



White Tank Mountain Regional Park

Phase 1 and Phase 2
Degraded Lands Mapping
Summary and Results

January 2022



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Background and Information

In the Sonoran Desert, many barriers exist to successful ecological restoration including both climatic (e.g. drought) and logistical constraints (e.g. a lack of available native plant materials). To support future restoration planning in White Tank Mountain Regional Park (WTRP or the Park) we mapped degraded areas, categorized these by types of disturbance, and then provided information to help the Park prioritize and support restoration efforts.

Methodology

For this project, we first prioritized the high use areas of WTRP encompassing about 16,000 acres in the eastern portion of WTRP and where all the official trails are located (Phase 1). Later, we covered the remaining roughly 14,000 acres in the western portion of WTRP, an area in which there are no official trails (Phase 2). Two scans of these areas were completed by volunteers. The first scan was done on Google Earth Pro (GE) and the second using ArcMap 10.8 with aerial imagery provided by Maricopa County Parks and Recreation (MCP).

The GE imagery was dated November 2018 and had estimated average resolution of 15 cm/pixel. The aerial imagery was taken during 2018 and had resolution of 10 cm/pixel in the extreme northern and eastern portions of WTRP covering approximately 4000 acres and resolution of 23 cm/pixel over the remainder of the study area.

Spatial data from MCP and the Arizona Department of Water Resources (ADWR) were added to both GE and to the ArcGIS

map prior to scanning that showed the following attributes:

1. WTRP boundary
2. WTRP trails, service roads (both active and abandoned), and known obstacles (e.g., constructed berms)
3. River 10-foot Countywide – centerline or boundary of water features including washes as defined by the ADWR 2001 10-foot countywide mapping project.

WTRP was divided into 11 sections from north to south. Each section extended about 1 km north-south and the east-west width of the study area, an average over both Phases of roughly 1300 - 1500 acres per section.

Citizen scientists were trained to scan assigned sections at a scale of about 1" on screen is equal to 25 m of mapped length.

When they saw a candidate degraded location, they marked it if it met the following criteria:

1. Generally at least 100 m² in extent
2. Bare dirt or visibly different from surrounding areas, with no or limited vegetation.
3. Human-caused rather than animal-caused or natural features.

Citizen scientists did not mark official trails, washes, or designated service roads. They did mark distinct, extended, generally linear features that were not designated as official trails or service roads. Each section was reviewed by two volunteers who did not see each other's results.

All the potential disturbed sites compiled by the volunteers were verified by a third trained observer to confirm whether the sites fit the above criteria. False positives were removed and the remaining candidate sites were transferred to ArcMap 10.8. The sites were then examined using the available aerial imagery. Note that for much of the study area, the GE imagery was higher-resolution than the aerial imagery. Both imagery sources were used and compared in this review round which eliminated some previously-identified sites, adjusted the sizes and shapes of some identified areas, and, in a few cases, added sites. Sites were eliminated based on these determinations:

- Did not meet the minimum size requirement. (Note, however, that some degraded junctions were retained even if they did not meet the minimum size because such areas often increase in size over time with continued use.)
- Were actually natural areas with no large plants rather than bare earth sites.
- Were animal (rather than human) trail clusters characterized by short, indistinct pathways in random directions without obvious goals.
- Had the characteristics of human-caused trails – linear, longer, with either a rationale (e.g., a shortcut) or a destination (e.g., connection with another trail) – but were heavily vegetated or obstructed suggesting a lack of continued use.
- Were previously unmarked wash extensions or branches.

In summary, “degraded areas” were defined either as dirt areas generally >100 m² with limited vegetation and likely to have been caused by human use or as clusters of unauthorized human trails or tracks. Four different categories of degraded areas were identified in the two phases (numbers refer to the combined total from both phases):

1. Polygons identifying either bare areas or clusters of use trails (53 features).
2. Polygons identifying visibly impacted areas, often near structures, for review by Park management. These are called “secondary” features (5 features).
3. Linear features identifying unauthorized trails or roads, i.e., easily visible, extended, largely unobstructed features that generally run linearly with a destination, but which are not marked on layers provided by MCP (55 features).
4. Linear features identifying possible additional unauthorized trails or roads, i.e., visible, extended, sometimes partially obstructed features that generally run linearly but which are not marked on layers provided by MCP. Some of these may still have occasional use. These are called “secondary” features and we suggest they be reviewed by Park management (7 features).

We developed tables to summarize information on the identified disturbed areas, including length for linear features (unauthorized trails and possible service roads) and area for polygons or non-linear features. For planning purposes, further information is provided for polygons including type of disturbance and, for both polygons and some isolated linear features, distance to the nearest official trail, official service road, or paved road. Note that the tables show both primary and secondary disturbed features. Secondary features are those that may be intentional, already partially mitigated, etc. The tables present the results from Phase 1 and Phase 2 separately, but the numbers in this report reflect the combined totals from both phases.

The methodology used in this study was described in a paper published in 2021 (Rowe, H, Gruber, D, Fastiggi, M 2021. ‘Where to start? A new citizen science, remote sensing approach to map recreational disturbance and other degraded areas for restoration planning’, *Restoration Ecology* (2021) 29: e13454).

Results and map information tools

We identified a total of 58 disturbed areas, i.e., polygons (53 primary and 5 secondary), 49 of which were at least 100 m² in size and another nine (four junctions, three widened areas, and two other disturbed sites) are <100 m², but were included because they may also be good candidates to consider for interventions over time (Table 1). An additional total of 62 linear disturbances, i.e., paths (55 primary and 7 secondary) were assumed to be unauthorized trails or roads (Table 2).

Sites ranged from 66 m² to 6971 m² (Table 1). We provide information associated with each disturbance to help managers prioritize mitigation or restoration activities. Information includes type of disturbance (trail/road junction, trail cluster, trail/road widening, and other disturbed area) and distance to the nearest access (Table 1). Additional considerations in prioritizing restoration activities may include whether the disturbance has ceased or can be stopped and the organization's capacity for restoration work in a given period. We have also provided the table information in Excel workbook format (Deliverable 1, Appendix A), which can be useful for sorting or prioritizing data according to size of disturbance or distance to nearest access. For example, one may choose to prioritize the largest disturbances with the nearest access.

Note that the lists of degraded polygons and paths may include some sites that were created intentionally, where use is permitted, or where remediation is in progress and therefore may not be suitable for mitigation:

- Some of the identified degraded areas are near or between structures. They may be used, for example, for outdoor activities, as overflow areas, etc.
- Some of the identified degraded areas are alongside paved or designated service roads. Although we did not include areas that obviously were created by blading or ripping or where supply piles were visible, we did include areas that do not appear intentional.

Some of the identified linear features actually may be WTRP roads or trails that remain semi-active or are planned firebreaks, emergency access routes, closed trails or roads with mitigation in progress, etc., even though they are not included in the map layers provided by MCP. We did omit visible but heavily overgrown routes that obviously were closed and mitigated in the past.

All maps and associated information can be found in Appendix A: Deliverables. The complete degraded lands map includes the following layers:

1. Two groups of identified disturbed sites – for the east and west portions of the Park – each with two layers:
 - Polygons (types: widened trail/road junctions, widened areas along roads/trails, human use-trail clusters, other disturbed areas)
 - Unauthorized trails or roads

When applicable, both “primary” and “secondary” disturbed sites are included in a layer, distinguished by symbology and associated information.

2. Official WTRP trails layer
3. Designated service roads layer
4. Wash centerlines or boundaries
5. USDA Web Soil Survey soil map units, useful for identifying native plant associations
6. Park boundary

Summary of degraded areas and possible mitigation actions

Most of the disturbances identified on Google Earth were unofficial trails and roads and widened areas along them or at junctions. Experience with mitigation of closed roads and trails in the McDowell Sonoran Preserve indicates that effective treatments for keeping traffic off of linear features is to close off the ends and junctions with some combination of ripping, transplants, deadfall, boulders, and signage to stop further use. We recently completed a study that assessed restoration outcomes of a combination of these restoration techniques (Rowe, H, Sprague, T, Broatch, J, Gruber, D, Langenfeld, D, & Rivera, L 2020. ‘Lessons Learned 5+ Years After Transplanting and Seeding Restoration Sites in the Sonoran Desert, U.S.A.’, *American Midland Naturalist* (2020) 184:129–148).

In addition to the areas directly associated with trails, we identified some disturbed sites that are isolated (each categorized in Table 1 as a “Disturbed Area”). In order to differentiate between sites that were human-caused rather than natural features, we looked for proximity to an official or abandoned service road, a trail, or a large wash that could serve as an access corridor to such a site. If sites had such associated access within 250 meters, we included them as disturbed areas. It is possible that such sites were associated with some historical activity like prospecting or mining test sites, which are common in the Phoenix area. However, we suggest that all “Disturbed Area” sites in Table 1 that are more than 5 meters from the nearest access be examined more closely to determine conclusively whether they are manmade or natural.

How to choose plant species for restoration: Soil Map and Ecological Site Descriptions

A critical first step before commencing ecological restoration is to stop the disturbance (Society for Ecological Restoration primer). In some cases, if the disturbance was not extensive, this may be all that is required to allow for natural recovery. In cases with extensive disturbance, more active restoration may be desired.

One common technique for active restoration is seeding with a native plant seed mixture and/or transplanting native plant seedlings or cuttings. However, with extensive degradation and disturbance, the native species in an area may not be obvious. Also, there can be significant changes in the dominant and common species over surprisingly short distances due to ecological changes related to soil type, slope, exposure, etc. This means that sometimes simply using the species that are visible in nearby areas may not be the best guide for active restoration.¹

The USDA Web Soil Survey (WSS) can be helpful in identifying the most common native species associated with the soil type of a specific area.² To determine appropriate species for WTRP, we established an “area of interest” that covered the Park, then generated a soil map for that area and included it as a layer in the restoration maps. The soil report generated by the WSS shows the soil map, lists the soil types, and provides a description of various characteristics of each soil type in the area (Deliverable #5a, Appendix A). An Ecological Site Description (ESD) is associated with each soil type. These are accessed via the hyperlinks provided in the “Links to WTRP Ecological Site Descriptions” document (Deliverable 6b, Appendix A). Each ESD document includes a state and transition model that describes the general impact on local species of ecological transitions such as the introduction of exotic species or degradation followed by extended recovery and provides a list of plant species in the potential plant community generally associated with the particular soil type of the ESD, listed as the “historical climax plant community”. An Excel workbook (ESD plant communities.xlsx) containing sheets listing the plant species associated with each ESD is attached (Deliverable #5c, Appendix A).

These species lists can be very useful as the basis for deciding what seed mix or transplants are most appropriate in restoration of a specific degraded site. On the map package, AGOL map, or GE (Deliverables 2, 3, and 5, respectively, in Appendix A), simply zoom to a specific degraded site and observe the map unit(s) of the local soil. Then go to the “WTRP ESD SITES.xlsx” workbook (Deliverable #5c, Appendix A) and refer to the correct sheet (sheets are named by the ESD code).

Because the plant communities listed in the ESDs are generalized with soil type and not specific to any particular location, these can be further refined by comparing them with a

¹ See https://cdn.ymaws.com/www.ser.org/resource/resmgr/custompages/publications/ser_publications/ser_primer.pdf

² See <https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>



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list of native flora for the area if available. The “WTRP ESD SITES.xlsx” workbook (Deliverable #5c, Appendix A) also includes a restoration priority list of Sonoran Desert plant species developed by USGS. This sheet is useful for choosing species with particular habitat benefits to wildlife and pollinators and for identifying species that may be easier to propagate.

Table 1A: Polygons of Degraded Lands at WTRP - East

NAME ¹	Primary or Secondary ²	Area (sq. m)	Type ³	Approx. Distance (m) to Nearest Access ⁴	Nearest Access Type
202006231241	Primary	1607.08	Disturbed Area	236.49	Park Trail
202006231249	Primary	99.19	Junction	0.00	Service Road
202006231253	Primary	271.52	Widening	1.65	Park Trail
202006231346	Primary	902.24	Disturbed Area	147.46	Service Road
202006231349	Primary	641.36	Disturbed Area	43.37	Park Trail
202006241514	Primary	106.91	Junction	1.20	Service Road
202006251521	Primary	511.21	Widening	5.77	Service Road
202006251533	Primary	406.24	Disturbed Area	147.92	Service Road
202006251555	Primary	790.66	Junction	6.09	Service Road
202006271441	Primary	189.60	Widening	0.27	Park Trail
202006271444	Primary	118.19	Widening	0.73	Park Trail
202006271457	Primary	346.44	Widening	1.40	Service Road
202006271513	Primary	169.12	Junction	0.77	Park Trail
202006271515	Primary	70.67	Widening	1.59	Park Trail
202006271517	Primary	80.40	Junction	1.36	Park Trail
202006271551	Primary	92.87	Disturbed Area	24.08	Service Road
202006271607	Primary	145.38	Junction	0.00	Service Road
202006271611	Primary	451.66	Junction	0.00	Park Trail
202006271613	Primary	486.79	Widening	0.67	Service Road
202006281256	Primary	357.79	Disturbed Area	0.72	Service Road
202006291511	Primary	159.72	Disturbed Area	40.00	Paved Road
202006301513	Primary	122.31	Junction	0.54	Service Road
202006301643	Primary	269.01	Widening	1.11	Service Road
202006301657	Primary	6152.89	Trail Cluster	10.00	Paved Road
202007011530	Primary	1410.86	Junction	3.04	Service Road
202007011621	Primary	103.82	Widening	2.20	Park Trail
202007011629	Primary	96.25	Disturbed Area	32.51	Park Trail
202007011644	Primary	409.80	Disturbed Area	64.86	Park Trail
202007011652	Primary	120.49	Widening	0.87	Park Trail
202007011706	Primary	886.33	Widening	1.47	Park Trail
202007011710	Primary	521.70	Widening	3.60	Park Trail
202007021638	Primary	70.51	Widening	0.26	Park Trail
202007021640	Primary	128.00	Widening	0.92	Park Trail
202007031319	Primary	1109.69	Disturbed Area	5.00	Paved Road

NAME ¹	Primary or Secondary ²	Area (sq. m)	Type ³	Approx. Distance (m) to Nearest Access ⁴	Nearest Access Type
202007031505	Primary	487.63	Disturbed Area	30.95	Service Road
202007061525	Primary	153.17	Disturbed Area	32.00	Paved Road
202007071413	Primary	113.41	Junction	1.02	Service Road
202007241352	Primary	364.32	Widening	2.06	Park Trail
202006281340	Secondary	526.45	Widening	1.67	Service Road
202006281351	Secondary	2455.91	Disturbed Area	0.00	Park Trail
202006301322	Secondary	6970.55	Trail Cluster	40.00	Paved Road
202007031401	Secondary	2645.99	Disturbed Area	0.00	Paved Road
202007031402	Secondary	2255.27	Disturbed Area	0.52	Park Trail

Table 1B: Polygons of Degraded Lands at WTRP – West

NAME ¹	Primary or Secondary	Area (sq. m)	Type ³	Approx. Distance (m) to Nearest Access ⁴	Nearest Access Type
202109091515 added	Primary	199.06	Disturbed area	0	Service road
202109131604 modified	Primary	158.10	Disturbed area	0	Service road
202109151036 modified	Primary	186.33	Junction	0	Service road
202109151038 modified	Primary	173.60	Widening	0	Service road
202109151139 modified	Primary	280.89	Junction	0	Service road
202109151140 modified	Primary	206.89	Widening	0	Service road
202109151143 modified	Primary	121.15	Widening	0	Service road
202109162207 modified	Primary	138.53	Widening	0	Service road
202110031348	Primary	554.26	Disturbed area	0	Service road
202110051344	Primary	79.48	Junction	0	Service road
202110051351	Primary	300.73	Disturbed area	0	Service road
202110061344	Primary	146.91	Junction	0	Service road
202110071018	Primary	404.04	Disturbed area	0	Service road
202110121314	Primary	66.34	Junction	0	Service road
202110141301	Primary	82.84	Widening	0	Service road

¹ Note that the “NAME” column shows the label applied to the feature on the map. These tables correspond to the attribute tables for the degraded area layers on the map. The contents of Tables 1 and 2 are included in the Excel workbook attached to this report.

² “Secondary” denotes a disturbed area that may be intentional, partially mitigated, etc.

³ “Disturbed Area” means a bare area that may be related to historical activities. “Junction” means a widened junction of several trails, several service roads, or trails with roads. “Trail Cluster” means multiple trails caused by human use in a compact area. “Widening” means an enlarged bare area along a road or trail.

⁴ This is the approximate closest distance from some portion of the degraded site to the nearest paved road or official trail or service road. There may be unauthorized trails or roads and wash corridors that are closer to the degraded site.

Table 2A: Degraded Paths at WTRP – East

NAME ¹	Primary or Secondary ²	Length (m)
202006231247	Primary	18.52
202006231255	Primary	27.98
202006231303	Primary	122.15
202006231343	Primary	112.22
202006241510	Primary	292.42
202006251500	Primary	74.45
202006251504	Primary	54.55
202006251508	Primary	322.56
202006251514	Primary	73.52
202006251540	Primary	993.29
202006251551	Primary	117.13
202006251603	Primary	67.54
202006271451	Primary	39.08
202006281328	Primary	61.80
202006291423	Primary	131.32
202006291426	Primary	32.37
202006291430	Primary	28.82
202006291446	Primary	270.13
202006291451	Primary	189.97
202006291453	Primary	17.32
202006291501	Primary	528.34
202006291530	Primary	42.70
202006301305	Primary	106.31
202006301320	Primary	49.17
202006301344	Primary	179.79
202006301352	Primary	32.95
202006301353	Primary	58.17
202006301652	Primary	390.17
202007011512	Primary	418.32
202007011513	Primary	87.26
202007011636	Primary	42.76
202007011637	Primary	27.76
202007021605	Primary	13.20
202007021637	Primary	10.92
202007021642	Primary	840.53

202007021702	Primary	83.26
202007031341	Primary	212.31
202007031343	Primary	17.06
202007031400	Primary	30.26
202007031523	Primary	174.11
202007031526	Primary	35.89
202007061532	Primary	717.45
202007071246	Primary	33.21
202007071257	Primary	32.87
202007241437	Primary	53.75
202006241427	Secondary	178.33
202006251515	Secondary	338.11
202006271621	Secondary	126.96
202006281329	Secondary	67.09
202006291433	Secondary	222.88
202007021555	Secondary	667.07
202007031323	Secondary	427.70

Table 2B: Degraded Paths at WTRP – West

NAME ¹	Primary or Secondary ²	Length (m)	Approx. Distance (m) to Nearest Access ³	Nearest Access Type
202109091512	Primary	180.92	1	Service road
*202109151010_modified	Primary	33.76	507	Service road
*202109151017_modified	Primary	130.22	242	Service road
202109151018_modified	Primary	30.97	247	Service road
202109152127	Primary	153.40	4	Service road
202109152128	Primary	500.15	76	Service road
202109152130	Primary	102.73	5	Service road
202110031354	Primary	39.67	0	Service road
202110031411	Primary	800.36	69	Service road
202110031412	Primary	86.33	279	Service road

* Parts of a much longer trail mostly outside the Park.

- ¹ Note that the “NAME” column shows the label applied to the feature on the map. These tables correspond to the attribute tables for the two degraded area layers on the map. The contents of Tables 1 and 2 are included in the Excel workbook attached to this report.
- ² “Secondary” denotes a disturbed area that may be intentional, partially mitigated, etc.
- ³ These are mostly isolated paths. This is the approximate closest distance from some portion of the degraded path to the nearest paved road or official trail or service road. There may be unauthorized trails or roads and wash corridors that are closer to the degraded path.

Appendix A: Deliverables

Deliverables from this project include the following:

1. An Excel workbook (“WTRP_Combined_Paths_Polys.xlsx”) with a separate worksheet for each class of potential restoration candidates is attached. We suggest using this workbook as a reference in conjunction with the various maps. Each worksheet includes type of feature, length or area, and names that correspond to map labels. For polygons, the area is an approximation of the actual size of the degraded site. Polygons are classified into 4 types: degraded areas along the side of a road or trail; widened junctions; extended, dense use-trail clusters; possible mining or other degraded sites. Also, the approximate distance to the nearest access is shown and the access type is identified, although there may be washes, unauthorized trails, or possible service roads that are closer to the polygon. The contents of this workbook are shown in Tables 1 and 2.

The degraded lands map is provided in several formats for ease of access and use. All versions of the map contain the same information except for inherent differences related to the formats, as noted.

2. A map package showing the final results is publicly available on ArcGIS Online (AGOL) and can be accessed by anyone with an ESRI license by searching for “WTRP_Degraded_Lands_Map_Combined_Final.” This package contains the map and also all the associated data, so it will open showing all layers on any computer with ArcMap or ArcGIS Pro installed. It is a very large file (~1 GB) that must be downloaded before opening. Note that the map has a reference scale of 1:4000, which means that all the degraded lands-related labels will display at their intended size when zoomed to this scale. All degraded site labels display only when zoomed in to 1:10,000 and soil unit labels display when zoomed in to 1:24,000.
3. A high-resolution PDF of the “Combined Final” map is attached. Note that some of the degraded site polygons are so small relative to the size of the Park that they do not reproduce on the PDF. The labels, which are visible, provide an indication of location. The map package, deliverable #2, provides full details.

The labels for all the potential restoration candidate features on the map package and PDF correspond to those in the Excel workbook, shown in Tables 1 and 2.

4. A KMZ file (“WTRP Degraded Lands Map Phase 1 - Final.kmz”), which will open the final results in Google Earth, is attached. Note that on GE the labels cannot be displayed but can be seen either by expanding each layer in the “Places” panel or by moving the cursor over a feature until a “hand” icon appears, right-clicking, and selecting “Properties” from the list that opens. Also note that for most of the study area the imagery on GE has higher resolution than that provided in the map package (deliverable #2).



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5. Several documents associated with soil data information are attached:
 - a) The "WTRP_Soil_Report," which shows the soil map for WTRP and describes the various soil types in the area.
 - b) "Links_to_WTRP_Ecological_Site_Descriptions," which provides access to the ESDs associated with each soil map unit in the Park and immediate vicinity.
 - c) An Excel workbook ("WTRP ESD SITES.xlsx") which shows the plant lists associated with each ESD in the Park plus a restoration priority list of Sonoran Desert plant species developed by USGS.



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