

# Annual Planning Meeting Reclamation on Shell Sites



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February 2014

**Objectives**

**Process Evaluation**

**Techniques & Trials**

**Monitoring Results**

**Reclamation Status 2013 and Look  
Ahead**



## Objectives of Successful Reclamation

**Interim reclamation -achieve healthy, biologically active topsoil; control erosion; and restore habitat, visual, and forage function on those portions of the disturbed area not need for production operations for the life of the well or facilities or until final reclamation is initiated.**

**Final reclamation-achieve habitat, forage, and hydrologic function the functions that existed prior to disturbance. Including restoration of the original landform or creating a landform that approximates and blends in with the surrounding landform. Final reclamation involves restoring natural vegetative community, hydrologic systems, visual resources, agricultural values and wildlife**

# Soil Quality

Organic content of a soil supplies

- direct indicator of fertility
- ability to support microbial populations
- retention on mineral nutrients
- water retention potential

As organic matter is incorporated into the soil, it provides food for soil organisms, which constitute the soil microbial community.

Microbes

- play a role in water and nutrient movement
- extract nutrients from minerals and organic sources
- enable plants to thrive in habitats that are poor in nutrients
- Symbiotic relationship with bi-directional flow of nutrients to the plant root and carbohydrates and carbon to the fungus.

# Soil Amendment Blends

Goal: Understand variability of soils and potential to apply amendments

**SOIL AMENDMENT BLENDS - 2004 FALL SEEDING**

	"A" amendment blend used in 2004	"W" amendment blend used in 2004	"M" amendment blend used in 2004
Fertil-Fiber tons/acre	1	2	1
Humic Shale lb/acre	500	500	500
Gypsum lb/acre		6000	
Urea lb/acre	10	15	
P2O5 lb/acre	20	20	25
MgO lb/acre		15	
Elemental Sulfur lb/acre	15		
Zinc lb/acre	2	4.3	2
Mn lb/acre	2.0	1.0	
Agricultural Lime lb/acre	300		
Boron lb/acre	1		
Kiwi Power gals/acre	5	5	5
Cliffhanger Tack lbs/acre	150	150	150

Amendments are determined per site.  
Those most commonly used include:

Magnesium

Iron

Manganese

Zinc

Ammonium Phosphate

Potash

Nitrogen

Kiwi Power -Organic bacterial and enzyme complex that flocculate soil

Humic acids-activate the development of soil microbes, improving physical properties of soil and aid in water retention

Stronghold Fibers - Yucca fibers

Cliffhanger Tack

Fertile Fibers -fibrous organic mulch

Soil Lock

# Seed Selection

Developed seed mix focused on Native plants in area

## Shell Sage Habitat Seed Mix - Fall 2004

Species	#/Acre (PLS)
Sandberg Bluegrass	1.00
Globemallow, Scarlet	0.03
WY Big Sagebrush	0.50
Fringed Sagewort	0.05
Penstemon Procerus	0.05
Yarrow, white N. American	0.05
Winterfat	1.00
Indian Ricegrass, Rimrock	1.00
Four-winged Saltbush	0.50
Lupine, Robinson L. polyphyllus	1.00
	<b>5.18</b>

## Shell Habitat Seed Mix SH13HAB

Species	PLS #/Acre
Indian Ricegrass, Rimrock	2.00
Sandberg Bluegrass	1.00
Scarlet Globemallow	0.04
Gooseberryleaf Globemallow	0.11
Fringed Sagewort	0.10
Penstemon eatonii (Firecracker P)	0.15
Penstemon procerus	0.05
White Primrose	0.02
Winterfat	0.50
WY Big Sagebrush	0.50
Yarrow, Western	0.10
Gardner's Saltbush	1.00
Bluebunch Wheatgrass Secar	0.50
Northern Sweetvetch	0.15
Rocky Mountain Beeplant	0.50
Shadscale Saltbush	0.50
Tapertip Hawksbeard	0.25
Slender Wheatgrass Revenue	1.00
Great Basin Lupine	0.15
Thickspike Wheatgrass Critana	1.50
	<b>10.12</b>

# Not only locations are seeded

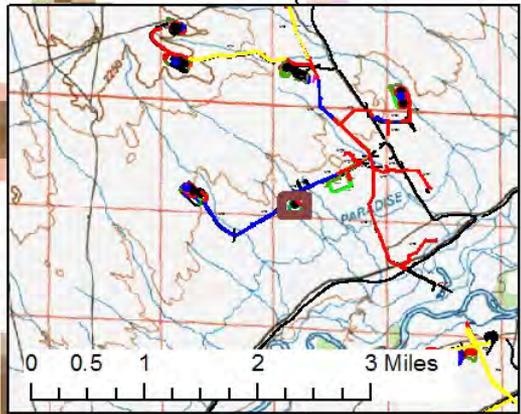


Topsoil piles  
Cut slopes  
Fill slopes  
Spoil piles  
Pipeline ROW's  
Over seeding locations



# Riverside 13-3

Riverside 13-3  
FULL INTERIM Reclaim  
4.2 acres  
Drill seeded with Truax Rough Rider (packer wheels) 10/17/09  
Amendments applied (300 gal sprayer) 10/29/09  
Slope areas along fence seeded with Great Plains 6 ft drill



Seeded with 6 ft Great Plains drill

Riverside 11-3d

gate

Riverside 13-3d

Hand broadcast seeded

RIV 13-3-1

base of fill slope

RIV 13-3-2

4.2 acres



0 30 60 120 180 240 300 Feet

# Techniques and Trials

- Seed Methods
- Over-seeding
- Fencing vs no Fencing
- Topsoil Pile Seeding
- Snow fences
- GPS on Seeder
- Biocrust application
- Planting grass species on interior of pad



# Seeding Methods Tried Over-seeding



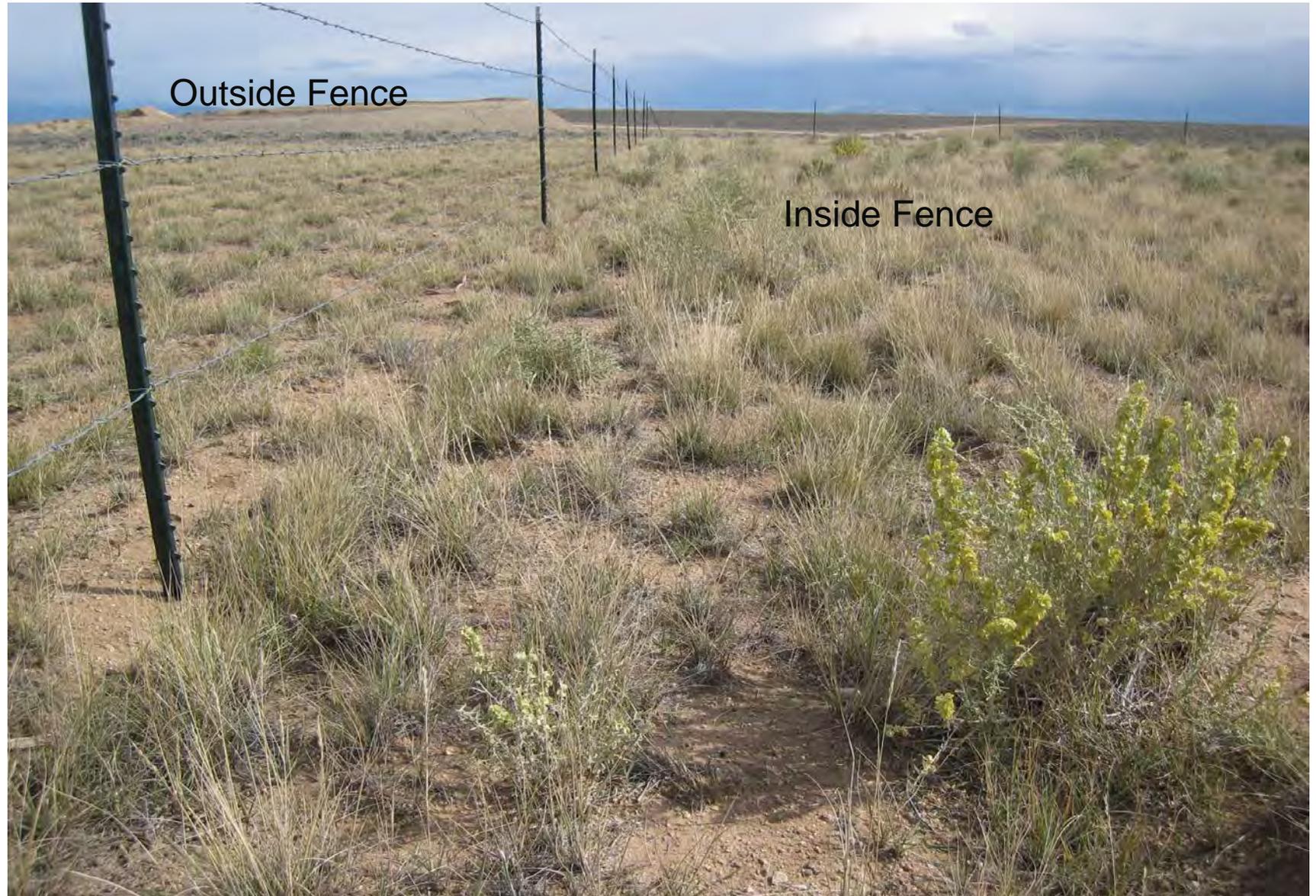
## Types of Seeding Methods

- Drill seeding
  - Truax Rough Rider
- Hydro-seeding
- Broadcast seeding

## Modifications on Equipment

- Packer wheels on drill seeder
- Hydro-seeder centrifugal pump

# Fence line comparison





no fence!

“The Spokesman”

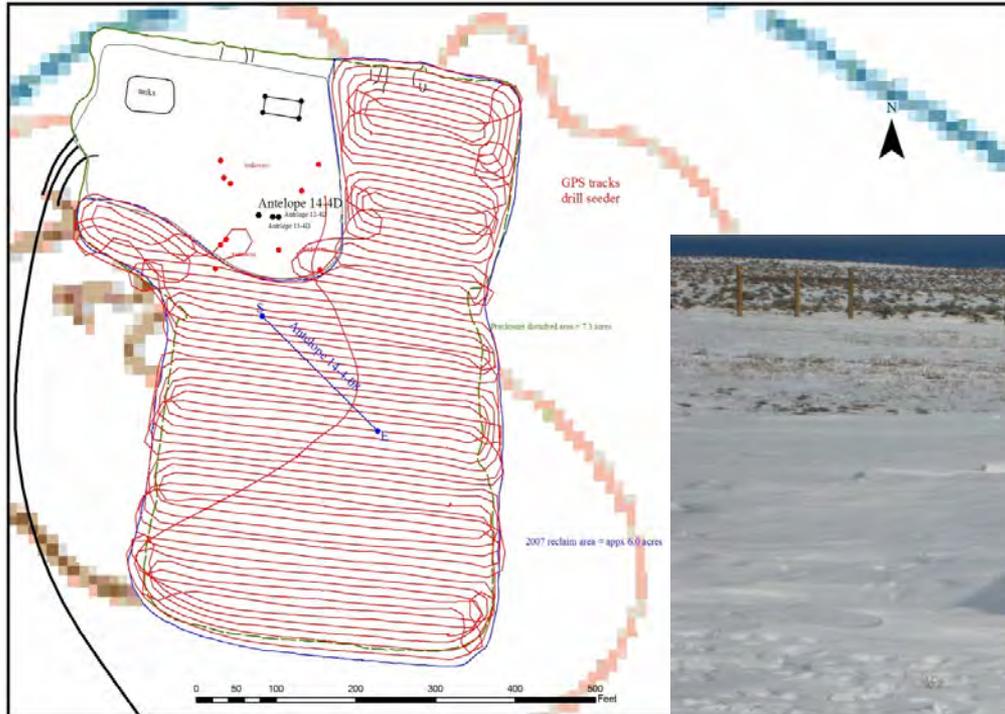
# Topsoil Pile Seeding

Intent to keep critical soil microbes alive during period that pad is being developed, keep soils healthier

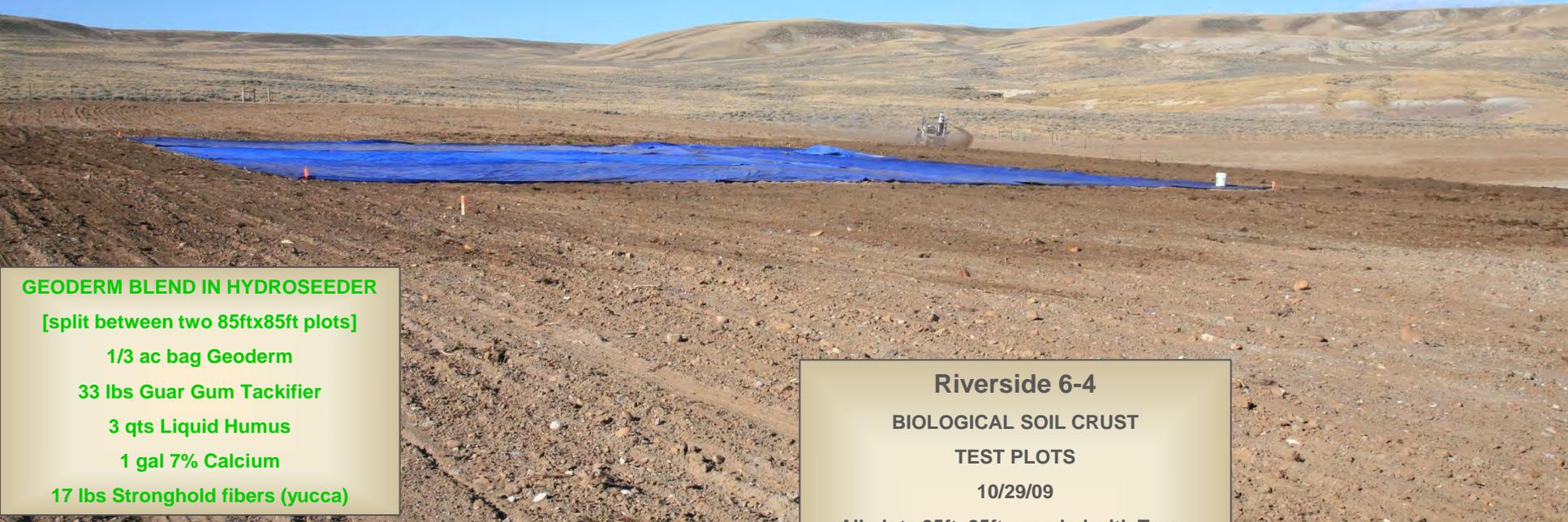
Reduce amount of weeds present when topsoil is transferred to reclamation



# GPS location of Seeding Snow fence Trial



# Biological Soil Crust Test Plots Riverside 6-4



## GEODERM BLEND IN HYDROSEEDER

[split between two 85ftx85ft plots]

1/3 ac bag Geoderm

33 lbs Guar Gum Tackifier

3 qts Liquid Humus

1 gal 7% Calcium

17 lbs Stronghold fibers (yucca)



## Riverside 6-4

BIOLOGICAL SOIL CRUST

TEST PLOTS

10/29/09

All plots 85ftx85ft - seeded with Truax  
Rough Rider drill during reclaim seeding -  
SH09F seed mix

North Test Plot

**GEODERM BLEND ONLY**

Middle Test Plot

**GEODERM BLEND**

+

**SOIL AMENDMENTS**

South Test Plot – 85 ftx85 ft

**NO GEODERM OR SOIL AMENDMENTS**

Soil Amendments

0.5 tons/ac Fertile Fibers

100 lbs/ac Leonardite shale

2 gal/ac Liquid Humus

5 gal/ac 7% Calcium

1 gal/ac Structure

# Supplemental Environmental Impact Statement (SEIS) Commitments & Monitoring

Per ROD “All operators are responsible for the satisfactory and timely reclamation of the land surface disturbed by their operations in accordance with federal regulations and the standards, guidelines, and criteria set forth below. These standards will apply to all surface disturbing activities including but not limited to pads, roads, right-of-way, and all industry associated pipelines.”

## Types of Reclamation:

Site Stabilization

Interim Reclamation

Final Reclamation

Monitoring of site reclamation success to compared to offsite reference area.

## Interim Success measured in stages

Year 1:  
Emergence  
of desirable  
seedling  
density or  
frequency

Year 5:  
Native Forbs on site 75% of  
reference  
Native Shrubs on site 50% of  
reference  
Native Grasses on site 3 perennial  
species (2 bunchgrasses)  
Non-Native Weeds – free from site  
Plant Vigor present

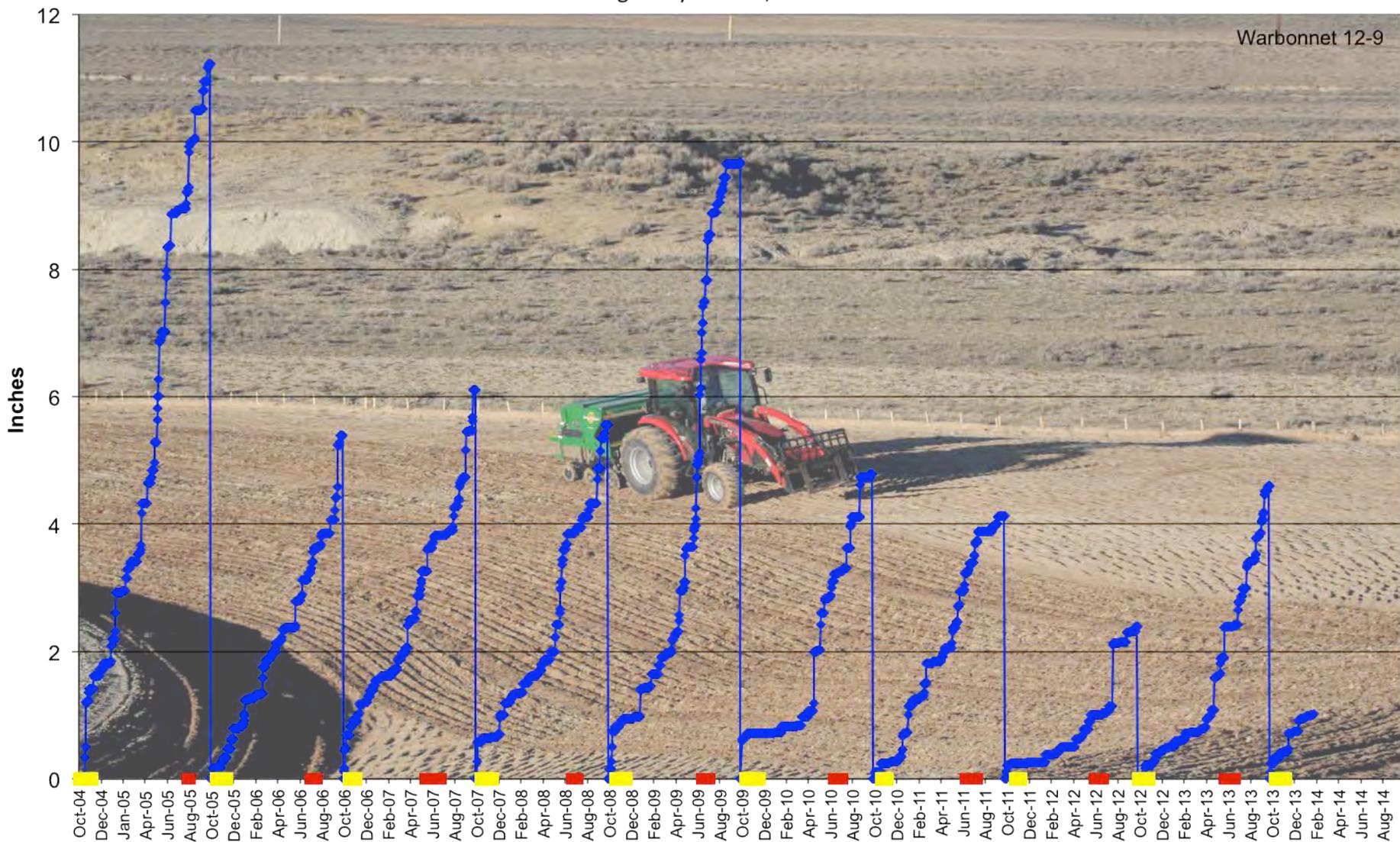
Year 8:  
Native Forbs equal or greater than reference  
Native Shrubs on site 80% of reference  
Native Grasses on site 3 perennial species (2  
bunchgrasses)  
Non-Native Weeds – free from site  
Plant Vigor present

# Cumulative Inches of Precipitation

Annually - Oct 1 through Sept 30

Big Piney Station, WY

Warbonnet 12-9



Rainfall data only - no snow accumulation data

—◆— Cumulative Precipitation    ■ Seeding    ■ Transects

# Monitoring Onsite and Reference Site

SWEPI Reclamation Monitoring 2012																			
Mesa 12-28(1of2) Reclaim Data Summary																			
Datum: NAD 83 UTM Zone: 12		Plot Center - Easting: 594397 Northing: 4729906																	
Date Last Seeded: 10/5/2004 Seeded Area Type: Pit		Reclaim Acres: 6.2 Current Growing Season: 8th																	
Seed Mix: ACHY, ATCA2, SPCO, POSE, LUPO2, KRLA2, ACMI2, PEPR2, ARTRW8, ARFR4		Data Collected By: T. Lingle & R. Downie, NWRC																	
		Monitoring Date: 06/11/2012																	
Line-point Intercept Summary																			
% Total Canopy Cover:	32.0%	% Bare Ground	49.5%																
% of Total Canopy Cover Comprised of Desirable Spp. (Goal >50%):	82.8%	Total % Grass Cover	14.5%																
Reference Canopy Cover	46.0%	Total % Forb Cover	1.5%																
Total Desirable Canopy Cover as a percentage of Reference Cover:	57.61%	% Basal Cover:	10.5%																
		% Litter	26.5%																
		Total % Shrub Cover	12.5%																
		% Rock	4.5%																
		Total % Weed Cover	5.5%																
Density Summary		Shrub Summary																	
Total Forb Density	0.56 forbs/m <sup>2</sup>	Average Live Shrub Height	29.5 cm																
Total Shrub Density	9.04 shrubs/m <sup>2</sup>																		
Grass Frequency Summary		Count																	
Total Grass Frequency	100%		5																
Life Form		Density (plants/m <sup>2</sup> ) (50x 0.5m <sup>2</sup> quadrats)																	
Top Three Species		Measured Species % cover																	
Grasses	ELEL5 Squirreltail	n/a	9.0%																
	POSE Sandberg bluegrass	n/a	2.5%																
	PASM Western wheatgrass	n/a	2.0%																
Forbs	SYMPH4 Aster	0.24	1.5%																
	ACMIO Western yarrow	0.16	0.0%																
	PHHO Hood's phlox	0.16	0.0%																
Shrubs	ARTRW8 Wyoming big sagebrush	8.80	12.5%																
	ATCA2 Fourwing saltbush	0.08	0.0%																
	ERNA10 Rubber rabbitbrush	0.08	0.0%																
Close-up Photograph of Site																			
																			
<table border="1"> <thead> <tr> <th colspan="2">PAPO QUALITATIVE EVALUATION</th> </tr> </thead> <tbody> <tr> <td>Is seed germination apparent?</td> <td>Yes</td> </tr> <tr> <td>Is the area free of undesirable materials?</td> <td>Yes</td> </tr> <tr> <td>Is the soil stable?</td> <td>Yes</td> </tr> <tr> <td>Absence of noxious weeds?</td> <td>Yes</td> </tr> <tr> <td>Absence of other undesirable species? (e.g. BRT)</td> <td>No</td> </tr> <tr> <td>Is there evidence of good reproductive capability?</td> <td>Yes</td> </tr> <tr> <td>Years of Reclamation</td> <td>8+ years</td> </tr> </tbody> </table>				PAPO QUALITATIVE EVALUATION		Is seed germination apparent?	Yes	Is the area free of undesirable materials?	Yes	Is the soil stable?	Yes	Absence of noxious weeds?	Yes	Absence of other undesirable species? (e.g. BRT)	No	Is there evidence of good reproductive capability?	Yes	Years of Reclamation	8+ years
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## Mesa 12-28 Reference Data Summary

Mesa 12-28 Reference Data Summary											
Datum: NAD 83 UTM Zone: 12		Plot Center - Easting: 594861 Northing: 4729690									
Plant Community: Big sage/ Bunchgrass		Ecological Site: MLRA 34A Loamy 10-14"W									
Data Collected By: T. Lingle & R. Downie, NWRC		Monitoring Date: 06/11/2012									
Line-point Intercept Summary											
% Total Canopy Cover:	46.0%	% Bare Ground	36.0%								
% Basal Cover:	23.0%	% Litter	26.0%								
		% Rock	2.5%								
		Total % Grass Cover	20.5%								
		Total % Forb Cover	7.0%								
		Total % Shrub Cover	22.0%								
		Total % Weed Cover	0.0%								
Density Summary		Shrub Summary									
Total Forb Density	9.44 forbs/m <sup>2</sup>	Average Live Shrub Height	22.2 cm								
Total Shrub Density	5.44 shrubs/m <sup>2</sup>										
Grass Frequency Summary		Count									
Total Grass Frequency	100%		6								
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Shrubs	ARTRW8 Wyoming big sagebrush	4.56	21.0%								
	OPPO Plains pricklypear	0.80	0.5%								
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2004



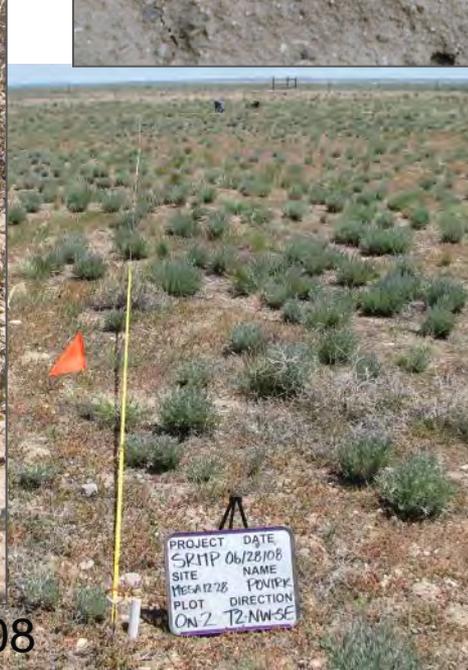
2005



2006



2007



2008

PROJECT DATE  
SKIP 06/28/08  
SITE NAME  
MESA 12-28 PONTIK  
PLOT DIRECTION  
ON 2 T2-NW-SE



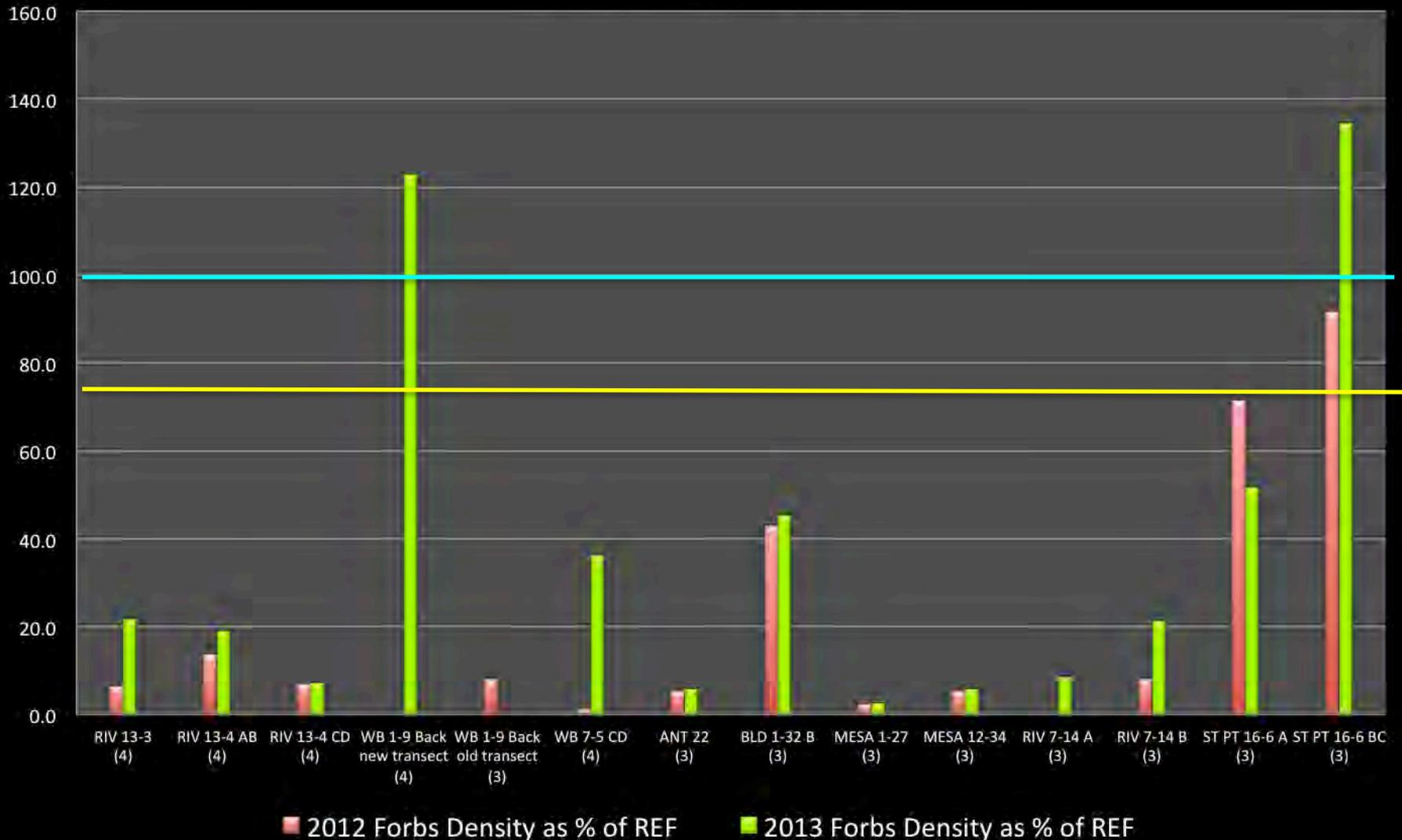
2009

**Mesa 12-28**

5 Year ROD requirement: 50% of REF

8 Year ROD requirement: 80% of REF

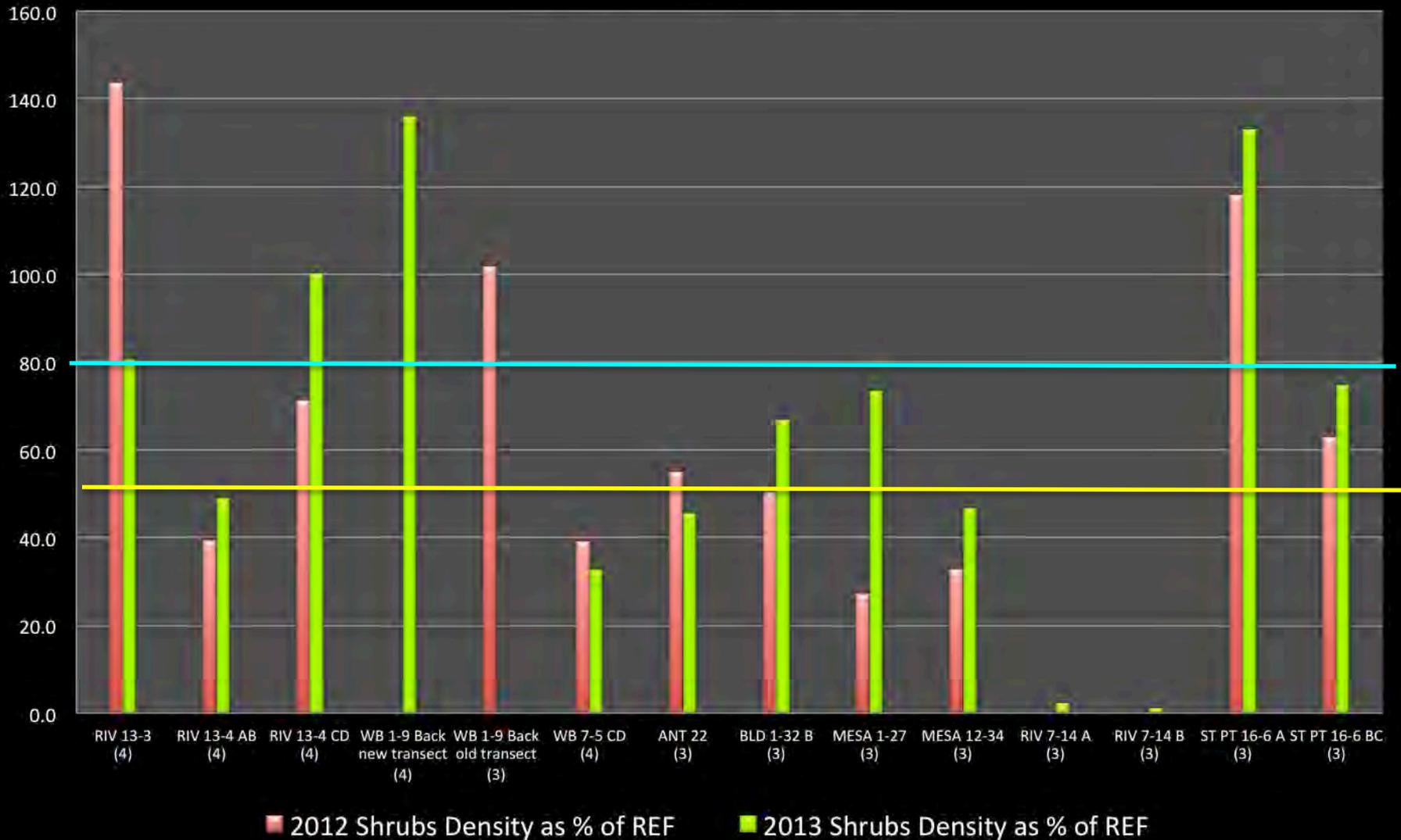
### Post-2008 Reclaims



5 Year ROD requirement: 50% of REF

8 Year ROD requirement: 80% of REF

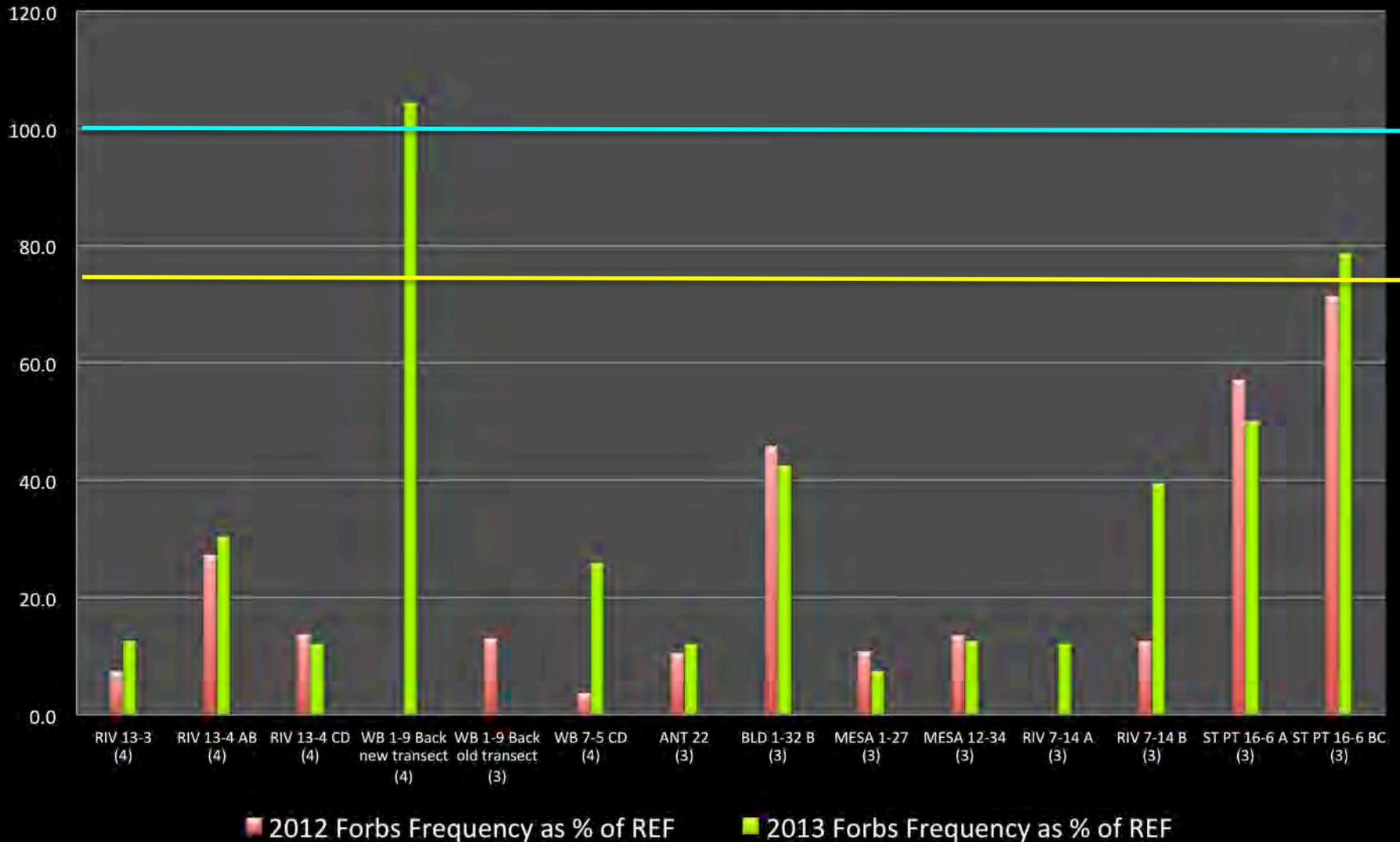
### Post-2008 Reclaims



5 Year ROD requirement: 75% of REF

8 Year ROD requirement: 100% of REF

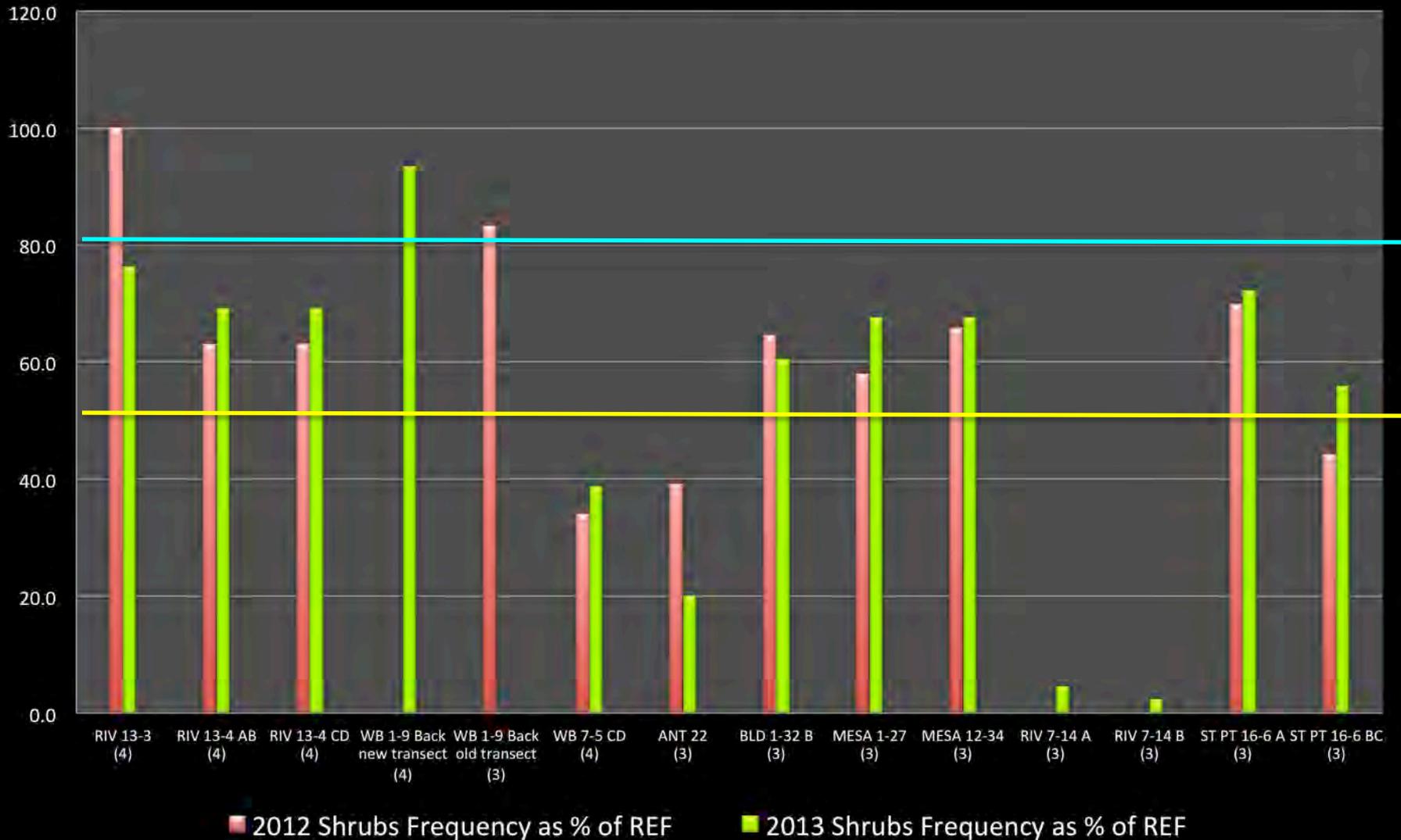
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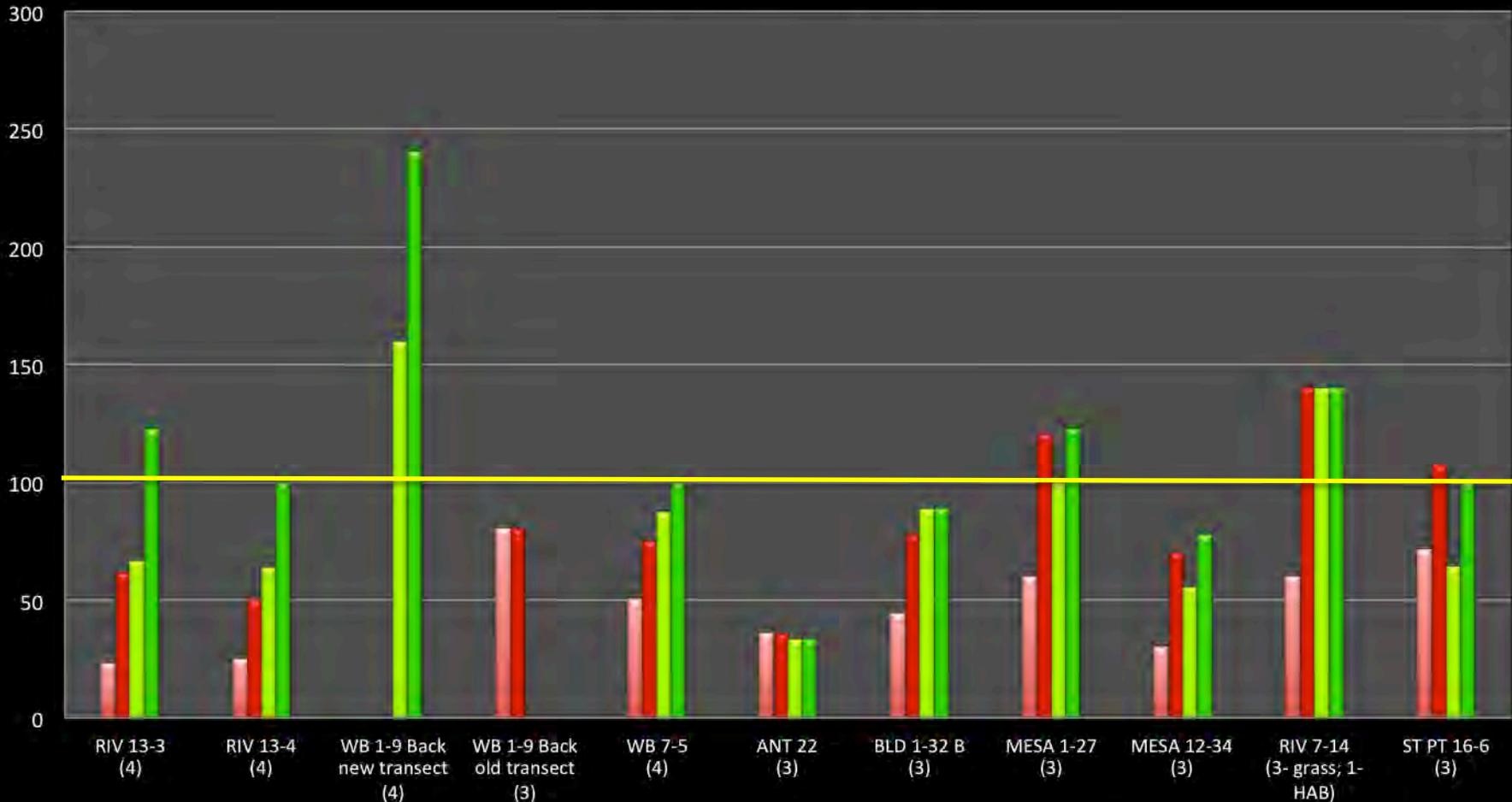
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### Post-2008 Reclaims



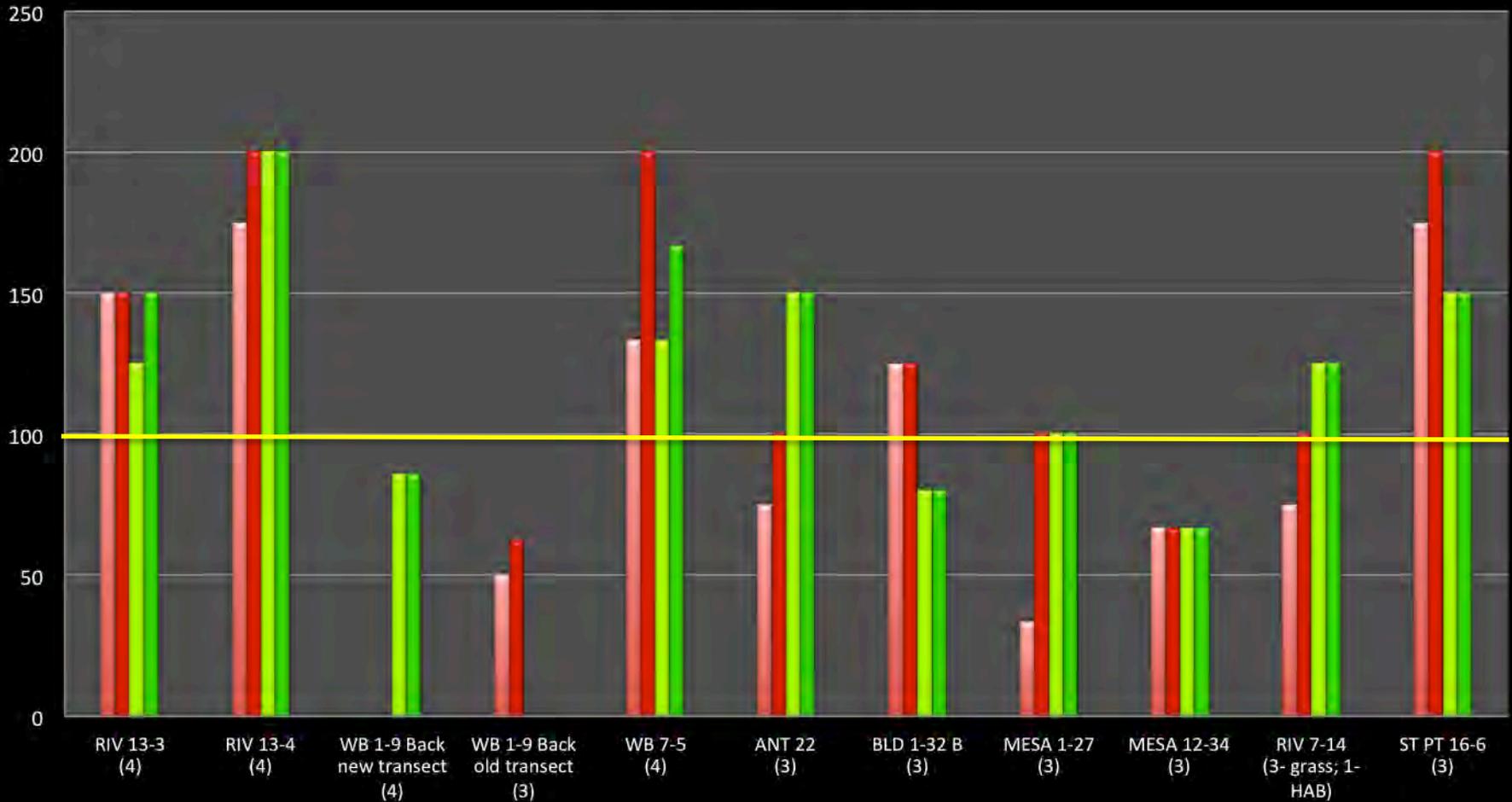
2012 IN CIRCLE/Trans Forbs Diversity as % of REF

2012 ALL Forbs Diversity as % of REF

2013 IN CIRCLE/Trans Forbs Diversity as % of REF

2013 ALL Forbs Diversity as % of REF

### Post-2008 Reclaims



■ 2012 IN CIRCLE/Trans Shrubs Diversity as % of REF     ■ 2012 ALL Shrubs Diversity as % of REF  
■ 2013 IN CIRCLE/Trans Shrubs Diversity as % of REF     ■ 2013 ALL Shrubs Diversity as % of REF

## In Summary

- **The Shell/BLM Pinedale Anticline Re-vegetation Pilot Project has been successful in restoring significant sage stands to the sites. Pellet counts captured through monitoring process indicates use by all wildlife species targeted.**
- **Soil amendments seem to jump start vegetative growth by allowing for greater nutrient transfer, especially in soils having high sodium.**
- **While there may be conditions where hydro-seeding is necessary, the Truax Rough Rider range drill is currently our preferred method of seeding in the project area.**
- **Over-seeding the habitat blend seed mix into previously seeded grass-dominated sites has shown limited success.**
- **Fencing of sites, at least for the first few growing seasons, has made a difference in native plant establishment, particularly in areas more heavily grazed.**

## Summary Continued...

- **Topsoil plantings seem to have mixed results and require replanting if left in place for greater than three years in most cases.**
- **GPS tracking is effective in realizing areas that may have gotten missed, causing equipment and planning to capture areas in the future, minimizing overall costs to the project.**
- **Snow fences have utility in areas with harsh soils and little moisture collecting ability.**
- **Biocrust trial has not been identified as a source of jumpstarting the natural process of rebuilding soil crusts.**
- **Site Stabilization planting has yielded low emergency and growth due to harsh soil substrate, consistent traffic and snowplowing sites for operations.**

# Shell Reclamation Current Status



## 2013 Reclamation Actions

- 5 pads put into interim reclamation
- 8 pads with reclamation enhancements
- 18 Ac ROW reseed

## Field wide Current Status

Disturbance 976 Acres

Reclaimed 687 Acres

15 Acres Site Stabilization

335 Acres Interim Reclamation

36 Acres Final Reclamation (pads & roads)

301 Acres reclaimed pipeline rights of way

- 4 of 63 pads are site stabilized
- 53 of 63 pads are in interim reclamation
- 6 of 63 pads are in final reclamation

# 2014 Look Ahead

Planning :

3 pads planned for interim reclamation (27 Acres)

20 enhancement reclamation reseeding (82 Acres)



# Challenges of Successful Reclamation



- Obtaining 75% Forb Density within 5 years; year 8 equal or greater forbs than reference
  - Various forbs expressed pending precipitation, not always consistent
  - Single stem verses mat forming – preferred habitat species
  - Seed Availability of offsite species/cost
- Revisiting pads once reclamation initiated
- Reducing amount of weeds present in reclaim specifically Cheatgrass
  - Topsoil plantings
  - Better soil management
  - Focus on weed free seeds and mulches

