STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

In the Matter of:	)	
	)	
PROPOSED AMENDMENT TO 20.6.2 NMAC (Copper Rule)	)	**No. WQCC 12-01(R)**
	)	

EXHIBIT SCOTT – B-2

TAILING DAM DESIGN, CONSTRUCTION, AND OPERATION

Technical Committee Presentation
Copper Rules Advisory Committee
May 3, 2012

FCX

URS

Jim Scott

- Principal Geotechnical Engineer with URS for 35 years
- BS (Arizona State University) and MSCE (Purdue University)
- P.E. in NM, AZ, CO, and B.C.
- Mining industry experience includes engineering analyses and design for development, operation, reclamation, and closure projects
- URS Principal-In-Charge for work at the Bagdad Mine in AZ (Mammoth, Upper Mammoth, and Mulholland tailing impoundments)
- New Mexico experience includes work at Chino Mines Company, Cobre Mine, Tyrone Mine, Hidalgo Smelter, and Questa Mine

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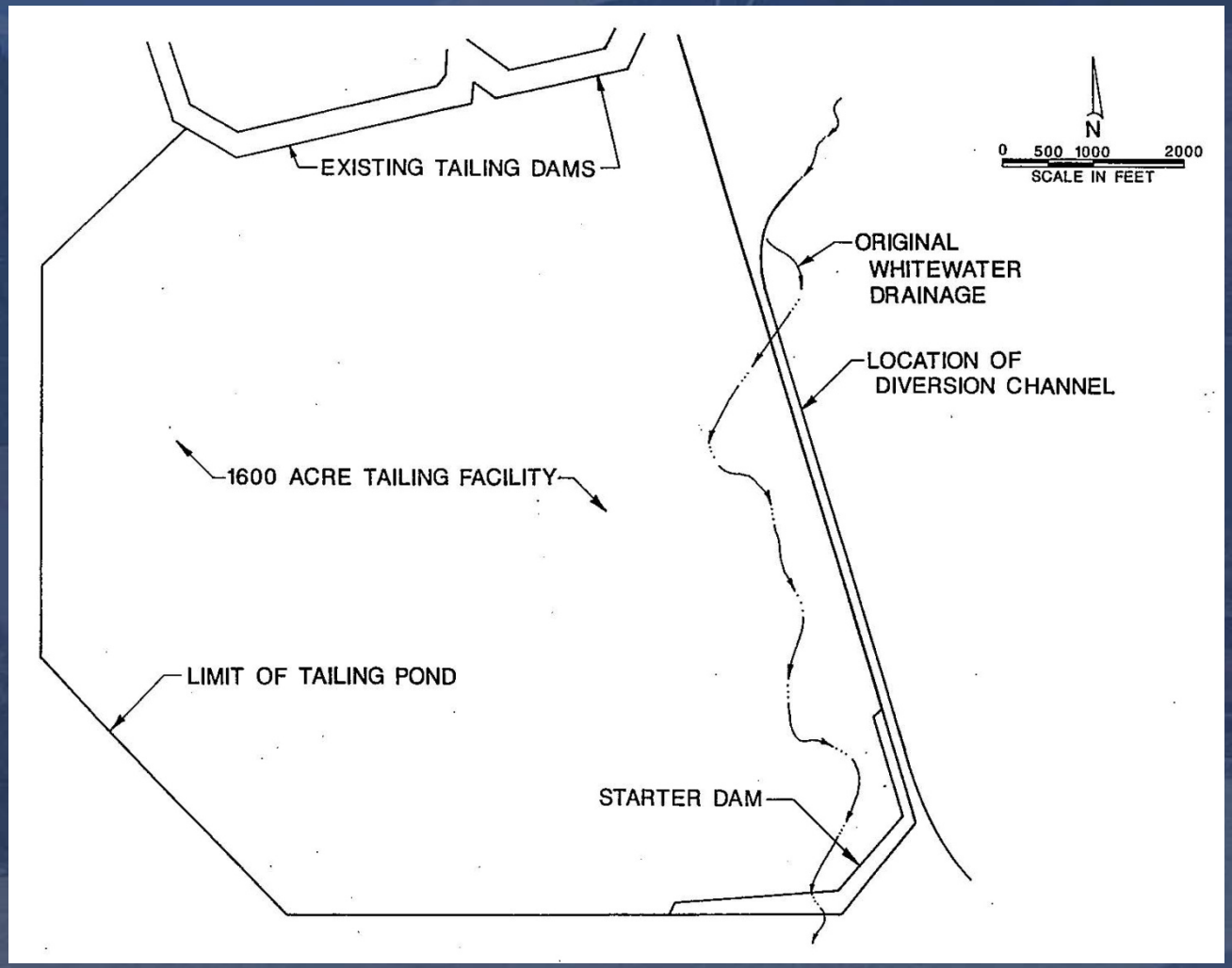
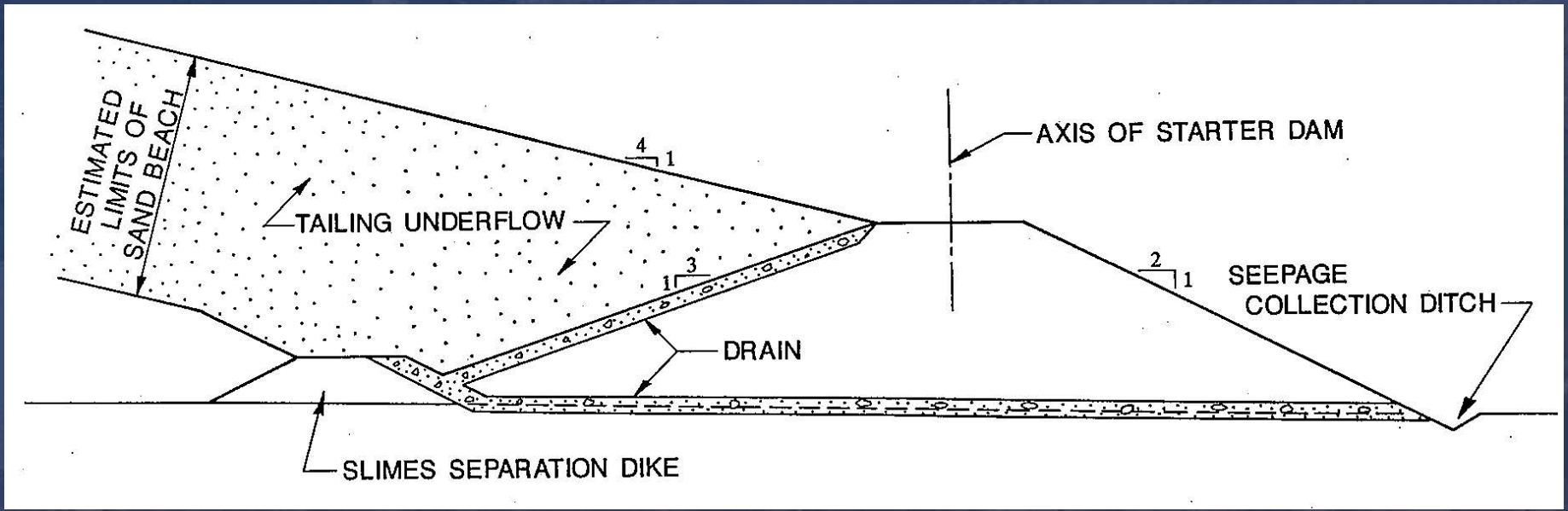
New Mexico State Engineer Office Dam Safety Design and Operation Criteria

- Hazard Potential Classification
- Hydrologic Analyses
- Geotechnical Field and Laboratory Investigations
- Foundation Conditions
- Seepage Analysis
- Embankment Stability (static and seismic)
- Surface Water Diversion Channels
- Design Report (construction drawings, specifications, cost estimate)
- Construction Completion Report (progress reports, as-builts)
- Operation and Maintenance Manual (O&M)
- Downstream Conditions (EAP)

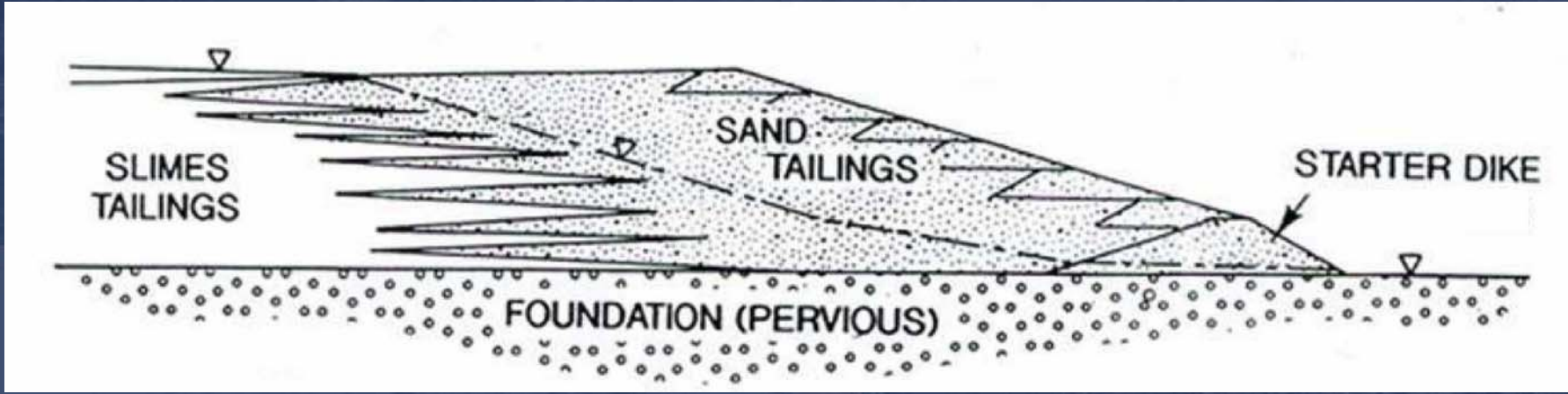
Tailing Pond No. 7



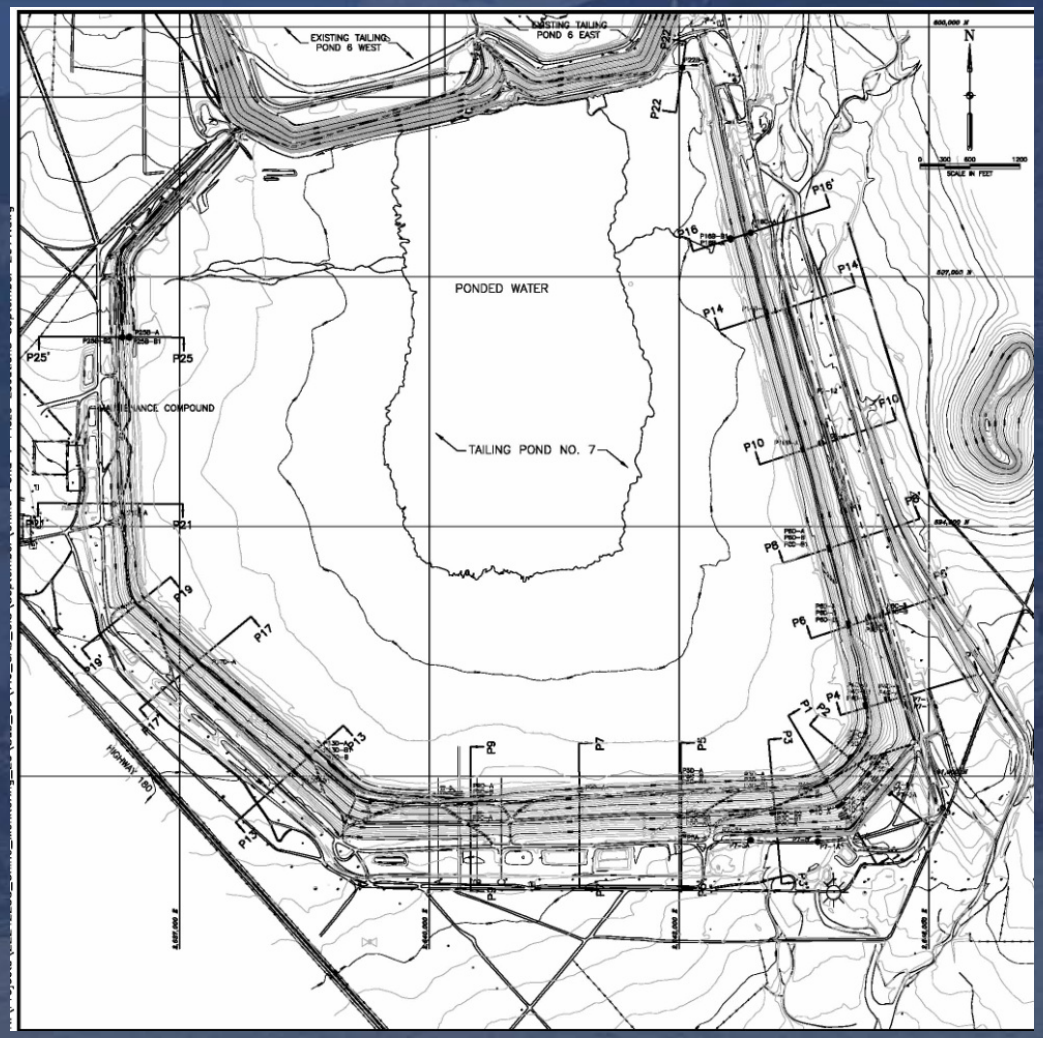
Starter Dam


ESTIMATED LIMITS OF SAND BEACH
TAILING UNDERFLOW
4
1
3
1
AXIS OF STARTER DAM
2
1
SEEPAGE COLLECTION DITCH
DRAIN
SLIMES SEPARATION DIKE

Typical Upstream Method Tailing Dam



Tailing Pond No. 7



State-of-the-Practice Design, Construction, and Operation of Conventional Tailing Dams

- All major copper tailing impoundments are unlined in the Western U.S.
- Wide drained tailing sand beach formed by hydraulic particle separation (low phreatic surface)
- Pervious foundation/sufficient underdrainage
  - maintain sand shell relatively drained (low phreatic surface)
  - prevent seepage emerging on the face
- Raise rate slow to allow dissipation of pore water pressures
- Regular performance monitoring, reviews, on-going operator/designer involvement

State-of-the-Practice Design, Construction, and Operation of Conventional Tailing Dams (cont.)

- U/S construction not for moderate to high seismicity areas
- Consistent design requirements
  - minimum sand beach width
  - pond size
  - freeboard
  - side slopes
- Good understanding of internal pore pressures and hydraulic gradients

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Factors Influencing Stability and Safe Performance

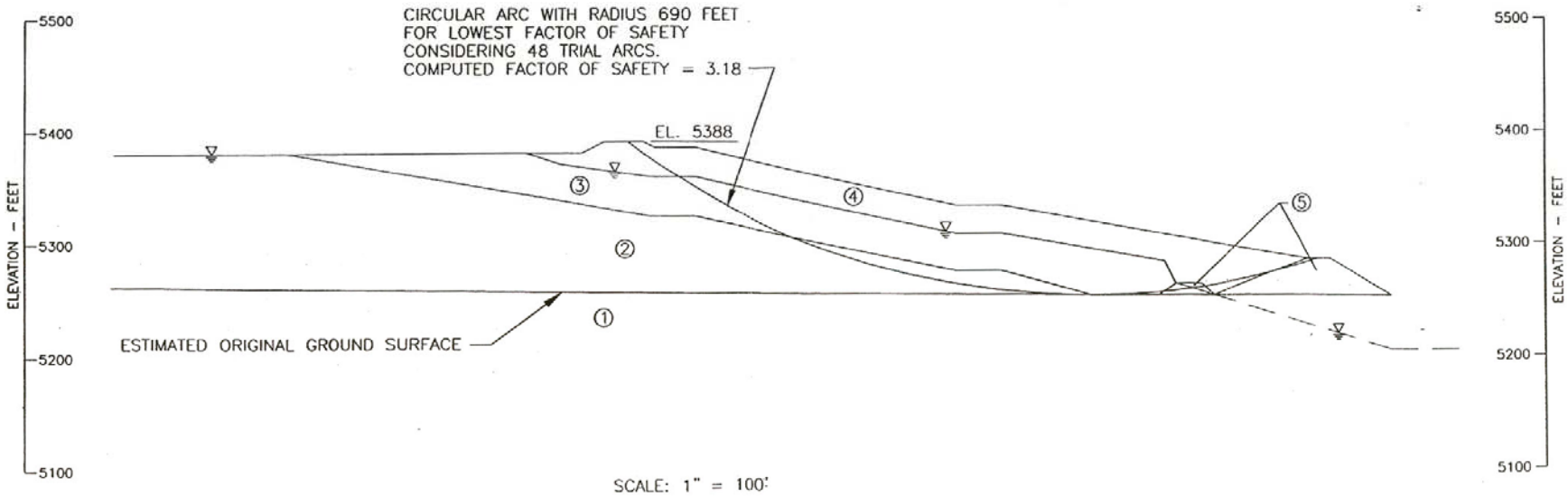
- Shear Strength of Slope Materials
- Pore Pressure/Phreatic Surface Location
- Slope Angle
- Unit Weight of Materials in the Slope
- Loading Condition (static, seismic)

NOTES:

1. STABILITY ANALYSES WERE PERFORMED WITH A COMPUTER USING THE SLOPE STABILITY PROGRAM "UTEXAS3" USING SPENCER'S METHOD.
2. PORE WATER PRESSURES IN TAILING DEFINED BY PIEZOMETRIC LINE ASSUMING HYDROSTATIC CONDITIONS.
3. SEE FIGURE 3.1 FOR LOCATION OF STABILITY STUDY SECTION P2–P2'.

ASSUMED MATERIAL PROPERTIES

SOIL TYPE NO.	MATERIAL DESCRIPTION	UNIT WEIGHT (pcf)	EFFECTIVE STRESS SHEAR STRENGTH	
			FRICTION ANGLE (degrees)	COHESION (psf)
1	NATURAL FOUNDATION SOILS	135	40	0
2	TAILING SLIMES	134	35	0
3	INTERLAYERED SANDS/SLIMES	132	35	0
4	UNDERFLOW SANDS	120	36	0
5	STARTER DAM AND SLIMES/SEPARATION DIKE	132	35	0



Discharge Controls

- All major copper tailing impoundments are unlined in Western U.S.
- Employ discharge control to various degrees and with various technologies
  - not jeopardize stability
  - practical
  - constructible
  - proven
  - cost-effective
  - timely

Discharge Controls (cont.)

- Seepage Interceptor Well System (Tailing Pond No. 7)
- Procedures for the sequencing of cycloning/spigotting
- Water management – relatively small pond to minimize seepage
- Minimize discharge heads using drains at/near starter dam base
- Seepage collection ponds
- Promote rapid dewatering after closure

Key Fundamentals for Successful and Safe Performance of Tailing Dams

- Wide drained tailing sand beach (low phreatic surface)
- Well-drained foundation
- Minimizing dam slope underlain by fine tailing (slimes)
- Preventing seepage from emerging on dam face

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QUESTIONS / COMMENTS?