safety (1.5) and seismic factor of safety (1.2) meet the most stringent of all standards.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

[10] The original issue factor only referenced the tailings storage facility, and has been modified to include both concentrate and tailings pipelines.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 5C: Public Health and Safety – Transportation-Related and General Safety Risks						
3.5.6.1	5C-1: Quantitative assessment of the potential change in traffic accidents.	No change from current traffic volumes and patterns.	Under Alternative 2 increased traffic associated with mine worker commuting and truck traffic to and from the mine is expected to result in increased traffic congestion and increased risk of traffic accidents.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	5C-2: [DROPPED][11]						

[11] The original issue factor expected to be analyzed was: "Quantitative assessment of the trip count per day for all hazardous materials and qualitative assessment of potential effectsl." The issue factor was combined with issue factor 5C-3.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.10.3.4	5C-3: Qualitative assessment of the risks to public health from potential accidents or spills during the transport of hazardous materials.	No impacts anticipated.	Potential releases of hazardous materials during transportation could occur, but the fate and transport of those hazardous materials depend entirely on where the release occurs and the quantity of the release. In general, there would be direct impacts on plants and wildlife in the immediate vicinity, direct impacts on soil in the immediate vicinity, and possible migration into surface water either directly or via stormwater runoff from contaminated areas. Queen Creek and tributary washes (like Silver King Wash) are the locations most likely to be affected in the event of a transportation release.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.5.6.1, 3.10.3.4, and 3.13.4.2	5C-4: Qualitative assessment of the impacts to local emergency response to accidents or spills on public roadways.	No change from current conditions.	Under Alternative 2, increased traffic associated with mine worker commuting and truck traffic to and from the mine is expected to result in increased risk of traffic accidents. There may also be an increased risk of hazardous materials simply due to an increased presence of hazardous materials at mine facilities and the regular transport of these materials to and from these facilities. The Town of Superior anticipates that its costs of providing services related to public safety would increase by about 50%; Resolution Copper has entered into an agreement with the Town of Superior to provide $1.65 million to support emergency response services by the Town over the period from 2016 to 2021.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Issue 5D: Public Health and Safety – Risks Related to Subsidence						
	5D-1: [DROPPED][12]						

[12] The original issue factor expected to be analyzed was: "Qualitative assessment of the public health risk from geological hazards." This duplicates issue factor 5A-2.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.10.2	5D-2: Qualitative assessment of increased fire risk due to mine operations and subsidence	No change from current conditions.	While increased risks of fire ignition from mine activities (i.e., blasting, construction, increased traffic) cannot be entirely prevented, risks are expected to be substantially mitigated through adherence to a fire plan that requires mine employees to be trained for initial fire suppression and to have fire tools and water readily available.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Issue 6A: Water Resources – Groundwater Availability						
3.7.1.4	6A-1. Direction and magnitude of change in aquifer water level, compared with background conditions.	Drawdown from mine dewatering anticipated under the no action alternative up to >50 feet at six springs. No effects anticipated to perennial streams.	Additional drawdown caused by block caving anticipated at two additional springs; one spring (DC-6.6W) feeds perennial flow in Devil's Canyon, contributing up to 5% of flow.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4	6A-2. Geographic extent in which water resources may be impacted.	Geographic area impacted by groundwater drawdown under the no action alternative shown in figure 3.7.1-8.	Geographic area impacted by groundwater drawdown caused by mine dewatering shown in figure 3.7.1-3; geographic area impacted by groundwater drawdown caused by the Desert Wellfield shown in figure 3.7.1-2.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.7.1.4	6A-3. Duration of the effect (in years).	Takes ~150–200 years to see maximum drawdown from mine dewatering; recovery of water levels would continue longer. No drawdown would occur at Desert Wellfield.	Takes ~500–900 years to see maximum drawdown from mine dewatering at some GDE locations; recovery of water levels would continue longer. Drawdown at Desert Wellfield recovers within ~130 years after closure.	Same as Alternative 2	Same as Alternative 2 for mine dewatering Drawdown at Desert Wellfield recovers within ~20 years after closure	Same as Alternative 2	Same as Alternative 2
3.7.1.4	6A-4. Comparison of mine water needs and water balance with overall basin water balance, both total volume (acre-feet) and annual rate (acre-feet per year).	No water would be pumped from Desert Wellfield. Mine dewatering pumping would continue indefinitely.	Desert Wellfield pumping over life of mine = 590,000 acre-feet 87,000 acre-feet pumped over life of mine for dewatering	Desert Wellfield pumping over life of mine = 490,000 acre-feet 87,000 acre-feet pumped over life of mine for dewatering	Desert Wellfield pumping over life of mine = 180,000 acre-feet 87,000 acre-feet pumped over life of mine for dewatering	Desert Wellfield pumping over life of mine = 540,000 acre-feet 87,000 acre-feet pumped over life of mine for dewatering	Desert Wellfield pumping over life of mine = 540,000 acre-feet 87,000 acre-feet pumped over life of mine for dewatering

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4	6A-5. REVISED[13] Assessment of impact to general groundwater supply areas (feet of water-level decrease).	No impacts anticipated.	For wells connected to regional aquifers, drawdown from mine dewatering up to 30 feet anticipated in Top-of-the-World and Superior. Wells in shallow alluvium or fractures are unlikely to be impacted. Maximum drawdown impacts from Desert Wellfield anticipated to be 40–50 feet at NMIDD, 110–140 feet near wellfield.	Same as Alternative 2	Same as Alternative 2 for mine dewatering Maximum drawdown impacts from Desert Wellfield anticipated to be less than 20 feet at NMIDD, 30–35 feet near wellfield	Same as Alternative 2	Same as Alternative 2
3.7.1.4	6A-6. Potential for subsidence to occur as a result of groundwater withdrawal.	No impacts anticipated.	Drawdown associated with the Desert Wellfield would contribute to lowering of groundwater levels in the East Salt River valley basin, including near two known areas of known ground subsidence. There is the potential for Desert Wellfield pumping to contribute to regional subsidence.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

[13] The original issue factor expected to be analyzed was: "Number of known private and public water supply wells within the geographic extent of the water-level impact and assessment of impact to these water supplies (feet of water-level decrease)." The Forest Service determined that analyzing impacts to individual wells was not feasible (see section 3.7.1). Impacts on representative wells were assessed instead.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 6B: Water Resources – Groundwater Quality						
3.7.2.4, Risk of Seepage Impacting Groundwater or Surface Water Quality (sections for each alternative)	6B-1. [REVISED][14] Quantitative assessment of anticipated groundwater quality changes, compared for context to Arizona water quality standards	No tailings seepage would occur; no changes in groundwater quality beyond existing conditions would be anticipated.	Concentrations are not anticipated to be above standards in aquifers downgradient of tailings facility. Selenium concentrations are anticipated to be above surface water standards at Whitlow Ranch Dam. Most concentrations are anticipated to increase from baseline conditions; sulfate concentrations are anticipated to be above secondary standards.	Concentrations are not anticipated to be above standards in aquifers or surface waters downgradient of tailings facility. Selenium and cadmium concentrations are anticipated to increase from baseline conditions.	Concentrations are not anticipated to be above standards in aquifers downgradient of tailings facility. Selenium concentrations are anticipated to be above surface water standards at Whitlow Ranch Dam. Most concentrations are anticipated to increase from baseline conditions; sulfate concentrations are anticipated to be above secondary standards.	Concentrations are not anticipated to be above standards in aquifers or surface waters downgradient of tailings facility. Most concentrations are anticipated to increase from baseline conditions; sulfate concentrations are anticipated to be substantially above secondary standards.	Concentrations are not anticipated to be above standards in aquifers or surface waters downgradient of tailings facility. Most concentrations are anticipated to increase from baseline conditions; sulfate concentrations are anticipated to be above secondary standards.
3.7.2.4, Risk of Seepage Impacting Groundwater or Surface Water Quality (sections for each alternative)	6B-2. [REVISED][15] Qualitative assessment of seepage control techniques	No seepage control needed.	Modeled seepage control efficiency of 99%. Risk of not meeting desired efficiency is high.	Modeled seepage control efficiency of 99.5%. Risk of not meeting desired efficiency is high.	Estimated seepage control efficiency of 90%. Risk of not meeting desired efficiency is moderate.	Modeled seepage control efficiency of 84%. Risk of not meeting desired efficiency is moderate.	Modeled seepage control efficiency of 90%. Risk of not meeting desired efficiency is moderate.

[14] The original issue factor expected to be analyzed was: “Quantitative assessment of the ability to meet Arizona Aquifer Water Quality Standards at points of compliance designated in the aquifer protection permit.” The authority to determine the ability to meet water quality standards lies with the State of Arizona. The Forest Service disclosure focuses on anticipated impacts to groundwater and surface water quality; comparison to water quality standards is presented for context, but is not a regulatory determination.

[15] The original issue factor expected to be analyzed was: “Qualitative assessment of the ability to demonstrate best available demonstrated control technology.” Assessment of the ability to meet best available demonstrated control technology is under the authority of the State of Arizona. The Forest Service has instead assessed the expected seepage control techniques and the ability of the project to control seepage to the point that water quality standards are likely to be met.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.2.4, Risk of Seepage Impacting Groundwater or Surface Water Quality (sections for each alternative)	6B-3. Quantitative assessment of the estimated changes in groundwater quality in situ in the area of block caving, including the estimated fate and transport.	No block-caving would occur; no changes in groundwater quality beyond existing conditions would be anticipated.	Thallium concentrations modeled to be above standards at end of operations. Substantial uncertainty with effect of oxidation over time, which would further degrade water quality.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	6B-4. [DROPPED][16]						

[16] The original issue factor expected to be analyzed was: “Quantitative assessment of the estimated changes in groundwater quality as a result of seepage from tailings area, including the estimated fate and transport.” This duplicates issue factor 6B-1.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.10.3.4	6B-5. Qualitative assessment of the potential for spills or inadvertent release of contaminants to groundwater.	No impacts anticipated.	The process water temporary storage ponds are double-lined with leak detection. Infiltration is unlikely to occur under normal operating conditions, and leak detection is incorporated into the process water portion of the pond. If an unplanned spill were to occur, releases underground or at the East Plant Site would be unlikely to migrate due to the hydraulic sink created by dewatering; releases at the tailings storage facility would be likely captured by seepage controls. The primary concern would be spills within the West Plant Site that could likely migrate toward Queen Creek and eventually downstream. Emergency response and material handling plans minimize the risk of release and provide for rapid emergency cleanup.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 6C: Water Resources – Surface Water Availability						
3.7.1.5	6C-1/6C-2. [REVISED][17] Qualitative assessment of the potential lowering of the water table or reduced groundwater flow to Queen Creek, Devil's Canyon, Arnett Creek, Mineral Creek, or other perennial waters that results in permanent changes in flow patterns and that may affect current designated uses	No impacts anticipated.	No direct impacts to perennial flow in Queen Creek, Devil's Canyon, Arnett Creek, or Mineral Creek are anticipated from groundwater drawdown. However, additional drawdown is anticipated to impact spring DC-6.6W which feeds perennial flow in Devil's Canyon, contributing up to 5% of flow.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.16.4	6C-3. [REVISED][18] Quantitative assessment of the number of water sources that would be lost to direct disturbance or dewatering	No impacts anticipated.	25 water sources anticipated to be impacted	Same as Alternative 2	24 water sources anticipated to be impacted	14 water sources anticipated to be impacted	21 water sources anticipated to be impacted

[17] Originally two issue factors were expected to be analyzed: "6C-1. Quantitative assessment of the number of stream miles changed from intermittent/perennial flow status to ephemeral flow status as a result of the project;" and "6C-2. Quantitative assessment of the potential lowering of the water table or reduced groundwater flow to Queen Creek, Devil's Canyon, Arnett Creek, Mineral Creek, or other perennial waters that results in permanent changes in flow patterns and that may affect current designated uses." Given the limitations of the groundwater model to predict surface water impacts, these factors were combined and modified.

[18] The original issue factor expected to be analyzed was: "Quantitative assessment of the number of stock watering tanks that would be lost to direct disturbance or reductions in surface flow." Most changes to water sources for both stock and wildlife are from loss of springs, not stock tanks. This issue factor was changed to reflect all water sources lost due to direct or indirect disturbance.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.3.4	6C-4. Quantitative assessment of the change in volume, frequency, and magnitude of runoff from the project area.	No impacts anticipated.	Reduction in annual average runoff of 3.5% at mouth of Devil's Canyon due to subsidence crater. Reduction in annual average runoff of 6.5% in Queen Creek at Whitlow Ranch Dam.	Same as Alternative 2	Reduction in annual average runoff of 3.5% at mouth of Devil's Canyon due to subsidence crater. Reduction in annual average runoff of 19.9% in Queen Creek at Boyce Thompson Arboretum, and 8.9% at Whitlow Ranch Dam.	Reduction in annual average runoff of 3.5% at mouth of Devil's Canyon due to subsidence crater. Reduction in annual average runoff of 21.3% at mouth of Donnelly Wash, and 0.2% in Gila River.	Reduction in annual average runoff of 3.5% at mouth of Devil's Canyon due to subsidence crater. Reduction in annual average runoff of 12.9% at mouth of Dripping Spring Wash, and 0.5% in Gila River.
	Issue 6D: Water Resources – Surface Water Quality						
3.7.2.4, Potential Surface Water Quality Impacts from Stormwater Runoff	6D-1. [REVISED][19] Quantitative assessment of anticipated surface water quality changes from runoff, compared for context to Arizona water quality standards.	No impacts anticipated.	No impacts anticipated due to operational stormwater controls and post-closure reclamation cover; runoff is not allowed to be released after operations until appropriate water quality standards are met.	Same as Alternative 2	Same as Alternative 2. Some potential for Alternative 4 to require treatment of collected PAG runoff prior to recycling.	Same as Alternative 2	Same as Alternative 2
3.7.3.4	6D-2. Qualitative assessment of the change in geomorphology and characteristics of downstream channels.	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.
	6D-3. [DROPPED][20]						

[19] The original issue factor expected to be analyzed was: "Quantitative assessment of the ability to meet Arizona Surface Water Quality Standards for the appropriate designated uses." The authority to determine the ability to meet water quality standards lies with the State of Arizona. The Forest Service disclosure focuses on anticipated impacts to groundwater and surface water quality; comparison to water quality standards is presented for context, but is not a regulatory determination. Note that surface water quality impacts potentially caused by tailings seepage are assessed under issue factor 6B-1.

[20] The original issue factor expected to be analyzed was: "Quantitative assessment of the acres and locations that may be affected by surface water quality impacts and the duration (in years) of those impacts." This duplicates issue factor 6D-1.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.3.4	6D-4. Quantitative assessment of the acres of potentially jurisdictional waters of the U.S. impacted.	No impacts anticipated.	No jurisdictional waters are located above Whitlow Ranch Dam (as determined by U.S. Army Corps of Engineers)	No jurisdictional waters are located above Whitlow Ranch Dam (as determined by U.S. Army Corps of Engineers)	No jurisdictional waters are located above Whitlow Ranch Dam (as determined by U.S. Army Corps of Engineers)	Preliminary impacts estimated as 182.5 acres; delineation not yet reviewed by U.S. Army Corps of Engineers	Preliminary impacts estimated as 120.0 acres; delineation not yet reviewed by U.S. Army Corps of Engineers
	Issue 6E: Water Resources – Seeps, Springs, Riparian Areas, and Groundwater-Dependent Ecosystems						
3.3.4	6E-1. Acres of riparian areas disturbed, by vegetation classification.	No impacts anticipated.	Riparian = 28 acres Xeroriparian = 135 acres	Same as Alternative 2	Riparian = 44 acres Xeroriparian = 184 acres	Riparian = 35 acres Xeroriparian = 171–195 acres (varies by pipeline route)	Riparian = 90–92 acres (varies by pipeline route) Xeroriparian = 766–813 acres (varies by pipeline route)

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4	6E-2. [REVISED][21] Number of GDEs degraded or lost.	Under the no action alternative Resolution Copper would continue dewatering activities at the East Plant Site. It is anticipated under the no action alternative that as many as six sacred springs could be adversely affected by drawdown due to continued mine dewatering.	Two additional springs would be impacted by dewatering once block-caving begins. Three additional springs would be buried beneath the tailings impoundment, and two additional springs would be within the subsidence area. In addition, two GDEs associated with Queen Creek and one GDE associated with Devil's Canyon would experience some reduction in surface flow due to runoff captured by the subsidence area or tailings facility. A total of 16 GDEs would be impacted under Alternative 2.	Same as Alternative 2	Same as Alternative 2 for mine dewatering, subsidence, and changes to surface flow (13 GDEs). Two additional springs would be buried beneath the tailings impoundment, but one of these would already be impacted by drawdown. A total of 14 GDEs would be impacted under Alternative 4.	Same as Alternative 2 for mine dewatering, subsidence, and changes to surface flow (13 GDEs). No GDEs have been identified that would be lost due to tailings facility, but one additional GDE (the Gila River) would be impacted by reductions in surface flow due to the tailings facility. A total of 14 GDEs would be impacted under Alternative 5.	Same as Alternative 2 for mine dewatering, subsidence, and subsidence changes to surface flow (13 GDEs). No GDEs have been identified that would be lost due to tailings facility, but one additional GDE (the Gila River) would be impacted by reductions in surface flow due to the tailings facility. A total of 14 GDEs would be impacted under Alternative 6.

[21] The original issue factor expected to be analyzed was: "Number of seeps and springs degraded or lost." Many springs on the landscape are not perennial sources or water or support riparian vegetation. While the impacts to livestock/grazing focused on any named springs of water sources, regardless of their connection to groundwater (see factor 6C-3), the focus of the groundwater analysis was on specific areas with perennial flow and riparian vegetation that were determined to be groundwater-dependent ecosystems. This factor was changed to reflect only groundwater-dependent ecosystems.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4; 3.7.3.4	6E-3. Change in the function of riparian areas.	Riparian function of six springs anticipated to be lost due to mine dewatering; mitigation measures would not be in place to replace flow to these springs.	A total of 13 springs anticipated to be impacted due to mine dewatering, subsidence, and direct disturbance. Mitigation measures would be effective at replacing water such that there would be no net loss of riparian ecosystems or aquatic habitat on the landscape, although ecosystems would change to adapt to new water sources. Devil's Canyon would receive less runoff and less inflow from one spring anticipated to be impacted (DC-6.6W), anticipated at 5 to 10%. Queen Creek would receive less runoff, ranging from 13% to 19% above Boyce Thompson Arboretum. Losses could contribute to a reduction in the extent and health of riparian vegetation. Complete drying of the downstream habitat, loss of dominant riparian vegetation, or loss of standing pools would be unlikely.	Same as Alternative 2	Same as Alternative 2, except 11 springs anticipated to be impacted. Greater flow losses are seen in Queen Creek, which could result in larger impacts than Alternative 2, but similar in nature.	Same as Alternative 2, except 10 springs anticipated to be impacted. Gila River would receive less runoff, but watershed losses (as a percentage change in perennial flow) are relatively low for Alternative 5 (0.2% at Donnelly Wash), largely due to the large watershed and flow of the Gila River.	Same as Alternative 2, except 10 springs anticipated to impacted. Gila River would receive less runoff, but watershed losses (as a percentage change in perennial flow) are relatively low for Alternative 6 (0.3% at Donnelly Wash), largely due to the large watershed and flow of the Gila River.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4; 3.7.3.4 (*Continued*)	6E-3. Change in the function of riparian areas. (*Continued*)		There are no anticipated impacts to riparian areas along Telegraph Canyon, Arnett Creek, or Mineral Creek.				
	6E-4. [DROPPED][22]						
	Issue 6F: Water Resources – Floodplains						
3.7.3.4	6F-1. Quantitative assessment of the acreage of 100-year floodplains impacted (acreage)	No impacts anticipated.	8.5 acres (based on available floodplain maps)	Same as Alternative 2	Same as Alternative 2	167–171 acres of floodplain (varies by pipeline route; based on available floodplain maps)	794 acres (based on available floodplain maps)
	6F-2. [DROPPED][23]						

[22] The original issue factor expected to be analyzed was: “Ability to meet legal and regulatory requirements for riparian areas.” This was originally considered in the event that some riparian areas had special designations under Arizona regulation, such as designated Outstanding Arizona Waters. No riparian areas were identified with special designations.

[23] The original issue factor expected to be analyzed was: “Qualitative assessment of the impact of floodplain changes to upstream or downstream users or residents.” Ultimately, the mapping coverage for floodplains is inconsistent and impacts to downstream users would require more specific designs for how washes would be filled. For instance, while pipelines might cross mapped floodplains, if they are buried, there would be no anticipated impacts to downstream users or residents.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Water Resources – Additional Issue Factors Analyzed						
3.7.3.4	Acres of wetland impacted, based on National Wetland Inventory	No impacts anticipated.	92.5 acres associated with ephemeral washes 5.1 acres associated with stock tanks 1 acre associated with Benson Spring and in subsidence area	Same as Alternative 2	86.2 acres associated with ephemeral washes 4.1 acres associated with stock tanks 0.2 acre in subsidence area	(Varies by pipeline alternative) 200.9–219.6 acres associated with ephemeral washes 8.6–8.8 acres associated with stock tanks 0.2 acre in subsidence area Includes crossings of Gila River, which may not require disturbance	(Varies by pipeline alternative) 229.6–232.9 acres associated with ephemeral washes 25.4–28.2 acres associated with Queen Creek, Devil's Canyon, Mineral Creek 11.9–12.7 acres associated with stock tanks 0.2 acre in subsidence area

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 7A: Biological Resources – Adverse Effects of Dewatering at the East Plant Site or Pumping at the West Plant Site						
3.7.1.4; 3.8.4	7A-1. Qualitative assessment of effects on riparian habitat and species due to changes in flow to Queen Creek, Devil's Canyon, Arnett Creek, Mineral Creek, or other perennial or intermittent waters. [This assessment will be based on the results of the Issue 6 Analysis Factors]	Riparian function of six springs anticipated to be lost due to mine dewatering; mitigation measures would not be in place to replace flow to these springs.	Impacts on fish species include mortality from loss or modification of habitat due to changes in surface water levels or flows, including changes due to changes in groundwater elevation and contribution to surface flows. Would occur for all action alternatives and would have the greatest potential to impact fish species along areas of Devil's Canyon and Queen Creek that currently have surface flows. Impacts are to non-native fish populations (no native fish known to occur) in these locations.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.1.4; 3.8.4 (*Continued*)	7A-1. Qualitative assessment of effects on riparian habitat and species due to changes in flow to Queen Creek, Devil's Canyon, Arnett Creek, Mineral Creek, or other perennial or intermittent waters. [This assessment will be based on the results of the Issue 6 Analysis Factors] (*Continued*)		No impacts are anticipated in Mineral Creek to longfin dace or Gila chub. Riparian changes impacting amphibious or invertebrate species could occur along areas of Devil's Canyon and Queen Creek that currently have perennial surface flows that would be reduced by changes in runoff. Most water sources potentially impacted by the project would be replaced.				
	Issue 7B: Biological Resources – Loss or Harassment of Individual Plants and Animals						
3.8.4	7B-1. Quantitative assessment of acres of suitable habitat disturbed for each special status species, including impacts to designated and proposed critical habitat.	No changes from current conditions are anticipated.	Please see DEIS table 3.8.4-2; this acreage information is too extensive to be summarized here.	Please see DEIS table 3.8.4-2; this acreage information is too extensive to be summarized here.	Please see DEIS table 3.8.4-2; this acreage information is too extensive to be summarized here.	Please see DEIS table 3.8.4-2; this acreage information is too extensive to be summarized here.	Please see DEIS table 3.8.4-2; this acreage information is too extensive to be summarized here.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.8.4	7B-2. Qualitative assessment of the potential to affect the population viability of any species and qualitative assessment of mortality of various animal species resulting from the increased volume of traffic related to mine operations.	No changes from current conditions are anticipated.	Under this or any action alternative there would be a high probability of mortality and/or injury of wildlife individuals from collisions with mine construction and employee vehicles, as well as the potential mortality of burrowing animals in areas where grading would occur. Some species could see impacts on local populations in the action area, but no regional population-level impacts are likely.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.8.4	7B-3. Qualitative assessment of the potential for disturbance to create conditions conducive for invasive species.	No changes from current conditions are anticipated.	Ground disturbance, particularly during project construction, would be likely to increase the potential for the introduction and colonization of disturbed areas by noxious and invasive plant species. These potential vegetation changes may decrease suitability of disturbed areas to support breeding, rearing, foraging, and dispersal activities of wildlife and special status species, and may also lead to a shift over time to more wildfire-adapted vegetation that favors noxious or invasive exotic species over native species.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.8.4	7B-4. Qualitative assessment of effects on wildlife behavior from noise, vibrations, and light.	No changes from current conditions are anticipated.	Noise, vibrations, and light from mine construction and operations may change habitat use patterns for some species. Some individuals would be likely to move away from the sources of disturbance to adjacent or nearby habitats. Project-related noise, vibration, and light may also lead to increased stress on individuals and alteration of feeding, breeding, and other behaviors. Some species could see impacts on local populations in the action area, but no regional population-level impacts are likely.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 7C: Biological Resources – Habitat Fragmentation and Loss						
3.8.4	7C-1. Qualitative assessment of the change in movement corridors and connectivity between wildlife habitats.	No changes from current conditions are anticipated.	Potential impacts to wildlife movement corridors from all action alternatives would include the loss and fragmentation of movement and dispersal habitats from the subsidence area and from the tailings storage facility. Ground-clearing and consequent fragmentation of habitat blocks for other mine-related facilities would also inhibit wildlife movement. Obstacles to wildlife movement would also be created by pipeline corridors and other linear facilities, though restrictions to movement across linear features may be eased through mitigation.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.8.4	7C-2. [REVISED][24] Quantitative assessment of acres by type of terrestrial habitat lost, altered, or indirectly impacted.	No changes from current conditions are anticipated.	Projected losses of habitat acres under each action alternative are itemized in table 3.8.4-3; this information is too extensive to be summarized here.	Projected losses of habitat acres under each action alternative are itemized in table 3.8.4-3; this information is too extensive to be summarized here.	Projected losses of habitat acres under each action alternative are itemized in table 3.8.4-3; this information is too extensive to be summarized here.	Projected losses of habitat acres under each action alternative are itemized in table 3.8.4-3; this information is too extensive to be summarized here.	Projected losses of habitat acres under each action alternative are itemized in table 3.8.4-3; this information is too extensive to be summarized here.

[24] The original issue factor expected to be analyzed was: "Quantitative assessment of acres by type of terrestrial and aquatic habitat lost, altered, or indirectly impacted." Aquatic habitat was removed from this issue factor because it is duplicated by issue factor 7A-1.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.8.3.2; 3.8.5; 3.7.1.4	7C-3. [REVISED][25] Qualitative assessment of impacts to surface water that support wildlife and plants such as stock tanks, seeps, and springs.	Six springs (not designated as wildlife waters) are anticipated to be lost due to mine dewatering; mitigation measures would not be in place to replace flow to these springs.	Of the 15 wildlife waters (waters built or improved such as stock tanks and wildlife guzzlers) within 5 miles of the project footprint, three would occur within the project facility area under this or other action alternatives. Benson Spring would be permanently lost beneath the tailings storage facility for Alternative 2. Mitigation would maintain or replace access to wildlife waters. An additional 12 springs not designated as wildlife waters are anticipated to be lost due to mine dewatering; mitigation would replace these waters as well.	Same as Alternative 2	Wildlife water Silver King Spring would be within the footprint of the tailings storage facility for Alternative 4 and would be permanently buried. Mitigation would maintain or replace access to wildlife waters. An additional 11 springs not designated as wildlife waters are anticipated to be lost due to mine dewatering; mitigation would replace these waters as well.	Wildlife water Mineral Mountain spring would be within the west pipeline route under this alternative. Mitigation would maintain or replace access to wildlife waters. An additional 10 springs not designated as wildlife waters are anticipated to be lost due to mine dewatering; mitigation would replace these waters as well.	No wildlife waters would be impacted under Alternative 6. Ten springs not designated as wildlife waters are anticipated to be lost due to mine dewatering; mitigation would replace these waters.
	7C-4. [DROPPED][26]						

[25] The original issue factor expected to be analyzed was: "Qualitative assessment of impacts to aquatic habitats and surface water that support wildlife and plants such as stock tanks, seeps, and springs." Aquatic habitat was removed from this issue factor because it is duplicated by issue factor 7A-1. This issue factor focuses instead on wildlife waters identified by the Arizona Game and Fish Department and springs.

[26] The original issue factor expected to be analyzed was: "Qualitative assessment of how changes in the function of riparian areas could impact wildlife habitat." This duplicates issue factor 7A-1.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 8: Impacts to Air Quality						
3.6.2.2; 3.6.4.2	8-1. Quantitative estimate of particulate emissions (particulate matter less than or equal to 2.5 microns in diameter (PM2.5) and particulate matter less than or equal to 10 microns in diameter (PM10)), compared with background (pounds per hour [for 24-hour impacts] and tons per year [tons/year]) and expected seasonal dust patterns and impact area	No impacts anticipated.	The PM10 emissions are estimated as 328.9 tons per year. Maximum emission concentration is modeled as 26 µg/m^3 (24-hour) and 7 µg/m^3 (annual), compared to background concentrations of 71 µg/m^3 and 17 µg/m^3, respectively. The PM2.5 emissions are estimated as 77.8 tons per year. Maximum emission concentration is modeled as 11 µg/m^3 (24-hour) and 2 µg/m^3 (annual), compared to background concentrations of 6 µg/m^3 and 4 µg/m^3, respectively. Impact area does not extend beyond fence line.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.2.2	8-2. Volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions and emission rates (tons/year)	No impacts anticipated.	The estimated potential HAP emissions from the project (0.17 tons per year) are less than the major source thresholds (10 tons per year of any one HAP or 25 tons per year of all HAPs) The estimated VOC emissions from the project are 102.7 tons per year.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.2.2; 3.6.4.2	8-3. Quantitative assessment of total mine emissions (lb/hour and tons/year), compared with the current total regional emissions (tons/year), including criteria and other pollutants (carbon monoxide, lead, sulfur dioxide, nitrogen dioxide, particulate matter, and carbon dioxide). Include tabulation of greenhouse gas emissions of CO_2, CH_4, and N_2O. Depict location of sources for considered alternatives	No impacts anticipated.	CO: 616 tons/year; 4,531 µg/m3 project (1-hour), 8,081 µg/m3 combined with background. NO2: 118 tons/year; 138 µg/m3 project (1-hour), 146 µg/m3 combined with background. PM10: 329 tons/year; 26 µg/m3 project (24-hour), 97 µg/m3 combined with background. PM2.5: 78 tons/year; 11 µg/m3 project (24-hour), 18 µg/m3 combined with background. SO2: 18 tons/year; 92 µg/m3 project (1-hour), 117 µg/m3 combined with background. Lead: 0.017 tons/year, below analysis threshold of 0.6 tons/year. CO2 and greenhouse gas: 173,000 equivalent tons/year.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.4.2	8-4. Quantitative assessment of the ability to meet air quality standards, include impacts based on representative background air quality levels and analyze cumulative emissions and impacts	No impacts anticipated.	The analysis of air quality impacts for the proposed action and alternatives shows that all impacts would be within the ambient air quality standards and are below the PSD increments. The proposed emission sources would comply with applicable regulations, and impacts on air quality-related values would be within the established thresholds for of acceptability.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.2.2	8-5. Quantitative assessment of the off-site impacts of hazardous or toxic air pollutants compared to health-based levels	No impacts anticipated.	The ability to meet air quality standards is considered protective of public health. In addition, levels of metals deposition associated with particulate emissions were estimated and compared with Regional Screening Levels for which the EPA has derived carcinogenic and/or non-carcinogenic chronic health effects. For all alternatives, the estimated human health risk associated with the maximum air concentrations of inorganic metals is less than established thresholds.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.4.2	8-6. Quantitative assessment of the ability to meet NAAQS for criteria pollutants (carbon monoxide, lead, sulfur dioxide, nitrogen dioxide, ozone, and particulate matter), as modeled at the perimeter fence line of the mine facility, taking into account all mobile and stationary emission sources. Include spatial depictions of impacts for the area around the mine and alternative sites	Existing and ongoing impacts to air quality from fugitive dust and vehicle emissions are expected to increase over time with continued population growth in central Arizona. However, it is expected that monitoring and remedial actions by Maricopa County, Pinal County, and ADEQ would be effective in keeping these gradual changes within NAAQS.	None of the predicted results are anticipated to exceed the NAAQS at the ambient air boundary/fence line.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.4.2	8-7. Quantitative assessment of the impacts at Class I airsheds, specifically, changes to air quality–related values (AQRVs) of visibility, ozone, and deposition of sulfur dioxide and nitrogen oxides, as modeled at perimeter of Class I airsheds, and compared with current deposition rates and critical loads[27]	No impacts anticipated.	All impacts are projected to be less than the PSD increments at the Class I areas and, except for the Superstition Wilderness Area, would have an insignificant[28] impact at those areas. The highest 24-hour impacts of PM_{10} and $PM_{2.5}$ emissions on air quality at the Superstition Wilderness Area consume up to 50% of the Class I PSD increments. Sulfur and nitrogen deposition impacts are lower than thresholds established by guidance.	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2

[27] See Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010) Natural Resource Report NPS/NRPC/NRR—2010/232.

[28] Comparisons to the PSD Class I Significant Impact Levels are provided for information only. No formal further analysis is required because the proposed action and alternatives do not trigger review and approval under the PSD regulations.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.6.4.2	8-8. Assessment using best available science of long-term trends in precipitation and temperature that may affect resources	Increases in global surface air temperatures in the Southwest have caused markedly increased average annual temperatures and reduced water storage due to early spring snowpack runoff. The trends in temperature and effects of snowmelt runoff, with declining river flow, are predicted to continue into the foreseeable future.	The proposed action would lead to emissions of greenhouse gases based largely on fuel use by mobile sources with a minor contribution from process combustion sources. The total greenhouse gas emissions would amount to 173,328 tons per year, based on year 14 with the highest emission rates. Project emissions would contribute to ongoing climate trends.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 9A: Long-term Land Stability – Subsidence						
3.2.4	9A-1. Quantitative assessment of the extent, amount, and timing of land subsidence, with estimates of uncertainty.	No changes from current conditions are anticipated.	Subsidence crater is estimated to first become evident at the surface at Oak Flat in mine year 6 or 7. At mine closure subsidence crater is expected to be approximately 800–1,100 feet deep and approximately 1.8 miles in diameter. Modeling indicates there would be no damage to Apache Leap, Devil's Canyon, or U.S. 60. Monitoring would take place and Resolution Copper has stated they would modify mining plans if it appears any of these areas would be impacted.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.2.4	9A-2. [REVISED][29] Qualitative assessment of the potential to impact caves or karst resources, and paleontological resources.	No changes from current conditions are anticipated.	A small area of Martin limestone with potential paleontological resources is within the footprint of Alternative 2; otherwise, no impacts to cave/karst resources or paleontological resources are anticipated.	Same as Alternative 2	No impacts to cave/karst resources or paleontological resources are anticipated.	No impacts to cave/karst resources or paleontological resources are anticipated.	No impacts to cave/karst resources or paleontological resources are anticipated.

[29] This issue factor originally focused solely on caves and karst resources. It has been expanded to include paleontological resources. These two resources are similar in that assessment of the potential to occur is largely based on types of geologic units present.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	9A-3. [DROPPED][30]						
	Issue 9B: Long-Term Land Stability – Impact to Existing Landscape Productivity, Stability, and Function						
	9B-1. [DROPPED][31]						
3.3.4.2	9B-2. Quantitative level of disturbance leading to lost soil productivity (acres)	No loss of soil productivity expected.	The level of impact, soil, productivity responses, and revegetation success potential is described in section 3.3.4. (see DEIS tables 3.3.4-1 and 3.3.4-2). Total facility disturbance and impacts to productivity 10,033 acres.	Same as Alternative 2	Total facility disturbance and impacts to productivity is 10,861 acres.	Total facility disturbance and impacts to productivity for the east pipeline option is 17,153 acres. Total facility disturbance and impacts to productivity for the west pipeline option is 17,530 acres.	Total facility disturbance and impacts to productivity for north pipeline option is 16,116 acres Total facility disturbance and impacts to productivity for the south pipeline option is 16,557 acres.

[30] The original issue factor expected to be analyzed was: “Qualitative assessment of the impact of the project to seismic activity.” This issue factor largely overlapped with issue factor 5A-2 that deals with geologic hazards. Issue factor 5A-2 has been modified to incorporate seismic activity specifically, and issue factor 9A-3 has been dropped.

[31] The original issue factor expected to be analyzed was: “Qualitative assessment of long-term stability of tailings and other mine facilities, including expected results of reclamation.” This is duplicated by issue factors 5B-1 and 5B-2 (for tailings stability), and issue factor 9B-3 (for expected results of reclamation).

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.3.4.2	9B-3. Qualitative and quantitative assessment of the potential for revegetation of tailings and other mine facilities, using data (where available and if equivalent) from other mine site revegetation efforts conducted in central and southern Arizona	Under this alternative there would be no tailings or other significant changes to existing mine facilities.	Analysis findings show that the following revegetation efforts from reclamation a minimum of 8% of vegetation cover (including both native and non-native species) can be consistently be established within project disturbance areas. Effects would remain including the complete loss during operations of soil productivity, vegetation, and functioning ecosystems within the area of disturbance, and eventual recovery after reclamation, though not likely to the level of desired conditions or potentially over extremely long time frames.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	9B-4. [DROPPED][32]						

[32] The original issue factor expected to be analyzed was: “Qualitative evaluation of alteration of soil productivity and soil development.” This is duplicated by issue factor 9B-2.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.7.3.4	9B-5. [REVISED][33] Qualitative assessment of the changes in sediment delivery to downstream streams and washes.	No impacts to sediment yield would occur.	Changes in magnitude of peak flow and amount of flow would reduce sediment transport and bedload transport. Effects are not expected to be substantial in a sediment-transport limited system.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Issue 10: Recreation Resources						
3.9.4.2	10-1. Quantitative assessment of acres that would no longer meet current forest plan Recreation Opportunity Spectrum designations	No impacts anticipated.	Under Alternative 2, based on the Recreation Opportunity Spectrum (ROS) designation of user experiences, direct removal of 5,288 acres of the semi-primitive motorized setting, and 2,215 acres within the roaded natural setting.	Same as Alternative 2	Alternative 4 would remove 5,548 acres of the semi-primitive motorized setting and 2,078 acres within the roaded natural setting.	Alternative 5 (east option) would remove 986 acres of the semi-primitive motorized setting, 1,209 acres of the semi-primitive non-motorized setting, and 1,977 acres of the roaded natural setting. Alternative 5 (west option) would remove 1,173 acres of the semi-primitive motorized setting, and 1,453 acres of the roaded natural setting.	Alternative 6 (north option) would remove 1,665 acres of the semi-primitive motorized setting, and 1,740 acres of the roaded natural setting. Alternative 6 (south option) would remove 1,617 acres of the semi-primitive motorized setting, and 2,054 acres of roaded natural setting.

[33] The original issue factor expected to be analyzed was: “Quantitative assessment of the changes in sediment delivery to Queen Creek, Arnett Creek, or other key streams and washes (tons/year), compared with background sediment loading.” This factor was changed to a qualitative assessment of sediment yields, due to lack of background data on sediment concentrations or current sediment loss.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
2.2	10-2. Quantitative assessment of acres of the Tonto National Forest that would be unavailable for recreational use, for various phases of mine life and reclamation	No impacts anticipated.	All public access would be eliminated on 4,909 acres within the tailings storage facility fence line during construction, operations, and until reclamation is completed, which likely would be decades after closure. The entirety of the Oak Flat Federal Parcel would no longer be public land, though some access could remain during operations.	Same as Alternative 2	All public access would be eliminated on 5,661 acres within the tailings storage facility fence line during construction, operations, and until reclamation is completed, which likely would be decades after closure.	All public access would be eliminated on 10,782 acres within the tailings storage facility fence line during construction, operations, and until reclamation is completed, which likely would be decades after closure.	All public access would be eliminated on 10,072 acres within the tailings storage facility fence line during construction, operations, and until reclamation is completed, which likely would be decades after closure. However, these lands are currently private and Arizona State Trust lands, and would remain private lands after closure of the mine with no expectation of public access.
	10-3. [DROPPED][34]						
3.5.4	10-4. Quantitative assessment of miles of NFS roads lost, for various phases of mine life and reclamation	No impacts anticipated	A total of 8.0 miles of NFS roads would be lost due to the West Plant Site, East Plant Site, and filter plant and loadout facility. For the tailings facility, 21.7 miles of NFS roads would be lost and decommissioned.	Same as Alternative 2	Under Alternative 4, a total of 17.7 miles of NFS roads would be lost to the tailings storage facility.	Alternative 5 would not have loss to NFS roads but would result in the loss or decommissioning of 29 miles of BLM inventoried routes.	Alternative 6 would be located on private lands and impact 5.7 miles of Dripping Springs Road.

[34] The original issue factor expected to be analyzed was: "Quantitative assessment of change in visitor uses." This is largely the same information considered by issue factor 2A-5, which looked at socioeconomic effects of changes in tourism and recreation.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.4.4	10-5. Qualitative assessment of potential for noise to reach recreation areas (i.e., audio "footprint")	No impacts anticipated.	Under most conditions, predicted noise during construction and operation as sensitive receptors representing recreation users are below thresholds of concern.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Noise levels along Dripping Springs Road exceed thresholds of concern. No residual impacts after mitigation applied (new access road).
3.9.4; 3.11.4	10-6. Qualitative assessment of impacts on solitude in designated wilderness and other backcountry areas	No impacts anticipated.	Visitors to the Superstition Wilderness, Picketpost Mountain, and Apache Leap would have foreground and background views of the Alternative 2 facilities from trails and overlooks, and the recreation setting from certain site-specific views would change if the tailings storage facility were visible.	Same as Alternative 2	Same as Alternative 2	Visitors to the White Canyon Wilderness would have background views of the tailings storage facility east pipeline corridor from some trails and overlooks, and the recreation setting from certain site-specific views would change if the tailings storage facility east pipeline corridor were visible.	The tailings storage facility would not be visible from any designated wilderness areas, however the southern tailings pipeline corridor would be visible from trails and overlooks on Picketpost Mountain, and the northern tailings pipeline corridor would be visible from the Superstition Wilderness.
	10-7. [DROPPED][35]						

[35] The original issue factor expected to be analyzed was: "Quantitative assessment of hunter days lost." This is largely the same information considered by issue factor 2A-5, which looked at socioeconomic effects of changes in tourism and recreation.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.9.4	10-8. Quantitative assessment of miles of Arizona National Scenic Trail, NFS trails, or other known trails requiring relocation, and qualitative assessment of user trail experience	No impacts anticipated.	0.07 miles of the tailings pipeline corridor would intersect the Arizona Trail. NFS Road 982 would also be intersected by the tailings pipeline corridor. Resolution Copper will construct an “overpass” for the tailings corridors that would span the Arizona Trail.	Same as Alternative 2.	Would require 3.05 miles of the Arizona Trail to be closed and relocated to an area that would be safe for public use. The new construction would require a different trailway approach and exit in addition to the 3.05-mile direct loss of Arizona Trail.	The Arizona Trail would be intersected by 0.18 mile of the proposed tailings storage facility east pipeline option, in the Passage 16 segment. Resolution Copper would construct an “overpass” for the tailings corridors that would span the Arizona Trail.	Impacts from south pipeline option are similar to Alternative 2.
3.9.5	10-9. Qualitative assessment of increased pressure on other areas, including roads and trails/trailheads, from displacement and relocation of recreational use as a result of mine facilities	No impacts anticipated.	It is likely that increased use would occur on other nearby lands that provide similar experiences, depending upon the recreational user type. A minor to moderate increase in user activity would be expected to occur in recreational use areas similar to those displaced by the project elsewhere in the Globe Ranger District, as well as on other Federal, State, and County lands.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	Issue 11: Impacts to Scenic Resources						
3.11.4	11-1. [REVISED][36] Acres of Tonto National Forest land that would no longer meet current forest plan Visual Quality Objective designations.	No impacts anticipated.	Analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 393 acres of Retention, and 5,184 acres of Partial Retention.	Same as Alternative 2	Under Alternative 4, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 371 acres of Retention, and 4,663 acres of Partial Retention.	Under Alternative 5, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 691 (east) or 530 (west) acres of Retention, and 1,905 (east) or 1,824 (west) acres of Partial Retention.	Under Alternative 6, analysis finds that within the project footprint the following acreage totals have designations that would not allow for the proposed project activities: 676 (north) or 771 (south) acres of Retention, and 2,043 (north) or 2,225 (south) acres of Partial Retention.
3.11.4	11-2. [REVISED][37] Anticipated changes in landscape character from key analysis viewpoints, for various phases of mine life and reclamation.	No impacts anticipated.	The analysis of anticipated changes in landscape character from key analysis viewpoints for Alternative 2 is too extensive to summarize here and is presented in tables 3.11.4-1, 3.11.4-3, 3.11.4-4, and 3.11.4-5.	Same as Alternative 2	Analysis of anticipated changes in landscape character for Alternative 4 is presented in tables 3.11.4-6 and 3.11.4-7.	Analysis of anticipated changes in landscape character for Alternative 5 is presented in tables 3.11.4-8 and 3.11.4-9.	Analysis of anticipated changes in landscape character for Alternative 6 is presented in table 3.11.4-10.

[36] The original issue factor expected to be analyzed was: “Quantitative assessment of acres that would no longer meet current forest plan Scenic Integrity Objective designations.” This was changed to align with terminology currently in use on the Tonto National Forest.

[37] The original issue factor expected to be analyzed was: “Qualitative assessment/degree of change in landscape character from key analysis viewpoints, for various phases of mine life and reclamation.” This factor was updated to better reflect the analysis presented.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.11.4	11-3. [REVISED][38] Miles of project area visibility along major thoroughfares in the area (i.e., U.S. 60, State Route [SR] 79 and SR 177).	No impacts anticipated.	The Alternative 2 facilities would be visible along 21.2 miles of U.S. 60 and 2.5 miles of SR 177.	Same as Alternative 2	Alternative 4 facilities would be visible along 18.3 miles of U.S. 60 and 3.6 miles of SR 177.	Alternative 5 facilities would be visible along 1.5 miles of U.S. 60 and 1.5 miles of SR 177.	The Alternative 6 tailings facilities would not be visible from either U.S. 60 or SR 177.
	11-4. [DROPPED][39]						
3.11.4	11-5. [REVISED][40] Potential for increase in sky brightness resulting from the mine facility and mine-related vehicle lighting.	No impacts anticipated.	Lighting at the East Plant Site, West Plant Site, and tailings facility would be visible and noticeable at night from the town of Superior, U.S. 60, Boyce Thompson Arboretum, the Arizona Trail, and the surrounding national forest landscape.	Same as Alternative 2	Same as Alternative 2	The visibility of lighting at the East Plant Site and West Plant Site would be unchanged from Alternative 2. Lighting at the Alternative 5 tailings location may be visible to nighttime recreationists in the area, Arizona Trail users, and persons traveling on the Florence-Kelvin Highway.	The visibility of lighting at the East Plant Site and West Plant Site would be unchanged from Alternative 2. However, there would be fewer observers of the night sky in the area of the tailings because of the remote location of the facility.
	Issue 12: Impacts to Transportation/ Access						
3.5.4	12-1. Quantitative assessment of change in type and pattern of traffic by road and vehicle type	Traffic volumes will continue to increase at an average 2% annual growth rate over the next 10 to 20 years, resulting in increased traffic levels on all roads in the area.	64 trips expected during the peak hour in peak construction and 46 trips expected during the peak hour at normal operations.	Same as Alternative 2	88 trips expected during the peak hour in peak construction and 58 trips expected during the peak hour at normal operations.	Same as Alternative 2	Same as Alternative 2

[38] The original issue factor expected to be analyzed was: "Quantitative assessment of miles of U.S. 60, State Route (SR) 79 or SR 177 with direct line-of-sight views of the project area." The factor was revised for added clarity.

[39] The original issue factor expected to be analyzed was: "Quantitative assessment of miles of project area visibility along concern level 1 and 2 roads and trails." This factor was eliminated because the Tonto National Forest does not use the term "concern level" roads or trails in its planning and Forest management efforts.

[40] The original issue factor expected to be analyzed was: "Qualitative assessment of increase in sky brightness resulting from mine facility and vehicle lighting." The factor was revised for added clarity.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.5.4	12-2. Quantitative assessment of the change in level of service on potential highway routes and local roads	With increasing traffic, due to normal background growth and development of the area, the intersections in the project area are generally expected to operate within an acceptable LOS in years 2022 and 2027. The Combs Road/Schnepf Road intersection is expected to operate with a side street LOS E/F by year 2022 through 2027.	Project-related traffic would contribute to decreased LOS at many intersections; unacceptable LOS (E/F) caused by project-related traffic occurs at Silver King Mine Road/U.S. 60 (construction and operations), Main Street/U.S. 60 (construction and operations), SR177/U.S. 60 (construction), and Magma Mine Road/U.S. 60 (operations).	Same as Alternative 2	Similar to Alternative 2	Similar to Alternative 2	Similar to Alternative 2
	12-3. [DROPPED][41]						
	Issue 13: Impacts Caused by Mine-Related Noise and Vibration						
	13-1. [DROPPED][42]						
3.4.4	13-2. Qualitative assessment of the ability of alternatives to meet rural landscape expectations	No impacts anticipated.	Under most conditions, predicted noise and vibration during construction and operation at sensitive receptors are below thresholds of concern; rural character would not change due to noise.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Noise levels along Dripping Springs Road exceed thresholds of concern. No residual impacts after mitigations applied (new access road), therefore rural character would not change due to noise.

[41] The original issue factor expected to be analyzed was: "Quantitative assessment of roads decommissioned by the mine and roads lost to motorized access." This is duplicated by issue factor 10-4.

[42] The original issue factor expected to be analyzed was: "Qualitative assessment of the potential for noise to reach recreation areas." This is duplicated by issue factor 10-5.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
3.4.4	13-3. Quantitative assessment of noise levels (A-weighted decibels (dBA)) and geographic area impacted from mine operations, blasting, and traffic and qualitative assessment of effects of noise at nearby residences and sensitive receptors	No impacts anticipated.	Noise impacts were modeled for 15 sensitive receptors representing residential, recreation, and conservation land uses. Under most conditions, predicted noise and vibrations during construction and operation, for both blasting and non-blasting activities, at sensitive receptors are below thresholds of concern.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Noise levels along Dripping Springs Road exceed thresholds of concern. No residual impacts after mitigation applied (new access road).
	13-4. [DROPPED][43]						
3.4.5.1	13-5. Qualitative assessment of effects of vibrations from blasting and mine operations at nearby residences and sensitive receptors	No impacts anticipated.	The vibration analysis indicates that within given levels of explosive loading, neither blasting nor non-blasting vibrations exceed selected thresholds based on structural damage.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
	Issue 14: Impacts to Land Ownership and Boundary Management						
	14-1. [DROPPED][44]						

[43] The original issue factor expected to be analyzed was: “Quantitative assessment of acres of habitat impacted from noise, vibrations, and light, at frequencies pertinent to species of concern.” This was duplciated by issue factor 7B-4.

[44] The original issue factor expected to be analyzed was “Quantitative assessment of acres of public lands no longer accessible, for various phases of the mine life and reclamation.” This is duplicated by issue factor 10-2.

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
1.4.2; Appendix B	14-2. Quantitative assessment of lands that will be conveyed to public ownership through the land exchange (i.e., approximately 5,344 acres in all parcel groups)	No exchange of lands would occur.	1,224 acres of land will be conveyed to the National Forest Service and 4,150 acres of land will be conveyed to the BLM.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2
3.16.4.2	14-3. Quantitative assessment of changes to acreage of grazing allotments, loss of animal unit months (AUMs), and qualitative assessment of impact from loss of grazing-related facilities (waters, stock tanks, roads, fences)	No impacts anticipated.	Under Alternative 2, affected grazing allotments would experience a reduction of 8,572 acres and 666 AUMs over six allotments and 17 grazing-related facilities would also be lost.	Same as Alternative 2	Under Alternative 4 there would be a reduction in 9,399 acres and 737 AUMs over six allotments, and 17 grazing-related facilities would be lost.	Under Alternative 5, for the east pipeline corridor: There would be a reduction in 15,672 acres and 1,378 AUMs over 10 allotments, and six grazing-related facilities would be lost. For the west pipeline corridor: There would be a reduction in 16,186 acres and 2,380 AUMs over 12 allotments, and six grazing-related facilities would be lost.	Under Alternative 6, for the north pipeline corridor: There would be a reduction of 14,747 acres and 2,674 AUMs over nine allotments, and 13 grazing-related facilities would be lost. For the south pipeline corridor: There would be a reduction in 15,209 acres and 2,745 AUMs over nine allotments, and 13 grazing-related facilities would be lost.
	14-4. Qualitative assessment of changes in fencing, boundary markers, and survey markers	No impacts anticipated.	It is anticipated that implementation of any action alternative would damage, destroy, or obliterate corner monuments and landownership boundaries (e.g., through ground-clearing activities or burial beneath tailings).	It is anticipated that implementation of any action alternative would damage, destroy, or obliterate corner monuments and landownership boundaries (e.g., through ground-clearing activities or burial beneath tailings).	It is anticipated that implementation of any action alternative would damage, destroy, or obliterate corner monuments and landownership boundaries (e.g., through ground-clearing activities or burial beneath tailings).	It is anticipated that implementation of any action alternative would damage, destroy, or obliterate corner monuments and landownership boundaries (e.g., through ground-clearing activities or burial beneath tailings).	It is anticipated that implementation of any action alternative would damage, destroy, or obliterate corner monuments and landownership boundaries (e.g., through ground-clearing activities or burial beneath tailings).

DEIS Section	Issue Category	Alternative 1 – No Action	Alternative 2 – Near West Proposed Action	Alternative 3 – Near West – Ultrathickened	Alternative 4 – Silver King	Alternative 5 – Peg Leg	Alternative 6 – Skunk Camp
	14-5. [DROPPED][45]						
3.2.4	14-6. Qualitative assessment of impact to mining claims	Non–Resolution Copper unpatented load or placer mining claims are located under the tailings storage facility and pipeline corridor.	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2	Same as Alternative 2

[45] The original issue factor expected to be analyzed was: “Qualitative assessment of impacts to regional land conservation efforts.” This factor cannot be assessed until a full mitigation package is available that includes additional lands that may be brought forth in repsonse to Clean Water Act Section 404 permitting of Endangered Species Act Section 7 consultation. At this time, regional conservation land efforts do not appear to be impacted in any specific way.