FRIENDS OF THE HEADWATERS

RESPONSE TO THE MINNESOTA DEPARTMENT OF COMMERCE
LINE 3 DRAFT EIS - Dockets CN-14-916, PPL-15-137
JULY 10, 2017

Ms. Jamie MacAlister, Environmental Review Manager
Minnesota Department of Commerce
85 7th Place East, Suite 280
St. Paul, MN 55101-2198

Dear Ms. MacAlister,

Please find enclosed a thumb drive containing Friends of the Headwaters response to the Line 3 DEIS. Paper copy of FOH Comments and Accufacts also enclosed.

Contents include:
- Comments from FOH,
- Report from Accufacts, an independent consulting firm,
- And supporting attachments.

Regarding the attachments: some are referenced in the FOH Response, others are materials from FOH's involvement with the Sandpiper proceedings. FOH believes these need to be entered into the Line 3 DEIS record.

Thank you for your attention to these materials. Thanks for permitting FedEx delivery of all materials. FOH Comments and Accufact Report will be posted to the docket today.

Have fun reading. ;-)

All the best,

Richard Smith
President, FOH
612-708-0908
grizrs615@gmail.com

Friends of the Headwaters
P.O.Box 583
Park Rapids, MN 56470

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Paul Stolen Letter to:
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Tamara Cameron, Chief, Regulatory Branch, USACE

Re: Proposed Enbridge Sandpiper and Line 3 Enlargement/Relocation/Abandonment projects in Minnesota: "Policy and technical reasons for independent, scientifically sound analysis of the risk and environmental, cultural, and human consequences of oil releases for the 50+ years of the project."

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Friends of the Headwaters and the Minnesota Center for Environmental Advocacy Brief to the Minnesota Appellate Court resulting in unanimous decision later upheld by the Minnesota Supreme Court for a full EIS on Enbridge's proposed new pipelines in Minnesota.

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S-1 Accufacts Report on Line 3 DEIS.

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Accufacts Richard Kuprewicz Curriculum Vitae

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Map of La Salle Valley, La Salle State Recreation and Scientific Natural Areas and Mississippi River region marked with proposed pipeline route

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Summary of Experience, Friends of the Headwaters Consultant, Paul Stolen

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LINE 3 DRAFT EIS - Dockets CN-14-916, PPL-15-137
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ATTACHMENTS "A"

A-1 Stolen 4.4.14 Sandpiper Comments
A-2 Stolen 5.28.14 Sandpiper comments

Record of Paul Stolen's comments and documents submitted to the Minnesota Department of Commerce for the respective Public Comment periods for the proposed Sandpiper Pipeline project

April 4, 2014

Paul Stolen
37603 370th Av SE,
Fosston, MN 56542,
218-435-1138

Mr. Larry Hartman
Environmental Review Manager
Minnesota Department of Commerce
85 67th Place East, Suite 500
St. Paul, MN 55101

Re: Comments on proposed Enbridge Sandpiper Pipeline, PUC Docket #13-474

Dear Mr. Hartman:

Enclosed are my comments on this proposed project. They concern the main topics solicited in the January 31, 2014 public notice. I suggest alternative routes and route segments, and provide answers to public notice questions "What human and environmental impacts should be studied in the comparative environmental analysis?" and "Are there any specific methods to address these impacts that should be studied in the comparative environmental analysis?"

My comments address human and environmental impacts. They identify appropriate methods of studying such impacts, based on PUC rules and standard methods used in Minnesota and elsewhere to review pipelines.

The most important point in these comments concerns the enormous quantity of oil and other hazardous product that is already flowing through multiple pipelines in one or two narrow corridors This project, and the new Line 3 Enbridge replacement and enlargement will add even larger amounts of oil and product to these corridors. These corridors cross highly valued natural resource areas that have many lakes and clean rivers,. They are often at or near the headwaters of drainages and in hilly areas, as well as being close to people and concentrations of residences.

It is time for Minnesota and federal regulatory agencies to address the problem of multiple large diameter pipelines in close proximity to each other. This concentration makes the consequences of a single site event—whether such an event is natural, accidental, or intentional—potentially catastrophic. Furthermore, my comments will show that the flow of oil and other product will be so large as to be larger than—or a significant portion of—the flow of well-known rivers crossed by the corridors.

I am submitting these comments as a citizen but also as an expert. These are my personal comments written without review or reimbursement of any party. I will be willing to provide testimony as such in legal and legislative forums, should this be necessary, depending on personal availability.

In lieu of providing a c.v. at this time, I summarize here my credentials for asserting that I have expertise regarding the Sandpiper review.

I have regulatory experience with large natural gas, carbon dioxide, water, and oil and product pipelines in Montana and Minnesota. This has involved on the order of 10-12 pipeline projects while employed at the Montana Department of Natural Resources and Conservation and the Minnesota Department of Natural Resources. In Montana, the DNRC had environmental review, locational approval, and Certificate of Need Authority for energy facilities combined in one agency.   I have also supervised , and /or participated in the preparation of EISs or EAs of such pipelines. This included conducting training sessions for other regulatory personnel on how to review pipelines for impacts and on pipeline construction methods.

I have written or coordinated the writing of major environmental review regulations for fixed linear energy facilities, including pipelines and HVTL lines. This experience included reviewing specific proposed linear and fixed large energy facilities (power plants and HVTL lines), and high-level nuclear waste repositories. I have been an environmental inspector on a number of large pipeline projects, including presenting agency views at pre-construction conferences with pipeline builders and sub-contractors.

I have policy-level experience with both federal and state laws and regulations regarding environmental review, pipelines, and solid and hazardous waste topics. This includes legislative staff work, legal depositions, testimony in court, and presentations to other agencies. Finally, this experience also includes years of doing environmental reviews of many other types of projects, including experience with formal risk assessment, and supervising and/or writing scopes of work for the preparation of highly technical studies conducted by outside consultants.

Review and permitting of significant projects such as the Sandpiper project, and the 36-inch Enbridge upgrade of its old Line 3, means that there are overlapping jurisdiction with other federal and state agencies. Some of these are broader than the narrow PUC review requirements. My comments also pertain to those other agency responsibilities. It is necessary to exchange information among such government authorities as a matter of good government. Many of my comments attempt to accomplish such a goal. Therefore, I am providing copies of my comments to these other agencies.

My comments are enclosed. Thank you for consideration of them.

Sincerely,

Paul D. Stolen

C:	Tom Landwehr, Commissioner, Minnesota DNR
John Stine, Commissioner, Minnesota PCA
Tamara Cameron, Regulatory Chief, Corps of Engineers
Bob Eleff, Minnesota Legislature, House Research
Ken Westlake, USEPA, Chicago Office
US State Department, Washington DC

Comments on proposed Enbridge Sandpiper Pipeline, PUC Docket #13-474
Expert Testimony of Paul Stolen, Fosston Minnesota
April 4, 2014

I. Potential oil leaks and pipeline ruptures must be addressed in the route permit, by Minnesota state agencies, and by the US Corps of Engineers and EPA.

Summary: In this section I make the case for using accepted methods of risk assessment to address the consequences of pipeline ruptures to the Minnesota environment and people from this project. A foundation principle of risk assessment is that the greater the consequences of an event, the greater the need to examine rare or unlikely events. There are five reasons why unlikely events need to be considered in this risk assessment for this project:

1) Risk assessment scenarios in Attachment 4 are roughly applicable to one of the existing and proposed pipeline corridors in Minnesota. For example, a 36-inch pipeline rupture of the "worst case" type used in the assessment, may still release on the order of 40,000 barrels of oil, even assuming the quickest reaction time of pipeline operators to close block valves(13 minutes.) If valve closure time is delayed for 30 minutes, this rises to about 70,000 barrels, and if delay is 60 minutes, the amount is 100,000 barrels.

Such releases could have extremely high consequences to the Minnesota environment, and higher releases are possible under some risk assessment scenarios.

2) The portion of the Sandpiper route between Clearbrook and Park Rapids already contains three pipelines. Enbridge is apparently planning one more 36-in line in the same corridor as the 30 inch Sandpiper route. I raise the question as to what "worst-case" scenario should be used when there are 5 pipelines in close proximity in remote areas and at least somewhat susceptible to natural or intentional damage, perhaps to all of them at one time?

3) The corridor Enbridge proposes to use traverses a landscape rich in aquatic and other natural resources, highly valued by Minnesotans, and that includes major groundwater resources.

4) The portion of the Sandpiper route between Clearbrook and Park Rapids was fraught with problems during construction of the MinnCan pipeline, which were at least partially due to the corridor being created for a small pipeline long before modern environmental laws were passed.

5) The other route likely to be considered in the Sandpiper comparative review—the Enbridge mainline corridor—suffers from very similar problems as do at least the first three listed above. There are already as much as 7 pipelines present in this corridor.

The Sandpiper project, as well as other new projects in the planning stages, will add significantly to the enormous quantity of oil and other hazardous product that is already flowing through two narrow pipeline corridors.

It is time for Minnesota and federal regulatory agencies to address this problem of multiple large diameter pipelines in close proximity to each other. This concentration makes them vulnerable to natural events, accident or intentional act—such as the Oklahoma City federal building bombing. In fact, in Comment II.A. I discuss a specific case on the Alberta Clipper route where very high flows caused by the large rainfall events that seemed to be caused by global warming could threaten the integrity of more than one of the large pipelines in this narrow corridor.

My comments on this topic are based on my experience with pipelines in Minnesota and Montana, as well as with exposure to risk assessment concepts and methods. Enbridge may object to the use of the ORNL study in Attachment 4, and say it is not appropriate to apply to these projects. I disagree: of course it isn't directly applicable, but its methods are modifiable so that it is. Extrapolating the findings of Attachment 4 to the two corridors could be pushing things a little—but I have found no information that anyone else is considering these issues and the deadline for PUC comment is now due. It is therefore entirely appropriate to use it, and I hope to trigger a helpful debate. And, I know for certain my view this topic is important will be shared by the public.

The jurisdiction of the PUC and other Minnesota agencies regarding the scope of review as it pertains to pipeline design and location lacks clarity and confusion among regulators as well as the pipeline company personnel. This is related to the issue of pipeline "safety standards", and is discussed in detail in Comment II below. This lack of clarity and confusion should not be allowed to continue, since in my view, Minnesota's natural resources and citizens are threatened by rare but reasonably foreseeable events.

As noted in Comment II, I believe the evidence is firm that the Minnesota state agencies can effectively develop measures regarding mandatory design features related to pipeline ruptures and leaks in order to that protect people and the environment without encroaching on federal "safety standards." Such involvement is extremely important, given the magnitude of oil and product potentially moving through these corridors.

<u>I. A. Estimates of existing and proposed pipeline oil and product flows in Minnesota as compared to selected river flows</u>.

After burial, pipelines, when functioning correctly, are largely invisible to the public and most policy makers—such as those currently concerned with oil transport by rail. In order to make considered judgment on policy and permits—as well as allowing proper public involvement—this needs to change. It is no longer acceptable to have an "out of sight, out of mind" attitude on the magnitude of current and potential oil transport through Minnesota in restricted corridors with multiple pipelines.

It is not possible to begin to analyze potential impacts from pipeline leaks and ruptures without knowing amounts of oil and product being transported. Attachment A provides details about oil flow into and through Minnesota in the corridors relevant to the Sandpiper analysis. It thus provides a basis for analyzing socio-economic, public safety, and environmental impacts from leaks and ruptures. Pipe size and amounts of oil and product pumped are given, as is ownership and origin (for most of the lines.) Attachment 2 provides a description of most of the Enbridge pipelines.

Also included on page 3 of Attachment A is a comparison of pipeline oil and product flow and selected river flows near where corridors cross the named rivers. These data, while in cubic feet per second (cfs), are useful for both public understanding of local residents as well as resource managers. The public in these locations can at least visualize the rivers even though most do not directly understand cfs figures.

The river flow data shown are long-term median flows for April 2, not current flows. Therefore, they are indicative of long-term spring runoff conditions, and are likely substantially higher than low-flow conditions.

In addition, the percentages listed comparing oil/product flow to river flow use the highest amounts based on the proposed pipeline projects in the permitting and planning stages.

There are some caveats with respect to the numbers in Attachment 1. First, I used reliable sources for the numbers. When I used news reports, I only used those where pipeline companies were directly quoted, and checked multiple news sources. However, the amounts indicated for the Minnesota Pipeline Company older lines rely on indirect conclusions based on Citation #2 figures and subtracting known amounts from specific projects. The Enbridge figures for existing pipelines in its Mainline corridor are taken directly from them. (Attachment 2) Finally, the source of oil/product was somewhat difficult to determine in some cases.

Attachment 1 indicates the following with respect to comparison of April 2 long-term median river flows with oil flow amounts in pipelines, both expressed in cubic feet per second:

--Four of the listed rivers, Snake River above Warren, Clearwater river at Plummer, Straight River at Park Rapids, and Prairie River at Taconite, have oil/product flows substantially higher than current spring flows in the rivers. In two cases oil flow is 200 percent of water flow.

--In all cases, especially if one considers large releases during higher flow conditions resulting in rapid dispersion downstream, these rivers are important and sensitive natural resources. For instance, the Straight River south of Park Rapids is a nationally recognized brown trout fishery.

<u>I.B. Methods of determining socio-economic and environmental impacts of pipeline ruptures</u> The PUC public notice on Sandpiper requested advice on methods of addressing potential impacts. There are indeed methods already in place, such as:

I.B.1. *Identification of "High Consequence Areas."* Comment II.B.1. addresses this topic in detail and provides recommendations for how to use this category in the project review. These areas are also roughly described in the federal agency prepared Attachment 3, which includes somewhat useful guidance as to their possible use in the Sandpiper project.

I.B.2*. Risk Assessment with respect to potential amounts of oil/product released by ruptures.* A foundation principle of risk assessment is that the greater the consequences of an event, the greater the need to examine rare or unlikely events in the risk assessment. Attachment 4 is a clear illustration of this principle. For example, it indicates that a "worst-case" pipeline rupture needs to be used, and justifies why it is needed. Such a rupture is called a "guillotine" rupture : "Guillotine-type breaks are less common than other pipeline breaks such as fish-mouth type openings, but they can occur as a result of different causes including landslides, earthquakes, soil subsidence, soil erosion (e.g. scour in a river) and third-party damage. The guillotine-type break is the largest possible break and is therefore considered in this study as the worst case scenario. " (page 5.)

The study goes on to use this scenario in its analysis of the cost-effectiveness of installing block valves, as well as assessing (some) environmental and socio-economic damages from ruptures. It calculates hypothetical releases in different scenarios in its appendix, including those figures listed in the above summary. More detail is provided in the verbatim (except for underlining) excerpts in Attachment 4.

As noted in the above summary, the estimates of amounts spilled from "guillotine" type ruptures of just one pipeline are large—perhaps a minimum of 40,000 barrels from a 36-inch line. Magnify this by the scenario of intentional serious efforts to damage several pipelines at one time—and this amount becomes potentially massive.

*I.B.3. Actual damages from recent spills associated with rivers.*_Attachment 4 also describes two case studies of actual spills. (pp. 10-11.) These two case studies were used to develop a factor to increase the estimated costs according to the Attachment 4 methods by a factor of two, since both found the risk assessment method underestimated actual costs by about 50%.

a. Enbridge spill into Talmadge Creek and the Kalamazoo River in Michigan. Approximately 20,000 barrels of oil were released. The cost of that spill from a 30-inch diameter pipeline was of 2012 was $767 million.

b. ExxonMobil Pipeline company rupture under the bed of the Yellowstone River 20 miles upstream of Billings, Montana. This was caused by scour from flooding that exposed and fractured the pipeline that was trenched under the river bed. An estimated 1,509 barrels of oil were released before the pipeline was closed. Clean-up and recovery costs were $135 million. (Recent news reports indicate final costs and fines are not yet resolved.)

I.B.4. *Comparison of pipeline flow rates compared to river flows.* Attachment 1 indicates total amounts of oil/product flows in the numerous pipelines that cross these rivers. They portray possible amounts subject to the most catastrophic possible pipeline rupture event—that of an event that caused damage severe enough to rupture more than one pipeline. Some of these lines have been trenched under these rivers, in other cases they have been bored so that burial is deep and not subject to certain kinds of rupture events. Damage could conceivably occur due to river scour from unusually large flood events, or from an outside party successfully and deliberately accomplishing such a rupture.

My intent in comparing river flows to oil flows is not to imply that the worst-possible event be used in an analysis. Rather, it is to portray the magnitude of the oil/product flows in terms that the public and reviewers can understand it. Again, I am responding to normal methods of conducting risk assessments: Very high consequences deserve be paired with looking at rare events. The possible use of this information in any kind of corridor analysis or spill magnitude is subject to a number of questions being answered first. This is discussed next.

I.C. <u>Recommendations regarding pipeline rupture for analysis of impacts, corridor/route comparison, and estimates of spill magnitude based on risk assessment.</u>

I.C.1. The Sandpiper project should be analyzed with respect to potential impacts from pipeline rupture using risk assessment methods modified from those used in Attachment 1. This would:

a. Entail determining Enbridge's methods for locating such valves on the Sandpiper pipeline, and making this available for critical review, and

b. Include both estimates of spill magnitude based on ideal block valve locations and rupture scenarios, such as the "guillotine" scenario, and differential valve response times.

c. Estimate the spill magnitude (in a range of minimum spill to somewhat longer response time spills) that then should then be used to assess socio-economic and environmental impact along the existing corridor.

d. The risk assessment should take into account the larger rainfall events in recent years possibly caused by global warming, including an assessment of the possibility of increased scouring in rivers crossed by these corridors.

I.C.2*. What is the "worst case" when multiple pipelines are in close proximity to use in the risk assessment*? "A review should be undertaken with respect what should be the proper "worst-case" rupture scenario when multiple pipelines are packed close together in a corridor. This should include:

a. An assessment of whether a "worst-case" rupture on one line threatens rupture of another line, such as a large fire.

b. An assessment of whether the response to a "worst case" event on one line is slowed by the presence of other lines either on one or both sides of the ruptured line because equipment can't cross the shallowly buried other lines. This should also include a description of circumstances where all or some lines still operating need to be shut-down during the response and the practicality of doing so. (It needs to be recognized that in some locations there are "cross-overs" where one line is constructed underneath other lines because of existing facilities on one side—such as railroad tracks—prevent construction on the preferred side.)

c. Consultation with state and federal pipeline authorities as well as the authors of the Attachment 4 study as to what constitutes "worst-case" ruptures when there are multiple lines in close proximity.

d. Consultation with the ORNL authors and others regarding the vulnerability of a corridor with multiple large pipelines in close proximity to deliberate actions and how this should be addressed in socio-economic and environmental impact reviews.

I.C.3*. A process is needed whereby problems found during review of additional pipelines in any given corridor that might threaten pipeline integrity are thoroughly reviewed by government personnel*. While perhaps outside the scope of the PUC Sandpiper review, procedures should be developed whereby state agency field staff who find potential problems at significant pipeline locations could be assured that the problems are adequately responded to by government agencies rather than pipeline owners.   I have personal knowledge of three such locations along these corridors, as discussed in Comment II.A below.

II. The PUC and Minnesota agencies indeed have significant jurisdiction over pipeline design issues related to oil spills and leaks and site-specific measures to prevent them.

<u>II.A. Overview and significance of the problem</u>. This is an important issue because a properly *designed and located* pipeline can result in the least amount of impact and be a safe way to transport petroleum products.

The central issue is that there is both federal and state jurisdiction and authority, and that it overlaps to some extent. In these comments I maintain that the PUC has clear authority to influence both pipeline *design* and location with respect to analyzing and mitigating impacts to people and the environment.

MDNR and MPCA field staff often have intimate knowledge of site specific conditions along pipeline corridors, and are trained to have such knowledge. Yet some pipeline companies, their consultants, and even some people in Minnesota government try to claim that pipeline *design* is solely the bailiwick of federal agencies and federal standards because such design pertains only to "safety standards."

On several occasions during my employment with the MDNR, and while working with other field staff, we suggested site-specific changes in design that would add more resource protection or mitigation, "pipeline safety standards" were invoked. This was strongly prevalent when DNR was trying to determine how block valve locations were selected, and why specific block valve recommendations weren't followed.

Other issues involved lack of clarity as to Minnesota Office of Pipeline Safety responsibilities regarding possible environmental damage at locations where pipe integrity was threatened. For example, during one review of the MinnCan pipeline, DNR staff (Fisheries and Ecological Resources) found a location at a proposed river crossing where a large tree had fallen into the river. This resulted in bottom scour exposing one of the older pipelines. Company officials were not interested, and indicated it was not in MDNR jurisdiction to solve this problem. A call to the State Office of Pipeline Safety only elicited a question as to whether it was brought to the attention of the pipeline company.

On another occasion during the Alberta Clipper review, an older pipeline was found to be hanging a foot or two over the surface of a designated trout stream east of Bemidji. A call to the Minnesota Office of Pipeline Safety elicited a statement that it was up to the pipeline company to correct the problem. This was likely Enbridge Line 1 because of its small size. (See attachment 2 for a description.)

The most serious problem occurred on the Alberta Clipper route on a Grant Creek crossing just west of Bemidji. I was directly involved in this site, and provided several written documentations as to what occurred. At this site, Grant Creek flows south through a narrow gap in an old railroad grade. Upstream of this gap Grant Creek flows through s a large expanse of wetland. The creek is also subject to numerous beaver dams upstream. The railroad bridge at this site had collapsed into the gap, which was also filled with segments of a five foot concrete culvert.

Immediately below the gap are 5 or 6 large pipelines, with the first being within just a few feet of the steep railroad grade. Grant Creek takes sharp turn to the east, actually following the pipeline in a parallel manner, until again turning south where it flows over the trenched pipes. I observed that bank erosion had removed 6 or 7 feet of the bank, and that this had all occurred since the previous summer. Therefore, this large pipeline was now only protected by about 5 feet of riverbank.

A large and rare rainfall event in the drainage above this site would have taken out beaver dams, and added to the flow through this narrow gap. It is likely that the first pipeline would have easily been exposed. In addition, the heavy concrete sections could have been eroded into the pipelines, threatening ruptures. Since Enbridge wanted to do something off the right of way in this location to "clean up" the site. They asked for my advice regarding permitting and repair. Since there were concrete sections available, and it looked as if there was a pipeline integrity issue present, I supplied the advice on armoring the eroding bank next to the pipeline, and moving the bank farther from the pipe. This was done by driving the 5 foot concrete sections into the stream bank, a technique I had essentially learned while employed at the DNR. I documented that this was a temporary solution

This site should be thoroughly assess at to susceptibility to scour—since it is an ideal site for down cutting caused by human activity restricting the floodplain of this river. On several other occasions, when DNR staff found exposed pipe on older—and large—pipelines in sensitive areas next to rivers, the same thing happened—staff were told it was up the pipeline company to fix the problem.

<u>II.B. Specific PUC rules on "safety standards."</u> The PUC rules for the route permit, in 7852.0200, Subp. 2 "Scope," has two sentences containing language pertaining to pipeline safety standards. In fact, the language is so similar as to be almost redundant:

--Second sentence: "This chapter does not set safety standards for pipelines."

--Last sentence: "The (permit) must not contravene applicable state or federal jurisdiction, rules, or regulations that govern safety standards for pipelines nor shall the permit set safety standards for the design or construction of pipelines."

I submit that the State of Minnesota has a number of clear ways it can influence Sandpiper (and any other liquid pipeline) without "setting safety standards." These are as follows:

II.B.1. Location of High Consequence Areas (HCA) is not necessarily only a "safety standard." These areas are referred to in federal safety standards for pipelines. They are areas where ". . .a release could have the most significant and adverse impact." Attachment 3 provides lots of detail concerning both human and ecologically important areas, such as "land area in which spilled liquids could affect the water supply……critically imperiled species…..areas where migratory birds congregate…..(pipelines) that pass near enough that a release could reach the area by flow over land or within a river, stream, lake, or other means, are assumed to affect (the HCA.)"

Strangely, this document doesn't mention an HCA identified by state authorities, but actually refers pipeline operators to Nature Conservancy personnel to be consulted on important areas. (A personal comment here: Might this not imply a rather over-reaching and likely unconstitutional claim of federal legal authority?)

In addition, while I was employed by the Minnesota DNR, we had a meeting with the Minnesota Office of Pipeline Safety regarding issues along the MinnCan route. The people we met with never mentioned the concept of HCAs. They were not familiar with or interested in site-specific environmental issues, in fact, and only referred to specific generic safety standards.

II.B.2. Recommendations top reduce confusion and lack of clarity among agencies with overlapping responsibilities.

a. PUC, DNR, BWSR and PCA staff consult the Minnesota Attorney General's Office to investigate the specific federal rules pertaining to HCA's to determine the ability of state authority to identify and influence the identification of both project-specific HSAs and more permanent HSAs. Examples of state-identified areas should include groundwater recharge zones, designated trout streams, canoe routes, rivers with significant fisheries or rivers leading to significant fisheries or drinking water supplies, and a number of others.

b. PUC, DNR, BWSR, and PCA should notify the federal Office of Pipeline Safety that Minnesota intends to actively propose additions to the National Pipeline Mapping System referred to in Attachment 3, based on the review of the Sandpiper proposal as well as the other Enbridge and Minnesota Pipeline company expansion plans. This should include the corridors identified in Attachment 1 as well as any other corridors and new pipelines.

c. The environmental analysis of the Sandpiper and alternatives identify HCAs along all alternative routes, including already-identified HCAs and ones identified by the public, Minnesota DNR, PCA, BWSR, federal COE during this pipeline review. The outside consultant hired by the PUC to do the analysis of impacts and the route comparison should be charged with consulting and coordinating with Minnesota state agencies to identify these areas. The route comparisons should then include these locations in the analysis.

d. Extra care should be taken in the identification of HCAs along any corridor with multiple pipelines because of the increased magnitude of possible ruptures affecting a wider area that normal for one pipeline.

II.C. Pipeline design features that protect people and the environment are site-specific and thus need site-specific design features. It should not be necessary to have to make this point because we are many years past such knowledge based on normal and standard techniques for assessing impacts and mitigating them. Almost every environmental permit given has site-specific measure.

Large-impact projects always should have site-specific design. In fact, well-designed pipeline projects when they are finally ready to be constructed uses something often called a "line list" which identifies down to the foot what environmental mitigation measures are to be used in sensitive locations.

II. D. Support for my contention that pipeline design features such as some block valve locations are not always a "safety standards" issue. The following information clearly supports this contention:

II.D.1. Citation 8 (Attachment 4). Block valves and other related design features work to rapidly shut down and isolate pipeline segments when a sudden pressure drop indicates a pipeline rupture of enough magnitude to trigger the designated pressure drop. They can either be manual valves or remotely-operated valves.

Attachment 4 is a recent (late 2012) major study regarding improving block valve usage to reduce releases of large amounts of hazardous liquids. This was done under the auspices of an internationally known energy research institution, the Oak Ridge National Laboratory. The instigation for this study was primarily driven by the natural gas pipeline explosion in California that killed 8 people, but also seems likely that it was influenced by the large Enbridge rupture in Michigan, since it uses both as case studies. This document illustrates why features such as block valves are clearly not always a "safety standard." Here are quotes relevant to site specific pipeline design that are not "safety standards."

".. . ..site-specific parameters that influence risk analyses and feasibility evaluations often vary significantly from one pipeline segment to another and may not be consistent with those considered in this study. Consequently, the technical, operational, and economic feasibility and potential cost benefits . . . . . .need to be evaluated on a case-by-case basis." (p. 1 of Attachment 4.)

"Section 4 of the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 calls for the Secretary of the U.S. Department of Transportation (DOT) to require by regulation the use of automatic or remotely controlled shutoff valves, or equivalent technology, where it is economically, technically, and operationally feasible on hazardous liquid and natural gas transmission pipeline facilities constructed or entirely replaced after the final rule was issued. . . . .The Act also requires a study to discuss the ability of transmission pipeline facility operators to respond to a hazardous liquid or natural gas release from a pipeline segment located in a high consequence area (HCA)." (p. 1 of attachment 4)

"In addition, operators are required to consider installing emergency flow restricting devices such as check valves and RCVs on pipeline segments to protect a HCA in the event of a hazardous liquid pipeline release. In making this determination, an operator must, at least, consider the swiftness of leak detection and pipeline shut down capabilities and benefits expected by reducing the spill size." (p. 2 attachment 4)

II.D.2. Citation 9. This engineering study, entitled "Method determines valve automation for remote pipelines," describes methods of determining where automated block valves are to be located. The method is clearly based on site-specific design features. In addition, the following quote summarizes how block valve location is not directly based on "safety standards":

"Most pipeline codes do not stipulate requirements for block valve spacing or remote pipeline valve operations along transmission pipelines carrying low-vapor-pressure petroleum products. This requirement is generally industry driven to control hazards and reduce environmental effects of pipeline ruptures or failures causing hydrocarbon spills. . . . . This article summarizes pipeline codes for valve spacing and spill limitations in high consequence areas (HCAs). It also provides a criterion for an acceptable oil spill volume caused by pipeline leak or full rupture. The criterion is based on industry's best practice." (Introduction to the study.)

Note: This study noted at the end that the acceptable spill volume used to determine the valve spacing was about 20,000 barrels of oil. The study was done for several large pipelines in Brazil. I did not attempt to decipher the meaning of that large amount being acceptable for design of block valve location.

II.D.3. Recommendations for Sandpiper review and analysis regarding block valve locations.

a. Enbridge be required to clearly describe their method of determining block valve determinations, including identifying what HCAs they used, as well as any other factors for determining such locations, including cost factors and "minimum acceptable leaks." This information should be submitted to the MPCA, MDNR, and COE in time for them to respond appropriately, and in time for incorporation into the analysis of impacts and Comparative Route Assessment.

b. MDNR, MPCA, and/or PUC (and COE) should request information from the Office of Pipeline Safety as to whether they have provided any advice to Enbridge as to method of determining block valve locations and acceptable minimum amounts of oil at HCA locations, potential HCA locations, and other-than HCA locations, including cost-factors.

c. Minnesota state agencies and the Corps of Engineers develop a cooperative and partnership relationship regarding the potential socio-economic and environmental risks of having multiple large pipelines in close proximity to each other.

III. The PUC, other Minnesota agencies, and the US Corps of Engineers and EPA must address "corridor fatigue."

PUC pipeline rules favor following existing corridors—even when the pipelines are squeezed into environmentally and socially sensitive areas. The current rules also allow pipeline companies to use the rules to their benefit and to reduce the scope of the analysis. Clearly, this needs a legislative solution. However, there are methods that can be used in the Sandpiper review that are within the current rules that can attempt to get at the "corridor fatigue" problem. I provide some detail in these comments because of the importance of this issue. My recommendations as to how to handle this in the Sandpiper review are in III.C. below.

III.A. Background. "Corridor fatigue" is a term that has been used to talk about what happens when multiple linear facilities such as pipelines and High Voltage Power Lines reach a point where cumulative impacts, objections from people nearby, and crowding of various sensitive areas along the edge of corridors began to be more and more apparent.

In fact, this term is inappropriate with respect to the pipeline corridors described in Attachment 1. Much more proper terms are "corridor sickness" or "corridor exhaustion."

Any resource manager with experience in environmental review of linear facilities in Minnesota (or elsewhere) knows the reasons that lead to overuse of corridors. Some of these are generic, and others are specifically relevant to the Sandpiper proposal. These are:

III.A. 1. *Original linear facility routes pre-date almost all environmental laws*. This meant the route went through high-impact locations that wouldn't otherwise be crossed under current laws and regulations. Essentially, these routes were the shortest distance between endpoints unless there were prohibitive obstacles in effect at the time of building. these original facilities were usually small pipelines. This is true of both the Enbridge Mainline corridor and the Minnesota Pipeline Corridor.

III.A.2. *Each additional facility was assessed independent of others.* Methodology to fairly assess cumulative impact of additional facilities after the second facility was usually not used. (It is often the third facility that starts to show the strain.)

III.A.3. *Large linear facilities are almost always controversial.* There was strong pressure to follow existing corridors. This then became embedded more and more strongly in either informal or formal policy, and finally made it into regulations. Unfortunately, when this was done, there was no concurrent regulation requiring an objective assessment of the pros and cons.

III.A.4*. Lack of appropriate regulations.* Policy-makers formalizing existing corridor locations as the most likely place to put new facilities didn't write corresponding policies that required a look at impacts of ever-larger corridors. Likely the best example of this I know of is the LaSalle Creek valley north of Itasca Park on the Minnesota Pipeline Corridor. This site is covered in detail below.

5. Citizens living next to corridors have little recourse to challenge expanding corridors, since the energy companies and PUC are essentially in agreement for all practical purposes. The PUC has not developed objective methodology to address this major problem. The result is that adjacent landowners are subject to the highest impact.

<u>III. B. Known potential impacts of enlarging Minnesota Pipeline and Enbridge mainline corridors because of previous recent reviews.</u> There are recent reviews of both of these corridors (except for the Sandpiper Green field route.) Therefore, these reviews, including comments of agencies with responsibilities for environmental protection during those reviews, are relevant to the current reviews.

II.B.1. PUC, MDNR,PCA, and COE review of the MinnCan pipeline. During the review process for the MinnCan pipeline, there were many issues raised by agencies with natural resource, wetland, and permitting authority. There was an important ALJ report prepared for this project. All of this is available in the PUC records for this project. There were also major problems identified during construction. The review of that project is recent enough so that environmental concerns raised are still relevant.

<u>I</u>*II.B.2. PUC, MDNR,PCA, and COE review of the Alberta Clipper/Southern Lights/LSr projects.* Even more recently, the Enbridge proposals follow its mainline corridor to Clearbrook. An alternative route to Sandpiper

follows the Mainline corridor on to Superior. Now, just 5 years later, Enbridge proposes to follow this same problematic route.

III.C. Route width for new reviews too restricted so that it exacerbates corridor fatigue. The PUC rules allow Enbridge to select the route width for their application. The rules state a route can be as narrow as the right of way required to construct the pipeline, and as wide as 1.25 miles. An examination of the Enbridge proposal indicates in many locations that Enbridge has selected a very narrow route width. It is obvious that the narrower the route width for this review along the existing Minnesota Pipeline Corridor, the more advantageous to Enbridge—because it becomes too late to adjust the right of way to avoid impacts found after finalization of the route width by the PUC.

Generally speaking, the PUC waits for others to object to this restrictive situation and propose enlargements, or other route segments or routes.

A good example concerns river and flood plain crossings. Normally, the clear standard for crossing of such environmentally sensitive features with linear facilities is perpendicular to the floodplain, and perpendicular to the river meander. In addition, as mentioned in Comment V, the MDNR does not have permit jurisdiction beyond the Ordinary High Water of the river or stream (this is the top of the bank in most cases.) The DNR has two options for influencing this—proposing a route segment change or widening, or relying on the PUC authority to require moving the centerline. Furthermore, DNR often indicates to applicants to begin preparing detailed applications for its license to cross before the environmental analysis of routes is completed.

In other areas, the 1.25 mile width is still too narrow to address the problems of pipeline corridors expanding more and more in high-impact areas.

III. D. LaSalle Creek problem area. More than any other location, this area epitomizes the landscape and regulatory issues of "corridor fatigue" and problems of following old straight-line routes. The crossing and surrounding landscape has the following characteristics:

--This location is not far north of Itasca park in a heavily forested area with steep and convoluted glacial moraine. LaSalle Creek itself is a small designated trout stream flowing in a glacial tunnel valley toward LaSalle Lake. The stream channel is deeply incised in the wetland with many meanders. Right at the crossing point, the stream and valley narrow upstream and widens out substantially downstream toward the lake. The ridges on either side of the tunnel valley are likely more than 100 feet higher than the stream.

--The existing Minnesota Pipeline Company pipelines transverse the valley at the almost the worst possible manner: a sharp oblique angle side-hilling down portions of the west hillside from the north, then side-hilling out of the valley on the east side after crossing the creek.

III.D.1. *Severe problems with the MinnCan crossing*. There were severe and numerous problems with this area. I am supplying some detail on these problems because I am proposing a re-route around this area several miles in length. The problems are as follows.

a. MDNR sent an "early-coordination" letter to the MinnCan consultant warning that this crossing was the worst site of all the locations in the Bemidji Region portion of the project. There was no response from MinnCan, and near-failure months later for MinnCan to even acknowledge such a letter. By then the PUC process had proceeded past the point for the MDNR to effectively examine another route in this high-resource area.

b. The two old and small pipelines were closely followed with the 24-inch MinnCan line with close separation, on the order of 40 feet if I recall. The old cleared right of way was fairly narrow. This greatly expanded during construction. MDNR measured a cleared right of way over 350 feet wide on the north end of the valley. (This was necessitated by the large amount of earth moving required to construct a 50-foot wide level construction word pad.) Topsoil was generally not separated here either, so impacts are long-term.

c. MinnCan did a directionally bore deep under LaSalle Creek. It was somewhat over 3,000 feet in length and done in the winter. As they bored under the creek itself, there was a large frac-out into the creek. Drilling mud escaped from several other locations besides the creek bed, all characterized by obvious groundwater upwelling. (In spite of the very cold temperatures the ground and wetland surface was not frozen.)

Construction stopped and clean-up was complicated and protracted. Because of the lack of frost from groundwater upwelling, it was impossible to get equipment to the site so that most work need to be done by hand.

However, it was necessary to get some equipment to the site, which was a very delicate operation because of the deep, soft, water saturated organic muck at the site. There were two existing pipelines floating in this water saturated muck near the surface. These could have been threatened by heavy equipment tipping into this area. Oil/ product flow was *not* shut off during these operations taking place a few feet from the pipes.

d. A large beaver dam downstream of the crossing had backed up water right to the crossing point, and covered parts of the creek receiving drilling mud. In other words, there was thin ice over the flooded creek channel. This obscured drilling mud material and caused safety problems in minus 15 degree weather.

III.D.2. Current Enbridge plans at this site. According to maps I examined during the public meeting at Clearbrook, Enbridge is now planning a warm weather crossing of the creek itself downstream from the existing crossing out in the broader wetland that leads to LaSalle Lake. The proposed crossing location is at a more perpendicular angle to the creek itself but not perpendicular to the valley, since the centerline of the pipe makes a sharp bend after coming down into the valley from the north. After the creek crossing, the Enbridge plan is to open up a new cleared right-of-way on the east side-hill of the valley. This plan was confirmed to me by MDNR staff. Enbridge had indicated to them they would accomplish the trenched crossing in a very short time to reduce impacts. I believe this is a very bad idea for the following reasons:

a. There is wetland along very much of this centerline proposal, including as the centerline comes down the hill from the north. There are wetlands on the slopes of the west hill side caused by abundant groundwater emergence. There is deep muck in this area, as well as out in the flat valley. Trenching through this soft area will require very large amounts of construction maps which usually require firmer wetland soils than are present. Furthermore, the trying to trench in such an area will result in slumping and the necessity of removing large amounts of material.

b. I have been involved in several wetland situations with some similarities to this site—but not such as large problem area as this. None of them approach the red flags of this area. The nature of the muck soil and substrate in the other areas meant that sheet pile had to be driven in on both sides of the trench in order to remove enough material to sink a weighted pipeline. I estimate that more than 1/4 mile of wetland is involved. Furthermore, both ends of this wetland traverse are on inclined wetland at the bottom of slopes. Attempting to excavate a temporary trench through such a location trenching could also easily open a channel so that unpredictable amounts of silt laden water—both groundwater and surface water—flows down the channel into LaSalle Creek.

c. The new right of way on the east side of the valley will also traverse groundwater emergent areas some distance before it rises far enough out of the valley to rejoin the corridor south some distance. This is also an additional impact of such a crossing.

d. I recommend that a route around LaSalle Creek and its valley be considered (see below.)

Recommendation: The route width should be expanded to the maximum 1.25 miles at every floodplain crossing that is oblique (not perpendicular to the floodplain.)

<u>III.C. Recommendations to begin to address "corridor fatigue" concerns relative to existing corridors followed by Sandpiper</u>.

II.C.1. *Federal EIS on Sandpiper.* The US Corps of Engineers should prepare a federal environmental impact statement for the Sandpiper project. The COE should do this for additional reasons beyond this topic, which will be contained in a separate recommendation to them.

It is clear that the PUC environmental analysis falls far short of what can be explored in an EIS. Nevertheless, Minnesota law says that the environmental analysis done by the PUC fulfils state environmental review requirements.

However, the MPCA and MDNR who are more familiar with the merits of EIS review than is the PUC, should certainly recommend to the COE that an EIS be done on this project.

III.C.2. *Incorporation by reference of the previous environmental analysis in these corridors*. I hereby incorporate by reference the PUC record of Alberta Clipper, LSr, Southern Lights and MinnCan projects into this Sandpiper review by the PUC. This should jump-start the review of "corridor fatigue" problems.

Examples of relevant documents for these four projects include: These issues and comments include:

> --The ALJ report son MinnCann and the Enbridge projects
> --All PCA and MDNR comments on the projects. There should be special focus on the MDNR objections to detailed and extensive comments that were ignored in ALJ findings.
> --All key determinations of the US COE on all projects, and all comments on the 404 notices for the projects

III.C.3. *Any records of specific unforeseen problems and impacts that developed post-permitting on these projects.* If the records cannot be found, these topics should be addressed in the environmental analysis:

a. "Frac-outs" on the MinnCan project. Frac-out is the common term for when drilling mud escapes from the bore from directionally drilled crossings, whether they be short or deep bores. Generally, this becomes evident by mud appearing on the surface or in water bodies. There were a large number of such events on the MinnCan project. Some of which were very large. These occurred in or next to the following rivers north of the point where the Sandpiper route turns east: Clearwater River floodplain east of Bagley, Mississippi

River at the crossing north of Itasca park, LaSalle Creek floodplain and creek bottom north of Itasca Park, and the Straight river just south of Park rapids. There were other frac-outs south of Park Rapids beyond the point where Sandpiper turns east on a Greenfield route.

Frac-outs occurred during winter bores, which greatly increased the difficulty with addressing them for several reasons. Determining amount and location of material was obstructed by ice. Recovery of material was difficult due to ice. Finally, ice conditions on flowing water was a hazard to workers attempting to recover material.

All records of frac-outs that occurred on MinnCan should be carefully examined as to amounts and locations. This may help to determine if there is a pattern as to when they occur. In each of the four rivers mentioned above, landscape conditions were such that groundwater upwelling zones were either present or suspected at the site of the frac-out. If this is correct, such landscape conditions that are present in other locations are a red flag for bores in the future.

Drilling mud is primarily bentonite clay but contains additives at the discretion of the pipeline company. Additives are a two edged sword: they can increase the success of the bore and reduce frac-outs, but some additives can be toxic to aquatic life. Furthermore, MinnCan initially claimed trade secret status on the first frac-out at the Clearwater river, which became a big obstacle to resolution. Therefore, PUC should require specific listing of any constituents of drilling mud before. Some of the frac-outs were in locations subject to direct DNR permit authority, but others were outside of the OHW so were not. PUC should make it a condition of the Route permit that frac-outs be handled in essentially the same manner wherever they occur, after recommendations from the DNR and MPCA.

b. *Winter construction successes and problems on MinnCan and Alberta Clipper.* Topsoil separation is important in all areas of deep excavation, including over the trench as well as side-cuts done to prepare the 50-foot level work pad. Poor separation leads to more successful invasive species invasion, and lost productivity. Frozen ground made topsoil separation problematic. In addition, winter construction made it erosion control more difficult and led to substantially higher erosion problems during spring runoff in certain locations.

IV. PUC and Hearing Officer must address concerns of the MDNR regarding natural resources not directly subject to MDNR and MPCA permits.

Environmental impact assessment includes—by law as well as best practice—consideration of impacts not necessarily covered by permits. As noted in a letter to the ALJ on the Alberta Clipper and Southern Lights project, the MDNR said it only had direct jurisdiction on less than 0.5 percent of the route. (April 21, 2008 letter to AlJ Judge Eric Lippman, from Matt Langan, MDNR). This jurisdiction involved public land crossings and river crossings restricted to the OHW (generally the top of the riverbank.)

Subsequently, the MDNR made extensive factually supported comments regarding natural resources in their areas of expertise. Serious problems with Enbridge's data, lack of supporting information, and assessment of impacts were noted. Some of these were glaring errors, such as obvious underestimation of area of impact. The ALJ report finalized its report without discussing the merits of the DNR comments, and did not address any of them in numerous findings on the route permit conditions. At the same time, it praised Enbridge's approach. A "reasonable person" perhaps would find it troubling that an ALJ, who lacks natural resource expertise, would replace the expertise of an important state agency charged by Minnesota law with protecting its natural resources, with that of an energy company with obvious motivations for downplaying impacts to such resources. The lack of attention to the MDNR comments is documented in three subsequent letters to the PUC staff after the ALJ report was finalized (April 25, 2008 letter to Larry Hartman from Matt Langan, MDNR; August 1, 2008 letter to Bill Haar, PUC Executive Director from Matt Langan, and November 13, 2008 letter to Larry Hartman from Matt Langan, MNDR.

Recommendation. The PUC should ensure that this does not happen again, and ensure that the ALJ for this project is charged with specifically making findings regarding potential environmental impacts found to be of concern by state agencies such as the PCA and MDNR.

V. PUC and ALJ must use accepted impact analysis methods and its own rules to proactively address the Sandpiper project and future even though its environmental report substitutes for an EIS or EA according to law and stature.

V.A. Pipeline rules available to the PUC to improve its responsibility, process ,and results. Many of the pipeline route permit rules appear on their face to restrict and narrow the environmental analysis as compared to that done under EIS rules and ;procedures for other large facilities. However, a reading of the rules indicates that the PUC has lots more authority than it used on the Alberta Clipper projects. All of the following rules allow the PUC to address **all** of the topics I have raised in these comments:

V.A.1. Rule "7852.3200, Subpart1: "When the commission issues a pipeline routing permit for the construction of a pipeline and associated facilities, the commission shall designate a route…..conditions for right of way preparation, construction, cleanup, and restoration. . . . **and any other conditions relevant to minimizing environmental and human impact.**" (emphasis added.)

Note: The PUC could have chosen to fully address the MDNR comments that were not addressed on Alberta Clipper using the highlighted language. It now needs to respond to comments by other state agencies on the Sandpiper project and use this clause.

V.A. 2. Rule "7852.0200 Authority, scope, purpose, and objectives

"Subp. 3. Purpose. Minnesota Statutes, section 216G.02, recognizes that pipeline location and restoration of the affected area after construction is important to citizens and their welfare **and that the presence or location of a pipeline may have a significant impact on humans and the environment**. To properly assess and determine the location of a pipeline**, it is necessary to understand the impact that a proposed pipeline project will have on the environment**. .. .. The purpose of this chapter is to aid in the selection of a pipeline route and **to aid in the understanding of its impacts and how those impacts may be reduced or mitigated through the preparation and review of information contained in pipeline routing permit applications and environmental review documents**.

Note: The PUC can use this clause to address pipeline rupture risk, corridor fatigue, and so forth.

"Subp. 4. Objectives. The process created by this chapter is designed to:
A. locate proposed pipelines in an orderly manner that minimizes adverse human and environmental impact;
B. provide information **to the project proposer, governmental decision makers, and the public** concerning the primary human and environmental effects of a proposed pipeline project**;**

*Note: Note that this clause contains the phrase "**to** the project proposer. . . .decision makers, and the public" concerning the human and environmental effects of the project. On the Alberta Clipper project, the PUC, and ALJ passively turned this phrase entirely on its head and accepted the Enbridge analysis of many issues rather than accept expert analysis from responsible state agencies. This must not happen on the Sandpiper project. The PUC should insist on its role of providing objective information **to** other parties. It should do so on the main topics of these comments.*

V.A. 3. "7852.1400 Route proposal acceptance.

> Subp. 2. Sources of route proposals. **The Public Utilities Commission staff and the citizen advisory committee may propose routes or route segments directly to the commission**.

Note: The PUC can use this clause to address corridor fatigue and to attempt to obtain objective comparisons of alter=natives to problem locations.

V.A. 4. "7852.1900 Criteria for pipeline route selection.

> "I. cumulative potential effects of related or anticipated future pipeline construction; . . ."

Note: The PUC can clearly address the issues of "corridor fatigue" by using this clause.

<u>V.B. PUC can use standard impact assessment methods</u> The statute governing pipelines indicates that the PUC Environmental report meets the requirements of an EIS or EA. However, this does not mean that methods of analysis of impacts do not need to reflect standard methods used in EISs.

The request to the public to propose methods of analysis in the PUC public notice actually is strange. There are effective methods for analyzing impacts to humans and the environment and methods for comparing routes for linear facilities. These methods have been in effective use for many years. All one needs to do is find an EIS that has done so effectively.

<u>V.C. PUC staff needs to acknowledge the limitations of the pipeline environmental analysis .</u> I was present at the Sandpiper public meeting Clearbrook some weeks ago. A citizen asked how the PUC environmental analysis compared to an EIS. The PUC lead person said it was essentially the same. I was taken aback, as were some others that were present. I was later informed that this same statement was made at the Park Rapids meeting. This is highly concerning since the citizen was misled. It also is concerning because it implies PUC staff is unaware of important and routine methods of analyzing impacts and alternatives in EISs on linear facilities. Such methods are an answer to the question in the Sandpiper public notice of "topics open to public discussion. . . .Are there specific methods to address these impacts. . . .?".

Here are some reasons how the PUC environmental report very much differs from an EIS:

--PUC rules on pipelines allow the project proposer to so narrowly define the project that there is a large burden to overcome to define alternatives and even to analyze impacts. Pipeline rules favor existing corridors without a specific requirement to objectively analyze impacts of concentrating facilities in environmentally inappropriate areas. This would be impossible under an EIS.

--The PUC environmental report is finalized in-house. There is no opportunity to comment on a public review draft report. On draft EISs, the preparer is bound by law and rule to address reasonable comments supported by sound data. No such process exists for pipelines under PUC rules. With the case of Alberta Clipper, the ALJ report would have been found deeply flawed if it had been subject to the standards for responding to comments that are found in the EIS process.

--Finally, compare the PUC process for siting HVTL lines: it uses routine methods of comparing routes and alternatives that are answers to the question posed as to how

VI. Proposed alternative routes and route enlargements

The PUC public notice solicits suggestions for alternative routes or route segments. In addition, Larry Hartman, the PUC person leading the Clearbrook public meeting, received a number of questions as to the burdensome format that appeared to be required for such proposals to be successful. He indicated alternatives would be considered that left out factors apparently required by the rules, and that a simple hand-drawn line on a map would be sufficient.

Therefore, the following recommendations for analyzing additional routes are provided:

<u>VI. A. Widen Sandpiper route width wherever it is less than 1.25 miles in width</u>. Enbridge has in many locations along its route narrowed the route nearly its minimum required by the PUC rule. This greatly reduces the scope of analysis of impacts very early in the siting process. This very much reduces the flexibility of moving the centerline to reduce impacts as problems are discovered during site reviews. This problem was severe during the Alberta Clipper review. Therefore, the route width should be expanded to the maximum allowable along the entire proposed route, as well as any new routes or route segments accepted for study. This is 1.25 miles in width. This will more appropriately meet the PUC requirements to adequately study environmental impacts. This is especially important at all crossings of rivers and other sensitive locations.

V.B<u>. Route segment following Enbridge's North Dakota Pipeline corridor to Clearbrook.</u> Enbridge's web site indicates that the existing pipeline has the capacity carry 475,000 bpd, yet Citation #2 says it is carrying 210,000 bpd at this time. If this is correct, there is excess capacity in the North Dakota line so as to allow it to carry the 225,000 bpd of the Sandpiper line. Therefore, there is a question as to whether another line is needed at this time for this route segment.

This route is clearly indicated on Enbridge's application.

<u>V.C. Enbridge Mainline Corridor, Clearbrook to Superior</u>. This route should be studied as an alternative to Enbridge's preferred route. The study corridor should be widened to the maximum 1.25 miles. This route is clearly indicated on the Alberta Clipper PUC files, which are incorporated into this PUC record by reference.

<u>V.D. Any route alternatives studied for the Alberta Clipper project</u>. There were a number of alternatives studied for the Alberta Clipper project. These routes are clearly identified on maps in the PUC record of that project. These include HVTL corridors and gas pipeline corridors. They should be re-studied for the Sandpiper project.

<u>V.E. LaSalle Creek alternative.</u> An alternative which avoids the major problems of crossing LaSalle Creek and its valley at an angle needs to be studied. Adding two large diameter pipelines to this area—Sandpiper and the Line 3 replacement/upgrade—is extremely likely to have large off-right-of-way impacts to groundwater, Big LaSalle Lake, and LaSalle Creek. In addition, given the sub-surface conditions, it will be very hard to

predict site-specific technical engineering plans for how to construct and maintain pipelines in this area. This could lead to massive problems and impact area growth during construction. This area could well become a case study of where not to build large pipelines.

A route avoiding this feature also crosses other areas with natural resource value, other private and public lands, and opens a new corridor. However, such an alternative for study must be accomplished because of escalating consequences of adding two more pipelines. I do not have an ability to submit a map today of my proposal, since I have to submit comments electronically in order to meet today's comment deadline. I can submit this by mail later. However, based on PUC statements made at the Clearbrook public meeting, this is sufficient as long as I describe the alternative in enough detail to identify it.

Here is a verbal description of the route: It is a 1.25 mile wide route deviating from the existing corridor in section 11 of Itasca Township in Clearwater County, then goes southwest to turn south along the east side of Clearwater County 2. It then turns SE to follow the north side of state highway 92, roughly paralleling it with the south edge of the route along this highway. It then turns east to rejoin the corridor in Section 32 of Lake Hattie township in Hubbard County.

On a final note, I believe it is within the PUCs ability to widen the "route" to more than 1.25 miles in this area.

<u>V.D. Enbridge Line #3 enlargement/replacement.</u> PUC needs to formally include the potential routes for this project that is clearly now in the planning stage. In addition, PUC should begin entering into studies for this project to analyze the alternative of following the corridors for the Great Northern Transmission line, now under review, since this line comes from Canada, and is potentially a route to Superior.

V. Significant impacts not otherwise indicated in these comments.

Here is a list of potential important impacts that need be addressed in the review of all route proposals, initially in a generic manner, and then as the focus is on site specific areas:

1. Analyze the advantages of topsoil separation in all areas where excavation into subsoil and parent material would otherwise result in mixing of parent material with top soil. It has been clearly demonstrated that creation of such disturbed areas leads to greater success for invasive species such as spotted knapweed and other noxious weeds. This also results in lowered productivity on not only farmland, but forest land, and reduced habitat value. In addition, it is becoming standard practice for responsible pipeline companies to accomplish this.

2. Requiring accurate depiction of any areas where excavation into parent material and subsoil occurs. Such excavation is routine in non-flat terrain in order to obtain the necessary 50-foot wide work pad for construction.

3. Detailed analysis of the product shipped in order to explore the environmental and human impacts of pipeline rupture.

4. Detailed analysis of the content of drilling muds to be used, and requirements for immediate notice to appropriate agencies when frac-outs occur during bores. Route permits should require agency review of any new additives considered during construction.

5. Careful analysis of the pros and cons of winter construction vs warm season construction. Such an analysis should be entirely independent of Enbridge desires to construct on their timetable, or for solely cost reduction reasons.

6. Careful analysis of the need for deep ripping of the work pad in areas of high clay soils. Operation of very heavy equipment along the work pad—which is essentially a road during construction—can create compaction layers in clayey soils that persist for as long as a projected 200 years.

7. Careful analysis and critique of proposed extra work space areas in sensitive locations such as stream crossings. Such areas sometimes are based solely on engineering requirements rather than given a careful review to reduce environmental impacts.

8. Careful review of the project's off-right of way affected area, and a PUC requirement that Enbridge submit all such areas to agencies for review.

9. An analysis of the damages caused by encroachment on the right of way from ATVs and other off-road highway vehicles. This has been observed to be intense in some areas, according to DNR comment letters. The MDNR has no jurisdiction to respond to this use which can cause stream bank erosion, siltation, and so forth.

V. Cumulative Impacts.

As noted in the above comments, the PUC rules require that the Commission **shall** consider "cumulative potential impacts of related or anticipated future pipeline construction. . . ."

Enbridge recently announced it is planning to "replace" in the near future its Line 3 pipeline that is in now within the mainline corridor from Canada to Superior. The announcements also note that operation of the old Line 3 will continue until the new line—upgraded to 36 inches—is completed. Therefore the new line will not be in the same location as the old line. Enbridge has indicated in the announcements that it is considering both the Mainline Corridor to Superior and its preferred Sandpiper route. Therefore, the PUC needs to conduct the following analysis:

--Cumulative impacts of adding two large pipelines in these routes, including the existing corridors and the new Greenfield route east of Park Rapids, and on any alternatives to the Sandpiper project accepted for study.

--PUC needs to inform state agencies that are currently in the early stages of reviewing applications for Sandpiper, (such as the DNR and PCA) that PUC is conducting a cumulative effects analysis on these two pipelines that may result in changes in locations. This should be done under the PUC rule cited above concerning responsibilities of the PUC to provide information **to** other stakeholders and the public.

List of attachments

1. Attachment 1. Estimates of oil/product flows in proposed and alternative corridors
2. Attachment 2. Enbridge schematic of its pipeline systems
3. Attachment 3. Web page from the US Department of transportation describing HCA areas
4. Attachment 4. Verbatim excerpts from an ORNL risk assessment appropriate for the Sandpiper project

CITATIONS

#1. Enbridge. 2013. "Enbridge Pipeline System Configuration." Quarter 1, 2013. Color chart showing entire Enbridge system in the United States and Canada, including data on individual lines, pipeline size, product type, and pipeline capacities (based on annual capacities). Available from one of the Enbridge web sites, and downloaded March 2014.

#2. Minnesota House of Representatives, House research. June 2013. Bob Eleff, Legislative Analyst. "Minnesota's Petroleum Infrastructure: :Pipelines, Refineries, Terminals.

#3. Thompson/Reuters News Service. March 31, 2014. "Enbridge to expand Southern Lights Pipeline as demand rises." Reuters Business and Financial News.

#4. Reuters News Services. March 4, 2014. "Update 2—Enbridge to spend C$7 billion (Canadian) to replace pipeline to US." Reuters Business and Financial News. (Concerns Line #3) Also, at the same time, Enbridge web sites indicate this 34 inch line will be upgraded to 36 inches from 34, and the old line won't be decommissioned until the new line is in service.

#5. Forum News Services. March 5, 2014. John Myers. "Another Enbridge proposal would replace line from Canada to Wisconsin." Concerns Enbridge Line 3 upgrade as in #4, but this article quotes an Enbridge spokesperson that both the Sandpiper Route/Corridor and the Enbridge Mainline Corridor along US 2 are being looked at as possible locations.

$6. Federal Reserve Bank of Minneapolis. May 1, 2007. Kathy Cobb. "This nation's rapacious appetite for oil products and Canada's vast supply spur district pipeline projects." Newsletter. This article notes that MinnCan can be increased by 185,000 bpd to increase the Mn Pipeline Corridor to 640,000 bpd.

$7. Minnesota Public Utility Commission (PUC) public notice on Sandpiper, January 31, 2014.

#8. Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" Date Published: October 2012. Revised: December 2012. For U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Pipeline Safety Program | East Building 2nd Floor 1200 New Jersey Avenue, S.E. Washington, DC 20590

#9. Online Oil and Gas Journal. January 17 2005. (Printed from site 3/29/2014.) "Method determines valve automation for remote pipelines."

Attachment 1

ESTIMATES OF EXISTING AND PROPOSED PIPELINE FLOWS RELATED TO PROPOSED SANDPIPER CORRIDORS AND TRANSLATED TO SELECTED RIVER FLOWS

Note: Pipeline capacities are given in barrels per day (bpd). Product flow rates are converted to cubic feet per second (cfs) in order to compare to typical river flows along the routes. Rates are calculated based on 42 gallons/barrel. A useful rule of thumb is that 100,000 bpd converts to 6.5 cfs. Product type is variable, and some information about types is given in Attachment 2.

A. Enbridge Pipelines from Minnesota border east to Clearbrook

Note: All lines are in one corridor except for North Dakota Pipeline which joins the "Mainline Corridor" at Clearbrook which then goes on to Superior roughly along US Highway #2.; Enbridge refers to the main corridor as "Enbridge Mainline Corridor.

A. 1. Existing Enbridge Pipelines

Note: All product flow is to the East-southeast except for the diluent line, which takes product from Illinois refineries back to Alberta for "thinning" heavy crude so it can be pumped in pipelines. Product types are listed by Enbridge in Attachment 2.

Pipeline name	Barrels per Day Amount	Flow rate cfs	Source	Pipe diameter	Citation
Line 1	236,500	15.4	Alberta	18/20 inches	#1
Line 2b	442,200	28.7	Alberta	24/26 inches	#1
Line 3	390,000	25.4	Alberta	34 inches	#1
Line 4	795,700	51.7	Alberta	36/48 inches	#1
Line 67 (Alberta Clipper)	450,000	29.2	Alberta	36 inches	#1
Line 65 (LSr)	186,000	12.1	North Dakota	20 inches	#1,#2
North Dakota Pipeline	210,000	13.6	North Dakota	?	#1, #2
Southern Lights Diluent	180,000	11.7	US refineries	20 inches	#2, #3
Totals	2,890,400 bpd	188 cfs			

A.2. Expansion proposals by Enbridge, Minnesota border east to Clearbrook

Expansions:	bpd amount	cfs		Pipe Diameter	Citation
Line 3 increase:	370,000	24.0	(total 760,000)	34 inches to 36	#4
Line 67 increase:	350,000	22.8	(total 800,000)	Pumps added	#2
Southern Lights increase:	95,000	6.2	(total 275,000)	Pumps added	#3
New line					
Sandpiper	225,000	14.6		24 inches	#7
Subtotal (new + expand)	1,040,000	67.6			
Grand total, existing and expanded	3,930,400	255 cfs			

B. Enbridge Pipelines from Clearbrook east to Superior

Note: There is a major facility at Clearbrook whereby some product is routed south to the Twin Cities on 3 pipelines owned by the Minnesota Pipeline Company—a different company from Enbridge. One of these, the MinnCan line, was recently constructed. (There are "loops" at a few locations, so that there may be 4 lines in place in the corridor at those locations.) According to Citation #2, currently this amount is 455,000 bpd. It is difficult to determine exact amounts in the two older lines, but it is not necessary for this level of analysis.

B.1. Existing Enbridge pipelines from Clearbrook to Superior

Note: For purposes of this analysis, it is sufficient to calculate a total of existing product flows from Clearbrook to Superior by subtracting the amount diverted south at Clearbrook from the total amount entering the Clearbrook terminal:

Total entering Clearbrook terminal: 2,890,400 bpd
Amount routed south: - 455,000 bpd
Total existing flows to Superior: 2,435,400 bpd or 158 cfs

B.2. **Expansion proposals by Enbridge, Clearbrook to Superior**
Note: An alternative route for the new proposed Sandpiper project is along this Enbridge mainline corridor. It is not listed here, but if it did follow this corridor, it would increase flows by 225,000 bpd, or 14.6 cfs. Also, the Line 3 replacement/expansion could follow the southern route, but is included here. If Line 3 would instead go south of Clearbrook, the amounts listed here should be decreased by 760,000 bpd or 49.4 cfs.

Pipeline name	bpd Amount	cfs		Pipe diameter	Citation
Line 3 increase:	370,000	24.0	(total 760,000)	34 inches to 36	#4
Line 67 increase:	350,000	22.8	(total 800,000)	Pumps added	#2
Southern Lights increase:	95,000	6.2	(total 275,000)	Pumps added	#3

Total increase: 815,000 53.0 cfs
Grand total, existing
+ increases 3,250,400 bpd 211.2 cfs

C. Pipelines routed south from Clearbrook
Note: New Enbridge proposals are to follow the existing Minnesota Pipeline Company corridor to near Park Rapids, and then create a new corridor east to Superior, Wisconsin,

C. 1. Existing Pipelines to Twin Cities, Minnesota Pipeline Company (owned by Koch Industries)

Pipeline name	Amount	cfs	Source	Pipe diameter	Citation
MinnCan	165,000	10.7	Canada	24	#2
Two older pipelines	290,000	16.9	ND, Canada?	?	#2

Total, Minnesota Pipeline: 455,000 29.6

C.2 Expanded capacity of Minnesota Pipeline Company

Total	640,000	41.6		Adding pumps?	#2

D. New Enbridge Pipelines potentially routed to existing corridor south from Clearbrook, then east from Park Rapids to Superior on new corridor

Note: Enbridge recently announced it is planning to "replace" and expand its older Line #3 in its mainline corridor across northern Minnesota to Superior, WI. It says it is also looking at instead going south from Clearbrook, then east from Park Rapids to follow the proposed Sandpiper route. Therefore, Line #3 is listed here in order to portray amounts of product potentially flowing in these corridors.

Pipeline name	bpd Amount	cfs	Source	Pipe diameter	Citation
Sandpiper	375,000	24.4	Alberta	30	#7
Line 3 expansion	760,000	49.4	Alberta	36	#4, #5

Total expansion: 1,135,000bpd 73.8cfs

E. Total potential Enbridge and Minnesota Pipeline company from Clearbrook to Park Rapids

Pipeline Company	bpd Amount	cfs	Source	Citation
Minnesota Pipeline Co.	640,000	41.6	North Dakota, Canada	#2
Enbridge	1,135,000	73.8	Canada	#2, #5

Total in corridor: 1,775,000 115.4

F. SUMMARY OF EXISTING AND PROPOSED OIL/PRODUCT FLOWS IN EXISTING PIPELINE CORRIDORS AS COMPARED TO SELECTED RIVER FLOWS

Company	Existing	cfs	Existing+Proposed	cfs
1. Enbridge N.D. Pipeline to Clearbrook	210,000	13.6	no increase	13.6
2. Enbridge mainline to Clearbrook	2,680,400	174.2	3,720,400	242 cfs
3. Enbridge Clearbrook to Superior	2,435,400	158.0	3,930,400	255 cfs
(Existing and proposed column includes Sandpiper and #3 expansion)				
4. Enbridge and MinnPipe Co. Clearbrook To south of Park Rapids	455,000	29.6	1,775,000	115.4
5. Enbridge, Park Rapids to Superior	No corridor	000	1,135,000	73.8

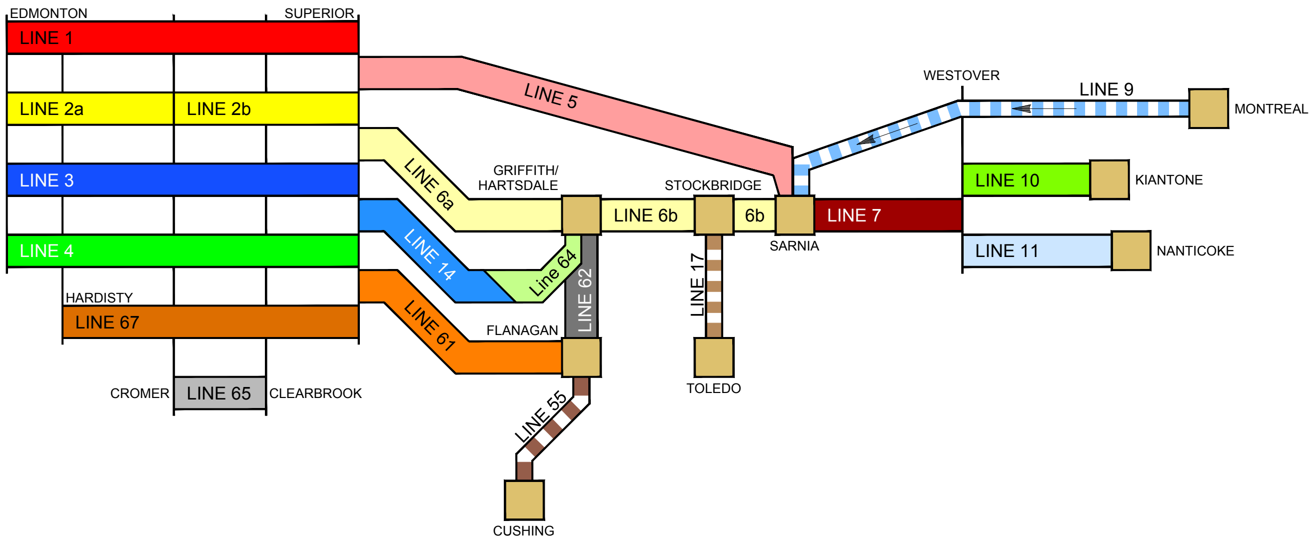
River name and location	Long-term median river flows (cfs) on this date from USGS Gauges, April 2, 2014	Approximate % of maximum oil flow to river flow
Snake river above Warren	124	195 percent
Clearwater river at Plummer	172	141 percent
Mississippi river at Bemidji	334	76 percent
Straight River south of Park Rapids	69	167 percent
Mississippi River at Grand Rapids	716	36 percent
Mississippi River at Aitkin	2,859	2.6 percent*
Prairie River at Taconite	125	204 percent
St. Louis River at Scanlon	1,850	14 percent

*New Enbridge corridor from Park Rapids to Superior crosses in this vicinity; all else are Enbridge mainline

Pipeline System Configuration

Quarter 1, 2013

ENBRIDGE



Line 1

37,600 m^3/d (236.5 kbpd)
18"/20" - 1098 miles
NGL
Refined Products
Light Synthetics

Line 2

Line 2a
70,300 m^3/d (442.2 kbpd)
24" - 596 miles
Line 2b
70,300 m^3/d (442.2 kbpd)
24"/26" - 502 miles
Condensates
Light Synthetics
Sweet
Light & High Sour

Line 3

62,000 m^3/d (390.0 kbpd)
34" - 1098 miles
Condensates (Edmonton to Hardisty)
Light Synthetics
Sweet
Light & High Sour

Line 4

126,500 m^3/d (795.7 kbpd)
36"/48" - 1098 miles
Heavy
Medium (Ex-Clearbrook)
Light Sour (Ex-Clearbrook)

Line 5

78,100 m^3/d (491.2 kbpd)
30" - 645 miles
NGL
Light Synthetics
Sweet
Light & High Sour

Line 6

Line 6a
106,000 m^3/d (666.7 kbpd)
34" - 467 miles
Line 6b
45,000 m^3/d (283.0 kbpd)
30" - 293 miles
Light Synthetics (Superior to Lockport)
Sweet (Superior to Lockport)
Light & High Sour
Medium
Heavy

Line 7

23,900 m^3/d (150.3 kbpd)
20" - 120 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 65

29,500 m^3/d (185.6 kbpd)
20" - 313 miles
Light Sour
Medium

Line 10

11,800 m^3/d (74.2 kbpd)
12"/20" - 91 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 11

18,600 m^3/d (117.0 kbpd)
16"/20" - 47 miles
Condensates
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 62

20,700 m^3/d (130.2 kbpd)
22" - 75 miles
Heavy

L 14 / L 64

50,500 m^3/d (317.6 kbpd)
24" - 467 miles
Light Synthetics
Sweet
Light & High Sour
Medium

Line 61

63,600 m^3/d (400.0 kbpd)
42" - 454 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 67

71,500 m^3/d (449.7 kbpd)
36" - 999 miles
Heavy

Not Part of the Enbridge Mainline System

Line 9

38,200 m^3/d (240.3 kbpd)
30" - 524 miles
Condensates
Sweet
Medium
Light & High Sour

Line 17

16,000 m^3/d (100.6 kbpd)
16" - 88 miles
Heavy

Line 55

30,700 m^3/d (193.3 kbpd)
22"/24" - 575 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

NOTES:

Capacities provided are Annual Capacities and do not include current restrictions.

- Updated: January 2013

File: 2013_Q1 System Config.dwg

Revised by: YZ
Drawn by: DRD

Choose One...

contained within each circle.

- Potential impact circles that contain 20 or more structures intended for human occupancy;, buildings housing populations of limited mobility; buildings that would be hard to evacuate (e.g., nursing homes, schools); or buildings and outside areas occupied by more than 20 persons on a specified minimum number of days each year, are defined as HCA's.

How do operators of pipelines know where HCA's are located?

- High population areas and other populated areas are identified using maps and data from the U.S. Census bureau.
- Critical drinking water sources and unusually sensitive ecological areas are identified using information from National Heritage Programs and Conservation Data Centers in each state, in conjunction with The Nature Conservancy.
- Because of the complexity of HCAs for Hazardous Liquid Pipelines, the Office of Pipeline Safety identifies and maps HCAs for Hazardous Liquids on its National Pipeline Mapping System (NPMS). These maps are revised periodically by OPS based on new and updated information.
- Operators of natural gas transmission pipelines must use a specified equation to calculate the radius of "potential impact circles" along their pipeline and compare the structures in those circles to the HCA criteria in the rule.

How do operators determine what pipeline segments require extra integrity protection due to the presence of HCAs?

- Pipeline operators must determine which segments of their pipeline could affect HCAs in the event of a release. This determination must be made assuming that a release can occur at any point, even though the likelihood of a release at any given point is very small.
- Hazardous liquid pipelines that pass through an HCA, or that pass near enough that a release could reach the area by flow over land or within a river, stream, lake, or other means, are assumed to have the potential to affect that area.
- Gas transmission pipelines that pass within any of the HCA potential impact circles are assumed to have the potential to affect that area. (Or, alternatively, operators may choose to treat all of their pipeline segments in Class 3 and 4 areas as HCAs.)

Date of Revision: 12012011

ATTACHMENT 4
VERBATIM EXCERPTS FROM THE FOLLOWING PIPELINE RISK ASSESSMENT OF SHUTOFF VALVES, INCLUDING ESTIMATES OF AMOUNTS OF RELEASES OF OIL AND OTHER PRODUCT FROM RUPTURES

Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" Date Published: October 2012. Revised: December 2012. For U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Pipeline Safety Program | East Building 2nd Floor 1200 New Jersey Avenue, S.E. Washington, DC 20590

ABSTRACT

Author's note: This 340 page study primarily concerns worst-case pipeline ruptures in populated areas, and was stimulated by a large California rupture of a gas pipeline in a urban area in California that killed 8 people. However, it also considers oil pipelines that do not catch fire, and those in High Consequence Areas (HCAs) that are also in or near ecologically significant areas. Therefore, it is highly relevant to certain the necessary route evaluation and environmental impact evaluation of the Sandpiper proposal. The underlined portions are indicate relevancy to Sandpiper, and in each case are the author's emphasis when they appear in the text.Page numbers at the bottom of the pages are excerpt page numbers rather than as in the original text.

This study assesses the effectiveness of block valve closure swiftness in mitigating the consequences of natural gas and hazardous liquid pipeline releases on public and environmental safety. It also evaluates the technical, operational, and economic feasibility and potential cost benefits of installing automatic shutoff valves (ASVs) and remote control valves (RCVs) in newly constructed and fully replaced transmission lines. Risk analyses of hypothetical pipeline release scenarios are used as the basis for assessing: . . . . and <u>(3) socioeconomic and environmental damage in HCAs caused by hazardous liquid pipeline releases of crude oil</u>. . . . . .However, these results may not apply to all newly constructed and fully replaced pipelines because <u>site-specific parameters that influence risk analyses and feasibility evaluations often vary significantly from one pipeline segment to another and may not be consistent with those considered in this study. Consequently, the technical, operational, and economic feasibility and potential cost benefits . . . . . .need to be evaluated on a case-by-case basis</u>. In theory, installing ASVs and RCVs in pipelines can be an effective strategy for mitigating potential consequences of unintended releases because decreasing the total volume of the release reduces overall impacts on the public and to the environment. <u>However, block valve closure has no effect on preventing pipeline failure or stopping the product that remains inside the isolated pipeline segments from escaping into the environment</u>. The benefits in terms of cost avoidance attributed to block valve closure swiftness increase as the time required to isolate the damaged transmission pipeline segment decreases. Block valve closure swiftness is most effective in mitigating damage resulting from a pipeline release. . . . .. Similarly, the avoided cost of socioeconomic and environmental damage for hazardous liquid pipeline releases without ignition increase as time required to isolate the damaged pipeline segment decreases.. . . .

The scope of the study is further limited by considering <u>only worst case pipeline release scenarios in HCAs involving guillotine-type breaks rather than other more common breaks, such as punctures and through-wall cracks.</u> Although ignition of the released product following a rupture is not ensured, this study only models release scenarios that result in immediate ignition of the released product at the break location. <u>The study also assesses potential socioeconomic and environmental effects of unintended crude oil releases without ignition from hazardous liquid pipelines in HCAs.</u>

EXECUTIVE SUMMARY

The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) is the Federal safety authority responsible for ensuring safety in the design, construction, operation and maintenance, and spill response planning for the 2.3 million (M) miles of natural gas and hazardous liquid transportation pipelines in the United States. Its mission is to protect people and the environment from the risks inherent in transportation of hazardous materials by pipeline and other modes of transportation. . . . Section 4 of the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 calls for the Secretary of the U.S. Department of Transportation (DOT) to require by regulation the use of automatic or remotely controlled shutoff valves, or equivalent technology, where it is economically, technically, and operationally feasible on hazardous liquid and natural gas transmission pipeline facilities constructed or entirely replaced after the final rule was issued.. . . .The Act also requires a study to discuss the ability of transmission pipeline facility operators to respond to a hazardous liquid or natural gas release from a pipeline segment located in a high consequence area (HCA). . . . . .

(This) study assesses the effectiveness of block valve closure swiftness in mitigating the consequences of natural gas and hazardous liquid pipeline releases on public and environmental safety. . . . . .It also evaluates the technical, operational, and economic feasibility and potential cost benefits of installing ASVs and RCVs in newly constructed and fully replaced pipelines. The results of this study apply to natural gas and hazardous liquid transmission lines. . . . .

Potential effects of unintended releases from natural gas and hazardous liquid pipelines on public and environmental safety are categorized as personal injuries and fatalities, property damage, and environmental impacts.

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Hazardous liquid pipeline operators are required to install block valves at prescribed locations to facilitate isolation of pump stations, breakout storage tanks, and lateral takeoffs and other points along the pipeline near designated bodies of water and populated areas to minimize damage and pollution from an accidental hazardous liquid discharge. In addition, operators are required to consider installing emergency flow restricting devices such as check valves and RCVs on pipeline segments to protect a HCA in the event of a hazardous liquid pipeline release. In making this determination, an operator must, at least, consider the swiftness of leak detection and pipeline shut down capabilities and benefits expected by reducing the spill size.

E.1 CONSEQUENCE MODELS

Risk analyses of hypothetical pipeline release scenarios are used as the basis for assessing: . . . . . .(3) socioeconomic and environmental damage in HCAs caused by hazardous liquid pipeline releases of crude oil.

E.4 ASSESSMENT METHODOLOGY AND RESULTS FOR HAZARDOUS LIQUID PIPELINE RELEASES WITHOUT IGNITION

Potential consequences on the human and natural environments resulting from a hazardous liquid release without ignition generally involve socioeconomic and environmental impacts. These impacts are influenced by the total quantity of hazardous liquid released and the habitats, resources, and land uses that are affected by the release. The methodology used in this study to quantify socioeconomic and environmental impacts resulting from a hazardous liquid release involves computing the quantity xxvii of hazardous liquid released as a function of block valve closure time and then using this quantity to establish the total damage cost based on the EPA's BOSCEM. The total damage cost is determined as follows:

☐ Add the unit response cost, the unit socioeconomic damage cost, and the unit environmental damage cost;

☐ Multiply the sum of these costs by the number of barrels spilled; and

☐ Apply a damage cost adjustment factor which aligns the total damage cost with the actual cleanup costs reported for recent crude oil spills in environmentally sensitive areas. The damage cost for crude oil released in the Enbridge Line 6B pipeline rupture in Marshall, Michigan in 2010 was approximately $38,000 per barrel.

The BOSCEM accounts for effects of spill size on the total damage cost by reducing the unit cost of damage as the number of barrels spilled increases.

The swiftness of block valve closure has a significant effect on mitigating potential socioeconomic and environmental damage to the human and natural environments resulting from hazardous liquid pipeline releases because damage costs increase as the spill size increases. The benefit in terms of cost avoidance for damage to the human and natural environments attributed to block valve closure swiftness increases as the duration of the block valve shutdown phase decreases.

1.3.2 Hazardous Liquid Pipeline Release Events

After a hazardous liquid pipeline ruptures, liquid begins flowing from the break and continues until draining is complete. The amount of material released following the break is influenced by a variety of factors. These factors include the type of liquid, the operating pressure of the pipeline, the size and position of the hole through which the liquid is released, the rate at which the liquid is being pumped through the pipeline, the response of the operator in terms of shutting off pumps and closing valves, the pipeline route and elevation profile, and the location of the break relative to the pumps and block valves. Block valves are installed in hazardous liquid pipelines to facilitate maintenance, operations, or construction and to limit the amount of liquid spilled following a pipeline rupture. For worst case, guillotine-type breaks, the effective hole size is equal to the line pipe diameter.

The behavior of the released liquid depends on its physical properties and the terrain in the vicinity of the break. For example, the liquid could flash on release of pressure to form a vapor cloud containing a fine mist of residual liquid droplets, accumulate in a pool on the ground surface near the pipeline break, create a stream that flows away from the release point, or soak into the surrounding soil (Acton, 2001).

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If the released liquid ignites following the break, it could result in a pool fire, a flash fire, or, under certain conditions, a vapor cloud explosion. Pool fires can spread out in all directions or flow in a particular path depending on the terrain. Figure 1.3 shows fire damage along a creek caused by a hazardous liquid pipeline release in Bellingham, Washington (NTSB, 2002). If ignition is delayed, the resulting evolution of vapor from the release could influence the magnitude and extent of a subsequent flash fire or explosion.

Fig. 1.3. Fire damage resulting from hazardous liquid pipeline release in Bellingham, Washington (NTSB, 2002).

Impacts resulting from time-dependent radiant thermal intensities at various separation distances from the break are based on the following hazardous liquid pipeline release scenario. The release occurs following a guillotine-type break where the escaping liquid accumulates in a pool on an impermeable level ground surface and ignites immediately upon release. Pool size is affected by the type of liquid released, the line pipe diameter, the pipeline operating pressure, the time required to detect the leak and initiate corrective actions to mitigate the consequences of the release, the spacing of block valves, the time required to close block valves and isolate the break, and the terrain features. Any potential environmental impacts to air and water quality caused by the released liquids and their products of combustions are beyond the scope of this study.

As discussed in Section 1.3.1, thermal radiation hazard zones with increasing impact severity are described by concentric circles centered on the pipeline rupture. The thermal radiation intensities at the perimeters of these concentric circles increase as the radii decrease. Effects of progressively higher heat fluxes on buildings and humans are described in Table 1.1. Because thermal radiation effects on buildings and humans are a function of radiant heat flux and exposure duration, quantifying the time-

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dependent variations in radiant heat fluxes for specific radii is key to assessing the benefits of installing RCVs and ASVs in hazardous liquid pipelines.

Given the wide range of actual pipeline sizes and operating pressures, leak detection periods, and block valve spacing and closure times, ORNL developed methodologies for quantifying the impacts of these parameters on areas affected by combustion of the escaping liquid hydrocarbon. The methodologies, which are described in Section 3.2, also characterize time-dependent radiant thermal intensities at various separation distances from the break.

Without ignition, the escaping liquid could adversely affect waterway navigation, surface and ground water quality, and other aspects of the human and natural environments. In addition, the cost to remediate the affected areas could be substantial. Consequence mitigation for a hazardous liquid pipeline release without ignition requires rapid detection, pump shutdown, and block valve closure. However, even if these actions are taken quickly, some amount of liquid in the pipeline will drain out of the broken pipeline segments. Methodologies for quantifying spill volumes for hazardous liquid pipelines releases and for estimating socioeconomic and environmental damage caused by the spill are described in Section 3.3.

1.3.2.1 Phases of a Hazardous Liquid Pipeline Release

A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Although the volume of the discharge depends on many factors, the event is subdivided into four sequential phases – Phase 1 Detection, Phase 2 Continued Pumping, Phase 3 Block Valve Closure, and Phase 4 Pipeline Drain Down (Borener, 1994 and California State Fire Marshal, 1993). The total discharge volume equals the sum of the volumes released during each phase. Events associated with each phase are described below.

Phase – 1 Detection: The detection phase begins immediately after the pipeline ruptures, t0, and continues until the leak is detected by any means and the Operator initiates corrective actions to mitigate the consequences of the release, td. The volume of liquid discharged during the detection phase, Vd, depends on the duration of this phase and is influenced by factors such as the size, shape, and location of the rupture; the pumping rate; the pipeline pressure; and the effectiveness of the leak detection system.

The volume of liquid discharged during the detection phase is determined using the following equation.

Vd = Qd(td – t0) (1.1)

where

Vd is the volume of liquid discharged during the detection phase, barrels (m3)

Qd is the discharge rate through the break that de

……..

Phase 2 – Continued Pumping: The continued pumping phase starts after corrective actions are initiated to mitigate the consequences of the release, td, and ends when the pumps stop operating, tp.

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During this time, additional hazardous liquid spills from the break. The duration of this phase can vary from a few minutes for systems with remotely operated pumps to hours for manually operated equipment located in remote areas. The volume of liquid discharged during the continued pumping phase, Vp, depends on the duration of this phase and is influenced by factors such as the type of equipment controls (automatically, remotely, or manually operated); personnel travel time to shutdown manually operated equipment; and the flow rates of the pumps.

…..Phase 3 – Block Valve Closure: The block valve closure phase starts when the pumps stop operating, tp, and ends when the upstream and downstream block valves close, ts. During this time, an additional amount of liquid in the pipeline spills from the break. The volume of liquid discharged during the block valve closure phase, Vs, depends on the duration of this phase and is influenced by factors such as the speed at which block valves located upstream and downstream from the break close. The duration of this phase can vary from a few minutes for systems with automatic or remotely controlled valves to hours for systems with manually operated valves located in remote areas.

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Phase 4 – Pipeline Drain Down: The pipeline drain down phase starts when the upstream and downstream block valves close isolating the portion of the pipeline that includes the break, ts. This phase

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ends when the remaining contents of the isolated portion of the damaged pipeline segment drain from the break, tf. The volume of liquid discharged during the drain down phase, Vf, is affected by the pipeline elevation profile including siphon action and the location of the break. A break that occurs at the highest elevation in the isolated portion of the pipeline results in no drain down volume, whereas a break that occurs at the lowest elevation could result in significant or complete drain down of the isolated portion of the pipeline.

The rate at which liquid drains from a break in the isolated portion of the damaged pipeline segment depends primarily on the size of the break and the pipeline elevation profile. It is also affected by the flow rate of air that must enter the break to replace the liquid and allow the draining to continue. In hilly or mountainous terrain, determining the length of pipeline, L, available to drain from a break must consider site-specific design and construction details. The volume of liquid discharged from the contributory length of pipeline, L, during the drain down phase, Vf, and the transient discharge rate, Qf, cannot be accurately determined without knowing the actual pipeline elevation profile as illustrated in Fig. 1.4.

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1.3.2.2 Block Valve Effects on a Hazardous Liquid Pipeline Release

The effectiveness of block valve closure swiftness on limiting the spill volume of a hazardous liquid pipeline release is influenced by the location of the block valves relative to the location of the break, the pipeline elevation profile between adjacent block valves, and the time required to close the block valves after the break is detected and the pumps are shut down.

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Block valves do not reduce the volume of liquid spilled during the detection and continued pumping phases because they are open. However, the total spill volume can be reduced by rapidly detecting the leak and taking immediate corrective actions including shutting down the pumps and closing the block valves to mitigate the consequences of the release. The effectiveness of block valve closure in mitigating the consequences of a hazardous liquid pipeline release decreases as the time required to close the block valve increases.

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1.3.5 Socioeconomic and Environmental Effects of a Hazardous Pipeline Release

Potential consequences and effects on the human and natural environments resulting from a hazardous liquid pipeline release without ignition generally involve socioeconomic and environmental impacts. These impacts are influenced by the total quantity of hazardous liquid released and the habitats, resources, and land uses that are affected by the release. The methodology used to quantifying socioeconomic and environmental impacts resulting from a hazardous liquid release involves computing the quantity of hazardous liquid released and then using this quantity to establish the total damage cost. The total damage cost is determined by adding the response cost, the socioeconomic damage cost, and the environmental damage cost as described in Section 3.3.3.

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3.2 HAZARDOUS LIQUID PIPELINES WITH IGNITION

Following a guillotine-type break in a hazardous liquid pipeline and ignition of the released hydrocarbon, a pool fire begins to form and continues to increase in diameter as liquid flows from the break. Eventually, the pool reaches an equilibrium diameter when the mass flow rate from the break equals the fuel mass burning rate. The fire will continue to burn until the liquid that remains in the isolated pipeline segments stops flowing from the pipeline.

A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Guillotine-type breaks are less common than other pipeline breaks such as fish-mouth type openings, but they can occur as a result of different causes including landslides, earthquakes, soil subsidence, soil erosion (e.g. scour in a river) and third-party damage. The guillotine-type break is the largest possible break and is therefore considered in this study as the worst case scenario. Although the volume of the discharge depends on many factors, to enable analysis, the event is divided into four sequential phases with the total discharge volume equal to the sum of the volumes released during each phase. The four phases (detection, continued pumping, block valve closure and pipeline drain down) are explained in Section 1.3.2.1.

The thermal radiation hazards from a hydrocarbon release and resulting pool fire depend on a variety of factors including the composition of the hydrocarbon, the size and shape of the fire, the duration of the fire, its proximity to the objects at risk, and the thermal characteristics of the object exposed to the fire.

3.3 HAZARDOUS LIQUID PIPELINES WITHOUT IGNITION

The socioeconomic and environmental effects of an oil spill are strongly influenced by the circumstances surrounding the spill including the type of product spilled, the location and timing of the spill, sensitive areas affected or threatened, liability limits in place, local and national laws, and cleanup strategy. The most important factors determining a per-unit cost are location and oil type, and possibly total spill amount.

The amount of oil spilled can have a profound effect on the cleanup costs. Obviously, the more oil spilled, the more oil there is to remove or disperse, and the more expensive the cleanup operation. However, cleanup costs on a per-unit basis decrease significantly with increasing amounts of oil spilled. Smaller spills are often more expensive on a per-unit basis than larger spills because of the costs associated with setting up the cleanup response, bringing in the equipment and labor, as well as bringing in the experts to evaluate the situation (Etkin, 1999).

The following methodology was used to determine: (1) the time-dependent discharge from a hazardous liquid transmission pipeline resulting from a guillotine-type break, and (2) the quantity of hazardous liquid released during the detection, continued pumping, block valve closure, and drain down phases

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needed to estimate cleanup costs. The total volume of a hazardous liquid pipeline release is primarily influenced by the flow rate at the time of the break; the combined durations of the detection, continued pumping, block valve closure phases; and the size and shape of the break. For worst case, guillotine-type breaks, where the effective hole size is equal to the line pipe diameter, the governing parameters are the line pipe diameter and the pipeline length between plateaus and peaks in the vicinity of the break.

Appendix A: Spill Volume Released Due to Valve Closure Times in Liquid Propane Pipelines, contains a family of curves for various hazardous liquid pipeline release scenarios that quantify the volume of liquid released following a guillotine-type break.

3.3.1 Analysis Scope, Parameters, and Assumptions

The methodology is based on fundamental fluid mechanics principles for computing the time-dependent response of hazardous liquid pipelines following a guillotine-type break. It is also suitable for determining the effects that detection, continued pumping, block valve closure duration have on a worst case discharge release determined in accordance with federal pipeline safety regulations in 49 CFR 194 for estimating worst case discharges from hazardous liquid pipelines (DOT, 2011e).

The configuration of the hypothetical hazardous liquid pipeline used to evaluate the effectiveness of RCVs and ASVs in mitigating the consequences of a release has the following design features and operating characteristics:

☐ The pump stations are located at 100 mile intervals along the pipeline.

☐ Each pressure pump station has a remote control device that can be activated by the pipeline operator to shut down the compressors after a rupture occurs.

☐ The rupture is a guillotine-type break that initiates the release event.

☐ The break is located at a low point in the pipeline elevation profile.

☐ The following times are study variables.

☐ The time when the operator detects the leak.

☐ The time when the operator stops the pumps.

☐ The time when the upstream and downstream block valves are closed and the line section with the break is isolated.

☐ The total volume of the hazardous liquid release equals the volume of liquid released during the detection, continued pumping, block valve closure, and drain down phases.

☐ The time-dependent flow rate is a study variable.

Study variables used to characterize hazardous liquid pipeline releases are listed in Table 3.24.

3.3.2 Analytical Approach and Computational Models

After a hazardous liquid pipeline ruptures without ignition, liquid begins flowing from the break and continues until draining is complete. A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Although the volume of the discharge depends on many factors, the event is subdivided into the four sequential phases with the total discharge volume equal to the sum of the volumes released during each phase. The phases of a hazardous liquid pipeline release are outlined in Section 1.3.2.1.

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block valve closure phase, minutes

The flow rate through the break remains constant through both the detection and continued pumping phases. In the block valve closure phase, the maximum flow rate through the break is based on the elevation difference of liquid in the pipeline. During the pipeline drain down phase, the maximum flow rate through the break is based on the difference between the operating pressure of the pipeline and atmospheric pressure. Requirements in 49 CFR 194.105(b)(1) state the worst case discharge is the largest volume of fluid released based on the pipeline's maximum release time, plus the maximum shutdown response time, multiplied by the maximum flow rate, which is based on the maximum daily capacity of the pipeline, plus the largest line drainage volume after shutdown of the line sections. In this methodology, the maximum flow rate can be estimated by multiplying the fluid speed at the pump by the cross sectional area of the line pipe. Although operators can use this rule to determine a worst case discharge, the actual flow rate during the block valve closure phase may be greater (less conservative) due to factors such as fluid density, pressure changes, pump performance characteristics, and the elevation profile of the pipeline which are not reflected in the methodology. These factors are important in a risk analysis because their effects influence time-dependent damage resulting from a release.

The influence of fluid density, pressure changes, and the elevation profile of the pipeline is taken into consideration in this study by using Bernoulli's equation to calculate the flow rate during the block valve closure and drain down phases. However, there are recognized limitations in using Bernoulli's equation to determine drain down time because it does not model the effects of air flow through the pipeline break which occurs as the fluid escapes following block valve closure. Although Bernoulli's equation does not produce an exact solution to this fluid dynamics problem, comparison of the results provides a consistent approach for evaluating the effectiveness of block valve closure swiftness on mitigating release consequences.

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3.3.3 Socioeconomic and Environmental Effects

The methodology for quantifying potential environmental effects resulting from a hazardous liquid release involves computing the quantity of hazardous liquid released and then using this quantity to establish the total damage cost. The total damage cost, Cd, is determined by adding the response cost, Cr, the socioeconomic damage cost, Cs, and the environmental damage cost, Ce. This methodology applies to crude oil and light fuel (gasoline) releases that affect the following areas.

☐ Commercially navigable waterways which means a waterway where a substantial likelihood of commercial navigation exists.

☐ High population areas and another populated areas which mean an urbanized area as defined and delineated by the Census Bureau that contains 50,000 or more people and has a population density of at least 1,000 people per square mile and a place as defined and delineated by the Census Bureau that contains a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area, respectively.

☐ Unusually Sensitive Areas (USAs) which is defined in 49 CFR 195.6 to mean a drinking water or ecological resource area that is unusually sensitive to environmental damage from a hazardous liquid pipeline release.

The response cost, Cr, is determined by multiplying the applicable unit response cost shown in Table 3.25 by the applicable medium modifier shown in Table 3.26.

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The response cost, C_r, is determined by multiplying the applicable unit response cost shown in Table 3.25 by the applicable medium modifier shown in Table 3.26.

Table 3.25. Unit response costs for crude oil and light fuel releases Release Quantity, barrels	**Crude Oil, $ per barrel**	**Light Fuels, $ per barrel**
<12	9,240	4,200
12-24	9,156	4,116
24-240	9,030	4,074
240-2,400	8,190	3,654
2,400-240,000	5,166	3,108
> 240,000	3,864	1,302

Table 3.26. Modifier for location medium categories for crude oil and light fuel releases Medium Category	**Medium Modifier**
Open Water/Shore	1.0
Soil/Sand	0.6
Pavement/Rock	0.5
Wetland	1.6
Mudflat	1.4
Grassland	0.7
Forest	0.8
Taiga (boreal forest)	0.9
Tundra	1.3

The socioeconomic damage cost, C_s, is determined by multiplying the applicable unit socioeconomic cost shown in Table 3.27 by applicable the socioeconomic cost modifier shown in Table 3.28.

Table 3.27. Unit socioeconomic and environmental costs for crude oil and light fuel releases Release Quantity, barrels	**Crude Oil, $ per barrel**		**Light Fuels, $ per barrel**	
Socioeconomic	**Environmental**		**Socioeconomic**	**Environmental**
<12	2,100	3,780	3,360	3,570
12-24	8,400	3,654	13,860	3,360
24-240	12,600	3,360	21,000	2,940
240-2,400	5,880	3,066	8,400	2,730
2,400-240,000	2,940	1,470	4,200	1,260
> 240,000	2,520	1,260	3,780	1,050

Table 3.28. Socioeconomic and cultural value ranking for crude oil and light fuel releases Value Rank	**Release Impact Site Description**	**Examples**	**Cost Modifier Value**

Extreme	Predominated by areas with high socioeconomic value that may potentially experience a large degree of long-term impact if oiled.	Subsistence/commercial fishing, aquaculture areas	2.0
Very High	Predominated by areas with high socioeconomic value that may potentially experience some long-term impact if oiled.	National park/reserves for ecotourism/nature viewing; historic areas	1.7
High	Predominated by areas with medium socioeconomic value that may potentially experience some long-term impact if oiled.	Recreational areas, sport fishing, farm/ranchland	1.0
Moderate	Predominated by areas with medium socioeconomic value that may potentially experience short-term impact if oiling occurs.	Residential areas; urban/suburban parks; roadsides	0.7
Minimal	Predominated by areas with a small amount of socioeconomic value that may potentially experience short-term impact if oiled.	Light industrial areas; commercial zones; urban areas	0.3
None	Predominated by areas already moderately to highly polluted or contaminated or of little socioeconomic or cultural import that would experience little short- or long-term impact if oiled.	Heavy industrial areas; designated dump sites	0.1

Note: Long-term impacts are those impacts that are expected to last months to years after the spill or be relatively irreversible. Short-term impacts are those impacts that are expected to last days to weeks after the spill occurs and are generally considered to be reasonably reversible.

Table 3.29. Freshwater vulnerability categories for crude oil and light fuel releases Freshwater Vulnerability Category	**Freshwater Vulnerability Modifier**
Wildlife Use	1.7
Drinking	1.6
Recreation	1.0
Industrial	0.4
Tributaries to Drinking/Recreation	1.2
Non-Specific	0.9

Table 3.30. Habitat and wildlife sensitivity categories for crude oil and light fuel releases

Habitat and Wildlife Sensitivity Category	Habitat and Wildlife Sensitivity Modifier
Urban/Industrial	0.4
Roadside/Suburb	0.7
River/Stream	1.5
Wetland	4.0
Agricultural	2.2
Dry Grassland	0.5
Lake/Pond	3.8
Estuary	1.2
Forest	2.9
Taiga	3.0
Tundra	2.5
Other Sensitive	3.2

This methodology is consistent with the U.S. Environmental Protection Agency (EPA) Basic Oil Spill Cost Estimation Model (BOSCEM) that was developed to provide the US EPA Oil Program with a methodology for estimating oil spill costs, including response costs and environmental and socioeconomic damages, for actual and hypothetical spills (Etkin, 2004).

Total Damage Cost Validation

The following case studies compare the actual damage costs for two hazardous liquid pipeline releases to the corresponding total damage costs determined using BOSCEM.

Case Study 1 – Enbridge 2010

The Enbridge Line 6B pipeline ruptured in Marshall, Michigan on July 25, 2010, and released approximately 20,000 barrels of crude oil. This release from the 30-in. nominal diameter pipeline caused environmental impacts along Talmadge Creek and the Kalamazoo River (Nicholson, 2012). Cleanup and recovery costs for this release totaled $767,000,000.

Using the EPA BOSCEM, the estimated total damage cost for this release is approximately $307,900,000. This total damage cost, C_d, includes the response cost, C_r, the socioeconomic damage cost, C_s, and the environmental damage cost, C_e, determined as follows.

Response cost, C_r = unit response cost □ medium modifier

Socioeconomic damage cost, C_s = unit socioeconomic cost □ socioeconomic cost modifier (High) = $2,940 □ 1.0 = $2,940/barrel

Environmental damage cost, C_e = unit environmental cost □ 0.5 □[freshw wildlife modifier (Wetland)] = $1,470 □ 0.5 □(1.7 + 4.0) = $4,190/barrel

Total damage cost (2004 basis), C_d = 20,000 barrels □ ($8,265 + $2

After adjusting for inflation, the total damage cost (2012 basis), C_d = $307,900,000 □ 1.25 (inflation factor) = $384,875,000 which is approximately 50% of the actual cost.

Case Study 2 – Yellowstone 2011

A 12-in. hazardous liquid pipeline owned by ExxonMobil Pipeline Company ruptured on July 1, 2011 under the Yellowstone River 20 miles upstream from Billings, Montana. The Yellowstone River is navigable water in the United States (EPA, 2011). The ruptured pipeline released an estimated 1,509 barrels of oil that entered the river before the pipeline was closed. Cleanup and recovery costs for this release totaled $135,000,000.

The estimated total damage cost for this release is $48,044,000 based on 2004 cost data. This total damage cost, C_d, includes the response cost, C_r, the socioeconomic damage cost, C_s, and the environmental damage cost, C_e, determined as follows.

Response cost, C_r = unit response cost m modifier (Wetland) = $8,190 □ 1.6 = $13,104/b

Socioeconomic damage cost, C_s = unit socioeconomic cost ☐ socioeconom
$5,880 ☐ 1.7 = $9,996/barrel.
Environmental damage cost, C_e = unit environmental cost ☐ 0.5 ☐ [fresh water modifier (Wildlife Use) +
wildlife modifier (Wetland)] = $3,066 ☐ 0.5 ☐ (1.7 + 4.0) = $8,738/barrel.
Total damage cost (2004 basis), C_d = 1,509 barrels ☐ ($13,104 + $9,9

After adjusting for inflation, the total damage cost (2012 basis), Cd = $48,044,000 ☐ 1.25 (inflation factor) = $60,054,000 which is approximately 44% of the actual cost.

Damage Cost Adjustment Factor
For this study, total damage costs of hazardous liquid pipeline releases are determined using the EPA BOSCEM and then increased by a damage cost adjustment factor of 2.1. This factor aligns the model with cleanup and recovery costs for two recent hazardous liquid pipeline releases of crude oil into sensitive socioeconomic and environmental areas.

3.3.4 Risk Analysis Results for Hazardous Liquid Pipeline Releases
The methodology for assessing socioeconomic and environmental damage to HCAs is based on computed release volumes corresponding to the detection, continued pumping, block valve closure, and drain down phases of a hazardous liquid pipeline release of crude oil without ignition. The method used in this analysis for defining maximum flow rate through the break is as defined in 49 CFR 195.105(b)(1) for the detection, pump shut down, block valve closure, and drain down phases. The damage is quantified using the EPA BOSCEM and the damage cost adjustment factor described in Section 3.3.3.
Eight case studies involving hypothetical hazardous liquid pipeline releases in HCAs are considered to assess effects of block valve closure time on socioeconomic and environmental damage resulting from a guillotine-type break. The duration of the detection and continued pumping phases for the hypothetical hazardous liquid pipelines are 5 minutes and 5 minutes, respectively. The duration of the block valve closure phases is 3 minutes.

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Characteristics for Case Study 8A, 8B, 8C, and 8D that involve 36-in. nominal diameter hazardous liquid pipelines are tabulated in Table 3.32. These case studies compare the following effects on avoided damage costs.

☐ Case studies 8A and 8B compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to either 400 psig or 1,480 psig, an elevation change of 100 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8C and 8D compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to either 400 psig or 1,480 psig, an elevation change of 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8A and 8C compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to 400 psig, an elevation change equal to either 100 ft or 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8B and 8D compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to 1,480 psig, an elevation change equal to either 100 ft or 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

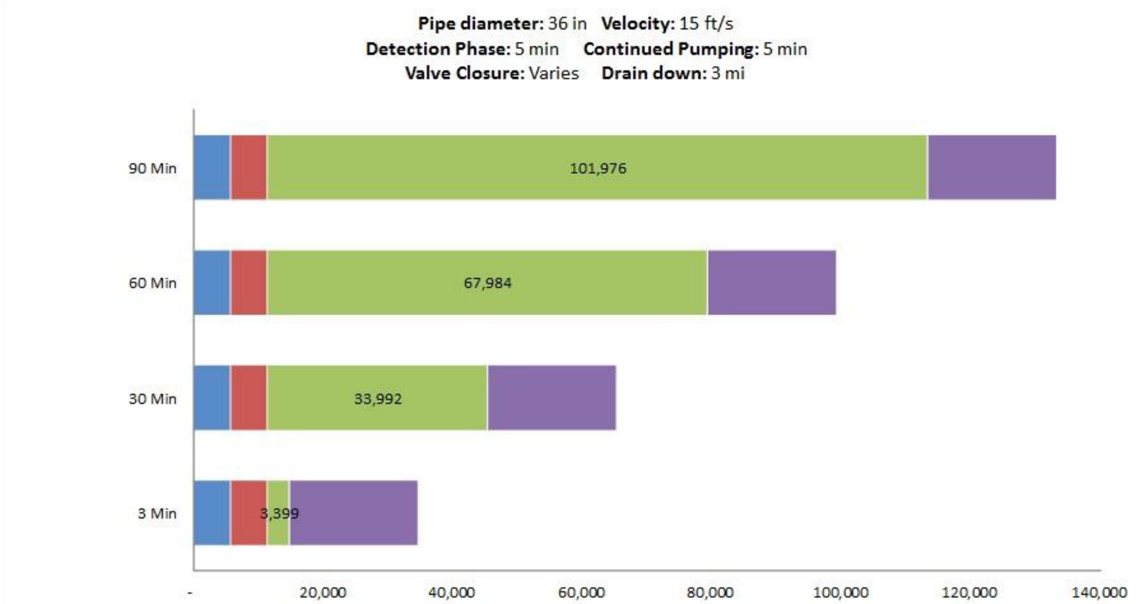
Figures 3.82 to 3.85 list the discharge volumes in barrels for Case Study 8A, 8B, 8C, and 8D. Discharge volumes listed in Table 3.32 for each case study are determined by adding the discharge volumes for the detection (5 minutes), continued pumping (5 minutes), block valve closure (3, 30, 60, and 90 minutes), and drain down (3 miles) phases. Avoided damage costs, which are also listed in Table 3.32, represent the differences between the discharge volumes for the various block valve closure durations and the 3 minute block valve closure duration multiplied by the avoided damage unit cost. The total damage unit cost for these case studies is estimated at $29,520 per barrel. This total damage cost is the sum of the response cost plus the socioeconomic damage cost plus the environmental damage cost. Note that the avoided damage costs are not sensitive to pressure and elevation changes because the model is based on the methodology in 49 CFR §194.105 (b) (1) for a worst case discharge which has a constant flow rate.

Benefits of Block Valve Closure Swiftness for a Hypothetical Hazardous Liquid Pipeline Releases without Ignition

The swiftness of block valve closure has a significant effect on mitigating potential socioeconomic and environmental damage to the human and natural environments resulting from hazardous liquid pipeline releases. The benefit in terms of cost avoidance for damage to the human and natural environments attributed to block valve closure swiftness increases as the duration of the block valve shutdown phase decreases.

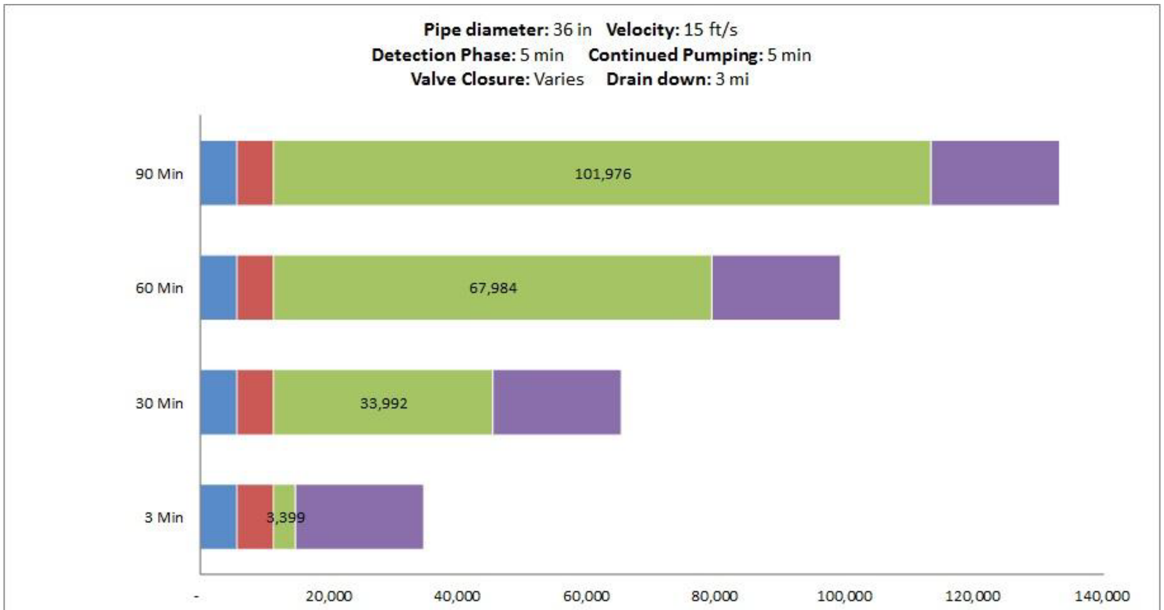
Table 3.32. Effects of hypothetical 36-in. hazardous liquid pipeline releases without ignition Characteristic	**Case Study 8A**	**Case Study 8B**	**Case Study 8C**	**Case Study 8D**
Type Hazardous Liquid	Crude Oil	Crude Oil	Crude Oil	Crude Oil
Flow Velocity, ft/s	15	15	15	15
Nominal Line Pipe Diameter, in.	36	36	36	36
Drain Down Length, mi.	3	3	3	3
MAOP, psig	400	1,480	400	1,480
Elevation Change, ft	100	100	1,000	1,000
Detection Phase Duration, minutes	5	5	5	5
Continued Pumping Phase Duration, minutes	5	5	5	5
Unit Response Cost, $/barrel	3,864	3,864	3,864	3,864
Medium Modifier (Wetland)	1.6	1.6	1.6	1.6
Response Cost, Cr	6,182	6,182	6,182	6,182
Unit Socioeconomic Cost, $/barrel	2,520	2,520	2,520	2,520
Socioeconomic Cost Modifier (Very High)	1.7	1.7	1.7	1.7
Socioeconomic	4,284	4,284	4,284	4,284

Damage Cost, C_s				
Unit Environmental Cost, $/barrel	1,260	1,260	1,260	1,260
One half Freshwater Modifier (Wildlife Use = 1.7) and Wildlife Modifier (Wetland = 4.0)	2.85	2.85	2.85	2.85
Environmental Damage Cost, C_e	3,591	3,591	3,591	3,591
Total Damage Unit Cost, C_d, $/barrel	14,057	14,057	14,057	14,057
Damage Cost Adjustment Factor for Hazardous Liquid Pipeline Releases	2.1	2.1	2.1	2.1
Total Damage Unit Cost on 2012 Basis, $/barrel	**29,520**	**29,520**	**29,520**	**29,520**
Detection Phase Release, barrels	5,665	5,665	5,665	5,665
Continued Pumping Phase Release, barrels	5,665	5,665	5,665	5,665
Drain Down Phase Release, barrels	19,942	19,942	19,942	19,942
Block Valve Closure Phase for Valve Closure in 3 minutes, barrels	3,399	3,399	3,399	3,399
Block Valve Closure Phase for Valve Closure in 30 minutes, barrels	33,992	33,992	33,992	33,992



	3 Min	30 Min	60 Min	90 Min
Detection	5,665	5,665	5,665	5,665
Continued Pumping	5,665	5,665	5,665	5,665
Shutoff Valve Closure	3,399	33,992	67,984	101,976
Pipeline Drain Down	19,942	19,942	19,942	19,942

Fig. 3.82. Case Study 8A – Discharge volumes for a 36-in. hazardous liquid pipeline with a 400 psig MAOP and an elevation change of 100 ft with a 3, 30, 60, and 90 minutes block valve closure phase.



	3 Min	30 Min	60 Min	90 Min
Detection	5,665	5,665	5,665	5,665
Continued Pumping	5,665	5,665	5,665	5,665
Shutoff Valve Closure	3,399	33,992	67,984	101,976
Pipeline Drain Down	19,942	19,942	19,942	19,942

Volume Lost [Barrels]

Detection Continued Pumping Shutoff Valve Closure Pipeline Drain Down

Fig. 3.83. Case Study 8B – Discharge volumes for a 36-in. hazardous liquid pipeline with a 1,480 psig MAOP and an elevation change of 100 ft with a 3, 30, 60, and 90 minutes block valve closure phase.

Hartman, Larry (COMM)

From: Paul Stolen <stolami@gvtel.com>
Sent: Monday, April 07, 2014 7:30 AM
To: Ek, Scott (PUC); Hartman, Larry (COMM)
Subject: Re: Sandpiper Pipeline Comments - P. Stolen

Good morning Scott and Larry. Thanks for your cooperation on responding. As you can see from my comment, I intend to send them to various other parties. I had an unfortunate computer problem on April 4th that delayed me and then prevented me from doing the final editing of my comments. So, in order to meet the deadline, I sent the comments in anyway. When I did the final edit this weekend, I found typos, name and cross reference problems, extra words left in, and other problems like that. (Not substantive.) However, there was an error on page 3 of Attachment 1—I had mistakenly put the Sandpiper amounts in the wrong column.

Therefore, I am sending the corrected version to the other parties rather than the one I officially submitted to you. I realize the one sent to you is the "legal" version under the rules, and I can live with that since none of the specific recommendations change in any way. I would, of course, prefer that you use the corrected "clean" version in the official record. I can send it to you if you wish. I am trying to get it scanned today into one digital version, so hopefully it will be available tomorrow morning.

Thanks again. Paul Stolen

From: Ek, Scott (PUC)
Sent: Friday, April 04, 2014 3:42 PM
To: mailto:stolami@gvtel.com
Subject: FW: Sandpiper Pipeline Comments - P. Stolen

Scott E. Ek
Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Ek, Scott (PUC)
Sent: Friday, April 04, 2014 3:32 PM
To: Hartman, Larry (COMM)
Cc: 'stolami@gvtel.com'; Nelson, Casey (COMM)
Subject: Sandpiper Pipeline Comments - P. Stolen

Hello Larry,

I received the attached comments from Paul Stolen concerning the Sandpiper project. The comments were received today (4/4/14) at ~ 3:30 p.m. Please let me know if you receive these and if you would like me upload to eDockets. I am also copying Paul on this as he wanted confirmation they were received.

Thank you,

Scott E. Ek

Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Paul Stolen [mailto:stolami@gvtel.com]
Sent: Friday, April 04, 2014 3:14 PM
To: Ek, Scott (PUC)
Subject: Re: from paul stolen

Hello Scott. Here are my comments plus one attachment. Two more attachments to follow. thanks Paul

From: Ek, Scott (PUC)
Sent: Thursday, April 03, 2014 11:47 AM
To: Paul Stolen
Subject: RE: from paul stolen

Hi Paul,

Yes, that is fine. As you know we will read any and all comments received. Please feel free to forward to me and copy Larry. I will send you an email confirming receipt.

Thank you,

Scott E. Ek
Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Paul Stolen [mailto:stolami@gvtel.com]
Sent: Thursday, April 03, 2014 11:38 AM
To: Ek, Scott (PUC)
Subject: from paul stolen

Hello Scott. Long time, huh? I've been retired for 5 years. I'm submitting comments on the Sandpiper project, and running a little late. I was planning on getting them in today in the overnight guaranteed delivery for tomorrow receipt, since that's the project deadline. so will need to submit via electronic mail. If Larry's inbox is swamped, can I get to you, and also get a response that you have received them? Thanks much. Paul Stolen

May 28 , 2014

Paul Stolen
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Mr. Larry Hartman
Environmental Review Manager
Minnesota Department of Commerce
85 67th Place East, Suite 500
St. Paul, MN 55101

Re: Comments on proposed Enbridge Sandpiper Pipeline, Minnesota Public Utilities Commission (PUC) Docket #13-474

Dear Mr. Hartman:

Enclosed are my additional comments on this proposed project based on the time extension previously granted. The attached material covers the following topics:

I. A copy of my updated April 4 2014 comments to correct minor editing problems and a request that you replace it with the enclosed comments.

II. The Scope of Work for the consultant to the PUC that will be doing the environmental analysis and route comparison.

III. The environmental "footprint" of the proposed pipeline. Enbridge continues to maintain that the project will require a 100 foot right of way (ROW). A report entitled "Construction of the Northern Border Pipeline in Montana" is enclosed that refutes Enbridge's position on ROW requirements, and shows that it only applies to flat terrain.

IV. Additional comments regarding the consequences of pipeline ruptures and leaks. This comment expands on my April 4 comments that these consequences need to be consider in assessment of impacts, location decisions, and need for the project.

V. Additional comments on the "corridor fatigue" issue.

If you have any questions, please give me a call.

Sincerely,
Paul Stolen

Paul Stolen

C: Tom Landwehr, Commissioner, Minnesota DNR
John Linc Stine, Commissioner, Minnesota PCA
Tamara Cameron, Regulatory Chief, Corps of Engineers

Additional comments on proposed Enbridge Sandpiper Pipeline, Minnesota Public Utilities Commission
Docket #13-474
Paul Stolen
May 28 2014

I. **Corrected April 4 comments**. My previous comments, submitted on April 4, 2014, were sent in a rush. I had a computer hang-up at the last minute and therefore didn't have time for a final proofing on the paper copy. Therefore, I did a corrected copy, which is enclosed. I'd appreciate it if you would replace the April 4 copy with the enclosed. There were some typos and a few confusing sentences that I clarified. The most substantive correction was a small correction of numbers in Table 1. The cover letter of the enclosed corrected copy has a note about this below the signature line. I apologize for any confusion this may cause.

II. Scope of work for PUC consultant doing the environmental analysis and comparison of routes. My understanding is that the PUC will be hiring a private party to develop the environmental analysis and comparison of routes for Sandpiper. The product of this contracted work will thus be key to government decisions on this project. How will the Scope of Work be developed? Is such a scope of work shown to Enbridge prior to its completion? My comments and those of others need to be incorporated into the Scope of Work. This Scope of Work should include specific questions focused on the key public policy decisions that need to be made about the Sandpiper project, rather than allowing the contractor to determine such questions. In addition, a draft of this Scope of Work should be available for review prior to letting the contract, since the product is so crucial to the decisions.

The rules regarding a Certificate of Need for this project clearly indicate that environmental and socioeconomic factors must be taken into account in the decision as to whether to grant a need certificate. (Section 7853.0130, Criteria.) Therefore, the Scope of Work is a key document for determining whether to grant a Certificate of Need.

III. **Pipeline construction environmental "footprint."**

A. Enbridge estimate the environmental "footprint" of the Sandpiper project is inaccurate. Enbridge's statement that they use a 100 foot ROW to construct the project seriously underestimates the project's effects and potential for long term damage. In fact, such a ROW only applies to flat or nearly flat areas, and are often farmland.

The environmental study and route comparison must use accurate figures on land requirements for building the pipeline. The estimate must include the topics of land clearing, earth moving and excavation, soil compaction, and potential for topsoil mixing. This is called the project's "environmental footprint." During a public meeting on Sandpiper at Clearbrook, a recent visit to the DNR, and the Enbridge documents on the PUC web site, I examined Enbridge's plan sheets and some applications for crossing streams. These plans are simply not accurate with respect to land clearing and extent of excavation.

Note: My comments here do not apply to the topic of "extra work space" at roads, river crossings, and a few other locations of specialized construction. Enbridge generally does include these locations on its plan sheets. Such locations are a small fraction of the ROW impacts beyond the 100-foot ROW in hilly terrain.

In spite of abundant evidence to the contrary, Enbridge continues to maintain to the public that it only needs a 100 foot right-of-way (ROW.) Enbridge also used this figure on the Alberta Clipper and Southern Lights Projects, even though during construction a much wider ROW was evident at some locations. Finally, the 100 foot ROW was also used for the MinnCan project as a guide to estimating the environmental footprint of the project. (I worked on all three projects while employed at the DNR, including conducting training for other DNR staff in pipeline construction.)

Both Enbridge and MinnCan did not provide accurate figures for excavation into parent material outside of the pipeline trench. Such excavation is abundant in hilly terrain. A key mitigation measure, topsoil separation in such areas, was ignored in many locations except for agricultural land.

The 100 foot ROW width does not apply to hilly terrain. It is time to put it to rest when large diameter pipelines are proposed in Minnesota. In fact, the construction ROW in hilly terrain can become 200 to 300 feet wide in some areas. In many cases on the three large, above-mentioned projects I was involved while at the DNR, these wider locations were never included in plains submitted for public review by the PUC, DNR, or PCA, and not included in calculations of the project's environmental footprint.

The terrain crossed by the proposed Sandpiper route crosses hilly glacial moraine in many locations Understanding pipeline construction in non-flat terrain is crucial because it directly relates to important environmental impacts such as the extent of land clearing, deep excavation outside of the pipe trench and accompanying potential serious loss of topsoil, susceptibility to invasion of non-native species and noxious weeds, and chronic erosion problems because re-vegetation is slower when topsoil is lost and replaced by parent material.

B. Detailed explanation of ROW requirements for construction of a large-diameter pipeline.

The enclosed report entitled "Construction of the Northern Border Pipeline in Montana" (referred hereafter as the IPTF Report) describes in detail why construction in non-flat terrain can lead to ROWs much wider than 100 feet. It also demonstrates why there can be extensive excavation outside of the pipeline trench. I wrote it (with review by supervisors) some years ago while Assistant Coordinator of the Montana Interagency Pipeline Task Force. One of the main reasons why it was written is because ROW was an important public issue for two proposed large pipelines in Montana. One of them, the Northern Tier Pipeline, was proposed to cross the entire state, a distance of approximately 600 miles. A detailed review of it was done, but it was never built.

The Northern Border project—a 42 inch gas pipeline—crossed 180 miles of NE Montana, and was built after an EIS was prepared. ROW of way width was generally limited to 100 feet on state lands during the permitting stage, with the consent of the pipeline company. However, during construction, it became abundantly clear that it was impossible to construct the pipeline in such a narrow area in hilly terrain.

1. Purpose of IPTF Report. This report is applicable to the Sandpiper project with respect to determining the project's environmental footprint. It had four main purposes:

a. To document the ROW width in hilly terrain compared to flat terrain, and to determine the minimum ROW for a large diameter pipeline,

b. To document the locations of, and reasons for, excavation into topsoil and parent material outside the pipeline trench, since during the review period prior to construction the pipeline company had indicated excavation only for the pipe trench.

c. To identify problems encountered during construction and reclamation after pipe burial.

d. To serve as a training manual for reviewers of proposals to construct large diameter pipelines.

2. Caveats as to use of the IPTF report for the Sandpiper project. Before pointing out key findings of the report that relate to the Sandpiper proposal, there a few caveats as to its use:

a. Northern Border was constructed on a new ROW, with no existing pipelines in place.

b. A level work pad generally 50 feet wide is needed for construction of large diameter pipelines, with the pipeline trench to the left of the forward movement of construction. This work pad is essentially a road during construction, with nearly all traffic confined to it. Width is needed for passage of traffic past active work areas, and also for worker safety. A *level* work pad is necessary for worker safety and equipment needs. This construction necessity is directly related to the environmental footprint of the project as discussed below.

c. There have been some changes in pipeline construction techniques since Northern Border, but essentially none that affect ROW width except at special areas such as rivers. (Examples include: welding methods are done somewhat differently, and machine welding is often done on-site; cathodic protection pipe coating is no longer done on site, as depicted in the report, except at field welding locations; and directional drill bores (HDD) are much more common.) The fact that Northern Border was a 42 inch pipeline made little difference in ROW width as compared to the 24 inch MinnCan pipeline. The ROW for the latter was perhaps 8-10 feet narrower on flat terrain than the Northern Border line, but there was little difference on hilly terrain. In addition, there have been changes in river crossing techniques with greater use of HDDs, and dam and pump methods are often used rather than open cut trenches.

d. When another large pipeline is added to an existing corridor, it is offset from the existing line by a project-specific distance. I've found it to be 35-40 as a minimum separation. Therefore, the construction ROW can be somewhat narrower than the standard 100 foot because spoil from the trench can be placed in the separation zone. However, there are site specific issues on hilly terrain so that generalizations don't work in such areas. Also, heavy equipment travel is restricted over the new and old lines.

e. Pipe is bent to *generally* follow the terrain, but not *exactly* follow the terrain. A straight pipe transfers gas or liquid most efficiently. Therefore, in hilly terrain with abrupt slopes, pipe curvature strikes a balance between the desire for a straight pipe and the constraints of excavation. In other words, in some locations, such as the crest of a hill, or under a small but steep hill, the pipe is buried much more deeply in order to lessen the curves. The report illustrates the result of this in expanded ROW width in some locations for the extra spoil and topsoil storage.

f. Topsoil separation in excavated areas is a crucial environmental issue because it relates to whether there are long-term impacts to land productivity in all areas, increased invasive species and noxious weeds, and increased erosion because re-vegetation is slow or non-existent. Topsoil separation can increase the ROW width because of separate piles; however, the expansion can be reduced by creative soil storage. Lack of topsoil separation causes long-term impacts whereas a somewhat wider ROW in some places causes temporary impacts. Furthermore, in recognition of this, topsoil separation has become a standard good practice in stormwater permits and all sorts of construction.

g. When done correctly based on known best practices for pipeline construction, environmental impacts of pipeline placement (not including future oil spill impacts) can be significantly reduced. The attached report suggests some of the good practices.

<u>3.Key points from IPTF report</u>. The IPTF report in its entirety is part of my comments, but the following are key points especially related to Sandpiper:

a. ROW requirements and topsoil stripping. Pages 31-32 provide a summary of the significance of ROW requirements as an environmental issue. It also references the details that support my findings that the IPTF Report is completely relevant to the Sandpiper project.

b. ROW requirements on flat terrain are discussed on page 33, and shown in pictures 51 and 52. On entirely flat terrain, it was possible to construct on an 85 foot ROW, although this increased somewhat as work progressed through clean-up.

c. Separation of topsoil from parent material on side-hill cuts is shown on page 37, and pictures 58 and 60. Page 39, picture 62, depicts lack of topsoil separation where it should have been done.

d. Page 40, and pictures 64 and 67 show deep side hill cuts, topsoil separation, and parent material storage.

e. Page 43 and photos 69-73 show extra-deep pipe burial in hilly areas and resulting large amounts of spoil.

f. Page 47-55 describe in detail why ROWs are wider than 100 feet in hilly terrain, and include diagrams explaining why this happens with respect to how pipelines must be constructed. The following significant conclusions are reached:

"1) Any deviation from flat terrain (0 degree slope) causes a geometric increase in width requirements, primarily for soil and spoil storage.

"2) There is often a progressive increase in r-o-w width after initial r-o-w clearing as different stages of construction proceed.

"3) there were numerous areas of extra r-o-w width needed beyond the 100 foot requested by DNRC.

"4) There was a high potential for topsoil mixing in the numerous side-hill cuts.

"6) Construction crews demonstrated an exceptional ability to re-contour the disturbed surface to the original configuration and replace topsoil when it had been correctly stripped.

IV. Consequences of pipeline leaks and ruptures must enter into route comparison, assessment of impacts, and need for the project.

My April 4 comments (pages 3 through 11) indicated in detail why impacts of pipeline leaks and ruptures need to be addressed in PUC decisions. I reiterate those recommendations, and have additional points regarding federal rules, and analysis of existing corridors, as follows:

A. Problems with federal rules. There are federal rules regarding hazardous liquid pipelines effects on the environment and people. These pipeline integrity rules pertain to environmental and socioeconomic impacts . They are administered by the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the U.S. Department of Transportation. These rules refer to High Consequence Areas (HCA) and Unusually Sensitive Areas (USAs). (Title 49: Transportation PART 195—TRANSPORTATION OF HAZARDOUS LIQUIDS BY PIPELINE.) Both of these categories refer to populated areas, some aquifers, and some ecologically sensitive areas. I referred to HCAs in my April 4, 2014 comments.

The problem is that the federal rules regarding USAs and HCAs very much "high-grade" sensitive environmental features, and only include the rarest and most unusual ecological or natural resource features. This is not just my opinion. Describing sensitive area—and making lists of them—has been standard regulatory practice for many years. Such areas are subsequently avoided, or if they cannot be avoided, various mitigation measures are incorporated into government permits to reduce impacts. For example, these lists include public lands dedicated to a public use such as parks and wildlife management areas, and critical habitat features for certain species, such as deer wintering areas.

One would expect that such normalized lists would have been incorporated into the PHMSA rules. *PHMSA did not even begin to do so.* The notice of the adoption of final rules noted that government agencies with much more expertise than PHMSA regarding pollution and natural resources, such as the EPA and US Department of Interior, strongly objected to the restricted list of USAs and HCAs. (See Federal Register / Vol. 65, No. 232 / Friday, December 1, 2000 / Rules and Regulations.) Many other commenters, including the US Department of Justice also objected to this limited list.

In spite of these objections, the Office of Pipeline Safety didn't budge and kept the limited list with little justification.

However, in 2011, Congress passed the Pipeline Safety Act, and it was signed into law in early 2012. This was in response to the Michigan Enbridge pipeline rupture, the explosion of a gas pipeline in California that killed 8 people, and other pipeline accidents. Now, PHMSA Administrator Cynthia Quarterman noted in a hearing last week in the US House of Representatives that new rules will be out for review shortly regarding USAs and HCAs and other rules regarding pipeline integrity and potential environmental impact.

B. PUC route comparison with respect to USAs and HCAs . The PUC route comparison needs to identify and compare:

1. Any USAs and HCAs as defined in *current* federal pipeline integrity rules on any of the routes that have been identified or are being studied.

2. Any USAs and HCAs—or other categories related to the environment—*as defined in proposed new rules* on any of the routes being studied and identified, assuming the new proposed rules come out in time.

3. Determine the effects on any USAs or HCAs should there be a pipeline rupture, based on the "worst case" as defined in the Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" December 2012. This should also incorporate a "worst case" regarding collateral damage to existing pipelines in the two corridors that already have multiple pipelines.

C. Collective facility plan. Enbridge is the owner of all of the lines in its mainline corridor to Superior. In other words, it collectively owns all the pipelines in most of this corridor. Enbridge should be required to submit a Facility Plan for the Mainline Corridor, and any other corridor that contains more than one Enbridge line. This should be in addition to the plans on each individual line. Such plans can provide indications of responses to spills constrained by existing lines, as well as be indicative of "corridor fatigue."

V. Additional comments on the analysis of "corridor fatigue" issues. My April 4 comments addressed "corridor fatigue" on pages 11-16, with recommendations on pages 15-16. I have the following additional comments.

The route comparison simply must address the growing problem of adding more and more pipelines to existing corridors that were established prior to environmental laws. Therefore, the key place to begin is in the contractor hired by the PUC. Information about the existing pipelines and corridors will aid in understanding the extent of "corridor fatigue" and the increased risk of accidents on one line cascading to others. Therefore, the Scope of Work for the PUC contractor should specifically require the contractor include at least the following with respect to existing corridors:

A. Information about existing lines. On each existing line this should include: locations, identification of any looped areas, locations of cross-overs, types of river crossings such as whether they are trenched or bored, and extent of cover in the riverbed if trenched. There are also a number of locations along the Enbridge Mainline where pipelines actually are not next to each other, which results in multiple corridors somewhat close together rather than one corridor.

B. Facility plans on existing lines. Federal rules require that a "facilities plan" be submitted by a pipeline company prior to its being built. According to a call to the state office of pipeline safety, these are sent to PHMSA, and are not filed with the Minnesota agency. These plans are to include such items as the company's risk assessment, identification of HCAs and USAs, and other content highly relevant to an assessment of impacts and a comparison of routes.

C. Locations of problems areas identified during construction of existing lines. Enbridge and MinnCan should provide information on problem areas identified during construction of the existing lines.

D. Identify "choke points." There are locations along existing corridors where it is simply not physically possible to add more pipelines. These are sometimes referred to as "choke points." Such areas are indicative of "corridor fatigue," and are also the reason for the divergence noted in #2 above.

E. Locations where existing pipelines are exposed or more vulnerable to damage. Pipelines constructed in the past were built to lesser standards than current pipelines. For instance, Enbridge Line 3 was placed on the surface of the ground in certain wetland locations and cover piled on top of it. Over time, this has resulted in pipe exposure. Federal rules do not require that older pipelines meet current standards; therefore, Enbridge has been re-covering such locations on a voluntary basis. These locations should be identified. Also, I am aware of at least one, and possibly two locations along the Enbridge corridor where pipe is exposed as it crosses a river. One of these is a trout stream in Beltrami County.

Such locations are more vulnerable to vandalism and environmental events such as large and unusual rainfall events. Therefore, these locations along the existing corridors increase the risk of ruptures and accidents which may cause increased risk to new lines. The contractor needs to obtain from Enbridge and MinnCan records that identify such areas, and include this factor in assessing "corridor fatigue" and the route comparison.

F. Rivers and floodplains crossed at an oblique angle. Such important natural resource areas should be crossed by pipelines in a perpendicular manner in order to minimize the length of crossing this feature. This would be done when a new corridor is established. Therefore, data on oblique crossings is a measure of existing corridor problems. The LaSalle Creek crossing north of Itasca Park is a good example of this problem. A good measure of each crossing is the distance crossed obliquely compared to the perpendicular distance of the same crossing.

G. Avoidance areas under current pipeline construction practices. The existing corridors should be assessed to determine locations that would have been avoided if the existing pipelines were not present. Admittedly, this assessment would be somewhat objective. However, there are such features as lakes crossed by pipelines on the existing corridor. It is highly unlikely such features would be crossed by a new pipeline corridor. Also, a new pipeline corridor could well be routed around at least some wetlands rather than the numerous wetland crossing now found on the old corridors proposed to be followed by Enbridge's new lines.

H. Areas of restricted access. The existence of buried lines actively interfering with response to pipeline ruptures can reduce response time because heavy equipment can't drive over lines in some locations. In addition, pipeline ruptures in areas with few roads likely would exacerbate spills. The existing corridors should be examined to find such areas.

FRIENDS OF THE HEADWATERS
RESPONSE TO THE MINNESOTA DEPARTMENT OF COMMERCE
LINE 3 DRAFT EIS - Dockets CN-14-916, PPL-15-137
JULY 10, 2017

ATTACHMENTS "A"

A-1 Stolen 4.4.14 Sandpiper Comments
A-2 Stolen 5.28.14 Sandpiper comments

Record of Paul Stolen's comments and documents submitted to the Minnesota Department of Commerce for the respective Public Comment periods for the proposed Sandpiper Pipeline project

April 4, 2014

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Mr. Larry Hartman
Environmental Review Manager
Minnesota Department of Commerce
85 67th Place East, Suite 500
St. Paul, MN 55101

Re: Comments on proposed Enbridge Sandpiper Pipeline, PUC Docket #13-474

Dear Mr. Hartman:

Enclosed are my comments on this proposed project. They concern the main topics solicited in the January 31, 2014 public notice. I suggest alternative routes and route segments, and provide answers to public notice questions "What human and environmental impacts should be studied in the comparative environmental analysis?" and "Are there any specific methods to address these impacts that should be studied in the comparative environmental analysis?"

My comments address human and environmental impacts. They identify appropriate methods of studying such impacts, based on PUC rules and standard methods used in Minnesota and elsewhere to review pipelines.

The most important point in these comments concerns the enormous quantity of oil and other hazardous product that is already flowing through multiple pipelines in one or two narrow corridors This project, and the new Line 3 Enbridge replacement and enlargement will add even larger amounts of oil and product to these corridors. These corridors cross highly valued natural resource areas that have many lakes and clean rivers,. They are often at or near the headwaters of drainages and in hilly areas, as well as being close to people and concentrations of residences.

It is time for Minnesota and federal regulatory agencies to address the problem of multiple large diameter pipelines in close proximity to each other. This concentration makes the consequences of a single site event—whether such an event is natural, accidental, or intentional—potentially catastrophic. Furthermore, my comments will show that the flow of oil and other product will be so large as to be larger than—or a significant portion of—the flow of well-known rivers crossed by the corridors.

I am submitting these comments as a citizen but also as an expert. These are my personal comments written without review or reimbursement of any party. I will be willing to provide testimony as such in legal and legislative forums, should this be necessary, depending on personal availability.

In lieu of providing a c.v. at this time, I summarize here my credentials for asserting that I have expertise regarding the Sandpiper review.

I have regulatory experience with large natural gas, carbon dioxide, water, and oil and product pipelines in Montana and Minnesota. This has involved on the order of 10-12 pipeline projects while employed at the Montana Department of Natural Resources and Conservation and the Minnesota Department of Natural Resources. In Montana, the DNRC had environmental review, locational approval, and Certificate of Need Authority for energy facilities combined in one agency.   I have also supervised , and /or participated in the preparation of EISs or EAs of such pipelines. This included conducting training sessions for other regulatory personnel on how to review pipelines for impacts and on pipeline construction methods.

I have written or coordinated the writing of major environmental review regulations for fixed linear energy facilities, including pipelines and HVTL lines. This experience included reviewing specific proposed linear and fixed large energy facilities (power plants and HVTL lines), and high-level nuclear waste repositories. I have been an environmental inspector on a number of large pipeline projects, including presenting agency views at pre-construction conferences with pipeline builders and sub-contractors.

I have policy-level experience with both federal and state laws and regulations regarding environmental review, pipelines, and solid and hazardous waste topics. This includes legislative staff work, legal depositions, testimony in court, and presentations to other agencies. Finally, this experience also includes years of doing environmental reviews of many other types of projects, including experience with formal risk assessment, and supervising and/or writing scopes of work for the preparation of highly technical studies conducted by outside consultants.

Review and permitting of significant projects such as the Sandpiper project, and the 36-inch Enbridge upgrade of its old Line 3, means that there are overlapping jurisdiction with other federal and state agencies. Some of these are broader than the narrow PUC review requirements. My comments also pertain to those other agency responsibilities. It is necessary to exchange information among such government authorities as a matter of good government. Many of my comments attempt to accomplish such a goal. Therefore, I am providing copies of my comments to these other agencies.

My comments are enclosed. Thank you for consideration of them.

Sincerely,

Paul D. Stolen

C: Tom Landwehr, Commissioner, Minnesota DNR
John Stine, Commissioner, Minnesota PCA
Tamara Cameron, Regulatory Chief, Corps of Engineers
Bob Eleff, Minnesota Legislature, House Research
Ken Westlake, USEPA, Chicago Office
US State Department, Washington DC

Comments on proposed Enbridge Sandpiper Pipeline, PUC Docket #13-474
Expert Testimony of Paul Stolen, Fosston Minnesota
April 4, 2014

I. Potential oil leaks and pipeline ruptures must be addressed in the route permit, by Minnesota state agencies, and by the US Corps of Engineers and EPA.

Summary: In this section I make the case for using accepted methods of risk assessment to address the consequences of pipeline ruptures to the Minnesota environment and people from this project. A foundation principle of risk assessment is that the greater the consequences of an event, the greater the need to examine rare or unlikely events. There are five reasons why unlikely events need to be considered in this risk assessment for this project:

1) Risk assessment scenarios in Attachment 4 are roughly applicable to one of the existing and proposed pipeline corridors in Minnesota. For example, a 36-inch pipeline rupture of the "worst case" type used in the assessment, may still release on the order of 40,000 barrels of oil, even assuming the quickest reaction time of pipeline operators to close block valves(13 minutes.) If valve closure time is delayed for 30 minutes, this rises to about 70,000 barrels, and if delay is 60 minutes, the amount is 100,000 barrels.

Such releases could have extremely high consequences to the Minnesota environment, and higher releases are possible under some risk assessment scenarios.

2) The portion of the Sandpiper route between Clearbrook and Park Rapids already contains three pipelines. Enbridge is apparently planning one more 36-in line in the same corridor as the 30 inch Sandpiper route. I raise the question as to what "worst-case" scenario should be used when there are 5 pipelines in close proximity in remote areas and at least somewhat susceptible to natural or intentional damage, perhaps to all of them at one time?

3) The corridor Enbridge proposes to use traverses a landscape rich in aquatic and other natural resources, highly valued by Minnesotans, and that includes major groundwater resources.

4) The portion of the Sandpiper route between Clearbrook and Park Rapids was fraught with problems during construction of the MinnCan pipeline, which were at least partially due to the corridor being created for a small pipeline long before modern environmental laws were passed.

5) The other route likely to be considered in the Sandpiper comparative review—the Enbridge mainline corridor—suffers from very similar problems as do at least the first three listed above. There are already as much as 7 pipelines present in this corridor.

The Sandpiper project, as well as other new projects in the planning stages, will add significantly to the enormous quantity of oil and other hazardous product that is already flowing through two narrow pipeline corridors.

It is time for Minnesota and federal regulatory agencies to address this problem of multiple large diameter pipelines in close proximity to each other. This concentration makes them vulnerable to natural events, accident or intentional act—such as the Oklahoma City federal building bombing. In fact, in Comment II.A. I discuss a specific case on the Alberta Clipper route where very high flows caused by the large rainfall events that seemed to be caused by global warming could threaten the integrity of more than one of the large pipelines in this narrow corridor.

My comments on this topic are based on my experience with pipelines in Minnesota and Montana, as well as with exposure to risk assessment concepts and methods. Enbridge may object to the use of the ORNL study in Attachment 4, and say it is not appropriate to apply to these projects. I disagree: of course it isn't directly applicable, but its methods are modifiable so that it is. Extrapolating the findings of Attachment 4 to the two corridors could be pushing things a little—but I have found no information that anyone else is considering these issues and the deadline for PUC comment is now due. It is therefore entirely appropriate to use it, and I hope to trigger a helpful debate. And, I know for certain my view this topic is important will be shared by the public.

The jurisdiction of the PUC and other Minnesota agencies regarding the scope of review as it pertains to pipeline design and location lacks clarity and confusion among regulators as well as the pipeline company personnel. This is related to the issue of pipeline "safety standards", and is discussed in detail in Comment II below. This lack of clarity and confusion should not be allowed to continue, since in my view, Minnesota's natural resources and citizens are threatened by rare but reasonably foreseeable events.

As noted in Comment II, I believe the evidence is firm that the Minnesota state agencies can effectively develop measures regarding mandatory design features related to pipeline ruptures and leaks in order to that protect people and the environment without encroaching on federal "safety standards." Such involvement is extremely important, given the magnitude of oil and product potentially moving through these corridors.

<u>I. A. Estimates of existing and proposed pipeline oil and product flows in Minnesota as compared to selected river flows</u>.

After burial, pipelines, when functioning correctly, are largely invisible to the public and most policy makers—such as those currently concerned with oil transport by rail. In order to make considered judgment on policy and permits—as well as allowing proper public involvement—this needs to change. It is no longer acceptable to have an "out of sight, out of mind" attitude on the magnitude of current and potential oil transport through Minnesota in restricted corridors with multiple pipelines.

It is not possible to begin to analyze potential impacts from pipeline leaks and ruptures without knowing amounts of oil and product being transported. Attachment A provides details about oil flow into and through Minnesota in the corridors relevant to the Sandpiper analysis. It thus provides a basis for analyzing socio-economic, public safety, and environmental impacts from leaks and ruptures. Pipe size and amounts of oil and product pumped are given, as is ownership and origin (for most of the lines.) Attachment 2 provides a description of most of the Enbridge pipelines.

Also included on page 3 of Attachment A is a comparison of pipeline oil and product flow and selected river flows near where corridors cross the named rivers. These data, while in cubic feet per second (cfs), are useful for both public understanding of local residents as well as resource managers. The public in these locations can at least visualize the rivers even though most do not directly understand cfs figures.

The river flow data shown are long-term median flows for April 2, not current flows. Therefore, they are indicative of long-term spring runoff conditions, and are likely substantially higher than low-flow conditions.

In addition, the percentages listed comparing oil/product flow to river flow use the highest amounts based on the proposed pipeline projects in the permitting and planning stages.

There are some caveats with respect to the numbers in Attachment 1. First, I used reliable sources for the numbers. When I used news reports, I only used those where pipeline companies were directly quoted, and checked multiple news sources. However, the amounts indicated for the Minnesota Pipeline Company older lines rely on indirect conclusions based on Citation #2 figures and subtracting known amounts from specific projects. The Enbridge figures for existing pipelines in its Mainline corridor are taken directly from them. (Attachment 2) Finally, the source of oil/product was somewhat difficult to determine in some cases.

Attachment 1 indicates the following with respect to comparison of April 2 long-term median river flows with oil flow amounts in pipelines, both expressed in cubic feet per second:

--Four of the listed rivers, Snake River above Warren, Clearwater river at Plummer, Straight River at Park Rapids, and Prairie River at Taconite, have oil/product flows substantially higher than current spring flows in the rivers. In two cases oil flow is 200 percent of water flow.

--In all cases, especially if one considers large releases during higher flow conditions resulting in rapid dispersion downstream, these rivers are important and sensitive natural resources. For instance, the Straight River south of Park Rapids is a nationally recognized brown trout fishery.

<u>I.B. Methods of determining socio-economic and environmental impacts of pipeline ruptures</u> The PUC public notice on Sandpiper requested advice on methods of addressing potential impacts. There are indeed methods already in place, such as:

I.B.1. *Identification of "High Consequence Areas."* Comment II.B.1. addresses this topic in detail and provides recommendations for how to use this category in the project review. These areas are also roughly described in the federal agency prepared Attachment 3, which includes somewhat useful guidance as to their possible use in the Sandpiper project.

I.B.2*. Risk Assessment with respect to potential amounts of oil/product released by ruptures.* A foundation principle of risk assessment is that the greater the consequences of an event, the greater the need to examine rare or unlikely events in the risk assessment. Attachment 4 is a clear illustration of this principle. For example, it indicates that a "worst-case" pipeline rupture needs to be used, and justifies why it is needed. Such a rupture is called a "guillotine" rupture : "Guillotine-type breaks are less common than other pipeline breaks such as fish-mouth type openings, but they can occur as a result of different causes including landslides, earthquakes, soil subsidence, soil erosion (e.g. scour in a river) and third-party damage. The guillotine-type break is the largest possible break and is therefore considered in this study as the worst case scenario. " (page 5.)

The study goes on to use this scenario in its analysis of the cost-effectiveness of installing block valves, as well as assessing (some) environmental and socio-economic damages from ruptures. It calculates hypothetical releases in different scenarios in its appendix, including those figures listed in the above summary. More detail is provided in the verbatim (except for underlining) excerpts in Attachment 4.

As noted in the above summary, the estimates of amounts spilled from "guillotine" type ruptures of just one pipeline are large—perhaps a minimum of 40,000 barrels from a 36-inch line. Magnify this by the scenario of intentional serious efforts to damage several pipelines at one time—and this amount becomes potentially massive.

*I.B.3. Actual damages from recent spills associated with rivers.*_Attachment 4 also describes two case studies of actual spills. (pp. 10-11.) These two case studies were used to develop a factor to increase the estimated costs according to the Attachment 4 methods by a factor of two, since both found the risk assessment method underestimated actual costs by about 50%.

a. Enbridge spill into Talmadge Creek and the Kalamazoo River in Michigan. Approximately 20,000 barrels of oil were released. The cost of that spill from a 30-inch diameter pipeline was of 2012 was $767 million.

b. ExxonMobil Pipeline company rupture under the bed of the Yellowstone River 20 miles upstream of Billings, Montana. This was caused by scour from flooding that exposed and fractured the pipeline that was trenched under the river bed. An estimated 1,509 barrels of oil were released before the pipeline was closed. Clean-up and recovery costs were $135 million. (Recent news reports indicate final costs and fines are not yet resolved.)

I.B.4. *Comparison of pipeline flow rates compared to river flows.* Attachment 1 indicates total amounts of oil/product flows in the numerous pipelines that cross these rivers. They portray possible amounts subject to the most catastrophic possible pipeline rupture event—that of an event that caused damage severe enough to rupture more than one pipeline. Some of these lines have been trenched under these rivers, in other cases they have been bored so that burial is deep and not subject to certain kinds of rupture events. Damage could conceivably occur due to river scour from unusually large flood events, or from an outside party successfully and deliberately accomplishing such a rupture.

My intent in comparing river flows to oil flows is not to imply that the worst-possible event be used in an analysis. Rather, it is to portray the magnitude of the oil/product flows in terms that the public and reviewers can understand it. Again, I am responding to normal methods of conducting risk assessments: Very high consequences deserve be paired with looking at rare events. The possible use of this information in any kind of corridor analysis or spill magnitude is subject to a number of questions being answered first. This is discussed next.

I.C. <u>Recommendations regarding pipeline rupture for analysis of impacts, corridor/route comparison, and estimates of spill magnitude based on risk assessment.</u>

I.C.1. The Sandpiper project should be analyzed with respect to potential impacts from pipeline rupture using risk assessment methods modified from those used in Attachment 1. This would:

a. Entail determining Enbridge's methods for locating such valves on the Sandpiper pipeline, and making this available for critical review, and

b. Include both estimates of spill magnitude based on ideal block valve locations and rupture scenarios, such as the "guillotine" scenario, and differential valve response times.

c. Estimate the spill magnitude (in a range of minimum spill to somewhat longer response time spills) that then should then be used to assess socio-economic and environmental impact along the existing corridor.

d. The risk assessment should take into account the larger rainfall events in recent years possibly caused by global warming, including an assessment of the possibility of increased scouring in rivers crossed by these corridors.

I.C.2*. What is the "worst case" when multiple pipelines are in close proximity to use in the risk assessment*? "A review should be undertaken with respect what should be the proper "worst-case" rupture scenario when multiple pipelines are packed close together in a corridor. This should include:

a. An assessment of whether a "worst-case" rupture on one line threatens rupture of another line, such as a large fire.

b. An assessment of whether the response to a "worst case" event on one line is slowed by the presence of other lines either on one or both sides of the ruptured line because equipment can't cross the shallowly buried other lines. This should also include a description of circumstances where all or some lines still operating need to be shut-down during the response and the practicality of doing so. (It needs to be recognized that in some locations there are "cross-overs" where one line is constructed underneath other lines because of existing facilities on one side—such as railroad tracks—prevent construction on the preferred side.)

c. Consultation with state and federal pipeline authorities as well as the authors of the Attachment 4 study as to what constitutes "worst-case" ruptures when there are multiple lines in close proximity.

d. Consultation with the ORNL authors and others regarding the vulnerability of a corridor with multiple large pipelines in close proximity to deliberate actions and how this should be addressed in socio-economic and environmental impact reviews.

I.C.3*. A process is needed whereby problems found during review of additional pipelines in any given corridor that might threaten pipeline integrity are thoroughly reviewed by government personnel*. While perhaps outside the scope of the PUC Sandpiper review, procedures should be developed whereby state agency field staff who find potential problems at significant pipeline locations could be assured that the problems are adequately responded to by government agencies rather than pipeline owners.   I have personal knowledge of three such locations along these corridors, as discussed in Comment II.A below.

II. The PUC and Minnesota agencies indeed have significant jurisdiction over pipeline design issues related to oil spills and leaks and site-specific measures to prevent them.

<u>II.A. Overview and significance of the problem</u>. This is an important issue because a properly *designed and located* pipeline can result in the least amount of impact and be a safe way to transport petroleum products.

The central issue is that there is both federal and state jurisdiction and authority, and that it overlaps to some extent. In these comments I maintain that the PUC has clear authority to influence both pipeline *design* and location with respect to analyzing and mitigating impacts to people and the environment.

MDNR and MPCA field staff often have intimate knowledge of site specific conditions along pipeline corridors, and are trained to have such knowledge. Yet some pipeline companies, their consultants, and even some people in Minnesota government try to claim that pipeline *design* is solely the bailiwick of federal agencies and federal standards because such design pertains only to "safety standards."

On several occasions during my employment with the MDNR, and while working with other field staff, we suggested site-specific changes in design that would add more resource protection or mitigation, "pipeline safety standards" were invoked. This was strongly prevalent when DNR was trying to determine how block valve locations were selected, and why specific block valve recommendations weren't followed.

Other issues involved lack of clarity as to Minnesota Office of Pipeline Safety responsibilities regarding possible environmental damage at locations where pipe integrity was threatened. For example, during one review of the MinnCan pipeline, DNR staff (Fisheries and Ecological Resources) found a location at a proposed river crossing where a large tree had fallen into the river. This resulted in bottom scour exposing one of the older pipelines. Company officials were not interested, and indicated it was not in MDNR jurisdiction to solve this problem. A call to the State Office of Pipeline Safety only elicited a question as to whether it was brought to the attention of the pipeline company.

On another occasion during the Alberta Clipper review, an older pipeline was found to be hanging a foot or two over the surface of a designated trout stream east of Bemidji. A call to the Minnesota Office of Pipeline Safety elicited a statement that it was up to the pipeline company to correct the problem. This was likely Enbridge Line 1 because of its small size. (See attachment 2 for a description.)

The most serious problem occurred on the Alberta Clipper route on a Grant Creek crossing just west of Bemidji. I was directly involved in this site, and provided several written documentations as to what occurred. At this site, Grant Creek flows south through a narrow gap in an old railroad grade. Upstream of this gap Grant Creek flows through s a large expanse of wetland. The creek is also subject to numerous beaver dams upstream. The railroad bridge at this site had collapsed into the gap, which was also filled with segments of a five foot concrete culvert.

Immediately below the gap are 5 or 6 large pipelines, with the first being within just a few feet of the steep railroad grade. Grant Creek takes sharp turn to the east, actually following the pipeline in a parallel manner, until again turning south where it flows over the trenched pipes. I observed that bank erosion had removed 6 or 7 feet of the bank, and that this had all occurred since the previous summer. Therefore, this large pipeline was now only protected by about 5 feet of riverbank.

A large and rare rainfall event in the drainage above this site would have taken out beaver dams, and added to the flow through this narrow gap. It is likely that the first pipeline would have easily been exposed. In addition, the heavy concrete sections could have been eroded into the pipelines, threatening ruptures. Since Enbridge wanted to do something off the right of way in this location to "clean up" the site. They asked for my advice regarding permitting and repair. Since there were concrete sections available, and it looked as if there was a pipeline integrity issue present, I supplied the advice on armoring the eroding bank next to the pipeline, and moving the bank farther from the pipe. This was done by driving the 5 foot concrete sections into the stream bank, a technique I had essentially learned while employed at the DNR. I documented that this was a temporary solution

This site should be thoroughly assess at to susceptibility to scour—since it is an ideal site for down cutting caused by human activity restricting the floodplain of this river. On several other occasions, when DNR staff found exposed pipe on older—and large—pipelines in sensitive areas next to rivers, the same thing happened—staff were told it was up the pipeline company to fix the problem.

II.B. Specific PUC rules on "safety standards." The PUC rules for the route permit, in 7852.0200, Subp. 2 "Scope," has two sentences containing language pertaining to pipeline safety standards. In fact, the language is so similar as to be almost redundant:

--Second sentence: "This chapter does not set safety standards for pipelines."

--Last sentence: "The (permit) must not contravene applicable state or federal jurisdiction, rules, or regulations that govern safety standards for pipelines nor shall the permit set safety standards for the design or construction of pipelines."

I submit that the State of Minnesota has a number of clear ways it can influence Sandpiper (and any other liquid pipeline) without "setting safety standards." These are as follows:

II.B.1. Location of High Consequence Areas (HCA) is not necessarily only a "safety standard." These areas are referred to in federal safety standards for pipelines. They are areas where ". . .a release could have the most significant and adverse impact." Attachment 3 provides lots of detail concerning both human and ecologically important areas, such as "land area in which spilled liquids could affect the water supply……critically imperiled species…..areas where migratory birds congregate…..(pipelines) that pass near enough that a release could reach the area by flow over land or within a river, stream, lake, or other means, are assumed to affect (the HCA.)"

Strangely, this document doesn't mention an HCA identified by state authorities, but actually refers pipeline operators to Nature Conservancy personnel to be consulted on important areas. (A personal comment here: Might this not imply a rather over-reaching and likely unconstitutional claim of federal legal authority?)

In addition, while I was employed by the Minnesota DNR, we had a meeting with the Minnesota Office of Pipeline Safety regarding issues along the MinnCan route. The people we met with never mentioned the concept of HCAs. They were not familiar with or interested in site-specific environmental issues, in fact, and only referred to specific generic safety standards.

II.B.2. Recommendations top reduce confusion and lack of clarity among agencies with overlapping responsibilities.

a. PUC, DNR, BWSR and PCA staff consult the Minnesota Attorney General's Office to investigate the specific federal rules pertaining to HCA's to determine the ability of state authority to identify and influence the identification of both project-specific HSAs and more permanent HSAs. Examples of state-identified areas should include groundwater recharge zones, designated trout streams, canoe routes, rivers with significant fisheries or rivers leading to significant fisheries or drinking water supplies, and a number of others.

b. PUC, DNR, BWSR, and PCA should notify the federal Office of Pipeline Safety that Minnesota intends to actively propose additions to the National Pipeline Mapping System referred to in Attachment 3, based on the review of the Sandpiper proposal as well as the other Enbridge and Minnesota Pipeline company expansion plans. This should include the corridors identified in Attachment 1 as well as any other corridors and new pipelines.

c. The environmental analysis of the Sandpiper and alternatives identify HCAs along all alternative routes, including already-identified HCAs and ones identified by the public, Minnesota DNR, PCA, BWSR, federal COE during this pipeline review. The outside consultant hired by the PUC to do the analysis of impacts and the route comparison should be charged with consulting and coordinating with Minnesota state agencies to identify these areas. The route comparisons should then include these locations in the analysis.

d. Extra care should be taken in the identification of HCAs along any corridor with multiple pipelines because of the increased magnitude of possible ruptures affecting a wider area that normal for one pipeline.

II.C. Pipeline design features that protect people and the environment are site-specific and thus need site-specific design features. It should not be necessary to have to make this point because we are many years past such knowledge based on normal and standard techniques for assessing impacts and mitigating them. Almost every environmental permit given has site-specific measure.

Large-impact projects always should have site-specific design. In fact, well-designed pipeline projects when they are finally ready to be constructed uses something often called a "line list" which identifies down to the foot what environmental mitigation measures are to be used in sensitive locations.

II. D. Support for my contention that pipeline design features such as some block valve locations are not always a "safety standards" issue. The following information clearly supports this contention:

II.D.1. Citation 8 (Attachment 4). Block valves and other related design features work to rapidly shut down and isolate pipeline segments when a sudden pressure drop indicates a pipeline rupture of enough magnitude to trigger the designated pressure drop. They can either be manual valves or remotely-operated valves.

Attachment 4 is a recent (late 2012) major study regarding improving block valve usage to reduce releases of large amounts of hazardous liquids. This was done under the auspices of an internationally known energy research institution, the Oak Ridge National Laboratory. The instigation for this study was primarily driven by the natural gas pipeline explosion in California that killed 8 people, but also seems likely that it was influenced by the large Enbridge rupture in Michigan, since it uses both as case studies. This document illustrates why features such as block valves are clearly not always a "safety standard." Here are quotes relevant to site specific pipeline design that are not "safety standards."

".. . ..site-specific parameters that influence risk analyses and feasibility evaluations often vary significantly from one pipeline segment to another and may not be consistent with those considered in this study. Consequently, the technical, operational, and economic feasibility and potential cost benefits . . . . . .need to be evaluated on a case-by-case basis." (p. 1 of Attachment 4.)

"Section 4 of the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 calls for the Secretary of the U.S. Department of Transportation (DOT) to require by regulation the use of automatic or remotely controlled shutoff valves, or equivalent technology, where it is economically, technically, and operationally feasible on hazardous liquid and natural gas transmission pipeline facilities constructed or entirely replaced after the final rule was issued. . . . .The Act also requires a study to discuss the ability of transmission pipeline facility operators to respond to a hazardous liquid or natural gas release from a pipeline segment located in a high consequence area (HCA)." (p. 1 of attachment 4)

"In addition, operators are required to consider installing emergency flow restricting devices such as check valves and RCVs on pipeline segments to protect a HCA in the event of a hazardous liquid pipeline release. In making this determination, an operator must, at least, consider the swiftness of leak detection and pipeline shut down capabilities and benefits expected by reducing the spill size." (p. 2 attachment 4)

II.D.2. Citation 9. This engineering study, entitled "Method determines valve automation for remote pipelines," describes methods of determining where automated block valves are to be located. The method is clearly based on site-specific design features. In addition, the following quote summarizes how block valve location is not directly based on "safety standards":

"Most pipeline codes do not stipulate requirements for block valve spacing or remote pipeline valve operations along transmission pipelines carrying low-vapor-pressure petroleum products. This requirement is generally industry driven to control hazards and reduce environmental effects of pipeline ruptures or failures causing hydrocarbon spills. . . . . This article summarizes pipeline codes for valve spacing and spill limitations in high consequence areas (HCAs). It also provides a criterion for an acceptable oil spill volume caused by pipeline leak or full rupture. The criterion is based on industry's best practice." (Introduction to the study.)

Note: This study noted at the end that the acceptable spill volume used to determine the valve spacing was about 20,000 barrels of oil. The study was done for several large pipelines in Brazil. I did not attempt to decipher the meaning of that large amount being acceptable for design of block valve location.

II.D.3. Recommendations for Sandpiper review and analysis regarding block valve locations.

a. Enbridge be required to clearly describe their method of determining block valve determinations, including identifying what HCAs they used, as well as any other factors for determining such locations, including cost factors and "minimum acceptable leaks." This information should be submitted to the MPCA, MDNR, and COE in time for them to respond appropriately, and in time for incorporation into the analysis of impacts and Comparative Route Assessment.

b. MDNR, MPCA, and/or PUC (and COE) should request information from the Office of Pipeline Safety as to whether they have provided any advice to Enbridge as to method of determining block valve locations and acceptable minimum amounts of oil at HCA locations, potential HCA locations, and other-than HCA locations, including cost-factors.

c. Minnesota state agencies and the Corps of Engineers develop a cooperative and partnership relationship regarding the potential socio-economic and environmental risks of having multiple large pipelines in close proximity to each other.

III. The PUC, other Minnesota agencies, and the US Corps of Engineers and EPA must address "corridor fatigue."

PUC pipeline rules favor following existing corridors—even when the pipelines are squeezed into environmentally and socially sensitive areas. The current rules also allow pipeline companies to use the rules to their benefit and to reduce the scope of the analysis. Clearly, this needs a legislative solution. However, there are methods that can be used in the Sandpiper review that are within the current rules that can attempt to get at the "corridor fatigue" problem. I provide some detail in these comments because of the importance of this issue. My recommendations as to how to handle this in the Sandpiper review are in III.C. below.

III.A. Background. "Corridor fatigue" is a term that has been used to talk about what happens when multiple linear facilities such as pipelines and High Voltage Power Lines reach a point where cumulative impacts, objections from people nearby, and crowding of various sensitive areas along the edge of corridors began to be more and more apparent.

In fact, this term is inappropriate with respect to the pipeline corridors described in Attachment 1. Much more proper terms are "corridor sickness" or "corridor exhaustion."

Any resource manager with experience in environmental review of linear facilities in Minnesota (or elsewhere) knows the reasons that lead to overuse of corridors. Some of these are generic, and others are specifically relevant to the Sandpiper proposal. These are:

III.A. 1. *Original linear facility routes pre-date almost all environmental laws*. This meant the route went through high-impact locations that wouldn't otherwise be crossed under current laws and regulations. Essentially, these routes were the shortest distance between endpoints unless there were prohibitive obstacles in effect at the time of building. these original facilities were usually small pipelines. This is true of both the Enbridge Mainline corridor and the Minnesota Pipeline Corridor.

III.A.2. *Each additional facility was assessed independent of others.* Methodology to fairly assess cumulative impact of additional facilities after the second facility was usually not used. (It is often the third facility that starts to show the strain.)

III.A.3. *Large linear facilities are almost always controversial.* There was strong pressure to follow existing corridors. This then became embedded more and more strongly in either informal or formal policy, and finally made it into regulations. Unfortunately, when this was done, there was no concurrent regulation requiring an objective assessment of the pros and cons.

III.A.4*. Lack of appropriate regulations.* Policy-makers formalizing existing corridor locations as the most likely place to put new facilities didn't write corresponding policies that required a look at impacts of ever-larger corridors. Likely the best example of this I know of is the LaSalle Creek valley north of Itasca Park on the Minnesota Pipeline Corridor. This site is covered in detail below.

5. Citizens living next to corridors have little recourse to challenge expanding corridors, since the energy companies and PUC are essentially in agreement for all practical purposes. The PUC has not developed objective methodology to address this major problem. The result is that adjacent landowners are subject to the highest impact.

<u>III. B. Known potential impacts of enlarging Minnesota Pipeline and Enbridge mainline corridors because of previous recent reviews.</u> There are recent reviews of both of these corridors (except for the Sandpiper Green field route.) Therefore, these reviews, including comments of agencies with responsibilities for environmental protection during those reviews, are relevant to the current reviews.

II.B.1. PUC, MDNR,PCA, and COE review of the MinnCan pipeline. During the review process for the MinnCan pipeline, there were many issues raised by agencies with natural resource, wetland, and permitting authority. There was an important ALJ report prepared for this project. All of this is available in the PUC records for this project. There were also major problems identified during construction. The review of that project is recent enough so that environmental concerns raised are still relevant.

<u>I</u>*II.B.2. PUC, MDNR,PCA, and COE review of the Alberta Clipper/Southern Lights/LSr projects.* Even more recently, the Enbridge proposals follow its mainline corridor to Clearbrook. An alternative route to Sandpiper

follows the Mainline corridor on to Superior. Now, just 5 years later, Enbridge proposes to follow this same problematic route.

III.C. Route width for new reviews too restricted so that it exacerbates corridor fatigue. The PUC rules allow Enbridge to select the route width for their application. The rules state a route can be as narrow as the right of way required to construct the pipeline, and as wide as 1.25 miles. An examination of the Enbridge proposal indicates in many locations that Enbridge has selected a very narrow route width. It is obvious that the narrower the route width for this review along the existing Minnesota Pipeline Corridor, the more advantageous to Enbridge—because it becomes too late to adjust the right of way to avoid impacts found after finalization of the route width by the PUC.

Generally speaking, the PUC waits for others to object to this restrictive situation and propose enlargements, or other route segments or routes.

A good example concerns river and flood plain crossings. Normally, the clear standard for crossing of such environmentally sensitive features with linear facilities is perpendicular to the floodplain, and perpendicular to the river meander. In addition, as mentioned in Comment V, the MDNR does not have permit jurisdiction beyond the Ordinary High Water of the river or stream (this is the top of the bank in most cases.) The DNR has two options for influencing this—proposing a route segment change or widening, or relying on the PUC authority to require moving the centerline. Furthermore, DNR often indicates to applicants to begin preparing detailed applications for its license to cross before the environmental analysis of routes is completed.

In other areas, the 1.25 mile width is still too narrow to address the problems of pipeline corridors expanding more and more in high-impact areas.

III. D. LaSalle Creek problem area. More than any other location, this area epitomizes the landscape and regulatory issues of "corridor fatigue" and problems of following old straight-line routes. The crossing and surrounding landscape has the following characteristics:

--This location is not far north of Itasca park in a heavily forested area with steep and convoluted glacial moraine. LaSalle Creek itself is a small designated trout stream flowing in a glacial tunnel valley toward LaSalle Lake. The stream channel is deeply incised in the wetland with many meanders. Right at the crossing point, the stream and valley narrow upstream and widens out substantially downstream toward the lake. The ridges on either side of the tunnel valley are likely more than 100 feet higher than the stream.

--The existing Minnesota Pipeline Company pipelines transverse the valley at the almost the worst possible manner: a sharp oblique angle side-hilling down portions of the west hillside from the north, then side-hilling out of the valley on the east side after crossing the creek.

III.D.1. *Severe problems with the MinnCan crossing*. There were severe and numerous problems with this area. I am supplying some detail on these problems because I am proposing a re-route around this area several miles in length. The problems are as follows.

a. MDNR sent an "early-coordination" letter to the MinnCan consultant warning that this crossing was the worst site of all the locations in the Bemidji Region portion of the project. There was no response from MinnCan, and near-failure months later for MinnCan to even acknowledge such a letter. By then the PUC process had proceeded past the point for the MDNR to effectively examine another route in this high-resource area.

b. The two old and small pipelines were closely followed with the 24-inch MinnCan line with close separation, on the order of 40 feet if I recall. The old cleared right of way was fairly narrow. This greatly expanded during construction. MDNR measured a cleared right of way over 350 feet wide on the north end of the valley. (This was necessitated by the large amount of earth moving required to construct a 50-foot wide level construction word pad.) Topsoil was generally not separated here either, so impacts are long-term.

c. MinnCan did a directionally bore deep under LaSalle Creek. It was somewhat over 3,000 feet in length and done in the winter. As they bored under the creek itself, there was a large frac-out into the creek. Drilling mud escaped from several other locations besides the creek bed, all characterized by obvious groundwater upwelling. (In spite of the very cold temperatures the ground and wetland surface was not frozen.)

Construction stopped and clean-up was complicated and protracted. Because of the lack of frost from groundwater upwelling, it was impossible to get equipment to the site so that most work need to be done by hand.

However, it was necessary to get some equipment to the site, which was a very delicate operation because of the deep, soft, water saturated organic muck at the site. There were two existing pipelines floating in this water saturated muck near the surface. These could have been threatened by heavy equipment tipping into this area. Oil/ product flow was *not* shut off during these operations taking place a few feet from the pipes.

d. A large beaver dam downstream of the crossing had backed up water right to the crossing point, and covered parts of the creek receiving drilling mud. In other words, there was thin ice over the flooded creek channel. This obscured drilling mud material and caused safety problems in minus 15 degree weather.

III.D.2. Current Enbridge plans at this site. According to maps I examined during the public meeting at Clearbrook, Enbridge is now planning a warm weather crossing of the creek itself downstream from the existing crossing out in the broader wetland that leads to LaSalle Lake. The proposed crossing location is at a more perpendicular angle to the creek itself but not perpendicular to the valley, since the centerline of the pipe makes a sharp bend after coming down into the valley from the north. After the creek crossing, the Enbridge plan is to open up a new cleared right-of-way on the east side-hill of the valley. This plan was confirmed to me by MDNR staff. Enbridge had indicated to them they would accomplish the trenched crossing in a very short time to reduce impacts. I believe this is a very bad idea for the following reasons:

a. There is wetland along very much of this centerline proposal, including as the centerline comes down the hill from the north. There are wetlands on the slopes of the west hill side caused by abundant groundwater emergence. There is deep muck in this area, as well as out in the flat valley. Trenching through this soft area will require very large amounts of construction maps which usually require firmer wetland soils than are present. Furthermore, the trying to trench in such an area will result in slumping and the necessity of removing large amounts of material.

b. I have been involved in several wetland situations with some similarities to this site—but not such as large problem area as this. None of them approach the red flags of this area. The nature of the muck soil and substrate in the other areas meant that sheet pile had to be driven in on both sides of the trench in order to remove enough material to sink a weighted pipeline. I estimate that more than 1/4 mile of wetland is involved.   Furthermore, both ends of this wetland traverse are on inclined wetland at the bottom of slopes. Attempting to excavate a temporary trench through such a location trenching could also easily open a channel so that unpredictable amounts of silt laden water—both groundwater and surface water—flows down the channel into LaSalle Creek.

c. The new right of way on the east side of the valley will also traverse groundwater emergent areas some distance before it rises far enough out of the valley to rejoin the corridor south some distance. This is also an additional impact of such a crossing.

d. I recommend that a route around LaSalle Creek and its valley be considered (see below.)

Recommendation: The route width should be expanded to the maximum 1.25 miles at every floodplain crossing that is oblique (not perpendicular to the floodplain.)

<u>III.C. Recommendations to begin to address "corridor fatigue" concerns relative to existing corridors followed by Sandpiper</u>.

II.C.1. *Federal EIS on Sandpiper.* The US Corps of Engineers should prepare a federal environmental impact statement for the Sandpiper project.   The COE should do this for additional reasons beyond this topic, which will be contained in a separate recommendation to them.

It is clear that the PUC environmental analysis falls far short of what can be explored in an EIS. Nevertheless, Minnesota law says that the environmental analysis done by the PUC fulfils state environmental review requirements.

However, the MPCA and MDNR who are more familiar with the merits of EIS review than is the PUC, should certainly recommend to the COE that an EIS be done on this project.

III.C.2. *Incorporation by reference of the previous environmental analysis in these corridors*. I hereby incorporate by reference the PUC record of Alberta Clipper, LSr, Southern Lights and MinnCan projects into this Sandpiper review by the PUC. This should jump-start the review of "corridor fatigue" problems.

Examples of relevant documents for these four projects include: These issues and comments include:

> --The ALJ report son MinnCann and the Enbridge projects
> --All PCA and MDNR comments on the projects. There should be special focus on the MDNR objections to detailed and extensive comments that were ignored in ALJ findings.
> --All key determinations of the US COE on all projects, and all comments on the 404 notices for the projects

III.C.3. *Any records of specific unforeseen problems and impacts that developed post-permitting on these projects.* If the records cannot be found, these topics should be addressed in the environmental analysis:

a. "Frac-outs" on the MinnCan project. Frac-out is the common term for when drilling mud escapes from the bore from directionally drilled crossings, whether they be short or deep bores. Generally, this becomes evident by mud appearing on the surface or in water bodies. There were a large number of such events on the MinnCan project. Some of which were very large. These occurred in or next to the following rivers north of the point where the Sandpiper route turns east: Clearwater River floodplain east of Bagley, Mississippi

River at the crossing north of Itasca park, LaSalle Creek floodplain and creek bottom north of Itasca Park, and the Straight river just south of Park rapids. There were other frac-outs south of Park Rapids beyond the point where Sandpiper turns east on a Greenfield route.

Frac-outs occurred during winter bores, which greatly increased the difficulty with addressing them for several reasons. Determining amount and location of material was obstructed by ice. Recovery of material was difficult due to ice. Finally, ice conditions on flowing water was a hazard to workers attempting to recover material.

All records of frac-outs that occurred on MinnCan should be carefully examined as to amounts and locations. This may help to determine if there is a pattern as to when they occur. In each of the four rivers mentioned above, landscape conditions were such that groundwater upwelling zones were either present or suspected at the site of the frac-out. If this is correct, such landscape conditions that are present in other locations are a red flag for bores in the future.

Drilling mud is primarily bentonite clay but contains additives at the discretion of the pipeline company. Additives are a two edged sword: they can increase the success of the bore and reduce frac-outs, but some additives can be toxic to aquatic life. Furthermore, MinnCan initially claimed trade secret status on the first frac-out at the Clearwater river, which became a big obstacle to resolution. Therefore, PUC should require specific listing of any constituents of drilling mud before. Some of the frac-outs were in locations subject to direct DNR permit authority, but others were outside of the OHW so were not. PUC should make it a condition of the Route permit that frac-outs be handled in essentially the same manner wherever they occur, after recommendations from the DNR and MPCA.

b. *Winter construction successes and problems on MinnCan and Alberta Clipper.* Topsoil separation is important in all areas of deep excavation, including over the trench as well as side-cuts done to prepare the 50-foot level work pad. Poor separation leads to more successful invasive species invasion, and lost productivity. Frozen ground made topsoil separation problematic. In addition, winter construction made it erosion control more difficult and led to substantially higher erosion problems during spring runoff in certain locations.

IV. PUC and Hearing Officer must address concerns of the MDNR regarding natural resources not directly subject to MDNR and MPCA permits.

Environmental impact assessment includes—by law as well as best practice—consideration of impacts not necessarily covered by permits. As noted in a letter to the ALJ on the Alberta Clipper and Southern Lights project, the MDNR said it only had direct jurisdiction on less than 0.5 percent of the route. (April 21, 2008 letter to AlJ Judge Eric Lippman, from Matt Langan, MDNR). This jurisdiction involved public land crossings and river crossings restricted to the OHW (generally the top of the riverbank.)

Subsequently, the MDNR made extensive factually supported comments regarding natural resources in their areas of expertise. Serious problems with Enbridge's data, lack of supporting information, and assessment of impacts were noted. Some of these were glaring errors, such as obvious underestimation of area of impact. The ALJ report finalized its report without discussing the merits of the DNR comments, and did not address any of them in numerous findings on the route permit conditions. At the same time, it praised Enbridge's approach. A "reasonable person" perhaps would find it troubling that an ALJ, who lacks natural resource expertise, would replace the expertise of an important state agency charged by Minnesota law with protecting its natural resources, with that of an energy company with obvious motivations for downplaying impacts to such resources. The lack of attention to the MDNR comments is documented in three subsequent letters to the PUC staff after the ALJ report was finalized (April 25, 2008 letter to Larry Hartman from Matt Langan, MDNR; August 1, 2008 letter to Bill Haar, PUC Executive Director from Matt Langan, and November 13, 2008 letter to Larry Hartman from Matt Langan, MNDR.

Recommendation. The PUC should ensure that this does not happen again, and ensure that the ALJ for this project is charged with specifically making findings regarding potential environmental impacts found to be of concern by state agencies such as the PCA and MDNR.

V. PUC and ALJ must use accepted impact analysis methods and its own rules to proactively address the Sandpiper project and future even though its environmental report substitutes for an EIS or EA according to law and stature.

V.A. Pipeline rules available to the PUC to improve its responsibility, process ,and results. Many of the pipeline route permit rules appear on their face to restrict and narrow the environmental analysis as compared to that done under EIS rules and ;procedures for other large facilities. However, a reading of the rules indicates that the PUC has lots more authority than it used on the Alberta Clipper projects. All of the following rules allow the PUC to address **all** of the topics I have raised in these comments:

V.A.1. Rule "7852.3200, Subpart1: "When the commission issues a pipeline routing permit for the construction of a pipeline and associated facilities, the commission shall designate a route…..conditions for right of way preparation, construction, cleanup, and restoration. . . . **and any other conditions relevant to minimizing environmental and human impact.**" (emphasis added.)

Note: The PUC could have chosen to fully address the MDNR comments that were not addressed on Alberta Clipper using the highlighted language. It now needs to respond to comments by other state agencies on the Sandpiper project and use this clause.

V.A. 2. Rule "7852.0200 Authority, scope, purpose, and objectives

"Subp. 3. Purpose. Minnesota Statutes, section 216G.02, recognizes that pipeline location and restoration of the affected area after construction is important to citizens and their welfare **and that the presence or location of a pipeline may have a significant impact on humans and the environment**. To properly assess and determine the location of a pipeline**, it is necessary to understand the impact that a proposed pipeline project will have on the environment**. .. .. The purpose of this chapter is to aid in the selection of a pipeline route and **to aid in the understanding of its impacts and how those impacts may be reduced or mitigated through the preparation and review of information contained in pipeline routing permit applications and environmental review documents**.

Note: The PUC can use this clause to address pipeline rupture risk, corridor fatigue, and so forth.

> "Subp. 4. Objectives. The process created by this chapter is designed to:
> A. locate proposed pipelines in an orderly manner that minimizes adverse human and environmental impact;
> B. provide information **to the project proposer, governmental decision makers, and the public** concerning the primary human and environmental effects of a proposed pipeline project**;**

*Note: Note that this clause contains the phrase "**to** the project proposer. . . .decision makers, and the public" concerning the human and environmental effects of the project. On the Alberta Clipper project, the PUC, and ALJ passively turned this phrase entirely on its head and accepted the Enbridge analysis of many issues rather than accept expert analysis from responsible state agencies. This must not happen on the Sandpiper project. The PUC should insist on its role of providing objective information **to** other parties. It should do so on the main topics of these comments.*

V.A. 3. "7852.1400 Route proposal acceptance.

> Subp. 2. Sources of route proposals. **The Public Utilities Commission staff and the citizen advisory committee may propose routes or route segments directly to the commission**.

Note: The PUC can use this clause to address corridor fatigue and to attempt to obtain objective comparisons of alter=natives to problem locations.

V.A. 4. "7852.1900 Criteria for pipeline route selection.

> "I. cumulative potential effects of related or anticipated future pipeline construction; . . ."

Note: The PUC can clearly address the issues of "corridor fatigue" by using this clause.

<u>V.B. PUC can use standard impact assessment methods</u> The statute governing pipelines indicates that the PUC Environmental report meets the requirements of an EIS or EA. However, this does not mean that methods of analysis of impacts do not need to reflect standard methods used in EISs.

The request to the public to propose methods of analysis in the PUC public notice actually is strange. There are effective methods for analyzing impacts to humans and the environment and methods for comparing routes for linear facilities. These methods have been in effective use for many years. All one needs to do is find an EIS that has done so effectively.

<u>V.C. PUC staff needs to acknowledge the limitations of the pipeline environmental analysis .</u> I was present at the Sandpiper public meeting Clearbrook some weeks ago. A citizen asked how the PUC environmental analysis compared to an EIS. The PUC lead person said it was essentially the same. I was taken aback, as were some others that were present. I was later informed that this same statement was made at the Park Rapids meeting. This is highly concerning since the citizen was misled. It also is concerning because it implies PUC staff is unaware of important and routine methods of analyzing impacts and alternatives in EISs on linear facilities. Such methods are an answer to the question in the Sandpiper public notice of "topics open to public discussion. . . .Are there specific methods to address these impacts. . . .?".

Here are some reasons how the PUC environmental report very much differs from an EIS:

--PUC rules on pipelines allow the project proposer to so narrowly define the project that there is a large burden to overcome to define alternatives and even to analyze impacts. Pipeline rules favor existing corridors without a specific requirement to objectively analyze impacts of concentrating facilities in environmentally inappropriate areas. This would be impossible under an EIS.

--The PUC environmental report is finalized in-house. There is no opportunity to comment on a public review draft report. On draft EISs, the preparer is bound by law and rule to address reasonable comments supported by sound data. No such process exists for pipelines under PUC rules. With the case of Alberta Clipper, the ALJ report would have been found deeply flawed if it had been subject to the standards for responding to comments that are found in the EIS process.

--Finally, compare the PUC process for siting HVTL lines: it uses routine methods of comparing routes and alternatives that are answers to the question posed as to how

VI. Proposed alternative routes and route enlargements

The PUC public notice solicits suggestions for alternative routes or route segments. In addition, Larry Hartman, the PUC person leading the Clearbrook public meeting, received a number of questions as to the burdensome format that appeared to be required for such proposals to be successful. He indicated alternatives would be considered that left out factors apparently required by the rules, and that a simple hand-drawn line on a map would be sufficient.

Therefore, the following recommendations for analyzing additional routes are provided:

VI. A. Widen Sandpiper route width wherever it is less than 1.25 miles in width. Enbridge has in many locations along its route narrowed the route nearly its minimum required by the PUC rule. This greatly reduces the scope of analysis of impacts very early in the siting process. This very much reduces the flexibility of moving the centerline to reduce impacts as problems are discovered during site reviews. This problem was severe during the Alberta Clipper review. Therefore, the route width should be expanded to the maximum allowable along the entire proposed route, as well as any new routes or route segments accepted for study. This is 1.25 miles in width. This will more appropriately meet the PUC requirements to adequately study environmental impacts. This is especially important at all crossings of rivers and other sensitive locations.

V.B. Route segment following Enbridge's North Dakota Pipeline corridor to Clearbrook. Enbridge's web site indicates that the existing pipeline has the capacity carry 475,000 bpd, yet Citation #2 says it is carrying 210,000 bpd at this time. If this is correct, there is excess capacity in the North Dakota line so as to allow it to carry the 225,000 bpd of the Sandpiper line. Therefore, there is a question as to whether another line is needed at this time for this route segment.

This route is clearly indicated on Enbridge's application.

V.C. Enbridge Mainline Corridor, Clearbrook to Superior. This route should be studied as an alternative to Enbridge's preferred route. The study corridor should be widened to the maximum 1.25 miles. This route is clearly indicated on the Alberta Clipper PUC files, which are incorporated into this PUC record by reference.

V.D. Any route alternatives studied for the Alberta Clipper project. There were a number of alternatives studied for the Alberta Clipper project. These routes are clearly identified on maps in the PUC record of that project. These include HVTL corridors and gas pipeline corridors. They should be re-studied for the Sandpiper project.

V.E. LaSalle Creek alternative. An alternative which avoids the major problems of crossing LaSalle Creek and its valley at an angle needs to be studied. Adding two large diameter pipelines to this area—Sandpiper and the Line 3 replacement/upgrade—is extremely likely to have large off-right-of-way impacts to groundwater, Big LaSalle Lake, and LaSalle Creek. In addition, given the sub-surface conditions, it will be very hard to predict site-specific technical engineering plans for how to construct and maintain pipelines in this area. This could lead to massive problems and impact area growth during construction. This area could well become a case study of where not to build large pipelines.

A route avoiding this feature also crosses other areas with natural resource value, other private and public lands, and opens a new corridor. However, such an alternative for study must be accomplished because of escalating consequences of adding two more pipelines. I do not have an ability to submit a map today of my proposal, since I have to submit comments electronically in order to meet today's comment deadline. I can submit this by mail later. However, based on PUC statements made at the Clearbrook public meeting, this is sufficient as long as I describe the alternative in enough detail to identify it.

Here is a verbal description of the route: It is a 1.25 mile wide route deviating from the existing corridor in section 11 of Itasca Township in Clearwater County, then goes southwest to turn south along the east side of Clearwater County 2. It then turns SE to follow the north side of state highway 92, roughly paralleling it with the south edge of the route along this highway. It then turns east to rejoin the corridor in Section 32 of Lake Hattie township in Hubbard County.

On a final note, I believe it is within the PUCs ability to widen the "route" to more than 1.25 miles in this area.

<u>V.D. Enbridge Line #3 enlargement/replacement.</u> PUC needs to formally include the potential routes for this project that is clearly now in the planning stage. In addition, PUC should begin entering into studies for this project to analyze the alternative of following the corridors for the Great Northern Transmission line, now under review, since this line comes from Canada, and is potentially a route to Superior.

V. Significant impacts not otherwise indicated in these comments.

Here is a list of potential important impacts that need be addressed in the review of all route proposals, initially in a generic manner, and then as the focus is on site specific areas:

1. Analyze the advantages of topsoil separation in all areas where excavation into subsoil and parent material would otherwise result in mixing of parent material with top soil. It has been clearly demonstrated that creation of such disturbed areas leads to greater success for invasive species such as spotted knapweed and other noxious weeds. This also results in lowered productivity on not only farmland, but forest land, and reduced habitat value. In addition, it is becoming standard practice for responsible pipeline companies to accomplish this.

2. Requiring accurate depiction of any areas where excavation into parent material and subsoil occurs. Such excavation is routine in non-flat terrain in order to obtain the necessary 50-foot wide work pad for construction.

3. Detailed analysis of the product shipped in order to explore the environmental and human impacts of pipeline rupture.

4. Detailed analysis of the content of drilling muds to be used, and requirements for immediate notice to appropriate agencies when frac-outs occur during bores. Route permits should require agency review of any new additives considered during construction.

5. Careful analysis of the pros and cons of winter construction vs warm season construction. Such an analysis should be entirely independent of Enbridge desires to construct on their timetable, or for solely cost reduction reasons.

6. Careful analysis of the need for deep ripping of the work pad in areas of high clay soils. Operation of very heavy equipment along the work pad—which is essentially a road during construction—can create compaction layers in clayey soils that persist for as long as a projected 200 years.

7. Careful analysis and critique of proposed extra work space areas in sensitive locations such as stream crossings. Such areas sometimes are based solely on engineering requirements rather than given a careful review to reduce environmental impacts.

8. Careful review of the project's off-right of way affected area, and a PUC requirement that Enbridge submit all such areas to agencies for review.

9. An analysis of the damages caused by encroachment on the right of way from ATVs and other off-road highway vehicles. This has been observed to be intense in some areas, according to DNR comment letters. The MDNR has no jurisdiction to respond to this use which can cause stream bank erosion, siltation, and so forth.

V. Cumulative Impacts.

As noted in the above comments, the PUC rules require that the Commission **shall** consider "cumulative potential impacts of related or anticipated future pipeline construction. . . ."

Enbridge recently announced it is planning to "replace" in the near future its Line 3 pipeline that is in now within the mainline corridor from Canada to Superior. The announcements also note that operation of the old Line 3 will continue until the new line—upgraded to 36 inches—is completed. Therefore the new line will not be in the same location as the old line. Enbridge has indicated in the announcements that it is considering both the Mainline Corridor to Superior and its preferred Sandpiper route. Therefore, the PUC needs to conduct the following analysis:

--Cumulative impacts of adding two large pipelines in these routes, including the existing corridors and the new Greenfield route east of Park Rapids, and on any alternatives to the Sandpiper project accepted for study.

--PUC needs to inform state agencies that are currently in the early stages of reviewing applications for Sandpiper, (such as the DNR and PCA) that PUC is conducting a cumulative effects analysis on these two pipelines that may result in changes in locations. This should be done under the PUC rule cited above concerning responsibilities of the PUC to provide information **to** other stakeholders and the public.

List of attachments

1. Attachment 1. Estimates of oil/product flows in proposed and alternative corridors
2. Attachment 2. Enbridge schematic of its pipeline systems
3. Attachment 3. Web page from the US Department of transportation describing HCA areas
4. Attachment 4. Verbatim excerpts from an ORNL risk assessment appropriate for the Sandpiper project

CITATIONS

#1. Enbridge. 2013. "Enbridge Pipeline System Configuration." Quarter 1, 2013. Color chart showing entire Enbridge system in the United States and Canada, including data on individual lines, pipeline size, product type, and pipeline capacities (based on annual capacities). Available from one of the Enbridge web sites, and downloaded March 2014.

#2. Minnesota House of Representatives, House research. June 2013. Bob Eleff, Legislative Analyst. "Minnesota's Petroleum Infrastructure: :Pipelines, Refineries, Terminals.

#3. Thompson/Reuters News Service. March 31, 2014. "Enbridge to expand Southern Lights Pipeline as demand rises." Reuters Business and Financial News.

#4. Reuters News Services. March 4, 2014. "Update 2—Enbridge to spend C$7 billion (Canadian) to replace pipeline to US." Reuters Business and Financial News. (Concerns Line #3) Also, at the same time, Enbridge web sites indicate this 34 inch line will be upgraded to 36 inches from 34, and the old line won't be decommissioned until the new line is in service.

#5. Forum News Services. March 5, 2014. John Myers. "Another Enbridge proposal would replace line from Canada to Wisconsin." Concerns Enbridge Line 3 upgrade as in #4, but this article quotes an Enbridge spokesperson that both the Sandpiper Route/Corridor and the Enbridge Mainline Corridor along US 2 are being looked at as possible locations.

$6. Federal Reserve Bank of Minneapolis. May 1, 2007. Kathy Cobb. "This nation's rapacious appetite for oil products and Canada's vast supply spur district pipeline projects." Newsletter. This article notes that MinnCan can be increased by 185,000 bpd to increase the Mn Pipeline Corridor to 640,000 bpd.

$7. Minnesota Public Utility Commission (PUC) public notice on Sandpiper, January 31, 2014.

#8. Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" Date Published: October 2012. Revised: December 2012. For U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Pipeline Safety Program | East Building 2nd Floor 1200 New Jersey Avenue, S.E. Washington, DC 20590

#9. Online Oil and Gas Journal. January 17 2005. (Printed from site 3/29/2014.) "Method determines valve automation for remote pipelines."

Attachment 1

ESTIMATES OF EXISTING AND PROPOSED PIPELINE FLOWS RELATED TO PROPOSED SANDPIPER CORRIDORS AND TRANSLATED TO SELECTED RIVER FLOWS

Note: Pipeline capacities are given in barrels per day (bpd). Product flow rates are converted to cubic feet per second (cfs) in order to compare to typical river flows along the routes. Rates are calculated based on 42 gallons/barrel. A useful rule of thumb is that 100,000 bpd converts to 6.5 cfs. Product type is variable, and some information about types is given in Attachment 2.

A. Enbridge Pipelines from Minnesota border east to Clearbrook

Note: All lines are in one corridor except for North Dakota Pipeline which joins the "Mainline Corridor" at Clearbrook which then goes on to Superior roughly along US Highway #2.; Enbridge refers to the main corridor as "Enbridge Mainline Corridor.

A. 1. Existing Enbridge Pipelines

Note: All product flow is to the East-southeast except for the diluent line, which takes product from Illinois refineries back to Alberta for "thinning" heavy crude so it can be pumped in pipelines. Product types are listed by Enbridge in Attachment 2.

Pipeline name	Barrels per Day Amount	Flow rate cfs	Source	Pipe diameter	Citation
Line 1	236,500	15.4	Alberta	18/20 inches	#1
Line 2b	442,200	28.7	Alberta	24/26 inches	#1
Line 3	390,000	25.4	Alberta	34 inches	#1
Line 4	795,700	51.7	Alberta	36/48 inches	#1
Line 67 (Alberta Clipper)	450,000	29.2	Alberta	36 inches	#1
Line 65 (LSr)	186,000	12.1	North Dakota	20 inches	#1,#2
North Dakota Pipeline	210,000	13.6	North Dakota	?	#1, #2
Southern Lights Diluent	180,000	11.7	US refineries	20 inches	#2, #3
Totals	2,890,400 bpd	188 cfs			

A.2. Expansion proposals by Enbridge, Minnesota border east to Clearbrook

Expansions:	bpd amount	cfs		Pipe Diameter	Citation
Line 3 increase**:**	370,000	24.0	(total 760,000)	34 inches to 36	#4
Line 67 increase:	350,000	22.8	(total 800,000)	Pumps added	#2
Southern Lights increase:	95,000	6.2	(total 275,000)	Pumps added	#3
New line					
Sandpiper	225,000	14.6		24 inches	#7
Subtotal (new + expand)	1,040,000	67.6			
Grand total, existing and expanded	3,930,400	255 cfs			

B. Enbridge Pipelines from Clearbrook east to Superior

Note: There is a major facility at Clearbrook whereby some product is routed south to the Twin Cities on 3 pipelines owned by the Minnesota Pipeline Company—a different company from Enbridge. One of these, the MinnCan line, was recently constructed. (There are "loops" at a few locations, so that there may be 4 lines in place in the corridor at those locations.) According to Citation #2, currently this amount is 455,000 bpd. It is difficult to determine exact amounts in the two older lines, but it is not necessary for this level of analysis.

B.1. Existing Enbridge pipelines from Clearbrook to Superior

Note: For purposes of this analysis, it is sufficient to calculate a total of existing product flows from Clearbrook to Superior by subtracting the amount diverted south at Clearbrook from the total amount entering the Clearbrook terminal:

Total entering Clearbrook terminal: 2,890,400 bpd
Amount routed south: - 455,000 bpd
Total existing flows to Superior: 2,435,400 bpd or 158 cfs

B.2. **Expansion proposals by Enbridge, Clearbrook to Superior**
Note: An alternative route for the new proposed Sandpiper project is along this Enbridge mainline corridor. It is not listed here, but if it did follow this corridor, it would increase flows by 225,000 bpd, or 14.6 cfs. Also, the Line 3 replacement/expansion could follow the southern route, but is included here. If Line 3 would instead go south of Clearbrook, the amounts listed here should be decreased by 760,000 bpd or 49.4 cfs.

Pipeline name	bpd Amount	cfs		Pipe diameter	Citation
Line 3 increase:	370,000	24.0	(total 760,000)	34 inches to 36	#4
Line 67 increase:	350,000	22.8	(total 800,000)	Pumps added	#2
Southern Lights increase:	95,000	6.2	(total 275,000)	Pumps added	#3

Total increase: 815,000 53.0 cfs
Grand total, existing
+ increases 3,250,400 bpd 211.2 cfs

C. Pipelines routed south from Clearbrook
Note: New Enbridge proposals are to follow the existing Minnesota Pipeline Company corridor to near Park Rapids, and then create a new corridor east to Superior, Wisconsin,

C. 1. Existing Pipelines to Twin Cities, Minnesota Pipeline Company (owned by Koch Industries)

Pipeline name	Amount	cfs	Source	Pipe diameter	Citation
MinnCan	165,000	10.7	Canada	24	#2
Two older pipelines	290,000	16.9	ND, Canada?	?	#2

Total, Minnesota Pipeline: 455,000 29.6

C.2 Expanded capacity of Minnesota Pipeline Company

Total	640,000	41.6	Adding pumps?	#2

D. New Enbridge Pipelines potentially routed to existing corridor south from Clearbrook, then east from Park Rapids to Superior on new corridor

Note: Enbridge recently announced it is planning to "replace" and expand its older Line #3 in its mainline corridor across northern Minnesota to Superior, WI. It says it is also looking at instead going south from Clearbrook, then east from Park Rapids to follow the proposed Sandpiper route. Therefore, Line #3 is listed here in order to portray amounts of product potentially flowing in these corridors.

Pipeline name	bpd Amount	cfs	Source	Pipe diameter	Citation
Sandpiper	375,000	24.4	Alberta	30	#7
Line 3 expansion	760,000	49.4	Alberta	36	#4, #5

Total expansion: 1,135,000bpd 73.8cfs

E. Total potential Enbridge and Minnesota Pipeline company from Clearbrook to Park Rapids

Pipeline Company	bpd Amount	cfs	Source	Citation
Minnesota Pipeline Co.	640,000	41.6	North Dakota, Canada	#2
Enbridge	1,135,000	73.8	Canada	#2, #5

Total in corridor: 1,775,000 115.4

F. SUMMARY OF EXISTING AND PROPOSED OIL/PRODUCT FLOWS IN EXISTING PIPELINE CORRIDORS AS COMPARED TO SELECTED RIVER FLOWS

Company	Existing	cfs	Existing+Proposed	cfs
1. Enbridge N.D. Pipeline to Clearbrook	210,000	13.6	no increase	13.6
2. Enbridge mainline to Clearbrook	2,680,400	174.2	3,720,400	242 cfs
3. Enbridge Clearbrook to Superior	2,435,400	158.0	3,930,400	255 cfs
(Existing and proposed column includes Sandpiper and #3 expansion)				
4. Enbridge and MinnPipe Co. Clearbrook To south of Park Rapids	455,000	29.6	1,775,000	115.4
5. Enbridge, Park Rapids to Superior	No corridor	000	1,135,000	73.8

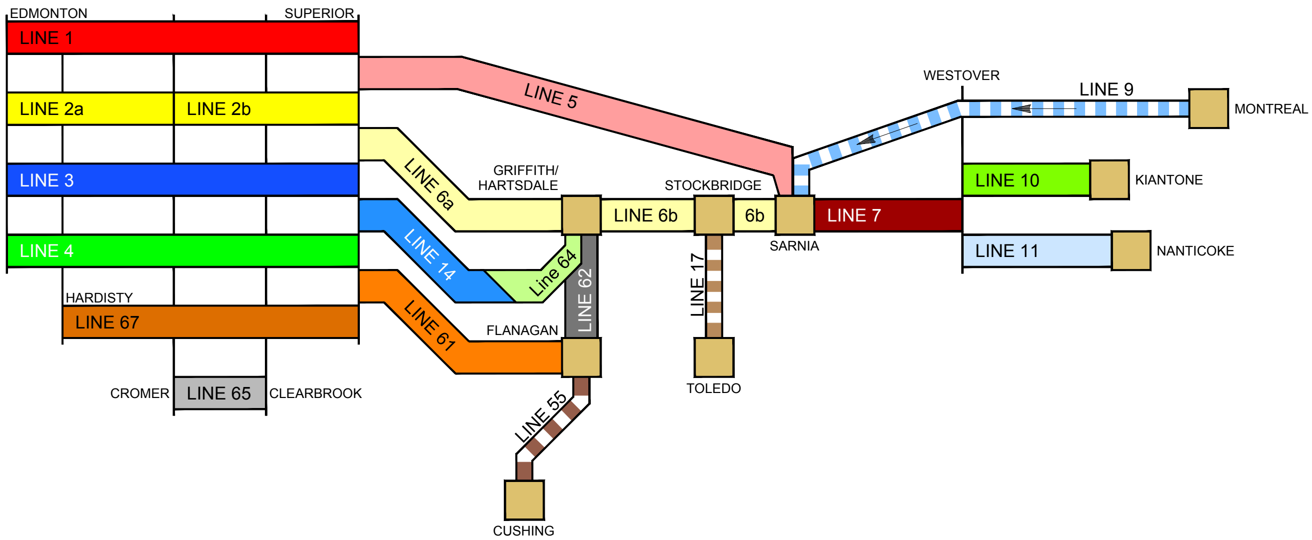
River name and location	Long-term median river flows (cfs) on this date from USGS Gauges, April 2, 2014	Approximate % of maximum oil flow to river flow
Snake river above Warren	124	195 percent
Clearwater river at Plummer	172	141 percent
Mississippi river at Bemidji	334	76 percent
Straight River south of Park Rapids	69	167 percent
Mississippi River at Grand Rapids	716	36 percent
Mississippi River at Aitkin	2,859	2.6 percent*
Prairie River at Taconite	125	204 percent
St. Louis River at Scanlon	1,850	14 percent

*New Enbridge corridor from Park Rapids to Superior crosses in this vicinity; all else are Enbridge mainline

Pipeline System Configuration

Quarter 1, 2013

ENBRIDGE



Line 1

37,600 m^3/d (236.5 kbpd)
18"/20" - 1098 miles
NGL
Refined Products
Light Synthetics

Line 2

Line 2a
70,300 m^3/d (442.2 kbpd)
24" - 596 miles
Line 2b
70,300 m^3/d (442.2 kbpd)
24"/26" - 502 miles
Condensates
Light Synthetics
Sweet
Light & High Sour

Line 3

62,000 m^3/d (390.0 kbpd)
34" - 1098 miles
Condensates (Edmonton to Hardisty)
Light Synthetics
Sweet
Light & High Sour

Line 4

126,500 m^3/d (795.7 kbpd)
36"/48" - 1098 miles
Heavy
Medium (Ex-Clearbrook)
Light Sour (Ex-Clearbrook)

Line 5

78,100 m^3/d (491.2 kbpd)
30" - 645 miles
NGL
Light Synthetics
Sweet
Light & High Sour

Line 6

Line 6a
106,000 m^3/d (666.7 kbpd)
34" - 467 miles
Line 6b
45,000 m^3/d (283.0 kbpd)
30" - 293 miles
Light Synthetics (Superior to Lockport)
Sweet (Superior to Lockport)
Light & High Sour
Medium
Heavy

Line 7

23,900 m^3/d (150.3 kbpd)
20" - 120 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 65

29,500 m^3/d (185.6 kbpd)
20" - 313 miles
Light Sour
Medium

Line 10

11,800 m^3/d (74.2 kbpd)
12"/20" - 91 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 11

18,600 m^3/d (117.0 kbpd)
16"/20" - 47 miles
Condensates
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 62

20,700 m^3/d (130.2 kbpd)
22" - 75 miles
Heavy

L 14 L 64

50,500 m^3/d (317.6 kbpd)
24" - 467 miles
Light Synthetics
Sweet
Light & High Sour
Medium

Line 61

63,600 m^3/d (400.0 kbpd)
42" - 454 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

Line 67

71,500 m^3/d (449.7 kbpd)
36" - 999 miles
Heavy

Not Part of the Enbridge Mainline System

Line 9

38,200 m^3/d (240.3 kbpd)
30" - 524 miles
Condensates
Sweet
Medium
Light & High Sour

Line 17

16,000 m^3/d (100.6 kbpd)
16" - 88 miles
Heavy

Line 55

30,700 m^3/d (193.3 kbpd)
22"/24" - 575 miles
Light Synthetics
Sweet
Light & High Sour
Medium
Heavy

NOTES:

Capacities provided are Annual Capacities and do not include current restrictions.

• Updated: January 2013
File: 2013_Q1 System Config.dwg

Revised by: YZ
Drawn by: DRD

Choose One...

contained within each circle.

- Potential impact circles that contain 20 or more structures intended for human occupancy;, buildings housing populations of limited mobility; buildings that would be hard to evacuate (e.g., nursing homes, schools); or buildings and outside areas occupied by more than 20 persons on a specified minimum number of days each year, are defined as HCA's.

How do operators of pipelines know where HCA's are located?

- High population areas and other populated areas are identified using maps and data from the U.S. Census bureau.
- Critical drinking water sources and unusually sensitive ecological areas are identified using information from National Heritage Programs and Conservation Data Centers in each state, in conjunction with The Nature Conservancy.
- Because of the complexity of HCAs for Hazardous Liquid Pipelines, the Office of Pipeline Safety identifies and maps HCAs for Hazardous Liquids on its National Pipeline Mapping System (NPMS). These maps are revised periodically by OPS based on new and updated information.
- Operators of natural gas transmission pipelines must use a specified equation to calculate the radius of "potential impact circles" along their pipeline and compare the structures in those circles to the HCA criteria in the rule.

How do operators determine what pipeline segments require extra integrity protection due to the presence of HCAs?

- Pipeline operators must determine which segments of their pipeline could affect HCAs in the event of a release. This determination must be made assuming that a release can occur at any point, even though the likelihood of a release at any given point is very small.
- Hazardous liquid pipelines that pass through an HCA, or that pass near enough that a release could reach the area by flow over land or within a river, stream, lake, or other means, are assumed to have the potential to affect that area.
- Gas transmission pipelines that pass within any of the HCA potential impact circles are assumed to have the potential to affect that area. (Or, alternatively, operators may choose to treat all of their pipeline segments in Class 3 and 4 areas as HCAs.)

Date of Revision: 12012011

ATTACHMENT 4
VERBATIM EXCERPTS FROM THE FOLLOWING PIPELINE RISK ASSESSMENT OF SHUTOFF VALVES, INCLUDING ESTIMATES OF AMOUNTS OF RELEASES OF OIL AND OTHER PRODUCT FROM RUPTURES

Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" Date Published: October 2012. Revised: December 2012. For U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration Pipeline Safety Program | East Building 2nd Floor 1200 New Jersey Avenue, S.E. Washington, DC 20590

ABSTRACT

Author's note: This 340 page study primarily concerns worst-case pipeline ruptures in populated areas, and was stimulated by a large California rupture of a gas pipeline in a urban area in California that killed 8 people. However, it also considers oil pipelines that do not catch fire, and those in High Consequence Areas (HCAs) that are also in or near ecologically significant areas. Therefore, it is highly relevant to certain the necessary route evaluation and environmental impact evaluation of the Sandpiper proposal. The underlined portions are indicate relevancy to Sandpiper, and in each case are the author's emphasis when they appear in the text.Page numbers at the bottom of the pages are excerpt page numbers rather than as in the original text.

This study assesses the effectiveness of block valve closure swiftness in mitigating the consequences of natural gas and hazardous liquid pipeline releases on public and environmental safety. It also evaluates the technical, operational, and economic feasibility and potential cost benefits of installing automatic shutoff valves (ASVs) and remote control valves (RCVs) in newly constructed and fully replaced transmission lines. Risk analyses of hypothetical pipeline release scenarios are used as the basis for assessing: . . . . and <u>(3) socioeconomic and environmental damage in HCAs caused by hazardous liquid pipeline releases of crude oil</u>. . . . . .However, these results may not apply to all newly constructed and fully replaced pipelines because <u>site-specific parameters that influence risk analyses and feasibility evaluations often vary significantly from one pipeline segment to another and may not be consistent with those considered in this study. Consequently, the technical, operational, and economic feasibility and potential cost benefits . . . . . .need to be evaluated on a case-by-case basis</u>. In theory, installing ASVs and RCVs in pipelines can be an effective strategy for mitigating potential consequences of unintended releases because decreasing the total volume of the release reduces overall impacts on the public and to the environment. <u>However, block valve closure has no effect on preventing pipeline failure or stopping the product that remains inside the isolated pipeline segments from escaping into the environment</u>. The benefits in terms of cost avoidance attributed to block valve closure swiftness increase as the time required to isolate the damaged transmission pipeline segment decreases. Block valve closure swiftness is most effective in mitigating damage resulting from a pipeline release. . . . .. Similarly, the avoided cost of socioeconomic and environmental damage for hazardous liquid pipeline releases without ignition increase as time required to isolate the damaged pipeline segment decreases.. . . .

The scope of the study is further limited by considering <u>only worst case pipeline release scenarios in HCAs involving guillotine-type breaks rather than other more common breaks, such as punctures and through-wall cracks.</u> Although ignition of the released product following a rupture is not ensured, this study only models release scenarios that result in immediate ignition of the released product at the break location. <u>The study also assesses potential socioeconomic and environmental effects of unintended crude oil releases without ignition from hazardous liquid pipelines in HCAs.</u>

EXECUTIVE SUMMARY

The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) is the Federal safety authority responsible for ensuring safety in the design, construction, operation and maintenance, and spill response planning for the 2.3 million (M) miles of natural gas and hazardous liquid transportation pipelines in the United States. Its mission is to protect people and the environment from the risks inherent in transportation of hazardous materials by pipeline and other modes of transportation. . . . Section 4 of the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 calls for the Secretary of the U.S. Department of Transportation (DOT) to require by regulation the use of automatic or remotely controlled shutoff valves, or equivalent technology, where it is economically, technically, and operationally feasible on hazardous liquid and natural gas transmission pipeline facilities constructed or entirely replaced after the final rule was issued.. . . .The Act also requires a study to discuss the ability of transmission pipeline facility operators to respond to a hazardous liquid or natural gas release from a pipeline segment located in a high consequence area (HCA). . . . . .

(This) study assesses the effectiveness of block valve closure swiftness in mitigating the consequences of natural gas and hazardous liquid pipeline releases on public and environmental safety. . . . . .It also evaluates the technical, operational, and economic feasibility and potential cost benefits of installing ASVs and RCVs in newly constructed and fully replaced pipelines. The results of this study apply to natural gas and hazardous liquid transmission lines. . . . .
Potential effects of unintended releases from natural gas and hazardous liquid pipelines on public and environmental safety are categorized as personal injuries and fatalities, property damage, and environmental impacts.
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Hazardous liquid pipeline operators are required to install block valves at prescribed locations to facilitate isolation of pump stations, breakout storage tanks, and lateral takeoffs and other points along the pipeline near designated bodies of water and populated areas to minimize damage and pollution from an accidental hazardous liquid discharge. In addition, operators are required to consider installing emergency flow restricting devices such as check valves and RCVs on pipeline segments to protect a HCA in the event of a hazardous liquid pipeline release. In making this determination, an operator must, at least, consider the swiftness of leak detection and pipeline shut down capabilities and benefits expected by reducing the spill size.

E.1 CONSEQUENCE MODELS

Risk analyses of hypothetical pipeline release scenarios are used as the basis for assessing: . . . . . .(3) socioeconomic and environmental damage in HCAs caused by hazardous liquid pipeline releases of crude oil.

E.4 ASSESSMENT METHODOLOGY AND RESULTS FOR HAZARDOUS LIQUID PIPELINE RELEASES WITHOUT IGNITION

Potential consequences on the human and natural environments resulting from a hazardous liquid release without ignition generally involve socioeconomic and environmental impacts. These impacts are influenced by the total quantity of hazardous liquid released and the habitats, resources, and land uses that are affected by the release. The methodology used in this study to quantify socioeconomic and environmental impacts resulting from a hazardous liquid release involves computing the quantity xxvii of hazardous liquid released as a function of block valve closure time and then using this quantity to establish the total damage cost based on the EPA's BOSCEM. The total damage cost is determined as follows:

☐ Add the unit response cost, the unit socioeconomic damage cost, and the unit environmental damage cost;

☐ Multiply the sum of these costs by the number of barrels spilled; and

☐ Apply a damage cost adjustment factor which aligns the total damage cost with the actual cleanup costs reported for recent crude oil spills in environmentally sensitive areas. The damage cost for crude oil released in the Enbridge Line 6B pipeline rupture in Marshall, Michigan in 2010 was approximately $38,000 per barrel.

The BOSCEM accounts for effects of spill size on the total damage cost by reducing the unit cost of damage as the number of barrels spilled increases.

The swiftness of block valve closure has a significant effect on mitigating potential socioeconomic and environmental damage to the human and natural environments resulting from hazardous liquid pipeline releases because damage costs increase as the spill size increases. The benefit in terms of cost avoidance for damage to the human and natural environments attributed to block valve closure swiftness increases as the duration of the block valve shutdown phase decreases.

1.3.2 Hazardous Liquid Pipeline Release Events

After a hazardous liquid pipeline ruptures, liquid begins flowing from the break and continues until draining is complete. The amount of material released following the break is influenced by a variety of factors. These factors include the type of liquid, the operating pressure of the pipeline, the size and position of the hole through which the liquid is released, the rate at which the liquid is being pumped through the pipeline, the response of the operator in terms of shutting off pumps and closing valves, the pipeline route and elevation profile, and the location of the break relative to the pumps and block valves. Block valves are installed in hazardous liquid pipelines to facilitate maintenance, operations, or construction and to limit the amount of liquid spilled following a pipeline rupture. For worst case, guillotine-type breaks, the effective hole size is equal to the line pipe diameter.

The behavior of the released liquid depends on its physical properties and the terrain in the vicinity of the break. For example, the liquid could flash on release of pressure to form a vapor cloud containing a fine mist of residual liquid droplets, accumulate in a pool on the ground surface near the pipeline break, create a stream that flows away from the release point, or soak into the surrounding soil (Acton, 2001).

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If the released liquid ignites following the break, it could result in a pool fire, a flash fire, or, under certain conditions, a vapor cloud explosion. Pool fires can spread out in all directions or flow in a particular path depending on the terrain. Figure 1.3 shows fire damage along a creek caused by a hazardous liquid pipeline release in Bellingham, Washington (NTSB, 2002). If ignition is delayed, the resulting evolution of vapor from the release could influence the magnitude and extent of a subsequent flash fire or explosion.

Fig. 1.3. Fire damage resulting from hazardous liquid pipeline release in Bellingham, Washington (NTSB, 2002).

Impacts resulting from time-dependent radiant thermal intensities at various separation distances from the break are based on the following hazardous liquid pipeline release scenario. The release occurs following a guillotine-type break where the escaping liquid accumulates in a pool on an impermeable level ground surface and ignites immediately upon release. Pool size is affected by the type of liquid released, the line pipe diameter, the pipeline operating pressure, the time required to detect the leak and initiate corrective actions to mitigate the consequences of the release, the spacing of block valves, the time required to close block valves and isolate the break, and the terrain features. Any potential environmental impacts to air and water quality caused by the released liquids and their products of combustions are beyond the scope of this study.

As discussed in Section 1.3.1, thermal radiation hazard zones with increasing impact severity are described by concentric circles centered on the pipeline rupture. The thermal radiation intensities at the perimeters of these concentric circles increase as the radii decrease. Effects of progressively higher heat fluxes on buildings and humans are described in Table 1.1. Because thermal radiation effects on buildings and humans are a function of radiant heat flux and exposure duration, quantifying the time-

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dependent variations in radiant heat fluxes for specific radii is key to assessing the benefits of installing RCVs and ASVs in hazardous liquid pipelines.

Given the wide range of actual pipeline sizes and operating pressures, leak detection periods, and block valve spacing and closure times, ORNL developed methodologies for quantifying the impacts of these parameters on areas affected by combustion of the escaping liquid hydrocarbon. The methodologies, which are described in Section 3.2, also characterize time-dependent radiant thermal intensities at various separation distances from the break.

Without ignition, the escaping liquid could adversely affect waterway navigation, surface and ground water quality, and other aspects of the human and natural environments. In addition, the cost to remediate the affected areas could be substantial. Consequence mitigation for a hazardous liquid pipeline release without ignition requires rapid detection, pump shutdown, and block valve closure. However, even if these actions are taken quickly, some amount of liquid in the pipeline will drain out of the broken pipeline segments. Methodologies for quantifying spill volumes for hazardous liquid pipelines releases and for estimating socioeconomic and environmental damage caused by the spill are described in Section 3.3.

1.3.2.1 Phases of a Hazardous Liquid Pipeline Release

A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Although the volume of the discharge depends on many factors, the event is subdivided into four sequential phases – Phase 1 Detection, Phase 2 Continued Pumping, Phase 3 Block Valve Closure, and Phase 4 Pipeline Drain Down (Borener, 1994 and California State Fire Marshal, 1993). The total discharge volume equals the sum of the volumes released during each phase. Events associated with each phase are described below.

Phase – 1 Detection: The detection phase begins immediately after the pipeline ruptures, t_0, and continues until the leak is detected by any means and the Operator initiates corrective actions to mitigate the consequences of the release, t_d. The volume of liquid discharged during the detection phase, V_d, depends on the duration of this phase and is influenced by factors such as the size, shape, and location of the rupture; the pumping rate; the pipeline pressure; and the effectiveness of the leak detection system.

The volume of liquid discharged during the detection phase is determined using the following equation.

$V_d = Q_d(t_d – t_0)$ (1.1)

where

V_d is the volume of liquid discharged during the detection phase, barrels (m^3)

Q_d is the discharge rate through the break that de

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Phase 2 – Continued Pumping: The continued pumping phase starts after corrective actions are initiated to mitigate the consequences of the release, td, and ends when the pumps stop operating, tp.

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During this time, additional hazardous liquid spills from the break. The duration of this phase can vary from a few minutes for systems with remotely operated pumps to hours for manually operated equipment located in remote areas. The volume of liquid discharged during the continued pumping phase, Vp, depends on the duration of this phase and is influenced by factors such as the type of equipment controls (automatically, remotely, or manually operated); personnel travel time to shutdown manually operated equipment; and the flow rates of the pumps.

…..Phase 3 – Block Valve Closure: The block valve closure phase starts when the pumps stop operating, tp, and ends when the upstream and downstream block valves close, ts. During this time, an additional amount of liquid in the pipeline spills from the break. The volume of liquid discharged during the block valve closure phase, Vs, depends on the duration of this phase and is influenced by factors such as the speed at which block valves located upstream and downstream from the break close. The duration of this phase can vary from a few minutes for systems with automatic or remotely controlled valves to hours for systems with manually operated valves located in remote areas.

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Phase 4 – Pipeline Drain Down: The pipeline drain down phase starts when the upstream and downstream block valves close isolating the portion of the pipeline that includes the break, ts. This phase

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ends when the remaining contents of the isolated portion of the damaged pipeline segment drain from the break, tf. The volume of liquid discharged during the drain down phase, Vf, is affected by the pipeline elevation profile including siphon action and the location of the break. A break that occurs at the highest elevation in the isolated portion of the pipeline results in no drain down volume, whereas a break that occurs at the lowest elevation could result in significant or complete drain down of the isolated portion of the pipeline.

The rate at which liquid drains from a break in the isolated portion of the damaged pipeline segment depends primarily on the size of the break and the pipeline elevation profile. It is also affected by the flow rate of air that must enter the break to replace the liquid and allow the draining to continue. In hilly or mountainous terrain, determining the length of pipeline, L, available to drain from a break must consider site-specific design and construction details. The volume of liquid discharged from the contributory length of pipeline, L, during the drain down phase, Vf, and the transient discharge rate, Qf, cannot be accurately determined without knowing the actual pipeline elevation profile as illustrated in Fig. 1.4.

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1.3.2.2 Block Valve Effects on a Hazardous Liquid Pipeline Release

The effectiveness of block valve closure swiftness on limiting the spill volume of a hazardous liquid pipeline release is influenced by the location of the block valves relative to the location of the break, the pipeline elevation profile between adjacent block valves, and the time required to close the block valves after the break is detected and the pumps are shut down.

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Block valves do not reduce the volume of liquid spilled during the detection and continued pumping phases because they are open. However, the total spill volume can be reduced by rapidly detecting the leak and taking immediate corrective actions including shutting down the pumps and closing the block valves to mitigate the consequences of the release. The effectiveness of block valve closure in mitigating the consequences of a hazardous liquid pipeline release decreases as the time required to close the block valve increases.

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1.3.5 Socioeconomic and Environmental Effects of a Hazardous Pipeline Release

Potential consequences and effects on the human and natural environments resulting from a hazardous liquid pipeline release without ignition generally involve socioeconomic and environmental impacts. These impacts are influenced by the total quantity of hazardous liquid released and the habitats, resources, and land uses that are affected by the release. The methodology used to quantifying socioeconomic and environmental impacts resulting from a hazardous liquid release involves computing the quantity of hazardous liquid released and then using this quantity to establish the total damage cost. The total damage cost is determined by adding the response cost, the socioeconomic damage cost, and the environmental damage cost as described in Section 3.3.3.

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3.2 HAZARDOUS LIQUID PIPELINES WITH IGNITION

Following a guillotine-type break in a hazardous liquid pipeline and ignition of the released hydrocarbon, a pool fire begins to form and continues to increase in diameter as liquid flows from the break. Eventually, the pool reaches an equilibrium diameter when the mass flow rate from the break equals the fuel mass burning rate. The fire will continue to burn until the liquid that remains in the isolated pipeline segments stops flowing from the pipeline.

A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Guillotine-type breaks are less common than other pipeline breaks such as fish-mouth type openings, but they can occur as a result of different causes including landslides, earthquakes, soil subsidence, soil erosion (e.g. scour in a river) and third-party damage. The guillotine-type break is the largest possible break and is therefore considered in this study as the worst case scenario. Although the volume of the discharge depends on many factors, to enable analysis, the event is divided into four sequential phases with the total discharge volume equal to the sum of the volumes released during each phase. The four phases (detection, continued pumping, block valve closure and pipeline drain down) are explained in Section 1.3.2.1.

The thermal radiation hazards from a hydrocarbon release and resulting pool fire depend on a variety of factors including the composition of the hydrocarbon, the size and shape of the fire, the duration of the fire, its proximity to the objects at risk, and the thermal characteristics of the object exposed to the fire.

3.3 HAZARDOUS LIQUID PIPELINES WITHOUT IGNITION

The socioeconomic and environmental effects of an oil spill are strongly influenced by the circumstances surrounding the spill including the type of product spilled, the location and timing of the spill, sensitive areas affected or threatened, liability limits in place, local and national laws, and cleanup strategy. The most important factors determining a per-unit cost are location and oil type, and possibly total spill amount.

The amount of oil spilled can have a profound effect on the cleanup costs. Obviously, the more oil spilled, the more oil there is to remove or disperse, and the more expensive the cleanup operation. However, cleanup costs on a per-unit basis decrease significantly with increasing amounts of oil spilled. Smaller spills are often more expensive on a per-unit basis than larger spills because of the costs associated with setting up the cleanup response, bringing in the equipment and labor, as well as bringing in the experts to evaluate the situation (Etkin, 1999).

The following methodology was used to determine: (1) the time-dependent discharge from a hazardous liquid transmission pipeline resulting from a guillotine-type break, and (2) the quantity of hazardous liquid released during the detection, continued pumping, block valve closure, and drain down phases

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needed to estimate cleanup costs. The total volume of a hazardous liquid pipeline release is primarily influenced by the flow rate at the time of the break; the combined durations of the detection, continued pumping, block valve closure phases; and the size and shape of the break. For worst case, guillotine-type breaks, where the effective hole size is equal to the line pipe diameter, the governing parameters are the line pipe diameter and the pipeline length between plateaus and peaks in the vicinity of the break.

Appendix A: Spill Volume Released Due to Valve Closure Times in Liquid Propane Pipelines, contains a family of curves for various hazardous liquid pipeline release scenarios that quantify the volume of liquid released following a guillotine-type break.

3.3.1 Analysis Scope, Parameters, and Assumptions

The methodology is based on fundamental fluid mechanics principles for computing the time-dependent response of hazardous liquid pipelines following a guillotine-type break. It is also suitable for determining the effects that detection, continued pumping, block valve closure duration have on a worst case discharge release determined in accordance with federal pipeline safety regulations in 49 CFR 194 for estimating worst case discharges from hazardous liquid pipelines (DOT, 2011e).

The configuration of the hypothetical hazardous liquid pipeline used to evaluate the effectiveness of RCVs and ASVs in mitigating the consequences of a release has the following design features and operating characteristics:

☐ The pump stations are located at 100 mile intervals along the pipeline.

☐ Each pressure pump station has a remote control device that can be activated by the pipeline operator to shut down the compressors after a rupture occurs.

☐ The rupture is a guillotine-type break that initiates the release event.

☐ The break is located at a low point in the pipeline elevation profile.

☐ The following times are study variables.

☐ The time when the operator detects the leak.

☐ The time when the operator stops the pumps.

☐ The time when the upstream and downstream block valves are closed and the line section with the break is isolated.

☐ The total volume of the hazardous liquid release equals the volume of liquid released during the detection, continued pumping, block valve closure, and drain down phases.

☐ The time-dependent flow rate is a study variable.

Study variables used to characterize hazardous liquid pipeline releases are listed in Table 3.24.

3.3.2 Analytical Approach and Computational Models

After a hazardous liquid pipeline ruptures without ignition, liquid begins flowing from the break and continues until draining is complete. A pipeline break can range in size and shape from a short, through-wall crack to a guillotine fracture that completely separates the line pipe along a circumferential path. Although the volume of the discharge depends on many factors, the event is subdivided into the four sequential phases with the total discharge volume equal to the sum of the volumes released during each phase. The phases of a hazardous liquid pipeline release are outlined in Section 1.3.2.1.

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block valve closure phase, minutes

The flow rate through the break remains constant through both the detection and continued pumping phases. In the block valve closure phase, the maximum flow rate through the break is based on the elevation difference of liquid in the pipeline. During the pipeline drain down phase, the maximum flow rate through the break is based on the difference between the operating pressure of the pipeline and atmospheric pressure. Requirements in 49 CFR 194.105(b)(1) state the worst case discharge is the largest volume of fluid released based on the pipeline's maximum release time, plus the maximum shutdown response time, multiplied by the maximum flow rate, which is based on the maximum daily capacity of the pipeline, plus the largest line drainage volume after shutdown of the line sections. In this methodology, the maximum flow rate can be estimated by multiplying the fluid speed at the pump by the cross sectional area of the line pipe. Although operators can use this rule to determine a worst case discharge, the actual flow rate during the block valve closure phase may be greater (less conservative) due to factors such as fluid density, pressure changes, pump performance characteristics, and the elevation profile of the pipeline which are not reflected in the methodology. These factors are important in a risk analysis because their effects influence time-dependent damage resulting from a release.

The influence of fluid density, pressure changes, and the elevation profile of the pipeline is taken into consideration in this study by using Bernoulli's equation to calculate the flow rate during the block valve closure and drain down phases. However, there are recognized limitations in using Bernoulli's equation to determine drain down time because it does not model the effects of air flow through the pipeline break which occurs as the fluid escapes following block valve closure. Although Bernoulli's equation does not produce an exact solution to this fluid dynamics problem, comparison of the results provides a consistent approach for evaluating the effectiveness of block valve closure swiftness on mitigating release consequences.

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3.3.3 Socioeconomic and Environmental Effects

The methodology for quantifying potential environmental effects resulting from a hazardous liquid release involves computing the quantity of hazardous liquid released and then using this quantity to establish the total damage cost. The total damage cost, Cd, is determined by adding the response cost, Cr, the socioeconomic damage cost, Cs, and the environmental damage cost, Ce. This methodology applies to crude oil and light fuel (gasoline) releases that affect the following areas.

☐ Commercially navigable waterways which means a waterway where a substantial likelihood of commercial navigation exists.

☐ High population areas and another populated areas which mean an urbanized area as defined and delineated by the Census Bureau that contains 50,000 or more people and has a population density of at least 1,000 people per square mile and a place as defined and delineated by the Census Bureau that contains a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area, respectively.

☐ Unusually Sensitive Areas (USAs) which is defined in 49 CFR 195.6 to mean a drinking water or ecological resource area that is unusually sensitive to environmental damage from a hazardous liquid pipeline release.

The response cost, Cr, is determined by multiplying the applicable unit response cost shown in Table 3.25 by the applicable medium modifier shown in Table 3.26.

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The response cost, C_r, is determined by multiplying the applicable unit response cost shown in Table 3.25 by the applicable medium modifier shown in Table 3.26.

Table 3.25. Unit response costs for crude oil and light fuel releases Release Quantity, barrels	**Crude Oil, $ per barrel**	**Light Fuels, $ per barrel**
<12	9,240	4,200
12-24	9,156	4,116
24-240	9,030	4,074
240-2,400	8,190	3,654
2,400-240,000	5,166	3,108
> 240,000	3,864	1,302

Table 3.26. Modifier for location medium categories for crude oil and light fuel releases Medium Category	**Medium Modifier**
Open Water/Shore	1.0
Soil/Sand	0.6
Pavement/Rock	0.5
Wetland	1.6
Mudflat	1.4
Grassland	0.7
Forest	0.8
Taiga (boreal forest)	0.9
Tundra	1.3

The socioeconomic damage cost, C_s, is determined by multiplying the applicable unit socioeconomic cost shown in Table 3.27 by applicable the socioeconomic cost modifier shown in Table 3.28.

Table 3.27. Unit socioeconomic and environmental costs for crude oil and light fuel releases Release Quantity, barrels	**Crude Oil, $ per barrel**		**Light Fuels, $ per barrel**	
Socioeconomic	**Environmental**		**Socioeconomic**	**Environmental**
<12	2,100	3,780	3,360	3,570
12-24	8,400	3,654	13,860	3,360
24-240	12,600	3,360	21,000	2,940
240-2,400	5,880	3,066	8,400	2,730
2,400-240,000	2,940	1,470	4,200	1,260
> 240,000	2,520	1,260	3,780	1,050

Table 3.28. Socioeconomic and cultural value ranking for crude oil and light fuel releases Value Rank	**Release Impact Site Description**	**Examples**	**Cost Modifier Value**

Extreme	Predominated by areas with high socioeconomic value that may potentially experience a large degree of long-term impact if oiled.	Subsistence/commercial fishing, aquaculture areas	2.0
Very High	Predominated by areas with high socioeconomic value that may potentially experience some long-term impact if oiled.	National park/reserves for ecotourism/nature viewing; historic areas	1.7
High	Predominated by areas with medium socioeconomic value that may potentially experience some long-term impact if oiled.	Recreational areas, sport fishing, farm/ranchland	1.0
Moderate	Predominated by areas with medium socioeconomic value that may potentially experience short-term impact if oiling occurs.	Residential areas; urban/suburban parks; roadsides	0.7
Minimal	Predominated by areas with a small amount of socioeconomic value that may potentially experience short-term impact if oiled.	Light industrial areas; commercial zones; urban areas	0.3
None	Predominated by areas already moderately to highly polluted or contaminated or of little socioeconomic or cultural import that would experience little short- or long-term impact if oiled.	Heavy industrial areas; designated dump sites	0.1

Note: Long-term impacts are those impacts that are expected to last months to years after the spill or be relatively irreversible. Short-term impacts are those impacts that are expected to last days to weeks after the spill occurs and are generally considered to be reasonably reversible.

Table 3.29. Freshwater vulnerability categories for crude oil and light fuel releases Freshwater Vulnerability Category	**Freshwater Vulnerability Modifier**
Wildlife Use	1.7
Drinking	1.6
Recreation	1.0
Industrial	0.4
Tributaries to Drinking/Recreation	1.2
Non-Specific	0.9

Table 3.30. Habitat and wildlife sensitivity categories for crude oil and light fuel releases

Habitat and Wildlife Sensitivity Category	**Habitat and Wildlife Sensitivity Modifier**
Urban/Industrial	0.4
Roadside/Suburb	0.7
River/Stream	1.5
Wetland	4.0
Agricultural	2.2
Dry Grassland	0.5
Lake/Pond	3.8
Estuary	1.2
Forest	2.9
Taiga	3.0
Tundra	2.5
Other Sensitive	3.2

This methodology is consistent with the U.S. Environmental Protection Agency (EPA) Basic Oil Spill Cost Estimation Model (BOSCEM) that was developed to provide the US EPA Oil Program with a methodology for estimating oil spill costs, including response costs and environmental and socioeconomic damages, for actual and hypothetical spills (Etkin, 2004).

Total Damage Cost Validation

The following case studies compare the actual damage costs for two hazardous liquid pipeline releases to the corresponding total damage costs determined using BOSCEM.

Case Study 1 – Enbridge 2010

The Enbridge Line 6B pipeline ruptured in Marshall, Michigan on July 25, 2010, and released approximately 20,000 barrels of crude oil. This release from the 30-in. nominal diameter pipeline caused environmental impacts along Talmadge Creek and the Kalamazoo River (Nicholson, 2012). Cleanup and recovery costs for this release totaled $767,000,000.

Using the EPA BOSCEM, the estimated total damage cost for this release is approximately $307,900,000. This total damage cost, C_d, includes the response cost, C_r, the socioeconomic damage cost, C_s, and the environmental damage cost, C_e, determined as follows.

Response cost, C_r = unit response cost □ medium modifier

Socioeconomic damage cost, C_s = unit socioeconomic cost □ socioeconomic cost modifier (High) = $2,940 □ 1.0 = $2,940/barrel

Environmental damage cost, C_e = unit environmental cost □ 0.5 □[freshw wildlife modifier (Wetland)] = $1,470 □ 0.5 □(1.7 + 4.0) = $4,190/barrel

Total damage cost (2004 basis), C_d = 20,000 barrels □ ($8,265 + $2

After adjusting for inflation, the total damage cost (2012 basis), C_d = $307,900,000 □ 1.25 (inflation factor) = $384,875,000 which is approximately 50% of the actual cost.

Case Study 2 – Yellowstone 2011

A 12-in. hazardous liquid pipeline owned by ExxonMobil Pipeline Company ruptured on July 1, 2011 under the Yellowstone River 20 miles upstream from Billings, Montana. The Yellowstone River is navigable water in the United States (EPA, 2011). The ruptured pipeline released an estimated 1,509 barrels of oil that entered the river before the pipeline was closed. Cleanup and recovery costs for this release totaled $135,000,000.

The estimated total damage cost for this release is $48,044,000 based on 2004 cost data. This total damage cost, C_d, includes the response cost, C_r, the socioeconomic damage cost, C_s, and the environmental damage cost, C_e, determined as follows.

Response cost, C_r = unit response cost modifier (Wetland) = $8,190 □ 1.6 = $13,104/b

Socioeconomic damage cost, C_s = unit socioeconomic cost ☐ socioeconom
$5,880 ☐ 1.7 = $9,996/barrel.
Environmental damage cost, C_e = unit environmental cost ☐ 0.5 ☐ [fresh water modifier (Wildlife Use) +
wildlife modifier (Wetland)] = $3,066 ☐ 0.5 ☐(1.7 + 4.0) = $8,738/barrel.
Total damage cost (2004 basis), C_d = 1,509 barrels ☐ ($13,104 + $9,9

After adjusting for inflation, the total damage cost (2012 basis), Cd = $48,044,000 ☐ 1.25 (inflation factor) = $60,054,000 which is approximately 44% of the actual cost.

Damage Cost Adjustment Factor

For this study, total damage costs of hazardous liquid pipeline releases are determined using the EPA BOSCEM and then increased by a damage cost adjustment factor of 2.1. This factor aligns the model with cleanup and recovery costs for two recent hazardous liquid pipeline releases of crude oil into sensitive socioeconomic and environmental areas.

3.3.4 Risk Analysis Results for Hazardous Liquid Pipeline Releases

The methodology for assessing socioeconomic and environmental damage to HCAs is based on computed release volumes corresponding to the detection, continued pumping, block valve closure, and drain down phases of a hazardous liquid pipeline release of crude oil without ignition. The method used in this analysis for defining maximum flow rate through the break is as defined in 49 CFR 195.105(b)(1) for the detection, pump shut down, block valve closure, and drain down phases. The damage is quantified using the EPA BOSCEM and the damage cost adjustment factor described in Section 3.3.3.
Eight case studies involving hypothetical hazardous liquid pipeline releases in HCAs are considered to assess effects of block valve closure time on socioeconomic and environmental damage resulting from a guillotine-type break. The duration of the detection and continued pumping phases for the hypothetical hazardous liquid pipelines are 5 minutes and 5 minutes, respectively. The duration of the block valve closure phases is 3 minutes.

….

Characteristics for Case Study 8A, 8B, 8C, and 8D that involve 36-in. nominal diameter hazardous liquid pipelines are tabulated in Table 3.32. These case studies compare the following effects on avoided damage costs.

☐ Case studies 8A and 8B compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to either 400 psig or 1,480 psig, an elevation change of 100 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8C and 8D compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to either 400 psig or 1,480 psig, an elevation change of 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8A and 8C compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to 400 psig, an elevation change equal to either 100 ft or 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

☐ Case studies 8B and 8D compare effects of block valve closure swiftness on the avoided damage costs for hypothetical 36-in. nominal diameter hazardous liquid pipelines with MAOPs equal to 1,480 psig, an elevation change equal to either 100 ft or 1,000 ft, a drain down length of 3 mi., and block valve closure durations of 3, 30, 60, and 90 minutes.

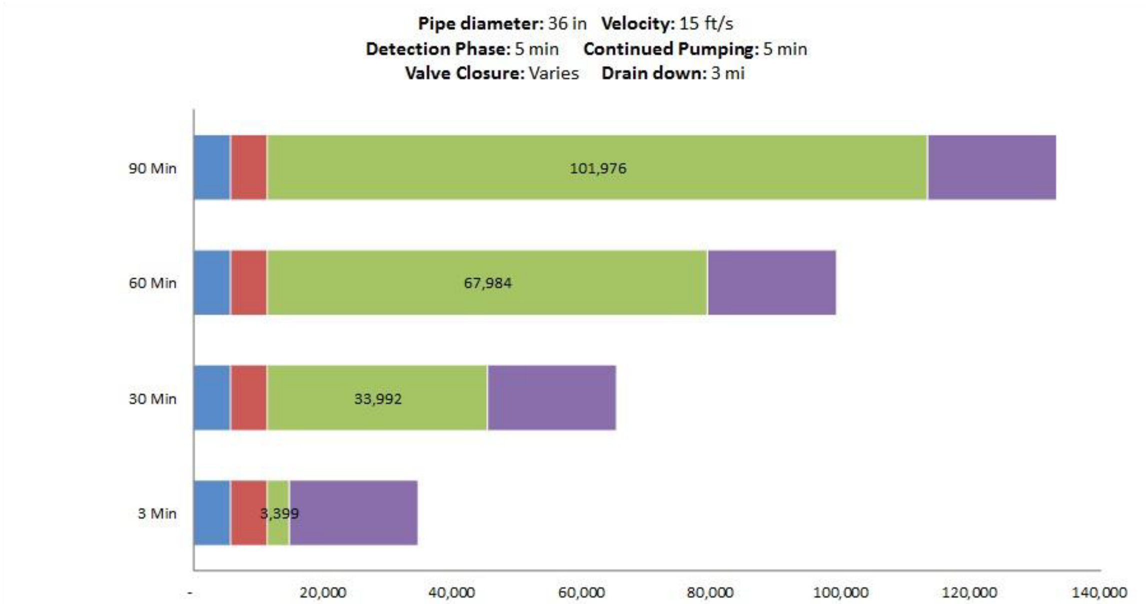
Figures 3.82 to 3.85 list the discharge volumes in barrels for Case Study 8A, 8B, 8C, and 8D. Discharge volumes listed in Table 3.32 for each case study are determined by adding the discharge volumes for the detection (5 minutes), continued pumping (5 minutes), block valve closure (3, 30, 60, and 90 minutes), and drain down (3 miles) phases. Avoided damage costs, which are also listed in Table 3.32, represent the differences between the discharge volumes for the various block valve closure durations and the 3 minute block valve closure duration multiplied by the avoided damage unit cost. The total damage unit cost for these case studies is estimated at $29,520 per barrel. This total damage cost is the sum of the response cost plus the socioeconomic damage cost plus the environmental damage cost. Note that the avoided damage costs are not sensitive to pressure and elevation changes because the model is based on the methodology in 49 CFR §194.105 (b) (1) for a worst case discharge which has a constant flow rate.

Benefits of Block Valve Closure Swiftness for a Hypothetical Hazardous Liquid Pipeline Releases without Ignition

The swiftness of block valve closure has a significant effect on mitigating potential socioeconomic and environmental damage to the human and natural environments resulting from hazardous liquid pipeline releases. The benefit in terms of cost avoidance for damage to the human and natural environments attributed to block valve closure swiftness increases as the duration of the block valve shutdown phase decreases.

Table 3.32. Effects of hypothetical 36-in. hazardous liquid pipeline releases without ignition Characteristic	**Case Study 8A**	**Case Study 8B**	**Case Study 8C**	**Case Study 8D**
Type Hazardous Liquid	Crude Oil	Crude Oil	Crude Oil	Crude Oil
Flow Velocity, ft/s	15	15	15	15
Nominal Line Pipe Diameter, in.	36	36	36	36
Drain Down Length, mi.	3	3	3	3
MAOP, psig	400	1,480	400	1,480
Elevation Change, ft	100	100	1,000	1,000
Detection Phase Duration, minutes	5	5	5	5
Continued Pumping Phase Duration, minutes	5	5	5	5
Unit Response Cost, $/barrel	3,864	3,864	3,864	3,864
Medium Modifier (Wetland)	1.6	1.6	1.6	1.6
Response Cost, Cr	6,182	6,182	6,182	6,182
Unit Socioeconomic Cost, $/barrel	2,520	2,520	2,520	2,520
Socioeconomic Cost Modifier (Very High)	1.7	1.7	1.7	1.7
Socioeconomic	4,284	4,284	4,284	4,284

Damage Cost, C_s				
Unit Environmental Cost, $/barrel	1,260	1,260	1,260	1,260
One half Freshwater Modifier (Wildlife Use = 1.7) and Wildlife Modifier (Wetland = 4.0)	2.85	2.85	2.85	2.85
Environmental Damage Cost, C_e	3,591	3,591	3,591	3,591
Total Damage Unit Cost, C_d, $/barrel	14,057	14,057	14,057	14,057
Damage Cost Adjustment Factor for Hazardous Liquid Pipeline Releases	2.1	2.1	2.1	2.1
Total Damage Unit Cost on 2012 Basis, $/barrel	**29,520**	**29,520**	**29,520**	**29,520**
Detection Phase Release, barrels	5,665	5,665	5,665	5,665
Continued Pumping Phase Release, barrels	5,665	5,665	5,665	5,665
Drain Down Phase Release, barrels	19,942	19,942	19,942	19,942
Block Valve Closure Phase for Valve Closure in 3 minutes, barrels	3,399	3,399	3,399	3,399
Block Valve Closure Phase for Valve Closure in 30 minutes, barrels	33,992	33,992	33,992	33,992

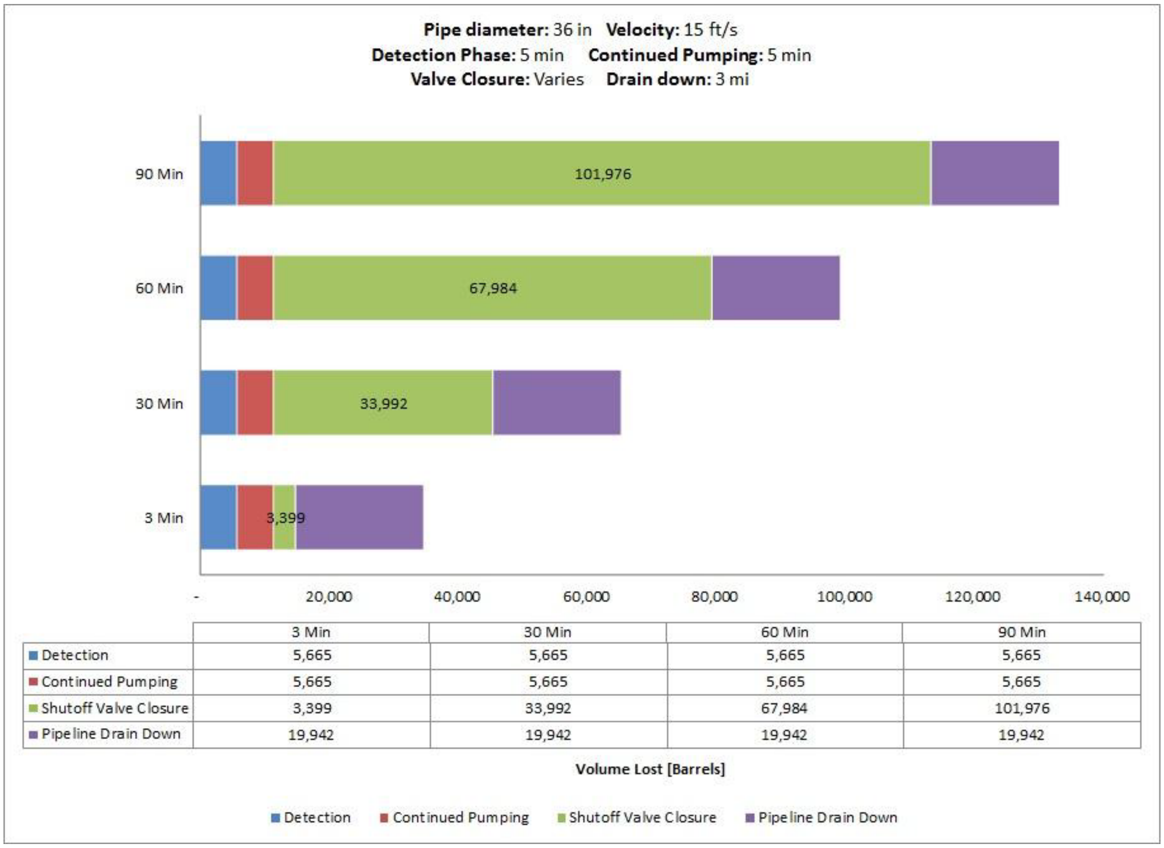


	3 Min	30 Min	60 Min	90 Min
Detection	5,665	5,665	5,665	5,665
Continued Pumping	5,665	5,665	5,665	5,665
Shutoff Valve Closure	3,399	33,992	67,984	101,976
Pipeline Drain Down	19,942	19,942	19,942	19,942

Volume Lost [Barrels]

Detection Continued Pumping Shutoff Valve Closure Pipeline Drain Down

Fig. 3.82. Case Study 8A – Discharge volumes for a 36-in. hazardous liquid pipeline with a 400 psig MAOP and an elevation change of 100 ft with a 3, 30, 60, and 90 minutes block valve closure phase.



	3 Min	30 Min	60 Min	90 Min
Detection	5,665	5,665	5,665	5,665
Continued Pumping	5,665	5,665	5,665	5,665
Shutoff Valve Closure	3,399	33,992	67,984	101,976
Pipeline Drain Down	19,942	19,942	19,942	19,942

Fig. 3.83. Case Study 8B – Discharge volumes for a 36-in. hazardous liquid pipeline with a 1,480 psig MAOP and an elevation change of 100 ft with a 3, 30, 60, and 90 minutes block valve closure phase.

Hartman, Larry (COMM)

From:	Paul Stolen <stolami@gvtel.com>
Sent:	Monday, April 07, 2014 7:30 AM
To:	Ek, Scott (PUC); Hartman, Larry (COMM)
Subject:	Re: Sandpiper Pipeline Comments - P. Stolen

Good morning Scott and Larry. Thanks for your cooperation on responding. As you can see from my comment, I intend to send them to various other parties. I had an unfortunate computer problem on April 4th that delayed me and then prevented me from doing the final editing of my comments. So, in order to meet the deadline, I sent the comments in anyway. When I did the final edit this weekend, I found typos, name and cross reference problems, extra words left in, and other problems like that. (Not substantive.) However, there was an error on page 3 of Attachment 1—I had mistakenly put the Sandpiper amounts in the wrong column.

Therefore, I am sending the corrected version to the other parties rather than the one I officially submitted to you. I realize the one sent to you is the "legal" version under the rules, and I can live with that since none of the specific recommendations change in any way. I would, of course, prefer that you use the corrected "clean" version in the official record. I can send it to you if you wish. I am trying to get it scanned today into one digital version, so hopefully it will be available tomorrow morning.

Thanks again. Paul Stolen

From: Ek, Scott (PUC)
Sent: Friday, April 04, 2014 3:42 PM
To: mailto:stolami@gvtel.com
Subject: FW: Sandpiper Pipeline Comments - P. Stolen

Scott E. Ek
Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Ek, Scott (PUC)
Sent: Friday, April 04, 2014 3:32 PM
To: Hartman, Larry (COMM)
Cc: 'stolami@gvtel.com'; Nelson, Casey (COMM)
Subject: Sandpiper Pipeline Comments - P. Stolen

Hello Larry,

I received the attached comments from Paul Stolen concerning the Sandpiper project. The comments were received today (4/4/14) at ~ 3:30 p.m. Please let me know if you receive these and if you would like me upload to eDockets. I am also copying Paul on this as he wanted confirmation they were received.

Thank you,

Scott E. Ek

Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Paul Stolen [mailto:stolami@gvtel.com]
Sent: Friday, April 04, 2014 3:14 PM
To: Ek, Scott (PUC)
Subject: Re: from paul stolen

Hello Scott. Here are my comments plus one attachment. Two more attachments to follow. thanks Paul

From: Ek, Scott (PUC)
Sent: Thursday, April 03, 2014 11:47 AM
To: Paul Stolen
Subject: RE: from paul stolen

Hi Paul,

Yes, that is fine. As you know we will read any and all comments received. Please feel free to forward to me and copy Larry. I will send you an email confirming receipt.

Thank you,

Scott E. Ek
Minnesota Public Utilities Commission
121 7th Place East, Suite 350 | St. Paul, MN 55101
(651) 201-2255 | scott.ek@state.mn.us | www.puc.state.mn.us

From: Paul Stolen [mailto:stolami@gvtel.com]
Sent: Thursday, April 03, 2014 11:38 AM
To: Ek, Scott (PUC)
Subject: from paul stolen

Hello Scott. Long time, huh? I've been retired for 5 years. I'm submitting comments on the Sandpiper project, and running a little late. I was planning on getting them in today in the overnight guaranteed delivery for tomorrow receipt, since that's the project deadline. so will need to submit via electronic mail. If Larry's inbox is swamped, can I get to you, and also get a response that you have received them? Thanks much. Paul Stolen

May 28 , 2014

RECEIVED

MAY 29 2014

MAILROOM

Paul Stolen
37603 370th Av SE,
Fosston, MN 56542
218-435-1138

Mr. Larry Hartman
Environmental Review Manager
Minnesota Department of Commerce
85 67th Place East, Suite 500
St. Paul, MN 55101

Re: Comments on proposed Enbridge Sandpiper Pipeline, Minnesota Public Utilities Commission (PUC) Docket #13-474

Dear Mr. Hartman:

Enclosed are my additional comments on this proposed project based on the time extension previously granted. The attached material covers the following topics:

I. A copy of my updated April 4 2014 comments to correct minor editing problems and a request that you replace it with the enclosed comments.

II. The Scope of Work for the consultant to the PUC that will be doing the environmental analysis and route comparison.

III. The environmental "footprint" of the proposed pipeline. Enbridge continues to maintain that the project will require a 100 foot right of way (ROW). A report entitled "Construction of the Northern Border Pipeline in Montana" is enclosed that refutes Enbridge's position on ROW requirements, and shows that it only applies to flat terrain.

IV. Additional comments regarding the consequences of pipeline ruptures and leaks. This comment expands on my April 4 comments that these consequences need to be consider in assessment of impacts, location decisions, and need for the project.

V. Additional comments on the "corridor fatigue" issue.

If you have any questions, please give me a call.

Sincerely,

Paul Stolen

Paul Stolen

C: Tom Landwehr, Commissioner, Minnesota DNR
John Linc Stine, Commissioner, Minnesota PCA
Tamara Cameron, Regulatory Chief, Corps of Engineers

Additional comments on proposed Enbridge Sandpiper Pipeline, Minnesota Public Utilities Commission
Docket #13-474
Paul Stolen
May 28 2014

I. **Corrected April 4 comments**. My previous comments, submitted on April 4, 2014, were sent in a rush. I had a computer hang-up at the last minute and therefore didn't have time for a final proofing on the paper copy. Therefore, I did a corrected copy, which is enclosed. I'd appreciate it if you would replace the April 4 copy with the enclosed. There were some typos and a few confusing sentences that I clarified. The most substantive correction was a small correction of numbers in Table 1. The cover letter of the enclosed corrected copy has a note about this below the signature line. I apologize for any confusion this may cause.

II. Scope of work for PUC consultant doing the environmental analysis and comparison of routes. My understanding is that the PUC will be hiring a private party to develop the environmental analysis and comparison of routes for Sandpiper. The product of this contracted work will thus be key to government decisions on this project. How will the Scope of Work be developed? Is such a scope of work shown to Enbridge prior to its completion? My comments and those of others need to be incorporated into the Scope of Work. This Scope of Work should include specific questions focused on the key public policy decisions that need to be made about the Sandpiper project, rather than allowing the contractor to determine such questions. In addition, a draft of this Scope of Work should be available for review prior to letting the contract, since the product is so crucial to the decisions.

The rules regarding a Certificate of Need for this project clearly indicate that environmental and socioeconomic factors must be taken into account in the decision as to whether to grant a need certificate. (Section 7853.0130, Criteria.) Therefore, the Scope of Work is a key document for determining whether to grant a Certificate of Need.

III. **Pipeline construction environmental "footprint."**

A. Enbridge estimate the environmental "footprint" of the Sandpiper project is inaccurate. Enbridge's statement that they use a 100 foot ROW to construct the project seriously underestimates the project's effects and potential for long term damage. In fact, such a ROW only applies to flat or nearly flat areas, and are often farmland.

The environmental study and route comparison must use accurate figures on land requirements for building the pipeline. The estimate must include the topics of land clearing, earth moving and excavation, soil compaction, and potential for topsoil mixing. This is called the project's "environmental footprint." During a public meeting on Sandpiper at Clearbrook, a recent visit to the DNR, and the Enbridge documents on the PUC web site, I examined Enbridge's plan sheets and some applications for crossing streams. These plans are simply not accurate with respect to land clearing and extent of excavation.

Note: My comments here do not apply to the topic of "extra work space" at roads, river crossings, and a few other locations of specialized construction. Enbridge generally does include these locations on its plan sheets. Such locations are a small fraction of the ROW impacts beyond the 100-foot ROW in hilly terrain.

In spite of abundant evidence to the contrary, Enbridge continues to maintain to the public that it only needs a 100 foot right-of-way (ROW.) Enbridge also used this figure on the Alberta Clipper and Southern Lights Projects, even though during construction a much wider ROW was evident at some locations. Finally, the 100 foot ROW was also used for the MinnCan project as a guide to estimating the environmental footprint of the project. (I worked on all three projects while employed at the DNR, including conducting training for other DNR staff in pipeline construction.)

Both Enbridge and MinnCan did not provide accurate figures for excavation into parent material outside of the pipeline trench. Such excavation is abundant in hilly terrain. A key mitigation measure, topsoil separation in such areas, was ignored in many locations except for agricultural land.

The 100 foot ROW width does not apply to hilly terrain. It is time to put it to rest when large diameter pipelines are proposed in Minnesota. In fact, the construction ROW in hilly terrain can become 200 to 300 feet wide in some areas. In many cases on the three large, above-mentioned projects I was involved while at the DNR, these wider locations were never included in plains submitted for public review by the PUC, DNR, or PCA, and not included in calculations of the project's environmental footprint.

The terrain crossed by the proposed Sandpiper route crosses hilly glacial moraine in many locations Understanding pipeline construction in non-flat terrain is crucial because it directly relates to important environmental impacts such as the extent of land clearing, deep excavation outside of the pipe trench and accompanying potential serious loss of topsoil, susceptibility to invasion of non-native species and noxious weeds, and chronic erosion problems because re-vegetation is slower when topsoil is lost and replaced by parent material.

B. Detailed explanation of ROW requirements for construction of a large-diameter pipeline.

The enclosed report entitled "Construction of the Northern Border Pipeline in Montana" (referred hereafter as the IPTF Report) describes in detail why construction in non-flat terrain can lead to ROWs much wider than 100 feet. It also demonstrates why there can be extensive excavation outside of the pipeline trench. I wrote it (with review by supervisors) some years ago while Assistant Coordinator of the Montana Interagency Pipeline Task Force. One of the main reasons why it was written is because ROW was an important public issue for two proposed large pipelines in Montana. One of them, the Northern Tier Pipeline, was proposed to cross the entire state, a distance of approximately 600 miles. A detailed review of it was done, but it was never built.

The Northern Border project—a 42 inch gas pipeline—crossed 180 miles of NE Montana, and was built after an EIS was prepared. ROW of way width was generally limited to 100 feet on state lands during the permitting stage, with the consent of the pipeline company. However, during construction, it became abundantly clear that it was impossible to construct the pipeline in such a narrow area in hilly terrain.

1. Purpose of IPTF Report. This report is applicable to the Sandpiper project with respect to determining the project's environmental footprint. It had four main purposes:

a. To document the ROW width in hilly terrain compared to flat terrain, and to determine the minimum ROW for a large diameter pipeline,

b. To document the locations of, and reasons for, excavation into topsoil and parent material outside the pipeline trench, since during the review period prior to construction the pipeline company had indicated excavation only for the pipe trench.

c. To identify problems encountered during construction and reclamation after pipe burial.

d. To serve as a training manual for reviewers of proposals to construct large diameter pipelines.

2. Caveats as to use of the IPTF report for the Sandpiper project. Before pointing out key findings of the report that relate to the Sandpiper proposal, there a few caveats as to its use:

a. Northern Border was constructed on a new ROW, with no existing pipelines in place.

b. A level work pad generally 50 feet wide is needed for construction of large diameter pipelines, with the pipeline trench to the left of the forward movement of construction. This work pad is essentially a road during construction, with nearly all traffic confined to it. Width is needed for passage of traffic past active work areas, and also for worker safety. A *level* work pad is necessary for worker safety and equipment needs. This construction necessity is directly related to the environmental footprint of the project as discussed below.

c. There have been some changes in pipeline construction techniques since Northern Border, but essentially none that affect ROW width except at special areas such as rivers. (Examples include: welding methods are done somewhat differently, and machine welding is often done on-site; cathodic protection pipe coating is no longer done on site, as depicted in the report, except at field welding locations; and directional drill bores (HDD) are much more common.) The fact that Northern Border was a 42 inch pipeline made little difference in ROW width as compared to the 24 inch MinnCan pipeline. The ROW for the latter was perhaps 8-10 feet narrower on flat terrain than the Northern Border line, but there was little difference on hilly terrain. In addition, there have been changes in river crossing techniques with greater use of HDDs, and dam and pump methods are often used rather than open cut trenches.

d. When another large pipeline is added to an existing corridor, it is offset from the existing line by a project-specific distance. I've found it to be 35-40 as a minimum separation. Therefore, the construction ROW can be somewhat narrower than the standard 100 foot because spoil from the trench can be placed in the separation zone. However, there are site specific issues on hilly terrain so that generalizations don't work in such areas. Also, heavy equipment travel is restricted over the new and old lines.

e. Pipe is bent to *generally* follow the terrain, but not *exactly* follow the terrain. A straight pipe transfers gas or liquid most efficiently. Therefore, in hilly terrain with abrupt slopes, pipe curvature strikes a balance between the desire for a straight pipe and the constraints of excavation. In other words, in some locations, such as the crest of a hill, or under a small but steep hill, the pipe is buried much more deeply in order to lessen the curves. The report illustrates the result of this in expanded ROW width in some locations for the extra spoil and topsoil storage.

f. Topsoil separation in excavated areas is a crucial environmental issue because it relates to whether there are long-term impacts to land productivity in all areas, increased invasive species and noxious weeds, and increased erosion because re-vegetation is slow or non-existent. Topsoil separation can increase the ROW width because of separate piles; however, the expansion can be reduced by creative soil storage. Lack of topsoil separation causes long-term impacts whereas a somewhat wider ROW in some places causes temporary impacts. Furthermore, in recognition of this, topsoil separation has become a standard good practice in stormwater permits and all sorts of construction.

g. When done correctly based on known best practices for pipeline construction, environmental impacts of pipeline placement (not including future oil spill impacts) can be significantly reduced. The attached report suggests some of the good practices.

<u>3.Key points from IPTF report</u>. The IPTF report in its entirety is part of my comments, but the following are key points especially related to Sandpiper:

a. ROW requirements and topsoil stripping. Pages 31-32 provide a summary of the significance of ROW requirements as an environmental issue. It also references the details that support my findings that the IPTF Report is completely relevant to the Sandpiper project.

b. ROW requirements on flat terrain are discussed on page 33, and shown in pictures 51 and 52. On entirely flat terrain, it was possible to construct on an 85 foot ROW, although this increased somewhat as work progressed through clean-up.

c. Separation of topsoil from parent material on side-hill cuts is shown on page 37, and pictures 58 and 60. Page 39, picture 62, depicts lack of topsoil separation where it should have been done.

d. Page 40, and pictures 64 and 67 show deep side hill cuts, topsoil separation, and parent material storage.

e. Page 43 and photos 69-73 show extra-deep pipe burial in hilly areas and resulting large amounts of spoil.

f. Page 47-55 describe in detail why ROWs are wider than 100 feet in hilly terrain, and include diagrams explaining why this happens with respect to how pipelines must be constructed. The following significant conclusions are reached:

"1) Any deviation from flat terrain (0 degree slope) causes a geometric increase in width requirements, primarily for soil and spoil storage.

"2) There is often a progressive increase in r-o-w width after initial r-o-w clearing as different stages of construction proceed.

"3) there were numerous areas of extra r-o-w width needed beyond the 100 foot requested by DNRC.

"4) There was a high potential for topsoil mixing in the numerous side-hill cuts.

"6) Construction crews demonstrated an exceptional ability to re-contour the disturbed surface to the original configuration and replace topsoil when it had been correctly stripped.

IV. Consequences of pipeline leaks and ruptures must enter into route comparison, assessment of impacts, and need for the project.

My April 4 comments (pages 3 through 11) indicated in detail why impacts of pipeline leaks and ruptures need to be addressed in PUC decisions. I reiterate those recommendations, and have additional points regarding federal rules, and analysis of existing corridors, as follows:

A. Problems with federal rules. There are federal rules regarding hazardous liquid pipelines effects on the environment and people. These pipeline integrity rules pertain to environmental and socioeconomic impacts . They are administered by the Pipeline and Hazardous Materials Safety Administration (PHMSA) in the U.S. Department of Transportation. These rules refer to High Consequence Areas (HCA) and Unusually Sensitive Areas (USAs). (Title 49: Transportation PART 195—TRANSPORTATION OF HAZARDOUS LIQUIDS BY PIPELINE.) Both of these categories refer to populated areas, some aquifers, and some ecologically sensitive areas. I referred to HCAs in my April 4, 2014 comments.

The problem is that the federal rules regarding USAs and HCAs very much "high-grade" sensitive environmental features, and only include the rarest and most unusual ecological or natural resource features. This is not just my opinion. Describing sensitive area—and making lists of them—has been standard regulatory practice for many years. Such areas are subsequently avoided, or if they cannot be avoided, various mitigation measures are incorporated into government permits to reduce impacts. For example, these lists include public lands dedicated to a public use such as parks and wildlife management areas, and critical habitat features for certain species, such as deer wintering areas.

One would expect that such normalized lists would have been incorporated into the PHMSA rules. *PHMSA did not even begin to do so.* The notice of the adoption of final rules noted that government agencies with much more expertise than PHMSA regarding pollution and natural resources, such as the EPA and US Department of Interior, strongly objected to the restricted list of USAs and HCAs. (See Federal Register / Vol. 65, No. 232 / Friday, December 1, 2000 / Rules and Regulations.) Many other commenters, including the US Department of Justice also objected to this limited list.

In spite of these objections, the Office of Pipeline Safety didn't budge and kept the limited list with little justification.

However, in 2011, Congress passed the Pipeline Safety Act, and it was signed into law in early 2012. This was in response to the Michigan Enbridge pipeline rupture, the explosion of a gas pipeline in California that killed 8 people, and other pipeline accidents. Now, PHMSA Administrator Cynthia Quarterman noted in a hearing last week in the US House of Representatives that new rules will be out for review shortly regarding USAs and HCAs and other rules regarding pipeline integrity and potential environmental impact.

B. PUC route comparison with respect to USAs and HCAs . The PUC route comparison needs to identify and compare:

1. Any USAs and HCAs as defined in *current* federal pipeline integrity rules on any of the routes that have been identified or are being studied.

2. Any USAs and HCAs—or other categories related to the environment—*as defined in proposed new rules* on any of the routes being studied and identified, assuming the new proposed rules come out in time.

3. Determine the effects on any USAs or HCAs should there be a pipeline rupture, based on the "worst case" as defined in the Oak Ridge National Laboratory 2012. "Studies for the Requirements of Automatic and Remotely Controlled Shutoff Valves on Hazardous Liquids and Natural Gas Pipelines with Respect to Public and Environmental Safety" December 2012. This should also incorporate a "worst case" regarding collateral damage to existing pipelines in the two corridors that already have multiple pipelines.

C. Collective facility plan. Enbridge is the owner of all of the lines in its mainline corridor to Superior. In other words, it collectively owns all the pipelines in most of this corridor. Enbridge should be required to submit a Facility Plan for the Mainline Corridor, and any other corridor that contains more than one Enbridge line. This should be in addition to the plans on each individual line. Such plans can provide indications of responses to spills constrained by existing lines, as well as be indicative of "corridor fatigue."

V. Additional comments on the analysis of "corridor fatigue" issues. My April 4 comments addressed "corridor fatigue" on pages 11-16, with recommendations on pages 15-16. I have the following additional comments.

The route comparison simply must address the growing problem of adding more and more pipelines to existing corridors that were established prior to environmental laws. Therefore, the key place to begin is in the contractor hired by the PUC. Information about the existing pipelines and corridors will aid in understanding the extent of "corridor fatigue" and the increased risk of accidents on one line cascading to others. Therefore, the Scope of Work for the PUC contractor should specifically require the contractor include at least the following with respect to existing corridors:

A. Information about existing lines. On each existing line this should include: locations, identification of any looped areas, locations of cross-overs, types of river crossings such as whether they are trenched or bored, and extent of cover in the riverbed if trenched. There are also a number of locations along the Enbridge Mainline where pipelines actually are not next to each other, which results in multiple corridors somewhat close together rather than one corridor.

B. Facility plans on existing lines. Federal rules require that a "facilities plan" be submitted by a pipeline company prior to its being built. According to a call to the state office of pipeline safety, these are sent to PHMSA, and are not filed with the Minnesota agency. These plans are to include such items as the company's risk assessment, identification of HCAs and USAs, and other content highly relevant to an assessment of impacts and a comparison of routes.

C. Locations of problems areas identified during construction of existing lines. Enbridge and MinnCan should provide information on problem areas identified during construction of the existing lines.

D. Identify "choke points." There are locations along existing corridors where it is simply not physically possible to add more pipelines. These are sometimes referred to as "choke points." Such areas are indicative of "corridor fatigue," and are also the reason for the divergence noted in #2 above.

E. Locations where existing pipelines are exposed or more vulnerable to damage. Pipelines constructed in the past were built to lesser standards than current pipelines. For instance, Enbridge Line 3 was placed on the surface of the ground in certain wetland locations and cover piled on top of it. Over time, this has resulted in pipe exposure. Federal rules do not require that older pipelines meet current standards; therefore, Enbridge has been re-covering such locations on a voluntary basis. These locations should be identified. Also, I am aware of at least one, and possibly two locations along the Enbridge corridor where pipe is exposed as it crosses a river. One of these is a trout stream in Beltrami County.

Such locations are more vulnerable to vandalism and environmental events such as large and unusual rainfall events. Therefore, these locations along the existing corridors increase the risk of ruptures and accidents which may cause increased risk to new lines. The contractor needs to obtain from Enbridge and MinnCan records that identify such areas, and include this factor in assessing "corridor fatigue" and the route comparison.

F. Rivers and floodplains crossed at an oblique angle. Such important natural resource areas should be crossed by pipelines in a perpendicular manner in order to minimize the length of crossing this feature. This would be done when a new corridor is established. Therefore, data on oblique crossings is a measure of existing corridor problems. The LaSalle Creek crossing north of Itasca Park is a good example of this problem. A good measure of each crossing is the distance crossed obliquely compared to the perpendicular distance of the same crossing.

G. Avoidance areas under current pipeline construction practices. The existing corridors should be assessed to determine locations that would have been avoided if the existing pipelines were not present. Admittedly, this assessment would be somewhat objective. However, there are such features as lakes crossed by pipelines on the existing corridor. It is highly unlikely such features would be crossed by a new pipeline corridor. Also, a new pipeline corridor could well be routed around at least some wetlands rather than the numerous wetland crossing now found on the old corridors proposed to be followed by Enbridge's new lines.

H. Areas of restricted access. The existence of buried lines actively interfering with response to pipeline ruptures can reduce response time because heavy equipment can't drive over lines in some locations. In addition, pipeline ruptures in areas with few roads likely would exacerbate spills. The existing corridors should be examined to find such areas.