LANDSCAPE ARCHITECTURE FOUNDATION

High Desert Community

Landscape Peformance Benefits

- Maintains 50% of the site's original juniper prairie ecotype by minimizing construction disturbance, cutting roads into the hillside instead of mass grading, and using a native plant palette for all public areas, right-of-ways and private areas outside of building envelopes.
- Uses only 20% of the city's annual water allowance in landscape areas, saving as much as 28.7 million gallons or $300,000 each year.
- Increased critical bird-breeding habitat for two endangered species, the Peregrine Falcon and the Gray Vireo, by approximately 7 acres.
- Increased carbon sequestration on the site by 170,160 tons by restoring twice the volume of vegetation that was displaced by all areas of disturbance.
- Preserves the equivalent of 15,230 trees a year, by using decomposed-granite mulch instead of a traditional yearly wood chip mulch application. At a ten-year lifespan, the granite mulch can save 100,000 gallons of fuel, and reduce carbon release by an estimated 617,600 tons.

Overview

High Desert community in Albuquerque, New Mexico honors low-impact design practices of water conservation, wildlife habitat restoration, material recycling and cultural endowment. This project changed water-conservation and landscape planting ordinances at city and state levels. Through this master plan, Design Workshop pioneered the firm's philosophy and comprehensive approach, DW Legacy Design®, which strives to balance environmental sensitivity, community connections, artistic beauty and economic viability with metrics that gauge the success of outcomes. High Desert's demonstrated success is a model for sustainable master planned communities.

Sustainable Features

- By using a Floor Area Ratio building envelope method rather than traditional zoning setbacks, the area of disturbance was minimized on each lot.
- Designing for cross-site drainage between parcels, eliminating curbs and gutters, and pairing natural stormwater arroyos with conservation open space preserved over 62% (665 acres) of pre-development hydrology.
- Rain gardens are fed and water-wise demonstration gardens are irrigated with stormwater harvested from arroyos.
- The amount of critical habitat vegetation of the Juniper pinion ecotype was doubled with this project. Pre-construction biomass was assessed, plants in areas of disturbance were stockpiled and replanted, sensitive plant species were transferred from disturbed areas to open space, and additional species from local nurseries were added.
- All public areas and open space are mulched with decomposed granite harvested onsite or with recycled dam sediments from downstream.
- Boulders from disturbed areas of the site were incorporated into the open space landscapes as amenities instead of being hauled offsite.
- Street lights are limited to intersections and cul-de-sacs in order to reduce night-sky glare.

Designer
Design Workshop, Inc.

Land Use
Greenfield
Residential

Project Type
Community

Location
12312-12390 Academy Rd NE
35.152331, -106.496939
Albuquerque, New Mexico 87111

Size
1,067 acres

Budget
$1,075,460 in design and consultation fees

Completion Date
2030

- A viewable "wildlife drinker" (a potable water-fed trickle pond) and planned corridor to the mountains beyond enhance habitat and human/wildlife connections.
- Educational signage, local art installations and demonstration gardens throughout the development enhance communal stewardship.
- High Desert influenced Albuquerque's Design and Construction Regulations by providing its drought tolerant plant list to the City Planning Department. The project also spurred regional nursery sales of native plants by requiring large orders of native stock for both open spaces and residential landscape construction.

Challenge

The designers were tasked with master planning a residential community in an area of sensitive high desert where concerns about disturbance of views, generation of stormwater runoff, and disruption of habitat connectivity generated significant controversy. The major challenge was planning a low-impact community that would support the area's dynamic natural systems and services, while cultivating social and cultural well-being for a diverse community of over 2730 residences.

Solution

Master planning at High Desert followed the natural landscapes to determine the development's form, density and materials. This approach conserved natural stormwater arroyos and placed all development out of the pre-existing hydraulic paths. Wildlife habitat was maximized by minimizing land disturbance and enhancing ecosystems through multifunctional open space. Clustering residential properties helped to buffer existing wildlife corridors and created a gradient that maximized connectivity to existing infrastructure and cultural resources and minimized impact closer to wilderness boundaries. The design incorporates locally-sourced materials, permeable hardscapes, native and onsite transplanted vegetation, and natural hydraulic recycling.

Cost Comparison

- Water-efficient native plants and limited areas of irrigated landscape save as much as $300,000 in water costs each year when actual water use at High Desert is compared to the city's annual water allowance.
- Using recycled materials as mulch will save up to $2,530,000 over the next 10 years when compared to typical wood chip mulch. The decomposed granite from onsite and dredged dam sediments from downstream need to be reapplied every 10 years, whereas wood mulch must be reapplied each year.
- Relocating 3,500 trees within areas of disturbance, instead of purchasing new trees, saved an estimated $496,000, a 73% cost reduction per installed tree.

Lessons Learned

- Public involvement and transparency are crucial to success. High Desert overcame considerable opposition from adjacent subdivision residents. As public incentive, High Desert used all homes sales profit to support local educational scholarships as a means of demonstrating broad sustainable intentions to the community.
- Pioneering sustainable features is highly dependent upon relationships with reputable manufacturers and contractors. High Desert originally planned all irrigation zones to run on solar-powered moisture sensors but nearly lost all plants because of defective equipment and subsequent default on product warranty. This feature was ahead of its time and will await time-tested reviews of the technology.
- Design Workshop Legacy Design® metrics are founded on quantifiable measures of project accountability. Earlier portfolio projects like High Desert demonstrated the need for solid baseline data and pre-construction analysis in order for post-construction evaluation and learning to take place. Although extensive analysis was performed for High Desert, hindsight recommends that all inventories and analysis be documented in a quantifiable manner, in-house. Additionally, strategies and processes for calculating data should be evaluated continuously to check for validity. Design Workshop has since standardized these baseline inquiries to ensure proper evaluation of their work.

Although extensive analysis was performed for High Desert

Project Team

Client: High Desert Investment Corporation/Albuquerque Academy
Master Planning and Design: Design Workshop, Inc.
Architect: Studio B, Inc.
Civil Engineers: Bohannan-Huston, Inc.

Planting Design: Sites Southwest
Environmental Consultants: SWCA, Inc.
Urban Consultant: Herbert M. Denish & Associates
Community Governance: Hyatt & Stubblefield
Economics/Marketing: Robert Charles Lesser & Co.
Public Relations: Strascina & Partners
Attorney: Hyatt & Rhoads
Attorney/Local Counsel: Sutin, Thayer & Browne

Role of the Landscape Architect

Design Workshop provided leadership for all phases of the project from master planning to design to construction management; led a multidisciplinary team of environmental consultants, civil engineers and architects; and collaborated with officials, students and teachers from Albuquerque Academy, involving them in the planning process and in conducting 3 public open houses and meetings. Principal-In-Charge: Kurt Culbertson. Project Team: Mark Soden, Keith Simon, Jeff McMenimen, Jeff Zimmermann.

Case Study Prepared by:

Research Fellow: Bo Yang, PhD, Assistant Professor, Utah State University
Research Assistant: Amanda A. Goodwin, MLA Candidate, Utah State University
August 2011

References & Resources

ASLA Colorado Honor Award, 1995

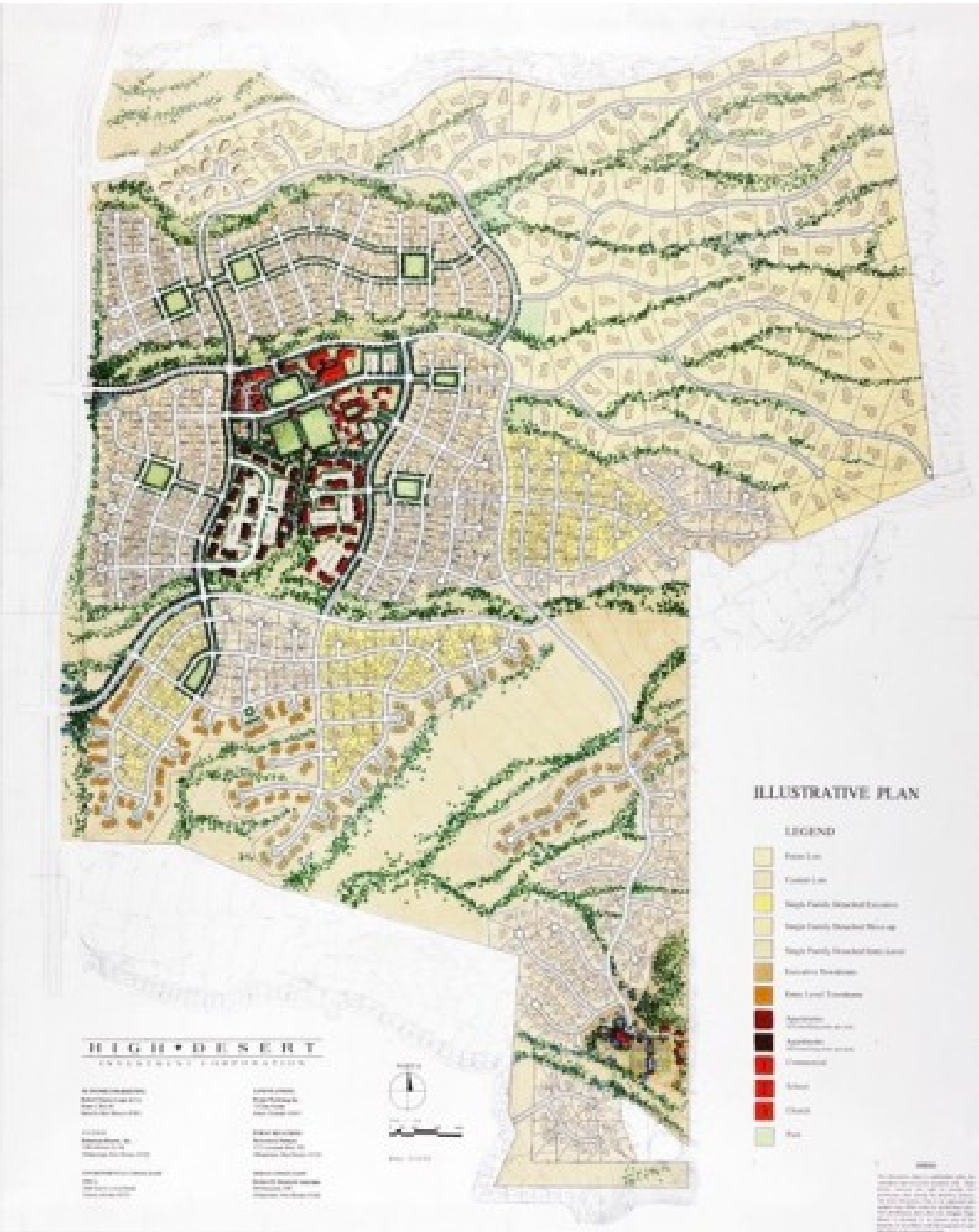
City of Albuquerque Environmental Planning Commission Community Award of Excellence, 1997

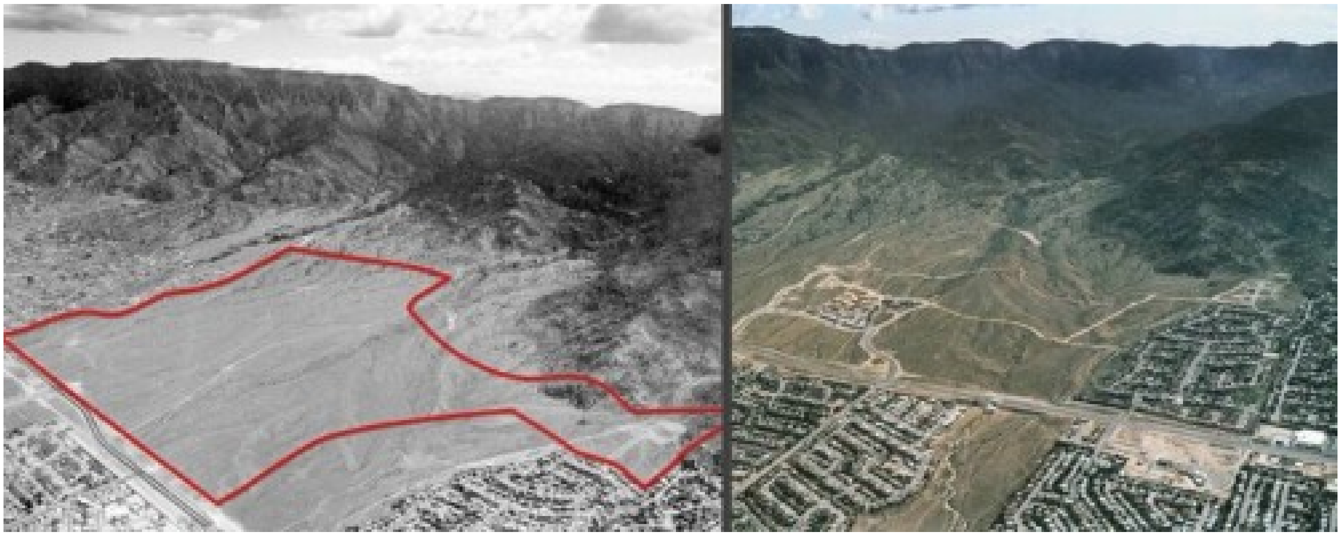
New Mexico ASLA Award of Honor, 1997

Toward Legacy, a book focused on Design Workshop's evidenced-based philosophy and comprehensive approach to sustainable design

Design Workshop Legacy Design (R) Metrics

Additional Images





High Desert Community

Case Study Prepared by:
Research Fellow: Bo Yang, PhD, Assistant Professor, Utah State University
Research Assistant: Amanda A. Goodwin, MLA Candidate, Utah State University
August 2011

Landscape Performance Benefits and Methods

- ***Maintains 50% of the site's original juniper prairie ecotype by minimizing construction disturbance, cutting roads into the hillside instead of mass grading, and using a native plant palette for all public areas, right-of-ways and private areas outside of building envelopes.***

To obtain maximum possible levels of disturbance, infrastructure was first digitalized with AutoCAD Civil 3d 2010 and a 6' maximum envelope was used, per the project development plan, to determine infrastructure disturbance area. Each developable plat was then researched for accompanying zoning maximum-percentage-of disturbance, and multiplied by the acreage of zoning type. These areas of disturbance were summed and divided by the total property acreage.

Digitized AutoCAD infrastructure area of disturbance = 5,862,827.4 sf

Residential plat acreage obtained from Sector Development Plan (Environmental Planning Commission, 2001):

Townhouses have a maximum floor area ratio of 0.70
223.1 acres x 0.7 =156 impervious acres or 6,795,360 sf

Detached houses have a maximum floor area ratio of 0.65
163 acres x 0.65 = 105 impervious acres or 4,573,800 sf

Estates have maximum floor area ratio of 0.30
524 acres x 0.3 =157 impervious acres or 6,838,920 sf

5,862,827 + 6,795,360 + 4,573,800 + 6,838,920 = 24,070,907 sf or
552.60 acres of possible disturbance

Area of possible disturbance divided by total property acreage:
552.60 / 1,067 total acres = 51% maximum possible ecosystem disturbance

To obtain percent of ecotype preserved, the 6' infrastructure envelope was omitted from the previous calculation. This area translates to the square footage that was replanted as native ecotype by High Desert.

Digitized AutoCAD infrastructure area of disturbance = 4,641,947 sf
5,862,827 – 4, 641,947 = 1,220,879 sf restored as original ecotype
4,641,947 + 6,795,360 + 4,573,800 + 6,838,920 = 22,850,027 or
524 acres of un-restored disturbance

524 / 1,067 total acres = 49% non-ecotype, or **51% ecotype maintenance**

- ***Uses only 20% of the city's annual water allowance in landscape areas, saving as much as 28.7 million gallons or $300,000 each year.***

Total gallons of water used in irrigated areas, allowable water units, and water rates for 2010 were obtained from the county water conservation department. Cost savings were determined by multiplying the gallon saved by the water prices on the county website (Water Use Authority, 2009)

> 1,660,416 sf of “irrigation only” area (Yuhas, 2010)
> Water used in these areas as recorded by the city for 2010: 7,456,085 gallons,
> Water allowed for these areas as recorded by the city for 2010: 36,227,405 gallons (Yuhas, 2010)
> 7,456,085 / 36,227,405 = 0.206, or **20% of allowance**
> 36,227,405 - 7,456,085 = **28,771,320 gallons saved**
>
> 2010 Albuquerque Bernallio Water rates @ $7.83 per unit. 1 unit = 748 gallons (Water Use Authority, 2009)
> 28,771,320 / 748 = 38,464 units
> 38,464 units x $7.83 = $**301,175.71 in annual cost savings**

- ***Increased critical bird-breeding habitat for two endangered species, the Peregrine Falcon and the Gray Vireo, by approximately 7 acres.***

This project had the goal of doubling the amount of the original Juniper pinion ecotype vegetation on the site. Pre-construction vegetation volume ecotype indices were provided by SWCA environmental consultants through the Chojnacky method (Chojnacky, 1985). This juniper prairie ecosystem was over-laid with a Zoned Plat Map obtained from the client, in order to determine allowable percent of disturbance per plat, inside areas of this pre-existing ecotype. Total area of disturbance within this ecotype was calculated by summing the maximum percent of allowable disturbance of each plat, by the total area acreage plat. This area translates to the area Design Workshop would replace with twice the vegetative volume.

> Total area of Juniper Prairie Ecotone digitized in AutoCAD Civil 3d: 13,909,945 sf
> Zoning allowed for 30% impervious disturbance max. in this area
> 0.3 x 13,909,945 = 369,477 sf of disturbance (Environmental Planning Commission 2001)
>
> Infrastructure was digitized in Auto CAD for a total area of disturbance of 1,231,589 sf
> 369,477 + 1,231,589 = 1,601,066 sf of disturbance
>
> Juniper Prairie Ecotone vegetative volume index provided by SCWA consultants through the Chojnacky method (Chojnacky, 1985). Starting vegetative volume index of woody material: 0.064 m3/m2 (or .2 cf/sf)
> 1,601,066 x 0.2 = 32,213 cf of volume to double = 64,426 cf of juniper volume needed.
>
> Replant at original volume index of 0.2 cf/sf
> 64,426 cf / 0.2 = 12,885 sf or 7.4 acres of additional Juniper Prairie Ecosystem

- ***Increased carbon sequestration on the site by 170,160 tons by restoring twice the volume of vegetation that was displaced by all areas of disturbance.***

Carbon sequestration was estimated by projecting rates of mature replacement trees. The number of trees was estimated by dividing the replacement vegetative volume by the typical vegetation volume of typical juniper trees (Note: see fifth Benefit for full calculations) (Ernest et al., 1993).

Typical volume of a mature juniper tree:18.17 cf (Ernest et al., 1993)
64,426 / 18.17 = 3,545 trees needed

The carbon sequestration rate was calculated for the number of new trees required through the National Tree Benefit Calculator and multiplied by estimated number of trees to double.

Carbon sequestration estimated through National Tree Benefit Calculator
http://www.treebenefits.com/calculator/index.cfm (Casey Trees, 2011)
96 tons annually per tree x 1,772 new trees = **170,160 tons of carbon annually**

- ***Preserves the equivalent of 15,230 trees a year, by using decomposed-granite mulch instead of a traditional yearly wood chip mulch application. At a ten-year lifespan, the granite mulch can save 100,000 gallons of fuel, and reduce carbon release by an estimated 617,600 tons.***

Onsite material recycling eliminated the need for annual reapplication of a typical 2" mulch covering. Total shrub landscape area 0 was determined from project bid estimates. Tree species were researched to determine which trees would most likely be milled for mulch in the region. These species were in turn researched for their typical density conversion from density to volume in order to estimate how many trees this project would need to mill per mulching application.

1,660,416 sf of landscape x 0.16" = 276,736 cf of mulch used annually (Yuhas, 2010)
Western junipers, typical for mulch available in Albuquerque

Typical volume per tree (Ernest et al., 1993)
Average of species heights: 12.6'
Averages of species DRc: 11.375"
Rocky mountain juniper: V = (0.02434 + 0.1 191 06 [DRc X HT]) = 17.1
Utah juniper: V = (-0.08728 + 0.1 35420 [DRc X HT] - 0.01 9587) = 19.24
where:
V = gross volume of tree, including bark(cubic feet);
DRc = diameter or equivalent diameter at root collar (in); and
HT = tree height (ft).
Average tree volume = (17.1 + 19.24) / 2 = 18.17 cf

276,736 cf/ 18.17cf = **152,304 trees needed annually**

Fuel savings were determined by subtracting the difference in trip miles between the two mulching methods, and dividing this difference by the typical dump truck fuel efficiency (8mpg, diesel).

Difference in trip miles: 820,000 - 20,500 = 799,500 trip miles saved
799,500 / 8 = **99,937 gallons of fuel saved**

Carbon release was reduced by eliminating importation of materials from off site. Trip miles saved were entered into the ALG Carbon Calculator, by using the metric of a v8 diesel engine (Future Climate, 2011).

Use ALG Carbon Calculator and use 0 household residential version. Convert trip miles into kilometers divide trip distance by 52 and provide vehicle fuel efficiency rate per year = **617,602 tons**

Cost Comparison Methods

- ***Water-efficient native plants and limited areas of irrigated landscape save as much as $300,000 in water costs each year when actual water use at High Desert is compared to the city's annual water allowance.***

See second Benefit for calculations.

- ***Using recycled materials as mulch will save up to $2,530,000 over the next 10 years when compared to typical wood chip mulch. The decomposed granite from onsite and dredged dam sediments from downstream need to be reapplied every 10 years, whereas wood mulch must be reapplied each year.***

Cost savings were determined by comparing typical annual wood chip mulch application to decennial granite application. Because High Desert did not use wood mulch, costs were determined by adding typical product prices with importation (fuel) prices. Cost of decennial granite mulch per/sf was determined by adding labor cost estimates from client contractors' fuel prices, and by researching dredging cost estimates. Fuel savings were determined by calculating and comparing the distance of needed round-trips between the nearest feasible wholesale mulch distributor and the dam, and High Desert, This distance was multiplied by current fuel prices for 2010 at divided by the typical dump truck fuel efficiency (8mpg, diesel).

<u>Wood Mulch</u>

Material Installation costs:
1,660,416 sf of landscape x .16 ft = 276,736 cf (or 10,250 cy) of mulch used annually (Yuhas, 2010)
Average cost of wood mulch: $25/cy
25 x 10,250 = 256,250 annual x 10 = $2,562,500 in product over 10 years

Fuel Costs:
276,736 cf or (10,250 cy) of mulch needed
Typical 1 ton dump truck carries 5 yards
10,250 / 5 = 2,050 trucks of mulch, or 2,050 trips needed

The nearest feasible mulch source is over 20 miles away (x 2 for return trip):
40 x 2050 = 82,000 trip miles (x10 years) = 820,000 trip miles

Typical dump truck fuel efficiency: 8 mpg (diesel)
820,000 / 8 =102,500 gallons of fuel needed

2010 diesel fuel price average: $3.56
102,500 x 3.56 = $364,900 in fuel costs over 10 years

$2,562,500 + $364,900 = $2,927,400 Total wood mulch costs over 10 years

<u>Granite Mulch</u>

Installation Costs:
Price quote for 2" granite application labor from contractor bids: $.20/sf
0.20 x 1,660,416 = 332,083 (applied x 2 every ten years = $664,166 in labor costs

Price Estimate for dredging of dam obtained from United States Army Corps of Engineers dredging cost estimates for similar size projects over the past 5 years (USACE, 2011): $55,500

Fuel Costs:
276,736 cf or (10,250 cy) of mulch needed
Typical 1 ton dump truck carries 5 yards
10,250 / 5 = 2,050 trucks of mulch, or 2,050 trips needed

The dam is 5 miles away (x 2 for return trip):
10 x 2,050 = 20,500 trip miles

Typical dump truck fuel efficiency: 8 mpg (diesel)
20,500/8 = 2,562.5 gallons of fuel needed

2010 diesel fuel price average: $3.56
2,562.50 x 3.56 = 9,122 in fuel costs every 10 years

664,166 + 55,500 + 9,122 = $397,369 total granite mulch costs over 10 years

<u>Difference in mulch costs</u>
$2,927,400 - $397,369 = **$2,530,031 in total mulch cost savings**

- **Relocating 3,500 trees within areas of disturbance, instead of purchasing new trees, saved an estimated $496,000, a 73% cost reduction per installed tree.**

Cost savings were determined by comparing typical balled and burlap installation prices against transplanting prices as reported by High Desert contractor bids. Local nurseries were researched for average prices of 6' evergreens, installed. The difference between the two options is presented as a ratio of price reduction.

High Desert price calculations provided by archived contactor bid calculations by landscape construction bids (1998): $150 per tree
3,545 trees needed (see 4th Benefit for full calculations)
150 x 3,545 = $638,100 in traditional tree installation costs

Transplant costs provided by landscape construction bids (1998): $40 per tree
40 x 3,545 = $141,800 in tree transplant costs

Total estimated cost savings:
638,100 - 141,800 = **$496,300 cost savings in tree installations**

$40 per tree / $150 per tree = 0.267, or **73% cost savings**

References

Casey Trees (2011). National Tree Benefit Calculator, Casey Trees and Davey Tree Expert Co. Available from http://www.treebenefits.com/calculator/index.cfm

Chojnacky, D.C. (1985). Pinyon-juniper volume equations for the central Rocky Mountain States. USDA Forest Service, Intermountain Forest and Range Experiment Station. Research Paper INT-339. 27 p.

Environmental Planning Commission (2001). High Desert Sector Development Plan, Volume 1. City of Albuquerque.

Ernest, K. A., Aldon, E. F., & Muldavin, E. (1993). Woody debris in undisturbed pinon juniper woodlands of New Mexico. General technical report RM, 236, 117-123.

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Yuhas, K. (2010). High Desert Water Use Report. Albuquerque Bernalillo County Water Utility Authority. Albuquerque, New Mexico.