PHYSICAL CHARACTERIZATION OF MINE WASTE PILES

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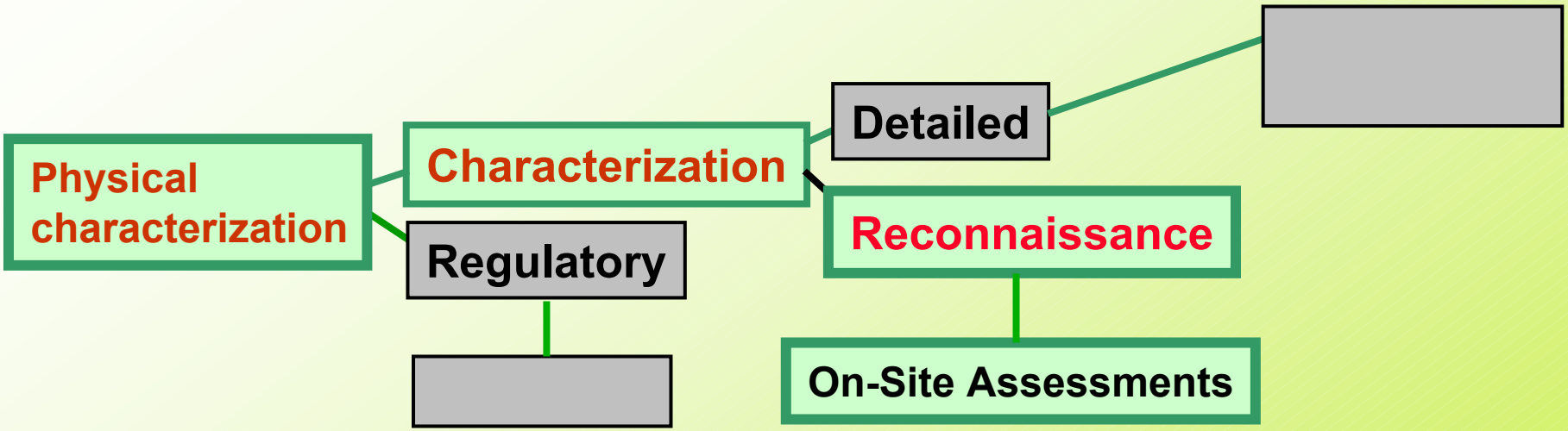
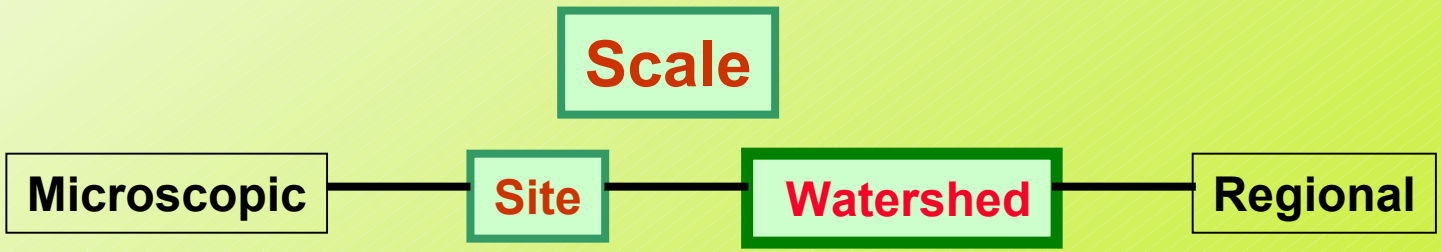
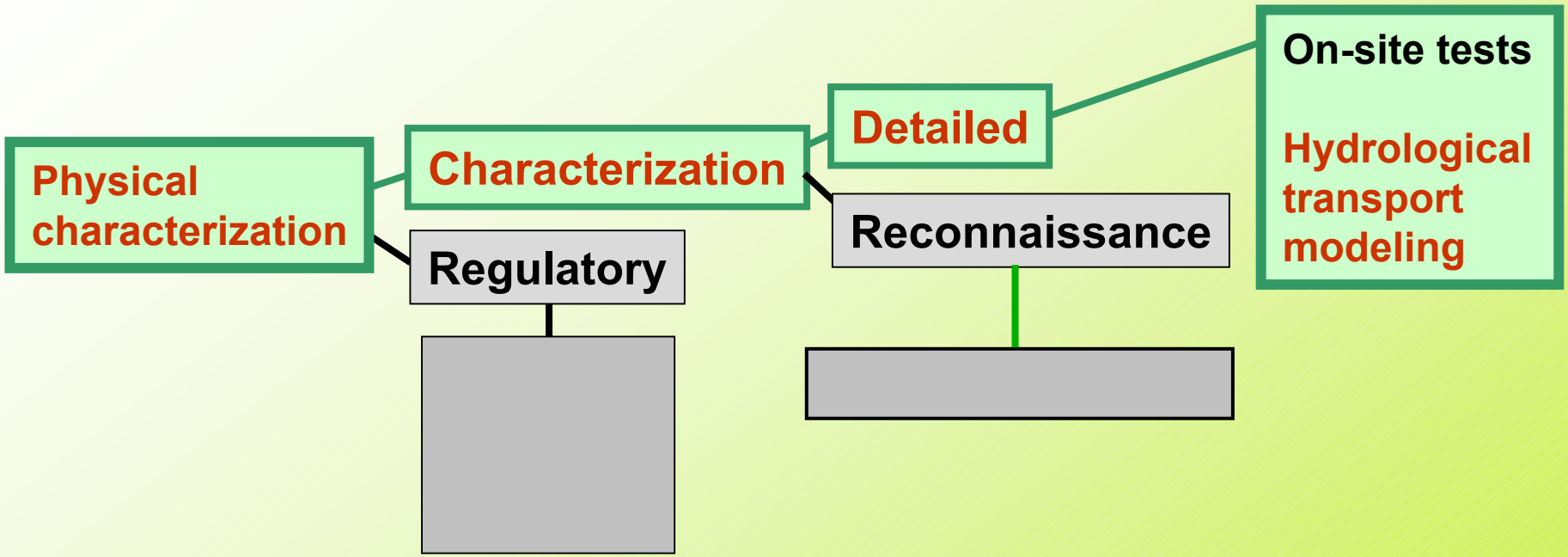
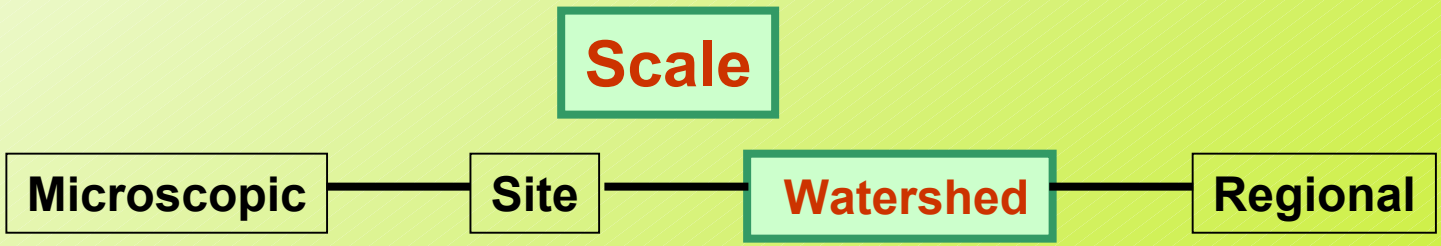
Flow Chart for Ranking and Prioritization (THOMAS WILDEMAN)





Flow Chart for Ranking and Prioritization (ROSALIA ROJAS)





OUR GOAL

- PROVIDE TOXICITY ASSESSMENT & RANKING OF MINE WASTE PILES
  - PHYSICAL & CHEMICAL ASSESSMENT
  - SIMPLE ASSESSMENT TESTS

MINE WASTE DECISION TREE

CHEMICAL CRITERIA

PASTE pH, ALKALINITY

- **< 5** → **Assume Toxicity. Check with TCLP & CDMG extraction tests.**
- **> 5** → **Toxicity Uncertain** → **TCLP, CDMG, & USGS extraction tests are necessary.** **Develop a simple bioavailability test to confirm toxicity.**

PHYSICAL CRITERIA

A. ON-SITE ASSESSMENTS

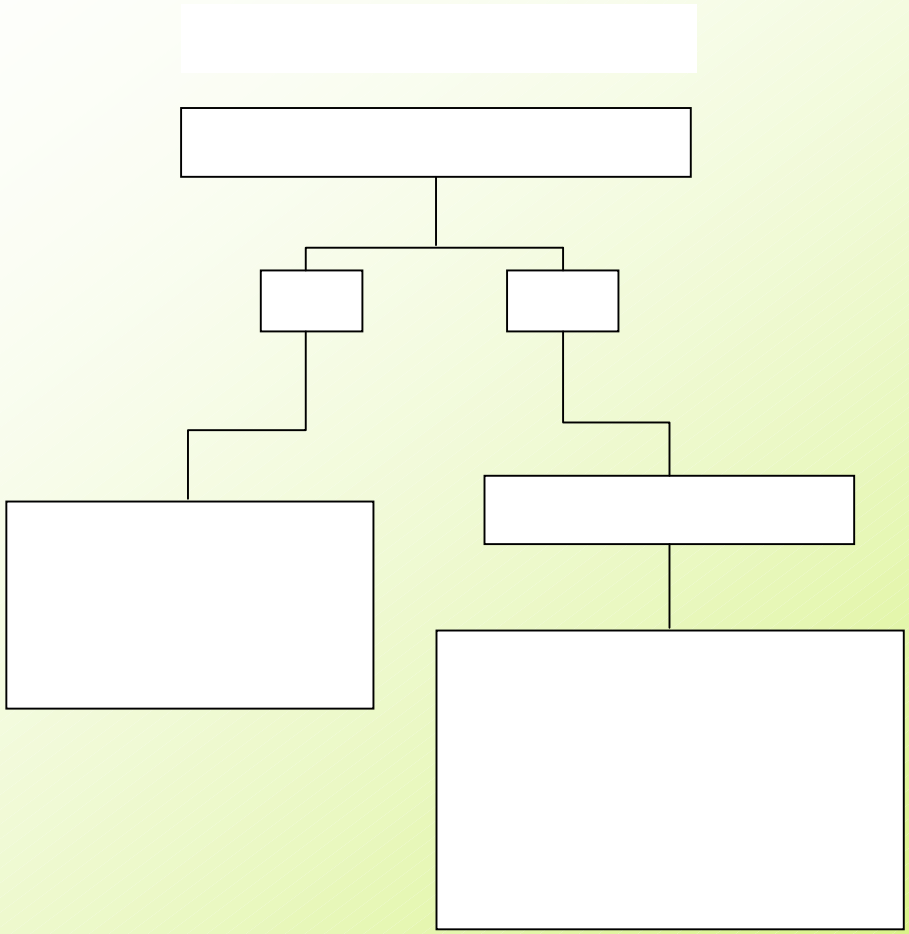
1. **Proximity to year-round or ephemeral stream or gulch.**
2. **Size of waste-rock pile.**
3. **Extensiveness of erosion features.**
4. **Presence of cementation crusts.**
5. **Presence of a kill zone.**
6. **Presence of vegetation.**

B. ON-SITE TESTS

1. **Develop a settling test.**

Concerning the tests and observations within the criteria, only the paste pH test can be used as an either/or criterion for determining toxicity. For the other tests, ratings will have to be developed for which the aggregate score will determine the degree of hazard of a waste-rock pile.

MINE WASTE DECISION TREE



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B. ON-SITE TESTS

1. Develop a settling test.

VIRGINIA CANYON STUDY

- Longitude / Latitude
- Mineralogy & presence of sulfides
- Degree of erosion (0 – 4)
- Volume of pile
- Texture

Related to Terrestrial & Aquatic Toxicity

- Distance from drainage channel
- Vegetation kill zone
- Vegetation on pile

USED IN AN OVERALL ASSESSMENT

RUSSELL GULCH PROJECT

- **PERFORMED SEPARATE PHYSICAL & CHEMICAL ASSESSMENTS.**
- **USED SIX DIFFERENT ON-SITE MEASURES TO MAKE AN OVERALL RATING.**

SAMPLING IN AND AROUND RUSSELL GULCH

- 29 TOTAL LOCATIONS
- 27 WASTE ROCK SAMPLES TESTED FROM 23 LOCATIONS
- 12 WATER SAMPLES TESTED FROM 6 LOCATIONS

SITE RANKING

- BASED ON A FIVE POINT SYSTEM
- POINTS FOR FOUR PHYSICAL CRITERIA AND FOUR CHEMICAL CRITERIA
- POINTS AVERAGED FOR TOTAL PHYSICAL, CHEMICAL, AND OVERALL RANK

PHYSICAL CRITERIA

A. **ON-SITE ASSESSMENTS**
   1. **Size of waste rock pile.**
   2. **Extensiveness of erosion features.**
   3. **Presence of cementation crusts.**

   Related to Terrestrial & Aquatic Toxicity

   4. **Proximity to year round or ephemeral stream or gulch.**
   5. **Presence of a Kill Zone.**
   6. **Presence of Vegetation**

B. **ON-SITE TESTS**
   1. **Develop a settling test.**

SITES CAN BE PHYSICALLY DETRIMENTAL AND CHEMICALLY BENIGN

PHYSICAL RATING CRITERIA

EROSION	DISTANCE TO CHANNEL	VEGETATION ON PILE	VEGETATIVE KILL ZONE
1 = none	1 = > 300 yds	1 = lots	1 = no kill zone
2 = sheet wash	2 = > 100 yds	2 = yes	
3 = rills < 6" deep	3 = > 100 ft	3 = little	3 = very little kill zone
4 = rills 6" – 12" deep	4 = < 100 ft		4 = trees but not underbrush
5 = gullies > 12"	5 = < 10 ft	5 = no	5 = yes

CHASE MINE IN ILLINOIS GULCH

CHASE MINE PHYSICAL RATING

- EROSION – 3 (rills 6” – 12”)
- DISTANCE TO CHANNEL - 2
  (>100 yds)
- VEGETATION – 5 (NONE)
- KILL ZONE – 3 (little kill zone)
- OVERALL PHYSICAL - 3.8 OUT OF 5
- OVERALL CHEMICAL - 3.1 OUT OF 5

GOLDEN WONDER WASTE PILE

PHYSICAL CRITERIA
PITTSBURG MILL TAILINGS

PITTSBURGH PHYSICAL RATING

- EROSION - 5 - (gullies > 12”)
- DISTANCE TO CHANNEL - 5
  (> 10 feet)
- VEGETATION – 5 (NONE)
- KILL ZONE – 5 (big kill zone)
- OVERALL PHYSICAL – 5 OUT OF 5
- OVERALL CHEMICAL – 1.5 OUT OF 5

TONY STANDING IN GULLY AT PITTSBURGH

OBSERVATIONS

- THERE IS LITTLE CORRELATION BETWEEN CHEMICAL AND PHYSICAL RATINGS.
- VEGETATION AND KILL ZONES ARE NOT NECESSARILY CONNECTED TO CHEMICALLY BAD SITES.
- CHEMICALLY BAD SITES DO NOT CONCLUSIVELY HAVE THE WORST IMPACT ON AREA WATER.
- PHYSICALLY BAD SITES DO NOT CONCLUSIVELY HAVE THE WORST IMPACT ON AREA WATER.

BOTH CRITERIA ARE IMPORTANT

- **CHEMICAL**
  - **Ranks availability of contaminants**
- **PHYSICAL**
  - **Ranks ability to deliver contaminants**


RIVER WATER
CONTAMINATED
BY HEAVY
METALS
DO NOT DRINK