Evaluation of Salvage and Replanted Native Plants on ADOT Projects

Final Report 587
June 2012

Arizona Department of Transportation
Research Center

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16. Abstract

ADOT has transplanted thousands of saguaros during the construction of roadway projects, and although the projects are typically tracked for two years, the long-term survivability of saguaros has never been documented. The purpose of this study is to examine ADOT projects in which saguaros were transplanted as part of the revegetation effort, and to evaluate the factors that contribute to the survival and good health of saguaros. The development of more successful techniques for salvaging saguaros will help ensure the long-term viability of transplanted saguaros and will enable ADOT to spend monies more effectively. Four projects involving saguaro salvage and replanting were selected for evaluation: State Route 86 Covered Wells, State Route 87 Tombstone Hill, State Route 188 Resort Road to Devore Wash, and US Route 93 Kaiser Spring. The projects occurred over a broad geographic area, with elevations ranging from 2,018 to 3,190 feet.

An inventory of all saguaros, both alive and dead, was conducted in 2008. Each plant was assigned a number, its location was recorded using GPS equipment, a photograph was taken, and information was recorded regarding plant size and health and surrounding environmental conditions. Consistent among the four projects inventoried was the finding that the taller saguaros had a lower survival rate and exhibited poorer health after transplantation. Saguaros up to 12 feet in height typically exhibited good health. A sharp decrease in the percentage of plants in good health was observed in the 12-foot-plus saguaros, and particularly in the 20-foot-plus size. The presence of arms had a negative effect on saguaro survivability and overall health, an observation that held true for all the projects. A third variable affecting saguaro survivability and health was planting depth. A marked decrease in health was observed among saguaros that did not exhibit taper at the base of the plant, an indication that the saguaro was planted too deep. Recommendations are discussed regarding saguaro salvage and replanting techniques.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TABLE OF CONTENTS

Page

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

Table **Page**

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The Arizona Department of Transportation (ADOT) provided funding for this project through the Arizona Transportation Research Center (ATRC). LeRoy Brady, Manager of ADOT's Roadside Development Section, was instrumental in initiating this project. He also served as a member of the Technical Advisory Committee (TAC), with Vicki Bever, Mike Daehler, Tao Fong, Ted Littlefield, Matt Moul, and Steve Thomas. Estomih (Tom) Kombe, Ph.D., served as chairman of the TAC and provided administrative assistance throughout the project. The Federal Highway Administration (FHWA) provided funding and support.

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EXECUTIVE SUMMARY

The Arizona Department of Transportation (ADOT) has transplanted thousands of saguaros during the construction of roadway projects. Saguaros represent a valuable natural resource, providing a major contribution to the ecosystem and the visual quality of an area. In addition, they are protected under the Arizona native plant law. While their ultimate value is impossible to quantify, the cost of salvaging and replanting saguaros and other native cacti can be $200,000 to $300,000 per mile. The ADOT projects involving saguaro salvage and replanting are typically tracked for up to two years after completion of the roadway work, but there has never been a follow-up study of this magnitude at ADOT analyzing the survival rate and health of transplanted saguaros.

Four projects were selected by the ADOT Technical Advisory Committee (TAC) and Logan Simpson Design (LSD) for analysis: State Route 86 Covered Wells, State Route 87 Tombstone Hill, State Route 188 Resort Road to Devore Wash, and US Route 93 Kaiser Spring. The projects were completed between 1998 and 2005 and occur over a broad geographic area, with elevations ranging from 2,018 to 3,190 feet.

LSD obtained information on each of the four projects, including the plant inventory conducted during the design phase, the contractor's inventory conducted prior to salvage activities, photos, replanting plans, planting details, special provisions, bid schedules, the contractor's transplanting plan, and inspection memos.

CRITERIA

The TAC and LSD developed a set of criteria with which to evaluate the individual saguaros. Among the criteria were plant size, plant health, aspect, plant orientation relative to original growing condition (indicated by north mark), slope, planting substrate (cut or fill material), amount of rock in the soil, amount of vegetative cover around the plant, taper in the stem at ground level, presence of a basin for rainwater harvesting, and presence of habitat for wildlife.

SURVEY RESULTS

The projects were field-surveyed in 2008 by LSD staff. An inventory number was assigned to all existing saguaros, living or dead, and a photo was taken of each plant. A global positioning system (GPS) unit was used to record the location of the saguaros at the same time that data were gathered regarding plant size and health, and surrounding environmental conditions. When the original inventory tag was still with the plant, the number was recorded.

The SR 86 Covered Wells section was inventoried on January 28, 2008. The inventory located 75 plants of the 98 plants salvaged. Of the 75 saguaros identified during the inventory, one was in excellent health, 38 were in good health, 14 were in fair health, 10

were in poor health, and 12 were dead. Based on an initial quantity planted of 98, minus two saguaros destroyed by utility work, the survival rate overall (63 of 96) was 66%.

The SR 87 Tombstone Hill section was inventoried between June 10 and June 17, 2008. Of the 259 saguaros identified during the inventory, four were in excellent health, 160 were in good health, 54 were in fair health, 16 were in poor health, and 25 were dead. Based on an initial quantity planted of 345, the survival rate overall was 68%.
The SR 188 Resort Road to Devore Wash section was inventoried between February 4 and June 4, 2008. Of the 279 saguaros inventoried, six were in excellent health, 116 were in good health, 82 were in fair health, 37 were in poor health, and 38 were dead. Based on an initial quantity planted of 335, the survival rate overall was 72%.

The US 93 Kaiser Spring section was inventoried between March 12 and October 15, 2008. Of the 155 plants identified during the inventory, three were in excellent health, 104 were in good health, 26 were in fair health, four were in poor health, and 18 were dead. Based on an initial quantity planted of 175, the survival rate overall was 78%.

FINDINGS

Certain characteristics of the saguaros or of how they were planted were correlated with survival rate and health:

- Height at transplantation
- Presence of arms
- Planting depth
- Orientation when replanted (with the north mark facing north)

Consistent among the four projects inventoried was the finding that the taller saguaros had a lower survival rate and exhibited poorer health. Saguaros up to 12 feet in height typically exhibited good health. A sharp decrease in the percentage of plants in good health was observed in the 12-foot-plus saguaros, and particularly in the 20-foot-plus size. Based on these findings, it would appear that the best candidates for transplantation are saguaros shorter than 12 feet in height.

The presence of arms had a negative effect on saguaro survival rate and overall health, an observation that held true for all the projects.

A third variable affecting saguaro survivability and health was a tapering trunk. A marked decrease in health was observed among saguaros that did not taper above the soil line, an indication that they were planted too deep.

The presence of a north mark oriented to the north had a moderately positive influence on survivability among saguaros in the four projects inventoried. However, because it could not be verified that the saguaros *without* a north mark were oriented *improperly*, the apparent correlation between no north mark and poorer health could not be confirmed.

Other variables had less of an effect. Aspect did not have a noticeable influence on saguaro survivability and health except in the SR 188 Resort Road to Devore Wash section, and that may be explained by the higher elevation of the project relative to the others, where the advantage of a south-facing (warmer) slope or the disadvantage of a north-facing (cooler) slope is magnified.

The results relative to steepness of slope, cut versus fill, the amount of rock in the soil, the amount of vegetative cover, and basins were varied, such that a determination could not be made regarding their effect on saguaro survivability and health.

RECOMMENDATIONS

Based on the results of the four inventories, as well as the consensus of opinion among authors cited in the literature review and members of the TAC, the following recommendations are made:

- The majority of saguaros salvaged for revegetation projects should be 12 feet or less in height. Limited numbers of larger saguaros may be salvaged to achieve the dramatic visual impact that only a multi-armed specimen can provide. Larger (more mature) saguaros can also increase the diversity of life stages on a revegetation project. The specimen saguaros should be planted in highly visible areas. When possible, the larger saguaros should be transplanted directly to their final location using a "move-once" technique.

- Saguaros should be planted at the same depth as originally grown or not more than 3 inches deeper. Saguaros planted too deep may suffer water stress because their roots are too far down to benefit from supplemental irrigation or natural rainfall. Prior to transplantation, a non-damaging mark should be made on the saguaro 12 inches above ground level to serve as a measure of how deep the saguaro was planted.

- Root length was not addressed in this study; however, the requirements outlined in the SR 188 Resort Road to Devore Wash and US 93 Kaiser Spring Special Provisions should be applied to future saguaro salvage projects. The requirements state, "Excavation of the root structure shall maintain the following minimum root lengths: three inches for roots less than one inch in diameter; 12 inches for roots greater than one inch but less than three inches in diameter; and 24 inches for roots greater than three inches in diameter." A photo of the roots should be taken following excavation. The photo should include a measuring stick.

- When an adequate root mass is salvaged, it should provide some support to the saguaro, though bracing is recommended for saguaros 6 feet and taller. A triangulated configuration of wooden supports, or nylon rope anchored by metal stakes, is recommended for the bracing, with padded boards or a "collar" of fiber-reinforced hose placed at the trunk of the saguaro at approximately two-thirds the height of the plant. Rope bracing is recommended for saguaros up to 12 feet in height, and wooden supports are recommended for saguaros taller than 12 feet.

- The north side of the saguaro should be marked prior to transplantation, and the plant should be replanted with the same orientation.

- Saguaros growing in a shaded situation (such as under a tree) should be noted on the initial plant inventory, and then they should be placed either in a similar situation, or shaded for a summer where possible.

- All saguaros three feet in height and smaller should be protected by shade cloth through the first summer of establishment.

- As project schedule and site conditions allow, saguaros to be transplanted should be watered two weeks prior to transplantation, to promote hydration of the plant tissues and potentially lessen the shock of transplantation. The application of water should be in a manner that allows for slow infiltration to a depth of at least 12 inches.

- Supplemental irrigation should be provided for at least two years following transplantation. Local conditions, including temperature and rainfall, should be considered when determining the necessary frequency of irrigation, with the maximum interval between irrigations to be one month. As indicated by the lower survivability of saguaros on the projects that received lower-than-average rainfall, the amount of moisture available to the plants after the temporary irrigation is discontinued may be critical. Continuation of the supplemental irrigation beyond two years may be beneficial.

- Creation of water-harvesting basins around the saguaros is recommended. Although the inventory results did not conclusively indicate a benefit from basins, any means of providing additional moisture should be beneficial.

- When saguaros are transplanted on projects above 2,800 to 3,000 feet elevation, care should be taken to place the plants on south- and west-facing slopes; north-facing slopes should be avoided. If planting on a north-facing slope is unavoidable, the plants should be placed near the top of the slope rather than near the base. In general, transplanted saguaros should be placed in situations that closely replicate how they occur naturally, particularly relative to aspect and density of saguaros per unit of land.

- In addition to the photos taken prior to transplantation, photos should be taken immediately following transplantation, and at the end of the plant establishment period, when care and monitoring for the plants is terminated.

- The plant inventory tag should be maintained on the plant throughout the plant establishment period.

1.0 INTRODUCTION

The saguaro cactus is one of the most recognizable symbols associated with the state of Arizona. It is found only within the Sonoran Desert, where it is considered an indicator plant of the desert's boundaries; the saguaro cactus flower is the Arizona state flower; and the saguaro is protected by the Arizona native plant law. ADOT has transplanted thousands of saguaros during the construction of roadway projects, and future projects will be constructed in saguaro habitat. Saguaros represent a valuable natural resource, providing a major contribution to the ecosystem and the visual quality of an area. While their ultimate value is impossible to quantify, the cost of salvaging and replanting saguaros and other native cacti can be $200,000 to $300,000 per mile.

Little research has been done on transplanting saguaros. And although many thousands of saguaros have been transplanted by commercial salvage operations, statistics on transplantation success are generally not available. ADOT typically tracks projects for two years after the saguaros are transplanted, but saguaros may survive that long by utilizing moisture stored in their tissues, only to later decline and die.

The purpose of this study is to examine ADOT projects where saguaros were transplanted as part of the revegetation effort and to evaluate the factors that contribute to the survival and good health of saguaros. The development of more successful techniques for salvaging saguaros will help ensure the long-term viability of transplanted saguaros and will enable ADOT to spend monies more effectively.

This document includes the following:

- A literature review bringing together the existing research and anecdotal evidence related to saguaro transplanting.
- The methodology of the study.
- The results of the inventories of four projects that involved saguaro transplantation.
- The conclusions drawn from analysis of the results.
- Recommendations based on the conclusions.
- Appendices containing supplemental information (planting details in Appendix A, and detailed inventory results in Appendix B).

2.0 REVIEW OF LITERATURE

2.1 TRANSPLANTED SAGUARO SURVIVAL

Information on the success rates of transplanted saguaros is mostly anecdotal, with one saguaro mover stating that the likelihood of survival and recovery after three to five years is as high as 90% (Emming 2007). Emming goes on to say that the smaller the plant and the better the care, the better its odds of survival. If a plant has never been moved before, is juvenile to middle age, is vigorous, comes free of the earth with abundant roots, was well-hydrated prior to the move, and was transplanted using proper transplanting techniques, then the prognosis for long-term survival is very good.

Another experienced mover of saguaros estimates a 95% survival rate (Elliott 1994). According to Elliott, the success rate of saguaro transplants is inversely related to the size of the plant. The smaller (younger) plants have a much greater chance of survival. In fact, it is almost impossible, says Elliott, to kill a saguaro that is 2 feet tall or shorter. By contrast, the very large saguaros of 25 feet and taller rarely survive. These giants do not reestablish due to a combination of problems: their own weight often causes tissues to be crushed, allowing rot to begin; they have to be planted so deeply that new roots do not reach the surface; and the trauma of transplanting may accelerate conditions within the plant that would have eventually killed it without the move.

A 10-year study of 800 saguaros transplanted near Tucson, Arizona, provides the most statistically sound information regarding saguaro survival following transplantation (Harris et al. 2004). After nine years of study, the survival rate overall was 66%. Saguaros in the study were stratified by height, and the corresponding survival rates indicate a general decrease in percentage of survival with increasing height. Heights and corresponding survival rates are listed in Table 1**.**

Table 1. Plant Health in Relation to Height.

Height	Survival Rate
0.1–0.9 m (4 inches to 3 feet)	76%
1.0–1.9 m (3 ft 3 in to 6 ft 3 in)	80%
2.0–3.9 m (6 ft 6 in to 12 ft 9 in)	71%
4.0–4.9 m (13 ft 1 inch to 16 ft)	56%
5.0–6.9 m (16 ft 5 in to 22 ft 8 in)	55%
≥7.0 m (≥23 ft)	40%

2.2 TIME OF TRANSPLANTATION

There is consensus among published sources that saguaros can be moved successfully at any time of the year (Desert Botanical Garden 2004; Mazier 1998). The Desert Botanical Garden notes that the coolest times of the year should be avoided, and the preferred time is in warm weather, with the caveat that the saguaros should be protected from the sun

with shade cloth for the first summer. Shade cloth may be placed directly on the plant, or on a support. Mazier concurs with the need to place shade cloth on a saguaro if sunburn (yellowing) occurs, although he recommends transplanting in the winter to lessen stress on the cactus. The months of October and November are optimal for transplanting (Mazier, undated). Emming (2007), another advocate of shade cloth, recommends shading transplanted adult saguaros for their first summer, especially if the plants are weakened for some reason. Emming observed dramatically different responses from young (two-foot) saguaros transplanted to his nursery during March and April versus mid-June, the difference being shade cloth. He covered the later transplants with 50% shade cloth but did not protect the earlier transplants, assuming that because of their head start, they did not need it. The spring-planted saguaros that were exposed to full sun ended up sunburning in patches, even though they had been planted months prior and had a recovery head start on the June crop. Eventually, 20% of them ended up sunburned along the southwest side of the stem and apex. The shaded June transplants, despite the heat of summer, rehydrated within eight weeks, and by September, a quarter of them were initiating new growth.

2.3 PRETRANSPLANTATION WATERING

Dehydrated plants do not fare well through transplantation, so watering saguaros before a move is important. If the plant is already in good shape and fully hydrated, then watering is not necessary, especially during cooler weather. But if a move candidate is dehydrated, with shrunken ribs and pinched tips, or if the hot season is approaching, then a number of deep soakings over the course of two or three months are recommended to get the plant into better shape before the move. Fully hydrating a saguaro before a move creates a reserve the plant can dip into while regenerating the 80% or more of the roots it will lose when dug up. Even the healthiest and most waterlogged saguaros lose 35% to 50% of their mass after a move before they fully recover (Emming 2007).

2.4 NORTH ORIENTATION

Cacti have adapted to the desert's intense sunshine by developing thicker skins on their sides that are exposed to the most intense rays of the sun (Mazier 1998). Cacti should be transplanted in such a way that the side that originally faced south is still facing south to prevent sunburn in its new location (Desert Botanical Garden 2004). Several sources recommend marking the north side of the plant (Elliott 1994, Mazier 1998, Mazier undated). Mazier (1998) asserts that if transplanting is done in the fall—November, for instance, or whenever temperatures become moderate and the days milder and shorter—orientation of the plant makes no difference. Transplanting in the spring, however, calls for orienting the plant in the same direction.

2.5 HANDLING PRIOR TO TRANSPLANTATION

A healthy saguaro can weigh as much as 100 pounds per foot of height (Elliott 1994). The weighty plants can easily snap in half if left unsupported while being tilted onto a vehicle for transport; therefore, it is important to support the entire length of the plant's main stem and any branches longer than three feet (Emming 2007). Both Elliott and

Emming recommend padding the saguaro prior to transplantation, while it is still upright, with material such as old carpet, foam rubber, pillows, or other soft items. Emming adds that in spite of being stiffly spined, saguaro stems are actually quite easy to damage. Gashes in the stem inflicted by hydraulic equipment can provide entry points for pathogens.

2.6 ROOT EXCAVATION

As many roots as possible should be preserved, although transplanting a large saguaro typically removes at least 80% of the roots, including the many long, shallow feeder roots that extend for many meters around the plant. At least a foot or so of every main lateral root should be retained so that new roots can re-form from the stubs (Emming 2007). The Desert Botanical Garden recommends digging a trench one to two feet away and 12 to 18 inches deep all around the cactus before prying the plant out of the ground, and allowing the roots to dry out for one week before planting. If that is not possible, the roots should be treated with a fungicide and a bactericide or be thoroughly covered with sulfur (Desert Botanical Garden 2004).

Another saguaro mover recommends a similar excavation technique as recommended by the Desert Botanical Garden, noting that at least three major roots typically radiate from the saguaro just a few inches under the soil surface (Elliott 1994). These radial roots support the plant in the absence of the anchorage provided by a taproot. Even a 20-foot specimen rarely has a taproot more than three feet deep. Elliott says to cut the roots with a bow saw, as the blades are easily replaced. He recommends stubbing back the lateral roots to about four inches long and then reducing the diameter of the taproot to about three to four inches so that it will have the strength to support the plant. Elliott emphasizes that the cuts should be clean and square and that they should either be allowed to dry for several hours or be disinfected with a 10% bleach solution and then treated with soil sulfur to speed the drying. Mazier (undated) recommends pruning all shredded or damaged roots following excavation and treating them with wettable sulfur and Agri-Mycin 17. Mazier also recommends that the minimum root length should be 18 inches.

2.7 PLANTING HOLE

Recommendations for the width of the planting hole range from two to three times the width of the plant (Mazier 1998), to twice as wide as the roots (Desert Botanical Garden 2004), to a few inches more than the widest dimension of the roots (Elliott 1994). Elliott states that he tries to make the walls of the hole as vertical as possible to minimize the amount of soil disturbed, because the biggest immediate danger with saguaros is that they will fall over shortly after transplantation. Mazier cautions that if a saguaro is placed in a hole that is too narrow, its roots will be forced to grow around the stem of the plant and up the sides of the planting hole, resulting in the plant becoming root bound. He maintains that a wider planting hole of soft, broken-up soil gives the saguaro's roots more space to anchor and establish themselves quickly (Mazier 1998).

Saguaros should be replanted to the same depth at which they were found growing (Desert Botanical Garden 2004; Mazier 1998; Mazier undated; Emming 2007). Mazier (1998) adds that a saguaro may be planted slightly deeper than it originally grew, but by no more than a few inches, and Emming states that even the largest saguaros should be planted no more than 18 inches deep. Mazier (1998) and Emming (2007) explain that the problem with planting saguaros too deep is that the roots, which grow at the base of the stem, are transplanted to a depth much greater than that at which they originally grew and are therefore far out of range of almost all desert rains. Saguaros do not produce roots from areoles along a buried portion of stem as some other cacti do. Long-term supplemental watering may allow the plant to survive, but without it, most will face a slow death by desiccation.

Emming adds that another problem with transplanting saguaros too deeply is that their stems, not designed to be in contact with soil, can easily develop rot, especially if the stem was damaged and soil aeration and drainage are inadequate.

Elliott (1994) suggests that the depth of the planting hole should increase with the height of the plant, as shown in Table 2.

Table 2. Saguaro Height Range and Corresponding Depth of Hole.

Height	Depth
1 to 2 ft	6 to 8 inches
3 to 4 ft	10 to 12 inches
6 ft	15 inches
8 ft	18 inches
12 ft	24 inches
15 to 20 ft	30 to 32 inches

The ultimate planting depth resulting from Elliott's recommendation, accounting for depth of root ball, would be from 2 to 15 inches deeper than original depth.

2.8 BACKFILL

Native soil (no amendments) should be used for backfill when transplanting saguaros (Elliott 1994), because a change in the composition of the soil in such a small area will create uneven water absorption. Inevitably, the soil to one side or the other of the walls of the planting hole will hold water better. That can have two effects; either the planting hole will stay wet (which introduces the potential of rotting roots) or the surrounding area will wick the water away, which is also bad for the plant. Good success rates have been achieved by simply replanting in the native soils, says Elliott. A backfill with 60% to 70% native soil and 30% to 40% sand is recommended by Mazier (1998). He explains that saguaros need sandy soil for their root systems to take hold faster, allowing the rootlets to move more easily through the loose soil. A soil already fairly sandy or loose

needs no additional sand. Mazier adds that all rocks larger than three inches should be removed from the transplantation hole to avoid crushing plant roots.

2.9 PLANTING

The soil should be firmly compacted around the plant (Emming 2007). This can be accomplished by adding a few inches of soil, tamping it down firmly, and repeating until the planting hole is filled (Elliott 1994). Mazier (1998) suggests filling the planting hole halfway with soil and using the shovel handle to tamp down the soil, pressing out the air pockets around the roots. Then the rest of the hole can be filled with soil and the tamping process repeated. Elliott (1994) suggests creating a tapered mound or cone of soil around the base of the saguaro to divert rainwater away from the soft disturbed soils that hold the saguaro up. This cone will gradually erode, but by that time, the soil has stabilized and the plant is secure.

2.10 WATERING

Among all the aspects of transplanting saguaros, watering elicits the widest range of recommendations, from watering immediately to withholding water for a period of weeks to months after transplantation.

The Desert Botanical Garden (2004) states that cacti that have been transplanted need to be watered deeply and slowly at the time they are transplanted. A hose should be placed about two feet from the plant and the ground should be thoroughly soaked so that the roots will be encouraged to spread out. After the first watering, the backfill soil typically settles and the plant may shift or lean. In the weeks following the first watering, on the second visit, the plant should be straightened, the soil firmed, and the stakes re-secured. If transplanting in the spring, it is necessary to water regularly through the first summer. In the hottest days of the summer, this will be every two to three weeks, unless there is a rain. If the plant is transplanted near the end of the summer, it will need water only two or three times during the winter. A summer watering schedule should begin when the weather has warmed and there has been no rain for 30 days (typically in April). If there is no rain for 60 days, the plant should be watered regardless of the temperatures. Emming (2007) recommends withholding water for two to four weeks following transplantation to allow broken root surfaces and buried stem nicks to heal. After that, he recommends, provide adequate and careful supplemental watering until the roots have recovered, which in the case of very large plants may take several years. A 10-year study (Harris et al. 2004) of transplanted saguaros in the Tucson area determined that the impact of transplantation on water uptake by saguaros persisted for four years. Mazier (1998) also recommends waiting two to three weeks after transplantation to begin watering, to allow any damaged roots to develop a protective callous. Watering is best done slowly over a period of hours with a slow-dripping system that delivers water to the level of the plant's root zone, 18 inches to two feet deep. Options for delivering the water include a hose laid on the ground near (but not touching) the trunk, a drip line with emitters, a ring-shaped hose emitting water slowly all around the base of the plant, or irrigation in a doughnut-shaped canal dug a few inches deep and about 18 inches away from the base. A recommended watering schedule is eight hours every three weeks in

summer or, if the temperature is greater than 110°F, eight hours every two weeks (Mazier, undated).

According to Elliott (1994), a newly transplanted saguaro should not be watered for six months or more. The stress of transplanting occasionally causes some rotting in the root area. If the plant and soils are dry, the saguaro's evolved defenses halt the problem and the plant lives. Elliott recommends that if the transplanted saguaro is very dehydrated after six months, a shallow watering well can be dug right at the plant's base. The well should hold no more than two or three gallons for a large plant and somewhat less for a plant shorter than eight feet tall. The saguaro should be given about five gallons of water once a week. Supplemental watering should not be started in winter, but when temperatures get back to the 90°F range. Saguaros in urban settings receive so much more water than in the desert that they average over one foot growth per year. The runoff from rain falling onto roofs and supplemental watering provided to other plants in the landscape creates an abundance of water for a saguaro.

2.11 STAKING/BRACING

It should not be necessary to secure plants shorter than five feet in height after transplanting. For larger plants, however, it is necessary. A collar made of a material that will not cut into the skin should be placed around the plant. The collar should be wired to rods or stakes that have been driven into the ground, and there should be a stake on each side of the plant. This support should be left on the plant for at least three months in fairly heavy soil, six months in finer soil or very rocky locations (Desert Botanical Garden 2004).

The cactus should be braced with three or four 2x4s spaced in a tripod around a vertically plumb plant, digging the ends of each brace into the soil. Cross pieces with carpeting should be affixed to the top of each brace where it rests against the trunk, and the braces can then be tied tightly to one another with a stout cord long enough to wrap around the plant several times. The plant should be well balanced and able to support its own weight without tipping; the braces are simply there to stop it from listing until re-rooting occurs. If diligent attention was paid to preserving the roots, and generous watering is applied in warm weather (little or none in cold), root recovery should be well under way within a few months. It is generally safe to remove braces after two growth seasons (Emming 2007).

Saguaros taller than 12 feet need support while they are getting reestablished. One method is to prop the plant on three sides with boards which are covered with carpet at the point of contact with the plant. This method does work, but can cause yellowing on the stem where the carpeted end pieces block out sunshine and prevent photosynthesis. The end pieces also can damage spines, provide places for insect infestation, and promote rot. Also, as the heavy cactus settles deeper into its new hole, the boards may be pressed too heavily against the plant. The preferred method is to use a collar and cables to hold the plant in place. A collar of tree straps or even a hose wrapped around a strong wire can be placed around the plant as high as possible for greatest leverage. A good rule of thumb is to place the collar at a spot about two-thirds up the height of the plant. Cables

can be attached to the collar, extending to the ground in three or more directions to metal stakes (such as rebar) driven at least 18 inches into the ground. Cables are more adjustable, less noticeable, and usually cheaper and easier to use than boards. After the plant has been in the ground for two or three weeks, it needs a good, deep drink, and then the cables should be checked to see if they are tight enough. After three waterings, the soil will be settled and the plant will be secure if the cables have been adjusted as necessary after each watering; at this point the cables can be removed. This will occur between two and three months after transplanting (Mazier 1998).

Elliott (1994) states that saguaros planted 2 to 15 inches deeper than their original depth will live very well without braces. Others have opposing viewpoints on this, warning of adverse health effects resulting from planting too deeply.

3.0 METHODS

The TAC and LSD considered as candidates for follow-up inventory a number of ADOT projects on which saguaros had been salvaged and replanted as part of the revegetation activities. From the list of 13 projects, four projects were selected, representing a variety of geographic areas and elevation ranges. The projects ranged in age from four to 11 years from transplantation date. The projects were SR 86 Covered Wells, SR 87 Tombstone Hill, SR 188 Resort Road to Devore Wash, and US 93 Kaiser Spring.

LSD obtained information on each of the four projects, including the plant inventory conducted during the design phase, the contractor's inventory conducted prior to salvage activities, photos, replanting plans, planting details, special provisions, bid schedules, the contractor's transplanting plan, and inspection memos. Some of the above items were not available for all four projects.

The TAC and LSD developed a set of criteria with which to evaluate the individual saguaros. Among the criteria were plant size, plant health, aspect, plant orientation relative to original growing condition (indicated by north mark), slope, amount of rock in the soil, amount of vegetative cover around the plant, taper in the stem at ground level, and presence of habitat for wildlife.

The projects were field-surveyed by LSD staff to locate the saguaros and collect information about them. The project limits, as indicated by the beginning and ending stations, were obtained for each project from the design plans. The replanting plans were of some help in identifying the locations of replanted saguaros, but in general, plant placement did not conform very closely to the plans. The survey team traversed the project area and inventoried all existing saguaros, living or dead. An inventory number was assigned to each saguaro and a photo was taken.

A GPS unit was used to record the location of the saguaros and the data about each plant's size, health, and surrounding environmental conditions. Four categories of plant height were used: 0 to 6 feet, >6 to 12 feet, >12 to 20 feet, and >20 feet. Plant height was determined by visual estimate; the number of arms was recorded, and the length of each arm was noted.

A subjective health rating of excellent, good, fair, poor, or dead was determined for each saguaro. The factors considered in determining the health rating were

- amount of hydration or "plumpness" of the saguaro overall;
- the condition of the main stem growing tip;
- skin color;
- presence or absence of spine clusters;
- verticality of the main stem; and
- extent of tissue damage or scarring.

The aspect (directional orientation of slope) at which the saguaros were planted was recorded, the variables being north, east, south, west, southeast, southwest, northeast, and northwest. When the ground was level, aspect was recorded as "none."

The presence or absence of the "north mark," a mark that should have been placed on the north side of the plant prior to transplantation so that it could be replanted at the same orientation, was noted. On occasion it was not possible to determine if the mark ever existed, due to the deterioration of the skin of dead saguaros.

If a north mark was present, the orientation of the mark was noted as one of the following: north, east, south, west, southeast, southwest, northeast, or northwest.

The amount of rock in the soil was noted. Five classes were used: loamy soil with no rock; <25% rock, 25% to 50% rock; >50% to 75% rock; and >75% rock.

The amount of perennial vegetative cover within a five-foot radius of the saguaro was noted. The classes of cover were as follows: 0% to 10%; >10% to 20%; >20% to 30%; >30% to 40%; >40% to 50%; >50% to 60%; >60% to 70%; >70% to 80%; >80% to 90%; and >90%.

The presence of an earthen basin surrounding the saguaro for the purpose of water harvesting was noted. The classes indicating depth of basin were the following: no grade (level ground); <3 inches; 3 to 6 inches; >6 to 9 inches; >9 to 12 inches; and >12 inches.

Taper at the base of the saguaro was noted. Taper is an indication that a saguaro was planted at the same depth, or nearly so, as it was prior to transplantation. The variables used to record tapering were "yes" or "no," or "unknown" if the saguaro was decayed to the extent that taper could not be determined.

The presence of habitat for wildlife on or within the saguaro was noted as either "yes" or "no." Habitat included cavities within the stem in which a bird or other animal could nest or seek shelter and nests observed between the main stem and arms.

If the original inventory tag was present, the number was recorded.

A field within the GPS unit's data dictionary was used for additional comments, such as "fire damage," "recently uprooted," or "leaning."

The GPS data was downloaded into a Microsoft Excel spreadsheet to provide a summary view of the results, and then the information was further manipulated into tables displaying the results according to the criteria examined. Those results are discussed in the following section.

4.0 RESULTS

4.1 SR 86 COVERED WELLS

The SR 86 Covered Wells section is located in Pima County just west of Indian Route 15, between Quijotoa and Covered Wells, approximately 115 miles west of Tucson. The section is 0.9 miles in length and the elevation ranges from approximately 2,435 to 2,500 feet.

The project plans called for 89 saguaros to be salvaged and replanted on site; the devegetation contractor's inventory identified 98 saguaros suitable for salvage (ADOT 2002).

Transplanting Details

The saguaros were transplanted between October 1 and October 17, 2002. All but two or three of the saguaros were placed in a temporary nursery and later planted back on the project site. The other two or three saguaros were moved once, to an area five or six feet beyond the limit of construction disturbance, according to the ADOT landscape inspector.

The twice-moved saguaros were planted in their final locations sometime prior to May 1, 2003, when a monthly inspection was conducted.

The planting details in the project plans specified that the saguaros be oriented in the same direction and planted at the same depth as originally grown. All wounds were to be sprayed with antibiotic, and roots dusted with sulfur powder. The bottoms and sides of the planting pits were to be roughened prior to setting the saguaros, the saguaros were to be planted at true vertical, and the backfill was to be native soil. The planting pits for saguaros with a root ball were to be two times the diameter of the root mass. The saguaros were to be staked if taller than 6 feet (plants without root ball) or taller than 12 feet (plants with root ball). The staking was to be composed of nylon guy ropes tied to either #4 rebar, 2 feet in length (plants without root ball), or 30-inch metal foreman's stakes (plants with root ball), in a triangulated pattern. Positive drainage was to be provided at the plant base, and a basin created with a diameter three times the diameter of the main stem, to retain water. Small saguaros which had been growing in a "nurse situation"—sheltered by a larger plant—were to be replanted in a partially shady orientation (ADOT 2002: 40). See Appendix A for copies of the planting details.

Post-Planting Inspections

According to the memorandum from the monthly inspection on May 1, 2003, two saguaros within the project were destroyed by utility work. The memorandum noted that the saguaros were receiving drip irrigation twice per week for one hour.

The memorandum from the monthly inspection on June 5, 2003, noted that a large saguaro (12 to 20 feet in height) was dead. The ADOT inspector directed the revegetation contractor to remove and dispose of the saguaro.

The memorandum from the inspection on September 8, 2003, noted that the saguaros were being watered five days per week for two hours with one 2-gph (gallons per hour) emitter for a total of 20 gallons per week. It was agreed to reduce the watering frequency from five to four days per week, in light of the cooler temperatures expected to come.

Rainfall

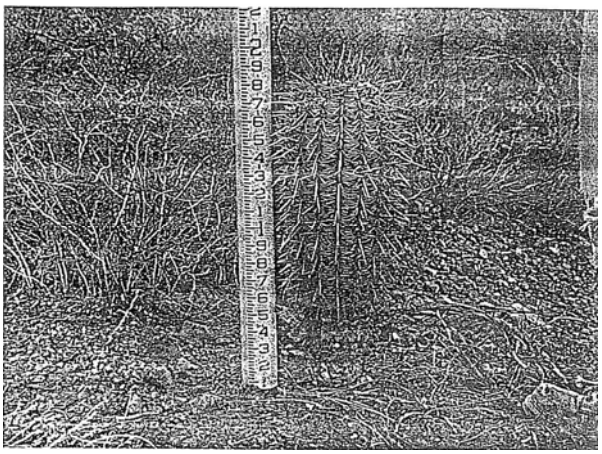
The rainfall data from a 21-year period (1988 to 2008) show an average rainfall per year of 9.53 inches. In comparison, six-year data from 2002 (the year of transplantation) through 2007 shows an average rainfall per year of 7.76 inches. Marana, Arizona, approximately 60 miles from the project site, was the closest weather station with rainfall data (Arizona Meteorological Network).

LSD Inventory

LSD conducted an inventory of the existing saguaros on January 28, 2008. During the inventory, LSD located 75 plants of the 98 plants salvaged. As noted in the monthly inspection memorandums, two saguaros were destroyed by utility work and one saguaro died and was removed, which accounts for 78 plants of the 98 salvaged. The 20 plants unaccounted for may have died and been removed from the project, or may have been overlooked during the inventory. See Appendix B for a table of the detailed inventory results.

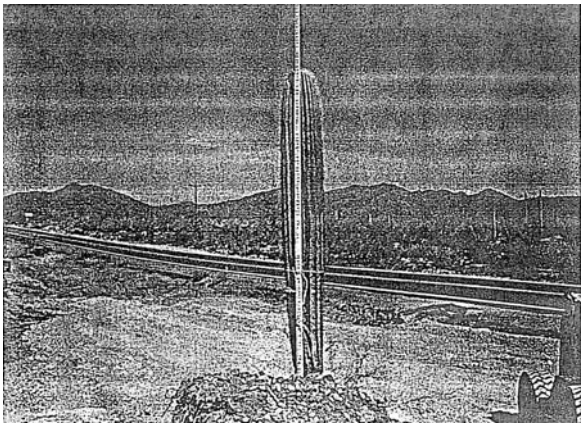
Survival Rates

Of the 75 saguaros identified during the inventory, 1 was in excellent health, 38 were in good health, 14 were in fair health, 10 were in poor health, and 12 were dead. Based on an initial quantity planted of 98, minus 2 saguaros destroyed by utility work, the survival rate overall was 66%. The saguaros 0 to 6 feet in height had a survival rate of 68%; the saguaros >6 to 12 feet in height had a 64% survival rate; the saguaros >12 to 20 feet in height had a 55% survival rate; and the saguaros >20 feet in height had a 57% survival rate. The survival rates by height do not take into account the 2 saguaros destroyed by utility work, because the height of those plants is unknown.



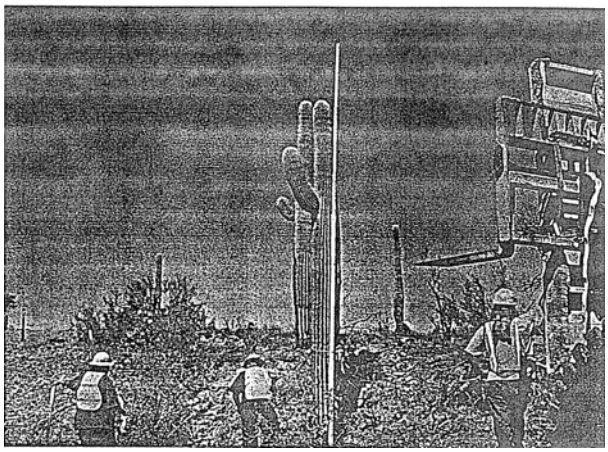
Above: Contractor's presalvage photo of saguaro tag #71, 2002.

Right: Saguaro in excellent condition at time of inventory, January 28, 2008. Original tag #71, LSD #166.



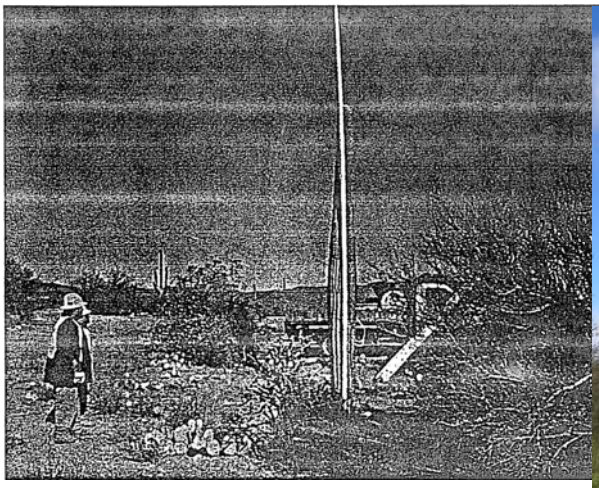
Above: Contractor's presalvage photo of saguaro tag #36.

Right: Saguaro in good condition at time of inventory, January 28, 2008. Original tag #36, LSD #100.



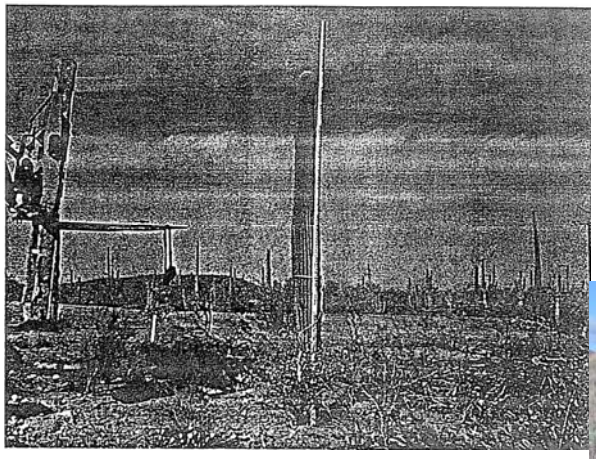
Above: Contractor's presalvage photo of saguaro tag #40.

Right: Saguaro in fair condition at time of inventory, January 28, 2008. Original tag #40, LSD #136.



Above: Contractor's presalvage photo of saguaro tag #50.

Right: Saguaro in poor condition at time of inventory, January 28, 2008. Original tag #50, LSD #114.



Above: Contractor's presalvage photo of saguaro tag #82.

Right: Saguaro dead at time of inventory, January 28, 2008. Original tag #82, LSD #101.

Height

Table 3 and Figure 1 show plant health rating by height classifications. The majority of the 0- to 6-foot saguaros (64%) were in good health, but health decreased as the height of saguaros increased.

Table 3. Plant Health in Relation to Height.

Height	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0– 6 ft	2%	64%	11%	11%	13%
6–12 ft	—	67%	11%	—	22%
12–20 ft	—	14%	43%	21%	21%
>20 ft	—	—	40%	—	20%

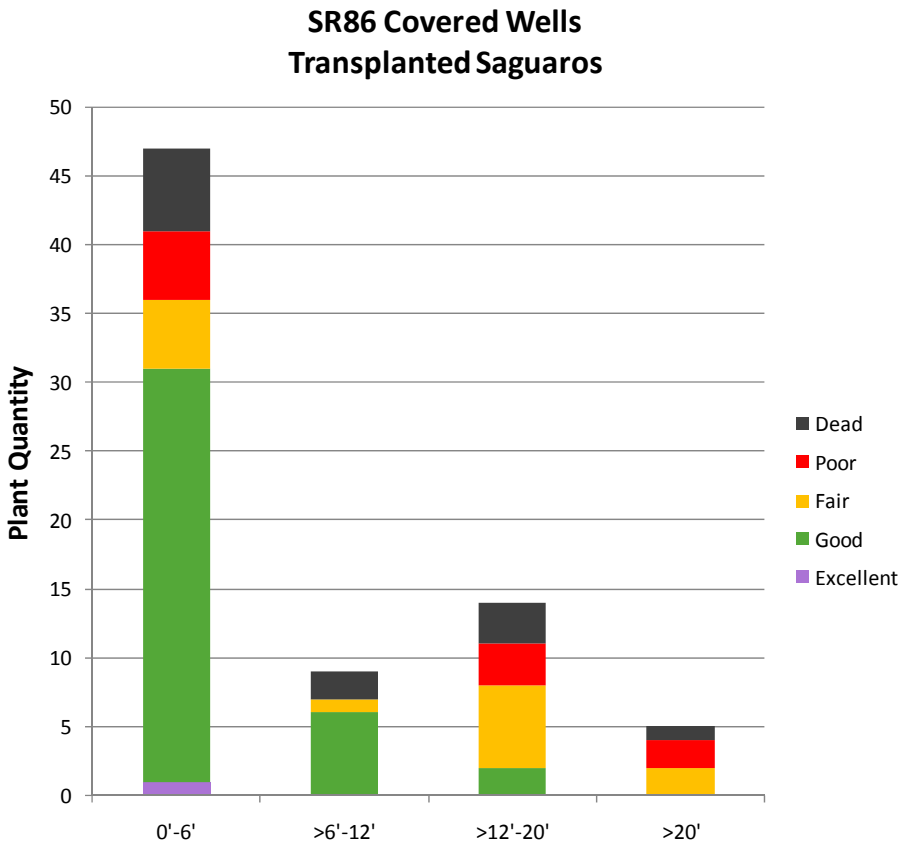


Figure 1. Plant Height.

Presence of Arms

There were significantly more saguaros (66 plants, 88%) without arms than with arms (9 plants, 12%), making a direct comparison more difficult; nonetheless, the plants without arms were noticeably healthier. The majority of plants without arms were in good health (58%), while one plant (2%) was found to be in excellent health; 14% were in fair health; 11% were in poor health; and 17% were dead. Of those plants with arms, none were found to be in excellent or good health; 55% were in fair health; 33% were in poor health; and one plant (11%) was dead (Figure 2).

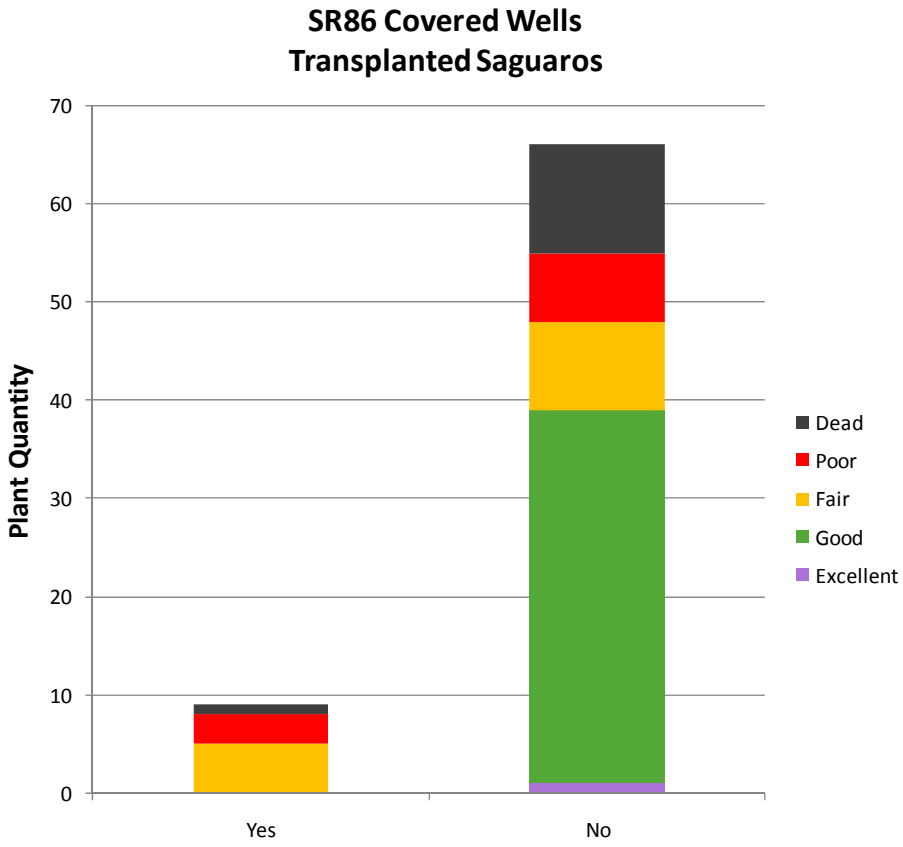


Figure 2. Presence of Arms.

Aspect

As a result of the east-west alignment of the roadway, most of the saguaros were planted on a south or north aspect (the directional orientation of slope). Aspect did not appear to have a significant effect on saguaro health (Table 4 and Figure 3).

Table 4. Plant Health in Relation to Aspect.

Aspect	Excellent Health	Good Health	Fair Health	Poor Health	Dead
South	—	53%	26%	11%	11%
Southeast	—	—	100% (1 plant)	—	—
North	2% (1 plant)	47%	16%	17%	17%
Northeast	—	100% (1 plant)	—	—	—
None (Level Terrain)	—	67%	11% (1 plant)	22% (2 plants)	—

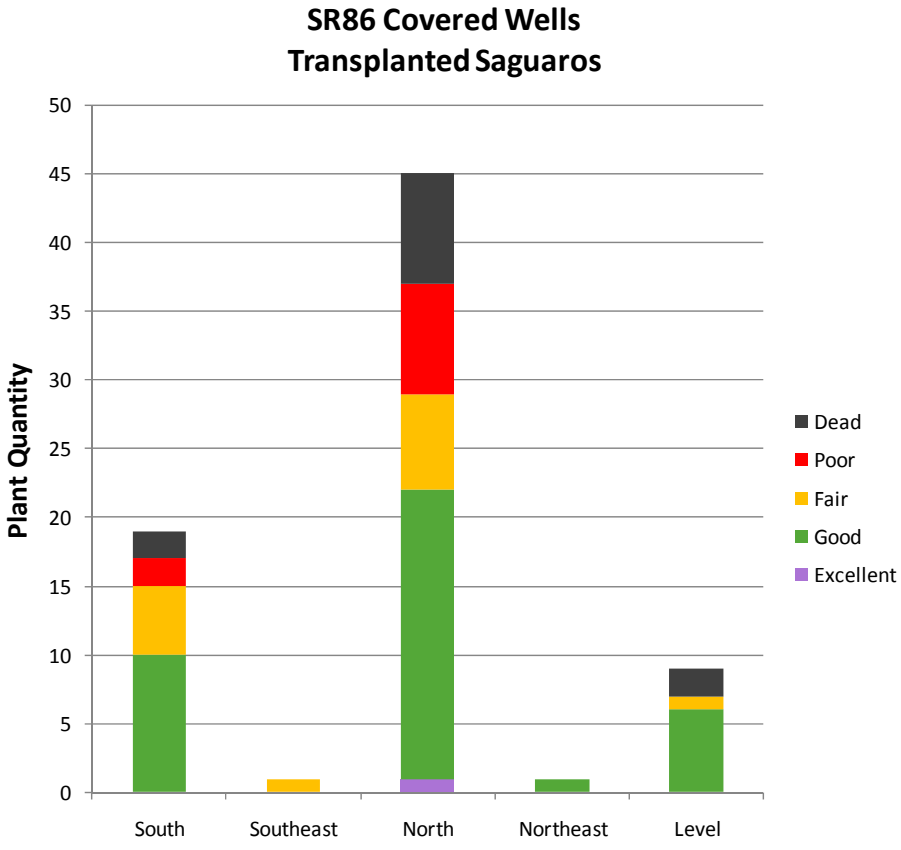


Figure 3. Aspect.

North Orientation

The presence of a mark on the north side of the saguaro, indicating that it was replanted at the same orientation as originally grown, is correlated with slightly higher ratings for health than the plants with no north mark. Forty-seven of the 75 plants inventoried had a north mark, while 16 plants had no mark, and 10 plants were decomposed to the extent that it was not possible to determine if a north mark ever existed. Of the plants with the north mark oriented to the north, 63% were in good health, one plant (2%) was in excellent health, 24% were in fair health, 13% were in poor health, and one plant (2%) was dead. One saguaro had the north mark oriented to the northeast, and it was in good health. Of the plants with no north mark, 50% were in good health, 19% were in fair health, 25% were in poor health, and 6% were dead (Figure 4). It should be noted that the absence of a north mark does not necessarily mean that the saguaro was planted at an orientation different from that at which it was originally grown; it simply means that it is undetermined, so a valid comparison is difficult to make.

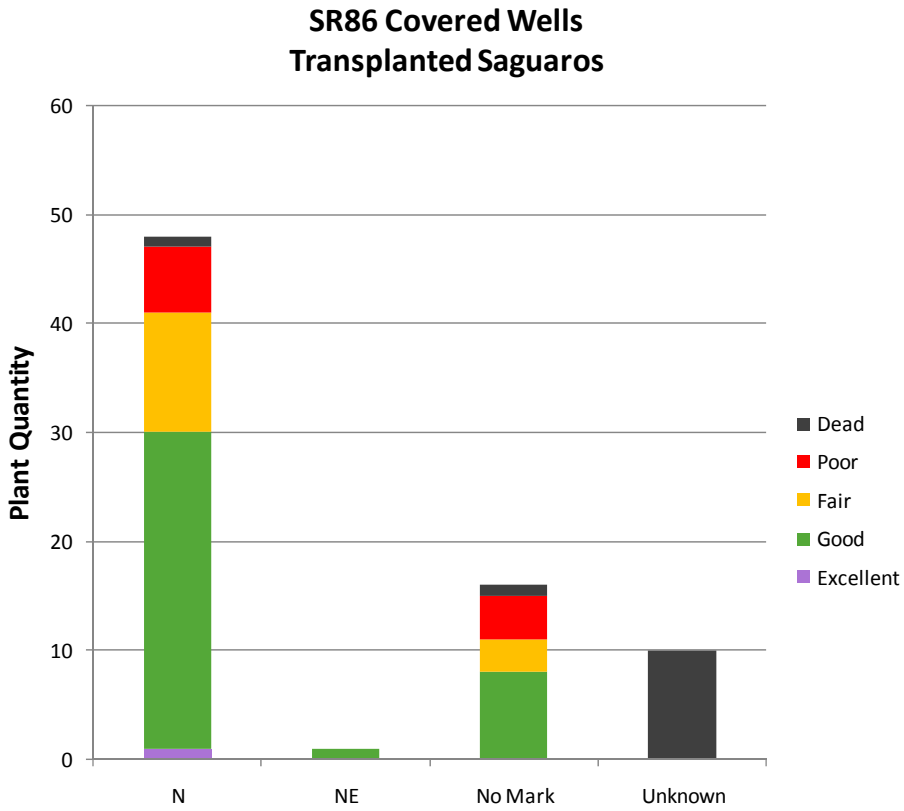


Figure 4. Orientation of North Mark.

Slope

Slope did not appear to have a significant effect on plant health (Table 5 and Figure 5). The slope classification with the highest percentage of plants in good health (75%) was 2:1. Of the plants on 2:1 slopes, 25% were dead. Conversely, the slope classification with the highest percentage of dead plants (33%) was 6:1. Of the plants on 6:1 slopes, 44% were in good health and 22% were in fair health.

Table 5. Plant health in relation to slope classification.

Slopes	Excellent Health	Good Health	Fair Health	Poor Health	Dead
1:1	—	46%	—	27%	27%
2:1		75%			25%
3:1	5%	55%	23%	9%	9%
4:1	—	44%	33%	22%	—
5:1	—	25%	75%	—	—
>6:1	—	56%	6%	19%	19%

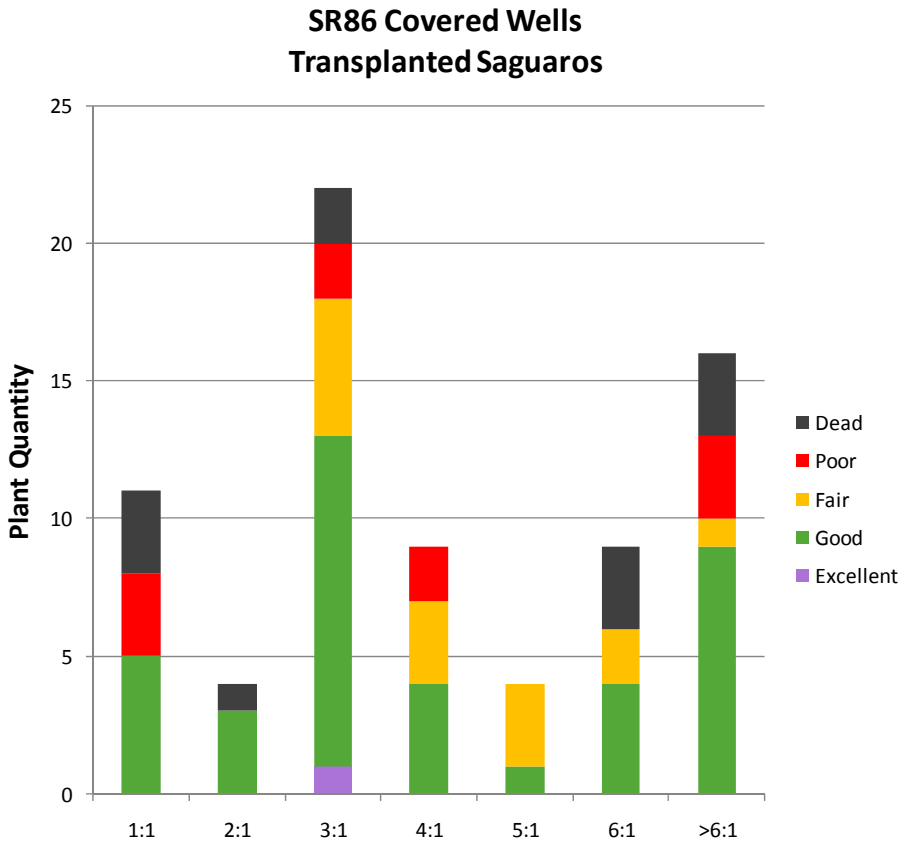


Figure 5. Slope.

Soil Composition

The amount of rock in the soil appeared to have little effect on saguaro health (Figure 6), although the saguaros in the rockiest soil (>50% to 75% rock) had the lowest percentage (43%) of individuals in good health and the highest percentage (29%) of dead plants. Of the plants in >50%-75% rock, 29% were in fair health. For soil with less than 25% rock, 51% of the saguaros were in good health, 2% (one plant) in excellent health, 16% in fair health, 12% in poor health, and 18% dead. In the soil classification of 25% to 50% rock, 53% of the saguaros were in good health, 21% in fair health, 21% in poor health, and 5% dead.

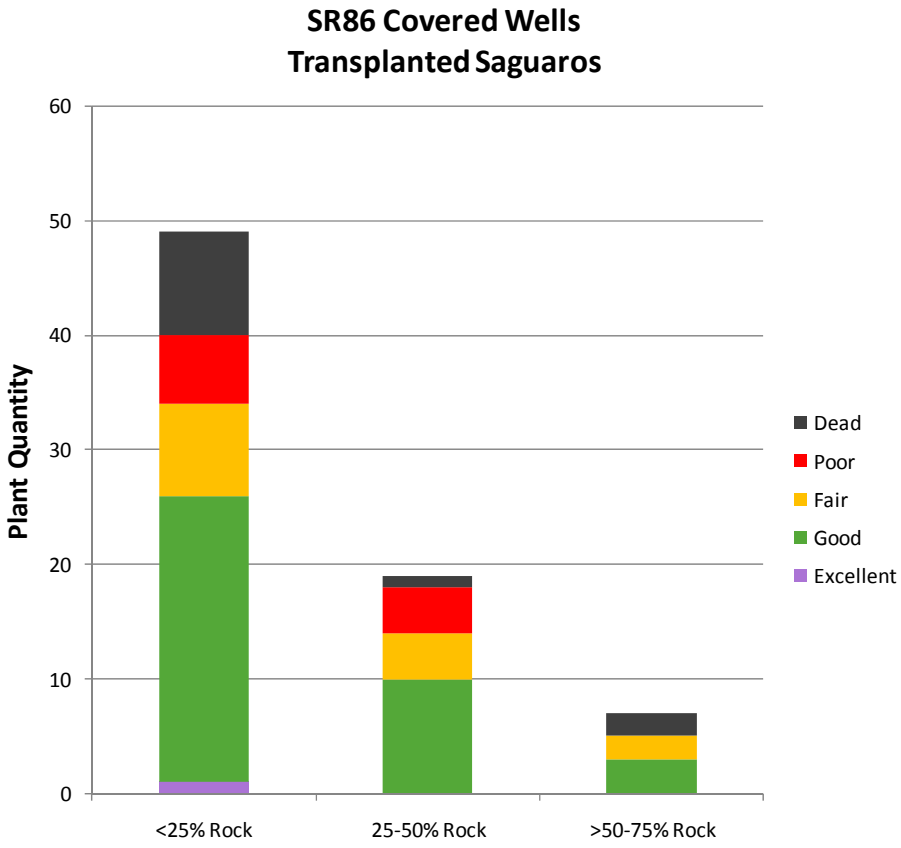


Figure 6. Amount of Rock in Soil.

Vegetative Cover

The amount of vegetative cover near the saguaros did not appear to have a significant effect on plant health. The cover range of >40% to 50% cover contained the highest percentage (77%) of plants in good health. Conversely, 50% of the saguaros in the >80% to 90% cover range and 100% of the saguaros in the >90% to 100% cover range were dead (cover ranges with a total of only two plants and one plant respectively). The complete results of plant health relative to vegetative cover are listed in Table 6 and shown in Figure 7.

Table 6. Plant Health in Relation to Vegetative Cover.

Vegetative Cover	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0%–10%	—	66%	—	—	33%
>10%–20%	—	40%	20%	40%	
>20%–30%	—	53%	13%	13%	20%
>30%–40%	—	25%	50%	19%	6%
>40%–50%	—	77%	6%	6%	12%
>50%–60%	13%	50%	13%	13%	13%
>60%–70%	—	66%	—	—	33%
>70%–80%	—	50%	50%	—	—
>80%–90%	—	—	—	50%	50%
>90%–100%	—	—	—	—	100%

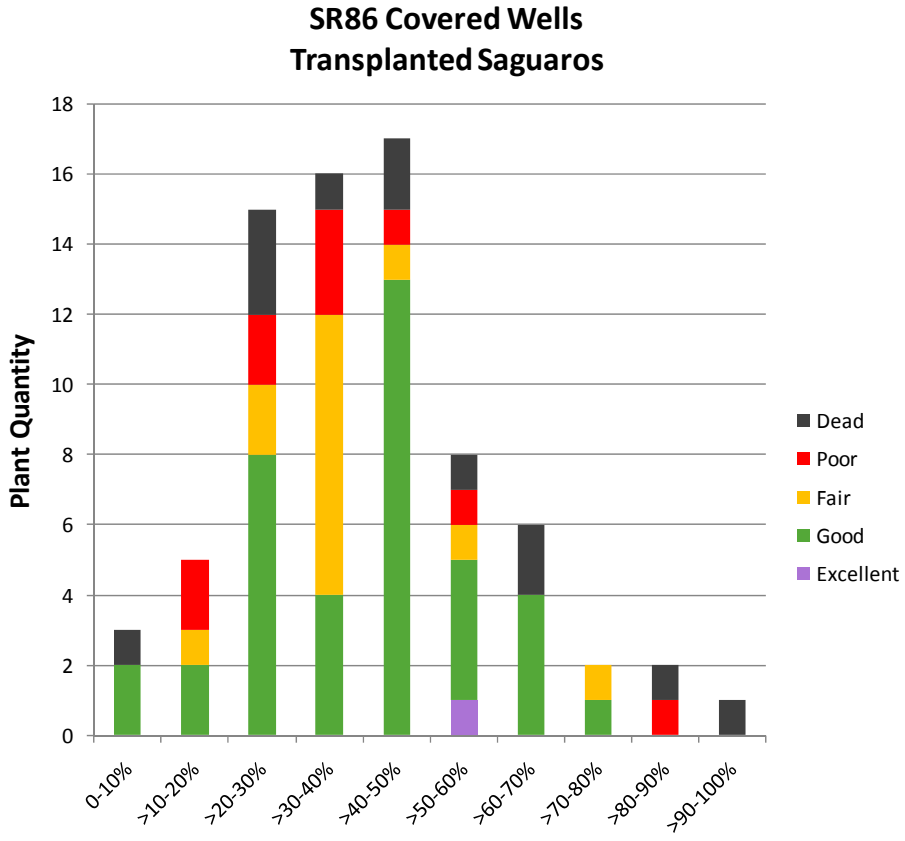


Figure 7. Vegetative Cover.

Taper at Base

The presence of a tapering stem at the base of the saguaro, an indication that the saguaro was not planted too deeply, was correlated with good plant health (Figure 8). Saguaros exhibiting taper were mostly in good health (73%), with 2% in excellent health, 15% in fair health, 8% in poor health, and 2% (one plant) were dead. In contrast, only 19% of the plants with no taper were in good health, 44% were in fair health, and 38% were in poor health. Whether there was taper could not be determined for another 11 plants, all of which were dead.

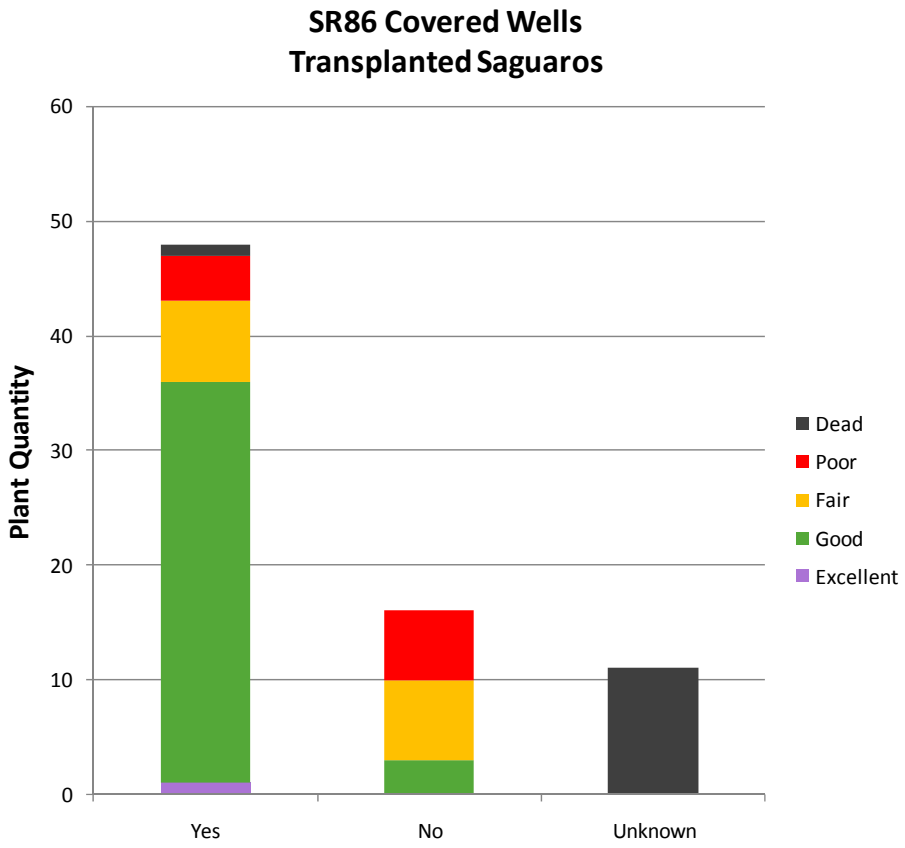


Figure 8. Taper at Base.

Wildlife Habitat

The presence of habitat for wildlife was noted for only four of the 75 saguaros inventoried.

4.2 SR 87 TOMBSTONE HILL

The SR 87 Tombstone Hill section is located in Maricopa County, approximately 14 miles northeast of Fountain Hills, between Four Peaks Road and Mesquite Wash. The section is 3 miles in length and the elevation ranges from approximately 2,170 to 2,610 feet. Project plans were approved August 30, 1995 (ADOT 1995).

Transplanting Details and Post-Planting Inspections

A total of 345 saguaros were salvaged and placed in a temporary nursery between February 9 and July 24, 1996. The saguaros were replanted along the roadway between November 25, 1996, and April 24, 1997.

The landscape inspector's records indicate that two saguaros died within three months of transplantation and two saguaros died within six months of transplantation.

Rainfall

The climate data for this area for a 70-year period (1939 to 2008) shows an average annual rainfall of 12.45 inches. In comparison, 13-year data from 1996 (the year of transplantation) to 2008 shows an average annual rainfall of 10.80 inches. The Stewart Mountain weather station, approximately 10 miles from the project site, was the closest weather station with rainfall data (Western Regional Climate Center. Stewart Mountain).

LSD Inventory

LSD conducted an inventory of the existing saguaros between June 10 and June 17, 2008. During the inventory, LSD located 259 plants of the 341 plants that were alive as of the final walk-through in November 1997. The 82 plants unaccounted for may have died and been removed from the project, or may have been overlooked during the inventory. See Appendix B for a table of the detailed inventory results.

Survival Rates

Of the 259 saguaros identified during the inventory, 4 were in excellent health, 160 were in good health, 54 were in fair health, 16 were in poor health, and 25 were dead. Based on an initial quantity planted of 345, the survival rate overall was 68%. The saguaros 0 to 6 feet in height had a survival rate of 63%; the saguaros >6 to 12 feet in height had a 93% survival rate; and the saguaros >12 feet in height had a 64% survival rate. The inspector's records from the project showed no plants taller than 20 feet, so the five plants inventoried by LSD that were over 20 feet were included in the >12-foot category, and no separate survival rate for the >20-foot plants was determined. Additionally, it was determined through comparison of the plant heights prior to transplantation and the heights as measured during the inventory that the average amount of growth was 1 foot. The comparison was made possible by the presence of the original-numbered tag on many of the plants, which allowed the inventory team to reference the original salvage data. The heights as measured during the inventory were adjusted downward by one foot

in order to assign the plants to the size classification in which they would have been when they were transplanted; this adjustment facilitated the determination of survivability by size classification.

Left: Contractor's presalvage photo of saguaro tag #1929-1.
Above: Saguaro in excellent condition at time of inventory, June 19, 2008. Original tag #1929-1, LSD #139.

Above Left: Contractor's presalvage photo of saguaro tag #1886-4.
Above Right: Saguaro in good condition at time of inventory, June 19, 2008. Original tag #1886-4, LSD #137.

Above: Contractor's presalvage photo of saguaro tag #2001-15.
Right: Saguaro in fair condition at time of inventory, June 19, 2008.
Original tag #2001-15, LSD #110.

Above: Contractor's presalvage photo of saguaro tag #1821-7.

Right: Saguaro in poor condition at time of inventory, June 19, 2008.
Original tag #1821-7, LSD #201.

Right: Contractor's presalvage photo of saguaro tag #1670-17.

Below: Saguaro dead at time of inventory, June 19, 2008. Original tag #1670-17, LSD

Height

Figure 9 shows plant health rating by height classifications. The majority of the 0- to 6-foot-high saguaros (65%) were in good health; one plant (1%) was in excellent health; 16% were in fair health; 10% were in poor health; and 8% were dead. The majority of the >6- to 12-foot-high saguaros (62%) were in good health; 3% were in excellent health; 20% were in fair health; 6% were in poor health; and 9% were dead. As the height of saguaros increased, health decreased: 60% of the >12- to 20-foot saguaros were classified as good, 24% as fair, and 16% as dead.

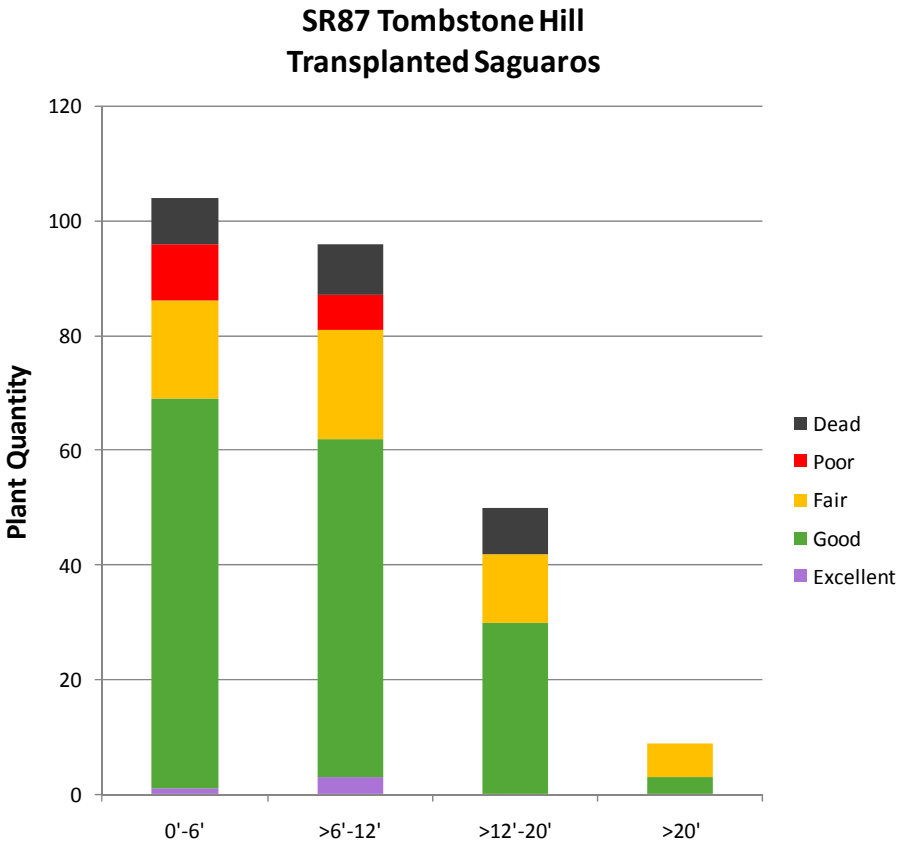


Figure 9. Plant Height.

Presence of Arms

The presence of arms appeared to have a negative effect on the health of the plants. The most noticeable difference between the plants with arms and plants without arms was in the percentage of dead plants (23% versus 7%, respectively). Of the plants without arms, the majority were in good health (63%); 2% were in excellent health; 21% were in fair health; and 8% were in poor health. Of the plants with arms, 57% were in good health and 19% were in fair health (Figure 10).

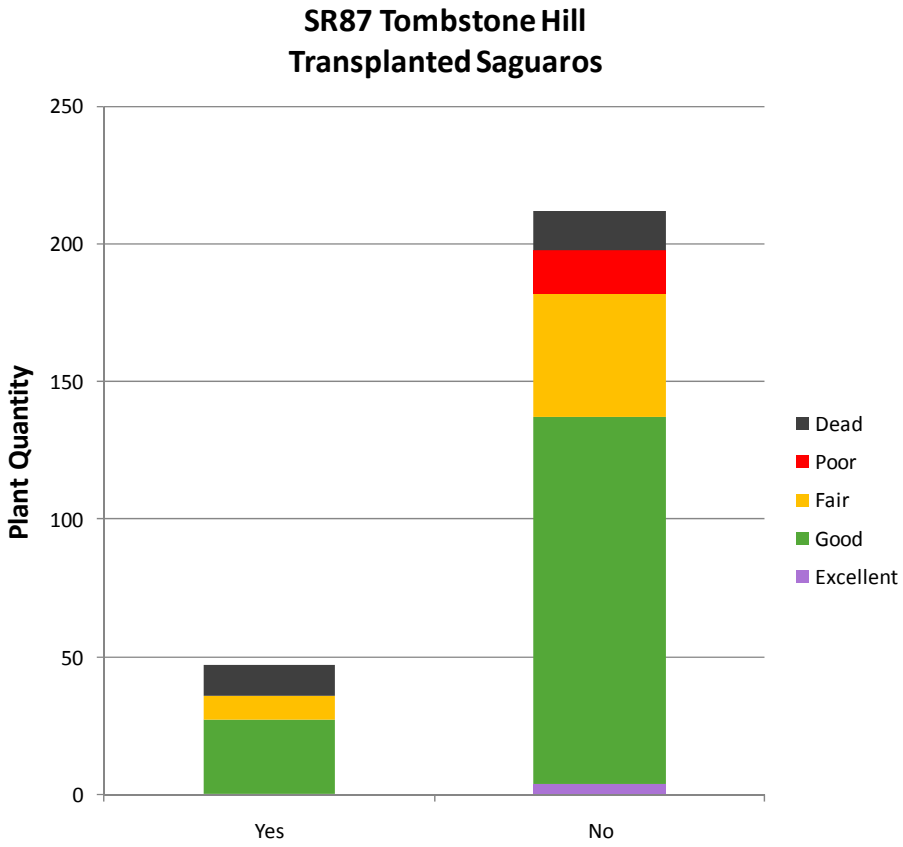


Figure 10. Presence of Arms.

Aspect

Aspect (the directional orientation of slope) did not appear to have a significant effect on saguaro health (Table 7 and Figure 11).

Table 7. Plant Health in Relation to Aspect.

Aspect	Excellent Health	Good Health	Fair Health	Poor Health	Dead
North	—	53%	35%	7%	7%
Northeast	1% (1 plant)	60%	20%	13%	7%
East	6%	66%	23%	—	6%
South	—	50%	25%	16%	8%
Southeast	12% (1 plant)	50%	—	12%	25%
West	—	69%	20%	2%	12%
Southwest	—	68%	11%	—	21%
Northwest	—	66% (2 plants)	—	—	33% (1 plant)

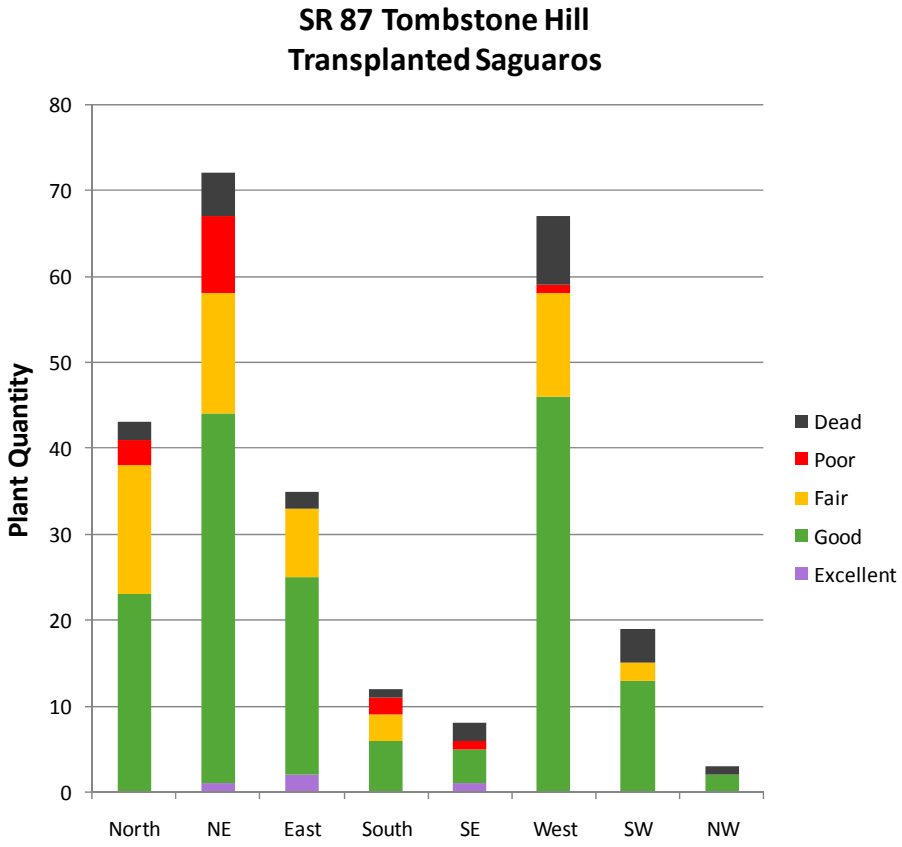


Figure 11. Aspect.

North Orientation

The presence of a mark on the north side of the saguaro, indicating that it was replanted at the same orientation as originally grown, is correlated with slightly higher ratings for health than the plants with no north mark. Of the 259 plants inventoried, 122 had a north mark, 121 plants had no mark, and 16 plants were decomposed to the extent that it was not possible to determine whether a north mark ever existed (Figure 12). It should be noted that the absence of a north mark does not necessarily mean that the saguaro was planted at an orientation different from that at which it was originally grown; it simply means that it is undetermined, so a valid comparison is difficult to make. The relationship of the north orientation to plant health is shown in Table 8.

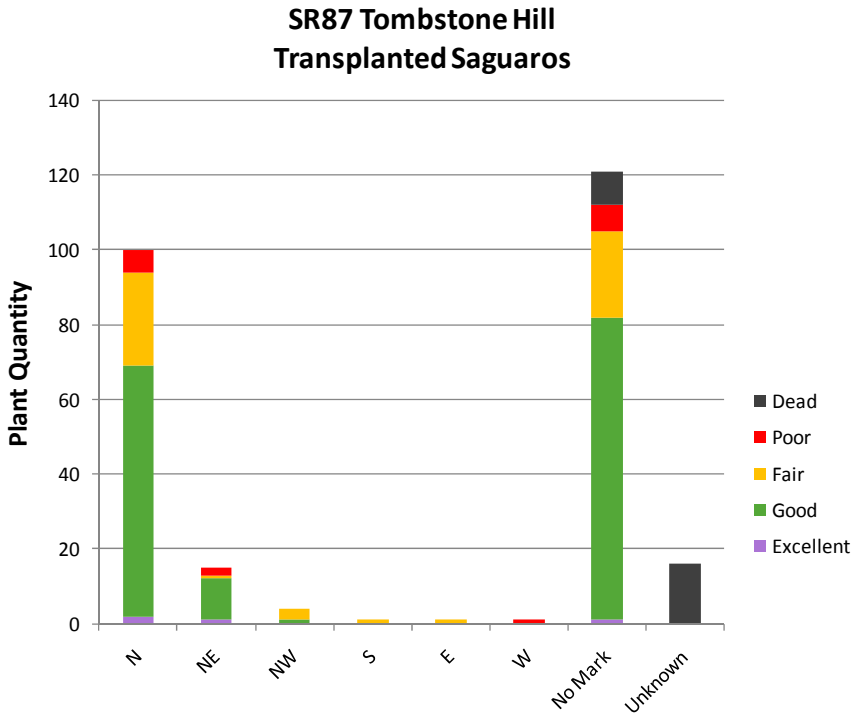


Figure 12. Orientation of North Mark.

Table 8. Plant Health in Relation to the Orientation of the North Mark.

North Mark Orientation	Excellent Health	Good Health	Fair Health	Poor Health	Dead
North	2%	67%	25%	6%	—
Northeast	7% (1 plant)	73%	7%	13%	—
Northwest	—	25% (1 plant)	75%	—	—
South	—	—	100% (1 plant)	—	—
East	—	—	100% (1 plant)	—	—
West	—	—	—	100% (1 plant)	—
None	1%	67%	19%	6%	7%

Slope

Slope did not appear to have a significant effect on plant health (Table 9 and Figure 13). The slope classification with the highest percentage of plants in good health was 2:1 at 68%. Conversely, the slope classification with the highest percentage of dead plants was 4:1 at 17%. The complete results of plant health relative to slope classification are as follows:

Table 9. Plant Health in Relation to Slope.

Slope	Excellent Health	Good Health	Fair Health	Poor Health	Dead
1:1	1%	64%	22%	10%	4%
2:1	5%	68%	16%	4%	7%
3:1	—	59%	21%	6%	14%
4:1	—	55%	24%	5%	17%
5:1	—	63%	25%	—	13%

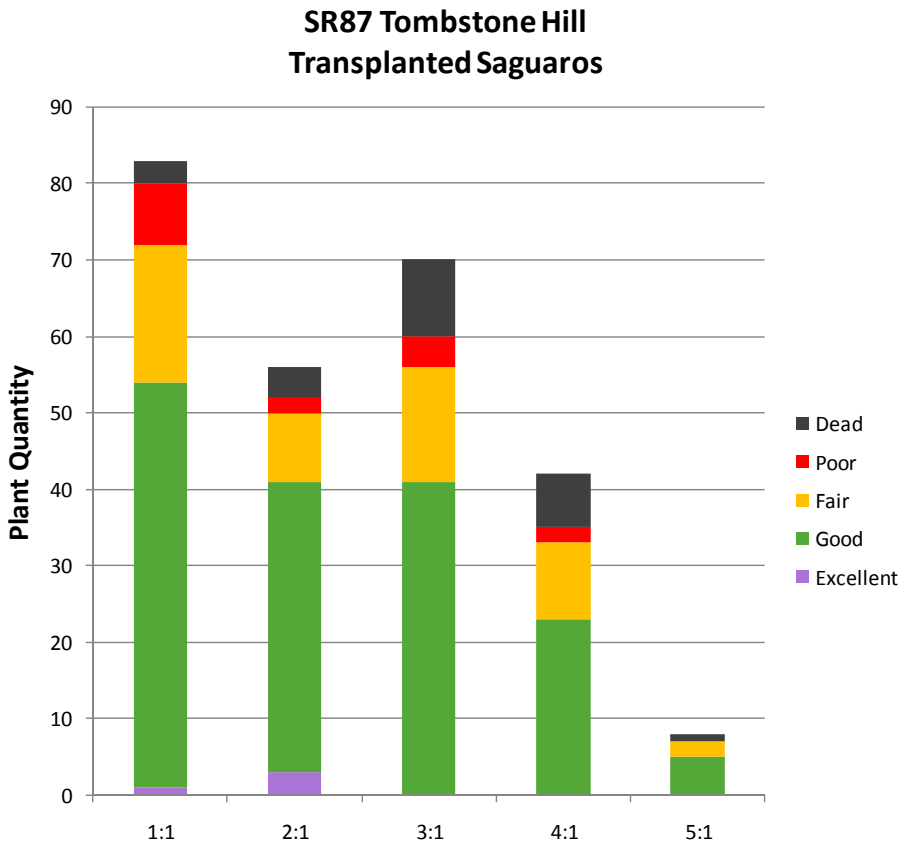


Figure 13. Slope.

Soil Composition

A significant increase in the health of the plants was noted when the planting area was composed of fill material rather than being cut material or undisturbed. Of the plants in the fill material, 68% were in good health; by comparison, only 40% of the plants in cut material were in good health, and only 20% in undisturbed soil were in good health. Table 10 and Figure 14 show the relationship of the soil material to plant health.

Table 10. Plant Health in Relation to Soil Material.

Soil Composition	Excellent Health	Good Health	Fair Health	Poor Health	Dead
Fill Material	—	68%	17%	7%	6%
Cut Material	—	40%	37%	5%	16%
Undisturbed Material	—	20%	30%	—	50%

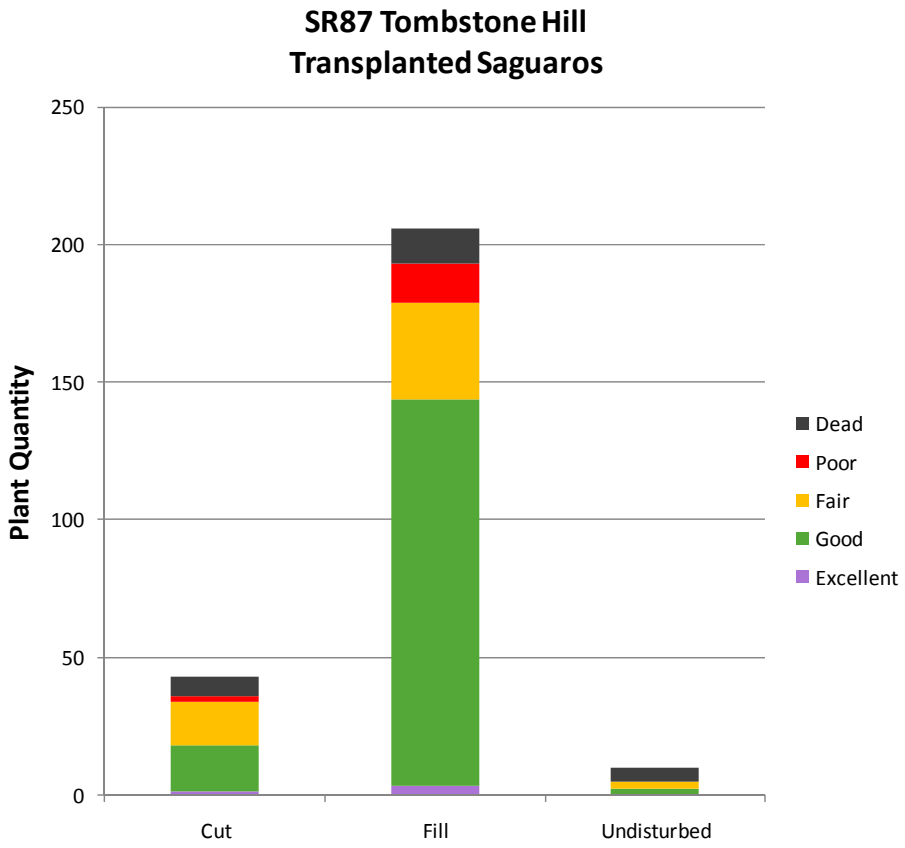


Figure 14. Cut/Fill.

As shown in Table 11 and Figure 15, a smaller amount of rock in the soil corresponds to better health of the plants. Of saguaros planted in soil with no rock, 67% were in good health, 2% in excellent health, 16% in fair health, 2% in poor health, and 12% dead. When the amount of rock was <25%, 63% of the plants were in good health, 1% (one plant) in excellent health, 23% in fair health, 7% in poor health, and 7% dead. For soil composed of 25% to 50% rock, 8% of the plants were in good health, 62% in fair health, 23% in poor health, and 8% dead. The health of plants in soils containing >50% rock was mostly poor (75%), with 25% (one plant) in good health.

Table 11. Plant Health in Relation to the Amount of Rock in the Soil.

Amount of Rock in Soil	Excellent Health	Good Health	Fair Health	Poor Health	Dead
None	2%	67%	16%	2%	12%
<25%	1% (1 plant)	63%	23%	7%	7%
25% to 50%	—	8%	62%	23%	8%
>50%	—	25% (1 plant)	—	75%	—

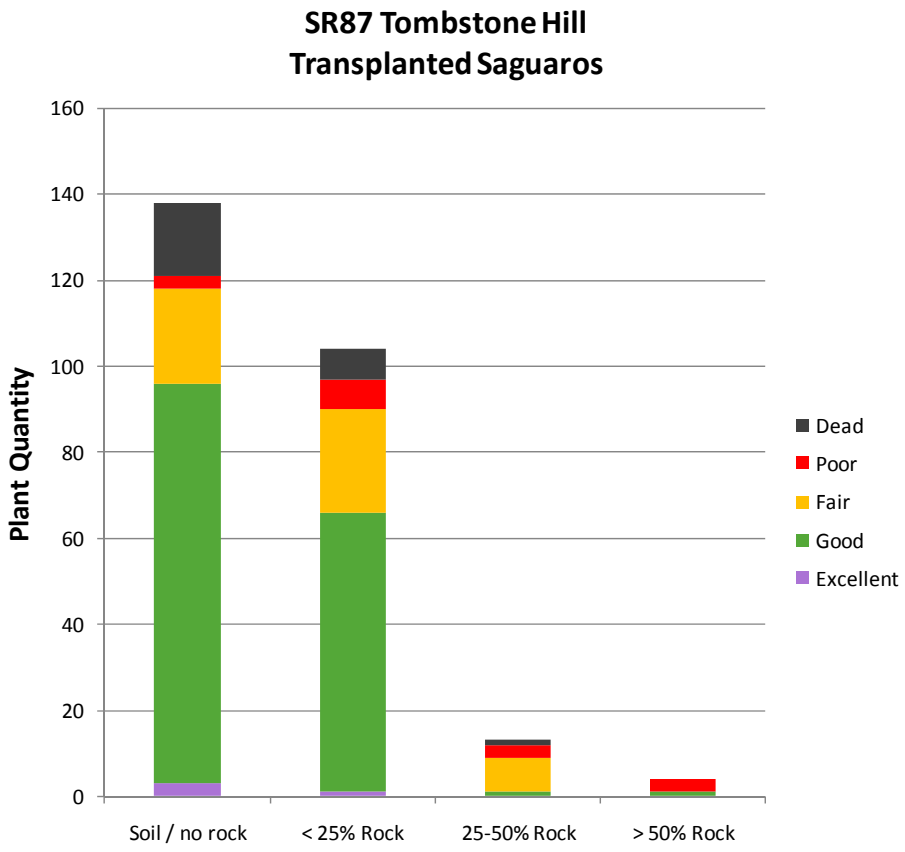


Figure 15. Amount of Rock in Soil.

Vegetative Cover

The amount of vegetative cover near the saguaros did not appear to have a significant effect on plant health. The cover range of >50% to 60% cover contained the highest percentage (83%) of plants in good health. The complete results of plant health relative to vegetative cover appear inTable 12 and Figure 16.

Table 12. Plant Health in Relation to the Amount of Vegetative Cover.

Percent Vegetative Cover	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0–10	—	54	36	—	11
>10–20	2	72	17	11	20
>20–30	2	72	17	4	9
>30–40	—	71	26	6	3
>40–50	3	69	17	9	3
>50–60	—	83	11	6	—
>60–70	5	45	25	5	20
>70–80	—	73	13	7	7
>80–90	—	45	27	9	18
>90–100	—	—	100	—	—

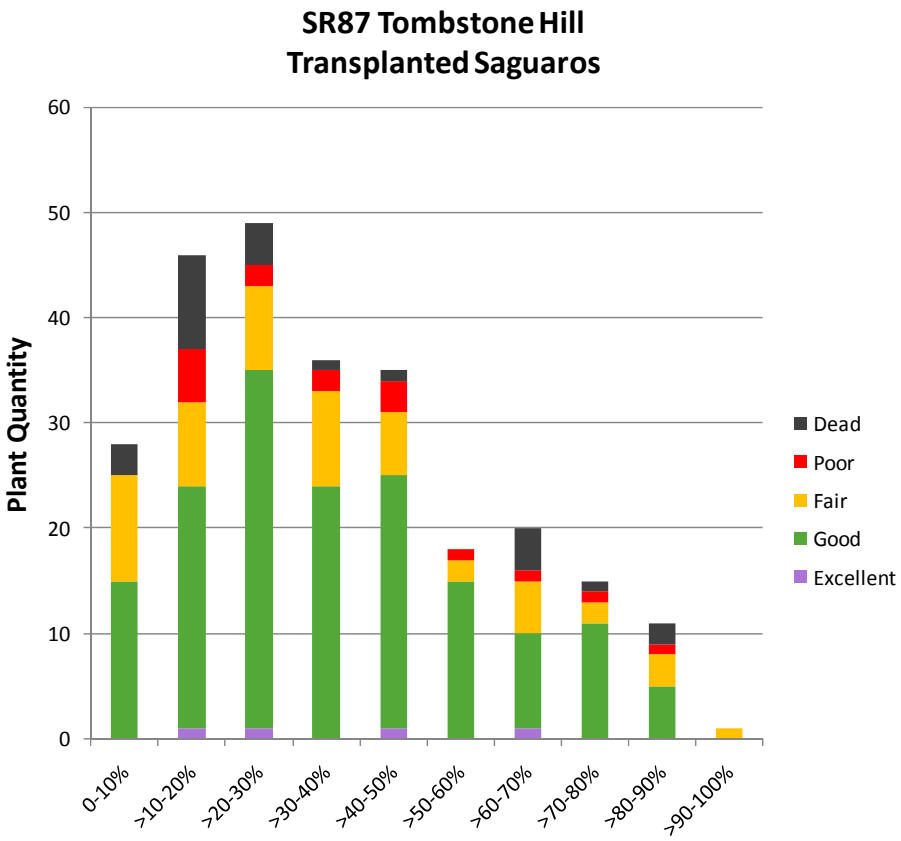


Figure 16. Vegetative Cover.

Presence of Watering Basin

Only 5 out of 259 plants inventoried (2%) had a shallow basin created for the purpose of capturing rainfall. Because of the limited variability in results, no meaningful conclusions could be drawn and no table was created.

Taper at Base

The presence of a tapering stem at the base of the saguaro, an indication that the saguaro was not planted too deeply, was correlated with good plant health (Figure 17). Saguaros exhibiting taper were mostly in good health (72%), with 2% in excellent health, 21% in fair health, and 5% in poor health. Of the saguaros with no visible taper, the overall percentage of plants in good health (53%) is smaller than those with a taper, with 30% in fair health and 16% in poor health. The presence or absence of a tapering stem could not be determined for the 25 dead plants.

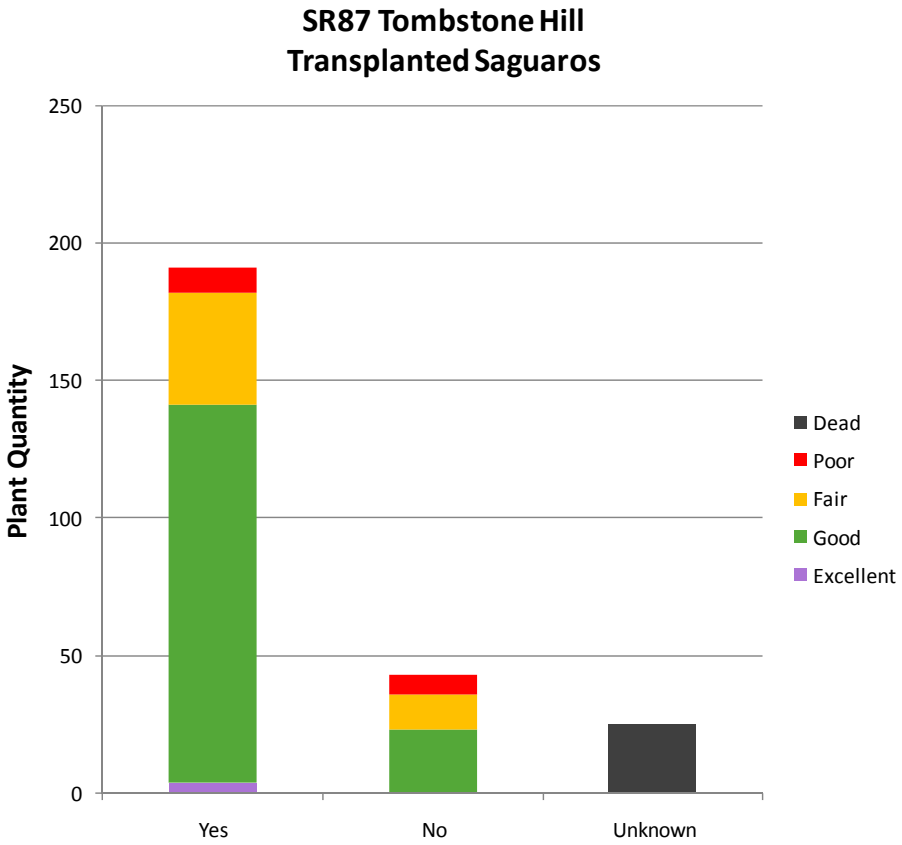


Figure 17. Taper at Base.

Wildlife Habitat

The presence of habitat for wildlife was noted for only 6 of the 259 saguaros inventoried. Twenty-five of the saguaros were decomposed to the extent that it was not possible to determine if habitat existed.

4.3 SR 188 RESORT ROAD TO DEVORE WASH

The SR 188 Resort Road to Devore Wash section is located in Gila County on SR 188 approximately 15 miles northwest of the town of Miami, starting at Devore Wash and going northwest to Resort Road. The section is 7.75 miles in length, including improvements along SR 288 (0.88 miles in length). The elevation ranges from approximately 2,360 to 3,190 feet.

Transplanting Details

A total of 335 saguaros were salvaged. Most of the saguaros were transplanted between December 1, 2003, and February 27, 2004, with four saguaros transplanted on December 3, 2004. The saguaros taller than six feet (with the exception of one plant) were moved only once, from their original location to their final location outside the limits of construction disturbance. Most of the saguaros that were six feet or less in height were moved to a temporary nursery for the duration of the roadway construction and then were planted as part of the revegetation effort within the area disturbed by construction. A few of the saguaros six feet and under were moved once. The start date for the plant establishment period was January 1, 2004.

The project planting details and special provisions (ADOT 2003; ADOT 2003a) specified that the saguaros be oriented in the same direction as they had originally grown and that they be planted at the same depth, or not more than two inches deeper than their original growing depth. The saguaros were to be replanted as near as possible to their vertical growth habit found prior to transplantation. All surface wounds were to be treated with bactericide. Excavation of the root structure was to maintain the following minimum root lengths: 3 inches for roots less than 1 inch in diameter; 12 inches for roots greater than 1 inch but less than 3 inches in diameter; and 24 inches for roots greater than 3 inches in diameter. All wounds and cuts made to the roots were to be treated with powdered sulfur or bactericide on the same day that the cut or wound was made. Bare roots were not to be out of the ground for more than five days before planting. The planting pits were to be excavated to a depth and width that ensured all tap, buttress, and lateral roots had a minimum clearance of 6 inches from the sides and bottom of the planting pit. Native soil removed from the planting pit was to be used for backfill, amended with three to four pounds of soil sulfur per cubic yard. Positive drainage was to be provided at the plant base, and a basin created with a diameter three times the diameter of the main stem and 12 inches deep, as roots allowed, to retain water. Small saguaros that had been growing in a shaded location or under a “nurse” tree were to be replanted in a similar situation. Saguaros 7 feet and taller were to be guyed, per shop drawings submitted by the landscape contractor. Additionally, the guying was to be capable of withstanding winds up to 40 mph and/or under wet soil conditions. See Appendix A for copies of the planting details.

Post-Planting Inspections

The Inventory Data Report dated September 22, 2005, listed 285 of the 335 saguaros salvaged as alive, for an overall survival rate of 85% after one year of establishment. The

survival rate was further broken down by height classification and whether the saguaro was moved once or twice (Table 13). The survival rate at one year dropped off noticeably for the >20-foot moved-once saguaros: they had a 69% survival, with 28 of 90 plants dead.

Table 13. One-Year Survival Rate of Moved Saguaros by Height.

Height	Moved Once		Moved Twice	
	Survival Rate	Dead Plants per Number Moved	Survival Rate	Dead Plants per Number Moved
0 to 6 ft	92%	1 of 13 died	88%	8 of 67 died
>6 to 12 ft	90%	3 of 38 died	100%	0 of 1 died
>12 to 20 ft	92%	10 of 126 died	—	—
>20 ft	69%	28 of 90	—	—

Rainfall

The rainfall data from a 34-year period (1975 to 2008) shows an average rainfall per year of 15.28 inches. In comparison, data from 2003 (the year of transplantation) to 2008 (the year of inventory) shows an average rainfall per year of 14.33 inches. Globe, Arizona, approximately 15 miles from the project site, was the closest weather station with rainfall data (Western Regional Climate Center. Globe 2).

According to the landscape contractor's transplantation plan, the saguaros were to receive 20 gallons of water per month during the summer months and 10 gallons during the winter months via a temporary drip irrigation system.

LSD Inventory

LSD conducted an inventory of the existing saguaros between February 4, 2008, and June 4, 2008. Of the 279 saguaros inventoried, 6 were in excellent health, 116 in good health, 82 in fair health, 37 in poor health, and 38 were dead. The 56 plants unaccounted for may have died and been removed from the project or may have been overlooked during LSD's inventory. Based on an initial quantity planted of 335, the overall survival rate was 72%. The saguaros 0 to 6 feet in height had a survival rate of 91%; the saguaros >6 to 12 feet in height had a 70% survival rate; the saguaros >12 to 20 feet in height had a 78% survival rate; and the saguaros >20 feet in height had a 56% survival rate.

Left:
Saguaro in excellent condition at time of inventory, February 5, 2008.
Original tag #N/A, LSD #163.
NOTE: No Contractor's presalvage photo available.

Left:
Contractor's presalvage photo of saguaro tag #290.

Right:
Saguaro in good condition at time of inventory, February 4, 2008.
Original tag #290, LSD #124.

Above, Left: Contractor's presalvage photo of saguaro tag #564.
Right: Saguaro in fair condition at time of inventory, February 13, 2008.
Original tag #564, LSD #249.

Left: Contractor's presalvage photo of saguaro tag #234.

Right: Saguaro in poor condition at time of inventory, February 4, 2008. Original tag #234, LSD #106.

Above: Contractor's presalvage photo of saguaro tag #530.
Right: Saguaro dead at time of inventory, February 13, 2008. Original tag #530, LSD #246.

Height

Table 14 and Figure 18 show plant health rating by height classifications.

Table 14. Plant Health in Relation to Height.

Height	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0–6 ft	9%	80%	7%	3%	1%
>6–12 ft	—	46%	29%	11%	14%
>12–20 ft	—	27%	40%	15%	18%
>20 ft	—	6%	43%	28%	24%

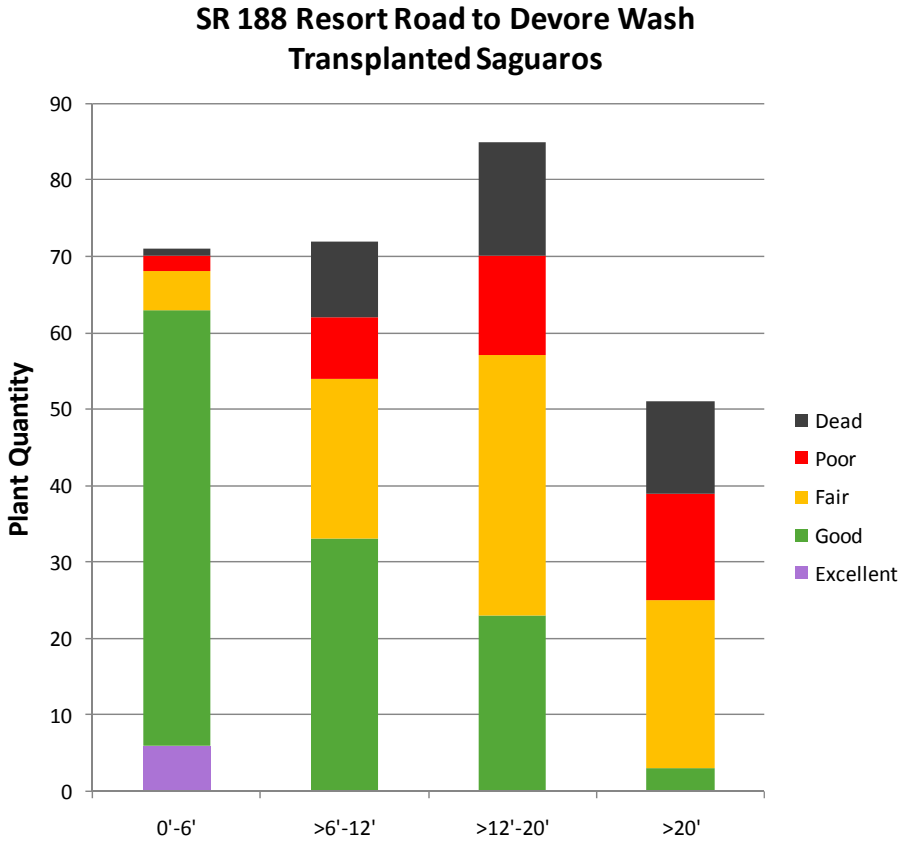


Figure 18. Plant Height.

Presence of Arms

The presence of arms appeared to have a negative effect on the health of the plants (Figure 19). Of the plants with arms, 20% were in good condition; 41% were in fair condition; 19% were in poor condition; and 20% were dead. Of the plants without arms, the majority were in good health (68%), while 5% were in excellent health; 15% in fair health; 6% in poor health; and 6% were dead.

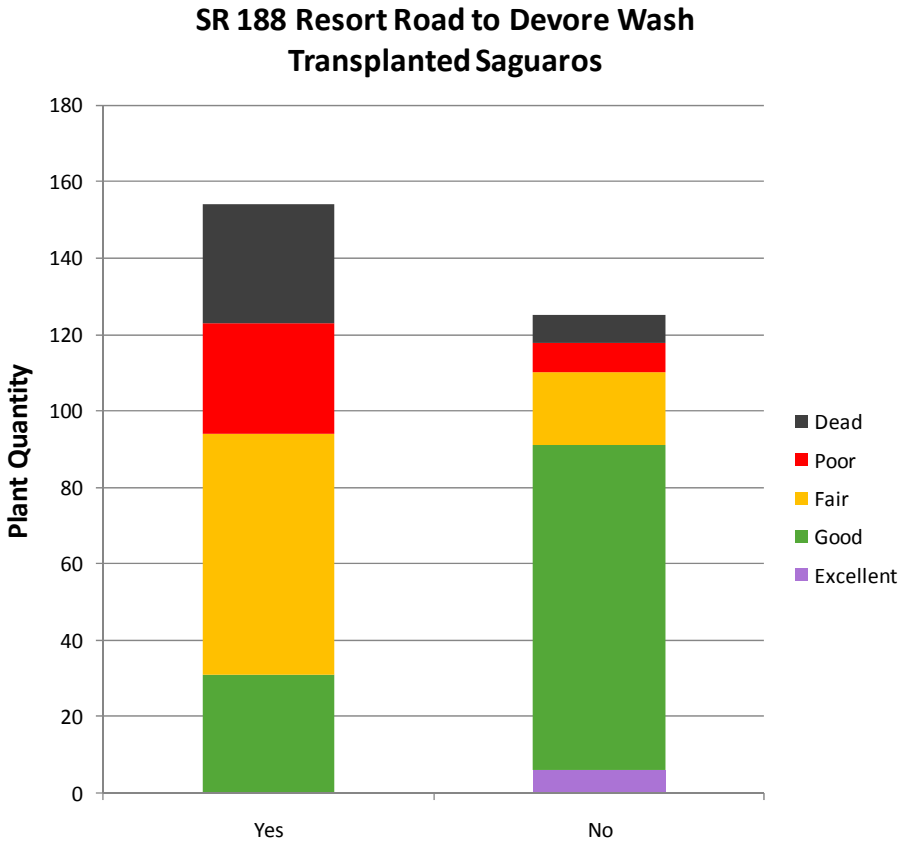


Figure 19. Presence of Arms.

Aspect

Aspect (the directional orientation of slope) appeared to have an effect on plant health (Table 15 and Figure 20), with the southern exposure containing the highest percentage of plants in good health (82%), aside from the two plants (100%) with no aspect (level ground) that were in good condition. Conversely, the northern exposure contained the highest percentage of dead plants (28%).

Table 15. Plant Health in Relation to Aspect.

Aspect	Excellent Health	Good Health	Fair Health	Poor Health	Dead
North	—	28%	41%	3%	28%
Northeast	—	32%	23%	30%	16%
East	11%	50%	25%	11%	4%
South	—	82%	9%	9%	—
Southeast	—	55%	18%	18%	9%
West	—	56%	26%	9%	9%
Southwest	7%	28%	36%	13%	17%
Northwest	—	40%	35%	11%	14%
Level Ground	—	100%	—	—	—

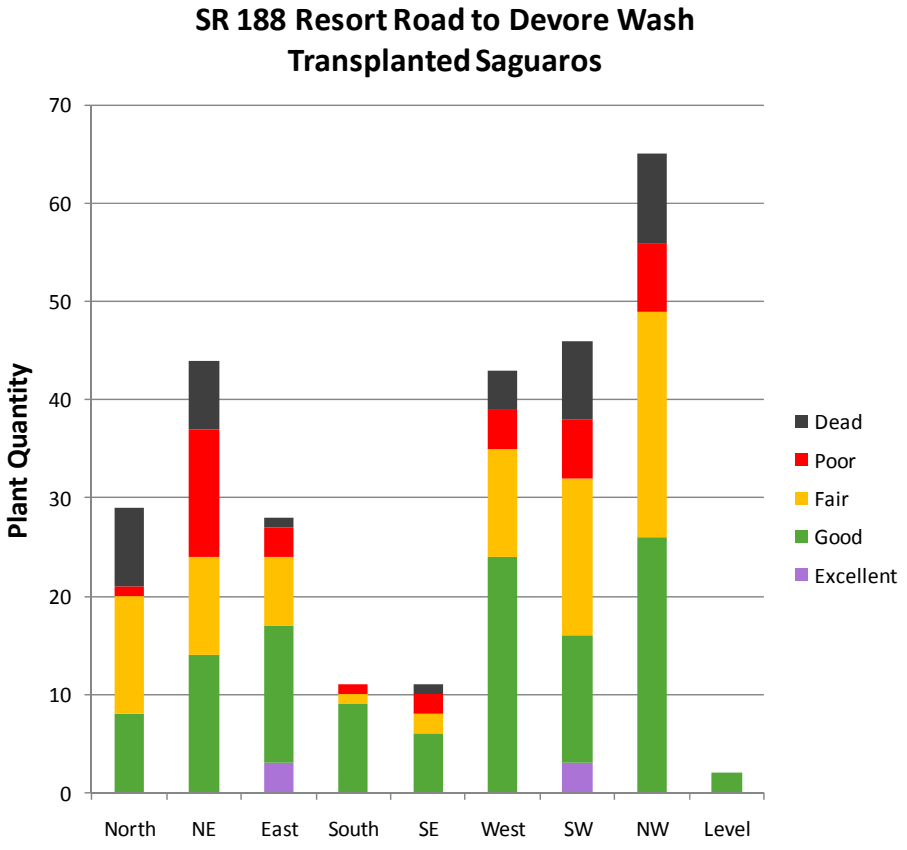


Figure 20. Aspect.

North Orientation

Only two of the 279 saguaros inventoried had a north mark, indicating that they were replanted at the same orientation as originally grown, so no valid conclusions could be drawn and a table was not created.

Slope

Slope did not appear to have a significant effect on plant health (Table 16 and Figure 21). Only a few plants were in the steepest and flattest slope categories, so those categories were set aside and just the four categories with a good number of plants were compared. The 2:1 slope category had the largest percentage of plants in good health (53%), as well as 13% of the plants in excellent health and the lowest percentage (6%) of dead plants. Of the saguaros planted on 2:1 slopes, 19% were in fair health and 9% were in poor health.

Table 16. Plant Health in Relation to Slope.

Slope	Excellent Health	Good Health	Fair Health	Poor Health	Dead
2:1	13%	53%	19%	9%	6%
3:1	2%	35%	31%	14%	18%
4:1	—	46%	29%	12%	14%
5:1	—	42%	33%	17%	8%

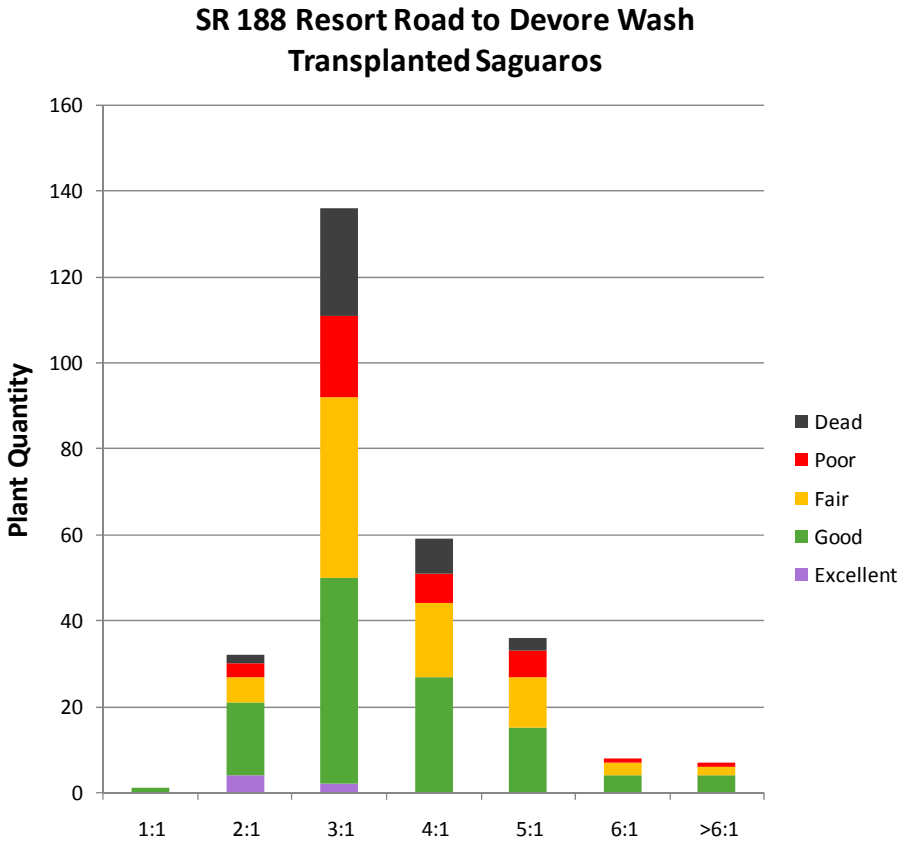


Figure 21. Slope.

Soil Composition

The majority of the saguaros transplanted were moved once, to undisturbed areas outside the area of project disturbance. Of the plants moved twice, more were placed on cut slopes than on fill slopes. There was little difference in the health of plants on cut or fill slopes; the health of saguaros planted on undisturbed ground was not as good as the saguaros planted in cut or fill (see Table 17 and Figure 22).

Table 17. Plant Health in Relation to Soil Composition (Cut/Fill).

Soil Composition	Excellent Health	Good Health	Fair Health	Poor Health	Dead
Cut	12%	65%	16%	6%	2%
Fill	—	66%	24%	7%	3%
Undisturbed	—	32%	34%	16%	18%

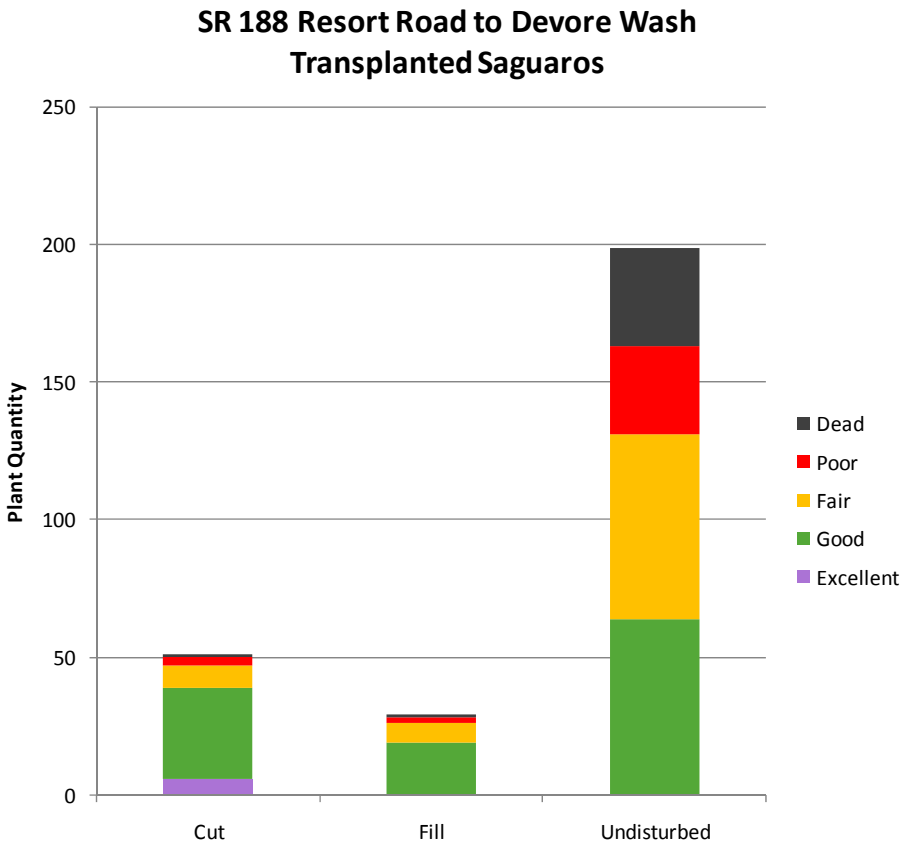


Figure 22. Cut/Fill.

Only seven of the 279 plants inventoried were planted in 25% to 50% rock; all others were in <25% rock, so no valid conclusions could be drawn regarding the effect of rock in the soil on plant health.

Vegetative Cover

The amount of vegetative cover near the saguaros did not appear to have a significant effect on plant health until cover exceeded 50% (Table 18 and Figure 23). The highest percentage of dead plants and plants in poor health, as well as the lowest percentage of plants in good health, occurred within the 50%-plus cover categories.

Table 18. Plant Health in Relation to Vegetative Cover.

Vegetative Cover	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0%–10%	—	44%	25%	19%	12%
>10%–20%	3%	40%	35%	6%	17%
>20%–30%	5%	44%	35%	14%	2%
>30%–40%	—	41%	33%	19%	7%
>40%–50%	9%	45%	27%	—	18%
>50%–60%	10%	40%	10%	—	40%
>60%–70%	—	17%	17%	33%	33%
>70%–80%	—	—	—	—	100

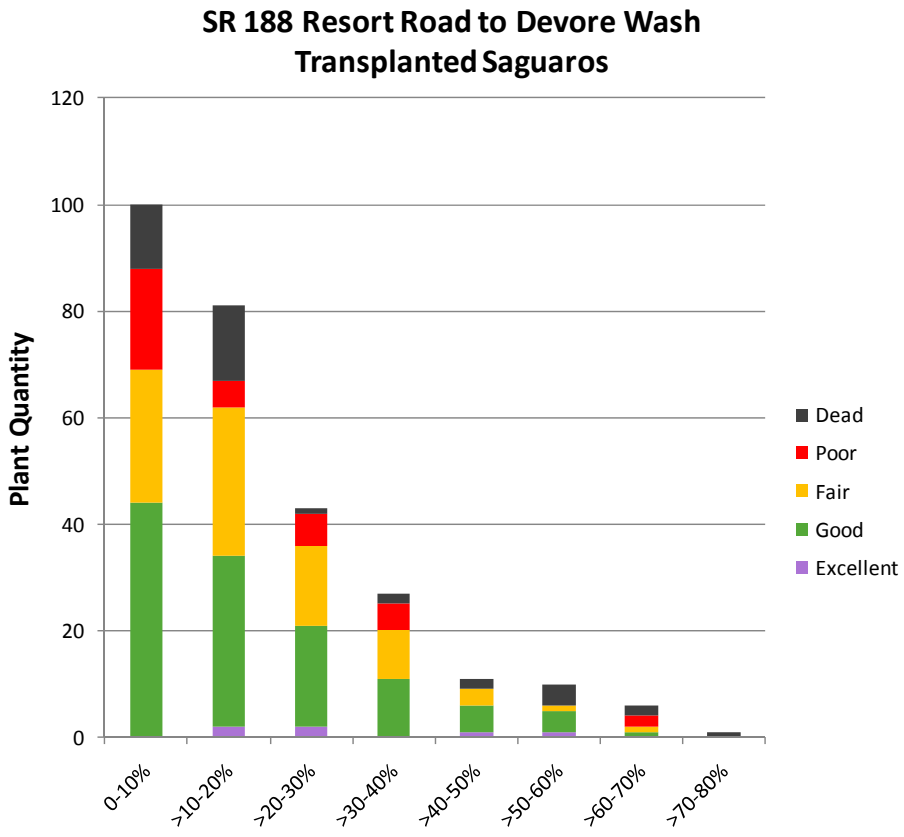


Figure 23. Vegetative Cover.

Presence of Watering Basin

Basin depth refers to the depression created at the base of the saguaro for the purpose of capturing rainfall. There were no significant differences in plant health relative to basin depth (Figure 24). Where there was no basin, 3% of the plants were in excellent health, 44% were in good health, 33% were in fair health, 12% were in poor health, and 9% were dead. When the basin depth was >0 to <3 inches, 1% of the plants were in excellent health, 48% were in good health, 30% were in fair health, 20% were in poor health, and 1% were dead. One plant with a basin depth of 3 to 6 inches was in good health and one plant was in poor health. It was not possible to determine whether or not a basin existed for 20 of the dead saguaros.

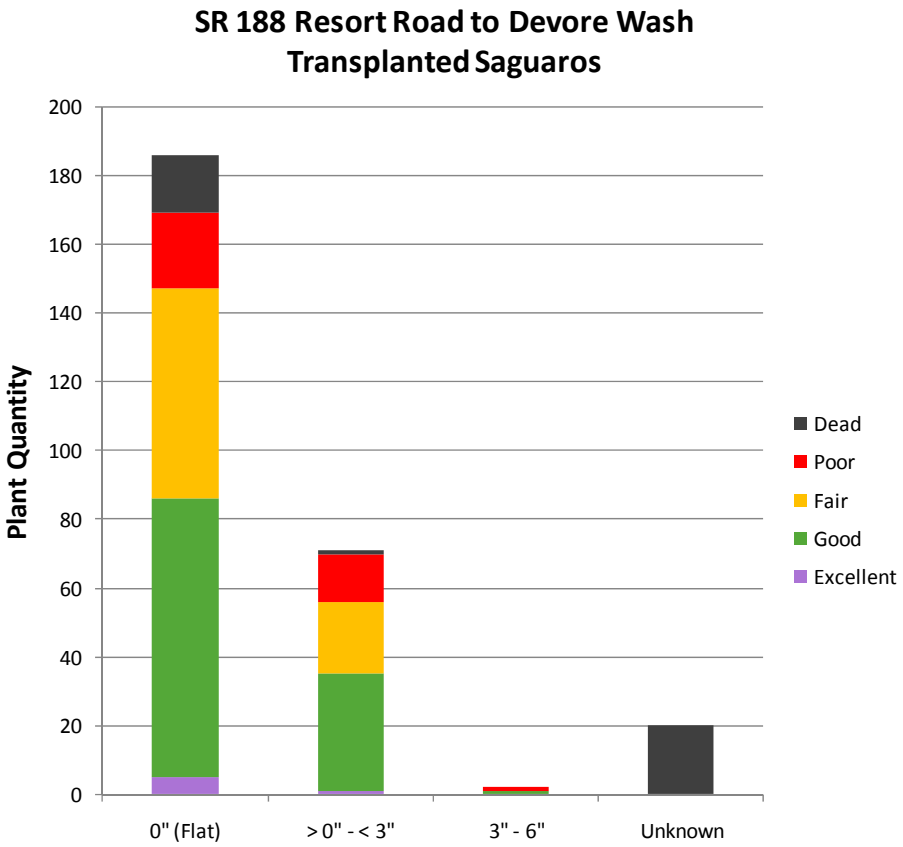


Figure 24. Basin Depth.

Taper at Base

The presence of a tapering stem at the base of the saguaro, an indication that the saguaro was not planted too deeply, was correlated with good plant health (Figure 25). Of the saguaros that exhibited taper, 6% were in excellent health, 84% in good health, 6% in fair health, 3% in poor health, and 1% were dead. In comparison, 1% of the plants with no taper were in excellent health, 29% were in good health, 47% were in fair health, 22% were in poor health, and 1% were dead. The presence of taper could not be determined for 35 of the 38 dead plants.

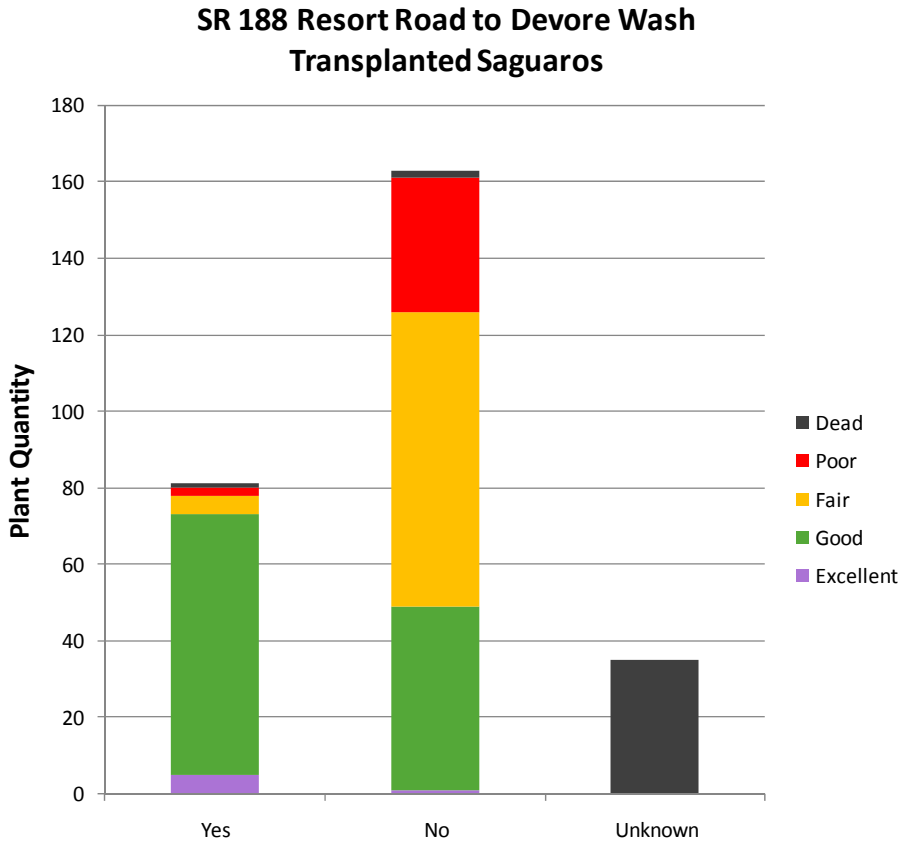


Figure 25. Taper at Base.

Wildlife Habitat

Eighteen of the 279 saguaros inventoried had wildlife habitat, while 30 saguaros were decomposed to the extent that it was not possible to determine if habitat existed.

4.4 US 93 KAISER SPRING

The US 93 Kaiser Spring section is located in Mohave County on US Route 93 approximately 12 miles southeast of the town of Wikieup. The section is 5 miles in length. The elevation ranges from approximately 2,018 to 2,438 feet.

The project plans called for 210 saguaros to be salvaged and replanted on site (ADOT 1999); the devegetation contractor's inventory identified 175 saguaros suitable for salvage.

Transplanting Details

The saguaros were transplanted beginning in December 1999. Most of the saguaros were placed in a temporary nursery and later planted back on the project site. At least five saguaros were moved once, to an area outside the construction disturbance.

The project planting details and special provisions specified that the saguaros be oriented in the same direction as originally grown and planted at the same depth. Excavation of the root structure was to maintain the following minimum root lengths: 3 inches for roots less than 1 inch in diameter; 12 inches for roots greater than 1 inch but less than 3 inches in diameter; and 24 inches for roots greater than 3 inches in diameter. All wounds and/or cuts made to the roots were to be treated with powdered sulfur and agricultural streptomycin bactericide. The planting pits were to be excavated to a depth and width that ensured all tap, buttress and lateral roots had a minimum clearance of 6 inches from the sides and bottom of the planting pit. Native soil removed from the planting pit was to be used for backfill, amended with three to four pounds of soil sulfur per cubic yard. Small saguaros that were in a "nurse" situation were to be replanted in partial shade. The saguaros were to be planted in dry site soil and remain dry for a minimum period of two weeks. As approved by the engineer, the plants could be watered within a few days to promote stability. The saguaros were to be staked if taller than 6 feet. The staking was to be composed of fiber-reinforced hose encircling the saguaro at two-thirds of its height, and nylon guy ropes tied to 2-foot-long #4 rebar, in a triangulated pattern. Positive drainage was to be provided at the plant base, and a basin created with a diameter three times the diameter of the main stem, to retain water. See Appendix A for copies of the planting details.

Rainfall

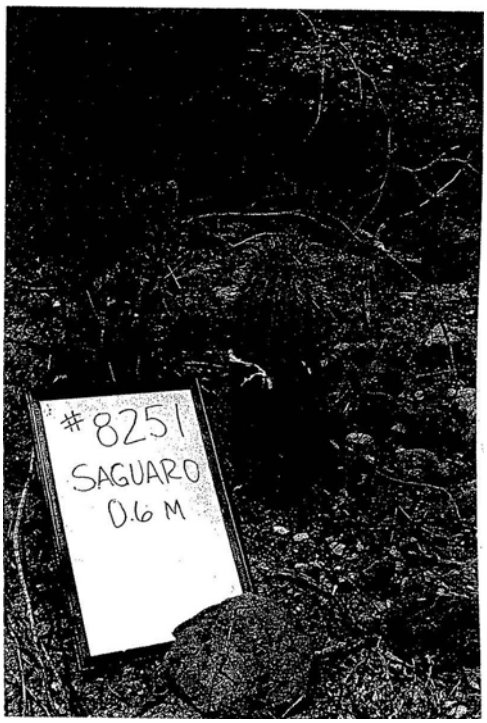
The rainfall data from a 100-year period (1908 to 2008) shows an average annual rainfall of 11.21 inches. In comparison, data from 1999 (the year of transplantation) to 2008 (the year of inventory) shows an average annual rainfall of 10.64 inches (Western Regional Climate Center. Wickenburg).

LSD Inventory

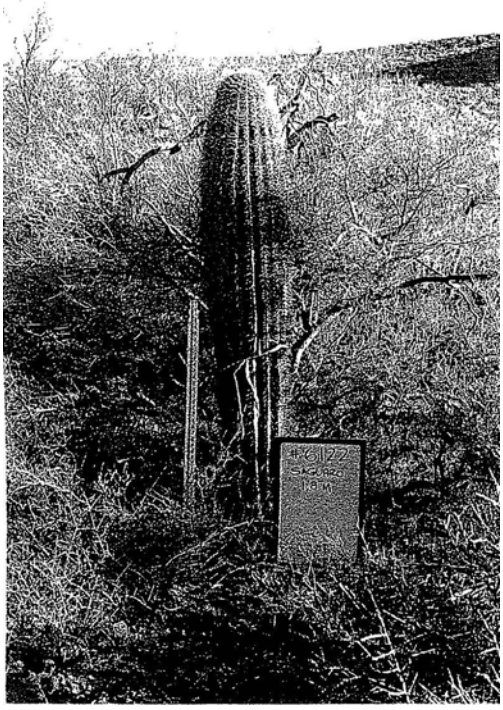
LSD conducted an inventory of the existing saguaros between March 12, 2008, and October 15, 2008.

Survival Rates

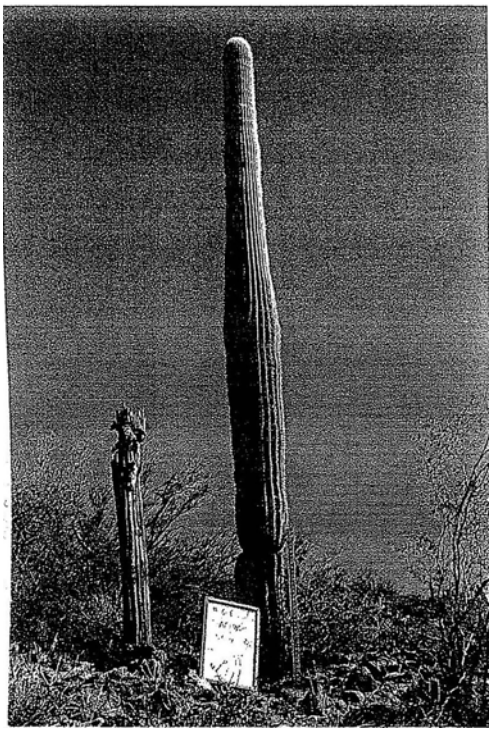
Of the 155 plants identified during the inventory, 3 were in excellent health, 104 were in good health, 26 were in fair health, 4 were in poor health, and 18 were dead. Based on an initial quantity planted of 175, the overall survival rate was 78%. The saguaros 0 to 6 feet in height had a survival rate of 92%; the saguaros >6 to 12 feet in height had a 90% survival rate; the saguaros >12 to 20 feet in height had a 77% survival rate; and the saguaros >20 feet in height had a 0% survival rate.



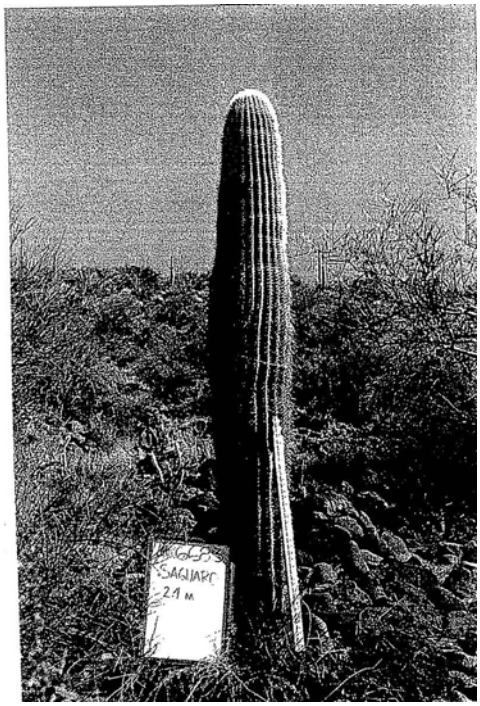
Left: Contractor's presalvage photo of saguaro tag #8251.
Right: Saguaro in excellent condition at time of inventory, October 15, 2008. Original tag #8251, LSD #242.



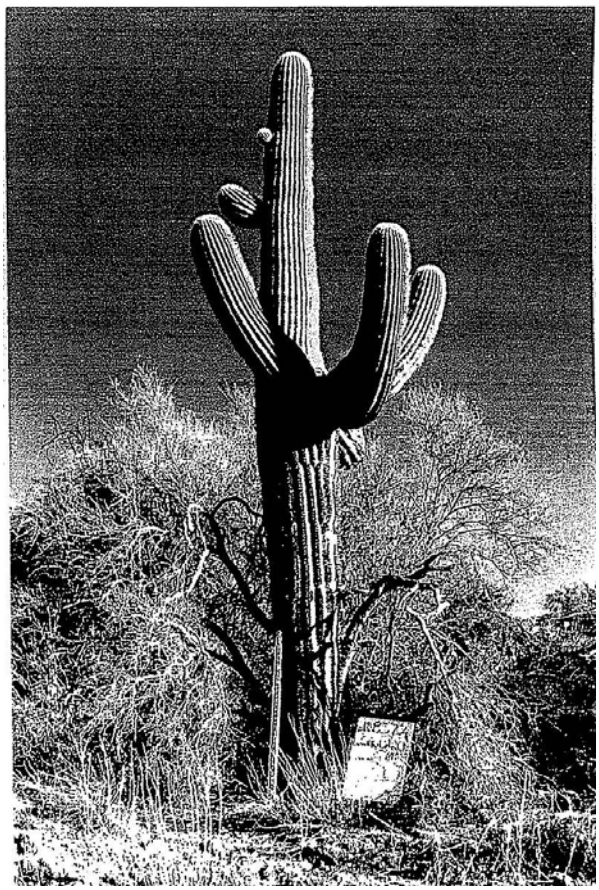
Left: Contractor's presalvage photo of saguaro tag #6122.
Above: Saguaro in good condition at time of inventory, October 9, 2008. Original tag #6122, LSD #102.



Above Left: Contractor's presalvage photo of saguaro tag #6655.
Above Right: Saguaro in fair condition at time of inventory, October 9, 2008. Original tag #6655, LSD #112.



Above Left: Contractor's presalvage photo of saguaro tag #6683.
Above Right: Saguaro in poor condition at time of inventory, October 9, 2008. Original tag #6683, LSD #108.



Left: Contractor's presalvage photo of saguaro tag #8372.

Below: Saguaro dead at time of inventory, October 9, 2008. Original tag #8372, LSD #135.

Height

Figure 26 shows plant health rating by height classifications. The majority of the 0- to 6-foot-high saguaros (73%) were in good health; 3% were in excellent health; 16% were in fair health; and 8% were dead. Most of the >6- to 12-foot-high saguaros (71%) were in good health, 13% were in fair health, 4% were in poor health, and 11% were dead. As the height of saguaros increased, health decreased: 36% of the >12- to 20-foot-high saguaros were classified as good, 27% as fair, 9% as poor, and 27% as dead.

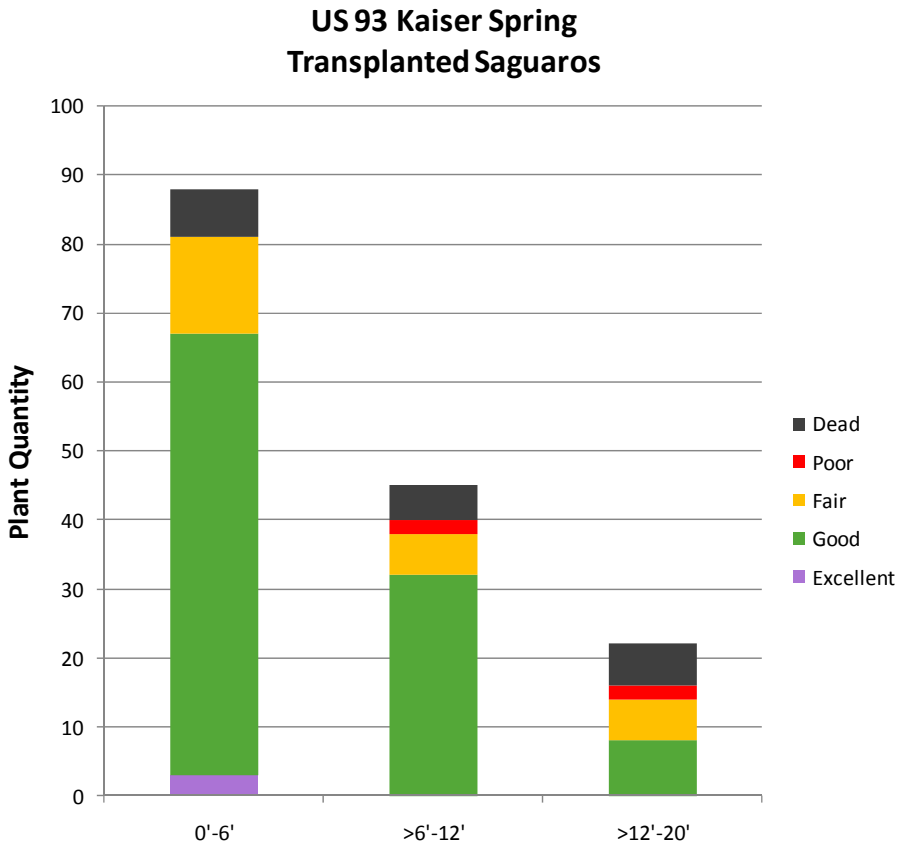


Figure 26. Plant Height.

Presence of Arms

There were significantly more saguaros (138 plants, 89%) without arms than with arms (17 plants, 11%), making a direct comparison more difficult; nonetheless, the plants without arms were noticeably healthier. The majority (71%) of the plants without arms were in good health; 2% were in excellent health; 17% were in fair health; 1% were in poor health; and 8% were dead. Of those plants with arms, 35% were in good health, 18% in fair health, 12% in poor health, and 35% were dead (Figure 27).

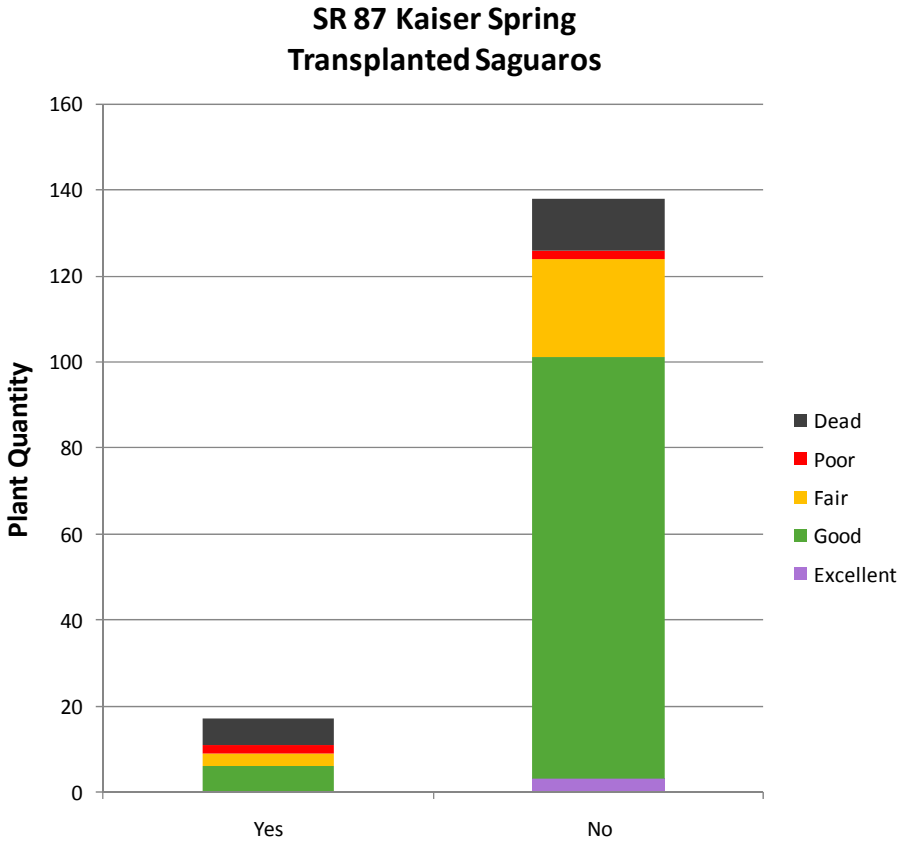


Figure 27. Presence of Arms.

Aspect

Aspect (the directional orientation of slope) did not appear to have a significant effect on saguaro health (Table 19 and Figure 28). The highest percentage (82%) of plants in good health were on the east aspect; the highest percentage (50%) of dead plants were on the south aspect.

Table 19. Plant Health in Relation to Aspect.

Aspect	Excellent Health	Good Health	Fair Health	Poor Health	Dead
North	—	67%	—	—	33%
Northeast	—	68%	24%	—	8%
East	—	82%	6%	—	12%
South	—	33%	17%	—	50%
West	3%	69%	16%	4%	9%
Southwest	—	67%	20%	7%	7%
Northwest	5%	58%	21%	—	16%

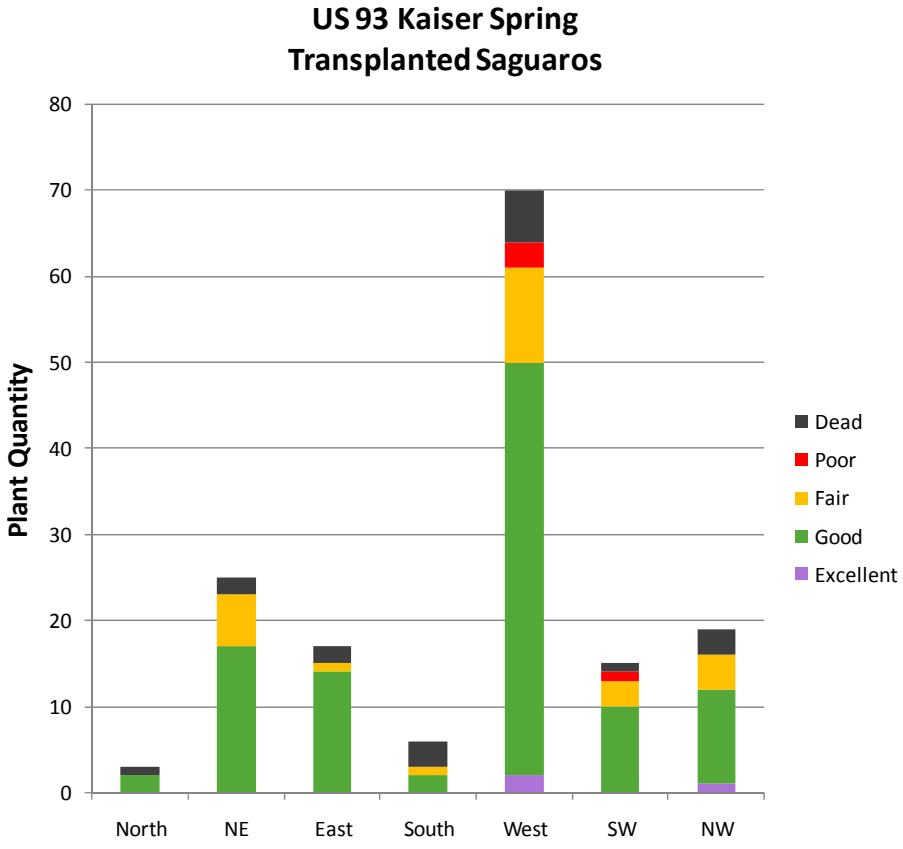


Figure 28. Aspect.

North Orientation

The presence of a mark on the north side of the saguaro, indicating that it was replanted at the same orientation as originally grown, is correlated with slightly higher ratings for health than the plants with no north mark (Figure 29). Of the saguaros with a north mark oriented to the north, 2% were in excellent health, 83% were in good health, 14% were in fair health, and 2% were dead. Five plants had a north mark oriented to the northeast; of those, 60% were in good health and 40% were in fair health. Of the plants with no mark, 3% were in excellent health, 68% were in good health, 21% were in fair health, 5% were in poor health, and 4% were dead. Fourteen of the dead saguaros were decomposed to the extent that it was not possible to determine if a north mark ever existed. It should be noted that the absence of a north mark does not necessarily mean that the saguaro was planted at an orientation different from that at which it was originally grown; it simply means that it is undetermined, so a valid comparison is difficult to make.

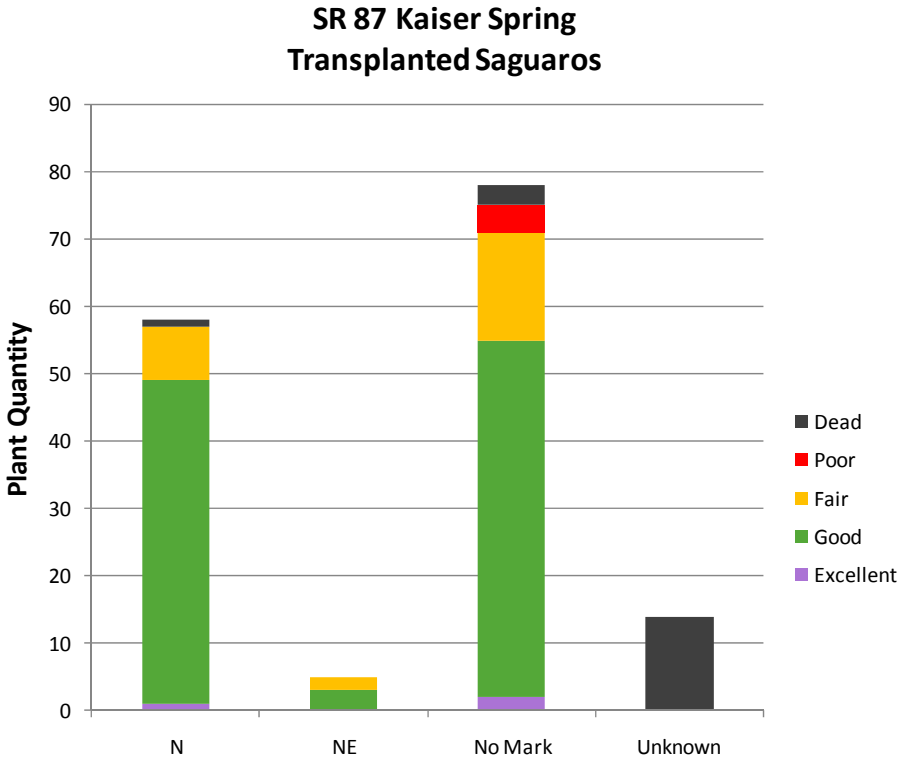


Figure 29. Orientation of North Mark.

Slope

Slope did not appear to have a significant effect on plant health (Table 20 and Figure 30). Slopes of >6:1 had the highest percentage of plants in good condition (100%), although only three plants occurred in this category, resulting in a small sample size. The highest percentage of dead plants (23%) occurred on the 6:1 slopes.

Table 20. Plant Health in Relation to Slope.

Slope	Excellent Health	Good Health	Fair Health	Poor Health	Dead
1:1	—	69%	19%	—	13%
2:1	—	68%	16%	—	16%
3:1	5%	69%	10%	7%	8%
4:1	—	73%	12%	—	15%
5:1	—	58%	42%	—	—
6:1	—	38%	38%	—	23%
>6:1	—	100%	—	—	—

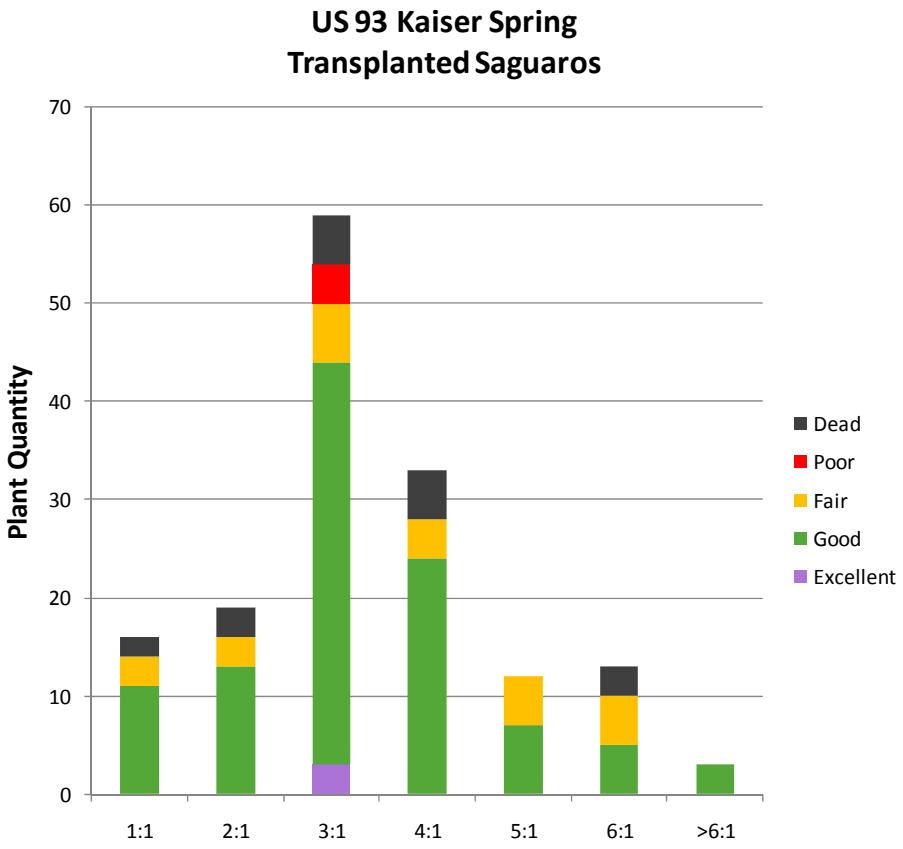


Figure 30. Slope.

Soil Composition

Saguaros planted on cut slopes exhibited slightly better health than saguaros planted on fill slopes, while saguaros planted on undisturbed ground were the least healthy (Figure 31). Of the saguaros planted on the cut slopes, 2% were in excellent health, 78% were in good health, 11% were in fair health, 2% were in poor health, and 7% were dead. Of the saguaros planted on fill slopes, 2% were in excellent health, 68% were in good health, 20% were in fair health, 1% were in poor health, and 8% were dead. On the undisturbed ground, 29% of the saguaros were in good health, 18% were in fair health, 12% were in poor health, and 41% were dead.

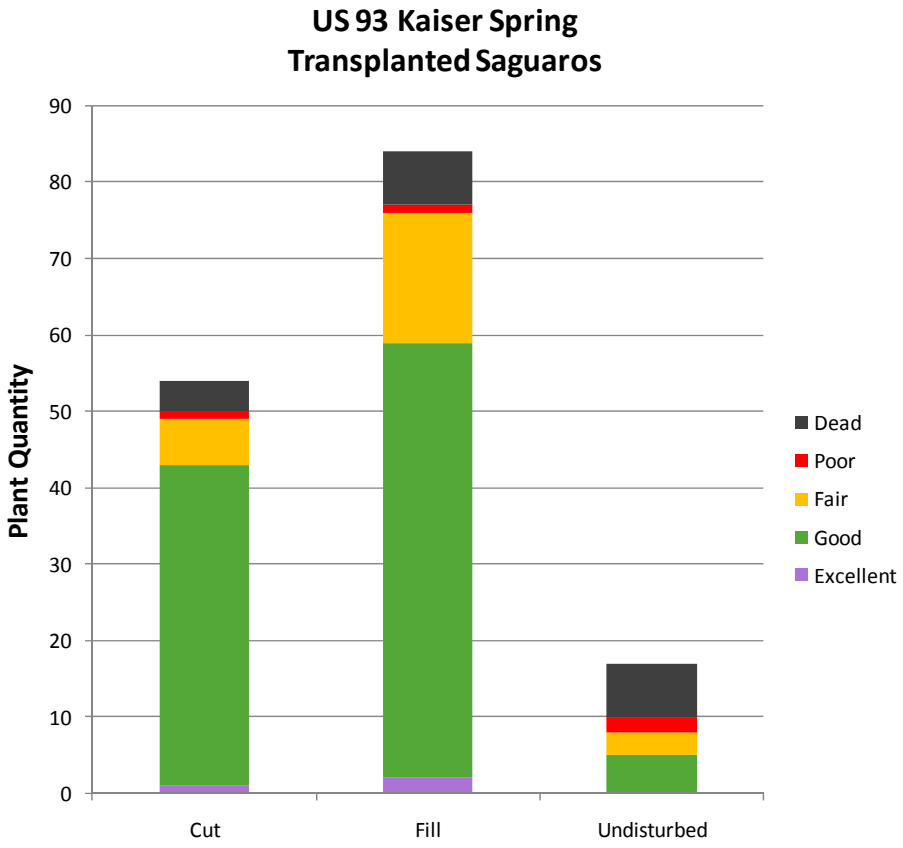


Figure 31. Cut/Fill.

Nearly all of the saguaros inventoried were in soil with <25% rock, so a direct comparison of plant health relative to the amount of rock in the soil was difficult to make. Only a few saguaros were planted in soil with no rock; of those, 33% were in good health and 67% were in fair health. Of the saguaros growing in <25% rock, 2% were in excellent health, 68% were in good health, 15% were in fair health, 3% were in poor health, and 12% were dead. Of the plants growing in 25% to 50% rock, 66% were in good health, 25% were in fair health, and 8% were dead (Figure 32).

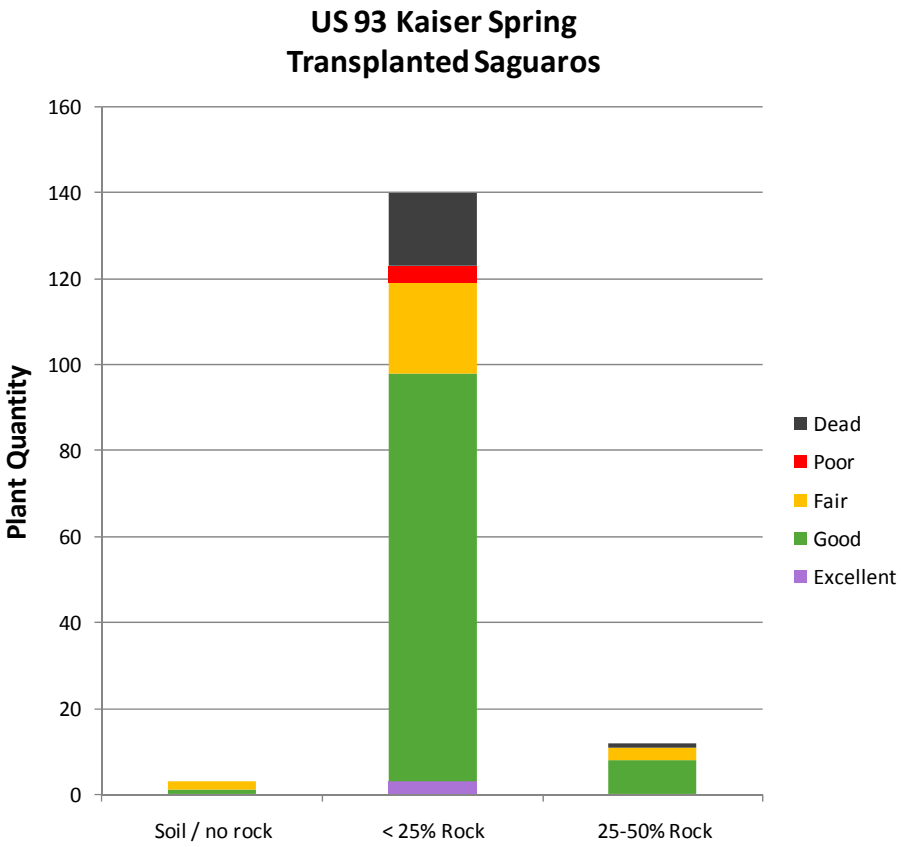


Figure 32. Amount of Rock in Soil.

Vegetative Cover

The amount of vegetative cover near the saguaros did not appear to have a significant effect on plant health (Table 21 and Figure 33). The number of plants in good health was fairly constant across all cover ranges.

Table 21. Plant Health in Relation to Vegetative Cover.

Vegetative Cover	Excellent Health	Good Health	Fair Health	Poor Health	Dead
0%–10%	3%	63%	14%	3%	17%
>10%–20%	—	62%	31%	4%	4%
>20%–30%	—	79%	13%	5%	5%
>30%–40%	—	69%	13%	—	19%
>40%–50%	—	67%	33%	—	—
>50%–60%	—	88%	13%	—	—
>60%–70%	—	100%	—	—	—
>70%–80%	14%	54%	14%	—	14%
>80%–90%	—	67%	—	—	33%

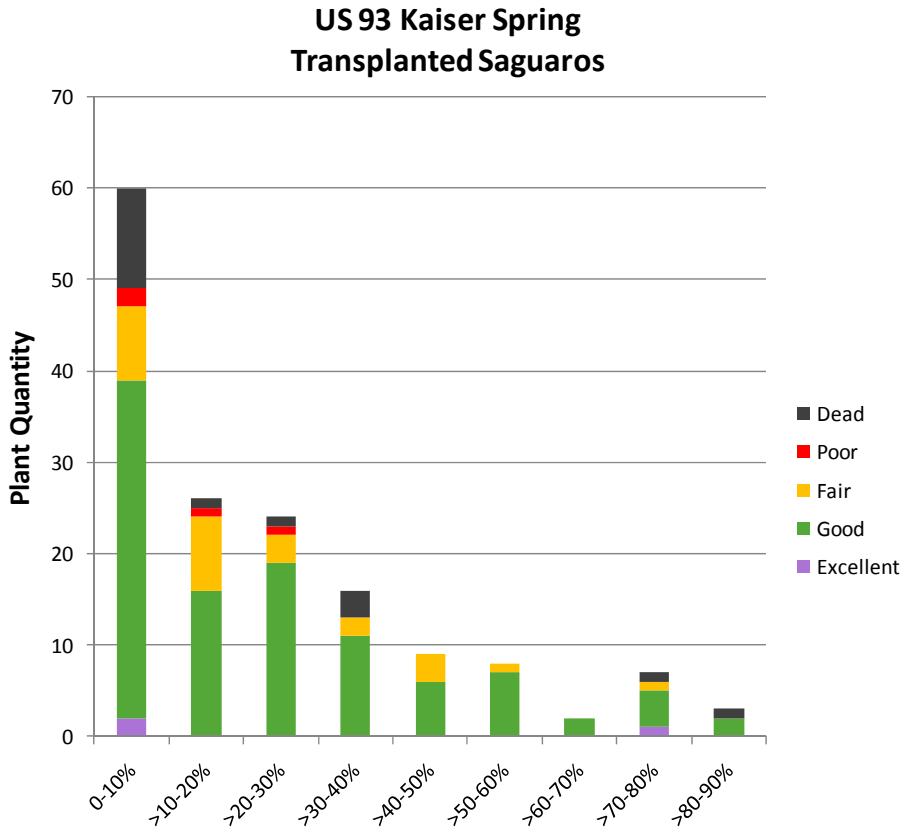


Figure 33. Vegetative Cover.

Presence of Watering Basin

Basin depth reflects the depression created at the base of the plant that could potentially capture rainfall. Nearly all of the saguaros inventoried either had no basin or had a basin >0 to <3 inches in depth, and the health ratings were similar between the two conditions. Where no basin existed, 3% of the saguaros were in excellent health, 63% were in good health, 19% were in fair health, 4% were in poor health, and 11% were dead. Saguaros which were surrounded by a basin >0 to <3 inches in depth were mostly in good health (78%), with 14% in fair health and 8% dead. The one saguaro with a basin of 3 to 6 inches was in good health. No entry regarding basin depth was made for seven of the saguaros inventoried (Figure 34).

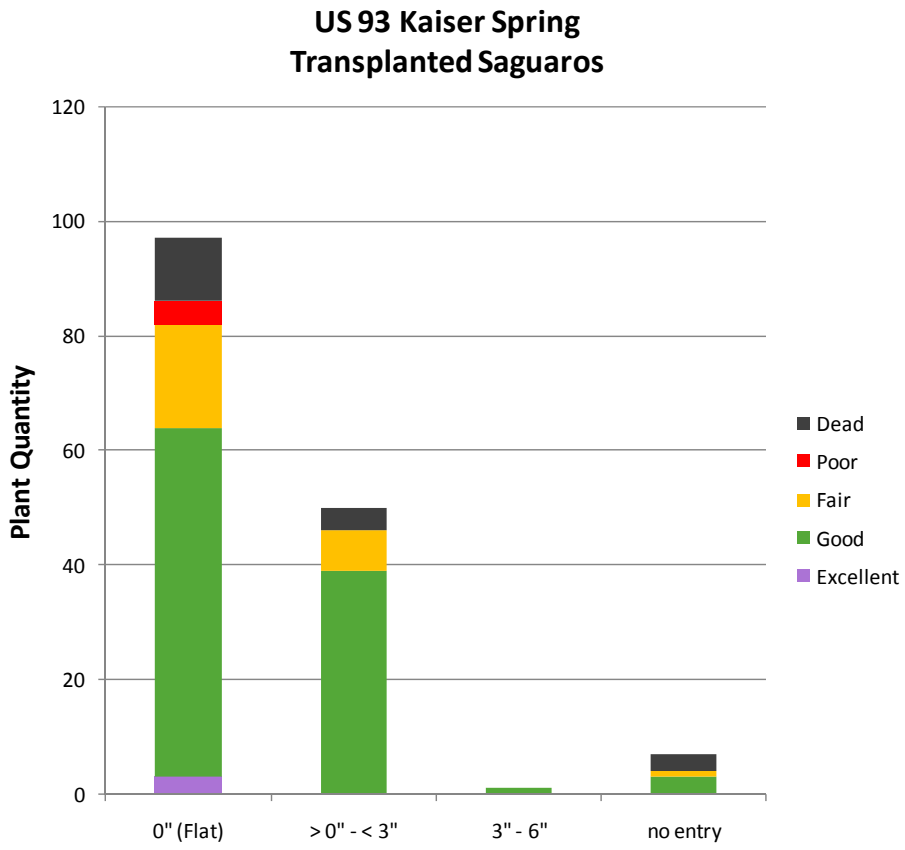


Figure 34. Basin Depth.

Taper at Base

The presence of a tapering base, an indication that the saguaro was not planted too deeply, was correlated with good plant health (Figure 35). Of the plants with a tapering base, 3% were in excellent health, 79% were in good health, 17% were in fair health, and 1% were in poor health. Of the saguaros without taper, 61% were in good health, 22% were in fair health, 7% were in poor health, and 10% were dead. Whether there was taper could not be determined for 13 of the 17 dead plants.

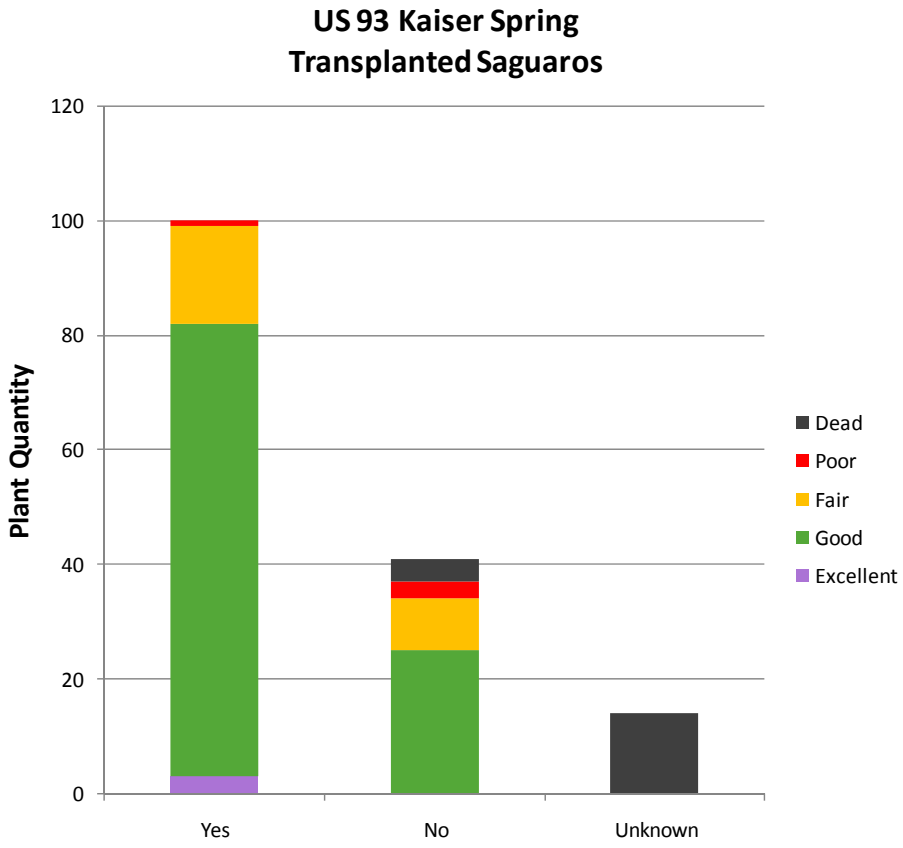


Figure 35. Taper at Base.

Wildlife Habitat

The presence of habitat for wildlife was noted for only one of the 155 saguaros inventoried, while 13 saguaros were decomposed to the extent that it was not possible to determine whether habitat existed.

5.0 CONCLUSIONS

From highest to lowest, the saguaro survival rates at each of the four projects were 78% (US 93 Kaiser Spring), 72% (SR 188 Resort Road to Devore Wash), 68% (SR 87 Tombstone Hill), and 66% (SR 86 Covered Wells). Common factors that were correlated with survival and health were annual rainfall and plant height, presence of arms, and a taper at the base of the plant. Higher annual rainfall may contribute to a higher survival rate. A shorter height, no arms, and the presence of a tapering stem were also correlated with a higher survival rate. As discussed previously and below, other factors may also contribute to the survival and health of a transplanted saguaro.

5.1 SR 86 COVERED WELLS

The survival rate of saguaros transplanted on the SR 86 Covered Wells project (66%) was the lowest of the four projects inventoried. Perhaps not coincidentally, the area of this project received the lowest amount of rainfall relative to the average rainfall amount for the larger area. Although the saguaros received supplemental irrigation from a temporary drip irrigation system for two years following transplantation, the next three years of lower-than-average rainfall may have taken a toll on the transplanted saguaros. Among the variables evaluated for their effect on saguaro survivability, height, arms, and taper were the most critical.

Taller cacti did not fare as well following transplantation. The percentage of plants in good health was similar for the 0- to 6-foot category (64%) and the >6- to 12-foot category (67%), but dropped dramatically to 14% for the >12- to 20-foot category. None of the tallest plants (the >20-foot category) were in good health. The smallest cacti (0 to 6 feet) had the lowest percentage (13%) of dead plants, while the other three size categories in ascending order had 22%, 21%, and 20% dead plants. When the percentages representing “poor health” and “dead” are combined, the numbers increase relative to plant height: 24% (0 to 6 feet), 33% (>6 to 12 feet), 42% (>12 to 20 feet) and 60% (>20 feet).

Saguaros without arms are commonly called spears. Overall, spears were rated as having much better health than saguaros with arms. The majority of the spears (58%) were in good health, compared to none of the saguaros with arms. The percentage of dead plants was higher for spears (17%) than for saguaros with arms (11%), but when the numbers for plants in poor health and dead plants are combined, the result is 28% of all spears transplanted were in poor health or dead, while 44% of the saguaros with arms were in poor health or dead.

The finding that larger saguaros, including saguaros with arms, have a lower survivability and worse health overall than smaller saguaros was echoed by several authors in the literature review section of this report. The assumption is that larger (older) saguaros do not have the same degree of vigor that smaller (younger) saguaros do, so they do not tolerate the stress of transplanting as well.

The importance of the third variable deemed most critical to saguaro survivability following transplantation—taper at the base—was indicated very clearly by the SR 86 Covered Wells results. Plants that tapered at the base were in much better health than plants that did not taper. Of the plants with a tapering base, 63% were in good health (and 2% were in excellent health), compared to 19% in good health without a taper. Although it cannot be confirmed, it seems likely that the 11 dead plants did not taper. Based on that assumption, the percentage of dead plants was much lower (2%) for plants that tapered than for plants that did not (41%).

The results regarding aspect, slope, rock in the soil, and vegetative cover did not indicate any particular condition being more desirable than another.

The presence of a mark on the north side of the saguaro, indicating that it was planted at the same orientation as originally grown, was correlated with good health; the majority of the plants so marked (63%) were in good health. However, these findings are of limited value in the absence of data from saguaros planted in the "wrong" orientation.

5.2 SR 87 TOMBSTONE HILL

The survival rate for saguaros transplanted on the SR 87 Tombstone Hill project was 68%, ranking third among the four projects inventoried. The amount of rainfall received (87% of the average) during the 12 years of establishment also ranked third. Being the oldest of the projects inventoried, SR 87 Tombstone Hill may provide the most valuable information on long-term survival of saguaros.

The variables that had the greatest impact on saguaro survivability and health were height, arms and taper, and, to a lesser extent, north mark, rock in soil, and cut or fill material as the planting substrate. The influence of height was apparent: the percentage of plants in good health decreased gradually from 65% for the 0- to 6-foot-size category, to 62% for the >6- to 12-foot category, to 60% for the >12- to 20-foot category, and then to 33% for the >20-foot category. The two smallest size categories also contained several saguaros in excellent health. Conversely, the percentage of dead plants increased with increasing height (8% for 0 to 6 feet, 9% for >6 to 12 feet, and 16% for 12 to 20 feet). There were no dead plants in the >20-foot category.

The presence of arms was correlated with poorer plant health. While the ratings for good health were not significantly different (57% for plants with arms compared to 63% for plants without arms), the percentage of dead plants was more than three times greater among plants with arms compared to plants without arms (23% and 7%, respectively).

Plants with taper at the base exhibited noticeably better health than plants without taper. Of the plants with a tapering base, 72% were in good health, compared with 53% of the plants without taper. While it is unknown if the dead plants had taper, based on the trend of the results, it seems likely that they did not.

Saguaros with a north mark oriented to the north were mostly in good health (67%), and while the same percentage of saguaros without a north mark exhibited good health, 7% of

those plants without a mark were dead. Complicating the analysis of whether or not a north mark is beneficial is the possibility that plants without a mark may nevertheless have been oriented properly.

Smaller amounts of rock in the soil resulted in better saguaro health in general. Of the plants in loamy soil with no rock, 67% were in good health, although 12% of the plants were dead. As the amount of rock increased to <25%, the plants in good health decreased to 63%, although the amount of dead plants also decreased (7%).

Saguaros are healthier overall when planted in fill material as opposed to cut. This may be a result of the fill material being less rocky, which would be consistent with the findings regarding the amount of rock in the soil.

The results regarding aspect, slope, and vegetative cover did not indicate any particular condition being more desirable than another.

5.3 SR 188 RESORT ROAD TO DEVORE WASH

Saguaros transplanted on the SR 188 Resort Road to Devore Wash project exhibited a 72% survival rate. It is interesting to note that most of the saguaros (80%) were transplanted just once, in contrast to the other three projects in the study in which nearly all the saguaros were moved twice (once to a temporary nursery and then to a final location). In theory, a moved-once operation is less stressful to a saguaro, but offsetting that advantage is the fact that the moved-once plants tended to be larger than the moved-twice plants. The rainfall received during the period between plant salvage and the follow-up inventory conducted by LSD amounted to 94% of the average rainfall for the project area, so there probably was no significant effect on plant survivability relative to rainfall.

As was the case with the previous two projects, height, arms, and taper were most critical in their influence on survivability and health. To a lesser extent, the north mark was also related to survivability and health. Saguaros in the 0- to 6-foot-high category were noticeably healthier than the other categories, even the next-tallest category of >6 to 12 feet. Of the 0 to 6-foot plants, 9% were in excellent health; 80% were in good health; and only one plant (1%) was dead. As the height of the saguaros increased, the percentage of plants in good health decreased and the percentage of dead plants increased, to the point where only 6% of the plants >20 feet were in good health and 24% were dead. When the percentages representing “poor health” and “dead” are combined, the numbers increase relative to plant height: 4% (0 to 6 feet), 25% (>6 to 12 feet), 33% (>12 to 20 feet) and 52% (>20 feet).

As dramatic as the results relative to height were, so were the results relative to arms. The percentage of plants in good health was more than three times greater for saguaros without arms as with arms (68% compared to 20%). Correspondingly, only 6% of the saguaro spears were dead, compared to 20% of the saguaros with arms.

Saguaros with a tapering base exhibited a much greater percentage (84%) in good health than saguaros without taper (29%). Plants with taper and those without both had 1% dead, although many (maybe all) of the 35 dead plants that were too decomposed for a determination may have lacked taper.

Aspect (directional orientation of slope) had an influence on plant health, with south-facing slopes being the most favorable and north-facing slopes the least favorable. On south-facing slopes, 82% of the plants were in good condition and no plants were dead. Conversely, north-facing slopes had the highest percentage of dead plants (28%) and only 28% in good health. These results may be explained by the higher elevation of this project relative to the others. The high point of the project is 3,190 feet, which is near the upper limit of the elevational range of saguaros; therefore, the influence of the direction in which a slope is facing would be magnified.

Vegetative cover had a negative influence on plant health after the cover exceeded 50%, although the limited quantity of plants in the higher-cover categories relative to the lower-cover categories makes it difficult to reach any definite conclusions.

The results regarding slope, cut and fill, and basins did not indicate any particular condition being more desirable than another.

5.4 US 93 KAISER SPRING

The survival rate of saguaros transplanted on the US 93 Kaiser Spring project (78%) was the highest of the four projects inventoried. This project also received the highest percentage (95%) of average annual rainfall for the project area during the period between transplantation and the inventory conducted by LSD.

The variables of height, arms, and taper were the most critical in determining survivability and health, as was the case for the other three projects inventoried. To a lesser extent, north mark, cut versus fill, and basins had an effect on survivability. The percentage of plants in good health was similar for plants in the 0- to 6-foot-high category and for those in the >6- to 12-foot category (72% and 71%, respectively); it dropped to nearly half that (36%) for the >12- to 20-foot-high category. Conversely, the percentage of dead plants increased with plant height, from 8% (0 to 6 feet), to 11% (>6 to 12 feet), to 27% (>12 to 20 feet).

When the percentages representing “poor health” and “dead” are combined, difference in health relative to height is even more apparent: 8% (0 to 6 feet), 15% (>6 to 12 feet), and 36% (>12 to 20 feet).

The presence of arms had a strong negative influence on plant health: 35% of the saguaros with arms were in good health compared to 71% of the saguaros without arms. Of the saguaros with arms, 35% were dead, while only 8% of the saguaros without arms were dead.

The findings relative to taper were that 79% of plants with a taper at the base were in good health, compared with 61% of plants without a taper. None of the plants with a taper were dead, while at least 4, and possibly as many as 17, of the plants without a taper were dead.

A slight benefit was noted with plants having a north mark oriented to the north, with 83% of those plants in good health compared to 68% of the plants with no north mark. The advantage of being planted in cut versus fill was reflected by 78% of the plants in cut in good health and 68% of the plants in fill in good health. The presence of a shallow basin for water harvesting was somewhat beneficial to plant health, with 78% of the plants with a basin in good health compared to 63% without.

The results regarding aspect, slope, rock in soil, and vegetative cover did not indicate any particular condition being more desirable than another.

5.5 SUMMARY

Consistent among the four projects inventoried was the finding that the taller saguaros had a lower survival rate and exhibited poorer health. Saguaros up to 12 feet in height typically exhibited good health. A sharp decrease in the percentage of plants in good health was observed in the 12-foot-plus saguaros, and particularly in the 20-foot-plus size. Based on these findings, it would appear that the best candidates for transplanting are saguaros shorter than 12 feet in height.

The presence of arms was correlated with lower saguaro survivability and worse overall health, an observation that held true for all the projects.

A third variable affecting saguaro survivability and health was the presence or absence of a tapering base. A marked decrease in health was observed among saguaros that did not have a tapering base, an indication that they were planted too deep.

The presence of a north mark oriented to the north was correlated moderately with a higher survival rate among saguaros in the four projects inventoried. However, because it could not be verified that the saguaros *without* a north mark were oriented *improperly*, the apparent correlation between no north mark (possibly because of being planted with the original north side oriented in another direction) and poorer health could not be confirmed.

Aspect did not have a noticeable influence on saguaro survivability and health except in the SR 188 Resort Road to Devore Wash section, and that may be explained by the higher elevation of the project relative to the others in which the advantage of a south-facing (warmer) slope or the disadvantage of a north-facing (cooler) slope is magnified by the higher elevation.

The results relative to steepness of slope, cut versus fill, the amount of rock in the soil, the amount of vegetative cover, and presence of water basins were varied, such that their effect on saguaro survivability and health could not be determined.

6.0 RECOMMENDATIONS

Based on the results of the four inventories, as well as the consensus of opinion among authors cited in the literature review and members of the Technical Advisory Committee, the following recommendations are made:

- The majority of saguaros salvaged for revegetation projects should be 12 feet or less in height. Limited numbers of larger saguaros may be salvaged to achieve the dramatic visual impact that only a multi-armed specimen can provide. Larger (more mature) saguaros can also increase the diversity of life stages on a revegetation project. The specimen saguaros should be planted in highly visible areas. When possible, the larger saguaros should be transplanted directly to their final location using a "move-once" technique.

- Saguaros should be planted at the same depth as originally grown or not more than three inches deeper. Saguaros planted too deep may suffer water stress because their roots are too far down to benefit from supplemental irrigation or natural rainfall. Prior to transplantation, a non-damaging mark should be made on the saguaro 12 inches above ground level, to serve as a measure of how deep the saguaro was planted.

- Root length was not addressed in this study; however, the requirements outlined in the SR 188 Resort Road to Devore Wash special provisions should be applied to future saguaro salvage projects. The requirements state:

  > "During excavation operations, final cuts to the roots of local and/or collected stock during each transplanting shall be accomplished to provide the minimum acceptable root lengths by the use of lopping shears, pruning saw and/or by the method approved in the Transplanting Plan. After the final cut, the remaining root attached to the local and/or collected stock shall be structurally intact with no signs of splintering or shredding. Final cuts to roots less than 1 inch in diameter shall leave the attached roots with a minimum length 3 inches from the buttress of the trunk or lateral support root. Roots greater than 1 inch in diameter shall leave the attached roots with a minimum length of 12 inches from the buttress of the trunk or lateral support root. Buttress roots greater than 3 inches in diameter shall leave the attached roots with a minimum length of 24 inches minimum root length from buttress or lateral support root." (ADOT 2003a, 181)

  A photo of the roots should be taken following excavation. The photo should include a measuring stick.

- When an adequate root mass is salvaged, it should provide some support to the saguaro, though bracing is recommended for saguaros 6 feet and taller. A triangulated configuration of wooden supports, or nylon rope anchored by metal stakes, is recommended for the bracing, with padded boards or a "collar" of fiber-reinforced hose placed at the trunk of the saguaro at approximately two-thirds the height of the plant. Rope bracing is recommended for saguaros up to 12 feet in height, and wooden supports are recommended for saguaros taller than 12 feet.

- The north side of the saguaro should be marked prior to transplantation, and the plant should be replanted with the same orientation.

- Saguaros growing in a shaded situation (such as under a tree) should be noted on the initial plant inventory, and then placed either in a similar situation, or shaded for a summer.

- All saguaros three feet in height and smaller should be protected by shade cloth through the first summer of establishment.

- As project schedule and site conditions allow, saguaros to be transplanted should be watered two weeks prior to transplantation, to promote hydration of the plant tissues and potentially lessen the shock of transplantation. The application of water should be in a manner that allows for slow infiltration to a depth of at least 12 inches.

- Supplemental irrigation should be provided for at least two years following transplantation. Local conditions, including temperature and rainfall, should be considered when determining the frequency of irrigation necessary, with the maximum interval between irrigations to be one month. As indicated by the lower survivability of saguaros on the projects that received lower-than-average rainfall, the amount of moisture available to the plants after the temporary irrigation is discontinued may be critical. Continuation of the supplemental irrigation beyond two years may be beneficial.

- Creation of water-harvesting basins around the saguaros is recommended. Although the inventory results did not conclusively indicate a benefit from basins, any means of providing additional moisture should be beneficial.

- When saguaros are transplanted on projects above 2,800 to 3,000 feet elevation, care should be taken to place the plants on south- and west-facing slopes; north-facing slopes should be avoided. If planting on a north-facing slope is unavoidable, the plants should be placed near the top of the slope rather than near the base. In general, transplanted saguaros should be placed in situations that closely replicate how they occur naturally, particularly relative to aspect and density of saguaros to a unit area of land.

- In addition to the photos taken prior to transplantation, photos should be taken immediately following transplantation, and at the end of the plant establishment period.

- The plant inventory tag should be maintained on the plant throughout the plant establishment period.

7.0 REFERENCES

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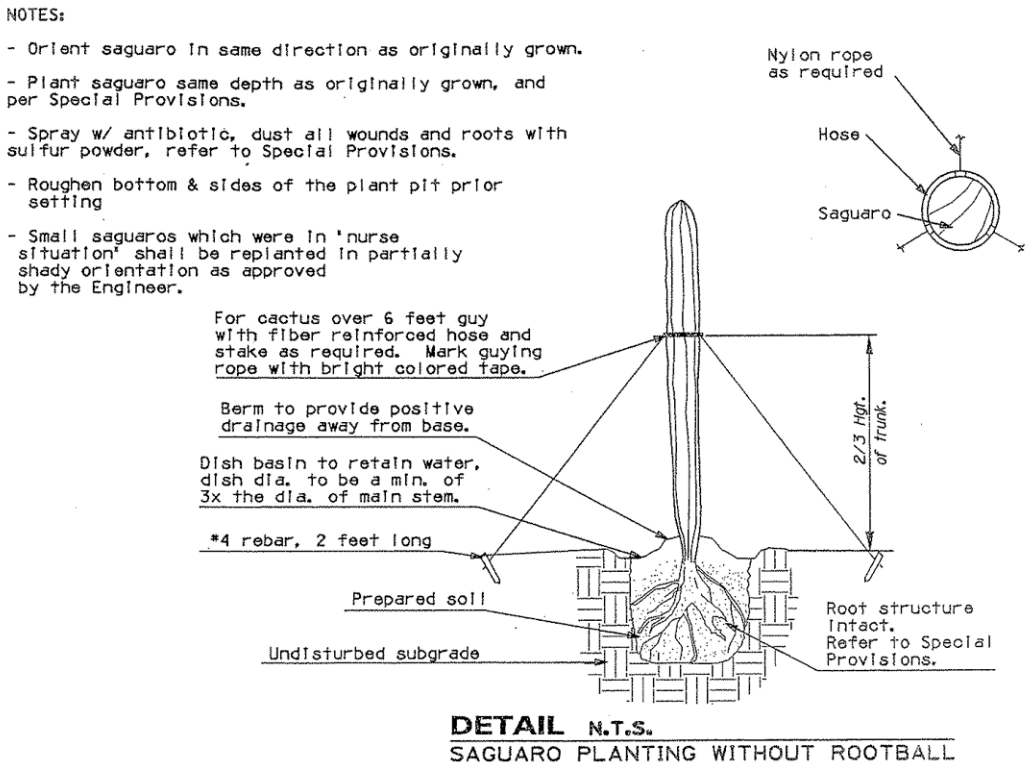
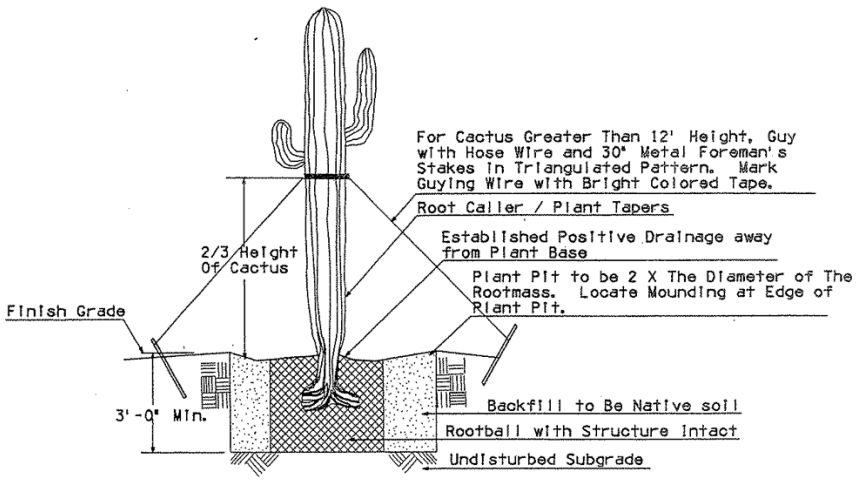
APPENDIX A

PLANTING DETAILS

SR 86 COVERED WELLS – Planting Details



(ADOT 2002: 39-40)

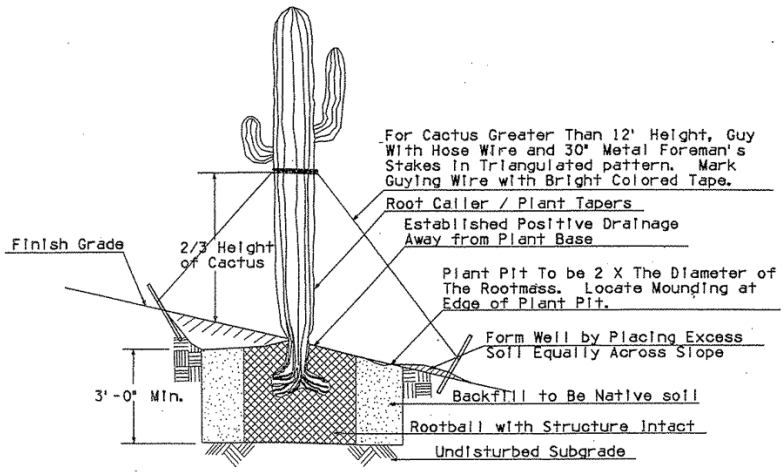


DETAIL N.T.S.

CACTUS/SAGUARO PLANTING WITH ROOTBALL ON LEVEL GROUND

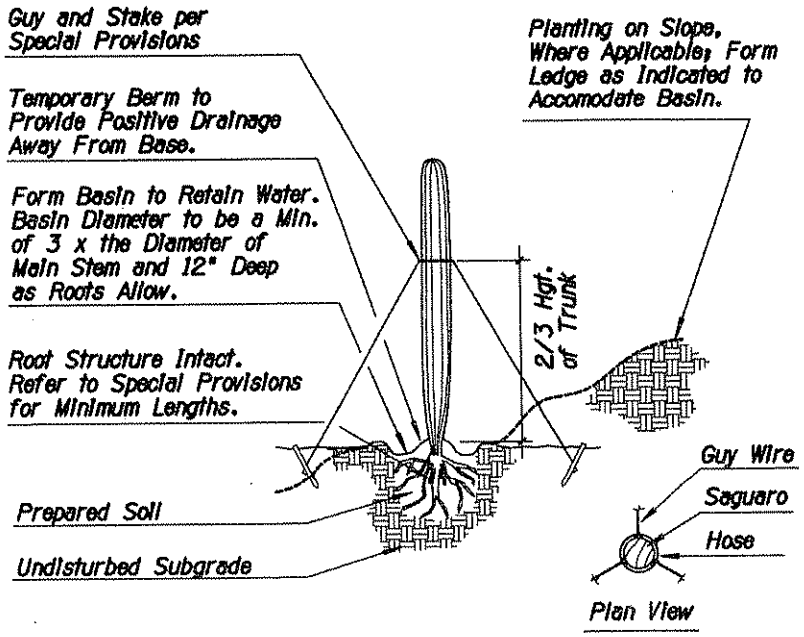
Notes:

1. *Orient saguaro in same direction as originally grown. Plant true vertical.*
2. *Plant saguaro at the same depth as originally grown.*
3. *Spray all wounds with antibiotics dust; dust roots with sulphur powder.*
4. *Roughen bottom & sides of the plant pit prior to setting.*
5. *small saguaros shall be transplanted in partially shaded orientation as approved by engineer.*



DETAIL N.T.S.

CACTUS/SAGUARO PLANTING WITH ROOTBALL ON SLOPE

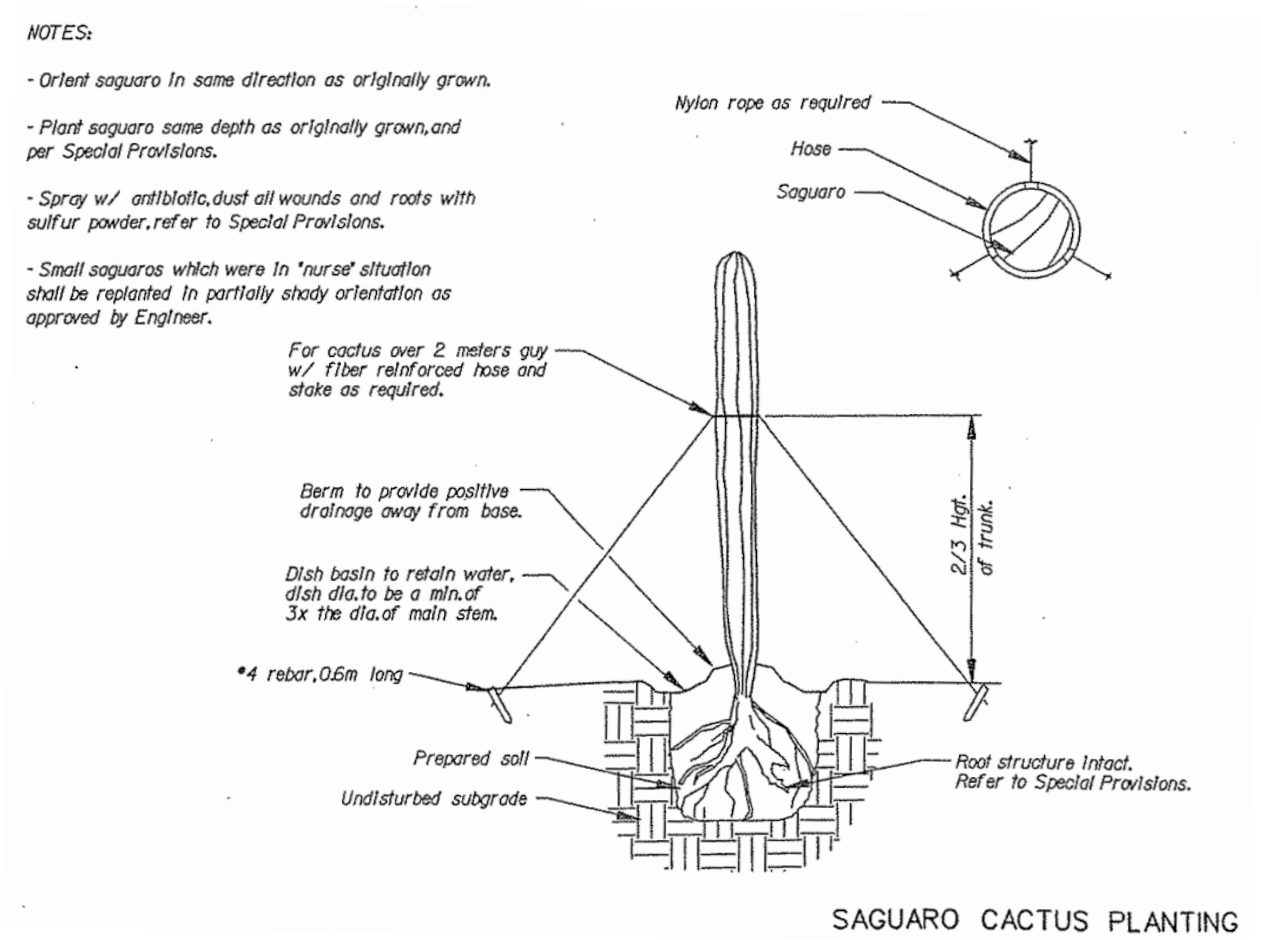


Notes:
1. Root prune all shredded or damaged roots. Refer to Special Provisions.
2. Planting depth to be that at which plant was orginally growing. Refer to Special Provisions.
3. If planted on slope, grade to drain to planting basin
4. Bare roots shall not be out of the ground for more than five days before planting.
5. Orient saguaro in the same direction as originally grown.
6. Treat all surface wounds w/ bactericide. Small saguaros which were growing in a shaded location or under a "nurse" tree shall be replanted in a similar situation.

SAGUARO PLANTING/ STAKING

(ADOT 2003: 245)

US 93 KAISER SPRING – Planting Details



(ADOT 1999: 307)

APPENDIX B

DETAILED INVENTORY RESULTS

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 86 Covered Wells - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (ft)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
100	9			Good	none	yes	N	>6:1	<25%rock	>40-50%	yes	no	36	
101	13			Dead	S	unknown	unknown	>6:1	<25%rock	0-10%	unknown	no	82	
102	3			Fair	S	yes	N	4:1	25-50%rock	>30-40%	yes	no	57	
103	25	3	3, 1, 1.5	Fair	S	yes	N	3:1	25-50%rock	>20-30%	no	no	81	
104	3			Good	S	no	no mark	3:1	25-50%rock	>50-60%	yes	no	59	
105	7			Good	S	yes	NE	3:1	25-50%rock	>60-70%	yes	no	79	
106	14			Fair	S	yes	N	4:1	25-50%rock	>30-40%	yes	no	38	
107	7			Good	S	yes	N	3:1	25-50%rock	>30-40%	yes	no	97	
108	3			Good	S	yes	N	3:1	25-50%rock	>20-30%	yes	no	15	
109	3			Good	S	yes	N	6:1	25-50%rock	>40-50%	yes	no	20	
110	10			Dead	N	unknown	unknown	6:1	>50-75%rock	>40-50%	unknown	no	78	
111	9			Good	S	yes	N	4:1	>50-75%rock	>40-50%	yes	no	96	
112	2			Good	N	yes	N	2:1	25-50%rock	>40-50%	yes	no	62	injury near base 3"x3" gouge
113	3			Good	N	no	no mark	3:1	<25%rock	>40-50%	yes	no	9	
114	13			Poor	N	no	no mark	>6:1	25-50%rock	>10-20%	no	no	50	flesh at ribs decaying
115	3			Good	N	yes	N	1:1	<25%rock	>40-50%	no	no	84	
116	2			Good	N	yes	N	1:1	<25%rock	>20-30%	yes	no	29	
117	1			Dead	N	unknown	unknown	1:1	<25%rock	>20-30%	unknown	no	11	
118	1			Dead	N	unknown	unknown	1:1	<25%rock	>20-30%	unknown	no	61	
119	1			Dead	N	unknown	unknown	3:1	<25%rock	>30-40%	unknown	no	21	
120	2			Dead	N	unknown	unknown	1:1	<25%rock	>60-70%	unknown	no	85	
121	2			Poor	N	no	no mark	1:1	<25%rock	>20-30%	no	no	10	damage at top
122	2			Good	N	yes	N	1:1	<25%rock	>10-20%	yes	no	25	not well rooted
123	5			Good	N	yes	N	3:1	<25%rock	>10-20%	yes	no	69	
124	3			Good	N	yes	N	1:1	<25%rock	>50-60%	yes	no	86	
125	3			Good	N	yes	N	2:1	<25%rock	>20-30%	yes	no	64	
126	2			Good	N	yes	N	1:1	<25%rock	>20-30%	yes	no	63	
127	1			Poor	N	yes	N	1:1	<25%rock	>30-40%	yes	no	22	damage S. side and top
128	1			Poor	N	no	no mark	1:1	<25%rock	>10-20%	yes	no	30	damage S. side and top
129	29	4	3, 7, 6, 5	Poor	N	yes	N	>6:1	<25%rock	>80-90%	no	yes	95	2nd trunk 6'
130	5			Good	N	yes	N	3:1	<25%rock	>40-50%	yes	no	53	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 86 Covered Wells - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (ft)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
131	3			Good	N	no	no mark	3:1	<25%rock	>30-40%	yes	no	16	
132	3			Good	N	no	no mark	3:1	<25%rock	>40-50%	yes	yes	98	
133	3			Good	N	yes	N	2:1	<25%rock	>50-60%	yes	yes	7	
134	10			Dead	N	yes	N	3:1	<25%rock	>90%	unknown	no		
135	10			Good	none	yes	N	>6:1	<25%rock	>60-70%	no	no	74	
136	1			Good	none	no	no mark	>6:1	<25%rock	>60-70%	no	no	67	
137	1			Good	none	yes	N	>6:1	<25%rock	>30-40%	yes	no	6	
138	6			Dead	none	unknown	unknown	>6:1	<25%rock	>80-90%	unknown	no		
139	7			Good	S	yes	N	>6:1	25-50%rock	>70-80%	yes	no	70	
140	18	2	1, 2	Fair	N	yes	N	5:1	<25%rock	>30-40%	no	no	41	leaning
141	7			Fair	N	no	no mark	5:1	<25%rock	>30-40%	yes	no	76	
142	14			Fair	N	yes	N	4:1	<25%rock	>70-80%	no	no	42	leaning
143	16	1	4	Fair	none	yes	N	>6:1	<25%rock	>10-20%	no	no	40	leaning
144	1			Good	N	yes	N	4:1	<25%rock	>60-70%	yes	no	3	
145	1			Good	NE	no	no mark	6:1	<25%rock	>20-30%	yes	no	1	
146	3			Good	N	yes	N	5:1	<25%rock	>50-60%	yes	no	8	
147	2			Good	N	yes	N	3:1	<25%rock	>40-50%	yes	no	27	
148	2			Good	N	yes	N	3:1	<25%rock	>40-50%	yes	no	13	
149	1			Good	N	yes	N	3:1	<25%rock	>20-30%	yes	no	2	
150	25	4	3, 5, 6, 5	Fair	SE	yes	N	6:1	<25%rock	>40-50%	no	no		leaning
151	19	3	5, 3, 5	Dead	S	unknown	unknown	6:1	<25%rock	>20-30%	unknown	no		
152	2			Good	S	yes	N	>6:1	<25%rock	>40-50%	yes	no	31	
153	3			Fair	S	no	no mark	5:1	<25%rock	>20-30%	yes	no	24	
154	32	3	2, 4, 4	Poor	N	yes	N	4:1	<25%rock	>50-60%	no	no		decay S. side; leaning
155	16			Fair	S	yes	N	3:1	<25%rock	>50-60%	no	no	44	
156	20			Poor	S	yes	N	3:1	25-50%rock	>40-50%	no	no	45	
157	18	1	4	Poor	S	yes	N	4:1	25-50%rock	>30-40%	no	no	49	
158	1			Good	S	yes	N	4:1	25-50%rock	>40-50%	yes	no	19	
159	1			Good	S	no	no mark	4:1	25-50%rock	>40-50%	yes	no	56	
160	2			Dead	N	no	no mark	2:1	25-50%rock	>50-60%	yes	no	51	
161	4			Poor	N	no	no mark	>6:1	25-50%rock	>30-40%	yes	no	75	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 86 Covered Wells - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (ft)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Tag Number	Comment
162	13			Good	N	yes	N	>6:1	>50-75%rock	0-10%	yes	no		
163	13			Good	N	yes	N	>6:1	>50-75%rock	0-10%	yes	no		
164	2			Poor	N	no	no mark	3:1	<25%rock	>20-30%	yes	no	52	
165	20.0+			Dead	none	unknown	unknown	>6:1	<25%rock	>60-70%	unknown	no		only base remaining
166	2			Exc	N	yes	N	3:1	<25%rock	>50-60%	yes	yes	71	shaded by brittlebush
167	13			Dead	N	unknown	unknown	6:1	>50-75%rock	>40-50%	unknown	no	55	
168	3			Good	none	yes	N	>6:1	<25%rock	>20-30%	yes	no	65	
169	19	1	3	Fair	N	yes	N	3:1	>50-75%rock	>30-40%	no	no	48	second trunk 8'
170	1			Fair	N	no	no mark	3:1	>50-75%rock	>30-40%	yes	no	83	
171	1			Fair	N	yes	N	3:1	25-50%rock	>30-40%	yes	no	23	
172	3			Good	N	yes	N	6:1	<25%rock	>20-30%	yes	no	68	
173	2			Fair	N	yes	N	6:1	<25%rock	>30-40%	yes	no	14	
174	3			Good	N	no	no mark	6:1	25-50%rock	>30-40%	yes	no		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 87 Tombstone Hill - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/ Fill	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
100	17			Fair	S	yes	N	3:1	Cut	loam/no rock	>80-90%	no	no		
101	11			Dead	W	unknown	unknown	3:1	Cut	loam/no rock	>10-20%	unknown	unknown	1930	
102	10	2	.5, 1	Fair	W	yes	N	2:1	Cut	loam/no rock	0-10%	yes	no		
103	13			Fair	W	yes	N	2:1	Cut	loam/no rock	>10-20%	yes	no	1953	
104	11			Dead	W	unknown	unknown	3:1	Cut	loam/no rock	>80-90%	unknown	unknown	1926	
105	4			Good	W	no	no mark	3:1	Cut	loam/no rock	>20-30%	yes	no	1998	
106	3			Good	W	yes	N	3:1	Cut	loam/no rock	>20-30%	yes	no	1931	
107	3			Good	W	no	no mark	2:1	Cut	loam/no rock	>20-30%	yes	no	2001-15a	
108	3			Good	W	no	no mark	2:1	Cut	loam/no rock	0-10%	yes	no	1924	
109	25	2	11, 11	Fair	N	yes	N	4:1	Undisturbed	loam/no rock	>30-40%	no	no		
110	14			Fair	E	no	no mark	3:1	Fill	loam/no rock	>20-30%	yes	no	2001-15	leaning
111	9			Fair	W	no	no mark	5:1	Fill	loam/no rock	>20-30%	yes	no		damage at lower 4' of trunk

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 87 Tombstone Hill - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/ Fill	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
112	9			Good	W	no	no mark	4:1	Fill	loam/no rock	>50-60%	yes	yes		damage at lower 2' of trunk
113	13			Fair	W	yes	N	4:1	Fill	loam/no rock	>60-70%	yes	no		damage at lower 1' of trunk
114	11			Fair	W	yes	NE	3:1	Fill	loam/no rock	>10-20%	yes	no		
115	22			Fair	W	no	no mark	3:1	Fill	loam/no rock	>40-50%	yes	no	1624-12	leaning, fire damage
116	8			Good	NW	no	no mark	3:1	Fill	loam/no rock	>50-60%	yes	no	1674-12	
117	13	3	2, 1, 5	Dead	W	unknown	unknown	3:1	Fill	loam/no rock	>10-20%	unknown	unknown	1670-17	
118	13			Good	W	no	no mark	5:1	Fill	loam/no rock	>20-30%	yes	no		
119	19			Fair	E	no	no mark	4:1	Fill	loam/no rock	0-10%	yes	no	1722-48	
120	16			Good	SW	no	no mark	4:1	Fill	loam/no rock	>40-50%	no	no		
121	7			Good	S	yes	N	4:1	Fill	loam/no rock	>30-40%	yes	no		
122	4			Good	W	no	no mark	4:1	Fill	loam/no rock	>10-20%	no	no	203-3se	
123	7			Good	S	no	no mark	4:1	Fill	loam/no rock	>10-20%	no	no	2026-4	
124	4	2	2, 3	Good	E	yes	NE	4:1	Fill	loam/no rock	>40-50%	no	no	1916-3	
125	16			Fair	E	yes	N	4:1	Fill	loam/no rock	0-10%	no	no	1678-22	
126	27	3	9, 11, 6	Fair	W	yes	N	4:1	Undisturbed	loam/no rock	0-10%	no	no	18-137	leaning
127	16	4	.5, 4, 2, 2	Good	E	yes	N	3:1	Fill	loam/no rock	>30-40%	yes	no	1930-23	
128	24	4	5, 5, 6, 6	Fair	E	yes	N	5:1	Undisturbed	loam/no rock	>40-50%	no	no	1630-12	
129	15	2	4, 3	Dead	E	unknown	unknown	5:1	Undisturbed	loam/no rock	>20-30%	unknown	unknown	1630-13	
130	16	2	2, 5	Good	SW	yes	NE	3:1	Undisturbed	loam/no rock	>30-40%	no	no	1630-2	
131	25	4	11, 9, 10, 6	Good	SW	yes	NE	3:1	Undisturbed	loam/no rock	>20-30%	no	yes	1634-11,	leaning
132	15	3	6, 4, 5	Dead	SE	unknown	unknown	4:1	Undisturbed	loam/no rock	>10-20%	unknown	unknown		
133	18	2	3, 3	Dead	SW	unknown	unknown	4:1	Undisturbed	loam/no rock	>10-20%	unknown	unknown	1632-12	
134	11	2	3, 3	Dead	SW	unknown	unknown	4:1	Undisturbed	loam/no rock	>10-20%	unknown	unknown		
135	15	3	6, 3, 8	Dead	SW	unknown	unknown	4:1	Undisturbed	loam/no rock	>10-20%	unknown	unknown		
136	3	1	.5	Good	E	yes	N	2:1	Fill	loam/no rock	>60-70%	yes	no	1931-300a	
137	9			Good	E	yes	NE	2:1	Fill	loam/no rock	>20-30%	yes	no	1886-4	
138	9			Exc	E	yes	NE	2:1	Fill	loam/no rock	>20-30%	yes	no	1930-2	
139	10			Exc	E	yes	N	2:1	Fill	loam/no rock	>40-50%	yes	no	1929-1	
140	4			Poor	E	yes	NE	2:1	Fill	loam/no rock	>30-40%	no	no	1918-1	
141	7			Good	E	yes	N	2:1	Fill	loam/no rock	>30-40%	yes	no	1928-9	
142	15			Good	E	no	no mark	2:1	Fill	loam/no rock	>30-40%	no	no	2233-19	
143	17			Good	E	no	no mark	2:1	Fill	loam/no rock	>50-60%	yes	no	2211-56	
144	14	1	3	Fair	E	yes	S	2:1	Fill	loam/no rock	>30-40%	yes	no	1995-28	
145	21	2	2, 2	Good	SW	no	no mark	2:1	Fill	loam/no rock	>30-40%	no	no	1969-7	
146	14	1	4	Good	SW	yes	N	2:1	Fill	loam/no rock	>60-70%	no	no		
147	17	4	3, 3, 3, 2	Good	SW	no	no mark	2:1	Fill	loam/no rock	>40-50%	yes	no	2217-1	
148	19	4	1, 2, 2, 1	Fair	SW	no	no mark	2:1	Fill	loam/no rock	>90%	no	no	1712-52	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 87 Tombstone Hill - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/ Fill	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
149	14	1	.5	Good	W	no	no mark	2:1	Fill	loam/no rock	>70-80%	yes	no	2215-5	
150	7			Good	S	yes	N	2:1	Fill	loam/no rock	>40-50%	yes	no	2023-1	
151	15	2	2, 2	Good	S	no	no mark	2:1	Fill	loam/no rock	>40-50%	no	no	1968-4	
152	15	2	1, 1	Good	S	no	no mark	2:1	Fill	loam/no rock	>30-40%	yes	no	2219-1	
153	16	3	.5, .5, .5	Good	W	no	no mark	2:1	Fill	loam/no rock	>40-50%	yes	no	1960-3	
154	15			Fair	SW	no	no mark	2:1	Fill	loam/no rock	>30-40%	yes	no	2208-5	
155	14			Good	W	no	no mark	2:1	Fill	loam/no rock	>30-40%	yes	no		
156	4			Good	W	no	no mark	2:1	Fill	loam/no rock	>20-30%	yes	no		
157	9			Dead	W	no	no mark	2:1	Fill	loam/no rock	>60-70%	unknown	unknown		
158	12			Dead	W	no	no mark	2:1	Fill	loam/no rock	>60-70%	unknown	unknown		
159	16	1	.5	Good	W	yes	N	2:1	Fill	loam/no rock	>30-40%	yes	no		
160	23	2	4, 4	Good	W	no	no mark	2:1	Fill	loam/no rock	>10-20%	yes	no	1960-9	
161	6			Good	W	no	no mark	5:1	Fill	loam/no rock	>20-30%	yes	no	2011-1	
162	7			Good	W	no	no mark	5:1	Fill	loam/no rock	>20-30%	yes	no	2211-38sb	
163	7			Good	SW	no	no mark	5:1	Fill	loam/no rock	>20-30%	no	no		
164	7			Good	SW	no	no mark	5:1	Fill	loam/no rock	>10-20%	yes	no	2025-300	
165	16			Good	SW	no	no mark	2:1	Fill	loam/no rock	>30-40%	yes	no	2205	
166	15	1	2	Good	SW	yes	N	2:1	Fill	loam/no rock	>30-40%	yes	no	2203-6	
167	12	3	1, 1, 1	Good	W	no	no mark	2:1	Fill	loam/no rock	>60-70%	yes	yes	1946-1	
168	12			Good	W	no	no mark	2:1	Fill	loam/no rock	>70-80%	yes	yes		
169	5			Good	SW	no	no mark	3:1	Cut	loam/no rock	>20-30%	yes	no	1840-1	
170	6			Dead	SW	no	no mark	3:1	Cut	loam/no rock	>10-20%	unknown	unknown	1820-1	
171	4			Dead	W	no	no mark	3:1	Cut	loam/no rock	>10-20%	unknown	unknown	1682-37	
172	3			Good	W	yes	N	3:1	Cut	loam/no rock	>20-30%	yes	no	1678-96	
173	6			Good	W	yes	N	3:1	Cut	loam/no rock	>40-50%	yes	no		
174	3			Good	SW	yes	N	3:1	Cut	loam/no rock	0-10%	yes	no	1683-490	
175	2			Good	W	no	no mark	3:1	Cut	loam/no rock	>20-30%	yes	no	2010-4	
176	1			Good	W	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
177	1			Good	W	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
178	1			Good	W	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
179	2			Good	W	no	no mark	3:1	Cut	loam/no rock	>30-40%	yes	no		double trunk
180	2			Good	W	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
181	2			Good	W	no	no mark	3:1	Cut	loam/no rock	>30-40%	yes	no	1923-10	
182	15	4	6, 3, 5, 7	Dead	NW	no	no mark	4:1	Cut	loam/no rock	>30-40%	unknown	unknown	1662-07	
183	4			Good	W	no	no mark	4:1	Cut	loam/no rock	>10-20%	yes	no	1881-8	burn damage
184	4			Good	W	no	no mark	4:1	Cut	loam/no rock	>20-30%	yes	no		
185	3			Good	S	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no	2010-9	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

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Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/ Fill	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
186	3			Good	SW	no	no mark	3:1	Cut	loam/no rock	>40-50%	yes	no	2025-2	
187	2			Dead	S	no	no mark	3:1	Cut	loam/no rock	>20-30%	unknown	unknown		
188	2			Dead	SE	no	no mark	3:1	Cut	loam/no rock	0-10%	unknown	unknown	2010-5	
189	7			Good	SE	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no	1708-06	
190	4			Good	E	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
191	4			Good	E	no	no mark	3:1	Cut	loam/no rock	0-10%	yes	no		
192	6			Good	E	no	no mark	3:1	Cut	loam/no rock	>10-20%	yes	no	1948-1	
193	4			Good	SE	no	no mark	2:1	Cut	loam/no rock	>10-20%	yes	no	1682-41	
194	3			Exc	SE	no	no mark	2:1	Cut	loam/no rock	>10-20%	yes	no	1712-34	
195	1			Poor	SE	no	no mark	4:1	Cut	loam/no rock	>10-20%	yes	no	1809-7	
196	2			Good	SE	no	no mark	4:1	Cut	loam/no rock	0-10%	yes	no		
197	3			Good	SE	yes	N	3:1	Cut	loam/no rock	>50-60%	yes	no		
198	3			Fair	E	yes	NW	4:1	Cut	loam/no rock	0-10%	no	no	1682-25	
199	3			Fair	E	yes	N	4:1	Cut	loam/no rock	>60-70%	yes	no	1682-25	
200	3			Fair	E	no	no mark	4:1	Cut	loam/no rock	>20-30%	yes	no		
201	3			Poor	E	no	no mark	4:1	Cut	loam/no rock	>10-20%	no	no	1821-7	
202	4			Good	E	no	no mark	4:1	Cut	loam/no rock	>10-20%	yes	no	1816-205	
203	12			Good	E	yes	N	2:1	Fill	loam/no rock	>30-40%	yes	no		
204	4			Good	E	no	no mark	3:1	Fill	loam/no rock	>70-80%	yes	no	2211-16	
205	13			Good	E	yes	N	3:1	Fill	loam/no rock	>30-40%	yes	yes	1912-1	
206	3			Good	E	no	no mark	2:1	Fill	loam/no rock	>80-90%	yes	no	2212-13	
207	11			Good	E	yes	N	2:1	Fill	loam/no rock	>30-40%	yes	no		
208	2			Good	E	no	no mark	2:1	Fill	loam/no rock	>10-20%	yes	no		
209	3			Dead	E	no	no mark	2:1	Fill	loam/no rock	>80-90%	unknown	unknown	2211-7	
210	3			Good	E	no	no mark	2:1	Fill	loam/no rock	>10-20%	yes	no	2211-33	
211	9			Good	E	yes	N	2:1	Fill	loam/no rock	0-10%	yes	no		
212	13			Good	E	yes	N	2:1	Fill	loam/no rock	>60-70%	yes	no	1993-1	
213	9			Good	E	yes	NE	2:1	Fill	loam/no rock	>10-20%	yes	no	1520-07	
214	9			Good	E	yes	N	2:1	Fill	loam/no rock	>80-90%	yes	no	1562-4	
215	17			Good	E	yes	N	2:1	Fill	loam/no rock	>70-80%	yes	no		
216	7			Good	W	yes	N	3:1	Fill	loam/no rock	>20-30%	yes	yes	1885-2	
217	2	4	1, .5, .5, -.5	Good	W	no	no mark	4:1	Fill	loam/no rock	>10-20%	yes	no		
218	4			Good	W	no	no mark	4:1	Fill	loam/no rock	>40-50%	yes	no		was 8', top removed
219	5			Dead	W	unknown	unknown	4:1	Fill	loam/no rock	>20-30%	unknown	unknown		
220	8			Good	W	yes	N	4:1	Fill	loam/no rock	>60-70%	yes	no	1820-3	
221	7			Good	W	yes	N	4:1	Fill	loam/no rock	>60-70%	yes	no		
222	11			Good	W	no	no mark	4:1	Fill	loam/no rock	>70-80%	yes	no		burn damage

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 87 Tombstone Hill - Saguaro Inventory

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223	9			Good	W	yes	N	4:1	Fill	loam/no rock	>50-60%	yes	no	1678-6	burn damage
224	8			Good	W	no	no mark	4:1	Fill	loam/no rock	>70-80%	yes	no		
225	7			Good	W	yes	N	4:1	Fill	loam/no rock	>70-80%	yes	no	1835-1	
226	6			Good	W	yes	N	4:1	Fill	loam/no rock	>70-80%	yes	no		
227	5			Good	W	no	no mark	4:1	Fill	loam/no rock	>50-60%	yes	no	1935-256	
228	8			Good	W	no	no mark	4:1	Fill	loam/no rock	>20-30%	yes	no		
229	7			Fair	W	no	no mark	3:1	Fill	loam/no rock	>30-40%	no	no		
230	7			Good	W	no	no mark	3:1	Fill	loam/no rock	>30-40%	no	no	1714-17	
231	7			Good	W	no	no mark	3:1	Fill	loam/no rock	>20-30%	no	no		
232	16			Fair	W	no	no mark	3:1	Fill	loam/no rock	>40-50%	yes	no	1988-4	
233	6			Good	W	no	no mark	3:1	Fill	loam/no rock	>80-90%	yes	no		
234	12			Good	W	yes	N	4:1	Fill	loam/no rock	>50-60%	yes	no	1823-3	
235	7			Good	NE	no	no mark	2:1	Fill	<25%rock	>10-20%	yes	no		
236	6			Fair	NE	no	no mark	2:1	Fill	<25%rock	>30-40%	yes	no	2008-4sb	
237	20	1	3	Good	NE	yes	NE	1:1	Fill	<25%rock	>50-60%	no	no	1988-7	
238	7			Poor	NE	yes	NE	1:1	Fill	<25%rock	>20-30%	no	no		damage at base
239	7			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	yes	no		
240	9	1	.5	Good	NE	no	no mark	1:1	Fill	<25%rock	>60-70%	yes	no		
241	6			Good	NE	yes	N	1:1	Fill	<25%rock	>30-40%	yes	no		
242	6			Good	NE	yes	NE	1:1	Fill	<25%rock	>70-80%	yes	no		
243	4			Good	NE	yes	NE	1:1	Fill	<25%rock	>10-20%	yes	no	2201-9	
244	4			Poor	NE	no	no mark	1:1	Fill	>50-75%rock	>70-80%	yes	no	2202-4	
245	4			Good	NE	no	no mark	1:1	Fill	>50-75%rock	>50-60%	yes	no		
246	5			Good	NE	no	no mark	1:1	Fill	<25%rock	>30-40%	yes	no		
247	7			Fair	NE	no	no mark	1:1	Fill	<25%rock	>50-60%	yes	no		
248	15	3	.5, 3, 2	Good	NE	yes	N	1:1	Fill	<25%rock	>10-20%	yes	no		
249	3			Good	NE	no	no mark	1:1	Fill	<25%rock	>10-20%	yes	no		
250	4			Fair	NE	no	no mark	1:1	Fill	25-50%rock	>40-50%	yes	no		damage at base
251	3			Poor	NE	no	no mark	1:1	Fill	>50-75%rock	>40-50%	yes	no	2204-2sb	leaning
252	7			Fair	NE	no	no mark	1:1	Fill	<25%rock	>30-40%	yes	no	2001-8	
253	3			Poor	NE	no	no mark	1:1	Fill	25-50%rock	>30-40%	yes	no	2023-13a	
254	4			Poor	NE	yes	N	1:1	Fill	25-50%rock	>50-60%	yes	no		
255	3			Dead	NE	unknown	unknown	1:1	Fill	25-50%rock	>60-70%	unknown	unknown		was much larger
256	7			Poor	NE	yes	N	1:1	Fill	>50-75%rock	>60-70%	no	no		damage at base
257	4			Fair	NE	no	no mark	1:1	Fill	<25%rock	>50-60%	yes	no		
258	8			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	yes	no		
259	7			Fair	NE	no	no mark	1:1	Fill	<25%rock	>70-80%	yes	no		

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260	7			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	no	no		
261	8			Dead	NE	unknown	unknown	1:1	Fill	<25%rock	>70-80%	unknown	unknown		
262	7			Poor	NE	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no		
263	5			Fair	NE	yes	N	1:1	Fill	25-50%rock	>40-50%	yes	no		
264	3			Poor	NE	yes	N	1:1	Fill	25-50%rock	>80-90%	yes	no		
265	4			Fair	NE	yes	N	1:1	Fill	25-50%rock	>60-70%	yes	no		
266	4			Good	NE	yes	N	1:1	Fill	25-50%rock	>10-20%	yes	no	1678-140a	
267	4			Fair	NE	yes	N	1:1	Fill	25-50%rock	>10-20%	yes	no		
268	3			Fair	NE	yes	N	1:1	Fill	25-50%rock	>10-20%	no	no		
269	3			Fair	NE	yes	N	1:1	Fill	25-50%rock	>10-20%	yes	no		
270	4			Fair	NE	yes	N	1:1	Fill	25-50%rock	>30-40%	yes	no	1644-6	
271	7			Fair	N	yes	N	1:1	Fill	25-50%rock	>30-40%	yes	no	1680-315	
272	10			Fair	W	yes	N	0	Fill	loam/no rock	>30-40%	yes	no		
273	14			Good	N	yes	N	3:1	Fill	<25%rock	>30-40%	yes	no	1968-1	
274	9			Fair	N	yes	N	3:1	Fill	<25%rock	>70-80%	yes	no	1927-11	
275	6			Good	N	yes	N	3:1	Fill	<25%rock	>10-20%	yes	no		
276	5			Poor	N	yes	N	3:1	Fill	<25%rock	>10-20%	yes	no	1906-71	
277	12			Poor	N	yes	W	3:1	Fill	<25%rock	>20-30%	no	no		tag nearby 1953-4
278	3			Poor	N	yes	N	3:1	Fill	<25%rock	>10-20%	no	no		damage all over; top missing
279	11			Poor	W	unknown	unknown	3:1	Fill	<25%rock	>40-50%	no	no		damage
280	12	2	1, 1	Dead	W	unknown	unknown	3:1	Fill	<25%rock	>20-30%	unknown	unknown		
281	4			Good	W	yes	N	3:1	Fill	<25%rock	>20-30%	no	no		
282	9			Fair	W	yes	N	3:1	Fill	<25%rock	>20-30%	yes	no		
283	15	1	3	Fair	W	yes	NW	3:1	Fill	<25%rock	>60-70%	yes	no		
284	17	4	2, 2, 2, 2	Good	NW	no	no mark	2:1	Fill	loam/no rock	>30-40%	yes	no		
285	15	5	2, 2, 2, 2, .5	Good	W	yes	N	3:1	Fill	<25%rock	>60-70%	no	no		
286	11			Good	N	yes	N	2:1	Fill	<25%rock	>40-50%	yes	no	1937-1	
287	5			Good	N	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no		
288	4			Good	N	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no	1666-18	
289	6			Good	N	yes	N	1:1	Fill	<25%rock	>10-20%	yes	no		
290	3			Good	N	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no		
291	5			Good	N	yes	NE	1:1	Fill	<25%rock	>20-30%	yes	no	1520-05	
292	12			Good	N	yes	N	1:1	Fill	<25%rock	>50-60%	yes	no		
293	4			Good	NE	yes	NE	1:1	Fill	<25%rock	>20-30%	no	no	1732-05	
294	18	3	5, 3, 4	Dead	NE	unknown	unknown	4:1	Fill	<25%rock	0-10%	unknown	unknown	1730-28	
295	10			Poor	NE	no	no mark	2:1	Fill	<25%rock	>10-20%	yes	no	2001-22	
296	12	6	less than 1	Good	NE	no	no mark	1:1	Fill	<25%rock	>50-60%	yes	no	2009-1	

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297	9			Dead	NE	unknown	unknown	2:1	Fill	<25%rock	>40-50%	unknown	unknown		
298	11			Exc	NE	yes	N	1:1	Fill	<25%rock	>60-70%	yes	no	1965-13	
299	12			Fair	NE	no	no mark	1:1	Fill	<25%rock	>60-70%	yes	no		
300	10	2	4, 5	Dead	NE	unknown	unknown	1:1	Fill	<25%rock	>10-20%	unknown	unknown	2232-2	
301	7			Good	NE	yes	N	1:1	Fill	<25%rock	>70-80%	yes	no		
302	9			Good	NE	yes	N	1:1	Fill	<25%rock	>60-70%	yes	no		
303	13			Fair	NE	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no	1676-62	
304	7			Good	NE	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no		
305	16	4	2, 3, 2, 4	Good	NE	yes	N	1:1	Fill	<25%rock	>30-40%	yes	no	1674-13	
306	4			Good	NE	no	no mark	1:1	Fill	<25%rock	>30-40%	yes	no		
307	10			Good	NE	yes	N	1:1	Fill	<25%rock	>70-80%	yes	no	1680-9	
308	9			Good	NE	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no	1680-21	
309	3			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	yes	no		
310	9			Good	NE	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no		
311	13			Good	NE	yes	NW	2:1	Fill	<25%rock	>10-20%	yes	no		leaning
312	17			Good	NE	yes	N	2:1	Fill	<25%rock	>40-50%	yes	no		leaning
313	3			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	yes	no		
314	7			Good	NE	no	no mark	1:1	Fill	<25%rock	>50-60%	yes	no		
315	3			Good	NE	yes	N	1:1	Fill	<25%rock	0-10%	yes	no		
316	8			Good	NE	no	no mark	1:1	Fill	<25%rock	>50-60%	yes	no		
317	13	1	< .5	Good	NE	yes	N	1:1	Fill	<25%rock	>50-60%	yes	no		
318	10			Good	NE	no	no mark	1:1	Fill	<25%rock	>30-40%	no	no		
319	10			Good	NE	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no		
320	11			Good	NE	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no		
321	5			Good	NE	no	no mark	1:1	Fill	<25%rock	>20-30%	yes	no		tag 2001-11
322	10			Good	NE	no	no mark	1:1	Fill	<25%rock	>40-50%	yes	no		
323	9			Good	NE	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no		
324	10			Good	NE	no	no mark	1:1	Fill	<25%rock	0-10%	yes	no		
325	11			Good	NE	yes	N	1:1	Fill	<25%rock	0-10%	yes	no		
326	8			Good	NE	yes	N	1:1	Fill	<25%rock	>80-90%	yes	no		tag 2002-4
327	9			Good	NE	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no		tag 1827-2
328	22	6	7, 5, 7, 7, 2, 6	Fair	S	yes	N	1:1	Fill	<25%rock	0-10%	no	no		tag 1750-01
329	23	5	11, 7, 7, 7, 8	Fair	S	yes	N	1:1	Fill	<25%rock	0-10%	no	no		
330	16			Good	N	yes	N	1:1	Fill	<25%rock	>50-60%	yes	no		
331	9			Good	N	yes	N	1:1	Fill	<25%rock	>40-50%	yes	no		tag 1954-3
332	5			Good	N	no	no mark	1:1	Fill	<25%rock	>80-90%	no	no		
333	10	3	2, 2, 2	Good	N	yes	N	1:1	Fill	<25%rock	>40-50%	no	no	1954-15	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 87 Tombstone Hill - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/ Fill	Amount of Rock in Soil	Vegetative Cover	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
334	7			Fair	N	no	no mark	1:1	Fill	<25%rock	>80-90%	no	no		
335	10			Good	N	yes	N	1:1	Fill	<25%rock	>20-30%	yes	no	2019-8sb	
336	3			Fair	N	no	no mark	1:1	Fill	<25%rock	>20-30%	yes	no		
337	6			Good	N	yes	N	1:1	Fill	<25%rock	>10-20%	yes	no		
338	11			Fair	N	no	no mark	2:1	Fill	<25%rock	>80-90%	yes	no		
339	12			Fair	N	yes	N	2:1	Fill	<25%rock	>20-30%	no	no	1926-8	
340	6			Good	N	no	no mark	3:1	Fill	<25%rock	>10-20%	yes	no		
341	6			Dead	N	no	no mark	3:1	Fill	<25%rock	>60-70%	unknown	unknown		
342	6			Good	N	yes	N	3:1	Fill	<25%rock	>20-30%	yes	no	1824-3	
343	12			Fair	N	yes	N	4:1	Fill	<25%rock	>40-50%	yes	no		
344	7			Good	N	no	no mark	4:1	Fill	<25%rock	>40-50%	yes	no		
345	4			Good	NE	no	no mark	2:1	Fill	loam/no rock	>20-30%	yes	no		
346	4			Good	N	yes	N	3:1	Fill	<25%rock	>20-30%	yes	no	1932-14	
347	16	3	1, 1, < .5	Good	N	yes	NE	3:1	Fill	<25%rock	>10-20%	no	no		
348	5			Good	N	no	no mark	3:1	Fill	<25%rock	>20-30%	yes	no		
349	5			Good	N	yes	N	3:1	Fill	<25%rock	>20-30%	yes	no	1926-9	
350	8			Good	N	yes	N	3:1	Fill	<25%rock	>20-30%	yes	no	1954-20,	burn damage
351	7			Fair	N	yes	NW	3:1	Fill	<25%rock	>10-20%	yes	no	1885-3	
352	6			Fair	N	no	no mark	3:1	Fill	<25%rock	0-10%	yes	no	1928-42	
353	6			Fair	N	yes	E	3:1	Fill	<25%rock	>20-30%	yes	no		
354	5			Fair	N	no	no mark	2:1	Fill	<25%rock	>10-20%	yes	no	1920-6	
355	5			Fair	N	yes	N	3:1	Fill	<25%rock	>10-20%	yes	no	1896-3	
356	7			Fair	N	no	no mark	3:1	Fill	<25%rock	0-10%	yes	no		
357	15	1	1	Dead	N	unknown	unknown	3:1	Fill	<25%rock	0-10%	unknown	unknown		
358	7			Fair	N	no	no mark	3:1	Fill	<25%rock	0-10%	yes	no		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
100	4			Good	none	no	no mark	>6:1	Fill	<25%rock	0-10%	no grade	no	no		
101	10			Fair	E	yes	E	3:1	Fill	<25%rock	>30-40%	no grade	no	no		
102	11	6	1, 1, 1, 1, 1, 1	Fair	E	no	no mark	4:1	Fill	<25%rock	>20-30%	no grade	no	no		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
103	12			Fair	E	no	no mark	4:1	Fill	<25%rock	>20-30%	no grade	no	yes		
104	13	1	1	Fair	E	no	no mark	>6:1	Fill	<25%rock	>10-20%	<3"	no	no		
105	3			Poor	E	no	no mark	>6:1	Cut	<25%rock	>20-30%	3"-6"	no	yes	176	Pack Rat Habitat
106	5			Poor	NE	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no	234	base flesh rotted
107	2			Fair	NE	no	no mark	>6:1	Cut	25-50%rock	0-10%	no grade	no	no	664	top damage on S. side
108	11			Good	NE	no	no mark	6:1	Cut	25-50%rock	0-10%	<3"	no	no	551	overhead power line
109	4			Good	SE	no	no mark	4:1	Cut	25-50%rock	0-10%	<3"	yes	no		overhead power line
110	6			Good	none	no	no mark	>6:1	Cut	<25%rock	>60-70%	no grade	yes	no		overhead power line
111	8			Good	NE	no	no mark	5:1	Cut	25-50%rock	>10-20%	no grade	yes	no		overhead power line
112	11	2	1, 5	Good	NE	yes	E	5:1	Fill	<25%rock	0-10%	no grade	yes	no		
113	4			Good	NE	no	no mark	>6:1	Fill	<25%rock	0-10%	no grade	yes	no		
114	8			Good	SW	no	no mark	6:1	Fill	<25%rock	0-10%	<3"	yes	no		
115	12			Fair	NE	no	no mark	5:1	Cut	<25%rock	>10-20%	no grade	yes	no		
116	12	3	2, 2	Poor	NE	no	no mark	5:1	Fill	25-50%rock	0-10%	<3"	no	no		scarring on lower 4'
117	9			Good	E	no	no mark	>6:1	Fill	25-50%rock	0-10%	<3"	no	no		tag nearby 62 or 82
118	13	4	1, 1, 1, 1	Fair	E	no	no mark	6:1	Fill	25-50%rock	0-10%	<3"	no	no		tag nearby 62 or 82, overhead pwrl.
119	5			Good	NW	no	no mark	3:1	Fill	<25%rock	0-10%	<3"	yes	no		
120	5			Good	NW	no	no mark	3:1	Fill	<25%rock	>20-30%	<3"	yes	no		
121	4			Good	NW	no	no mark	3:1	Fill	<25%rock	>20-30%	<3"	no	no		
122	5			Good	SE	no	no mark	3:1	Fill	<25%rock	>10-20%	3"-6"	yes	no		
123	3			Good	NE	no	no mark	5:1	Fill	<25%rock	0-10%	no grade	yes	no		
124	4			Good	NE	no	no mark	5:1	Fill	<25%rock	0-10%	no grade	yes	no	290	
125	4			Good	E	no	no mark	5:1	Fill	<25%rock	>20-30%	no grade	yes	no		
126	1			Good	E	no	no mark	3:1	Fill	<25%rock	>20-30%	no grade	yes	no	886	
127	21	1	5	Poor	NE	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
128	32	2	2, 2	Poor	NE	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
129	22	1	4	Poor	N	no	no mark	4:1	Undisturbed	<25%rock	>30-40%	<3"	no	no		leaning
130	24	2	3, 10	Poor	NE	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
131	14	4	2, 2, 5, 4	Poor	NE	no	no mark	5:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning slightly
132	10			Poor	NE	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
133	14	1	1	Fair	N	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
134	24	3	4, 6, 11	Dead	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	unknown	unknown	625	
135	7			Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
136	17	1	5	Poor	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning, scarred
137	16	9	5, 7, 3, 4, 4, 3, 3, 4, 3	Dead	NW	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	yes		
138	9	1	3	Dead	W	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown		leaning
139	1			Good	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
140	20	3	6, 4, 6	Poor	NE	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning, gap between soil and base
141	11			Poor	NE	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	<3"	no	no		leaning
142	20	3	4, 3, 3	Dead	N	unknown	unknown	4:1	Undisturbed	<25%rock	>50-60%	no grade	unknown	yes		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
143	12	3	1, 1, 1	Fair	N	no	no mark	5:1	Undisturbed	<25%rock	0-10%	<3"	no	no	83	
144	7			Fair	N	no	no mark	5:1	Undisturbed	<25%rock	>20-30%	no grade	yes	no		
145	14	1	1	Fair	N	no	no mark	5:1	Undisturbed	<25%rock	>20-30%	<3"	no	no		
146	14			Poor	S	no	no mark	3:1	Cut	<25%rock	>10-20%	<3"	no	no		rot near base, leaning
147	15			Fair	SE	no	no mark	2:1	Cut	<25%rock	>10-20%	<3"	no	no		
148	27	4	10, 10, 5, 6	Dead	E	unknown	unknown	4:1	Undisturbed	<25%rock	>50-60%	no entry	unknown	unknown		
149	9			Fair	N	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	no		damage at base ribs exposed
150	32	3	6, 9, 5	Dead	SE	unknown	unknown	3:1	Fill	<25%rock	>70-80%	no entry	unknown	unknown		
151	12			Poor	SE	no	no mark	3:1	Fill	<25%rock	>10-20%	<3"	no	no		leaning
152	15	2	3, 3	Fair	NE	no	no mark	3:1	Fill	<25%rock	>60-70%	no grade	no	no		leaning
153	5	3	13, 11, 9	Fair	SE	no	no mark	3:1	Fill	<25%rock	>10-20%	no grade	no	no		main trunk cut off at 5'
154	2			Good	SE	no	no mark	3:1	Fill	<25%rock	>10-20%	<3"	no	no		
155	3			Good	SE	no	no mark	5:1	Fill	<25%rock	>10-20%	<3"	yes	no		
156	3			Good	SE	no	no mark	3:1	Fill	<25%rock	>10-20%	no grade	yes	no		
157	3			Good	S	no	no mark	3:1	Fill	<25%rock	0-10%	<3"	yes	no		
158	3			Good	S	no	no mark	2:1	Fill	<25%rock	>10-20%	<3"	yes	no		
159	2			Good	S	no	no mark	3:1	Fill	<25%rock	>30-40%	no grade	yes	no		
160	30	3	11, 6, 7	Dead	N	unknown	unknown	4:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		
161	22	2	5,7	Good	NW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		leaning
162	20	5	3, 4, 1, 1, 4	Good	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
163	3			Exc	SW	no	no mark	2:1	Cut	<25%rock	>50-60%	no grade	yes	no	c-2145	jojoba cover
164	4	3	12, 2, 2	Good	SW	no	no mark	3:1	Cut	<25%rock	>20-30%	<3"	yes	no		trunk broken off at 4', leaning
165	18	2	3, 4	Good	SW	no	no mark	3:1	Cut	<25%rock	>20-30%	<3"	no	no		
166	19	5	4, 4, 5 , 4, 2	Dead	SW	unknown	unknown	3:1	Cut	<25%rock	>40-50%	no entry	unknown	unknown	2925	no roots, recently fallen
167	19	3	3, 3, 4	Good	SW	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	yes	no	2928	
168	11			Fair	NW	no	no mark	3:1	Cut	<25%rock	0-10%	no grade	yes	no		2nd trunk 10'
169	10			Fair	NW	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	no	no		
170	19	3	1, 2, 3	Good	W	no	no mark	4:1	Undisturbed	<25%rock	>30-40%	no grade	no	no	c-2083	
171	2			Good	SW	no	no mark	2:1	Cut	<25%rock	>30-40%	no grade	yes	no		
172	1			Exc	SW	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	no	no		
173	1			Exc	SW	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	yes	no		
174	23	5	1, 1, 1, 1, 1	Fair	SW	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no		
175	20	3	3, 1, 1	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	yes		leaning
176	13			Good	SW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		tag 333 nearby
177	26	3	3, 3, 3	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		leaning
178	3			Good	W	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	no grade	yes	no		yelllow tag 2625, silver 334
179	27	5	11, 5, 6, 6, 1	Dead	SW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		recently fallen
180	22	3	6, 3, 4	Poor	W	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
181	7			Good	W	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	<3"	yes	no		
182	15	8	1, 2, 1, 1, 1, 1, 1, 1	Good	W	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	yes	no		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
183	17	3	1, 4, 1	Good	W	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
184	15	4	2, 2, 2, 3	Good	NW	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
185	13	2	1, 1	Good	NW	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
186	12			Good	NW	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
187	36	15	1,5,2,2,6,8,2,3,3,5,19,3,2,8,1	Poor	NW	no	no mark	6:1	Undisturbed	<25%rock	0-10%	no grade	no	yes		leaning, 4 fallen arms- 6, 5, 7, 5
188	17	3	3, 2, 1	Poor	NE	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
189	7			Good	NE	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
190	11			Good	NE	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
191	22	3	6, 3, 1	Fair	NE	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
192	13	1	1	Good	NE	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
193	21	4	1, 3, 3, 3	Good	W	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
194	21	1	1	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
195	13			Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
196	23	4	6, 7, 4, 6	Poor	NE	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning
197	11	5	2, 1, 1, 1, 1	Good	NE	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
198	2			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	yes	no		
199	4			Good	E	no	no mark	1:1	Cut	<25%rock	>10-20%	no grade	yes	no		
200	3	1	3	Fair	N	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	no grade	no	no		leaning, gouge at base ribs exp
201	20	5	1, 1, 3, 1, 1	Dead	N	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown		
202	26	7	6, 6, 7, 8, 6, 10, 3	Dead	N	unknown	unknown	4:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown		
203	24	3	6, 8, 4	Fair	N	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no	c-2162	leaning
204	7			Good	N	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	yes	no		
205	7	2	2, 2	Good	N	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		2 additional trunks
206	9			Good	N	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
207	23	4	5, 6, 8, 4	Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		
208	20	3	3, 4, 5	Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		
209	10			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	yes		
210	10	1	2	Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		
211	6			Good	N	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	yes	no		
212	22	3	3, 5, 7	Poor	SW	no	no mark	5:1	Undisturbed	<25%rock	>30-40%	<3"	no	no		
213	9			Good	NE	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	<3"	yes	no		
214	13	1	1	Good	N	no	no mark	4:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
215	23	4	6, 9, 11, 9	Fair	N	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
216	19			Good	NW	no	no mark	4:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
217	24	3	8, 7, 8	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning
218	13	2	2, 2	Good	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	yes	no		
219	5			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	yes	no		
220	24	4	8, 8, 1, 4	Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>50-60%	no grade	no	no		
221	11			Good	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
222	23	8	7, 3, 3, 2, 1, 2, 1, 12	Poor	NW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	yes		leaning

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
223	15	3	1, 1, 1	Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	no grade	no	no		
224	11	1	1	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	<3"	yes	no		
225	15			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
226	15	6	1, 1, 2, 1, 1, 1	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	>40-50%	no grade	no	no		
227	18	1	4	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		leaning
228	28	3	11, 19, 5	Dead	NE	unknown	unknown	3:1	Undisturbed	<25%rock	>20-30%	no entry	unknown	yes		
229	24	4	8, 5, 10, 10	Dead	NE	unknown	unknown	4:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	no		recently fallen
230	32	6	11, 5, 2, 1, 6, 7	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
231	4			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	no grade	yes	no		
232	25	4	7, 1, 9, 8	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
233	17	4	4, 9, 5, 3	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	yes		leaning
234	24	6	12, 1, 12, 1, 1, 11	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
235	16	3	1, 2, 4	Fair	NE	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
236	17			Dead	NE	unknown	unknown	3:1	Undisturbed	<25%rock	>60-70%	no entry	unknown	unknown	415	
237	16	2	3, 3	Dead	NE	unknown	unknown	3:1	Undisturbed	<25%rock	>60-70%	no entry	unknown	unknown		skeleton broken into pieces
238	6			Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no entry	unknown	unknown		skeleton broken into pieces
239	1			Good	NW	no	no mark	3:1	Cut	<25%rock	0-10%	no grade	yes	no		
240	2			Good	W	no	no mark	2:1	Cut	<25%rock	0-10%	no grade	yes	no		
241	19	3	3, 5, 1	Fair	SW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
242	26	4	13, 12, 11, 9	Poor	E	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
243	25	7	3, 3, 3, 4, 11, 13, 7	Poor	NW	no	no mark	2:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
244	20	5	5, 1, 1, 7, 3	Fair	E	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
245	12	5	1, 1, 1, 1, 7	Poor	E	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning
246	15	2	2, 2	Dead	W	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown	530	
247	8			Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown		
248	13	1	1	Fair	W	no	no mark	6:1	Undisturbed	<25%rock	>20-30%	no grade	no	no	588	
249	19	2	3, 5	Fair	SW	no	no mark	6:1	Undisturbed	<25%rock	0-10%	no grade	no	yes	564	2nd trunk 10'
250	4			Good	W	no	no mark	6:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
251	11			Good	SW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		damage at base
252	7			Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	yes		rodent damage
253	11			Good	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
254	16	2	1, 2	Poor	SW	no	no mark	2:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
255	15	1	2	Good	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	yes	no		
256	21	1	1	Good	SW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	yes		leaning
257	15	3	3, 1, 4	Poor	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning
258	19	4	6, 5, 5, 5	Fair	SW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
259	22	4	1, 4, 8, 8	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
260	3			Good	E	no	no mark	2:1	Cut	<25%rock	>10-20%	no grade	yes	no		
261	2			Good	E	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	no	no		
262	2			Fair	E	no	no mark	2:1	Cut	<25%rock	>10-20%	<3"	no	no		top scarred on South-west side

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
263	2			Exc	E	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	yes	no		
264	3			Good	E	no	no mark	2:1	Cut	<25%rock	0-10%	<3"	yes	no		
265	2			Good	NE	no	no mark	2:1	Cut	<25%rock	>40-50%	<3"	yes	no		
266	1			Good	N	no	no mark	4:1	Cut	<25%rock	0-10%	no grade	yes	no		
267	1			Good	N	no	no mark	3:1	Cut	<25%rock	>30-40%	no grade	yes	no		
268	3			Exc	E	no	no mark	2:1	Cut	<25%rock	>40-50%	no grade	yes	no		
269	3			Good	E	no	no mark	4:1	Cut	<25%rock	>10-20%	<3"	yes	no		
270	2			Good	E	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	yes	no		
271	2			Exc	E	no	no mark	3:1	Cut	<25%rock	>10-20%	<3"	yes	no		
272	1			Good	E	no	no mark	3:1	Cut	<25%rock	>30-40%	<3"	yes	no		
273	2			Good	W	no	no mark	5:1	Cut	<25%rock	>10-20%	no grade	yes	no		
274	2			Good	W	no	no mark	4:1	Cut	<25%rock	>50-60%	<3"	yes	no		
275	2			Good	E	no	no mark	4:1	Cut	<25%rock	>10-20%	<3"	yes	no		
276	5			Good	W	no	no mark	5:1	Cut	<25%rock	>10-20%	no grade	yes	no		
277	1			Good	NE	no	no mark	4:1	Cut	<25%rock	0-10%	no grade	yes	no		
278	2			Good	W	no	no mark	4:1	Cut	<25%rock	0-10%	no grade	yes	no		
279	2			Good	N	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no		
280	2			Good	N	no	no mark	2:1	Cut	<25%rock	>10-20%	no grade	yes	no		
281	1			Good	E	no	no mark	2:1	Cut	<25%rock	>10-20%	<3"	yes	no		
282	18			Poor	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		damage near base, leaning
283	22	2	8, 8	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning
284	7			Good	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
285	14	5	1, 1, 1, 1, 3	Good	NW	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
286	8			Fair	N	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
287	12	4	11, 5, 6, 9	Dead	NE	unknown	unknown	4:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown		
288	12	1	1	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
289	15	4	2, 3, 3, 3	Poor	SE	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		2 extra trunks 12,14'
290	13	1	7	Poor	NE	no	no mark	3:1	Undisturbed	<25%rock	>60-70%	no grade	no	yes		leaning, gap between soil and base
291	12	2	3, 1	Fair	NE	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	<3"	no	no		
292	17	3	5, 4, 4	Fair	NE	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
293	16	2	2, 3	Fair	NW	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
294	20	5	6, 6, 5, 4, 6	Poor	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
295	12	3	1, 1, 1	Poor	NW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
296	10	1	4	Dead	N	unknown	unknown	5:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown	416	
297	14	3	8, 9, 3	Dead	N	unknown	unknown	4:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown		
298	4			Good	E	no	no mark	2:1	Cut	<25%rock	>20-30%	no grade	no	no		
299	12	7	12, 3, 6, 17, 12, 3, 3	Poor	SW	no	no mark	2:1	Undisturbed	<25%rock	0-10%	<3"	no	yes		leaning
300	26	6	4, 4, 4, 11, 11, 9	Poor	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	yes		
301	16	1	1	Fair	NE	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
302	24	4	13, 2, 7, 6	Poor	NE	no	no mark	3:1	Undisturbed	<25%rock	0-10%	<3"	no	no		leaning

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
303	23	3	8, 4, 5	Dead	SW	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown		
304	3			Good	SE	no	no mark	2:1	Cut	<25%rock	0-10%	no grade	yes	no		
305	1			Good	E	no	no mark	2:1	Cut	<25%rock	>50-60%	no grade	no	no	894	
306	1			Good	NE	no	no mark	2:1	Cut	<25%rock	>50-60%	no grade	yes	no	889	
307	20	3	5, 6, 3	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
308	25			Fair	N	no	no mark	2:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
309	25	3	6, 3, 6	Fair	N	no	no mark	2:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
310	19	6	5, 9, 3, 8, 8, .5	Good	SW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
311	14	2	1, .5	Fair	SW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
312	10			Dead	SW	unknown	unknown	4:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown		
313	20	5	3, 2, 2, 1, 1	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
314	10			Fair	SW	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no		double trunk 9' high
315	10	2	3, 3	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		leaning
316	13	3	5, 3, 3	Dead	N	unknown	unknown	2:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown		
317	5			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no	131	
318	10			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		
319	18	2	4, 4	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		gouge on trunk, ribs exposed
320	25	1	6	Dead	SW	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
321	18	3	7, 7, 8	Dead	W	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no grade	no	unknown		
322	27	5	6, 6, 6, 5, 11	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		leaning
323	16	2	3, 3	Fair	S	no	no mark	2:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		leaning
324	7			Good	S	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
325	19	3	4, 11, 10	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		leaning
326	9			Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	<3"	no	no		leaning
327	9			Dead	N	unknown	unknown	3:1	Undisturbed	<25%rock	>50-60%	no grade	no	no		
328	1			Fair	W	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no	1	9' of trunk broken off, 1' remains
329	19	2	2, 5	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
330	16	8	6, 6, 2, .5, 5, 1, 1, 11	Good	S	no	no mark	2:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		
331	19	4	7, 3, 7, 5	Good	S	no	no mark	2:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
332	14	2	2, 1	Dead	NE	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no grade	unknown	unknown		
333	7			Good	W	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	<3"	yes	no		
334	6	4	3, 3, 2, .5	Good	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		main trunk decapitated
335	10			Good	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	yes	no		
336	2			Good	SW	no	no mark	2:1	Undisturbed	<25%rock	>30-40%	no grade	yes	no		
337	14	1	1	Good	SW	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	no grade	no	yes		slight lean
338	9			Good	S	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
339	12	1	.5	Fair	NE	no	no mark	3:1	Undisturbed	<25%rock	>40-50%	no grade	no	no		leaning
340	21	1	.5	Fair	NE	no	no mark	3:1	Undisturbed	<25%rock	>50-60%	no grade	no	no		leaning
341	22	8	3, 2, 2, 2, 11, 8, 1, 10	Fair	SW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
342	19	2	4, 4	Dead	SW	unknown	unknown	3:1	Undisturbed	<25%rock	>30-40%	no grade	unknown	unknown		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

SR 188 Resort Road to Devore Wash - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut/Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth (in)	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
343	21	6	11, 10, 3, 3, 10, 10	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		leaning
344	17			Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	<3"	no	no		slight lean
345	16	4	3, 3, 3, 4	Fair	NW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
346	1			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	yes	no		
347	16	3	4, 3, .5	Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no grade	unknown	no		
348	19	4	1, 2, 1, 2	Good	S	no	no mark	6:1	Undisturbed	<25%rock	0-10%	<3"	no	no		
349	10	1	1	Good	S	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
350	21	5	5, 5, 4, .5, .5	Fair	SW	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	<3"	no	no		
351	11			Dead	SW	no	no mark	3:1	Undisturbed	<25%rock	>50-60%	no grade	unknown	unknown		
352	10	3	5, 7, 10	Good	W	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		4 trunks
353	12	1	3	Dead	NW	unknown	unknown	3:1	Undisturbed	<25%rock	>30-40%	<3"	unknown	unknown		
354	15	5	4, 4, 4, 5, 3	Fair	NW	no	no mark	4:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		slight lean
355	7	3	8, 4, 5	Fair	NW	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
356	9			Good	NW	no	no mark	5:1	Undisturbed	<25%rock	>20-30%	no grade	yes	no		
357	23	4	6, 7, 6, 8	Fair	W	no	no mark	5:1	Undisturbed	<25%rock	>10-20%	no grade	no	no		
358	23	5	5, 6, 3, 4, 2	Fair	NW	no	no mark	5:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		leaning
359	24	8	13, 2, 4, 6, 13, 9, 1, .5	Fair	N	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		leaning
360	17	5	4, 4, 3, 3, 4	Dead	NE	unknown	unknown	2:1	Undisturbed	<25%rock	>10-20%	no grade	unknown	unknown		
361	25	5	8, 9, 13, 9, 10	Fair	SW	no	no mark	5:1	Undisturbed	<25%rock	>20-30%	<3"	no	no		slight lean
362	25	5	9, 7, 13, 6, 7	Dead	W	unknown	unknown	5:1	Undisturbed	<25%rock	0-10%	no grade	unknown	unknown		
363	22	4	3, 12, 5, 3	Poor	W	no	no mark	5:1	Undisturbed	<25%rock	>60-70%	no grade	no	no	2 5	slight lean
364	23	10	1, 9, 9, 5, 1, 1, .5, 11, 1, .5	Fair	W	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	yes		slight lean
365	4			Good	W	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
366	7			Good	W	no	no mark	4:1	Undisturbed	<25%rock	0-10%	<3"	yes	no		
367	15	2	3, 5	Poor	W	no	no mark	4:1	Undisturbed	<25%rock	>30-40%	no grade	yes	no		slight lean
368	11			Poor	SW	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	yes	no		slight lean
369	11			Dead	SW	unknown	unknown	3:1	Undisturbed	<25%rock	>40-50%	no grade	unknown	unknown		
370	10	2	4, 1	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
371	7			Good	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no	155	
372	7			Good	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
373	11	2	1, 2	Good	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	yes	no	152	
374	22	6	7, 7, 6, 1, 11, 7	Fair	W	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no		
375	11			Good	W	no	no mark	4:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		2nd trunk 6'
376	18	4	5, 5, 5, 3	Fair	W	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		leaning
377	15	6	3, 4, 3, 5, 3, 4	Poor	W	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	no	no		
378	9			Good	W	no	no mark	3:1	Undisturbed	<25%rock	>20-30%	no grade	no	no		

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

US 93 Kaiser Spring - Saguaro Inventory

Plant Number	Height (feet)	Number of Arms	Arm Heights (feet)	Health	Aspect	North Mark	Orientation of North Mark	Slope	Cut /Fill	Amount of Rock in Soil	Vegetative Cover	Basin Depth	Taper at Base	Wildlife Habitat	Original Tag Number	Comment
100	12			Good	NW	no	no mark	4:1	Cut	<25%rock	>10-20%	no grade	no	no	6397	damage, gouges in trunk
101	11	1	1	Good	W	no	no mark	3:1	Cut	<25%rock	>20-30%	no grade	no	no	8369	
102	6			Good	W	no	no mark	4:1	Cut	<25%rock	0-10%	<3"	no	no	6122	
103	18			Good	W	no	no mark	4:1	Cut	<25%rock	>20-30%	no grade	no	no	6668	
104	10			Good	W	no	no mark	2:1	Cut	<25%rock	>10-20%	no grade	no	no	8375	
105	6			Good	SW	yes	N	3:1	Cut	<25%rock	0-10%	no grade	no	no	6951	
106	2			Good	W	yes	N	3:1	Cut	<25%rock	>20-30%	no grade	yes	no	8088	
107	8			Good	W	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no	8317	
108	8			Poor	W	no	no mark	3:1	Cut	<25%rock	>20-30%	no grade	no	no	6683	
109	4			Good	W	no	no mark	3:1	Cut	<25%rock	0-10%	no grade	yes	no		
110	7			Good	W	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no		
111	14			Good	W	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no		
112	18			Fair	W	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	no	no	6655	
113	7			Good	SW	no	no mark	4:1	Cut	<25%rock	>10-20%	no grade	no	no	8012	
114	6			Good	SW	no	no mark	4:1	Cut	<25%rock	0-10%	<3"	no	no	8403	
115	8			Dead	E	no	no mark	4:1	Cut	<25%rock	>10-20%	no grade	no	no	6403	
116	7			Good	E	no	no mark	4:1	Cut	<25%rock	>20-30%	<3"	no	no	6432	
117	9			Good	W	no	no mark	3:1	Cut	<25%rock	0-10%	no grade	no	no		
118	2			Good	W	yes	N	2:1	Fill	<25%rock	>20-30%	no grade	yes	no	6641	
119	4			Good	W	yes	N	2:1	Fill	<25%rock	>50-60%	no grade	yes	no		
120	4			Good	W	yes	N	3:1	Fill	<25%rock	>20-30%	no grade	yes	no		damage at base
121	2			Good	W	yes	N	3:1	Fill	<25%rock	>20-30%	no grade	yes	no	6772	
122	1			Good	W	no	no mark	2:1	Fill	<25%rock	>30-40%	no grade	yes	no	7089	inventory said "in rock"
123	3			Good	W	yes	N	2:1	Fill	<25%rock	0-10%	no grade	yes	no	2319	Valley Rain tag (replacement)
124	1			Good	W	yes	N	3:1	Fill	<25%rock	>30-40%	no grade	yes	no		
125	6		5 trunks, 6, 5, 5, 4, 3	Good	S	no	no mark	6:1	Cut	<25%rock	0-10%	<3"	no	no	8255	5 trunks, 6, 5, 5, 4, 3
126	12			Good	W	no	no mark	3:1	Fill	<25%rock	0-10%	no grade	yes	no	6366	
127	8			Good	W	no	no mark	5:1	Fill	<25%rock	>20-30%	no grade	no	no	6582	
128	14			Fair	W	no	no mark	5:1	Fill	<25%rock	>20-30%	<3"	no	no		burn damage
129	4			Dead	W	no	no mark	2:1	Fill	<25%rock	0-10%	no grade	unknown	no		
130	1			Good	W	yes	N	2:1	Fill	<25%rock	>20-30%	no grade	yes	no		
131	15	2	2, 1	Poor	W	no	no mark	3:1	Undisturbed	<25%rock	>10-20%	no grade	no	no	8373	bacterial rot, leaning
132	18	3	3, 1, 1	Poor	W	no	no mark	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no	8374	leaning
133	8			Good	W	no	no mark	>6:1	Cut	<25%rock	0-10%	3"-6"	no	no		
134	7	6	3, 3, 1, 1, 1, 1	Fair	W	no	no mark	5:1	Undisturbed	<25%rock	0-10%	no grade	no	yes	8371	main trunk cut off at 3 ft
135	18	4	5, 5, 5, 5	Dead	W	unknown	unknown	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no	8372	
136	2			Good	W	yes	N	2:1	Fill	<25%rock	0-10%	no grade	yes	no	8172	
137	15			Dead	N	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	no grade	no	no	6389	inventory said "inaccessible"
138	15	1	4	Dead	NW	no	no mark	2:1	Undisturbed	25-50%rock	>30-40%		no	unknown		
139	1			Good	E	yes	N	5:1	Fill	<25%rock	0-10%	no grade	yes	no	4807	

Evaluation of Salvage and Replanted Native Plants on ADOT Projects

US 93 Kaiser Spring - Saguaro Inventory

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140	4			Good	E	yes	N	5:1	Fill	<25%rock	0-10%	no grade	yes	no	7489	
141	6			Dead	S	unknown	unknown	4:1	Undisturbed	<25%rock	0-10%	no entry	unknown	unknown	8281	
142	12	1	3	Good	SW	no	no mark	4:1	Undisturbed	<25%rock	0-10%	no entry	no	no	8289	
143	3			Good	E	yes	N	3:1	Fill	<25%rock	>30-40%	no entry	yes	no	6845	
144	3			Good	W	yes	N	3:1	Cut	<25%rock	>20-30%	no entry	no	no	6275	
145	3			Fair	W	yes	NE	2:1	Fill	<25%rock	0-10%	no entry	yes	no		
146	12	2	2, 3	Dead	SW	unknown	unknown	2:1	Fill	<25%rock	0-10%	no grade	unknown	unknown	7938	
147	5			Fair	SW	yes	N	2:1	Fill	<25%rock	>20-30%	no grade	no	no	6684	
148	4			Fair	SW	yes	N	2:1	Fill	<25%rock	>40-50%	no grade	no	no	6974	
149	5			Good	SW	yes	N	2:1	Fill	<25%rock	>20-30%	no grade	yes	no	6670	2nd trunk 3.5'
150	12			Good	E	no	no mark	2:1	Fill	<25%rock	0-10%	no grade	yes	no	6108	
151	9			Good	E	no	no mark	2:1	Fill	<25%rock	>30-40%	no grade	no	no	8313	
152	6			Good	SW	yes	N	4:1	Undisturbed	<25%rock	0-10%	no grade	yes	no	1938	Valley Rain tag (replacement)
153	4			Good	SW	yes	N	4:1	Undisturbed	<25%rock	0-10%	no grade	no	no	6152	
154	7			Good	SW	yes	N	4:1	Undisturbed	<25%rock	0-10%	no grade	yes	no		
155	6			Good	SW	yes	N	2:1	Cut	<25%rock	0-10%	<3"	yes	no	7936	
156	5			Good	NE	yes	N	3:1	Fill	<25%rock	>50-60%	no grade	yes	no	8087	
157	11			Good	NE	no	no mark	5:1	Fill	loam/no rock	>10-20%	no grade	no	no	7534	
158	7			Fair	NE	no	no mark	5:1	Fill	loam/no rock	>50-60%	no grade	no	no		
159	11	2	1,1	Fair	NE	no	no mark	5:1	Fill	loam/no rock	>40-50%	no grade	no	no		
160	7			Good	W	no	no mark	2:1	Fill	25-50%rock	>10-20%	no grade	yes	no	8351	
161	3			Fair	SW	yes	N	4:1	Fill	<25%rock	>30-40%	no grade	yes	no		
162	2			Good	SW	yes	N	4:1	Fill	<25%rock	>30-40%	<3"	yes	no	6425	
163	3			Dead	W	unknown	unknown	1:1	Fill	<25%rock	>30-40%	<3"	unknown	unknown	2311	Valley Rain tag (replacement)
164	2			Good	W	no	no mark	1:1	Fill	25-50%rock	0-10%	no grade	yes	no		
165	4			Fair	W	yes	N	1:1	Fill	25-50%rock	>20-30%	<3"	yes	no	8445	
166	2			Fair	W	no	no mark	1:1	Fill	25-50%rock	0-10%	no grade	yes	no	6673	
167	8			Good	E	no	no mark	6:1	Fill	<25%rock	0-10%	<3"	yes	no	8010	
168	4			Good	E	no	no mark	6:1	Fill	<25%rock	0-10%	<3"	yes	no	6352	
169	5			Good	E	yes	N	6:1	Fill	<25%rock	0-10%	<3"	yes	no		
170	16			Good	E	no	no mark	6:1	Fill	<25%rock	0-10%	<3"	yes	no	7991	
171	17			Fair	E	no	no mark	6:1	Fill	<25%rock	0-10%	<3"	no	no		
172	3			Fair	W	yes	N	6:1	Fill	<25%rock	>10-20%	no grade	yes	no	6777	
173	2			Fair	W	no	no mark	6:1	Fill	<25%rock	>10-20%	no grade	yes	no	6788	
174	5			Fair	W	yes	N	1:1	Fill	<25%rock	0-10%	no grade	yes	no	6564	
175	4			Good	W	yes	N	1:1	Fill	<25%rock	0-10%	<3"	yes	no	6679	
176	4			Good	W	yes	N	1:1	Fill	<25%rock	0-10%	<3"	yes	no	6667	
177	6			Good	W	yes	N	1:1	Fill	<25%rock	0-10%	<3"	yes	no	6171	
178	3			Good	N	yes	N	1:1	Fill	<25%rock	>10-20%	no grade	yes	no	6711	
179	4			Good	N	yes	N	1:1	Fill	25-50%rock	>50-60%	no grade	yes	no	1874	Valley Rain tag (replacement)

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180	3			Good	W	no	no mark	1:1	Fill	25-50%rock	0-10%	no grade	yes	no	1981	Valley Rain tag (replacement)
181	3			Good	W	no	no mark	1:1	Fill	25-50%rock	>50-60%	<3"	yes	no	6764	
182	4			Good	NE	yes	NE	1:1	Fill	<25%rock	>50-60%	<3"	yes	no	5608	
183	6			Good	NE	yes	N	1:1	Fill	<25%rock	>70-80%	<3"	yes	no	8082	
184	3			Good	E	yes	N	1:1	Fill	<25%rock	>20-30%	no grade	yes	no	8103	
185	4			Dead	E	unknown	unknown	1:1	Fill	<25%rock	>30-40%	no grade	unknown	unknown	8077	burn damage
186	16	2	1, 2	Good	NE	no	no mark	4:1	Fill	<25%rock	>10-20%	<3"	no	no	8330	
187	11			Good	NE	no	no mark	4:1	Fill	<25%rock	>70-80%	<3"	yes	no		
188	6			Good	NE	yes	N	4:1	Fill	<25%rock	>70-80%	no grade	yes	no	6298	
189	7			Good	NE	no	no mark	4:1	Fill	<25%rock	>60-70%	no grade	yes	no	8023	
190	16	1	.5	Good	NE	no	no mark	4:1	Fill	<25%rock	>20-30%	<3"	yes	no		
191	5			Fair	NE	yes	N	4:1	Fill	<25%rock	0-10%	no grade	yes	no	7063	
192	3			Good	NW	yes	N	>6:1	Cut	25-50%rock	0-10%	<3"	yes	no	8488	
193	3			Good	NW	yes	N	>6:1	Cut	25-50%rock	0-10%	<3"	yes	no	2559	Valley Rain tag (replacement)
194	6			Good	NE	yes	N	4:1	Cut	25-50%rock	>20-30%	<3"	yes	no	8252	Valley Rain tag (replacement)
195	9			Dead	NE	unknown	unknown	3:1	Cut	<25%rock	>70-80%	<3"	unknown	unknown	8173	Valley Rain tag (replacement)
196	8			Fair	NE	no	no mark	4:1	Cut	<25%rock	>10-20%	<3"	no	no	8017	
197	3			Good	NW	yes	NE	4:1	Cut	<25%rock	>20-30%	no grade	yes	no	7959	
198	8			Good	NW	no	no mark	4:1	Cut	<25%rock	>10-20%	<3"	yes	no		
199	6			Good	NW	yes	N	4:1	Cut	<25%rock	0-10%	<3"	yes	no	8298	
200	2			Dead	W	unknown	unknown	4:1	Fill	<25%rock	0-10%	no grade	unknown	no		
201	2			Good	W	no	no mark	5:1	Fill	<25%rock	>20-30%	no grade	yes	no		
202	1			Good	W	no	no mark	5:1	Fill	<25%rock	>20-30%	no grade	yes	no		
203	2			Good	W	no	no mark	3:1	Fill	<25%rock	>10-20%	no grade	yes	no		
204	2			Fair	W	no	no mark	5:1	Fill	25-50%rock	>40-50%	no grade	yes	no		
205	2			Dead	W	unknown	unknown	4:1	Fill	<25%rock	>80-90%	no grade	unknown	unknown	7085	
206	2			Fair	W	no	no mark	4:1	Fill	<25%rock	>10-20%	no grade	yes	no	2244	Valley Rain tag (replacement)
207	2			Good	W	yes	N	4:1	Fill	<25%rock	>10-20%	<3"	yes	no	8267	
208	1			Good	W	no	no mark	2:1	Fill	<25%rock	>10-20%	<3"	yes	no	2058	Valley Rain tag (replacement)
209	18	3	1, 5, 3	Dead	NW	unknown	unknown	6:1	Fill	<25%rock	0-10%	no grade	unknown	unknown	6461	
210	3			Good	W	yes	N	4:1	Fill	<25%rock	0-10%	<3"	yes	no	7306	
211	2			Good	W	yes	N	4:1	Fill	<25%rock	>40-50%	<3"	yes	no		
212	2			Good	W	yes	N	4:1	Fill	<25%rock	>40-50%	no grade	yes	no	8358	
213	3			Good	W	yes	N	3:1	Fill	<25%rock	0-10%	<3"	yes	no		
214	10			Good	W	no	no mark	5:1	Fill	<25%rock	>80-90%	<3"	yes	no		
215	9			Good	E	no	no mark	3:1	Fill	<25%rock	0-10%	<3"	no	no		
216	7			Good	E	no	no mark	3:1	Fill	<25%rock	0-10%	<3"	yes	no	6273	
217	10			Good	W	no	no mark	3:1	Fill	<25%rock	>10-20%	no grade	yes	no		
218	12			Good	W	no	no mark	3:1	Fill	<25%rock	0-10%	no grade	yes	no	7965	
219	8			Fair	S	no	no mark	3:1	Fill	<25%rock	0-10%	<3"	yes	no		

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220	10	1	1	Dead	S	unknown	unknown	3:1	Undisturbed	<25%rock	0-10%	<3"	unknown	unknown		
221	9			Good	W	no	no mark	3:1	Fill	<25%rock	>10-20%	no grade	yes	no	6290	
222	3			Exc	W	no	no mark	3:1	Fill	<25%rock	0-10%	no grade	yes	no		
223	3			Exc	W	no	no mark	3:1	Fill	<25%rock	0-10%	no grade	yes	no		
224	7			Poor	SW	no	no mark	3:1	Fill	<25%rock	0-10%	no grade	yes	no	7383	
225	6			Good	W	yes	N	3:1	Cut	<25%rock	0-10%	<3"	yes	no	7760	
226	16			Dead	S	yes	N	3:1	Cut	<25%rock	0-10%	<3"	unknown	unknown	8009	
227	4			Good	S	yes	N	3:1	Cut	<25%rock	0-10%	no grade	yes	no		
228	13			Fair	NE	no	no mark	3:1	Cut	<25%rock	>10-20%	no grade	yes	no	8005	
229	7			Good	NE	no	no mark	3:1	Cut	<25%rock	>30-40%	no grade	yes	no	6774	
230	5			Good	NE	yes	N	3:1	Cut	<25%rock	>30-40%	no grade	yes	no	2313	Valley Rain tag (replacement)
231	8			Good	NE	no	no mark	3:1	Cut	<25%rock	>60-70%	<3"	yes	no	7987	
232	11			Good	NE	no	no mark	3:1	Cut	<25%rock	>30-40%	<3"	yes	no	8296	
233	13			Good	NE	no	no mark	3:1	Cut	<25%rock	>30-40%	no grade	yes	no	6646	
234	6			Good	W	yes	N	3:1	Cut	<25%rock	>20-30%	no grade	yes	no		
235	6			Good	W	yes	N	3:1	Cut	<25%rock	>40-50%	no grade	yes	no	6537	
236	12			Good	W	no	no mark	3:1	Cut	<25%rock	>50-60%	no grade	yes	no	8002	
237	4			Good	W	yes	N	3:1	Cut	<25%rock	>40-50%	no grade	yes	no	2538	Valley Rain tag (replacement)
238	5			Dead	none	unknown	unknown	3:1	Cut	<25%rock	>30-40%		unknown	unknown	6113	
239	18	6	1, 1, 1, 1, 1, 2	Good	NW	no	no mark	3:1	Cut	<25%rock	>30-40%	<3"	no	no	8377	
240	6			Fair	NW	yes	N	3:1	Cut	<25%rock	>30-40%	<3"	yes	no	8315	
241	19			Good	NW	no	no mark	3:1	Cut	<25%rock	>70-80%	no grade	no	no	8449	
242	5			Exc	NW	yes	N	3:1	Cut	<25%rock	>70-80%	no grade	yes	no	8251	
243	5			Good	NW	yes	N	3:1	Cut	<25%rock	>20-30%	<3"	yes	no	8063	
244	4			Fair	NW	yes	NE	3:1	Cut	<25%rock	>10-20%	no grade	yes	no		
245	6			Good	NW	no	no mark	3:1	Cut	<25%rock	>40-50%	<3"	yes	no		
246	3			Good	NE	yes	N	3:1	Cut	<25%rock	>50-60%	no grade	yes	no	8057	
247	16			Fair	NE	no	no mark	3:1	Cut	<25%rock	>70-80%	<3"	yes	no	8309	
248	5			Good	NE	yes	NE	3:1	Cut	<25%rock	>40-50%	<3"	yes	no	2537	Valley Rain tag (replacement)
249	5			Good	E	yes	N	3:1	Fill	<25%rock	>80-90%	no grade	yes	no	6922	
250	12			Fair	NW	no	no mark	6:1	Undisturbed	<25%rock	>10-20%	no grade	yes	no	6567	twin dead 12', 2 arms
251	18	1	1	Fair	NW	no	no mark	6:1	Undisturbed	<25%rock	0-10%	no grade	yes	no	6570	
252	11			Dead	NE	unknown	unknown	6:1	Undisturbed	<25%rock	0-10%	no grade	unknown	unknown	6575	
253	20	2	10, 8	Dead	NW	unknown	unknown	6:1	Undisturbed	<25%rock	>20-30%	no grade	unknown	unknown	6873	
254	10			Good	NW	no	no mark	3:1	Undisturbed	<25%rock	>30-40%	no grade	yes	no