The State of Mining in Nevada

27th Annual Mine Design, Operations & Closure Conference, May 5-9, 2019

Christine Olson, Ph.D.
Environmental Scientist III
Bureau of Mining Regulation & Reclamation
Nevada Division of Environmental Protection
colson@ndep.nv.gov
775-687-9406

NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

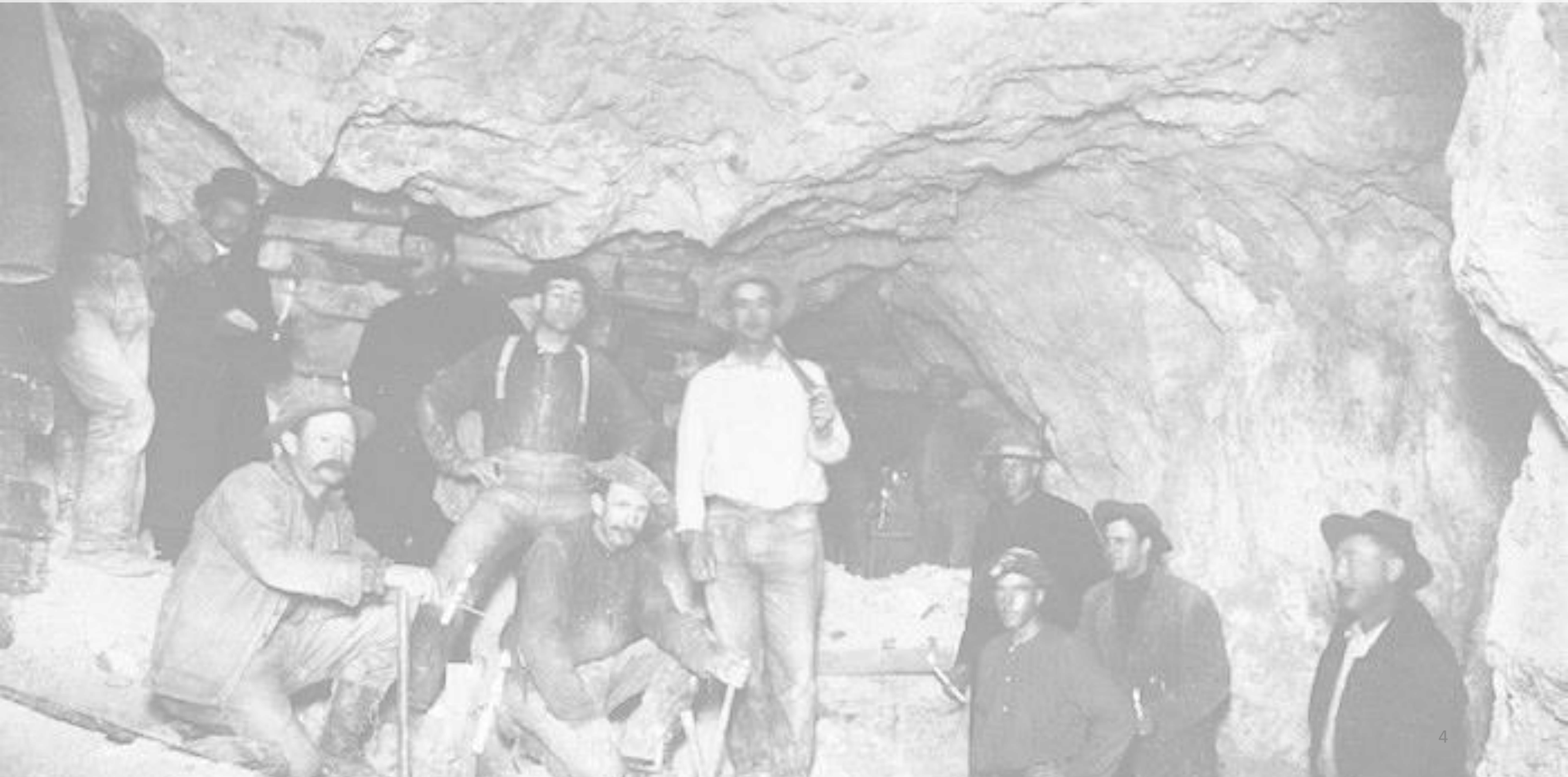
Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

Introduction – *History* of Mining in Nevada



Introduction – *History* of Mining in Nevada

- Mining has played a central role in Nevada's economy since the discovery of gold and silver in the Comstock Lode in 1859, virtually ending the CA Gold Rush[2,3]
- 1962, Newmont Mining discovered large Carlin deposit – 50 mile wide by 40 mile long belt of gold deposits[3]
- Over 20 minerals mined in NV: gold, silver, copper, molybdenum, barite, gypsum, lithium, dolomite, turquoise, diatomaceous earth[6]
- 72% of U.S. gold production, 26% of U.S. silver production (2017) [2]

Introduction – *Future* of Mining in Nevada

Introduction – *Future* of Mining in Nevada

From Mid-2000s Recession Until Now…a growing hub for technological innovation

- Data centers – Switch
- Tesla Gigafactory
- Apple, Amazon

Major projects + overwhelming demands for technology means the Silver State and US are more reliant on mineral production than ever[1]

- Plug-in cars use 3xs the amount of copper than a traditional vehicle
- Lithium-powered devices
- Silver is vital in renewable energies

Nevada mines produce 12% of the minerals consumed in the US[6]

Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

2. Bureau of Mining Regulation and Reclamation (BMRR)

The Division includes:

- 10 Environmental Bureaus
- 1 Administrative Bureau
- BMRR was created in 1989

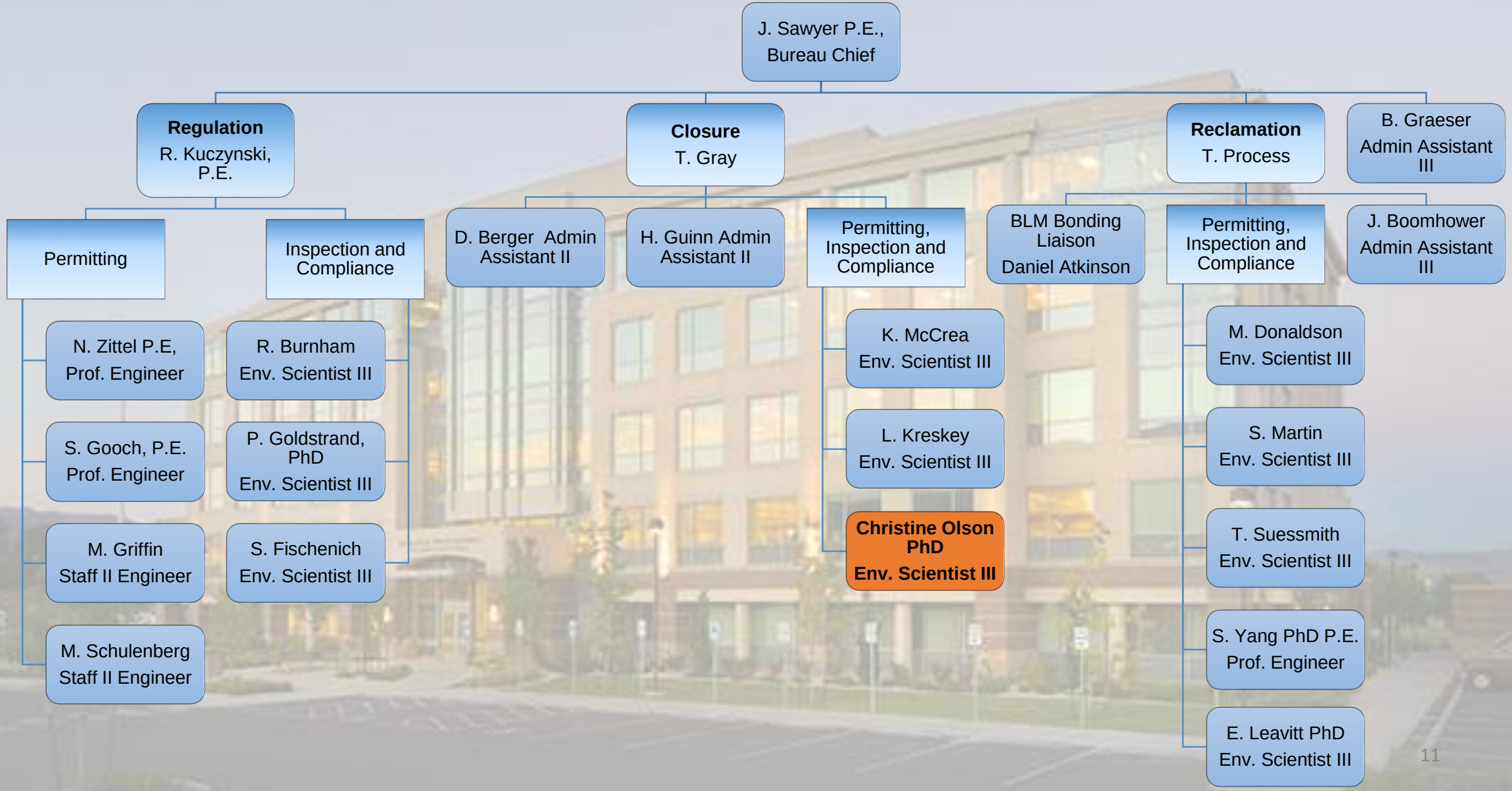
2. Bureau of Mining Regulation and Reclamation (BMRR)

The Division includes:

- 10 Environmental Bureaus
- 1 Administrative Bureau
- BMRR was created in 1989

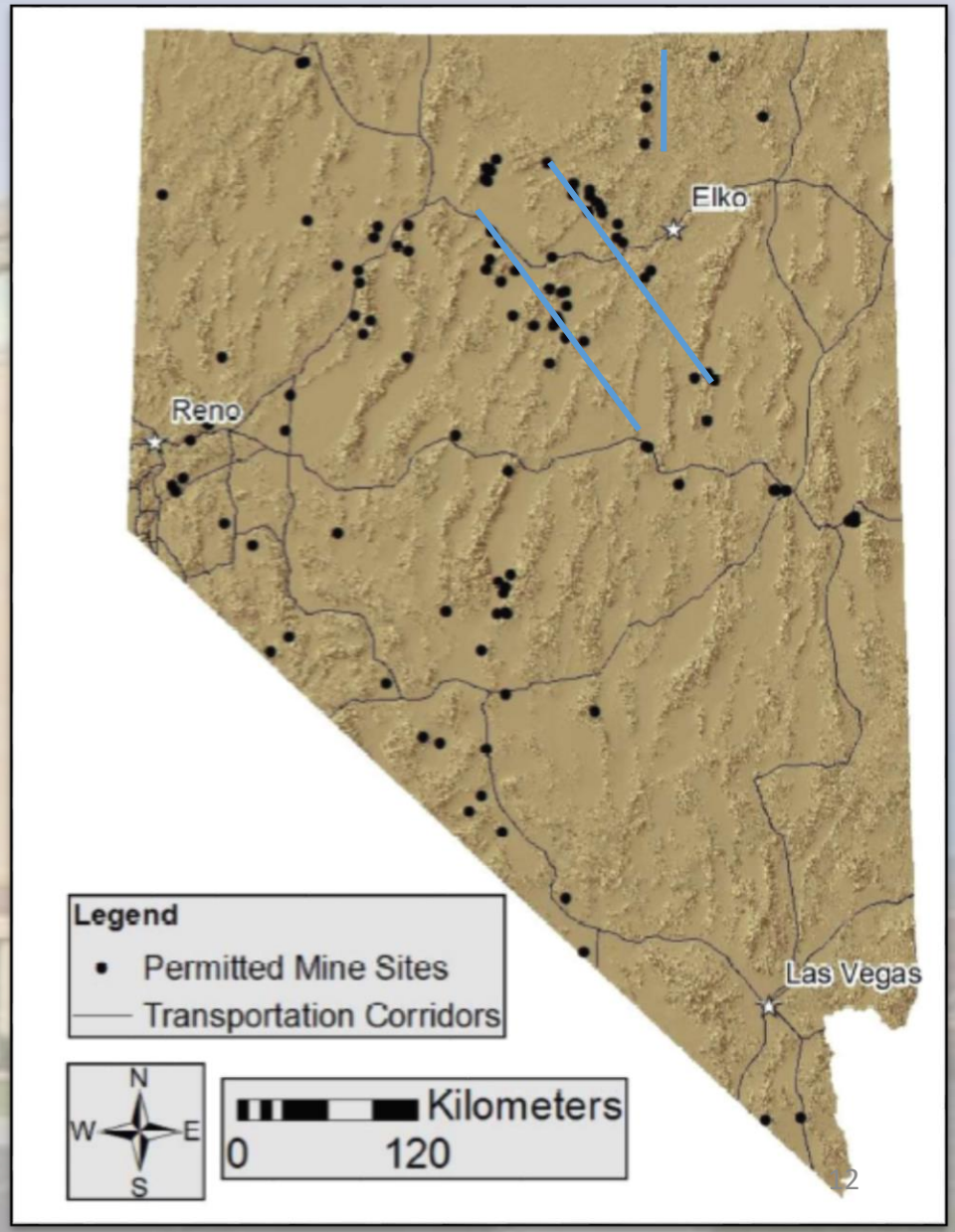
"Preserve and enhance the environment of the State in order to protect public health, sustain healthy ecosystems, and contribute to a vibrant economy"

2. Bureau of Mining Regulation and Reclamation (BMRR)



2. Bureau of Mining Regulation and Reclamation (BMRR)

- 256 Reclamation Projects
- 97 Operating Mines
- 31 Mines Not Yet Built
- 17 Mines in Temporary Closure
- 31 Mines in Permanent Closure



Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

3. Regulation Branch

- Prevent degradation to (ground and surface) waters of the State
- Administer mining regulations and State water pollution control law
- Govern site characterization, design, construction, and operation

3. Regulation Branch

3. Regulation Branch

Quarterly WPCP Inspections

3. Regulation Branch

Quarterly WPCP Inspections

- ✓Process Components
- ✓Tanks, Piping, Solution Channels
- ✓Solution Ponds
- ✓Leach Pads
- ✓Tailings Impoundments
- ✓Truck shop
- ✓Fuel/Wash Bays

Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

4. Closure Branch

"Waters of the State" are not degraded and components are left chemically stable for the long term

4. Closure Branch

Challenges For Final Closure

- Long-term active and/or passive treatment
- Process solution drain-down/disposal
- Pit lake water quality
- Acid rock drainage
- Groundwater contamination
- Long-term funding mechanisms

4. Closure Branch

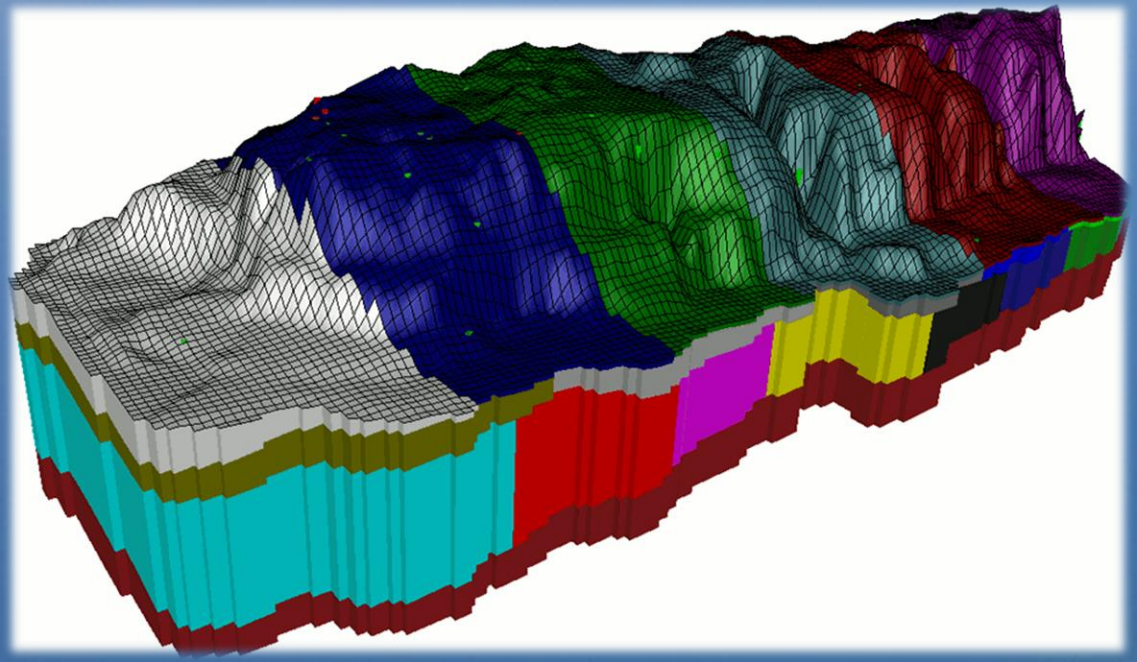
Pumpback well system

Contaminated groundwater

4. Closure Branch

Groundwater, Pit Lake, Geochemical Modeling

- Guidance documents on BMRR webpage: https://ndep.nv.gov/land/mining/
- List of approved software



Conceptual Model

GW/Pit Lake Model

Geochemical Model

Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

5. Reclamation Branch

Ensures mining and exploration projects are returned to safe and stable post mining productive land use

- Issue reclamation permits
- Oversee financial assurance
- 256 active reclamation permits

5. Reclamation Branch

Suitable for productive post-mining use

- Wildlife Habitat
- Cattle Grazing
- Recreation
- Industrial Site/Business Park
- Future Mineral Exploration and Development
- Renewable Energy Creation and Storage

5. Reclamation Branch

5. Reclamation Branch

NV Standardized Reclamation Cost Estimator (SRCE): Agency approved EXCEL workbook file with standardized cost data

- https://nvbond.org/
- Standardized Process Fluids Cost Estimator (PFCE)
- Heap Leach Drain down Estimator (HLDE)

5. Reclamation Branch

*In millions $	2005	2008	2011	2014	2017	2018
Bonds	248	214.0	998.9	1,680.7	2,070.5	2,176.3
Letters of Credit	254	618.1	413.4	434.9	395.1	402.7
CD/Cash	4	9.3	7.0	10.8	33.2	38.3
Corp Guarantee	204	182.0	183.0	198.5	140.9	140.9
USFS	10	12.5	13.3	22.0	21.9	21.9
Bond Pool	1	2.7	2.2	0.7	1.4	1.4
TOTAL	$721	$1,038.6	$1,617.8	$2,347.6	$2,662.9	*$2,781.5

Outline

1. Introduction – Mining in Nevada
2. The Bureau of Mining Regulation and Reclamation
3. Regulation Branch
4. Closure Branch
5. Reclamation Branch
6. Mine Water Management Database

6. Mine Water Management Database

Problem:

- Avg. monitoring locations per mine site: **30** (range: 2-156)
- Individual geochemical data records collected on quarterly basis per mine site: **73,000-110,000**
- **Quantitative analysis and distribution to stakeholders difficult, inefficient, lack of analytical functionality**

6. Mine Water Management Database

Solution:

- Electronic database and reporting
- Allows for advanced analysis including:
  - Determination of flow paths
  - Analysis of geochemical characteristics of surface and groundwater
  - Determination of regulatory compliance

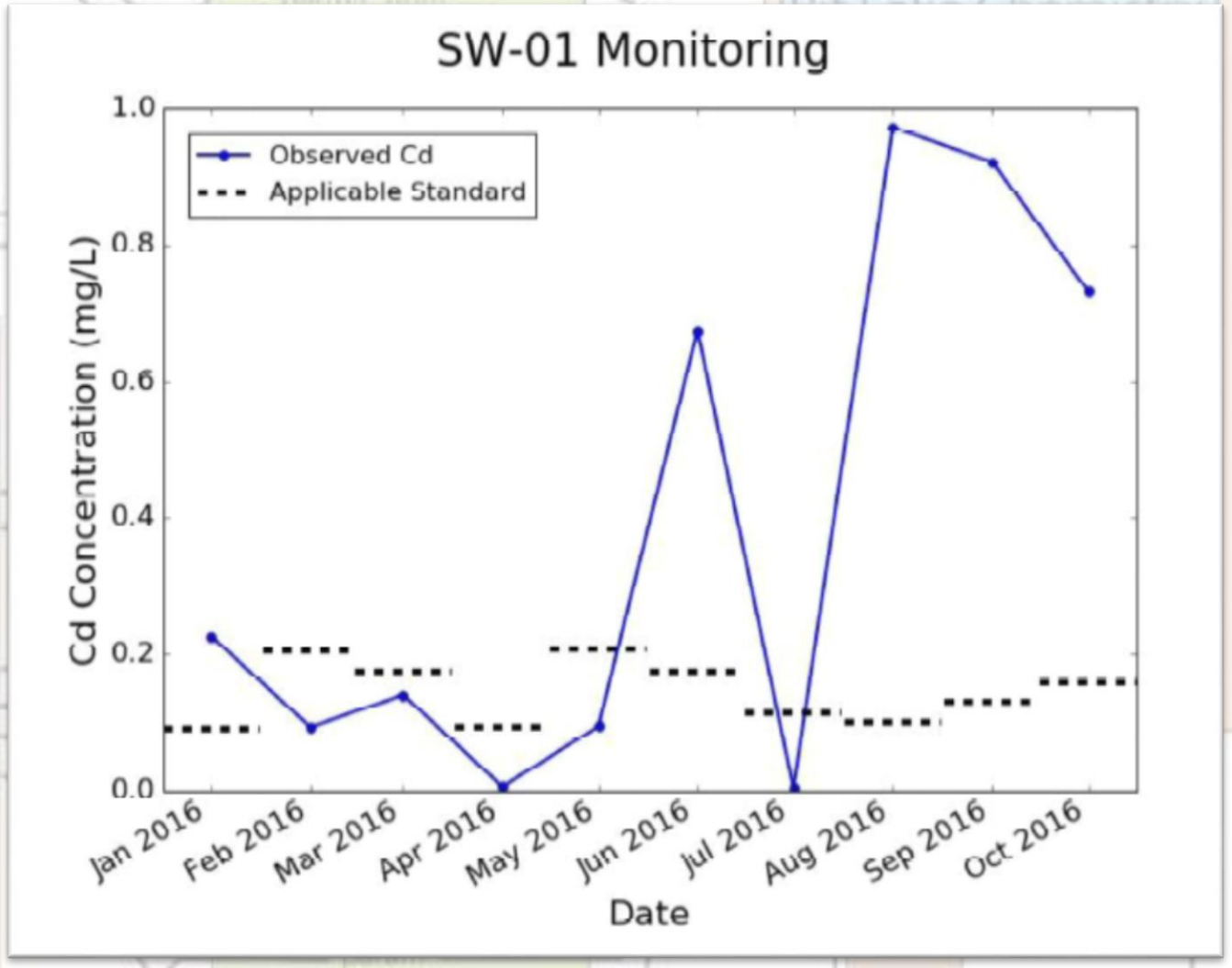
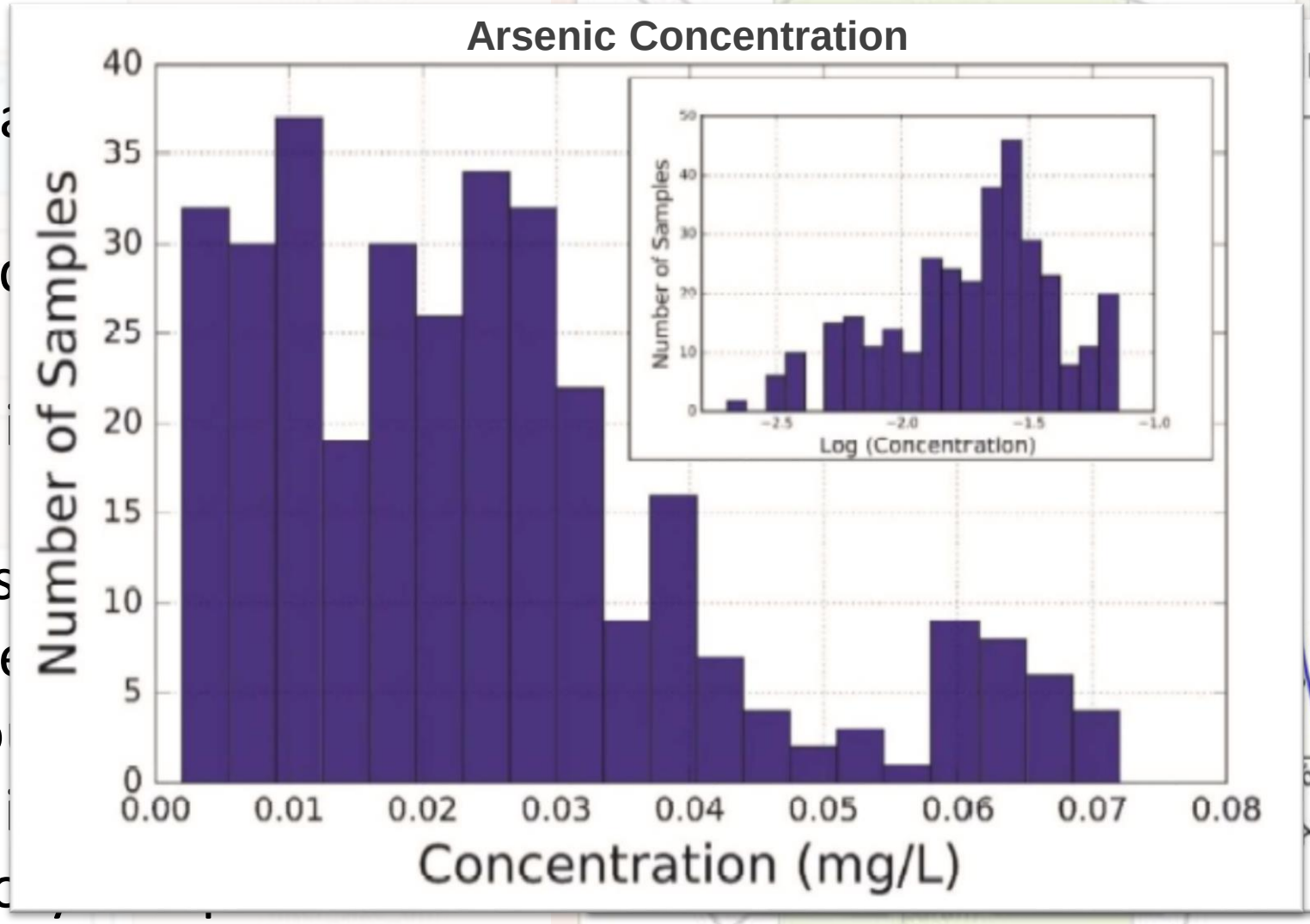


Figure 3. Newman, 2017

6. Mine Water Management Database

<u>Solution:</u>

- Electronic da
  reporting
- Allows for ac
  including:
  - Determi
    paths
  - Analysis
    characte
    and gro
  - Determi
    regulato



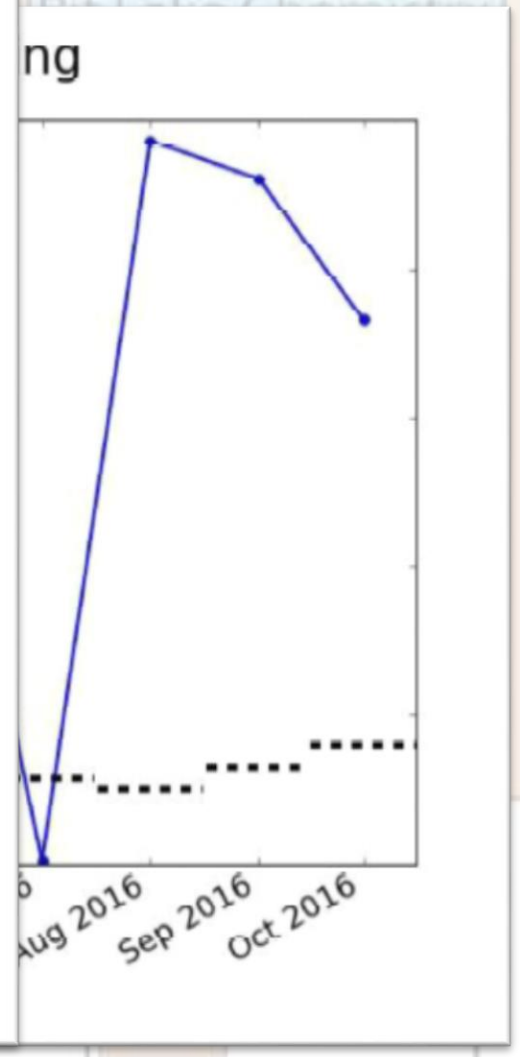


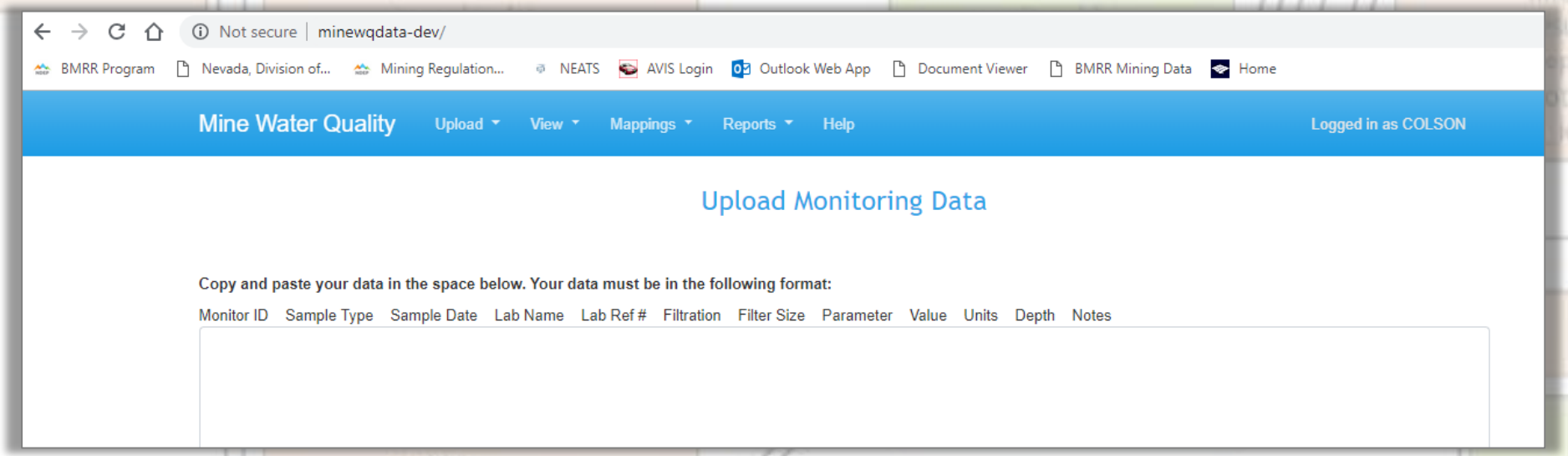
Figure 4. Newman, 2017

6. Mine Water Management Database

Design:

- SQL – Structured query language
- Allows for use across many operating and computer systems
- For more information see:

  Newman, C. 2017. **Design and Implementation of a Geochemical and Hydrologic Database for Nevada Mine sites**. Journal of the Nevada Water Resources Association, Summer 2017, p. 5-16. DOI: 10.22542/3. Copyright 2017 Nevada Water Resources Association



References

Literature Sources

[1]Sources: https://www.nevadamining.org/reclamation-bonding-mining-responsibly-in-nevada/

[2]https://www.blm.gov/about/history/history-by-region/Nevada

[3]https://www.legendsofamerica.com/nv-comstocklode/

[4]https://investingnews.com/innspired/nevada-largest-gold-producer/

[5]Newman, C. 2017. Design and Implementation of a Geochemical and Hydrologic Database for Nevada Mine sites. Journal of the Nevada Water Resources Association, Summer 2017, p. 5-16. DOI: 10.22542/3. Copyright 2017 Nevada Water Resources Association

[6]https://minerals.usgs.gov/minerals/pubs/mcs/2018/mcs2018.pdf

Photo Sources

Slide 3: https://www.mininghistoryassociation.org/Tonopah.htm

Slide 4: https://motherboard.vice.com/en_us/article/yp34pj/the-mine-of-the-future-is-run-by-drones

Slide 6-9: https://https://forterrabp.com/structural-precast/case-studies/commercial/nevada-state-office-building-richard-h-bryan-building/

Slide 9: Literature Reference 5, Newman

Slide 18: https://www.waterloohydrogeologic.com/2012/06/22/what-is-modflow/

Thank you for your attention. Questions?

NDEP Website:

ndep.nv.gov/land/mining