DEQ Nutrient Work Group
6th Meeting Summary
December 1, 2009

Introductions
A list of the members and others in attendance is attached below as Appendix 1.

Agenda
- Review of the September 17, 2009 Meeting Summary
- Public Comment
- Industry Presentation on the Technical Challenges/Costs of Nutrient Treatment Options
- Nutrient Permit Guidance
- MPDES Permitting
- Nutrient Permit Alternative Analysis
- Nutrient Criteria Affordability Advisory Group Recommendations
- NWG Work Plan
- Public Comment
- Next Meeting Schedule

Review of the September 17, 2009 Meeting Summary
NWG members present at this meeting had no comments on the September 17, 2009 meeting summary.

Public Comment
There was no public comment on matters not on the agenda but within NWG's purview.

Industry Presentation on the Technical Challenges/Costs of Nutrient Treatment Options
Three presenters discussed the technical challenges and costs of nutrient treatment options from the mining, paper mill, and petroleum refinery perspective. The presenters were: Bruce Gilbert for Stillwater Mining Company, Craig Caprara for Smurfitt-Stone Container Corporation, and Dr. Matt Gerhardt for the Montana Petroleum Association. Each presentation will be discussed below. Doug Parker offered a summary from the industry perspective following the three presentations.

Stillwater Mining Company
Bruce Gilbert, Director of Environment and Government Affairs for Stillwater Mining, used a PowerPoint presentation entitled "Stillwater Mining Company" to discuss his company's nutrient control activities. Specific topics covered included: background regarding the company's East Boulder and Stillwater mines, the water treatment chronology and progression at both mines, information about the biological treatment at both mines, the nitrogen treatment technologies used, a summary of water treatment capital and operating costs, and nutrient issue concerns. Appendix 2 contains the presentation text and tables. The presentation is available on the NWG web page at: http://www.deq.mt.gov/wqinfo/NutrientWorkGroup/agendasMinutes/2009/Dec09/TreatmentPresentationV3.pdf

Because of the location of the East Boulder and Stillwater mines adjacent to wilderness areas, the company has relied on cutting edge technology to control nitrogen discharges. Neither mine discharges to surface water. The source of nitrogen in the mines (point source) and in waste rock (non-point source) is consumed explosives. Because of the geology, water in fractures flows through the mine and the amount varies with precipitation. In each of the last two years, mine flows have increased by 30%.

Question - What is the range of temperature of ground water?
Answer - The temperature remains fairly constant at 55° F.

Question - What is the source of heat for warming the water to support biological treatment?
Answer - Propane and natural gas.

Question - Is waste rock a point or non-point nitrogen source?
Answer - Non-point.

Question - Does DEQ accept this designation?
Answer - Yes.

Question - What is the rate of flow through the anox ammonia nitrification system?
Answer - The flow is 250 gallons per minute (gpm). Because of the variation in flow through the mine, we cannot depend on biological nitrogen removal, so we also have the anox and reverse osmosis (RO) systems as a backup.

Question - Are the process tanks enclosed?
Answer - Yes.

Question - What is the concentration of organic nitrogen in your treatment system outflows?
Answer - Organic nitrogen is 2 parts per million (ppm); total nitrogen is about double this value, 4 ppm.

Question - What is the speciation of the organic nitrogen?
Answer - We don't know; however, we do not have direct discharges from the mines to surface water.

Question - What is the percentage of evaporation in your land application system?
Answer - From mid-April through the first part of October when the land application occurs, the evaporation averages about 50%. During July, August, and September, evaporation exceeds 50%. We do not run the land application during rain or when snow is on the ground.

Question - How do you manage grass production?
Answer - In the short-term, we use intensive grazing.

Question - What species do you use for hay?
Answer - We use a regular pasture mix.

Smurfit-Stone Container Corporation
Craig Caprara, a Professional Engineer with HDR Engineering, Inc, and Terry McLaughlin discussed nutrient control at the Smurfit-Stone paper mill in Missoula using a PowerPoint presentation entitled "Smurfit-Stone Container Treatment Process Review and Alternatives Evaluation." The content of this presentation is included below in Appendix 3. The topics discussed included: project goals, voluntary nutrient reduction program (VNRP) overview, existing treatment process summary, typical treatment performance, limits of technology and in-stream nutrient criteria, potential wastewater management options, advanced treatment with micro filtration reverse osmosis, mechanical side stream treatment, poplar habitat development, constructed wetlands, phosphorus precipitation, alfalfa irrigation, and capital cost comparison of alternatives.

Question - Will the poplar trees for the pilot project be located on the mill property?
Answer - Yes. We would grow and chip the trees and use the chipped fiber in our process. Growing the poplar trees, will, however, require only a small percentage of the mill water discharge.

Comment - The Missoula water treatment plant has a poplar tree demonstration project.

Question - How much discharge could be addressed through constructed wetlands?
Answer - We have not determined flow rates as we are considering constructed wetlands at the conceptual level for a pilot. The economic downturn and the company's financial difficulties halted all pilot activities. The company hopes to emerge from Chapter 11 bankruptcy in the first half of 2010. The Missoula plant is the only integrated pulp and paper mill in EPA region 8. It is the highest cost operation of the company's twelve mills.

Comment - The nutrient discharge levels at the mill do not result from treatment.
Response - Process wastewater from the mill is nutrient deficient. We add supplemental nutrients to maintain the biology of the treatment system. Nitrogen and phosphorus levels in the treated effluent are 75-80 % lower than they were 20 years ago. Almost all of this reduction has occurred through internal process modifications or downsizing of operation in conjunction with reductions in the amount of supplemental nutrients added.

Question - If you applied treatment, could the mill meet the nutrient criteria?
Answer – It is unclear if the mill could attain end-of-pipe concentrations that would be at in-stream standards levels. We know that given the volume of our wastewater, we cannot afford advanced mechanical or biological treatment. Mechanical treatment would cost on the order of $53 million, and the mill would close if we faced this level of treatment costs. We have been proactive since the 1980s. Significant storage is the most useful tool in our tool bag. We do not discharge during the summer months. The concentration of nitrogen and phosphorus in the seepage component from our storage ponds has been dropping over the last 20 years. Consequently, discharge loading of nitrogen and phosphorus has correspondingly been reduced over the last twenty years

Comment - Both the Stillwater and Smurfit-Stone facilities have been out front in controlling nutrient discharges. Both use large amounts of land that many existing and future industrial plants will not have.

Montana Petroleum Association

Dr. Matt Gerhardt used a PowerPoint presentation entitled, "Nitrogen and Phosphorus Removal in Refinery Wastewater Treatment Plants" to provide the Montana Petroleum Association perspective. The content of his presentation is included below in Appendix 4. The topics covered included: Dr. Gerhardt's background, nitrogen components in refinery effluents, nitrogen component concentrations in Billings-area refineries, nitrogen component concentrations in refineries with nitrifying waste water treatment plant systems, best available demonstrated nitrogen treatment technology, nitrogen component concentrations in refinery with best available demonstrated technology, best available demonstrated phosphorus treatment technology, and a summary. He noted that different refineries present different challenges for nitrogen and phosphorus control due to size and throughput differences.

Question - Is land application used by refineries?
Answer - It can be used and has been used in a few instances. A Chevron refinery in California uses a wetland. A refinery at Mandan, North Dakota also uses a form of land application.

Question - What technologies that you have looked at are feasible and commercially available?
Answer - A system including activated sludge and anoxic denitrification followed by aerobic treatment and filtration should get discharge levels as low as possible.

Question - What volume of water is treated at the Billings refineries?
Answer - A 60 thousand barrel per day refinery, which is the size of the Billings refineries, would use about 1million gallons per day of water.

Question - What is the water temperature?
Answer - Water in a refinery waste stream would be warm enough to nitrify.

Question - Would you have to add buffering?
Answer - Yes, for pH control.

Question - Do the refineries have readily available carbon sources?
Answer - Methanol is brought in for a carbon source.

Summary

The three examples that we examined today resulted in similar numbers for nutrient control discharges. Control technology costs were high. The industries discussed have been conducting research and demonstration for a long time and are using cutting edge technologies. Biological treatment systems are cheaper and use less energy than reverse osmosis and ion exchange systems, but they require large amounts of land. Biological treatment systems are also more fragile. We may over the next 20 years be able to lower nutrient discharges, but no significant technology improvements are likely over the next 5 years. Industries different than the three we looked at today will face different challenges and use different means of nutrient removal.

Comment - While BNSF has many miles of track, it has little land for nutrient treatment. We have difficulty just controlling storm water runnoff.

Nutrient Permit Guidance

Dave Clark presented a summary of October 23, 2009 meeting of the nutrient permit guidance subcommittee with DEQ using a PowerPoint presentation entitled, "DEQ Nutrient Discharge Permitting." A copy of the presentation in a pdf format is available at the NWG web page. Mr. Clark addressed the summary of the meeting; nutrient permit discussion issues, including details for Montana Pollutant Discharge Elimination System (MPDES) permitting; and temporary water quality standards, including the variance process.

Comment by Mike Suplee - Regarding reservoirs, Montana statutes provide that the conditions resulting from the reasonable operation of dams must be considered natural.

Question - You said that all current dischargers will require a temporary variance from the nutrient standards at levels that we have discussed. Did you mean all?
Answer - I should have said most, if not all.

Comment - Sewage treatment plant operators may not need a variance if the inputs to their plants are drastically reduced by using technologies such as composting toilets.

Question - Does your comment about the likelihood of variances reflect application of the alternatives analysis?
Answer - We need to understand the alternative process better to answer.

Comment - Although EPA has apparently not decided finally, it has said that it will not accept a 1% median household income (MHI) threshold for the affordability variance to nutrient standards. It may consider a threshold in the 1-2% range. This implies the need for additional analysis.
Response by Gerald Mueller - I thought Tina Laidlaw has told us that Tim Connor of EPA Headquarters favors a 2% cost cap. However, Mr. Connor acknowledged that given the conditions in Montana, which includes significant non-point nutrient sources, a 1% cap may be appropriate. However EPA does not want to limit the cap to 1% in the cases when point sources are the predominate source of the nutrient discharges. We will ask EPA to clarify its position on the MHI cost cap.

Question - What does 30Q10 flow mean?
Answer - It means the lowest flow for a 30-day period that would occur on average once in 10 years.

Comment by Jenny Chambers - In the October 23 subcommittee meeting, one of the assumptions was that permitting would be based on existing conditions that do not include a nutrient standard. Once the nutrient standard is adopted, other actions may be possible.

Question - Under the affordability variance, would costs determine the technology that a community can purchase for sewage treatment?

Answer by Mike Suplee - If a community does not qualify for an affordability variance, but still cannot meet the nutrient standards, then the limits-of-technology variance would be applicable.

Question - Will there be end-of-pipe criteria for industry?
Answer by Mike Suplee - Yes, but how to define them and their cost of compliance is a new area. We may need a case-by-case approach which will be a challenge.

Question - The standards will be facility and not drainage specific?
Answer - Yes. Ideally, standards would be set individually for each stream. The ideal is not practical, so we have used a level IV ecoregion approach to setting the standards on a regional basis. For industrial facilities we will be examining what can be treated at what cost.

Comment - If DEQ uses averages conditions, concentrations rather than mass balances, a longer term averaging period, and a broader watershed framework, then maybe all dischargers will not need a variance.

Question - How will the total maximum daily load (TMDL) process address industrial facilities and nutrients?
Answer - We will have to bring in the DEQ TMDL group to answer this question.

Question - One of your slides was entitled, "Effluent Performance Variability at Low Nutrient Levels in an Exemplary Facility." What causes the spikes in the performance?
Answer - The chart shows the best that you can do with exemplary treatment plant performance and illustrates the complexity of statistical calculations.

Comment - Another option for meeting standards is zero discharge.

MPDES Permitting

Jenny Chambers discussed Montana Pollutant Discharge Elimination System (MPDES) permitting using a PowerPoint presentation, the content of which is included below in Appendix 5.

Question - At the September 17 meeting, I asked if storm water permits will be subject to the same permitting process. According to the meeting summary, you answered, "We expect that MS4, MDT, and CAFO permits to include nutrient considerations. We do not expect that industrial storm water discharges will be significant sources of nutrients." I had to look up these acronyms. My understanding is that MS4 refers to permits for small municipal storm water systems, MDT refers to the Montana Department of Highways, and CAFO refers to confined animal feeding operations. Am I correct?
Answer - Yes.

Question - If nitrogen and phosphorus standards are adopted at the levels we have discussed, will storm water systems have to include treatment, and will variances be available for them?
Answer - Storm water systems will be subject to best management practices. We do not have specific monitoring requirements in these permits, with the possible exception of sediment monitoring for construction disturbances of areas larger than 10 acres.

Question - How do we translate technology based effluent standards into instream nutrient standards? Do we use back calculations?
Answer - In general, if a discharger meets best management practices, they will comply with technology based standards. If a discharger is contributing nutrients, then they will be subject to the instream nutrient standard. If discharges would occur to a stream impaired for nutrients, then no additional nutrient discharge will be allowed.

Question - Will you require load or concentration limits for nutrients?
Answer - We won't know until the nutrient standards are adopted. The standards will apply science to determine what levels are protective of beneficial uses.

Comment - The standards are supposed to be technology forcing. Every permit should be different.

Question - What will be the length of the permit cycle?
Answer - Permits are for five years. As permit expiration nears, we will conduct an alternative analysis to determine if variances may be appropriate. We will need to set interim discharge limits into the middle of the second five year cycle if variances are granted to ensure progress in improving water quality.

Question - Will you allow load offsets and trading in permits?
Answer - DEQ is working on a trading policy.

Comment - Applicants need to have a larger role in the environmental assessment portion of the permitting process.
Response - We do need to do a better job in communicating with permittees in the pre-permit process.

Nutrient Permit Alternative Analysis

Dr. Mike Suplee reported on the results of the meetings of a subcommittee considering DEQ's alternative analysis for nutrient standards using a handout included below in Appendix 6. In addition to Dr. Suplee, subcommittee participants included: Mark Bostrom, DEQ Water Quality Planning Bureau Chief; Bob Bukantis, Water Quality Standards Section Supervisor; EPA representatives, and Dave Aune, Great Western Engineering and Nutrient Work Group member. Issues discussed included what elements are best addressed by an alternatives analysis, and how alternatives analyses currently undertaken to satisfy engineering specifications of wastewater facilities (per DEQ circular 2) contrast with the intent of the alternatives analysis of MCA 75-5-313. Another topic raised by the Alternative Analysis subcommittee is the need for consistency among DEQ standard setting, permitting, and total maximum daily load (TMDL) activities. DEQ and the subcommittee intend to produce an outline showing how these processes fit together, with key milestones including discussions with permittees about permit contents. The processes will be iterative. They will likely toggle between technical and economic solutions and natural resource impacts. The alternative analysis subcommittee's work is not finished. It will seek to describe what the iterative process will look like.

Nutrient trading may be a part of the alternative analysis. DEQ has drafted a nutrient trading policy and has sent it to a national expert on pollution trading, Mark Kieser, for his review. Dr. Suplee passed out copies of the draft trading policy, emphasizing widespread release of the draft is pending Mr. Kieser's review.

Question - Is there a time period for public comments on the draft trading policy?
Answer - We have not set a comment period because we first want Mr. Kieser's review. For this reason, we have not posted the draft policy on a DEQ web site. We plan to discuss the policy at the next NWG meeting in January.

Comment - In Billings, we have been told that if we land apply our 16 million gallons per day of sewage treatment effluent, DNRC would require gallon for gallon mitigation to avoid depletions to the Yellowstone River.
Response - Water rights are not within the purview of DEQ. We will discuss this with DNRC. Also, as mentioned at the September NWG meeting, we are conducting mechanistic modeling of the Yellowstone River. We should be able to discuss this modeling with this group early next year.

Question - Will a goal of the alternative analysis be to identify the most cost effective approach for the community to comply with the nutrient standards?
Answer - The alternative analysis along with the economics and limits of technology variances should result in the most cost effective approach to water treatment for communities.

Question - You said that we would use the alternative check list as the starting place for the assessing nutrient standard compliance. Will this increase scrutiny by outside parties?
Answer - Allowing variances may increase outside scrutiny, but we have not discussed this specifically within the department.

Comment - The preliminary engineering review (PER) that we conduct for permittees will now have another level and be more complicated and expensive. We will need to get DEQ involved early.

Question - Would the alternatives listed on your handout as 1a, b, and c preclude the need for a variance from the nutrient standards?
Answer - Yes.

Question - Does the alternative analysis as developed to date reflect a public entity (municipal) perspective?
Answer - Yes because we know more about it. The list of alternatives may expand for private entities (industry).

Comment - Large facilities will likely have more alternatives to consider under #1 of the handout.

Nutrient Criteria Affordability Advisory Group Recommendations

DEQ would like comments from this group on the recommendations for an affordability variance for public systems developed by the Nutrient Criteria Affordability Advisory Group.

Comment by Gerald Mueller - We will ask for comments at the next NWG meeting in January.

Comment - The League of Cities will meet in January. We will discuss a municipal view of the public affordability variance.

NWG Action - Those members of the NWG present at this meeting agreed to form a subcommittee tasked with developing a proposal for an affordability variance for private entities. This group will be asked to report on its progress at the February NWG meeting.

NWG Work Plan

Gerald Mueller stated that the work plan is targeted towards NWG consideration of a draft rule for nutrient standards. The plan has three components: the legal basis for the nutrient standards, the scientific basis for the standards, and standard implementation. To date the NWG has spent considerable time on the legal and scientific basis of the standards and is now focused on standard implementation.

Comment by Don Quander - I have some remaining questions regarding the legal basis, including EPA's view of the permit shield and a sunrise date, i.e. a delayed implementation date, for nutrient standards. Prior to the next meeting, I will prepare a list of my legal questions.
Response by Gerald Mueller - I will add its view of the permit shield and a sunrise date to the list of questions we will ask EPA to address at the next meeting.

Comment by Rosemary Rowe - EPA agrees with the DEQ view of the permit shield.

Comment - I am interested in DEQ's policy towards limiting non-point pollution.

Comment by Dr. Suplee - DEQ may also have tweaks to the nutrient criteria presented in the November 2008 technical document, and will present those to the group next year as part of the rule making package.

Public Comment

There was no additional public comment.

Next Meeting

The next meeting is scheduled for Thursday, January 21 in room 226, 301 South Park Avenue, Helena. The agenda may include:

- A report from the alternative analysis subcommittee including a flow chart of the alternative process and discussion of the draft trading policy;
- Comments on the NCAAG recommendations for an affordability variance to the base nutrient standards for the public sector;
- A preliminary analysis of the economic impacts of the numeric nutrient standards;
- Discussion of Mr. Quander's list of legal questions; and
- The questions to EPA;

Appendix 1
NWG Attendance List
December 1, 2009

Members

Scott Murphy	Morrison-Maierly, Inc.
Don Allen	Western Environmental Trade Association (WETA)
Donald Quander	Holland & Hart
Brian Sugden	Plum Creek
Dave Aune	Great Western Engineering
Chris Brick	Clark Fork Coalition
Jim Jensen	Montana Environmental Information Center
John Rundquist	City of Helena
Michael Perrodin	BNSF Railway
Donald Quander	Holland & Hart/Missoula Petroleum Association
Dick Hoehne	Town of Philipsburg
John Wilson	City of Whitefish
Debbie Shea	Montana Mining Association
Terry McLaughlin	Smurfit-Stone Container
Michael J. Perrodin	BNSF Railway
Ryan Swinney	Bruce Swinney & Associates

Alternate Members

Kate Miller	Montana Department of Commerce/Treasure State Endowment (alternate for Jim Edgcomb)
Jay Bodner	Montana Stock Growers Association (alternate for John Youngberg)
Doug Parker	Hydrometrics (alternate for Debbie Shea)

Non-Voting Members

Dr. Jeff Blend	Department of Environmental Quality (DEQ), Economist
Dr. Mike Suplee	DEQ, Water Quality Standards Section, Water Quality Specialist

Other Meeting Participants

Matt Wolfe	Stillwater Mining Company
Dave Clark	H2R
David Mumford	City of Billings
Dave Galt	Missoula Petroleum Association
Jenny Chambers	DEQ Water Protection Bureau Chief
Tom Reid	DEQ Senior Environmental Science Specialist
Mark Bostrom	DEQ Water Quality Planning Bureau Chief
Claudia Massman	DEQ Attorney
Matt Gerhardt	Brown and Caldwell

Rosemary Rowe	US Environmental Protection Agency (EPA)
Tina Laidlaw	EPA
Judel Buls	AE2S, Inc.
Mark Simonich	Helena Association of Realtors
Bruce Gilbert	Stillwater Mining Company
Ron Nissan	CHS - Refinery Billings
Amanda McInnis	H2R
Judy Hanson	DEQ Administrator of the Compliance and Control Division
Todd Teegarden	DEQ Technical and Financial Assistance Bureau Chief
Paul LaVigne	DEQ, Technical and Financial Assistance, Water Pollution Control Revolving Fund Section Supervisor
George Mathieus	DEQ Planning, Prevention and Assistance Division

Appendix 2
East Boulder Mine/Stillwater Mine
Stillwater (SMC) Background

- Only Primary Source of PT/PD in North America
- PT/PD - Primary usage in clean air technologies - Catalytic Conv
- SMC – Approx. 1300 employees
- SMC – Mines no acid rock potential
- Explosives - primary source of nutrients
- Fracture Driven Hydraulics
- MPDES Loads based upon 1 mg/L change in surface water
- Point and Non-point potential for nutrients
- No direct discharge to surface water – point source or stormwater
- Point source discharge to groundwater after treatment
- BMP's utilized to control non-point discharges
- Nutrient impacts to surface water within historic ranges
- Non-point discharges in groundwater elevated above baseline

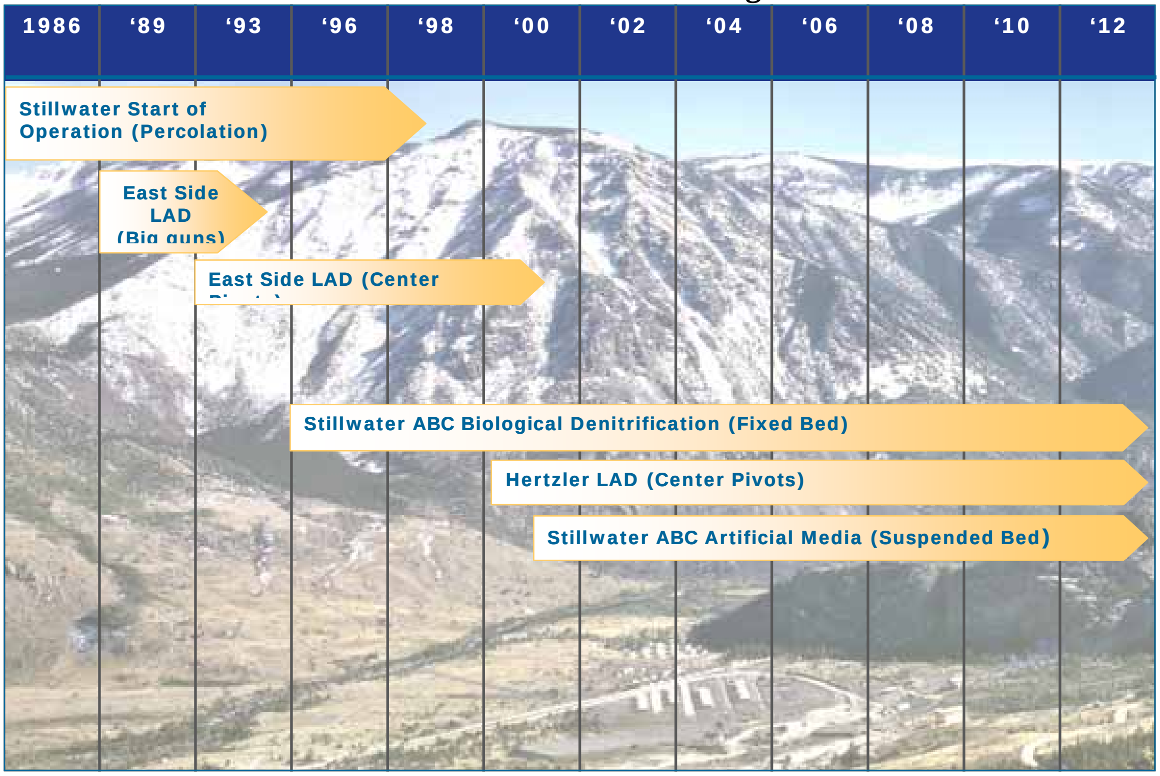
Treatment Chronology

- 1986 – Stillwater begins operation – percolation
- 1989 – Big gun sprinklers – East side LAD
- 1993 – 1st pivot start up – East side LAD
- 1993 – Biological denitrification – initial test work
- 1993 – Ion exchange – initial test work
- 1994 – 2nd pivot start up – East side LAD
- 1995/1996 – Pilot biological cell (ABC) start up
- 1998 – ABC expansion cells 2 & 3
- 1998 – Early snow making test work at Stillwater
- 1999 – ABC cell 4 constructed
- 2000 - East Boulder (EB) ABC constructed
- 2000 - ABC cell's 5 & 6 constructed - Stillwater

Treatment Chronology

- 2001 - Artificial media in cell # 5 - Stillwater
- 2000 - Hertzler LAD construction & start-up
- 2001/2002 - Snowmaking & LAD test work- EB
- 2002 - Analysis of Ion Exchange & Breakpoint Chlorination - EB
- 2002 - Artificial media in cell #4 - Stillwater
- 2004 - Insitu-denit test work - Stillwater
- 2006 - Bio pods (septic system) - Stillwater
- 2006 - Anox ammonia nitrification – EB
- 2008 - Heat exchanger - East Boulder
- 2009 - Reverse osmosis - East Boulder
- 2010 - Insitu-denitrification - East Boulder

Stillwater Water Treatment Progression



East Boulder Water Treatment Progression

Biological Treatment

Stillwater Mine

- Clarification/sediment removal
- Fixed bed up-flow reactors – rock media & artificial media
- Storage & summer-time LAD

East Boulder

- Clarification/sediment removal
- Fixed bed up-flow reactors – rock media
- Fluidized (Anox) reactors/artificial media – nitrifying & de-nit
- Heat exchangers & R.O. as necessary to meet MPDES limitations
- Percolation after treatment

Nitrogen Treatment Technologies in Use by SMC

			Effluent Concentrations (Avg.)		
	Nitrate % Reduction	**Ammonia % Reduction**	**NOx ppm**	**NHx ppm**	**Total Inorganic N ppm**
Biological Denitrification (Fixed Bed)	70-90%	0%	5	5	10
Biological Denitrification (Suspended Bed)	90-99%	0%	1-2	5	6-7
Biological Nitrification/Denitrification (ANOX Mixed Bed w/ Heat Exchanger)	90-99%	90-99%	1-2	1-2	2-4
Reverse Osmosis	90%	90%	(Use as Secondary Treatment - requires storage for brine - 30% of volume)		
LAD with modified Center Pivots	80-90%	80-90%	(Use as Secondary Treatment - requires large land holding and storage of water for 7 months)		
Snowmaking	80-90%	80-90%	(Use as Secondary Treatment - best suited for high elevation sites & limited to winter)		

- Notes: Influent concentration of Total Inorganic Nitrogen ranges from 30 ppm to 60 ppm.
  Phosphorus must be added to achieve Nitrogen reduction in the range of 2-4ppm.
  Phosphorus is utilized sparingly and is one of the limiting factor in bio cell efficiencies.
  The addition of cement underground and the corresponding increase in ph can impact on biological treatment efficiencies.
  Other chemicals such as biocides in lubricating fluids can also be limiting.

Capital & Operating Costs

SMC Water Treatment Capital & Operating Costs			
	Capital $	Annual Operating $	Operating Cost / MillionGal
Stillwater Mine / Hertzler LAD	$ 10,500,000	$ 155,000	$ 750
East Boulder Mine	$ 3,500,000	$ 225,000	$ 1700

Nutrient Issues Concerns

- Extensive capital and R&D expended at both mine sites
- Current MPDES limits are basis for treatment design
- Treatment is designed for finite flows & % removal
- Fracture driven in-flows vs. treatment capacities
- Non-point & BMP's vs. point source & treatment
- Temperature standard may preclude direct discharge
- Headwater drainages are P-limited not NOx-limited
- Extensive chemical and biological data set at both mines suggest that current limits are protective given:
  - Stream gradient, water temperatures & shading
  - 20 years of biological monitoring
- Standards should be drainage specific especially where a preponderance of data exists

Appendix 3

Smurfit-Stone Container Treatment Process Review and Alternatives Evaluation

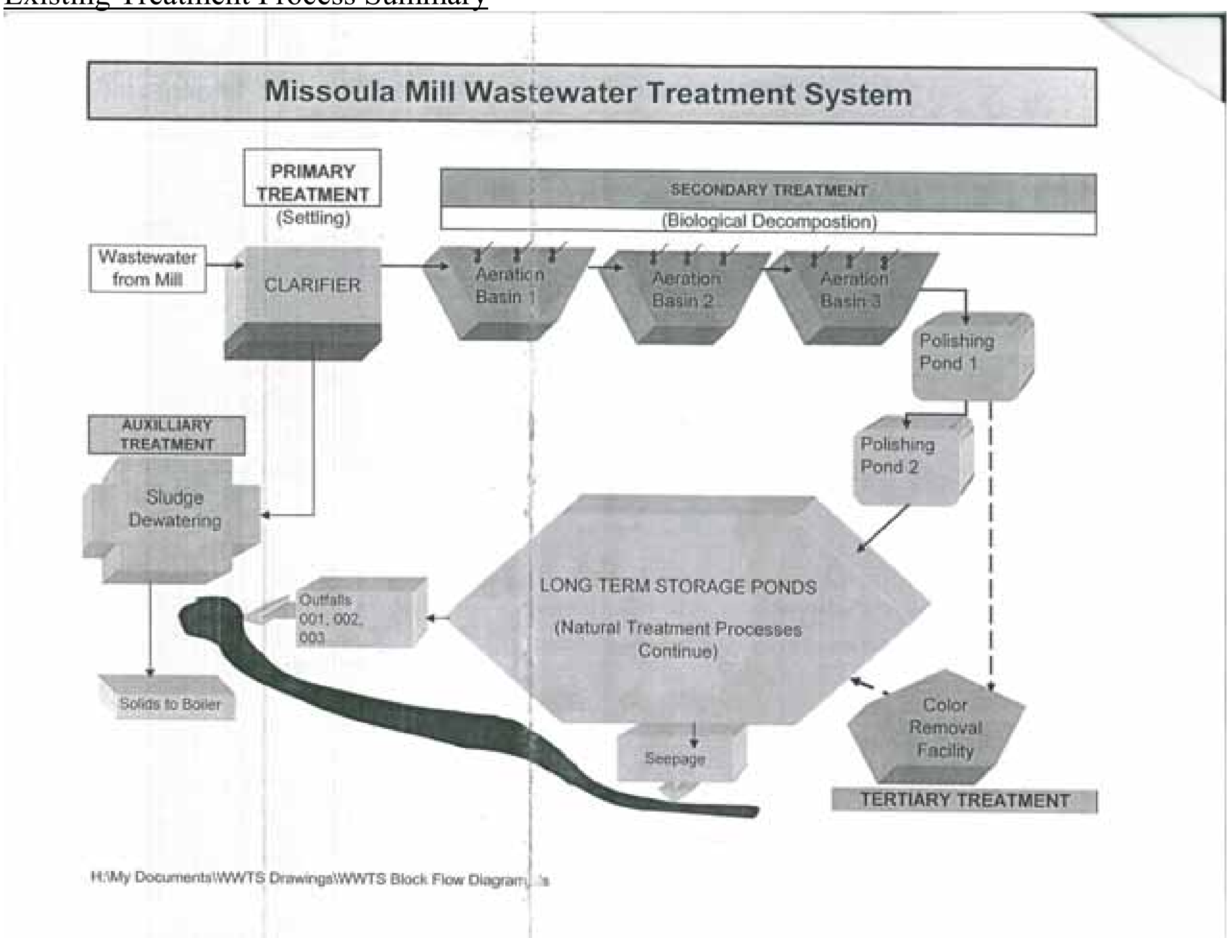
Project Goals

- To Investigate Treatment and Water Reuse Options

Voluntary Nutrient Reduction Program (VNRP) Overview

- VNRP Published August 1998
  - 10 Year Program
- Reducing loading to meet in-stream nutrient and algae targets in the Clark Fork River through:
  - Early start-up of the color removal plant at river flow at or below 4,000 cfs;
  - No direct discharge to the river during July and August at flow below 4,000 cfs
  - Summer use of storage ponds farthest from river to reduce seepage
  - Researching additional nutrient reduction techniques

Existing Treatment Process Summary



Existing Treatment Process Summary

- Direct Discharge
  - Nitrogen – 2.7 mg/L, 106 lbs/day
  - Phosphorus – 0.40 mg/L, 16 lbs/day

- Seepage
  - Nitrogen – 1.1 mg/L, 82 lbs/day
  - Phosphorus – 0.44 mg/L, 33 lbs/day
- Supplemental Nutrient Addition
  - Nitrogen – 33 lbs/day
  - Phosphorus – 33 lbs/day

Typical Treatment Performance, Limits of Technology and In-Stream Nutrient Criteria

Parameter	Typical Aeration Stabilization Basin mg/L	Smurfit-Stone Container Effluent mg/L	Typical Advanced Treatment Nutrient Removal (BNR) mg/L	Enhanced Nutrient Removal (ENR), mg/L	Limits of Treatment Technology mg/L	Developing In-Stream Nutrient Criteria mg/L
Total P	1.6	0.40	1	0.25 to 0.50	0.05 to 0.07	0.05
Total N	7	2.7	10	4 to 6	3 to 4	0.30

Potential Wastewater Management Options

- Advanced Treatment (MFRO)
- Mechanical Side Stream Treatment
- Poplar Habitat Development
- Constructed Wetlands
- Phosphorus Precipitation
- Alfalfa Irrigation

Advanced Treatment with MFRO

- Removes N & P To In-Stream Standards
- Removes TDS to 10-30 mg/L
- Chemical Handling Including pH adjustments
- Brine (Waste) Storage in Lined Pond
- Capital Cost ~$53,000,000

Mechanical Side Stream Treatment

- Would provide the greatest treatment efficiency by treating a concentrated side stream only
- Have yet to identify a source stream
- Undeveloped alternative

Poplar Habitat Development

- Consume a lot of water and nutrient
- Harvested after 7-14 years
- SSCC potential sites identified
  - 160 acres north, 275 acres east, 450 acres south
- Recommend Piloting

Constructed Wetlands

- Developed in previous study by Dr Inskeep, Montana State University
- Previous study indicated nutrient removal benefit
- Recommend piloting

Phosphorus Precipitation

- Chemical handling including pH adjustments
- Phosphorus not currently the main problem

Alfalfa Irrigation

- Alfalfa farming currently under way
- Supplement current irrigation with "Clearwater"
- Potentially reclaim 202 million gallons a year (4% of total plant flow in 2009)
- Additional sampling required

Capital Cost Comparison of Alternatives:

Treatment Alternative	Capital Cost	Cost/MG Treated
Advanced MFRO	$53,000,000	$2,074.00
Poplar Development	$1,800,000	$1,594.00
Constructed Wetlands	$9,300,000	$1,000.00
Phosphorus Precipitation	$200,000	$3.90
Alfalfa Farming	$71,900	$35.60

Appendix 4
Nitrogen and Phosphorus Removal in Refinery Wastewater Treatment Plants

Matt Gerhardt, Ph.D.
Brown and Caldwell

December 1, 2009

Nitrogen and Phosphorus Removal in Refinery Wastewater Treatment Plants (WWTPs) Outline

- My background
- Nitrogen
- Phosphorus

My Background

- B.S. Chemical Engineering – Cornell University
- M.S. and Ph.D. Civil/Environmental Engineering
  – University of California, Berkeley
- 24 years experience in wastewater treatment
  - Chevron Research Company
  - Brown and Caldwell
- Wastewater work at 30 refineries

Nitrogen

- Two sources in refineries:
  - Crude oil
  - Amines used to remove hydrogen sulfide from gas to meet low sulfur fuel requirements
- Most is recovered
  - Sour water strippers → ammonia thiosulfate or nitrogen gas
  - Amine regeneration/reuse
- Small amount goes to wastewater as ammonia or organic nitrogen (amines)

Nitrogen Components in Refinery Effluents

Total Nitrogen =
Organic nitrogen (non-biodegradable and particulate fractions)
+ Ammonia (degradation product of biodegradable organic nitrogen + ammonia not removed by sour water stripper)
+ Nitrate (product of nitrification [biological ammonia oxidation])
+ Nitrite (same; typically very low in refinery effluent)

Nitrogen Component Concentrations in Billings-Area Refineries

Component	Average mg/L as N	Maximum mg/L as N
Organic nitrogen	Rarely Measured	2.7 - 27
Ammonia	0.8 - 16	3 - 38
Nitrate + Nitrite	0.02 - 13	7 - 34
Total	>5 - >16	12 - 55

Nitrogen Component Concentrations in Refineries with Nitrifying WWTPs

Component	Average mg/L as N	Maximum mg/L as N
Organic nitrogen	Unknown – insufficient data	Unknown – insufficient data
Ammonia	1	8
Nitrate + Nitrite	**4 - 9**	**27**
Total	**>5 - >10**	**>27**

Best Available Demonstrated Technology

From primary treatment to discharge the steps are: primary treatment to aeration tank to anoxic denitrification to final aerobic treatment to clarifier to filter to discharge. A supplemental carbon source is added between the aeration tank and the anoxic denitrification. For 60,000 bpd refinery already nitrifying, the approximate capital cost of adding the anoxic denitrification, final aerobic treatment, and a filter is $5 million.

Nitrogen Component Concentrations in Refinery with Best Available Demonstrated Technology

Component	Average mg/L as N	Maximum mg/L as N
Organic nitrogen	1.5	Unknown – insufficient data
Ammonia	1	8
Nitrate + Nitrite	0.4	Unknown – insufficient data
Total	3	>10

Phosphorus

- Not enough in crude oil to provide necessary phosphate for biological WWTPs. Need > 0.3 mg/L.
- Two sources in refineries:
  - Phosphoric acid added to WWTP (required)
  - Phosphonates in cooling water treatment (reduces corrosion, so it reduces copper loading to WWTP)
- Some phosphate gets removed in WWTP
- Typical effluent concentration: 0.4 mg/L – 1.0 mg/L

Best Available Demonstrated Technology

Average effluent total phosphorus = 0.08 mg/L to 0.14 mg/L
95th percentile effluent total phosphorus = 0.2 mg/L to 0.7 mg/L

From Biological WWTP to discharge the steps are: add alum, ferric chloride or lime to chemical precipitation (clarifiers) to discharge. Sludge is removed from the chemical precipitation step for dewatering and disposal.

For 60,000 bpd refinery, approximate capital cost is $6 million, and sludge generation is approximately 80 tons/year.

Summary

- Limits of technology for nitrogen:
  - 3 mg/L as N average
  - >10 mg/L as N maximum
- Refinery wastewater contains some non-biodegradable nitrogen compounds
- Limits of technology for phosphorus removal are:
  - 0.08 – 0.14 mg/L as P average
  - 0.2 – 0.7 mg/L as P maximum

Appendix 5

Program Elements

- Montana Pollutant Discharge Elimination System
- Montana Ground Water Pollution Control System
- Short-Term Authorizations
  - 308 Pesticides
  - 318 Turbidity
- 401 Certifications – Federal Clean Water Act

What is a Permit?

- It is a license…
  - -issued by the government to a person
  - - granting permission to do something which would be illegal in the absence of the permit.

  (75-5-605, MCA – It is unlawful to…)
- No right to permit; is revocable for cause
- Permit is license to discharge

NPDES Delegation - 1974

The purpose of this subchapter 11, 12, 13 and 14 is to establish and implement one common system for issuing permits …… which is compatible with the national pollutant discharge elimination system as established by the US EPA pursuant to section 402 of the federal Clean Water Act. ARM 17.30.1301.

Basic Program
General Permit
Federal Facilities

<u>Non-delegated</u>
Pretreatment
Biosolids

Effluent Limitations

- Technology-Based Effluent Limits (TBEL)

  e.g. Secondary Treatment
  (BOD, TSS, pH, % Removal)

- Water Quality-Based Effluent Limits (WQBEL)

  e.g. Ammonia, Fecal, Nutrients, Metals, VOCs

Technology Based Effluent Limits
"Minimum Treatment Requirements - WQA"

Federal Effluent Limit Guideline (ELGs) - Industrial
- Best Conventional Technology (BCT)
- Best Available Technology (BAT)
- New Source Performance Standards (NSPS)
  "Zero Discharge"
- Best Professional Judgment (BPJ) CWA 402(a)(1)
  "Case-by-Case Basis"

National Secondary Treatment Standards – POTWs

Pretreatment Standards for Existing Sources (PSES)
Pretreatment Standards for New Sources (PSNS)

Water Quality Based Effluent Limits (WQBEL)

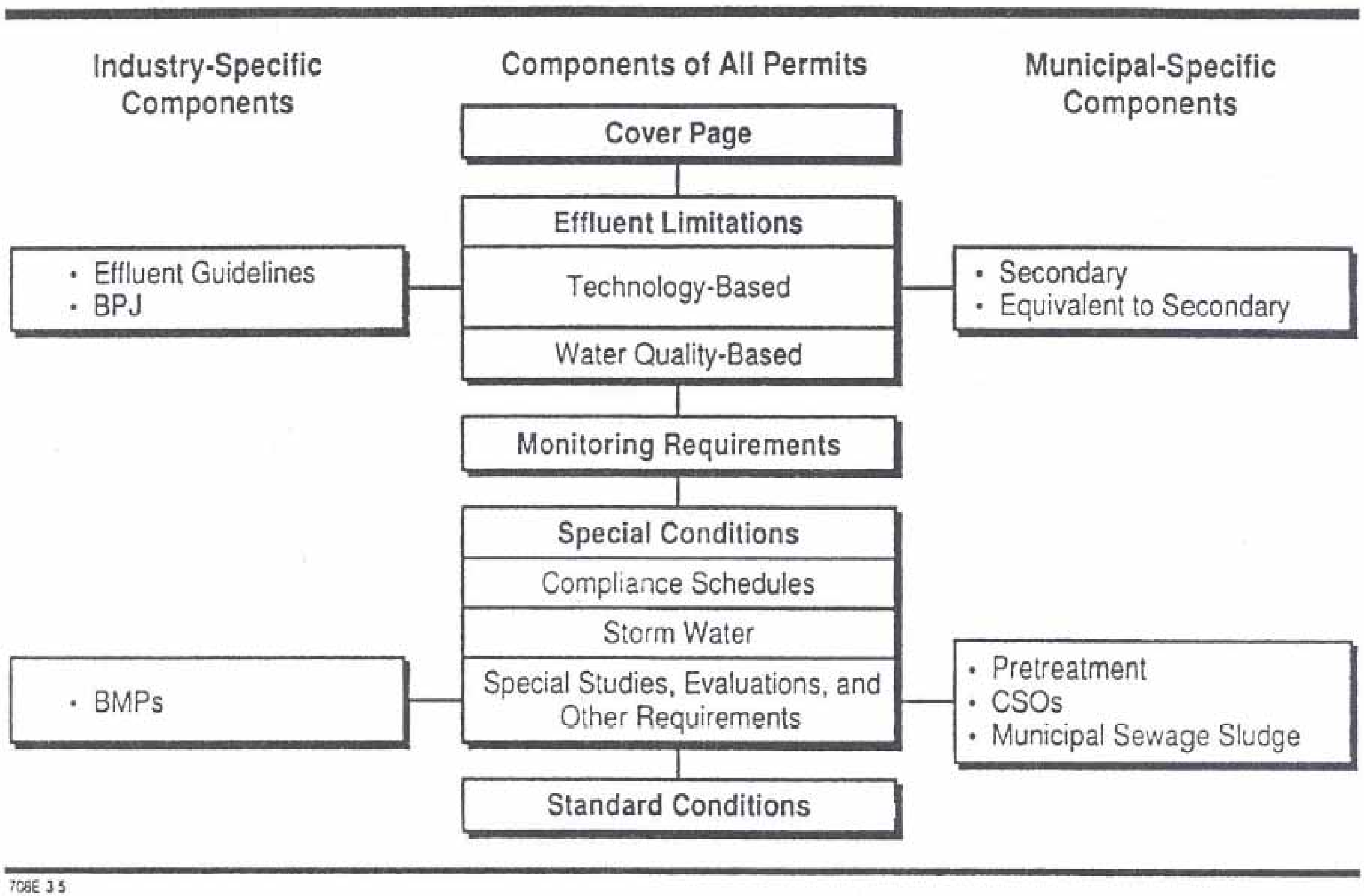
- 40 CFR 122.44 (ARM 17.30.1344)
  - Necessary when technology based limits are not adequate to protect water quality standards, including narrative;
  - Necessary for all pollutants which may cause or have a reasonable potential to cause or contribute to excursion of a WQS

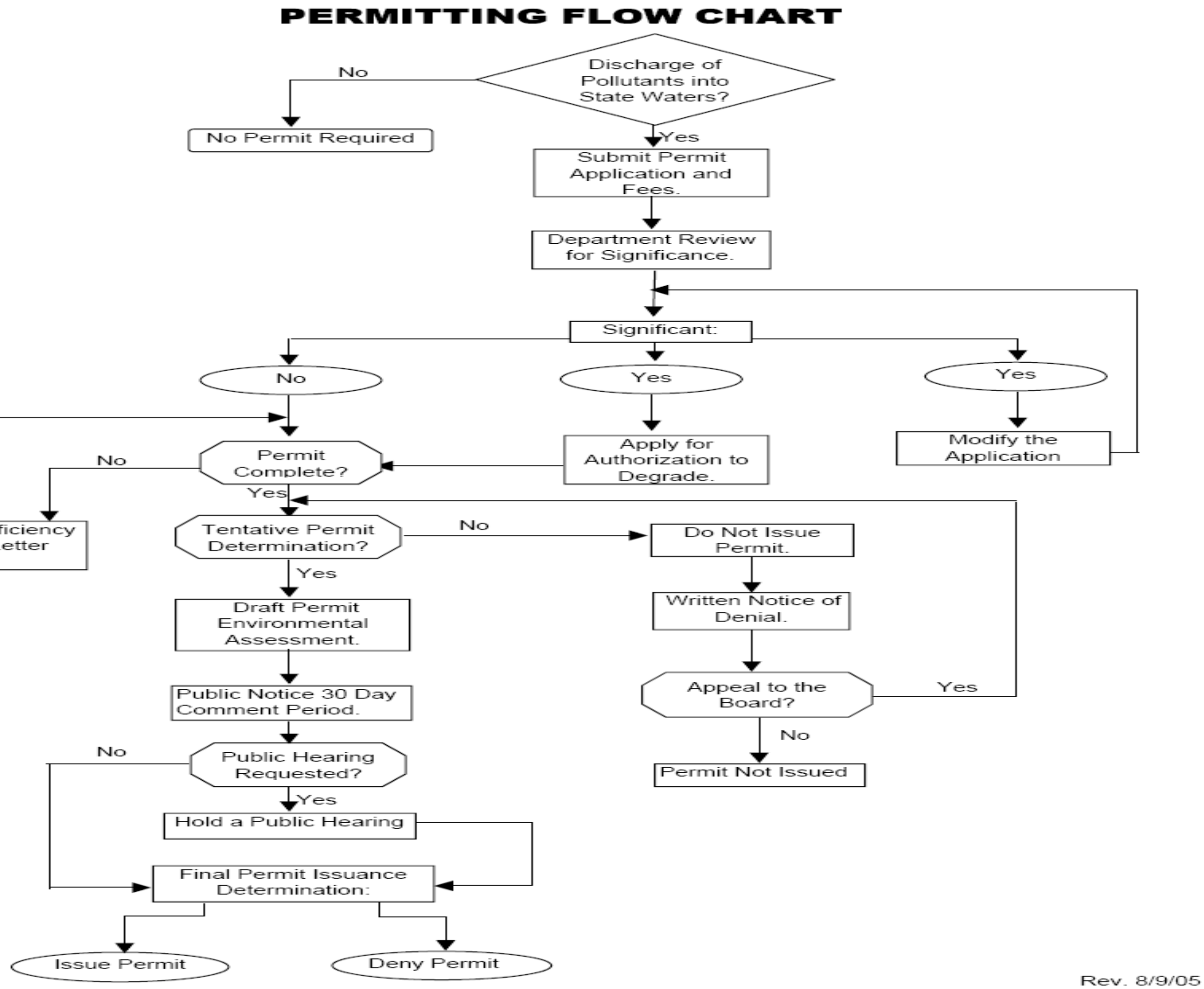
- ARM 17.30.637(2)
  - No waste that may be discharged such that either alone or in combination with other wastes, will violate or can reasonably be expected to violate, any of the standards.

Development of a WQBEL

WQS
(numeric or narrative)
to
Translator Mechanism
(only narrative, i.e. WET)
to
Wasteload Allocation
to
Permit Limit

Permit Components




PERMITTING FLOW CHART
Discharge of Pollutants into State Waters?
No
No Permit Required
Yes
Submit Permit Application and Fees.
Department Review for Significance.
Significant:
No
Yes
Yes
Apply for Authorization to Degrade.
Modify the Application
No
Permit Complete?
Yes
Deficiency Letter
Tentative Permit Determination?
No
Do Not Issue Permit.
Yes
Draft Permit Environmental Assessment.
Written Notice of Denial.
Public Notice 30 Day Comment Period.
Appeal to the Board?
Yes
No
No
Public Hearing Requested?
Permit Not Issued
Yes
Hold a Public Hearing
Final Permit Issuance Determination:
Issue Permit
Deny Permit
Rev. 8/9/05

Appendix 6

Alternatives Analysis Sub-committee

(subcommittee of the Nutrient Work Group)

MCA 75-5-313 (31: The denartment shall review each apulication for temporary nutrient criteria on a case-by-case basis to determine if there are reasonable alternatives, such as trading or permit compliance schedules, that preclude the need for the temporary criteria.

SUMMARY OF PROGRESS THROUGH NOVEMBER 2009

1. Subcommittee*s conclusion as to what elements best comprise an alternative analysis for purposes of meeting MCA 75-5-313(3)
   a. Land application
   b. Total/seasonal retention
   c. Trading (an option, not a requirement)

2. Expansion of Current Alternatives Analysis
   a. Current alternatives analysis checksheet (Facilities Plan/PER checklist)
   b. Differentiation between alternatives analysis to meet Circular DEQ-2 and alternatives analysis to preclude a variance per MCA 75-5-3 13.
      i. DEQ could include variance alternatives analysis on checksheet

3. Nutrient Trading
   a. *Draft* trading policy - basic framework outline (handout)
   b. Policy will receive technical review by Mark Kieser (author of book on topic) in January
   c. Trading ratios
      i. Nonpoint trading should be based on generic BMP performance data, then (later) on more sophisticated watershed-specific model
      ii. Should generally be >1:1 for point-nonpoint (explain)
      iii. Discuss idea of "proximity effect" on trade ratios, and when trade ratios might reasonably be set at 1:1.

4. Future Plans: Internal DEQ Review Group
   a. Inter-departmental group (permitting, WQ standards, SPY, TMDL) that would review applications for both (1) alternatives analysis and (2) temporary nutrient criteria.
      i. Internal Group helps assure internal DEQ consistency
      ii. Alternative analysis/PER/temporary nutrient criteria processes are interrelated, and will likely be iterative
      iii. DEQ would work with a community through process
      iv. Subcommittee will work on outlining process for future Nutrient Work Group review
         1. All or parts of the final process would end up in rule