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Applying Numerical Hydrochemical Models as Decision Support Tools for Mine Closure Planning

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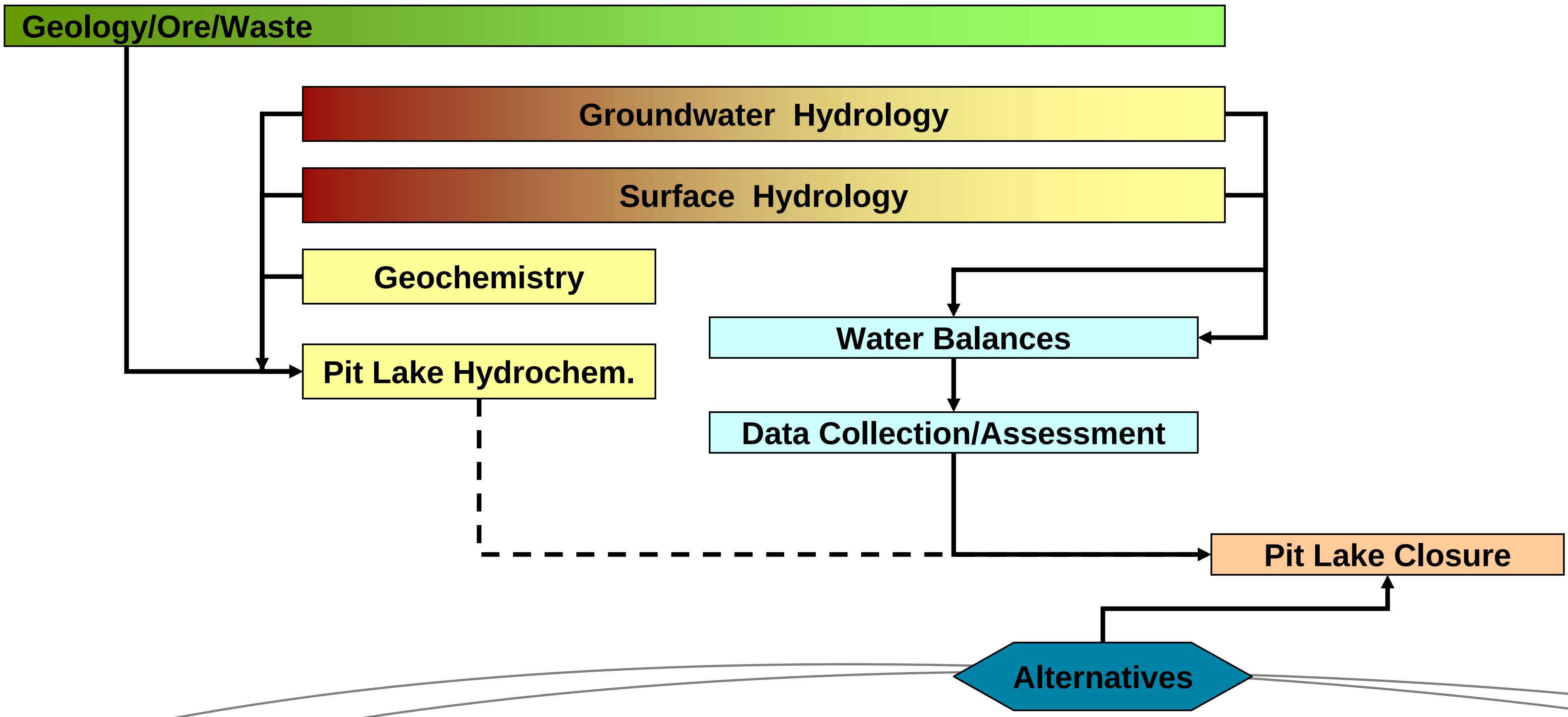
Topics

- Purpose of a decision-support model for closure
- Modeling approach and structure
- Example application for evaluating closure alternatives for pit lakes

Life Cycle for Pit Lake-Related Models

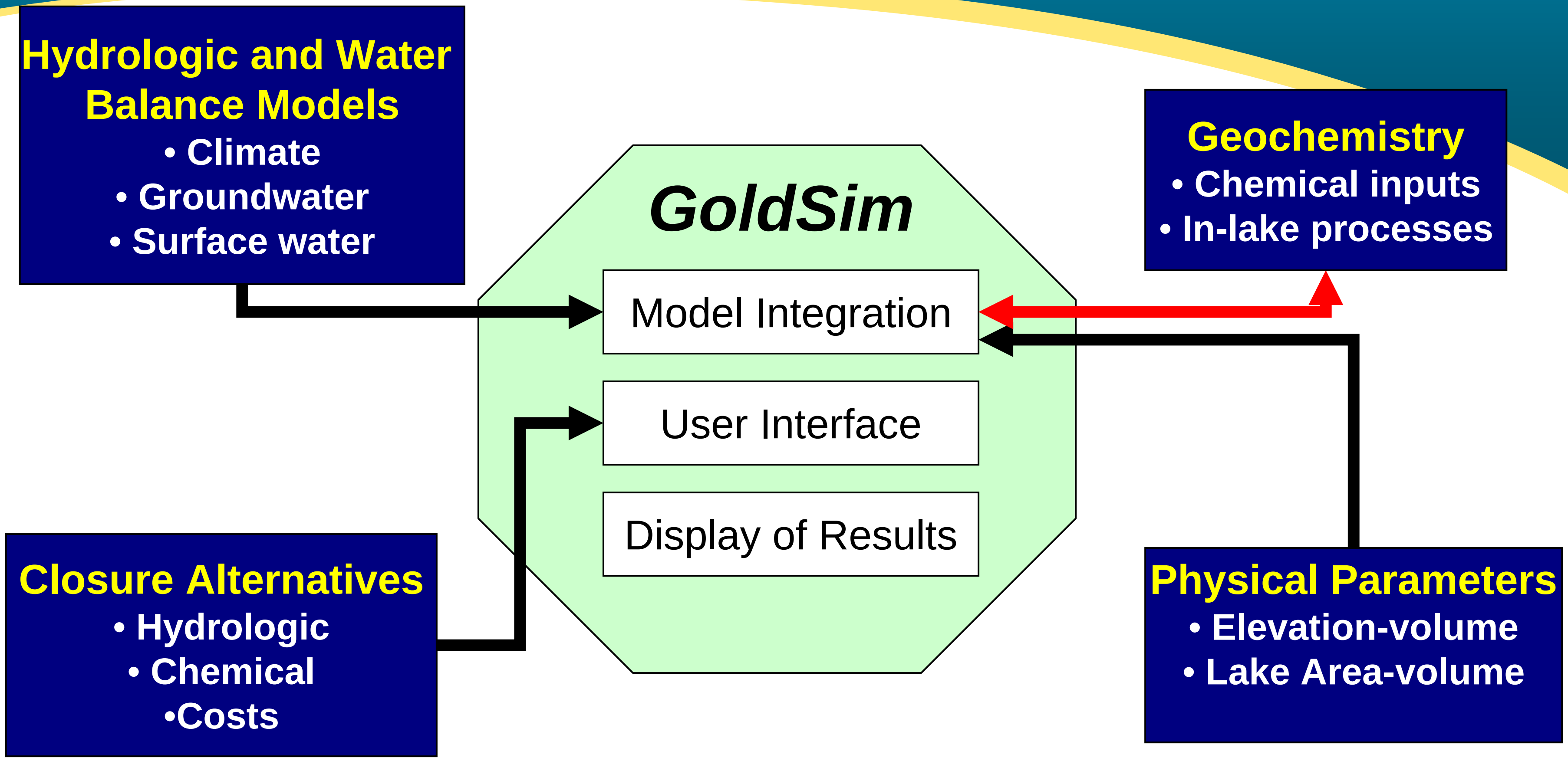
Exploration	Permitting/ Development	Operation	Facility Closure Planning



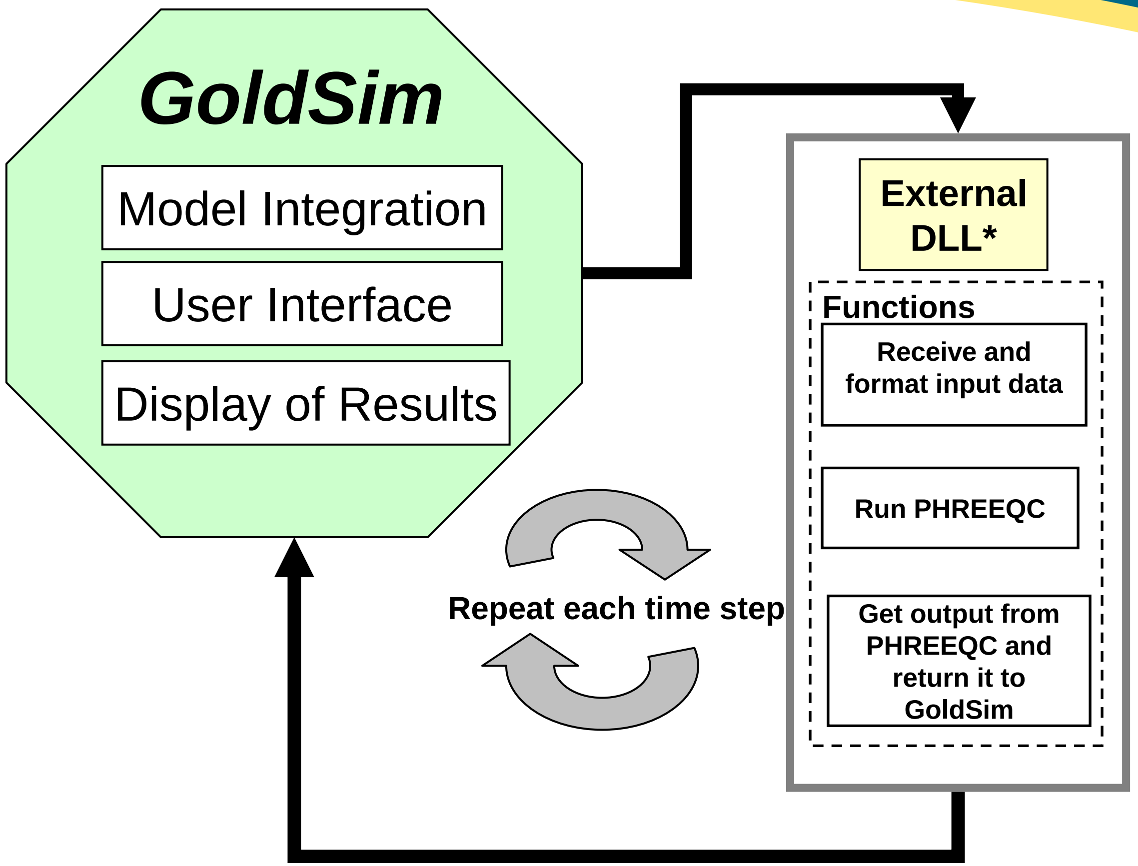
Purpose of a Decision-Support Model for Closure

- Assemblage of information gained during permitting and operating phases
- Incorporate features representing potential closure alternatives
- Allow the user to select different alternatives (singly or in combination) for "***What if***?" types of simulations (e.g., help make informed decisions).

Modeling Approach and Structure

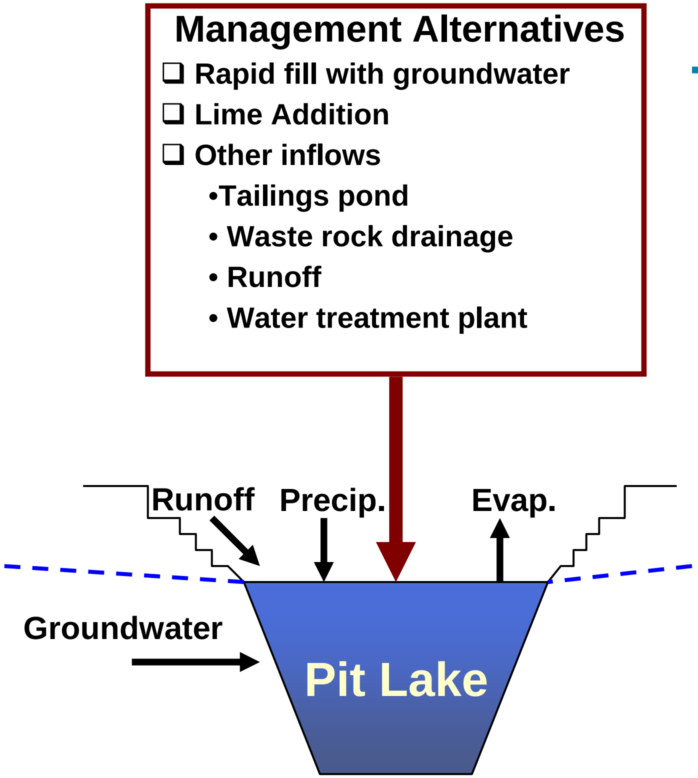


Key Aspect: Linkage to Geochemical Model to Allow Simulation of Chemical Processes



*DLL = Dynamic Link Library

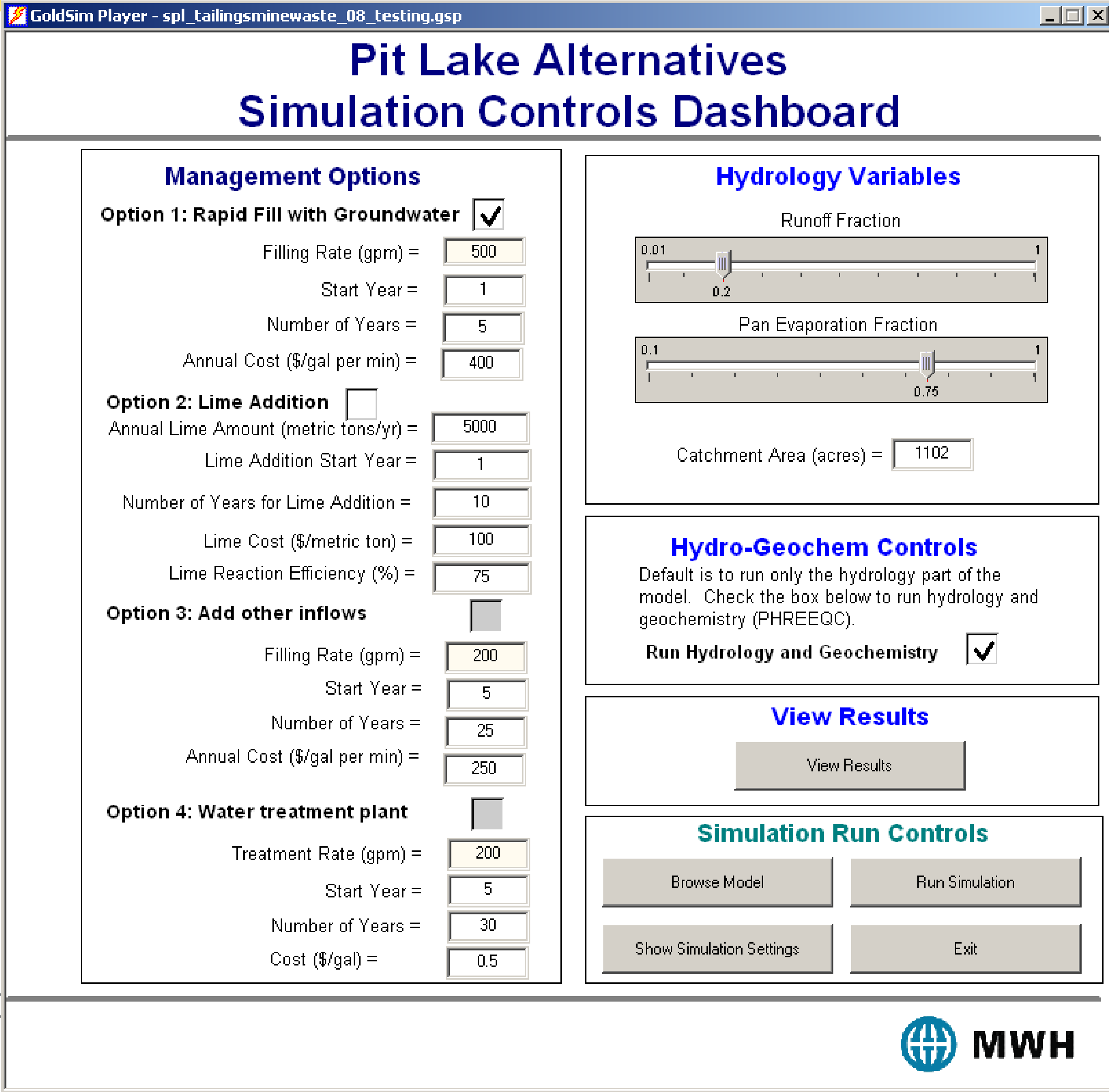
Conceptual Model for Pit Lake Closure Alternatives Assessment



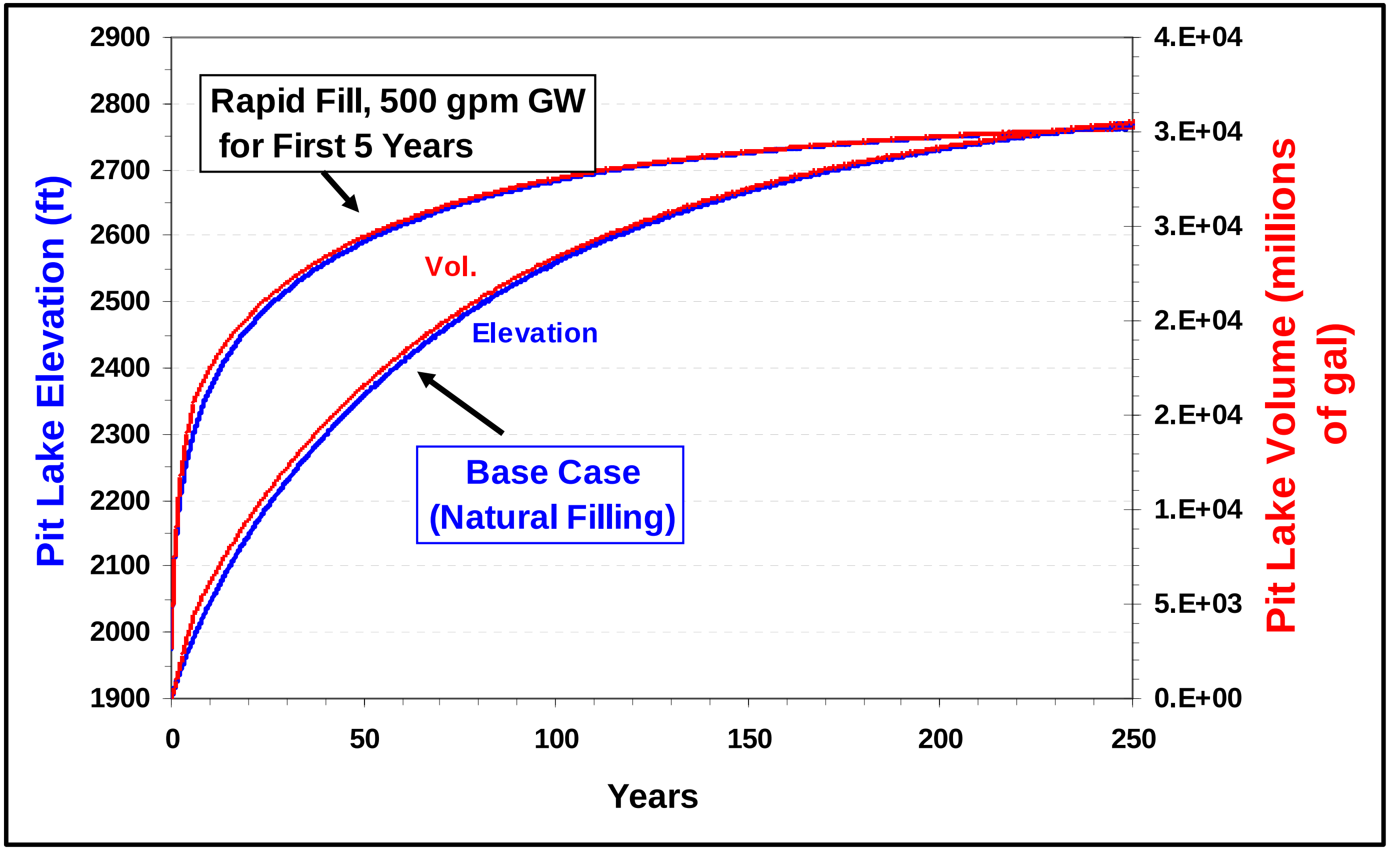
Analyte	Groundwater mg/L	Pit Wall Runoff mg/L	Precipitation mg/L	Other Waste Stream	WTP Effluent
Alkalinity	457	0	1.1	0	250
pH (s.u.)	6.88	2.00	5.50	3.8	7.5
DO	8.1	8.1	8.0	4	-
Ca	197	355	2	350	500
Mg	88	322.1	-	55	41
Na	81	456	0.4	94	22
K	3.6	9.4	-	17	8
Al	-	151	-	29	-
SO4	473	5750	4.5	1500	1650
NO3	2.5	1.5	0.1	18	-
Cl	57	0.1	0.4	15	22
F	1.2	25.8	-	16	-
As	0.0016	0.0009	-	0.0009	-
Cd	0.0001	0.183	-	0.363	-
Cr	0.005	0.213	-	0.013	-
Cu	0.020	147	-	27	-
Fe	0.13	161.1	-	86	-
Hg	0.0001	0.0001	-	0.0001	-
Mn	0.25	96.3	-	55	-
Pb	0.0015	0.020	-	0.020	-
Se	0.00005	0.112	-	0.052	-
Sb	0.0006	0.032	-	0.012	-
Zn	0.15	13.2	-	10.5	-

User Interface designed around assessment of closure alternatives

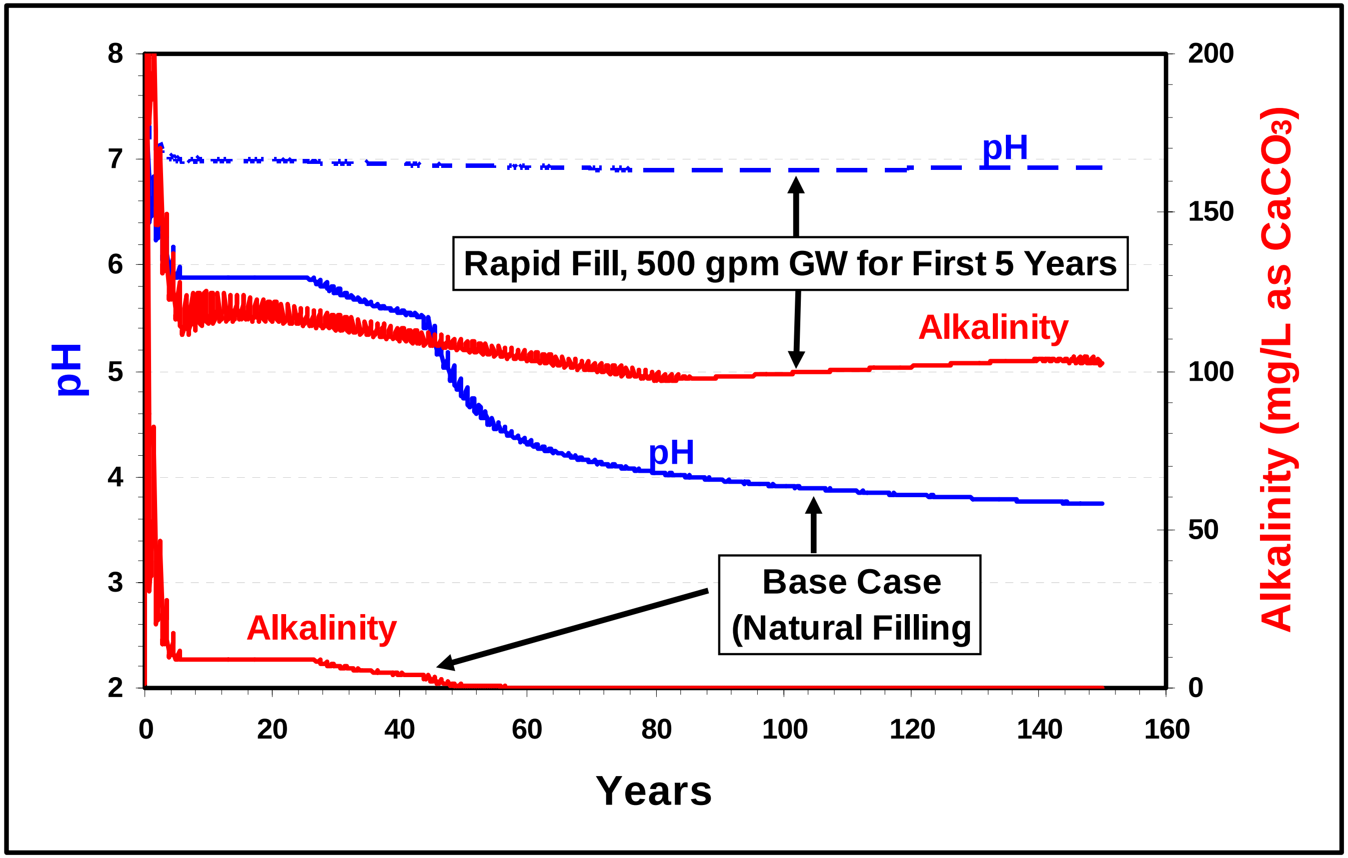
- Run in hydrology-only mode or hydro-geochemical mode
- Define input parameters
- Define alternatives



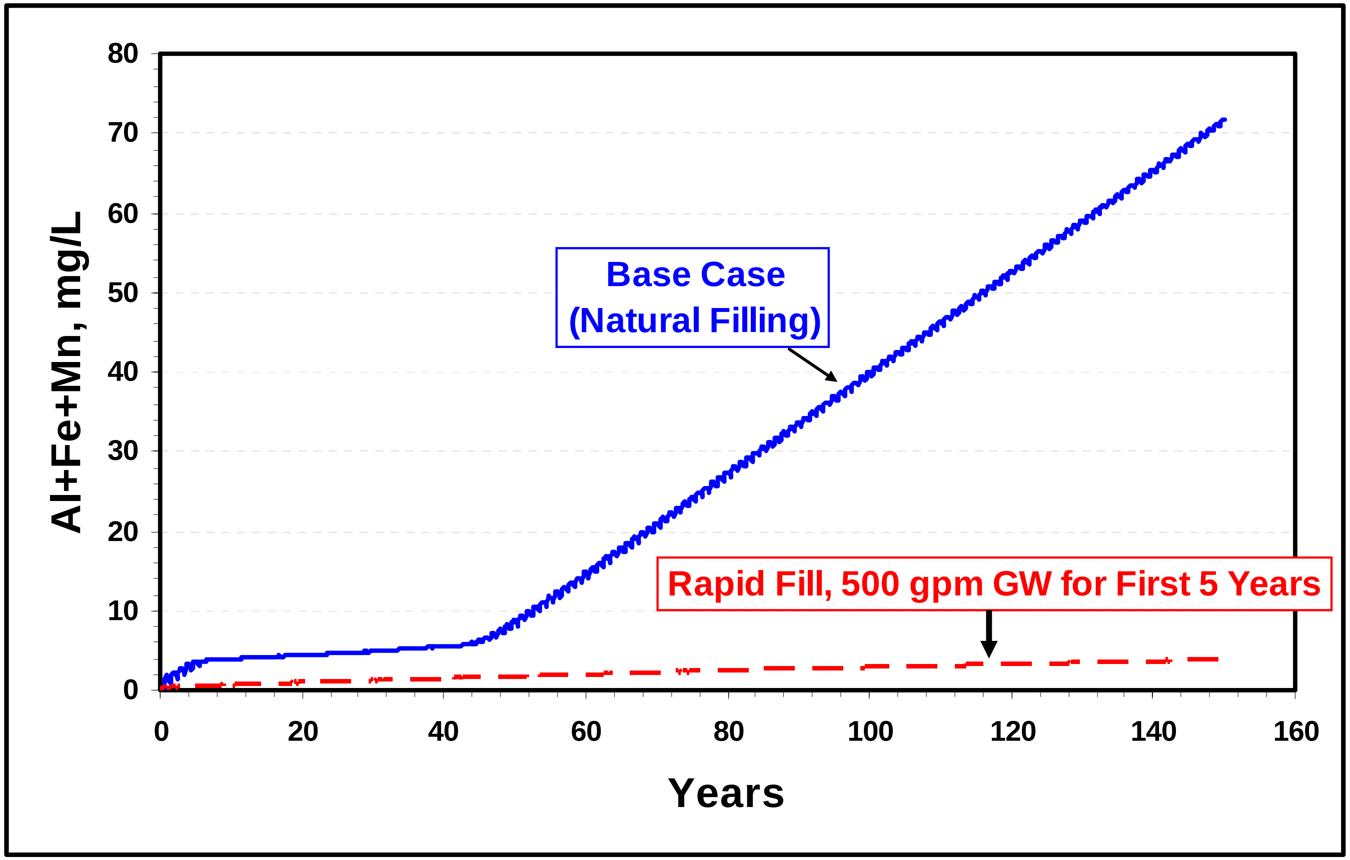
Effect of Rapid Fill with GW (Elevation/Volume)



Effect of Rapid Fill with GW (pH and Alkalinity)

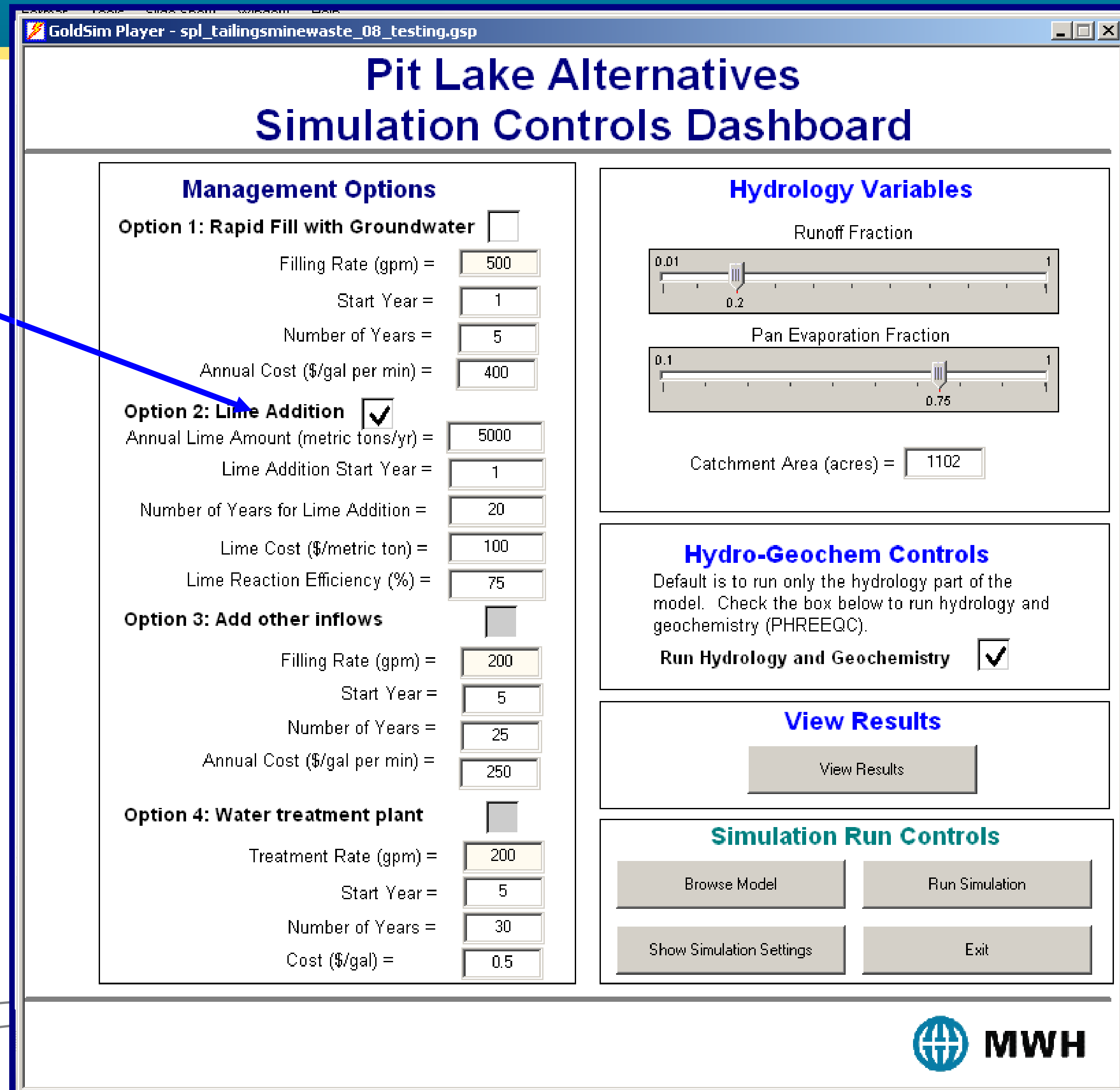


Effect of Rapid Fill with GW (metals)

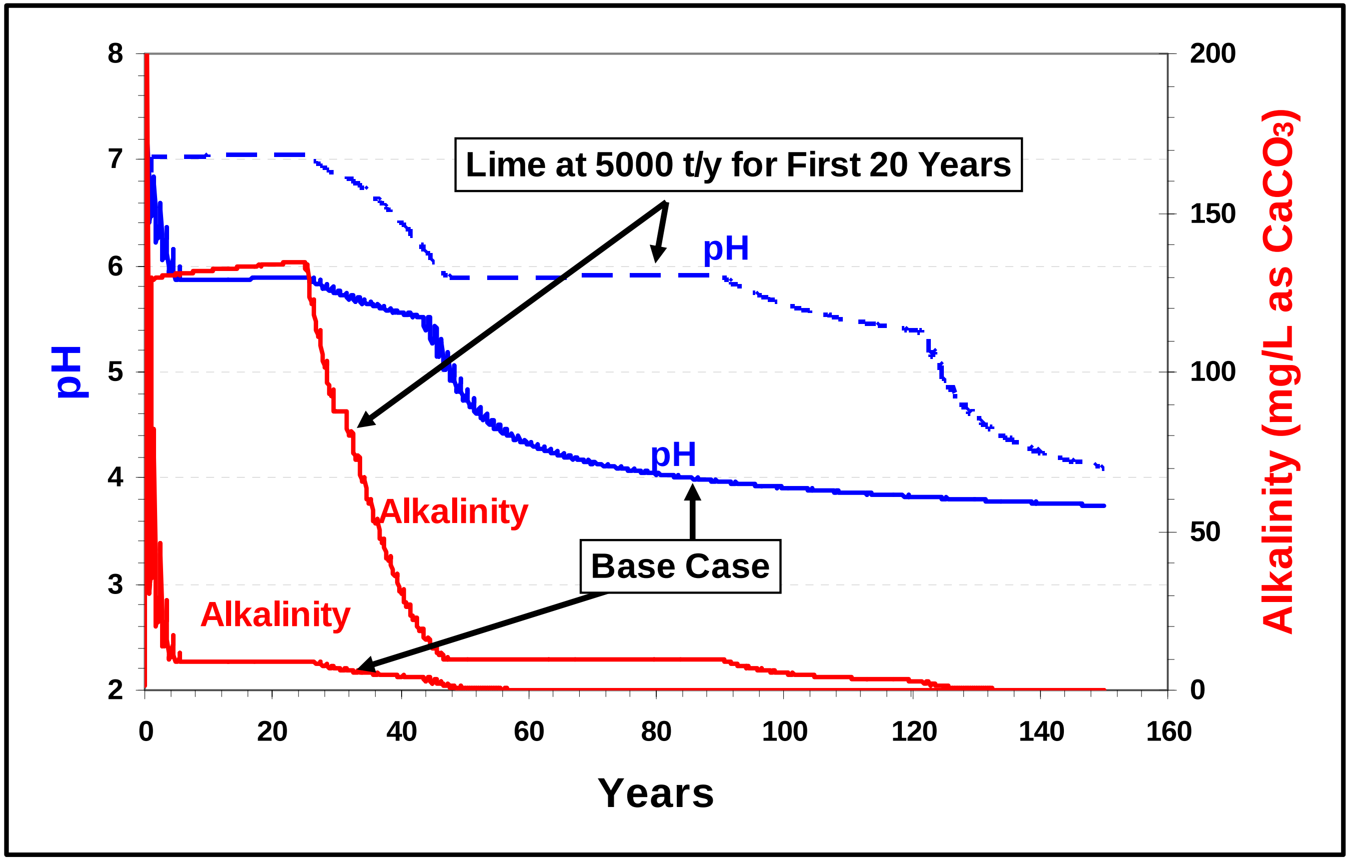


Assess a different “what if?”

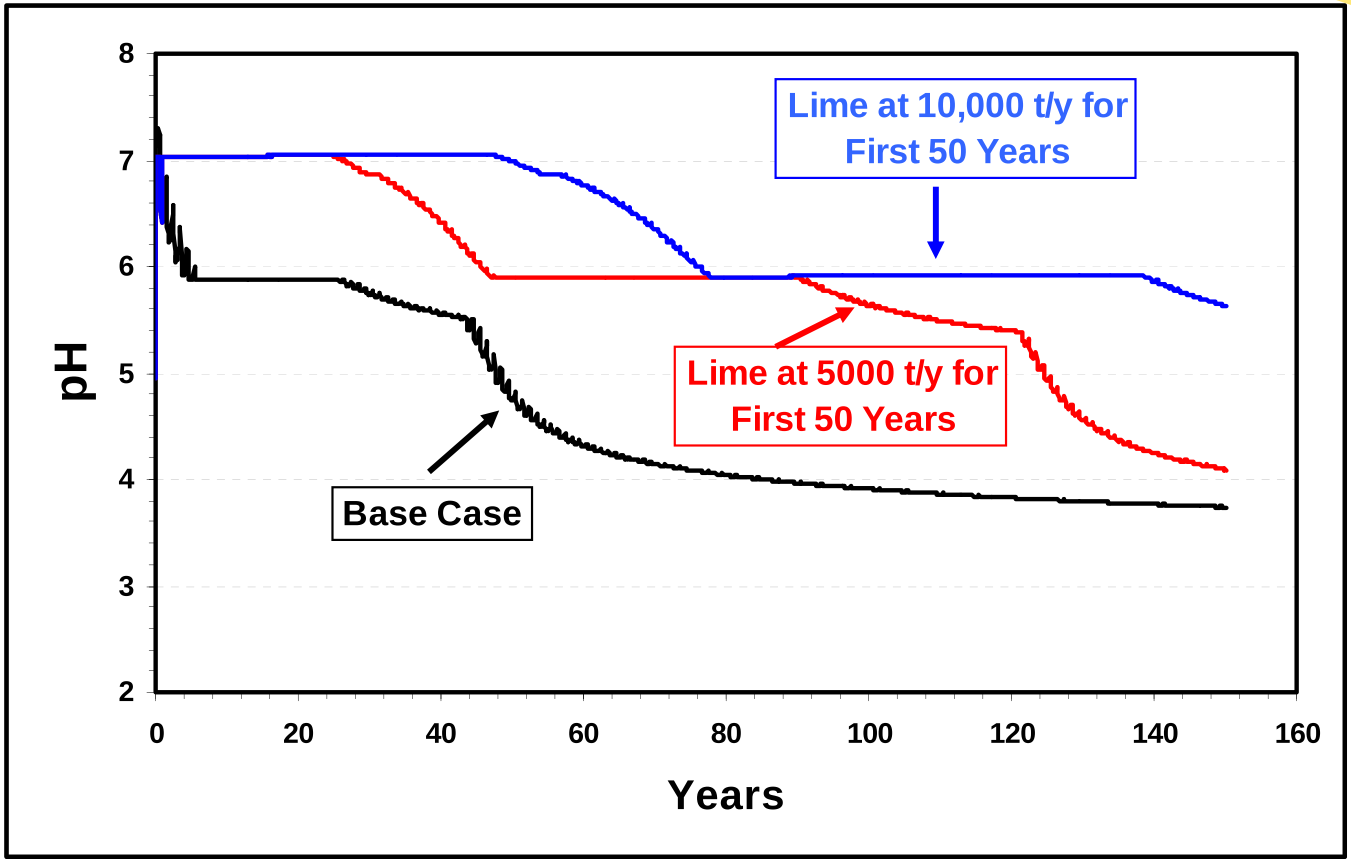
- Select lime addition alternative



Effect of Lime Addition (pH and Alkalinity)



Effect of Lime Addition
(pH and Alkalinity)



Summary

- Relatively simple water-chemical balance models can be useful tools for improving decision-making about closure alternatives
  - Leverage data and formulations from already existing models
  - Incorporate operational data
  - Flexible framework for adding alternatives as needed
  - User interfaces designed around answering “***What if?***” types of scenarios about effectiveness of different closure strategies

Thank you