LEGACY SITE RECLAMATION

UNIVERSITY OF ALBERTA

"uplifting the whole people"

— HENRY MARSHALL TORY, FOUNDING PRESIDENT, 1908

WHY DO MINES CLOSE?

1. Depletion of mineable reserves, resulting from total extraction within deposit or mine limits
2. Unexpected deterioration in geologic condition
3. Deterioration of market condition
4. Changes in other external market conditions that make the project un-workable (i.e. changes in liability or regulation)
5. Financial non-viability of company or parent company
6. Adverse environmental conditions
7. Adverse political or social conditions

WHY ARE MINES (INTENTIONALLY) ABANDONED?

1. Absence of reclamation policies or regulations
2. Lack of, or ineffective, enforcement of policies and regulations, if they exist
3. Absence of financial security mechanisms, either as incentive to reclaim or for the government to reclaim
4. Insufficient financial security
5. A result of small-scale or artisanal mining
6. Political instability, conflict, & evacuation of area

Government has a role to play in prevention as well!

MINE CLOSURE: A FORWARD FOCUSSED DEBATE

History: abandonment was common practice & there was no responsible party for the site after abandonment.

Recent history: potential cost of reclaiming 100's of thousands of sites & lack of standards have delayed action (+/- 500,000 sites in USA alone).

- Little done unless highly visible. At most fences erected to protect against physical hazards.
- Backcountry recreation has drawn people to these sites
- ARD becoming an issue.

Present: This is a problem that affects everyone. Blaming is not productive (especially if the "guilty" party is bankrupt). We need to tackle it as a multi-stakeholder group and work together.

So, **how do we tackle closure after-the-fact?**

FOCUS ON THE FUTURE: DEVELOPMENT

Ontario, Canada: create future economic & social values in a healthy environment, as opposed to simply cleaning up.

Joint venture between the province and the Ontario Mining Association (OMA). Each provides equal dollar-equivalents:

- Province: **$$$**
  Incentive: reduce pollution, liability
- OMA: Expertise, equipment, supplies, personnel
  Incentive: new exploration on old sites is encouraged

Step 1: inventory & prioritize sites / issues

FIND VALUE IN THE SITE

- Re-mine
- Adaptive re-use of old infrastructure
- Combine waste disposal needs of the region with the mine rehabilitation. Cost splitting.
- Re-use the land for periodic or low-input uses (i.e. forestry, grazing, etc.)

KEY POINT: Go beyond environmental remediation & include elements that contribute to the greater good (employment, social outcomes). This secures long-term stewardship, and can lead to unlikely partnerships.

FIND VALUE IN THE SITE

- Inventory and analysis tells you what is a viable solution
- Community consultation is important!
  - Community may dictate the extent of reclamation they want
  - Be open and honest about outcomes and expectations
- Look for partnerships with other natural resource stakeholders
  - I.e. Fishing Association for help cleaning waterways or a paper products company for help planting trees

IDENTIFYING FUNDING SOURCES

- No single funding approach will provide a complete solution
- Cause marketing: consumers seek companies that give back
  - Companies have found that helping the environment is good for business too. They may seek these opportunities. (i.e. Dawn dish soap)
- Be creative!
- In addition to private stakeholders, government has the ability to contribute
  - Amend existing or enact new legislation implementing funding for clean-up (a US-inspired “SuperFund” model)
  - From levies on mining industry (California: $5/oz gold produced to Abandoned Mined Lands Program. Potentially raising this to $20/oz.)
  - Funding from single levels of government
  - Cost sharing between levels of government

http://static.wixstatic.com/media/a9c5aa_4b2eeae1fe7f4428858f9bb7f41c05ff.jpg

WHO SHOULD INITIATE RECLAMATION WORKS?

- Not practical to apply the “polluter pays” principle
- Ideally, the community makes their own future and reinvents itself (along with reclamation)
  - Cornwall, UK
- Government may need to act as facilitator – distribute cost across those who benefit most


NOT ACCEPTED

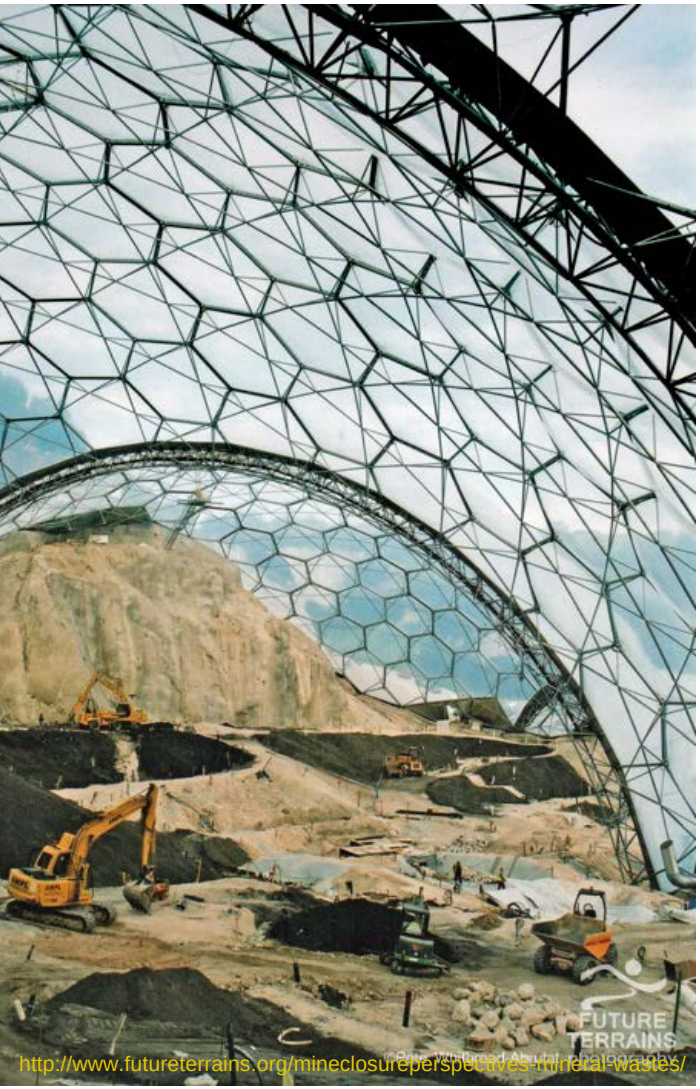

ACCEPTED

- Mining from 2150 BC – 1998
- Tin, copper, silver, zinc, granite, china clay, etc.
- Closure left a devastated region
- Farming only income surrounded by actively polluting legacy sites

http://planetearth.nerc.ac.uk/images/uploaded/custom/tin-map.jpg

https://www.flickr.com/photos/john47kent/3330786989

LEGACY SITE RECLAMATION | Cornwall, UK



http://www.futureterrains.org/mineclosureperspectives-mineral-wastes/

http://www.solarcentury.com/uk/wp-content/uploads/sites/2/2013/05/Wheal-Jane-Solar-Farm-in-Cornwall.jpg

£141 million
total cost to build

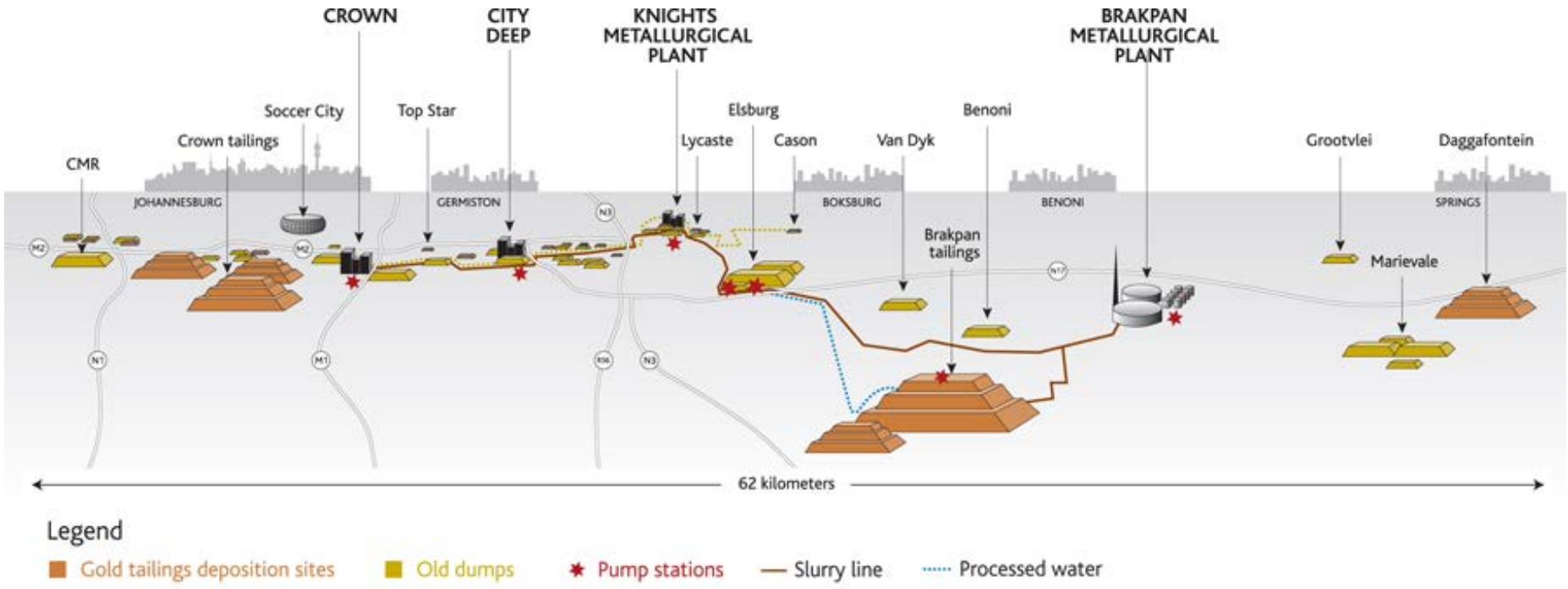
14 million
visitors since opening in 2001

£1.1 billion
resultant revenue injection to Cornwall since opening

"what will the future be?"

- Tony Kendle, Founding Partner & former Foundation Director, The Eden Project

LEGACY SITE RECLAMATION | Ergo, Johannesburg, South Africa



http://www.drdgold.com/assets/images/DRDGold-PipelineMap_l.png

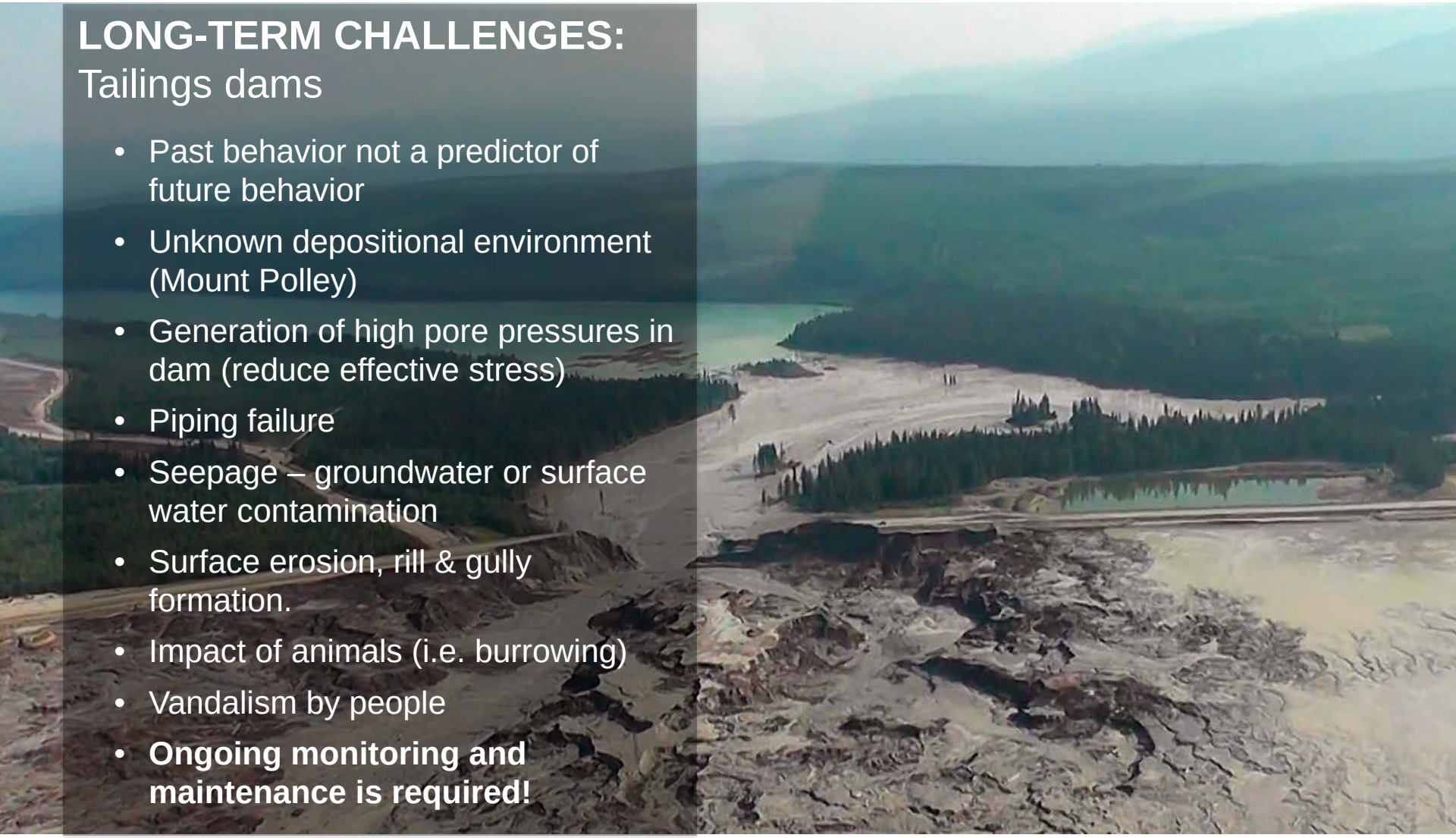
- Ergo, established to re-mine and treat the waste from mines in an 62 x 25 km area around Johannesburg, S. Africa
- Emphasis on: human capital, financial capital, social capital, & natural capital

ARTISANAL-SCALE LEGACY SITES

- Minimal infrastructure or physical challenges
- Disbursed pollution (tailings often deposited in rivers or other water bodies), possibly chemical challenges
- Community ideally plays strong role in ‘re-build & reclaim’ work

VS. CORPORATE-SCALE LEGACY SITES

- Extensive infrastructure and physical challenges
- Breadth of pollution impact due to scale, possibly chemical challenges.
- Large waste rock dumps and tailings ponds. Adits?
- Big job: community + government and/or private assistance



LONG-TERM CHALLENGES:
Tailings dams

- Past behavior not a predictor of future behavior
- Unknown depositional environment (Mount Polley)
- Generation of high pore pressures in dam (reduce effective stress)
- Piping failure
- Seepage – groundwater or surface water contamination
- Surface erosion, rill & gully formation.
- Impact of animals (i.e. burrowing)
- Vandalism by people
- **Ongoing monitoring and maintenance is required!**

LONG-TERM CHALLENGES:
Waste Dumps

- Geotechnical stability* & differential settlement
  - Static liquefaction (flow failure after heavy rainfall), foundation failure, over-steepened crests, etc.
- Airborne pollutants: Dust, etc.
- Waterborne pollutants: ARD, saline drainage, fines wash-out & increased sediment load, etc.
- Dump material is ecologically dead – make or import “topsoil”
- Angle of repose (>35°) vs. erosion-resistance (<25°) – regrade!

LONG-TERM MAINTENANCE

- Water quality monitoring
- Tailings dam monitoring & maintenance
- Drainage pipes are clear and functional
  - Too much sediment? Piping failure, pipe crack?
  - Altered chemistry? Microbial action or ARD generation?
- Waste rock dumps
  - stability

Coal mine in Vintondale, PA

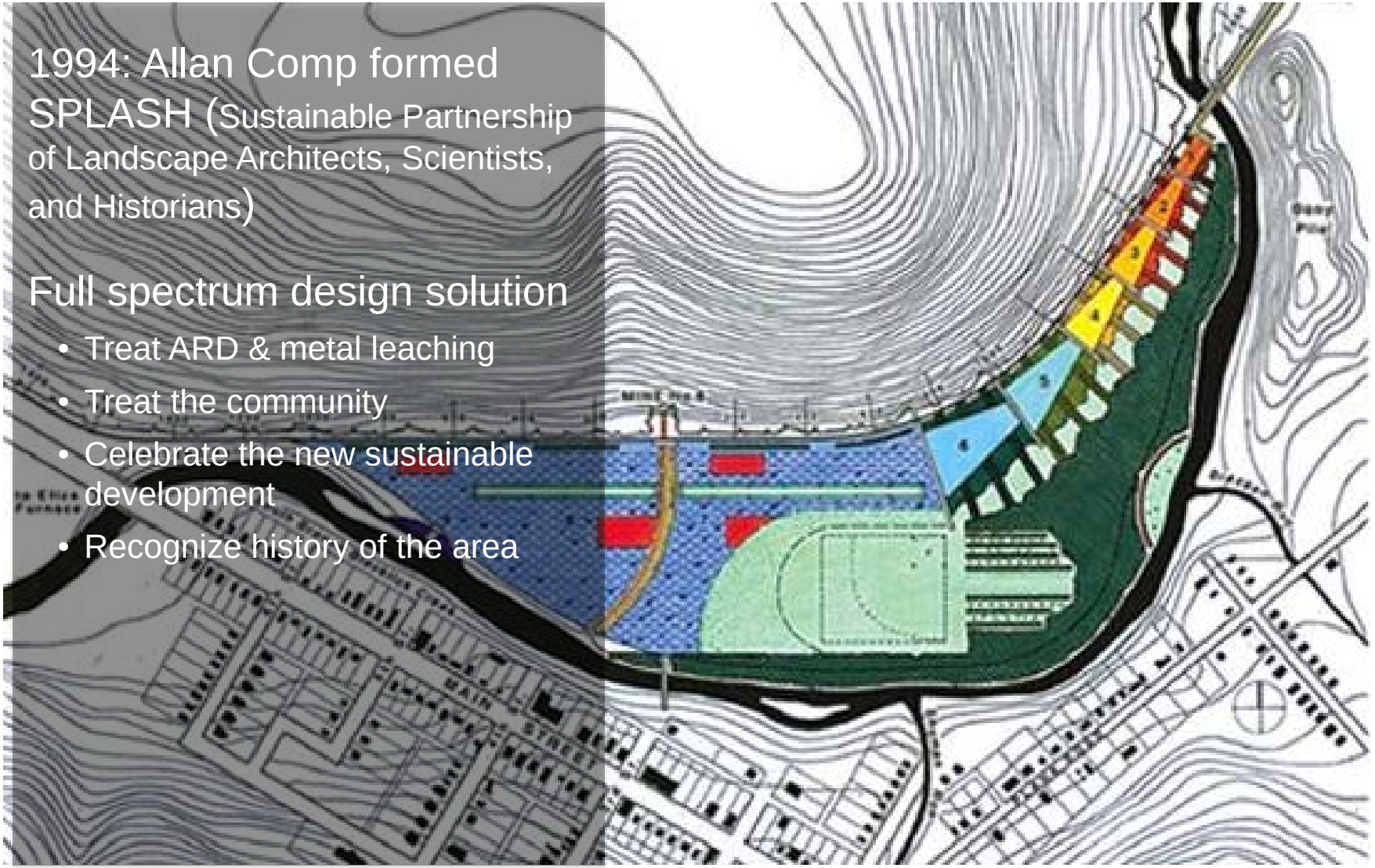
Unregulated mining before 1977

Mines closed, taking with it:

- Train access/ transport of people and goods
- Company store (only one permitted)

Left behind:

- Workers & families
- Waste dumps
- AMD


1994: Allan Comp formed SPLASH (Sustainable Partnership of Landscape Architects, Scientists, and Historians)
Full spectrum design solution
• Treat ARD & metal leaching
• Treat the community
• Celebrate the new sustainable development
• Recognize history of the area

Science

Removed large waste coal heaps producing ARD

Collects ARD (pH 2.5-3) discharge in limestone-lined pool

Remove metals in wetlands

Remove oxygen (organic decay) & limestone filter

Re-aerate & settle

http://studioforcreativeinquiry.org/wp-content/uploads/2011/01/acid.jpg

Art

Miners Memorial: 6’x12’ portal entrance scene taken from 1938 home movie

Interpretive signage along treatment and settling pond area (“History Wetlands”)

9’ x 15’ granite mosaic map of park, mimics historic 1923 map at Vinton Colliery

http://amdandart.info/tourphoto/detail53.html

Community

Goal: Recreate a town center for community involvement

Community consultation from "idea generation" stage

Initial & ongoing maintenance by volunteers – custodianship

Site features from design competition amongst students at state universities

Community hub for sports and recreation

Environmental education center

http://amdandart.info/tourphoto/detail9.html

Funding Sources & Partners

PCA Support for Arts

Heinz Arts Grant

EPA Sustainable Development Grant

Community Foundation Operating Funds

Community Foundation Outreach Support

CVI Outreach Materials

Tides Foundation, Potrero Nuevo Fund

Compton Foundation Outreach Initiative

Mid-Atlantic Arts Foundation Artists & Communities

Lounsbery Foundation

Penn State Scholars in Residence

Rockefeller PACT Grant

Nearby mining companies (in-kind support)

http://amdandart.info/tourphoto/detail9.html

TAKE HOME MESSAGES:

- Inventory sites and make priority list
  - Hazards to human health, safety, land, or water resources are #1
- Create task force of stakeholders and regulatory agencies
- Work with experienced professionals
- Seek public / community input
- Develop funding strategy (may change site-to-site)
- Do as much preliminary work as possible before construction
  - Paperwork, applications, ecological background, seed collection, EA, etc.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