Evolution of a Monitoring System - Wyoming AML Reclamation Evaluation Program

Presenters:
Joe Schroeder

ABNOVA
ECOLOGICAL SOLUTIONS

TETRA TECH

WYAML Monitoring Program Overview

#1 – Issuance of Site List

#2 – Site Data Acquisition & Review

#3 – Site Prioritization

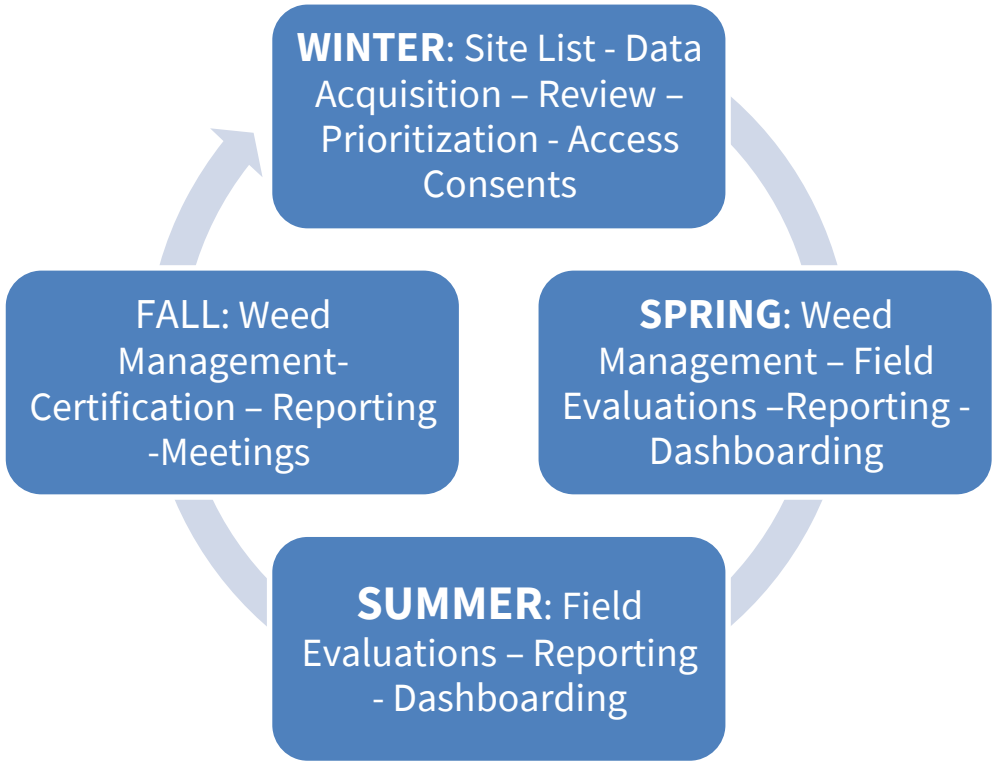
#4 – Access Consents

#5 - Field Evaluation

#6 – Weed Management Planning/Oversight

#7 – Data Processing

#8 – Reporting

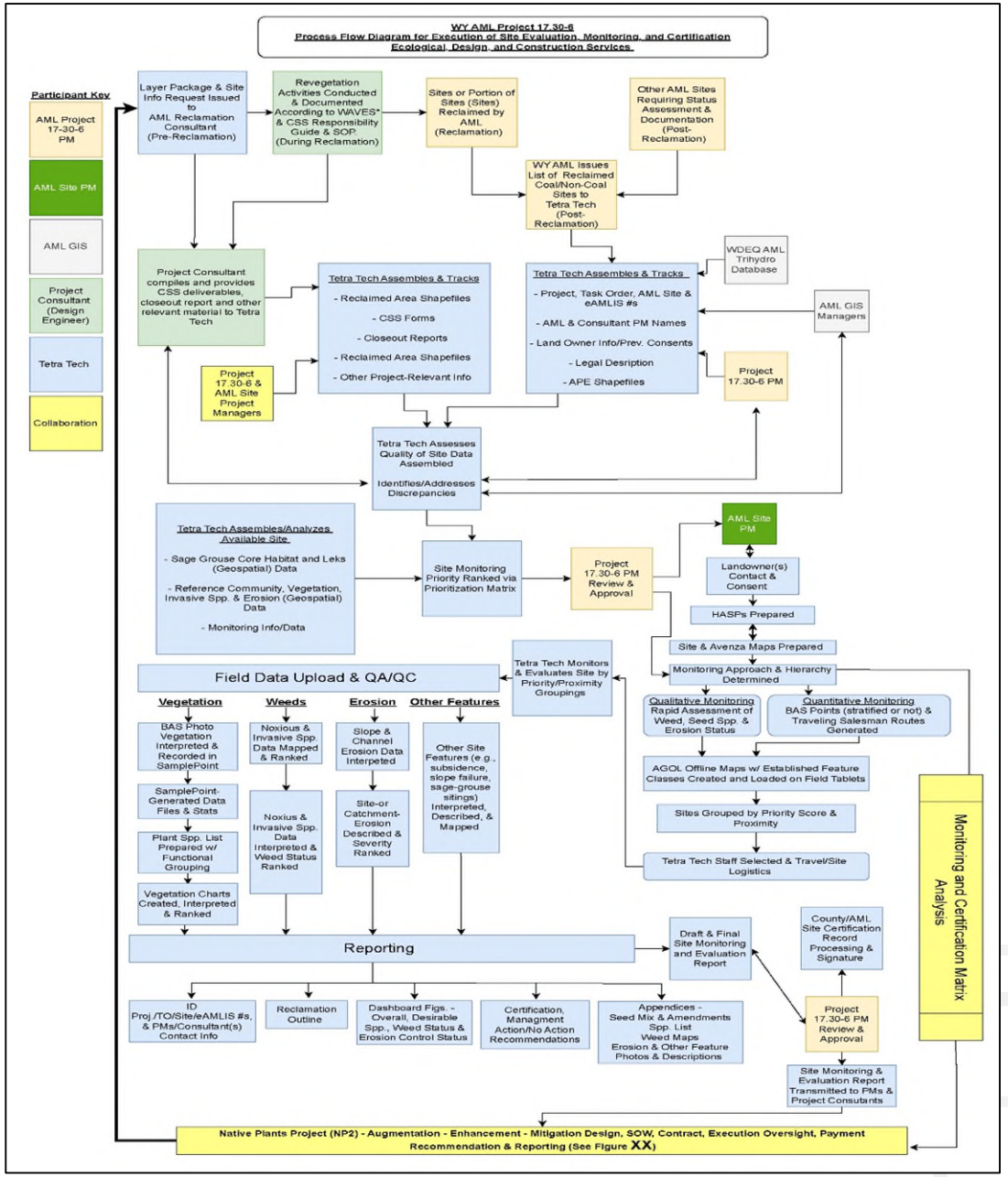


Monitoring Program Overview

Administration

Site Evaluations

Reporting

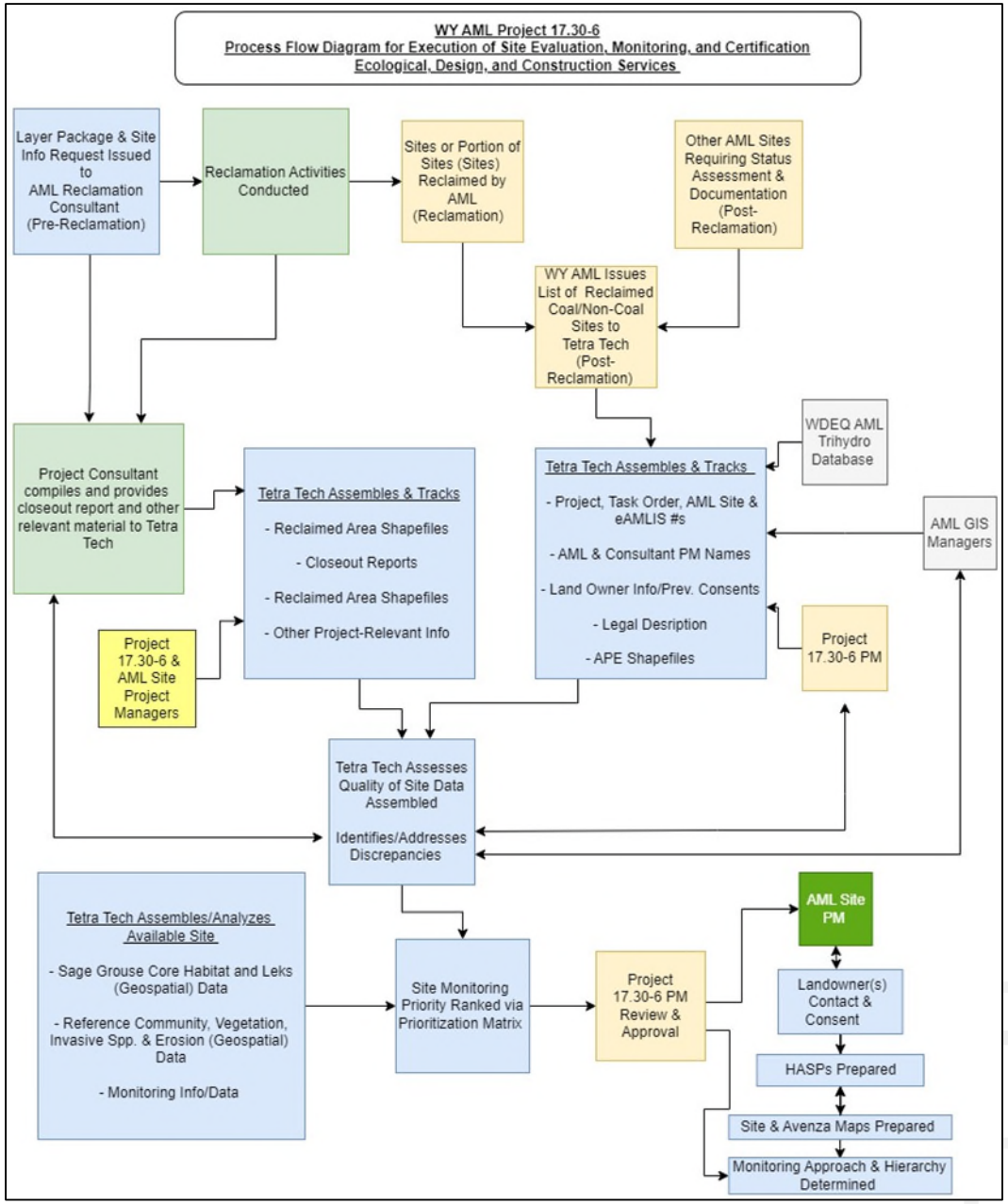


Administration

The administrative time/cost per site has been decreasing every year and is in the process of disappearing.

Why?

Certified Seeding Specialist Program & Deliverables



Administration: Site Prioritization

- Site prioritization is:
  - One of the final administrative stages.
  - A tool to evaluate the administrative and ecological context of a site
  - An information source that field staff reviews prior to evaluating a site
  - Adaptable based on AML priorities
  - Continually improving

Site ID: Deitz 1-4, 7 & 8 — Date Ranked: 5/25/2023 — Date Approved: 5/XX/2022

Ranked by: Henry Sauer, Christina Coulter

Approved by : Joe Schroeder

Ranking Factor	Category	Score	Weighted Score	Rank System	Notes/Comments
Land Surface Reclamation for young sites (0-2 years) (5x weight)	Erosion Features	1	5	**High Priority (3)** - Major erosion features exist OR erosion potential is high. **Medium Priority (2)** - Minor erosion features exist OR potential is moderate. **Low Priority (1)** - No erosion features exist OR potential is low.	Henry - Reveg of 19.3 acres on 11/16 & 20/2020 following sinkhole and subsidence mitigation include ripping, disking, 131 lbs/ac Humate (at 55% humic acids) applied to soil surface and 33 lbs/ac mycorrhizal fungi (at 40K live spores/lbs) incorporated into soil (during drill seeding) and fencing installed as well; 1 Qt Milestone plus 1 lb. Escort herbicide mixed with 200 gallons of water an sprayed on 10 acres. Same mixture applied to a separate 10 acres for a total of 20 acres treated on June 1, 2020 (RESPEC). Treated area shown to the right. See seed mixture sown at site to the right. Seeds of 18 spp. sown as follows: 6-Triticeae, 2-Stipeae, 1-Poeae, 1-Chloridoideae, 1-Avenaeae, 2 -shrubs (1-sagebrush, 1-subshrub), 5 forbs, w/ triticale nurse crop. Elev. 3.8K Henry - Joe Schroeder's note based on Tetra Tech July 22, 2021 site evaluation. The Dietz reclamation areas are 70-80% bare ground, with very sparse and discontinuous cover from drillseeded wheatgrasses and sparse to moderate cover from invasive species such as Scotch thistle, burdock (Arctium minus), Canada thistle (Cirsium arvense), houndtongue (Cynoglossum officinale), Russian knapweed (Rhaponticum repens), field bindweed (Convulvulus arvense), and common mullein (Verbascum thlapsus). Overall, the vegetation condition of the reclamation areas starkly contrast adjacent healthy and diverse native sagebrush steppe and mixed-grass prairie. It is unclear what the seed source of the invasive species was but the populations are localized within the site's drillseeded areas, dried out water impoundments, and mine-shaft cave-ins. In combination, these areas are dispersed throughout the Dietz site and, due to the high diversity and productivity of invasive weed species within them, they are functioning as invasive plant nurseries that risk expanding invasive species populations across the site and into adjacent lands. Henry- Tt plans herbicide application to control weeds identified by Tt in 2021. Henry - Despite the poor vegetation cover and widespread presence of several noxious weed species described above erosion was limited at the time of the site evaluation to minor rill networks as slope gradient of most reclaimed areas is low. Christina - NDVI 87.63% of adjacent
	Undesirable Species	2	10	**High Priority (3)** - Weeds previously identified but not managed at the site. **Medium Priority (2)** - Weeds identified and managed, no follow up monitoring occurred. **Low Priority (1)** - No weeds previously identified at site	
	Desirable species establishment	3	15	**High Priority (3)** - Lack of desired vegetation establishment. **Medium Priority (2)** - Low/moderate desired vegetation establishment. **Low Priority (1)** - High desired vegetation establishment.	
Land Surface Reclamation for sites 3+ years (5x weight)	Erosion Features		0	**High Priority (3)** - Major erosion features exist. **Medium Priority (2)** - Minor erosion features exist **Low Priority (1)** - No erosion features exist.	
	Undesirable Species		0	**High Priority (3)** - Weeds previously identified but not managed at site. **Medium Priority (2)** - No weed surveys conducted or weeds identified and managed but no followup monitoring conducted. **Low Priority (1)** - Surveys conducted and no weeds identified at the site.	
	Desirable Species Establishment		0	**High Priority (3)** - Lack of forb OR shrub richness AND/OR lack of cover from desirable grasses AND/OR sagebrush not evident on sites. **Medium Priority (2)** - Forbs AND shrubs exist at richness levels less than reference area OR below regulatory criteria AND/OR moderate cover from desired grasses AND/OR sagebrush evident on site but doesn't meet density requirements. **Low Priority (1)** - Forb AND shrub richness exist at levels equal to or greater than reference area AND in satisfactory to regulatory criteria AND acceptable cover from desired grasses AND sagebrush present and meets	
Ecological Setting (3x Weight)	Reference Community	2	6	**High Priority (3)** - Within or adjacent to sage-grouse core habitat. **Medium Priority (2)** - Not adjacent to sage-grouse core, but in otherwise suitable habitat areas for other [illegible] **Low Priority (1)** - In degraded habitat, adjacent or within populated areas.	
	Proximity to lek	1	3	**High Priority (3)** - Within 3.1 miles of a lek **Medium Priority (2)** - Between 3.1 and 5 miles of a lek **Low priority (1)** - >5 miles from a lek	
Time since last monitoring (3x weight)	Time since last monitored	1	3	**High Priority (3)** -- First year site OR second year site which hasn't been monitored OR older site which hasn't been monitored in 5+ years. **Medium (2)** -- Site hasn't been monitored in past 3-4 **Low priority (1)** -- Site was monitored within past 2	Henry - July 22, 2021 by Tetra Tech 2023 JMS Rescore Comment: Site was monitored in 2022.
Site Ownership (3x Weight)	Ownership	3	3	**High Priority (3)** - Private ownership **Medium Priority (2)** - Split private/public ownership **Low Priority (1)** - Public ownership	Henry- Private (Source: RESPEC Close Out Rpt.)
Size of Site (1x Weight)	Reclamation Area	2	2	**High Priority (3)** - Site > 50-acres **Medium Priority (2)** - Site >1 acres, <50 acres **Low Priority (1)** - Site <1 acres	Henry - 123 acres site. Reclaimed area as of 2021 appears to be ~ 20 acres.
Priority Assessment					
Weighted Score (Sum) =			53		
Weighted Score (Average) =			6.6		

Table 3. Lowland Seed Mix

Species	Scientific Name	PLS lbs./acre
Slender Wheatgrass	*ELTR7*	0.80
Canada Wildrye	*ELCA4*	1.00
Basin Wildrye	*LECI4*	0.80
Basin Big Sagebrush	*ARTRT*	2.40
Western Yarrow	*ACMI*	0.10
Upright Prairie Coneflower	*RACO*	0.40
Scarlet Globe Mallow	*SPCO*	0.40
	Total PLS lbs./acre:	5.90

Table 4. Slope Seed Mix

Species	Scientific Name	PLS lbs./acre
Western Wheatgrass	*PASM*	4.60
Green Needlegrass	*NAVI6*	1.50
Thickspike Wheatgrass	*ELLAL*	3.00
Needle and Thread	*HECO*	2.30
Bluebunch Wheatgrass	*PSSP6*	2.50
Sandberg Bluegrass	*POSE*	0.40
Prairie Junegrass	*KOMA*	0.20
Blue Grama	*BOGR*	0.40
Sterile Triticale	*TRAX*	1.20
American Vetch	*VIAM*	3.00
Purple Prairieclover	*DAPU*	0.60
Big Wyoming Sagebrush	*ARTRW*	0.30
Winterfat	*KRLA*	1.20
	Total PLS lbs./acre:	21.20

Table 5. Upland Seed Mix

Species	Scientific Name	PLS lbs./acre
Western Wheatgrass	*PASM*	3.00
Green Needlegrass	*NAVI6*	1.00
Thickspike Wheatgrass	*ELLAL*	2.00
Needle and Thread	*HECO*	1.50
Bluebunch Wheatgrass	*PSSP6*	1.60
Sandberg Bluegrass	*POSE*	0.25
Prairie Junegrass	*KOMA*	0.10
Blue Grama	*BOGR*	0.25
Sterile Triticale	*TRAX*	0.80
American Vetch	*VIAM*	2.00
Purple Prairieclover	*DAPU*	0.40
Wyoming Big Sagebrush	*ARTRW*	0.20
Winterfat	*KRLA*	0.80
	Total PLS lbs./acre:	13.90

Administration: Site Prioritization Summary Table

Summary of 2022 Site Scores		Cottonwood Creek Bentonite	Crows Nest NW #20	Dave Johnston	Day Loma Overall	Day Loma 2012	Day Loma 2014	Deep Creek North #35 & South #26
Ranking Factor	**Category**	**Wt. Score**	**Wt. Score**	**Wt. Score**	**Wt. Score**	**Wt. Score**	**Wt. Score**	**Wt. Score**
Land Surface Reclamation for young sites (0-2 years) (5x weight)	Erosion Features	15	5	0	0	0	0	5
	Undesirable Species	10	5	0	0	0	0	5
	Desirable species establishment	10	5	0	0	0	0	5
Land Surface Reclamation for sites 2+ years (5x weight)	Erosion Features	0	0	10	15	10	15	0
	Undesirable Species	0	0	10	15	15	15	0
	Desirable Species Establishment	0	0	10	15	15	15	0
Ecological Setting (3x Weight)	Reference Community	9	6	9	9	9	9	9
	Proximity to lek	9	6	9	9	9	9	9
Time since last monitoring (3x weight)	Time since last monitored	9	9	3	3	3	3	9
Site Ownership (3x Weight)	Ownership	3	6	9	6	6	6	3
Size of Site (1x Weight)	Reclamation Area	2	2	3	3	3	3	2
Priority Assessment								
Weighted Score (Sum) =		**67.0**	**44.0**	**63.0**	**75.0**	**70.0**	**75.0**	**47.0**
Weighted Score (Average) =		**8.4**	**5.5**	**7.9**	**9.4**	**8.8**	**9.4**	**5.9**

Group Site Prioritization

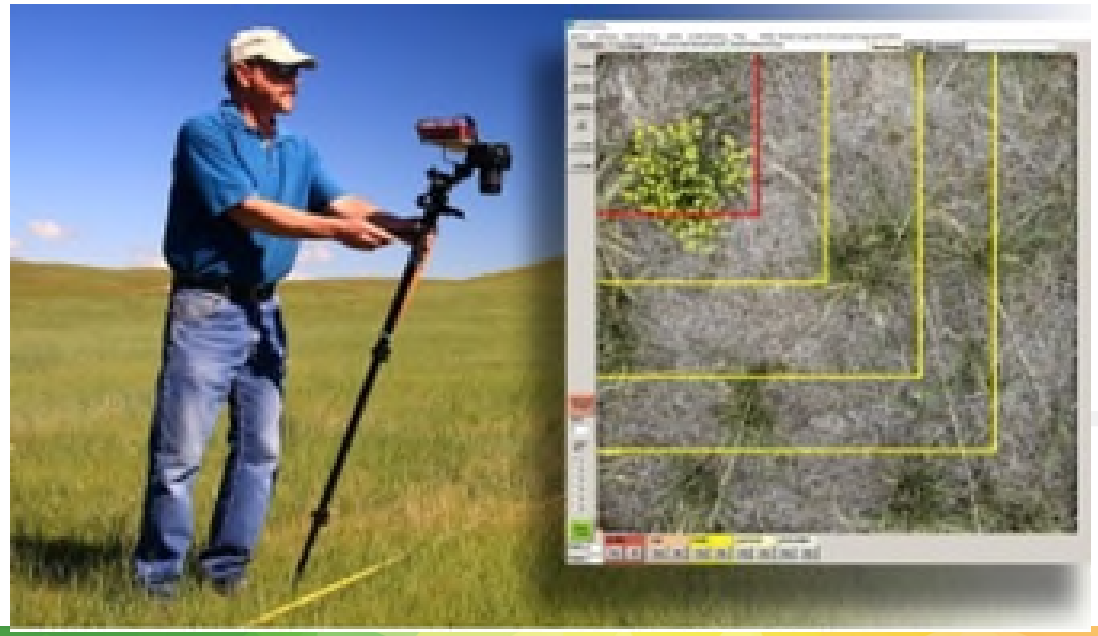
- It's inefficient to crisscross the state to evaluate sites sequentially based on individual site priority.
- To avoid this inefficiency, we group sites based on proximity to each other and average the group priority scores.
- We then visit sites sequentially, based on group priority score.

Grouping	Site Name	Site Ownership	Weighted Score (Sum) =	Weighted Score (Average) =	Group Priority Score
1	Site ID: Little Medicine Bow	Mixed	71	8.9	8.85
	Site ID: Shirley Basin Pile 400	Mixed	70	8.8	
2	Site ID: Elk Mountain	Private	78	9.8	8.05
	Site ID: Horse Creek Limestone Quarry	Private	72	9	
	Site ID: Nebraska	Private	59	7.4	
	Site ID: Carbon No. 3	Mixed	50	6.3	
	Site ID: Hanna No. 4 (Grouting)	Private	79	9.9	
	Site ID: Rawlins Prospect	Private	47	5.9	
3	Site ID: Reliance Tipple	Private	56	7	7.37
	Site ID: CC & C No 2 Mine	Private	61	7.6	
	Site ID: Colony Strip Mine No.2 (Colony Coal	Private	70	8.8	
	Site ID: D.O. Clark Mines	Mixed	47	6.7	
	Site ID: Rainbow Mine	Private		5	
	Site ID: Reliance ~~& Reliance~~ Mine1 ~~No. 5~~	Private	65	8.1	
	Site ID: Rock Springs No. 7 & 9 Mines	Private		5	
	Site ID: Star No. 3 Mine	Private	59	7.4	
	Site ID: Superior "D"	Private	61	7.6	
	Site ID: Superior No. 1	Private	66	8.3	
	Site ID: Superior No. 3 & Copenhagen Mines	Private	72	9	
	Site ID: Sweetwater Mine	Public	58	7.3	
	Site ID: Sweetwater Mine No. 1	Private	64	8	
4	Site ID: Old Spencer Mine	Public	60	7.5	6.73
	Site ID: Pettingrew	Public	66	8.3	
	Site ID: Mahoney Lake	Public	35	4.4	
5	Site ID: Dave Johnston	Private	63	7.9	6.24
	Site ID: Deitz 1-4, 7 & 8	Private	53	6.6	
	Site ID: Record-Eveland	Private	59	7.4	
	Site ID: Storm King	Private	64	8	
	Site ID: Bighorn Forest No. 2	Public	37	4.6	
	Site ID: Black Diamond Tipple (Timm Mine)	Private	40	5	
	Site ID: Burgess Visitor Center	Public	37	4.6	
	Site ID: Cottonwood Creek Bentonite	Public	67	8.4	

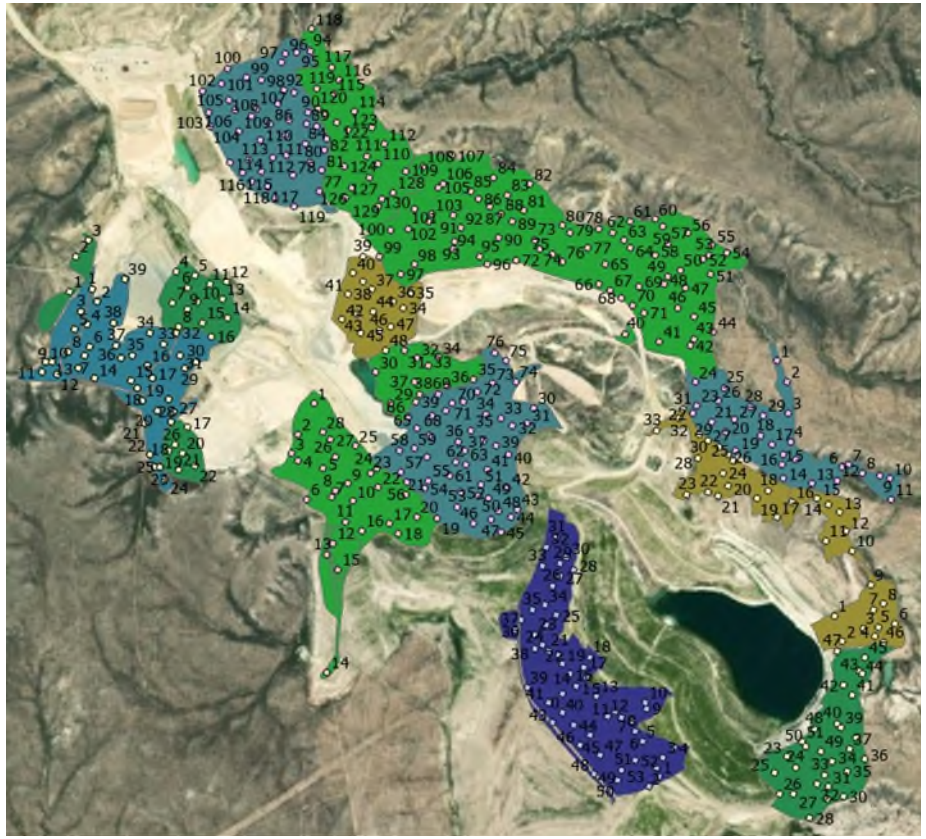
Finally! Site Evaluations

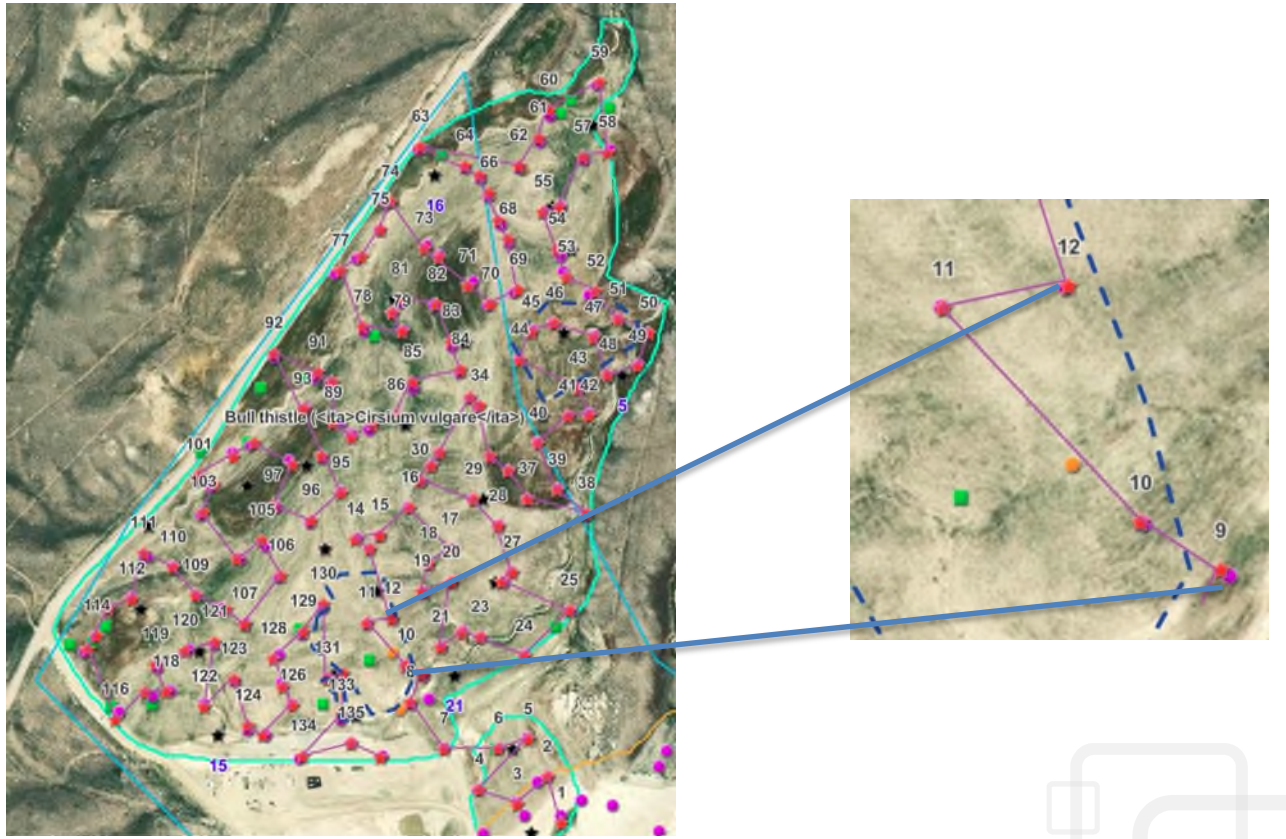
- The old monitoring system
  - Line point intersect and Daubenmire plots
    - Time intensive and takes away from field investigations
    - Quality of data likely decreases towards the end of the day.. and there's no way to evaluate data quality

- The new monitoring system:
  - Image-based monitoring and BAS sampling
    - Extremely fast to collect data
      - More time for site investigations
    - Research-grade data collected
    - Ability to revisit photo plots to answer additional questions, whenever needed.
    - Very strong platform (SamplePoint) to sample the photoplots in a controlled environment.



BAS Sample Points and Everything Between





Summary

- Able to collect data in fraction of time compared to LPI and better site coverage
- Increased
  - Statistical power
  - Analysis capabilities
  - Power of site characterization
- Permanent record
- Cost savings increase as study area increases
- Leads to rapid report generation and easy to understand reports

Dashboard Driven Reports

- Visual representation of performance metrics
- Ability to quickly ID and correct negative trends
- Measure efficiencies/inefficiencies
- Ability to make more informed decisions based upon collected intelligence
- Align strategies and overall goals
- Total visibility of entire project
- Data > Knowledge > Action > Improved Practices (current and future)

Traffic Light Dashboard Indicators

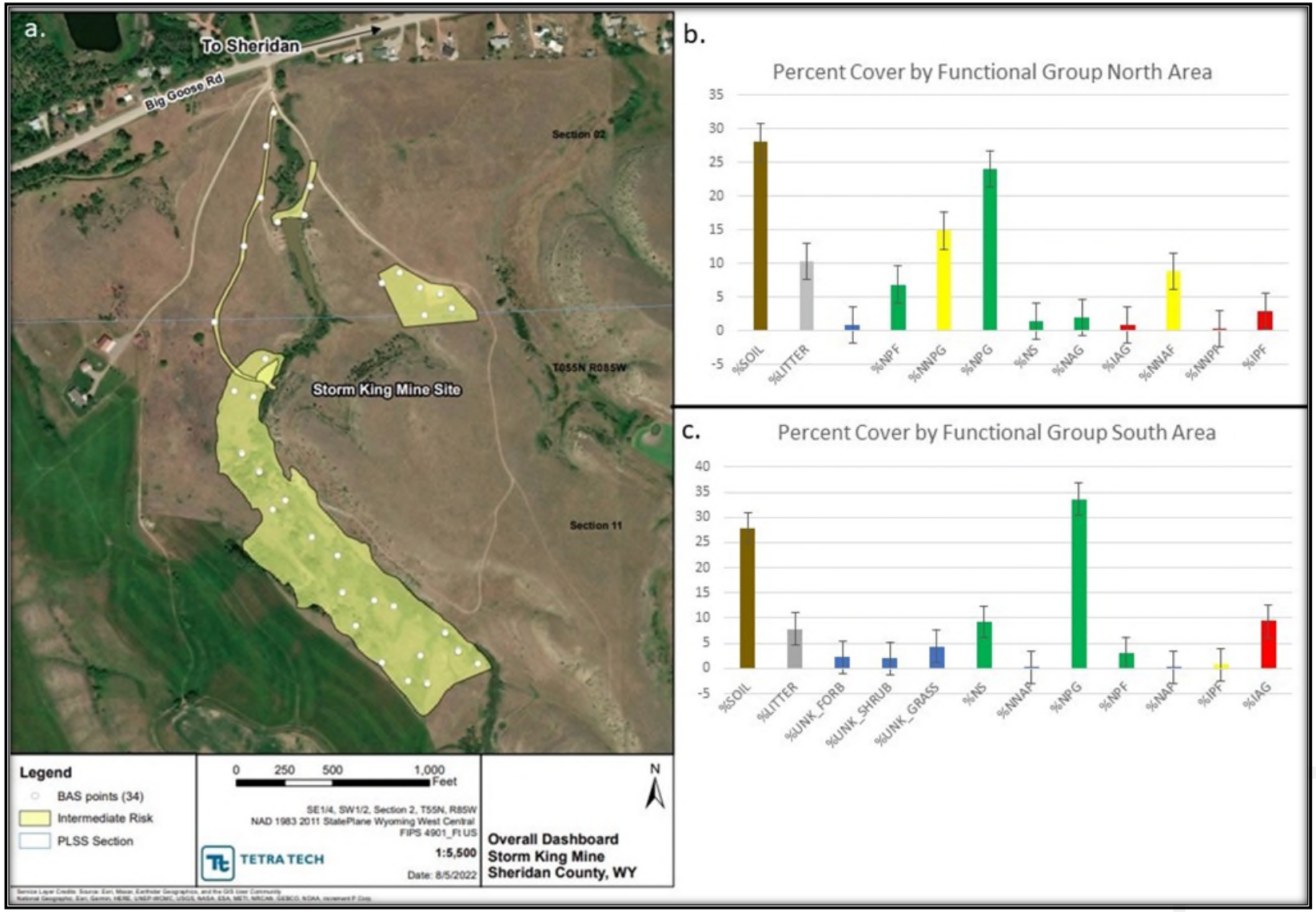
Kerzner, H. 2013. Project Management: Metrics, KPIs, and Dashboards. International Institute for Learning

Report Framework

	GREEN - No/Very Low Risk	LIME GREEN - Low Risk	YELLOW - Intermediate Risk	ORANGE - High Risk	RED - Extreme Risk
Overall Site Assessment *(based on supporting category assessments below)*	Relevant monitoring data suggest site condition is good, with no weed, erosion, bare ground, or desired species issues. No management actions are necessary. For old sites (3+ years since reclamation), consider site certification or continue monitoring for young sites (0-2 years since reclamation).	Relevant monitoring data suggest site condition is good, with very minor weed, erosion, bare ground, and desired species issues. Management actions are unnecessary or very minor. For old sites, consider site certification, one-year additional monitoring at minimum, or continued monitoring for young sites.	Relevant monitoring data suggest site conditions are moderate, with singular or combinations of weed, erosion, bare ground, or desired species issues. The necessity for management action is uncertain and based on professional judgement, careful evaluation of and ambiguous or conflicting trends in site data, and consultation(s).	Relevant monitoring data suggest site condition is marginal with combinations of weed, erosion, bare ground, or desired species issues. For young and old sites, necessity for action is likely and based on professional judgement, careful evaluation of and corroborating trends in site data, and consultation (if necessary).	Relevant monitoring data suggest site condition is poor to severe, with weed, erosion, bare ground, or desired species issues. For young and old sites, necessity for action is unequivocal and based on clear trends in site data.
Weed Status	Weeds do not exist on site.	Successional/non-invasive native weeds exist on young sites or non-native weeds with low invasion potential and density exist on old sites and a resilient adjacent native plant community(s) (where invasive species are absent or rare). Example: Russian thistle present on a site 1-2 years after initial reclamation efforts.	Moderate invasive weed issues exist on site, with, for example, low density or few individual plants of invasive species or larger quantities of non-invasive weeds species, and a resilient adjacent native plant community(s). Professional judgement, careful data review, and consultation are required to determine management action or no action.	Many weed issues exist on site, with, for example, moderate densities of noxious or invasive species with an adjacent native plant community(s) at high risk of being overtaken by invasive weeds. Management action(s) is likely.	Significant weed issues exist on site with, for example, noxious or invasive species present in high densities or Significant weed risk exists on site with, for example, any noxious/invasive weeds at a young site with low native plant cover or at a site (or portion of a site) planned for revegetation within a 2-year timeframe. The need for highly intense management action(s) to reset site trajectory is certain.
Erosion Control Status	Erosion features do not exist on site, and erosion potential is low because of gentle slope gradients.	Erosion features exist on site but are very minor, and erosion potential is low to moderate because of gentle to moderate slope gradients.	Erosion features exist on site that have the potential to cause reclamation failure, and erosion potential is moderate because of moderate slope gradients. Professional judgement, careful data review and consultation are required to determine whether management action is warranted.	Erosion features exist on site that have caused or are highly likely to cause reclamation failure without management action, and erosion potential is high because of high slope gradients.	Severe and widespread erosion features exist on site that have caused significant and widespread reclamation failure, and erosion potential is extreme because of very high slope gradients. The need for highly intense management action to reset site trajectory is certain.
Desired Vegetation Community Status	For young sites, emergence of seeded species from drill rows is evident and uninterrupted. For old sites, vegetation richness and density (or cover) is meeting, or exceeding expectations based on reference site or ESD characterization.	For young sites, emergence of seeded species from drill rows is evident but notably absent from drill rows. For old sites, vegetation richness and density (or cover) is near expectations from the seed mix and vegetation standard (e.g., ESD, reference site), respectively, without dominance by any specific species.	For young sites, emergence of seeded species from drill rows is apparent but absent from 33 to 50% of drill rows. For old sites, vegetation richness and density (or cover) is below the seed mix or vegetation and vegetation standard (e.g., ESD, reference site), respectively, with several species dominating.	For young sites, emergence of seeded species from drill rows is apparent but absent from >50% of drill rows. For old sites, vegetation richness and density (or cover) is well below expectations from the seed mix and vegetation standard (e.g., ESD, reference site), respectively, with one or two dominant species throughout the site.	For young sites, emergence of seeded species from drill rows is absent. For old sites, vegetation richness and density (or cover) is well below the expectations of the seed mix and vegetation standard (e.g., ESD, reference site), respectively. Reseeding or other management action is necessary.

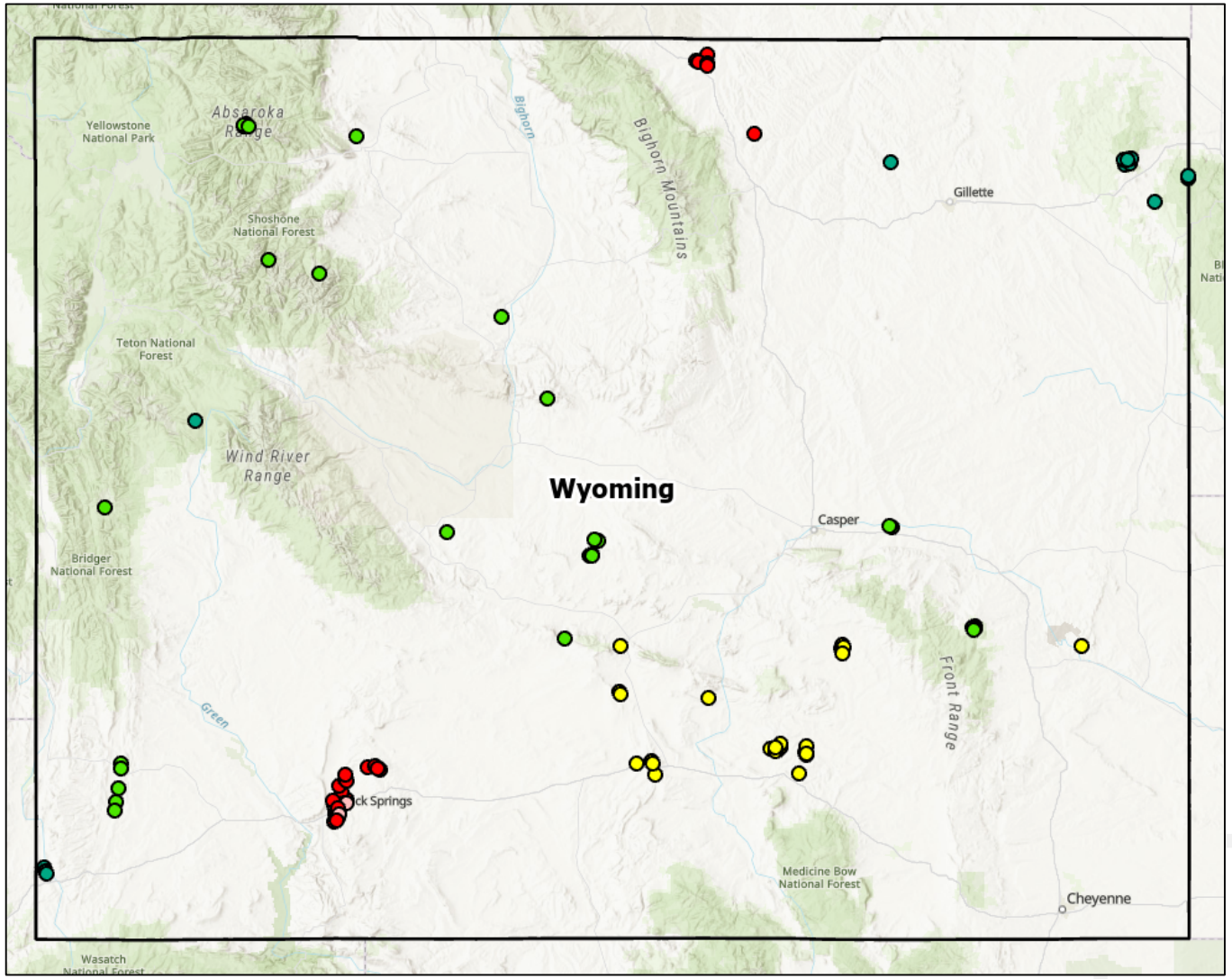
ExampleDashboard

- Traffic light coding used for overall Site rating and, in this case, plant functional group summary charts.
- Data can be split and presented in numerous different ways.



Statewide Dashboarding

- Each monitored and classified Site can then be ported to a state-wide map and/or dashboard system for quick administrative reference.
- Each point could be hyperlinked to the Dashboard reports, along with any other desired supporting information.
- The system could be used for administrative purposes and as a communication tool for interagency collaborations.



Our Work's Not Done

- Continue building and memorializing institutional knowledge of what does and doesn't work within the AML program.
- Identification of areas for improvement of seeding practices through quantitative analysis of results of different seeding mixes and approaches
- Provide a state-wide web-based mapping product containing traffic light site status (overall, veg, weed, erosion) hyperlinked to the monitoring reports for quick administrative reference.
- Continue identifying data gaps and incomplete administrative records for all monitored AML sites.
- Improve the consistency, dependability and scale of seasonal weed management efforts to encourage more statewide contractor involvement.
- Provide the ability to discern which species, varieties and seed sources are most beneficial for AML to focus on within the Native Plants Project.
- Complete process development for timely reporting/delivery.