Technical Memorandum

Pacific Gas and Electric Company

Status of the Transplantation Effort and Recommendations for Future Transplantation Efforts: Final Groundwater Remedy, Topock Compressor Station, California

Prepared by: Virginia Strohl/ PG&E Date: April 30, 2020

Introduction

Pacific Gas and Electric Company (PG&E) has taken efforts during construction to protect indigenous plants of traditional cultural significance pursuant to Mitigation Measure CUL-1a-5 of the Final Environmental Impact Report (FEIR) of the Final Groundwater Remedy, PG&E Topock Compressor Station, Needles, California. The "*Topock Groundwater Remediation Project Mitigation and Monitoring Plan for Culturally Significant Plants*" (Plan) (CH2M 2014) was prepared for PG&E to provide information on salvage, relocation and transplantation methods as required by FEIR mitigation measure CUL-1a-5. The Plan was written by a botanist who researched the best practices to successfully salvage and transplant culturally significant trees in a desert environment. Section 2.2.2 of the Plan provided guidance for transplanting trees which addressed the following items:

- Tree salvages should be limited to trees no more than six feet tall as larger trees would be unlikely to survive the transplant due to "transplant shock" caused by extensive and unavoidable loss of roots.
- Transplanting of trees should occur between November and March, when temperatures are cooler and trees are dormant.
- Transplant location should be identified prior to digging up the plant and the transplant hole should be large enough to accommodate the root system of the plant being moved.
- Minimum size guidelines for the root ball should be met for transplanted trees.
- The excavated tree should be immediately transported to its new location, lowered into the hole and roots backfilled with the soil that was removed from the planting hole.
- Additional soil amendments, fertilizer or mulch should not be added to the soil as these have been found to be unnecessary for desert trees and shrubs.
- Add water to minimize air pockets when backfilling.
- Avoid staking of the tree.
- Transplanted trees and shrubs should be watered using deep irrigation pipes.

- Water (1 quart) will be directly applied to seedlings once every week for the first eight weeks. Then irrigation pipes will be filled with 2 quarts every other week for 3 months after the initial watering.

Approach

Transplanting of sensitive plants for the Topock Groundwater Remedy Construction Project occurred over two separate events in 2018: November 27 and 28 and December 19. Additionally, five cacti were transplanted on March 21, 2019.

The transplanting was monitored by biologists who assessed the initial condition of the plants being relocated from within construction zones prior to the transplant activities.

During the transplanting efforts, a total of 173 plants were transplanted including 146 blue palo verde (*Parkinsonia florida*), five desert smoke tree (*Psorothamnus spinosus*), 16 western honey mesquite (*Prosopis glandulosa* var. *torreyana*) and six beavertail cacti (*Opuntia basilaris*).

Of this total number of transplanted plants, only 88 plants (about 51 percent) were assessed to be suitable to survive transplant. PG&E decided in the field to transplant the remaining 85 plants that were assessed to be not suitable for transplant because it represented very little extra effort that could potentially result in additional surviving plants as these trees would otherwise be lost during construction.

All the transplants were placed within the Upland Revegetation Area located on the west side of National Trails Highway near the site of the former roadhouse. The planting site was formerly a leveled parking area. After the December 19 transplanting event, PG&E and its contractor initiated the roughly once-a-week watering program for the transplants. The watering schedule was adjusted to accommodate natural precipitation that was occurring periodically after the transplanting.

Preliminary Results

A brief assessment of plant mortality conducted on April 22, 2019 indicated 33 plants (not including cacti) were barely alive as indicated by minor cellular life in the base of the tree. All leaves were dead or absent and branches were dead. For this reason, the survival rate of the transplants was considered to be near zero percent. Watering of the remaining 33 surviving plants continued weekly. A second brief assessment of the transplants conducted on August 22, 2019 indicated that 8 of the transplants were barely alive. Four of these were blue palo verde and four were 4 beavertail cactus. A third brief assessment was conducted on October 15, 2019 indicated that two green blue palo verde were barely alive and four beavertail cactus were alive with most stems hydrated and green.

Discussion

PG&E and its contractors followed the transplanting protocol that was written in the Plan and approved by DTSC. The results of the transplanting effort indicate that implementation of the transplanting Plan was not successful. Considering the results of the transplantation effort, PG&E has conducted additional research and discovered new information that could improve future transplantation efforts.

Transplantation of Non-Transplantable Individuals

Some potential causes of high transplant mortality included the fact that many non-suitable plants were transplanted. This decision to transplant these individuals was made in the field at the time of transplant because it was believed that there was relatively little extra effort involved. If any of those plants survived, it would be a positive outcome because they would have been otherwise removed as a part of project construction if left in place.

Transplantation of Mesquite in Arid Conditions Poses Challenges

During the transplant effort, it was noted that the tree roots for western honey mesquite and blue palo verde appeared to have very few fine roots and were predominantly characterized by a single or few large taproots. There were only a few instances where there was visible damage to the taproots from excavation and that was limited to the case of several of the larger transplants. Overall, smaller trees were removed without visible damage to the taproots. New research that PG&E has obtained recognizes that mesquite typically only develop a single or few large taproots in desert environments.

Mesquites are generally believed to be facultative phreatophytes (Heitschmidt et al.,1988). However, in the Mojave and the Sonoran deserts the rainfall is usually insufficient to provide adequate surface soil moisture for these trees to survive unless they have access to permanent underground water and hence resemble obligate phreatophytes under these conditions (Heitschmidt et al.,1988; Steinberg, 2001; Crampton et al., 2006). Even though the taproots on the majority of transplanted individuals appeared to be undamaged during salvage, the excavation itself may have injured the tap roots. Defective root systems have been shown to lead to poor growth, breakage and death especially root defects in the main tap root, major branch roots or both (Moore, 1983).

Success Dependent on Size of Transplant

PG&E identified new research favoring transplantation of stock around 5.9-11.8 inches with approximate 7.9 inch root system (Heitschmidt et al.,1988; Bainbridge, et al., 2001; Grantz, et al., 1998; Bainbridge, 1989). Most of the individuals transplanted during the 2018/ 2019 winter effort were over 12 inches tall.

Lack of Root Ball in Desert Soils

Another potential cause for high mortality may be related to the bare root transplant method that was defaulted to during transplant. It can be difficult to gather plants with a root ball in desert soils, which lose structure and fall apart when they are disturbed, so bare roots are inevitable without a much more involved process for isolating and preserving the root ball (e.g., boxing the soils before removing the plants). Minimum size guidelines for the root ball discussed in the Plan for transplanted trees were not obtainable in desert soils.

Irrigation

The Plan required watering of transplants to occur once every week for the first eight weeks and then watering every other week for 3 months after the initial watering. This protocol was based on research gathered from successful desert restoration projects where transplanted trees and shrubs used deep irrigation pipes.

Additional, new research indicates that maintaining adequate soil moisture during the first week after transplanting is crucial due to the limited root volume (Moore, 1983). Removal of supplemental water should be gradual as not to shock the tree (Moore, 1983). The once-a-week watering regime was likely insufficient to keeping the root zone moist enough for the plants to overcome initial transplant shock and become established.

Timing

Research prior to the transplanting effort indicated that winter transplanting times, between November and March, were preferred when temperatures are cooler, trees are dormant, and irrigation demands are less. New research post-transplantation indicated that mesquite tree salvage had a lower success rate observed between October and March (Bainbridge, 1995) and that spring is the preferred time for transplanting desert trees.

Replacement Plantings for Failed Transplants

The habitat restoration plans for the project address monitoring and adaptive management for transplanting of salvaged plants from within the construction areas. The Topock Groundwater Remediation Project Mitigation and Monitoring Plan for Culturally Significant Plants (Appendix A to the CIMP) (CH2M 2014) states the following: "*Trees and shrubs will be monitored for a minimum of 3 years and up to 5 years. If survivorship of tree and shrub transplants falls below 75 percent survival, additional plants will be added until survivorship and plant vigor goals are reached and maintained for at least one year.*"

One plant will be planted for each of the required salvaged plants that did not survive transplant and monitored for a minimum of 3 years to ensure that the 75 percent

survival is met. These plants will be propagated at a nursery from seeds collected from the site. Planting and monitoring of these plants will be combined with the replacement planting effort for protected plants that were removed during construction.

Future Transplants

PG&E is recommending to incorporate the new information discussed in this memo into future transplanting efforts (or salvage attempts) for protected tree and shrub species. The new techniques to be added into the Plan would include:

- Salvaging individuals less than 11.8 inches only.
- Boxing of wetted soils around the rootball before transplant.
- Daily watering of transplanted individuals for the first week and then gradually reducing the watering to once a week.
- Transplanting the plants in the spring rather than the winter.

Additionally, PG&E would limit transplants to only suitable candidates. PG&E will continue to implement its rigorous minimization and avoidance measures to reduce the loss of protected plant species. Lessons learned from the 2018/ 2019 winter transplanting effort will be incorporated where appropriate to any replacement planting effort.

Efforts to salvage and transplant cactus species would still be implemented since there was success in the salvage and transplant of these species. Watering tubes from existing site of failed transplants will be removed and stored at the construction headquarters for later use with future plantings.

References

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