

# Western Joshua Tree Relocation Guidelines and Protocols

California Department of Fish and Wildlife  
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## Introduction

The California Department of Fish and Wildlife (CDFW) developed this document to provide guidance on how and when to relocate western Joshua trees (*Yucca brevifolia*) in order to minimize impacts to populations, prevent habitat fragmentation, and preserve connectivity corridors for gene flow and pollinator migration.

The Guidelines section of this document discusses the circumstances in which CDFW would consider including permit conditions requiring relocation of one or more western Joshua trees under the Western Joshua Tree Conservation Act (WJTCA). The Protocol section of this document provides a summary of best practices for relocating western Joshua trees and increasing the survival rate of relocated (salvage) western Joshua trees. Information on post-relocation maintenance, monitoring, and reporting is also provided. This document will be updated as needed based on the best scientific information available.

## Western Joshua Tree Conservation Act Relocation Provisions

Section 1927.3, subdivision (a)(4)(A) of the California Fish and Game Code gives CDFW authority to require WJTCA incidental take permittees to relocate one or more western Joshua trees. Furthermore, pursuant to that subdivision, where relocation is required, permittees must implement reasonable measures required by CDFW to facilitate the successful relocation and survival of salvage trees. Relocation is deemed successful where the health of a salvaged western Joshua tree is stable or improving without any supplemental care after the post-relocation maintenance period. The relocation measures shall include but are not limited to:

1. A requirement that the salvage trees are placed in locations and with proper orientation to improve their chances of survival.
2. A requirement that salvage trees are relocated at a time that maximizes their chances of survival when feasible.
3. A requirement that a desert native plant specialist be onsite to oversee relocation.

Fish and Game Code section 1927.3, subdivision (a)(4)(B) states that CDFW may limit relocation requirements to certain size classes of trees.

This document is intended to fulfill the requirement of Fish and Game Code section 1927.3, subdivision (a)(4)(C) that by July 1, 2024, CDFW adopt guidelines and relocation protocols, developed in consultation with desert native plant specialists, based on the best available science, to relocate western Joshua trees successfully. Pursuant to Fish and Game Code section 1927.3, subdivision (g)(1), the permittee shall be legally responsible for ensuring the measures included in its WJTA ITP are implemented consistent with these guidelines. The permittee may, however, contract with the landowner of the relocation site(s) to conduct the post-relocation maintenance and monitoring activities required under its WJTCA ITP.

Subdivision (g)(2) of that section further states, “[u]nless specifically required by written agreement, a landowner that agrees in writing to allow western Joshua trees to be relocated onto land it owns shall not be liable for the continued survival of the western Joshua trees, shall not be required to manage or maintain the translocated western Joshua trees, and shall not be required to change existing land use practices, provided that the land use practices do not result in the taking, possession, sale, or further translocation of the western Joshua trees.” While landowners accepting salvage trees are not responsible for maintaining the trees or otherwise ensuring the trees’ continued survival, it is important to note that import, export, take, possession, purchase, and sale of salvage trees or any part or product thereof, is prohibited, except as authorized pursuant to the WJTCA.

The WJTCA also requires CDFW, by December 31, 2024, to prepare a Western Joshua Tree Conservation Plan in collaboration with the Fish and Game Commission, other governmental agencies, California Native American tribes, and the public and to incorporate in the plan, among other provisions, protocols for the successful relocation of Western Joshua trees. The Commission will then consider the plan and take final action on the conservation plan by June 30, 2025. During the one-year period between implementation of the July 1, 2024, relocation standards and finalization of the Western Joshua Tree Conservation Plan by June 30, 2025, CDFW will have an opportunity to supplement the collection of best available science and recommend appropriate amendments as part of the Commission’s process of considering and taking final action on the Conservation Plan. These guidelines will be incorporated by reference into the Western Joshua Tree Conservation Plan.

## Definitions

The following definitions are used in this document:

Bare root relocation – method for relocating a living western Joshua tree by excavating around the root ball of the tree to dislodge the tree from the ground. Any relocation method other than tree spade relocation (defined below) is considered bare root relocation for the purposes of this document.

Containerize – to place a salvage tree into a container, such as a plastic pot or tree box, for temporary storage.

Project site – the area(s) where project activities are expected to occur (e.g., access, staging, construction, etc.)

Recipient site – a salvage tree’s (defined below) final planting location.

Relocation – the removal of a living western Joshua tree from the ground and transplantation back into the ground at another location (referred to as a recipient site).

Relocation area – an area with one or several recipient sites.

Retained tree – a living western Joshua tree that is located within the project site, may be avoided or minimally impacted by the project and will therefore not be relocated.

Root ball – a mass of soil that contains concentrated roots growing from the base of the stem of a western Joshua tree.

Salvage tree – a living western Joshua tree that is being, or has been, relocated. Each western Joshua tree stem or trunk arising from the ground shall be considered an individual tree, regardless of its proximity to any other western Joshua tree stem or trunk.

Size Class A – a western Joshua tree that is less than one meter in height.

Size Class B – a western Joshua tree that is one meter or greater, but less than five meters in height.

Size Class C – a western Joshua tree that is five meters or greater in height.

Tree spade – a specialized piece of heavy equipment that consists of hydraulically controlled spade blades that can encapsulate the root ball of a salvage tree, as well as adjacent soil.

Tree spade relocation – method for relocating a living western Joshua tree by using a tree spade to dig, transport, and replant a western Joshua tree and its root ball.

## Best Available Science on Relocation

There are many accounts of successful western Joshua tree relocation (i.e., stable or increasing signs of tree health without any supplemental care after a period of maintenance), but little scientific research has been done to compare the relative success rates for different relocation techniques. Rather, most relocation efforts that monitor salvage western Joshua tree survivorship evaluate only one method of relocation (i.e., using hand tools for small trees and/or excavators or tree spade for large trees) (Wagner 2018, Balogh 2019, City of Palmdale 2024). The best available scientific information on how to achieve success when relocating western Joshua trees therefore comes from the experience of experts working in the field of restoration and Joshua tree relocation. In Bainbridge (2007), the author offers advice on relocating Joshua trees and other salvaged succulents, such as cacti and shrubs, based on his expertise and knowledge. The National Park Service (NPS) (Goodwin 2024) and a tree transplanting expert (Reynolds 2024) also provided CDFW with information relevant to the development of this document.

In addition, CDFW reviewed the results of known relocation projects. Bainbridge (2007) states that “Joshua trees often transplant well but require intensive aftercare and irrigation[.]” Bainbridge suggests that relocation is best done with machinery, but hand tools can also be used. Front loaders, excavators, and hydraulic tree spades are useful.

Tree spades work best in silty or sandy soils but using them is difficult in rocky soils. Salvaged trees can be placed in containers or immediately replanted but should be protected as much as possible from drying winds, heat, and sun. Bainbridge (2007) also mentions that yucca, such as western Joshua trees, seem to survive better if replanted in the same orientation they grew. Overall, Bainbridge (2007) shows the survival rates for salvage trees can be improved if the relocation work is timed carefully, the trees are handled gently, and there is good aftercare and irrigation in a holding facility or at the recipient site. Goodwin (2024) and Reynolds (2024) suggest that minimizing disturbance to the root ball and adequate care after trees have been relocated are the most important factors for successful relocation. Tree spade relocation of western Joshua tree minimizes impacts to roots and can have a success rate of greater than 90% with sufficient aftercare (City of Palmdale 2024, Goodwin 2024, Reynolds 2024). Bare root relocation of western Joshua tree causes more damage to roots and is reported to have a success rate of approximately 50-90% even with sufficient aftercare, based on preliminary findings of a monitoring period of 1-3 years (Goodwin 2024, Reynolds 2024). Beyond the initial 3-year monitoring period, however, success rates can decline (Graver 2024). This document describes additional methods that can be used to aid long-term survival and improve chances of reproduction events. However, there is no foolproof method that guarantees relocation success, and some mortality is always expected to result. Therefore, relocation is considered a method to minimize impacts to western Joshua tree populations, rather than a substitution for mitigation through the payment of fees.

The size and growth pattern of a western Joshua tree may also present additional challenges. Small trees, especially those salvaged through the bare root method, experience higher rates of mortality even with sufficient aftercare (Goodwin 2024). And, though it may be possible to relocate western Joshua trees over 7 meters in height, tree spades may be unable to sufficiently encapsulate the root ball for trees of this size (Reynolds 2024). These trees may also be difficult to stabilize to withstand high wind speeds after being relocated. Dense, clonal reproduction can also affect relocation success. Separating smaller trees from larger, parent trees that are connected through rhizomes below ground can result in higher mortality rates for those smaller trees (Goodwin 2024, Graver 2024).

## Guidelines

### Relocation Requirement Considerations

CDFW will determine whether relocation will be required under a WJTCA incidental take permit (ITP) during the permit application review process. Factors that CDFW may consider in making this determination for each project site include the following:

- Number of trees to be lethally taken (greater than 20 trees removed);
- Area of impacted western Joshua tree habitat within a project site (greater than 20 acres impacted);

- Avoidance and minimization measures proposed by the applicant to reduce project impacts to western Joshua tree;
- Quality of habitat on, and adjacent to, the project site (e.g., ecologically core or intact);
- Overall population health on the project site (e.g., declining versus stable or increasing);
- Whether the project is within predicted climate refugia for western Joshua tree.
- Extent of permanent project impacts;
- Density of clonal growth; and
- Anticipated temporal impacts of a project including operation or maintenance activities, where applicable.

When CDFW staff determine that a WJTCA ITP will require relocation of western Joshua trees, the applicant will develop a [Relocation Plan](#) for CDFW approval, including the number of trees to be relocated and the method(s) for relocation. Applicants will calculate the number of trees to be relocated based on the number of trees that will be lethally taken as confirmed by the approved census. The number of trees to be relocated will be based on the expected rate of relocation success for each method used, as well as the size class of each tree proposed for relocation, as explained below:

	<b>Bare root relocation<sup>1</sup></b>	<b>Tree spade relocation<sup>2</sup></b>
Size Class A (<1 m)	30%	15%
Size Class B (≥1m and <5)	20%	10%
Size Class C (≥5m)	10%	5%

Table 1. Recommended western Joshua tree Relocation Percentages

The number of trees in each size class recommended for relocation under a WJTCA ITP should be rounded to the nearest whole number and be greater than zero, provided at least one tree in that size class will be lethally taken. Because tree spade relocation has a higher expected success rate than bare root relocation, the relocation of fewer trees is required to minimize project impacts and offset the expected mortality of salvage trees where the tree spade method is used. See "[WJT Salvage Requirement Calculator spreadsheet](#)" for assistance in calculating salvage tree numbers using a combination of methods.

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<sup>1</sup> When conducted in accordance with this document, the expected success rate of bare root relocation is between 50 and 90 percent (Goodwin, J. 2024. Joshua Tree National Park. Discussion with J. Goodwin, Vegetation Branch Manager. *in.*; Reynolds, D. 2024. The Landscape Center. Discussion with D. Reynolds, Project Manger/ISA Certified Arborist. *in.*).

<sup>2</sup> When conducted in accordance with this document, the expected success rate of tree spade relocation is greater than 90 percent (Goodwin, J. 2024. Joshua Tree National Park. Discussion with J. Goodwin, Vegetation Branch Manager. *in.*; Reynolds, D. 2024. The Landscape Center. Discussion with D. Reynolds, Project Manger/ISA Certified Arborist. *in.*; City of Palmdale. 2024. Report of the City of Palmdale Joshua tree preservation program.).

Example:

Project A is expected to cause lethal take of 200 western Joshua trees: 100 Class A trees, 70 Class B trees, and 30 Class C trees.

- If the bare root relocation method is used, the Relocation Plan should propose relocating 47 trees: 30 Class A trees, 14 Class B trees, and 3 Class C trees.
- If the tree spade relocation method is used, the Relocation Plan should propose relocating 24 trees: 15 Class A trees, 7 Class B trees, and 2 Class C trees.
- If a combination of methods is used, one example of mixed methods may include:
  - Tree Spade: 10 Class A, 5 Class B, 1 Class C and,
  - Bare Root: 10 Class A, 4 Class B, 1 Class C

An approved Relocation Plan is an attachment to the WJTCA ITP and any changes after issuance of the associated WJTCA ITP will require amendment of the permit. If the permittee later wishes to relocate or remove any western Joshua tree that has been relocated on-site, the permittee must apply for a new WJTCA ITP.

### Adjustments to Requirements

Upon review of a Relocation Plan, CDFW may, in its discretion, adjust the number of trees in a size class that must be relocated, including at the request of an applicant. Factors that may weigh in favor of an adjustment to the number of trees within a specific size class that must be relocated include:

- A higher number of trees in a different size class will be relocated;
- Trees that will be retained in place that will be minimally impacted;
- The size and physical characteristics of the available recipient sites, including available capacity for additional trees;
- The composition of the soil/substrate and feasibility of the proposed relocation method;
- The overall health of the western Joshua trees to be impacted; and
- The overall health of the western Joshua tree population around the project site.

### Relocation Areas

The applicant should identify one or more relocation areas in the proposed Relocation Plan they submit to CDFW for approval. The permittee should first evaluate if salvage trees can be relocated on the project site and if any project design modifications can be made to accommodate salvage trees on site.

If salvage trees cannot be relocated on the project site, the permittee must propose one or more off-site relocation areas that can accept trees designated for relocation. Off-site relocation areas must be within occupied western Joshua tree habitat that has been degraded by impacts (e.g., human, wildfire). If available, priority should be given to relocation areas located within local preserves, parks, land trusts, and conservancies. Salvage trees should not be relocated where relocation activities could disrupt existing



ecosystem processes, the genetic integrity of healthy western Joshua tree populations or the natural communities upon which they depend. Each salvage tree should be relocated as close to its original location as is possible. Criteria for selecting off-site relocation areas include:

- In a natural vegetation community that supports western Joshua trees;
- Within 16 kilometers of the salvage tree's original location;
- Within 152 meters of the salvage tree's original elevation; and
- Occupied habitat that has been previously impacted by wildfire or human activities that have led to the removal or death of western Joshua trees.

Relocation areas that do not meet the criteria listed above may be approved by CDFW on a case-by-case basis.

Once an off-site relocation area has been identified, the permittee must provide CDFW with written permission from the landowner of the proposed relocation area(s) confirming that the permittee will have site access to implement the maintenance and monitoring measures required under the WJTCA ITP. The landowner must also confirm in writing that CDFW staff may access the property to conduct compliance inspections in accordance with the measures outlined in the WJTCA ITP.

This document does not provide guidance regarding how to implement or support the assisted migration of western Joshua tree. At this time there is insufficient research published on the geographic boundaries of genetically distinct populations and/or climate adaptive traits within populations that may be suited for assisted migration to expand western Joshua's tree's range or assisted geneflow to enhance a population's ability to adapt to climate change impacts. Assisted migration, assisted geneflow, and/or boundaries of genetically distinct populations may be discussed in future amendments to this document.

## Relocation Plan

Where relocation is required, a Relocation Plan must be approved by CDFW prior to the issuance of an WJTCA ITP. The Relocation Plan may combine bare root and tree spade relocation methods and must include the following information:

- The contact information and qualifications of the desert native plant specialist(s) overseeing relocation;
- The date range when trees will be relocated. If salvage trees will be temporarily stored in containers, the plan must indicate when the trees will be replanted;
- The landowner's name, location name, and address or APN for each relocation area property;
- If salvage trees will be relocated outside of the project site, a signed, written statement from the owner of each relocation area granting permittee permission to relocate salvage trees to the relocation area property and access to implement any maintenance and monitoring measures;

- The unique identifier, size class, planned and contingency relocation methods, current and recipient site GPS coordinates (latitude/longitude in decimal degrees), overall health of each tree, signs of pest/human damage (if any), and a photo of each tree to be relocated, (see the [census instructions](#) for submitting photographs);
- If utilizing multiple receiver sites, the permittee must document the receiver site where each tree will be relocated using the unique identifier and recipient site coordinates;
- If tree spade relocation is proposed, additional trees must be identified for relocation as a contingency in case the tree spade relocation method is impractical due to rocky terrain or other issues. The number of additional trees that must be identified will vary on a project-by-project basis. The information described above must be provided for each additional contingency tree; and
- Any other pertinent information regarding relocation operations.

Each permittee may, but is not required to, use [CDFW's Relocation Plan template](#) and [spreadsheet](#), so long as the permittee's proposed Relocation Plan contains all the required information set forth above. Any questions regarding the development of the Relocation Plan should be discussed with CDFW staff prior to submittal in order to avoid project delays.

## Protocol

### Pre-Relocation

#### Selecting Trees for Relocation

Western Joshua trees that are in good health should be prioritized for relocation. Indications that a tree is in good health include where 60% or more of the tree's branches are living; minimal pest damage (no or few bore holes and/or less than 25% periderm [bark] stripping); recent signs of unrestricted hard growth; recent signs of flowering events, and/or strong vigor. Where a tree is greater than 7 meters in height, its size may limit its ability to be successfully relocated. Therefore, healthy salvage trees between 5-7 meters in height should be prioritized within Size Class C.

#### Siting

Trees identified for relocation should be clearly flagged or marked with a unique identifier and the recipient site should be identified before tree removal begins. Preferred and contingency methods for each relocation should also be identified (e.g., bare root relocation versus tree spade relocation) in advance. Each recipient site should be compatible with the corresponding salvage tree's relocation method (see Tree Spade Relocation under Digging/Tree Removal section below). The recipient site location should also be recorded using a Global Positioning System (GPS) unit and marked with pin flags or wood stakes that are clearly labeled with the unique identifier of the corresponding salvage tree. The permittee should identify a recipient site for each salvage tree that is: accessible for relocation and irrigation equipment, such as

water trucks or trailers; provides or enhances connectivity corridors; and mimics the density of the surrounding WJT population and is located at least 4.5 meters from the nearest western Joshua tree. If possible, recipient site locations should be chosen at random and be spatially balanced throughout the relocation area. Geographic Information System (GIS) tools can assist with this process.

### Timing

When feasible, western Joshua trees should be relocated at a time that maximizes their chance of survival. (Fish & G. Code, § 1927.3, subd. (a)(4)(A)(ii).) The optimal time to relocate trees occurs in the fall when heat/drought stress is low and roots have adequate time to reestablish before the onset of hot, dry summer conditions. For bare root relocation, winter is a suboptimal but acceptable time to relocate trees but provides less time for roots to re-establish and may result in lower rates of survival. For tree spade relocation, there is a wider range of suboptimal but acceptable times to relocate trees because this method results in less root exposure and potential water loss through evapotranspiration as compared to bare root relocation. Relocating when trees are exposed to hot conditions for an extended period, should be avoided.

#### Bare Root Relocations

Winter	Spring	Summer	Fall
OK	Avoid	Avoid	Preferred

#### Tree Spade Relocations

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
OK	OK	OK	OK	Avoid	Avoid	Avoid	OK	OK	Prefer	Prefer	Prefer

### Pre-Relocation Watering

In preparing for relocation, both the salvage trees and the recipient sites should be watered 24-48 hours in advance. An earthen berm 4-6 inches in height should be created around the trees and recipient sites to create water basins that ensure water saturates the soil around the root ball and recipient site. For bare root relocations, the perimeter of the berm should be no less than 24 inches from the base of the trunk. For tree spade relocations, the size of the berm should be slightly wider than the width of the tree spade to be used on that individual. The water basins should be filled with water to just below the top of the berm twice and allowed to fully drain between fillings. Root stimulant additives such as vitamin B1 and rooting hormone may assist in root regeneration but are not required. Root stimulant additives should be utilized according to product label recommendations.

### Orientation

Prior to relocation, using a compass set to the correct declination, mark the north side of the tree identified for relocation with a water-based tree marking paint or other CDFW-approved means in a place that will not be impacted or obscured during

relocation operations (e.g., a small paint mark on the trunk 12 inches above ground level or ribbon tape tied to one of the branches on the north side of the tree). When setting a salvage tree in a recipient site, best efforts should be made to place the tree in its original orientation; however, this may not be possible based on the terrain of the recipient site.

### Other Pre-Relocation Precautions

- Relocation operations should adhere to the American National Standards Institute Z133 Safety Requirements for Arboricultural Operations.
- Permittees should obtain all information necessary to avoid existing underground infrastructure at salvage and recipient sites prior to relocation (see [Underground Service Alert of Southern California \(DigAlert\)](#)).
- To prevent the spread of invasive species and pathogens, digging equipment should be clean and free from dirt and debris and sanitized with a 10% bleach solution prior to arriving at the site where trees will be salvaged.
- Depending on the method used, tree limbs may need to be trimmed to facilitate relocation. Limbs should only be trimmed as necessary to facilitate relocation.

## Relocation

### Digging/Tree Removal

If trees are in close proximity to each other (less than 18 inches apart at the bases of their trunks), all efforts should be attempted to relocate the trees together to avoid separation of trees that are connected through rhizomes below ground.

Bare root removal by hand – Relocations using only hand tools should only be done for trees that are less than 1 meter in height. The root ball and surrounding soil should be salvaged in a way that keeps the root ball as intact as possible. This can be accomplished by excavating a circular trench 10-12 inches deep, 1-2 feet from the base of the trunk. Once the trench is complete, hand tools should be used to undercut the root ball and sever the roots below. Only apply as much lateral pressure to the tree as necessary to expose roots for severing with hand tools. The cut surfaces on roots should be kept small to minimize root dieback and exposure to soil-borne pathogens.

Bare root removal by (non-tree spade) heavy equipment/excavator – As with bare root removal by hand, the root ball and surrounding soil should be salvaged in a way that keeps the root ball as intact as possible. There are different ways to accomplish this using an excavator, depending on the tree's size, soil conditions, and other factors. For trees that are less than 1 meter in height, an excavator with a bucket attachment at least 24 inches in width can be used to extract the tree and root ball in one scooping motion. The equipment operator should minimize incidental damage to the aboveground portion of the tree to the greatest extent possible. Root balls should be handled with care when they are unloaded from the bucket. For trees that are 1 meter or greater in height, a trench 18-24 inches deep should be excavated 2 feet from the base of the trunk. If the soil around the root ball stays intact and does not show signs of

fracturing, the tree should be firmly rigged to the rounded exterior of the bucket using nylon straps at least 4 inches in width (Figure 1). Additional cloth padding may be placed around the straps to prevent damage to the periderm. Straps should be rigged at multiple points along the main trunk of the tree to prevent excessive swinging once freed from the soil. Once firmly rigged, the root ball should be undercut using hand tools as safely as possible until all or most of the roots are severed. Snapping roots should be minimized, as much as possible.

If the soil around the root ball does not hold together and shows signs of fracturing and instability when excavating the trench, as is common in sandy soils, the excavator should be used to undercut the root ball as much as possible without causing the tree to fall freely to the ground.

The tree should then be rigged to the bucket attachment using the methods described above and gentle but increasing lateral pressure should be applied to the tree to dislodge the root ball and lay the tree down. Once the tree is resting on the ground, the straps may need to be adjusted in order for the tree to be picked up by the excavator.

Trees removed from the ground using the bare root method should be replanted or containerized within 24 hours of removal.



Figure 1 – Bare Root Removal: Removing soil around the root ball of a salvage tree using hand tools (left). Salvage tree being removed from the ground by an excavator (right).  
(Photo credit: National Park Service)

Tree spade relocation – Tree spades come in different sizes based on the width of the soil surface that they can encapsulate (Figure 2). Tree spades can be used to relocate



trees of most sizes. However, they are not recommended for trees over 7 meters in height due to stabilization issues during high-speed wind events after relocation.

The following steps must be carried out sequentially, in a timely manner, and thoughtfully. Each western Joshua tree and corresponding recipient site should be evaluated for tree spade acceptability prior to digging. The desert native plant specialist should evaluate soil conditions to assess whether large rocks or boulders may prevent tree spade blades from fully encapsulating the root ball. This may be apparent by scanning the surface of the surrounding area or reviewing existing soil maps (see “Shallow Excavation Ratings” on [NRCS Web Soil Survey: https://websoilsurvey.nrcs.usda.gov/app](https://websoilsurvey.nrcs.usda.gov/app)). Tree limbs may be trimmed only where necessary to allow the tree spade blades to fully close around the tree. The tree spade size should be selected to ensure the blades do not come within 18 inches of the base of the trunk at ground level. Recipient sites should be dug immediately before, or no more than 4 hours prior to, tree extraction to prevent the soil from drying out and collapsing. Excavated recipient site dirt should be used to backfill the tree removal site where available. Open pits should be flagged with stakes and high-visibility ribbon tape and temporary fencing should be installed around any unattended open pits to prevent people or animals from falling in.



Figure 2. A salvage tree being removed from the ground using a tree spade (Photo credit: National Park Service).

## Transporting Trees

If salvage trees are not going to be transported to recipient sites by hand or by the equipment used to extract the tree (e.g., by truck or trailer), precautions must be taken to avoid damage to the tree and root ball. Root balls should be loosely wrapped in burlap and kept moist during transport. Salvage trees should be supported at all times and not dropped or thrown. Salvage trees should be securely transported upright or at a slight angle. Salvage trees may touch other salvage trees during transport, but they should not be stacked or otherwise fully supported by other salvage trees. Salvage trees should be positioned in transport vehicles in a way that minimizes branch entanglement.

## Planting Methods

Bare root relocations - The width of each recipient site hole should be approximately 12 inches greater than the width of the root ball. Root balls should fit snugly within their recipient holes to avoid stabilization issues. The depth of recipient sites holes should be 2-4 inches less than the height of the root ball to account for settling. If recipient site holes are dug too deep, they should be backfilled and compacted by foot or using hand tools. Salvage trees should be placed as close to their original orientation as the terrain will allow. Salvage trees should be supported when lowered into holes. Holes should be simultaneously backfilled with soil and water to eliminate air pockets and voids. Soil should be lightly compacted by foot or using hand tools.

Tree spade relocations - The salvage trees should be placed as close to their original orientation as the terrain will allow. If needed, soil should be backfilled and lightly compacted by foot or using hand tools to meet the grade of the surrounding soil surface.

## Storage

If salvage trees need to be stored for later replanting, in-ground storage is preferred over containerizing. In-ground storage procedures should follow the pre-relocation water berm, planting, post-relocation water berm, and stabilization methods described herein. Salvage trees stored in-ground should be flagged for avoidance and/or fenced off.

If in-ground storage is not possible, each salvage tree should be placed in a container that is at least twice the size of the unrestricted root ball and includes drainage holes. The containers should be sanitized with a 10% bleach solution. The container should be filled using soil from the removal site if the salvage tree is being stored for less than 6 months or with a soil mix ratio of 100 parts organic potting soil to 160 parts course perlite to 200 parts washed concrete sand to 1 part "13-13-13" fertilizer (Goodwin 2024) if the salvage tree is being stored for longer than 6 months. The bottom one third of the container should be filled with soil mixture before placing the root ball into the container. Once the root ball is placed into the container, the remaining volume of the container should be filled with soil and water simultaneously to eliminate air pockets

and voids. Salvage trees should not be stored in containers for longer than 2 years unless approved by CDFW. Containerized salvage trees should be stored either upright or at a slight angle to improve drainage and prevent root rot. If weather forecasts predict wind gusts over 60 mph, containerized trees should be closely grouped and tied together 24 hours in advance for added stability. If containerized salvage trees are pushed over, they should be promptly righted and stabilized using the methods described below for the duration of the storage period. Containerized salvage trees should be maintained and monitored following the methods described below. If trees show signs of drought stress, watering frequency may need to be increased. Containerized soil should always be allowed to thoroughly dry out before rewatering. Containerizing a salvage tree that has been removed from the ground using the tree spade method in a container would eliminate the benefits from this relocation method; therefore, salvage trees removed from the ground using the tree spade method should always be stored in the ground.

## Post-Relocation

### Water Basins

An earthen berm at least 4 inches in height should be created around each salvage tree following relocation. The top of the berm should be level. For bare root relocations, the perimeter of the berm should be no less than 24 inches from the base of the trunk. For tree spade relocations, the perimeter of the berm should be the width of the tree spade.

### Stabilization

Stabilization material should be installed for salvage trees that are greater than 3 meters in height and for trees that are less than 3 meters in height with a tree height to canopy width ratio that exceeds 2:1. For example, a 2-meter-tall tree with a canopy width greater than 1 meter should have stabilization material installed. Non-abrasive guying materials, such as Arbor Ties, should be attached to three equidistant lateral ground-point anchors outside of the water basin. Guys should be taut but allow for some movement so they do not cause friction in light to moderate wind conditions.

### Identification

Each salvage tree should be clearly flagged with tape ribbon or a metal tree tag, and labeled with a unique identifier (e.g., #1, #2, #3) and the relocation date (or the date when first removed from the ground for containerized salvage trees) in the following format: MM/DD/YYYY. Each tree tag should be loosely secured to the main trunk of the tree, rather than nailed directly into hard growth, and should be visible from the south. Each western Joshua tree stem or trunk arising from the ground shall be considered an individual tree requiring flagging, regardless of its proximity to any other western Joshua tree stem or trunk.



## Recordation

A GPS unit should be used to record the location of each salvage tree's recipient site. The relocation method (bare root – hand, bare root – excavator, or tree spade) should also be recorded, along with a color photo of each tree taken from the south of the tree facing north. The picture should include the entire tree.

## Maintenance and Monitoring

Where relocation is required under a WJTCA ITP, it is the permittee's responsibility to ensure the maintenance and monitoring measures set forth below are implemented and as required in the permittee's WJTCA ITP.

### Site Visits

Site visits should be conducted by desert native plant specialists to determine maintenance needs for relocated trees according to the following schedule:

#### Year 1

- Months 0-3, once every two weeks.
- Months 4-12, once per month.

#### Year 2

- Months 13-24, every other month.

#### Year 3

- Months 25-36, every other month only for trees showing signs of declining health. At the end of the 3-year maintenance period, all trees should receive a final site visit and be assessed according to the Completion Report section below.

During site visits, desert native plant specialists should assess and record maintenance needs for each salvage tree. They should also have a site map showing the locations of all salvage trees, a GPS device to confirm salvage tree locations, and notes and photos from previous visits, and they should be prepared to address maintenance needs during site visit or shortly thereafter.

## Watering

During the months of May to September, salvage trees should only be watered during site visits if the total rainfall (or snowfall equivalent) for the region within which the recipient site is located is less than 0.4 inches within the previous 7 days. During the months of October to April, salvage trees should only be watered during site visits if the total rainfall (or snowfall equivalent) for the region within which the recipient site is located is less than 0.3 inches within the previous 7 days. Regional precipitation models may be used in determining rainfall amounts; however, rain gauges within, or adjacent to, relocation areas provide the best indicator of precipitation totals. Water basins should be filled to the top of the berm, but not allowed to overtop the berm.

## Tree Health

Tree health should be assessed by a desert native plant specialist and recorded for each salvage tree during site visits. Tree health should consider signs of new leaf growth, branch loss, signs of flowering/fruitletting, signs of pest/human-caused damage, leaf discoloration, restricted hard growth, overall vigor, and other indicators worth noting. If salvage trees are showing signs of increasing health after two years of maintenance, they do not need to be visited during the third year (see reporting requirements below), except for the final site visit.

## Invasive Plant Removal

Invasive plants should be controlled and removed within the water basin. Removal should occur before invasive plant seeds reach maturity. Invasive plants should be removed through mechanical methods and hand pulling or with hand tools, rather than by chemical means, and appropriately disposed of. In removing invasive plants, care should be taken to not damage salvage tree roots. A list of common invasive plant species can be found on the California Invasive Plant Council Invasive Plant Inventory (Cal IPC Inventory) website at: <https://www.cal-ipc.org/plants/inventory/>. Native plants should be retained where possible.

## Maintenance of Berms, Stabilization Supports, and Identification Markers

During site visits, berms should be checked for height and any breaks that would allow water to escape from the water basin. Stabilization supports should be checked for damage and tightness. If relocated trees are showing signs of leaning, stabilization supports should be added or adjusted. Identification markers should also be checked for intactness, legibility, and maintenance needs.

## Completion Activities

During the final site visit at the end of the 3-year maintenance period, berms, stabilization supports, and identification markers must be removed from the relocation area.

## Reporting

Where relocation is required under a WJTCA ITP, it is the permittee's responsibility to ensure the reporting measures set forth below are implemented. Where relocation is voluntary, CDFW requests that the permittee provide the same reporting information to CDFW to better inform updates to these guidelines and relocation protocols.

## Post-Relocation Reporting

When a WJTCA ITP requires relocation of western Joshua trees, the permittee must submit a post-relocation report to CDFW no more than 30 days after relocations are completed. The post-relocation report should include the following:

- The date range when relocation operations occurred.
- For each salvage tree:

- The unique identifier and recipient site coordinates;
- The final recipient site, including GPS coordinates (latitude/longitude in decimal degrees);
- The relocation method used;
- The height and diameter of the post-relocation water basin constructed;
- Any stabilization supports installed;
- Any major damage, including any necessary limb trimming, that occurred during relocation;
- Any deviation from the tree's original orientation;
- Any root stimulant additives used in pre- or post-relocation irrigations; and
- A photo of the tree facing north, with the unique identifier in each file name.

### Maintenance Reports

When a WJTCA ITP requires relocation of western Joshua trees, the permittee must submit annual reports detailing the 1-year and 2-year maintenance periods, as appropriate, to CDFW. Maintenance reports should include the following information:

- The date(s) when site visit(s) occurred;
- The contact information and qualifications of the desert native plant specialist(s) performing tree assessments;
- Information for each salvage tree regarding the following:
  - The unique identifier and recipient site coordinates;
  - Whether the tree is alive or dead;
  - Dates of supplemental waterings;
  - Identity and estimated number of invasive plants observed/controlled and the methods used;
  - Any signs of pest/human damage;
  - Any signs of declining tree health;
  - Any maintenance conducted to repair, replace, add, or adjust berm, stabilization supports, and/or identification markers;
  - A photo of the tree facing north, with the unique identifier in each file name; and
  - At the end of the 2-year period, the reasons for discontinuing maintenance on trees showing stable or increasing health, such as new leaf growth, flowering/fruitletting, good leaf color, no signs of pest/human damage, and/or unrestricted hard growth.

### Completion Report

A completion report must be submitted to CDFW no more than 30 days after the end of the 3-year maintenance period. The completion report must contain the following:

- The date when the final site visit occurred;

- The date when berm/stabilization materials/identification markers were removed;
- The contact information and qualifications of the desert native plant specialist(s) performing the final assessment;
- Information for each salvage tree regarding the following:
  - Whether the tree is alive or dead;
  - Any damage that occurred during or after relocation;
  - Any signs of declining health;
  - Any signs of pest damage; and
  - A photo of the tree facing north, after berm, stabilization materials, and identification markers are removed, with the tree's unique identifier in each file name; and
- Any recommendations that may help to improve tree relocation methods.

## Literature

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## Personal Communications

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