

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

PRAIRIE RIVERS NETWORK	)	
and SIERRA CLUB,	)	
	)	
Petitioners,	)	
	)	PCB _____
v.	)	(Third Party NPDES Appeal)
	)	
	)	
ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY and	)	
PEABODY GATEWAY NORTH	)	
MINING, LLC	)	
	)	
Respondents.	)	

**NOTICE OF ELECTRONIC FILING**

To: **Attached Service List**

PLEASE TAKE NOTICE that on November 2, 2012, I electronically filed with the Clerk of the Pollution Control Board of the State of Illinois, a Petition for Administrative Review of an NPDES Permit Issued by the Illinois Environmental Protection Agency from Prairie Rivers Network and Sierra Club (collectively, "Petitioners"), along with the Appearance of Jessica Dexter, copies of which are attached hereto and herewith served upon you.

Respectfully Submitted,




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Jessica Dexter  
Staff Attorney  
Environmental Law and Policy Center  
35 East Wacker Drive, Ste. 1600  
Chicago, IL 60601  
312-795-3747

**BEFORE THE ILLINOIS POLLUTION CONTROL BOARD**

PRAIRIE RIVERS NETWORK )  
and SIERRA CLUB, )

Petitioners, )

v. )

PCB \_\_\_\_\_  
(Third Party NPDES Appeal)

ILLINOIS ENVIRONMENTAL )  
PROTECTION AGENCY and )  
PEABODY GATEWAY NORTH )  
MINING, LLC )

Respondents. )

**APPEARANCE OF JESSICA DEXTER**

NOW COMES Jessica Dexter, of the ENVIRONMENTAL LAW & POLICY CENTER,  
and hereby enters her appearance in this matter on behalf of Sierra Club and Prairie Rivers  
Network.

Dated: November 2, 2012

Respectfully Submitted,



\_\_\_\_\_  
Jessica Dexter  
Staff Attorney  
Environmental Law and Policy Center  
35 East Wacker Drive, Ste. 1600  
Chicago, IL 60601  
312-795-3747

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

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v.	)	PCB _____
	)	(Third Party NPDES Appeal)
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ILLINOIS ENVIRONMENTAL	)	
PROTECTION AGENCY and	)	
PEABODY GATEWAY NORTH	)	
MINING, LLC	)	
	)	
Respondents.	)	

**PETITION FOR ADMINISTRATIVE REVIEW OF AN NPDES PERMIT ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY**

Pursuant to 415 ILCS 5/40(e)(1) and 35 Ill. Adm. Code § 105, Prairie Rivers Network and Sierra Club (collectively, "Petitioners") hereby petition for review of the September 28, 2012 decision of the Illinois Environmental Protection Agency ("IEPA") to grant a new National Pollutant Discharge Elimination System ("NPDES") permit (Permit No. IL0079481) to Peabody Gateway North Mining, L.L.C., Gateway North Mine to discharge pollutants from a coal mining site into unnamed tributaries of Coulterville Lake and Marys River. (See Final Permit attached as Exhibit 1 and Responsiveness Summary at <http://www.epa.state.il.us/public-notices/2012/peabody-gateway-north-mining/responsiveness-summary.pdf>).

In support of their petition, Petitioners state:

**Statement of Petitioners**

1. Prairie Rivers Network is an Illinois not-for-profit corporation concerned with river conservation and water quality issues in Illinois. It works with concerned citizens throughout the state to address issues that impact Illinois streams. Prairie Rivers Network members live in the Marys River and Mud Creek watersheds (which includes Coulterville Lake) and are concerned with pollution that would affect their access to clean drinking water in Coulterville Lake and their ability to enjoy recreational activities dependent on the ecological health of the Marys River and its tributaries including swimming, wading, fishing, canoeing, kayaking, hiking, nature study, bird watching and other wildlife viewing. (Joint

Post-Hearing Comments of Prairie Rivers Network and Illinois Chapter of the Sierra Club, July 20, 2012, attached as Exhibit 2).

2. The Sierra Club is a California not-for-profit corporation, which has among its purposes to protect and restore the quality of the natural and human environment. The Sierra Club has over 20,600 members residing in the State of Illinois and has members who are adversely affected by the unnecessary degradation of water quality in the Marys River and Mud Creek watershed. Members depend on Coulterville Lake as a drinking water source and fishing spot and streams in the watersheds for activities including nature study, birdwatching and fishing, (See Public Hearing Transcript (June 20, 2012), available at <http://www.epa.state.il.us/public-notices/2012/peabody-gateway-north-mining/hearing-transcript.pdf> and Exhibit 2).
3. Members of the Petitioners, including Cindy Skrukrud, Joyce Blumenshine, Brian Perbix, Mike Fullerton, Tony Lehr and Kathy Andria appeared at the hearing held in this proceeding or submitted comments in opposition to the permit. (See Transcript and Exhibit 2). Because they are concerned that additional pollution from the new Gateway North Mine will degrade the drinking water supply and the water resources they enjoy for recreational purposes, these members and other members of Petitioners are so situated as to be affected by the unnecessary increase in pollution in the Marys River and Coulterville Lake watersheds.

#### **Marys River, Coulterville Lake and the Mud Creek Watershed**

4. An unnamed tributary to Mud Creek was impounded to create the Coulterville City Reservoir, which is also known as Coulterville Lake. Coulterville Lake then empties into Mud Creek which then feeds into the Kaskaskia River, a public drinking water source for downstream communities. The Kaskaskia River also provides water for recreational and industrial uses.
5. Marys River is a tributary of the Mississippi River.
6. Coulterville Lake is the public drinking water supply for over 1,100 Coulterville-area residents. Coulterville Lake is listed as impaired for Public and Food Processing Water Supply and aesthetic uses in the IEPA's draft 2010 Illinois Integrated Water Quality Report and Section 303(d) List. Manganese and total suspended solids are among pollutants causing the impairments. The Total Maximum Daily Load (TMDL) report that has been completed to address the impairments in the Lower Kaskaskia River Watershed states that to improve water quality, lands surrounding Coulterville Lake and its tributary streams should implement best management practices to control erosion and reduce runoff and pollutant loading to those waters. The TMDL recognizes that in other watersheds throughout southern Illinois, mining activities have been identified as sources of impairment for certain pollutants, including manganese.
7. Coal mining discharges are known to contain pollutants such as sulfate, chloride, total dissolved solids, pH, total suspended solids, aluminum, iron, manganese and other metals.

8. Given that waters receiving pollution from the Gateway North Mine are considered impaired even before new coal mining begins near Coulterville Lake, Petitioners argue that further degradation, especially of a public water supply, should not be allowed where there are viable alternatives.

### **Grounds for Appeal**

9. This permit appeal challenges IEPA's failure to comply with Illinois antidegradation law in its issuance of a permit to the Gateway Mine. Specifically, IEPA failed to adequately consider alternatives to the proposed discharge that would reduce pollutant loading. Therefore IEPA issued a permit in violation of 35 Ill. Admin. Code 302.105 (c)(2)(B), which requires IEPA to assure that "all technically and economically reasonable measures to avoid or minimize the extent of the proposed increase in pollutant loading have been incorporated into the proposed activity."
10. On April 26, 2012, IEPA issued a public notice of its tentative decision to issue a new NPDES permit to Peabody Gateway North Mining, L.L.C., Gateway North Mine for discharges into an unnamed tributary of Marys River and an unnamed tributary of Coulterville Lake. The new permit would allow the Gateway North Mine to discharge mine drainage, reclamation area drainage and stormwater runoff into these receiving streams. In the public notice, IEPA set June 20, 2012 as a date for a public hearing on the draft permit.
11. The Gateway North Mine is located near the existing Gateway Mine. Coal processing for both mine sites will take place at the existing Gateway Mine Central Cleaning Plant facility. The Gateway Mine is owned by Peabody Coulterville Mining, LLC.
12. The April 26, 2012 public notice included an Antidegradation Assessment, which stated that the mine company had evaluated several alternatives to the proposed discharge. All of these alternatives were rejected. One alternative, a "no discharge" alternative, was rejected because 1) the company did not think evaporation of the water was feasible and 2) "containing and re-using all the effluent is not viable given that there are no users for this water available that would want water after storm events."
13. In 2012, the Gateway Mine had to obtain water from offsite sources in order to continue operations at its Central Cleaning Plant.
14. After reviewing the draft permit, on June 20, 2012, members of Petitioners testified at the public hearing in Sparta, Illinois. During this hearing, members of Petitioners raised a number of concerns and questions regarding legal and scientific deficiencies in the draft permit.
15. During the hearing Petitioners specifically asked whether the permittee or IEPA had considered a closed-loop no-discharge alternative that would re-use water (that would otherwise be discharged) in the coal-preparation and washing system, as well as for dust control and other operational needs at Gateway North Mine and at the existing Gateway Mine coal processing facility, which has experienced water shortages. IEPA staff stated they had not considered that alternative, but

- that it would consider it and provide its findings in the Responsiveness Summary when a final permit was issued.
16. After the hearing, Petitioners submitted written comments on July 20, 2012 (Exhibit 2). Among other issues, Petitioners again asked that a closed-loop no-discharge option be explored that would re-use water collected on site in the nearby Central Cleaning Plant or for other mining operations including dust suppression. Petitioners suggested that the Agency's analysis would be aided if the company were to provide more complete water balance information for the sites.
  17. On September 28, 2012, IEPA issued a final NPDES permit for pollution discharges from the Gateway North Mine. This permit issuance is the agency action for which Petitioners are seeking administrative review by the IPCB.
  18. IEPA posted a Responsiveness Summary along with the final permit. In the Responsiveness Summary, IEPA provided its responses to issues that had been raised at the public hearing.
  19. In the Responsiveness Summary, IEPA dismissed Petitioners' suggested closed-loop no-discharge system as an alternative to the increased pollutant loading. In rejecting the alternative, it is not clear that IEPA actually evaluated the option of re-using the water for mine operations at the Gateway North and Gateway mines. Instead, IEPA stated that "surface runoff collected in the sedimentation pond would have to be pumped to another watershed to avoid discharge." Further, IEPA stated that "pumping expenses would be excessive."
  20. IEPA provided no information regarding the "excessive" costs of the alternative, nor did it weigh those costs against the benefits that would be gained by both the mine company (offsetting the need to purchase and transport off-site water for use on-site) and by watershed users, including those dependent on Coulterville Lake for clean drinking water.
  21. In the Responsiveness Summary, IEPA also stated that the need to make a consumptive use of the water was a consideration, and that "[i]t is possible that too much water would have to be consumed in the slurry pond under this scenario."
  22. IEPA apparently did not consider the consumptive uses of water at mining operations, including water used for dust suppression and coal washing and water that remains in coal after it is processed. Furthermore, even if only some of the water could be consumed by the mine operations, that re-use would reduce pollutant loading into Marys River and Coulterville Lake.
  23. Petitioners repeatedly urged IEPA to take the steps necessary to comply with 35 Ill. Adm. Code § 302.105(c) by assuring that all technically and economically reasonable measures to avoid or minimize the extent of the proposed increase in pollutant loadings be incorporated into the permit and that IEPA perform the required financial analyses regarding pollution control costs. Despite this urging, IEPA never adequately weighed pollution control alternatives and failed to determine both the costs of the various alternatives and the impact of those costs on the viability of the proposed project.
  24. IEPA's issuance of the permit without requiring alternatives to the increase in pollutant loading failed to comply with Illinois antidegradation rules at 35 Ill.

- Admin. Code §302.105 (c) and (f). IEPA's rejection of alternatives was improper. Simply stating that an alternative will cost more, or might not address all pollutant loading does not justify eliminating that alternative under the antidegradation rules.
25. IEPA's failure to require a proper antidegradation analysis will lead to degradation of a public water supply and will injure the ecology of the watersheds. Members of Petitioners will be adversely affected when pollution discharged under the permit causes unnecessary degradation of the water quality in Marys River, Coulterville Lake and tributaries thereto.

WHEREFORE, Prairie Rivers Network and the Sierra Club ask that the Pollution Control Board set aside the NPDES permit (No IL0078727) issued to Peabody Gateway North Mining, L.L.C., Gateway North Mine as not sufficiently protective of the environment and not in accord with law, and direct that the Agency reconsider the permit in order to establish conditions and limits necessary to protect Illinois waters, assure protection of Illinois water quality standards, and comply with the Federal Water Pollution Control Act, 33 U.S.C. § 1251 et seq., and Illinois law.



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Jessica Dexter (Reg. No. 6298340)  
*Counsel for Prairie Rivers Network and Sierra Club*

Date: November 2, 2012

Environmental Law & Policy Center  
35 E. Wacker Dr. Suite 1600  
Chicago, Illinois 60601  
312-795-3747

**EXHIBIT 1:**  
Final Permit



ILLINOIS ENVIRONMENTAL PROTECTION AGENCY



1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-2829  
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, ILLINOIS 60601 • (312) 814-6026

PAT QUINN, GOVERNOR

JOHN J. KIM, INTERIM DIRECTOR

September 28, 2012

618/993-7200

Peabody Gateway North Mining  
7100 Eagle Crest Boulevard  
Suite 100  
Evansville, IN 47715-8152

Re: Peabody Gateway North Mining  
Gateway North Mine  
NPDES Permit No. IL0079481  
Final Permit

Gentlemen:

Attached is the final NPDES Permit for your discharge. The Permit as issued covers discharge limitations, monitoring, and reporting requirements. The failure of you to meet any portion of the Permit could result in civil and/or criminal penalties. The Illinois Environmental Protection Agency is ready and willing to assist you in interpreting any of the conditions of the Permit as they relate specifically to your discharge.

The Permit as issued is effective as of the date indicated on the first page of the Permit. You have the right to appeal any conditions of the Permit to the Illinois Pollution Control Board within a 35 day period following the issuance date.

Should you have questions concerning the Permit, please contact the undersigned at 618/993-7200.

Respectfully,

ENVIRONMENTAL PROTECTION AGENCY

Handwritten signature of Ronald E. Morse in black ink.

Ronald E. Morse, Manager  
Mine Pollution Control Program  
Bureau of Water

REM:LDC:IW:cs/5998c/2-3-12

Enclosure: Final Permit

cc: IDNR/Office of Mines and Minerals/Land Reclamation/with Enclosure  
IDNR/Division of Water Resources/with Enclosure  
Larry Crislip, Marion Region/Mine Pollution Control Program/with Enclosure  
BOW/DWPC/CAS  
BOW/DWPC/Records

NPDES Permit No. IL0079481

Illinois Environmental Protection Agency

Division of Water Pollution Control

1021 North Grand Avenue, East

P.O. Box 19276

Springfield, Illinois 62794-9276

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

New NPDES Permit

Expiration Date: September 30, 2017

Issue Date: September 28, 2012

Effective Date: October 1, 2012

Name and Address of Permittee:

Peabody Gateway North Mining, LLC  
7100 Eagle Crest Boulevard  
Suite 100  
Evansville, IN 47715-8152

Facility Name and Address:

Peabody Gateway North Mining, LLC  
Gateway North Mine  
12968 State Route 13  
Coulterville, Illinois 62237  
½ mile west of Coulterville, Illinois  
(Randolph County)

Discharge Number and Classification:

001 Alkaline Mine Drainage

002 Alkaline Mine Drainage

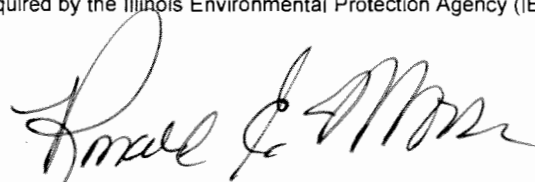
Receiving waters

Unnamed tributary to Marys River

Unnamed tributary to Coulterville Lake

In compliance with the provisions of the Illinois Environmental Protection Act, Subtitle C and/or Subtitle D Rules and Regulations of the Illinois Pollution Control Board, and the Clean Water Act, the above-named permittee is hereby authorized to discharge at the above location to the above-named receiving stream in accordance with the standard conditions and attachments herein.

Permittee is not authorized to discharge after the above expiration date. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit the proper application as required by the Illinois Environmental Protection Agency (IEPA) not later than 180 days prior to the expiration date.



Ronald E. Morse, Manager  
Mine Pollution Control Program  
Bureau of Water

REM:LDC:IW:cs/5982c/4-17-12

NPDES Coal Mine Permit

NPDES Permit No. IL0079481

Effluent Limitations and Monitoring

From the effective date of this Permit until the expiration date, the effluent of the following discharge shall be monitored and limited at all times as follows:

Outfall\*: 001 (Alkaline Mine Drainage)

Discharge Condition	Parameters												
	Total Suspended Solids (mg/l) ***		Iron (total) (mg/l) ***		pH** (S.U.) ***	Alkalinity/ Acidity ***	Sulfate (mg/l) ***	Chloride (mg/l) ***	Mn (total) (mg/l) ***	Hardness ***	Mercury see Special Condition No. 14	Flow (MGD)	Settleable Solids (ml/l)
	30 day average	daily maximum	30 day average	daily maximum									
I	35	70	3.0	6.0	6.5-9.0	Alk.>Acid	1746	500	1.0	Monitor only	Monitor only	Measure When Sampling	-
II	-	-	-	-	6.0-9.0	-	1746	500	-	Monitor only	-	Measure When Sampling	0.5
III	-	-	-	-	6.0-9.0	-	1746	500	-	Monitor only	-	Measure When Sampling	-
IV	35	70	3.0	6.0	6.5-9.0	Alk.>Acid	1746	500	1.0	Monitor only	Monitor only	Measure When Sampling	-

- I Dry weather discharge (base flow or mine pumpage) from the outfall.
- II In accordance with 35 Ill. Adm. Code 406.110(a), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt or equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.106(b). The 10-year, 24-hour precipitation event for this area is considered to be 4.76 inches.
- III In accordance with 35 Ill. Adm. Code 406.110(d), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.106(b).
- IV Discharges continuing 24 hours after cessation of precipitation event that resulted in discharge. For outfalls which have no allowed mixing, monitoring requirements and permit limitations of Discharge Condition IV are identical to Discharge Condition I to which the outfall discharge has reverted.

Sampling during all Discharge Conditions shall be performed utilizing the grab sampling method.

\*\*\* There shall be a minimum of nine (9) samples collected during the quarter when the pond is discharging. Of these 9 samples, a minimum of one sample each month shall be taken during either Discharge Condition I or IV should such discharge condition occur. A "no flow" situation is not considered to be a sample of the discharge. In the event that Discharge Conditions II and/or III occur, grab sample of each discharge caused by the above precipitation events (Discharge Conditions II and/or III) shall be taken and analyzed for the parameters identified in the table above during at least 3 separate events each quarter. For quarters in which there are less than 3 such precipitation events resulting in discharges, a grab sample of the discharge shall be required whenever such precipitation event(s) occur(s). Should a sufficient number of discharge events occur during the quarter, the remaining three (3) quarterly samples may be taken during any of the Discharge Conditions described above.

The water quality standards for sulfate and chloride must be met in discharges from the above referenced outfall as well as in the receiving stream.

\* The Permittee is subject to the limitations, and monitoring and reporting requirements of Special Condition No. 12 for the discharges from Outfall 001 and unnamed tributary to Marys River receiving such discharges.

\*\* No discharge is allowed from any above referenced permitted outfall during "low flow" or "no flow" conditions in the receiving stream unless such discharge meets the water quality standards of 35 Ill. Adm. Code 302.204 for pH.

NPDES Coal Mine Permit

NPDES Permit No. IL0079481

Effluent Limitations and Monitoring

From the effective date of this Permit until the expiration date, the effluent of the following discharge shall be monitored and limited at all times as follows:

Outfall\*: 002 (Alkaline Mine Drainage)

Discharge Condition	Parameters													
	Total Suspended Solids (mg/l) ***		Iron (total) (mg/l) ***		pH** (S.U.) ***	Alkalinity/Acidity ***	Sulfate (mg/l) ***	Chloride (mg/l) ***	Total Dissolved Solids (mg/l)	Mn (total) (mg/l) ***	Hardness ***	Mercury see Special Condition No. 14	Flow (MGD)	Settleable Solids (ml/l)
	30 day average	daily maximum	30 day average	daily maximum										
I	35	70	3.0	6.0	6.5-9.0	Alk.>Acid	250	250	750	1.0	Monitor only	Monitor only	Measure When Sampling	-
II	-	-	-	-	6.0-9.0	-	250	250	750	-	Monitor only	-	Measure When Sampling	0.5
III	-	-	-	-	6.0-9.0	-	250	250	750	-	Monitor only	-	Measure When Sampling	-
IV	35	70	3.0	6.0	6.5-9.0	Alk.>Acid	250	250	750	1.0	Monitor only	Monitor only	Measure When Sampling	-

- i Dry weather discharge (base flow or mine pumpage) from the outfall.
- ii In accordance with 35 Ill. Adm. Code 406.110(a), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt or equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.106(b). The 10-year, 24-hour precipitation event for this area is considered to be 4.76 inches.
- iii In accordance with 35 Ill. Adm. Code 406.110(d), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.106(b).
- IV Discharges continuing 24 hours after cessation of precipitation event that resulted in discharge. For outfalls which have no allowed mixing, monitoring requirements and permit limitations of Discharge Condition IV are identical to Discharge Condition I to which the outfall discharge has reverted.

Sampling during all Discharge Conditions shall be performed utilizing the grab sampling method.

\*\*\* There shall be a minimum of nine (9) samples collected during the quarter when the pond is discharging. Of these 9 samples, a minimum of one sample each month shall be taken during either Discharge Condition I or IV should such discharge condition occur. A "no flow" situation is not considered to be a sample of the discharge. In the event that Discharge Conditions II and/or III occur, grab sample of each discharge caused by the above precipitation events (Discharge Conditions II and/or III) shall be taken and analyzed for the parameters identified in the table above during at least 3 separate events each quarter. For quarters in which there are less than 3 such precipitation events resulting in discharges, a grab sample of the discharge shall be required whenever such precipitation event(s) occur(s). Should a sufficient number of discharge events occur during the quarter, the remaining three (3) quarterly samples may be taken during any of the Discharge Conditions described above.

The water quality standards for sulfate and chloride must be met in discharges from the above referenced outfall as well as in the receiving stream.

\* The Permittee is subject to the limitations, and monitoring and reporting requirements of Special Condition No. 12 for the discharges from Outfall 002 and unnamed tributary to Coulterville Lake receiving such discharges.

\*\* No discharge is allowed from any above referenced permitted outfall during "low flow" or "no flow" conditions in the receiving stream unless such discharge meets the water quality standards of 35 Ill. Adm. Code 302.204 for pH.

NPDES Coal Mine Permit

NPDES Permit No. IL0079481

Effluent Limitations and Monitoring

Upon completion of Special Condition 9 and approval from the Agency, the effluent of the following discharge shall be monitored and limited at all times as follows:

Outfall\*: 001 (Reclamation Area Drainage)

Discharge Condition	Parameters					
	pH** (S.U.) ***	Sulfate (mg/l) ***	Chloride (mg/l) ***	Hardness ***	Flow (MGD)	Settleable Solids (ml/l) ***
I	6.5-9.0	1746	500	Monitor only	Measure When Sampling	0.5
II	6.0-9.0	1746	500	Monitor only	Measure When Sampling	0.5
III	6.0-9.0	1746	500	Monitor only	Measure When Sampling	-
IV	6.5-9.0	1746	500	Monitor only	Measure When Sampling	0.5

- I Dry weather discharge (base flow, if present) from the outfall.
- II In accordance with 35 Ill. Adm. Code 406.109(b), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt or equivalent volume) shall comply with the indicated limitations. The 10-year, 24-hour precipitation event for this area is considered to be 4.76 inches.
- III In accordance with 35 Ill. Adm. Code 406.109(c), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt or equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.109(b).
- IV Discharges continuing 24 hours after cessation of precipitation event that resulted in discharge. For reclamation area discharges, monitoring requirements and permit limitations of Discharge Condition IV are identical to Discharge Condition I to which the outfall discharge has reverted.

Sampling during all Discharge Conditions shall be performed utilizing the grab sampling method. A "no flow" situation is not considered to be a sample of the discharge.

\*\*\* One sample per month (1/month) shall be collected if and/or when a discharge occurs under either Discharge Condition I, II or IV and analyzed for the parameters identified in the table above. In addition, at least three (3) grab samples shall be taken each quarter from separate precipitation events under Discharge Condition III and analyzed for parameters indicated in the above table. For quarters in which there are less than 3 such precipitation events, a grab sample of the discharge shall be required whenever such precipitation event(s) occur(s).

The water quality standards for sulfate and chloride must be met in discharges from the above referenced outfall as well as in the receiving stream.

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\* The Permittee is subject to the limitations, and monitoring and reporting requirements of Special Condition No. 12 for the discharges from Outfall 001 and unnamed tributary to Marys River receiving such discharges.

\*\* No discharge is allowed from any above referenced permitted outfall during "low flow" or "no flow" conditions in the receiving stream unless such discharge meets the water quality standards of 35 Ill. Adm. Code 302.204 for pH.

NPDES Coal Mine Permit

NPDES Permit No. IL0079481

Effluent Limitations and Monitoring

Upon completion of Special Condition 9 and approval from the Agency, the effluent of the following discharge shall be monitored and limited at all times as follows:

Outfall\*: 002 (Reclamation Area Drainage)

Discharge Condition	Parameters						
	pH** (S.U.) ***	Sulfate (mg/l) ***	Chloride (mg/l) ***	Total Dissolved Solids (mg/l)	Hardness ***	Flow (MGD)	Settleable Solids (ml/l) ***
I	6.5-9.0	250	250	750	Monitor only	Measure When Sampling	0.5
II	6.0-9.0	250	250	750	Monitor only	Measure When Sampling	0.5
III	6.0-9.0	250	250	750	Monitor only	Measure When Sampling	-
IV	6.5-9.0	250	250	750	Monitor only	Measure When Sampling	0.5

- I Dry weather discharge (base flow, if present) from the outfall.
- II In accordance with 35 Ill. Adm. Code 406.109(b), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt or equivalent volume) shall comply with the indicated limitations. The 10-year, 24-hour precipitation event for this area is considered to be 4.76 inches.
- III In accordance with 35 Ill. Adm. Code 406.109(c), any discharge or increase in the volume of a discharge caused by precipitation within any 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) shall comply with the indicated limitations instead of those in 35 Ill. Adm. Code 406.109(b).
- IV Discharges continuing 24 hours after cessation of precipitation event that resulted in discharge. For reclamation area discharges, monitoring requirements and permit limitations of Discharge Condition IV are identical to Discharge Condition I to which the outfall discharge has reverted.

Sampling during all Discharge Conditions shall be performed utilizing the grab sampling method. A "no flow" situation is not considered to be a sample of the discharge.

\*\*\* One sample per month (1/month) shall be collected if and/or when a discharge occurs under either Discharge Condition I, II or IV and analyzed for the parameters identified in the table above. In addition, at least three (3) grab samples shall be taken each quarter from separate precipitation events under Discharge Condition III and analyzed for parameters indicated in the above table. For quarters in which there are less than 3 such precipitation events, a grab sample of the discharge shall be required whenever such precipitation event(s) occur(s).

The water quality standards for sulfate and chloride must be met in discharges from the above referenced outfall as well as in the receiving stream.

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\* The Permittee is subject to the limitations, and monitoring and reporting requirements of Special Condition No. 12 for the discharges from Outfall 002 and unnamed tributary to Coulterville Lake receiving such discharges.

\*\* No discharge is allowed from any above referenced permitted outfall during "low flow" or "no flow" conditions in the receiving stream unless such discharge meets the water quality standards of 35 Ill. Adm. Code 302.204 for pH.

NPDES Coal Mine Permit

NPDES Permit No. IL0079481

Effluent Limitations and Monitoring

Upon completion of Special Condition 9 and approval from the Agency, the effluent of the following discharge shall be monitored and limited at all times as follows:

Outfalls: 001, 002 (Stormwater Discharge)

Parameters	
pH* (S.U.) **	Settleable Solids (ml/l) **
6.0-9.0	0.5

Stormwater discharge monitoring is subject to the following reporting requirements:

Analysis of samples must be submitted with second quarter Discharge Monitoring Reports.

If discharges can be shown to be similar, a plan may be submitted by November 1 of each year preceding sampling to propose grouping of similar discharges and/or updated previously submitted groupings. If updating of a previously submitted plan is not necessary, a written notification to the Agency, indicating such is required. Upon approval from the Agency, one representative sample for each group may be submitted.

Annual stormwater monitoring is required for all discharges until Final SMCRA Bond is released and approval to cease such monitoring is obtained from the Agency.

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\* No discharge is allowed from any above referenced permitted outfalls during "low flow" or "no flow" conditions in the receiving stream unless such discharge meets the water quality standards of 35 Ill. Adm. Code 302.204 for pH.

\*\* One (1) sample per year shall be collected and analyzed for the indicated parameter; however, such sampling and analysis is required only if and/or when a discharge occurs from the individual Outfall(s) identified above.

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Construction Authorization No. 6138-12

C.A. Date: April 6, 2012

Authorization is hereby granted to the above designee to construct and operate the mine facilities described as follows:

Surface facilities in support of an underground mine containing a total of 172.1 acres, as described and depicted in IEPA Log No. 6138-12 and located in Section 11, 14, 15, 22 and 23, Township 4 South Range 5 West, Randolph County, 3<sup>rd</sup> P.M., Illinois. These surface facilities in support of the underground mine contains office buildings, parking areas, access roads, surface areas associated with mine portal, topsoil and subsoil stockpiles, sediment control structures, collection diversion ditch, haulage/access road, borrow area, overlaid conveyor, intake and exhaust shafts and materials and electrical drops.

No coal processing or coal waste disposal is proposed at this facility. All coal processing and waste disposal will be performed at the Peabody Coulterville Mining, LLC, Gateway Mine site. In accordance with information provided in IEPA Log No. 6051-12, the coal from Gateway North Mine will not increase the production or coal stockpile areas at the Gateway Mine site and will therefore not result in increased loadings to the discharges from that site.

Surface drainage control is provided by two (2) sedimentation ponds with discharge designated as Outfalls 001 and 002, classified as alkaline mine drainage.

Location and receiving stream of the Outfalls at this facility is as follows:

Outfall Number	Latitude			Longitude			Receiving Waters
	DEG	MIN	SEC	DEG	MIN	SEC	
001	38°	10'	55.1"	89°	37'	26.8"	Unnamed tributary to Marys River
002	38°	11'	30.9"	89°	37'	8.0"	Unnamed tributary to Coulterville Lake

As depicted in IEPA Log Nos. 6138-12 and 6138-12-B compacted clay liners will be constructed beneath the coal stockpile, within sedimentation pond No. 001 that receives runoff from the coal stockpile and the drainage control structure (ditch) that connects these facilities. Construction of the two (2) foot compacted clay liners for the areas discussed above shall be subject to and in accordance with the specifications and testing requirements of Condition No. 12.

Groundwater monitoring requirements are outlined in Condition No. 13.

The abandonment plan shall be executed and completed in accordance with 35 Ill. Adm. Code 405.109.

All water remaining upon abandonment must meet the requirements of 35 Ill. Adm. Code 406.202. For the constituents not covered by Parts 302 or 303, all water remaining upon abandonment must meet the requirements of 35 Ill. Adm. Code 406.106.

This Authorization is issued subject to the following Condition(s). If such Condition(s) require(s) additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval to secure issuance of a Supplemental Authorization to Construct.

1. If any statement or representation is found to be incorrect, this permit may be revoked and the permittee thereupon waives all rights thereunder.
2. The issuance of this permit (a) shall not be considered as in any manner affecting the title of the premises upon which the mine or mine refuse area is to be located; (b) does not release the permittee from any liability for damage to person or property caused by or resulting from the installation, maintenance or operation of the proposed facilities; (c) does not take into consideration the structural stability of any units or parts of the project; and (d) does not release the permittee from compliance with other applicable statutes of the State of Illinois, or with applicable local laws, regulations or ordinances.
3. Final plans, specifications, application and supporting documents as submitted by the person indicated on Page 1 as approved shall constitute part of this permit and are identified in the records of the Illinois Environmental Protection Agency.
4. There shall be no deviations from the approved plans and specifications unless revised plans, specifications and application shall first have been submitted to the Illinois Environmental Protection Agency and a supplemental permit issued.
5. The permit holder shall notify the Environmental Protection Agency (217/782-3637) immediately of an emergency at the mine or mine refuse area which causes or threatens to cause a sudden discharge of contaminants into the waters of Illinois and shall immediately undertake necessary corrective measures as required by 35 Ill. Adm. Code 405.111. (217/782-3637 for calls between the hours of 5:00 p.m. to 8:30 a.m. and on weekends.)



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6. The termination of an NPDES discharge monitoring point or cessation of monitoring of an NPDES discharge is not authorized by this Agency until the permittee submits adequate justification to show what alternate treatment is provided or that untreated drainage will meet applicable effluent and water quality standards.
7. Initial construction activities in areas to be disturbed shall be for collection and treatment facilities only. Prior to the start of other activities, surface drainage controls shall be constructed and operated to avoid violations of the Act or Subtitle D. At such time as runoff water is collected in the sedimentation pond, a sample shall be collected and analyzed, for the parameters designated as 1M through 15M under Part 5-C of Form 2C and the effluent parameters designated herein with the results sent to this Agency. Should additional treatment be necessary to meet the standards of 35 Ill. Adm. Code 406.106, a Supplemental Permit must be obtained. Discharge from ponds is not allowed unless applicable effluent and water quality standards are met in the basin discharge(s).
8. This Agency must be informed in writing and an application submitted if drainage, which was previously classified as alkaline (pH greater than 6.0), becomes acid (pH less than 6.0) or ferruginous (base flow with an iron concentration greater than 10 mg/l). The type of drainage reporting to the basin should be reclassified in a manner consistent with the applicable rule of 35 Ill. Adm. Code 406 as amended in R84-29 at 11 Ill. Reg. 12899. The application should discuss the treatment method and demonstrate how the discharge will meet the applicable standards.
9. A permittee has the obligation to add a settling aid if necessary to meet the suspended solids or settleable solids effluent standards. The selection of a settling aid and the application practice shall be in accordance with a. or b. below
  - a. Alum ( $Al_2(SO_4)_3$ ), hydrated lime ( $Ca(OH)_2$ ), soda ash ( $Na_2CO_3$ ), alkaline pit pumpage, acetylene production by-product (tested for impurities), and ground limestone are acceptable settling aids and are hereby permitted for alkaline mine drainage sedimentation ponds.
  - b. Any other settling aids such as commercial flocculents and coagulants are permitted only on prior approval from the Agency. To obtain approval a permitted must demonstrate in writing to the Agency that such use will not cause a violation of the toxic substances standard of 35 Ill. Adm. Code 302.210 or of the appropriate effluent and water quality standards of 35 Ill. Adm. Code parts 302, 304, and 406.
10. A general plan for the nature and disposition of all liquids used to drill boreholes shall be filed with this Agency prior to any such operation. This plan should be filed at such time that the operator becomes aware of the need to drill unless the plan of operation was contained in a previously approved application.
11. Any of the following shall be a violation of the provisions required under 35 Ill. Adm. Code 406.202:
  - a. It is demonstrated that an adverse effect on the environment in and around the receiving stream has occurred or is likely to occur.
  - b. It is demonstrated that the discharge has adversely affected or is likely to adversely affect any public water supply.
  - c. The Agency determines that the permittee is not utilizing Good Mining Practices in accordance with 35 Ill. Adm. Code 406.204 which are fully described in detail in Sections 406.205, 406.206, 406.207 and 406.208 in order to minimize the discharge of total dissolved solids, chloride, sulfate, iron and manganese. To the extent practical, such Good Mining Practices shall be implemented to:
    - i. Stop or minimize water from coming into contact with disturbed areas through the use of diversions and/or runoff controls (Section 406.205).
    - ii. Retention and control within the site of waters exposed to disturbed materials utilizing erosion controls, sedimentation controls, water reuse or recirculation, minimization of exposure to disturbed materials, etc. (Section 406.206).
    - iii. Control and treatment of waters discharged from the site by regulation of flow of discharges and/or routing of discharges to more suitable discharge locations (Section 406.207).

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- iv. Utilized unconventional practices to prevent the production or discharge of waters containing elevated contaminant concentrations such as diversion of groundwater prior to entry into a surface or underground mine, dewatering practices to remove clean water prior to contacting disturbed materials and/or any additional practices demonstrated to be effective in reducing contaminant levels in discharges (Section 406.208).
12. The two (2) foot compacted clay liners to be constructed beneath the coal stockpile, within sedimentation Pond No. 001 and the drainage control structure (ditch) that connects these facilities shall be subject to the following specifications and procedures as detailed in IEPA Log Nos. 6138-12 and 6138-12-B.
- a. All trees and/or roots that may compromise liner integrity will be thoroughly removed and the area properly backfilled and compacted.
  - b. Soil for liner construction will be placed in two (2) individual lifts of 12 inch thickness each.
  - c. The soil will be compacted to at least 95% standard Proctor dry unit weight at a moisture content within 3% (+ or -) of the optimum.
  - d. Moisture and density testing by nuclear methods shall be conducted at a rate of at least four (4) tests per structure (sedimentation pond 001, coal stockpile base and connecting drainage structures) per twelve (12) inch lift. Testing of the lower or initial soil lift shall be performed prior to placement or construction of the upper lift.
  - e. Permeability testing using Shelby tube samples may be used instead of nuclear density testing as discussed in Condition 12(d) above. If Shelby tube sampling is elected, the testing frequency and/or rate shall remain the same of at least four (4) tests per structure per twelve (12) inch lift.

13. Groundwater monitoring requirements for Well Nos. 14MW-1 and 14MW-2 are as follows:

- a. Ambient background monitoring shall be performed for all wells identified in 13(a) above. Such ambient monitoring shall consist of six (6) samples collected during the first year (approximately bi-monthly) following well installation but no later than during the first year of facility operation to determine ambient background concentrations. Background monitoring shall include the following list of constituents:

Aluminum	Fluoride	Sulfate
Antimony	Iron (dissolved)	Thallium
Arsenic	Iron (total)	Total Dissolved Solids
Barium	Lead	Vanadium
Beryllium	Manganese (dissolved)	Zinc
Boron	Manganese (total)	pH
Cadmium	Mercury	Acidity
Chloride	Molybdenum	Alkalinity
Chromium	Nickel	Hardness
Cobalt	Phenols	Static Water Elevation
Copper	Selenium	
Cyanide	Silver	

Note: Ambient background monitoring for Well Nos. 14MW-1 and 14MW-2 has been completed with the results of such monitoring summarized and included in IEPA Log No. 6138-12-B.

- b. Following the ambient monitoring as required under Condition No. 13(a) above, routine monitoring shall continue on a quarterly basis as follows:
  - i. Monitoring Well No. 14MW-2 shall continue to be monitored quarterly for the contaminants identified in Condition No. 13(a) above.
  - ii. Monitoring Well No. 14MW-1 shall be monitored quarterly as required by IDNR/OMM for the following list of constituents:

Iron (dissolved)	Chloride
Iron (total)	Hardness
Manganese (dissolved)	Acidity
Manganese (total)	Alkalinity
Sulfate	pH
Total Dissolved Solids	Static Water Elevation

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- c. Following completion of active mining and reclamation, post-mining monitoring of the above referenced wells shall consist of six (6) samples collected during a 12-month period (approximately bi-monthly) to determine post-mining concentrations. Post-mining monitoring shall include the list of constituents identified in Condition No. 13(a) above.
- d. Groundwater monitoring reports shall be submitted to the Agency in accordance with Special Condition Nos. 3 and 5 of this NPDES permit.
- e. A statistically valid representation of background and/or post mining water quality required under Condition No. 13(a) and 13(c) above shall be submitted utilizing the following method. This method shall be used to determine the upper 95 percent confidence limit for each parameter listed above.

Should the Permittee determine that an alternate statistical method would be more appropriate based on the data being evaluated, the Permittee may request utilization of such alternate methodology. Upon approval from the Agency, the alternate methodology may be utilized to determine a statistically valid representation of background and/or post mining water quality.

This method should be used to predict the confidence limit when single groundwater samples are taken from each monitoring (test) well.

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- i. Determine the arithmetic mean ( $\bar{X}_b$ ) of each indicator parameter for the sampling period. If more than one well is used, an equal number of samples must be taken from each well.

$$\bar{X}_b = \frac{X_1 + X_2 + \dots + X_n}{n}$$

Where:

$\bar{X}_b$  = Average value for a given chemical parameter

$X_n$  = Values for each sample

n = the number of samples taken

- ii. Calculate the background and/or post mining variance ( $S_b^2$ ) and standard deviation ( $S_b$ ) for each parameter using the values ( $X_n$ ) from each sample of the well(s) as follows:

$$S_b^2 = \frac{(X_1 - \bar{X}_b)^2 + (X_2 - \bar{X}_b)^2 + \dots + (X_n - \bar{X}_b)^2}{n - 1}$$

$$S_b = \sqrt{S_b^2}$$

- iii. Calculate the upper confidence limit using the following formula:

$$CL = \bar{X}_b \pm t \sqrt{1 + 1/n} (S_b)$$

Where:

CL = upper confidence limit prediction  
(upper and lower limits should be calculated for pH)  
t = one-tailed t value at the required significance level and at n-1 degrees of freedom from Table 1  
(a two-tailed t value should be used for pH)

- iv. If the values of any routine parameter for any monitoring well exceed the upper confidence limit for that parameter, the permittee shall conclude that a statistically significant change has occurred at that well.
- v. When some of the background and/or post mining values are less than the Method Detection Limit (MDL), a value of one-half (1/2) the MDL shall be substituted for each value that is reported as less than the MDL. All other computations shall be calculated as given above.

If all the background and/or post mining values are less than the MDL for a given parameter, the Practical Quantitation Limit (PQL), as given in 35 Ill. Adm. Code Part 724 Appendix I shall be used to evaluate data from monitoring wells. If the analytical results from any monitoring well exceed two (2) times the PQL for any single parameter, or if they exceed the PQLs for two or more parameters, the permittee shall conclude that a statistically significant change has occurred.

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Table 1  
Standard t-Tables Level of Significance

Degrees of freedom	t-values (one-tail)		t-values (two-tail)*	
	99%	95%	99%	95%
4	3.747	2.132	4.604	2.776
5	3.365	2.015	4.032	2.571
6	3.143	1.943	3.707	2.447
7	2.998	1.895	3.499	2.365
8	2.896	1.860	3.355	2.306
9	2.821	1.833	3.250	2.262
10	2.764	1.812	3.169	2.228
11	2.718	1.796	3.106	2.201
12	2.681	1.782	3.055	2.179
13	2.650	1.771	3.012	2.160
14	2.624	1.761	2.977	2.145
15	2.602	1.753	2.947	2.131
16	2.583	1.746	2.921	2.120
17	2.567	1.740	2.898	2.110
18	2.552	1.734	2.878	2.101
19	2.539	1.729	2.861	2.093
20	2.528	1.725	2.845	2.086
21	2.518	1.721	2.831	2.080
22	2.508	1.717	2.819	2.074
23	2.500	1.714	2.807	2.069
24	2.492	1.711	2.797	2.064
25	2.485	1.708	2.787	2.060
30	2.457	1.697	2.750	2.042
40	2.423	1.684	2.704	2.021

Adopted from Table III of "Statistical Tables for Biological Agricultural and Medical Research" (1947, R.A. Fisher and F. Yates).

\* For pH only when required.

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Special Conditions

**Special Condition No. 1:** No effluent from any mine related facility area under this permit shall, alone or in combination with other sources, cause a violation of any applicable water quality standard as set out in the Illinois Pollution Control Board Rules and Regulations, Subtitle C: Water Pollution.

**Special Condition No. 2:** Samples taken in compliance with the effluent monitoring requirements shall be taken at a point representative of the discharge, but prior to entry into the receiving stream.

**Special Condition No. 3:** All periodic monitoring and reporting forms, including Discharge Monitoring Report (DMR) forms, shall be submitted to the Agency according to the schedule outlined in Special Condition No. 4 or 5 below with one (1) copy forwarded to each of the following addresses:

Illinois Environmental Protection Agency  
Division of Water Pollution Control  
1021 North Grand Ave., East  
P.O. Box 19276  
Springfield, IL 62794-9276

Illinois Environmental Protection Agency  
Mine Pollution Control Program  
2309 West Main Street, Suite 116  
Marion, Illinois 62959

Attn: Compliance Assurance Section

Should electronic filing be available and elected for any periodic monitoring and reporting requirements, the Agency shall be notified via correspondence or e-mail at such time that the electronic filing has been completed.

**Special Condition No. 4:** Completed Discharge Monitoring Report (DMR) forms and stream monitoring results, shall be retained by the Permittee for a period of three (3) months and shall be mailed and received by the IEPA at the addresses indicated in Special Condition No. 3 above in accordance with the following schedule, unless otherwise specified by the permitting authority.

Period	Received by IEPA
January, February, March	May 1
April, May, June	August 1
July, August, September	November 1
October, November, December	February 1

The Permittee shall record discharge monitoring results on Discharge Monitoring Report forms (DMR's) using one such form for each applicable Discharge Condition each month.

**Special Condition No. 5:** Completed periodic monitoring and reporting, other than DMR's and stream monitoring (i.e., groundwater monitoring, coal combustion waste analysis reports, etc.), shall be retained by the Permittee for a period of three (3) months and shall be mailed and received by the IEPA at the addresses indicated in Special Condition No. 3 above in accordance with the following schedule, unless otherwise specified by the permitting authority.

Period	Received by IEPA
January, February, March	May 1
April, May, June	August 1
July, August, September	November 1
October, November, December	February 1

**Special Condition No. 6:** If an applicable effluent standard or limitation is promulgated under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a)(2) of the Clean Water Act and that effluent standard or limitation is more stringent than any effluent limitation in the permit or controls a pollutant not limited in the NPDES Permit, the Agency shall revise or modify the permit in accordance with the more stringent standard or prohibition and shall so notify the permittee.

**Special Condition No. 7:** The permittee shall notify the Agency in writing by certified mail within thirty days of abandonment, cessation, or suspension of active mining for thirty days or more unless caused by a labor dispute. During cessation or suspension of active mining, whether caused by a labor dispute or not, the permittee shall provide whatever interim impoundment, drainage diversion, and wastewater treatment is necessary to avoid violations of the Act or Subtitle D.

**Special Condition No. 8:** Plans must be submitted to and approved by this Agency prior to construction of a sedimentation pond. At such time as runoff water is collected in the sedimentation pond, a sample shall be collected and analyzed for the parameters designated as 1M-15M under Part 5-C of Form 2C and the effluent parameters designated herein with the results sent to this Agency. Should additional treatment be necessary to meet these standards, a Supplemental Permit must also be obtained. Discharge from a pond is not allowed unless applicable effluent and water quality standards are met.

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Special Conditions

**Special Condition No. 9:** The special reclamation area effluent standards of 35 Ill. Adm. Code 406.109 apply only on approval from the Agency. To obtain approval, a request form and supporting documentation shall be submitted 45 days prior to the month that the permittee wishes the discharge be classified as a reclamation area discharge. The Agency will notify the permittee upon approval of the change.

**Special Condition No. 10:** The special stormwater effluent standards apply only on approval from the Agency. To obtain approval, a request with supporting documentation shall be submitted 45 days prior to the month that the permittee proposes the discharge to be classified as a stormwater discharge. The documentation supporting the request shall include analysis results indicating the discharge will consistently comply with reclamation area discharge effluent standards. The Agency will notify the permittee upon approval of the change.

**Special Condition No. 11:** Annual stormwater monitoring is required for all discharges not reporting to a sediment basin until Final SMCRA Bond is released and approval to cease such monitoring is obtained from the Agency.

- A. Each discharge must be monitored for pH and settleable solids annually.
- B. Analysis of samples must be submitted with second quarter Discharge Monitoring Reports. A map with discharge locations must be included in this submittal.
- C. If discharges can be shown to be similar, a plan may be submitted by November 1 of each year preceding sampling to propose grouping of similar discharges and/or update previously submitted groupings. If updating of a previously submitted plan is not necessary, a written notification to the Agency indicating such is required. Upon approval from the Agency, one representative sample for each group may be submitted.

**Special Condition No. 12:** Sediment Pond Operation and Maintenance (Outfalls 001, 002):

- a. For discharges resulting from precipitation events, in addition to the alternate effluent (Discharge Condition Nos. II and III) monitoring requirements, as indicated on the applicable effluent pages of this Permit, discharges from Outfalls 001 and 002 shall be monitored and reported for Discharge Rate, Sulfate, Chloride and Hardness.
- b. The following sampling and monitoring requirements are applicable to flow in the unnamed tributary to Marys River and unnamed tributary to Coulterville Lake which receive discharges from Outfalls 001 and 002.
  - i. All sampling and monitoring required under 12(b)(ii) and (iii) below shall be performed during a discharge and monitoring event from the associated outfall.
  - ii. Unnamed tributary to Marys River and unnamed tributary to Coulterville Lake shall be monitored and reported quarterly for Discharge Rate, Chloride, Sulfate and Hardness downstream of the associated outfall. This downstream monitoring shall be performed a sufficient distance downstream of the associated outfall to ensure that complete mixing has occurred. At such time that sufficient information has been collected regarding receiving stream flow characteristics and in-stream contaminant concentrations the permittee may request a re-evaluation of the monitoring frequency required herein for possible reduction or elimination. For the purpose of re-evaluating the downstream monitoring frequency of the receiving stream, "sufficient information" is defined as a minimum of ten (10) quarterly sampling events.

In the event that downstream monitoring of the receiving waters is eliminated during the term of this permit based on an evaluation of the quarterly data, a minimum of three (3) additional samples analyzed for the parameters identified above must be submitted with the permit renewal application a minimum of 180 days prior to expiration of this permit.

- iii. Unnamed tributary to Marys River and unnamed tributary to Coulterville Lake shall be monitored and reported annually for Discharge Rate, Chloride, Sulfate and Hardness upstream of the associated outfall.

**Special Condition No. 13:** Data collected in accordance with Special Condition No. 12 above will be utilized to evaluate the appropriateness of the effluent limits established in this Permit. Should the Agency's evaluation of this data indicate revised effluent limits are warranted; this permit may be reopened and modified to incorporate more appropriate effluent limitations. This data will also be used for determination of effluent limitations at the time of permit renewal.

**Special Condition No. 14:** Mercury shall be monitored quarterly until a minimum of ten (10) samples have been collected. Samples shall be collected and tested in accordance with USEPA 1631E using the option at Section 11.1.1.2 requiring the heating of samples at 50°C for 6 hours in a BrCl solution in closed vessels. This test method has a Method Detection Limit (MDL) of 1.0 ng/l (nanograms/liter). The results of such testing must be reported in ng/l (nanograms/liter) and submitted with the quarterly Discharge Monitoring Reports (DMRs). The Permittee may submit a written request to the Agency to discontinue quarterly Mercury monitoring if the sampling results show no reasonable potential to exceed the Mercury water quality standard.

**Standard Conditions****Definitions**

**Act** means the Illinois Environmental Protection Act, 415 ILCS 5 as Amended.

**Agency** means the Illinois Environmental Protection Agency.

**Board** means the Illinois Pollution Control Board.

**Clean Water Act** (formerly referred to as the Federal Water Pollution Control Act) means Pub. L 92-500, as amended. 33 U.S.C. 1251 et seq.

**NPDES** (National Pollutant Discharge Elimination System) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318 and 405 of the Clean Water Act.

**USEPA** means the United States Environmental Protection Agency.

**Daily Discharge** means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurements, the "daily discharge" is calculated as the average measurement of the pollutant over the day.

**Maximum Daily Discharge Limitation** (daily maximum) means the highest allowable daily discharge.

**Average Monthly Discharge Limitation** (30 day average) means the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

**Average Weekly Discharge Limitation** (7 day average) means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

**Best Management Practices** (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

**Aliquot** means a sample of specified volume used to make up a total composite sample.

**Grab Sample** means an individual sample of at least 100 milliliters collected at a randomly-selected time over a period not exceeding 15 minutes.

**24-Hour Composite Sample** means a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period.

**8-Hour Composite Sample** means a combination of at least 3 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over an 8-hour period.

**Flow Proportional Composite Sample** means a combination of sample aliquots of at least 100 milliliters collected at periodic intervals such that either the time interval between each aliquot or the volume of each aliquot is proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot.

- (1) **Duty to comply.** The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified to incorporate the requirements.
- (2) **Duty to reapply.** If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. If the permittee submits a proper application as required by the Agency no later than 180 days prior to the expiration date, this permit shall continue in full force and effect until the final Agency decision on the application has been made.
- (3) **Need to halt or reduce activity not a defense.** It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
- (4) **Duty to mitigate.** The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
- (5) **Proper operation and maintenance.** The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up, or auxiliary facilities, or similar systems only when necessary to achieve compliance with the conditions of the permit.
- (6) **Permit actions.** This permit may be modified, revoked and reissued, or terminated for cause by the Agency pursuant to 40 CFR 122.62 and 40 CFR 122.63. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.
- (7) **Property rights.** This permit does not convey any property rights of any sort, or any exclusive privilege.
- (8) **Duty to provide information.** The permittee shall furnish to the Agency within a reasonable time, any information which the Agency may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with the permit. The permittee shall also furnish to the Agency upon request, copies of records required to be kept by this permit.



- \* \* \* \* \* PCB 2013-021 \* \* \* \* \*
- (9) **Inspection and entry.** The permittee shall allow an authorized representative of the Agency or USEPA (including an authorized contractor acting as a representative of the Agency or USEPA), upon the presentation of credentials and other documents as may be required by law, to:
- Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
  - Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
  - Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
  - Sample or monitor at reasonable times, for the purpose of assuring permit compliance, or as otherwise authorized by the Act, any substances or parameters at any location.
- (10) **Monitoring and records.**
- Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.
  - The permittee shall retain records of all monitoring information, including all calibration and maintenance records, and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of this permit, measurement, report or application. Records related to the permittee's sewage sludge use and disposal activities shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503). This period may be extended by request of the Agency or USEPA at any time.
  - Records of monitoring information shall include:
    - The date, exact place, and time of sampling or measurements;
    - The individual(s) who performed the sampling or measurements;
    - The date(s) analyses were performed;
    - The individual(s) who performed the analyses;
    - The analytical techniques or methods used; and
    - The results of such analyses.
  - Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit. Where no test procedure under 40 CFR Part 136 has been approved, the permittee must submit to the Agency a test method for approval. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals to ensure accuracy of measurements.
- (11) **Signatory requirement.** All applications, reports or information submitted to the Agency shall be signed and certified.
- Application.** All permit applications shall be signed as follows:
    - For a corporation: by a principal executive officer of at least the level of vice president or a person or position having overall responsibility for environmental matters for the corporation;
    - For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or
    - For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.
  - Reports.** All reports required by permits, or other information requested by the Agency shall be signed by a person described in paragraph (a) or by a duly authorized representative of that person. A person is a duly authorized representative only if:
    - The authorization is made in writing by a person described in paragraph (a); and
    - The authorization specifies either an individual or a position responsible for the overall operation of the facility, from which the discharge originates, such as a plant manager, superintendent or person of equivalent responsibility; and
    - The written authorization is submitted to the Agency.
  - Changes of Authorization.** If an authorization under (b) is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of (b) must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.
  - Certification.** Any person signing a document under paragraph (a) or (b) of this section shall make the following certification:
 

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.
- (12) **Reporting requirements.**
- Planned changes.** The permittee shall give notice to the Agency as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when:
    - The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source pursuant to 40 CFR 122.29 (b); or
    - The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements pursuant to 40 CFR 122.42 (a)(1).
    - The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.
  - Anticipated noncompliance.** The permittee shall give advance notice to the Agency of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.
  - Transfers.** This permit is not transferable to any person except after notice to the Agency.
  - Compliance schedules.** Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.
  - Monitoring reports.** Monitoring results shall be reported at the intervals specified elsewhere in this permit.
    - Monitoring results must be reported on a Discharge Monitoring Report (DMR).

- \* \* \* \* \* PCB 2013-021 \* \* \* \* \*
- (2) If the permittee monitors any pollutant more frequently than required by the permit, using test procedures approved under 40 CFR 136 or as specified in the permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR.
- (3) Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Agency in the permit.
- (f) **Twenty-four hour reporting.** The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24-hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and time; and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The following shall be included as information which must be reported within 24-hours:
- (1) Any unanticipated bypass which exceeds any effluent limitation in the permit.
  - (2) Any upset which exceeds any effluent limitation in the permit.
  - (3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Agency in the permit or any pollutant which may endanger health or the environment.
- The Agency may waive the written report on a case-by-case basis if the oral report has been received within 24-hours.
- (g) **Other noncompliance.** The permittee shall report all instances of noncompliance not reported under paragraphs (12) (d), (e), or (f), at the time monitoring reports are submitted. The reports shall contain the information listed in paragraph (12) (f).
- (h) **Other information.** Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Agency, it shall promptly submit such facts or information.
- (13) **Bypass.**
- (a) Definitions.
    - (1) Bypass means the intentional diversion of waste streams from any portion of a treatment facility.
    - (2) Severe property damage means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.
  - (b) Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs (13)(c) and (13)(d).
  - (c) Notice.
    - (1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.
    - (2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in paragraph (12)(f) (24-hour notice).
  - (d) Prohibition of bypass.
    - (1) Bypass is prohibited, and the Agency may take enforcement action against a permittee for bypass, unless:
      - (i) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
      - (ii) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and
      - (iii) The permittee submitted notices as required under paragraph (13)(c).
    - (2) The Agency may approve an anticipated bypass, after considering its adverse effects, if the Agency determines that it will meet the three conditions listed above in paragraph (13)(d)(1).
- (14) **Upset.**
- (a) Definition. Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.
  - (b) Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph (14)(c) are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.
  - (c) Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:
    - (1) An upset occurred and that the permittee can identify the cause(s) of the upset;
    - (2) The permitted facility was at the time being properly operated; and
    - (3) The permittee submitted notice of the upset as required in paragraph (12)(f)(2) (24-hour notice).
    - (4) The permittee complied with any remedial measures required under paragraph (4).
  - (d) Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.
- (15) **Transfer of permits.** Permits may be transferred by modification or automatic transfer as described below:
- (a) Transfers by modification. Except as provided in paragraph (b), a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued pursuant to 40 CFR 122.62 (b) (2), or a minor modification made pursuant to 40 CFR 122.63 (d), to identify the new permittee and incorporate such other requirements as may be necessary under the Clean Water Act.
  - (b) Automatic transfers. As an alternative to transfers under paragraph (a), any NPDES permit may be automatically

transferred to a new permittee if: \* \* \* PCB 2013-021 \* \* \* \* \*

- (1) The current permittee notifies the Agency at least 30 days in advance of the proposed transfer date;
  - (2) The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage and liability between the existing and new permittees; and
  - (3) The Agency does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement.
- (16) All manufacturing, commercial, mining, and silvicultural dischargers must notify the Agency as soon as they know or have reason to believe:
- (a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant identified under Section 307 of the Clean Water Act which is not limited in the permit, if that discharge will exceed the highest of the following notification levels:
    - (1) One hundred micrograms per liter (100 ug/l);
    - (2) Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6 dinitrophenol; and one milligram per liter (1 mg/l) for antimony.
  - (3) Five (5) times the maximum concentration value reported for that pollutant in the NPDES permit application; or
  - (4) The level established by the Agency in this permit.
  - (b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the NPDES permit application.
- (17) All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Agency of the following:
- (a) Any new introduction of pollutants into that POTW from an indirect discharge which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants; and
  - (b) Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.
  - (c) For purposes of this paragraph, adequate notice shall include information on (i) the quality and quantity of effluent introduced into the POTW, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.
- (18) If the permit is issued to a publicly owned or publicly regulated treatment works, the permittee shall require any industrial user of such treatment works to comply with federal requirements concerning:
- (a) User charges pursuant to Section 204 (b) of the Clean Water Act, and applicable regulations appearing in 40 CFR 35;
  - (b) Toxic pollutant effluent standards and pretreatment standards pursuant to Section 307 of the Clean Water Act; and
  - (c) Inspection, monitoring and entry pursuant to Section 308 of the Clean Water Act.
- (19) If an applicable standard or limitation is promulgated under Section 301(b)(2)(C) and (D), 304(b)(2), or 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit, or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked, and reissued to conform to that effluent standard or limitation.
  - (20) Any authorization to construct issued to the permittee pursuant to 35 Ill. Adm. Code 309.154 is hereby incorporated by reference as a condition of this permit.
  - (21) The permittee shall not make any false statement, representation or certification in any application, record, report, plan or other document submitted to the Agency or the USEPA, or required to be maintained under this permit.
  - (22) The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed \$25,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318 or 405 of the Clean Water Act is subject to a fine of not less than \$2,500 nor more than \$25,000 per day of violation, or by imprisonment for not more than one year, or both. Additional penalties for violating these sections of the Clean Water Act are identified in 40 CFR 122.41 (a)(2) and (3).
  - (23) The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than \$10,000, or by imprisonment for not more than 2 years, or both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment is a fine of not more than \$20,000 per day of violation, or by imprisonment of not more than 4 years, or both.
  - (24) The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.
  - (25) Collected screening, slurries, sludges, and other solids shall be disposed of in such a manner as to prevent entry of those wastes (or runoff from the wastes) into waters of the State. The proper authorization for such disposal shall be obtained from the Agency and is incorporated as part hereof by reference.
  - (26) In case of conflict between these standard conditions and any other condition(s) included in this permit, the other condition(s) shall govern.
  - (27) The permittee shall comply with, in addition to the requirements of the permit, all applicable provisions of 35 Ill. Adm. Code, Subtitle C, Subtitle D, Subtitle E, and all applicable orders of the Board or any court with jurisdiction.
  - (28) The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit is held invalid, the remaining provisions of this permit shall continue in full force and effect.

**EXHIBIT 2:**  
Post-Hearing Comments of Prairie Rivers Network and  
Illinois Chapter of the Sierra Club, July 20, 2012



**PRAIRIE RIVERS NETWORK**

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July 20, 2012

Via email to [epa.publichearingcom@illinois.gov](mailto:epa.publichearingcom@illinois.gov)

Hearing Officer Dean Studer  
Illinois Environmental Protection Agency  
1021 North Grand Avenue East  
PO Box 19276  
Springfield, IL 62794-9276

RE: NPDES Permit No. IL0079481, Notice No. 5982c  
Peabody Gateway North Mining, LLC- Gateway North Mine  
Post-Hearing Comments

Dear Mr. Studer,

On behalf of the Prairie Rivers Network (PRN) and the Illinois Chapter of Sierra Club (SC), we provide these post-hearing comments and recommendations on the proposed NPDES permit planned to be issued to Peabody Gateway North Mining for discharges of alkaline mine drainage and stormwater discharges into an unnamed tributary to Marys River and unnamed tributary to Coulterville Lake in Randolph County, Illinois. Prairie Rivers Network is the state affiliate of the National Wildlife Federation, a non-profit organization that strives to protect the rivers, streams and lakes of Illinois and to promote the lasting health and beauty of watershed communities. Several of our members and members of the Illinois Chapter of the Sierra Club, a statewide organization representing over 26,000 individuals committed to protecting the Illinois environment, live and recreate in the Marys River and Mud Creek watersheds and would be adversely affected by the discharge of pollutants that degrade water quality.

These comments are follow-up to the issues and questions we raised at the public hearing held on June 20, 2012.

**Objections**

As detailed below, we object to the issuance of this permit for the following reasons:

- I. **The Agency has Failed to Fully Identify and Quantify Proposed Pollutant Load Increases and the Potential Impacts of those Load Increases on the Affected Waters and share the findings with the public as Required by 35 IAC 302.105 c) 2),f) 1) B) and f)3).**
- II. **The Agency Has Failed to Demonstrate Existing Uses Will be Fully Protected in accordance with 35 IAC 302.105.**
- III. **IEPA has not Demonstrated that the Proposed Discharge will not Cause or Contribute to the Violation of Water Quality Standards in Coulterville Lake and the tributaries to Coulterville Lake and Marys River.**
- IV. **Illinois Antidegradation Rule, 35 Ill. Adm. Code 302.105 (c)(B)(iii) has also not been satisfactory addressed in that alternatives for minimizing increases in pollutant loadings (sulfate, chloride, iron, manganese, etc.) have not been fully explored.**
- V. **This permit should not be issued as it does not address entire scope of anticipated modifications to permit site and operations and potential cumulative impacts.**

**I.**

**The Agency has Failed to Fully Identify and Quantify Proposed Pollutant Load Increases and the Potential Impacts of those Load Increases on the Affected Waters and share the findings with the public as Required by 35 IAC 302.105 c) 2),f) 1) B) and f)3).**

It does not appear from the draft fact sheet, antidegradation assessment and draft permit that a complete characterization of the proposed pollutant load to the receiving waterbodies has been conducted.

For example,

- Both Marys River and Mud Creek watersheds are already adversely impacted by coal mining discharges (Attachment A, Spartan Mine & Gateway Mine Inspection Report 4-26-12), and consequently the Agency must assess the



cumulative impact of this proposal in conjunction with impacts from other permitted discharges in those watersheds.

- The draft permit does not take into consideration the potential additional pollutant loading from the coal stockpiles to the underlying groundwater given that a high water table is present.
- The draft permit does not fully consider the additional loading of pollutants from pumping of the underground mine acres.
- The draft permit does not fully consider the additional loading of phosphorus, important because Lake Coulterville, downstream of Outfall 002 is considered impaired due to high levels of total phosphorus.

Illinois' antidegradation rules were designed to ensure the protection of existing uses of Illinois waters, protect water quality and prevent unnecessary deterioration of waters of the state. 35 IAC 302.105. Under these regulations, the Illinois Environmental Protection Agency is charged with implementing the policy and in doing so, must assess any proposed increase in pollutant loading that necessitates a renewed or modified NPDES permit. 35 IAC 302.105 (c)(2). Most importantly, the agency must also analyze the potential impacts of these pollutant loadings on the affected waters, including the fate and effect of each pollutant, to ensure full compliance with water quality standards and protection of existing uses. Failure to do so is a direct violation of the regulations and grounds for appeal. The antidegradation analysis must also show what pollution-minimizing alternatives were considered by the applicant to reduce the impact of the new pollution sources.

## II.

### **The Agency Has Failed to Demonstrate Existing Uses will be Fully Protected in accordance with 35 IAC 302.105.**

The Illinois EPA has not identified and characterized the conditions and existing uses for the unnamed tributaries receiving new mine and stormwater discharges from Outfalls 001 and 002 in violation of Illinois antidegradation regulations. Under Illinois' antidegradation rule, applicants are required to include a characterization of the impacted body of water in their permit application: "Identification and characterization of the water body affected by the proposed load increase or proposed activity and the existing water body's uses. Characterization must address physical, biological and chemical conditions of the water body." *35 Ill. Adm. Code 302.105 f)1A*). The IEPA Water Quality Standards Section has stated numerous times that the Agency does not require any kind of assessment of headwater-type streams, assuming they have very little aquatic life potential. The importance of headwater streams is recognized by the scientific community. While headwater-type streams may require different assessment methods, many do indeed have important existing aquatic life uses that cannot be dismissed categorically as insignificant. They are waters of Illinois, and they are subject to the same existing use rules, even if the

existing uses are of a different type than for larger-order streams. The Antidegradation Assessment states "The applicant conducted macroinvertebrate and fish surveys at several stream sites in the area of the mine site." Surveying streams in the area of the mine site is not the same as assessing the streams which will be impacted.

Once existing uses are properly assessed, the agency must examine the impacts of the proposed activity on those uses and determine whether existing uses will be fully protected through issuance of an NPDES permit. Without evidence of existing use protection, the agency must further condition the NPDES permit or refuse to issue. In light of the lack of information on the streams that will be receiving discharge, this NPDES permit should not be issued unless and until the Applicant or the Agency completes the studies necessary to adequately characterize the conditions and existing uses of each of the streams required by Ill. Adm. Code § 302.105.

### III.

#### **IEPA has not Demonstrated that the Proposed Discharge will not Cause or Contribute to the Violation of Water Quality Standards in Coulterville Lake and the tributaries to Coulterville Lake and Marys River.**

The permit proposes storm related discharges of wastewater from a 172.1 acre mine site including pond overflow from runoff from: office buildings, parking lots, access roads, surface area associated with mine portal, temporary coal storage areas, soil and overburden stockpiles, mine pumpage associated with slope/shaft construction activities, and pumpage from the underground mining operations to unnamed tributaries to Coulterville Lake and Marys River. Because of the inadequate characterization of proposed pollutant load increases mentioned previously in this letter, it follows that reasonable potential analyses for pollutants of concern were not completed. The IEPA must include limitations in the permit necessary to achieve water quality standards. Such limitations must control all pollutants which will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard. 40 CFR 122.44 (d) (1).

Despite this requirement, the appropriate reasonable potential analyses (RPAs) have not been performed on the proposed pollutant loadings. The agency cannot postpone its duty to perform the reasonable potential analysis (RPA) which must be done using data representing all wastestreams likely contributing to the discharge (i.e. alkaline mine drainage, mine pumpage, coal refuse disposal piles, and stormwater discharges). It must perform the requisite analysis before issuing the final permit and set permit limits as necessary to ensure compliance with water quality standards. 40 CFR 122.44.

Finally, additional permit requirements are necessary, considering the amount of coal and dust and fines that will be present onsite and contributing to stormwater pollutants as a result of coal and coal refuse management and disposal activities. Coal is known to have many toxic, carcinogenic organic compounds. Some of them are collectively known as



PAHs. This stands for polycyclic aromatic hydrocarbons of which 20 found in coal are also on the ATSDR (Agency for Toxic Substances and Disease Registry) list. These compounds are semi-volatile and adhere to particles. They are found in unburnt coal and coal slurry and pose a threat to designated uses of the receiving waters. This permit should include a monitoring requirement for PAHs at all outfalls.

#### IV.

**Illinois Antidegradation Rule, 35 Ill. Adm. Code 302.105 (c)(B)(iii) has also not been satisfactory addressed in that alternatives for minimizing increases in pollutant loadings (sulfate, chloride, iron, manganese, etc.) have not been fully explored.**

Illinois Antidegradation Rule has not been satisfactorily addressed in the draft NPDES permit in that alternatives for minimizing increases in pollutant loadings (sulfate, chloride, iron, manganese, etc.) have not been fully explored. 35 IAC Section 302.105(c) (2) states that in making the antidegradation assessment, "the Agency must: (B) Assure the following: (iii) All technically and economically reasonable measures to avoid or minimize the extent of the proposed increase in pollutant loading have been incorporated into the proposed activity." Further, under 35 IAC Section 302.105(f) (1) "A permit application for any proposed increase in pollutant loading that necessitates the issuance of a new, renewed, or modified NPDES permit or a CWA Section 401 certification must include, to the extent necessary for the Agency to determine that the permit application meets the requirements of this Section, the following information : (D) Assessments of alternatives...may include: (i) additional treatment levels, including no discharge alternatives; (ii) Discharge of waste to alternate locations, including publicly -owned treatment works and streams with greater assimilative capacity; or (iii) Manufacturing practices that incorporate pollution prevention techniques."

Of critical concern is the potential impact of the proposed mine on the quality of water in the Coulterville City Reservoir, which serves as a drinking water source for residents. Outfall 002 discharges to a tributary to Coulterville Lake. As we describe below, there are many alternatives which should be considered before any discharge to Coulterville Lake is permitted. As the Antidegradation Assessment reports, the levels of pollutants typically found in mine effluent are low: "Peabody collected water quality data for Coulterville Lake in 2011. In mg/l, the results were as follows: Sulfate 24.2; Chloride 5.9; Manganese 0.6 mg/l and Total Dissolved Solids 146." Degradation of a public water supply should not be allowed while there are viable alternatives. Under 35 IAC 406.202, no mine effluent discharge should be permitted to Coulterville Lake as it likely to adversely affect that public water supply.

A no-discharge option should be explored for the mine operation, especially for discharges proposed for Outfall 002. For example, directing stormwater discharges to the Central Cleaning Plant for reuse in coal washing should be explored. Stormwater collected in the

sedimentation basins could be used for mining operations including dust suppression. Sedimentation basins could be sized large enough to hold all stormwater runoff and be used to store and manage water until needed for onsite operations, effectively creating a closed-circuit system. Any wastewater that was deemed unfit for use due to poor water quality could then be stored in a concrete tank and treated with chemicals to precipitate out pollutants. A more complete onsite water balance would help develop this idea better and should be provided to the Agency for review.

Discharge of wastewater to alternate locations such as a larger stream with greater assimilative capacity and which are not tributary to a public water supply should also be considered.

Opportunities for improving the quality of the water proposed to be discharged to both Outfalls 001 and 002 also need to be more fully explored. Certainly mine pumpage should not be directed to Outfall 002 as it is currently indicated on page 3 of the draft permit. But maintaining a steady flow which mine pumpage provides does allow for the use of treatment methods such as biological treatment in wetlands and reactors which the Antidegradation Assessment dismisses as infeasible due to “the intermittent nature of the stormwater runoff.” Biological sulfate reduction can also be undertaken in the mine itself. This option for reducing sulfate loadings should be explored (See Att. C-A Review of Sulfate Removal Options for Mine Waste).

In addition, the Mary's River / North Fork Cox Creek Watershed TMDL Report “Mary's River TMDL” found at <http://www.epa.state.il.us/water/tmdl/report/marys-river/marys-river.pdf> recommends BMPS for mine operations in order to reduce sulfate and TDS, the main pollutants discharged from mining activities. Anaerobic wetlands, open limestone channels vertical flow reactors, and sulfate-reducing bioreactors are the BMPs recommended for mining activities in this watershed. These are appropriate BMPs to implement at Outfall 001.

While we strongly believe that no mine effluent should be directed to Coulterville Lake, we note the following specific problems with the limits proposed for Outfall 002 in the draft permit:

- As stated earlier, no mine pumpage should be directed to the lake.
- In the event IEPA allows discharge to the lake, TSS should be limited at all discharge conditions on Outfall 002, as Coulterville Lake is already impaired for TSS.
- The AD Assessment states “All Public and Food Processing Water Supply water quality standards will be met in the effluent. Increases in lake concentration of chloride and sulfate will be in terms of a few mg/l.” While it is true that the limits at Outfall 002 are set at the chloride and sulfate standards for Public and Food Processing Water Supply as found at 35 IAC 302.304, the TDS limit isn't. It should be set at 500 mg/L.

- A manganese limit should be set for all discharge conditions at Outfall 002, since Coulterville Lake is already impaired for manganese. The limit should be set at 0.15 mg/L, the public water supply standard.
- Coulterville Lake is impaired due to phosphorus. Outfall 002 should contain a limit on phosphorus at all discharge conditions, in line with the TMDL developed for Coulterville Lake. According to the *Lower Kaskaskia River Watershed TMDL Report* "Kaskaskia TMDL" (found at <http://www.epa.state.il.us/water/tmdl/report/lower-kaskaskia-river/lower-kaskaskia-report-final.pdf>) the TMDL developed to address total phosphorus levels in Coulterville Lake will likely remedy the elevated levels of manganese. The Kaskaskia TMDL call for a 94% reduction in phosphorus loading to the lake. Phosphorus limits should be set at the lake water quality standard of 0.05 mg/L phosphorus.

V.

**This permit should not be issued as it does not adequately address cumulative impacts due to the permitted activities and associated operations.**

Peabody North Gateway Mining, LLC is seeking an NPDES permit for expansion of the Gateway Mine to the north, including the addition of a new portal, airshaft, conveyor belts, raw coal stockpiles, and sedimentation ponds. The coal brought to the surface through the portal will be transferred to the Gateway Mine's Central Cleaning Plant, similar to current operations with coal from the South Portal. Proposed are two outfalls, one discharging to the north into an unnamed tributary to the South Fork Mud Creek (dammed as the Coulterville City Reservoir) and the second outfall discharging into the unnamed tributary of Marys River presently receiving outfalls 002 and 003 from the existing Gateway Mine.

The NPDES permit for the Gateway Mine has been drafted, publicly noticed, and is now under additional revisions due to additional modification to the mine site and operations. It has been unclear from the start why these two portals and the preparation plant have not been permitted together. Clearly the coal being extracted from the North Portal will be sent to the processing plant, thereby contributing to additional pollutant loading to the waterbodies identified and assessed during the Gateway Mine NPDES process. However, the draft permit and antidegradation assessment did not reflect this. Now given the opportunity to develop the North Gateway Mine into a no-discharge system with stormwater runoff being collected and transferred for use at the coal processing plant, it only makes sense to combine the facilities under one NPDES permit and adequately and appropriately apply Illinois' antidegradation regulations to the discharges that will result from the proposed operations.

\* \* \* \* \*

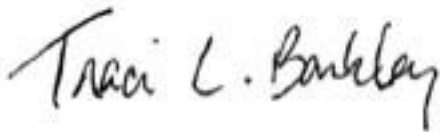
**Additional questions that were not answered adequately at the public hearing include:**

- 1) Gateway North mining activities are proposed to occur within the watershed of Coulterville Lake. (See Attachment B) Under the Safe Drinking Water Act, what is the IEPA's policy with regards to pollution prevention within the watershed of a public water supply?
- 2) Why isn't the Outfall 002 limit for total dissolved solids set at the Public and Food Processing Water Quality Standard given that the receiving stream flows into Coulterville Lake, a public drinking water reservoir?
- 3) Why isn't a manganese limit applied to the Outfall 002 discharge? Manganese is often found in disturbed earth, including soil, and subsoil rock layers including but not limited to coal. The Kaskaskia TMDL report states it is likely that the main source of manganese to the reservoir is through lake-bottom sediments and watershed erosion. Manganese levels in the stormwater runoff proposed to be discharged to Outfall 002 should be limited to 0.15 mg/L to protect the public water supply use of the lake.

\* \* \* \* \*

In conclusion, based on the grounds presented in this letter, the Agency should modify the Peabody North Gateway Mining, LLC NPDES permit for their North Gateway Mine site in order to facilitate a no-discharge mining operation. We appreciate your consideration of our comments.

Sincerely,



Traci L. Barkley  
Water Resources Scientist



Cindy Skrukrud  
Clean Water Advocate  
Illinois Sierra Club

**Attachments:**

**Attachment A: Spartan Mine & Gateway Mine Inspection Report 4-26-12**

**Attachment B Coulterville Lake\_Source Water Assessment Program factsheet**

**Attachment C: A Review of Sulfate Removal Options for Mine Waters**

CC: Peabody North Gateway Mining, LLC  
c/o James Tolen  
7100 Eagle Crest Boulevard, Suite 100  
Evansville, IN 47715-8152

**Attachment A:**  
**Spartan Mine & Gateway Mine Inspection**  
**Report 4-26-12**

**Land Reclamation General Inspection Report**

Illinois Department of Natural Resources  
Office of Mines and Minerals  
One Natural Resources Way  
Springfield, IL 62702-1271

Inspector/(#): 42 - Tim DeVardo Inspection Date: 04-03-12 Last Inspect Date: N/A  
 Company/Mine Name: Peabody Coulterville Mining LLC, Gateway, CCP Unit No: 1098  
 Company/Mine Name: Alpena Vision Resources, LLC - Spartan Mine Unit No: 1097  
 Permit No(s): Unit 1098: 51,53,160, 225 County(ies): Randolph  
 Permit No(s): Unit 1097: 52 County(ies): Randolph  
 Location/Address: Coulterville  
 Type of Operations: Underground Type of Inspection: Citizen Complaint  
 Rep. on Inspection: Grady White (Peabody) Ground Conditions: Drying

## Parameter Check List:

<input type="checkbox"/> 1. Field Decision	<input type="checkbox"/> 8. Support Facilities
<input type="checkbox"/> 2. Topsoil	<input type="checkbox"/> 9. Prime Farmland
<input type="checkbox"/> 3. Hydrologic Balance	<input type="checkbox"/> 10. High Capability Land
<input type="checkbox"/> 4. Coal & Non Coal Wastes	<input type="checkbox"/> 11. Blasting
<input type="checkbox"/> 5. Backfilling & Grading	<input checked="" type="checkbox"/> 12. Other: <u>Citizen Complaint</u>
<input type="checkbox"/> 6. Revegetation	<input type="checkbox"/> 13. Sign & Markers
<input type="checkbox"/> 7. Roads	<input type="checkbox"/> 14. Off-Site Impact

## Comments or Actions:

The purpose of this inspection was to investigate the alleged impacts to the water quality of Mary's River as a result of nearby coal mining related activities. Present for this inspection were representatives of the IDNR, Office of Mines and Minerals, Land Reclamation Division. These included, Vickie Broomhead, Staff Hydrologist and Tim DeVardo, Field Inspector assigned to these mines. Also present was Mr. Brian Perbix, of the Prairie Rivers Network who requested this state inspection. Mr. Grady White, a Peabody representative accompanied us on those properties controlled by Peabody Coulterville Mining LLC. There was no representative present on behalf of Alpena Vision Resources, LLC. These inspections were made without giving any advance notice to the companies.

Two distinct companies have discharges into Mary's River upstream of where Mr. Perbix observed the orange streambed coating and surface scum described in his March 9, 2012 email requesting this state inspection. See the attached map delineating the permitted lands for the Peabody Coulterville Mining LLC, Gateway Mine and Alpena Vision Resources, LLC, Spartan Mine.

We initially met Mr. Perbix in Coulterville, before proceeding to the Gateway Mine. Upon arriving at the entrance, we stopped at the manned guard office and announced who we were and the purpose of our visit. The security officer ask us come inside and to read and sign the hazard training form while he contacted the main office. Shortly thereafter, Mr. Grady White with Peabody met us. I briefly explained to Mr. White why we were here. Mr. Perbix requested to go to the NPDES Outfalls that report to Mary's River, namely 002, 003 and 008. At that point we proceeded to Outfalls 002 and 003.

Both 002 and 003 lie at the eastern toe of the Cell No. 2 embankment within Permit No. 160. They collect runoff from the out slope of Cells No's. 2 and 3. The embankment structure is constructed of soil material and is well vegetated. No refuse contact water reports to these outfalls. Outfall 002 had an almost imperceptible discharge, making it difficult to capture in the test tube. The effluent was clear and had a field pH of 7.0 as measured with the Hach Kit. No laboratory sample was taken at this location. Outfall 003 was not discharging on this date. At this point we proceeded to Outfall 008.

Outfall 008 is located at the southernmost extent of the Gateway Mine complex and is in Permit No. 53. It receives runoff from the Recirculation Lake. It was discharging at an estimated 5 gpm and had a field pH of 7.5 as measured with the Hach Kit. A 500 ml sample was taken at this location.<sup>[1]</sup> It will be tested for the following parameters required in the NPDES permit: pH, Total Suspended Solids, Total Dissolved Solids, Alkalinity, Acidity, Chlorides, Sulfates and Total Iron. Sampling at this location without disturbing the stream bed was difficult given the low level of discharge. Some orange staining and discoloration of the riprap at and near the outfall was observed. The streambed itself did not exhibit much discoloration in the immediate area just downstream of the outfall. This concluded our inspection of the Peabody Coulterville Mining LLC, Gateway Mine.

We then moved to Alpena Vision Resources, LLC, Spartan Mine. We started this inspection at NPDES Outfall 001. There was no discharge occurring on this date. This Sediment Pond, known as 52-01, is a two cell pond. The upstream pond is cell A and the downstream pond is cell B [outfall 001]. We then proceeded south to Mary's River, downstream of Outfall 001.

The first stream sample was taken at N38.15640, W89.64853 and denoted as, "Mary's River - Downstream." See attached map delineating all Mary's River sampling locations [also shown is the approximate inspection path along Mary's River as noted by the green dotted line]. A 500 ml sample was taken at this location.<sup>[1]</sup> It will be analyzed for the following parameters required in the NPDES permit: pH, Total Suspended Solids, Total Dissolved Solids, Alkalinity, Acidity, Chlorides, Sulfates, Total Iron and Manganese. Sampling at this location without disturbing the stream bed was difficult given the low level of discharge. Field pH was measured with the Hach Kit at 6.0. Orange scum was observed on the water surface and what appears to be iron precipitate was prevalent on the stream substrate.

The next stream observation was made at N38.15702, W89.64629. Field pH was measured with the Hach Kit at 6.5. No laboratory sample was taken. The water had an orange coloration and iron precipitate was again noted on the stream substrate.

The second stream sample was taken at N38.15733, W89.64536 and denoted as, "Mary's River - Midstream." A 500 ml sample was taken at this location.<sup>[1]</sup> It will be analyzed for the same parameters outlined in the first stream sample narrative. Field pH was measured with the Hach Kit at 7.0. Water color and substrate observations were consistent with that noted at the previous two locations. See attached downstream and upstream photographs taken at this location.

The next stream observation was made at N38.15812, W89.64347. Field pH was measured with the Hach Kit at 7.0. No laboratory sample was taken. The water had an orange coloration and iron precipitate was again noted on the stream substrate.

The third and final stream sample was taken at N38.15876, W89.64268 and denoted as, "Mary's River - Upstream." A 500 ml sample was taken at this location.<sup>[1]</sup> It will be analyzed for the same parameters outlined in the first stream sample narrative. Field pH was measured with the Hach Kit at 7.0. Water color and substrate observations were consistent with that noted at the previous locations.

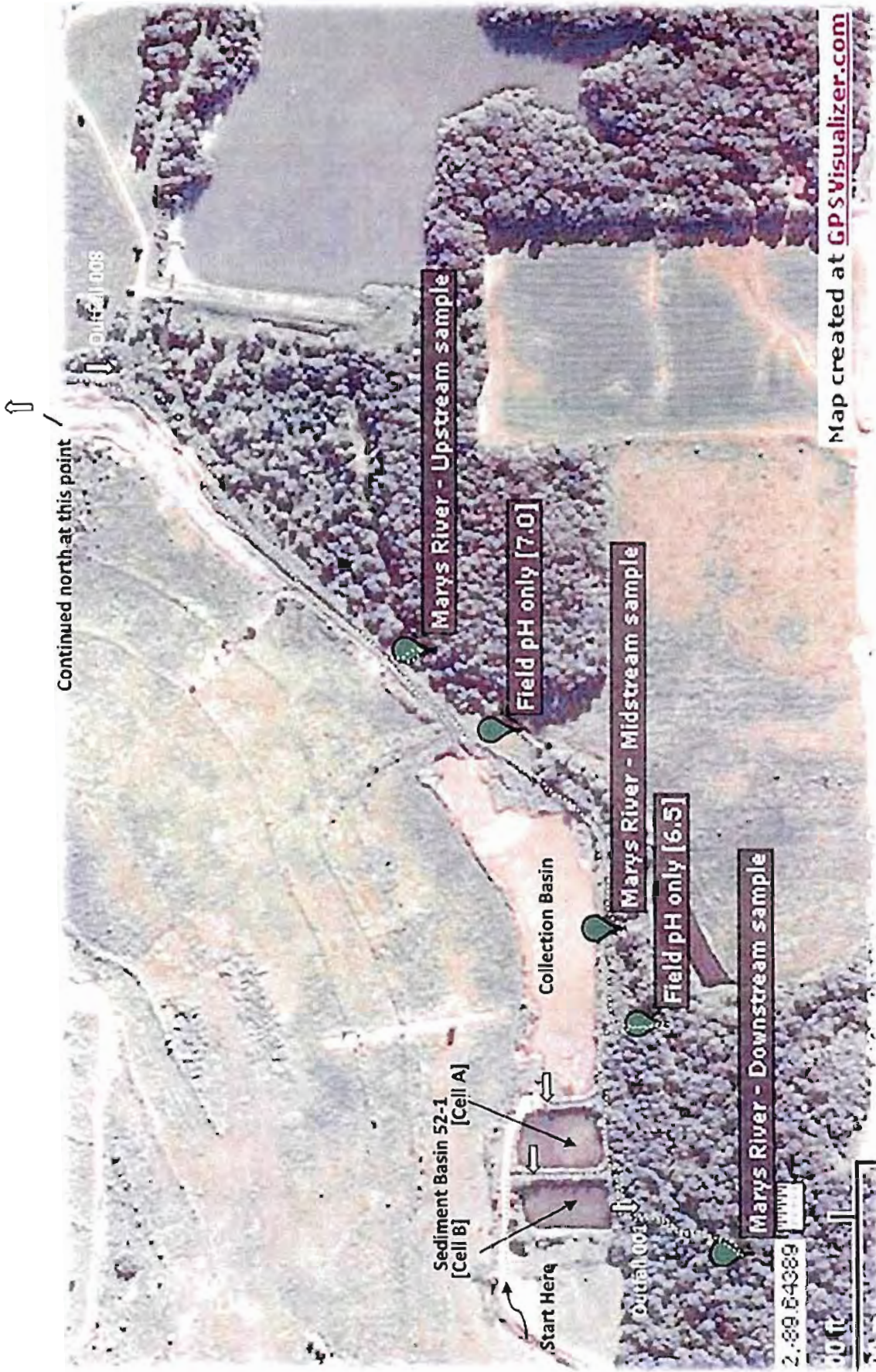


We continued walking in the Mary's River stream channel or the outside levee of the east perimeter ditch at the Spartan Mine until we reached the Gateway Mine Outfall 008. At this point we continued northward. Reclamation work done last fall was observed and discussed during the remainder of the inspection. The majority of that work focused on the east perimeter ditch, the un-reclaimed part of the east refuse slope, the haul road corridor, a portion of the top of the refuse pile and a narrow band along the east access road. See attached map delineating those areas.

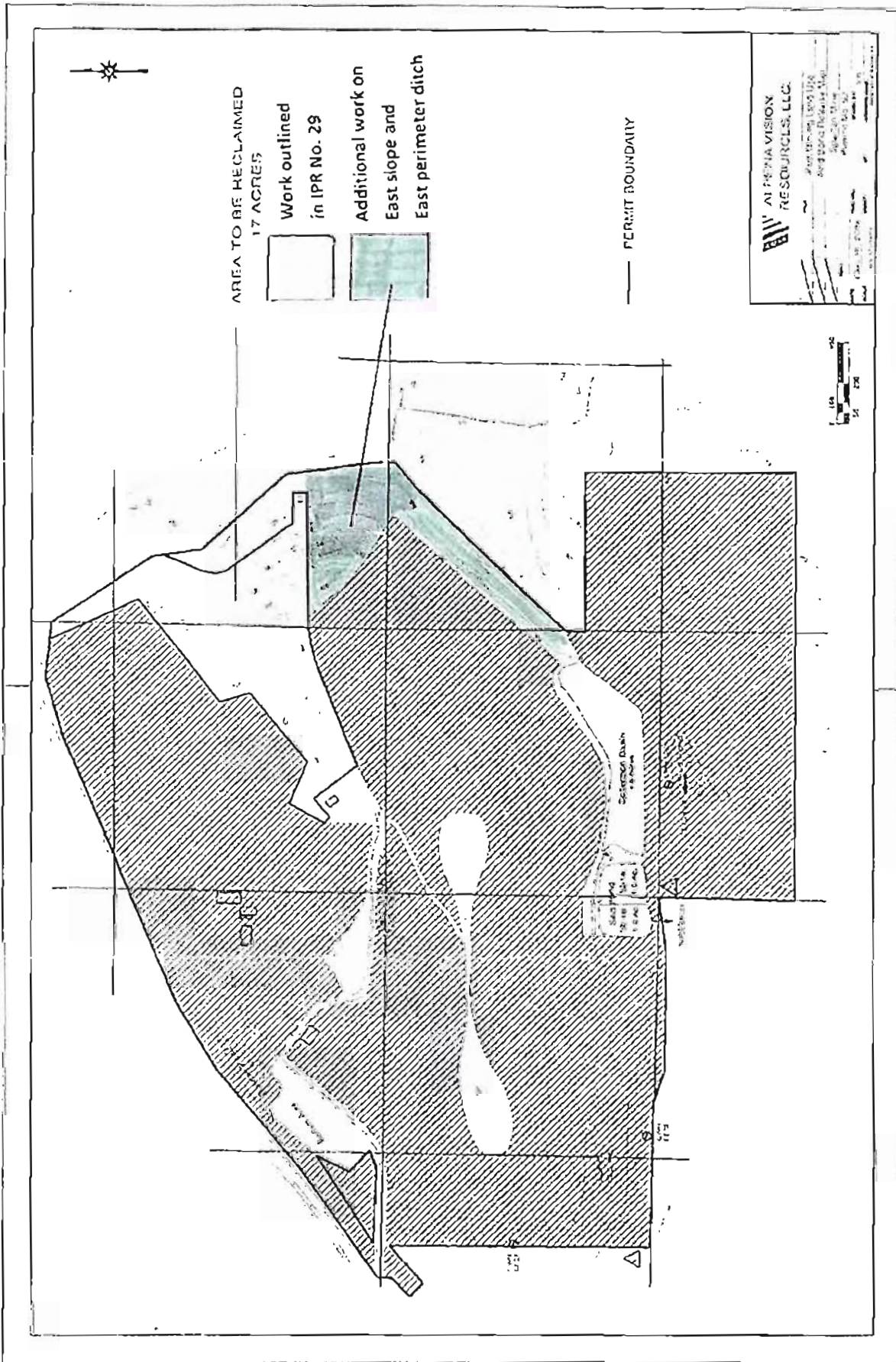
Laboratory results have since been received and are included with this inspection report.

[1] All samples were collected by Tim DeVardo at the location indicated in this report. Each sample was collected and stored in a new, clean 500 ml plastic bottle and labeled accordingly. All samples remained in my possession until they were relinquished to the Benton Analytic Laboratory on April 03, 2012 at 3:00 PM. The laboratory is located at 503 E. Main St., Benton, IL, 62812.

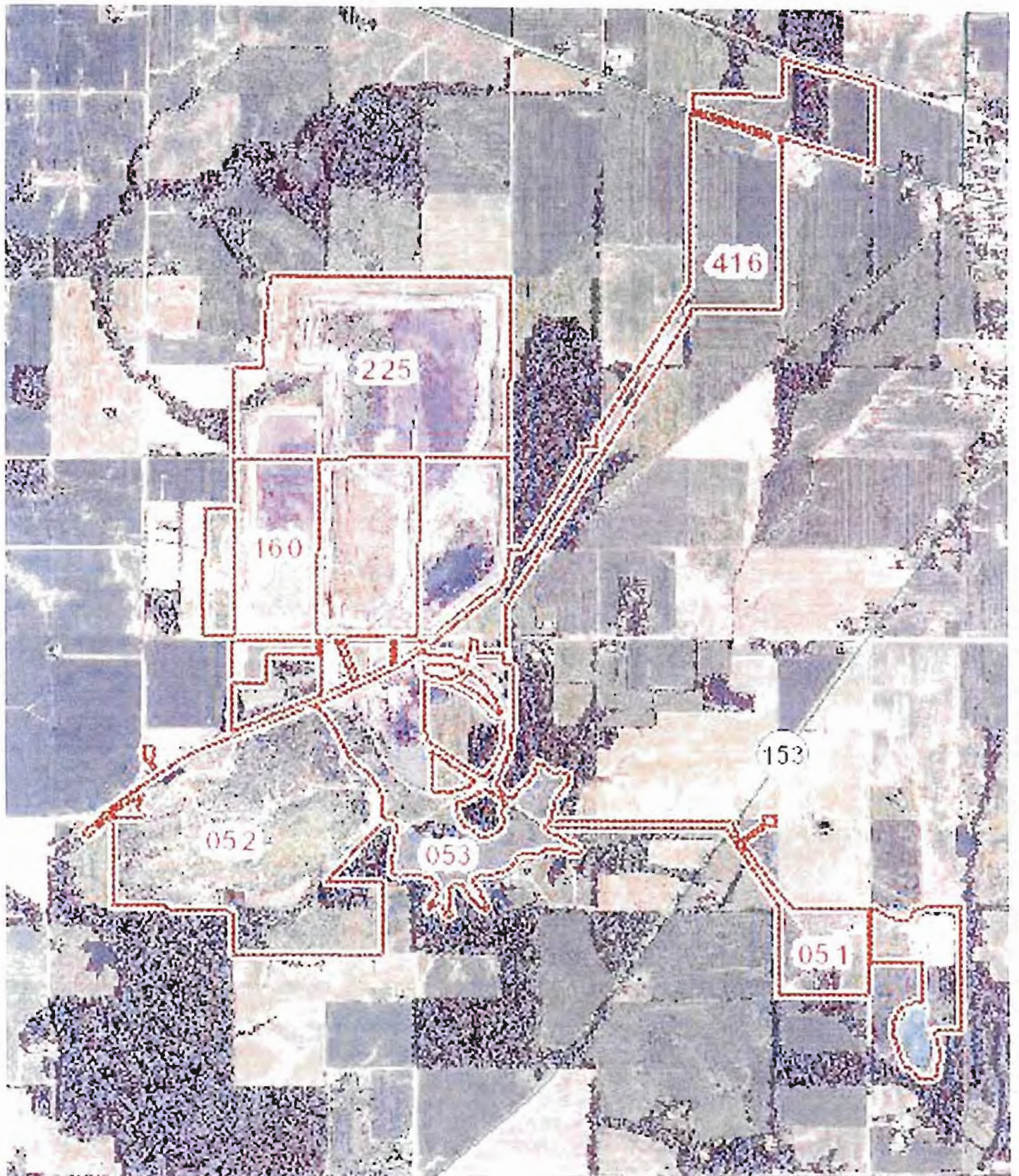
# Aerial View of Sampling Locations along Mary's River



# Reclamation Activities - Fall 2011



### General Reference Map Showing Permit Numbers and Boundaries







Illinois Department of Natural Resources  
Office of Mines and Minerals  
Analytical Laboratory

503 E. Main St. Benton, IL 62812  
Ph: 618-439-9111 Fax: 618-438-8111  
e-mail: chad.parker@illinois.gov

Chad Parker, Chemist  
Krystal Pankey, Chemist  
Ashley Thomas, Lab Intern

Project/Site Gateway / Spartan Citizens Complaint Inspection

Division/Contact OMM / LRD Tim Devardo

Received Date 4/3/2012

Sample	4/5/2012 Chloride	4/5/2012 Sulfate	4/5/2012 Iron	4/5/2012 Manganese	4/3/2012 pH	4/4/2012 TDS	4/4/2012 Alkalinity	4/4/2012 Acidity	4/4/2012 TSS
Outfall 008	174.3	782.7	3.32		7.460	1566	321.6	0.0	48
Mary River- DS	106.5	1491.3	58.52	33.35	6.257	2524	53.5	143.6	30
Mary River- MS	112.5	1035.2	7.56	15.70	6.930	1846	158.1	0.0	23
Mary River- US	122.2	835.0	1.07	13.34	6.925	1684	205.4	0.0	11

**Attachment B:**  
Coulterville Lake Source Water Assessment Program  
Factsheet

## Source Water Assessment Program Factsheets

Select Water System Type

Select County  Search County

-- Or --

Enter any part of a Facility Name  Search Facility Name

Search Results  Select Water System

To view a summary version of the completed Source Water Assessments, you may search our records by county or public water supply name. This summary information describes pertinent sub-sections of each completed assessment including: Importance of Source Water; Susceptibility to Contamination Determination; and documentation/recommendation of Source Water Protection Efforts. However, summaries of Source Water Protection Efforts have not been documented for non-community water supplies. It should be noted that these Source Water Assessment summaries are presented in strict compliance with Illinois EPA's security policy on the release of sensitive information. Therefore, all locational data and maps pertaining to wells, aquifers and/or surface water intakes have been removed. To obtain a complete version of the Source Water Assessment Report, please contact your local water supply officials.

### Water Percentages:

Surface Water %	Surface Water Purchase %	Ground Water %	Ground Water Purchase %	Ground Water UDI %
100.00	0.00	0.00	0.00	0.00

### Importance Of Source Water:

Drinking water for the Village of Coulterville, Illinois (Facility No. 1570150) is supplied by the Coulterville community water supply (CWS). Coulterville Reservoir acts as the source of this drinking water. Coulterville operates a surface water intake (IEPA #60056) in the lake drawing an average of 179,100 gallons per day. This intake has one port at a fixed depth in the lake. Coulterville provides water to approximately 515 service connections and an estimated population of 1,100 people in Randolph County.

### Source Of Water Supply:

The Coulterville Reservoir is located within Randolph County and has a small, predominantly agricultural watershed of 5,366 acres. The watershed, featured in Figure 1, includes one main stream, a tributary to the South Fork Mud



Creek, which feeds into the lake. The lake was created in 1942 by damming and subsequently flooding portions of a tributary to the South Fork Mud Creek and has a surface area of 27 acres. There are no major cities or urban areas within the watershed.

**Well Data For This Facility:**

No Data

**Intake Details:**

Intake ID	Source	Description	Watershed ID	Stream Segment
IN60056		INTAKE (60056) RESERVOIR		

**Source Water Quality:**

The overall resource quality of the lake is considered good. Results from Illinois EPA's 1999 Ambient Lake Monitoring Program indicate the untreated raw water supply has had low level detections of the pesticide compound atrazine. These detections are well below the Drinking Water Standard, set at 3 parts per billion (ppb). Atrazine is a widely used selective herbicide for control of broadleaf and grassy weeds in crops such as corn. Atrazine is fairly persistent and highly mobile in soils and water. (As a result, atrazine is often found in surface waters, and in some cases groundwater, in areas where it is used extensively.) The water supply has installed equipment to add powdered activated carbon (PAC), when necessary, to reduce levels of atrazine in the finished water. In general, inorganic parameters meet Public and Food Processing Water Supply Standards. These standards apply to Waters of the State at the point of withdrawal for treatment and distribution. Manganese levels are slightly elevated, but not unusual for surface waters in Illinois. Waters not attaining water quality standards with technology-based controls alone (e.g. water quality limited) must be identified in accordance with Section 303(d) of the Federal Clean Water Act (CWA). Water body segments (streams) within this watershed are included on the 303(d) list. An explanation of how water body segments are rated can be found in the document entitled "Guidance For Developing Watershed Implementation Plans In Illinois", available from the Watershed Management Section. For information pertaining to the water bodies or watershed discussed in this factsheet, refer to the CWA Section 303(d) list: Illinois' submittal for 1998. Information pertaining to this program, designated stream segments and this document can be obtained by contacting the Watershed Management Section of the Bureau of Water at 217/782-3362.

**Finished Water Quality:**

Finished water quality data is available at USEPA's website <http://www.epa.gov/safewater/data/getdata.html>. This data includes tables of monitored parameters and any contaminants detected, including any health advisory information, drinking water standards, or maximum contaminant levels (MCLs). This data is also available in the Consumer Confidence Report supplied by the Coulterville CWS to its customers.

**Potential Sources Of Contamination:**

The phrase potential source is expressly used here to describe sources existing in possibility or having the capability of becoming a source of contamination. Figure 1 shows the locations of known potential point sources of contamination. The term point source is used to distinguish it from the term nonpoint source. Nonpoint source pollution is the diffuse, intermittent runoff of pollutants from various sources. The names of potential point sources of contamination identified in Figure 1 are listed in Table I. The sites listed in Table I are considered potential sources of contamination due to: the nature of the activity; the availability of data in electronic databases; and their geographic proximity to the source water protection area. These are divided into seven different types that are classified by the following abbreviations: CU = cleanup (sites that are actively doing cleanups); CERCL = Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site; LF = landfill; NPDES = National Pollutant Discharge Elimination System discharge point; RCRA = Resource Conservation and Recovery Act site, LU = Leaking Underground Storage Tank (sites with leaking underground storage tanks that have not received a No

Further Remediation letter); and TRI = Toxic Release Inventory site (a site that has had a toxic release to a receiving stream or publicly owned treatment works).

Figure 2 illustrates the land cover within the watershed, indicating areas that may contribute to nonpoint source pollution. Nonpoint source pollution is the diffuse, intermittent runoff of pollutants from various sources. Precipitation moving over and through the ground picks up pollutants from these sources and carries them into rivers, lakes, and groundwater. Major activities that contribute to Illinois' nonpoint source pollution problems are agriculture, construction erosion, urban runoff, hydrologic modifications, and resource extraction activities. Figure 3 shows mining activities within the Coulterville Reservoir Watershed. Within the 5,366-acre watershed, the percent of land cover is composed of: 45% agricultural, 0% urban, 4% transportation, 40% forest/grasslands, and 11% water/wetlands.

Potential nonpoint source contaminants of concern include waterborne pathogens such as Cryptosporidia, Leptospira, E. coli, Giardia, and fecal coliform, as well as nitrogen and herbicides such as atrazine. Cryptosporidia and Leptospira are single cell disease causing parasites that live in wildlife, livestock and domestic animals. If these animals live near bodies of water they may serve as carriers of these parasites. Figure 4 shows estimated wildlife and livestock density information for relevant counties in the watershed. Livestock densities are based on actual numbers of cattle, hogs, sheep, goats and horses per county; wildlife densities are based on the estimated number of whitetail deer per county. Due to their ability to adapt to different environments, whitetail deer are a good indicator of wildlife density on a countywide level. See <http://www.epa.gov/ogwdw/> for more information on Cryptosporidia. Figure 5 shows estimated atrazine usage in the watershed area, illustrated in pounds per square mile.

Table I

MAP ID	FACILITY NAME	SOURCE CLASS
1	COULTERVILLE WTP	NPDES

Data and information used in the maps supplied with this fact sheet were obtained from the following sources: Transportation, Rivers, County Boundary, Land Cover, and Wildlife Density from Illinois Department of Natural Resources, CERCLA and RCRA sites from U.S. Environmental Protection Agency's Envirofacts Database, Herbicide and Nitrogen Usage from U.S. Geological Survey, Livestock Densities from U.S. Department of Agriculture, TRI, NPDES, LUST Sites, Cleanups, Landfills, Watershed Boundaries, and Intakes provided by Illinois EPA.

**Site Data For This Facility:**

No Data

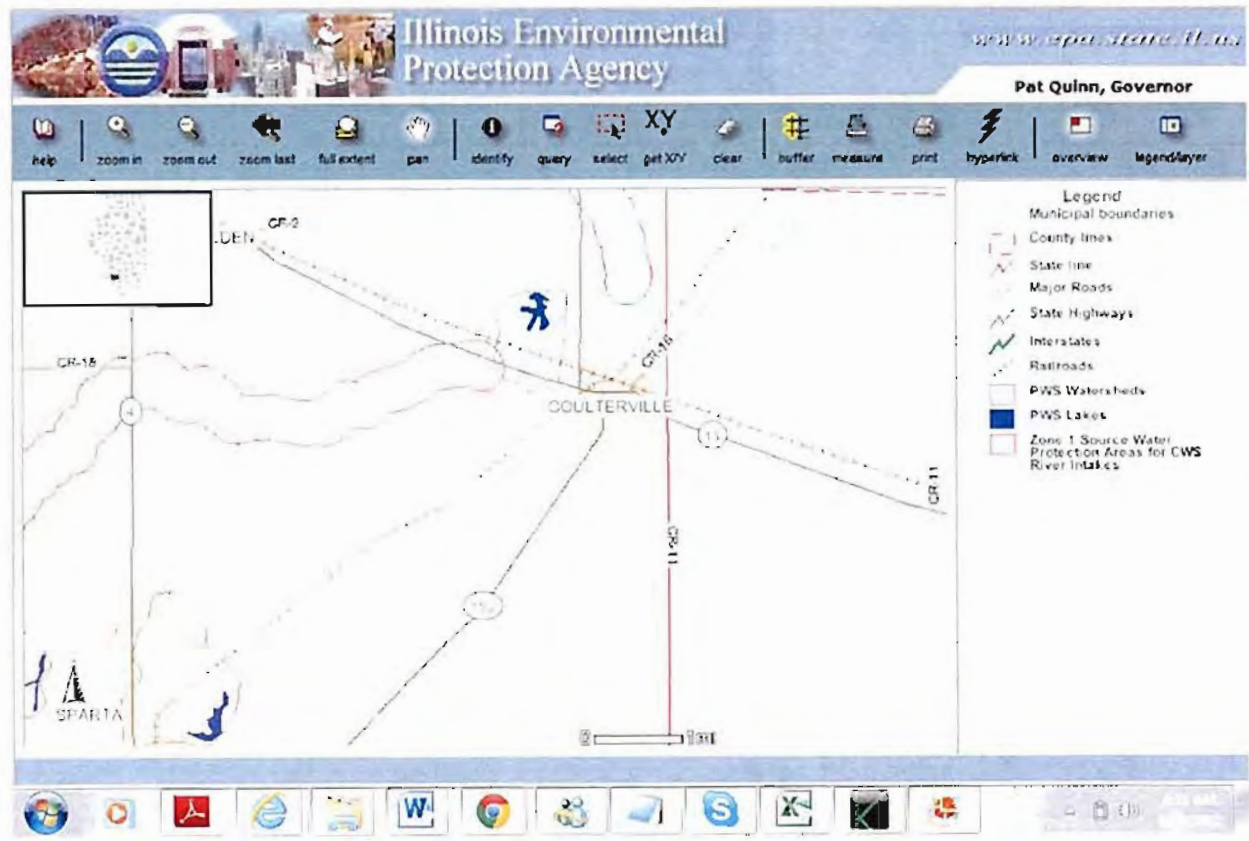
**Susceptibility To Contamination:**

Illinois EPA considers all surface water sources of community water supply to be susceptible to potential pollution problems. Hence, the reason for mandatory treatment for all surface water supplies in Illinois. Mandatory treatment includes coagulation, sedimentation, filtration, and disinfection.

**Source Water Protection Efforts:**

In 1992, a watershed committee was formed to address pesticide concerns in the Coulterville Reservoir, particularly atrazine. In 1994 to 1996, Coulterville participated in a Voluntary Atrazine Monitoring Program, sponsored by the Ciba-Geigy Corporation. Results of this testing were similar to Illinois EPA's, and are available from Ciba-Geigy. In a national effort to ensure adequate protection against groundwater contamination from the herbicide atrazine, USEPA made significant changes to the atrazine use label in 1990. It is a violation of law to apply, mix, or load atrazine within 50 feet of any well, including water wells, irrigation wells, livestock water wells, abandoned wells or sinkholes. In 1992, the atrazine label was further amended to protect surface waters by requiring a 200 foot application setback for

lakes and reservoirs. In addition, there is a 66 foot setback from any point where field surface water runoff enters a stream or river. A concerted effort to incorporate best management practices for atrazine applications is on-going, an atrazine BMP document is available from Novartis Crop Protection, or by contacting the Illinois Fertilizer & Chemical Association at (800) 892-7122. In order to help farmers in adopting sound agricultural practices the Illinois Council on Best Management Practices (C-BMP) was formed. The Council is a coalition of agribusiness and agricultural producer organizations with the support of the University of Illinois Extension and serves as a clearinghouse on current research to protect water quality in Illinois. The Council also provides information and support to local watershed groups to help implement sound water quality initiatives and can offer educational assistance and help facilitate the technical and financial resources needed to carry out water quality objectives. For more information on BMPs, please refer to the website at <http://www.ctic.purdue.edu>, as well as "A Guide to Illinois Lake Management" available from Illinois EPA. The Illinois Agronomy Handbook should also be used as guidance in implementing BMPs. For more information on C-BMP contact Dr. George Czapar, Springfield Extension Center, P.O. Box 8199, Springfield, IL 62791, email: [g-czapar@uiuc.edu](mailto:g-czapar@uiuc.edu). In an effort to minimize the impact of livestock facilities on water resources on a statewide basis, livestock facilities are now regulated under the Livestock Management Facilities Act. This legislation is designed to keep Illinois' livestock industry productive and environmentally responsible by establishing requirements for design, construction, operation and management of livestock facilities and waste-handling structures. Detailed information on the Livestock Management Facilities Act may be found at the website <http://www.agr.state.il.us>. In addition, further watershed protection efforts and priorities of the Illinois EPA, Illinois Department of Agriculture, Illinois Department of Natural Resources, U.S. Department of Agriculture's Natural Resources Conservation Service, U.S. Army Corps of Engineers, and The Nature Conservancy are described and illustrated at the website: <http://www.epa.state.il.us/water/unified-watershed-assessment/index.html>.



**Attachment C:**  
**A Review of Sulfate Removal Options for Mine Water**

## **A REVIEW OF SULFATE REMOVAL OPTIONS FOR MINE WATERS**

R.J.Bowell

SRK Consulting, Windsor Court, 1 Windsor Place, Cardiff CF10 3BX,  
Wales

### **Abstract**

Sulfide oxidation is a common phenomenon associated with many mined ore bodies and extracted or processed waste. Where the products of these chemical reactions can enter a water body the result is often a reduction in water quality through the increase of acidity, metals and dissolved salts. Due to an attributed lower environmental impact the release of sulfate has received little attention in many regulatory jurisdictions when compared to control of dissolved metals or acidity. Consequently the literature on sulfate removal from mine waters is comparatively small when compared to metal control despite the use and development of several technologies to reduce sulfate and total salt loadings. Sulfate control levels are based primarily on the secondary drinking water recommendations of approximately 500 mg/L, based on the laxative effect of high magnesium sulfate concentration.

Sulfate control in mine waters primarily follows one of two methodologies; (1) Removal through membrane separation of salts from water; (2) Removal of sulfate by salt precipitation through ion exchange, permeable reactive barrier, biological reduction or formation of insoluble mineral precipitate.

These approaches are reviewed within this paper and an economic and technical comparison made between the available technologies. Based on demonstrated technology and economic benefits the most promising technologies to date are biological sulfate reduction, SAVMIN, and GYPCIX. At sulfate concentrations less than 2000 mg/L the limestone/lime process is an effective low-cost or pre-treatment removal option for sulfate. As with any mine water treatment option site-specific conditions will control the most suitable option for a particular mining operation.

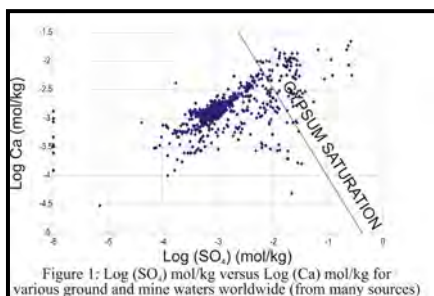
## 1. Introduction

Acid rock drainage mechanisms involve the oxidation of sulfide minerals and can lead to highly acidic, metal-rich waters with high sulfate content. However sulfate has a potential corrosive and purgative effect (AWWA, 1999). Waters rich in sulfate also have a high scaling potential. In South Africa, for example, it is estimated that 75% of gold mines have scaling processes essentially related to saturation of water with respect to  $\text{CaSO}_4$  (Juby, 1989). Increasingly sulfate is being considered as one of the more significant long term water quality issues for mining operations and process plants, particularly in countries with problems of fresh water supply such as South Africa and Australia (Bosman, 1985; Maree et al., 1989; Adlem et al., 1991; Du Plessis and Swartz, 1992; Everett et al., 1994; Bowell, 2000; Geldenhuys et al., 2001; Younger et al., 2002).

This invited review will assess the options available for sulfate removal from mine waters and discuss an economic and technical comparison made between the available technologies

### 1.1 Sulfur hydrogeochemical cycle

Sulfur occurs in a number of oxidation states of which only three, the -2 (sulfide), 0 (native sulfur) and +6 (sulfate) are considered stable in nature, with sulfate the dominant aqueous sulfur species found in most aerobic geochemical systems (Chappelle, 1993). The dissolved concentration of sulfate in mine drainage appears largely to be controlled by the solubility of gypsum ( $\sim 2.3$  g/L  $\text{CaSO}_4$  assuming no other interactions). This solubility generally equates to  $\sim 500$  mg/L Ca and 1800 mg/L sulfate (Figure 1).



The actual mechanisms involved in sulfide oxidation are complex and reviews have been published elsewhere (Nordstrom, 1982; Kleinmann and Pacelli, 1991). The most common source of sulfate release is oxidation of  $\text{FeS}_2$ . Pyrite and/or marcasite generate the acidity of the mine waters and

simultaneously supply large quantities of Fe and sulfate, for example, one tonne of ore with 1% pyritic sulfur can produce over 15 kg of ochre and 30 kg of sulfuric acid.

On weathering, sulfides can either release all sulfate or only a portion and form secondary salts, such as halotrichite. These minerals are highly soluble so can represent an instantaneous source of sulfate-rich water upon dissolution and hydrolysis. (Cravotta, 1994; Alpers et al., 2003).

Sulfate reduction has been identified to occur in sediments (Fillipek and Owen, 1980) natural wetlands and in mine waste (Kleinmann and Pacelli, 1991; Benner et al., 2002) and in natural gas reservoirs at low and high temperatures (Trudinger et al., 1985). Over time in these locations metal and sulfate concentrations have been observed to be lower and pH increases to pH 7-8. The activities of sulfur species may be directly or indirectly associated with the metabolism of microorganisms (Gould et al., 1994). Indirect activities include the dissolution of the minerals under acidic conditions that result from microbial metabolism, mineral precipitation in anaerobic environments, adsorption to microbes and the formation or disassociation of organometallic and arsine complexes. Direct metabolic activity requires minerals as either soluble trace element within the cell metabolic activity or to serve as specific oxidizing substrates, electron donors/acceptors in the oxidation reduction activities.

### **1.2 Regulatory Control, Sulfate Corrosion and Toxicity**

The accumulation of salts such as calcium sulfate in waters limits the number of cycles of reuse of water on a mine site and creates environmental problems if discharged (Sayre, 1988; DWAF, 1989). This is particularly a problem where mining is active in semi-arid to arid environments such as western USA, southern Africa, the Middle East, Central Asia, parts of Australia and southern Europe. Demand on available water in some places is such that much of the water is recycled. For example in South Africa the average TDS of discharge water in the Rand Water Board Area has risen from approximately 130 mg/L in 1935 to in excess of 1000 mg/L in 1980 (Heynike and McCulloch, 1982). Although not toxic in itself elevated sulfate (concentrations above 600 mg/L) in drinking water has been observed to result in a purgation of the alimentary canal (WHO, 1996). Where high magnesium or sodium corresponds with high sulfate a laxative and/or dehydration effect has also been reported (WHO, 1996).

Increasing concern has led to the introduction of recommended guideline values, rather than standards, for sulfate and TDS in groundwater and effluent discharge (Table 1). These typically are based on USEPA or WHO guidelines as to the maximum concentration of a particular chemical constituent in drinking water or water utilized by livestock or for irrigation and generally recommend no more than 500 mg/L sulfate (WHO, 1996; Sayre, 1988; DWAF, 1993; Flanagan, 1990; USEPA, 1999, 2002).



**Table 1: Recommended maximum Sulfate levels, in mg/l**

<b>Country</b>	<b>Sulfate</b>
USA effluent	500
Canada effluent	1500
EU guide limit	1000
DWAF effluent (South Africa)	600
Australia	1000
WHO guideline for drinking water	250

References: WHO, 1996; Sayre, 1988; DWAF, 1993; Flanagan, 1990; USEPA, 1999, 2002

## **2. Treatment options and selection**

Information on the treatment options presented was obtained from published and unpublished sources from Europe, South Africa, Australia, and the USA. The various approaches are discussed under two broad categories; Membrane removal and Sulfur precipitation. A tabulated summary of each of the processes is presented in the appendix and are based on previous compilations by Bowell (2000) and Lorax (2003).

## **3. Membrane removal of sulfate**

Membrane removal of sulfate utilizes three possible methods; reverse osmosis, electrical dialysis and filtration.

### **3.1 Reverse Osmosis**

This process relies on a semi-permeable membrane which separates a strong solution and a dilute solution. The greater the concentration differential across the membrane, the higher the tendency for water to permeate to the concentrated solution. This hydraulic force is the osmotic pressure of the system. In reverse osmosis an external hydraulic pressure is applied to the saline brine thus forcing water through the membrane against osmotic pressure.

In the case of brine concentration of ~ 30 g/L osmotic pressure is around 25 bars. Where water is low in calcium (<100 mg/L) and sulfate (<700 mg/L), conventional reverse osmosis can be used, although at higher concentrations scaling will occur. Modified processes have been proposed including seeded reverse osmosis (SRO) (Harries, 1985) and special reverse osmosis has been developed to treat mine waters (SPARRO) in South Africa (Chamber of Mines Organization, 1988).

Seeded Reverse Osmosis (SRO) actively promotes precipitation of

CaSO<sub>4</sub> prior to membrane treatment, reducing the corrosion of the membrane walls and fouling by salt precipitation. This pre-treatment method involves a suspension of seed crystals introduced into the effluent *via* recycling of waste slurry. This crystal slurry is approximately 10% solids and a tubular reverse osmosis (TRO) system is required because hollow fibre systems are unsuitable because of fouling. A number of disadvantages exist with SRO despite high salt and water recovery and reduced costs. Energy consumption is high; there is poor control of CaSO<sub>4</sub> seed and seed solution controls.

Redevelopment of the SRO process led to the patent of the Slurry Precipitation and Recycle Reverse Osmosis (SPARRO) process (Pulles et al., 1992). Extensive pilot plant test work has been undertaken and included the precipitation of metals by increasing effluent pH to 10 as a pre-treatment step. This is followed by cooling, filtration and readjustment of pH 5-6 for protection of the membrane process. A pilot plant for SRO has been operated in South Africa for 5000 hours and had a 96% water recovery reducing sulfate from approximately 6600 mg/L to 150 mg/L. A water recovery of over 95% has been demonstrated by pilot studies. A problem observed during pilot operation of the process was difficulty in maintaining a flux rate of 550 L/m<sup>2</sup>/d due to fouling of the membrane, most likely due to suspended SiO<sub>2</sub> particles.

Laboratory testwork for a lower pressure RO circuit have been published (Everett et al., 1994). At pressures of ~ 600 Kpa, at least 80% recovery of water was achieved. Several pre-treatment steps have been proposed in order to extend membrane life. This includes chlorination to remove bacteria, water softening to buffer pH and ion exchange to reduce salt loading.

### **3.2 Electrodialysis and Electrodialysis Reversal (EDR)**

This process uses direct electrical current across a stack of alternating cation and anion selective membranes. In the effluent, anions are attracted to the anode but cannot pass through anion-impermeable membranes and are thus concentrated. Cations move in the opposite direction and are impeded by cation-impermeable/anion-permeable barriers. The initial container has thus been depleted of salts and the cleaned water can be extracted. By the use of current reversal the process is greatly improved. The anode and cathode can be periodically changed as can the effluent and clean water channels. This reduces potential for membrane fouling and facilitates regeneration of the membrane by self-cleaning. A major advantage of EDR over other RO techniques is that the system is not sensitive to effluent temperature or pH. Capital costs are reduced as are working costs due to lower working pressures. However CaSO<sub>4</sub> scaling can occur due to inade-

quate pre-treatment. A pilot plant study at Beatrix gold mine in South Africa achieved a recovery of 80% salt and recycled 84% water. The water has high Fe, Mn, Na and Cl as well as sulfate (Juby and Pulles, 1990).

### **3.3 Filtration**

Filtration is probably one of the more effective means by which suspended particles can be separated from fluids (Buchanan, 1987). Mine waters are characterized by high suspended solid loadings which can be efficiently removed by settlement of coarse material and filtration of the majority of particles, most of which are less than 30  $\mu\text{m}$ . Any filtration process requires pre-treatment where coarse particles dominate suspended load high fluid flow is present and consequently rapid rates of thickening and filtration.

Common techniques of filtration involve the use of polyelectrolytes or metal salts to act as a precipitating agent or target for flocculation. Physical rather than chemical techniques are also available including screening, freezing or thawing, elutriation and irradiation. A number of filtration options are available from deep bed filters which can be used to clarify fluids to high purity, slow or continuous (or rapid) sand filters can be used to reduce turbidity and TDS.

Ultra-fine slurry particles can also be filtered using vacuum filtration and electrolysis (Bollinger, 1984). Electrofiltration is particularly suited to ultra-fine or colloidal particles (50%  $< 2 \mu\text{m}$ ). A well dispersed slurry is placed in an active electric field results in migration of particles towards the anode since they have a net negative charge. As most slurries are at high pH the net negative charge is due to surface pH exceeding  $\text{pH}_{\text{pzc}}$  imparting a negative charge on mineral surfaces (Ericksson, 1988). At the anode a densely packed precipitate or cake is formed with a low water content. Through electro-osmosis the cake can be further dewatered, increasing water recovery. The cathode essentially acts as a mechanical filter in which a vacuum is created on the filtrate side forming a thin precipitate or cake on the filter cloth. This acts as a trap for ultra-fine particles. Electro-osmotic pressure operates in conjunction with the vacuum enabling the production of a clear filtrate at higher rates than conventional vacuum filters (Bollinger, 1984).

### **4. Sulfur precipitation approaches**

The removal of sulfur from mine waters by precipitation may be approached in one of three ways:

1. Precipitation of gypsum or mirabilite,  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  through ion exchange removal, and saturation through converging of pure cation or anion streams.

2. Precipitation of an insoluble sulfate salt through chemical saturation and precipitation to produce gypsum,  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  (limestone/lime), barite,  $\text{BaSO}_4$  (addition of barium salts) or ettringite,  $\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12} \cdot 26\text{H}_2\text{O}$  (addition of alum, gypsum and lime).

3. Precipitation of sulfur or sulfide through biologically mediated reduction. This has the benefit of potentially also removing metal sulfides that can be economically recovered as ore material (such as with the Biotech process installed at the Bisbee mining operation, Arizona).

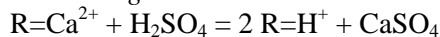
#### 4.1 Ion-Exchange

Ion exchange resins are materials which contain large polar exchange groups held together by a three dimensional network (Helffrich, 1962). The process is an exchange of ions or molecules between solid and liquid with no substantial change to the solid structure. One of the targeted ions is essentially removed from the liquid phase and attached to the solid structure in exchange for another ion (typically hydrogen or hydroxyl) thus rendering the target ion immobile.

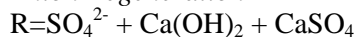
In the case of  $\text{CaSO}_4$  sulfate, being an anion, would typically be exchanged for hydroxyl on a positively charged resin (an *anionic resin*) while calcium, a cation, would be exchanged for hydrogen and so be attached to a negatively charged resin (a *cationic resin*). As with reverse osmosis, scaling of  $\text{CaSO}_4$  is common in conventional circuits. To overcome these problems a modified form of ion exchange has been developed to treat Ca-sulfate waters (GYPCIX).

The GYPCIX process (Gussmann and Nagy, 1993; Robertson et al., 1993) is a novel process based on ion exchange resins which uses low cost reagents such as lime and sulfuric acid for resin regeneration (Figure 2). The resins used have been designed so as to target calcium and sulfate so as to reduce gypsum levels in effluent thereby reducing TDS and corrosion potential. Additionally a pure gypsum product is the result of both cationic and anionic exchange and can be sold commercially thus offsetting treatment costs. The reactions occur by mechanisms such as:

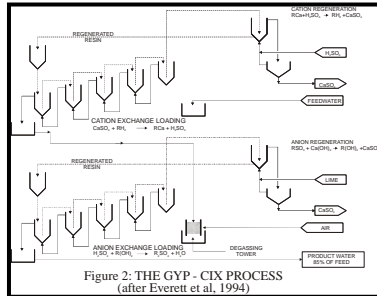
##### *Cation Regeneration*



##### *Anion Regeneration*



Pilot plant results in South Africa suggest that fouling caused by gypsum precipitation in conventional ion exchange circuits can be avoided using the GYPCIX process (Robertson et al., 1993). As the waste streams can be combined the gypsum in the slurry can be settled and the supernatant water recycled so improving water recovery.



In a pilot plant the effluent of Berkeley Pit, Butte, Montana was treated by the GYPCIX process and the results are given in Table 2. The GYPCIX process can be used to treat solutions with sulfate up to 2000 mg/L and calcium up to 1000 mg/L. Thereafter membrane filtration is required to remove salts.

A variant of the GYP CIX process was developed by Feng et al. (2000) to co-remove metals and sulfate. In this approach mine water was completely oxidized with hydrogen peroxide as a pre-treatment and this was followed by magnetite-seed precipitation to create Fe-Mn hydroxide precipitate. This was accomplished at pH > 5 to prevent formation of H<sub>2</sub>S gas. Sodium sulfide addition followed this to form metal sulfides, which were precipitated at pH > 8 through lime addition. The Fe-Mn hydroxide-oxide fraction can be magnetically separated from the base metal sulfide fraction.

**Table 2: Results of GYPCIX treatment on Berkeley Pit effluent (Robertson et al., 1993)**

	UNLIMED	LIMED	GYPCIX
TDS, mg/l	10000	3000	350
pH	2.7	8.5	8.0
Ca, mg/l	490	600	50
Mg, mg/l	420	350	20
Na, mg/l	70	70	50
Fe, mg/l	1100	0.1	<0.1
Mn, mg/l	182	3.6	<0.1
Cu, mg/l	186	<0.1	<0.1
Zn, mg/l	550	<0.1	<0.1
Sulfate, mg/l	8000	1980	200

## 4.2 Chemical Saturation and Sulfate Salt Precipitation

Sulfate barriers may be constructed by using an inorganic source which will produce a low solubility sulfate phase. Both lime and barium salts have been proposed. With all the precipitation mechanisms the addition of a chemically inert large particle material, such as carbon, to the reactor feed will facilitate better settling of the sulfate precipitate. This is because the ultra fine precipitates will attach to the larger particles and will thus settle quicker than isolated fine sulfate particles.

### 4.2.1 Formation of Gypsum

The removal of sulfate by addition of lime or limestone occurs through saturation of  $\text{CaSO}_4$ . The precipitation of insoluble gypsum ( $K_{sp} \sim 10^{-2.3}$ ) usually occurs as a by-product of lime addition in response to buffering of drainage pH rather than designed remediation of sulfate concentrations (Tahija et al., 1990). The impact of lime treatment on Berkeley pit effluent can be observed to have a pronounced influence on water quality but is nowhere as significant as Ba-salts (Table 3). Similar methods have been proposed for neutralizing acidic drainage with both limestone and dolomite (Maree and DuPleiss, 1994). Recent schemes proposed have demonstrated the ability of semi-passive limestone/lime process to reduce sulfate in mine waters to  $< 1000$  mg/L (Gelddenhuys et al., 2001).

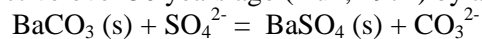
**Table 3: Treatment of Sulfate-rich effluents by Ba- and Ca-salt precipitation**

Shown as % removal

pH	Lime	BaCO <sub>3</sub>	BaS	Ba(OH) <sub>2</sub>
2.9	62.3	24.2	95.6	107.7
7.9	80.5	101.6	110.8	137
12	51	90.1	90.1	134

### 4.2.2 Formation of Barite

The removal of sulfate by barium carbonate was demonstrated to be effective over 30 years ago (Kun, 1972) by a process such as:



Kun (1972) recognized three main problems with the method on an industrial scale, the requirements for more soluble Ba in solution than is required stoichiometrically, long retention times and high cost of Ba. The cost problem can be overcome by recycling Ba through roasting of barite

to form BaS and then purging with CO<sub>2</sub> to reform BaCO<sub>3</sub> (Wilsenach, 1986). Further consideration of BaCO<sub>3</sub> to remove sulfate has come from two research programs in South Africa in the late eighties (Trusler et al., 1988; Maree, 1989; Maree et al., 1989; Adlem, 1997). The processes proposed by these workers are summarized in Figure 3.

Barium carbonate and lime would be added to the effluent to soften the water and produce a precipitate. From experimental work it was found that CaCO<sub>3</sub> was necessary to act as a seed to encourage BaSO<sub>4</sub> formation from BaCO<sub>3</sub> due to the insolubility of the latter ( $K_{sp} \sim 10^{-8}$ ). Calcium salts were found to achieve a better removal than Na or Mg salts as the products (CaCO<sub>3</sub>/CaSO<sub>4</sub>) were much less soluble. The slurry from the reactor is then sent to a thickener where clean water can be decanted and recycled in the mine or process operation. The thickened slurry is then filtered, dried and treated to recycle barium and collect sulfur. In a modification of this process a two-stage fluidized bed reactor system has been proposed although this process has difficulty with high metal concentrations and separation of fine CaCO<sub>3</sub> and BaSO<sub>4</sub> (Maree et al., 1989).

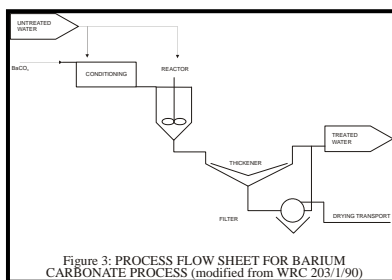


Figure 3: PROCESS FLOW SHEET FOR BARIUM CARBONATE PROCESS (modified from WRC 203/1/90)

As an alternative to BaCO<sub>3</sub>, BaS has been proposed (Maree et al., 1989; Bosman et al., 1991) as a greater quantity of sulfate is recovered but not as much gypsum is produced; acid waters can be treated directly, eliminating the need for a pre-neutralization step; and sludge disposal (essentially gypsum) is greatly reduced.

The presence of metals in solution and production of metal sulfides can significantly reduce the recovery of Ba from the process. This can be avoided by sulfuric acid leaching which will oxidize sulfides, possibly catalyzed by bacteria. Economically valuable metals can then be recovered (Maree et al., 1989; Bosman et al., 1991). Alternatively the gas H<sub>2</sub>S can be formed and vented through a wet scrubbing circuit to recover sulfur. A possible flow sheet for this process is given in Figure 4.

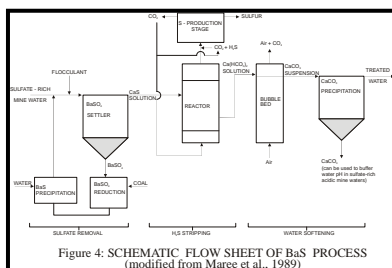


Figure 4: SCHEMATIC FLOW SHEET OF BaS PROCESS (modified from Maree et al., 1989)

The use of Ba(OH)<sub>2</sub> has also been proposed to treat more neutral waters where metals have been largely precipitated already as metal hydroxide salts (Adlem et al., 1991). The process eliminates the necessity for complex water treatment associated with the

BaCO<sub>3</sub> and BaS processes, does not require long retention times for reactions (such as in the BaCO<sub>3</sub> process), and does not require stripping of H<sub>2</sub>S as in the BaS process.

As a consequence of all of these reactions direct buffering of protons can occur or, alternatively alkalinity is generated for neutralizing free protons. Because of the cost of barium and its environmental toxicity it is advantageous to have a barium recovery plant to recycle barium salts.

All three processes can remove sulfate from solution from very high levels to within regulatory standards. In the case of BaS and Ba(OH)<sub>2</sub> acidic solutions can be treated directly, although in practice some lime treatment is required for very acidic solutions to prevent metal hydroxide precipitation on the surface of the barium salt. The process additionally removes transition metals, Mg, NH<sub>3</sub> and, to a limited extent, Na. Thus the overall TDS is lowered as well as the concentration of deleterious elements. The Ba(OH)<sub>2</sub> causes significant CaSO<sub>4</sub> precipitation improving sulfate removal by up to 30%, but increasing the volume of sludge requiring disposal. A major benefit of the process is that valuable by-products are created, the sale of which can be used to offset treatment costs. In the BaCO<sub>3</sub> and BaS processes sulfur, metals and Ba-salts can be commercially produced while NaHS is produced in the Ba(OH)<sub>2</sub> process. Overall the BaS process is perhaps the most attractive for treating mine waters.

#### 4.2.3 Precipitation of Ettringite

Sulfate removal through the precipitation of Ettringite has been proposed by Smit (1999) as the SAVMIN process. The three stages of the process successively remove metals as hydroxides through lime addition (to pH 12) as a pre-treatment step (Figure 5).

This is followed by removal of gypsum through seed crystallization and in the third step aluminum hydroxide addition to form insoluble ettringite. Finally, prior to discharge, CO<sub>2</sub> is added to reduce pH and precipitate pure CaCO<sub>3</sub>. The ettringite can either then be disposed of or dissolved in sulfuric acid to recycle Al(OH)<sub>3</sub>. The resulting effluent can then be seeded with gypsum to produce more gypsum precipitate. Trials at the Stillfontein plant in South Africa successfully treated 500 m<sup>3</sup> of water with a sulfate concentration of 800 mg/L to < 200 mg/L. A variant on the SAVMIN process is the *Cost Effective Sulfate Removal* (CESR) process. In addition to sulfate, metals can also be removed by this process more effectively. Other contaminants, such as nitrate, are removed during the ettringite precipitation step.

#### 4.3 Biological Sulfate Reduction

Under anoxic conditions sulfate may be removed from mine waters as



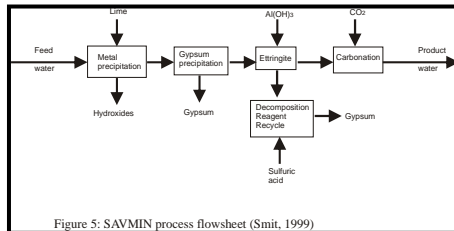


Figure 5: SAVMIN process flowsheet (Smit, 1999)

stable sulfide precipitates. Under these conditions sulfide minerals remain stable and have low solubility (Arnesen et al., 1991). Flooded underground mine workings and open pits can be anoxic, and as such provide a

suitable environment for the implementation of a sulfate reduction system. Alternatively a dedicated reactor can be used or anaerobic conditions created in a passive system, such as a constructed wetland. The presence of sulfides ( $H_2S$  odor) in many mine water discharges indicates that sulfate reduction is already occurring in mine workings (Huang and Tahija, 1990). The reduction of sulfate to hydrogen sulfide is brought about by specialised strictly anaerobic bacteria and is accomplished primarily by two genera: *Desulfovibrio* (five species) and *Desulfotomaculum* (three species). These organisms have a respiratory metabolism in which sulfates, sulfites and/or other reducible sulfur compounds serve as the final electron acceptors, with the resulting production of hydrogen sulfide (Chappelle, 1993). The organic substrates for these bacteria are generally short chain acids such as lactic and pyruvic acid. In nature these substrates are provided through fermentative activities of other anaerobic bacteria on more complex organic substrates (Gould et al., 1994).

Due to the natural occurrence of the sulfate reducing bacteria, sulfate reduction can be utilized *in situ* for the treatment of acid rock drainage provided the correct conditions can be maintained to sustain bacterial activity. Anaerobic conditions may be enhanced by sealing shafts, adits and air vents. For conditions to be sufficiently anaerobic however, it is likely that a significant depth of water will be required. A wide variety of organic substrates have been investigated for this purpose including molasses, sewage sludge, straw, newspaper, sawdust and manure. Other possibilities are wastes from the chemicals industry such as short chain organic acids. Sulfide precipitation, like hydroxide precipitation, is not just dependent on availability of constituent ions but also on environmental parameters. At low pH copper and iron sulfides can be readily precipitated over a wide pH range but zinc, which forms sulfides in a similar way, has a much slower rate of formation than copper or iron sulfides. Neutral or mildly alkaline conditions tend to be the most favorable for sulfide formation.

#### 4.3.1 In-situ reactor

Because sulfate reducing bacteria occur naturally there is a possibility of treating high sulfate waters using an *in situ* process. So far fixed bed reactors and in-pit reactors have been utilized (Arnesen et al., 1991; Huang and

Tahija, 1990; Robins et al., 1997) but stirred reactors with a suspended solid medium have also been proposed, with the aim of achieving higher reduction rates through improved operating conditions and reactor utilization.

Based on limnological-microbiological-geochemical studies a series of three zones have been described for the Summer Camp Pit lake in Nevada (Bowell, 2002). The upper oxic zone is characterized by high levels of total epifluorescent algae and heterotrophic aerobic bacteria and has high dissolved oxygen content and consequently total sulfur is dominated by sulfate. This zone extends to a depth of 6 m, after which a transitional zone develops, which is characterized by an increase in the presence of heterotrophic anaerobic bacteria and decreasing levels of total epifluorescent algae and heterotrophic aerobic bacteria. Within this zone sulfates (and thiosulfate) are being gradually reduced to sulfide. This zone grades into a zone with little or no available dissolved oxygen and is dominated by heterotrophic anaerobic bacteria. In this zone sulfate is being actively reduced to sulfide and the potential exists for the precipitation of metal sulfides. The addition of raw potato and steer manure amended systems increased sulfate reduction (Gannon et al., 1996). It was found that raw potato-stimulated sulfate reduction was effective at low levels whereas steer manure stimulated sulfate reduction by bacteria at mid-high levels. Using 2500 mg C/l raw potato, 80% sulfate reduction was achieved and additionally soluble arsenic, after an initial increase, decreased to less than 1% of initial values in some cells, presumably due to formation of arsenic sulfide.

#### 4.3.2 Constructed Bioreactors

Anaerobic bioreactors use bacterial reduction of sulfate and iron to accomplish precipitation of metal sulfides (Figure 6).

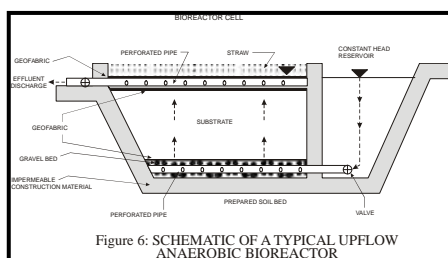


Figure 6: SCHEMATIC OF A TYPICAL UPFLOW ANAEROBIC BIOREACTOR

These reactions can only occur in an anaerobic reactor as the bacteria cannot tolerate oxygen. Effluent treatment therefore requires a uniform rate and flow through the substrate to be effective. In an experimental reactor the removal of sulfate was

found to be dependent on energy source, flow and time (Dill et al., 1994). The biological reduction of sulfate from industrial effluents has been shown to be an effective method with producer gas being a reliable energy source (Maree et al., 1991; Du Preez et al., 1992). From studies by Dill et al. (1994) a pilot plant produced a sulfate reduction rate of 1.7-2.2 g/l/d

over 70 hours reducing effluent drainage sulfate from over 3000 mg/l to less than 250 mg/l.

#### **4.3.3 Constructed wetlands**

In recent years constructed wetlands have become increasingly popular in dealing with closed mines where little or no records are preserved and it is not possible, in general, to prevent or contain the effluent (Machemer et al., 1993; Younger et al., 2002). In the Pelenna valley a pilot scheme was assessed for the effectiveness of wetlands in removing sulfate (Rees and Bowell, 1999). The design discharge flow rate is 3 l/s at an average pH 5.6 with an average total iron content of 21.7 mg/l and sulfate content of 459 mg/l. Over the ten year period of monitoring on the pilot scheme sulfate has been observed to decrease. Sulfur isotope analysis of pore waters from the scheme indicated that whilst sulfate reduction was occurring in the beds, subsequent metal sulfide oxidation offset the treatment with the net effect that in the long term sulfate attenuation would not occur (Rees and Bowell, 1999).

#### **4.3.4 Permeable Reactive Barriers**

Permeable Reactive Barriers are a reactive zone in an aquifer created for removal of contaminants by reaction with an introduced material. Although no specific PRB has been developed for sulfate treatment, the reduction in high levels of sulfate in groundwater at an Ontario mine site has been reported (Benner et al., 1999). In this system a mixture of gravel and compost was used to create a biological sulfate reduction zone that precipitated iron sulfide at a rate of sulfate removal of 14 mg/L/day over a 3-year period. A major limitation on the application of such a system is the requirement for stoichiometrically equivalent amounts of reduced metals to sulfide ions in order to limit sulfur dispersion.

### **5. Evaluation of treatment options for sulfate removal**

The criteria by which one of these options is chosen typically depend on the ability of the process to adequately remove sufficient sulfate in a given time such that discharge of the treated water meets all regulatory requirements. A further (as important) criterion is that of economics. In any mining operation, the costs have to be balanced with the income. In a feasibility study, all the costs are assessed including the costs of environmental protection. The approach with the design of any aspect of the mine is generally BATNEEC (Best Available Technology Not Entailing Excessive Cost). The detail will be a function of the planning authority requirements and the philosophy of the mining company.

The approach taken for water treatment generally involves assessment

of treatment alternatives and risk assessment for release of contaminants. However, a mine is developed on the basis of a return on investment. There is a limit as to the environmental costs beyond which the mine will not go ahead. Although risk assessments are done, the methods of assessment and monitoring cannot be considered as exhaustive and engineering decisions are made at some stage of investigation, which are commensurate with the level of investment in the mining project itself.

Whilst a direct evaluation of the differing merits of the different sulfate removal options outlined in this review is difficult to compare, due to the importance of site-specific requirements, some general comments can be made. Membrane and ion-exchange type processes tend to have high capital and operating costs associated with them (Appendix). Many of the processes also are susceptible to fouling of the membrane or column and virtually all require some form of pre-treatment. In terms of mine water treatment GYPCIX and SPARRO appear to be the most suitable for treatment of high sulfate waters. However, in an economic evaluation of requirements for the treatment of water at the Grootvlei mine in South Africa (Schoeman and Steyn, 2001) operating costs and associated savings were such that EDR and GYPCIX processes were more favourable than RO methods (Table 4).

**Table 4: Calculated costs for the treatment of Grootvlei mine water (from data published by Schoeman & Steyn, 2001)**

	Reverse Osmosis	EDR	GYPCIX
Unit cost, US\$/m <sup>3</sup>	0.88	0.48	0.60
Annual operating costs, \$ M	21.9	9	9.6
Brine disposal, US\$0.19/m <sup>3</sup>	0.82	1.9	2.5
Annual saving (drinking water)	5.5	4.2	3.5
Total annual operating costs, US\$M <sup>1</sup>	17.2	6.7	8.6

<sup>1</sup>Calculated costs for a 80,000 m<sup>3</sup>/day plant

Chemical precipitation processes, although not widely demonstrated, show some potential for application. However they all require high quantities of relatively pure chemicals for successful operation and produce high volumes of waste. Of the processes reviewed the limestone/lime and SAVMIN processes are the most applicable to mine waters. Where cheap

sources of Ba-salts can be procured the Ba-precipitation processes could also be highly effective in reducing sulfate in mine effluents.

In recent years the majority of research related to sulfate removal has focused on biological sulfate reduction and currently these are the most widely applied methods (after addition of lime/limestone) for sulfate removal. The advantage of processes such as the Biotech method in producing a commercially value by-product (metal sulfide concentrate), the low volume of resulting solid waste, and the relative inexpensive approach, make bioreactors the most favourable approach currently in sulfate removal from mine waters.

Where sulfate levels are very low there is no requirement for sulfate treatment. Below sulfate levels of approximately 500-1500 mg/l, passive measures can be utilized, while at higher levels (1500-10000 mg/l) a wide range of options are available including Reverse Osmosis, SAVMIN, GYPCIX, filtration, desalination, bioreactors and salt precipitation. At very high levels of sulfate (> 10000 mg/l) co-precipitation is probably most suitable, options for which include SAVMIN, CESR and possibly bioreactors.

## **6. Conclusions**

Sulfate removal from mine waters is still considered to be of secondary importance compared to removal of metals and acidity. As such it is comparatively less understood and few case studies exist for evaluation.

Future trends in regulatory practice may promote more research and application of sulfate removal technologies as desalination of mine water effluent becomes more important.

Various options exist for sulfate removal. Chemical precipitation is generally the least costly, but produces high volumes of waste by-products. The SAVMIN process, although expensive in terms of proposed operating and capital costs, offers the most efficient treatment of high sulfate waters by precipitation methods.

Membrane and ion exchange processes, with the exception of SPARRO and GYPCIX, are not suitable for mine water treatment unless extensive pre-treatment is applied.

Biological Sulfate Reduction offers perhaps the most versatile and widely applicable approach to sulfate removal from mine waters and has the benefit of being able to couple sulfate and metal removal.

### **Acknowledgements**

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<b>Table A.1</b>					
<b>Summary of case studies on treatment processes using membranes and ion-exchange (after Bowell, 2000; Lorax, 2003)</b>					
	<b>RO</b>	<b>SPARRO</b>	<b>EDR</b>	<b>GYP-CIX</b>	<b>Filtration</b>
<b>Pretreatment</b>	yes	yes	yes	no	Yes
<b>Feed water sulfate limits</b>	SO <sub>4</sub> : any	SO <sub>4</sub> : any	SO <sub>4</sub> : any	SO <sub>4</sub> : any	SO <sub>4</sub> : any
<b>Sulfate removal</b>	SO <sub>4</sub> :>99%	SO <sub>4</sub> :>99%	SO <sub>4</sub> :>95%	SO <sub>4</sub> :>95%	SO <sub>4</sub> :>95%
<b>Brine production</b>	yes	yes	yes	yes	yes
<b>Sludge production</b>	low	low	low	low-moderate	moderate-high
<b>Monitoring</b>	low-moderate	low-moderate	low-moderate	low	moderate-high
<b>Maintenance</b>	high	high	high	moderate	high
<b>Capital cost</b>	£0.46 M <sup>1</sup> per 10 <sup>3</sup> m <sup>3</sup> / day	£0.48 M <sup>1</sup> per 10 <sup>3</sup> m <sup>3</sup> / day	£0.39 M <sup>1</sup> per 10 <sup>3</sup> m <sup>3</sup> / day	£0.22 M <sup>1</sup> per 10 <sup>3</sup> m <sup>3</sup> / day	£ 0.28 M <sup>1</sup> per 10 <sup>3</sup> m <sup>3</sup> / day
<b>Operating costs</b>	£ 0.49 / m <sup>3</sup>	£ 0.17 / m <sup>3</sup>	£ 0.27 / m <sup>3</sup>	£ 0.33 / m <sup>3</sup>	£ 0.15 / m <sup>3</sup>
<b>Advantages</b>	- drinking water quality	- drinking water quality - improved membrane life	- drinking water quality	- drinking water quality	- drinking water quality
<b>Disadvantages</b>	- scaling problems - short membrane life	- short membrane life	- scaling problems - short membrane life	- sludge production	- scaling problems - short membrane life
<b>Improvements</b>	- not suitable for scaling waters	- membrane life	- not suitable for scaling waters	- sludge recycling - metal recovery	

<sup>1</sup> Conversion used: South African R 15 = £1 = USD1.78)

<b>Table A.2</b>				
<b>Summary of case studies on treatment processes with mineral precipitation</b>				
	<b>Limestone / Lime</b>	<b>BaS</b>	<b>SAVMIN</b>	<b>CESR</b>
<b>Pretreatment</b>	no	no	no	no
<b>Feed water sulfate limits</b>	SO <sub>4</sub> : any	SO <sub>4</sub> : any	SO <sub>4</sub> : any	SO <sub>4</sub> : any / L
<b>Sulfate removal</b>	50 %	>98%	>90%	>95%
<b>Brine production</b>	no	no	no	no
<b>Sludge production</b>	low-moderate	low-moderate	moderate-high	high-very high
<b>Monitoring</b>	moderate-high	high	high	high
<b>Maintenance</b>	low	low	low	low
<b>Capital cost<sup>2</sup></b>	£ 0.13 M per 10 <sup>3</sup> m <sup>3</sup> / day	£ 0.25 M per 10 <sup>3</sup> m <sup>3</sup> / day (ΔSO <sub>4</sub> : 2,000mg / L)	£ 0.18 M per 10 <sup>3</sup> m <sup>3</sup> / day	£0.22 M per 10 <sup>3</sup> m <sup>3</sup> / day
<b>Operating costs<sup>1</sup></b>	£ 0.34 / m <sup>3</sup>	£ 0.22 / m <sup>3</sup> (SO <sub>4</sub> : 2,000mg / L)	£ 0.12 / m <sup>3</sup>	£ 0.44 / m <sup>3</sup> (SO <sub>4</sub> : 1,500mg / L)
<b>Advantages</b>	- also trace metal removal - very cheap	- low levels of sulphate - recycling of expensive BaS	- low levels of sulphate - recycling of ettringite - also trace metal removal	- low levels of sulphate - also trace metal removal
<b>Disadvantages</b>	- limited sulphate removal - production of sludges	- little trace metal removal - production of sludges	- production of sludges	- production of sludges
<b>Improvements</b>	- recycling of sludges	- recycling of sludges	- recycling of sludges	- recycling of sludges

<b>Table A.3</b>				
<b>Summary of case studies on treatment processes using biological sulphate removal</b>				
	<b>Bioreactor</b>	<b>Constructed Wetland</b>	<b>Alk. Producing systems</b>	<b>Permeable barrier</b>
<b>Pre-treatment</b>	yes	yes	yes	no
<b>Feed water sulfate limits</b>	SO <sub>4</sub> : any	SO <sub>4</sub> : <2000mg / L	SO <sub>4</sub> : <2000mg / L	SO <sub>4</sub> : <2000mg / L
<b>Sulfate removal</b>	>90 %	>50%	>50%	>80%
<b>Sludge production</b>	low-moderate	moderate-high	moderate-high	moderate
<b>Monitoring</b>	moderate-high	low	low	low
<b>Maintenance</b>	moderate	low	low	low
<b>SO<sub>4</sub> reduction rate</b>	5-30g / L, day	0.03-0.2mg / L, day	0-0.05mg / L,day (low)	<1-20mg / L,day
<b>Capital cost</b>	£ 0.18 M per 10 <sup>3</sup> m <sup>3</sup> / day (ΔSO <sub>4</sub> : 2,500mg / L)	£0.06 M per 10 <sup>3</sup> m <sup>3</sup> / day	£0.08 M per 10 <sup>3</sup> m <sup>3</sup> / day	£45,000
<b>Operating costs</b>	£0.17 / m <sup>3</sup> (ΔSO <sub>4</sub> : 2,500mg / L)	£0.05 / m <sup>3</sup>	£0.06 / m <sup>3</sup>	£16,850 / yr
<b>Advantages</b>	- also trace metal recovery - recycling of H <sub>2</sub> S and CO <sub>2</sub> - low maintenance	- also trace metal removal - passive treatment	- gypsum precipitation - also (trace) metal removal	- passive treatment - also trace metal removal
<b>Disadvantages</b>	- cost of C + energy source - production of sludge	- little sulphate reduction - sludge disposal - limited time life	- sludge disposal - limited time life	- long-term performance unknown - prone to scaling
<b>Improvements</b>	- recycling of sludge - cheap C + energy source	- specific design required	- specific design required	- alternative reactive media

**CERTIFICATE OF SERVICE**

I, Jessica Dexter, hereby certify that I have filed the attached **NOTICE OF FILING, APPEARANCE OF JESSICA DEXTER** and **PETITION FOR ADMINISTRATIVE REVIEW OF AN NPDES PERMIT ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** upon the parties below by depositing said documents in the United States Mail, postage prepaid, in Chicago, Illinois on November 2, 2012.

Respectfully submitted,



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