

Oil & Gas Industry Reclamation Shrub Salvage Transplant



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Salvage Transplant Overview

- Salvage shrubs from donor site
- Transport shrubs to recipient site
- Plant shrubs in final reclamation area



Goal of Salvage Transplanting

Achieve reclamation goals faster!

- Meet plant diversity and density requirements
- Restore ecosystem function
- Restore nutrient cycling

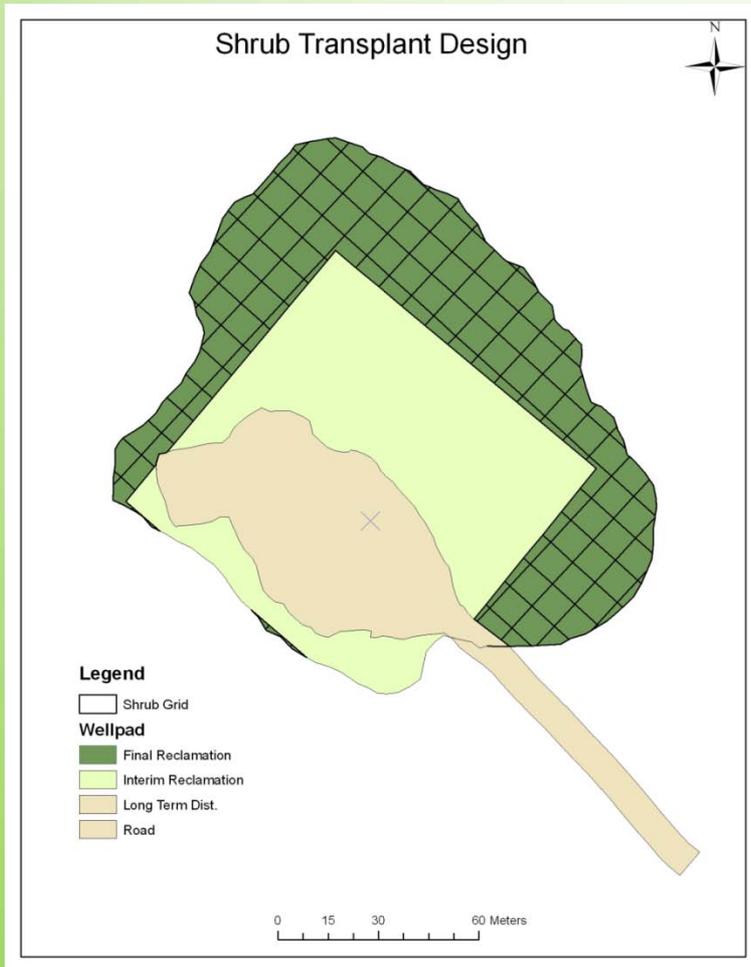


Benefits of Salvage Transplanting

- Utilizes ecotype specific material that would otherwise be destroyed
- Establishes a “mother plant”
 - Seed dispersal in future years
- Functions as an “island of fertility”
 - Facilitates growth and re-colonization of native communities
 - Restores nutrient cycling in soil
- Additional plant and soil material is relocated with the shrub
 - Soil microorganisms
 - Species not available on the commercial seed market



Shrub Transplant Design



Shrub transplanting is focused in the final reclamation area to minimize loss of transplanted shrubs during the P&A process

Shrub Placement

- Clusters of shrubs are thought to be ideal for:
 - Increasing survivorship
 - Re-establishing nutrient cycling between shrubs
 - Acting as a natural snow capture
- Shrub clusters oriented perpendicular to the predominant wind direction



Selection of Recipient and Donor Sites

- Select ecologically similar sites
- Logistics
 - Can significantly increase or decrease the cost of a salvage transplant project
- 3 categories of well sites to consider
 - P&A locations
 - High priority for release
 - Sites with established grasses that lack a shrub component
 - Newly constructed sites that will be seeded for the first time
 - Partial transplant to accelerate restoration



Shrub Salvage Variables

- Shrub age class/size
 - Age class and size/stem width do not always correspond
- Density/spacing of planted shrubs
- Timing of transplant project
 - Coordination with development activities

Jonah Field – Shrub Salvage Project

Field Example #1



- A pilot sagebrush salvage project was initiated in Jonah in the fall of 2006
- 60 shrubs were salvaged from a donor location, transplanted to a new location, and tagged for monitoring

Moxa Arch - Shrub Salvage Project

Field Example #2

- 865 shrubs were relocated to 4 sites in the Moxa Arch in November 2008
 - 3 P&A sites, targeted areas re-disturbed during the P&A process
 - 1 newly developed location
- Shrubs were placed in 81m² clusters at densities comparable to off-site



Preliminary Monitoring Results



- Jonah Field Project
 - 90% survivorship (54/60 shrubs) after one year



- Moxa Arch Project
 - 3 months into the project
 - Snow capture apparent around some shrub clusters

Project Evaluation

- Is salvage transplanting more efficient than competing methods (i.e. seeding or natural recruitment)?
- Does transplanting improve grass and forb establishment in the reclamation area?
- Does shrub transplanting improve snow/water capture on-site?
- Does shrub transplanting improve soil quality (i.e. stability, organic matter, nutrients, pH, salts, biota)?

Project Monitoring

- Parameters to measure
 - Shrub/plant survivability
 - Soil health
 - Vegetation – density, cover, diversity
 - Wildlife (e.g. ants, beetles)
 - New seedling recruitment



Final Reclamation Success Criteria for Shrub Component (JIO)

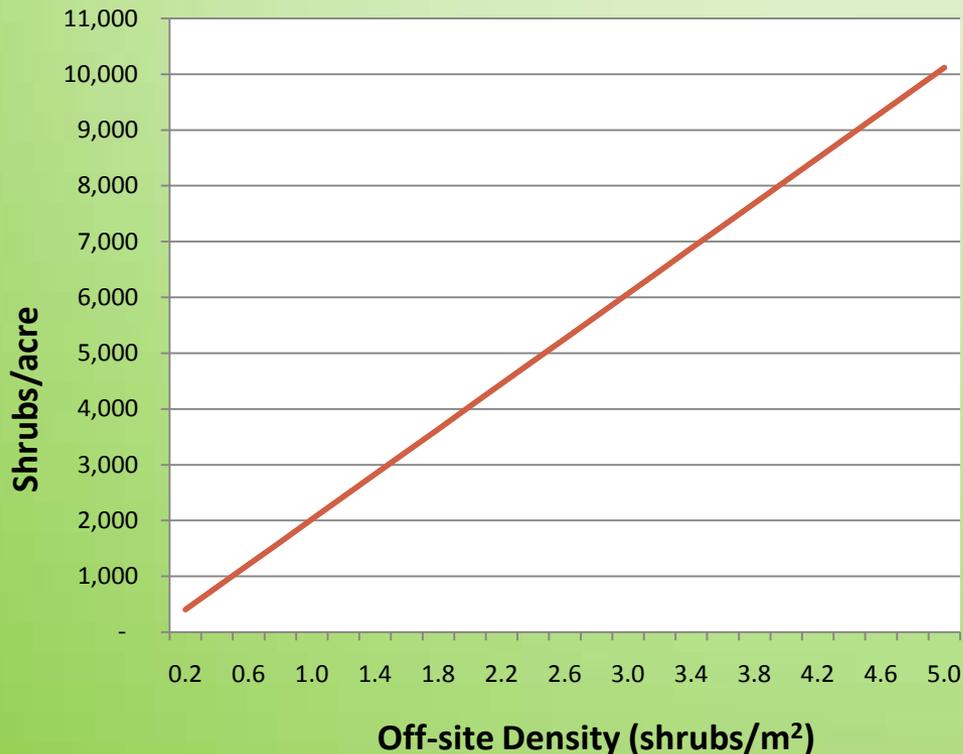
- Average shrub density/frequency must be at least 50% of reference site
- At least 25% of the density/frequency must be dominant species from the reference site
- Diversity must be equal to or greater than the reference site
- Shrubs must be at least 3 years of age

What this means...an example

- Off-site shrub density/ m^2 ranges from 0.6 to 5.1 in the Jonah area



Shrubs/acre required to match 50% off-site density



- Example Calculations
 - 2.5 shrubs/ m^2 measured off-site
 - $\sim 4047 \text{ m}^2/\text{acre}$
 - $\sim 10,100$ shrubs/acre
 - ~ 5058 shrubs/acre needed on-site to meet 50% requirement
- 3 acre location would need $\sim 15,000$ shrubs to meet requirement

Questions?



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