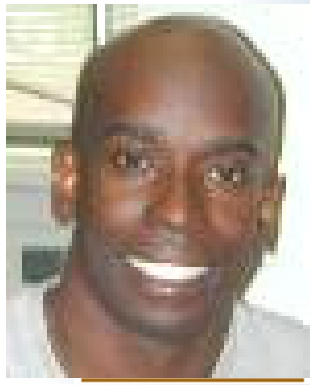
14th Annual BC/MEND - Metal Leaching/Acid Rock Drainage Workshop

MEND Treatment and Sludge Management Survey

Janice Zinck and Wesley Griffith

November 28, 2007



Introduction

- Treatment and sludge management are two important facets of mine site environmental control practices
- Most sites employ some form of chemical treatment to address acid drainage issues.
  - varies from site to site
- No single, comprehensive database containing treatment and sludge management information for mine sites

Methodology

- A questionnaire was developed
- Mining companies, federal, territorial and provincial governments were contacted
- Information compiled in an interactive database
- Focussed mainly on Canadian sites.
  - Data on sites in the US and globally will also be collected
- The surveys were completed thoroughly. Quality of the data is generally very good.

The Survey

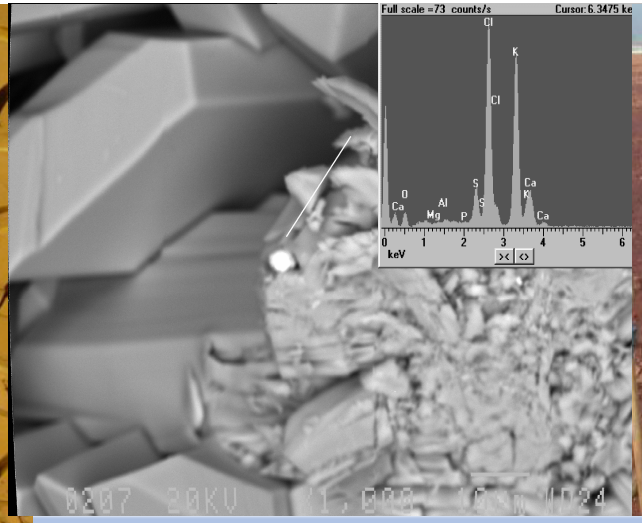
- The survey collected information on
  - Site background and history
  - Acidic drainage characteristics

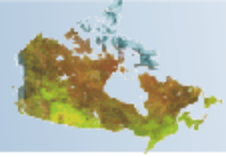
The Survey

- Type of treatment used (e.g. basic neutralization, mechanical solid/liquid separation, high density sludge, passive treatment, others
  - Reagents
  - Costs
  - Solid/liquid separation
  - Treatment issues

The Survey

- Sludge management practices (e.g. sludge pond, with tailings or other wastes, in mine working, landfill, in pit, reprocessed, etc.
  - Sludge composition
  - Sludge management issues





pick from list↓

Treatment Process Details

Unit Operations (check all that apply)

- Basic Neutralization
- Aeration
- Passive Treatment
- Flocculation
- High Density Sludge
- Sludge Recycle
- Reactors
- Acidification
- Mechanical Liquid/Solid

Operating Mode pick from list↓

pick from list↓
Batch
Continuous

Capital Cost Total Cost pick↓

Cost Breakdown

- Treatment Plant % of tota
- Clarifier % of tota
- Polishing Pond % of tota
- Water Management Infrastructure % of tota
- Other % of tota

Are any Repairs Planned for the Coming Year? pick↓

Estimated Life of Current System (if known)

Reagents

- Nutrients (passive treatment)
- CO2 for pH reduction post-treatment
- Caustic Soda (NaOH)
- Hydrated Lime (Ca(OH)2)
- Slaked Lime (Ca(OH)2)
- Other
- Ferro
- Barium
- Lime
- Quick

Principal Reagents Usage pick↓ pick↓

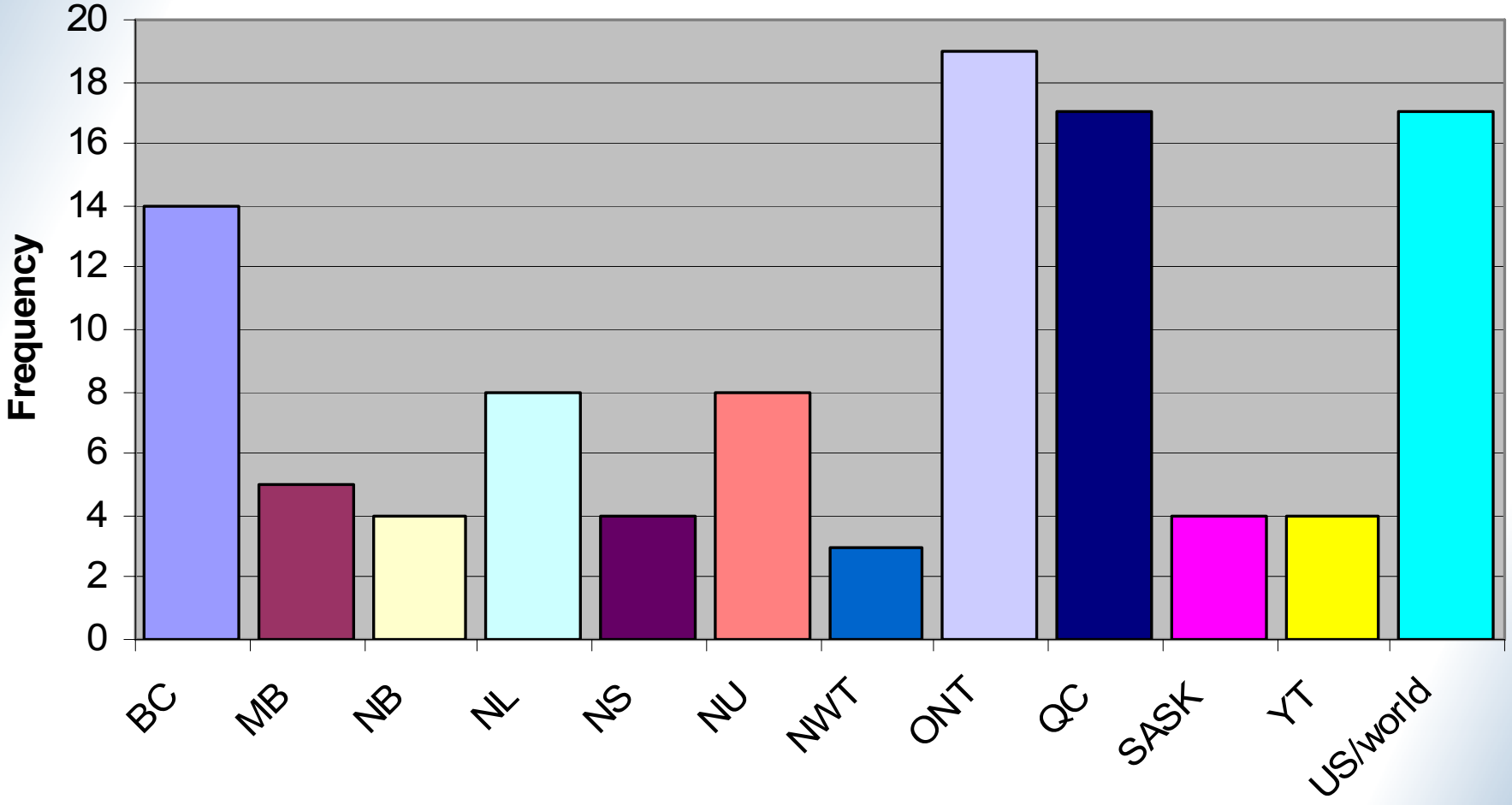
Flocculant

- Commercial Name
- Type
- Dosage (with units)
- Annual Cost pick↓

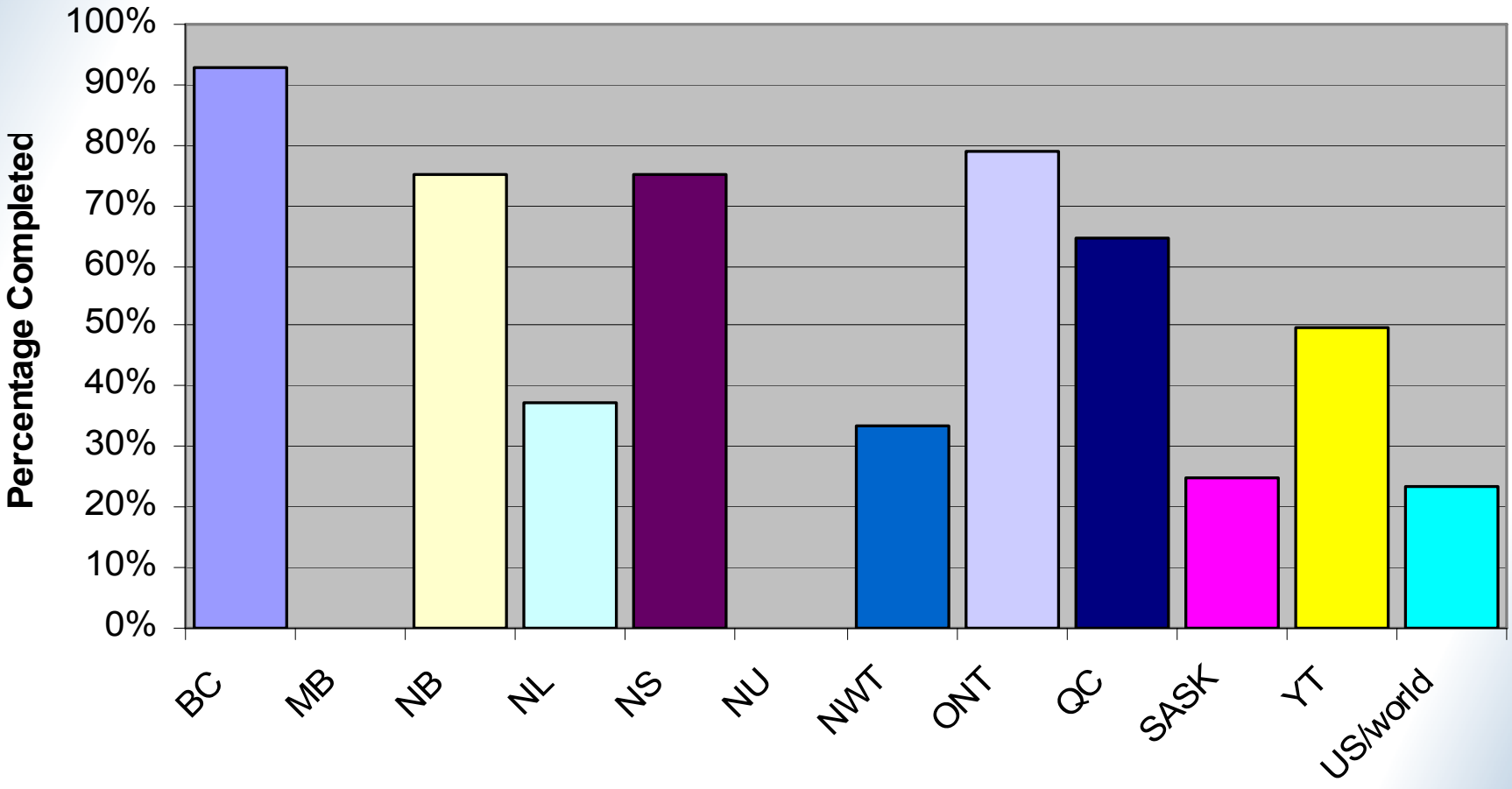
Liquid/Solid Separation

Data Input Form | Entered Data

Sites by Contacted by Region



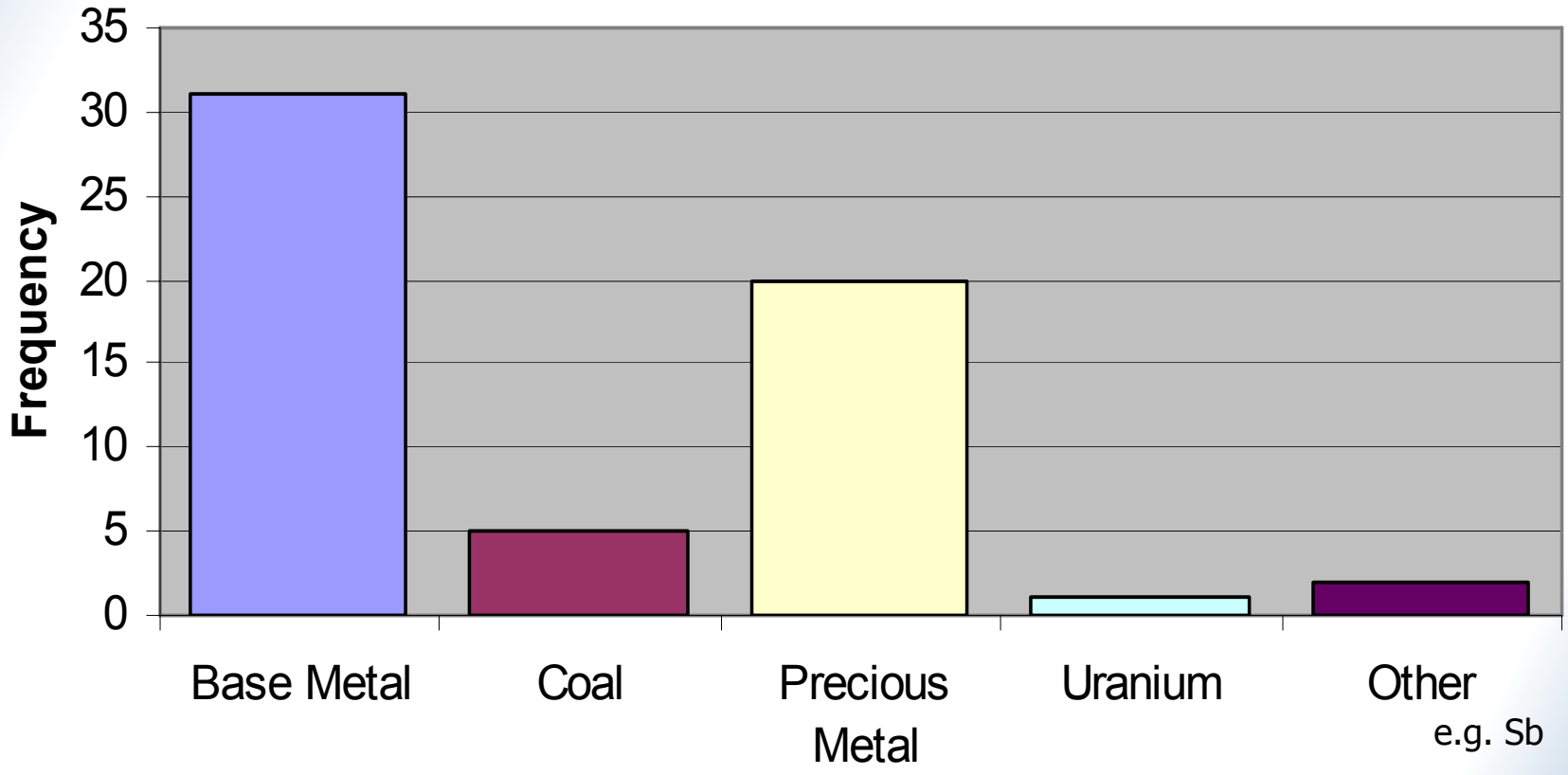
Completed Surveys by Region



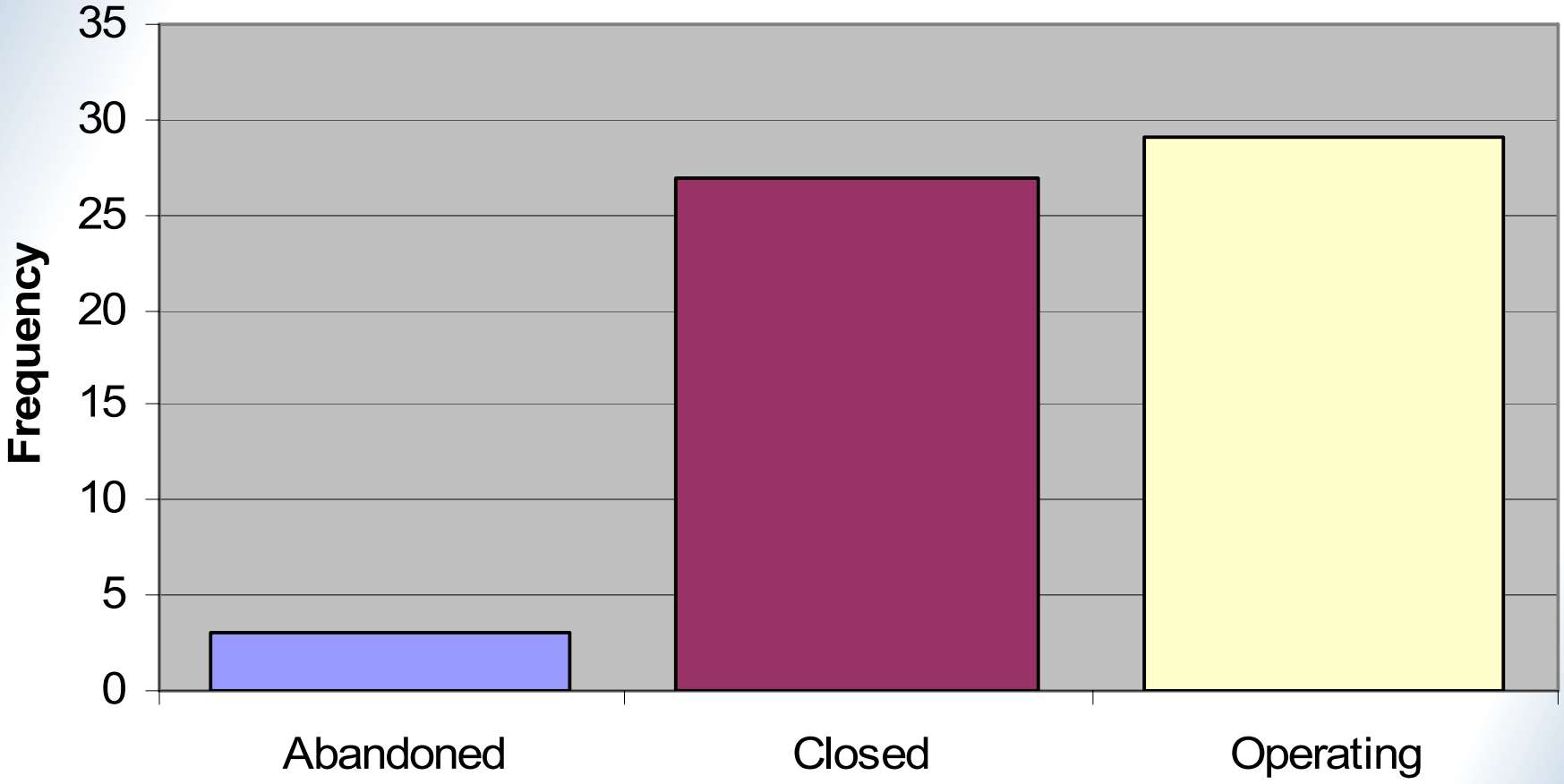

Red Dog Mine- WTP #1 and #2
Mt. Nansen
Giant Mine
Greens Creek Mine
McClean Lake Operation - JEB Water Treatment Plant
Bell Mine
Huckleberry Mines Ltd.
Island Copper Mine
Myra Falls
Samatosum Division
Brenda Mines
Nickel Plate Mine
Rambler Mine
Beaver Brook Antimony Mine
Duck Pond Mine
CBDC No. 26 Treatment Facility
CBDC - V
Brunswick Mine No. 12
Heath Steele Mine
Fire Road Mine
East Kemptville
Les Mines Selbaie
Lac Dufault Division, Norbec Mine Site
Island Gold Project
Geco
Mattabi Division
Winston Lake Mine
Crean Hill Mine
Lockerby Mine
Image NASA
Image © 2007 TerraMetrics
©2007 Google™
Pointer 65°08'30.32" N 100°14'17.05" W
Streaming 100%
Eye alt 4392.94 km


Division East Amphi
Mine Doyon
Lac Dufault Division, Norbec Mine Site
Kam Kotia
Island Gold Project
Geco
Williams Mine
Golden Giant Mine
River Gold Project
Winston Lake Mine
Nolin Creek Wastewater Treatment
Whistle Mine
Copper Cliff Wastewate Treatment
Crean Hill Mine
Lockerby Mine
Image NASA
Image © 2007 TerraMetrics
Image PA DCNR-PAMAP/USGS
©2007 Google
Pointer 47°02'38.58" N 83°05'11.60" W
Streaming 100%
Eye alt 977.86 km

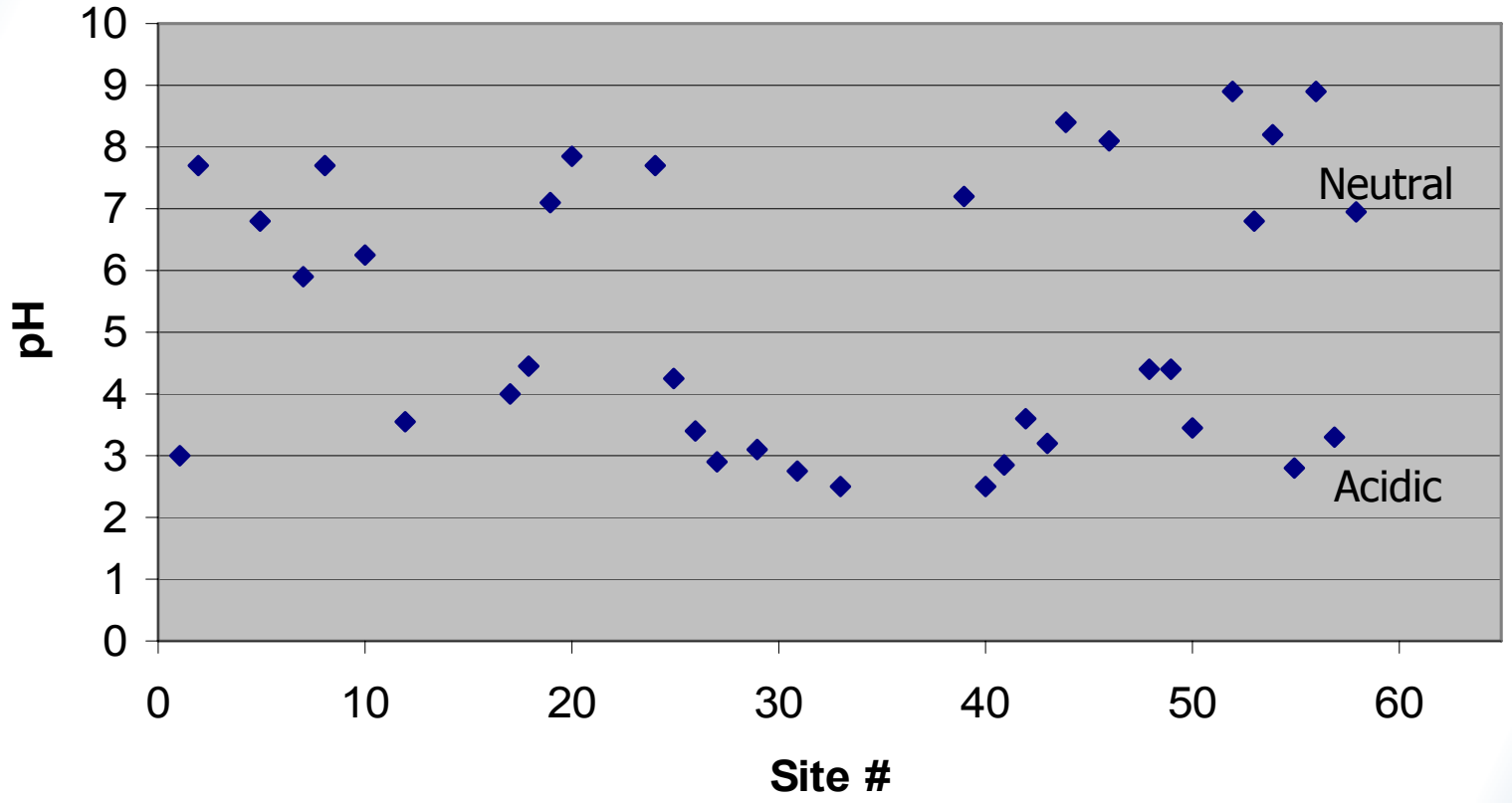
Type of Operation



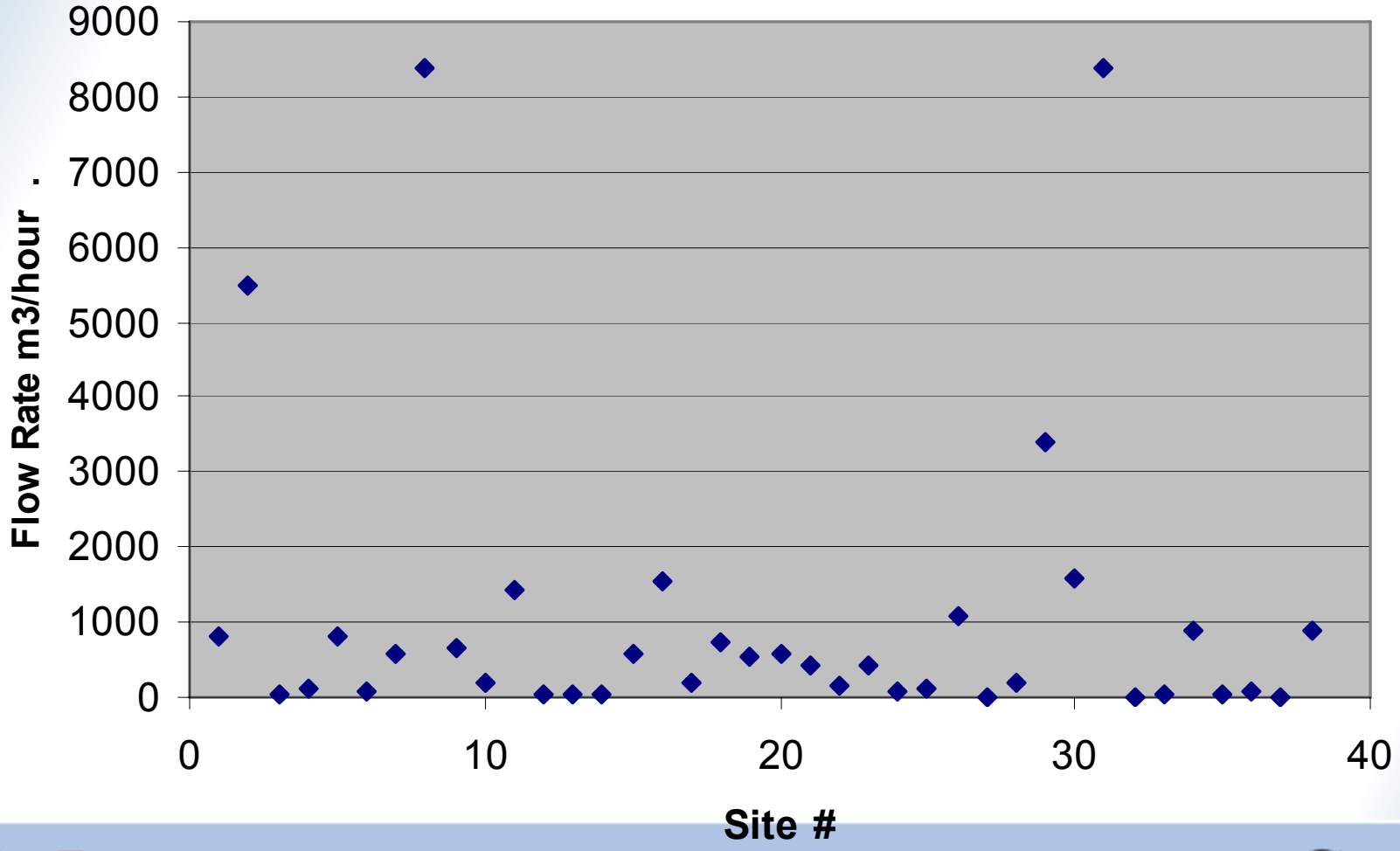
Operation Status



Average Influent pH



Average Flow Rate



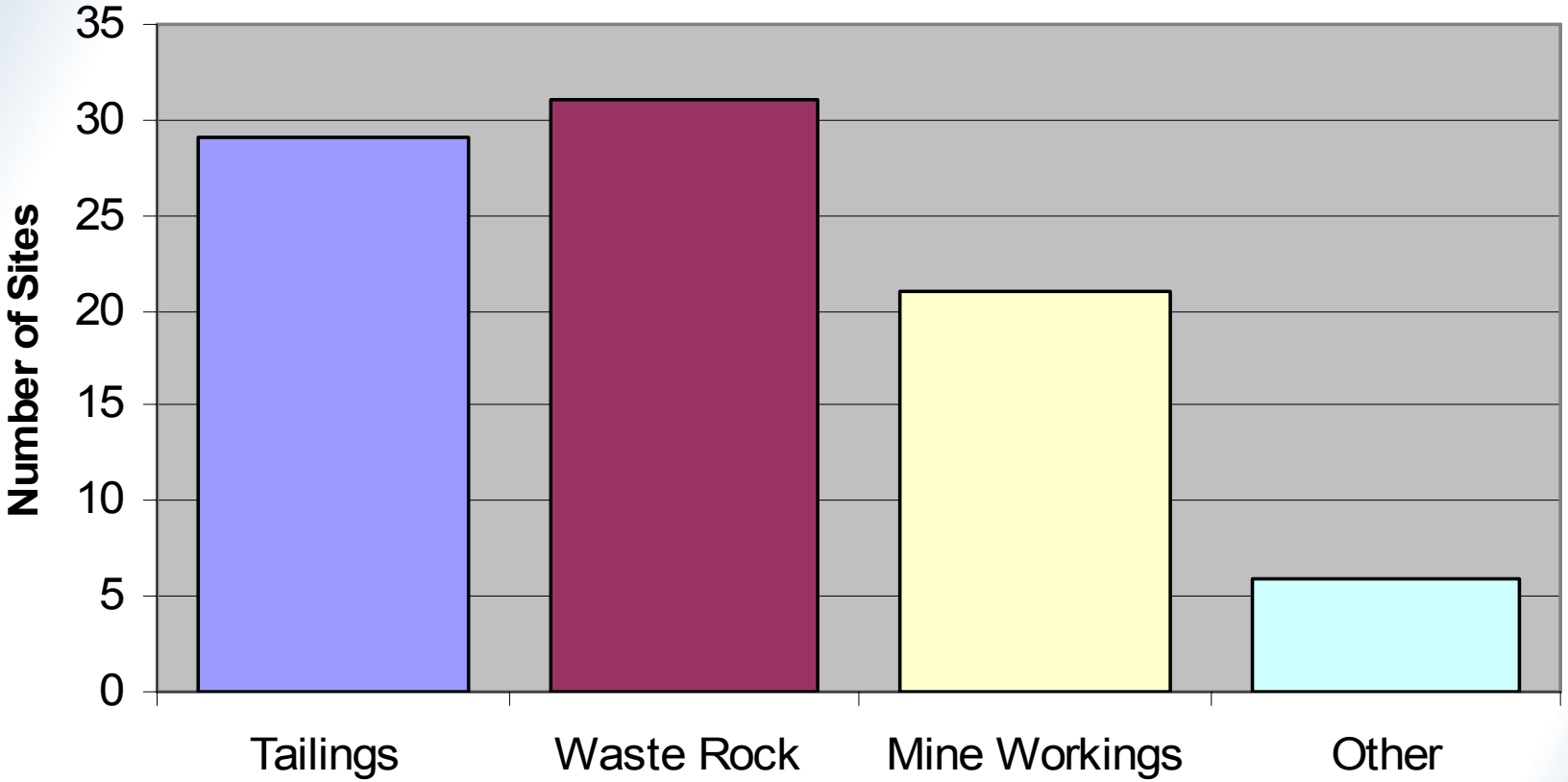
Peak Flows

- Maximum flows typically 2- 4 times greater than average flows.

Other Information Collected

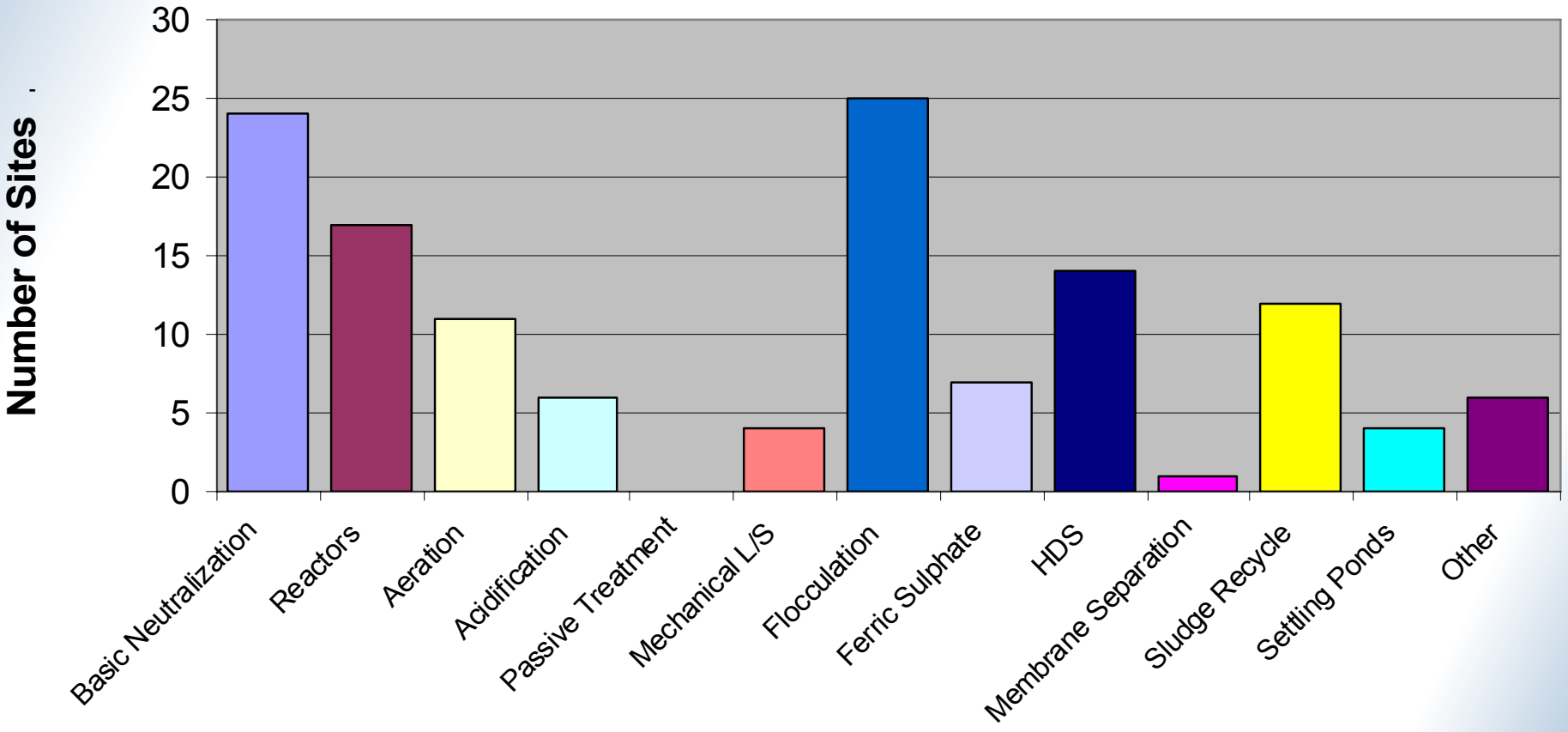
- Mine drainage composition
- Temperature, TDS, TSS, turbidity, conductivity, Eh, acidity
- Receiving environment
- Expected length of treatment
  - 9 months to in perpetuity

Source of Acidic/Neutral Drainage



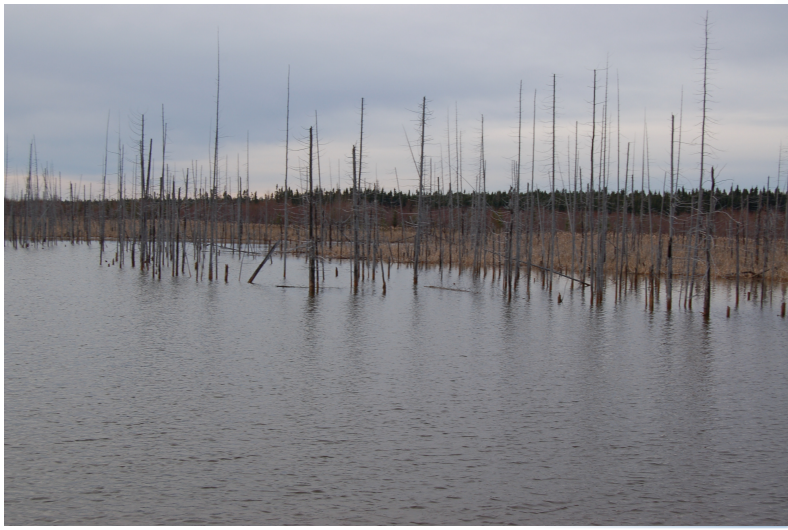
- ~30% sites treat other waste streams with their AD/ND

Treatment Process Details

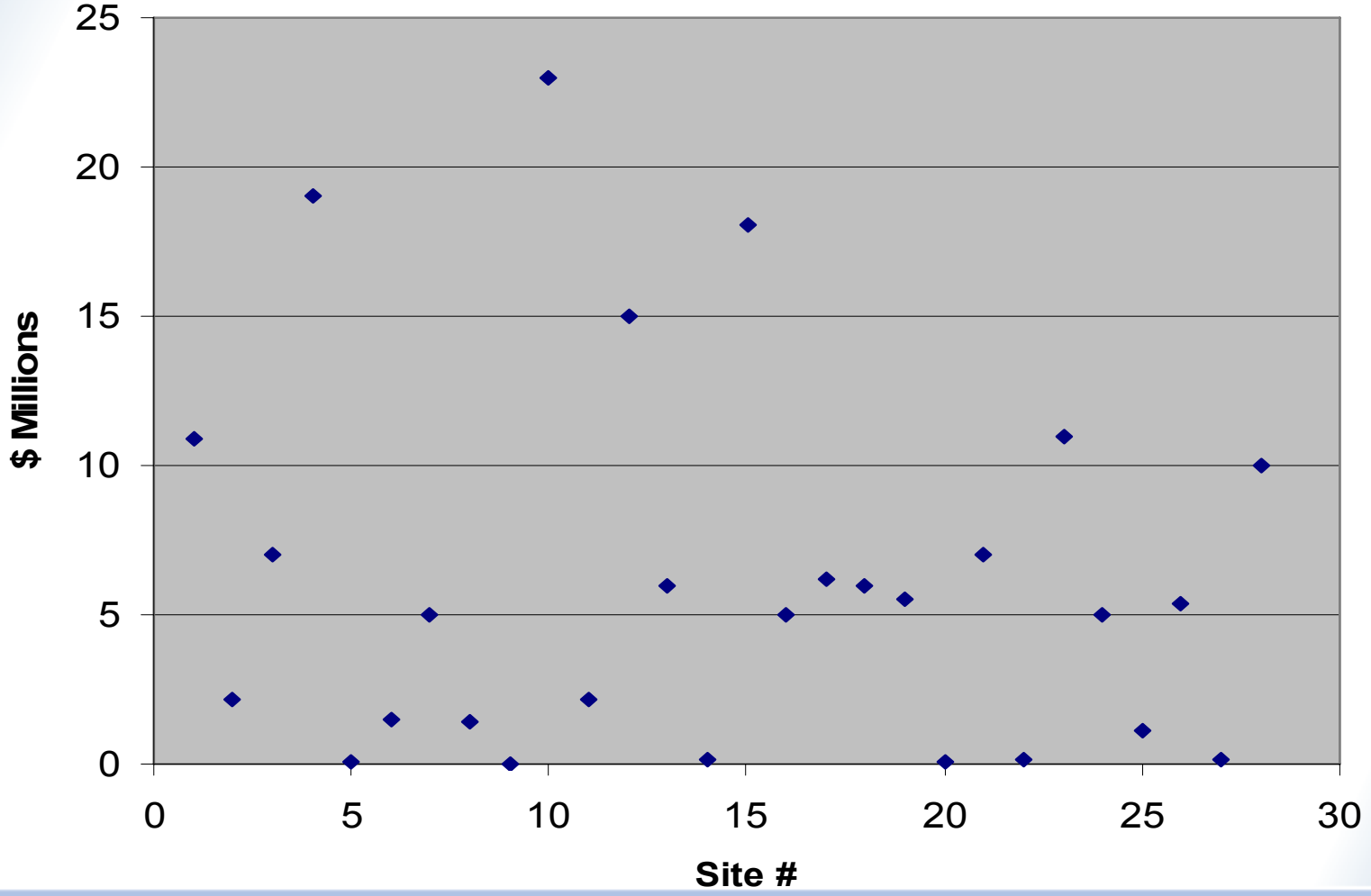


Flow Equalization

- Holding/collection ponds
- pH controller on lime pH feed line
- Buffer pond and water management
- Feed pumps
- Pump from surge pond
- Pump and level control



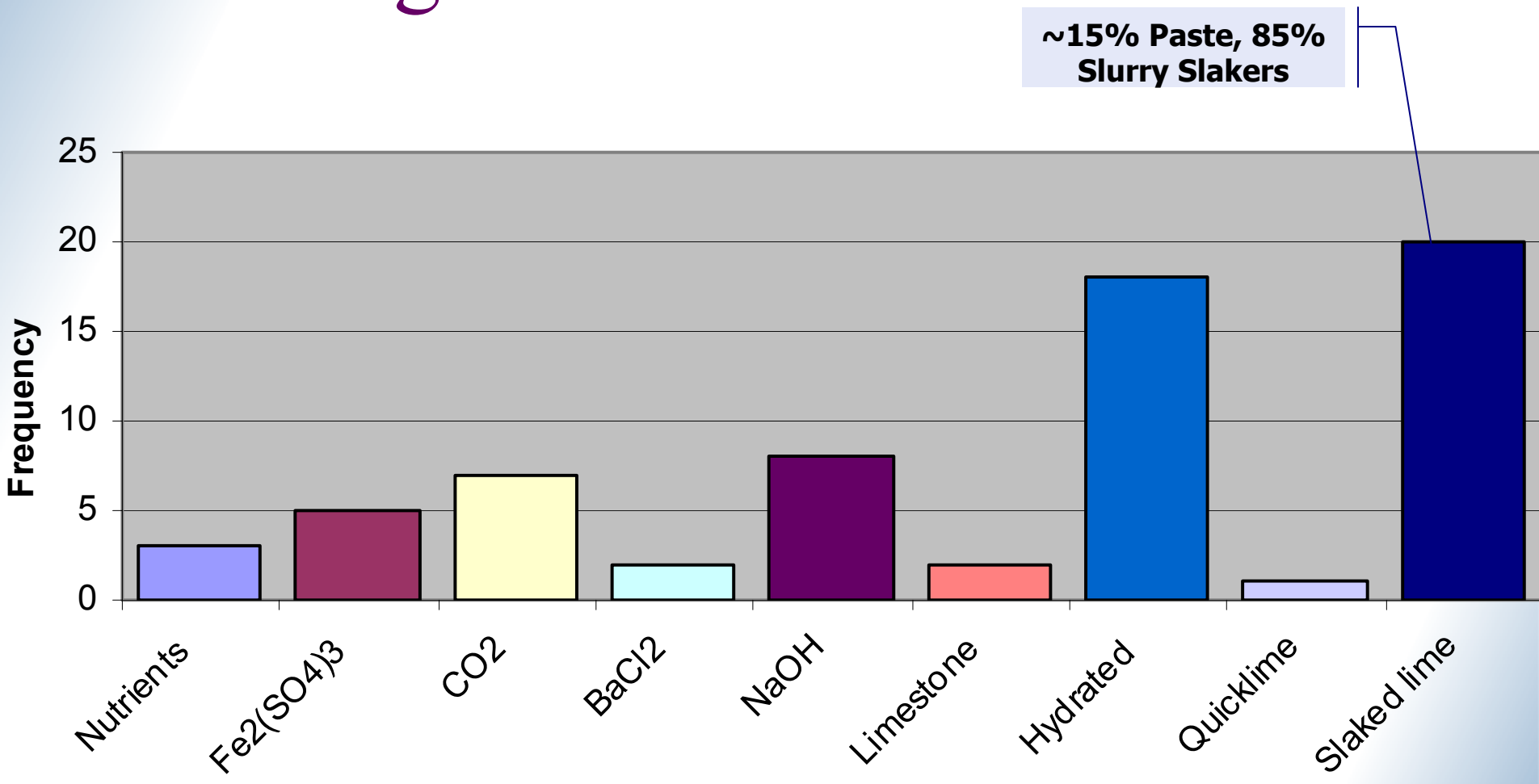
Capital Costs



Some Planned Upgrades

- Rebuild/replace clarifier and steel tank
- Addition new reactor tanks
- Expand and winterize facilities pending government approval
- Sludge handling improvements
- Reconfiguration
- Slaker replacement
- Replacement with newer unit with higher flow capacity
- Spiral rakes in the clarifier
- Preventive maintenance

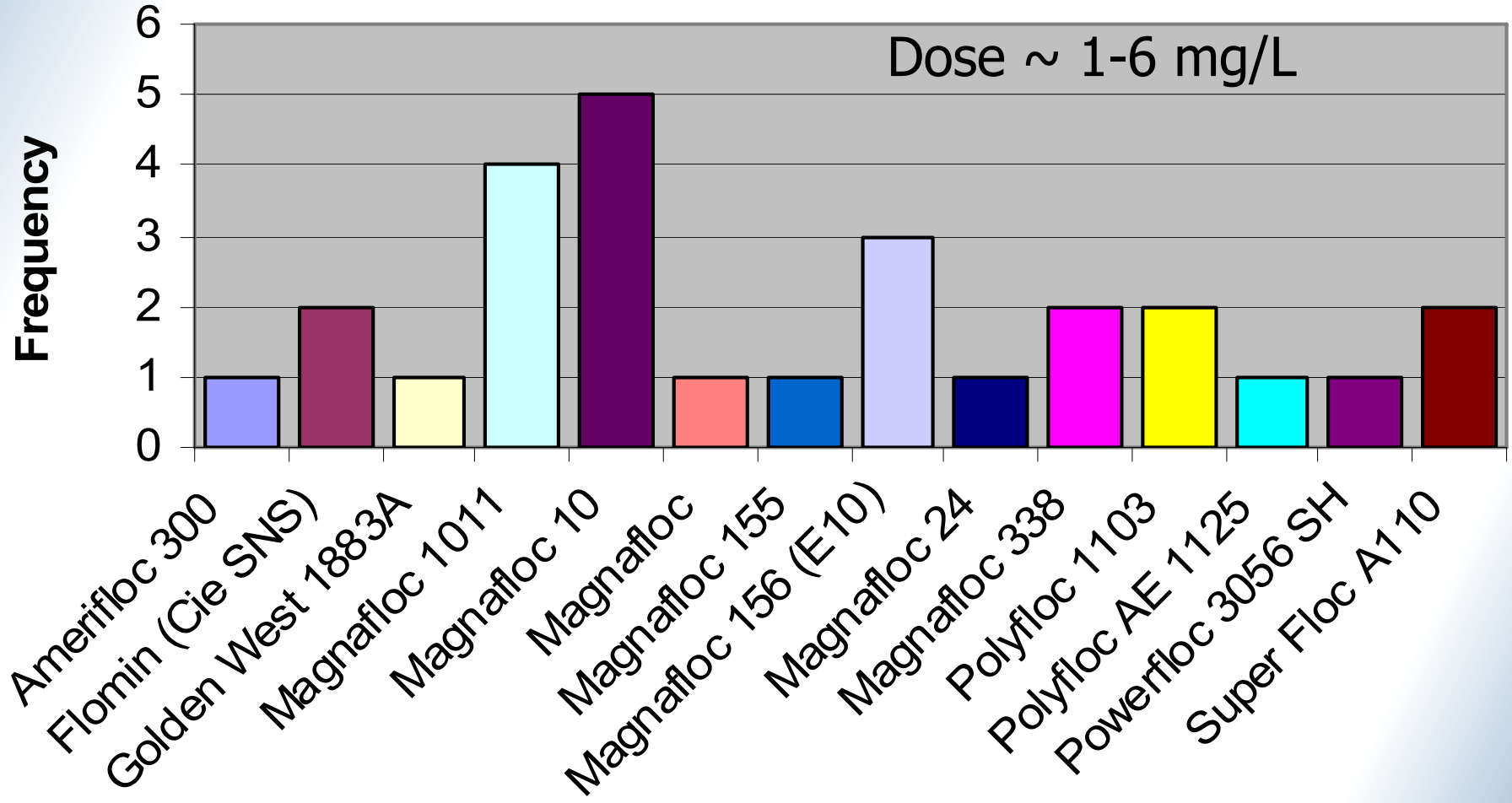
Reagents


~15% Paste, 85% Slurry Slakers
Frequency
25
20
15
10
5
0
Nutrients
Fe2(SO4)3
CO2
BaCl2
NaOH
Limestone
Hydrated
Quicklime
Slaked lime

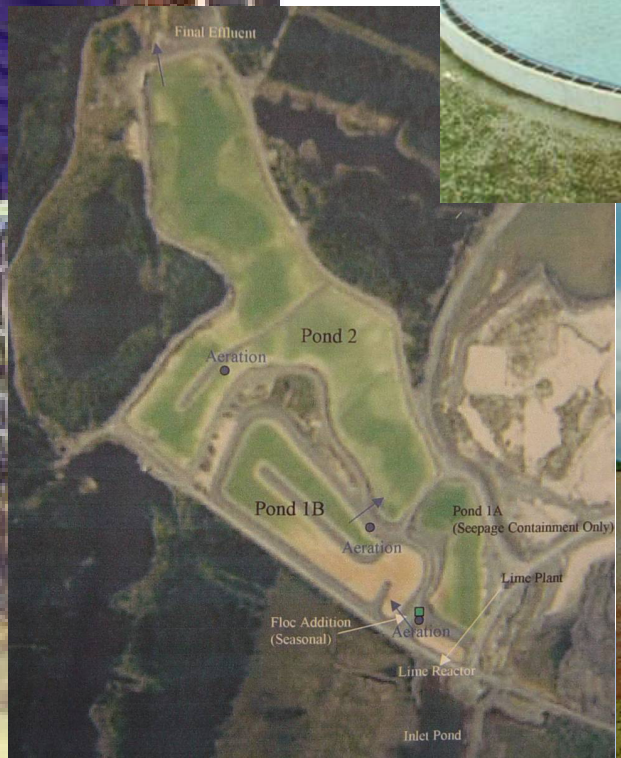
Other Reagents

- Sulphuric acid
- Ferric chloride
- Hydrogen peroxide
- Aluminum chloride hydrate sulphate (coagulant)
- Sodium Hypochlorite
- Sodium metabisulfide

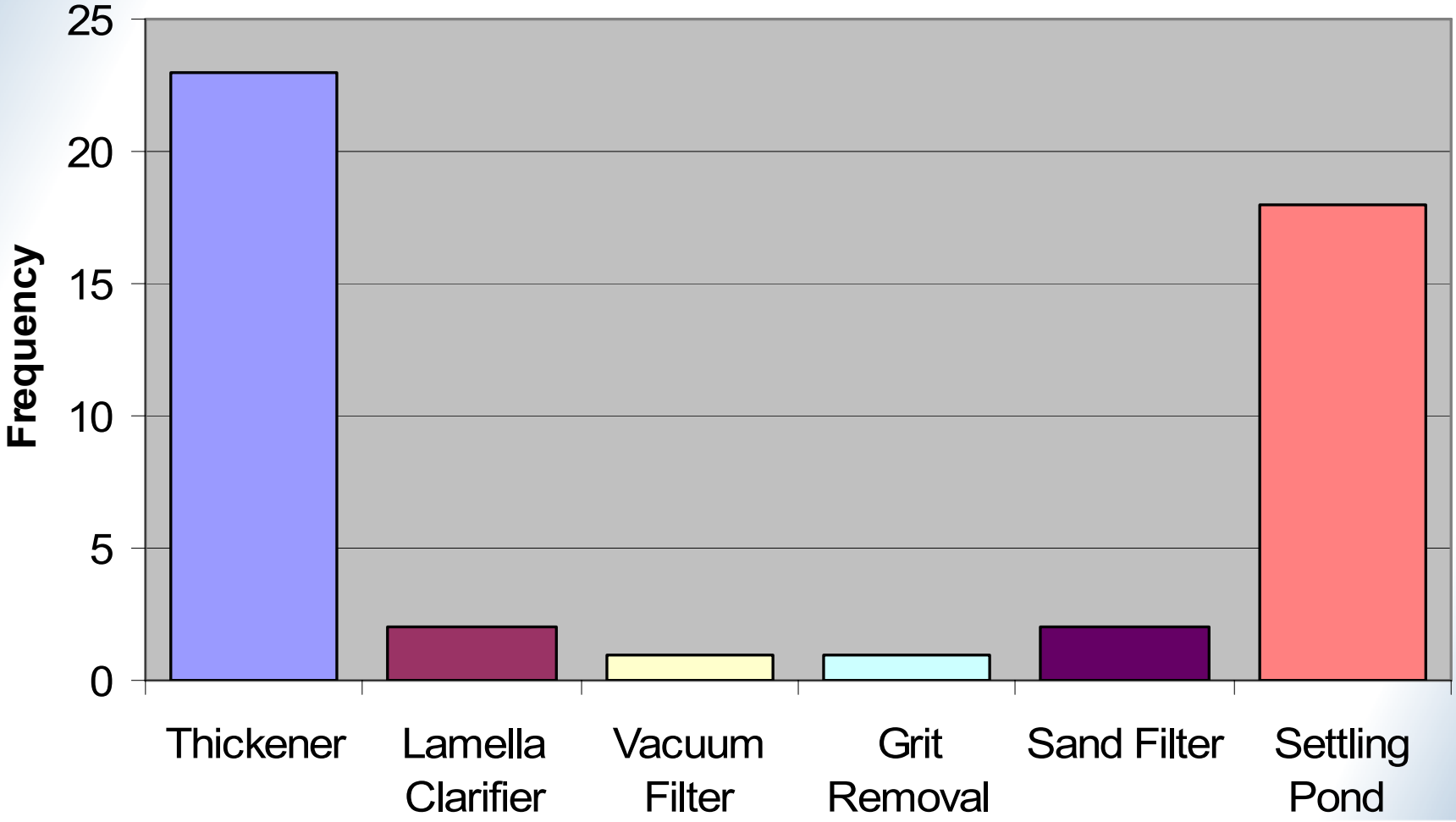
Flocculant


Dose ~ 1-6 mg/L
Frequency
0
1
2
3
4
5
6
Amerifloc 300
Flomin (Cie SNS)
Golden West 1883A
Magnafloc 1011
Magnafloc 10
Magnafloc
Magnafloc 155
Magnafloc 156 (E10)
Magnafloc 24
Magnafloc 338
Polyfloc 1103
Polyfloc AE 1125
Powerfloc 3056 SH
Super Floc A110

Solid/Liquid Separation



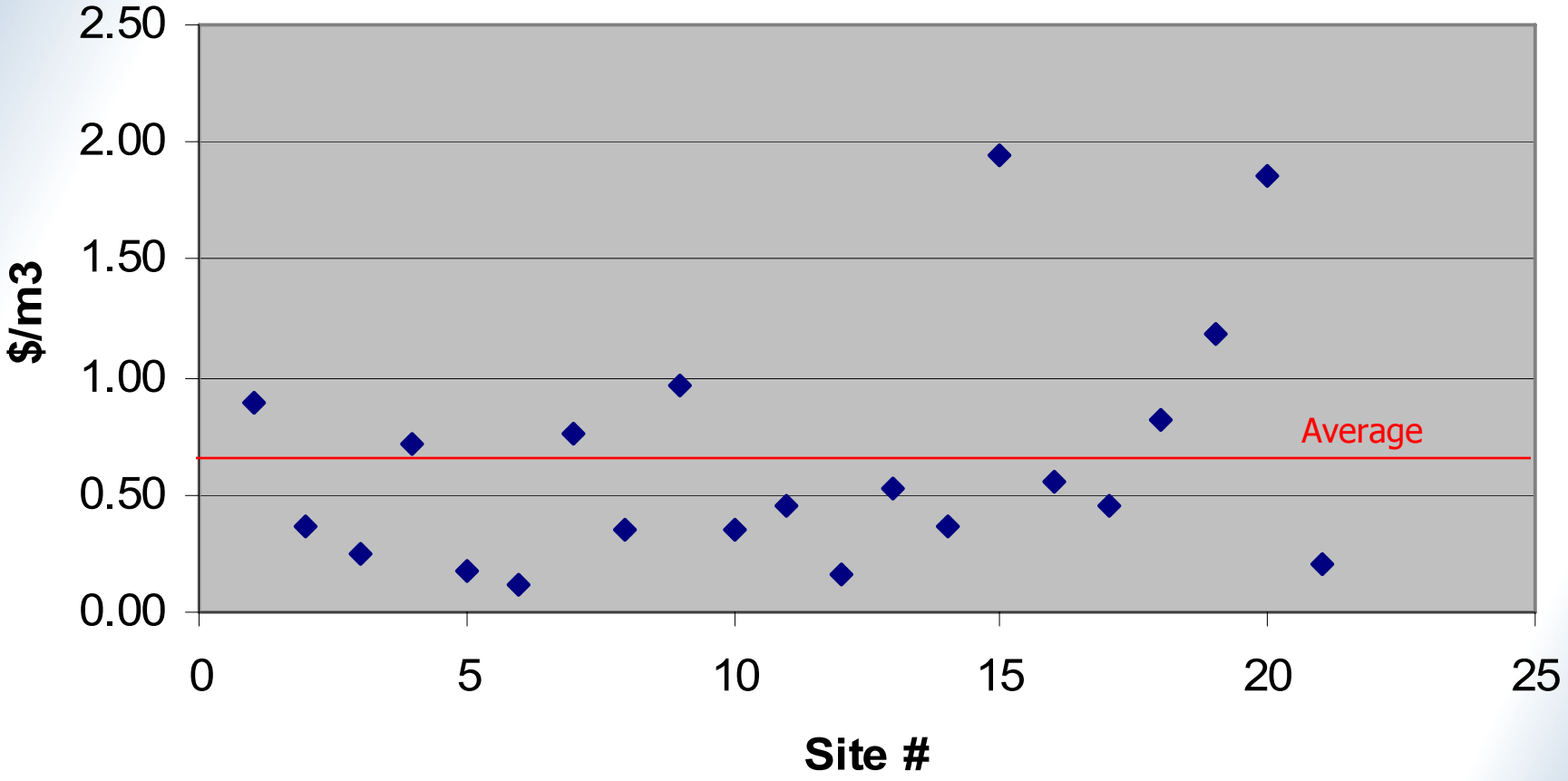
Solid/Liquid Separation



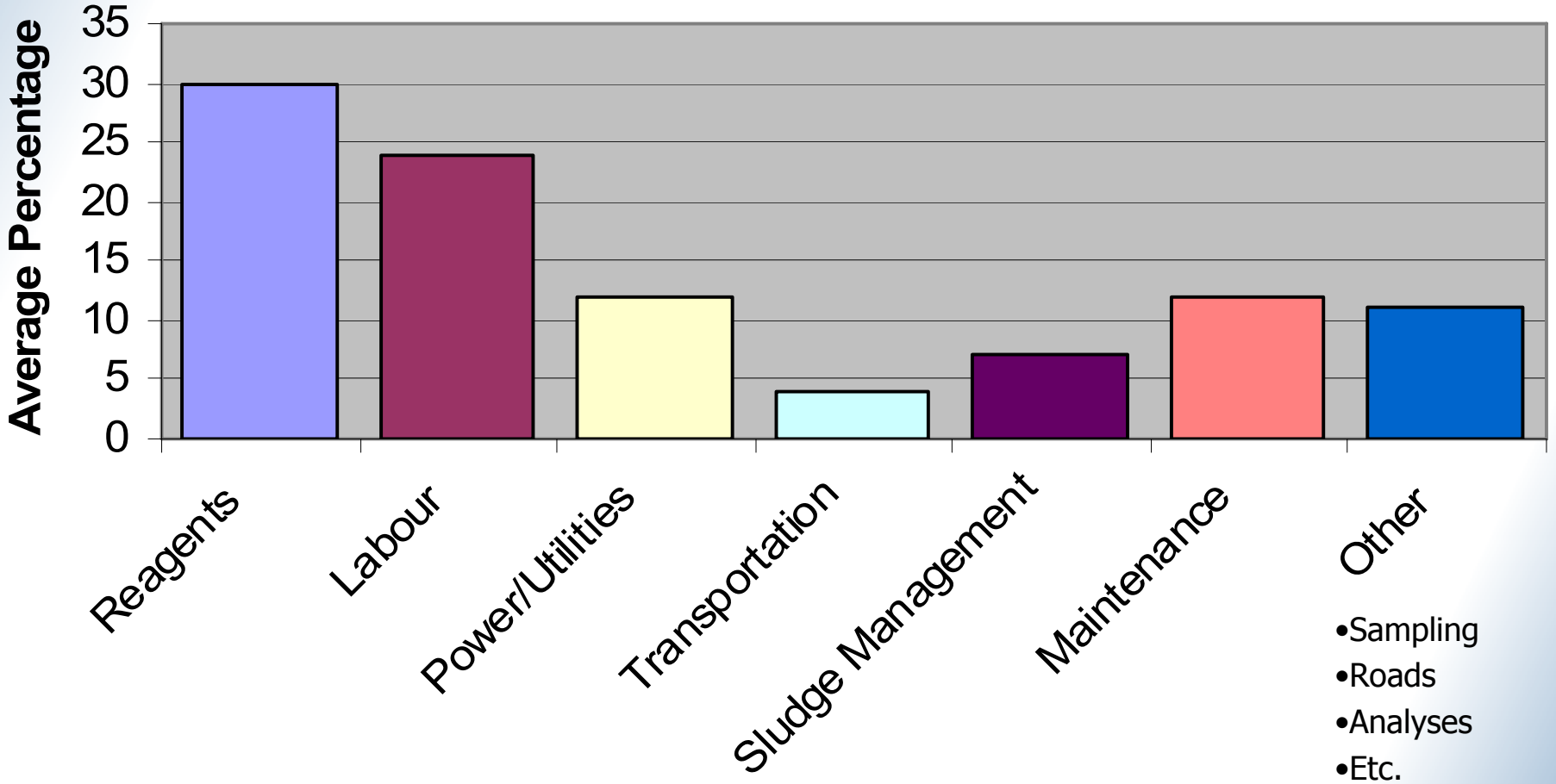
Treatment Issues

- Gypsum scaling – most common problem
- Suspended solids
- Lime handling and mixing
- Sludge density, settling, dredging disposal
- Winter related
  - Metal dissolution under ice cover (ponds)
  - Pipeline freeze ups
  - Polymer mixing during winter
- Other
  - Algal blooms in collection ponds
  - Seepage water corrosive to pumps

Treatment Costs

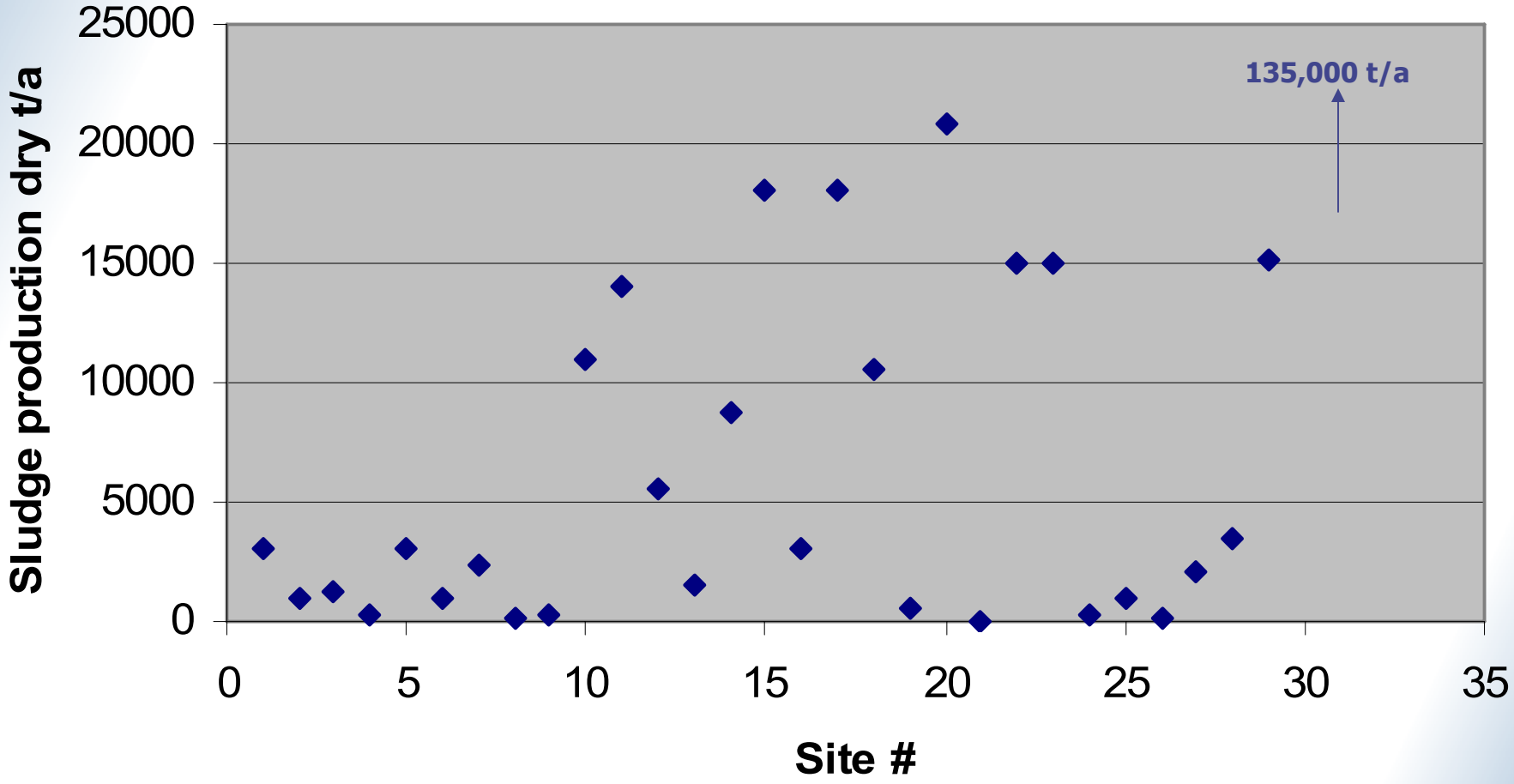


Operating Cost Breakdown

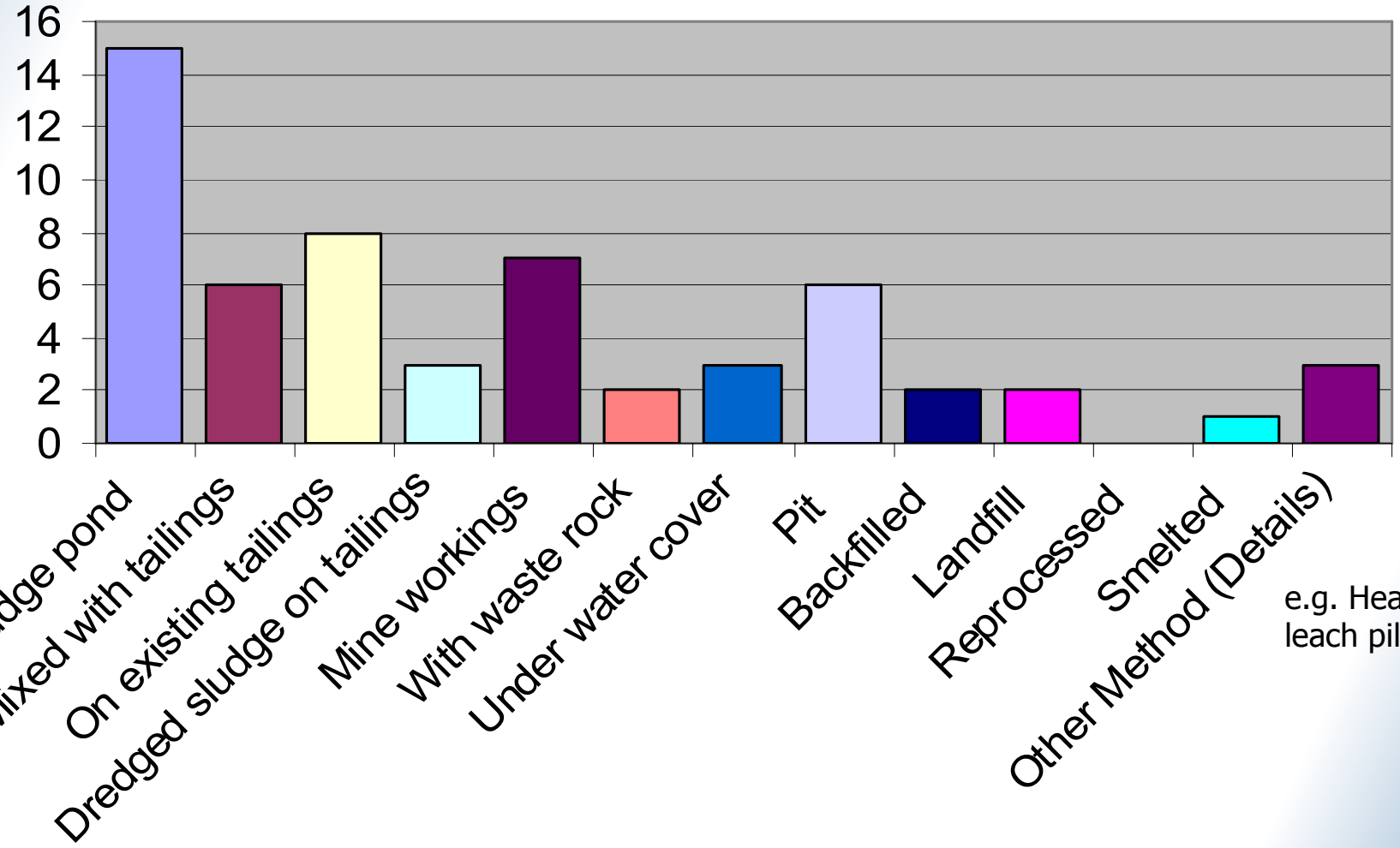


- Sampling
- Roads
- Analyses
- Etc.

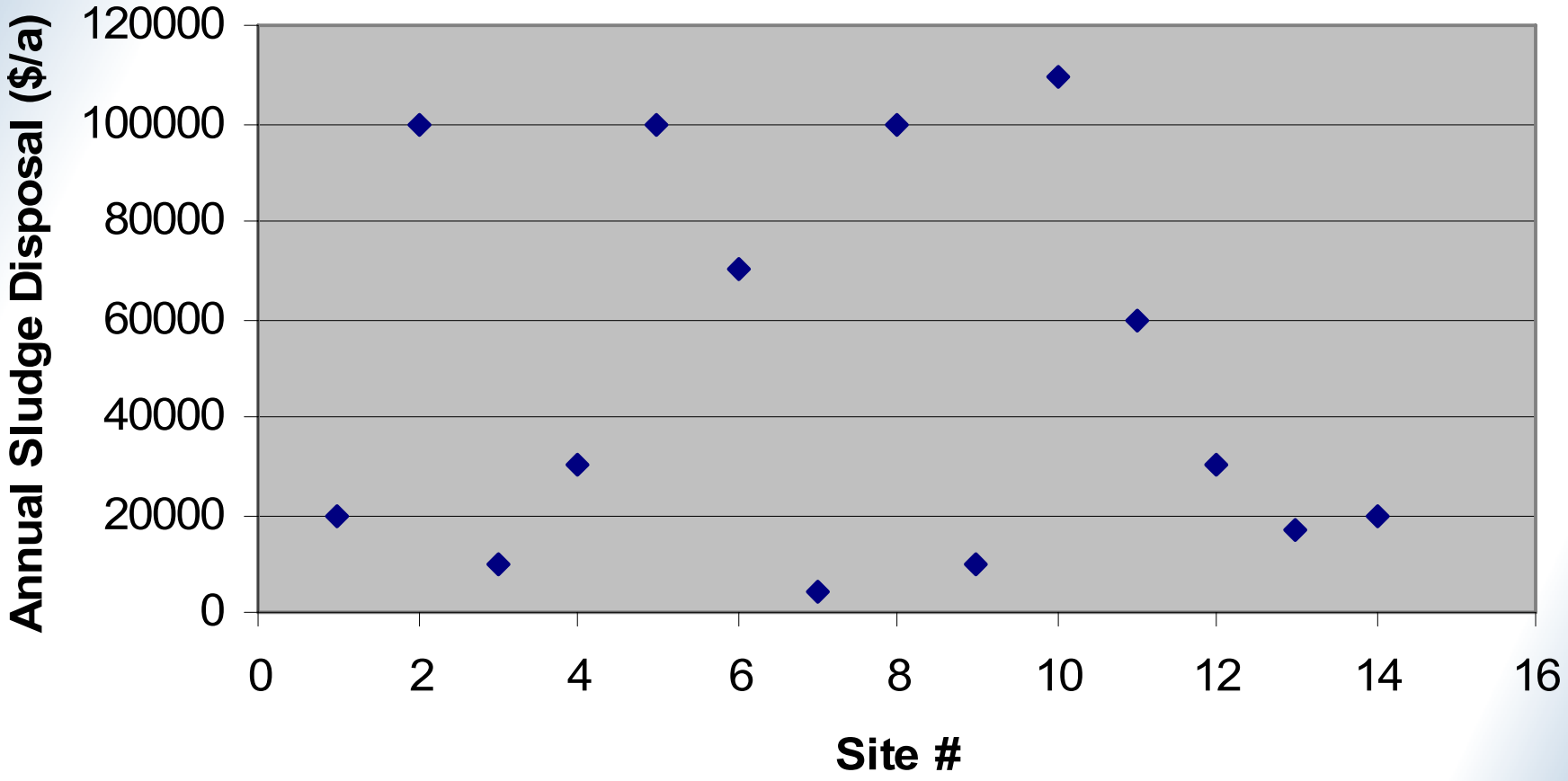
Annual Sludge Production



Sludge Disposal



Annual Sludge Disposal Costs



Sludge Management Issues

- Sludge desiccation and dusting – difficult to manage
- Some sites have limited sludge disposal capacity and are looking at off site disposal for the future
- Difficulty in dredging sludge, high disposal costs, pH spikes in ponds
- Presence of cadmium over permissible leachate limits
- Dewatering NaOH sludge more difficult than lime based sludge

Next Steps

- Will continue to take surveys up until January 2008
  - All sites encouraged to participate
  - More international sites to be included
- Final report to be completed by March'08
- Database to be updated on a regular basis – working document

Acknowledgements

EPCOR
CVRD
INCO
Ontario
NEWMONT
The Gold Company
RICHMONT
Yanacocha
RAMBLER
Affaires indiennes et du Nord Canada
Indian and Northern Affairs Canada
Mining Association of Canada
L'Association minière du Canada
Rescan
Rescan Environmental Services Ltd.
xstrata
IAMGOLD
WESDOME
INMET MINING
bhpbilliton
Yukon
Énergie NB Power
Production Generation
Highland Valley Copper
Beaver Brook Antimony Mine Inc.
Natural Resources Canada
Ressources naturelles Canada
Aur Resources Inc.
BARRICK
Huckleberry Mines Ltd.
teckcominco
AREVA
BREAKWATER RESOURCES LTD
CAPE BRETON DEVELOPMENT CORPORATION
SOCIÉTÉ DE DÉVELOPPEMENT DU CAP-BRETON

Thank You
Merci

jzinck@nrcan.gc.ca