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Mine Restoration Using Municipal BioSolids

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Mine Restoration Using Municipal BioSolids

Vegetation – "Hello" !

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Mine Restoration Using Municipal BioSolids

Vegetation – "Hello" !

Or

Vegetation - Hell ????

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Mine Restoration Using Municipal BioSolids

Finding a way out?

Or

Getting in deep doo-doo?

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Vegetative Community Analysis of Biosolids Test Plots After Five to Ten Years of Growth



Rick Black (ENVIRON International)
Richard K. Borden (Rio Tinto)

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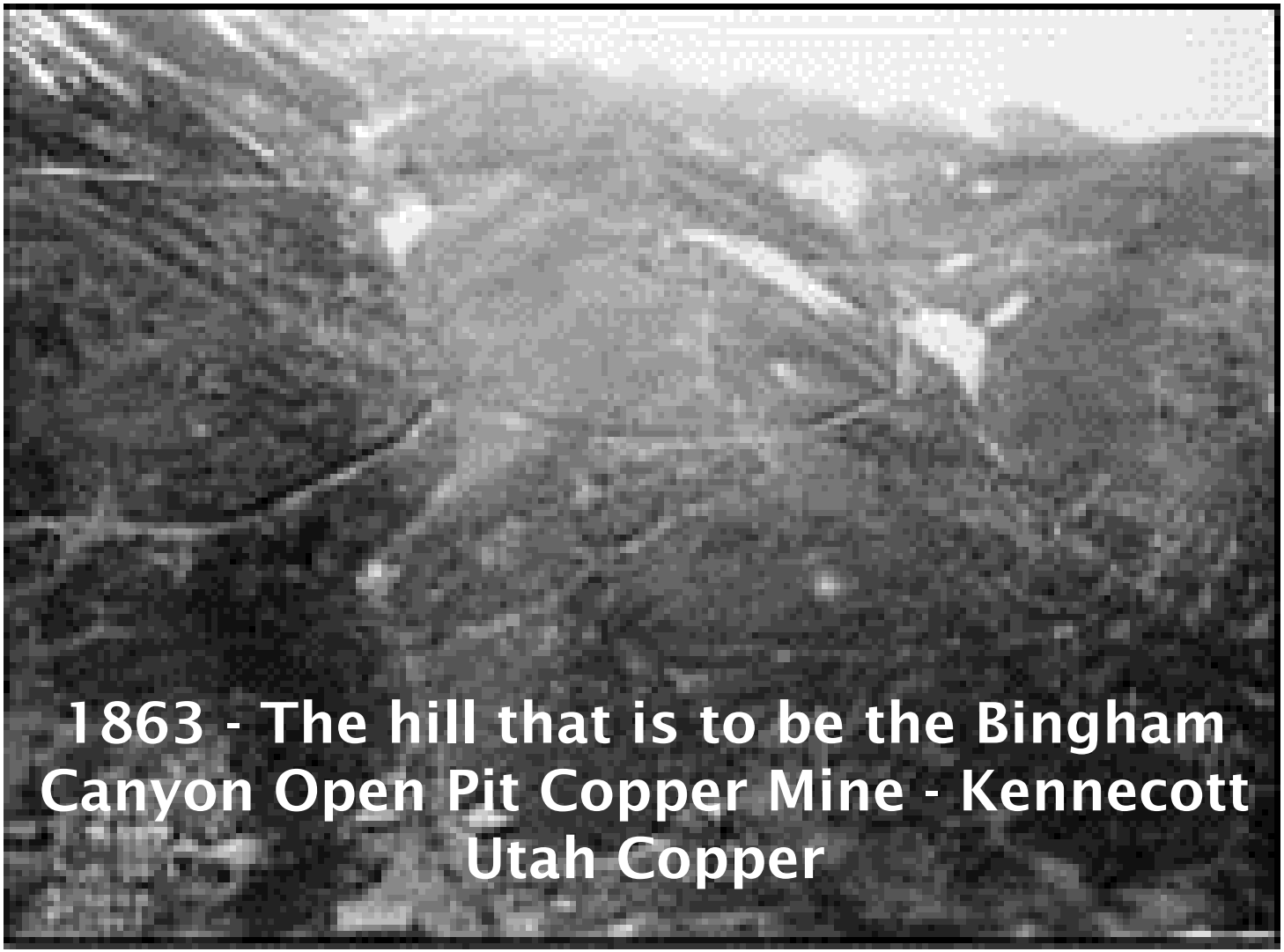
THEN



1863 - The hill that is to be the Bingham Canyon Open Pit Copper Mine - Kennecott Utah Copper

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NOW

2012

The Bingham Canyon Open Pit Copper Mine

Kennecott Utah Copper

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- Inexpensive
- Delivered on site
- Dust cover
- Organic matter
- Moisture Retention
- High in nitrogen

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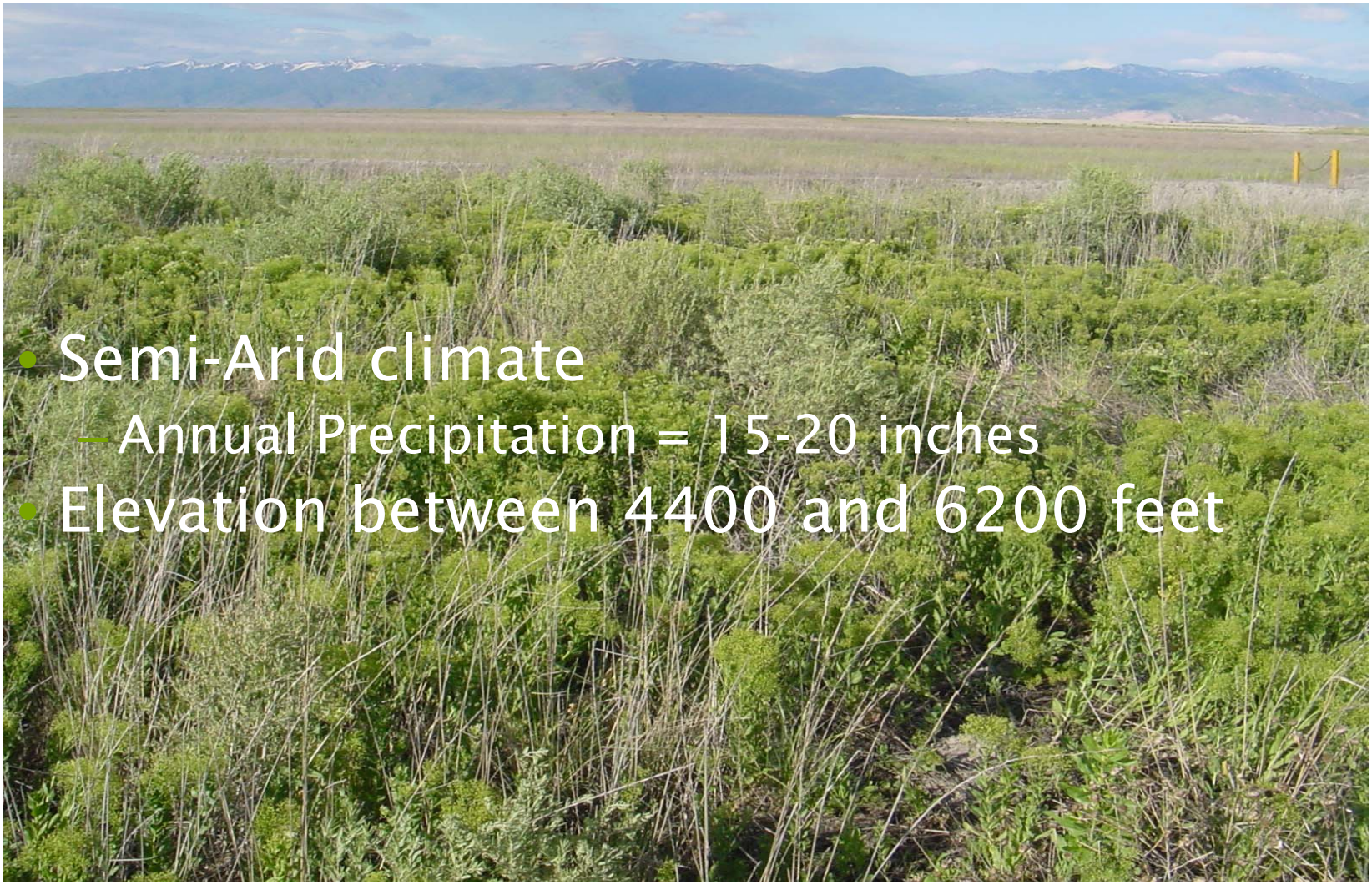
Reclamation Test Plots established in 1995 and in 2000



- Semi-Arid climate
  - Annual Precipitation = 15-20 inches
- Elevation between 4400 and 6200 feet

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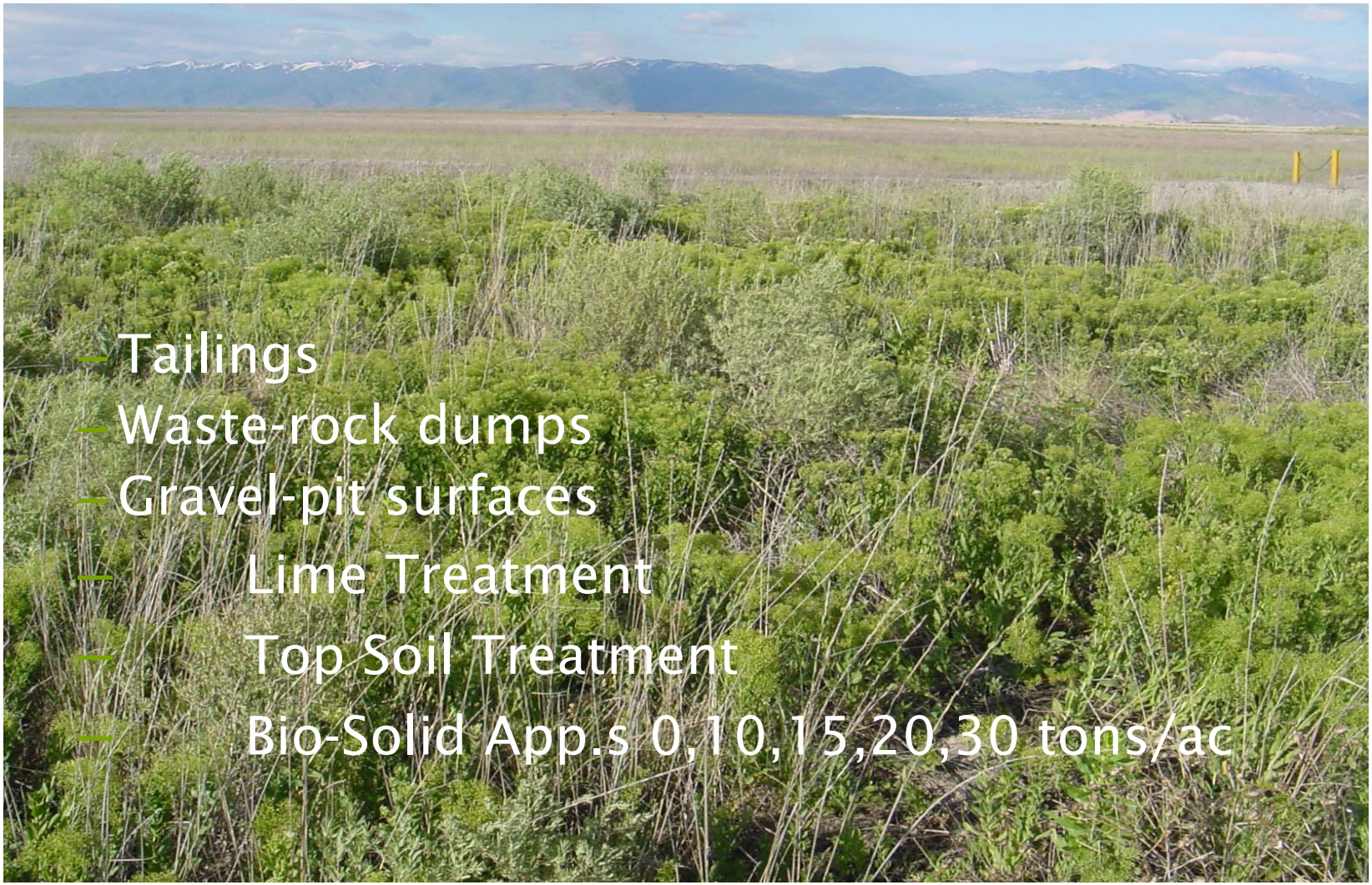
Reclamation Test Plots established in 1995 and in 2000



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Methodology

Test Plot Selection

- Detailed documentation available on establishment date and treatment received
- Plots were older than 5 years (7-10 in some cases)
- Plots had not been disturbed since establishment
- Location and borders of plots identifiable in the field

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Methodology

Vegetation Sampling

- RelevÉ ("sample stand") method - Barbour et al. 1987
  - Absolute percent cover of each plant species - Braun-Blanquet

Vegetation Cover Classes (Braun-Blanquet)

Class	Range of % Cover	Median
1	75-100	87.5
2	50-75	62.5
3	25-50	37.5
4	2-25	15.0
5	1-5	3
+	<1- 0.5	0.75
R*	Rare	*

* R=Individuals occurring seldom or only once; cover ignored and assumed to be insignificant. SOURCE: Mueller-Dombois and Ellenburg 1994

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Methodology

Vegetation Sampling

- RelevÉ ("sample stand") method - Barbour et al. 1987
  - Absolute percent cover of each plant species - Braun-Blanquet
  - Sociability of each plant species - Braun-Blanquet

Sociability Scale (Braun-Blanquet)

Value	Meaning
5	Growing in large, almost pure stands
4	Growing in small colonies or carpets
3	Forming small patches or cushions
2	Forming small but dense clumps
1	Growing singly

SOURCE: Barbour et al. 1987

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Methodology

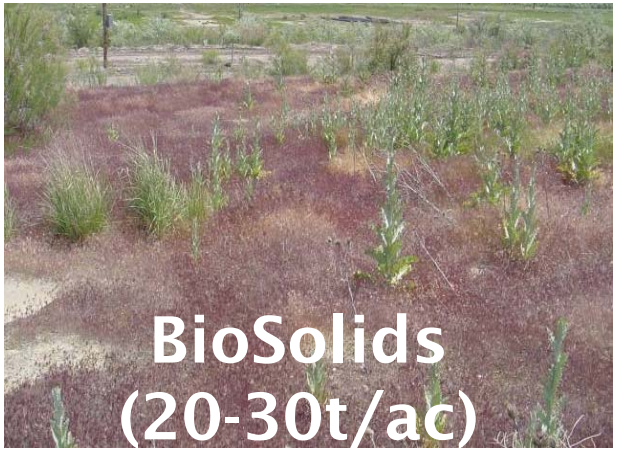
Vegetation Sampling

- RelevÉ ("sample stand") method - Barbour et al. 1987
  - Absolute percent cover of each plant species - Braun-Blanquet
  - Sociability of each plant species - Braun-Blanquet
  - Vigor of each plant species

Vigor Class

Class	Meaning
E	Excellent
G	Good
F	Fair
P	Poor

Site 01-04 Tailings (Elevation 4400 feet)



Weedy Species	# Spp.	2	2
	Cover	11%	88%
Non-Weedy Species	# Spp.	5	1
	Cover	60%	0.2%
Total All Spp.	# Spp.	7	3
	Cover	71%	88%

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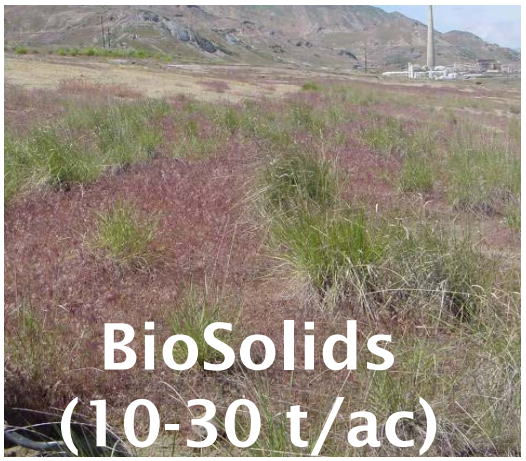
Site 01-05 Tailings (Elevation 4400 feet)



Weedy Species	# Spp.	2	2
	Cover	11%	54%
Non-Weedy Species	# Spp.	3	2
	Cover	64%	46%
Total All Spp.	# Spp.	5	4
	Cover	75%	100%

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Site 01-06 Waste Rock (Elevation 6150 feet)

Weedy Species	# Spp.	3	4
	Cover	6%	92%
Non-Weedy Species	# Spp.	2	2
	Cover	16%	0.4%
Total All Spp.	# Spp.	5	7
	Cover	22%	93%

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Site 01-06 Waste Rock &Soil (Elevation 6150 ft)

Weedy Species	# Spp.	7	6
	Cover	17%	101%
Non-Weedy Species	# Spp.	14	7
	Cover	62%	7%
Total All Spp.	# Spp.	21	14
	Cover	79%	108%

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Site 01-07 Waste Rock (Elevation 6050 feet)

		Non-BioSolids	BioSolids (30 t/ac)
Weedy Species	# Spp.	5	8
	Cover	8%	99%
Non-Weedy Species	# Spp.	14	8
	Cover	120%	29%
Total All Spp.	# Spp.	19	16
	Cover	128%	128%

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Site 01-09 Gravel Pit–no lime (Elevation 5400 ft)

Weedy Species	# Spp.	6	7
	Cover	1.5%	59%
Non-Weedy Species	# Spp.	15	6
	Cover	33%	60%
Total All Spp.	# Spp.	21	13
	Cover	35%	119%

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Site 01-09 Gravel Pit (Elevation 5400 ft)

Weedy Species	# Spp.	4	7
	Cover	0.7%	85%
Non-Weedy Species	# Spp.	14	3
	Cover	48%	25%
Total All Spp.	# Spp.	18	10
	Cover	49%	110%

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Comparison of Absolute Cover and Species Richness between Paired Test Plots

	Weed Species				Non-Weed Species			
Test Plot	Absolute Cover (%)		No. of Species Observed		Absolute Cover (%)		No. of Species Observed	
	BS	NBS	BS	NBS	BS	NBS	BS	NBS
01-04	88	21	2	2	0.2	90	1	5
01-05	54	41	2	2	46	64	2	3
01-06 Tailings	92	6	4	3	0.4	16	2	2
01-06 Soil	101	17	6	7	7	62	7	14
01-07	99	8	8	5	29	120	8	14
01-09 No Trts	59	1.5	7	6	60	33	6	15
01-09 All Trts	85	0.7	7	4	25	48	3	14

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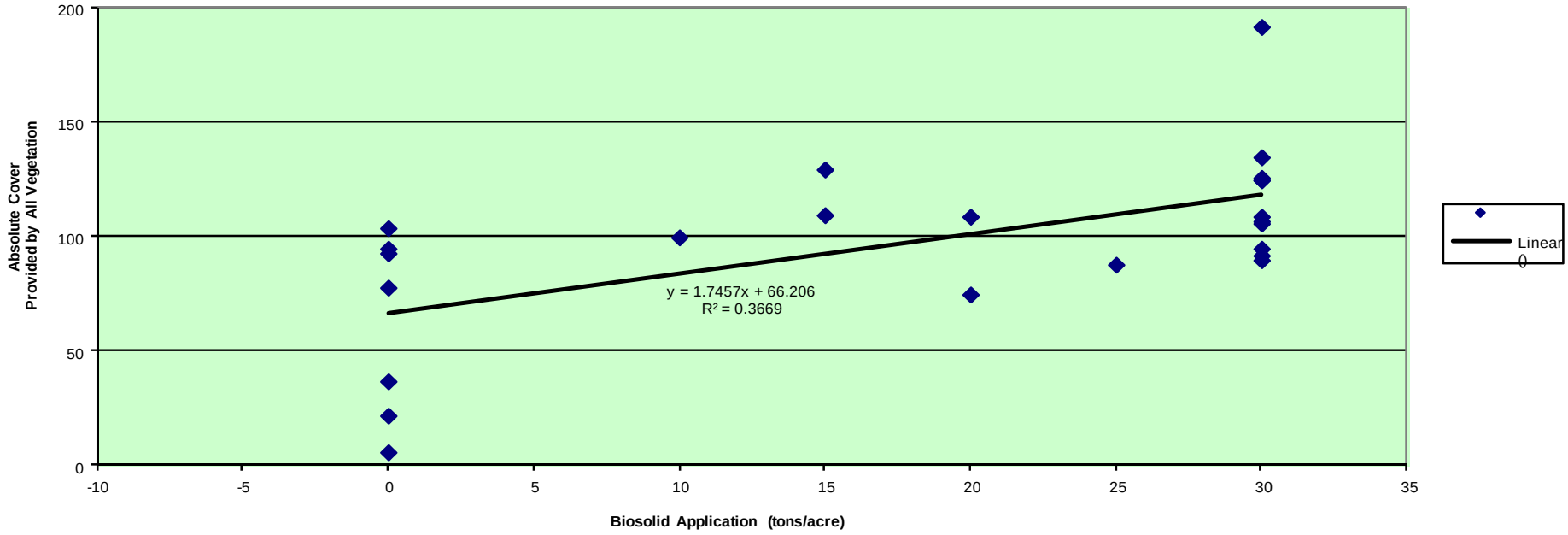
Absolute Cover provided by All Species versus tons of Biosolids (applied for all paired sub-plots)



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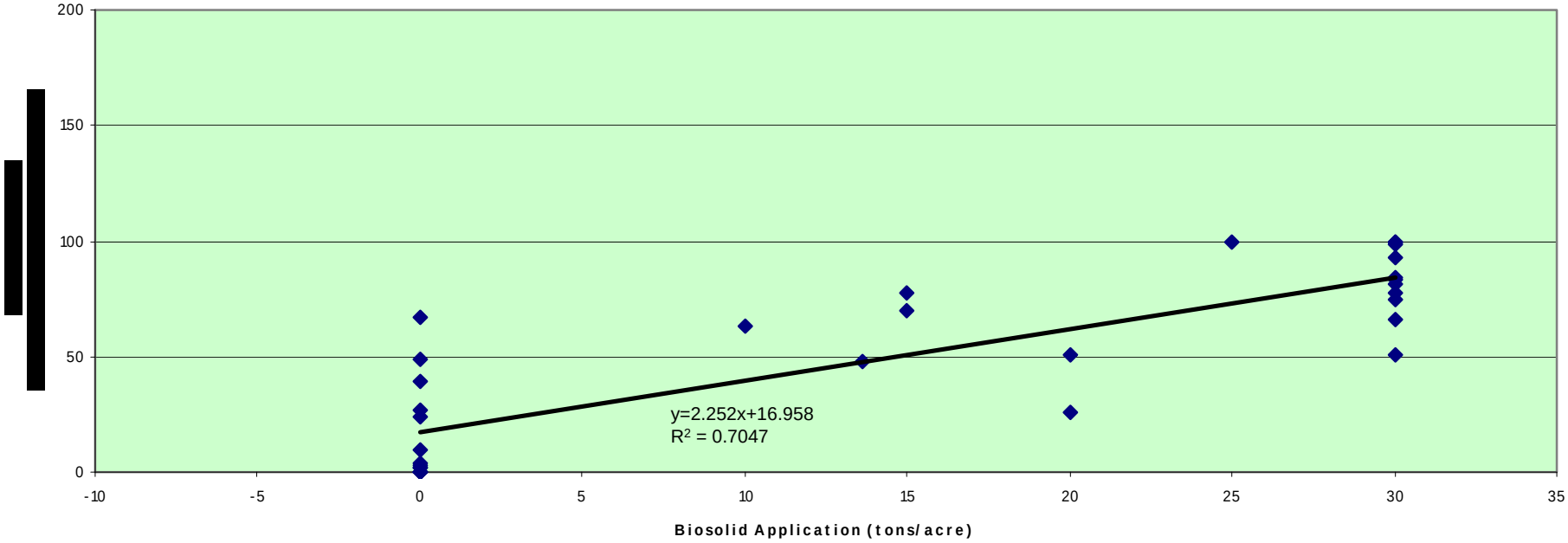
Absolute Cover provided by Weedy Species versus tons of Biosolids (applied for all paired sub-plots)



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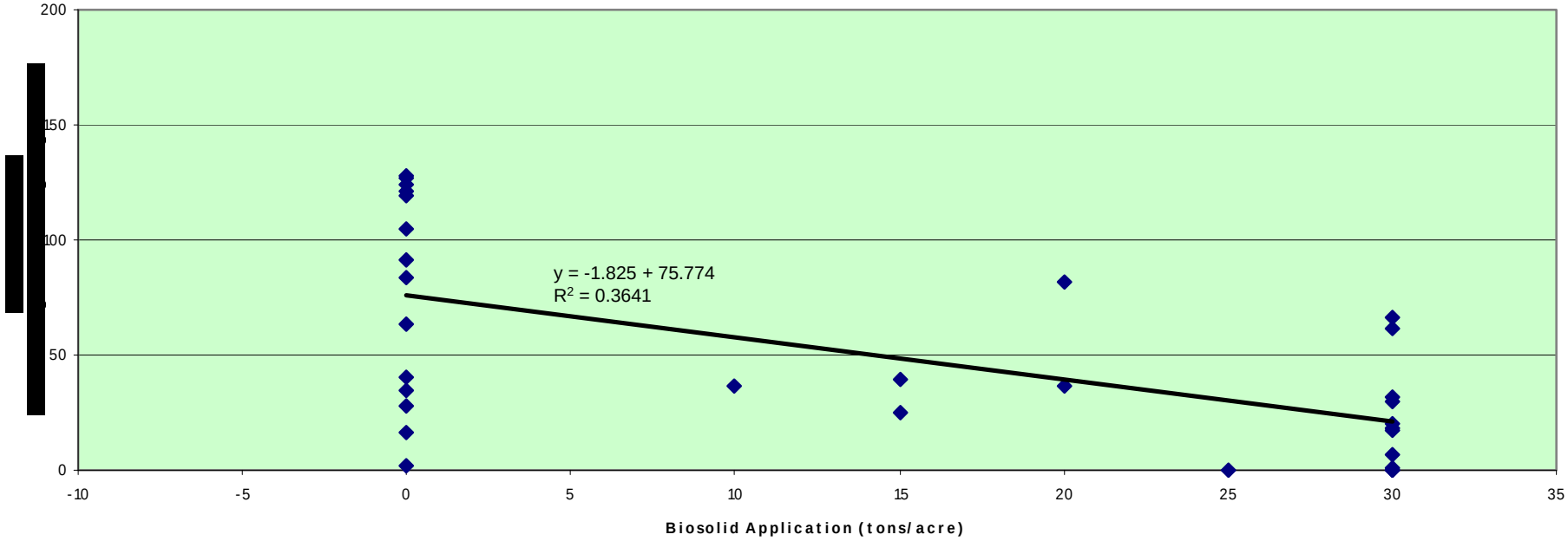
Absolute Cover provided by Non-Weedy Species versus tons of Biosolids (applied for all paired sub-plots)



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