UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

RECEIVED

AUG 20 1990

REPLY TO ATTENTION OF: 5 HS-11

BUREAU OF SOLID & HAZARDOUS WASTE MANAGEMENT

August 15, 1990

Mr. Gary Edelstein
State Project Manager, WDNR
P.O. Box 7921
Madison, Wisconsin 53707

Dear Gary,

Enclosed is a copy of the comments for Moss-American. As we discussed today, the pre-negotiation meeting will be held August 27, 1990 in Milwaukee, tentatively at 1 p.m. at the offices of DNR. EPA plans to visit the site before the meeting.

I do plan to attend the briefing in Madison the 21st and hope you will be able to come to the briefing here on the 29th.

Sincerely yours,

Betty G. Lavis
Project Manager
(312) 886-4784

Enclosure

JUL 24 1990

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BUREAU OF SOLID & HAZARDOUS WASTE MANAGEMENT

Comment Sheet

U.S. EPA would like your comments on the cleanup alternatives and Preferred Alternative (3A) presented in this fact sheet. EPA considers public comments in selecting a final cleanup remedy for the site. Please use the space below to write your comments, then fold and mail this form. Comments must be postmarked by July 5, 1990. If you have questions about the comment period, please contact Susan Pastor at EPA's toll free number: 1-800-621-8431.

As a resident of the "corridor", I was amazed that I had not heard anything of this in the three years duration.

I didn't see anything in the study as to the economic or "inconvenience" impact on the site or the corridor (i.e. disruption of business, closing roads to traffic, non-use of parkways, etc). Certainly something must be done, it would seem that better publicizing of this current problem and its clean-up could aid in making citizens aware of long-range effects of present actions that are being mentioned as environmentally unsound. We're losing the chance to make a very important point by not telling this story!

A final note: I didn't see mention of plans for concrete "beds" underlaying parts of river bed (i.e. South of Silver Spring).

Name JOHN & CYNTHIA A. PIERSON
Address 5345 N. 107th St
City MILWAUKEE State WIS
Zip 53225

(Sorry this is tardy — we received it from a neighbor only yesterday!)

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JUL 18 1990

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BUREAU OF SOLID
HAZARDOUS WASTE MANAGEMENT

Comment Sheet

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These comments are late, however; I just learned about the cleanup study this past week.

I live near the contaminated area and recreate on the multi use trail, that runs near the river, several times a week. Many times seeing young boys playing near the water edge.

This heavily populated Greenway will be attracting more & more people of all ages as time goes on. This can either be a pleasant experience or a dreadful one depending on the action taken in this study.

I am sure there are many factors that have entered into selecting alternative 3A that I am not aware of, having been absent from the public forum at Vincent High school in June. My only comment would be to select the alternative that would assure the most thorough cleanup for future generations who will need this greenway for recreational purposes in the future.

I will appreciate being informed about the impending cleanup and what impact it will have on our neighborhood.

Name Lois Lovejoy
Address 5556 N. 103 St.
City Milwaukee State Wi
Zip 53225

JUL 17 1990

Comment Sheet

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Dear Susan

My name is Marty Ordinans and I am a resident in the area affected by the Moss-American pollution/Contamination problem. I would like to voice my support for the U.S. E.P.A's proposed plan. If I could assist in any way feel free to call on me. Please keep me updated on events. Thank You.

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AUG 20 1990

BUREAU OF SOLID - HAZARDOUS WASTE MANAGEMENT

Name Marty Ordinans
Address 5380 No. 107 St.
City Milwaukee State Wi
Zip 53225

received JUN 25 1990

Comment Sheet

U.S. EPA would like your comments on the cleanup alternatives and Preferred Alternative (3A) presented in this fact sheet. EPA considers public comments in selecting a final cleanup remedy for the site. Please use the space below to write your comments, then fold and mail this form. Comments must be postmarked by July 5, 1990. If you have questions about the comment period, please contact Susan Pastor at EPA's toll free number: 1–800-621-8431.

At the hearing conducted June 21, 1990 in Milwaukee, there were comments made by several people who identified themselves as "Residents of Milwaukee County" but then proceeded to elaborate on the technical aspects of incineration. One of them was named Schaeffer. Another approached me after the meeting and attempted to influence my opposition to the Remedy 6 (which involved incineration).

I feel this practice makes a mockery of the hearing process for the following reasons:

(1) Their true interests were concealed from those attending the meeting and those who will read the transcript.

(2) This coverup prevented discussion based on true interest as is intended in the hearing process. Those present had been denied their right to know the position of the speaker.

A careful analysis of the transcript will reveal the testimony + questions of Messrs Schaeffer and Kohlmann to be that of contractors looking for business and instead attempted to influence the hearing process by identifying their interests as residents. Other people who had employment interests or environmental concerns identified themselves properly.

The testimony of Schaeffer & Kohlmann should be stricken. If this is not possible, rules of order should be written to prevent this situation from reoccurring

Name Mark A. Walkrick
Address 9309 W. Fairlane Ct
City Milwaukee State WI
Zip 53224

June 26, 1990
5011 N. 110st
Milwaukee, WI

JUN 27 1990
RECEIVED

AUG 20 1990

BUREAU OF SOLID -
HAZARDOUS WASTE MANAGEMENT

Dear Susan Pastor,

I live along the Little Menomonee River and wish to express my opinion on the proposed creosote cleanup plan that will soon take place. I read about the six alternatives to cleaning the five miles of the river downstream from the former plant and let me say that I am most in favor of alternative number five. I feel that this alternative represents an effective cleanup plan with the least environmental disruption. I think that it is important to treat both contaminated river sediment AND soil, and alternative number five accomplishes this.

Alternative number five calls for no re-routing of the river, which I also strongly favor. This entire river system is lined with many magnificent old deciduous trees, mostly Oaks and Willows. I have lived and hiked along this river for thirty years now and I want those big beautiful trees to remain standing!

Much of the affected part of the Little Menomonee River passes through Milwaukee County Parkway land. This land is precious and it MUST be protected and preserved in its natural, wild state. The river that you are about to clean is part of our county park system which, as you should know, is one of the most unique urban park systems in the entire nation! All parkway land is just as important to the overall system as are the established parks!

In summary, let me say that I am in favor of implementing your alternative number five because of its thoroughness and because it does NOT call for the re-routing of the Little Menomonee. Thank you so much for your time on this matter.

Sincerely,

Fred Retzlaff

P.S., I wish to be put on the Moss-American mailing list.

MOSS AMERICAN SUPERFUND SITE
IMPACT OF REMEDIAL ALTERNATIVE NO. 3A
ON NEIGHBORING PROPERTIES
SPECIFICALLY THE PROPERTY OWNED BY A.F. GALLUN & SONS COMPANY

The property of A. F. Gallun & Sons Company which consists of approximately 65.2424 acres and adjoins the Moss American property immediately to the west will be impacted by the remedial remedy (NO. 3A) as proposed by the U.S. Environmental Protection Agency in their Fact Sheet release dated May 29, 1990 and their contractor's Feasibility Study (FS) report dated May 24, 1990. The negative impacts will result from remedial efforts proposed on the Moss American site as well as along the Little Menomonee River which could affect the value of the subject property.

It is argued that these negative impacts are long-term and result directly from insufficient cleanup and environmental precautions as proposed for the on-site remedy as well as long-term environmental damage to the environmental corridor due to river remediation along the 2000 foot section of the subject property. A review of specific concerns and conclusions derived from information presented in the Fact Sheet, The Remedial Investigation (RI) and Feasibility (FS) reports is presented on the attached table. The concerns within the table are categorized based on the media to be treated and the remedial element or steps to be taken.

Contaminated media at the site and along the river requiring long-term remediation consist of at least 210,000 cubic yards of contaminated on-site soils, 500,000 gallons per year of contaminated groundwater and 26,000 cubic yards of contaminated river sediment. One of the inherent problems with the long-term effectiveness of Alternative #3A is that it is not a "robust" solution. It only provides partial treatment and containment of these volumes and these volumes are only rough (order-of-magnitude) estimates of the quantities that may actually be encountered during removal.

Specific items affecting the long-term effectiveness of Alternative 3A and which can negatively impact the value of the subject property are:

- Lack of concrete quantity estimates of contaminated soil and sediment

- Insufficient removal of contaminated soils

- Potentially ineffective treatment methodologies for carcinogenic PAHs

- Unsecured disposal and containment of treated and untreated soils and sediment

- Inconclusive and potentially ineffective recovery and treatment of contaminated groundwater

- Widespread long-term damage of the adjoining environmental corridor

A discussion of these items is presented below. Further details are presented in the attached table.

The FS notes that contamination of the soil may extend to depths potentially as deep as 20 feet and that some contaminated soils will be left in place. It also notes that the vertical results of soil investigations in the area are inconclusive. The methods of limited trench dewatering and excavation do not provide for discovery or removal of deep hot spots of free product or contaminated soil and groundwater. Nearly half of the contaminated soil is below the high water table. With limited dewatering identification of contaminated zones will be difficult and placement of "treated" sediment and soil into this environment may result in recontamination of those materials.

The treatment methodologies proposed in Alternative 3A also have some difficulties. Soil washing is apparently effective for coarse grained soils, but additional testing is needed to determine just how much of the soil to be subject to washing would actually be considered coarse grained. Of course this will affect the remaining quantity of soil to be treated by bio-slurry methods. There are several references within the FS to unknown factors regarding the effectiveness of the bio-slurry method to treat the carcinogenic PAH fraction of organic contamination. Additional pilot testing is proposed but the overall long-term effectiveness of the method appears to still be in doubt. Regardless the methods proposed do not have the intent of reducing the lifetime excess cancer risk to a level below 1×10^{-6}.

Disposal of treated soils and sediment will be in the same location as untreated contaminated soils. No effort will be made to provide a continuous vertical hydraulic barrier and cap. This unsecured landfill will be subject to groundwater inflow and surface recharge such that further leaching and migration of contaminants could continue. The landfill will also form a topographic high of unknown proportion, because actual quantities of material to be treated and disposed are unknown. The landfill will be of detrimental value to the adjoining subject property because of:

- its potential to release groundwater and airborne contaminants to the environment

- visual incompatibility

- negative social overtones

- it must rely on continued institutional controls because of the remaining presence of carcinogens.

The proposed remedial alternative also contains groundwater remedial methods that appear to be too limited and of questionable success and duration. Groundwater flow rates are reported in the RI and FS as being on the order of 7 feet per year. A significant increase in gradients via the proposed collection method will be required to remove the contaminants from the groundwater in less than the 10 years projected. This is especially the case when no continuous barrier will be provided to inhibit inflow to the site. In addition the FS states that the time required to lower PAH concentrations to acceptable levels is unknown, because the movement of these contaminants is not well understood. It therefore appears possible that groundwater adjacent to the subject property will remain contaminated for sometime further impacting the value of the subject property.

Impacts to the designated environmental corridor adjacent to the site could be significant and long-term. As with the removal of contaminated site sediments, the quantity and location of contaminated sediment in the river channel and flood plain is not fully defined. Quantities of contaminated sediment will be left in place and covered, only to potentially migrate at a later date. Removal of the sediments and construction of a new channel will cause widespread destruction of the natural habitat of the corridor. In addition artificially designed channel features to restore aquatic habitats usually are difficult to establish until the channel develops some form of natural sedimentation/erosion equilibrium. Establishment of wooded vegetation will take many years further impacting the long-term value of the subject property.

OUTLINE OF NEGATIVE IMPACTS
PROPOSED REMEDIAL ALTERNATIVE NO. 3A
MOSS AMERICAN SUPERFUND SITE

MEDIA/ITEM/FACTOR	POTENTIAL CONCERN
SOIL	
Excavation	The depth and distribution of an estimated 210,000 cubic yards of contaminated soil having an excess lifetime cancer risk of 1×10^{-6} is not well defined.
	Soils excavation and replacement (some under saturated conditions), stockpiling and handling in a manner which will prevent spreading of contamination has not been detailed.
	There will probably be significant pockets of highly contaminated soil lenses lying beneath less or not visibly contaminated soils. Identification of these will be difficult if there is overlying soil which is not excavated to reveal those contaminant zones.
	The FS notes that potentially deep (up to 20 feet) migration of contaminants may have occurred and that the results of the RI regarding vertical extent are "inconclusive".
	It appears that potentially contaminated soils between the river and groundwater collection trench will not be handled. Releases from that zone have to be cleaned up before the river sediments, or recontamination of the river sediments will take place.
	It appears that a potentially significant amount of contaminated soil will be left in place.

Soil washing

It is suggested in the FS that over one-half of the contaminated soils on site are coarse grained such that they can be washed. The RI and FS indicate that most of the soils on site are derived from the Oak Creek Till which are actually sandy silts and clays with a small fraction in the coarse range. Estimates for how much soil will need to be bioslurred and how much to be washed is therefore unclear and may significantly affect the time and effectiveness of the treatment remedy.

Soil/sediment treatment

As noted in the FS, vendors and services required to complete this treatment work are not widespread; suggesting a limited experience in this technology.

Reduction in levels of carcinogenic PAHs is more difficult than non-carcinogenic and may significantly affect the overall time of treatment called for in the remedy. As noted in the FS the method will require pilot testing. The FS also notes that reductions in the concentration of carcinogenic PAHs might be achievable "given sufficient time." A 90 percent reduction may not be significant in terms of risk reduction, if high levels and volumes of contaminant are present. This leaves a lot of doubt as to the long-term effectiveness of this preferred alternative and the length of time for its successful completion.

Placement of treated soil and sludge	Maintaining a dry excavation, such that soil will not become recontaminated by untreated soil and potential pockets of free product in the excavated zone, will be difficult given the current groundwater scheme, and will be even more difficult if the system fails. Coarse-grained soils, washed and place within the designated fill area, could act as high permeability avenues for fluid transport of water into and through the fill and add to the potential for leaching of contaminants from inplace soils not treated.
Landfill design	Disposal of treated sediment and soil on the site and placement of cover material will change the topographic character of the site. Because the actual quantities of materials to be deposited and covered could be greater than estimated, visual and social impacts of the landfill presence on this property will more greatly affect adjoining properties. This will be the creation of an approximately 10 acre unlined disposal area with essentially no design considerations for preventing migration of fluids or air releases. This will require indefinite continuous monitoring of groundwater until contaminant loadings become insignificant.

GROUNDWATER

Recovery	Pumping has no contingency for shut down or failure. See concerns above.
	There are no [illegible] or cutoffs to control [illegible] groundwater inflow to [illegible] rect recharge [illegible] the conceptu[illegible] in the FS indicate[illegible] l be constructed th[illegible] weathered till but not [illegible] the unweathered z[illegible] n addition, the barrier a[illegible] ection trench will be subjec[illegible] y-pass flow of groundwater a[illegible] open ends of this disc[illegible] system. This could l[illegible] ficantly higher ground[illegible] mes to be treated and [illegible] leads to greater risk [illegible] ant release, if th[illegible] fails.
	The effectiveness of the system will only be known after a trench is installed and test pumped. The remedy does not include contingencies for complete redesign should the initial system be inadequate.
Treatment	The length of time to clean up the groundwater is unknown, and will be exacerbated by the presence of unremoved and untreated soils.
Fate and transport	The FS notes that the time required to lower PAH concentrations to acceptable levels is "unknown" because the movement of the contaminants in the groundwater system is not well understood. The remedy appears to leave the groundwater as an unsolved issue, yet predicts clean up in less than ten years.

RIVER SEDIMENT

Sediment Removal	The plan appears to be insufficient in determining how all "highly" contaminated sediments are identified and removed. It still leaves some of the estimated 26,000 cubic yards of contaminated sediment in place.
Sediment Treatment	As with the soils, there is no guarantee that carcinogenic PAH biotreatment will be significantly effective within the 3 to 4 year time frame projected.
Stream channel replacement	The area along the river is currently a primary environmental corridor, making lands along the corridor desireable because they afford some buffer from surrounding uses. Under this alternative significant damage will occur to wildlife habitats and the visual attractiveness of the corridor, and as noted in the FS this damage could extend beyond the Little Menomonee River. Normal stream channel development is the result of long-term effects of natural channel modification. The FS discusses a variety of artificial bank and stream bottom configurations for the new channel. It is doubtful, that whatever construction methods and designs are used for the new channel it will be many years before equilibrium of the channel is reached such that normal habitats are restored. Disturbance of wetland vegetative mats could subject the area to infestation by undesirable populations of loosestrife.

Old Channel Sediment Excavation

The volume and distribution of contaminated sediment in the flood plain in unknown and will require predesign investigations. These could conceivably [illegible] a significant affe[illegible] the amount of sediment to [illegible] and treated as well [illegible] location of the new channel.

Inasmuch as the [illegible]tion of contaminated sed[illegible] the channel is not a[illegible]ly known and will requir[illegible]d sampling prior to remed[illegible]e volumes estimated to be [illegible] and methodologies [illegible] may have to be changed. [illegible]mate of 25 percent overexc[illegible]f visually contaminated s[illegible] very low considering tha[illegible]ils will be found in discon[illegible] stringers and lenses. Actual [illegible]lumes to be removed could be many times greater than given in the FS.

Summary of Long-term Effectiveness

This alternative does not remove all contaminant sources from the site. It does not provide separation of contaminated soils from groundwater and surface water infiltration. It does not provide positive groundwater release protection in the event of recovery system failure. Institutional controls could be altered later thereby increasing risks of exposure.

POLACHECK

Samuel D. Dickman
Executive Vice President

July 31, 19

VIA TELEFACSIMILE
277-0656

Mr. Donald Gallo
Michael, Best & Friedrich
100 East Wisconsin Avenue
Milwaukee, Wisconsin 53202-4108

Re: 8440 North Granville Road
Milwaukee, Wisconsin

Dear Don:

This letter presents my opinion as to the effect on the above captioned property of the Moss-American site which is adjacent to the subject property. The recent notoriety has been to the effect that the Moss-American property is a Super-Fund clean-up site as a result of the creosote operations performed there. As you know, environmental concerns have played an increasingly important part in our business and generally take longer to negotiate than any other issue, including price. Purchasers and, more important, their lenders are increasingly reluctant to associate themselves with or come in to the chain of title of any property where there is an unknown with regard to environmental issues.

While I feel that the Granville Road property is a very salable property. I think that the proximity to the Moss-American site will make that sale much more difficult and will take a much longer time to accomplish. It is difficult to put a dollar amount to the effect on the ultimate purchase price which the adjacent site has, but I am sure that the effect will be negative.

The purchaser must be convinced that the clean-up on the Moss-American site has been done competently and completely and that there is no danger of the creosote migrating onto the Granville property. If they are not so convinced then we will have a very difficult time in disposing of this land.

Should you wish to disc I will make myself available at your convenience.

cerely,

muel D. Dickman
ecutive Vice President

SDD/dw

cc: Mr. Glen R. Stub

The Polacheck Company, Inc. Real Estate Avenue • Milwaukee, Wisconsin 53202-5353
Telephone: 414 mile: 414/273-4362

AUG 3 1990

Chicago and NorthWestern
Transportation Company

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AUG 20 1990

BUREAU OF SOLID -
HAZARDOUS WASTE MANAGEMENT

One NorthWestern Center
Chicago, Illinois 60606

Law Department
Direct Dial Number

August 3, 1990

Ms. Susan Pastor
Community Relations Coordinator
U.S. Environmental Protection Agency
U.S. EPA - Region V
230 South Dearborn Street
Chicago, IL 60604

RE: Moss-American Site
Milwaukee, Wisconsin
Comments on Remedial Investigatino/Feasibility Study

Dear Ms. Pastor:

This letter and the attachments thereto constitute Chicago and Northwestern Transportation Company's ("CNW") comments on the Remedial Investigation/Feasibility Study (RI/FS) for the Moss-American Site in Milwaukee, Wisconsin, and are submitted in accordance with the United States Environmental Protection Agency's publication of these documents for public comment. It is CNW's understanding that these comments shall be taken into consideration by the Agency in its finalization of the remedial selection for the Moss-American Site and shall be specifically addressed in publicly available responses.

As the Agency is aware, CNW has a particular interest in the selection of response actions for the Moss-American Site since it owns a portion of the property that the Agency has included within that Site's boundaries. CNW purchased that property in 1980 from Kerr-McGee after that company had implemented a clean-up of the property and decided a larger section of the original parcel to Milwaukee County for use as parkland. That transaction took place prior to the passage of the Comprehensive Environmental Compensation and Liability Act of 1980 (CERCLA) or Superfund. CNW then graded filled and paved portions of the site in constructing a rail to truck transfer station to serve Ford Motor dealerships throughout Wisconsin. The CNW property was fenced and access was restricted through a security gate manned twenty-four hours a day by a guard.

The property which CNW owns is currently zoned for industrial use and based on he location and setting of the property, it is anticipated that such use will continue. CNW itself has no intention of selling the property or significantly altering its current operations at this location. In fact, in order to eliminate any concern about potential residential development of the property. CNW is amenable to entering into institutional controls, such as deed restrictions if appropriate, to preclude such development in the future. Such controls would be considered an appropriate response alternative under the National Contingency Plan (NCP), 40 C.F.R. 300.430(e)(9)(c)(iii).

Through contracts with site operators, CNW manages transfers approximately 2,900 rail carloads of new automobiles, or 35,000 to 40,000 new vehicles per year, through its Milwaukee location. Those operations involve about twenty-two full-time employees, on-site and as truck drivers to transport vehicles from the operation. The annual revenue generated through these ongoing activities is almost two million dollars.

Reviewing the RI/FS within this factual description of property conditions, it becomes clear that numerous fundamental flaws and inconsistencies exist in those documents. Many of those problems are described in the attached technical comments. CNW has additionally provided the general listing to facilitate the Agency's review:

1) Under the National Contingency Plan, the RI must be sufficient to define the nature and extent of contamination at an investigated site. In the Moss-American RI, the U.S. EPA has stated that it does not know about the vertical extent of the groundwater flow to define the depth of soil contamination and that it has not sampled the sediments of the Little Menominee River adequately to define extent of contamination in that media. Further, the Agency has not conducted any bioassay(?) of that River to determine what plant or animal populations may exist as potential receptors of compounds identified at the site or in the watering. Clearly, the RI is not sufficient under the forms of the Agency's own regulations. The shortcomings of the RI also render the relative cost analysis within the FS unsupportable since the volume of materials addressed under each remedial alternative is impossible to define with available information. The Agency acknowledges that fact in the FS.

2) The risk assessment on which the RI/FS is based was not performed in accordance with the Agency's own guidance. As noted above, a residential scenario was assumed in defining possible risks despite the fact that this property is industrial zoned and is partially located in a flood plain and wetlands making residential development exceedingly unlikely. In such circumstances, U.S. EPA's *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual Part A Interim Final (July, 1989)* specifically states that use of a residential scenario for risk assessments for that type of property is inappropriate. Yet is was done in the Moss-American RI and relied upon in the FS.

3) Also with respect to the risk assessment, the soil concentration referenced were the highest detected concentrations without regard to where those concentrations were detected. (RI, Chapter 4) Consequently, the risk assessment hypothesizes direct exposure

and inhalation exposures to surface soils while using subsurface soil analytical results. Again, under the above-referenced U.S. EPA Guidance document, as well as sound risk assessment procedures, that methodology is inappropriate.

4) The risk assessment performed by U.S. EPA acknowledges that no RFD's were exceeded under any of the postulated exposure situations. That fact does not appear to have been addressed in the FS evaluation of remedial alternatives.

5) The FS is similarly inadequate and fails to meet the regulatory requirements. The FS Report is confusing, failing to properly present, either from an analytical or a factual viewpoint, a sufficient basis for the conclusory statements made as to the various remedial alternatives addressed. The FS itself is internally inconsistent in a number of ways. For example, the soil treatment options are assessed based on the assumption that the polynuclear asomatic hydrocarbon (PAHs) will migrate from soils into groundwater. At the same time, the statement is made in the FS that these PAH's are not mobile, but rather absorb on soils. That fact is used as the basis for concluding that burial of the sediments in the existing stream channel is appropriate. It is clearly inconsistent to include that PAH compounds will not migrate and yet identify a preferred remedy based on migration. Similarly, it is again inconsistent to conclude PAH's will not migrate from a permeable stream channel but will through less permeable site soils. Yet, that is precisely what the Agency has done in the FS. Additional inconsistencies are described in the attached Technical Comments.

6) In the FS, the Agency acknowledges that Alternative 2 which includes groundwater treatment and site capping will meet all applicable and relevant and appropriate (ARAR) standards. The FS then goes on to summarily reject Alternative 2 stating that the groundwater treatment will take too long; as long as 100 years according to the Agency. No basis for the ascription of the 100 year period is included in the FS.

7) In evaluating the identified remedial alternatives utilizing on-site soils treatment, the U.S. EPA failed to adequately address the short-term risks associated with implementation. The FS does not include any assessment of transportation or construction risks, or the hazards posed by the release of dusts during the construction or implementation period. Under the National Contingency Plan, 40 CFR 300.430(e)(g)(iii)(E) and (F), both the short-term effectiveness and the implementability of the evaluated remedial

alternatives must be considered. That simply was not done in this case.

8) In terms of the implementability of the preferred remedial alternative, the Agency gave no consideration to interference with ongoing CNW operations or impact on protected wetlands. Further, if Figure 3-12 is compared to figures depicting the alleged extent of soil contamination, U.S. EPA has apparently postulated locating various treatment facilities on top of areas the Agency has defined as contaminated. No consideration is give to the coordination of these facts in the FS assessment of alternatives (see for example FS Figure C-1).

9) In assessment the implementability of the remedial alternatives, no consideration of CNW's ongoing operations or certain actual site features is reflected in the FS. The Agency describes various soil removal, treatment and re-containment activities which would significantly disrupt or destroy CNW's ability to continue its transfer station operations. No mention of those resource costs is made in he FS. Similarly, no assessment of the report on he parkland, wetlands, floodplain or river ecosystem is contained in the FS. Under the National Contingency Plan, each of these factors had to have been incorporated into the remedial alternative assessment. 40 CFR 300.430.

10) The FS also does not contain any discussion of the fact that much of CNW's portion of the property is already paved with asphalt and fenced. The fact that there is a clay barrier wall between the CNW property and the Little Menominee River is also totally ignored in the FS. All of these factors must be included in the detailed assessment of the remedial alternatives under the National Contingency Plan, Section 40 CFR 300.430.

The above listing represents some of the most fundamental inadequacies noted in the Moss-American Site RI/FS. As stated above, a more detailed review is contained in the Technical Comments attached hereto. CNW is quite concerned with the direction which U.S. EPA appears to be taking with respect to the Moss-American Site and believes that a meeting among all concerned parties would be appropriate. Accordingly, CNW requests that the Agency contact them to discuss scheduling such a meeting to resolve technical issues and, if possible, develop a mutually agreeable solution to the potential concerns associated with that property. Please contact me at (312) 559-6076 to discuss arranging such a meeting.

Very truly,

Thomas E. Greenland
Associate General Counsel

TEG/pcc

Enclosures
c:PCSK071

RECEIVED

AUG 20 1990

BUREAU OF SOLID -
HAZARDOUS WASTE MANAGEMENT

TECHNICAL COMMENTS

Remedial Investigation Report

The following comments relate to the shortcomings of the Remedial Investigation Report ("RI"). In some instances, these comments relate to points requiring clarification, in others they concern deviations of this RI from Agency guidance and/or the National Contingency Plan.

The RI Statement of Findings indicates that the Agency has not met two of the essential objectives of an RI. Therefore the RI must be viewed as incomplete. Based on a review of the RI, it is clear that the Agency has failed to:

- Define the extent of contamination;
- Define the actual or potential level of health and environmental risks resulting from the past site operations.

As the more detailed comments below demonstrate, the RI does not clearly delineate either the extent of contamination or correctly identify significant actual or potential exposure pathways.

A. The Agency has failed to adequately or correctly define the extent of contamination as required by the National Contingency Plan.

1. Pages 1-4 and Figure 5. Figure 5 shows contamination north of the Site is as high as the contamination detected in many of the down River sections. Clearly, the Site is not the sole source of PAH's to the Little Menomonee River. The RI does not include any assessment of that independent source, nor is any recognition of that source reflected in the risk assessment or FS.

2. Figure 5. The PAH levels found appear to present an ambiguous picture of the Moss-American sites contaminant contribution to all sections of the Little Menomonee River. If the Site continues to be a source of PAH's in that River, PAH concentrations should have

been higher immediately downstream of the Site. However, that was not the case. The Agency improperly failed to address this finding of the RI in its analyses of possible risks or remedial alternatives for the Site.

3. Page vii. Reference is made to the fact that additional samples were collected from the Little Menomonee River sediments in October, 1989. The RI makes no clear statement as to the status or substance of analytical results related to that sampling effort. Clearly a complete RI must incorporate all available Site analytical data.

4. Pages 1-5. The RI includes a statement that Kerr-McGee samples the effluent from the Site. Those results are not included in the RI although they are clearly pertinent to an assessment of Site conditions. Again, the RI must take into account all data generated with respect to the Site.

5. Pages 3-11. According to the RI, additional sediments from the River were collected to be used in calculating sediment constituent background levels for use in the FS. The referenced sampling was apparently done in November, 1989. Neither the RI or FS make it clear whether these analytical results were incorporated into the Site evaluations.

6. Page vi. At no point in the RI are the locations of the sediment samples corresponding to stated PAH's levels clearly indicated. For example, the statement is made that PAH's were detected at 0.6% in the sediments of the Little Menomonee River. That percentage would be equivalent to 6 g/kg or 6,000,000 ug/kg. No sample containing that concentration of PAH's is shown in Figure 6.

This PAH concentration has been factored into the assessment of potential risk levels to be addressed through remediation. It is unclear, based on the information presented in the RI, whether such a sample exists, so that any portion of the RI Site characterization reliant on the finding of that concentration is of questionable validity.

7. Page 3-12. The statement is made that methylene chloride results may be due to laboratory contamination and that inorganic concentrations for sediment were not calculated because not enough samples were available to calculate a background level. It is unclear how these facts are addressed in the risk assessment or FS.

8. Pages 1-4 and Figure 5. The Agency makes reference to studies conducted on or behalf of Rexnord. However no indication of the results of those studies is given in the RI. In addition, according to Figure 5, all present concentrations of PAHs detected in the sediments are below the 5,000 mg/kg clean-up goals established in 1973 for Rexnord. This indicates that the Rexnord dredging program was effective as to the stretches of the River addressed. That fact must be considered in evaluating present Site conditions and remediation concerns and alternatives.

9. Figure 3-6 and 3-7. These RI graphics purportedly depict the levels of carcinogenic and non-carcinogenic subsurface soils detected at the Site. In mapping the areas of detection, the Agency uses a 30 parts per million to 1,000 parts per million range. That range of concentrations is clearly overly broad. The impact of a finding of 30 ppm of a contaminant is substantially different from the implications

of a 1,000 ppm reading. The range should be more narrowly defined in order for these evaluations to be at all meaningful in terms of potential risks and remediation requirements.

10. The RI does not indicate how much of the contaminated soil lies within the 100 year flood plain. Clearly the degree of contamination located within the flood plain is an essential factor in determining the nature and level of potential risks associated with the Site and the nature and appropriateness of remedial technologies considered.

11. Pages 3-4. The RI states that background levels were not calculated for the BTX constituents. No explanation of this failure to complete the calculation of background levels was provided in the RI.

12. Pages 3-7. The statement is made that some deeper contamination found in bore hole SB08 may be due to cross contamination during the sampling process. This conclusion does not seem to have been consistently incorporated throughout the FS particularly with respect to the Agency's analyses of the volumes of soils requiring remediation.

B. The actual and potential health and environmental risks associated with the Site due to past wood treating operations have not been correctly or adequately defined in the RI;

1. Pages 1-3. The RI risk and remedial assessments must be re-evaluated to factor in present Site circumstances apparently disregarded by the Agency. For example, the Agency acknowledges that discharges to the Little Menomonee River from the Moss-American property were diverted from the River to a treatment plant in 1971, therefore any addition of new contaminants

to the River should have been significantly reduced as of that date. The analytical results for River water samples confirm that this is in fact the case. Any analysis of potential risks posed by the River sediments must also reflect this fact. Yet, no mention of this element is made in the RI analyses.

2. Page viii. In the RI, mention is made that some individuals received burns, purportedly from the River sediments in 1971. The Agency also acknowledges that some sediments were dredged from the Little Menomonee River in that same year. Yet, in performing the RI risk review for the River, the Agency apparently makes the assumption that the risks from direct contact burns remain the same despite the fact that dredging has taken place. No assessment is done to determine whether the potential for skin burns still exists given the post-dredging activities and passage of nineteen years. The RI assessment must be redone to factor in the past dredging of the River, as well as other elements, to more accurately reflect current Site conditions.1/ (see Comment 10 of Risk Assessment Section of these Technical Comments).

3. Page 4-4. The conclusion that the Site is easily accessible is incorrect. In order to gain unauthorized access, an individual would have to cross the railroad tracks and a major highway on one side,

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1/ Page iii. In this opening section, the Agency makes reference to the dredging and filling of the sludge residue in the Moss-American settling ponds without any statement as to the details of this operation. Information as to who undertook this action, the volumes of material involved and the construction of the settling ponds is clearly pertinent to a complete site investigation and evaluation of potential environmental risks.

Pages 3-14. The RI demonstrates that none of the off-site dredging samples were contaminated with PAHs. That finding is clearly inconsistent with the estimated potential risks for sediment contact used in the risk assessment of the River and the evaluation of the need for remediation and the appropriate remedial alternative.

or cross a landfill or farm field on the other. The Site is not directly bordered by a residential area on any side. Even portions of the Site which are not fenced are heavily vegetated so that access is not easily obtained. Therefore, the Agency's assumptions as to recreational or trespass access do not comport with the actual Site setting.

4. Page iii. Throughout the RI, the Agency also inaccurately describes the eastern portion of the Site as park land. In actuality, that area is more of a wilderness preserve, with limited access, rather then a park. The characterization of this area is important in that the RI Risk Assessment is based, in part, on a recreational use scenario for the so called "parkland" areas. The County land and eastern portions of C&NW's property are in fact not presently suitable for recreational use. A restricted trespass scenario, correctly evaluated, would produce a lower risk estimate more accurately reflecting Site conditions.

5. The RI conclusions are based on an assumption that the groundwater beneath the property is migrating to the Little Menomonee River. However, the RI does not contain any studies done to determine whether or not the Little Menomonee River is a "gaining or losing stream" and under what conditions that hydrologic characteristic exists. If the River is in fact a losing stream, the interrelationship of the River and groundwater has not been properly assessed in the RI and the selection of potential risks and remedial alternatives in the RI/FS is inaccurate. To adequately characterize the Site, this element must be addressed in the RI.

6. Pages 2-7. The RI indicates that the Oak Creek Formation is a confining bed. That fact was not properly incorporated in the selection or assessment of soil or groundwater remedial alternatives. Clearly, if the contamination cannot reach the lower aquifer, and has not shown up in the surface water samples at a significant level, a different, less elaborate groundwater remedy may be appropriate at this Site.

7. Page 4-4. Reference is made to people who fish in the Little Menomonee River and eat their catch. However no assessment of the River's fish population is included in the RI, nor is any information detailing a survey of fishing activities provided. In contrast, the statement is made that PAH's do not bio-concentrate in aquatic organism. A risk of PAH exposure through ingestion of Little Menomonee River fish is improbable and reference to such a risk must therefore be eliminated from the RI.

RISK ASSESSMENT

This section contains comments pertaining to the risk assessment portion of the RI. The comments demonstrate that the risk assessment incorporates inaccurate assumptions as to Site conditions and deviates from the Agency's own Risk Assessment guidance.

1. In performing the risk assessment in this case, U.S.EPA has viewed the Moss-American and undeveloped properties as a unified setting. However, given the actual Site conditions, that approach is unrealistic.[2/]. A more valid delineation of potential

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2/ Page 4-7. The Agency explicitly states that no RfD's are exceeded at the Site as it exists today. Given that conclusion, the Agency has clearly overstated potential risks which may be associated with the Site.

risks would be developed if the Site were divided into discrete areas. For example, the potential risks a paved, fenced area such as C&NW's transfer operation would be significantly different from the potential risks associated with an unpaved area with less restricted access. These actual significant distinctions must be incorporated into the valid risk assessment in order to generate a valid estimate of potential risks associated with the Site.

2. The RI risk assessment inadequately depicts the level of potential risks at different locations within the Site. Isopleths should have been prepared indicating soil and sediment contamination areas directly corresponding to the 1×10^{-4}, 1×10^{-5}, and 1×10^{-6} risk levels for soils and sediments. The failure of the Agency to include these diagrams in these reports makes it impossible to determine the relative risk associated with different portions of the Site. That information is essential to an evaluation of what, if any, remedial action is appropriate for the various distinct areas within the Site boundaries.

3. The risk assessment contained in the RI was clearly performed in disregard of the Agency's own guidance. The U.S.EPA's "Risk Assessment Guidance for Superfund Volume 1, Human Health Evaluation Manual (Part A)", EPA154011-891022, states that the reasonable maximum exposure is defined as the highest exposure that is reasonably expected to occur at a given Site. The reasonable maximum exposure is designed to represent a conservative, but realistically possible, exposure scenario for a given setting.

Section 6.4 of this U.S.EPA Guidance Document details the methodology used for quantifying the reasonable maximum exposure for the magnitude, frequency and duration of exposure. In defining the exposure concentration, the Agency Document recommends that an upper confidence level of 95% of the arithmetic average of the parameter evaluated generally be used. For other parameters such as contact rate, exposure frequency and duration, the U.S.EPA Guidance Document recommends that the 90% to 95% confidence level value be used.

The Agency arbitrarily ignored its recommended methodology in performing the risk assessment incorporated into the Moss-American RI. For example, the Agency relied on a residential exposure setting in defining potential risks despite the fact that residential development of this Site is exceedingly unlikely. The property is zoned industrial and contains publicly owned parkland, wetlands and areas within the flood plain. To assume that this Site would be used for residential purposes is wholly unrealistic and violates the Agency's own risk assessment Guidance.

In assessing inhalation or ingestion risks the Agency again deviated from its own Guidance and selected the highest PAH concentration detected as the level of contaminant to which an individual might be exposed. No consideration was given to the fact that other samples showed no or lower levels of PAHs. That type of selective approach to the definition of risk has been generally rejected as invalid by the Agency. The Agency erred in disregarding its own Guidance and recommendations and arbitrarily selected contaminant levels to support risk conclusions.

4. Page K-24. The Agency's formulation of the trespass scenario for the Site is similarly flawed. The assumptions on which that trespass evaluation is based were clearly arbitrarily selected. For example, the trespass risk assessment does not include any rationale for how the forty (40) visits per year figure was derived.[3/] In reality, access to this Site is restricted due to the dense vegetation, highway, railroad tracks and security fencing. It is simply unrealistic to assume that the number of Site visits for this Site is comparable to that for a developed park with associated amenities, as was apparently done in this risk assessment. Actual Site conditions and trespass experience must be factored into the risk assessment in accordance with U.S.EPA's Guidance and proper risk assessment methodologies.

5. Page K-24. The Agency further erred in assuming that each trespass would persist for two hours. No factual basis for that time period is provided in the risk assessment. Having arbitrarily adopted a two hour per visit period, the Agency then failed to incorporate that assumption into its assessment of ingestion and inhalation exposure risks. Obviously an exposure limited to two hours would result in a lower ingestion and/or inhalation level than an exposure lasting a full day. The Agency's arbitrary selection of the two hour period, and its subsequent failure to consistently use that defined parameter, renders it risk assessment invalid.

3/ A rate of 40 trespasses a year means that an individual will improperly enter this private property for about two hours, approximately once a week over his seventy year lifetime. That scenario is simply unrealistic.

6. Page K-31. The Agency has incorporated the same assumptions in evaluating both the trespass exposure and the recreational River setting exposure (40 visits/year, 2 hours/visit, 10 years) in its risk assessment. More accurately, access to the Little Menomonee River through trespass would be difficult and therefore less frequent than trespass on areas closer to the Site boundaries. Use of equivalent occurrence and duration factors for each of these scenarios was clearly incorrect in light of the actual Site setting.

7. Page K-18. The Risk Assessment identifies the consumption of contaminated fish from the Little Menomonee River as a potentially important pathway. However, no survey of the aquatic population or fishing activity was done as part of the RI, and on page 4-8 the conclusion is stated that PAH's do not readily bio-concentrate in fish. To identify fish consumption as an important pathway is therefore simply not supportable under the RI. To the contrary, fish consumption appears not to be a significant risk. The Agency incorrectly ignored that conclusion in the Site risk assessment and evaluation of remediation of the River.

8. Page K-26. Regardless of whether the trespass, recreational or residential scenario is addressed, the Agency incorrectly selected contaminant levels and concentrations in formulating potential exposures. Based on the RI report, it appears that no samples of Site surface soil were collected.[4/] Yet, the risk assessment postulates direct contact, ingestion and inhalation as the potential

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4/ Figure 3-10. In the RI, surface soils are considered to be soils 0-4 feet in depth. This is clearly inappropriate. Surface soils are acceptably defined as soils at a depth of 0-4 inches.

exposure pathways. In assessing the levels of exposure possible through ingestion and inhalation, U.S.EPA simply used the highest PAH concentration detected, irrespective of sampling depth; shallow test pit samples taken from several feet beneath the Site were used to represent surface soil. U.S.EPA's own Risk Assessment Guidance Document, referred to above, states that use of subsurface results to characterize surface exposures is inappropriate. This mistake is compounded in this case since as the Agency's own Site cross-sections show, much of the surface of this Site is covered by fill postdating the wood treatment operations. (See RI Appendix D). Using samples taken from test pits to represent surface soil conditions clearly overestimates the possible surficial risk. Reliance on this improper assessment methodology to overstate potential risks clearly influenced the remedial alternatives identified and improperly skewed the ultimate selection of a preferred alternative.

9. Page 4-10. The RI risk analysis applies the benzo (a) pyrene cancer potency factor to all PAH's found at and around the Site. No scientific basis for this extrapolation is provided, though the Agency does acknowledge that some PAH's are more carcinogenic than others. In conjunction with the other improperly defined variables relied upon in the risk assessment, use of the benzo(a) pyrene potency factor produces an insupportably conservative portrayal of risks at the Site.

10. The Risk Assessment discusses the acute effects of phenolic compounds when in contact with skin as a potential risk at this Site citing a 1971 incident purportedly involving skin burns after direct

contact with River sediments. Phenolic compounds were not detected in any sediment samples collected during the RI and phenol was only detected in one surface water sample at a concentration of 4.3 ug/L. While it is true that pure phenol may have a corrosive effect on skin, that acute effect is not observed at the parts per billion level found in the one RI water sample from the Little Menomonee River. Therefore, U.S.EPA erred in postulating an acute phenolic risk with respect to this Site.

11. Page K-26. U.S.EPA's "Exposure Factors Handbook" recommends using Site specific data in determining the concentration of contaminants on respirable particles and the particulate concentration in air. U.S.EPA ignored this recommendation and arbitrarily selected 100 ug/m^3 for use in this matter. Using this national average for urban locations doesn't take into account the fundamental fact that this Site is located in a rural setting. In addition, simple reliance on a published average ignores Site-specific variables such as differences in precipitation and periods of snow cover. All of these elements would obviously impact the level of particulates in the air and the Agency erred in failing to consider each in its risk assessment.

12. Page K-25. The risk assessment assumes a 100% bioavailability for ingestion of PAH's on dust. That assumption is not only too high, but it is not based on the U.S.EPA's own recommended method of calculating reasonable maximum exposure. As per U.S.EPA's "Risk Assessment Guidance for Superfund Volume 1. Human Health Evaluation Manual (Part A)", inhalation estimates must be derived using the fraction of the particulate that is

respirable (i.e., particles 10mm or less in size) and the concentration of the chemical of concern in that respirable fraction. The assumption used in this case, of 100% respirable dust, is arbitrarily conservative and not in accordance with the Agency's own Guidance.

13. The Agency factored a 70-year lifetime exposure risk into its risk assessment for this Site. The use of a 70-year period is in clear abrogation of the Agency's own Human Health Evaluation Manual, Page 6-21, which recommends 30-year lifetime reasonable maximum residential exposure. Again U.S.EPA has grossly overstated potential risks by deviating from its own Guidance and accepted risk assessment protocols.

14. This RI is not complete as the ATSDR health assessment has not been incorporated and made available for public comment. The National Contingency Plan specifically requires that ATSDR do an assessment for each Site. The results of that effort must logically be factored into each RI/FS and made available for public comment in a timely manner.

FEASIBILITY STUDY

The following comments pertain to the internal inconsistencies and inaccuracies reflected in the Feasibility Study. As these comments substantiate, the derivation of a preferred remedial alternative based on this FS does not and can not meet National Contingency Plan pre-requisites and requirements.

1. U.S.EPA incorrectly rejects Remedial Alternative 2 based on an arbitrarily assigned groundwater treatment period. Table 4-2 states that Alternative 2 would be in compliance with ARAR's and fails to

present adequate reasons for elimination of the Alternative from further consideration. Since Alternative 2 meets the National Contingency Plan preference for treatment, addresses each identified principal risk and is cost-effective, the Agency should have retained this Alternative as a preferred remedy.

2. In the FS, U.S.EPA states that all alternatives, other than the "No Action" alternative, meet the ARAR's. That is not true. All onsite alternatives other than Alternative 2, require "Treatability Variances" from the Land Disposal Restrictions to comply with standards. Only Alternative 2 meets the ARAR's and should be viewed as preferred for that reason.

3. Page 3-8 to 3-19. The Agency's FS analyses totally disregard several pertinent Site features. For example, none of the remedial alternatives considered leaving the existing macadam and pavement covers in place. A remedial alternative relying on the pavement and installation of extraction wells should have been designed to address both the soil and groundwater conditions on at least the covered portion of the Site. Such a remedial approach would clearly address Site conditions in a cost-effective manner. Similarly, the underground clay wall installed in 1971 between the settling ponds and the River was not located and factored into the remedial alternative identification. The EPA simply disregarded the present Site situation in developing possible remedial alternatives.

4. The Agency failed to properly assess the short term effectiveness and implementability of the various remedial alternatives in defining its preferred alternative. That assessment is essential under the National Contingency Plan. For example, no consideration was

given to health and safety concerns for workers involved in construction of groundwater and/or soils treatment facilities, particularly in contaminated areas of the Site. No consideration was given to transportation risks. With respect to the bioremediation alternatives, no consideration was given to the fact that the presently detected contamination has undergone natural bioremediation for years so that remaining contaminants may not be amenable to further bioremediation. In addition, the remedial alternative assessment does not reflect any consideration of the costs and risks associated with restarting the treatment project each Spring after the Winter shut-down. The Agency's failure to consider each of these elements is in clear contravention of National Contingency Plan requirements.

5. One of the most blatant instances of the Agency's disregard of short term effectiveness and implementability relates to the destruction of the Little Menomonee River. Even assuming that some remediation within the river channel is necessary, the Agency has not taken into account the destruction of the existing land and aquatic plant and animal populations. Nor has the Agency taken into account the length of time required for those ecosystems to recover from such destruction, assuming that recovery is possible. The resource losses and costs associated with these factors must be considered in evaluating remedial alternatives under the National Contingency Plan.

6. Page 3-5. In evaluating remedial alternatives for the Little Menomonee River, the Agency rejects fencing due to aesthetics. The National Contingency Plan does not cite aesthetics as a viable

basis for remedial alternative rejection. Fencing should have been retained and costed as a potentially acceptable remedy. Certainly fencing is less disruptive to the River, forest and wetlands habitats than relocating the stream bed would be.

7. Page 1-6. U.S.EPA acknowledges both that the shallow groundwater beneath the Site does not yield sufficient water to be considered a true aquifer and that analyses of water samples from the River show no significant PAH concentrations.[5/] In conjunction, these facts preclude the characterization of the groundwater as a significant source of contaminants to the River or as an ingestion risk. However despite these facts, the U.S.EPA identifies a pump and treat and/or discharge remedial system for this groundwater in every remedial alternative assessed. The Agency rationalizes that inclusion by stating that the groundwater remediation is not that costly and so can be included in all alternatives. No clear statement of the risk being protected against is included in the FS. The possibility of "No Action" is not even assessed for the groundwater in other than a summary dismissal as part of the overall "No Action" alternative, in obvious contravention of the National Contingency Plan.[6/]

5/ Page 3-8 indicates the need for more information on the vertical extent of the groundwater contamination. However, the RI previously concluded that there was no real aquifer so EPA must have defined the vertical component of the groundwater regime. If the Agency is uncertain as to the nature of the groundwater flow, then its RI was clearly inadequate and its proposed pump and treat systems, and associated cost analyses, can have no validity.

6/ Table 3-1 arrays the groundwater alternatives considered - no action is not included. Under the National Contingency Plan the no action alternative must be evaluated. The National Contingency Plan also states that remedial alternatives are to be developed to address principal threats at a Site. Given the Agency's RI findings it is unlikely that the groundwater could be characterized as a principal threat necessitating remediation.

8. Page 3-8. In developing remedial alternative arrays, the Agency concludes that groundwater treatment options are not impacted by actions taken on other media. That statement is clearly incorrect. Any groundwater remediation selection must be contingent on the nature and extent of soils remediation, the construction of Site cover and the remediation of the River. U.S.EPA's failure to acknowledge the interdependence of remedial activities can only produce a redundant, non-cost-effective remedial program in contravention of the National Contingency Plan.

9. As both the RI and FS indicate, the Rexnord Little Menomonee sediment dredging was considered a success. Yet hydraulic dredging is rejected in favor of dry excavation in identifying remedial actions for the River.[7/] Given the success of the earlier efforts and the improvements in dredging techniques during the interim, the Agency's failure to adequately address dredging is a significant error.

10. The FS addresses the location of the "contaminant mass" in relation to the water table inconsistently. Page E-3 states that the large volume of the contaminant mass is below the high water table and page G-5 reiterates that conclusion. However on page H-10, the FS concludes that much of the contamination is above the high water table. This inconsistency is significant in that the Agency uses the relationship of the water table to the contaminant mass as

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7/ In reviewing Appendix D of the FS, additional inconsistencies in the way in which the Agency has viewed the past dredging projects become clear. The Agency cites significant benefits result from hydraulic dredging, as well as the success of the Rexnord project, but rejects the technique nonetheless. Hydraulic dredging should have been retained for more detailed consideration.

a basis to retain or reject remedial alternatives. For example, U.S.EPA rejects soil flushing as an option due to the location of the contaminants below the water table. A proper ranking of alternatives as required in an FS is impossible without correction of this error.

11. Page G-6 and H-12. The Agency's approach to the potential mobility risks presented by PAH's in soils is also inconsistent within the FS. Generally, the Agency concludes that PAH's adsorb to soil and are relatively insoluble in water. This conclusion is reinforced by the Agency's conclusion that the PAH's migration from covered sediments to surface waters would be negligible. Yet, despite these statements, the Agency identifies a groundwater pump and treatment system as necessary due to movement of PAH's from subsurface soils into groundwater and then into the River. This assertion of remedial need is clearly inconsistent with the Agency's own analytical findings and conclusions.[8/]

12. Page A-1. The FS contains no indication that U.S. Fish and Wildlife was involved in the assessment of remedial alternatives for this Site. This lack of coordination is clearly inappropriate under the National Contingency Plan and is especially problematic in this instance given the proposal to destroy the River and bordering habitats. In addition, the FS does not reflect any input from the Corps of Engineers with respect to the River relocation. A remedial activity as drastic as destruction of a five-mile stretch of waterway

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8/ If remediation is believed to be necessary, removal of pure phase PAH's from the saturated zone would be the most protective of the groundwater and the Little Menomonee River and would certainly be more cost-effective than remedial technologies identified by the Agency in the FS.

can not be properly assessed without timely consultation with these concerned agencies.[9/]

13. Page 3-8 to 3-19. In performing the mandatory cost evaluation, the Agency inappropriately compares alternatives which propose to remediate widely disparate soil volumes. If the various remedial options identified are scaled to address the same soil volumes, the Agency's cost comparisons would change dramatically. For example, applying the bioremediation alternatives to the larger volume of soils postulated in the FS produces a cost estimate of $50 to $60 million, which is significantly higher than the cost now attributed to that technology. By varying the soil volumes, the Agency has improperly skewed its cost analysis so that very expensive technologies appear more cost-effective than they are in fact.

14. Attachment 1. U.S.EPA has adopted a costing scheme that artificially decreases certain costs making chosen remedial alternatives appear less expensive than they realistically would be. In its cost comparisons, U.S.EPA used differing assumptions depending on the remedial alternatives being evaluated, despite the fact that the same cost parameters were being addressed in each instance.

   - It is not substantially documented that the Health and Safety impacts of incineration are significantly different than those of bioremediation. These costs are properly calculated as a function of time on Site, and types and levels of contamination addressed. The health and safety costs of

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9/ Consultation with these agencies in a timely manner would mean that any comments or recommendations Fish and Wildlife or the Corps might communicate would be available for public review and comment.

incineration should therefore be less than those for bioremediation since incineration requires less time on site. The Agency's cost formulations do not reflect these time and constituent variables.

- U.S.EPA's category of "other" costs which includes administration, service, and permitting costs, should also be calculated as a function of time and contamination present, rather than as percentages of the remedial alternative cost. Based on that type of formulation the bioremedial costs would equal or exceed incineration costs in this area.

- U.S.EPA has not sufficiently explained why the incineration alternative has substantially higher allowances and contingencies factored into its cost totals. These elements of the overall costs should be defined in terms of time and contaminants as explained above.

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AUG 6

August 4, 1990

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AUG 06 1990
OFFICE OF PUBLIC AFFAIRS

Ms. Susan Pastor
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Coordinator
U.S. EPA Region 5
Office of Public Affairs (5PA-14)
230 South Dearborn Street
Chicago, IL 60604

Re: Moss-American Site, Milwaukee, Wisconsin

Dear Ms. Pastor:

I enclose two copies of comments submitted on behalf of Kerr-McGee Chemical Corporation ("Kerr-McGee") concerning the RI/FS and EPA's proposed plan for remedial actions at the Moss-American Site. I would appreciate it if you file-stamp one of the enclosed copies and return it to me in the enclosed postage-paid envelope.

I very much appreciate your assistance.

Very truly yours,

Richard A. Meserve

RAM:lmb
Enclosures

BEFORE THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

RECEIVED

AUG 06 1990

OFFICE OF
PUBLIC AFFAIRS

Re: Moss-American Site Milwaukee, Wisconsin	)

COMMENTS OF KERR-McGEE CHEMICAL CORPORATION

RECEIVED

AUG 20 1990

BUREAU OF SOLID -
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August 4, 1990

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BEFORE THE UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

Re: Moss-American Site
Milwaukee, Wisconsin

COMMENTS OF KERR-McGEE CHEMICAL CORPORATION

The U.S. Environmental Protection Agency ("EPA") has requested comment on the Remedial Investigation ("RI"), Feasibility Study ("FS"), and Proposed Remedial Action Plan ("Proposed RAP") relating to the Moss-American Site in Milwaukee, Wisconsin. These comments are submitted by Kerr-McGee Chemical Corporation ("Kerr-McGee") in response to EPA's request. They supplement the comments that have been prepared and submitted on behalf of Kerr-McGee by Roy F. Weston, Inc. ("Weston").

SUMMARY

EPA has tentatively determined that certain of the soils and sediments associated with the site pose risks that are sufficient to justify significant remedial activities.1/ But, as discussed in Part I of these comments, EPA has significantly exaggerated the risks arising from the site. As

1/ Kerr-McGee recognizes that much of the material on which EPA seeks comment was prepared for EPA by an outside contractor. For ease of reference, these comments shall refer to all such materials as EPA workproduct.

a result, EPA has failed to provide an adequate justification for the proposed remedial actions. In fact, as Weston has demonstrated, if EPA had followed its own guidance, the risks are reduced by several orders of magnitude from those set out in the RI. Thus, EPA's conclusion that there is a need for extensive remedial action is cast into significant doubt.

EPA has evaluated various remedial alternatives in terms of three operable units -- soils, sediments, and groundwater. In Part II we discuss EPA's proposed remedial approach for onsite soils -- treatment by use of soil washing and a slurry bioreactor. It is the opinion of Kerr-McGee's technical experts that this approach does not provide a feasible means for achieving the required reductions in the concentration of certain of the polynuclear aromatic hydrocarbons ("PAHs"), the contaminants of principal concern. And, in any event, the technology will be significantly more costly -- as much as ten-times more costly -- than EPA has estimated. In light of the low risk that is presented by the soils and the fact that much of the site is subject to long-term control by a governmental entity (the County of Milwaukee), a more appropriate remedial approach may be the application of institutional controls, perhaps coupled with the placement of a cap over some of the more contaminated areas.

In Part III we discuss EPA's proposed approach to the remediation of contaminated sediments. As Weston has demonstrated, a risk assessment for the sediments that is performed in a fashion consistent with EPA guidance shows that the sediments in fact present carcinogenic risks that are considerably less than 10^{-6}.[2/] The sediments do not thus present any threats that warrant remediation. See 40 C.F.R. § 300.430(e)(2)(i)(2) (defining 10^{-6} risk level as "point of departure" for remediation goals). Moreover, in examining its proposed remedial alternative, EPA has failed adequately to recognize that any contamination of the sediments is likely to be dispersed in highly localized layers that extend only for an inch or two. The contamination is thus not found in large deposits that lend themselves to the construction-style excavation that EPA has proposed. Perhaps even more important, the application of the EPA approach would result in the complete destruction of valuable wetlands and aquatic habitat and appears inconsistent with the ARARs governing such areas. In short, a full evaluation of risk, feasibility, environmental factors, and legal issues shows that EPA should adopt the no-action alternative for dealing with contaminated sediments.

In Part IV we discuss EPA's proposed approach to the remediation of groundwater. Any groundwater contamination at the site is and will likely remain highly localized under

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2/ EPA has already determined that the noncarcinogenic risks are not of concern.

circumstances in which it presents no meaningful threat to human health or the environment. Moreover, in light of the fact that PAHs sorb to soil and are highly insoluble in water, EPA's proposed remedial proposal is impractical because the removal of the contamination would require the pumping and treatment of groundwater in perpetuity. Although no remediation of groundwater is justified, at most EPA should consider a pilot program to determine whether any remedial approach to the groundwater is feasible and cost-effective.

Finally, in Part V, we discuss EPA's assertion that Kerr-McGee may appropriately be designated as a potentially responsible party for remedial actions. EPA had previously sought to require remediation by Kerr-McGee, but the suit was dismissed with prejudice as a sanction for the government's misconduct. United States v. Moss-American, Inc., 78 F.R.D. 214 (E.D. Wis. 1978). In light of this fact, EPA is barred from seeking to involve Kerr-McGee in any action it may now take at the site.

COMMENTS

I. EPA HAS SIGNIFICANTLY EXAGGERATED THE RISK ASSOCIATED WITH THE MOSS-AMERICAN SITE.

EPA has conducted a baseline risk assessment for the site that demonstrates, for the most part, that the existing circumstances do not present any significant noncarcinogenic risks. However, EPA has estimated carcinogenic risks arising from certain postulated exposure scenarios that are as high as

4×10^{-2} (residential scenario, west bank, highest detected concentrations). But the methodology applied by EPA for estimating the risk is inconsistent with EPA guidance in many respects. As a result, EPA has significantly exaggerated the risk that is likely to arise from the existing site conditions. And it has developed risk-based cleanup targets that are excessively stringent.

A. Contaminant Concentrations.

The starting point for the estimation of risk is, of course, the determination of the concentration of the relevant contaminants. The summary of the sampling data in Appendix K of the RI is significantly different from the input data to the calculation of carcinogenic risk listed in Appendix M. Appendix 1 to these comments consists of various tables documenting some of the discrepancies. It shows that the sampling data often reflect considerably lower contamination than EPA has assumed in its assessment of risk. The result, of course, is that the EPA-reported risk numbers are exaggerated. Indeed, the inconsistency is troubling as it raises very significant questions as to the accuracy of all the results reported in the RI/FS.[3/]

3/ Indeed, both Appendix K and M appear inconsistent with the raw sampling data. The highest detected concentrations applied in Appendix K and M are often not reflected in any of the reported soil sampling results. RI, Table E-4.

Moreover, in estimating the upper bound of risk, EPA assumed in the RI that all exposures are at the highest detected contaminant level for the area of concern. RI, 4-6. EPA guidance specifically provides, however, that the upper limit of the 95 percent confidence interval should be used in calculating the reasonable maximum exposure -- not the maximum detected level.[4/] EPA's use of maximum detected levels in the RI for the Moss-American site allows the estimates of risk to be driven by outliers in the sampling data.[5/] As a result, even if proper sampling data were applied, the maximum estimates of risk in the RI are significantly exaggerated.

B. Toxicity.

EPA finds that the carcinogenic PAHs are the principal contributors to risk from the Moss-American site. In evaluating the risk from these substances, EPA has assumed that all PAHs are as potent as benzo[a]pyrene ("B[a]P"). RI, 4-1. But, as an EPA-sponsored study has stated, "estimates of cancer risk using a B[a]P one-to-one equivalency approach will greatly overestimate the carcinogenic potency of most mixtures

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4/ EPA, Risk Assessment Guidance For Superfund Volume I Human Health Evaluation Manual (Part A), 6-19 (Dec. 1989) (EPA/540/1-89/002) (hereinafter "EPA Risk Assessment Guidance").

5/ The raw sampling data show that the highest detected concentrations of the PAHs significantly exceed the vast preponderance of the data. RI, Table E-4.

of PAHs."[6/] Accordingly, several years ago EPA's contractor recommended the application of the "relative potency approach" in which each of the carcinogenic PAHs are compared to the carcinogenic potency of benzo[a]pyrene. Id. As Weston has discussed, the relative potency approach is now widely accepted and has been used at other Superfund sites. The relative potency approach should thus also be applied in the assessment of risk at the Moss-American site. If it were applied, it would serve to reduce the estimated risk significantly for all the scenarios that were evaluated.

In addition, EPA has assumed a potency for benzo[a]pyrene (and for all other PAHs) that is significantly in excess of the level suggested by its own contractor. EPA applied a potency factor for the benzo[a]pyrene of 11.5 $(mg/kg/day)^{-1}$ (RI, M-3), whereas the more appropriate value is 3.22 $(mg/kg/day)^{-1}$. ICF Clement, supra note 6, iv. This factor alone, without regard to the need to apply the relative potency approach, serves to reduce the risks from the PAHs by a factor of roughly 3.5.[7/]

6/ ICF-Clement Ass's, Comparative Potency Approach For Estimating The Cancer Risk Associated With Exposure To Mixture Of Polycyclic Aromatic Hydrocarbons, iii (April 1988). The Executive Summary of this report is attached as Appendix 2.

7/ Indeed, EPA should not consider benzo[g,h,i]perylene to be a carcinogenic PAH. We understand that EPA's Carcinogen Assessment Group has determined that this substance should be classified in Group D, which means there is insufficient

(footnote cont'd)

C. Residential Scenario

The RI shows that the assumed residential development of the site yields the greatest estimates of risk (RI, 4-7) and hence this risk scenario is used to establish target concentrations for carcinogenic PAHs in soil. See FS, App. C. There are many errors, in addition to those discussed above, with EPA's assessment of this exposure scenario:

1. Much of the site is currently owned by the County of Milwaukee and is preserved as parkland. RI, 1-2. It is thus highly unlikely that the site would ever be available for residential use, particularly since the County has interests in safeguarding the site from such development. Moreover, as discussed herein, much of the site is valuable wetland, that is protected by law from development. The residential-development scenario thus does not exist today and is highly unlikely to arise in the future. EPA guidance shows that such implausible future usage scenarios should not be given credence in the risk assessment process. EPA Risk Assessment Guidance, 6-7 ("an assumption of future residential use may not be justifiable if the probability that the site will support residential use in the future is exceedingly small").

(footnote cont'd)

evidence of carcinogenicity. This substance should thus not be included in the calculations of carcinogenic risk at all.

2. The RI states that, as a result of residential development, "[i]t was assumed that subsurface material to a depth of 15 feet may be exposed and left on the site surface as a result of site development." RI, 4-7. Because the Moss-American site has low relief, the only reason for such extensive subsurface excavation would be for the construction of basements for residential dwellings. But, because the depth to groundwater at the site varies between 0 and 15 feet below the ground surface (FS, 2), the current hydrological conditions at the site preclude the construction of basements. The assumption that soil 15 feet below the surface will be exposed is thus unrealistic.[8/] Of course, if heavily contaminated soil is not exposed, the assumed concentrations for residential exposure would be reduced. Compare FS, Table K-10 with id., Table K-12.

3. The evaluation of the exposure arising from the residential scenario includes several implausible assumptions that depart from EPA guidance. The risk arising from the residential usage is assumed to occur over a 70-year term (RI, Table K-9). Current EPA guidance suggests, however, the use of an exposure duration of 30 years, which is the upper limit of the 90 percent confidence interval for time at

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8/ As Weston has discussed, PAHs tend to both photodegrade and biodegrade. Thus the concentration of surface contamination is expected to be less than deeper contamination, particularly over time.

a single residence.[9/] Moreover, EPA has assumed that exposure through ingestion occurs throughout the year (RI, Table K-9), whereas the cold climate in the Milwaukee area would preclude gardening or other yard activities that could lead to ingestion of contaminated soil for as much as 4-6 months of each year. Thus, the exposure assumptions applied in the RI are unjustified and serve to exaggerate the risk from the site significantly.

D. Trespass Scenario.

EPA also evaluated a trespass scenario in which individuals trespassing on the site were assumed to have contact with contaminants. The scenario was not found to create any significant non-carcinogenic risks, but the lifetime carcinogenic risks were found to be as large as 5×10^{-4} (highest detected concentrations, west site). RI, 6-7. But, in addition to the errors discussed above, EPA has made several incorrect assumptions that serve to exaggerate this risk significantly:

1. EPA has assumed exposure from soils at the site on 40 occasions each year over a period of 10 years. The RI acknowledges, however, that the most likely site visitors would be children. RI, K-19. In light of the fact that the site is over one-quarter mile from the nearest residential

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9/ EPA, Exposure Factors Handbook, 5-34 (1989) (EPA/600/8-89/043) (hereinafter "EPA Handbook").

area (RI, Fig. K-4), it is not reasonable to assume that the site will be used as extensively as EPA has assumed, particularly in light of other undeveloped areas nearby.[10/]

2. The EPA calculation of the risk from this exposure scenario departs from EPA guidance and is misguided in other respects. The RI assumes ingestion at a rate of 0.1 gm/day, but this represents a ten-fold overestimate for individuals in the age groups to which this exposure scenario would apply (individuals older than 5 years). EPA Handbook, 2-58. EPA has also assumed that the entire daily soil ingestion arises from the 2-hour visit to the site. Obviously, a significant portion of the daily ingestion would likely occur elsewhere. Moreover, in estimating the maximum risk, EPA has assumed that all the exposure arises from the most contaminated soil that is found at the site. It is simply implausible that all the exposure from a trespassing scenario could always occur at the same spot. In short, the exposure estimate derived in the RI is far too large.

3. The inhalation exposure applied in determining the excess lifetime cancer risk in the trespass

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10/ EPA guidance provides that walking/biking activities amount to 1.21 hours/week at the 90th percentile level. EPA Handbook, 5-65. This amounts to 62.9 hours/year, or roughly 31 2-hour visits to the site if all walking/biking activities were at the site. In light of the undeveloped nature of the site and its distance from the nearest residences, it is not plausible to assume that all walking/biking activities will take place at the site.

scenario was calculated as if there were an exposure duration of 8 hours for each visit to the site. RI, Table M-9, M-12. Because EPA assumes presence on the site for 2-hour visits -- an estimate that is excessive by itself -- it is incorrect to assume a four-fold longer exposure duration for inhalation. Moreover, the inhalation rate applied in the RI -- 20 liters/minute -- is too large. EPA guidance suggests an inhalation rate of about 20 liters/minute (or 2.4 m^3/day) for adults engaging in outdoor activities, but the inhalation rates for children, the most likely users of the site in this scenario, are less. EPA Handbook, 3-4 and 3-8.

E. Recreational Scenario.

EPA also evaluates the risks arising from a recreational scenario in which there might be exposures to contaminated sediments resulting from recreational use of the river. Although this scenario was found to present no non-carcinogenic risks, the carcinogenic risks were estimated to be as high as $1x10^{-4}$ (river mile 1, highest detected concentrations). RI, 4-8. In addition to the various errors in EPA's approach that are discussed above, the risk arising from recreational use has been exaggerated for various other reasons:

1. The RI does not include information that enables the reliable evaluation of the background concentration of PAHs -- the concentrations that arise from activities upstream of the site and from tributaries that flow into the

Little Menomonee. This is a major omission because PAHs are ubiquitous in the environment and have been released to the stream from other sources. Data in the FS show, moreover, that there is significant doubt that the Moss-American site contributes meaningfully to the risk in several of the stream segments. The FS shows that the best estimate of the maximum probable background concentration is 18,000 µg/kg for total carcinogenic PAHs, and 47,000 µg/kg for total PAHs. FS, J-4, Table J-2 (Group 2). Moreover, the tributaries provided maximum probable background concentrations of 29,000 µg/kg of carcinogenic PAHs and of 78,000 µg/kg of total PAHs (FS, J-3), which suggests that the tributaries have made a significant contribution to the PAH-content of the stream sediments. If the maximum probable background concentrations are compared to the sampling data, it appears that stream reaches 4 and 5 should not be viewed as contaminated by the Moss-American site at all.[11/]

11/ The FS provides the following data concerning the carcinogenic PAHs:

	Concentration (µg/kg)	Data Source
Background		
Tributaries & Upstream	18,000	FS, Table J-2, Group 2
Tributaries	29,000	FS, J-3
Stream Reach 4	19,500	RI, Table K-14
Stream Reach 5	11,700	RI, Table K-14

2. EPA applied many of the same exposure assumptions in the recreational scenario as were applied in the trespass scenario. As discussed above, these assumptions are inconsistent with relevant EPA guidance. Moreover, the risk assessment assumes recreational contact with contaminated sediments on roughly 40 occasions per year. As shown by Weston's field study, however, it is difficult to obtain access to the river in light of the very dense underbrush that surrounds it. The recreational scenario is thus premised on exposures that are much greater than those that are ever likely to arise.

F. Required Revision of Risk Assessment.

It is apparent that the RI departs significantly from EPA guidance in the methodology that was used for estimating risk. As shown by the Weston comments, the correction of some of these errors yields estimates of risk that are reduced by several orders of magnitude from those that were calculated by EPA. In light of this fact, EPA cannot properly use its risk assessment to guide its selection of a remedial alternative. Indeed, as Weston has demonstrated, a risk assessment that is consistent with EPA guidance shows that the extensive remedial activities proposed by EPA cannot be justified.

II. EPA SHOULD RECONSIDER ITS APPROACH TO REMEDIATION OF SOILS.

EPA must conduct a thorough re-examination of the the cost and feasibility of the alternative it has proposed for the treatment of contaminated soils and sediment.

A. EPA's Proposed Remedial Approach.

Guided by the evaluation of various alternatives in the FS, EPA proposes that visibly contaminated onsite soils should be treated to reduce the concentrations of contaminants. The treatment involves the removal of creosote residues from coarse sand and detritus using soil washing and the biological destruction of the creosote residues associated with contaminated soil fines using a slurry bioreactor. Both the treated soil and the remaining contaminated soil are then to be placed in an area containing lesser contaminated soils and covered with a cap.

A full assessment by Kerr-McGee's Technology Division of EPA's proposed remediation approach is set out as Appendix 3. Kerr-McGee concludes that the soil-washing approach advocated by EPA is not feasible for application to the Moss-American site. EPA has determined that the affected soil on the site consist of approximately 50 percent fine material. FS, 3-13. But, as the FS acknowledges, "[a] study of soil washing vendors in Europe found [soil-washing systems] have a practical upper limit for the fraction of fines in the soil to be treated of 20 to 30 percent." FS, H-11. Thus, as is discussed more thoroughly in the appendix, the soil-washing technology that EPA proposes is not appropriate.

Moreover, a slurry bioreactor also does not provide a feasible remediation technology. Creosote is used for the treatment of wood products because it serves to delay biological decomposition. Not surprisingly then, long residence times in the bioreactor are required to achieve significant degradation of PAHs, a principal component of creosote and the contaminant of concern at the site. Long residence times in the bioreactor imply either a long timeframe for remediation (and extended operating costs) or large capital costs for numerous bioreactors.

The EPA guidance for a treatability variance to EPA's RCRA Land Disposal Restrictions shows that the bioreactor must be designed for 99.9 percent reduction of certain PAHs, and must actually achieve 95 percent reduction.[12/] But EPA's data show that a residence time in the bioreactor on the order of 150 days is likely to be required to achieve even a 90-percent reduction in PAH concentration. FS, Appendix K. And the degradation may well approach an asymptotic non-zero

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12/ EPA, Superfund LDR Guide #6A, Obtaining a Soil and Debris Treatability Variance for Remedial Actions (July 1989) (Directive: 9347.3-06FS). The Guidance provides that if the threshold concentration of polynuclear aromatics exceeds 400 ppm, the technology must be designed to achieve the stringent end of the treatment range (99.9% reduction). EPA seems incorrectly to have assumed in the FS that design for 95% reduction will suffice.

value that could be larger than the levels required by the treatability variance. As a result, Kerr-McGee's Technology Division concludes that the achievement of the target reductions in concentration is not feasible using this technology. In any event, however, EPA's assumption that a 15-day residence time in the bioreactor will provide sufficient degradation is completely unjustified.

Even if it is possible to apply the proposed remediation approach, EPA has significantly underestimated the cost. If a 90-percent reduction in concentration is assumed to be sufficient (159-day bioreactor residence time), a careful evaluation shows that the costs for soil washing and the slurry bioreactor process would be roughly $55 million. See Appendix 3. This cost is nearly ten-times the $5.6 million cost that is estimated in the FS. Given the low risks associated with the soil contamination, the expenditure of such funds can not be justified.

B. Other Approaches.

In light of the low risk that the soil contamination provides, EPA should conclude that the appropriate response to the presence of soil contamination is the institution of institutional controls, perhaps coupled with some capping of contaminated areas. In the event that EPA decides that some treatment should be attempted, however, it is necessary at the least that EPA reject the proposed remedial approach because of its infeasibility and excessive cost. As noted in

Appendix 3, other bioremediation techniques might be considered for the Moss-American site. For example, engineered aerobic compost pile reactors and in situ biological techniques might be feasible. However, no such technology is sufficiently developed as to provide any assurance of effectiveness or to allow any reasonable estimation of cost. In light of this fact, any treatment of soils should proceed at most with a pilot effort to assess the feasibility and cost-effectiveness of the technology selected.

In any event, the RI/FS does not present adequate data to allow selection of a remedial alternative that involves excavation and treatment. The FS acknowledges that there has been inadequate delineation of the volume of contaminated soil in a variety of on-site areas. FS, C-4. Moreover, the FS suggests that there may be contamination of floodplain soils, but EPA's studies have been completely inadequate to define either the location or the volume of such materials. As discussed more thoroughly in the Weston comments, the gap in the data is a significant shortcoming because, without a reasonable estimate of the volume of affected materials, it is impossible to compare and evaluate various alternatives for remediation. For example, if the volume is larger than EPA has assumed, alternatives that are more capital intensive but with low operating costs would be favored.

Kerr-McGee submits that no excavation and treatment is warranted at the site. But, if EPA concludes otherwise, at the least there is crucial information that must be in hand before a treatment technology is selected.

III. EPA SHOULD RECONSIDER ITS APPROACH TO REMEDIATION OF CONTAMINATED SEDIMENT.

Guided by the evaluation of various alternatives in the FS, EPA suggests that the Little Menomonee River should be rerouted from Brown Deer Road to the conjunction with the Menomonee River. Visibly contaminated river sediment would be removed and treated using the slurry bioreactor, and then disposed of with treated soils. All remaining sediments would then be covered with soil excavated from the new channel.

As discussed above, the available data suggest that several of the stream reaches are not contaminated with PAHs at levels above background. And, if the evaluation of risk is performed in a fashion consistent with EPA guidance, Weston has shown that the risk arising from the maximum observed levels of contamination -- a risk that significantly exaggerates any risk that is likely to be incurred -- is considerably less than 10^{-6}. There is thus no justification for cleanup of the sediments. But, in any event, there are several problems with EPA's approach.

A. Nature of the Contamination.

The FS suggests that contaminated sediments in the Little Menomonee River may appropriately be excavated using a "front-end loader, backhoe, or clamshell." FS, Appendix D. EPA evidently envisions that the contamination consists of large contiguous areas that lend themselves to excavation using construction equipment. A consideration of the circumstances governing the movement of creosote in the River, however, suggests that the large deposits of contamination imagined by EPA do not in fact exist.

As explained in the report (Appendix 4) prepared by Dr. W.J. Ganus, a professional hydrologist in the Kerr-McGee Technology Division, any creosote released to the river would be expected to sink to the bottom of the stream, break up into beads of material, and then be carried along with the bed load. Like stream sediments, the particles of creosote would be moved and reworked with each new major runoff event. The result is that creosote should be found to be dispersed throughout the sediments as small particles. Personal observations confirm this conclusion: creosote is only occasionally found and, when it is found, it is in thin localized layers that never extends for more than an inch or two.

Consideration of the mechanism for movement of the creosote and personal observation thus confirm the error of the EPA hypothesis that the stream may be remediated by excavation of pools of heavily contaminated sediments. Such areas are in fact unlikely to exist and thus the proposed remedial approach is thus entirely misguided.

B. Environmental Impacts.

EPA has also failed to evaluate adequately the adverse consequences of its proposed remedial plan for contaminated sediments. EPA acknowledges that the proposal would involve the destruction of existing aquatic habitats for an entire 5-mile length of the Little Menomonee. FS, 4-3. But, while the FS mentions destruction of aquatic habitat, it fails to discuss adequately the full environmental consequences of its proposal. As Weston has described, the wetland along the river provides a valuable habitat for over 40 species of birds, numerous small animals, and over 60 species of plants. Moreover, the vegetation surrounding the 5-mile portion of the Little Menomonee River is very dense, thereby protecting these birds and animals from man's intrusion. EPA's remedial approach would destroy not only the existing aquatic habitat, but also this vulnerable wetland area.

Of course, wetlands not only provide an important natural habitat, they also reduce flooding problems by storing large quantities of water temporarily and curbing the velocity of flood water. Although flooding has not recently been a problem along the Little Menomonee River, changes of the type that EPA proposed to the present river and wetland system could serve to create the prospect for flood damage to downstream property.

EPA attempts to justify the destruction of an existing ecological system by noting that such action is necessary for long-term improvement. FS, 4-3. Weston has found, however, that the existing circumstances in fact provide a valuable and diverse habitat. There is serious doubt that destruction of the habitat can be justified on the premise that such action offers long-term benefits.[13/]

C. ARARs

When discussing applicable or relevant and appropriate requirements (ARARs) in Appendix A, EPA mentions two ARARs that would apply to re-routing the river: Executive Order 11990 and NR 116 Wisconsin DNR Guidance on Department Regulation of Stream Channelization Projects. FS, A-5. Inexplicably, Tables A-6, A-7, and A-8 list at least five other ARARs for the river re-routing that are not mentioned in the appendix text. In addition, when Kerr-McGee requested DNR to send the rules that might govern the re-routing the river, DNR sent Chapters NR 115-117, 87-88 Wis. Stats. 30.195 and the Guidance mentioned above. Only one of these is listed in Tables A-6, A-7, or A-8; the tables list only NR 116, NR 340, NR 345, and NR 347. Further, the tables list EPA wetlands rules, but not the Corps of Engineers dredge and fill rules.

13/ In any event, even EPA elsewhere acknowledges that any degradation of the existing habitat may not be the result of releases from the Moss-American site. FS, 1-10. Since EPA has not documented what effect, if any, the creosote has actually had on the river's ecology, it is difficult to ascertain what improvement is expected from remediation.

In short, it appears that EPA has failed to evaluate fully the ARARs associated with its alternative.[14/]

IV. EPA SHOULD RECONSIDER ITS APPROACH TO REMEDIATION OF GROUNDWATER.

Guided by the FS, EPA proposes that groundwater should be collected in trenches near the Little Menomonee River and treated on site. EPA has not identified any health threats that justify such action. Moreover, as will be seen, EPA has not adequately considered the feasibility of its proposed groundwater remediation program.

As discussed in Appendix 5, an examination of the physical circumstances shows that there is no substantial justification for the proposed remedial activities. The groundwater contamination is found in a surficial aquifer that discharges to the Little Menomonee River. Because PAHs, the

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14/ Indeed, EPA's own rules at 40 C.F.R. § 230.10(a) show that the EPA proposal is misguided. The rule provides:

> Except as provided under section 404(b)(2) [of the Clean Water Act], no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

But there is a practicable alternative to the proposed action -- leaving the existing system as is. This alternative would have less adverse impact (no destruction of the 5-miles of stream habitat) and would not have other significant adverse environmental consequences.

contaminant of concern, sorb on soils and are highly insoluble, any releases to the river are at low concentrations and then are further diluted by the river flow. As a result, any discharge to the river will be so slight as to present a negligible impact on surface-water quality. Moreover, because the affected groundwater is a surficial aquifer, it is highly unlikely that any beneficial use will ever be made of it. And, given the groundwater flow direction toward the river, the plume will not spread over time. In short, any contamination of groundwater does not present a threat.

The physical circumstances also limit the opportunities for effective remedial actions. As discussed by Weston, because the PAHs sorb on soils and are insoluble in water, the PAHs are likely to move only millionths of a foot per year. It would thus be necessary to collect groundwater in perpetuity in order to remove the contamination using the approach EPA has proposed. In short, the proposed action is not feasible.

It is Kerr-McGee's view that the circumstances do not warrant cleanup activities directed at groundwater. But, if any actions are undertaken, at most they should constitute a pilot scale program to assess whether any approach can prove effective to addressing the limited groundwater problem presented at the Moss-American site.

V. KERR-McGEE CAN NOT PROPERLY BE CONSIDERED A POTENTIALLY RESPONSIBLE PARTY.

EPA has stated that Kerr-McGee is a potentially responsible party for the cleanup of the Moss-American site. But the EPA has already brought an action against Kerr-McGee for cleanup arising from its operation of the Moss-American facility. See United States v. Moss-American, Inc., 78 F.R.D. 214 (E.D. Wisc. 1978). During discovery in that case, Kerr-McGee learned that one of EPA's agents had falsified the evidence upon which the government had relied in prosecuting the case. The court found the government's conduct "offensive," id. at 216, and held that the "government's willful failure to meet its high standard of conduct in this case justifies . . . the dismissal of its case." Id. at 217-18.

Because the judgment in the Moss-American case was an adjudication on the merits for res judicata purposes, Cemer v. Marathon Oil Co., 583 F.2d 830, 832 (6th Cir. 1978); Fed.R.Civ.P. 41(b), it operates to extinguish the government's claim against Kerr-McGee for injuries alleged to have occurred from Kerr-McGee's (or its predecessors) operation of the facility. See Restatement (Second) of Judgments, § 24(1) (1982) (the claim extinguished by the doctrine of res judicata "includes all rights of the plaintiff to remedies against the defendant with respect to all or any part of the transaction, or series of connected transactions, out of which the action arose"); Page v. United States, 729 F.2d 818, 820 (D.C. Cir. 1984). EPA can not avoid the res judicata effect of the judgment in the prior action by bringing a suit under a different statute (CERCLA). "Where two successive suits seek recovery for the same injury, a judgment on the merits operates as a bar to the later suit, even though a different legal theory of recovery is advanced in the second suit." Cemer, 583 F.2d at 832. The second suit is barred even though it raises new grounds, asks for new remedies, or seeks recovery for any additional damages that have occurred since the time of the first action. See Carbonaro v. Johns-Manville Corp., 526 F. Supp. 260 (E.D. Pa. 1981), aff'd, 688 F.2d 819 (3d Cir. 1982); see also Restatement, § 24, comment c.

The public would not be disserved by the operation of res judicata in these circumstances. Other potentially responsible parties are available to ensure that the public is not saddled with any of the cleanup costs that may be incurred at the site. And, in any event, the government must live with the consequences of its impropriety in prosecuting its prior claim. As the Court in Moss-American stated:

> The government also argues that the dismissal of this case would unfairly penalize members of the public who were harmed by the defendant's alleged pollution of the Little Menomonee River. Assuming that such pollution could be proved, the dismissal of this case would be unfortunate. However, the public is obliged to accept the consequences which may accrue in any . . . case in which its interests are improperly represented by the federal government.

78 F.R.D. at 217.

In sum, EPA can not properly look to Kerr-McGee for remedial activities associated with the Moss-American site.

CONCLUSION

As these comments and those submitted by Weston serve to establish, the RI/FS includes several significant deficiencies. A proper assessment of the risks throws into question whether any remedial actions can be justified, particularly with regard to the stream sediments. Moreover, an evaluation of the EPA's proposed remedial alternatives for soils, sediments, and groundwater reveals both unresolved legal questions and very substantial issues as to feasibility, practicality, and cost-effectiveness. Indeed, if any selection of a remedial alternative is to be made, data that are not yet available must be collected.

Under the circumstances, Kerr-McGee urges EPA to undertake a reconsideration of its approach to the Moss-American site and to revise its proposed remedy significantly. Although Kerr-McGee cannot properly be found to be responsible for cleanup, Kerr-McGee stands ready to lend its assistance to EPA in its reevaluation.

Respectfully submitted,

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Chemicals	Residential East Development Highest Detected K-12	 M-15	Residential East Development Geometric Mean K-12	 M-15
Arsenic	6800	6800	4695	4700
Benzo[a] Anthracene	190,000	410,000	2675	2800
Benzo[b] Fluoranthene	87,000	99,000	3274	2100
Benzo[k] Fluoranthene	78,000	99,000	1707	1900
Benzo[g,h,i] Perylene		12,000		1500
Benzo[a] Pyrene	71,000	100,000	1736	1900
s (2-Ethylhexyl) Phthalat	460	460	a	460
Chrysene	460	300,000	2524	2700
1, 1 Dichloroethane	210	210	a	210
Indeno (1,2,3-cd) Pyrene	13,000	210,000	1065	1500

(a) This chemical detected in less than 10% of samples taken. No estimate of a mean concentration made.

Chemicals	Residential West Development Highest Detected K-12	Residential West Development Highest Detected M-18	Residential West Development Geometric Mean K-12	Residential West Development Geometric Mean M-18
Arsenic	71,400	71,000	4482	4500
Benzene	100	100	4	4
Benzo[a] Anthracene	380,000	650,000	1802	3900
Benzo[b] Fluoranthene	270,000	270,000	1466	2800
Benzo[k] Fluoranthene	250,000	250,000	1009	2200
Benzo [g,h,i] Perylene		77,000		2100
Benzo[a] Pyrene	230,000	230,000	1315	2600
Bis (2-Ethylhexyl) Phthalat	1600	16,000	265	270
Chrysene	510,000	550,000	1864	4000
Dibenz[a,h] Anthracene	24,000	24,000	452	450
Indeno (1,2,3-cd) Pyrene	78,000	120,000	927	2100
Methylene Chloride	10,000	10,000	6	6

Chemicals	Trespass Setting East Site Highest Detected K-10	Trespass Setting East Site Highest Detected M-3	Trespass Setting East Site Geometric Mean K-10	Trespass Setting East Site Geometric Mean M-3
Arsenic	5600	5600	4490	4500
Benzo[a] Anthracene	170,000	410,000	2893	3800
Benzo[b] Fluoranthene	78,000	98,000	2232	2700
Benzo[k] Fluoranthene	78,000	98,000	2232	2700
Benzo[a] Pyrene	71,000	100,000	2163	2600
Benzo[g,h,i] Perylene		31,000		2100
Chrysene	190,000	300,000	3003	3700
Indeno [1,2,3-cd] Pyrene	13,000	210,000	1228	2200

Trespass Setting West Site			Trespass Setting West Site	
Chemicals	Highest Detected		Geometric Mean	
	K-10	M-6	K-10	M-6
Arsenic	110,000	110,000	7780	7800
Benzene	11	11	4	4
Benzo[a] Anthracene	380,000	380,000	8418	13,000
Benzo [b] Fluoranthene	270,000	270,000	9050	11,000
Benzo[k] Fluoranthene	240,000	240,000	8714	10,000
Benzo[a] Pyrene	200,000	200,000	5673	8200
Benzo[g,h,i] Perylene		51,000		6800
Chrysene	490,000	490,000	11,448	16,000
Indeno [1,2,3-cd] Pyrene	49,000	120,000	3387	6800

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COMPARATIVE POTENCY APPROACH FOR ESTIMATING THE CANCER RISK ASSOCIATED WITH EXPOSURE TO MIXTURES OF POLYCYCLIC AROMATIC HYDROCARBONS

INTERIM FINAL REPORT

Contract No. 68-02-4403

Prepared by

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April 1, 1988

EXECUTIVE SUMMARY

This report was prepared in response to a request by the EPA Office of Health and Environmental Assessment to develop a method for assessing the cancer risk of polycyclic aromatic hydrocarbons (PAHs) for which inadequate ingestion or inhalation bioassay data exist, as well as to improve existing risk estimates using methodologies that are consistent with the experimental protocols and observations. A relative potency approach was developed as an alternative to the current practice of assuming that all carcinogenic PAHs are equivalent in potency to benzo[a]pyrene (B[a]P), which has little scientific support. B[a]P has consistently been demonstrated to be one of the most potent carcinogenic PAHs to which people might be expected to be exposed environmentally. As a result, estimates of cancer risk using a B[a]P one-to-one equivalency approach will greatly overestimate the carcinogenic potency of most mixtures of PAHs. Use of a relative potency approach that takes into account the differing potencies of carcinogenic PAHs would yield a more realistic estimate of risk, with a sounder biological basis.

In this report, a new method is developed for estimating the cancer risk associated with exposure to mixtures of PAHs that attempts to rectify the problems inherent in earlier approaches in use by EPA and others. A two-stage mathematical dose-repose model is postulated that is consistent with the biological mechanisms of action of PAHs. The model parameters are estimated using rodent tumor response data following exposure to B[a]P. The two-stage model is a special case of the Moolgavkar and Knudson (1981, 1986) cancer risk model that was adapted by Thorslund et al. (1987) to account for exposure to known levels of carcinogenic agents. The model may also be viewed as a special case of the classic Armitage and Doll (1954) multistage model in its time-independent form and a restricted case of the Armitage and Doll (1957) two-stage model in both its time-independent or -dependent forms. The advantages of the model are that it is based on a strong theoretical argument derived from biological principles yet is simple enough to obtain estimates for its parameters using very limited data. Using this model, the estimate of cancer potency for B[a]P was changed from 11.53 (EPA 1980) to 3.22 $(mg/kg/day)^{-1}$ for ingestion exposure and from 6.11 (EPA 1980) to 0.453 $(mg/kg/day)^{-1}$ for inhalation exposure.

The second critical element in the development of the method was obtaining estimates of relative potencies for carcinogenic PAHs other than B[a]P using the structural form of the model derived for B[a]P. These estimates were based on bioassay results that were obtained from systems that are not suitable for direct extrapolation to humans because the routes of exposure employed are not comparable to those by which humans are exposed in the environment (with the exception of dermal exposure). Experiments in which carcinogenic PAHs and B[a]P have been tested concurrently can be used to estimate the relative potencies of other PAHs compared with B[a]P. These relative potencies have a specific biological interpretation at low doses under the assumptions of the model: They provide an estimate of the ratio of exposure-induced mutation rates per unit of exposure. These mutations are thought to transform a normal stem cell into a preneoplastic cell and a preneoplastic cell into a malignant cell. Using 11 experimental studies, estimates of potency for carcinogenic PAHs were obtained that ranged from 0.004 to 4.50 as compared with B[a]P. The estimates were consistent among studies for a particular PAH. Those that were obtained from the most reliable studies are summarized in the table below.

SUMMARY OF RELATIVE POTENCY ESTIMATES
DERIVED FOR PAHs

Anthanthrene	0.320[a]
Benzo[a]pyrene	1.0
Benzo[e]pyrene	0.004[a]
Benz[a]anthracene	0.145[b]
Benzo[b]fluoranthene	0.140[a]
Benzo[j]fluoranthene	0.061[c]
Benzo[k]fluoranthene	0.066[a]
Benzo[ghi]perylene	0.022[a]
Chrysene	0.0044[d]
Cyclopentadieno(cd)pyrene	0.023[c]
Dibenz[ah]anthracene	1.11[d]
Indeno[1,2,3-cd]pyrene	0.232[a]
Pyrene	0.081[e]

[a]Deutsch-Wenzel et al. (1983).
[b]Bingham and Falk (1969).
[c]Habs et al. (1980).
[d]Wynder and Hoffmann (1959).
[e]Wislocki et al. (1986).

The relative potency estimates can be used in conjunction with the B[a]P dose-response model and the dose additivity assumption to obtain estimates of cancer risk associated with any specified exposure to multiple PAHs (for which potency estimates are available). The dose additivity assumption is synonymous with what is referred to by Finney (1964) as simple similar action and advocated for use in the EPA (1986a, 1986b) guidelines for assessing the cancer risk of mixtures when inadequate data on the mixture itself are available. Simple similar action implies that all carcinogenic agents in a mixture induce carcinogenesis by similar mechanisms. Since carcinogenic PAHs appear to be metabolized to similar reactive derivatives, produce comparable adducts with

DNA and histologically similar tumors at the site of introduction and metabolism in experimental animals, the assumption of a common mechanism of action (i.e., dose additivity) is plausible.

Under the assumption of dose additivity, the cancer risk caused by exposure to multiple PAHs can be obtained as follows. The total exposure units equivalent to B[a]P in a mixture to which an individual is exposed is calculated by taking the sum of the products of the relative potencies and the exposure levels for each PAH. These B[a]P-equivalent exposure units are then substituted into the dose-response model for B[a]P to obtain the cancer risk associated with exposure to the PAH mixture. This procedure is evaluated in this document using bioassay results from an experiment conducted by Schmahl et al. (1977) using two different mixtures of PAHs. The resulting predictions were encouragingly close to the tumor rates observed.

For the sake of comparison, the more familiar linearized multistage model has also been used in this report to estimate relative potencies, although it is less defensible biologically. Results reasonably comparable to those from the two-stage model were obtained, suggesting that the results are not highly model dependent.

This study has demonstrated that estimation of the total cancer risk from exposure to a mixture of PAHs should be based on measurements of the concentrations of its carcinogenic components and relative estimates of their potency.

This report is organized as follows. Section I describes the special problems associated with estimating cancer risks of complex mixtures of chemicals in the environment, why adding estimated individual risks together is appropriate for mixtures of PAHs, and why using B[a]P as a surrogate for other

PAHs is not appropriate. The assumptions required for using a two-stage model for PAH carcinogenesis are described and their experimental support presented. A broader context for the development of biologically based cancer risk models is provided and then a specific model for B[a]P is derived. In Section II, the model derived for B[a]P is applied to tumor data from an inhalation bioassay performed using hamsters (Thyssen et al. 1981) and an ingestion bioassay using mice (Neal and Rigdon 1967) and unit risk estimates are obtained. Studies in which the carcinogenicity of other PAHs was evaluated and compared with that of B[a]P are reviewed in Section III and used to establish relative potencies for the other PAHs. The results of Section III are recalculated in Section IV using the standard linearized multistage modeling approach to demonstrate how different biological and mathematical assumptions affect these results. Section V uses the biologically based model and relative potency method to estimate the cancer risk of mixtures of PAHs tested in the laboratory and compares the results with those actually observed.

This report is an interim final report because resources were inadequate to obtain the best cancer potency estimates possible for B[a]P and the best comparative potency estimates possible for the other carcinogenic PAHs. Use of individual animal data and other supplementary data sets, as well as more sophisticated statistical estimation procedures, along with evaluation of the sensitivities of the estimates to the assumptions made in order to derive them, are necessary for the completion of this work. The following list constitutes the specific tasks that remain to be performed in order to finalize this project and provide adequate support for the potency estimates derived.

1. Use individual animal exposure and pathology data from Thyssen et al. (1981) bioassay to recalculate inhalation risk for B[a]P.

a. Estimate individual animal exposure levels from analytical data for B[a]P, exposure durations, and dates of initiation and termination of exposure.

b. Code individual animal exposure and pathology data and place in a computer file to enable computer manipulations.

c. Use individual animal data to derive more precise, target site-specific time-to-tumor dose-response models for inhalation exposure to B[a]P.

2. Estimate ingestion risk for B[a]P using the Thyssen et al. (1981) bioassay data by relating the portion of the inhaled dose that was swallowed following mucociliary clearance and gastrointestinal tract tumor formation.

3. Estimate and improve the precision of the relative potency estimates.

a. Develop methods for the simultaneous estimation of dose-response model parameters within a single bioassay and obtain confidence limits on the relative potencies obtained.

b. Extend the methods developed in (a) to include multiple bioassays.

c. Use the methods developed in (b) to estimate relative potencies for the PAHs used in the mixture bioassay conducted by Schmähl et al. (1977).

d. Examine the time-dependency of the PAH-induced tumor response where time-to-tumor data are available.

4. Improve confidence associated with B[a]P ingestion risk derived from Neal and Rigdon (1967) bioassay.

a. Use the dose-response model derived for the ingestion risk of B[a]P to predict tumor responses for the short-term exposure data and the data from the other Rigdon and Neal bioassays. If the predictions are consistent with what is observed, incorporate these data into the dose-response model parameter estimates.

b. Evaluate the sensitivity of the ingestion risk estimate to the assumption that one-half of the animals in the bioassay were exposed to B[a]P for an earlier exposure duration while one-half were exposed for a later duration.

c. Evaluate the sensitivity of the ingestion risk estimate to the use of surrogate background tumor rates.

d. Derive an ingestion risk estimate for B[a]P from the Triolo et al. (1977) bioassay data for the purposes of comparison to that based on Neal and Rigdon (1967).

5. Extend the model to account for additional PAHs and other biological information.

   a. Develop methods for using historical controls and other assumptions about background tumor rates in the estimation process.

   b. Develop a tri-nomial dose-response model in which the response can be expressed as no tumor, adenoma, or carcinoma (instead of the binomial relationship, with or without tumor).

   c. Develop methods of estimating relative potencies for PAHs for which no cancer bioassay data are available based on, for example, DNA adduct formation or structure-activity relationships.

   d. Refine the dose-response models for B[a]P to include information on potential tumor promotional effects and effects from the saturation of activating enzymes.

   e. Develop a method for the estimation of relative potencies when the transition rate parameters are not proportional between cell stages. Investigate the bias that is introduced when the proportionality assumption is made but is invalid.

6. Evaluate the dose-response relationships for B[a]P and other PAHs in bioassay systems other than those examined in the report for their consistency with the two-stage model. These data may include complex mixture bioassays in which B[a]P was used as a positive control, bioassays using alternative routes of exposure such as intratracheal instillation, and data on experimental PAHs such as 3-methylcholanthrene.

7. Use tumor data for several PAHs administered by different routes in the same bioassay to evaluate the route-independence of relative potency estimates.

8. Using the same techniques that were developed for the estimation of relative potencies for PAHs as compared with B[a]P, estimates of the relative potencies of cigarette smoke condensate, roofing tar emissions, and coke oven emissions, can be obtained using the SENCAR mouse tumor initiation and complete carcinogenesis studies discussed by Albert et al. (1983). Two-stage dose-response models using human epidemiological data would also be obtained for each of these complex mixtures. Estimates of the cancer risk from a single PAH would then be obtained by multiplying the following three factors together:

   a. Relative potency of the PAH as compared with B[a]P;

   b. Relative potency of B[a]P as compared with the complex mixture; and

   c. The unit cancer risk for the complex mixture.

   This approach eliminates the need to extrapolate animal bioassays directly to humans.

MOSS-AMERICAN SITE
Milwaukee, Wisconsin

TECHNOLOGY DIVISION REPORT
TR-90034

COMMENTS ON THE TECHNICAL AND ECONOMIC FEASIBILITY OF IMPLEMENTING THE TREATMENT PROCESSES INCLUDED IN ALTERNATIVE 3A FOR SOIL AND SEDIMENT PROCESSING

July 27, 1990

Prepared by

Technology Division
Kerr-McGee Corporation

July 27, 1990

TR-90034

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CHAPTER 1

EXECUTIVE SUMMARY

INTRODUCTION

Region V of the US-EPA has proposed selecting Alternative 3A from the Feasibility Study (FS) as the appropriate remedial action to address clean up of the Moss-American Site at Milwaukee, Wisconsin. To better understand Alternative 3A, Kerr-McGee's Technology Division was asked to review the practicality and feasibility of the proposed treatment process and to develop a more detailed cost estimate. The process description and cost estimate are attached.

Alternative 3A of the FS incorporates two major processing steps;

1. Removal of creosote residues from coarse soil sands and detritus by soil washing.

2. Biological destruction of the creosote residues associated with the contaminated soil fines using a slurry bioreactor.

The process engineering and cost estimates were prepared as accurately as possible within the allowable time. As with any untested process, in depth engineering reviews and pilot testing may identify improvements in the process design and impact associated costs.

Carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs) in the soils and sediments provide the health based driving force for remedial action at the Site. Chrysene is the carcinogenic PAH found in highest concentration at the Site and, according to the FS, is the most difficult PAH to degrade by biological processing. Therefore, chrysene is the "target compound" for the process design and clean up criteria for both the soil washing and the slurry bioreactor operations.

FEASIBILITY OF THE PROPOSED SOIL WASHING PROCESS

Soil washing is similar to the processing used by the copper and gold minerals industries as the "front-end" to their leach circuits. Kerr-McGee Technology Division's process engineers, who have extensive experience in the mineral processing industry, have reviewed the Conceptual Process of Alternative 3A as described in Chapter 3, pages 12 through 15 and Figure 3-11, and Appendix H of the FS. It is the opinion of these process engineers that the proposed Conceptual Process as described in the FS would not work without the substitution or addition of mineral processing equipment. In order to provide a working process for evaluation and remain consistent with the intent of the US-EPA in selecting FS Alternative 3A, the process engineers modified the soil washing process to conform with standard minerals industries' engineering practices.

In the FS report, Appendix H, page 11, CH2M Hill states, "A study of soil washing vendors in Europe found they have a practical upper limit for the fraction of fines in the soil to be treated of 20 to 30 percent (Nunno et al. 1989)." No other evidence of successful soil washing at higher fines levels is available. In the FS report, Chapter 3, page 13, CH2M Hill states, "About half of the contaminated soil on site, however, is classified as a coarser granular material." In other words, about 50% of the soil is fines.

The US-EPA Risk Reduction Engineering Laboratory published a Project Summary, dated January 1990, entitled, "Cleaning Excavated Soil Using Extractive Agents: A State-of-the-Art Review" (EPA/600/S2-89/034), in which they state the following conclusion: "Contaminant extraction experience does not provide enough information to support a decision on the technical feasibility of applying soil washing at NPL sites."

According to CH2M Hill's evaluation of the site, and the US-EPA's evaluation of the state of soil washing technology, the Milwaukee Site soils are not suitable to treatment by soil washing.

Soil washing is the only treatment proposed in Alternative 3A for the coarse soil material and detritus which the FS estimates comprises 50% of the bulk of the contaminated soil. Only the soil fines progress on to the slurry bioreactor for further treatment. It is the opinion of Kerr-McGee Technology Division's process engineers that, based upon information available in the literature, the soil washing process would not achieve the clean up criteria required by the PAH Treatability Variance on the coarse soil material or detritus.

FEASIBILITY OF THE PROPOSED SLURRY BIOREACTOR PROCESS

Slurry bioreactor processing of water contaminated with dissolved priority pollutants is a proven technology. For example, DuPont has been treating contaminated groundwaters, containing dissolved hydrocarbon pollutants, using a slurry bioreactor employing bacteria supported on activated carbon since 1978 at their Delaware Chambers Works site.

Slurry bioreactor processing of water contaminated with suspended priority pollutants is a relatively new technology which has seen limited application where low molecular weight hydrocarbons with appreciable water solubilities are addressed.

Slurry bioreactor processing of soils contaminated with priority pollutants involving high molecular weight hydrocarbons with essentially no water solubility, i.e., PAHs, is a new and unproven technology. After extensive review and contacts with US-EPA and University researchers and 13 leading bioremediation firms, Kerr-McGee is not aware of any site where creosote or PAH contaminated soils are being remediated using slurry bioreactor processing.

The 15-day residence time proposed in FS Alternative 3A for slurry bioreactor processing only allows for 20% removal of the target carcinogenic PAH, chrysene. The FS's contention that a 15-day residence time is sufficient to provide for 95% removal of target carcinogenic PAHs is unsupported by the FS's own treatability study and is also unsupported by any peer reviewed study described in the available literature. The peer reviewed literature does, however, generally support the test data reported in the FS's treatability study. The chrysene degradation curve shown in Figure 1, and developed in the FS, Appendix K, shows how the proposed 15-day residence time is unrelated to the facts.

The peer reviewed literature does not support the extrapolation of the treatability study data to 99.9% degradation, or reduction to 0.5ppm, of the 5 & 6-ring carcinogenic PAHs as required by the PAH Treatability Variance (see Figure 1). Rather, the literature demonstrates that the biological degradation will cease at concentrations well in excess of those required by the PAH Treatability Variance. The Kerr-McGee Technology Division concurs with the information in the literature and believes that the PAH Treatability Variance clean up criteria cannot be achieved through the slurry bioreactor process for 5 & 6-ring carcinogenic PAHs.

However, for the purposes of this engineering evaluation, the Kerr-McGee Technology Division assumed that improvements in slurry bioreactor processing were available that would enable achievement of the clean up criteria. As shown by Figure 1, the FS's treatability study data demonstrate that a residence time of from 159 to 623 days in the bioreactor will be required to achieve the criteria. Such long residence times necessitate either a very large slurry bioreactor system to accomplish the clean up in 4 to 5 years, or a very long clean up time using several small bioreactors. Since the US-EPA selected an alternative which provided clean up within 3 to 4 years, Kerr-McGee's Technology Division elected to engineer the slurry bioreactor process to accomplish the clean up objectives within the shortest practical time frame (3 years for 90% to 95% degradation and 5 years for 99.9% or greater degradation).

COST ESTIMATES

TOTAL OPERATING COST: For the Soil Washing and Slurry Bioreactor Process (FS Alternative 3A) the Total Operating Cost is estimated to be $55,000,000 or $532 per cubic yard for 103,000 cubic yards. This estimated cost is 10-fold that estimated in the FS for Alternative 3A ($5,600,000).

In engineering terms the Total Operating Cost includes the total cost for the operation. Included items are Raw Materials and Chemicals, Utilities, Labor, Capital (installed equipment, taxes, maintenance and salvage), and Contingencies. This cost estimate (Chapter 3 of this report) is for Case 1, 159-day bioreactor residence time (90% removal), and is exclusive of any costs associated with digging and transporting the soil and sediments to the process area or disposing of the treated materials.

The engineered cost estimate (Chapter 3 of this report) for the 159-day retention time (90% removal) case 1 shows that the FS's cost estimate (Attachment 1) for the Alternative 3A process is grossly under estimated.

As an example of how costs were under estimated take the estimate for the soil washing process. Kerr-McGee Technology Division's soil washing process is essentially identical to that proposed in the FS; both processes are the same size and capacity. The only real differences are in Kerr-McGee's selection of the proper equipment to make the process run as described by the FS in Chapter 3 and Appendix H.

- o The FS estimates the cost of the installed equipment for the soil washing process to be $686,000. (From the FS, Attachment 1)
- o The Kerr-McGee Technology Division estimates the cost of the installed equipment for the soil washing process to be $11,500,000. (From Chapter 3 of this report.)

The FS under estimated the cost of installed equipment by >16-fold.

OTHER BIOREMEDIATION ALTERNATIVES

Other biological remediation alternatives are available which were inadequately considered in the FS. For example, studies suggest that engineered aerobic compost pile reactors appear to be capable of providing clean up levels for carcinogenic PAHs similar to that of slurry bioreactors but at much lower cost; this technology was not considered in the FS. In situ biological techniques may be applicable to portions of the site; in situ techniques generally provide the lowest cost processing but were only casually considered in the FS.

University based research (Utah State, Stanford and Rutgers) is just beginning to address hypotheses for greatly accelerating the rate of biological degradation of PAH compounds; especially the carcinogenic PAHs. While some of this research is encouraging, the researchers estimate that it will take 3 to 5 years to quantify the benefits and demonstrate the application through pilot tests. This research has not yet progressed to the extent where processes based upon its use could be considered for remedial action alternatives at NPL sites.

While the Kerr-McGee Technology Division is critical of the selection of slurry bioreactor processing, we are of the opinion that other biological remediation alternatives are available which may be suitable for the remediation of the Milwaukee Site.

CONCLUSIONS

It is Kerr-McGee Technology Division's opinion that:

- Based upon current US-EPA and CH2M Hill studies, soil washing cannot achieve the necessary clean up design criteria required by the PAH Treatability Variance.
- There is no evidence that soil washing technology will ever be able to achieve the clean up design criteria required by the PAH Treatability Variance.
- Soil washing is not an economically viable remedial action alternative for treatment of the Milwaukee Site soils.
- Because of the long processing times required, slurry bioreactor processing is not currently an economically viable remedial action alternative for use at the Site.
- The cost of slurry bioreactor processing is excessive relative to the benefits and to other and lower cost biological remediation options.
- Other biological remediation alternatives are available which may provide preferred solutions for the remediation of the Milwaukee Site.
- Other remediation alternatives, other than those considered in the FS, may also be suitable for the remediation of the Milwaukee Site.

Chrysene Concentration vs. Bioslurry Residence Time

Data From FS, Appendix K, Treatability Study

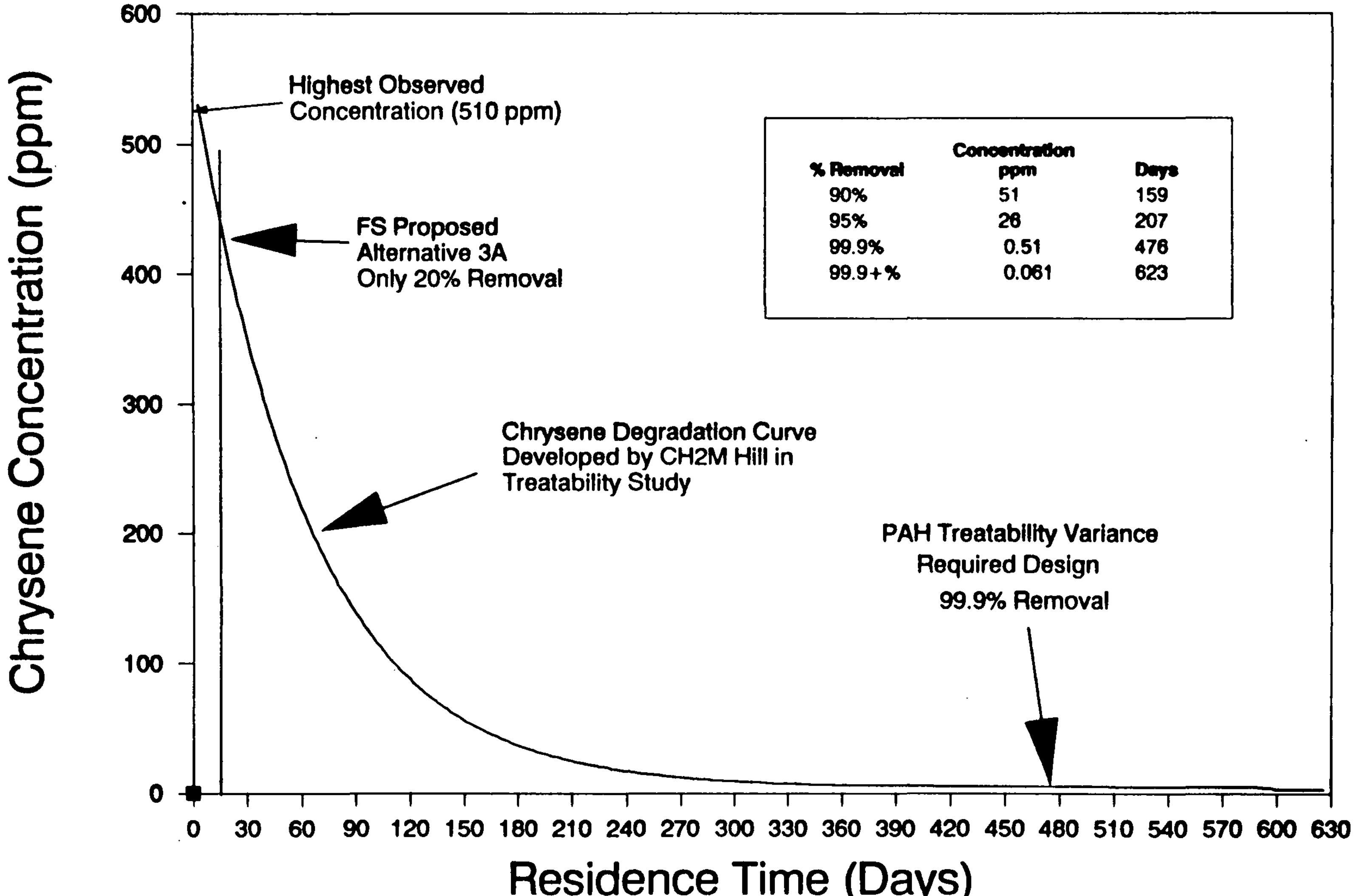


Figure 1

TR-90034

CHAPTER 2

TREATMENT OF VISIBLY CONTAMINATED SOIL AND SEDIMENTS

(THE PROCESS ENGINEERING DESIGN)

CHAPTER 2

TREATMENT OF VISIBLY CONTAMINATED SOIL AND SEDIMENTS

2.0 INTRODUCTION

This study presents the conceptual design of a hazardous waste treatment facility for treating creosote contaminated soil and sediments at the Moss-American site near Milwaukee, Wisconsin. The treatment would include soil washing and slurry bioreactor technology. The presentation of CH2M Hill (Feasibility Study) provides the design concepts for the process and must therefore bear the responsibility of practicability of the process. The concept development is at the bench and pilot plant level. This study assumes the clean up schedule of CH2M Hill of 3 years for soil washing with 115 days per year of operation. Due to the longer residence time of the bioreactor, processing continues during the winter months for 350 days per year as required. Pre-design should study extending the processing time from 3-4 years to 7 or to 10 years to improve the processing economics. The process effectiveness is unproven, and no guarantee of serviceability can be made. A pre-design study must determine the clean up criteria for the "end products" and how the PAH Treatability Variance affects the process design. Detailed design requires significant additional process development. This study does not include these costs. This study assumes that the process will work and that the basic design is fixed. This study develops a pre-feasibility flow sheet and presents an estimate of the fixed and operating costs. The flow sheets (1, 2, and 3) indicate the bounds of the process. Calculation of the mass flow combined with mining practice gives a preliminary method of sizing the equipment.

The contaminated soil and sediment treatment facilities include soil washing, bioreactors, day storage of feed (contaminated soil and sediments), and day storage of products (oversize, wood chips, washed coarse soil and biotreated material). The cost of the facility does not include process development, pilot-plant scale tests, and the development of the basic design package. The process boundaries start with the front-end loader feeding the process and end with a truck taking the material away. The estimate does not include either the front-end loader or the truck for transfer of material from the stockpile or to the disposal site. The study includes a loader for in-plant use. The study excludes capture of the soil and sediment, pumping and treating groundwater, and disposal of processed materials.

The process requires significant quantities of water. The process flow-sheet includes three types of water - fresh, ground, and waste. Recycle of wastewater will constitute the majority of the water usage. The process uses groundwater where possible. Since groundwater collection and treatment period of 10 years exceeds the soil and sediment treatment period, this study does not include groundwater collection, treatment and disposal facilities. The initial charge of water to the system will be from the groundwater collection system. The flow sheet includes a small groundwater storage tank. The process produces wastewater into a wastewater storage tank. Wastewater passes through an oil/water separator which collects nonaqueous phase liquids. If an appreciable amount of free organic collects, the operator will transport it off-site for disposal. The wastewater then passes through three activated carbon beds in series. Periodically the activated carbon supplier replaces carbon beds. Uncertainty of treatment quantities prevents inclusion of the cost of activated carbon in this study. An off-site regeneration facility reactivates the carbon. Transportation of this material to the regeneration facility would require the proper manifest documentation for hazardous wastes.

The design assumes that activated carbon treatment of wastewater yields a water suitable for discharge into the Little Menomonee River. Since the moisture content of the feed and product materials is unknown, the discharge quantity remains unknown. A storm drainage system collects spills and precipitation from the process area and directs this water to the wastewater system. Drawing 1 depicts the water and utility facilities.

The nature of the soil and sediment plays a significant part in process design and operation. Good process design requires several pre-design studies not included in this study. Design of the stockpiling area should collect and pump any leachate from the pile to the wastewater tank. The design does not include treatment of water of this type except as needed by the process. Because the water table sometimes rises above the 2- to 4-foot depth where much of contaminant mass in soil is located, some site dewatering may be necessary before or during excavation of contaminated soil. Pre-design investigations would determine whether the groundwater collection system would provide sufficient site dewatering for excavation purposes. Contaminant migration from sediment should be investigated in greater detail in the pre-design through hydro-geologic characterization and bench-scale tests. Migration will greatly influence the organic content of the feed material and the quantity.

Removal methods, dewatering, and storage play a significant part in the quality of the plant feed. Removal of contaminated soil at the Moss-American site would be by dry excavation. In case of dredging, sediments would already be in slurry form (probably between 10 to 30 percent solids). This slurry would be fed to the soil washing process to reject oversize material and provide solids content control. The operator will remove and stockpile visibly contaminated soil. Before stockpiling, soil would be screened to remove oversize objects. The operator will also remove and stockpile visibly contaminated sediment. CH2M Hill indicates that most of the contaminated soil lies above the seasonal high water table and would have a soil moisture content of less than 15 percent. Following the diversion of the river, the operator will drain the old channel and remove the visibly contaminated sediment by backhoe or loader. The operator will remove the contaminated sediment by either wet dredging or by dry excavation. The contaminated sediment would be loaded into lined trucks for hauling to the original property for treatment/storage. CH2M Hill believes that even with dry excavation, the sediment would probably be in the range of 20 to 40 percent solids.

The removal criterion would be visible evidence of creosote in the soil or sediment matrix. Where visual observation is inconclusive, the operator could use a quantitative criterion (1,000 mg/kg extractable organic). Based on field observations of samples, CH2M Hill estimates the volume of contaminated soil at 80,000 cubic yards and the contaminated sediment at 5,000 cubic yards. CH2M Hill classifies about half of the contaminated soil on-site as a coarser granular material. The contamination distributes between coarse and fine soils. If most of the contaminants adhere to the fine solids, soil washing could reduce the volume of soil requiring subsequent treatment. A pre-design study must confirm this. Because the soil would be slurried as part of the washing process, slurry biotreatment appears to be more applicable for the subsequent treatment than incineration or land treatment. The sediment at the Moss-American site consists of fines and contains a significant organic fraction. CH2M Hill estimates a 25 percent increase in volume (physical limitations). CH2M Hill indicates that soil washing will probably not be effective in removing contaminants from sediment or reducing the sediment volume requiring subsequent treatment. CH2M Hill estimates the volume of oversize material (based on very limited information) at 3,000 cubic yards. During the pre-design phase, a sampling survey must provide a more refined estimate of the volume and contaminant content of visibly contaminated soil and sediment. Verification of field methods should define the correlations between visual contamination and quantitative criteria.

2.1 SOIL WASHING

2.10 Introduction

The EPA (Environmental Protection Agency) reviewed cleaning excavated soils (EPA/600/S2-89/034 Jan. 1990). Washing excavated soil holds promise for removing contaminants chemically or physically attached to soil particles. Soil washing uses process equipment derived from the mining industry. The choice of soil washing method depends upon the type of contaminant and the type of soil. Soil washing consists of soil excavation, above-ground treatment, isolation and removal or destruction of the contaminant, and redeposit of the cleaned soil. The above-ground treatment separates contaminants from the soil particles by mobilizing the contaminants with extraction agents. Washing soil with water is one generic extractive treatment for cleaning excavated soils. Water with additives (such as surfactants) and alkaline pH is one extractant for cleaning nonvolatile hydrophilic and hydrophobic organic from soils. Additives increase the effectiveness and rate of removal of contaminants. Washing removes contaminants adhering to soil and puts them into the washing solution. A solid/liquid process separates a cleaned soil and a contaminated extractant. Further processing removes the contaminants from the extractant. Cleaned extractant recycles for further washing. Extraction of organic from excavated sandy/silty soil low in clay and humus content has been successfully demonstrated at several pilot plant test facilities. Pilot-scale tests washed sand or silt, but not clay or humus soils. The EPA review concludes that more applied pilot-scale testing must be conducted to support any statement on the environmental and economic practicability of soil washing. Washing soils which have a higher fraction of fines is less economical because the fraction requiring handling and treatment a second time is higher. A study of soil washing vendors in Europe indicates a practical upper limit for the fraction of fines in the soil to be treated of 20 to 30 percent (Nunno et al. 1989). CH2M Hill expects the feed to the Moss-American soil washing circuit to exceed this practical limit (greater than 50 percent fines). Pre-design studies must determine if soil washing is cost effective. Pre-design studies comparing the capital and operating cost of circuits with and without soil washing may indicate that the contaminated materials should be biologically treated directly without soil washing.

The effectiveness of a soil washing system depends on how tightly the contaminants adhere to the soil, how well the extractant works, how intense the mixing, and how long the extractant and soil mix. The contaminant concentration, the solubility of the organic contaminants in water, and the contaminant's chemical and physical characteristics and the characteristics of the adsorbing matrix, such as particle size (which affects interfacial tension), mineralogy and physical and chemical analysis determine washing effectiveness. Temperature affects many of these parameters. Thermal washing may improve performance. Pre-design studies should confirm the best temperature for soil washing. The pollution control industry does not possess general correlations for washing effectiveness. Surfactant, emulsifying agents, and alkaline agents are normally added to water to help de-adsorb compounds (Kuhn and Piontek 1988). To answer the question of "What surfactants are potentially useful and at what concentrations?", pre-design bench-scale testing must determine the most effective types and combinations of surfactant, alkaline agents, and polymers. For effective contaminant removal, the extractant must remove the contaminant from the soil particle. Polishing the soil particle removes insoluble or slightly soluble organic contaminants. Ball milling is one method of polishing soil particles. Intense mixing is another method of polishing soil particles. High pressure jets provide intense mixing environments. Soil washing mixes excavated soil vigorously in a tank with a washing solution. Soil washing systems currently available have been effective in removing contaminants from coarser sands, but they only perform a physical separation of contaminated fines from the "washable" coarser particles. Surfactants are largely ineffective in removing contaminants from organic and clay particles (more strongly adsorbed).

2.11 Soil Washing Flow Sheet

Drawing 1 depicts a conceptual soil washing circuit. The soil washing operation will run for three years beginning at the start of year one after completion of construction and ending at the end of year three. Weather will limit operation to 115 days per year (low ambient temperatures would limit the availability of unfrozen soils or sediments for feeding to the process). During the operating period the facility will operate 24 hours per day, seven days per week (continuously). The equipment will be cleaned, emptied and remain on stand-by during the remaining 250 days of the year. The quantity of material to treat and the time to treat indicates a design rate of approximately 400 tons per day. The operator would feed contaminated soil and sediment directly to the washing circuit. During operation, recycled wastewater and wastewater from the stockpiling area will provide most of the water to the circuit. Groundwater pumping will provide the initial water to fill the circuit. Both soil and sediment enter the soil washing circuit. Pretreatment separates the large material and tramp iron from the feed. The majority of the sediment and fine soil pass through the pretreatment and scrubbing sections unchanged. The first stage of washing separates the majority of the sediment and fines, and transfers them to a thickener. The thickener concentrates the sediment and fine soil before transfer to the bioreactor section. This assures minimum bioreactor volume. Bottom withdrawal combined with cyclones passes the coarse fraction through three stages of countercurrent washing and a final classifier. An overflow system passes the floating debris through three washing stages. A chain conveyor removes the floating debris from the last wash stage. Fifty percent of the feed material will be cleaned coarse sands and floating debris. The remaining material (soil fines and sediments) proceed for further processing in the slurry bioreactor system.

2.111 Pretreatment - Screening and Iron Removal (Magnetic)

Pretreatment removes oversize material and scrap from the soil and sediments. The first step in rejection of oversize material will occur outside the processing area at the excavation site. The excavation operator will set aside oversize material such as railroad ties, logs, tires, and pilings. Screening separates other large objects. Passing the feed material over a grizzly above the process feed bin removes plus four inch material. The size of the feed hopper determines the grizzly size. The size of the feeding equipment (loader) and the operating rate determines the size of the feed bin. The dry material flows through the bin onto a feeder belt. The feed belt determines the feed rate to the soil washing plant. Loader capacity and feed rate dictate the hopper size. Minimum sizing width of a feeder for minus four inch material would be approximately two feet. Sampling and passing the feed material across a weight belt provide the required process control parameters - feed rate and contaminant concentration to the circuit. An inclined conveyor elevates the feed to the rod mill. A magnet collects material such as scrap iron from the inclined belt. CH2M Hill considers the oversize material from excavation and +4 inch material as not derived from hazardous substance releases or disposal practices. A pad area with high pressure water is available in the process area to clean large objects of external contamination. This material along with the scrap iron would be hauled off-site for disposal in a special waste landfill.

2.112 Breaking and Scrubbing

Large clumps of clay, organic saturated material, and conglomerates require breaking up before screening. Particles covered with low-solubility creosote material need significant scrubbing action. CH2M Hill recommends either a rod mill or an attrition scrubber. The selected rod mill provides the necessary shredding, crushing, and scrubbing step for large material. Final scrubbing occurs in the washing circuit.

The feed drops off the inclined feed belt into the rod mill. The rod mill operates continuously in an open cycle mode. Based on feed rate and moisture content, the operator meters water into the rod mill to obtain the optimum solids content in the rod mill discharge (approximately 75 percent solids). A design rod mill retention time of 0.25 hours should provide the breaking and scrubbing action. The operator fine tunes the rod mill by varying the size distribution of the rods and the number of rods in the mill. The rod mill discharges a uniform slurry into a vibrating screen and then into the rod mill sump.

2.113 Screening (+3/4 inch and +1/4 inch)

The washing circuit treats material at minus 1/4 inch. The material leaving the rod mill contains material as large as four inch. CH2M Hill suggests that a vibrating screen or a trammel screen are acceptable screening devices. Two stages of screens remove the plus 1/4 inch material from the rod mill discharge. The first vibrating screen removes the non-slurryable material from the rod mill discharge just prior to the rod mill sump. This protects the sump and the pump. Selection of a size of 3/4 inch provides the minimum protection. The operator may select a smaller screen to prevent clogging the sump and pump. An agitator in the rod mill sump maintains a suspension of the slurry. The rod mill sump pump discharges the slurry onto a second stage screen. The elevation of the second stage screen allows direct discharge into the first stage of soil washing. The scrubbing action in the rod mill should remove the majority of the contaminants from the outside of the oversize material. Water sprays on both screens remove loose fine material from the oversize material. The oversize material at the rod mill sump fall into a concrete bin for pick up by a loader. The oversize material from the second stage screen also falls into a concrete bin for pick up by a loader.

2.114 Washing Stages (Separation of Contaminants from Coarse Soil)

The conceptual process indicates three-step co-current soil washing. The conceptual process description lacks details on retention time, mixing intensity, and additives. Pre-design testing must supply this information. Discussions with several environmental engineering firms claiming experience in soil washing suggest a total retention time of 3 hours (recommendations ranged from 1 to >12 hours). A typical 3-stage counter-current process attempts to handle the high fines content of the feed. This selection facilitates the removal of the fines from the coarse fraction and maximizes the efficiency of the soil washing process. Early removal of the majority of the fine fraction reduces the tank size in the second and third stages to half that of the first stage. Early rejection of the fines also concentrates the scrubbing action of the following stages on the coarse fraction. A final spiral classifier removes the remaining contaminants and fine material. Overflow from the first wash stage to the next wash stage transfers the floating material. This transfer allows washing of fine material from the floating material.

In a recent publication entitled "Chemically Enhanced In Situ Soil Washing" presented at a conference organized by the NWWA and the API, November 15-17, 1989, CH2M Hill relied upon Stepan Chemical Company's recommendations for the selection of extractant additives. For the purposes of this evaluation, Stepan Chemical Company recommended a specific biodegradable surfactant mixture at one to three percent of the dry-weight of soil to be treated. A surfactant mixture of two percent may be suitable. Stepan's mixture is 15% Agent 1100-149 (an alcohol oxalate ester), 15% SEE-340 (a sorbitan oxalate ester), and 70% Stepan 8X (sodium lauryl sulfate - 35% active).

The slurry from the rod mill drops from the second stage screen into the first stage wash tank. The agitator suspends the solids in the extractant. The mixing action of the first stage tank is moderate. Water addition brings the solids content to 35 percent. Recycle water from the thickener provides a significant share of the water. Recycle water from the second stage wash tank provides a similar quantity of water. The operator may use wastewater and groundwater. A nuclear density gauge provides a continuous solids content analysis. A single meter gauges the surfactant addition. Wet analysis and a meter provide surfactant control. The addition of soda ash solution controls the pH. Alternatively, lime usage may reduce reagent costs. Instrumentation continuously monitors the pH. This prevents the mortification of the bacterial life. Design allows the addition of the majority of the chemical additives in the first wash tank. The residence time within the first stage wash tank is one hour. Higher percent solids or lower feed rates allow longer residence time for special treatment.

A pump continuously removes the slurry from the bottom of the first stage wash tank. Cyclones separate the slurry into a fine fraction and a coarse fraction. The separation removes all of the coarse fraction from the fine fraction while leaving some fines in the coarse fraction. A pipe directs the fine fraction to the thickener. The thickener removes the excess water and returns the water to the first stage wash tank. The bioreactor feed pump transfers the thickened fines to the bioreactor. Continuous monitoring assures an acceptable pH and solids content. Sampling provides a measure of the organic content. Metering determines the flow. This information characterizes the bioreactor feed. A pipe directs the coarse fraction with some fines to the second stage wash tank.

Advanced water from the third wash tank mixes with the coarse fraction. The operator also injects additives and pH control chemicals. The residence time of the second wash tank is one hour. The fines solid content is significantly less than the first wash tank. Mixing and chemicals free additional fine material from the coarse fraction. A pump continuously removes the slurry from the bottom of the second stage wash tank. Cyclones separate the slurry into a fine fraction and a coarse fraction. The separation maximizes the removal of the fine fraction from the coarse fraction while leaving some coarse fraction in the fines. A pipe directs the fine fraction to the first stage wash tank. Continuous monitoring assures an acceptable pH and solids content. Sampling provides a measure of the organic content. Metering determines the flow.

A pipe directs the coarse fraction with some fines to the third stage wash tank. Advanced water from the spiral classifier mixes with the coarse fraction. The operator injects additives and pH control chemicals. The residence time of the third wash tank is one hour. The fines solid content is minimal. Mixing and chemicals free additional fine material from the coarse fraction. A pump continuously removes the slurry from the bottom of the third stage wash tank. Cyclones separate the slurry into a fine fraction and a coarse fraction. The separation maximizes the removal of the fine fraction from the coarse fraction while leaving some coarse fraction in the fines. A pipe directs the fine fraction to the second stage wash tank. Continuous monitoring assures an acceptable pH and solids content. Sampling provides a measure of the organic content. Metering determines the flow.

A pipe directs the coarse fraction with some fines to the final separation - a spiral classifier. A water wash provides final removal of extractant and final fines. A pump transfers the overflow from the spiral classifier to the third stage wash tank. A conveyor transfers the separated coarse fraction to a concrete bin. A loader removes the washed soil from the bin.

2.12 Products

The products from the soil washing circuit include three oversize materials (plus four inch, minus four inch - plus 3/4 inch and minus 3/4 inch - plus 1/4 inch), floating debris, coarse washed material, fine contaminated material, and wastewater. The design includes a loader for loading the products. Oversize material along with the scrap iron would be hauled off-site for disposal in a special waste landfill. CH2M Hill estimates the volume of oversize material (based on very limited information) at 3,000 cubic yards. No estimate of the volume of floating debris exists. A pre-design study must establish an order of magnitude estimate of this type of material. Wood chips or other debris that floats to the surface of the soil washing scrubbers would be managed with the oversize material. The weight of coarse washed material may be one half the weight of the soil processed. This material would be hauled off-site for disposal in a special waste landfill. Pre-design tests must determine the bulk density of the floating debris and the washed coarse material. The washed coarse material would be placed back on-site for containment if concentrations of contaminants are acceptable.

Soil washing produces a suspension of fine particles in the effluent for subsequent biological treatment in a slurry bioreactor. The thickened sediment and soil fines would be pumped to the slurry bioreactor for treatment.

Published information, and the US-EPA's own evaluation, indicates that the soil washing performance will not achieve the level of clean up required by the PAH Treatability Variance for on site disposal. (See EPA publication EPA/600/S2-89/034 Jan. 1990, titled "Cleaning Excavated Soil Using Extraction Agents: A State-of-the-Art Review".)

2.2 BIOREACTOR

2.21 Introduction

Drawing 2 depicts a conceptual treatment process for the slurry bioreactors. The bioreactor operation will run for three years plus the required residence time beginning at the start of year one after completion of construction and ending at the end of year three plus the required retention time. The bioreactors will be constructed to operate year round (350 days per year). The bioreactors operate on a batch basis with the filter operating on a semi-continuous basis. Batch reactor design minimizes the reactor volume. The bioreactors require little care during operation. The facility will operate 24 hours per day, seven days per week (continuously). CH2M Hill considers biological treatment of sediments contaminated with PAHs in a slurry bioreactor an innovative technology, with proven basic components. Land treatment of petroleum hydrocarbons illustrates biodegradation of PAHs. Extensive use of slurry reactors in both mining and chemical processing demonstrates their value. The use of a slurry bioreactor to treat sediments is similar to the use of aerobic or anaerobic digesters to treat municipal and industrial wastewaters. Mining process applications of slurry reactors have established appropriate procedures for the materials feeding, slurry mixing, and solids dewatering components required in a slurry bioreactor application. Information on these applications is not, however, generally available in the technical literature. Available literature information does, however, suggest that biodegradation of carcinogenic PAHs cannot achieve the 99.9% destruction, or reduction to 0.5ppm, design required by the PAH Treatability Variance.

The surfactant additives will be the primary source of food for the organisms in the bioreactor. The concentration of the surfactant determines the nutrients and the aeration rate. Consumption of the surfactant and additives may enhance the consumption of the PAHs. Pre-design testing must determine if co-metabolites enhance PAHs biological degradation rates at low concentrations. Consumption of the surfactant should be rapid relative to the PAH materials. Low aqueous solubility of 4 to 6-ring PAHs may slow biological activity to ineffectual levels as their constituent concentrations drop below ten ppm. Pre-design tests must determine this rate. For sediments, another factor affecting degradation rates could be the organic content of the sediments. Higher organic fractions could promote co-metabolism and thus enhance biodegradation. On the other hand, the organic could decrease the availability of the compounds because of the high degree of adsorption. Again, pre-design, site-specific testing determines the effect of these constituents.

The quantity of nutrients provided to the bacteria are based upon the FS's (Feasibility Study) treatability study. This study uses a ratio of 100:5:1 for BOD (biological oxygen demand) to ammonia nitrogen to phosphorous. Urea provides the majority of the ammonium nitrogen requirement. Diammonium phosphate provides some of the ammonium nitrogen requirement and the phosphate requirement. The BOD was based upon the sum of the total-PAH concentration plus the surfactant carryover from the soil washing operation. Surface aerators supply the supplemental oxygen for the high initial rate of biological metabolism from the high initial concentration of biodegradable organic. Subsequently, as the BOD decreases, the surface aerators would be placed on standby. The primary aeration system at the bottom of the reactor supplies the oxygen during the remainder of the biodegradation period.

2.211 Decontamination Rate

The contaminants of concern discussed in Chapter 2 of the FS are the carcinogenic PAHs. Since the contaminants have existed in the sediment and soil for many years, it is likely that microbial populations have already been acclimated to those contaminants. A slurry bioreactor would be used to optimize the environmental conditions important to their growth. The microbial community would be enhanced by providing sufficient oxygen and such nutrients as nitrogen and phosphorus and by controlling temperature. By providing close contact between the microbes and the contaminants, treatment of the sediment and soil in a bioreactor results in a faster rate of biodegradation than occurs under natural conditions.

Because contaminated sediment and soil are considered K001 wastes, their treatment must comply with the LDRs. At this time, the U.S. EPA is developing treatment standards for debris contaminated with K001 wastes. It is assumed for now that the treatment standard will be derived from a Treatability Variance as outlined in 40 CFR 268.44 and OSWER Directive 9347.3-06FS, and that this alternative will comply with the LDRs through the variance.

It should be noted that, while high percentage removals of non-carcinogenic PAHs (i.e., greater than 95 percent) have been demonstrated for a variety of biological treatment systems, similar percentage reductions in carcinogenic PAHs typically require significantly greater time. Under this alternative, wastes would be treated until concentrations of constituents restricted in the LDRs are below the limits set by the Treatability Variance, and concentrations of carcinogenic PAHs are below health-based targets (1×10^{-4} excess lifetime cancer risk) for soil (see Chapter 4 of the FS for specific treatment levels).

An important feature in the design of the bioreactor is the length of time required to aerate the slurry to achieve the desired level of degradation. The concentration of contaminants in the feed, the desired effluent concentrations, and the rate of degradation determine this hydraulic retention time. Very limited information is available from studies on rates of PAH degradation observed in bioreactors and, therefore, bench-and pilot-scale studies would be required during the preliminary design. Bench-scale testing of a system similar to slurry biotreatment was performed as part of the FS. Results of these tests indicate that treatment times to reduce concentrations of carcinogenic PAHs by 90 percent would be approximately 13 to 150 days (see Appendix K of the FS). It is likely that this range of treatment times is conservative for a full-scale system since the bench test samples were not continuously stirred or aerated. Based on limited information on pilot-scale tests of slurry biotreatment of creosote-contaminated soil, the FS assumes a 15-day retention time would achieve the desired cleanup goal, which is assumed to be a 95 percent reduction. For soil having average concentration of carcinogenic PAHs of 300 mg/kg, a 95 percent reduction would still leave residues with risk levels slightly greater than 1×10^{-4} (excess lifetime cancer risk as calculated by CH2M Hill in the Site Hazard Assessment) and well in excess of the Treatability Variance requirements. If this option is selected as part of the remedial action, pilot tests should be performed to more accurately determine achievable levels of treatment. For residence times more than 115 days per year and less than one year, design requires the bioreactor volume of one third of the contaminated material. The residence time determines the design of the bioreactor. For residence times in excess of one year but less than two years, the bioreactors must hold two thirds of the contaminated material. The literature indicates that aliphatic & paraffinic hydrocarbons and PAHs biologically degrade slowly and often require 2-3 years to achieve essentially maximum practical biological degradation using best current soil farming practice.

Available information based upon current laboratory, pilot or field practices and by the reaction kinetics identified in the FS's treatability study does not support the 15 day reactor retention time proposed in the FS. (It is noteworthy that the kinetics for PAH's biodegradation presented in the FS's treatability study are very similar to those reported by other investigators from their biodegradation studies of other creosote and coal gassification sites.) While some new innovative technologies may be developed in the future, this study uses the observed kinetics of creosote biodegradation (the kinetics reported in the FS's treatability study). The FS's analyses of PAH compositions and the FS treatability study's reaction-rates of carcinogenic PAH compounds indicate that the carcinogenic PAH's chrysene is the target compound which will drive the performance of the slurry bioreactor system. The higher concentration and slower degradation of chrysene, relative to benzo(a)pyrene, will determine whether the "cleansed" soil or sediments meet the clean up criteria of the proposed remedial action. For this reason Kerr-McGee used the starting and proposed final concentration of chrysene to select the retention times required for the slurry bioreactor to achieve the designed clean up criteria. Four different clean up criteria provide four different design and cost basis for the slurry bioreactor system. These 4 clean up criteria are:

Case 1: 90% reduction in each carcinogenic PAH (FS Alternative 3A design criteria).

Case 2: 95% reduction in each carcinogenic PAH (PAH Treatability Variance required for on-site reduction based upon chrysene being ≥ 400ppm).

Case 3: 99.9% reduction in each carcinogenic PAH (PAH Treatability Variance required design criteria based upon chrysene being ≥ 400ppm).

Case 4: 0.061mg/kg final maximum concentration in each carcinogenic PAH (FS Table 2-1, starting with the Highest Observed Concentration, 510 ppm chrysene, to conform with the Site Hazard Assessment).

2.212 Reactor Selection

As with most bioremediation applications, the feasibility of using slurry bioreactors is a site-specific consideration. Pre-design testing remains in the key areas of solids handling and the ability to meet clean up criteria.

The filters operate when the soil washing circuit operates (115 days per year). The quantity of material to filter and the time to treat indicates a design rate of approximately 400 tons per day. The design of the filter system requires the production of a cake with solids content greater than 50 percent. Pre-design tests must determine the sizing parameters for the filter. The operator would haul dry filter cake to disposal. Pre-design tests must determine the bulk density of the cake. The bioreactor cleans the extraction agent (water) for recycle.

Aerobic biological degradation of hydrocarbons "mineralizes" the hydrocarbon - converts the hydrocarbons completely to carbon dioxide and water. Assuming the hydrocarbons are largely saturated in hydrogen, approximately three pounds of oxygen oxidizes one pound of hydrocarbon (one CH_2 at a weight of 14 units requires 1-1/2 O_2 at a weight of 48 units for a CH_2:O weight ratio of approximately 1:3). Since air is approximately 20 percent oxygen, and assuming a microbial oxygen utilization efficiency of ten percent, approximately 150 pounds of air passes through the slurry for each pound of hydrocarbon oxidized.

The nature of the material to be slurried influences the effectiveness and implementability of the bioreactor. The degree to which the contaminated materials remain in suspension greatly affects the performance and energy costs of the system. Generally the sediments at the Moss-American site are silty clay and organic material. The fine soil and sediment should remain in suspension with little agitation. Much of the soil may not be suitable for a slurry bioreactor. A series of pre-design settleability tests must be performed prior to design of the system.

Vigorous aeration of soil in reactors enhances the potential of volatilization of hydrocarbons. Based on the RI results, this does not appear to be a problem (PAHs and other principal contaminants have low volatility). Pre-design pilot-scale tests must confirm control of volatilized contaminants. If volatilization does occur, the air could be pre-treated with granular activated carbon before it is discharged to the atmosphere (this is not included in this study).

2.22 Bioreactor Flow Sheet

Slurry bioreactors treat contaminated soil by mixing the soil slurry with microorganisms in an aerated tank. The reactor (a large tank with mixers and aeration equipment) provides a favorable environment for microbial growth and maintains contact between the contaminants and microorganisms performing the degradation. As with other biotreatment processes, temperature, pH, oxygen, nutrients, and contact between contaminants and microorganisms are critical factors controlling the rate of degradation. Because these parameters can be more easily controlled in an enclosed reactor than in a treatment bed, slurry bioreactors should achieve faster rates of degradation. Fine soil and sediment remain in the bioreactor until biological activity achieves the desired contaminant level.

Case 1 & 2: The slurry bioreactor system will run for three years beginning with treatment operation near the beginning of year one and ending during treatment operation early in the fourth year. One batch will be processed per treatment operation year. A total of three batches process the soil fines and sediments.

Case 3 & 4: The slurry bioreactor system will run for four years beginning with treatment operation year near the beginning of year one and ending during treatment operation year four (case 3) or treatment operation year five (case 4). One batch will be processed per two treatment operation years. Processing requires two batch cycles.

2.221 Operation of Bioreactor

The soil fines and sediments proceed from the thickener to the batch bioreactor. The thickener concentrates the sediment and fine soil before transfer to the bioreactor section. This assures minimum bioreactor volume. The additives are biodegradable. The high concentrations of biodegradable additives significantly increase the organic level of the soil fines and sediment and form the major organic food for the microorganisms. Aeration, mechanical agitation, and slurry recycle mix the slurry. Surface mounted aerators satisfy early aeration requirements. The surface mounted aerators use draft tubes to assist in stirring the bioreactor. Sewage treatment guides the selection of the aerator horsepower requirements based upon mixing. A rake mechanism with aeration ports stirs the heavy material on the bottom of the reactor. The rake also moves the heavy material to a circulation pump at the center of the bioreactor. The pump circulates the heavier sludge to the top of the reactor. This prevents dead spots within the reactor. Mixing creates a homogeneous mixture with respect to contaminants, biomass, and oxygen. This promotes contact between microorganisms and organic contaminants. Nutrients can be added to enhance degradation. CH2M Hill expects the soil to contain adequate microflora population. Proper supply and control of moisture, oxygen, pH and nutrients will sustain this population through the washing circuit into the bioreactor.

The aerators are critical to the bioreactor. The surface aerators will operate during summer conditions. Heat loss will prohibit operation of the surface aerators during the winter months. The rake aerators will supply the oxygen requirements during the winter months. Controlled air flow will limit heat loss and reduce operating costs. Humidification of the air prevents plugging of the aeration ports and evaporation of water from the bioreactor.

Verification of decontamination of the fine soil and sediment allows the transfer of the slurry to the filter presses.

2.222 Filtration

After treatment in the bioreactor, filtering the slurry creates a manageable solid and a wastewater. Dewatered-treated soil and sediment having contaminant concentrations below the limits set by the treatability variance would be placed on-site, covered with clean soil, and planted with vegetation. Wastewater generated from the dewatering step would either be recycled for slurrying or treated on-site prior to discharge to the river or POTW. This study assumes that an activated carbon treatment will yield water of sufficient quality for discharge. A pre-design study must confirm this.

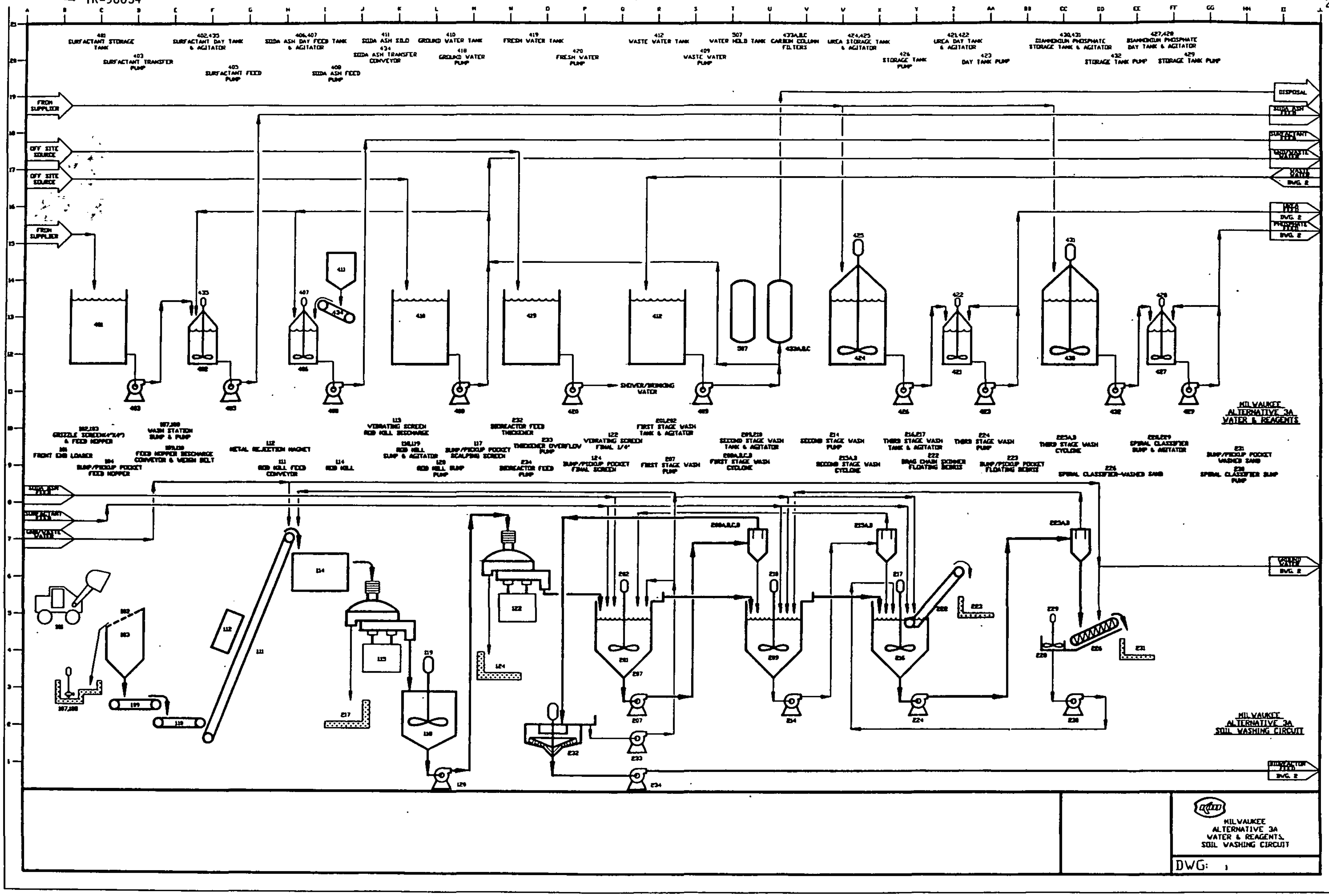
The bioreactor circulating pump will transfer the slurry to the filter booster pump. This pump provides the pressure to operate the filter. The filter cake falls from the filter onto a conveyor. An inclined conveyor carries the dry cake to the holding bin or truck. A tank capable of holding the contents of one bioreactor provides storage for filtrate during the bioreactor empty/fill cycle. In event of a rake problem, this tank provides storage during repair of the bioreactor.

2.23 DISPOSAL

This processing section does not cover disposal of the residues.

2.24 DURATION OF OPERATION

Operation of Alternative 3A, depending upon the residence time employed (Case 1, 2, 3 & 4), would take 3 to 6 years (excluding pre-design, design, construction, and demolition).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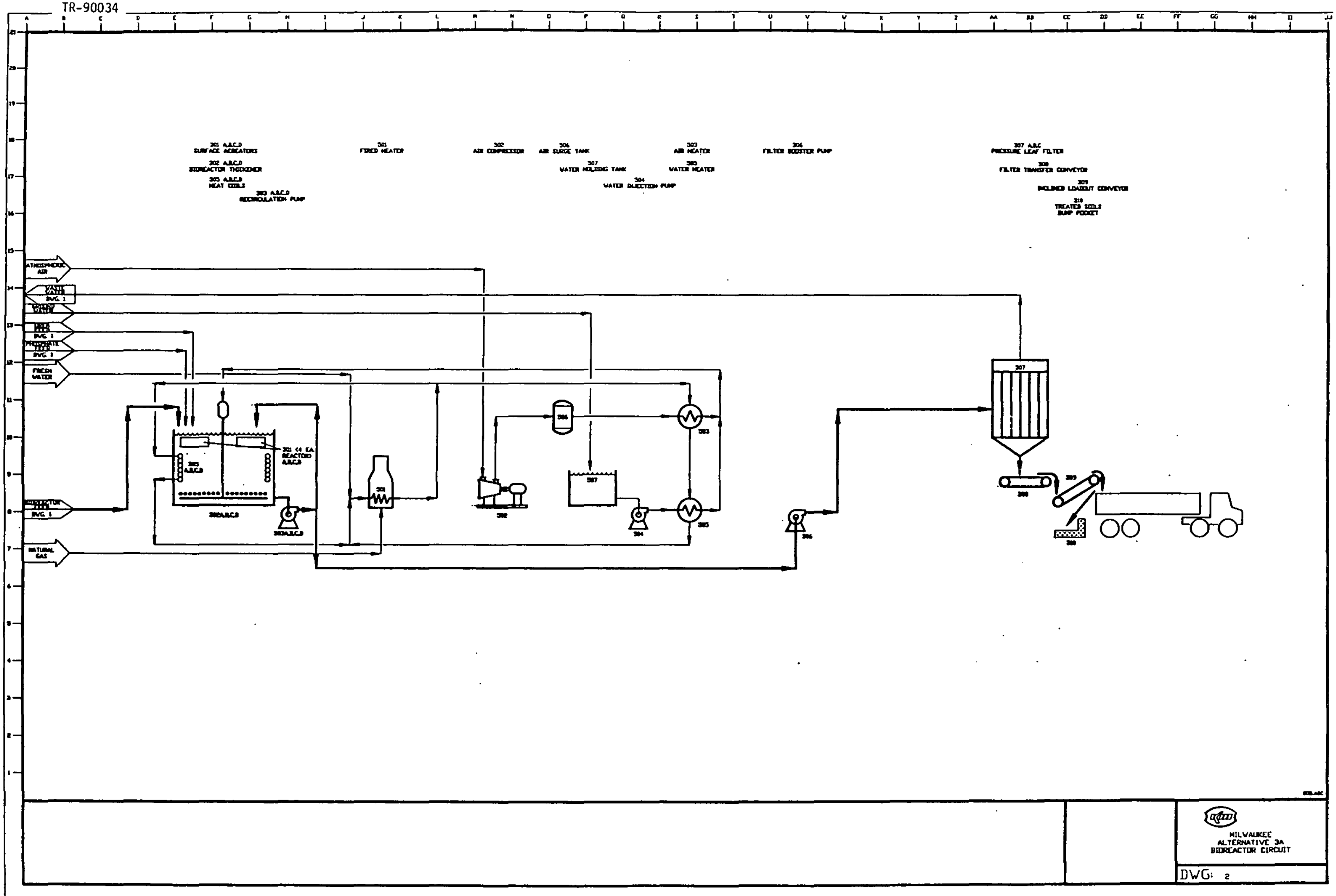
SOIL WASHING CIRCUIT
DWG: 1



SURFACE AERATORS
301
FIRED HEATER
302
AIR COMPRESSOR
AIR SURGE TANK
307
WATER HOLDING TANK
304
AIR HEATER
WATER HEATER
FILTER BOOSTER PUMP
307 A,B,C
PRESSURE LEAF FILTER
FILTER TRANSFER CONVEYOR
309
TREATED SOILS
ATMOSPHERIC AIR
FRESH WATER
NATURAL GAS
MILWAUKEE
ALTERNATIVE 3A
BIOREACTOR CIRCUIT
DWG: 2

CONCEPTUAL PROCESS DESIGN DATA

This section is intended to provide the reader hardcopy documentation of the Lotus 1-2-3 spreadsheet used for the design of the FS-Alternative 3A. Cambridge Spreadsheet Analyst, version 2.50, was used to print the cell contents report.

Moss-American Bioslurry Treatment Operation

Summary:

		Reference
Contaminated Soil (Cubic Yards)	80000	3-12
Contaminated Sediment (Cubic Yards)	5200	3-12
Operating Time (years)	3	3-14
Operating Time (days/yr)	115	Weather limiting
Residence Time-3 Wash Tank each (hr)	1	Assumed
Wash Solids Concentration (%)	35	Appendix I-5
Solids Content to BioReactor (%)	35	Appendix I-5
Case		
1 days	159	Limited by Chrysene
2 days	207	Limited by Chrysene
3 days	476	Limited by Chrysene
4 days	623	Limited by Chrysene
Organic Loading (ppm Carcinogenic)	313	Table 2-2, weighted avg.
Total/Carcinogenic Ratio	8.628507	Based on four samples
Estimated Total Organic (ppm)	2700.722	
First Order Reaction Constant (mg/(Kg-day-mg)	0.1	Appendix K-4
Outside Ambient Mininum (F)	-10	Assumed
BioReactor Temperature (F)	104	Assumed

Feed Material:

Item		Reference
Contaminated Soil (Cubic Yards)	80000	3-12
Additional Capture Factor (percent)	25	See F10
Uncontaminated Soil (Cubic Yards)	20000	
Contaminated Sediment (Cubic Yards)	5200	3-12
Additional Capture Factor (percent)	25	3-13
Uncontaminated Sediment (Cubic Yards)	1300	3-13
Oversize Material (Cubic Yards) (to special waste landfill)	3000	3-12
Total Plant Feed (Cubic Yards)	103500	
Soil Sand/fine Split (% > 20 mesh)	50	3-13
Sediment Sand/fine Split (% > 20 mesh)	0	3-12
Soil Density dry (tons/cubic Yard)	1.3	Standard
Sediment Den. dry (tons/cubic yard)	1.3	Standard
Soil to Process (tons)	126100	

Sand to Process - Soil (tons)	63050	
Fines to Process - Soil (tons)	63050	
Sediment to Process (tons)	8450	
Sand to Process - Sediment (tons)	0	
Fines to Process - Sediment (tons)	8450	
Fines to Process (tons)	71500	
Sand to Process (tons)	63050	

Process Flows

Solids to Rod Mill (tons/day)	390	
Solids Density Rod Mill Discharge (%)	75	Assumed
Specific Gravity of Rod Mill Discharge	1.735849	
Water Feed to Mill including recycle(GPM)	21.63585	
Rod Mill Residence Time (Hours)	0.25	Assumed
Specific Gravity of Solids	2.3	Assumed
Density of Slurry (lb/ft^3)	108.3169	
Slurry Volume in Rod Mill (Ft^3)	100.0150	
Void Volume in Rod Mill (%)	21.5	Similar Diameter Rods
Rod Volume (FT^3)	465.1864	
Rod Loading (% of Mill Volume)	45	Assumed
Rod Mill Volume (Ft^3)	1033.747	
Rod Mill Length (feet)	18	
Rod Mill Diameter (Feet)	10	
Rod Mill Power (hp)	936	
Sump Flow Rate (gpm)	49.68083	
Sump Residence Time (hours)	0.5	Assumed
Sump Active Volume (ft^3)	200.0301	
Sump Loading (% of Full)	60	
Sump Dimension (feet)	7	
Screen Area Factor 1/4 inch (Tons/(ft^2-hr)	2	CIM 25
Screen Area (Ft^2)	8.125	
Screen Length (ft)	9	
Screen Width (ft)	3	

Washing Circuit

Rod Mill Discharge - solids (Tons/day)	390	
Rod Mill Discharge - Water (GPM)	130	
Surfactant Requirements (lb/ton)	40	Stepan
Surfactant Concentration (%)	35	Stepan
Surfactant Specific Gravity	1	
Surfactant Feed - Solution (tons/day)	22.28571	
Surfactant Day Tank Active Volume (Gallons)	5340.965	
Water in Surfactant (Tons/day)	14.48571	
Soda Ash Requirements (lb/ton)	16	Assumed
Soda Ash Concentration (%)	20	
Soda Ash Specific Gravity	1.21	
Soda Ash Feed - Solution (Tons/day)	15.6	
Soda Ash Day Tank Active Volume (Gallons)	3089.814	
Water in Soda Ash (tons/day)	12.48	

Wash Sand - Solids (tons/day)	182.7536
Sands Water Content (%)	15
Wash Sand - Water Content (tons/day)	32.25063
Fines to BioReactor (tons/day)	207.2463

______Begin Estimate Wash Circuit Flowrates_________

Solids Content of Wash Stages (%)	35
Water Needed for First Stage (tons/day)	724.2857
Water to Wash Circuit (tons/day)	599.5706
Wash Water to Spiral Classifier (tons/day)	339.3995
Recycle Water to First Stage (Tons/day)	260.1710

Spiral Classifier

Third Wash Stage Spigot Solid (%)	70
Water in Third Wash Spigot (tons/day)	78.32298
Water to Spiral Classifier (tons/day)	339.3995
Sands Water Content (tons/day)	32.25063
Water Overflow to Third Wash (tons/day)	385.4719
Fines in Overflow to Third Wash (tons/day)	0.503663
Specific Gravity	1.000738
Transfer Pump Flow (GPM)	64.19041

Third Stage Wash

Second Wash Stage Spigot Solid (%)	70
Water in Second Wash Spigot (tons/day)	78.32298
Water from Sprial Classifier (tons/day)	385.4719
Sands Water Content to Spiral(tons/day)	78.32298
Water Overflow to Second Wash (tons/day)	385.4719
Fines in Overflow to Second Wash (tons/day)	3.342251
Fines in Spigot to Spiral (tons./day)	0.576764
Specific Gravity	1.193612
Transfer Pump Flow (GPM)	90.69700

Second Stage Wash

First Wash Stage Spigot Solid (%)	70
Water in First Wash Spigot (tons/day)	78.32298
Water from Third Wash (tons/day)	385.4719
Sands Water Content to Third Wash (tons/day)	78.32298
Water Overflow to First Wash (tons/day)	385.4719
Fines in Overflow to First Wash (tons/day)	20.15114
Fines in Spigot to Third Wash (tons./day)	3.415352
Specific Gravity	1.210688
Transfer Pump Flow (GPM)	92.11870

First Stage Wash

Rod Mill Discharge Solids (%)	75
Water in Rod Mill Discharge (tons/day)	130
Water from Second Wash (tons/day)	385.4719
Sands Water Content to Second Wash (tons/day)	78.32298
Water in Surfactant (Tons/day)	14.48571
Water in Soda Ash (tons/day)	12.48
Surfactant (ton/day)	7.8
Soda Ash (ton/day)	3.12
Recycle Water to First Stage (Tons/day)	260.1710
Water from Cyclone to Thickener (tons/day)	724.2857
Fines to Thickener (tons/day)	207.2463
Fines in First Wash Cyclone Overflow (%)	20.52238
Specific Gravity	1.233728
Transfer Pump Flow (GPM)	165.0741

Estimate of Fines to Following Stages

Fines in First Wash Spigot (tons/day)	20.22424
Fines in Second Wash Overflow (%)	4.178397
Fines in Second Wash Spigot (tons/day)	3.415352
Fines in Third Wash Spigot (%)	0.731009
Fines in Third Wash Spigot (tons/day)	0.576764
Washing Efficiency -Spiral Classifier (%)	90
Fines in Spiral Classifier Sand (tons/day)	0.073100
Est. Overall Wash Efficiency (%)	99.96472

_______End Estimate Wash Circuit Flowrates__________

Thickener

Fines to Thickener (tons/day)	207.2463	
Water from Cyclone to Thickener (tons/day)	724.2857	
Fines in Thickener Feed (%)	22.24790	
Fines in Thickener Overflow (%)	0	
Fines in Thickener Underflow (%)	35	
Overflow (tons/day)	339.3995	
Specific Gravity Overflow	1	
Overflow Transfer Pump Flow (gpm)	56.48616	
Recycle Water to First Stage (Tons/day)	260.1710	
Recycle Water to Rod Mill (tons/day)	79.22853	
Underflow (tons/day)	592.1325	
Specific Gravity Underflow	1.246612	
Underflow Transfer Pump Flow (gpm)	79.05297	
Thickener Area Factor (ft^2/(ton/day))	2	CIM 25
Thickener Diameter (ft)	23	

BioReactor

Case 1

BioReactor Residence Time (days)	159

Fines to Thickener (tons/day)	207.2463	
Underflow (tons/day)	592.1325	
Fines in Thickener Underflow (%)	35	
Specific Gravity Underflow	1.246612	
Total BioReactor Volume (ft^3)	1750776.	One Soil Wash season
Number of BioReactors	4	
Depth of Reactor (Feet)	20	
Effective Volume (%)	85	
Reactor Diameter (feet)	166.9688	
Reactor Area (ft^2)	21884.70	
Reactor Settling Area Factor (ft^2/(ton/day))	2	CIM 25
Solids Content (%)	35	
Specific Gravity	1.246612	
Underflow Transfer Pump Flow (gpm)	4173.899	
Heat Loss (BTU/hr)	37110457	

Case 2

BioReactor Residence Time (days)	207	
Fines to Thickener (tons/day)	207.2463	
Underflow (tons/day)	592.1325	
Fines in Thickener Underflow (%)	35	
Specific Gravity Underflow	1.246612	
Total BioReactor Volume (ft^3)	1750776.	One Soil Wash Season
Number of BioReactors	4	
Depth of Reactor (Feet)	20	
Effective Volume (%)	85	
Reactor Diameter (feet)	166.9688	
Reactor Area (ft^2)	21884.70	
Reactor Settling Area Factor (ft^2/(ton/day))	2	CIM 25
Solids Content (%)	35	
Specific Gravity	1.246612	
Underflow Transfer Pump Flow (gpm)	4173.899	
Heat Loss (BTU/hr)	37110457	

Case 3

BioReactor Residence Time (days)	476	
Fines to Thickener (tons/day)	207.2463	
Underflow (tons/day)	592.1325	
Fines in Thickener Underflow (%)	35	
Specific Gravity Underflow	1.246612	
Total BioReactor Volume (ft^3)	2626164.	1.5 Soil Wash seasons
Number of BioReactors	4	
Depth of Reactor (Feet)	20	
Effective Volume (%)	85	
Reactor Diameter (feet)	204.4942	
Reactor Area (ft^2)	32827.05	
Reactor Settling Area Factor (ft^2/(ton/day))	2	CIM 25
Solids Content (%)	35	
Specific Gravity	1.246612	
Underflow Transfer Pump Flow (gpm)	6260.848	

Heat Loss (BTU/hr)	53691506	

Case 4

BioReactor Residence Time (days)	623	
Fines to Thickener (tons/day)	207.2463	
Underflow (tons/day)	592.1325	
Fines in Thickener Underflow (%)	35	
Specific Gravity Underflow	1.246612	
Total BioReactor Volume (ft^3)	2626164.	1.5 Soil Wash seasons
Number of BioReactors	4	
Depth of Reactor (Feet)	20	
Effective Volume (%)	85	
Reactor Diameter (feet)	204.4942	
Reactor Area (ft^2)	32827.05	
Reactor Settling Area Factor (ft^2/(ton/day))	2	CIM 25
Solids Content (%)	35	
Specific Gravity	1.246612	
Underflow Transfer Pump Flow (gpm)	6260.848	
Heat Loss (BTU/hr)	53691506	

Nutrient Information

Oxygen

Cresote Organic Loading (tons/day)	1.053281	
Surfactant Organic Loading (tons/day)	7.8	
Total Organic Loading (tons/day)	8.853281	
Total Organic Loading (ppm)	42718.63	
Reaction Constant (mg/(kg-day-mg)	0.1	Appendix K-4
Initial Reaction Rate (mg/(kg-minute))	2.966571	
Initial Reaction Rate (lb/minute)	1.229622	
Oxygen Consumption Ratio (lb O2/Lb Organic)	3	Reaction Stoichiometry
Oxygen Consumption (lb/minute)	3.688867	
Oxygen Content of Air (mole %)	21	
Theoretical Air Requirement (SCFM)	369.8626	
Air Efficiency (%)	10	
Actual Air Requirement (SCFM)	3698.626	

Nitrogen

NH3-N Requirement (lb-N/lb-Organic)	0.05	Appendix K-6
NH3-N Requirement (tons/day)	0.442664	
NH3-N Requirement less PO4 Credit (tons/day)	0.423894	
Ammonia - Nitrogen Concentration (%) (Assume Ammonium Nitrate)	17.5	
Ammonium Nitrate Consumption (tons/day)	2.422253	
Solution Storage Tank Conc (% AN)	30	
Specific Gravity of Ammonium Nitrate Solution	1.1252	
Active Volume (%)	65	
Nitrogen - Day Tank Volume	2645.748	

Nitrogen Solution Delivery Tank	18000	
Phosphate		
Phosphate Requirement (lb-P/lb-Organic)	0.01	Appendix K-6
PO4-P Requirement (tons/day)	0.088532	
(Assume as Units of P, not P205)		
P Concentration in (NH4)2HPO4 (%)	23.45253	
Ammonium Phosphate Consumption (tons/day)	0.377497	
Solution Storage Tank Conc (% AP)	20	
N Concentration in (NH4)2HPO4 (%)	21.20087	
Specific Gravity of Ammonium Phosphate Soluti	1.11	
Active Volume (%)	65	
Phosphate - Day Tank Volume	626.9623	
Phosphate Solution Delivery Tank	7000	
N Credit in Phosphate Source (ton/day)	0.018769	
Filter		
Fines to Filters (tons/day)	207.2463	
Press. Leaf Filter Factor(lb/(hr-ft^2))	10	
Total Filter Area (ft^2)	1727.053	
Press. Leaf Filter Max Size (Ft^2)	600	
Filters (number)	3	
Pump Filter Booster Pump Flowrate (GPM)	79.05297	

NOTES:
CIM 25 - Canadian Institute of Mining (Bulletin 25)
Where no reference is made, field has been calculated.
See Cambridge Spreadsheet Analyst printout for calculations.

Feed Equipment

	Item	Size	Size	Size	Material	Units
101	Front End Loader	2.5			CS	Cubic Yard
102	Grizzle screen on top of Feed Hopper (4"X4")	8	6		CS	LXW Feet
103	Feed Hopper	8	6	4	CS	LXWXH Feet
104	Dump/pickup Pocket - Feed Hopper	8	6	4	Concrete	LXWXH Feet
105	Pad - Wash Station (16'X16' with containment)	16	16	0.666666	Concrete	LXWXH Feet
106	Wash Station - High Pressure	10	450		CS	GPMXPSI
107	Wash Station Sump	20			CS	GPM
108	Pump - Wash Station Sump	30	45		Rubber Coated CS	GPMXFeet Head
109	Conveyor - Feed Hopper Discharge (Variable Speed)	2	12	1.5	Rubber/CS	WXLXHP Feet/HP
110	Weight belt	2	6	1	Rubber/CS	WXLXHP Feet/HP
111	Conveyor - Rod Mill Feed	2	30	2	Rubber/CS	WXLXHP Feet/HP
113	Water Station - Rod Mill Feed	29			CS	GPM
114	Rod Mill	18	10	1200	CS	LXDXHP Feet/HP
115	Vibrating Screen - Rod Mill Discharge 3/4 inch	7	9.898		CS	WXL Feet
116	Wash Station - Scalping Screen	5			CS	GPM
117	Dump/Pickup Pocket - Scalping Screen	8	6	4	Concrete	LXWXH Feet
118	Rod Mill Sump	7	7	7	Rubber/CS	LXWXH Feet
119	Agitator - Rod Mill Sump	7.5			Rubber/CS	HP
120	Pump - Rod Mill Sump	75	60	1.74	Rubber/CS	GPMXFeet Head
121	Solids Density Control Point - Rod Mill Sump	Nuclear Density Gauge				
122	Vibrating Screen - Final 1/4"	9	3	9	SS/CS	LXWXHP Feet/hp
123	Wash Water Station - Final Screen	29			CS	GPM
124	Dump/Pickup Pocket - Final Screen	8	6	4	Concrete	LXWXH Feet
201	Tank - First Stage Wash with Launder Overflow	15000			Rubber/CS	Gallons
202	Agitator - First Stage Wash	110			Rubber/CS	Hp
203	Surfactant Station - First Stage Wash	6			SS	GPM
204	Soda Ash Station - First Stage Wash	4			SS	GPM
205	pH Control Point - First Stage Wash					
206	Solids Density Control Point - First Stage Wash					
207	Pump - First Stage Wash	250	50	1.23	Rubber/CS	GPM/Head-ft/SpGr
208.1	Cyclone - First Stage Wash A	14			Urethane/ceramic	Diameter (in)
208.2	Cyclone - First Stage Wash B	14			Urethane/ceramic	Diameter (in)

208.3	Cyclone - First Stage Wash C	14			Urethane/ceramic	Diameter (in)
208.4	Cyclone - First Stage Wash D	14			Urethane/ceramic	Diameter (in)
209	Tank - Second Stage Wash with Launder Overflow	9000			Rubber/CS	Gallons
210	Agitator - Second Stage Wash	70			Rubber/CS	Hp
211	Surfactant Station - Second Stage Wash	6			SS	
212	Soda Ash Station - Second Stage Wash	4			SS	
213	pH Control Point - Second Stage Wash					
214	Pump - Second Stage Wash	140	50	1.21	Rubber/CS	GPM/Head-ft/SpGr
215.1	Cyclone - Second Stage Wash A	15			Urethane/ceramic	Diameter (in)
215.2	Cyclone - Second Stage Wash B	15			Urethane/ceramic	Diameter (in)
216	Tank - Third Stage Wash	9000			Rubber/CS	Gallons
217	Agitator - Third Stage Wash	70			Rubber/CS	Hp
218	Surfactant Station - Third Stage Wash	6			SS	
219	Soda Ash Station - Third Stage Wash	4			SS	
220	pH Control Station - Third Stage Wash					
221	Solids Density Control Point - Third Stage Wash					
222	Drag Chain Skimmer - Floating Debri	1	15	1	SS	WXLXhp Feet/hp
223	Dump/Pickup Pocket - Floating Debri (May Use Washed	8	6	4	Concrete	LXWXH Feet
224	Pump - Third Stage Wash	140	50	1.19	Rubber/CS	GPM/Head-ft/SpGr
225.1	Cyclone - Third Stage Wash A	15			Urethane/ceramic	Diameter (in)
225.2	Cyclone - Third Stage Wash B	15			Urethane/ceramic	Diameter (in)
226	Spiral Classifier - Washed Sand	2	13	3		WXLXHP Feet/hp
227	Wash Water Station - Spiral Classifier	90			Rubber/CS	Gallons
228	Sump - Spiral Classifier	1500			Rubber/CS	Hp
229	Agitator - Spiral Classifier Sump	20				
230	Pump - Spiral Classifier Sump	100	50	1	Rubber/CS	GPM/Head-ft/SpGr
231	Dump/Pickup Pocket - Washed Sand	12	12	8	Concrete	LXWXH Feet
401	Tank - Surfactant Storage 10 day Supply	54000			CS	Gallons
402	Tank - Surfactant Day Tank	6000				
403	Pump - Surfactant Transfer	100	50	1	SS	GPMXHead-feetXSpGR
404	Wash Water Station - Surfactant Day Tank	5				GPM
405	Pump - Surfactant Feed	6	50	5340.97	SS	GPMXHead-feetXSpGR
406	Tank - Soda Ash Day Feed Tank	4000			SS	Gallons
407	Agitator - Soda Ash Day Feed Tank	30			Rubber/CS	Hp

408 Pump - Soda Ash Feed	4			SS	
412.1 Wash Water Station - Soda Ash Tank	5				
411 Storage Area - Soda Ash Silo	50				tons
434 Conveyor - Soda Ash Transfer	30	1.5			LengthXWidth feet
413 Thickener - Bioreactor Feed	23			CS	Diameter ft
414 Pump - Thickener Overflow	15	75	1	Rubber/CS	GPM/Head-ft/SpGr
415 Pump - Bioreactor Feed	16	75	1.25	Rubber/CS	GPM/Head-ft/SpGr
416 pH Control Point - Thickener Feed					
417 Solids Density Control Point - Bioreactor Feed					

	----------Case 1	----------		Material	Units
301 Areator-High Speed Mech. Surface, Draft Core Ext		16	90	AntiErosion	Number/hp
302 Bioreactor - Thickener with aeration on Rake	4	20	170	Concrete	NumberXdepthXDiameter Feet
303 Pump - Recirculation	4	5300	30	Rubber/CS	
501 Boiler - Hot Water 210 F	50				10^6 BTU/hr
305 Heat Coils - Bioreactor	40	500		SS	Number/Area Ft^2
412 Waste Water Tank		20	170	CS	HeightXDiameter Feet

Item				Material	Units
409 Pump - Waste Water	2	200	60	Rubber/CS	Number/GPM/Head
306 Pump - Filter Booster Pump	2	100	90	Rubber/CS	Number/GPM/Head
307 Filter - Pressure Leaf	3	600		CS	Number/Area- Ft^2
308 Conveyor - Filter Transfer	3	100		Rubber/CS	Width/Length -feet
309 Conveyor - Inclined Loadout	3	100		Rubber/CS	Width/Length -feet
310 Dump Pocket - Treated Solids	12	12	8	Concrete	LXWXH Feet
502 Air Compressor	4700	100			SCFM/PSI
503 Heater - Air	300			SS	Area Ft^2
504 Water Injection Pump	1	125		CS	GPM/psi
505 Heater - Water	1			SS	Area Ft^2
506 Air Surge Tank - Pressure Vessel	14000	150		CS	Gallons/PSI
410 Ground Water Tank	10000			CS	Gallons

418 Pump - Ground Water Pump	1	200	60	Rubber/CS	Number/GPM/Head
419 Fresh Water Tank	10000			CS	Gallons
420 Pump - Fresh Water	1	200	60	Rubber/CS	Number/GPM/Head
421 Ammonium Nitrate Day Tank	4100			SS	Gallons
422 Agitator - Ammonium Nitrate Day Tank	6			SS	HP
423 Pump - Ammonium Nitrate Day Tank	3	50		SS	GPM/Head
424 Ammonium Nitrate Storage Tank	18000			SS	Gallons
425 Agitator - Ammonium Nitrate Storage Tank	25			SS	HP
426 Pump - Ammonium Nitrate Storage Tank	70	50		SS	GPM/Head
427 Ammonium Phosphate Day Tank	1000			SS	Gallons
428 Agitator - Ammonium Phosphate Day Tank	2			SS	HP
429 Pump - Ammonium Phosphate Day Tank	1	50		SS	GPM/Head
430 Ammonium Phosphate Storage Tank	7000			SS	Gallons
431 Agitator - Ammonium Phosphate Storage Tank	10			SS	HP
432 Pump - Ammonium Phosphate Storage Tank	20	50		SS	GPM/Head
433 Carbon Column Filters	3	12	12		Number/HeightXDiameter feet
507 Hold Tank - Water	1	12	12		Number/HeightXDiameter feet
502.1 Air Filter	1				Number
508 Water Mist Tank	1500				Gallons
435 Agitator - Surfactant Day Tank	1				Number

Bioreactor	Case 1			Case 2			Material	Units
301 Areator-High Speed Mech. Surface, Draft Core Ext		16	90		16	90	AntiErosi	Number/hp
302 Bioreactor - Thickener with aeration on Rake	4	20	170	4	20	170	Concrete	NumberXdepthXDiameter Feet
303 Pump - Recirculation	4	5300	30	4	5300	30	Rubber/CS	
501 Boiler - Hot Water 210 F	50			50				10^6 BTU/hr
305 Heat Coils - Bioreactor	40	500		40	500		SS	Number/Area Ft^2
412 Waste Water Tank		20	170		20	170	CS	HeightXDiameter Feet

Bioreactor	Case 3			Case 4			Material	Units
301 Areator-High Speed Mech. Surface, Draft Core Ext		36	60		48	50	AntiErosi	Number/hp
302 Bioreactor - Thickener with aeration on Rake	4	20	210	4	20	210	Concrete	NumberXdepthXDiameter Feet
303 Pump - Recirculation	4	7900	30	4	7900	30	Rubber/CS	
501 Boiler - Hot Water 210 F	70			70				10^6 BTU/hr
305 Heat Coils - Bioreactor	80	400		120	300		SS	Number/Area Ft^2
412 Waste Water Tank		20	210		20	210	CS	HeightXDiameter Feet

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
30		'Feed Equipment					
32		'Item	'Size	'Size	'Size	'Material	'Units
33	[101]	'Front End Loader	[2.5]			'CS	'Cubic Yard
34	[102]	'Grizzle screen on top of Feed Hopper (4"X4")	[8]	[6]		'CS	'LXW Feet
35	[103]	'Feed Hopper	[8]	[6]	[4]	'CS	'LXWXH Feet
36	[104]	'Dump/pickup Pocket - Feed Hopper	[8]	[6]	[4]	'Concrete	'LXWXH Feet
37	[105]	'Pad - Wash Station (16'X16' with containment)	[16]	[16]	[0.666666]	'Concrete	'LXWXH Feet
38	[106]	'Wash Station - High Pressure	[10]	[450]		'CS	'GPMXPSI
39	[107]	'Wash Station Sump	[20]			'CS	'GPM
40	[108]	'Pump - Wash Station Sump	[30]	[45]		'Rubber Coated CS	'GPMXFeet Head
41	[109]	'Conveyor - Feed Hopper Discharge (Variable Speed)	[2]	+G36+4	[1.5]	'Rubber/CS	'WXLXHP Feet/HP
42	[110]	'Weight belt	[2]	[6]	[1]	'Rubber/CS	'WXLXHP Feet/HP
43	[111]	'Conveyor - Rod Mill Feed	[2]	[30]	[2]	'Rubber/CS	'WXLXHP Feet/HP
44	[113]	'Water Station - Rod Mill Feed	@ROUND(C63/0.75+0.5,0)			'CS	'GPM
45	[114]	'Rod Mill	+C72	+C73	@ROUND(C74*1.25,-2)	'CS	'LXDXHP Feet/HP
46	[115]	'Vibrating Screen - Rod Mill Discharge 3/4 inch	+C79	+C79*1.414		'CS	'WXL Feet
47	[116]	'Wash Station - Scalping Screen	[5]			'CS	'GPM
48	[117]	'Dump/Pickup Pocket - Scalping Screen	[8]	[6]	[4]	'Concrete	'LXWXH Feet
49	[118]	'Rod Mill Sump	+C79	+C79	+C79	'Rubber/CS	'LXWXH Feet
50	[119]	'Agitator - Rod Mill Sump	[7.5]			'Rubber/CS	'HP
51	[120]	'Pump - Rod Mill Sump	@ROUND(C75*1.5+0.5,0)	[60]	@ROUND(C62,2)	'Rubber/CS	'GPMXFeet Head
52	[121]	'Solids Density Control Point - Rod Mill Sump	'Nuclear Density Gauge				
53	[122]	'Vibrating Screen - Final 1/4"	+C82	+C83	@ROUND(0.35*(G53*H53)^0.95+0.5,0)	'SS/CS	'LXWXHP Feet/hp
54	[123]	'Wash Water Station - Final S	+G44			'CS	'GPM

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
		creen					
55	[124]	'Dump/Pickup Pocket - Final Screen	[8]	[6]	[4]	'Concrete	'LXWXH Feet
56	[201]	'Tank - First Stage Wash with Launder Overflow	@ROUND(C164*60*C10*1.5+500,-3)			'Rubber/CS	'Gallons
57	[202]	'Agitator - First Stage Wash	@ROUND(G56/7.481*0.05+5,-1)			'Rubber/CS	'Hp
58	[203]	'Surfactant Station - First Stage Wash	@ROUND(C92*2000/C91/8.3452/1440*1.5+0.5,0)			'SS	'GPM
59	[204]	'Soda Ash Station - First Stage Wash	@ROUND(C98*2000/C97/8.3452/1440*1.5+0.5,0)			'SS	'GPM
60	[205]	'pH Control Point - First Stage Wash					
61	[206]	'Solids Density Control Point - First Stage Wash					
62	[207]	'Pump - First Stage Wash	@ROUND(C164*1.5+5,-1)	[50]	@ROUND(C163,2)	'Rubber/CS	'GPM/Head-ft/SpGr
[illegible]	[208.1]	'Cyclone - First Stage Wash A	@ROUND(1.5*(C164/4)^0.59+0.5,0)			'Urethane/ceramic	'Diameter (in)
64	[208.2]	'Cyclone - First Stage Wash B	+G63			'Urethane/ceramic	'Diameter (in)
65	[208.3]	'Cyclone - First Stage Wash C	+G63			'Urethane/ceramic	'Diameter (in)
66	[208.4]	'Cyclone - First Stage Wash D	+G63			'Urethane/ceramic	'Diameter (in)
67	[209]	'Tank - Second Stage Wash with Launder Overflow	@ROUND(C147*60*C10*1.5+500,-3)			'Rubber/CS	'Gallons
68	[210]	'Agitator - Second Stage Wash	@ROUND(G67/7.481*0.05+5,-1)			'Rubber/CS	'Hp
69	[211]	'Surfactant Station - Second Stage Wash	+G58			'SS	
70	[212]	'Soda Ash Station - Second Stage Wash	+G59			'SS	

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
71	[213]	'pH Control Point - Second Stage Wash					
72	[214]	'Pump - Second Stage Wash	@ROUND(C147*1.5+5,-1)	[50]	@ROUND(C146,2)	'Rubber/CS	'GPM/Head-ft/SpGr
73	[215.1]	'Cyclone - Second Stage Wash A	@ROUND(1.5*(C147/2)^0.59+0.5,0)			'Urethane/ceramic	'Diameter (in)
74	[215.2]	'Cyclone - Second Stage Wash B	+G73			'Urethane/ceramic	'Diameter (in)
75	[216]	'Tank - Third Stage Wash	@ROUND(C135*60*C10*1.5+500,-3)			'Rubber/CS	'Gallons
76	[217]	'Agitator - Third Stage Wash	@ROUND(G75/7.481*0.05+5,-1)			'Rubber/CS	'Hp
77	[218]	'Surfactant Station - Third Stage Wash	+G58			'SS	
78	[219]	'Soda Ash Station - Third Stage Wash	+G59			'SS	
79	[220]	'pH Control Station - Third Stage Wash					
80	[221]	'Solids Density Control Point - Third Stage Wash					
81	[222]	'Drag Chain Skimmer - Floating Debri	[1]	[15]	[1]	'SS	'WXLXhp Feet/hp
82	[223]	'Dump/Pickup Pocket - Floating Debri (May Use Washed Sand Pocket)	[8]	[6]	[4]	'Concrete	'LXWXH Feet
83	[224]	'Pump - Third Stage Wash	@ROUND(C135*1.5+5,-1)	[50]	@ROUND(C134,2)	'Rubber/CS	'GPM/Head-ft/SpGr
84	[225.1]	'Cyclone - Third Stage Wash A	@ROUND(1.5*(C135/2)^0.59+0.5,0)			'Urethane/ceramic	'Diameter (in)
85	[225.2]	'Cyclone - Third Stage Wash B	+G84			'Urethane/ceramic	'Diameter (in)
86	[226]	'Spiral Classifier - Washed Sand	[2]	[13]	[3]		'WXLXHP Feet/hp
87	[227]	'Wash Water Station - Spiral Classifier	@ROUND(C111*2000/8.3452/1440*1.5+5,-1)			'Rubber/CS	'Gallons
88	[228]	'Sump - Spiral Classifier	@ROUND(C1			'Rubber/CS	'Hp

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
			23*15*1.5+50,-2)				
	[229]	'Agitator - Spiral Classifier Sump	@ROUND(G88/7.481*0.05+5,-1)				
90	[230]	'Pump - Spiral Classifier Sump	@ROUND(C123*1.5+5,-1)	[50]	@ROUND(C122,2)	'Rubber/CS	'GPM/Head-ft/SpGr
91	[231]	'Dump/Pickup Pocket - Washed Sand	[12]	[12]	[8]	'Concrete	'LXWXH Feet
92	[401]	'Tank - Surfactant Storage 10 day Supply	@IF(C92*2000/C91/8.3452*10<10000,10000,@ROUND(C92*2000/C91/8.3452*10+500,-3))			'CS	'Gallons
93	[402]	'Tank - Surfactant Day Tank	@IF(C92*2000/C91/8.3452<5000,5000,@ROUND(C92*2000/C91/8.3452+500,-3))				
	[403]	'Pump - Surfactant Transfer	+G93/60	[50]	@ROUND(C91,2)	'SS	'GPMXHead-feetXSpGR
95	[404]	'Wash Water Station - Surfactant Day Tank	+G47				'GPM
96	[405]	'Pump - Surfactant Feed	@ROUND(C92*2000/C91/8.3452/1440*1.5+0.5,0)	[50]	@ROUND(C93,2)	'SS	'GPMXHead-feetXSpGR
98	[406]	'Tank - Soda Ash Day Feed Tank	@IF(C98*2000/C97/8.3452<3000,3000,@ROUND(C98*2000/C97/8.3452+500,-3))			'SS	'Gallons
99	[407]	'Agitator - Soda Ash Day Feed Tank	@ROUND(G98/7.481*0.05+5,-1)			'Rubber/CS	'Hp

FILE:CREOSOTE.WK1 RANGE:E30..K154<USER DEFINED> CREATED: 7/11/1990 14:

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
100	[408]	'Pump - Soda Ash Feed	@ROUND(C98*2000/C97/8.3452/1440*1.5+0.5,0)			'SS	
101	[412.1]	'Wash Water Station - Soda Ash Tank	@IF(G100<G47,G47,G100)				
103	[411]	'Storage Area - Soda Ash Silo	[50]				'tons
104	[434]	'Conveyor - Soda Ash Transfer	[30]	[1.5]			'LengthXWidth feet
105	[413]	'Thickener - Bioreactor Feed	+C195			'CS	'Diameter ft
106	[414]	'Pump - Thickener Overflow	@ROUND(C188*2000/C187/8.3452/1440*1.5+0.5,0)	[75]	@ROUND(C187,2)	'Rubber/CS	'GPM/Head-ft/SpGr
107	[415]	'Pump - Bioreactor Feed	@ROUND(C193*2000/C192/8.3452/1440*1.5+0.5,0)	[75]	@ROUND(C192,2)	'Rubber/CS	'GPM/Head-ft/SpGr
108	[416]	'pH Control Point - Thickener Feed					
109	[417]	'Solids Density Control Point - Bioreactor Feed					
		'Bioreactor	'--------- --Case 1- ---------			'Material	'Units
113	[301]	'Areator-High Speed Mech. Surface, Draft Core Ext		[16]	@ROUND(C205*7.45*150/1500000/H113+5,-1)	'AntiErosion	'Number/hp
114	[302]	'Bioreactor - Thickener with aeration on Rake	+C206	+C207	@ROUND(C209+5,-1)	'Concrete	'NumberXdepthXDiameter Feet
115	[303]	'Pump - Recirculation	+G114	@ROUND(C214*1.25+50,-2)	[30]	'Rubber/CS	
116	[501]	'Boiler - Hot Water 210 F	@ROUND(C215/1000000*1.25+0.5,-1)				'10^6 BTU/hr
117	[305]	'Heat Coils - Bioreactor	[40]	@ROUND(G116/(210-C24)/25*10		'SS	'Number/Area Ft^2

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
				00000/G11 7+50,-2)			
[illegible]8	[412]	'Waste Water Tank		+H114	+I114	'CS	'HeightXD iameter F eet
121		'Item				'Material	'Units
123	[409]	'Pump - Waste Water	[2]	[200]	[60]	'Rubber/CS	'Number/G PM/Head
124	[306]	'Pump - Filter Booster Pump	[2]	@ROUND(C3 25*1.25+5 ,-1)	[90]	'Rubber/CS	'Number/G PM/Head
125	[307]	'Filter - Pressure Leaf	+C324	+C323		'CS	'Number/A rea- Ft^2
126	[308]	'Conveyor - Filter Transfer	[3]	[100]		'Rubber/CS	'Width/Le ngth -fee t
127	[309]	'Conveyor - Inclined Loadout	[3]	[100]		'Rubber/CS	'Width/Le ngth -fee t
128	[310]	'Dump Pocket - Treated Solids	[12]	[12]	[8]	'Concrete	'LXWXH Fe et
129	[502]	'Air Compressor	@ROUND(C2 87*1.25+5 0,-2)	[100]			'SCFM/PSI
130	[503]	'Heater - Air	@ROUND(+G 129/379*2 9*0.25*(C 24-C23)*6 0/(150-C2 4)/50+50, -2)			'SS	'Area Ft^ 2
131	[504]	'Water Injection Pump	@ROUND(+G 129/379*0 .1*18/500 +0.5,0)	[125]		'CS	'GPM/psi
132	[505]	'Heater - Water	[1]			'SS	'Area Ft^ 2
133	[506]	'Air Surge Tank - Pressure Ve ssel	@ROUND(G1 29/(H129+ 14.7)*14. 7*3*7.481 +500,-3)	[150]		'CS	'Gallons/ PSI
134	[410]	'Ground Water Tank	[10000]			'CS	'Gallons
135	[418]	'Pump - Ground Water Pump	[1]	[200]	[60]	'Rubber/CS	'Number/G PM/Head
136	[419]	'Fresh Water Tank	[10000]			'CS	'Gallons
137	[420]	'Pump - Fresh Water	[1]	[200]	[60]	'Rubber/CS	'Number/G PM/Head

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CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
138	[421]	'Ammonium Nitrate Day Tank	@ROUND(C300/0.65+50,-2)			'SS	'Gallons
139	[422]	'Agitator - Ammonium Nitrate Day Tank	@ROUND(G138/7.451*0.01+0.5,0)			'SS	'HP
140	[423]	'Pump - Ammonium Nitrate Day Tank	@ROUND(C300/1440*1.25+0.5,0)	[50]		'SS	'GPM/Head
141	[424]	'Ammonium Nitrate Storage Tank	+C301			'SS	'Gallons
142	[425]	'Agitator - Ammonium Nitrate Storage Tank	@ROUND(G141/7.451*0.01+0.5,0)			'SS	'HP
143	[426]	'Pump - Ammonium Nitrate Storage Tank	@ROUND(G138/60+5,-1)	[50]		'SS	'GPM/Head
144	[427]	'Ammonium Phosphate Day Tank	@ROUND(C314/0.65+50,-2)			'SS	'Gallons
145	[428]	'Agitator - Ammonium Phosphate Day Tank	@ROUND(G144/7.451*0.01+0.5,0)			'SS	'HP
	[429]	'Pump - Ammonium Phosphate Day Tank	@ROUND(C314/1440*1.25+0.5,0)	[50]		'SS	'GPM/Head
147	[430]	'Ammonium Phosphate Storage Tank	+C315			'SS	'Gallons
148	[431]	'Agitator - Ammonium Phosphate Storage Tank	@ROUND(G147/7.451*0.01+0.5,0)			'SS	'HP
149	[432]	'Pump - Ammonium Phosphate Storage Tank	@ROUND(G144/60+5,-1)	[50]		'SS	'GPM/Head
150	[433]	'Carbon Column Filters	[3]	[12]	[12]		'Number/HeightXDiameter feet
151	[507]	'Hold Tank - Water	[1]	[12]	[12]		'Number/HeightXDiameter feet

CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-
152	[502.1]	'Air Filter	[1]				'Number
153	[508]	'Water Mist Tank	[1500]				'Gallons
154	[435]	'Agitator - Surfactant Day Ta	[1]				'Number
		nk					

FILE:CREOSOTE.WK1 RANGE:A1..D330<USER DEFINED> CREATED: 7/11/1990 14:

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
1	'Moss-American Bioslurry Treatment O			
	peration			
	'Summary:			
5				'Reference
6	'Contaminated Soil (Cubic Yards)	[80000]	[80000]	'3-12
7	'Contaminated Sediment (Cubic Yards)	[5200]	[5200]	'3-12
8	'Operating Time (years)	[3]	[3]	'3-14
9	'Operating Time (days/yr)	[115]	[115]	'Weather limiting
10	'Residence Time-3 Wash Tank each (hr	[1]	[1]	'Assumed
	)			
11	'Wash Solids Concentration (%)	[35]	[35]	'Appendix I-5
12	'Solids Content to BioReactor (%)	[35]	[35]	'Appendix I-5
13	'Case			
14	[1]	[159]	[159]	'Limited by Chrysene
15	[2]	[207]	[207]	'Limited by Chrysene
16	[3]	[476]	[476]	'Limited by Chrysene
17	[4]	[623]	[623]	'Limited by Chrysene
18	'Organic Loading (ppm Carcinogenic)	[313]	[313]	'Table 2-2, weighted a
				vg.
19	'Total/Carcinogenic Ratio	[8.6285072	[8.628507	'Based on four samples
		]	]	
20	'Estimated Total Organic (ppm)	[2700.7227	+C18*C19	
		]		
21	'First Order Reaction Constant			
22	' (mg/(Kg-day-mg)	[0.1]	[0.1]	'Appendix K-4
23	'Outside Ambient Minimum (F)	[-10]	[-10]	'Assumed
24	'BioReactor Temperature (F)	[104]	[104]	'Assumed
	'Feed Material:			
32	'Item			'Reference
33	'Contaminated Soil (Cubic Yards)	[80000]	+C6	'3-12
34	'Additional Capture Factor (percent)	[25]	+C37	'See F10
35	'Uncontaminated Soil (Cubic Yards)	[20000]	+C33*C34/	
			100	
36	'Contaminated Sediment (Cubic Yards)	[5200]	+C7	'3-12
37	'Additional Capture Factor (percent)	[25]	[25]	'3-13
38	'Uncontaminated Sediment (Cubic Yard	[1300]	+C36*C37/	'3-13
	s)		100	
39	'Oversize Material (Cubic Yards)			
40	' (to special waste landfill)	[3000]	[3000]	'3-12
42	'Total Plant Feed (Cubic Yards)	[103500]	+C33+C35+	
			C36+C38-C	
			40	
44	'Soil Sand/fine Split (% > 20 mesh)	[50]	[50]	'3-13
45	'Sediment Sand/fine Split (% > 20 me	[0]	[0]	'3-12
	sh)			
47	'Soil Density dry (tons/cubic Yard)	[1.3]	[1.3]	'Standard
48	'Sediment Den. dry (tons/cubic yard)	[1.3]	[1.3]	'Standard
50	'Soil to Process (tons)	[126100]	(+C33+C35	

FILE:CREOSOTE.WK1 RANGE:A1..D330<USER DEFINED> CREATED: 7/11/1990 14:

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			-C40)*1.3	
	'Sand to Process - Soil (tons)	[63050]	+C50*C44/	
			100	
52	'Fines to Process - Soil (tons)	[63050]	+C50-C51	
53	'Sediment to Process (tons)	[8450]	(C36+C38)	
			*C48	
54	'Sand to Process - Sediment (tons)	[0]	+C53*C45/	
			100	
55	'Fines to Process - Sediment (tons)	[8450]	+C53-C54	
56	'Fines to Process (tons)	[71500]	+C52+C55	
57	'Sand to Process (tons)	[63050]	+C51+C54	
59	'Process Flows			
60	'Solids to Rod Mill (tons/day)	[390]	(C50+C53)	
			/C8/C9	
61	'Solids Density Rod Mill Discharge (	[75]	[75]	'Assumed
	%)			
62	'Specific Gravity of Rod Mill Discha	[1.7358490	100/(C61/	
	rge	]	C65+(100-	
			C61)/1)	
63	'Water Feed to Mill including recycl	[21.635857	+C60*2000	
	e(GPM)	]	/C61*(100	
			-C61)/144	
			0/8.3452	
64	'Rod Mill Residence Time (Hours)	[0.25]	[0.25]	'Assumed
65	'Specific Gravity of Solids	[2.3]	[2.3]	'Assumed
66	'Density of Slurry (lb/ft^3)	[108.31698	1/(C61/10	
		]	0/2.3+(10	
			0-C61)/10	
			0/1)*62.4	
67	'Slurry Volume in Rod Mill (Ft^3)	[100.01509	+C60/C61*	
		]	100*2000/	
			24*C64/C6	
			6	
68	'Void Volume in Rod Mill (%)	[21.5]	(4-3.14)/	'Similar Diameter Rods
			4*100	
69	'Rod Volume (FT^3)	[465.18649	+C67/C68*	
		]	100	
70	'Rod Loading (% of Mill Volume)	[45]	[45]	'Assumed
71	'Rod Mill Volume (Ft^3)	[1033.7477	+C69/C70*	
		]	100	
72	'Rod Mill Length (feet)	[18]	@ROUND((C	
			71/4/3.14	
			)^(1/3)*4	
			+0.5,0)	
73	'Rod Mill Diameter (Feet)	[10]	@ROUND(C7	
			2/2+0.5,0	
			)	
74	'Rod Mill Power (hp)	[936]	0.52*C73^	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			2*C72	
	'Sump Flow Rate (gpm)	[49.680832	+C60/C61*	
		]	100*2000/	
			24/60/C66	
			*7.451	
76	'Sump Residence Time (hours)	[0.5]	[0.5]	'Assumed
77	'Sump Active Volume (ft^3)	[200.03019	+C75*60/7	
		]	.451*C76	
78	'Sump Loading (% of Full)	[60]	[60]	
79	'Sump Dimension (feet)	[7]	@ROUND((C	
			77/C78*10	
			0)^(1/3)+	
			0.5,0)	
80	'Screen Area Factor 1/4 inch (Tons/(	[2]	[2]	'CIM 25
	ft^2-hr)			
81	'Screen Area (Ft^2)	[8.125]	+C60/24/2	
82	'Screen Length (ft)	[9]	@IF(+C81<	
			4,4,@ROUN	
			D(C81+0.5	
			,0))	
83	'Screen Width (ft)	[3]	@IF(+C81/	
			C82<3,3,@	
			ROUND(C81	
			/C82+0.5,	
			0))	
85	'Washing Circuit			
	'Rod Mill Discharge - solids (Tons/d	[390]	+C60	
	ay)			
88	'Rod Mill Discharge - Water (GPM)	[130]	+C60/C61*	
			(100-C61)	
89	'Surfactant Requirements (lb/ton)	[40]	2*20	'Stepan
90	'Surfactant Concentration (%)	[35]	[35]	'Stepan
91	'Surfactant Specific Gravity	[1]	[1]	
92	'Surfactant Feed - Solution (tons/da	[22.285714	+C87*C89/	
	y)	]	C90*100/2	
			000	
93	'Surfactant Day Tank Active Volume (	[5340.9658	+C92*2000	
	Gallons)	]	/8.3452/C	
			91	
94	'Water in Surfactant (Tons/day)	[14.485714	+C92*(100	
		]	-C90)/100	
95	'Soda Ash Requirements (lb/ton)	[16]	0.8*20	'Assumed
96	'Soda Ash Concentration (%)	[20]	[20]	
97	'Soda Ash Specific Gravity	[1.21]	[1.21]	
98	'Soda Ash Feed - Solution (Tons/day)	[15.6]	+C87*C95/	
			C96*100/2	
			000	
99	'Soda Ash Day Tank Active Volume (Ga	[3089.8149	+C98*2000	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
	llons)	]	/8.3452/C	
			97	
	'Water in Soda Ash (tons/day)	[12.48]	+C98*(100	
			-C96)/100	
101	'Wash Sand - Solids (tons/day)	[182.75362	+C57/C8/C	
		]	9	
102	'Sands Water Content (%)	[15]	[15]	
103	'Wash Sand - Water Content (tons/day	[32.250639	+C101/(10	
	)	]	0-C102)*C	
			102	
104	'Fines to BioReactor (tons/day)	[207.24637	+C87-C101	
		]		
106	'_______Begin Estimate Wash Circuit			
	Flowrates__________			
108	'Solids Content of Wash Stages (%)	[35]	+C11	
109	'Water Needed for First Stage (tons/	[724.28571	+C87/C108	
	day)	]	*(100-C10	
			8)	
110	'Water to Wash Circuit (tons/day)	[599.57063	+C109-C88	
		]	-C94-C100	
			+C103	
111	'Wash Water to Spiral Classifier (to	[339.39958	+C101/C10	
	ns/day)	]	8*(100-C1	
			08)	
112	'Recycle Water to First Stage (Tons/	[260.17105	+C110-C11	
	day)	]	1	
114	'Spiral Classifier			
	'Third Wash Stage Spigot Solid (%)	[70]	[70]	
117	'Water in Third Wash Spigot (tons/da	[78.322981	+C101/C11	
	y)	]	6*(100-C1	
			16)	
118	'Water to Spiral Classifier (tons/da	[339.39958	+C111	
	y)	]		
119	'Sands Water Content (tons/day)	[32.250639	+C103	
		]		
120	'Water Overflow to Third Wash (tons/	[385.47192	+C117+C11	
	day)	]	8-C119	
121	'Fines in Overflow to Third Wash (to	[0.5036638	+C172-C17	
	ns/day)	]	4	
122	'Specific Gravity	[1.0007381	(C120+C12	
		]	1)/(C120/	
			1+C121/2.	
			3)	
123	'Transfer Pump Flow (GPM)	[64.190411	(C120+C12	
		]	1)*2000/C	
			122/8.345	
			2/1440	
125	'Third Stage Wash			

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
127	'Second Wash Stage Spigot Solid (%)	[70]	+C116	
128	'Water in Second Wash Spigot (tons/d	[78.322981	+C101/C12	
	ay)	]	7*(100-C1	
			27)	
129	'Water from Sprial Classifier (tons/	[385.47192	+C120	
	day)	]		
130	'Sands Water Content to Spiral(tons/	[78.322981	+C117	
	day)	]		
131	'Water Overflow to Second Wash (tons	[385.47192	+C128+C12	
	/day)	]	9-C130	
132	'Fines in Overflow to Second Wash (t	[3.3422514	+C170-C17	
	ons/day)	]	2+C121	
133	'Fines in Spigot to Spiral (tons./da	[0.5767648	+C172	
	y)	]		
134	'Specific Gravity	[1.1936127	(C131+C13	
		]	2+C133+C1	
			01+C117)/	
			((C131+C1	
			17)/1+(C1	
			32+C133+C	
			101)/2.3)	
135	'Transfer Pump Flow (GPM)	[90.697001	(C131+C13	
		]	2+C133+C1	
			01+C117)*	
			2000/C134	
			/8.3452/1	
			440	
137	'Second Stage Wash			
139	'First Wash Stage Spigot Solid (%)	[70]	+C127	
140	'Water in First Wash Spigot (tons/da	[78.322981	+C101/C13	
	y)	]	9*(100-C1	
			39)	
141	'Water from Third Wash (tons/day)	[385.47192	+C131	
		]		
142	'Sands Water Content to Third Wash (	[78.322981	+C128	
	tons/day)	]		
143	'Water Overflow to First Wash (tons/	[385.47192	+C140+C14	
	day)	]	1-C142	
144	'Fines in Overflow to First Wash (to	[20.151143	+C168-C17	
	ns/day)	]	0+C132	
145	'Fines in Spigot to Third Wash (tons	[3.4153524	+C170	
	./day)	]		
146	'Specific Gravity	[1.2106881	(C143+C14	
		]	4+C145+C1	
			01+C128)/	
			((C143+C1	
			28)/1+(C1	
			44+C145+C	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			101)/2.3)	
	'Transfer Pump Flow (GPM)	[92.118707	(C143+C14	
		]	4+C145+C1	
			01+C128)*	
			2000/C146	
			/8.3452/1	
			440	
149	'First Stage Wash			
151	'Rod Mill Discharge Solids (%)	[75]	+C61	
152	'Water in Rod Mill Discharge (tons/d	[130]	+C87/C151	
	ay)		*(100-C15	
			1)	
153	'Water from Second Wash (tons/day)	[385.47192	+C143	
		]		
154	'Sands Water Content to Second Wash	[78.322981	+C140	
	(tons/day)	]		
155	'Water in Surfactant (Tons/day)	[14.485714	+C94	
		]		
156	'Water in Soda Ash (tons/day)	[12.48]	+C100	
157	'Surfactant (ton/day)	[7.8]	+C92-C155	
158	'Soda Ash (ton/day)	[3.12]	+C98-C156	
159	'Recycle Water to First Stage (Tons/	[260.17105	+C112	
	day)	]		
160	'Water from Cyclone to Thickener (to	[724.28571	+C152+C15	
	ns/day)	]	3-C154+C1	
			55+C156+C	
			159	
161	'Fines to Thickener (tons/day)	[207.24637	+C56/C8/C	
		]	9	
162	'Fines in First Wash Cyclone Overflo	[20.522388	+C161/(C1	
	w (%)	]	61+C160+C	
			154)*100	
163	'Specific Gravity	[1.2337282	(C155+C15	
		]	6+C157+C1	
			58+C143+C	
			144+C87+C	
			88+C112)/	
			((C155+C1	
			56+C157+C	
			158+C88+C	
			143+C112)	
			/1+(C87+C	
			144)/2.3)	
164	'Transfer Pump Flow (GPM)	[165.07414	(C155+C15	
		]	6+C157+C1	
			58+C143+C	
			144+C87+C	
			88+C112)*	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			2000/C163	
			/8.3452/1	
			440	
166	'Estimate of Fines to Following Stag			
	es			
168	'Fines in First Wash Spigot (tons/da	[20.224244	+C140/(10	
	y)	]	0-C162)*C	
			162	
169	'Fines in Second Wash Overflow (%)	[4.1783974	+C168/(C1	
		]	68+C143+C	
			140)*100	
170	'Fines in Second Wash Spigot (tons/d	[3.4153524	+C128/(10	
	ay)	]	0-C169)*C	
			169	
171	'Fines in Third Wash Spigot (%)	[0.7310097	+C170/(C1	
		]	70+C117+C	
			120)*100	
172	'Fines in Third Wash Spigot (tons/da	[0.5767648	+C117/(10	
	y)	]	0-C171)*C	
			171	
173	'Washing Efficiency -Spiral Classifi	[90]	[90]	
	er (%)			
174	'Fines in Spiral Classifier Sand (to	[0.0731009	+C171*(10	
	ns/day)	]	0-C173)/1	
			00	
17[illegible]	'Est. Overall Wash Efficiency (%)	[99.964727	100-C174/	
		]	C161*100	
177	'________End Estimate Wash Circuit F			
	lowrates__________			
179	'Thickener			
181	'Fines to Thickener (tons/day)	[207.24637	+C161	
		]		
182	'Water from Cyclone to Thickener (to	[724.28571	+C160	
	ns/day)	]		
183	'Fines in Thickener Feed (%)	[22.247905	+C181/(C1	
		]	81+C182)*	
			100	
184	'Fines in Thickener Overflow (%)	[0]	[0]	
185	'Fines in Thickener Underflow (%)	[35]	+C12	
186	'Overflow (tons/day)	[339.39958	(C182-C18	
		]	1*(100-C1	
			85)/C185)	
			/((100-C1	
			84)/100-C	
			184/100*(	
			100-C185)	
			/C185)	
187	'Specific Gravity Overflow	[1]	100/(C184	

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CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			/2.3+(100-C184)/1)	
188	'Overflow Transfer Pump Flow (gpm)	[56.486161]	+C186*2000/C187/8.3452/1440	
189	'Recycle Water to First Stage (Tons/day)	[260.17105]	+C159	
190	'Recycle Water to Rod Mill (tons/day)	[79.228532]	+C186-C189	
191	'Underflow (tons/day)	[592.13250]	+C181+C182-C186	
192	'Specific Gravity Underflow	[1.2466124]	100/(+C185/2.3+(100-C185)/1)	
193	'Underflow Transfer Pump Flow (gpm)	[79.052970]	+C191*2000/C192/8.3452/1440	
194	'Thickener Area Factor (ft^2/(ton/day))	[2]	[2]	'CIM 25
195	'Thickener Diameter (ft)	[23]	@ROUND((C181*C194/3.14)^0.5*2+0.5,0)	
197	'BioReactor			
199	'Case 1			
	'BioReactor Residence Time (days)	[159]	+C14	
	'Fines to Thickener (tons/day)	[207.24637]	+C181	
202	'Underflow (tons/day)	[592.13250]	+C191	
203	'Fines in Thickener Underflow (%)	[35]	+C185	
204	'Specific Gravity Underflow	[1.2466124]	+C192	
205	'Total BioReactor Volume (ft^3)	[1750776.3]	+C202*2000/C204/62.4*115	'One Soil Wash season
206	'Number of BioReactors	[4]	[4]	
207	'Depth of Reactor (Feet)	[20]	[20]	
208	'Effective Volume (%)	[85]	[85]	
209	'Reactor Diameter (feet)	[166.96887]	(C205/4/20/3.14)^0.5*2	
210	'Reactor Area (ft^2)	[21884.704]	+C209^2*3.14/4	
211	'Reactor Settling Area Factor (ft^2/(ton/day))	[2]	+C194	'CIM 25
212	'Solids Content (%)	[35]	+C185	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
	'Specific Gravity	[1.2466124	+C192	
		]		
214	'Underflow Transfer Pump Flow (gpm)	[4173.8990	+C210/C21	
		]	1/C212*10	
			0*2000/8.	
			3452/C213	
			/1440	
215	'Heat Loss (BTU/hr)	[37110457.	1.5*(C24-	
		]	C23)*C206	
			*(C210*2+	
			C209*3.14	
			*C207)	
217	'Case 2			
218	'BioReactor Residence Time (days)	[207]	+C15	
219	'Fines to Thickener (tons/day)	[207.24637	+C181	
		]		
220	'Underflow (tons/day)	[592.13250	+C191	
		]		
221	'Fines in Thickener Underflow (%)	[35]	+C185	
222	'Specific Gravity Underflow	[1.2466124	+C192	
		]		
223	'Total BioReactor Volume (ft^3)	[1750776.3	+C220*200	'One Soil Wash Season
		]	0/C222/62	
			.4*115	
224	'Number of BioReactors	[4]	[4]	
	'Depth of Reactor (Feet)	[20]	[20]	
	'Effective Volume (%)	[85]	[85]	
227	'Reactor Diameter (feet)	[166.96887	(C223/4/2	
		]	0/3.14)^0	
			.5*2	
228	'Reactor Area (ft^2)	[21884.704	+C227^2*3	
		]	.14/4	
229	'Reactor Settling Area Factor (ft^2/	[2]	+C$194	'CIN 25
	(ton/day))			
230	'Solids Content (%)	[35]	+C$185	
231	'Specific Gravity	[1.2466124	+C$192	
		]		
232	'Underflow Transfer Pump Flow (gpm)	[4173.8990	+C228/C22	
		]	9/C230*10	
			0*2000/8.	
			3452/C231	
			/1440	
233	'Heat Loss (BTU/hr)	[37110457.	1.5*(C24-	
		]	C23)*C224	
			*(C228*2+	
			C227*3.14	
			*C225)	
235	'Case 3			

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
	'BioReactor Residence Time (days)	[476]	+C16	
	'Fines to Thickener (tons/day)	[207.24637	+C181	
		]		
238	'Underflow (tons/day)	[592.13250	+C191	
		]		
239	'Fines in Thickener Underflow (%)	[35]	+C185	
240	'Specific Gravity Underflow	[1.2466124	+C192	
		]		
241	'Total BioReactor Volume (ft^3)	[2626164.5	+C238*200	'1.5 Soil Wash seasons
		]	0/C240/62	
			.4*115*1.	
			5	
242	'Number of BioReactors	[4]	[4]	
243	'Depth of Reactor (Feet)	[20]	[20]	
244	'Effective Volume (%)	[85]	[85]	
245	'Reactor Diameter (feet)	[204.49427	(C241/4/2	
		]	0/3.14)^0	
			.5*2	
246	'Reactor Area (ft^2)	[32827.057	+C245^2*3	
		]	.14/4	
247	'Reactor Settling Area Factor (ft^2/	[2]	+C$194	'CIM 25
	(ton/day))			
248	'Solids Content (%)	[35]	+C$185	
249	'Specific Gravity	[1.2466124	+C$192	
		]		
250	'Underflow Transfer Pump Flow (gpm)	[6260.8486	+C246/C24	
		]	7/C248*10	
			0*2000/8.	
			3452/C249	
			/1440	
251	'Heat Loss (BTU/hr)	[53691506.	1.5*(C24-	
		]	C23)*C242	
			*(C246*2+	
			C245*3.14	
			*C243)	
253	'Case 4			
254	'BioReactor Residence Time (days)	[623]	+C17	
255	'Fines to Thickener (tons/day)	[207.24637	+C181	
		]		
256	'Underflow (tons/day)	[592.13250	+C191	
		]		
257	'Fines in Thickener Underflow (%)	[35]	+C185	
258	'Specific Gravity Underflow	[1.2466124	+C192	
		]		
259	'Total BioReactor Volume (ft^3)	[2626164.5	+C256*200	'1.5 Soil Wash seasons
		]	0/C258/62	
			.4*115*1.	
			5	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
	'Number of BioReactors	[4]	[4]	
261	'Depth of Reactor (Feet)	[20]	[20]	
262	'Effective Volume (%)	[85]	[85]	
263	'Reactor Diameter (feet)	[204.49427]	(C259/4/20/3.14)^0.5*2	
264	'Reactor Area (ft^2)	[32827.057]	+C263^2*3.14/4	
265	'Reactor Settling Area Factor (ft^2/(ton/day))	[2]	+C$194	'CIN 25
266	'Solids Content (%)	[35]	+C$185	
267	'Specific Gravity	[1.2466124]	+C$192	
268	'Underflow Transfer Pump Flow (gpm)	[6260.8486]	+C264/C265/C266*100*2000/8.3452/C267/1440	
269	'Heat Loss (BTU/hr)	[53691506.]	1.5*(C24-C23)*C260*(C264*2+C263*3.14*C261)	
271	'Nutrient Information			
273	'Oxygen			
275	'Cresote Organic Loading (tons/day)	[1.0532818]	+C20*C87/1000000	
276	'Surfactant Organic Loading (tons/day)	[7.8]	+C92*C90/100	
277	'Total Organic Loading (tons/day)	[8.8532818]	+C275+C276	
278	'Total Organic Loading (ppm)	[42718.632]	+C277/C201*1000000	
279	'Reaction Constant (mg/(kg-day-mg)	[0.1]	+C22	'Appendix K-4
280	'Initial Reaction Rate (mg/(kg-minute))	[2.9665717]	+C278*C279/1440	
281	'Initial Reaction Rate (lb/minute)	[1.2296224]	+C280/1000000*C201*2000	
282	'Oxygen Consumption Ratio (lb O2/Lb Organic)	[3]	[3]	'Reaction Stoichiometry
283	'Oxygen Consumption (lb/minute)	[3.6888674]	+C281*C282	
284	'Oxygen Content of Air (mole %)	[21]	[21]	
285	'Theoretical Air Requirement (SCFM)	[369.86263]	+C281*C282/18*379/C284*100	
286	'Air Efficiency (%)	[10]	[10]	

	-A-	-B-	-C-	-D-
287	'Actual Air Requirement (SCFM)	[3698.6263	+C285/C28	
		]	6*100	
289	'Nitrogen			
291	'NH3-N Requirement (lb-N/lb-Organic)	[0.05]	[0.05]	'Appendix K-6
292	'NH3-N Requirement (tons/day)	[0.4426640	+C277*C29	
		]	1	
293	'NH3-N Requirement less PO4 Credit (	[0.4238943	+C292-C31	
	tons/day)	]	6	
294	'Ammonia - Nitrogen Concentration (%	[17.5]	[17.5]	
	)			
295	' (Assume Ammonium Nitrate)			
296	'Ammonium Nitrate Consumption (tons/	[2.4222534	+C293/C29	
	day)	]	4*100	
297	'Solution Storage Tank Conc (% AN)	[30]	[30]	
298	'Specific Gravity of Ammonium Nitrat	[1.1252]	[1.1252]	
	e Solution			
299	'Active Volume (%)	[65]	[65]	
300	'Nitrogen - Day Tank Volume	[2645.7481	+C296/C29	
		]	7*100*200	
			0/8.3452/	
			C298/C299	
			*100	
301	'Nitrogen Solution Delivery Tank	[18000]	@ROUND(@I	
			F(C300*C2	
			99*10/100	
			<5000,600	
			0,C300*C2	
			99*10/100	
			)+500,-3)	
303	'Phosphate			
305	'Phosphate Requirement (lb-P/lb-Orga	[0.01]	[0.01]	'Appendix K-6
	nic)			
306	'PO4-P Requirement (tons/day)	[0.0885328	+C277*C30	
		]	5	
307	' (Assume as Units of P, not P2O5)			
308	'P Concentration in (NH4)2HPO4 (%)	[23.452532	30.97376/	
		]	132.07*10	
			0	
309	'Ammonium Phosphate Consumption (ton	[0.3774979	+C306/C30	
	s/day)	]	8*100	
310	'Solution Storage Tank Conc (% AP)	[20]	[20]	
311	'N Concentration in (NH4)2HPO4 (%)	[21.200878	28/132.07	
		]	*100	
312	'Specific Gravity of Ammonium Phosph	[1.11]	[1.11]	
	ate Solution			
313	'Active Volume (%)	[65]	[65]	
314	'Phosphate - Day Tank Volume	[626.96234	+C309/C31	
		]	0*100*200	

CELL CONTENTS REPORT

	-A-	-B-	-C-	-D-
			0/8.3452/	
			C312/C313	
			*100	
315	'Phosphate Solution Delivery Tank	[7000]	@ROUND(@I	
			F(C314*C3	
			13*10/100	
			<5000,600	
			0,C314*C3	
			13*10/100	
			)+500,-3)	
316	'N Credit in Phosphate Source (ton/d	[0.0187697	+C306*C31	
	ay)	]	1/100	
318	'Filter			
320	'Fines to Filters (tons/day)	[207.24637	+C181	
		]		
321	'Press. Leaf Filter Factor(lb/(hr-ft	[10]	[10]	
	^2))			
322	'Total Filter Area (ft^2)	[1727.0531	+C320*200	
		]	0/24/C321	
323	'Press. Leaf Filter Max Size (Ft^2)	[600]	[600]	
324	'Filters (number)	[3]	@ROUND(C3	
			22/C323+0	
			.5,0)	
325	'Pump Filter Booster Pump Flowrate (	[79.052970	+C193	
	GPM)	]		
327	'NOTES:			
[illegible]	'CIM 25 - Canadian Institute of Mini			
	ng (Bulletin 25)			
329	'Where no reference is made, field h			
	as been calculated.			
330	'See Cambridge Spreadsheet Analyst p			
	rintout for calculations.			

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CELL CONTENTS REPORT

	-E-	-F-	-G-	-H-	-I-	-J-	-K-	-N-	-O-
111		'Bioreactor	'--------- --Case 1- ---------			'Material	'Units	'--------- --Case 2- --------- ------	
113	[301]	'Areator-High Speed Mech. Sur face, Draft Core Ext		[16]	@ROUND(C2 05*7.45*1 50/150000 0/H113+5, -1)	'AntiErosion	'Number/h p		[16]
114	[302]	'Bioreactor - Thickener with aeration on Rake	+C206	+C207	@ROUND(C2 09+5,-1)	'Concrete	'NumberXd epthXDiam eter Feet	+C224	+C225
115	[303]	'Pump - Recirculation	+G114	@ROUND(C2 14*1.25+5 0,-2)	[30]	'Rubber/CS		+N114	@ROUND(C2 32*1.25+5 0,-2)
116	[501]	'Boiler - Hot Water 210 F	@ROUND(C2 15/100000 0*1.25+0. 5,-1)				'10^6 BTU /hr	@ROUND(C2 33/100000 0*1.25+0. 5,-1)	
117	[305]	'Heat Coils - Bioreactor	[40]	@ROUND(G1 16/(210-C 24)/25*10 00000/G11 7+50,-2)		'SS	'Number/A rea Ft^2	[40]	@ROUND(N1 16/(210-C 24)/25*10 00000/N11 7+50,-2)
118	[412]	'Waste Water Tank		+H114	+I114	'CS	'HeightXD iameter F eet		+O114

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CELL CONTENTS REPORT

	-P-	-Q-	-R-	-S-	-T-	-U-	-V-
111		'---------			'---------		
		--Case 3-			--Case 4-		
		---------			---------		
113	@ROUND(C223*7.45*150/1500000/Q113+5,-1)		[36]	@ROUND(C241*7.45*150/1500000/R113+5,-1)		[48]	@ROUND(C259*7.45*150/1500000/U113+5,-1)
114	@ROUND(C227+5,-1)	+C242	+C243	@ROUND(C245+5,-1)	+C260	+C261	@ROUND(C263+5,-1)
115	[30]	+Q114	@ROUND(C250*1.25+50,-2)	[30]	+T114	@ROUND(C268*1.25+50,-2)	[30]
116		@ROUND(C251/1000000*1.25+0.5,-1)			@ROUND(C269/1000000*1.25+0.5,-1)		
117		[80]	@ROUND(Q116/(210-C24)/25*1000000/Q117+50,-2)		[120]	@ROUND(T116/(210-C24)/25*1000000/T117+50,-2)	
118	+P114		+R114	+S114		+U114	+V114

CHAPTER 3

COST ESTIMATE

TM-900560
COST ESTIMATE REPORT

TO	G. Van De Steeg	DATE	July 9, 1990
FROM	R. K. Boles	PROJECT No.	
		CHARGE No.	27325
ESTIMATE No.	2200-90-001	SBU	Forest Products

FACILITY DESC. Moss-American Bioslurry Treament Operation

LOCATION Milwaukee, WI

CAPACITY The facility is designed to treat 103,500 cubic yards of soil in three years at an operating rate of 24 Hrs/Day and 115 days/year for the washing curcuit and 159 days/year for the bioreactors.

ESTIMATED COST

Capital Cost $41,500,000 with an accuracy range of +50%/-20% and a scope contingency of 10% and a project contingency of 30%.

Operating Cost $532/CY with an accuracy range of +50/-20% and a contingency of 10%

The capital estimate is based on a project start date of April, 1992 and plant start-up date of September, 1993. The operating cost is presented in 1990 dollars. Should the project schedule change appropriate escalation factors should be applied to the costs.

CLASSIFICATION OF ESTIMATE The classification of this estimate is designated below:

[ ]	Definitive Cost Estimate	[ ]	Preliminary Cost Estimate
[X]	Conceptual Cost Estimate	[ ]	Order Of Magnitude Cost Estimate

SCOPE The above cost estimate includes the items indicated on the attached cost details, and as described in attachments to this report. A summary of the assumptions used to arrive at the cost is given below:

Basic Engineering	X	Kerr-McGee		Contractor
Detail Engineering		Kerr-McGee	X	Contractor
Field Supervision		Kerr-McGee	X	Contractor
Construction		Kerr-McGee	X	Contractor
Const. Parameters	X	Grass Roots		Addition
	X	Outdoor		Indoor
Services - Steam (water heater)		Excluded	X	Included
Air		Excluded	X	Included
Cooling Water	X	Excluded		Included
Process Water		Excluded	X	Included
Substation		Excluded	X	Included
MCC's		Excluded	X	Included
Control Room		Excluded	X	Included
Control Panel		Excluded	X	Included
Roads		Excluded	X	Included
Offices		Excluded	X	Included
Process Buildings	X	Excluded		Included

Instrumentation [ ] Pneumatic [X] Electronic [ ] Distributed

ATTACHMENTS

MEMO DATED July 9, 1990

R.K. Boles
Estimator

Approved:
G. Alexander
Sr. Project Manager

CC: J. C. Lowry
G. Alexander
D A. Milligan
K. L. Zachgo

INTERNAL CORRESPONDENCE

KM-814

	TM-900560		
Km Technology (UNIT)	TO G. Van De Steeg	DATE	July 10, 1990
	FROM R. K. Boles	SUBJECT	Capital Cost Estimate - Moss-American Bioslurry Treatment Operation

The attached cost estimate is based on a preliminary, conceptual process scheme, as illustrated on the flow diagrams presented in Appendix C. The estimate was compiled for the purpose of predicting what a facility, which is based on this process scheme, might cost if generally accepted practices were followed. Given the preliminary nature of this estimate, no effort was made to define exact equipment requirements, installation requirements, schedules, layouts, and other parameters that could affect the final cost. Due to the short amount of time that was available to prepare this estimate, some inconsistencies may exist. The estimated investment cost of $41.5 million is therefore considered to have an accuracy range of +50%, -20%, and is based on the following major assumptions:

Operating cost are estimated at $532/cubic yard as per Appendix D.

1) Excavation and transportation of contaminated soil to the processing site is not included.

2) Transportation of reclaimed soil and backfill of excavated areas with reclaimed soil is not included.

3) The site for erecting the soil reclamation process area is available in the location shown on sketch A, in Appendix C. It was assumed that the site is accessible from existing roads and that it contains no structures or other items requiring demolition.

4) It was assumed that the top two feet of soil would be scraped away from the site where construction will be required and that this soil could be stockpiled on site until it can be processed in the new facility.

5) It was assumed that potable and process (ground) water would be available at the site battery limits.

6) It was assumed that carbon treated process water can leave the battery limits as indicated, without further processing.

7) It was assumed that process equipment would be surrounded by a concrete slab (except reactors, which are uncurbed) to control minor spills. Dikes for total containment of major spills are not included.

8) It was assumed that carbon steel equipment, protected by rubber lining in high erosion areas, would be a suitable material of construction.

9) Demolition of the process area at the end of the reclamation campaign is not included in the capital cost, but has been estimated to be a credit

of $85,000 in today's dollars. The demolition cost includes decontamination of the equipment and support structures, landfilling of concrete in a non-hazardous land fill site, and selling steel equipment and piping for scrap.

10) It was assumed that natural gas and electric power is available at the site battery limits.

11) It was assumed that spare equipment is not required.

12) Since the plant life is expected to be only three years, it was assumed that painting is not required.

13) Thermal insulation is included for the bioreactors and for personnel protection only.

14) A security fence for the property has been included in the cost.

15) There are no costs included for environmental monitoring of ground water, air quality, or plant effluents.

16) Equipment selection and sizing is based on typical design criteria for similar processes. Actual design data is not available at this time. Major assumptions in this area include:

a) Reclamation of 103,000 cubic yards of soil in three years, at 115 days/year operation of the wash circuit and 159 days/year operation of the bioreators.

b) Bioreactor residence time of 159 days at 104°F (-10°F minimum ambient). Residence time in wash tanks of one hour per tank.

c) Slurry handling at 35% by weight (except rod mill at 75%). Soil density of 1.3 tons per cubic yard.

d) Half of the excavated soil can be treated by washing only. The other half (fines) will require subsequent processing in bioreactors.

The cost estimate summary and details are included in Appendix A. A detailed description of the cost estimate scope is included in Appendix B.

R. K. Boles

CC: J. C. Lowry
G. Alexander
D. A. Milligan
K. L. Zachgo

APPENDIX A.

7/10/90

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE
Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NO.: 7325

PREPARED BY : RKB

Engineering Costs	DOLLARS	
Contract Engineering & Services	4,130,000	
Kerr-McGee Costs: Basic Engineering	410,000	
Project Control	830,000	
Engineering		5,370,000

Major Equipment	DOLLARS	
Major Equipment	6,960,000	
Non-Equipment Items	100,000	
Turnkey Sub-Contracts		
Major Equipment		7,060,000

Construction Costs	DOLLARS		
Equipment Installation	570,000		
Concrete & Civil Work	1,910,000		
Structural Steel	810,000		
Process Piping	1,580,000		
Instrumentation	620,000		
Electrical	920,000		
Insulation	830,000		
Painting			
Buildings	220,000		
Direct Construction Costs		7,460,000	
Indirect Construction Cost	5,610,000		
Freight Costs	250,000		
Sales Taxes	250,000		
Indirect Construction Costs		6,110,000	
Construction Costs			13,570,000

Fixed Capital Costs			DOLLARS	
Engineering			5,370,000	
Major Equipment			7,060,000	
Construction Costs			13,570,000	
Scope Contingency			2,600,000	
Project Contingency			7,860,000	
Escalation	Project start date	01-Apr-92	5,040,000	
	Plant start up date	30-Sep-93		
Approved By: G. A. Date: 7/10/90			Fixed Capital Cost	41,500,000

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE

7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000

PREPARED BY : RKB

ITEM NO.	DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA	100 Soil Preparation														
100.0	Containment pad w/ sump	(1) =	1.0	0.1	25.0	0.2	4.3	2.9	3.5			36.9			
101.0	Front End Loader	(1) =											100.0		
102.0	Grizzle screen (4"X4")	(1) =	1.0	0.1		0.2						1.2			
103.0	Feed Hopper	(1) =	7.0	0.4	2.8	3.5			1.2			14.9			
104.0	Dump/pickup Pocket - Feed Hopper	(1) =			4.0				1.2			5.2			
105.0	Concrete Pad - Wash Station	(1) =			2.2				1.2			3.4			
106.0	Wash Station - High Pressure	(1) =	7.0	0.9	1.0		10.8	5.5	6.4			31.4			
107.0	Wash Station Sump	(1) =			0.5							0.5			
108.0	Pump - Wash Station Sump	(1) =	3.1	0.3	0.6		2.8	2.9	4.2			13.9			
109.0	Conveyor - Feed Hopper Discharge (Variable Speed)	(1) =	24.3	0.9	1.8	18.2	0.5	5.5	5.7			56.8			
110.0	Weight belt	(1) =	32.9	0.8	1.8	12.3	1.1	11.2	4.3			64.5			
111.0	Conveyor - Rod Mill Feed	(1) =	26.7	1.6	2.6	20.0	0.6	5.6	6.9			64.0			
112.0	Guard Magnet	(1) =	4.0	0.2		1.8	0.3	2.7	1.5			10.5			
113.0	Water Station - Rod Mill Feed	(1) =					1.0					1.0			
114.0	Rod Mill	(1)	790.0	10.8	80.9	11.9	6.6	2.8	29.8			941.8			
115.0	Vibrating Screen - Rod Mill Discharge 3/4 inch	(1) =	19.6	1.3		2.9	8.1	3.0	6.7			41.6			
116.0	Wash Station - Scalping Screen	(1) =					0.5					0.5			
117.0	Dump/Pickup Pocket - Scalping Screen	(1) =			4.0							4.0			
118.0	Rod Mill Sump	(1) =	15.3	0.8	3.1	2.3	12.8	6.0	1.8			42.1			
119.0	Agitator - Rod Mill Sump	(1) =	3.3	0.2		0.5	2.9	2.5	6.1			15.4			
120.0	Pump - Rod Mill Sump	(1) =	3.0	0.2	0.6	0.5	2.6	2.3	5.4			14.5			
121.0	Solids Density Control Point - Rod Mill Sump	(1) =					1.0	9.5	1.0			11.4			
122.0	Vibrating Screen - Final 1/4"	(1) =	9.8	0.5	2.0	1.5	8.6	7.4	5.2			34.8			
123.0	Wash Water Station - Final Screen	(1) =					1.0					1.0			
124.0	Dump/Pickup Pocket - Final Screen	(1) =			4.0							4.0			
			948.0	27.7	136.8	75.7	65.3	69.7	92.2			1415.4	100.0		

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000

PREPARED BY : RKD

ITEM NO. DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA 200 Soil Washing														
200.0 Containment pad w/ sump	(1) =	1.0	0.1	25.0	0.2	0.9	0.0	0.4			28.3			
201.0 Tank - First Stage Wash with Launder Overflow	(1) =	92.0	0.7	14.8	13.8	91.6	4.2	1.6			218.7			
202.0 Agitator - First Stage Wash	(1) =							10.3			10.3			
203.0 Surfactant Station - First Stage Wash	(1) =													
204.0 Soda Ash Station - First Stage Wash	(1) =					0.5					0.5			
205.0 pH Control Point - First Stage Wash	(1) =					0.4	3.5	0.4			4.2			
206.0 Solids Density Control Point - First Stage Wash	(1) =					1.0	9.5	1.0			11.4			
207.0 Pump - First Stage Wash	(1) =	3.5	0.4	0.7	0.5	4.3	2.8	6.6			18.7			
208.1 Cyclone - First Stage Wash A	(1) =	7.5	0.5	0.5	1.1	6.3	2.8	0.3			18.9			
208.2 Cyclone - First Stage Wash B	(1) =	7.5	0.5	0.5	1.1	6.3	2.8	0.3			18.9			
208.3 Cyclone - First Stage Wash C	(1) =	7.5	0.5	0.5	1.1	6.3	2.8	0.3			18.9			
208.4 Cyclone - First Stage Wash D	(1) =	7.5	0.5	0.5	1.1	6.3	2.8	0.3			18.9			
209.0 Tank - Second Stage Wash with Launder Overflow	(1) =	55.9	0.4	11.7	8.4	61.3	8.4	2.0			148.2			
210.0 Agitator - Second Stage Wash	(1) =							8.4			8.4			
211.0 Surfactant Station - Second Stage Wash	(1) =					0.5					0.5			
212.0 Soda Ash Station - Second Stage Wash	(1) =					0.5					0.5			
213.0 pH Control Point - Second Stage Wash	(1) =					0.4	3.5	0.4			4.2			
214.0 Pump - Second Stage Wash	(1) =	3.5	0.2	0.8	0.5	3.1	2.6	5.4			15.9			
215.1 Cyclone - Second Stage Wash A	(1) =	10.5	0.5	0.4	1.0	8.7	2.8	0.3			24.0			
215.2 Cyclone - Second Stage Wash B	(1) =	10.5	0.5	0.4	1.0	8.7	2.8	0.3			24.0			
216.0 Tank - Third Stage Wash	(1) =	51.9	0.4	11.7	7.8	61.4	8.4	2.0			143.6			
217.0 Agitator - Third Stage Wash	(1) =							7.2			7.2			
218.0 Surfactant Station - Third Stage Wash	(1) =					0.5					0.5			
219.0 Soda Ash Station - Third Stage Wash	(1) =					0.5					0.5			
220.0 pH Control Station - Third Stage Wash	(1) =					0.4	3.5	0.4			4.2			
221.0 Solids Density Control Point - Third Stage Wash	(1) =					1.0	9.5	1.0			11.4			
222.0 Drag Chain Skimmer - Floating Debris	(1) =	5.0	0.3		0.8	0.4	3.0	3.6			13.7			
223.0 Dump/Pickup Pocket - Floating Debris	(1) =			4.0							4.0			
224.0 Pump - Third Stage Wash	(1) =	3.5	0.2	0.7	0.5	3.1	2.9	5.5			16.4			
225.1 Cyclone - Third Stage Wash A	(1) =	10.5	0.5	0.4	1.0	8.7	2.8	0.3			24.0			
225.2 Cyclone - Third Stage Wash B	(1) =	10.5	0.5	0.4	1.0	8.7	2.8	0.3			24.0			
226.0 Spiral Classifier - Washed Sand	(1) =	24.9	1.2	5.0	3.7	20.8	8.4	5.3			69.3			
227.0 Wash Water Station - Spiral Classifier	(1) =					1.5					1.5			
228.0 Sump - Spiral Classifier	(1) =	30.0	1.6	8.0	4.5	24.8	8.4	0.8			78.1			
229.0 Agitator - Spiral Classifier Sump	(1) =							7.9			7.9			
230.0 Pump - Spiral Classifier Sump	(1) =	3.0	0.2	0.6	0.5	2.0	2.3	4.7			13.7			
231.0 Dump/Pickup Pocket - Washed Sand	(1) =			4.7							4.7			
232.0 Thickener - Bioreactor Feed	(1) =	110.5	1.5	6.3	17.8	95.1	2.8	6.3			240.3			
233.0 Pump - Thickener Overflow	(1) =	3.0	0.2	0.6	0.5	2.7	2.8	3.2			12.9			
234.0 Pump - Bioreactor Feed	(1) =	3.0	0.2	0.6	0.5	2.7	2.8	3.5			13.2			
235.0 pH Control Point - Thickener Feed	(1) =					0.4	3.5	0.4			4.2			
236.0 Solids Density Control Point - Bioreactor Feed	(1) =					1.0	9.5	1.0			11.4			
		470.7	11.1	96.6	70.6	442.8	128.2	91.4			1309.3			

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000

PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA	300 Slurry Bioreactor														
300.0	Containment pad w/ sump	(1) =	1.0	0.1	12.5	0.2	0.9	0.0	3.3			18.0			
301.0	Aerator-High Speed Mech. Surface, Draft Core Ext	(10)	500.0	28.0		5.3	2.3	23.1	217.0			836.3			
302.0	Bioreactor - Thickener with aeration on Rake	(4)	2000.0	400.0	1000.0	300.0	84.5	44.8	51.2	750.0		4630.5			
303.0	Pump - Recirculation	(4)	100.0	8.0	32.0	7.0	68.1	22.4	44.0	14.0		356.3			
305.0	Heat Exchanger - Bioreactor Panels	(4)	100.0	5.0			81.1	11.2	1.1			198.4			
306.0	Pump - Filter Booster Pump	(2) =	12.8	0.6	0.8	1.9	11.2	9.6	11.3			48.3			
307.0	Filter - Pressure Leaf	(3) =	392.4	4.9	23.5	14.7	80.0	15.0	5.1			535.6			
308.0	Conveyor - Filter Transfer	(3) =	114.6	5.7	2.3	17.2	0.3	3.0	15.9			159.0			
309.0	Conveyor - Inclined Loadout	(3) =	144.0	7.2	2.9	21.6	0.3	3.0	25.5			204.5			
310.0	Dump Pocket - Treated Solids	(1) =			4.7							4.7			
			3484.8	459.5	1078.7	367.8	328.7	132.8	375.8	764.0		6992.2			

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE — 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000 — PREPARED BY : [illegible]

ITEM NO. DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA 400 Storage & Reagents														
400.0 Containment pad w/ sump	(1) =	1.0	0.1	25.0	0.2	0.9	0.8	3.3			31.1			
401.0 Tank - Surfactant Storage 10 day Supply	(1) =	28.8	1.4	14.8	8.6	23.4	3.4	0.3			80.7			
402.0 Tank - Surfactant Day Tank	(1) =	10.8	0.5	7.4	3.2	9.5	8.1	0.8			40.3			
402.1 Agitator - Surfactant Day Tank	(1) =	10.0	0.5		3.0	0.1	1.4	5.3			20.4			
403.0 Pump - Surfactant Transfer	(1) =	3.1	0.2	0.6		2.7	2.3	4.7			13.6			
404.0 Wash Water Station - Surfactant Day Tank	(1) =					0.5					0.5			
405.0 Pump - Surfactant Feed	(1) =	3.1	0.2	0.6		2.7	2.3	2.5			11.4			
406.0 Tank - Soda Ash Day Feed Tank	(1) =	53.7	2.7	7.3	8.1	43.3	3.0	0.3			118.3			
407.0 Agitator - Soda Ash Day Feed Tank	(1) =							8.9			8.9			
408.0 Pump - Soda Ash Feed	(1) =	3.1	0.2	0.6	0.5	2.7	2.3	2.0			11.3			
409.0 Pump - Waste Water	(2) =	13.6	0.7	2.7	2.0	11.9	10.2	12.7			53.9			
410.0 Ground Water Tank	(1) =	9.1	0.5	8.9	1.4	8.0	6.8	0.7			35.3			
411.0 Soda Ash Silo	(1) =	12.4	0.6	7.3	1.9	10.9	9.3	2.1			44.5			
412.0 Waste Water Tank	(1)	589.1		117.8	29.2	47.4	3.0	0.3			786.8			
412.1 Wash Water Station - Soda Ash Tank	(1) =					0.5					0.5			
418.0 Pump - Ground Water Pump	(1) =	3.4	0.2	0.7	0.5	3.0	2.6	6.1			16.4			
419.0 Fresh Water Tank	(1) =	9.1	0.5	8.9	1.4	8.0	6.8	0.7			35.3			
420.0 Pump - Fresh Water	(1) =	3.4	0.2	0.7	0.5	3.0	2.6	6.1			16.4			
421.0 Urea Day Tank	(1) =	22.3	1.1	7.3	3.3	18.0	1.6	0.2			53.8			
422.0 Agitator - Urea Day Tank	(1) =	9.7	0.5	1.9	1.5	8.5	7.3	6.2			35.5			
423.0 Pump - Urea Day Tank	(3) =	9.3	0.5	1.9	1.4	8.1	7.0	12.5			40.6			
424.0 Urea Storage Tank	(1) =	46.1	2.3	14.8	6.9	37.1	2.2	1.4			110.8			
425.0 Agitator - Urea Storage Tank	(1) =	11.8	0.6	2.4	1.8	10.3	8.9	7.3			43.0			
426.0 Pump - Urea Storage Tank	(1) =	1.9	0.1	0.4	0.3	1.7	1.4	4.1			9.8			
427.0 Diammonium Phosphate Day Tank	(1) =	7.2	0.4	10.7	1.1	6.3	5.4	0.5			31.6			
428.0 Agitator - Diammonium Phosphate Day Tank	(1) =	6.5	0.3	1.3	1.0	5.7	4.9	4.4			24.1			
429.0 Pump - Diammonium Phosphate Day Tank	(1) =	1.9	0.1	0.4	0.3	1.7	1.4	4.1			9.8			
430.0 Diammonium Phosphate Storage Tank	(1) =	11.3	0.6	10.7	1.7	9.9	8.5	2.0			44.7			
431.0 Agitator - Diammonium Phosphate Storage Tank	(1) =	11.8	0.6	2.4	1.8	10.3	8.9	7.3			43.0			
432.0 Pump - Diammonium Phosphate Storage Tank	(1) =	1.9	0.1	0.4	0.3	1.7	1.4	3.1			8.8			
433.0 Carbon column filters	(3) =	281.4	14.1	44.4	12.7	76.1	18.0	3.0			449.6			
433.1 Carbon column filters holding tank	(1) =	42.8	2.1	14.8	6.4	5.4	3.0	0.3			74.9			
434.0 Conveyor - soda ash Transfer	(1) =	23.6	1.2	4.7	3.5	0.6	6.0	3.5			43.2			
		1243.2	32.7	321.6	104.2	379.7	150.6	116.8			2348.8			

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000

PREPARED BY : RKD

ITEM NO. DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA 500 Utilities														
500.0 Containment pad w/ sump	(1) =	1.0	0.1	25.0	0.2	0.9	0.0	3.3			31.1			
501.0 Boiler - Hot Water 210 F	(1) =	482.5	23.1	46.3	20.0	94.3	18.0	3.0	57.8		725.0			
502.0 Air Compressor	(1) =	90.0	4.5	15.4	13.5	72.5	4.5	24.5			224.8			
502.1 Air filter - air compressor	(1) =													
503.0 Heater - Air	(1) =	21.3	1.1	4.3	3.2	3.3	16.0	1.6	5.3		56.0			
504.0 Water Injection Pump	(1) =	2.1	0.1	0.4	0.3	1.8	1.6	2.3			8.6			
505.0 Heater - Water	(1) =	0.3	0.0	0.1	0.0	0.3	0.2	0.0	0.8		1.7			
506.0 Air Surge Tank - Pressure Vessel	(1) =	50.9	2.5	10.7	7.6	3.8	3.0	0.3			78.9			
507.0 Hold tank - water	(1) =	9.1	0.5	8.9	1.4	8.0	6.8	0.7			35.3			
508.0 Water mist Tank	(1) =	13.9	0.7	3.4	2.1	3.8	10.4	1.0			35.4			
		651.1	32.6	114.4	49.1	188.6	61.3	36.7	63.9		1197.6			

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325 Dollars / 1000 PREPARED BY : RKB

ITEM NO.	DESCRIPTION	QTY	MAJOR EQUIP	EQUIP INSTALL	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS
AREA 600	Plant General & Misc Equip.														
600.0	Office/Laboratory/Guard house/Change room	(1) =							4.4			4.4			50.0
601.0	Maintenance Building	(1) =							1.2			1.2			106.0
602.0	Motor Control Center	(1) =							1.2			1.2			38.0
603.0	Control Room	(1) =							1.2			1.2			25.0
604.0	Control Panel	(1) =					2.9	28.8	2.9			34.6			
605.0	Instrument Air Compressor	(1) =	30.0	1.5	6.0	4.5	26.3	22.5	3.5			94.2			
606.0	Main transformer	(1) =			4.5	8.7			179.8			193.0			
607.0	Vehicle wash station	(1) =	1.0	0.1	2.5	2.5	3.0	2.0	6.5			17.6			
608.0	Utility instruments	(1) =					2.8	28.0	2.8			33.6			
609.0	Misc. Pipe Supports	(1) =				100.0						100.0			
610.0	Chemical Unloading Station	(1) =			0.6	6.6	4.5	2.8	2.7			17.2			
611.0	Misc Utility Piping	(1) =					26.0					26.0			
612.0	Site Prep	(1) =			150.0							150.0			
999.0	Miscellaneous Equipment	5%	131.5	6.6		19.7	105.2					263.0			
			162.5	8.1	163.6	142.0	170.6	84.2	206.2			937.2			219.0
	sub-total		6,960.3	571.7	1,911.7	809.4	1,575.6	624.8	919.0	827.9		14,200.5	100.0		219.0

TR-90034

Class 2, Conceptual Cost Estimate for Plant Demolish and Landscaping
Moss-American Bioslurry Treatment Operation

07/10/90

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

Dollars / 1000

PREPARED BY : RKB

ITEM NO.	DESCRIPTION	Unit Cost	Units	QTY	MAJOR EQUIP	LABOR	CONC. & CIVIL -WORK	STRUCT STEEL	PIPING	INSTRU.	ELEC.	INSUL	PAINT	TOTAL	NON-EQUIP ITEMS	TURNKEY SUB-CONTR.	BUILDINGS	TOTAL
700	Demolition costs																	
701	Salvage value of equipment, includes removal cost	-20%	purch equip	84,000	(1,000.0)													(1,000.0)
702	Demolition & disposal of conc foundation & slabs	120	$/CY	4312			520.0											520.0
703	Demolition of structural steel	0.1	$/lb	4,113,304				410.0										410.0
704	Salvage value of structrual steel	-0.02	$/lb	4,113,304				(80.0)										(80.0)
705	Demolition of structural steel	0.1	$/lb	151,343					20.0									20.0
706	Salvage value of piping, includes removal cost	-0.02	$/lb	151,343					(3.0)									(3.0)
707	Demolition & disposal of instr, no salvage value	5%	capital cost	$825						30.0								30.0
708	Demolition & disposal of elect, no salvage value	5%	capital cost	$919							50.0							50.0
709	Steam clean & decontaminate site 400'W by 700'L	0.2	$/SqFt	280000		80.0												80.0
710	Salvage value of front end loader	-75%	purch price	1											(80.0)			(80.0)
711	Salvage value of Office/Lab/Guard/Chg rm trailers	-80%	purch price														(30.0)	(30.0)
712	Demolition and disposal of Maint Bldg	0.075	$/CuFt	24000													4.0	4.0
713	Demolition and disposal of MCC	0.20	$/CuFt	10800													4.0	4.0
714	Salvage value of Control Room trailer	-0.6	purch price														(20.0)	(20.0)
715	Main transformer	-0.5	purch price														(90.0)	(90.0)
716	Backfill abandoned plant site with select fill	3.5	$/CY	20741			70.0											70.0
717	Landscaping	1.7	$/SqYd	31111			50.0											50.0
																		(85.0)

APPENDIX B.

Cost Estimate Scope
Moss-American Bioslurry Treatment Operation

INTRODUCTION

The objective of this project is to decontaminate the creosote laden soil on the deactivated Moss-American forest product site, in Milwaukee, Wisconsin.

ENGINEERING

Engineering responsibilities for this project are premised to be as follows:

Basic engineering and project control will be assigned to Kerr-McGee's Technology Division.

Detail design and construction supervision will be assigned to an outside design contractor.

EQUIPMENT

A list of major equipment is attached to this document. A 5% allowance for undefined equipment has been added to the estimate.

CONSTRUCTION

Equipment Installation

The proposed location for the plant is near Milwaukee, Wisconsin. The site is open and easily accessible by construction equipment. It is premised that there will be no abnormal labor constraints.

Concrete & Civil Work

Cost are included to clear and grub vegetation from the site and excavate the top two feet of contaminated soil. This excavated material will be stock piled. A Security fence and a gravel access road has also been provided. Allowances are included for sewer lines, potable water lines, natural gas lines, and fire loops.

All process areas, with the exception of the Bioreactors, will have containment slabs with sumps.

All steel structures and tanks will have pier footings. Pumps, compressors and other mechanical equipment are supported by block footings.

Structural Steel

Due to the temporary nature of this plant all piping is premised to be supported on sleeper. Access platforms are provided for all tanks and elevated equipment. Support structures are provided were necessary.

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE - EQUI[illegible] LIST — 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325 — PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA	100 Soil Preparation									
100.0	Containment pad w/ sump	* 1	Concrete		50'W by 100'L by 6"T	1	1		$1,000	$1,000
101.0	Front End Loader	* 1	CS		2.5 CY			included in Non-Equip acctg		
102.0	Grizzle screen (4"X4")	* 1	CS		8'L by 6'W			Reject > 4" material	$1,000	$1,000
103.0	Feed Hopper	* 1	CS		8'L by 6'W by 4'H				$7,000	$7,000
104.0	Dump/pickup Pocket - Feed Hopper	* 1	Concrete		8'L by 6'W by 4'H			included in civil acctg		
105.0	Concrete Pad - Wash Station	* 1	Concrete		16'L by 16'W by 8"T			included in civil acctg		
106.0	Wash Station - High Pressure	* 1	CS	10 GPM @ 1040' TDH		7.5	7.5	Recip pump	$7,000	$7,000
107.0	Wash Station Sump	* 1	Concrete		4'L by 4'W by 4'D,6"T			included in civil acctg		
108.0	Pump - Wash Station Sump	* 1	CS	30 GPM @ 105' TDH		2	2		$3,100	$3,100
109.0	Conveyor - Feed Hopper Discharge (Variable Speed)	* 1	CS		2'W by 12'L	2	2		$24,300	$24,300
110.0	Weight belt	* 1	CS		2'W by 6'L	1	1		$32,900	$32,900
111.0	Conveyor - Rod Mill Feed	* 1	CS		2'W by 30'L	5	5		$26,700	$26,700
112.0	Guard Magnet	* 1	CS					Rejects metals	$4,000	$4,000
113.0	Water Station - Rod Mill Feed	* 1	CS	20 GPM				included in piping acctg		
114.0	Rod Mill	* 1	CS		10'D by 18'L	1250	1250		$790,000	$790,000
115.0	Vibrating Screen - Rod Mill Discharge 3/4 inch	* 1	CS		7'W by 10'L	10	10		$19,600	$19,600
116.0	Wash Station - Scalping Screen	* 1	CS	5 GPM				included in piping acctg		
117.0	Dump/Pickup Pocket - Scalping Screen	* 1	Concrete		8'L by 6'W by 4'H			included in civil acctg		
118.0	Rod Mill Sump	* 1	CS/RL	2500 gallons	7'L by 7'W by 7'H			CS tank with Rubber lining	$15,300	$15,300
119.0	Agitator - Rod Mill Sump	* 1	CS/RL			7.5	7.5	rubber covered	$3,300	$3,300
120.0	Pump - Rod Mill Sump	* 1	CS/RL	75 GPM @ 80' TDH		5	5	rubber lined	$3,000	$3,000
121.0	Solids Density Control Point - Rod Mill Sump	* 1						included in instrumentation acctg		
122.0	Vibrating Screen - Final 1/4"	* 1	CS/SS		9'L by 3'W	3	3		$9,800	$9,800
123.0	Wash Water Station - Final Screen	* 1	CS	20 GPM				included in piping acctg		
124.0	Dump/Pickup Pocket - Final Screen	* 1	Concrete		8'L by 6'W by 4'H			included in civil acctg		
							1294			$948,000

TR-90034

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA 200 Soil Washing										
200.0	Containment pad w/ sump	* 1	CS		50'W by 100'L by 0"T	1	1	included in civil acctg	$1,000	$1,000
201.0	Tank - First Stage Wash with Launder Overflow	* 1	CS/RL	15000 gallons	12.5'D by 17'H			CS tank with rubber lining	$92,000	$92,000
202.0	Agitator - First Stage Wash	* 1	CS/RL			50	50	includ with tank cost		
203.0	Surfactant Station - First Stage Wash	1		6 GPM				included in piping acctg		
204.0	Soda Ash Station - First Stage Wash	* 1		4 GPM				included in piping acctg		
205.0	pH Control Point - First Stage Wash	* 1						included in instrumentation acctg		
206.0	Solids Density Control Point - First Stage Wash	* 1						included in instrumentation acctg		
207.0	Pump - First Stage Wash	* 1	CS/RL	250 GPM @ 50' TDH		10	10	CS pump with rubber lining	$3,500	$3,500
208.1	Cyclone - First Stage Wash A	* 1	CS/RL		14"D			CS with urethane lining	$7,500	$7,500
208.2	Cyclone - First Stage Wash B	* 1	CS/RL		14"D			CS with urethane lining	$7,500	$7,500
208.3	Cyclone - First Stage Wash C	* 1	CS/RL		14"D			CS with urethane lining	$7,500	$7,500
208.4	Cyclone - First Stage Wash D	* 1	CS/RL		14"D			CS with urethane lining	$7,500	$7,500
209.0	Tank - Second Stage Wash with Launder Overflow	* 1	CS/RL	9000 gallons	10.5'D by 14'H			CS tank with rubber lining	$55,900	$55,900
210.0	Agitator - Second Stage Wash	* 1	CS/RL			25	25	Cost included with tank		
211.0	Surfactant Station - Second Stage Wash	* 1		6 GPM				included in piping acctg		
212.0	Soda Ash Station - Second Stage Wash	* 1		4 GPM				included in piping acctg		
213.0	pH Control Point - Second Stage Wash	* 1						included in instrumentation acctg		
214.0	Pump - Second Stage Wash	* 1	CS/RL	140 GPM @ 50' TDH		5	5	CS pump with rubber lining	$3,500	$3,500
215.1	Cyclone - Second Stage Wash A	* 1	CS/RL		15"D			CS with urethane lining	$10,500	$10,500
215.2	Cyclone - Second Stage Wash B	* 1	CS/RL		15"D			CS with urethane lining	$10,500	$10,500
216.0	Tank - Third Stage Wash	* 1	CS/RL	9000 gallons	10.5'D by 14'H			CS tank with rubber lining	$51,900	$51,900
217.0	Agitator - Third Stage Wash	* 1	CS/RL			15	15	Cost included with tank		
218.0	Surfactant Station - Third Stage Wash	* 1		6 GPM				included in piping acctg		
219.0	Soda Ash Station - Third Stage Wash	* 1		4 GPM				included in piping acctg		
220.0	pH Control Station - Third Stage Wash	* 1						included in instrumentation acctg		
221.0	Solids Density Control Point - Third Stage Wash	* 1						included in instrumentation acctg		
222.0	Drag Chain Skimmer - Floating Debris	* 1	SS		15'L by 1'W	1	1		$5,000	$5,000
223.0	Dump/Pickup Pocket - Floating Debris	* 1	Concrete		8'L by 6'W by 4'H			included in civil acctg		
224.0	Pump - Third Stage Wash	* 1	CS/RL	140 GPM @ 50' TDH		5	5	CS pump with rubber lining	$3,500	$3,500
225.1	Cyclone - Third Stage Wash A	* 1	CS/RL		15"D			CS with urethane lining	$10,500	$10,500
225.2	Cyclone - Third Stage Wash B	* 1	CS/RL		15"D			CS with urethane lining	$10,500	$10,500
226.0	Spiral Classifier - Washed Sand	* 1	SS		24"D by 13'L	3	3		$24,900	$24,900
227.0	Wash Water Station - Spiral Classifier	* 1		90 GPM				included in piping acctg		
228.0	Sump - Spiral Classifier	* 1	CS/RL	1500 gallons	6'D by 7'H			CS tank with rubber lining	$30,000	$30,000
229.0	Agitator - Spiral Classifier Sump	* 1	CS/RL			20	20	Cost included with tank		
230.0	Pump - Spiral Classifier Sump	* 1	CS/RL	100 GPM @ 50' TDH		3	3	CS pump with rubber lining	$3,000	$3,000
231.0	Dump/Pickup Pocket - Washed Sand	* 1	Concrete		12'L by 12'W by 8'H			included in civil acctg		
232.0	Thickener - Bioreactor Feed	* 1	CS	15000 gallons	23'D by 5'H	1.5	1.5	Cost of rake included with thickener	$118,500	$118,500
233.0	Pump - Thickener Overflow	* 1	CS/RL	15 GPM @ 75' TDH		0.75	0.75		$3,000	$3,000
234.0	Pump - Bioreactor Feed	* 1	CS/RL	16 GPM @ 75' TDH		1	1		$3,000	$3,000
235.0	pH Control Point - Thickener Feed	* 1						included in instrumentation acctg		
236.0	Solids Density Control Point - Bioreactor Feed	* 1						included in instrumentation acctg		
							141.3			$470,700

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE - EQUI[illegible]IST 7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA 300 Slurry Bioreactor										
300.0	Containment pad w/ sump	# 1	CS		50'W by 50'L by 6"T	1	1	included in civil acctg	$1,000	$1,000
301.0	Aerator-High Speed Mech. Surface, Draft Core Ext	#16				120	1920		$35,000	$560,000
302.0	Bioreactor - Thickener with aeration on Rake	# 4	CS		170'D by 20'H	75	300		$500,000	$2,000,000
303.0	Pump - Recirculation	# 4	CS/RL	5300 GPM @ 15' TDH	12"D inlet BY 12"D outlet	50	200	Elbow pump	$40,000	$160,000
305.0	Heat Exchanger - Bioreactor Panels	# 4	CS	5000 SqFt	2"D pipe coil			pipe coil inside bioreactor tank	$25,000	$100,000
306.0	Pump - Filter Booster Pump	# 2	CS/RL	100 GPM @ 90' TDH		5	10		$6,400	$12,800
307.0	Filter - Pressure Leaf	# 3	CS		600 sq. ft.				$130,800	$392,400
308.0	Conveyor - Filter Transfer	# 3	CS/RL	270 TPH	36"W by 100'L	5	15		$38,200	$114,600
309.0	Conveyor - Inclined Loadout	# 3	CS/RL	270 TPH	36"W by 100'L	25	75		$48,000	$144,000
310.0	Dump Pocket - Treated Solids	# 1	Concrete		12'L by 12'W by 8'H			included in civil acctg		
							2521			$3,484,800

TR-90034

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA 400 Storage & Reagents										
400.0	Containment pad w/ sump	* 1	CS		50'W by 100'L by 8"T	1	1	included in civil acctg	$1,000	$1,000
401.0	Tank - Surfactant Storage 10 day Supply	* 1	CS	54000 gallons	17'D by 32'H			Cone roof tank	$28,000	$28,000
402.0	Tank - Surfactant Day Tank	* 1	CS	6000 gallons	8'D by 16'H			Cone roof tank	$10,800	$10,800
402.1	Agitator - Surfactant Day Tank	1	CS			5			$10,000	$10,000
403.0	Pump - Surfactant Transfer	* 1	SS	100 GPM @ 50' TDH		3	3		$3,100	$3,100
404.0	Wash Water Station - Surfactant Day Tank	* 1		5 GPM				included in piping acctg		
405.0	Pump - Surfactant Feed	* 1	SS	6 GPM @ 50' TDH		0.33	0.33		$3,100	$3,100
406.0	Tank - Soda Ash Day Feed Tank	* 1	SS	4000 gallons	8'D by 11'H				$53,700	$53,700
407.0	Agitator - Soda Ash Day Feed Tank	* 1	CS/RL			30	30	Cost included with tank		
408.0	Pump - Soda Ash Feed	* 1	SS	4 GPM @ 50' TDH		0.13	0.13		$3,100	$3,100
409.0	Pump - Waste Water	* 2	CS/RL	200 GPM @ 60' TDH		7.5	15		$6,800	$13,600
410.0	Ground Water Tank	* 1	CS	10000 gallons	9'D by 19'H			Open top tank	$9,100	$9,100
411.0	Soda Ash Silo	* 1	CS	6000 gallons	8'D by 16'H				$12,400	$12,400
412.0	Waste Water Tank	* 1	CS	4700000 gallons	200'D by 20'H				$589,100	$589,100
412.1	Wash Water Station - Soda Ash Tank	* 1		5 GPM				included in piping acctg		
418.0	Pump - Ground Water Pump	* 1	CS/RL	200 GPM @ 60' TDH		7.5	7.5	CS pump with rubber lining	$3,400	$3,400
419.0	Fresh Water Tank	* 1	CS	10000 gallons	9'D by 19'H			Open top tank	$9,100	$9,100
420.0	Pump - Fresh Water	* 1	CS/RL	200 GPM @ 60' TDH		7.5	7.5	CS pump with rubber lining	$3,400	$3,400
421.0	Urea Day Tank	* 1	SS	4100 gallons	8'D BY 11'H			Cone roof tank	$22,300	$22,300
422.0	Agitator - Urea Day Tank	* 1	SS			6	6		$9,700	$9,700
423.0	Pump - Urea Day Tank	* 3	CS/RL	50 GPM @ 60' TDH		2	6	CS pump with rubber lining	$3,100	$9,300
424.0	Urea Storage Tank	* 1	CS	18000 gallons	13.5'D by 17'H			Cone roof tank	$46,100	$46,100
425.0	Agitator - Urea Storage Tank	* 1	CS			10	10	Cost included with tank	$11,800	$11,800
426.0	Pump - Urea Storage Tank	* 1	CS	70 GPM @ 50' TDH		2	2		$1,900	$1,900
427.0	Diammonium Phosphate Day Tank	* 1	CS	1000 gallons	5'D by 7'H			flat top & bottom storage tank	$7,200	$7,200
428.0	Agitator - Diammonium Phosphate Day Tank	* 1	CS			2	2		$8,500	$8,500
429.0	Pump - Diammonium Phosphate Day Tank	* 1	CS	50 GPM @ 60' TDH		2	2		$1,900	$1,900
430.0	Diammonium Phosphate Storage Tank	* 1	CS	7000 gallons	10'D by 12'H			Cone roof tank	$11,300	$11,300
431.0	Agitator - Diammonium Phosphate Storage Tank	* 1	CS			10	10		$11,800	$11,800
432.0	Pump - Diammonium Phosphate Storage Tank	* 1	CS	20 GPM @ 50' TDH		0.75	0.75		$1,900	$1,900
433.0	Carbon column filters	* 3	CS		12'D by 12't-t			Column packed with Activated Carbon	$93,800	$281,400
433.1	Carbon column filters holding tank	* 1	CS		12'D by 12't-t			Holding tank used during replacement of Activated Carbon	$42,000	$42,000
434.0	Conveyor - soda ash Transfer	* 1		0.12 TPH	18"W by 30'L	0.75	0.75		$23,600	$23,600
							104			$1,243,200

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

PREPARED BY : [illegible]

ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA 500 Utilities										
500.0	Containment pad w/ sump	* 1	CS		50'W by 100'L by 6"T	1	1	included in civil acctg	$1,000	$1,000
501.0	Boiler - Hot Water 210 F	* 1	CS	[illegible] MM Btu/h 1400 GPM					$462,500	$462,500
502.0	Air Compressor	* 1	CS	4700 CFM @ 30 PSIG		700	700	Centrif blower	$90,000	$90,000
502.1	Air filter - air compressor	* 1	CS	4700 CFM				Inlet filter included with air compressor		
503.0	Heater - Air	* 1	SS	300 sq. ft.	shell: 12"D by 20'L			tubes: 1"D	$21,300	$21,300
504.0	Water Injection Pump	* 1	CS	1 GPM @ 300' TDH		0.25	0.25		$2,100	$2,100
505.0	Heater - Water	* 1	SS	1 sq. ft.					$300	$300
506.0	Air Surge Tank - Pressure Vessel	* 1	CS	14000 gallons	10'D by 24'H			150 psig design pressure	$50,900	$50,900
507.0	Hold tank - water	* 1	CS	10000 gallons	9'D by 19'H			Open top tank	$9,100	$9,100
508.0	Water mist Tank	* 1	CS	1000 gallons	5'D by 7'H				$13,900	$13,900
							701.3			$651,100

TR-90034

CLASS 2, CONCEPTUAL CAPITAL COST ESTIMATE - EQUIPMENT LIST

7/10/90

Moss-American Bioslurry Treatment Operation

LOCATION : Milwaukee, WI
CHARGE NUMBER : 7325

PREPARED BY : RHD

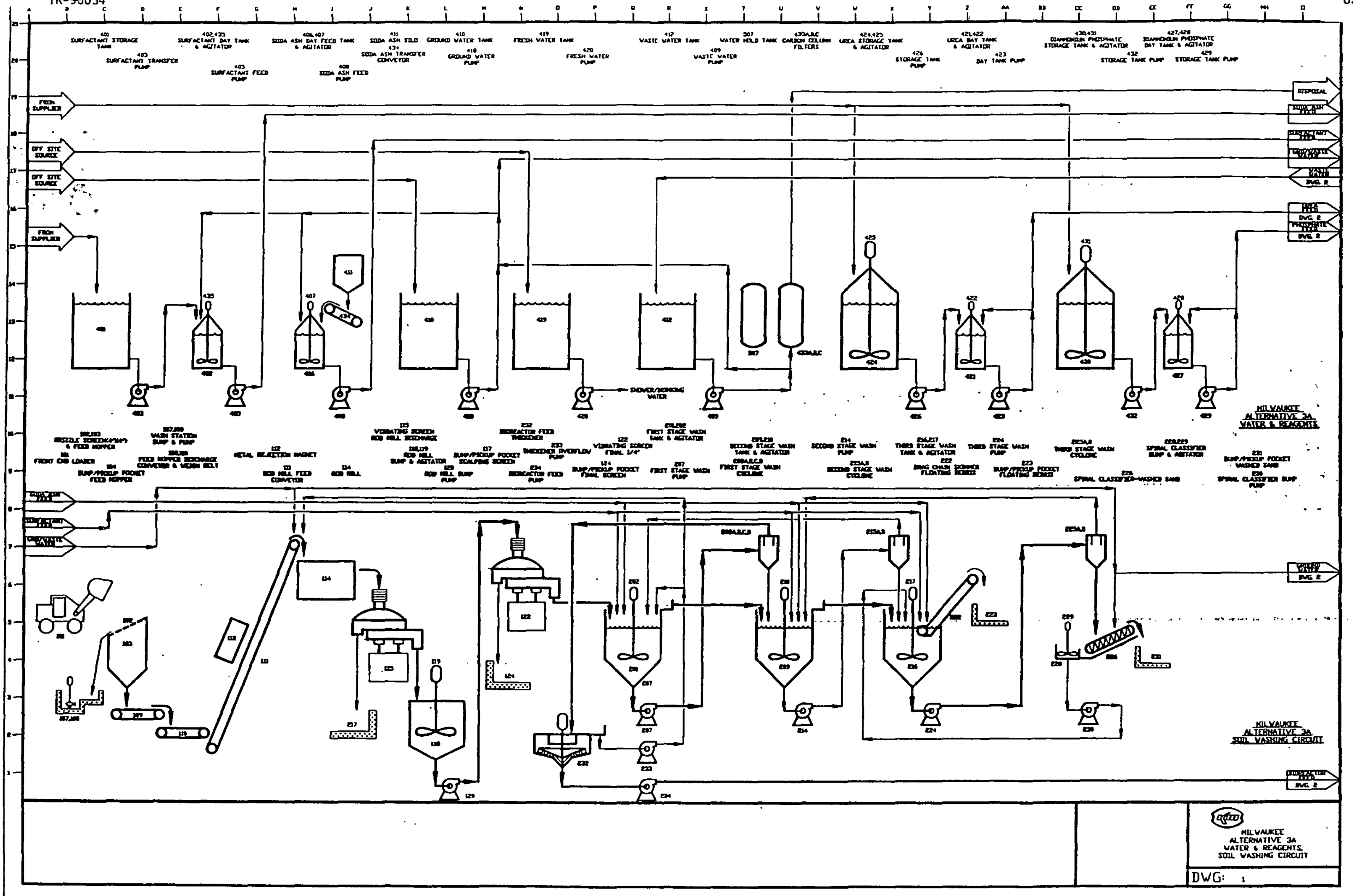
ITEM NO.	DESCRIPTION	QTY	MAT'L	CAPACITY	SIZE	CONN. hp	TOTAL CONN. hp	COMMENTS	ESTIMATE PURCHASE COST (each)	ESTIMATE PURCHASE COST (total)
AREA 600 Plant General & Misc Equip.								Building costs are included in the building acctg		
600.0	Office/Laboratory/Guard house/Change room	# 1			2ea - 12'W by 40'L	1	1	Temporary trailer		
601.0	Maintenance Building	# 1			40'W by 40'L by 15'H			Pole Barn with metal siding		
602.0	Motor Control Center	# 1			30'W by 30'L			Concrete block building		
603.0	Control Room	# 1			1ea - 12'W by 40'L			Temporary trailer		
604.0	Control Panel	# 1						Control Panel w/o panel instrument		
605.0	Instrument Air Compressor	# 1	CS	allowance	1ea - 12'W by 40'L			allowance	$30,000	$30,000
606.0	Main transformer	# 1		10,000 KVA				included in electrical acctg		
607.0	Vehicle wash station	# 1	Concrete		16'L by 8'W by 8'T	2	2	high pressure pump, plus conc pad etc.	$1,000	$1,000
608.0	Utility instruments	# 1						allowance for instrumenting plant utilities		
609.0	Misc. Pipe Supports	# 1						pipe shoe and angle supports		
610.0	Chemical Unloading Station	# 1			4'W by 20'L platform			includes piping, instr, lights and support steel		
611.0	Misc Utility Piping	# 1						Sewer lines, potable water, fire loop, and natural gas lines		
612.0	Site Prep	# 1			Total site is 400'W by 700'L			Clear & grub, excav contaminated soil on coast site, fence		
699.0	Miscellaneous Equipment	# 1								
							3			$31,000
							4784			$8,828,800

78 Starter Req'd

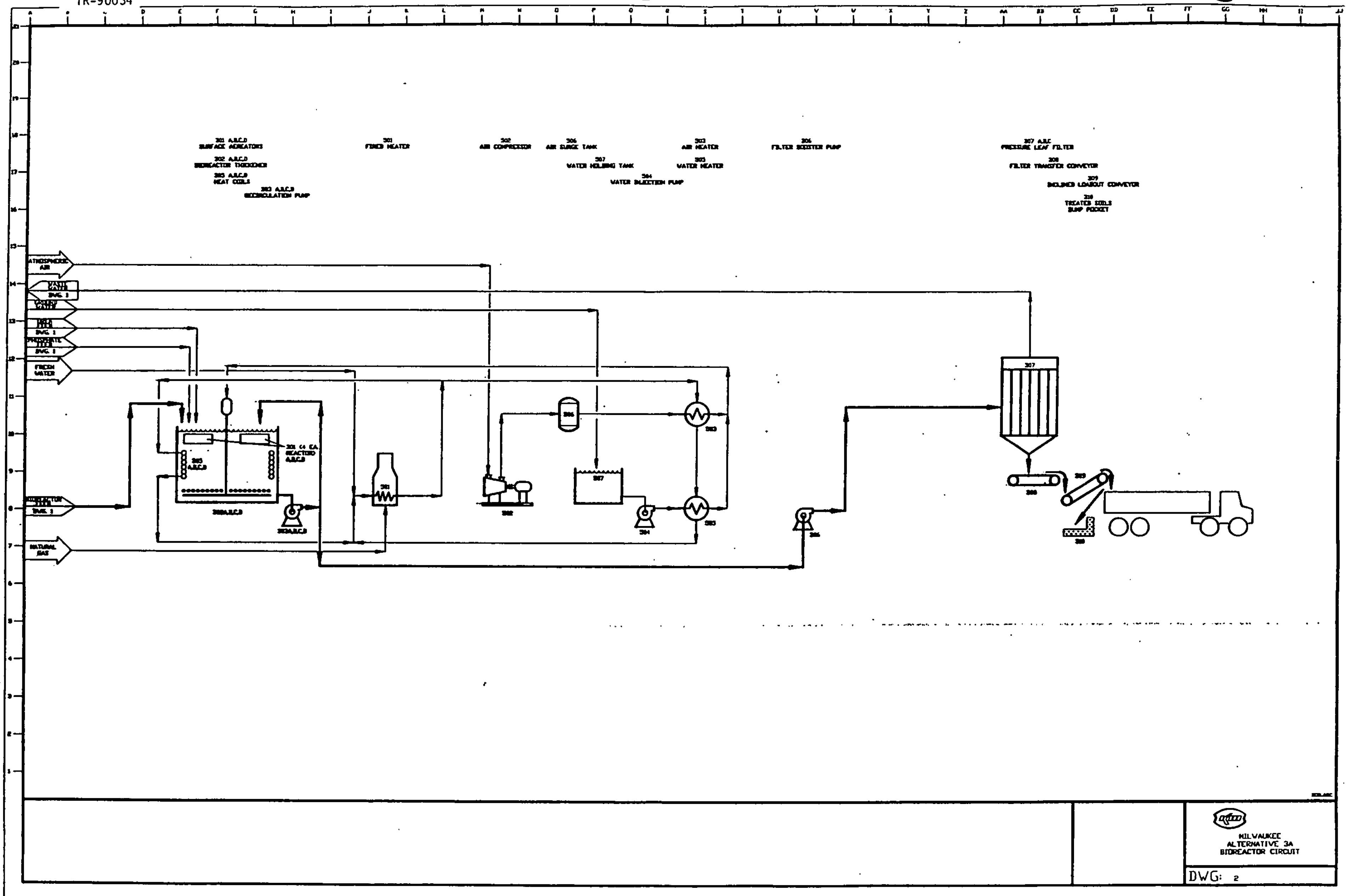
CS=Carbon Steel
RL=Rubber Lining
SS=Stainless Steel

L=Length, W=Width,
D=Diameter, T=Thickness

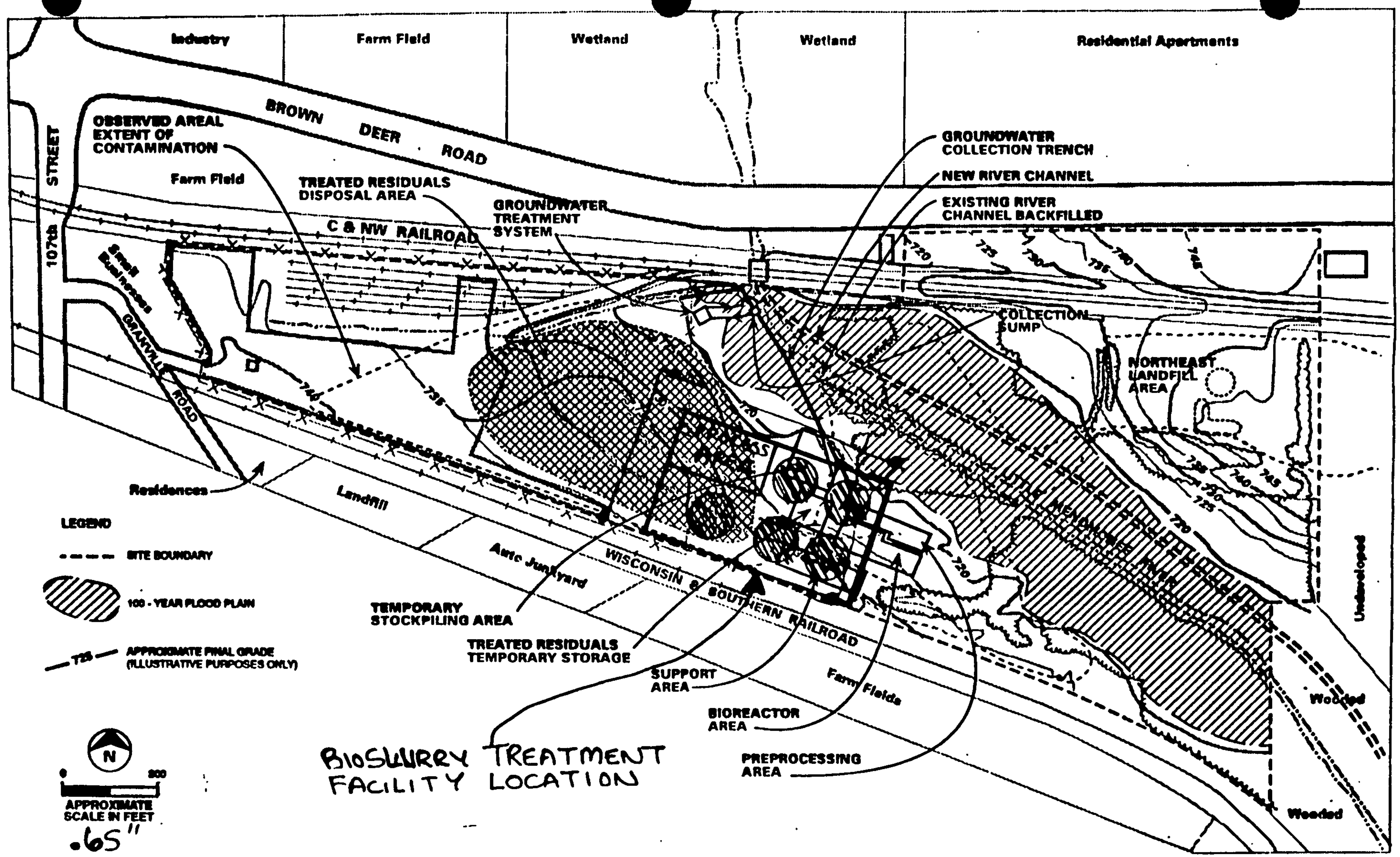
APPENDIX C.


MILWAUKEE
ALTERNATIVE 3A
WATER & REAGENTS
SOIL WASHING CIRCUIT
DWG: 1
DISPOSAL
FROM SUPPLIER
OFF SITE SOURCE

TR-90034



301 A,B,C,D
SURFACE AERATORS
302 A,B,C,D
BIOREACTOR THICKENER
303 A,B,C,D
HEAT COILS
303 A,B,C,D
RECIRCULATION PUMP
301
FIRED HEATER
302
AIR COMPRESSOR
306
AIR SURGE TANK
307
WATER HOLDING TANK
304
WATER INJECTION PUMP
303
AIR HEATER
305
WATER HEATER
306
FILTER BOOSTER PUMP
307 A,B,C
PRESSURE LEAF FILTER
308
FILTER TRANSFER CONVEYOR
309
INCLINED LOADOUT CONVEYOR
310
TREATED SOILS
SUMP POCKET
ATMOSPHERIC AIR
FRESH WATER
NATURAL GAS
MILWAUKEE
ALTERNATIVE 3A
BIOREACTOR CIRCUIT
DWG: 2



SKETCH A
DRAWING EXTRACTED FROM FS

FIGURE 3-12
ALTERNATIVE 3A - SLURRY TREATMENT OF SOIL AND SEDIMENT AND TREATMENT OF GROUNDWATER
MOSS-AMERICAN FS

Appendix D.

TECHNOLOGY

R. K. Boles

S. B. Malvadkar

July 10, 1990

Operating Cost of Bio-Remediation of Creosote Contaminated Soil

The operating cost reported in this memo is based on the process concept and flow diagram developed by D. A. Milligan for bioremediation of creosote contaminated soil near Milwaukee (Wisconsin). It excludes cost of excavation and landfill as well as laboratory support. It is subjected to the following additional bases and assumptions:

1. 3 year operation involving 115 days/yr for soil preparation, washing and screening, and 159 days/yr for bioreaction.

2. During the campaign, the operation is 7 days/week, 24 hrs/day.

3. A total of 103,500 yd^3 of soil with a bulk density of 1.3 tons/yd^3 is to be processed. The average $-CH_2-$ loading is 2700 ppm (wt/wt soil).

4. Electricity unit cost is $0.05/kwhr and natural gas unit cost is $3/MM BTUs.

5. Connected horse powers for different areas (~1,436 hp for soil preparation, washing and screening, and ~3330 hp for other areas) are as supplied by R. K. Boles.

6. Natural gas consumption is primarily meant for maintaining the bioreactor temperature at 40°F. The average overall heat loss rate is 20 MM BTUs/hr for all the four reactors is employed on the basis of the overall heat loss coefficient supplied by D. A. Milligan. (The reactors are filled and operated in a staggered manner. Their heating is started when they are half filled. The heat loss for each reactor is based on the monthly average temperature for Milwaukee (Wisconsin)).

7. One operator per shift for 115 days/yr is employed to operate the front end loader and two operators per shift for 274 days/yr to run the soil preparation, washing, screening and bioreaction.

8. The average operator wages are $12/hr plus +20% of wages for overhead. The burdens, i.e. supervision, guards, secretarial support etc., are 100% of direct labor costs.

9. The surfactant usage is as given by K. Zacho:

   - Agent 1100-149 @ $0.64/lb is used at 0.3% (wt/wt) of the soil.

   - SEE-340 @ $0.90/lb is used at 0.3% (wt/wt) of the soil.

   - STEPAN8X @ $0.215/lb) is used at 1.4% (wt/wt) of the soil.

10. The soil contains 2,700 ppm (wt/wt) $-CH_2-$ with respect to the soil. The surfactant adds another 3,200 ppm (wt/wt) $-CH_2-$ with respect to the soil.

11. The nutrient consumption is based on G. Van De Steeg's recommendations, viz. 5% (wt/wt) nitrogen with respect to $-CH_2-$ and 1% (wt/wt) phosphorus with respect to $-CH_2-$.

12. Phosphorus is supplied in the form of dissolved diammonium phosphate (@ $160/ton (Chemical Marketing Reporter)) and nitrogen is supplied partly by diammonium phosphate and partly by urea (@ $145/ton (Chemical Marketing Reporter)).

13. Soda ash consumption is at 16 lbs/ton of soil.

14. Soda ash unit cost is $100/ton.

15. The plant is depreciated over the three year of its operation. Its annual maintenance is assumed to be 1% of fixed capital, and its taxes and insurance are also assumed to be 1% of fixed capital per year. The plant demolition is expensed and the plant salvage value is credited. The net demolition/salvage credit data was supplied by R. K. Boles.

S. B. Malvadkar

S. B. Malvadkar

Operating Cost Estimate for Bio-Remediation of Creosote Contaminated Soil Near Milwaukee (WI)

Cost Item	Project Cost $	Unit Cost $/yd^3
I. Raw Materials and Chemicals		
Agent 1100-149	517,000	5.00
SEE-340	727,000	7.02
STEPAN8X	810,000	7.83
Soda Ash	108,000	1.04
Diammonium Phosphate	6,000	0.06
Urea	11,000	0.11
	2,179,000	21.06
II. Utilities		
Electricity for Soil Preparation, Washing and Screening	444,000	4.29
Electricity for BioReactors	1,422,000	13.74
Natural Gas for heating the BioReactors	46,000	0.44
Natural Gas for maintaining the Bio-Reactor Temperatures at 40°C	752,000	7.27
	2,664,000	25.74
III. Labor-Related		
Direct Labor	573,000	5.54
Overhead	115,000	1.11
Burdens	573,000	5.54
	1,261,000	12.19

INTERNAL CORRESPONDENCE

Technology Hydrology (UNIT)	TO	File Memorandum	DATE	August 1, 1990
	FROM	W. J. Ganus	SUBJECT	Stream Sediments, Moss-American site Milwaukee

The approach to sampling the stream sediments along the Little Menomonee River by CH2M Hill and their subsequent interpretation of the data indicates a lack of understanding of the processes involved with the uncontrolled releases of creosote from the plant site and the gradual migration of creosote downstream. Without a reasonable understanding of these processes, the sampling of sediments, the interpretation of data, and the formulation of remedial actions are all subject to faulty conclusions and a waste of time, effort and money.

The creosote used at the site was reported to be composed of approximately equal parts of fuel oil and coal tar. The fuel oil fraction was lighter than water and the coal tar fraction heavier than water. This mixture was slightly heavier than water and would typically sink to the bottom of a pond. Along the bottom of a stream of moving water, however, this mixture would be expected to break up into beads of material, and be carried along like bed load in the stream, tumbling and rolling along the creek bottom. Commonly, the creosote beads would be trapped along with the sediment and other debris being carried by the stream. Like stream sediments, the particles of creosote would remain in one place for a period of time or be reworked to another location downstream with each new runoff event that would scour and fill the creek sediments. Each time the creosote beads were agitated, some fraction of the fuel oil was probably released, resulting in a heavier residual left behind.

In field investigations in 1977 and again in 1990, I was able to find small isolated occurrences of the creosote in the sediment. More widespread occurrences were evident in 1977 than in 1990, as would be expected. I conclude that in the 13 year period, much of the creosote has been reworked and dispersed.

In the field investigations in 1977, I made numerous cuts with a hand shovel along the stream bank above the water level, searching for the presence of creosote. Occasionally I found a localized thin layer of creosote that never extended more than an inch or two. Commonly this creosote was with debris such as twigs or leaves, indicating that a storm event was probably responsible for the creosote being transported and trapped. I saw no evidence that the creosote in this form was moving as a fluid through the sediments.

A review of the CH2M Hill sediment sampling protocol and activity indicates some interesting problems and results. Initially they tried to take stream bottom samples with a sampling tube. Recovery of sediment was very poor, so they switched to sampling with an augering tool. If creosote was present at a shallow depth at any location, the sampling activity would disturb the sediments, releasing some oil and a sheen on the water would be noted. Precautions that were taken to avoid vertical contamination in this kind of a sampling environment are not described.

To CH2M Hill, the presence of creosote in the sample or the occurrence of a sheen on the water while sampling suggests that pools of creosote must be present in the sediment. Therefore, they imply, if one excavates the sediment with field equipment, such as a backhoe, these pools of creosote will be discovered and could be removed for treatment or disposal. This is highly unlikely based on my observations in the field and my understanding of the processes involved with the release and migration of creosote from the plant site. If one wished to carry out excavation of the sediments with a hand utensil, perhaps small pockets of creosote could be found and separated from the clean sediment.

The consequence of these sampling problems is that CH2M Hill assumes more sediment is contaminated than is likely to be the case. Likewise, the conclusion that significant pockets of creosote could be located and removed seems to be highly improbable.

In conclusion, I believe that CH2M Hill did not properly characterize the presence of creosote in the stream sediments. Sampling of a fluid below water level is fraught with cross-contamination problems and the significance of sheens occurring during sampling activities is unclear. A consideration of the mechanism of movement and examination of the sediment banks suggest that any contamination of the sediments is likely to be in small localized layers and not the extensive deposits assumed by CH2M Hill.

WJG/dw

INTERNAL CORRESPONDENCE

TECHNOLOGY/ HYDROLOGY (UNIT)	TO	File Memorandum	DATE	July 31, 1990
	FROM	S. M. Logan	SUBJECT	Groundwater Recovery, Moss-American Site Milwaukee, Wisconsin

I have reviewed the reports prepared for this site by CH2M Hill for the EPA. The reports describe site surface and subsurface conditions found during the Remedial Investigation (RI) and identify several options for remedial action in the Feasibility Study (FS). My review of the reports centered around the proposed plans for the recovery of contaminated groundwater.

Of the seven alternative remedial actions evaluated by CH2M Hill, EPA has focused on a plan (3A) that would primarily involve the excavation of source material. Contaminated groundwater would be collected by a trench constructed adjacent to the river. The Feasibility Study (FS) concludes that " Because most of the source material would be removed, a groundwater collection and treatment system might not be necessary...." (page 3-14). However, the FS assumes later that groundwater collection and treatment would still be required and is estimated to be in operation for 10 years or until no longer necessary (page 3-15). Cost estimates were then made based on this scenario.

Groundwater remediation is not warranted at this site due to the relative immobility of contaminant present, the fact that no impact to the surface waters of the adjoining river has been found and that there is no current or reasonable future use of the shallow groundwater. The contaminant in the subsurface at the Milwaukee site, being practically insoluble in water, represents a simplified example of immiscible liquid-liquid or two phase flow. At Milwaukee, creosote appears to have entered the subsurface through discharge into facility settling ponds. In order to move beyond that point it had to displace the water from the pores in the silty sands. Resisting this movement is the viscosity of the creosote itself and the capillary forces between the creosote and water. Once the interfacial tension and wettability characteristics of the water/soil have been satisfied, the further movement of free phase creosote is primarily controlled by the pore size distribution that exists in the subsurface. Contamination potentially released from the free phase creosote by dissolution is readily sorbed to soil organics thereby greatly reducing the mobility of the contaminants by groundwater flow.

Eventual elimination of the creosote and any dissolved components by way of groundwater recovery, will be controlled by the same constraints that limit the ability for the free phase and dissolved contaminants to migrate. Recovery of the free phase dense liquid (creosote) is very difficult due to the limited saturated thickness of the identified zone and the low hydraulic conductivities of the subsurface materials. It will not be possible to create the hydrodynamic forces needed to exceed the capillary forces in order to effectively remove the creosote. This will result in residual creosote being left behind in the subsurface materials that will continue to provide trace levels of dissolved constituents to groundwater for a long time period. The proposed EPA remedial action is unnecessary since the source material is essentially immobile and the low levels of contaminants in groundwater would require an indefinite period of pumping to remove the dissolved constituents.

At the Milwaukee site, therefore, groundwater remediation should not be considered for the following reasons:

* Free phase product removal is very difficult and could never be totally complete.

* Dissolved contamination is readily sorbed onto soil particles and will not result in a widespread impact.

* No evidence of measurable impacts to surface water has been identified or is expected.

* No current or future uses are expected for the shallow groundwater. The aquifer material is not suitable for water supply development due to the low hydraulic conductivities and minimal saturated thickness present at the site.

Groundwater remediation at the Milwaukee site is likely to be very costly, time consuming and not lead to significant improvement in site conditions.

SML/bw

KERR-McGEE CHEMICAL CORPORATION
Oklahoma City, Oklahoma

Review Comments on Remedial Investigation and Feasibility Study Reports

Moss-American Site
Milwaukee, Wisconsin

August 1990

WESTON®
MANAGERS DESIGNERS/CONSULTANTS

WESTON
MANAGERS DESIGNERS/CONSULTANTS

THREE HAWTHORN PARKWAY
VERNON HILLS, ILLINOIS 60061
PHONE: 708-918-4000

3 August 1990

Ms. Susan Pastor
U.S. EPA Region V
Office of Public Affairs (5PA-14)
230 South Dearborn Street
Chicago, Illinois 60604

Subject: Written Comments on Moss-American Site RI/FS, Proposed Plan, and Administrative Record

Dear Ms. Pastor:

The U.S. EPA has requested comments on the Moss-American site Remedial Investigation/Feasibility Study (RI/FS) and Proposal Plan. Roy F. Weston, Inc. has prepared and hereby submits comments on the above-referenced documents on behalf of Kerr-McGee Chemical Corporation.

Very truly yours,

ROY F. WESTON, INC.

Kurt S. Stimpson
Vice President

KSS/slr
Attachments

cc: B. Lavis

\WO\W2500\0591.LTR

REVIEW COMMENTS ON
REMEDIAL INVESTIGATION
AND FEASIBILITY STUDY REPORTS
MOSS-AMERICAN SITE
MILWAUKEE, WISCONSIN

Prepared For:

Kerr-McGee Chemical Corporation
Kerr-McGee Center
Oklahoma City, Oklahoma

Prepared By:

Roy F. Weston, Inc.
Three Hawthorn Parkway
Vernon Hills, Illinois 60061

August 1990

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A Specific Comments on Risk Assessment

B Carcinogenic Risk Comparisons Based on Relative PAH Toxicity

C Carcinogenic Risk Comparisons Based on Revised Exposure Assumptions

D Specific Comments on the Feasibility Study

E Review Comments on the Environmental Assessment

EXECUTIVE SUMMARY

These comments are submitted by Roy F. Weston, Inc. (WESTON) on behalf of Kerr-McGee Chemical Corporation concerning EPA's evaluation of remedial alternatives for the Moss-American site in Milwaukee, Wisconsin. WESTON has overseen and reviewed all remedial planning work conducted by U.S. EPA at the site. WESTON's technical review, initiated in January 1988, has included review of all project plans, field work, reports and documentation included within the site Administrative Record. These comments are based upon documents that U.S. EPA has compiled within the Administrative Record as the basis for the Proposed Plan for site remedial action.

WESTON's comments cover the entire Record, but the vast majority of comments focus on the Feasibility Study, Risk Assessment, Proposed Plan document and, to a lesser degree, the Remedial Investigation. WESTON's review and resulting comments are based upon statutory, regulatory, policy, and guidance documents that provide the basic rules, or framework, for conduct of an RI/FS and the development of a remedial action program under Superfund.

WESTON's review was supported by 10 years of corporate experience in Superfund-driven projects and our knowledge of technical, regulatory, and financial requirements of the program. The comments contained herein are based only upon scientific and engineering facts. RI/FS findings, conclusions, and proposed decisions were evaluated using sound scientific and engineering judgment. The RI/FS findings, conclusions and proposed decisions were evaluated for compliance with current statutory and regulatory requirements and applicable policy and guidance developed and endorsed by U.S. EPA.

WESTON's comments are provided in the 13 sections of the attached document. Sections 1 through 6 provide comments specific to the Risk Assessment. Comments in Sections 7 through 13 address issues noted within the Feasibility Study.

Risk Assessment -- Major Comments

Evaluation of the risk assessment yielded many significant issues related to data quality, technical approach, and compliance with U.S. EPA procedures, policy, and guidance. The Risk Assessment process and its findings are the pivotal step in determining site-specific remedial action objectives. In short, the Risk Assessment dictates the level of site cleanup that should be undertaken.

This review generated several comments on the manner in which the Risk Assessment was conducted. Briefly, our review identified the following major issues that require further consideration prior to finalization of the FS and development of the Record of Decision:

1) The Risk Assessment was not developed in accordance with the relevant guidance for assessment of health risks.

2) Potency factors used in the computation of carcinogenic risk were overly conservative. U.S. EPA endorses the relative toxicity approach for assessment of carcinogenic contaminants. This method was not applied and resulted in significant overestimation of health risks.

3) The exposure scenarios are unrealistic and overly conservative, do not follow U.S. EPA guidance, and significantly overstate health risks.

4) The concentration of PAHs in the lower two reaches of the Little Menomonee River were lower than U.S. EPA-documented background concentrations.

5) Cursory review of data utilized in the calculation of risk identified numerous instances where inaccurate concentration and risk-related data were used that suggesting fundamental errors in calculated risk.

WESTON conducted a parallel risk assessment using the same data utilized by U.S. EPA, but followed U.S. EPA policy and procedures for the calculation of health risks. The cumulative result of the various problems listed above was the overstatement of risk, in some instances, by up to three orders of magnitude. It is emphasized that the procedures, principles, and policies followed by WESTON in calculating health risk were in strict accordance with U.S. EPA-endorsed guidance. All procedures are clearly documented herein, are readily reproducible, and do not compromise the overall goal of conservatism in the estimation of risk. The resultant calculations of risk using present-day, accepted, U.S. EPA procedures show that EPA should reconsider its proposed remedial action. It is clear, for example, that the no-action alternative should be selected for the Little Menomonee River.

Feasibility Study -- Major Comments

The Feasibility Study review identified five principal areas that generated significant technical comment:

1) The slurry biotreatment that EPA has proposed may prove neither feasible nor effective and will certainly be far more costly than EPA has estimated.

2) The proposed river realignment cannot be justified in light of minimal risks, the problems in construction, and concerns for destruction of wetlands.

3) The implementability and effectiveness of the groundwater collection system are suspect given the site hydrogeology and rate of contaminant migration.

4) The volume of contaminated soil and groundwater may be grossly inaccurate, thereby casting the assessment of the remedial alternatives into doubt.

5) Neither the adverse environmental impacts to floodplain and wetlands have been considered (as required by the NCP) nor have the costs for mitigation and restoration been evaluated.

The proposed slurry bioreactor technology has never been proven effective for PAHs at a full scale. The bench scale studies demonstrate the PAHs resist biotreatment. The treatment objectives EPA has applied in defining the system are inconsistent with the treatability variance to EPA's land disposal restrictions. The assumed efficiency of slurry biotreatment is overly optimistic. Bench scale studies showed that treatment periods of hundreds of days per batch would be required to meet design objectives. If the proper design objectives are targeted and U.S. EPA's bench-scale treatment efficiency data accurately applied, slurry biotreatment does not pass screening for implementability or effectiveness.

River realignment is dubious based on consideration of need, effectiveness, and cost. EPA's risk assessment overstated the health risks; if properly computed, the health risks are in the 10^{-8} range -- significantly below the risk threshold established by U.S. EPA for cleanup action. Secondly, the concentrations of PAHs documented by U.S. EPA in the lower two reaches of the Little Menomonee River are lower than background concentrations, raising additional doubts as to the justification for the selection of the remedial alternative for the stream.

The proposed cleanup approach has assumed that visible PAH contamination will be removed from the existing riverbed. No visible contamination was observed by trained WESTON personnel anywhere downstream from the site during field work in July 1990 and U.S. EPA-laboratory data showed concentrations well below levels that would likely be visible. WESTON thus questions whether stream relocation and dewatering of the streambed will facilitate removal of visibly contaminated sediment.

Finally, with respect to river realignment, the FS did not provide a floodplain/wetland assessment as required by the NCP and U.S. EPA policy. Construction during realignment will destroy most, if not all, wetlands along the Little Menomonee River. The beneficial values of the wetlands will never be fully regained through restoration. Moreover, wetlands migration/restoration costs may approach tens of millions of dollars and decades to stabilize--costs that EPA has inappropriately failed to consider.

The proposed groundwater collection and treatment system will likely prove ineffective. Based upon the contaminant chemistry and mobility in groundwater, it appears that the proposed collection and treatment system could require operation for tens of millions of years to achieve cleanup objectives.

The effectiveness of the proposed cleanup plan is highly dependent upon the volume of contaminated material to be treated. There are many data gaps and irreproducible numbers in the EPA volume estimates which, if not resolved, could render proposed cleanup technologies inappropriate.

In addition to these major issues, a host of other issues are raised herein. Our review raises serious questions as to the need, effectiveness, and implementability of the proposed plan. WESTON urges a thorough reconsideration of the proposed plan before the issuance of a Record of Decision.

SECTION 1

INTRODUCTION TO THE EVALUATION OF EPA'S RISK ASSESSMENT

EPA's risk assessment is the culmination of the remedial investigation and should define, with United States Environmental Protection Agency (U.S. EPA) guidance, the ultimate remedial action goals. Because of the critical decisions that are based upon the findings of the risk assessment, it is imperative that this important step be performed in accordance with state-of-the-art scientific practices and accepted/promoted U.S. EPA directives and guidance. WESTON has thus focused on the overall accuracy of the risk assessment, its compliance with U.S. EPA directives and guidance, and its use of sound scientific approaches.

Our review documents many inconsistencies in the data, significant deviations from U.S. EPA directives and guidance, and unsound scientific judgment that resulted in serious overstatement of the level of public health risk associated with the Moss-American site.

This initial section provides a general discussion of the risk assessment and a summary of the key issues. Subsequent sections of this document discuss each of the key issues in greater detail. Specific comments on other issues related to the risk assessment as presented in the RI and FS are included in Appendix A.

1.1 OVERVIEW

Roy F. Weston, Inc. (WESTON's) review determined that the risk assessment contains a number of inconsistencies, errors, and undocumented assumptions; is overly conservative; and is generally more in line with a worst-case screening evaluation than a risk assessment based on current U.S. EPA guidelines. The problems we have identified show that the risk assessment does not fulfill its primary objective -- to establish an accurate baseline for the development of remedial action goals. Some of the more important problems are briefly discussed below:

- The use of maximum soil concentrations to determine an upper bound of risk is inappropriate and inherently assumes that all exposure could somehow occur based on the highest detected level in a single location. This provides inappropriately elevated risk estimates and conflicts with current U.S. EPA guidelines, which specifically recommend a reasonable maximum approach (U.S. EPA, 1989).

- PAHs were determined to be the key pollutant contributing to the risk estimates and driving the cleanup criteria. The assumption that all carcinogenic PAHs are as toxicologically potent as benzo(a)pyrene represents a vast overestimate of carcinogenic risk, conflicts with current internal U.S. EPA guidance, and is inconsistent with the Records of Decision (RODs) for similar sites.

- Incidental soil ingestion represents the major pathway of exposure to soils and sediments. This pathway was not evaluated in a manner consistent with current U.S. EPA guidance (U.S. EPA, 1989).

- A number of metals should have been eliminated based on background data. Additionally, the polycyclic aromatic hydrocarbons (PAHs) should have been evaluated in light of background concentrations, but were not.

- The exposure assessment contained a number of assumptions that were undocumented and considerably higher than recommended current U.S. EPA guidelines (U.S. EPA, 1989). No site-specific information was provided to justify using the departures from EPA guidance.

- There were numerous inconsistencies and errors in the data presented in the report, which indicate an apparent lack of quality control. These inconsistencies and errors raise serious questions about the overall accuracy of the conclusions and make a detailed review of the reports extremely difficult.

Each of these issues and a large number of other issues are discussed in greater detail in subsequent sections of this document. Section 2 discusses specific issues of concern relating to contaminant identification. Section 3 discusses toxicological issues and Section 4 discusses issues surrounding the exposure assessment. Section 5 evaluates the risk characterization portion and provides a recalculation of risks utilizing more appropriate assumptions. In addition, Section 5 will provide a more balanced discussion of the uncertainty associated with the overall risk assessment. Section 6 evaluates the cleanup targets and discusses the RODs for sites similar to the Moss-American site.

Appendix A includes a detailed list of other specific comments on risk assessment issues, based on both the RI and the FS.

REFERENCES

U.S. EPA, 1989. Risk Assessment Guidance for Superfund - Human Health Evaluation Manual Part A - Interim Final, Office of Solid Waste and Emergency Response. OSWER Directice 9285.7-01a.

SECTION 2

HAZARD (CONTAMINANT) IDENTIFICATION

Hazard (contaminant) identification is undertaken in order to develop a list of chemicals of potential concern which represent the dominant risks presented by the site. By definition, the chemicals of potential concern should be site related and should be detected at levels significantly elevated above naturally occurring levels. As an initial screen, the U.S. EPA Risk Assessment Guidance For Superfund (U.S. EPA, 1989) suggests a comparison of site concentrations with background concentrations (e.g., using the geometric mean concentrations of the two data sets) as a useful tool for identifying non-site-related chemicals that are found at or near the site.

The RI states (page K-3) that "inorganic compounds were not included if the detected concentrations did not exceed background soil concentrations." Comparison of the reported data for on-site soils and sediment with the background data suggests that several of the contaminants selected as chemicals of potential concern may not be site related (i.e. background levels were not exceeded). These inorganics include: barium, beryllium, cadmium, chromium, copper, manganese, mercury, nickel, and vanadium. These contaminants should not be included in the risk assessment.

For the primary pollutants of concern, i.e., PAHs, an examination of the typical background levels in soils was not provided. While current U.S. EPA guidance (U.S. EPA, 1989) does not recommend eliminating anthropogenic levels from consideration, it does recommend considering risks from non-site-related anthropogenic sources separately so that the decisionmakers can more appropriately determine the realistic concentrations and resulting risks due to site activities. The following subsections present the background data, illustrate the comparison between background and the site, and discuss the implications of this error on the risk estimates.

2.1 BACKGROUND LEVELS

There are two types of background levels of chemicals in environmental media:

(1) Naturally occurring levels, which are ambient concentrations of chemicals present in the environment that have not been influenced by humans, such as naturally occurring levels of a wide variety of metals in soils and sediments.

(2) Anthropogenic levels, which are concentrations of chemicals that are present in the environment due to human-made, non-site sources (EPA, 1989).

The naturally occurring levels of the inorganics in soil are presented in Table 2-1. These background values were calculated from the data reported for background samples:

MA-SB001-01
MA-SB013-01
MA-SB015-01
MA-SS053-02
MA-SS078-02
MA-SS081-02

as reported on page 3-4 of the RI report.

Background data for inorganics in the sediment of the Little Menomonee River were reported in the RI by reference to the IJC Menomonee River Watershed Study Volume 6 (U.S. EPA, 1979). Table 3-3 of the RI report presents background data for the Menomonee River Watershed.

Background data for polycyclic aromatic hydrocarbons (PAHs) in the sediment of the Little Menomonee River were reported in Appendix J of the Feasibility Study report. The background sample results were reported for six groups of data collected from various sections of the Little Menomonee River. The results of the background sediment sampling suggest that total PAH concentrations average between 11,500 to 23,000 μg/kg for the six background sample groups.

2.2 SELECTION OF CONTAMINANTS OF POTENTIAL CONCERN

The naturally occurring levels of the inorganics in soil were not eliminated in the risk assessment. This is accomplished here by comparing the geometric means of the background soil levels of inorganics to the geometric means of the on-site levels of inorganics (U.S. EPA, 1989). Table 2-2 shows this comparison. For the Residential scenario, east site soils, barium, beryllium and mercury should be eliminated from consideration in the risk assessment because the geometric means fall below the geometric means of the background levels. For the Residential scenario, west site soils, beryllium, chromium, manganese, mercury, nickel, and vanadium should be eliminated. For the Trespass scenario, west site, the following metals should be eliminated for the same reasons; cadmium, chromium, copper, manganese, mercury, and nickel.

The comparison between sediment data and background data for the Little Menomonee Watershed suggests that only lead and zinc were clearly detected in the sediment at concentrations exceeding the available inorganic background data.

TABLE 2-1

BACKGROUND CONCENTRATIONS OF
INORGANIC CHEMICALS IN SOIL (mg/kg)

Inorganic Chemical	Background Samples Geometric Mean	 Highest Detected
Arsenic	1.82	3.6
Barium	59.3	86.5
Beryllium	0.555	1.2
Cadmium	4.08	6.7
Chromium	15.8	27.9
Copper	19.2	42.3
Lead	8.76	11.4
Manganese	346.	583.
Mercury	0.402	4.5
Nickel	16.9	29.5
Vanadium	16.9	33.
Zinc	122.	311.

Data from Remedial Investigation report, Moss-American site.

TABLE 2-2

COMPARISON OF INORGANIC GEOMETRIC MEAN CONCENTRATIONS TO BACKGROUND MEAN CONCENTRATIONS (ug/kg)

Chemical	Residential Development East	Residential Development West	Trespass East	Trespass West	Background* Geometric Mean
Arsenic	4,695	4,482	4,490	7,780	1,820
Barium	58,263	62,253	82,762	98,628	59,300
Beryllium	409	491	978	1,010	555
Cadmium	5,315	4,952	6,125	1,010	4,080
Chromium	20,789	15,696	25,008	13,484	15,800
Copper	25,659	24,814	27,028	18,517	19,200
Lead	14,926	21,609	10,606	60,430	8,760
Manganese	517,778	328,182	651,926	225,443	346,000
Mercury	239	247	603	379	402
Nickel	24,181	15,254	29,256	15,904	16,900
Vanadium	25,948	13,719	33,537	17,686	16,900
Zinc	130,310	285,190	124,451	735,438	122,000

*Background values are calculated from Remedial Investigation Report, Moss American Site, Milwaukee, WI. Appendix K, Risk Assessment, January 9, 1990

PAHs, primarily related to anthropogenic sources, are widely distributed in the environment and have been detected in air, water, sediment, soil, food, and other consumer products (ATSDR, 1990). PAHs are also the key pollutants involved in the estimation of carcinogenic risk for the Moss-American site.

Data available from a variety of sources throughout the United States (ATSDR, 1990) indicate that these background levels can be relatively high. Table 2-3 presents some typical background soil concentrations reported in the literature, compared to the range of concentrations of all soil data from the site for the carcinogenic PAHs. This comparison shows that for several of these carcinogenic PAHs, the upper end of the range from the site is lower than the upper end of the range listed for urban soils; for several, it is in roughly the same order of magnitude, and for several, site levels are significantly higher.

The total PAH concentrations in the sediment samples downstream from the Moss-American site average between 10,700 to 250,000 µg/kg. However, average concentrations of total PAHs in stream reaches 4 and 5 are 18,400 and 10,700 µg/kg, respectively, which are within the average range reported for the background data in Appendix J of the feasibility study. This clearly suggests that only the first three stream reaches may contain elevated concentrations of PAHs compared to the background data. EPA guidance requires consideration of this fact, but EPA has failed to do so.

While it is apparent that some effort was made to ensure that the background samples were unbiased, it is important to note that the sediments containing PAHs are not expected to be uniformly distributed in the Menomonee River Watershed. Sediments with high concentrations of PAHs are expected to appear in the areas of the stream near turns or bends where large quantities of sediment are deposited in the stream bed. This is true for both natural and anthropogenic sources. The large database of sediment data in the Little Menomonee River, downstream from the Moss-American site, reflects the nonuniform distribution. Therefore, the exact location of the background samples (whether or not in areas with high sediment deposition) may affect the results. Although some effort was taken to ensure the background samples contained high silt, several samples were taken in gravel and sandy stream segments which would not be expected to have high natural levels of PAH compounds. As a result, the results of the background sampling may underestimate the background levels in the watershed.

2.3 IMPLICATIONS ON RISK ESTIMATES

The inorganics with concentrations below background should not be included in the risk assessment. They should be screened out according to U.S. EPA guidance (U.S. EPA, 1989) on dealing with naturally occurring levels of inorganics in soils.

TABLE 2-3

BACKGROUND SOIL CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Compound	Concentration (µg/kg) Rural Soil	Agricultural Soil	Urban Soil	Concentrations at Moss-American Site[1]
Acenaphthene	1.7	6		
Acenaphthylene		5		
Anthracene		11-13		
Benzo(a)anthracene	5-20	56-110	169-59,000	ND-133,000
Benzo(a)pyrene	2-1,300	4.6-900	165-220	ND-58,000
Benzo(b)fluoranthene	20-30	58-220	15,000-62,000	ND-71,000
Benzo(e)pyrene		53-130	60-14,000	
Benzo(g,h,i)perylene	10-70	66	900-47,000	ND-17,000
Benzo(k)fluoranthene	10-110	58-250	300-26,000	ND-65,000
Chrysene	38.3	78-120	251-640	ND-118,000
Fluoranthene	0.3-40	120-210	200-166,000	
Fluorene		9.7		
Indeno(1,2,3-cd)pyrene	10-15	63-100	8,000-61,000	ND-17,000
Phenanthrene	30.0	48-140		
Pyrene	1-19.7	99-150	145-147,000	

Sources:
IARC (1973).
White and Vanderslice (1980).
Windsor and Hites (1979).
Edwards (1983).
Butler, et. al. (1984).
Vogt, et. al. (1987).
Jones, et. al. (1987).

[1]Upper end of range represents 95 percent confidence interval of all soil data.

The PAHs should be evaluated with consideration given to the ubiquitous levels of PAHs typical in urban soils. U.S. EPA guidance (U.S. EPA, 1989) indicates that risks from anthropogenic, non-site-related sources could be evaluated separately at the beginning or the end of the risk assessment. This would provide the decisionmakers with a more realistic estimate of the potential human health risks associated with site-related PAHs. Consideration of this factor would serve to diminish the risks that EPA has attributed to the Moss-American site.

Finally, the sediment concentrations in stream reaches 4 and 5 should be compared to the background concentrations from Appendix J of the FS. This comparison would show that these two stream reaches do not have elevated levels compared to background. In addition, all the sediment data should be evaluated in light of the potential bias in the sampling of sediments.

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U.S. EPA. 1979. The IJC Menomonee River Watershed Study - Dispersibility of Soils and Elemental Composition of Soils, Sediments, and Dust and Dirt from the Menomonee River Watershed - Great Lakes National Program Office EPA-905/4-79-029-F.

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White JB, Vanderslice RR. (1980). POM source and ambient concentration data: Review and analysis. Washington, D.C.: United States Environmental Protection Agency, Office of Research and Development. EPA-600/70-80-044.

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Vogt NB, Brakstad F, Thrane K, et. al. (1987). Polycyclic aromatic hydrocarbons in soil and air: statistical analysis and classification by the SIMCA method. Environ Sci Technol 21:35-44.

SECTION 3

TOXICITY ASSESSMENT

The assumptions used in the development of health criteria for the contaminants at the site are extremely important in the estimation of risk and in the development of cleanup goals. The risk assessment for the Moss-American site used inappropriate and scientifically unjustifiable criteria for the primary pollutants of concern, i.e., carcinogenic PAHs, thereby significantly overestimating the risks. These criteria do not represent current U.S. EPA guidance and are toxicologically unsupportable.

3.1 PAH POTENCY FACTORS

Carcinogenic PAHs represent the most important set of pollutants at the Moss-American site. The vast majority of carcinogenic risk from exposure to soils and sediments is due to the carcinogenic PAHs. Therefore, it follows that assumptions regarding the relative potency of the variety of PAHs are critical to both the estimates of risk and the necessity and degree of remedial action.

The risk assessment states that U.S. EPA guidance is to assume that all PAHs are as toxic as benzo(a)pyrene. In fact, the U.S. EPA has issued an interim final report entitled "Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons" (ICF, 1988), which details the development and application of a relative potency approach for the assessment of carcinogenic risk of PAH mixtures as an alternative to the practice of assuming that all carcinogenic PAHs are equivalent in potency to benzo(a)pyrene. The uniform potency approach has been shown to overestimate the carcinogenic potency of most PAH mixtures (Slaga et. al., 1980; Misfeld 1980), and has questionable scientific merit. The relative potency approach yields more realistic estimates of risk and has a more sound biological basis. Furthermore, the relative potency approach is consistent with U.S. EPA's (1986) guidelines for the assessment of chemical mixtures when there is inadequate data to assess the mixture itself. The final report was due to the agency at the end of June 1990, with an expected release date of 30 September 1990. In addition, the U.S. EPA is due to release a draft Drinking Water Criteria document in the very near future which utilizes the relative potency approach and not the uniform toxicity approach.

The EPA report (ICF 1988) also presents a revised potency factor for benzo(a)pyrene, effectively lowering its potency by three to four times. This potency factor is based on a two-stage mathematical dose-response model which is far better suited to the biological mechanisms of action of PAHs than the linearized multistage model. The use of this model results in a modification of the oral potency factor from 11.5 (U.S. EPA, 1980) to 3.22

$(mg/kg/day)^{-1}$. It also results in a reduction in the inhalation potency factor, but, since inhalation exposure to PAHs is insignificant, this issue is not evaluated here. It should be noted that the U.S. EPA, in the Integrated Risk Information System (IRIS) network, has withdrawn the 11.5 potency estimate and does not have a currently recommended value. This is further evidence that the U.S. EPA considers 11.5 to be an overestimate.

Another indication that the uniform potency approach is not current U.S. EPA guidance can be found in a number of RODs relating to similar Superfund sites which contained PAH contamination. A brief review indicates that the following RODs considered the comparative potency approach for carcinogenic PAHs:

- United Creosoting 9/30/86.
- Bayou Bonfouca 9/11/86.
- Koppers, Texarkana 9/23/88.

Finally, on 12 October 1989, an internal U.S. EPA memo from Andrew Podowski, toxicologist, to Betty Lavis, Regional Project Manager, commenting on the risk assessment states,

> "Tables 1 and 4: A relative potency approach for the assessment of carcinogenic risk of PAH mixtures as an alternative to the current practice of assuming that all carcinogenic PAHs are equivalent in potency to Benzo[a]pyrene is recommended. The one-to-one potency approach has been shown to overestimate the carcinogenic potency of most PAH mixtures and has questionable scientific merit. The relative potency approach yields more realistic estimates of risk and has a more sound biological basis. Furthermore, the relative potency approach is consistent with U.S. EPA's (1986) guidelines for the assessment of chemical mixtures when there is inadequate data to assess the mixture itself. . . ."

In summary, the one-to-one or uniform potency approach applied in the RI does not represent current U.S. EPA policy. Based on the Comparative Approach document (ICF, 1988), the Chemical Mixtures Guidance (U.S. EPA, 1986), the expected draft Drinking Water Criteria document (1990), the precedent set by previous RODs, and the internal U.S. EPA memo on this project (U.S. EPA 1989a), current U.S. EPA policy requires the application of the more scientifically valid relative potency approach. Furthermore, based on the U.S. EPA report (ICF 1988) and the fact that the 11.5 $(mg/kg/day)^{-1}$ value has been removed from IRIS, the overall potency factor should be reduced to the 3.22 $(mg/kg/day)^{-1}$ recommended in the U.S. EPA report.

3.1.1 Conservative Nature of Relative Potency Approach

The relative potency approach for estimating the cancer risk associated with exposure to mixtures of PAHs is clearly less conservative than the current practice of considering all PAHs as equivalent to benzo[a]pyrene (B[a]P). However, based on our review of the ICF document on the relative potency approach (ICF, 1988), we feel that this approach is still quite conservative. Reasons for this include:

1. The use of surface area differences to convert from animal risk to human risk overestimates the human risk by almost an order of magnitude. Page II-12 of the ICF-Clement document states "A final adjustment for differences in surface area between species is required to obtain an expression for human exposure in terms of mg/kg/day and in order to be consistent with current risk assessment methodology." Therefore, their equations corrected for size differences based on differences in surface area rather than differences in body weights. A document prepared for the U.S. EPA by Clement Associates, entitled "Investigation of Cancer Risk Assessment Methods: Summary" (report number EPA/600/6-87/007a) demonstrates that body weight corrections for animal-to-human extrapolations are more appropriate than surface-area based extrapolations and that surface area corrections overestimate human cancer rates by almost an order of magnitude.

2. The experiments used as the basis for deriving the potency of each of the PAHs were far from being state-of-the-art cancer bioassays. For instance, an inappropriate route of administration was used, unrealistic solvents were utilized, and many of the experiments were not properly controlled. Considering tumor incidence as evidence of carcinogenicity under these conditions is quite conservative. The following provides more detail:

    a. The use of mouse strains, like the SENCAR mouse, is extremely conservative. This mouse strain was chosen as an experimental model because it is highly susceptible to skin tumor formation.

    b. The newborn mouse assay provides an unrealistic technique for evaluating cancer risk potential in humans. The mice are injected intraperitoneally on days 1, 8 and 15 of life, weaned on day 21, and sacrificed at 1 year of age. This assay is only valid as a screening tool for identifying carcinogens, not for quantitative risk assessments in humans.

c. DMSO was used as solvent for some of the intraperitoneal injections. DMSO is an excellent solvent which can aid unrealistically in the transport of the PAHs through body tissues.

d. The implantation of pellets in the left lobe of lung is certainly unrealistic and involved trauma to the animals. Other unrealistic routes of administration included subcutaneous injections between shoulder blades and subcutaneous injections into the right axilla (armpit).

e. Some experiments included the use of promoters after initial exposures to the PAHs. Theoretically, this could maximize the number of tumors seen compared to standard bioassay conditions.

f. Appropriate controls were sometimes not included. Again, this could lead to the erroneous conclusion that all tumors were treatment-related, rather than due to solvent interactions or normal background incidences.

3. When the mixtures with known bioassay results were evaluated using the comparative potency approach, the experimental tumor incidences were lower, sometimes far lower than the predicted tumor incidences, as Table 3-1 demonstrates.

3.2 IMPLICATIONS ON RISK ASSESSMENT

To evaluate the impact of the relative potency approach and the modified potency factor, a comparison was made between the original risk estimates and those calculated based on these modifications, including both the 11.5 and 3.22 $(mg/kg/day)^{-1}$ potency factors. This adjustment by itself yields revised risk estimates that average from about one-half to more than a full order of magnitude lower than those presented in Appendix K of the RI. The actual values are presented in Appendix B of these comments.

In summary, the risk assessment presented in the RI did not follow currently accepted U.S. EPA directives and guidance which, in itself, results in a significant overestimate of the risk associated with the site. Specifically, the relative potency approach was not applied. The use of the uniform potency approach represents very questionable science and does not follow accepted U.S. EPA guidance. In addition, the use of the 11.5 $(mg/kg/day)^{-1}$ potency factor is not current U.S. EPA guidance and should be replaced with a potency factor which is more representative of the biological mechanisms of action of PAHs. The RI report should be revised to use of the relative potency approach and the current

TABLE 3-1

MIXTURE RESULT PREDICTIONS FROM
COMPARATIVE POTENCY APPROACH

Application	Dose (μg)	Number of Animals with Carcinoma/ Effective Number of Animals Observed	Predicted
Mixture 1	4.0	25/81	29/81
	6.8	53/88	60/88
	12.0	63/90	87/90
Mixture 2	65.0	1/85	13/85
	195.0	0/84	57/85
	585.0	1/88	88/88
	1755.0	15/86	86/86
Mixture 2[a]	65.0	1/85	1/85
	195.0	0/84	2/84
	585.0	1/88	6/88
	1755.0	15/86	29/86

[2a]Assumes a zero relative potency for pyrene.

Source: ICF, 1988.

estimate of the potency of benzo(a)pyrene for the analysis of risks associated with carcinogenic PAH compounds.

REFERENCES

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SECTION 4

EXPOSURE ASSESSMENT

There are a number of overestimates of exposure and undocumented assumptions in EPA's risk assessment for each of the three exposure scenarios. The U.S. EPA has released specific guidance (U.S. EPA, 1989) presenting the methodology for calculating exposure and specific guidance for exposure assumptions (U.S. EPA, 1989a). Neither of these documents was followed in an appropriate manner. The following subsections present these overestimations and undocumented assumptions, provide modified estimations and documented assumptions, and discuss the impact on the risk assessment. Appendix C presents revised risk estimates based on the modified exposure assumption presented in this section.

4.1 TRESPASS SCENARIO

In the trespass scenario three exposure routes were determined to be potentially significant:

- Dermal absorption of contaminants for both children and adults.
- Incidental ingestion of contaminated soil for both children and adults.
- Inhalation of contaminated soil from airborne dust for both children and adults.

The original risk assessment made several conservative assumptions for the dermal absorption exposure pathway and determined that the potential risk was substantially less than the estimates of exposure via incidental soil ingestion. Therefore this pathway was eliminated from further consideration.

The most significant potential exposure route was incidental soil ingestion. A number of overly conservative assumptions and general inconsistencies were evident in the original risk assessment which require correction if a more reasonable estimate of potential exposure is to be obtained.

The original risk assessment calculated soil ingestion without taking into account certain modifying parameters, such as the fraction of soil ingestion during a typical day that would be from the contaminated source. These exposures were recalculated using the most recent U.S. EPA guidance (EPA, 1989).

The Incidental Soil Ingestion Exposure Equation is as follows:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical Concentration in Soil (mg/kg)
IR = Ingestion Rate (mg soil/day)
CF = Conversion Factor (10^{-6} kg/mg)
FI = Fraction Ingested from Contaminated source (unitless)
EF = Exposure Frequency (days/years)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged days)

CS: Geometric mean and maximum soil concentrations were included in the original risk assessment. The maximum value is an inappropriate overestimate; U.S. EPA (EPA, 1989) recommends using the upper 95 percent confidence interval level. However, the maximums are calculated here so that the risk values can be compared with EPA's estimates. It is also important to note that the data set for the trespass scenario (soil test pit data) is insufficient to calculate a meaningful estimate of the 95 percent confidence interval.

IR: 0.01 grams/day (EPA, 1989a). The original assessment used 0.1 grams/day. According to the EPA Exposure Factors Handbook, 0.1 grams/day may be an overestimate of normal soil ingestion behavior or represent a high tendency to ingest soil for individuals in the age group under evaluation (5 to 18 years). The 0.01 grams/day value is a more representative value for a Trespass scenario.

FI: Soil ingestion can occur from numerous activities in the older child to adult age range. EPA assumes incorrectly that the entire amount of soil ingested in a day comes from a two hour exposure on the site. We assume, consistent with EPA guidance, that a two-hour trespass exposure will yield 20 percent of the soil ingested in a given day. This is considered a reasonable maximum since it is assumed that only two hours per day are spent on the site and some portion of this two hours would likely be spent on uncontaminated soils.

EF: 31.5 days/year. Based on a 1.21 hours per week for biking/walking activities at the 90th percentile from the Exposure Factors Handbook. 1.21 hours/week x 52 weeks per year = 62.9 hours/year. 62.9 ÷ 2 hours per day (same as original assumption) = 31.5 days per year. The original assessment assumed 40 days per year with no apparent documentation.

ED: 10 years for carcinogens. One year for noncarcinogens (same as original assessment).

BW: 35 kilograms (child) and 70 kilograms (adult) - same as original assessment.

AT: 365 days/year. One year for noncarcinogens and 70 years (lifetime) for carcinogens.

Inhalation exposure was also based on a number of conservative assumptions in the original assessment, some of which overestimated exposure and some of which underestimated exposure. Two changes were made in this re-evaluation of risk due to inhalation:

- Exposure in the EPA assessment was calculated based on 8 hours exposure duration even though the assumed length of exposure was only 2 hours. This was modified to 2 hours.

- Beryllium, cadmium, chromium (VI), and nickel were eliminated as carcinogens in the original assessment. This is inappropriate since these metals are considered carcinogenic via the inhalation route. This is more conservative than the original assessment.

The modified exposure assumptions for the trespass scenario documented here result in a lower estimate of exposure than EPA has calculated for the Moss-American site. Appendix C presents a detailed summary of the revised risks based solely on the modified exposure assumptions. Table C-1 presents a summary of the revised noncarcinogenic and carcinogenic risks associated with the trespass scenario.

4.2 RECREATIONAL EXPOSURE SCENARIO

The recreational scenario assumes that children or adults may come into contact with contaminated sediment in the Little Menomonee River. As a casual visit to the area reveals, most of the Little Menomonee River south of Brown Deer Road is inaccessible except at major road/bridge crossings. Most of the banks are covered with thick vegetation which prohibits easy access. While it is possible that individuals may make their way to the river, it is not expected to be a regular event. There is no evidence to support the routine recreational use of the Little Menomonee River, that EPA has assumed.

Based on a WESTON survey by a field team of the river, the exposure scenario relative to the recreational use of the river is overly conservative. At a time of year that it might be expected for local residents to make recreational use of the river, no evidence could be found, even at the road bridge crossings, that would support a scenario for ingestion of 0.1 g/day of sediment for 40 days/year for 10 years. The vegetation cover renders the river virtually inaccessible for much of the reach downstream of the site to the Menomonee River. Indeed, the bike paths laid out through the park appeared well used, but there was no evidence of casual access to the river leading from these paths through the dense vegetation. Furthermore, the acknowledged patchy nature of the PAH contamination and the absence of obvious releases or odor of supposed deposits, bring into question the acute exposure to PAHs assumed by the risk scenarios relating to the river.

The repeated references throughout the available reports to a single incident 20 years ago of skin contact leading to what is variously described as "skin burns" and "skin irritations" serve to exaggerate the significance of this potential effect. On the basis of the field team visit, such impacts are very unlikely.

Two exposure pathways were investigated for the recreational scenario:

- Dermal absorption of contaminants by both children and adults.
- Incidental ingestion of contaminated soil by both children and adults.

The original risk assessment reviewed the dermal absorption pathway and determined it to be significantly lower than the soil ingestion pathway. Therefore, dermal absorption was eliminated from consideration.

The same exposure assumptions for incidental soil ingestion that were used for the trespassing scenario (Subsection 4.1) were also used in this scenario, except for the modification of contaminant concentrations. The original assessment calculated risks for each of five one-mile stream segment downstream from the site. This recalculation of risks focused on the highest concentrations of each contaminant regardless of which one-mile stream segment that contaminant level was found. This is inconsistent with EPA guidance. As discussed above, the risk assessment should be revised to include the upper 95 percent confidence limit as a reasonable maximum estimate.

The modified exposure assumptions for the recreational scenario result in a lower estimate of exposure compared with the original risk assessment. Appendix C includes a detailed comparison of the original and revised risk estimates associated with the recreational scenario.

4.3 RESIDENTIAL SCENARIO

The site is currently owned in large part by Milwaukee County and is classified as undeveloped park land. The county has plans to develop the site into a useable park facility (Sullivan, 1989).

This proposed land use suggests that the county may impose institutional controls (deed restrictions) over the property, which may eliminate the possibility of future residential development. If so, the future residential scenario is not appropriate for this site.

Two exposure pathways were investigated by EPA for the residential scenario which involves the future development of either the east or west site as a residential community. These pathways were:

- Dermal absorption of contaminants by both children and adults.
- Incidental ingestion of contaminated soil by both children and adults.

As was the case with the previous two exposure scenarios, the dermal absorption pathway was determined by EPA to be significantly lower than the soil ingestion pathway and was eliminated from detailed evaluation.

The incidental soil ingestion pathway is similar to that analyzed in the previous two scenarios, with the exception that soil ingestion is calculated for a small child (ages 1-6). Whereas an older child would be involved in more activities away from home, such as those discussed in the Trespass and Recreation scenarios, a smaller child would spend most of his/her time near the home, and thus could receive a greater exposure in the Residential scenario. The following assumptions relating to soil ingestion were applied by WESTON in this scenario:

- The EPA risk assessment used the highest concentrations detected in soil. The upper 95 percent confidence interval concentration is the value recommended by the U.S. EPA (U.S. EPA, 1989) and is the value used in the WESTON recalculation.
- For a small child (ages 1-6), a higher soil ingestion rate (200 mg/day), was used than for the older child in the Trespass and Recreational scenarios (EPA, 1989). This rate (200 mg/day) is the same as that used in the EPA assessment.
- For an adult, an ingestion rage of 100 mg/day was assumed, based on the potential for gardening activities and house dust ingestion (EPA 1989). This is the same rate used in the EPA assessment.
- Fraction ingestion was assumed to be 1 since it is possible that most of someone's time could be spent at home. This was not discussed in the EPA assessment.

- Body weight for a child ages 1-6 is assumed to be 15 kilograms. This is the same as the EPA assessment.

- Exposure frequency was assumed to be 243 days per year, which is approximately 8 out of 12 months. The other 4 months are either too cold for outside activities or have frozen or snow-covered ground such that soil ingestion would be precluded. The original assessment assumed 365 days per year.

- Exposure duration is 30 years based on the upper 90 percent confidence interval of data for time of a single residence (EPA, 1989). The EPA assessment used an exposure duration of 70 years.

The modified exposure assumptions for the residential scenario result in a lower estimate of exposure, compared to the original risk assessment. Appendix C includes a detailed comparison of the original and revised risk estimates associated with the residential scenario.

4.4 IMPLICATIONS FOR THE RISK ASSESSMENT

The exposure assumptions used in the Risk Assessment for the Moss-American site should be modified to include:

- Recent U.S. EPA guidance (U.S. EPA, 1989) on calculating soil ingestion.

- Upper 95 percent confidence intervals or some other reasonable measure of maximum exposure and not maximum soil concentrations (U.S. EPA, 1989).

- More reasonable maximum exposure assumptions, or at least appropriate documentation for the ones used.

- The use of a two-hour exposure duration for inhalation exposure when exposure is assumed for two hours.

- Consideration of carcinogenic metals inappropriately excluded. (This is more conservative than original assessment.)

- Appropriate noncarcinogenic inhalation criteria.

These recommendations are all based on U.S. EPA guidance or criteria. The EPA risk assessment does not follow such guidance and criteria and must clearly be modified. Such modifications would result in a proper estimate of the "reasonable maximum" risk (U.S. EPA, 1989).

The exposure modifications alone yield estimated risks that are significantly lower than those calculated by EPA. Both carcinogenic and non-carcinogenic risks are between one and three orders of magnitude lower than those presented in the EPA assessment.

REFERENCES

Sullivan, 1989. Personal Communication between A.M. Stumpf, CH2MHILL and B. Sullivan - Wisconsin County Park District as reported in Remedial Investigation Report Volume 2 Moss-American Site, U.S. EPA Region V, prepared by CH2MHILL, 1990.

U.S. EPA, 1989. Risk Assessment Guidance for Superfund Human Health Evaluation Manual Part A Interim Final Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-01a.

U.S. EPA, 1989a. Exposure Factors Handbook - Office of Health and Environmental Assessment EPA/600/8-89/043.

SECTION 5

RISK CHARACTERIZATION/UNCERTAINTY ANALYSIS

5.1 REPORTED RISKS vs REVISED RISKS

The exposure and toxicity assumptions used in the original report do not follow U.S. EPA guidance. They combine to significantly overestimate the risks at the Moss-American Site. To quantitatively evaluate the impact of the errors discussed in Sections 2, 3, and 4 of this document, the risk estimates for selected contaminants were revised using the more realistic site-specific exposure assumptions and the PAH relative potency approach. Table 5-1 presents a comparison between the original risks and the recalculated risk levels modified on the basis of the more appropriate exposure assumptions and the relative PAH toxicity data. Two separate revised cases are presented in Table 5-1. The first revision is based on the old 11.5 $(mg/kg/day)^{-1}$ potency factor and the second revision is based on the 3.22 $(mg/kg/day)^{-1}$ potency factor. Based on our understanding of the U.S. EPA position, the potency factor will definitely be lower than 11.5 once the revision is finalized. It is likely that the 3.22 value is a good approximation of the final value, based on the 1988 U.S. EPA report (ICF, 1988). It should be noted, that these revised calculations are still conservative and represent a reasonable maximum estimate of risk based on current U.S. EPA guidance.

The revised risks associated with the Trespass scenario are two to three orders of magnitude lower than those presented in the RI report. The revised risks associated with the Residential development scenario range between one to two orders of magnitude lower than those presented in the RI report. The revised risks associated with the recreational use of the Little Menomonee River are more than two orders of magnitude lower than those presented in the RI report. This clearly demonstrates that any remedial action alternatives based on the original risk assessment should be re-evaluated.

5.2 UNCERTAINTY

There is always a certain amount of uncertainty in the risk assessment process. This can result from poor or inadequate data, questionable or conservative exposure assumptions, or questionable or conservative assumptions concerning toxicity, among others. It is incumbent upon the risk assessor to investigate this uncertainty to determine the likely impact on the overall calculations of risk.

There are a number of extremely important areas of uncertainty associated with the risk assessment that need to be considered in this project. They include:

TABLE 5-1

COMPARISON OF RISK ESTIMATES

Exposure Scenario	EPA Report Highest	EPA Report Average	Revised Risk-Based on 11.5 (mg/kg/day)$^{-1}$ Highest	Revised Risk-Based on 11.5 (mg/kg/day)$^{-1}$ Average	Revised Risk-Based on 3.22 (mg/kg/day)$^{-1}$ Highest	Revised Risk-Based on 3.22 (mg/kg/day)$^{-1}$ Average
Trespass						
East	3.0E-4	5.1E-6	6.9E-07*	7.9E-08	3.5E-07*	7.0E-08
West	5.0E-4	2.0E-5	4.3E-06*	1.3E-07	1.1E-06*	4.6E-08
Residential						
East	2.0E-2	2.0E-4	3.5E-04	1.7E-05	1.0E-04	7.3E-06
West	4.0E-2	3.0E-4	5.9E-04	1.6E-05	2.0E-04	7.3E-06
Recreational	1.0E-4	2.0E-5	4.6E-7*	1.7E-7	1.6E-07*	8.0E-08

* Calculated using maximum observed concentration. EPA Guidance requires use of upper limit of 95 percent confidence interval, which, if applied, would reduce the highest estimate of risk.

- Surface soil related pathways were evaluated based on subsurface soil data for the Trespass scenario. This is important since incidental soil ingestion is the dominant exposure pathway. The calculation of risk based on subsurface soil data is inappropriate. Since PAHs are the prime contributors to the overall risk, and since these compounds tend to photodegrade and biodegrade, it is likely that the concentrations on the surface are or will become lower than those below the surface.

- The assumption was made that subsurface soils would be disturbed during residential development and these concentrations would then be applicable to surface soil related pathways such as soil ingestion. This is a likely overestimate due to mixing of contaminated with uncontaminated soils during excavation and the heightened tendency for the organics to degrade when exposed on the surface.

- PAHs are evaluated based on the carcinogenic potential of benzo(a)pyrene, which is the most potent of all PAHs. Based on the discussion presented in Section 3. This effect should not be evaluated as an uncertainty, but should be modified by application of the relative potency approach previously described.

- A number of contaminants are evaluated based on a single value, including those for 2,3,7,8-TCDD for carcinogenic risk for the Residential scenario and 2,4-Dinitrophenol for noncarcinogenic risk for the Residential scenario (West site). This serves to exaggerate the risk.

- Soil ingestion-related exposure assumptions do not follow current guidance and are not documented. Based on the discussion presented in Section 4, this should not be evaluated as an uncertainty, but should be modified to the revised assumptions.

Table 5-2 highlights some of the key areas of uncertainty and attempts to qualitatively determine the impact on overall risks. This is an approach recommended by the U.S. EPA (U.S. EPA, 1989), which was not satisfactorily performed in the EPA risk assessment for the site. For decisionmakers (risk managers), this type of discussion represents one of the most important aspects of the entire document since it greatly helps to put the wide range of uncertainty in the risk assessment into perspective.

Table 5-2 illustrates that while there may be some areas of uncertainty that may tend to underestimate the risk, the majority of the uncertainty is likely to overestimate the risk. For certain assumptions this uncertainty can be significant, and it clearly

TABLE 5-2

QUALITATIVE ANALYSIS OF UNCERTAINTY

Assumptions	Potential for Overestimation of Risk	Potential for Underestimation of Risk	Potential for Either (or both) Underestimation or Overestimation of Risk
Use of subsurface soil data to estimate surface soil related risks.			High
Assumption that subsurface soil concentrations are directly applicable to future residential development situations.	Mod		
All PAH's equal to Benzo(a)pyrene in Carcinogenic potential.	High*		
Use of maximum soil concentration value for reasonable maximum case instead of upper confidence intervals.	Mod		
Exposure assumptions utilized such as soil ingestion rate, exposure duration, and fraction ingested.	High*		
Not including background PAH concentrations in the evaluation	Low		
Decision not to calculate dermal absorption risks.		Low	
Use of typical non-threshold theory of carcinogens.	High		
Failing to treat carcinogens as non-carcinogens also.		Low	
All PAHs in the Little Menominee River are due to the site.	Mod		
Use of zero values in geometric mean case instead of calculated value based on non-detects.		Low	

*These uncertainties are considered separately in Sections 3 and 4 and collectively and quantitatively in Section 5. It is our contention that they are not really "uncertainties," but rather require the use of the approaches recommended elsewhere by U.S. EPA (U.S. EPA, 1989).

undermines the validity and appropriateness of any proposed remedial actions based on the original risk estimates.

REFERENCES

ICF, 1988. Comparative Potency Approach for Estimating the Cancer Risk Associated with Exposure to Mixtures of Polycyclic Aromatic Hydrocarbons - Interim Final Report.

U.S. EPA, 1989. Risk Assessment Guidance for Superfund - Human Health Evaluation Manual Part A - Interim Final Office of Solid Waste and Emergency Response OSWER Directive 9285.7-01a.

SECTION 6

CLEANUP TARGETS

The Feasibility Study (FS) relies on the Risk Assessment to identify a need for remedial action and to identify a risk-based concentration as the contaminant specific goal (target concentration) for cleanup of soil and sediment. The 1 X 10^{-6} and 1 X 10^{-4} target concentrations for the carcinogenic PAHs in soil are listed in Table 2-1 of the FS Report. Since the risk assessment has been developed without following applicable U.S. EPA guidance and with erroneous toxicological assumptions, and because the risk assessment was used to develop the remedial action objectives, the target concentrations should be recalculated based on more appropriate exposure assumptions and toxicity data.

6.1 REPORTED CLEANUP TARGETS vs REVISED CLEANUP TARGET

Table 6-1 presents the comparison between the reported target concentrations for carcinogenic PAH compounds in the FS and the revised target concentrations based on the more appropriate exposure assumptions and toxicity data. Values are presented for both the old 11.5 and the proposed 3.22 $(mg/kg/day)^{-1}$ potency factors. It should be stressed again that this recalculation of risk is still conservative and follows current U.S. EPA guidance on risk assessments.

If the revised target concentrations are applied, the nature and extent of the remedial action for on-site soils would be greatly reduced. Furthermore, the revised target concentrations for sediment clearly indicate that remedial action is not warranted for the Little Menomonee River since the current sediment concentrations are below the revised cleanup target concentrations. In fact, if the highest sediment concentrations in any stream reach are compared to the revised risk based target concentrations at 10^{-6}, it becomes even more evident. As can be seen in Table 6-2, the highest concentrations of individual carcinogenic PAHs in any of the five stream reaches (based on data presented in Table K-14 of the RI or Table 2-3 of the FS) constitute from less than 1 to a maximum of 27 percent of the revised 10^{-6} target concentrations, based on the old 11.5 $(mg/kg/day)^{-1}$ potency factor. If the proposed value of 3.22 $(mg/kg/day)^{-1}$ is used, these ratios would be lower still. This table clearly shows that there is no need for remedial action in the Little Menomonee River based on health risk concerns.

TABLE 6-1

TARGET CONCENTRATIONS FOR CARCINOGENIC PAH COMPOUNDS
(ALL CONCENTRATIONS MG/KG)

Media	FS Report Risk-Based Target Concentrations 10^{-4}	FS Report Risk-Based Target Concentrations 10^{-6}	Revised Risk-Based Target Concentrations Using 11.5 mg/kg/day^{-1} 10^{-4}	Revised Risk-Based Target Concentrations Using 11.5 mg/kg/day^{-1} 10^{-6}	Revised Risk-Based Target Concentrations Using 3.22 mg/kg/day^{-1} 10^{-4}	Revised Risk-Based Target Concentrations Using 3.22 mg/kg/day^{-1} 10^{-6}
<u>Soil</u>						
Benzo(a)anthracene	6.1	0.061	147.	1.47	525.	5.25
Benzo(b)fluoranthene	6.1	0.061	152.	1.52	543.	5.43
Benzo(k)fluoranthene	6.1	0.061	323.	3.23	11,150.	11.5
Benzo(g,h,i)perylene	6.1	0.061	969.	9.69	3,460.	34.6
Benzo(a)pyrene	6.1	0.061	21.3	.213	76.1	.761
Chrysene	6.1	0.061	4840.	48.4	17,300.	173.
Dibenzo(a,h)anthracene	6.1	0.061	19.1	.191	687.	.687
Ideno(1,2,3-cd)pyrene	6.1	0.061	91.8	.918	328.	3.28
<u>Sediment</u>						
Benzo(a)anthracene	389.	3.89	170,000.	1,700.	608,000.	6,080.
Benzo(b)fluoranthene	389.	3.89	176,000.	1,760.	630,000.	6,300.
Benzo(k)fluoranthene	389.	3.89	374,000.	3,740.	1,330,000.	13,300.
Benzo(g,h,i)perylene	389.	3.89	1,120,000.	11,200.	4,010,000.	40,100.
Benzo(a)pyrene	389.	3.89	24,700.	247.	88,200.	882.
Chrysene	389.	3.89	5,610,000.	56,100.	20,000,000.	20,000.
Dibenzo(a,h)anthracene	389.	3.89	22,200.	222.	79,500.	795.
Indeno(1,2,3-cd)pyrene	389.	3.89	106,000.	1,060.	380,000.	3,800.

TABLE 6-2

COMPARISON OF REVISED 10^{-6} TARGET CONCENTRATION WITH HIGHEST CARCINOGENIC PAH CONCENTRATION IN ANY STREAM REACH

Contaminant	Revised 10^{-6} Target Concentration* (mg/kg)	Highest Concentration (mg/kg)	Ratio: Concentration/ Target Conc.
Benzo(a)anthracene	1,700	190.	0.11
Benzo(b)fluoranthene	1,760	64.	0.04
Benzo(k)fluoranthene	3,740	58.	0.02
Benzo(g,h,i)perylene	11,200	24.	<0.01
Benzo(a)pyrene	247	67.	0.27
Chrysene	56,100	150.	<0.01
Dibenzo(a,h)anthracene	222	2.4	0.01
Indeno(1,2,3-cd)pyrene	1,060	26.	0.03

*Based on BaP CPF of 11.5 $(mg/kg/day)^{-1}$.

6.2 RECORDS OF DECISION

A review of historic EPA Records of Decision (RODs) has identified many sites where PAH compounds have been found to be significant contaminants and the driving force behind remedial action. Several of these sites have contamination with creosote similar to the conditions at the Moss-American Site. The RODs issued for the sites have included cleanup objectives for PAH compounds. Table 6-3 presents a list of RODs and their associated cleanup objectives for the PAH compounds.

Although the cleanup criteria referenced in the RODs are not directly comparable to the risk-based target concentrations developed in the FS and these comments, a comparison can be made. A cleanup criteria of 100 ppm for carcinogenic PAHs in residential soils has been issued by the U.S. EPA at several sites. In addition, based on an internal Wisconsin DNR memo from Terry Evanson (SW-3) to Gary Edelstein (SW-3), it seems that the State of Wisconsin has a similar cleanup standard for PAHs at coal gas sites (i.e., 100 ppm). This 100 ppm level is higher than the target cleanup concentrations for soils calculated using the revised exposure assumptions and toxicity information (see Table 6-1). The revised total carcinogenic PAH target concentrations, based on the old potency value (11.5), is 65.6 ppm. This is well below the 100 ppm benchmark. This further supports the contention that the revised risk assessment is still conservative.

The United Creosoting site (Table 6-3) used a 0.330 ppm total benzo(a)pyrene equivalent cleanup target for residential soil. If the revised target concentrations for carcinogenic PAHs were converted into a B(a)P equivalent, they would result in a B(a)P equivalent of 0.213 ppm. This is well below the 0.330 value and is further proof that the revised assessment is still conservative.

In addition, a cleanup criteria of 1300 ppm PAHs in sediments has been issued by the U.S. EPA for at least one site (Bayou Bonfouca). This cleanup level is more conservative than that developed using revised exposure assumptions based on site specific conditions. More importantly, it is also considerably higher than the <u>highest</u> levels of any carcinogenic PAH in any stream reach of the Little Menomonee River (see Table 6-2).

TABLE 6-3

RECORD OF DECISION SUMMARY

Site	Date ROD Issued	Cleanup Criteria
United Creosoting Site	September 1986 September 1989	100 ppm (mg/kg)total PAHs 0.330 ppm total Benzo(a)pyrene Equivalents for residential soil
Mid South	October 1986	3.00 ppm total carcinogenic PAHs
Petro Chemical	March 1987	100 ppm total PAHs
Bayou Bonfouca	March 1987	100 ppm carcinogenic PAHs on-site 1,300 ppm PAHs sediments
Koppers Co.	September 1988	100 ppm carcinogenic PAHs for residential soil

SECTION 7

INTRODUCTION TO FEASIBILITY STUDY COMMENTS

Review of the FS brought out several problems that require EPA to reconsider its proposed remedial action plan. WESTON has found significant data gaps that affect the estimated cost and implementability of the remedial alternatives that were evaluated. Although the FS cannot remove all uncertainty, it must provide information sufficient to support an informed risk management decision. However, review of the FS for the Moss-American site indicates that information sufficient to support an informed risk management decision is not currently available.

Specific key issues include:

- Uncertainty about the applicability, implementability and cost of the slurry biotreatment system.
- Uncertainty about the implementability and cost of the proposed river realignment and wetlands restoration.
- Uncertainty about the cost/benefit of the groundwater collection system.
- Uncertainty about volume of contaminated soil and groundwater.

SECTION 8

TREATMENT DESIGN

Slurry biotreatment is the central element of Alternative 3A (the Proposed Plan), Alternative 4, and Alternative 5. The success and economics of bioslurry treatment in this application will be largely determined by the interrelated issues of treatment kinetics and cleanup criteria.

The evaluation of this technology in the FS has the following major shortcomings:

- The treated effluent must be designed for more stringent regulatory requirements than the FS assumed.

- The degradation rate was measured by CH_2MHill to be slower than the FS assumed.

- Numerous design needs have been overlooked including scrubber-bioreactor interaction, washwater disposal, and ancillary equipment.

The following subsections describe the shortcomings and their implications.

8.1 REGULATORY REQUIREMENTS

The required degree of treatment is determined by the combined influences of risk-based concentrations, variances from land disposal restrictions, and Superfund program cleanup goals. FS Table 4-3 purports to display concentrations to be achieved as if they were the basis of design, but this table is incorrect. The actual concentrations to be achieved and designed for are set out in U.S. EPA Guidance "Superfund LDR Guide #6A--Obtaining a Soil and Debris Treatability Variance for Remedial Actions" (OSWER Directive 9347.3-06FS) and are shown in Table 8-1.

The U.S. EPA guidance clearly states that design must aim for the stringent end of the treatment range so that operation can consistently achieve the lenient end of the treatment range. The levels in FS Table 4-3 are indeed the treatment levels to be achieved to comply with the LDR treatability variance, but, based on EPA guidance, do not set the design requirements. As Table 8-1 shows, the slurry bioreactor must be designed to achieve significantly more complete degradation of certain PAHs than EPA has recognized.

TABLE 8-1

LAND DISPOSAL RESTRICTION VARIANCE TREATMENT OBJECTIVES

Contaminant	Regulatory Status	Chemical Class	Initial Conc. >400 ppm Design	Initial Conc. >400 ppm Achieve	Initial Conc. <400 ppm Design	Initial Conc. <400 ppm Achieve
Naphthalene	K001 Land Ban	PAH	99.9% Removal	95% Removal	0.5 ppm Residual	20 ppm Residual
Pentachlorophenol	K001 Land Ban	Halogenated phenols	99.9% Removal	90% Removal	0.5 ppm Residual	40 ppm Residual
Phenanthrene	K001 Land Ban	PAH	99.9% Removal	95% Removal	0.5 ppm Residual	20 ppm Residual
Pyrene	K001 Land Ban	PAH	99.9% Removal	95% Removal	0.5 ppm Residual	20 ppm Residual
Toluene	K001 Land Ban	Polar Organic	99.9% Removal	90% Removal	0.5 ppm Residual	10 ppm Residual
Xylene	K001 Land Ban	Polar Organic	99.9% Removal	90% Removal	0.5 ppm Residual	10 ppm Residual
All Other PAHs	Contaminants of Concern	PAH	90% Removal	90% Removal	90% Removal	90% Removal

8.2 TREATABILITY STUDY

The success of the proposed technology depends entirely on the ability of microorganisms to degrade the PAH compounds. The biotreatability study (Appendix K) assesses this ability.

The data collected during the study indicate that reaction kinetics for the biodegradation of PAH compounds proceed slowly at best, and in some cases (carcinogenic PAH) almost not at all. If the calculated reaction rate constants in Tables K-3 and K-5 are accepted as the best available information on biotreatment kinetics, it is possible to determine the treatment time required to proceed from a beginning concentration to a final contaminant concentration.

The last sentence of the fourth paragraph on page H-2 states that a comparison of the rates observed in the treatability study to those observed in other research projects (Table H-4) suggests that higher rates might be achievable than those observed in the treatability study. However, a close review of the treatability study data (Appendix K) and the cited reference (B.D. Symons, et al.) revealed that the column headings in Table H-4 are incorrect and should be switched with each other. Therefore it appears that treatability study degradation rates are higher than the cited reference and thus are more optimistic than the cited reference about the viability of biodegration as a treatment technology. In any event, the work of Symons, et al. was conducted in the vadose zone and may, therefore, have limited relevance to bioslurry design.

8.3 REACTOR DESIGN

The reactor design is central to the accurate selection of the best remedial alternative and crucial for the success of the Proposed Plan advanced by U.S. EPA. Despite the importance of reactor design, the present review has concluded that the FS is inaccurate, inconsistent, and misleading with respect to process design.

The FS does not incorporate the results of its own treatability study. After concluding in the treatability study that 13 to 150 days are required to achieve 90 percent reduction, the reactor is designed to allow 15 days to achieve a 95 percent reduction (Page H-8). This crucial assumption is completely unjustified. At 15 days into the treatability study, however, soil flasks still had about half of their initial PAH concentration and nearly all of their carcinogenic PAH compounds.

With three pieces of information, it is possible to calculate the residence time needed in the reactor:

1. Contaminant concentrations found at the site (RI Table O-1).

2. Cleanup objectives for contaminants (Federal Treatability Variance guidance as per OSWER Directive 9347.3-06FS).

3. Reaction decay constant (FS Table K-2).

Table 8-2 herein provides the results of the residence time calculation. As the table indicates, a residence time (in round numbers) of 150 days would certainly be more reasonable than 15 days and is probably inadequate for many compounds. But a ten-fold increase in residence time would have enormous impact. Most notably, either the treatment duration must be extended to several decades or 10 times as much equipment must be used.

The conceptual model of the slurry bioreactor (FS Figure H-2) also neglects treatment of several ancillary process flows. Oversize material is rejected from treatment, yet the possibility exists that oversize materials may be heavily contaminated. Wash water from the attrition scrubber has no provision for treatment in the process schematic, yet if scrubbing is successful the water will be contaminated.

The treatability study (FS Appendix K) does not reflect the possible toxic effects of surfactants from the scrubber (FS Figure H-2) on the subsequent slurry bioreactor treatment. Even low concentrations of surfactants can be lethal to microorganisms, so direct contact in the scrubber and also carryover into the bioreactor must be addressed.

The cost estimate for the slurry bioreactor (FS Table I-3, Alt 3A) purportedly allows 12 percent for instrumentation and 20 percent for electrical and mechanical equipment, but only adds approximately half that amount to the cost calculation.

The FS cost estimate, Table I-3, makes use of CORA cost data according to the column of assumptions. The introduction to the CORA cost manual provides:

> "The Cost of Remedial Action (CORA) Model is designed for the development of order of magnitude cost estimates for remedial actions (RAs) at Superfund sites. The model's primary purpose is to assist EPA Regional offices in the development of outyear RA budget estimates for sites which do not have feasibility study (FS) estimates. The CORA Model is intended to provide the user with a range of costs for each site: costs are developed for a variety of different site RA scenarios. The CORA model is not intended to result in a cost estimate which would be as site specific as an FS estimate...." (emphasis added)

It appears, therefore, that the CORA model costs should not be used for the FS -- a higher level of accuracy is expected of an FS.

TABLE 8-2

DURATION OF FIRST-ORDER DECAY PERIODS ANTICIPATED IN SOIL

CONTAMINANT NAME	INITIAL CONCENTRATION MEASURED (MASS/MASS)	FINAL DESIGN CONCENTRATION DESIRED (MASS/MASS)	DECAY RATE MEASURED (1/TIME)	RESULTANT DURATION (TIME)
Naphthalene (1)	1800	1.8	0.0197	351
	0.11	0.5	0.0197	0
Phenanthrene (1)	2700	2.7	0.0526	131
	0.35	0.5	0.0526	0
Pyrene (1)	2000	2	0.0502	138
	0.6	0.5	0.0502	4
Chrysene	510	51	0.0145	159
	0.11	0.011	0.0145	159
Benzo(a)anthracene	420	6.1	0.04	106
	0.079	0.0079	0.04	58
Benzo(a)pyrene	230	6.1	0.0203	179
	0.082	0.0082	0.0203	113
Benzo(b)fluoranthene	270	6.1	0.0173	219
	0.013	0.0013	0.0173	133
Benzo(k)fluoranthene	250	6.1	0.0173	215
	0.017	0.0017	0.0173	133
Indeno(1,2,3-cd)pyrene	78	6.1	0.0332	77
	0.16	0.016	0.0332	69

1. Footnoted chemicals are subject to alternate treatability variance levels established by U.S. EPA guidance because of K001 restrictions. All other chemicals subject to 90% reduction as Superfund contaminants of concern or 6.1 mg/kg residual on basis of risk.

8.4 IMPLICATIONS ON FEASIBILITY STUDY

The treatment system is grossly under-designed, based on the information and assumptions provided in the FS. A more appropriately sized system would have approximately 10 times the residence time allowed in the system proposed in the FS. No attempt has been made herein to design and independently price a system; however, it is likely that the FS's anticipated $5,600,000 for the slurry bioreactor (Table I-3, Alt 3A) should be scaled up according to the residence time and would be something on the order of 10 times more costly, assuming that all other assumptions in the FS are correct.

The inappropriate selection of residence time results in incorrect analysis of bioreactors with respect to the standard Superfund evaluation criteria. A system with a 150-day residence time would have entirely different implementability, community acceptance, and cost than a system with a 15-day residence time. EPA must re-evaluate the ranking of the remedial alternatives with a more realistic reactor design.

SECTION 9

RIVER REALIGNMENT

9.1 ENGINEERING EVALUATION AND COST CALCULATIONS

EPA proposed to remediate the sediments by realignment of the Little Menomonee River for a distance of five miles. As discussed above, there is no justification for such action based on the potential risks. Based on WESTON's review of the Feasibility Study, site observations, and knowledge of construction in floodplains, WESTON finds that EPA's proposed action has other significant deficiencies. River realignment may not be practical, technically-effective, cost-effective, or time-efficient. Moreover, it presents significant environmental hazards.

The technical steps and cost implications of river realignment are reviewed and discussed in the following paragraphs. An independent comparative cost estimate is shown in Table 9-1. Details of the independent estimate are shown in Table 9-2. As will be seen, EPA has significantly underestimated the cost of river realignment.

Access Roads

The current design includes a gravel access road along the entire river or about 31,680 linear feet. This road will be 10 feet wide and have an 8 inch gravel base. During construction, access roads to the public highways will be developed as will laydown areas for equipment and material storage. Also, in certain areas a second access may have to be constructed on the other side of the river. Due to the wet nature of the area in which the roads will be constructed, a geonet will have to be provided under the gravel to maintain a firm base for the trucks and equipment to travel on. Prior to proceeding on the public highways, the dump trucks and equipment may have to be cleaned to prevent the spread of contaminants.

The additional access roads and laydown areas are quantified as follows:

- One access road to the public highway every 0.5 mile, approximate length 100 feet.
- Approximately 5,000 linear feet of additional access roads.
- A 50 foot by 50 foot laydown area at one mile intervals.

The only cost included for the road construction in the FS estimate is the cost of the gravel installed. The estimate needs to include

TABLE 9-1

RELOCATION OF RIVER COMPARISON OF ESTIMATE SUMMARIES

Description	CH2M-Hill Estimate	WESTON Estimate	Variance (West-Hill)
Clearing and grubbing	$740,000	$946,000	$206,000
Access roads	$170,000	$443,000	$273,000
Parallel river bed	$1,400,000	$1,368,000	($32,000)
Roadway crossing transition	$470,000	$470,000	$0
Tributary crossing extension	$46,000	$46,000	$0
Fill old river bed	$980,000	$1,035,000	$55,000
Soil cover over old river bed	$120,000	$120,000	$0
Sediment excavation + haul	$200,000	$356,000	$156,000
Access road revegetation	$420,000	$490,000	$70,000
Total, base costs	$4,546,000	$5,274,000	$728,000
Potential/Other Costs			
Dewatering 15% of river beds	NA	$1,500,000	$1,500,000
Additional landscaping	NA	NA	
Excavation 5%/yr-midpoint 4 yrs.	$980,000	$1,130,000	$190,000
Weather + schedule impacts	NA	NA	
Wetlands/Restoration (Design/Construct)	0	$4,000,000	4,000,000
Total order of magnitude est.	$5,526,000	$11,904,000	$6,418,000

TABLE 9-2

MOSS - AMERICAN SITE, MILWAUKEE, WISCONSIN
REVISED ESTIMATE FOR RIVER RELOCATION

DESCRIPTION	QUANTITY	UNIT	WORK LEVEL	LABOR FACTOR	CONVENTIONAL LABOR UNIT PRICE (DOLLARS)	SITE LABOR UNIT RATE (DOLLARS)	COST	SUBTOTAL	ASSUMPTIONS
CAPITAL COST DURING OPERATION									
CLEARING + GRUBBING									
TREES AND STUMPS	44	ACRE	E	1	$11,500.00	$11,500.00	$506,000		cut and chip, max. 24" dia. stumps removed, 021-104-0300.0350
TERRAIN CLEARING	44	ACRE	E	1	$3,800.00	$3,800.00	$167,200		dozer and brush rake. adverse conditions. 021-108-0600
TOPSOIL STRIPPING	44,000	CY	E	1	$1.40	$1.40	$61,600		200 hp dozer. top 6", 300" haul. 022-286-0100
STUMP + DEBRIS DISPOSAL	176	TN	E	1	$40.00	$40.00	$7,040		Vendor quote landfill assume 4 tn/acre
INITIAL GRADING	220,000	SY	E	1	$0.11	$0.11	$24,200		025-122-0200
EROSION CONTROLS	60,000	LF	E	1	$3.00	$3.00	$180,000		silt fence 2 sides 022-704-1000
								$946,040	
ACCESS ROADS (INCL LAYDOWN)									
GRAVEL	45,000	SY	E	1	$4.71	$4.71	$211,950		8" gravel depth, no surface, 015-552-0100
GEONET	45,000	SY	E	1	$2.50	$2.50	$112,500		vendor quote
GRADING	45,000	SY	E	1	$0.52	$0.52	$23,400		025-122-0100
EROSION CONTROLS	31,600	LF	E	1	$3.00	$3.00	$94,800		silt fence 1 side 022-704-1000
								$442,650	
PARALLEL RIVER BED									
EXCAVATION OF NEW BED	200,000	CY	E	1	$3.00	$3.00	$600,000		14t scraper - 022-246-1350
EXCAVATION OF NEW BED	120,000	CY	E	1	$3.30	$3.00	$360,000		105 hp dozer- 150' haul - 022-242-3220
GRADING CHANNEL SIDES	350,000	SY	E	1	$0.12	$0.12	$42,000		025-122-3300
PLACE CABLE/RUBBLE	500	CY	E	1	$26.00	$26.00	$13,000		2.5in-10in dia cobble/rubble: 022-712-0100
PLACE GRAVEL	1,300	CY	E	1	$20.00	$20.00	$26,000		0.1-2.5 in dia gravel; 022-262-1100
PLACE RIP RAP	900	CY	E	1	$25.00	$25.00	$22,500		6" riprap; estim. judgement
EROSION CONTROLS	31,600	LF	E	1	$3.00	$3.00	$94,800		silt fence 1 side 022-704-1000
EROSION CONTROLS	950,000	SF	E	1	$0.20	$0.20	$190,000		polyethelene cover over spoil - 015-600-602
CONSTRUCT POOLS	1,000	CY	E	1	$20.00	$20.00	$20,000		3/4 cy backhoe - 022-252-035
								$1,368,300	
ROADWAY CROSSING TRANSITION									
NUMBER OF TRANSITIONS	11								
EXCAVATE CONTAMINATED SOIL	1,650	CY	D	1.2	$10.00	$12.00	$19,800		1 CY backhoe, estim judgement, 022-254-1300
MOVE SEDIMENT TO OLD BED	1,800	CY	D	1.2	$2.72	$3.26	$5,875		2.5 CY FE loader, 300 foot haul, 022-262-0170-$1/cy compact
CONSTRUCT TRANSITION DAM	13,420	CY	D	1.2	$1.72	$2.06	$27,699		2.5 CY FE loader, 300 foot haul. 022-262-0170
COMPACT DAM	13,420	CY	D	1.2	$2.89	$3.47	$46,541		vibrating plate, 022-254-1900
RUNOFF DIVERSION SUMP	22	EA	D	1.2	$815.00	$978.00	$21,516		4 foot dia. x 6' deep, concrete, 027-152-0500
RUNOFF DIVERSION SUMP PUMPS	2	EA	D	1.2	$3,000.00	$3,600.00	$7,200		pumped upstream of dam, Flygt quote, Alumax
BYPASS DIVERSION PUMPS	2	EA	D	1.2	$10,000.00	$12,000.00	$24,000		temporary bypass pumps, 5,000 gpm each
BYPASS DIVERSION PIPING	1,000	LF	D	1.2	$26.00	$31.20	$31,200		24" dia CMP, 027-164-2140
SHEET PILING	1	LS	D	1.2	$220,000.00	$264,000.00	$264,000		
SILT CURTAINS	1	LS	D	1.2	$20,000.00	$24,000.00	$24,000		
								$471,831	

TABLE 9-2 (CONT.)

MOSS - AMERICAN SITE, MILWAUKEE, WISCONSIN
REVISED ESTIMATE FOR RIVER RELOCATION

DESCRIPTION	QUANTITY	UNIT	WORK LEVEL	LABOR FACTOR	CONVENTIONAL LABOR UNIT PRICE (DOLLARS)	SITE LABOR UNIT RATE (DOLLARS)	COST	SUBTOTAL	ASSUMPTIONS
CAPITAL COST DURING OPERATION									
TRIBUTARY CROSSING EXTENSIONS									
EXCAVATE TRENCH	500	CY	D	1.2	$2.14	$2.57	$1,284		2.5 CY backhoe, 6 feet to 10 feet, 022-254-0620
TRIBUTARY PIPE	500	LF	D	1.2	$64.00	$76.80	$38,400		36" dia culvert, 027-162-2060
DRAINAGE GRANULAR FILL	75	CY	D	1.2	$41.00	$49.20	$3,690		pea gravel, 029-504-0900
BACKFILL TRENCH	500	CY	D	1.2	$1.46	$1.75	$876		1 CY FE loader, minimal haul, 022-254-3020
COMPACT AREA	500	CY	D	1.2	$2.89	$3.47	$1,734		vibrating plate, 022-254-1900
SEEDING	5,000	SF	D	1.2	$0.04	$0.05	$240		hydraulic seeding, 029-308-1300
								$46,224	
FILL OLD RIVER BANK									
DEWATERING SUMP	10	EA	D	1.2	$890.00	$1,068.00	$10,680		4 foot dia. x 8' feet deep, precast concrete, 027-152-1130
DEWATERING PUMP	2	EA	D	1.2	$3,000.00	$3,600.00	$7,200		pumped upstream of dam, flygt quote, Alumax
PLACE BACKFILL IN CHANNEL	180,000	CY	D	1.2	$1.51	$1.81	$326,160		1 CY FE loader, minimal haul, 022-254-3020
COMPACT RIVER BED COVER	180,000	CY	D	1.2	$0.35	$0.42	$75,600		Riding, vibrating roller, 022-226-5020
SPREAD EXCESS SOIL	210,000	CY	E	1	$1.21	$1.21	$254,100		Grading at dump; 022-266-1600
COMPACT SPREAD SOILS	210,000	CY	E	1	$0.89	$0.89	$186,900		Sheepsfoot roller; 022-226-6030
SEEDING	2,800	MSF	E	1	$40.00	$40.00	$112,000		
GEONET	21,000	SY	D	1.2	$2.50	$3.00	$63,000		vendor quote - 20% of area
								$1,035,640	
SOIL COVER OVER OLD RIVER BED									old river bed
TOPSOIL	18,000	CY	E	1	$4.00	$4.00	$72,000		furnish and place top 6" from stripped area
SEEDING	140,000	SF	E	1	$0.36	$0.36	$50,400		hydraulic seeding, 029-308-1300
								$122,400	
SEDIMENT EXCAVATION + HAUL									sediment only
EXCAVATION + LOAD SEDIMENT	6,500	CY	D	1.2	$10.00	$12.00	$78,000		1 CY backhoe estim. judgement/022-254-1300
HAUL TO SITE	7,200	CY	D	1.2	$7.93	$9.52	$68,515		12CY dump truck, 5 mile heavy traffic round trip,022-266-0540
SEDIMENT STAGING PAD	1	LS	D	1.2	$55,000.00	$66,000.00	$66,000		80 x 80 concrete pad with leak detection - pad demo.
ADDITIONAL ACCESS WAYS - GRAVEL	20,000	SY	E	1	$4.71	$4.71	$94,200		8" gravel depth, no surface, 015-552-0100
- GEONET	20,000	SY	E	1	$2.50	$2.50	$50,000		vendor quote
								$356,715	

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TABLE 9-2 (CONT.)

MOSS - AMERICAN SITE, MILWAUKEE, WISCONSIN
REVISED ESTIMATE FOR RIVER RELOCATION

DESCRIPTION	QUANTITY	UNIT	WORK LEVEL	LABOR FACTOR	CONVENTIONAL LABOR UNIT PRICE (DOLLARS)	SITE LABOR UNIT RATE (DOLLARS)	COST	SUBTOTAL	ASSUMPTIONS
CAPITAL COST DURING OPERATION									
ACCESS ROAD VEGETATION									
TOPSOIL	9,000	CY	E	1	$3.46	$3.46	$31,140		spread from piles, 5", FE loader, 022-266-0400
TREE PLANTING	2,100	EA	E	1	$100.00	$100.00	$210,000		Dogwood and willow; 029-536
BRUSH PLANTING	2,100	EA	E	1	$40.00	$40.00	$84,000		bush, 029-528-0500
SEEDING	600	MSF	E	1	$40.00	$40.00	$24,000		hydraulic seeding, 029-308-1300
OAT STRAW	600	MSF	E	1	$29.00	$29.00	$17,400		1" deep w/ large mulcher, 029-516-0700
REMOVE ACCESS ROAD GRAVEL	10,000	CY	E	1	$1.25	$1.25	$12,500		2.5 CY FE loader, load into truck, 022-238-1600
HAUL ACCESS ROAD GRAVEL	10,000	CY	E	1	$6.10	$6.10	$61,000		12 CY truck, 5 mile round trip, 022-266-0540
DISPOSE ACCESS ROAD GRAVEL	10,000	CY	E	1	$5.00	$5.00	$50,000		Vendor quote for construction debris
								$490,040	
TOTAL, RIVER RELOCATION WORK								$5,279,840	

grading for the roads and laydown areas, the cost of the geonet installed, and the cost of sedimentation controls for the roads.

Clearing and Grubbing

Clearing and grubbing in the FS estimate includes the cutting down of the trees and removal of the stumps. It does not include the disposal of these items (although costs are included for chipping). After the grubbing is completed, the site needs to be graded and erosion controls put into place. These controls will prevent soil from washing into the river as well as the park area and streets.

The estimate for this activity needs to be revised to include stump and material disposal, grading, and erosion controls.

Parallel Riverbed

Excavation of the new riverbed is predicated in the FS on using a 1 cubic yard hydraulic backhoe for the excavation. This equipment has a typical production rate of 320 cubic yards a day and a reach less than 30 feet. Based on the quantity of the soil, 1,000 machine-work-days are required (assuming an eight hour day). Assuming five machines are working, almost one full year is needed to complete the excavation. The machines would probably be working from the access road, thus a minimum of a 30 foot reach would be required. Working in the new bed should be minimized due to probable softness of the soil, although some excavation will necessarily occur in the bed.

To be completed within the first year, a six-month excavation schedule would be required with a production rate of 2,500 cubic yards per day. A different procedure needs to be followed employing several machines larger than the backhoe assumed in the FS.

A reasonable and timely approach would be to use scrapers for the first several feet, possibly down to a three to four feet depth, depending on the water table and the softness of the soil. The scrapers will work faster than a backhoe. To final grade the riverbed, a dozer or a grader should be used. Possibly due to the softness of the soil, planks or mats may have to be placed on the riverbed bottom to prevent the equipment from becoming embedded. A well point system may be required at spots along the bed to lower the water table to ensure sufficient dryness. Since final grading is required to be completed only when the bed is dry, delays are likely to occur. Therefore, the costs will probably be higher than the general estimated unit prices.

Spoil from the excavation will be placed directly on the ground during the first phase of construction (see FS p. B-5). Erosion controls will be required to minimize the soil from running into either the new or existing river. These controls can range from silt fences to drainage ditches and sumps. Silt fences and Visqueen covers will be assumed for the soil.

Additional time needs to be included, as shown in the independent estimate, for creation of the pools and riffles in the new riverbed.

Roadway Crossing Transitions

The one cubic yard backhoe selected in the FS for this work is too small for the same reasons as described for the construction of the new riverbed. Based on a 40-hour work week, the excavation of each transition will take one month or 11 months for the project since this work has to be conducted sequentially.

The revised independent estimate includes construction equipment better suited to the task.

Tributary Extensions

There will be modification work to the existing tributaries and drainage swales that is not included in the FS estimate. In addition, the final design may change the approach to the work under I-145 and Fond-du-Lac Road. However, until the detailed design can improve upon the assumptions, the current estimate will have to suffice.

Old Riverbed

Currently in the estimate for this work, there are only minor allowances for dewatering. If groundwater problems arise, a well point system may be required until the backfilling is complete.

The construction equipment identified in the FS for this work may not be the most efficient type to be used, but is acceptable for estimating purposes at this stage. Construction problems associated with the filling and compaction may arise due to the underlaying softness of the river bank. Geonet may be included as part of the final design to provide stability in the riverbed. This cost is included in the revised independent estimate.

Sediment Excavation and Haul

Major constructibility problems are associated with the removal of the sediment from the existing riverbed.

Access from the riverbed must be supplied to where the trucks are loaded based on the current design, which has the access road 30 feet across the fill pile from the riverbed. The pile will have to be arranged to allow trucks to go to the riverbed at set intervals, say 50 feet, resulting in about 600 access paths. Each of these paths will have the same design parameters as the access roads.

The construction equipment will have to work inside the existing riverbed in order to remove the visibly contaminated sediment, since no room is available next to the river for staging of the equipment. A standard backhoe cannot do this work; a specialized dozer designed for soft soil will have to work in the bed. In addition, dewatering could be a problem due to groundwater or rain, and perhaps a well point system or mats will be required.

The costs to be added to the FS estimate for this work include the access paths and added costs of specialized equipment.

Access Road Revegetation

Revegetation of the access road and laydown areas will be similar to that already estimated. However, two major refinements are necessary. The area to be revegetated will be increased due to the additional roads and laydown space. Also the FS does not include costs for the disposal of the gravel and geonet in a landfill (the transportation is included in the estimate but the disposal is not).

These materials cannot be assumed to be reused due to potential contamination, and would have to be disposed of as either a construction waste or a special waste. The assumption to be included in this estimate is as construction waste.

Other Potential Costs

As mentioned in several of the construction activities, a well point dewatering system may be required. A typical cost for such a system is $162 per linear foot (1) for installation and one month of operation. Additional months of operation run about $112 per month (1). If only 15 percent of the riverbeds require a well point system, about 4,600 linear feet per bed or 9,200 feet total, the additional cost the system, including one month of operation, would be about $1.5 million.

Escalation is excluded from line item estimates. Allowing 5 percent per year inflation and a midpoint of construction/operation four years from now, 21.5 percent needs to be added to each estimate. The escalation allowance for the FS estimate would be about $1 million and about $1.1 million for the independent estimate.

Landscaping the park area after completion could be a major cost. Each estimate currently has a single line consisting of a shrub and a six foot tree planted at 15 foot intervals. The current parkway has lush growth and large trees, with many overlapping rows of bushes and trees. To reconstruct what is currently there could be orders of magnitude more costly than estimated in the FS.

Weather problems, which can complicate the river relocation project, have not been addressed in either the original FS estimate or in this independent estimate. If winter duration is longer than normal, the construction work will be impaired due to lower production and additional costs for winter protection and construction techniques. Also, periods of rain will disrupt the construction and delay the work. At this level of estimate, these potential major cost impacts can be identified but not accurately estimated.

Environmental Considerations

The NCP and U.S. EPA policy on floodplains and wetland assessments (OSWER Directive 9280.002) requires consideration of environmental issues in the remedial planning process. An environmental assessment is required under the guidance for conduct of RI/FS projects. In addition, the NCP and U.S. EPA policy require that a floodplain/wetlands assessment be performed and integrated into the feasibility study whenever floodplain/wetland areas are potentially impacted. Floodplain/wetland assessments should consist of a description of the proposed action, a discussion of its effect, a description of the alternatives and their effects on the floodplain and wetland and measures to minimize potential harm to the floodplain/wetland. If the potential alternative is likely to impact a floodplain or wetland, the agency shall act to minimize adverse effects and take steps to restore and preserve the beneficial effects of floodplains/wetlands.

The Moss-American Administrative Record, including the RI and FS reports, does not satisfy the NCP or current U.S. EPA policy. WESTON has conducted a survey of the project area and concluded that: 1) the potential adverse impacts to wetlands and floodplain areas are significant, long-term, and difficult to minimize; 2) the adverse impacts may include an irretrievable loss of wetland habitat; 3) the technical approach to wetland/floodplain mitigation or restoration has not been established nor have the time or cost requirements been evaluated. A discussion of the survey is set out as Appendix E.

Extensive wetland areas occur along the Little Menomonee River. It appears that the state wetlands maps underestimate the true extent of wetlands that would meet the unified Federal criteria and that would be affected by the proposed river realignment. Furthermore, the state wetlands maps do not depict wetlands smaller than 2 acres, nor do the maps always depict the river channel proper as wetlands, both of which also serve to underestimate the expected acreage of wetlands.

The purpose of state and Federal wetlands inventory mapping is to locate areas that are likely to include wetlands. These maps are typically used in conjunction with soil survey data by field personnel prior to and during a wetlands delineation to guide field efforts. However, ultimate definition of wetlands boundaries for jurisdictional determination is necessary if dredge or fill material is to be placed in the wetlands, and can only be achieved through the unified Federal methodology, which requires on-site verification of soils, vegetation, and hydrology.

The feasibility study (FS) report, page B6, assumes that the construction corridor for the new alignment would be 100 feet wide and involve clearing of wetlands. The estimates of disturbed wetlands acreage in Table B-2 totals 67 acres, based on the State Wetlands Inventory which, as noted above, underestimates the amount of wetland present in the Primary Environmental Corridor. The acreage of cleared wetland is likely to be on the order of 100 acres.

In addition the State of Wisconsin regulates wetlands under Wisconsin Administrative Code Sec. NR115.03. All uses of wetlands and shorelands are prohibited by the state except those otherwise permitted by the Shoreland Management Regulations or by an amendment to the local zoning ordinance. Thus, both Federal and State review of the wetlands impact and mitigation plan would be necessary to be in compliance with the site-specific ARARs. (Permit review by the COE was omitted in Appendix A of the Feasibility Study report, p. A-5; Location-Specific ARARS).

As stated in the Feasibility Study report, all alternatives (except no action) include significant excavation affecting wetlands adjacent to and downstream of the site. Under Executive Order 11990, Federal agencies involved with actions at contaminated sites are required to conduct remediation efforts in a manner minimizing the destruction, loss, or degradation of wetlands. Realignment of the Little Menomonee River channel, however, will include significant wetlands impacts which should be reviewed in conjunction with the Corps of Engineers (COE). The FS report did not include this evaluation. The agency is also required to "mitigate" adverse environmental impacts under the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Clean Water Act Section 404(b)(1) guidelines. To show mitigation there are three steps which must be taken:

- Avoidance of impacts.
- Minimization of impacts.
- Compensation for impacts which cannot be avoided.

In the context of Section 404, avoiding impacts means staying out of the wetland or other waters of the United States. This will not be possible in the proposed realignment corridor area since much of the Little Menomonee floodplain appears to be wetlands. After careful review of the proposed plan to reroute the Little Menomonee River, it can be concluded that most, if not all, of the floodplain wetlands will be destroyed during construction.

Compensation for wetlands impacts usually means restoring previously converted wetlands, enhancing degraded wetland, or creating wetlands. In the FS report, minimization of construction activities in existing wetlands was noted as a means for mitigating riparian habitat destruction in the design of the new river channel. However, no discussion was given as to how the wetlands may be restored after construction. The proposed realignment does nothing towards meeting any of the conditions for compensation of wetlands impacts, namely, restoring previously converted wetlands, enhancing degraded wetlands, or creating wetlands since the new alignment is apparently contained entirely within existing wetlands.

The FS suggests the creation of new wetlands after construction is completed. This approach bypasses the avoidance and minimization steps of mitigation and does not satisfy the Section 404 (b)(1) guidelines. Also, because wetlands creation is a new technology it does not always replace natural wetlands functions and values successfully (National Wildlife Federation, 1989). In other words, the beneficial values of the existing wetlands (e.g., flood-control, nutrient, and silt removal, fostering of fish and wildlife, etc.) will not be replaced by any newly created wetland. Certain beneficial attributes of the existing wetlands may be regained after construction, but the total environmental benefits will be irretrievable.

In summary, RI and FS reports as well as the entire Administrative record have not adequately considered the technical, environmental, schedule or cost implications of construction in the Little Menomonee River floodplain and associated wetlands. RI/FS guidance, the NCP and EPA policy (OSWER Directive 9280.002) require the preparation of a floodplain/wetland assessment during preparation of the FS. The floodplain/wetland policy requires that remedial alternatives must not be selected that will be located in a floodplain or wetland unless a determination is made that no practical alternative exists. No such determination has been made. If it is determined that a remedial action must be located in a floodplain or wetland, then potential adverse effects must be minimized. Minimizing adverse impacts may include restoration, rehabilitation or replacement to assure retention of the beneficial effects of floodplains/wetlands.

The primary questions that remain unanswered therefore include:

1. What are the actual locations and acreages and habitats that may be impacted?

2. To what degree may floodplain/wetland areas be adversely affected?

3. What mitigative activities may be required?

4. How effective could mitigative efforts be to preserve the qualities of the floodplain/wetlands?

5. What could be the time-frame and associated cost for floodplain/wetland mitigation.

The FS report (Appendix B-6) lists a total of 67 acres of potentially disturbed wetlands. The estimated quantity of wetlands that may be disturbed was based upon the Wisconsin Wetland Inventory. WESTON's ecological assessment determined that additional large areas, if not the entire floodplain would be classified as wetland using Wisconsin and EPA-accepted standards. The quantity of wetlands that may be impacted has, therefore, been significantly underestimated. Based upon WESTON's review of the construction plan, sequence and approach, an estimated 100 acres of wetland appears to be a more realistic, minimum, quantity of wetlands to be disturbed. Disturbance or adverse impacts will include dewatering, filling, vegetation clearing and excavation. In many, if not most cases, wetlands along the realignment will be eliminated during construction. This initial loss is inestimable in financial terms relevant to the beneficial values (e.g., groundwater recharge, nutrient removal, wildlife and waterfowl habitat loss, flood and sedimentation control). To regain these beneficial values through restoration, reclamation or reconstruction of new wetlands may require decades to achieve, if ever achievable. Restoration or construction of new wetlands is subject to a very high failure rate. This is evidenced by federal wetlands policy that requires set-aside or replacement of wetlands in excess of the quantity lost. In many cases, it is necessary to establish new wetlands at a ration of 2:1 to wetlands lost in order to achieve the ecological benefits of the original wetland unit.

The restoration process requires a significant planning, permitting and design phase followed, in this case, by a complicated civil engineering construction project. Restoration activities will include construction and upgrading of drainage controls, repair of construction access/staging areas, excavation and importation of soils and extensive revegetation. WESTON estimates that the planning, permitting and design phase would require one to three years to complete at a cost of approximately 1.0 million dollars. This design estimate is conservative and assumes that requisite design information (e.g., installation of groundwater monitoring wells to establish seasonal water levels) could be completed in eighteen months.

The construction period is difficult to predict with certainty; however, it is likely that the earthmoving/civil construction activities will extend at least one year beyond the realignment activities. Monitoring and maintenance activities will likely be required for several additional years. Restoration costs have been estimated by WESTON to total approximately $3M. This total is based on an assumed (minimum) 100 acres of impacted wetland and a unit cost per acre of $30,000. The $30,000/acre unit cost is conservatively low and based on published results on similar projects completed in the upper Midwest under USCOE demonstration and state department of transportation projects.

In short, EPA has failed to evaluate an important environmental impact adequately in its FS. In consideration of impacts on wetlands, it is strongly urged that EPA not attempt remedial actions directed at the sediments in the Little Menomonee River.

9.2 IMPLICATIONS ON FEASIBILITY STUDY

WESTON's independent estimate shows that EPA has underestimated realignment cost by $6.4 million. The items that are added to the EPA estimate do not revise the type of estimate nor increase the level of accuracy of the estimate. These new items are, however, legitimate quantifiable costs that need to be incorporated into the FS estimate and given consideration in evaluation of alternatives. Indeed, an assessment of the feasibility of EPA's proposed riverbed realignment would have to be completed before any increase in the accuracy of the estimate could be achieved. A significant contingency needs to be added to the revised estimate for this reason.

REFERENCES

1. Means Sitework Cost Data. 1990 9th Annual Edition RS Means Co. 1989, p. 304.

2. "Excavating & Grading Handbook"; Nicholas Capachi, Craftsman Book Co. 1985; pages 95-98.

SECTION 10

GROUNDWATER CONTAMINATION

The FS does not adequately examine groundwater contamination.

- The areal extent of contamination is not defined.
- The chemical properties of the contaminants are not addressed.

The following subsections describe the inadequacies of EPA's groundwater assessment.

10.1 OCCURRENCE

Only 17 areal locations were chosen for installation of groundwater monitoring wells (FS Figure 1-8). Because of the absence of adequate data, the FS includes rough estimates on the occurrence of contaminated groundwater that are based on a conceptual interpretation of site hydrology. Most graphical depictions of groundwater contamination in the FS suggest that the areal and vertical extent have been clearly defined (e.g., FS Figures ES-3, 1-14, C-5, and C-8). Other graphical depictions (e.g., FS Figure C-7) come closer to displaying the uncertainty associated with the extent of groundwater contamination.

The extent of groundwater contamination is inadequately defined in all areas of the site. The western and southern boundaries of the main body of on-site contaminated groundwater are not delineated by monitoring wells. The contaminated groundwater limits are a conceptual estimate at best, as reflected by the line of question marks in FS Figure C-7. The FS recommends that additional wells are needed to define the contamination (FS p. 1-8).

The isolated region of contamination at MW-11S must also be considered only a conceptual estimate because its boundary, too, is not delineated by monitoring wells. In short, there is inadequate data to define the area of contamination.

U.S. EPA should provide a more detailed and more comprehensive study of groundwater contamination or explain how the nine-point remedial alternative screening would be affected by variation in volume of contaminated groundwater.

10.2 CHEMISTRY

The contamination at the Moss-American site is primarily PAHs, members of a class of contaminants known as dense, nonaqueous phase liquids (DNAPLs). The most important properties of the contaminants with respect to cleanup are their density, low solubility, and very high organic carbon partition coefficient (K_{oc}). The density property tends to make the PAHs sink when in the pure phase. The low solubility makes the pure phase likely to be encountered. The high K_{oc} makes the dissolved material tend to sorb to the organic fraction of soil particles.

$$K_{oc} = \frac{\text{mass of solute on carbon / unit mass of carbon}}{\text{mass of solute in solution / unit volume of solution}}$$

Given the opportunity to leave a dissolved state and enter an organic carbon matrix, the PAH contaminants show an exceptionally strong preference to enter the organic carbon matrix. As an example, the K_{oc} for acetone or ethanol, two chemicals inclined to stay in water, is 2.2 mL/g. In contrast, the K_{oc} for benzo(a)pyrene is 5,500,000 mL/g, making it one of the most strongly partitioning environmental contaminants. K_{oc} values for several other of the PAHs at the Moss-American site exceed one million mL/g.

The FS devotes insufficient attention to the sorption chemistry of PAHs, despite the bearing of this chemistry on the transport and cleanup of the groundwater. Failure to consider sorption leads to unfounded expectations of releases of contamination in the case of uncontrolled sites and to impractical treatment schemes in the case of remedial action.

10.3 TRANSPORT

EPA has failed to consider the contaminant transport phenomena at the site. Given a hydraulic conductivity in the 10^{-4} cm/sec range, a gradient in the 10^{-2} range, and a porosity of 0.34, groundwater would be expected to travel at about 8 feet per year. The groundwater flow velocity is not, however, necessarily the same as contaminant transport velocity. For a hydrophobic, biologically recalcitrant chemical such as the PAHs at the Moss-American site, the phenomenon of sorption is the primary determinant of contaminant transport (RI p. 3-1). Assuming a modest 3 percent organic carbon content for the water-bearing material, it is calculated that sorption reduces PAH mobility relative to water mobility by 874,000 times. The calculated contaminant transport velocity based on sorption effects is estimated in the range of millionths of a foot per year. The foregoing calculation was also confirmed in principle by the PRP RI (RI Appendix J), which calculates transport velocities for dissolved creosote in the range of hundred-thousandths of a foot per year. The limited mobility of the PAHs has significant impacts on the feasibility of remediation.

The behavior of DNAPLs in groundwater is fundamentally different from the behavior of most contaminants in groundwater. Whereas groundwater monitoring wells provide an accurate measure of bulk contamination from most contaminants, they may only provide a measure of the relatively small dissolved fraction of contamination from DNAPLs. When released from a continuous source at the ground surface, pure-phase DNAPLs fall vertically through the unsaturated and saturated zone, leaving deposits of residual sorbed to soil behind them. When DNAPLs encounter an impermeable layer, they form a pool of pure-phase contamination which may move along the impermeable layer in accordance with the layer's slope. Movement along the impermeable surface may be independent of local groundwater flow direction.

The upper layer of the unweathered till at the Moss-American site should probably be considered to form the surface upon which pure-phase PAH rests. The consequence of subsurface DNAPL pools would be that lingering units of source material would remain even if surface soil contamination were removed. The deep material would serve as a perpetual source of groundwater contamination and further complicate a groundwater extraction system.

10.4 IMPLICATIONS ON FEASIBILITY STUDY

The Proposed Plan involves extraction of contaminated groundwater over a 10-year period (FS p. 3-15). The schedule and cost estimate provided by the Proposed Plan assumes removal of all source material and apparently assumes non-reactive (i.e., same speed as groundwater) contaminant transport. If, however, sorption is considered and a 300-foot travel distance to collectors at existing gradients is assumed, the cleanup duration may be calculated to extend to approximately 94 million years. Indeed, the RI (page J-3) confirms that transport of contaminants could require millions of years. If the presence of deep, pure-phase DNAPL pools is also assumed, the required cleanup duration extends beyond 94 million years. Thus, after the planned 10-year groundwater remediation, essentially all dissolved contaminants in the water-bearing zone will still be present at their original location.

The major remedial action goal of the proposed cleanup at the Moss-American site is to prevent the transport of contaminants to the Little Menomonee River. The present review has identified the following reasons why the proposed cleanup will not achieve the stated goal:

- The extent of groundwater contamination has not been defined.
- The contaminants at the Moss-American site sorb to soil rather than flowing with groundwater and, therefore, will migrate much less than implied by the FS.
- The chemistry of DNAPLs assures that complete source removal is probably impossible by means of excavation.
- The strong affinity of PAHs for soil will require that the proposed groundwater collection and treatment system

will require millions of years to meet cleanup objectives.

Although the site hydrology is not well suited for groundwater extraction and treatment, it is also not well suited for contributing to widespread contamination of environmental media. Because contaminants are nearly immobile, the potential for expansion of groundwater contamination is not significant. Given these facts, EPA's proposed groundwater collection system design should be rejected as unnecessary and ineffective.

SECTION 11

SOIL VOLUME ESTIMATE

The soil and sediment volume estimate is one of the most important parameters required for accurate analysis of remedial alternatives. The cost of almost any alternative rises and falls as a function of treatment volume. The implementability of many alternatives can disappear at the extremes of large and small volumes, as can state and community acceptance.

The FS review uncovered a number of shortcomings in the soil and sediment volume estimate which cast doubt on the analysis of alternatives. The FS soil volume estimate was examined in a variety of ways. First, the assumptions of the FS were accepted as given conditions, and the resulting calculations were duplicated. Second, the influence of the cleanup target assumptions on soil volumes were examined. Third, the influence of data availability on cleanup volumes was investigated. The following subsections describe the methods and results of the review of the soil volume estimate.

11.1 <u>VERIFICATION OF VOLUME BY ACCEPTING ASSUMPTIONS</u>

The first step in review of the soil volume estimate was to examine whether the stated assumptions given in the FS were used as stated to calculate the anticipated treatment volume. FS Figure C-3 provides sufficient information to define completely the overall surface areas assumed in the FS to potentially require remediation. Deep soil could not be evaluated because no information is provided regarding the occurrence of contaminated deep soils. Lack of information on deep soils is of great consequence -- at a DNAPL site, contaminated deep soils would be expected to be a significant portion of the overall contaminated soil volume. WESTON does not consider the estimate of 75,000 cubic yards to be a defensible figure.

For evaluation of the proposed plan (Alternative 3A), an independent calculation of the volume of "visibly contaminated soils" based on areas from RI Figure E-7 and thicknesses from FS Table C-2 was conducted. All volumes are bank volumes without swell allowance. To a reasonable degree of accuracy, the volume figures check, particularly if selective excavation of visibly contaminated soil is not especially efficient. In the cost estimate for Alternative 3A, provision is correctly made for treatment, hauling, and grading of an extra 25 percent of soil volume due to swelling after excavation relative to the calculated bank volume before excavation.

The foregoing verification of volumes based on accepting the assumptions of the FS does not lend credibility to the volume

SECTION 12

ADDITIONAL RESEARCH REQUIREMENTS

12.1 RESEARCH NEEDS IDENTIFIED BY FS

The FS explicitly and implicitly identifies a variety of research needs that must be completed during predesign. It is WESTON's opinion that the research needs identified in the FS are notable and could significantly alter the conclusions presented in the current FS, especially with regard to implementability and remediation costs. Most of the research/data needs affect the extent and volume of the contamination. Collectively, the research needs could change the extent and volume expectations so as to change the relative rankings of the various alternatives presented in the FS. For example, large increases in contaminated soil volumes would have a significant impact on cost, implementability, and cleanup time.

The following excerpts are examples of additional research needs identified in the FS:

> Page 1-7, Paragraph 3 -- "Portions of the site in the vicinity of what was the pit and ditch in the untreated storage area were investigated to a limited extent. The limited information obtained suggests that the extent of contamination does not extend into the northwest portion of the site. Additional investigations during the remedial design may be required to verify this."

> Page 1-8, Paragraph 6 -- "The extent of the northern unit [of the Northeast Landfill] was not as well defined: it appears that the northern unit was removed." This statement suggests additional investigation is indicated.

> Page 1-8, Paragraph 7 -- "Because of the nature of activities conducted at the site, additional wells should be installed before the design phase, particularly in the process and drip track (sic) areas."

> Page 2-2, last paragraph -- "The flood plain soil issue will be addressed separately as a part of the preliminary design and, if necessary, a separate operable unit FS may be performed."

> Page 3-8, Paragraph 2 -- "Until more information on the vertical extent of groundwater contamination is obtained, using drains to collect groundwater appears to be the most appropriate approach to removing contaminated groundwater and preventing migration of contaminants to the river."

Page 3-13, Paragraph 4 -- "During the predesign phase, a more refined estimate of the volume of visibly contaminated soil and sediment should be performed through a sampling survey."

Page C-1, Paragraph 5 -- "The extent of soil contamination outside the former property boundaries, particularly for the flood plain deposits along the Little Menomonee River, could not be determined based upon existing data."

Page C-3, Paragraph 2 -- "From the observed variability, it is clear that the volume of contaminated soil (determined during predesign or construction phase) could differ significantly from the estimated volume."

Appendix I, Table I-3, Alt 3A -- "Field Pilot Study ...$100,000."

In light of these acknowledged data inadequacies, it is premature for EPA to select a remedial approach.

12.2 RESEARCH NEEDS IDENTIFIED BY WESTON

The Proposed Plan includes a groundwater collection system to remove groundwater contaminants. Although the site contains a variety of ordinary BTEX-type contaminants, the main purpose of the groundwater collection system must be to intercept and remove PAHs, a class of DNAPLs. In the dissolved phase, DNAPLs preferentially sorb onto soil (see RI Appendix J). In the pure phase, DNAPLs tend to sink until they reach a low-conductivity layer or lens where they form a thin seam of pure-phase contamination (see FS Figure C-6). Given the challenges imposed by DNAPL chemistry, it is doubtful that EPA should seek any remediation of groundwater. At the least, however, a pilot study will be required to determine whether DNAPLs can effectively be removed.

The Proposed Plan includes an aqueous soil washing system to remove PAHs from the soil. Given that PAHs are strongly hydrophobic, the effectiveness and implementability of the technology is by no means certain. At a minimum, a bench-scale test must be provided to demonstrate the existence of a water-surfactant solution that can achieve the design requirements of the proposed treatability variance (design for 0.5 ppm residual or 99.9% reduction according to OSWER Directive 9347.3-06FS).

The Proposed Plan includes slurry biotreatment to remove PAH from fine-grained soil and sediment. Given the results from the treatability study (see FS Appendix K) the ability to biodegrade PAHs within the stated FS design duration of 15 days is very questionable. Even after 60 days in laboratory tests, the soil had not been cleaned to the design goal of the proposed treatability variance. Additional bench-scale tests must be provided to demonstrate the possibility of successful removal of PAHs from the soil. At present, no evidence at the bench scale suggests that a pilot-scale test could be expected to demonstrate successful cleanup.

The Proposed Plan will involve the sequential treatment of some coarse-grained materials in the soil washing system prior to slurry biotreatment. If surfactants, especially ionic surfactants, are used in the soil washing system, the hydrocarbon-metabolizing microorganisms expected to perform the biotreatment could be inhibited or killed. Ionic surfactant concentrations as low as 2-3 ppm have killed aerobic hydrocarbon-metabolizing bacteria. A demonstration must be made that sequential soil washing and biotreatment can be accomplished without the deleterious interaction between the two technologies. The interaction of the two technologies should be explored in the additional bench-scale studies.

12.3 IMPLICATIONS ON FEASIBILITY STUDY

The Feasibility Study has left a significant amount of site characterization, and remediation design for further characterization at some later date. Delaying critical evaluation until after the FS creates undesirable consequences:

First, decisions are made regarding alternative ranking and selection without adequate knowledge of the physical system. If, for instance, the uncertainty surrounding volume has resulted in a gross underestimation of the material to be treated, then technologies that involve high capital but low operation and maintenance costs may have been disregarded without true justification. If, for instance, treatability of the material has been overestimated, then containment options may have been discarded without reason.

Second, commitments are made without proof that they can be kept. In other words, the Superfund standard criterion of implementability has not been accorded proper importance. Alternative 3A, which advanced to Proposed Plan status, centers on a treatment technology that has so far given indications that it cannot degrade the contaminants present at the site at a practical rate.

Third, the open-ended nature of the many requirements for additional study almost guarantees that the $25 million capital cost for Alternative 3A will ultimately prove to be much less than the ultimate project cost.

In light of these problems, it is inappropriate for EPA to settle on a remedial approach until the necessary information that should guide the decision is assembled.

APPENDIX A

SPECIFIC COMMENTS ON RISK ASSESSMENT

APPENDIX A

SPECIFIC COMMENTS ON THE RISK ASSESSMENT

Baseline Risk Assessment. Following are other specific comments on the Baseline Risk Assessment for the Moss-American site. Chapter 4 of the RI report is a summary of the actual baseline risk assessment which is presented in Appendix K. Since the details of the risk assessment approach, methodology, assumptions, and calculations are presented in Appendices K, L, and M, they will be the focus of the comments.

Contaminant Identification. According to the last sentence on page K-3, "Inorganic compounds were not included if the detected concentrations did not exceed background soil concentrations." A comparison of the geometric mean background soil concentration with the geometric mean sample soil concentration for each inorganic contaminant (in accordance with the latest U.S. EPA guidance) suggests that only arsenic, lead, and zinc are clearly found in samples at levels higher than background. Some individual contaminant concentrations were found above the background range for on-site soils; however, the geometric mean for samples and background were generally comparable. Similarly, only lead and zinc were clearly detected in the Menomonee River sediment at concentrations exceeding the available background data. While it is recognized that the risk posed by these background contaminants is low, compared to the site-related chemicals, they should not be included in the calculation of estimated risk because they overestimate the total risk associated with the site.

Toxicity Assessment. The toxicity assessment section of this report provides general information on contaminant classification and toxicity profiles. This summary should include all information of particular importance to the evaluation of risk associated with the site. In particular, the summary profiles should include pertinent pharmacokinetic properties (i.e., absorption, metabolism, and elimination efficiencies) as they apply to the dose/response relationship. Information concerning the absorption efficiency may decrease the estimates of exposure calculated in subsequent sections of the report.

Page K-4. The statement is made that "Carcinogens are chemicals that cause or induce cancer. Carcinogenic effects demonstrate a nonthreshold mechanism." This is both unclear and an overstatement. Carcinogens are chemicals that may cause cancer based on varying degrees of conservatism inherent in developing the cancer potency factor from human, or more likely, animal data. The nonthreshold theory is very conservative, disputed by many scientists, and results in an upper bound of risks which may actually be much lower or approaching zero. A more complete and tempered discussion of this mechanism should be provided so that the public and decisionmakers can obtain a more realistic understanding of the predicted risks.

Since the toxicity profiles present information concerning both acute and chronic health effects, the report should distinguish between subchronic and chronic reference dose (RfD) values. The U.S. EPA provides reference dose values for both subchronic and chronic exposures. All of the RfDs presented in Table K-5 are for the evaluation of chronic health effects only, as would be anticipated from chronic exposures. This distinction is important in subsequent sections of the report where exposures and risks are evaluated.

<u>Potentially Exposed Populations</u>. Page K-21. The RI report states that "A 1970 survey (SEWRPC 1976) listed the four most important recreational activities associated with the entire Menomonee watershed to be swimming, picnicking, fishing, and target shooting. Forty-three percent of recreational activities were water-based." These are very misleading statements and refer primarily to the Menomonee River. WESTON's survey of the Little Menomonee found very little evidence of public usage, such as swimming, fishing, etc. There is very little access due to the lush vegetation except at bridge locations. This discussion should be modified to more appropriately describe the actual conditions at and near the site. Similar discussion is provided on page K-22.

<u>Trespass Setting</u>. Pages K-24 and K-25 -- It was assumed that the average "trespass exposure" would consist of 40 site visits per year at 2 hours per visit for 10 years. There is no basis for this assumption. A detailed discussion of human activity patterns is provided in the U.S. EPA Exposure Factors Handbook (1989). Human activity can be divided into numerous categories (i.e., time spent outside at home; time at home vs. time away from home and time indoors vs. time outdoors). Based on this reference, the total amount of time spent away from the home in an outdoor activity may average 0.12 to 0.27 hours per day or 43 to 98 hours per year. This includes such activities as outdoor playing, attending sports events, active sports, and other outdoor activities, such as walking/biking, camping, etc. The maximum average time spent in the walking/biking category (similar to the trespass scenario at this site) is 0.81 hours per week or 42 hours per year. The assumption of 40 days per year at 2 hours per day (80 hours per year) is nearly twice the activity level suggested by the available literature.

<u>Page K-26</u> -- For noncarcinogenic risks, it was assumed that exposures occur on a daily basis, every day during the life of the individual. This assumption was made "because trespass exposures are intermittent and averaging exposure over a lifetime or an extended period may underestimate noncarcinogenic risks." This logic is inaccurate for several reasons and results in an overly conservative estimate of exposure and associated risks. By nature,

trespass exposures are indeed intermittent, and expected to occur for no more than two hours per event. Calculating exposure on a daily basis without averaging the exposure over a "chronic" time period is equivalent to calculating an acute exposure dose. This would be acceptable if comparing the acute exposure to an acute RfD. However, this was not done in this risk assessment. Indeed, by the very nature of the intermittent exposure scenario associated with the trespass setting, the dose is chronic by definition and should be compared to a chronic RfD. To calculate a chronic dose, the Risk Assessment Guidance for Superfund Volume 1 Part A (1989) recommends an averaging time (AT) of 365 days for noncarcinogenic effects. This averaging time factor accounts for the intermittent nature of the exposure and more accurately estimates a chronic exposure dose that can be compared to a chronic RfD. This methodology does not underestimate the noncarcinogenic risks associated with the site.

Absorption Factor -- There was no consideration given to the importance of an absorption factor in the discussion of exposure assumptions. An absorption factor is a chemical specific value used to reflect the desorption of the chemical from soil and the absorption of the chemical into the blood stream. Pharmacokinetic toxicity data may be used to conservatively estimate the absorption efficiency of the contaminant through the route of exposure of concern. The appropriate toxicity information should be presented in the toxicity profiles and used here to document the value used. Available data for some compounds suggests that less than 100 percent absorption efficiency may be assumed. The Risk Assessment Guidance for Superfund Volume 1 Part A (1989) provides for the use of an absorption factor (ABS).

Fraction Ingested from Contaminated Source -- The Risk Assessment Guidance for Superfund Volume 1 Part A (1989) also provides for consideration of the fraction of the soil that is presumed to be contaminated (FI). It is unlikely that all of the soil to which an individual in the trespass scenario would come into contact with would be contaminated. If there are bike trails at the site, what percentage of the trails are actually in contaminated soils? Assuming that an individual would show no preference to specific trail segments, the percentage of trails actually contaminated would be an appropriate estimate of FI.

Pages K-27, K-32. A number of places in the RI report have the phrase "conservative outer bound." This is indicative of the type of assumptions made throughout the report. The U.S. EPA (U.S. EPA, 1989) recommends a "reasonable maximum approach," not worst case or conservative outer bound as is used in this report. Both the terminology and the approach should be modified.

Pages K-28, K-33. The discussion on the PAH toxicity issue does not follow currently accepted opinions concerning the relative potency of various PAHs. It does not, as stated, follow U.S. EPA guidance. The statement concerning the balancing of conservatism and synergism shows a significant lack of understanding of the realities of both the potency approach and synergism. This entire discussion should be eliminated and the PAH relative potency approach utilized.

Residential Development Setting. The comments for the trespass setting also apply here. It is agreed that the activity level for a person at home for both indoor and outdoor fractions is expected to be significantly more than for the trespass setting. However, a significant amount of time would occur away from the home where exposures would not be expected to occur (see U.S. EPA Exposure Factors Handbook, 1989). In addition, while it is recognized that future residential soil contaminant concentrations would be the result of soil excavation, it is also reasonable to assume that residential development would result in considerable mixing of the site soils (both contaminated and uncontaminated), such that the current concentrations of contaminants may significantly overestimate future concentrations and exposures.

River Recreational Setting. The comments for the trespass setting also apply here. It is recommended that the Exposure Factors Handbook (U.S. EPA, 1989) be referred to for the development of an appropriate activity level assumption for this setting along the river. Activity along the river is not related to "trespass" activity and may be significantly different than the estimate recommended for "trespass" exposures. There is no basis on which to assume that the two settings are the same. In addition, WESTON personnel walked the entire length of the Little Menomonee from above the site to the confluence with the Menomonee and found access to the actual stream exceedingly minimal. This further supports our assertion that the exposure assumptions are significantly overstated.

Exposure and Risk Calculations (Appendix M). Concentration data presented in the summary tables (K-10, K-12, and K-14) are significantly different than concentration data used in the risk estimations (Appendix M). To ensure the accuracy of the Risk Calculation Data Tables (Appendix M, Tables M-1 - M-33), an effort should be made to double-check the input parameters, especially the exposure point concentrations and exposure assumptions. Data quality problems severely undermine the credibility of the entire assessment. Tables K-10, K-12, and K-14 present the exposure point soil concentrations for the three exposure settings. These are the soil concentrations that should be used in the risk calculations. A review of Tables M-1 through M-33 discovered several errors in the highest detected and geometric mean concentrations used in the calculations. While some of the values were different due to rounding, other values were clearly suspect. For example, Table K-10 shows values for benzo(a)anthracene of 170,000 and 2,893 mg/kg for the east site, while Table M-3 shows corresponding values of 410,000 and 3,800 mg/kg. Other similar errors in exposure concentrations appear in Tables M-1, M-2, M-3, M-4, M-5, M-6, and M-13. These discrepancies should be resolved before any conclusions can be drawn.

Tables M-9 and M-12 calculate inhalation cancer risks associated with the trespass setting. The calculations include an assumption of eight hours of exposure per day. The exposure assumptions presented in the text (Table K-9) indicate two hours of exposure per day for the same trespass setting. This error results in an overestimate of inhalation cancer risk by a factor of 4.

Four contaminants (nitrosodiphenylamine, cyanide, tetrachloroethene, and 4-chloroanaline) were not selected as indicator contaminants. However, these contaminants were included in the exposure and risk calculations in Appendix M (Tables M-4, M-5, M-10, M-11, M-16, M-17, M-19, and M-24). These contaminants should be deleted from these tables.

All of the above exposure assumptions and calculation errors combine to overestimate the risk at the site. The exposure and risk estimates should be recalculated based on the activity pattern analysis, AT, ABS, FI assumptions and current errors described above.

<u>Environmental Evaluation (Page K-35)</u>. The statement is made that "Aquatic life in general was found to be about 50 percent as abundant downstream than it is upstream of the site." There is no support given for this statement and WESTON's stream survey failed to even qualitatively detect such a difference. The statement should be removed and a more unbiased evaluation of the stream should be presented in its place.

Limitations and Assumptions. Given the overconservative approach followed throughout this report, the results as presented in the report are greatly limited. The uncertainties should be quantified in the report so that the level of uncertainty is clearly stated. Based on the overly conservative exposure assumptions, the risks presented may be overestimated by several orders of magnitude.

The uncertainty should be dealt with within the report by "fine-tuning" the exposure assumptions to eliminate overconservativism. This is not to suggest that the conservative integrity of the assessment should be compromised. However, when assumptions can be justified in accordance with U.S. EPA guidance manuals and technical handbooks, the appropriate and valid assumptions should be used. In addition, the uncertainties associated with each assumption and input parameter should be quantified so that the risk manager has a measure of the quality assurance and sensitivity of the analysis. The uncertainty analysis, as presented, fails to provide the reader with a realistic sense of the overconservatism of the study. For example, in the RI report, the term "conservative outer bound" is used in several places to describe exposure assumptions. However, in the uncertainty analysis, the discussion on exposure assumptions merely states that they may under- or overestimate risks. This shows that this analysis fails to accurately portray the uncertainty. This entire section should be modified.

Risk Assessment Methodology (Appendix L). The methodology should be revised as appropriate to be consistent with the Risk Assessment Guidance for Superfund, Volume 1 Human Health Evaluation Manual, Part A (U.S. EPA, 1989), and to include appropriate exposure factors for exposure duration (based on activity pattern analysis), AT, ABS, and FI.

Specific Comments on FS Report with Respect to the Risk Assessment

Page 3 - Summary of Risk Assessment - last paragraph page 3. Risk levels presented for the Trespass and Residential development scenarios are overly conservative based on documentation provided in Sections 1 through 6 of these comments (main text).

Page 4 - 1st paragraph. The risk levels presented for the Recreational scenario are overly conservative based on documentation provided in Sections 1 through 6 of these comments (main text).

Page 5 - 1st and 2nd paragraph.

The EPA report states that the site-specific goals for sediment in the river include minimizing the downstream migration of contaminated sediments and minimizing acute and chronic effects on aquatic life posed by contaminated sediments. The volume of sediment that has carcinogenic PAH concentrations that exceed background levels is estimated to be 26,000 cubic yards.

In addition, the clean up goal stated in Table 2-1 for soil is 0.061 ppm(mg/kg) and in Table 2-3 for sediments is 4 ppm (ug/kg). Note that Table 2-3 also states the clean-up target for total carcinogenic PAHs is 4 ppm (mg/kg) which seems at odds with individual PAH targets. This latter target suggests, based on analysis of the confirmatory samples and the proportion of each carcinogenic PAH species, the following individual targets:

Benzo-a-anthracene	1.2 mg/kg (ppm)
Chrysene	0.92 mg/kg
Benzo-b-fluoranthene	0.56 mg/kg
Benzo-k-fluoranthene	0.48 mg/kg
Benzo-a-pyrene	0.56 mg/kg
Indeno-2,3,4,-cd-pyrene	0.16 mg/kg
Dibenzo-ah-anthracene	0.01 mg/kg
Benzo-g,h,i-perylene	0.08 mg/kg

The attainability of these targets, especially in the light of the potential for other inputs via urban runoff and atmospheric deposition should be addressed in the report. Background concentrations of PAHs for rural, agricultural and urban soils for the United States and other countries are quoted in the ATSDR review (2/90). Average concentration ranges for total PAHs are approximately 12 to 200 mg/kg for rural soil, 49 to 162 mg/kg for agricultural soil, and 25 to 583 mg/kg for urban soil.

The purpose of introducing these data is to indicate that aside from being unsupportable based on risk, the proposed target levels of clean-up in an urban area may be optimistic no matter what remedial action is taken due to the contributions from atmospheric deposition and solids transport in urban, agricultural and rural run-off. Likewise, the building of a new river channel in a floodplain that has received regular inundation and about which little is known of the PAH distribution may not allow the target levels to be reached.

It is incumbent on the RI/FS to demonstrate unequivocally that a remedial action of the magnitude proposed will solve the problem. Without direct information on the PAH levels in the floodplain and the levels contributed via runoff this is a "blind" step.

Page 5 - 1st full paragraph. Site-specific goals for soil were based on a 1×10^{-6} lifetime cancer risk. The volume of soil should be recalculated based on the revised target cleanup levels presented in Section 6 of these comments (main text).

Page 5 - 2nd full paragraph. Site-specific goals for sediment were based on comparison to background. The volume of sediment should be recalculated based on the revised target cleanup levels presented in Section 6 of these comments (main text).

Page 5 - 3rd full paragraph. Concentrations of water associated with $1x10^{-6}$ cancer risk levels were not presented in the risk assessment. Where are the site-specific target concentration goals for the groundwater?

Pages 1-9 through 1-10 - Risk Assessment Summary. The summary of the Risk Assessment should be revised to reflect the revised results based on Sections 1 through 6 of these comments (main text).

Page 2-3. The proposed risk-based concentration is actually lower than the detection limit as were all on-site background concentrations. The proposed target risk-based concentrations are lower than normal background concentrations in urban soils indicating that the selected goal is more stringent than background.

Page 2-3 - last paragraph. The estimated volume of contaminated soil having concentrations that exceed the $1x10^{-6}$ target concentration should be recalculated based on the revised risk assessment presented in Sections 1 through 6 of these comments (main text).

Table 2-1. This table presents a number of different data related to the evaluation of remedial action objectives (cleanup goals) for soil. The data reported for detection limits, background concentrations, highest observed, geometric mean, and target concentrations are all in error. Detection limits for the carcinogenic PAH compounds in the six identified background samples for the site range of 0.380 to 0.790 ppm (mg/kg) (see RI Appendix P). In fact, the detection limits for five of the six samples range from 0.740 to 0.790 ppm, with only one sample with a detection limit of 0.380 ppm. The value reported in Table 2-1 was 0.330 ppm. The detection limits for the background samples should be changed accordingly.

The highest and geometric mean concentrations for the PAH compounds, as presented in Table 2-1, do not agree with values reported in tables within the RI report. What are the correct values? The values presented in Table 2-1 for the 10^{-4} risk-based targets are in error. The value for benzene should be 2,400 ppm. The value for each carcinogenic PAH compound is assumed to be 6.087. There is no documentation in the report for either 10^{-4} or 10^{-6} target concentrations. Where did these values come from? The risk assessment review was able to duplicate the values that were presented (considering the typographical errors); however, documentation for the development of the target concentrations should have been presented in a separate section of the RI or FS. These values are critical because they are used to define the extent of remediation. The same assumptions and methodology used in the risk assessment were used to develop these risk-based target concentrations. As demonstrated in Sections 1 through 6 of this comment document, the assumptions and methodology used were not appropriate and were in error. The values for 10^{-4} and 10^{-6} target concentrations for soil should be corrected.

In addition, a value of 105 ppm was presented in Table 2-1 for a risk-based target for lead. This level is not consistent with recent U.S. EPA Guidance (OSWER Directive 9355.4-02, September 1989) which establishes a soil lead cleanup level for total lead at 500 to 1,000 ppm. The recommended U.S. EPA cleanup level should be referenced.

Page 2-4 - Sediment Operable Unit. The first paragraph itemizes four remedial action objectives. These objectives are not documented in the RI and risk assessment. Based on appropriate risk assessment assumptions and methodology, there is no present or potential unacceptable risk to public health associated with concentrations of contaminants in the Little Menomonee River. Acute risks to humans and acute and chronic effects on aquatic life were not quantitatively evaluated in the RI and Risk Assessment. As a result, development of scientifically defensible cleanup target concentrations for the sediment have not been demonstrated in the RI and Risk Assessment. In addition, an accurate evaluation of current sediment loading into the Menomonee River has not been completed. An evaluation of geometric mean PAH concentrations in the sediment of the last two stream miles of the Little Menomonee River before the confluence with the Menomonee River suggests that the levels are comparable to background. The remedial action objectives for the sediment operable unit are unfounded. Remediation of the Little Menomonee River is not warranted.

Table 2-3. The Risk-Based Target Concentrations for the sediment are not documented in the report. Where did these values come from? The risk assessment review was able to duplicate the values presented in Table 2-3; however, some documentation for the development of the target concentrations should have been presented in a separate section of the RI or FS. These values are critical because they are used to define the need and extent of remediation. The same assumptions and methodology used in the risk assessment were used to develop these risk-based target concentrations. As demonstrated in Sections 1 through 6 of this comment document, the assumptions and methodology used in the EPA assessment were not appropriate and were in error. The values for 10^{-4} and 10^{-6} target concentrations for sediment should be corrected.

Table 2-4. The range of carcinogenic PAH concentrations detected for each stream reach of the Little Menomonee River is misleading. As part of the review of this document, the geometric mean total carcinogenic PAH concentrations for each stream reach were calculated and compared to background levels. Only stream reaches 1, 2, and 3 (from Brown Deer Road and Mill Road) contain total carcinogenic PAH levels which exceed background concentrations. The geometric mean concentrations for stream reach 4 and 5 (Mill Road to Hampton Road) are comparable to background data presented in Appendix J of the FS.

APPENDIX B

CARCINOGENIC RISK COMPARISONS BASED ON RELATIVE PAH TOXICITY

APPENDIX B

Table B-1 presents the risks from the original assessment along with the risks using the relative potency approach with the 11.5 and 3.22 $(mg/kg/day)^{-1}$ potency factors. This table is presented for reference and does not represent what we consider to be the most appropriate estimate of risk, taking all issues into consideration. It represents the risks associated with adjustments to the toxicity of PAHs only.

TABLE B-1

CARCINOGENIC RISK COMPARISONS - MOSS-AMERICAN SITE
INGESTION OF CONTAMINATED SOIL/SEDIMENT

	Original		Revised Based on Relative PAH Toxicity [11.5 (mg/kg/day)$^{-1}$]		Revised Based on Relative PAH Toxicity [3.22 (mg/kg/day)$^{-1}$]	
	Highest	Average	Highest	Average	Highest	Average
Trespass						
East	3.0E-04	5.1E-06	6.0E-05	1.0E-06	2.0E-05	5.0E-07
West	5.0E-04	2.0E-05	9.0E-05	4.0E-06	3.0E-05	1.0E-06
Residential						
East	2.0E-02	2.0E-04	4.0E-03	1.0E-04	1.0E-03	9.0E-05
West	4.0E-02	3.0E-04	7.0E-03	5.0E-05	2.0E-03	2.0E-05
Recreational	1.0E-04	2.0E-05	3.0E-05	1.0E-05	1.0E-05	5.0E-06

APPENDIX C

CARCINOGENIC RISK COMPARISONS
BASED ON REVISED EXPOSURE ASSUMPTIONS

APPENDIX C

The purpose of this Appendix is to present revised risk estimates based solely on changes in exposure assumptions discussed in Section 4. The revised risk estimates are also compared to the risks presented in the EPA assessment. The revised risks are directly comparable to the risks presented in the EPA assessment (i.e., the same three settings were used, the same routes of exposure, and both east and west site concentrations were used).

It should be noted that the revised scenarios differ from the original in that the revised uses the soil concentrations listed in tables K10, K12 and K14 in the original assessment. The reason for this is that some discrepancies were noted between the chemicals and concentrations listed in these tables and the chemicals and concentrations used in the original calculations (Appendix M). It is stated in the original risk assessment that the concentrations listed in these tables were used in the calculation of risk. However, WESTON reviewed both the concentration summary tables (K10, K12, and K14) and the concentrations used in the actual risk calculations (Appendix M Tables) and noted differences, and therefore chose to use the more consistent data listed in tables K10, K12, and K14. As a result, some of the concentrations used by WESTON may differ from the concentrations used to calculate risk in the original assessment. A more detailed discussion of this problem is included in Section 1. This type of inconsistency makes the review of the document difficult.

In addition to the differences in exposure assumptions and concentration levels, there were also differences in the reference doses used for the inhalation pathway. In the revised assessment, when inhalation RfDs were not available, a value was developed based on a modified Threshold Limit Value (TLV). The following contaminants had inhalation RfDs modified in this revised assessment due to inappropriate use of oral RfDs in the original assessment: beryllium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc.

Overall, the revised total risk values for each scenario are lower than the original values. These comparisons are presented in Tables C-1, C-2, and C-3.

Table C-1 presents the comparisons for the Trespass scenario. Based on the revisions discussed in Section 4.1, the noncarcinogenic hazard indices have been reduced by one to two orders of magnitude, and are all below one which indicates that this exposure scenario is not likely to cause any noncarcinogenic health impacts. For carcinogenic risks, the original estimates have all been reduced by about two orders of magnitude. The carcinogenic risks in the original assessment for exposure to the maximum soil concentrations ranged from 300 to 500 chances in a million. The revised risks range from 2.7 to 7.6 chances in a million. The risks for exposure to the geometric mean concentrations was similarly reduced to below one chance in a million for both sites.

Table C-2 presents the risks for the Recreational scenario. The noncarcinogenic risks have been reduced by about three orders of magnitude and are not a concern from a health impact perspective. The carcinogenic risks went from 100 chances in a million to 2.3 chances in a million for maximum soil concentrations and from 20 to less than one chance in a million for the geometric mean concentrations.

Table C-3 presents the results for the Residential scenario. For noncarcinogenic risks, all the adult and child hazard indices have been reduced in the revised scenario. For the East and West sites, the carcinogenic risks were reduced by an order of magnitude for exposure to the maximum soil concentrations. For the geometric mean soil concentrations (East site), the risks went from 200 to 69 chances in a million. For the geometric mean soil concentrations (West site), the risks went from 300 to 49 chances in a million in the revised assessment.

All the carcinogenic risks would be further reduced if EPA had applied appropriate potency factors, as discussed in Section 3.

TABLE C-1

MOSS AMERICAN SITE
TRESPASS SCENARIO

TOTAL NON-CARCINOGENIC RISK COMPARISONS

	ADULT		ADULT		CHILD		CHILD	
	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED
EAST SITE								
INGEST	7.4E-02	1.3E-03	5.6E-02	8.6E-05	1.5E-01	1.9E-02	1.1E-01	2.0E-04
INHALA	1.1E-02	1.8E-03	1.1E-02	3.8E-03	1.4E-02	2.3E-03	1.5E-02	2.0E-03
HAZARD	8.5E-02	3.1E-03	6.7E-02	3.9E-03	1.6E-01	2.1E-02	1.3E-01	2.2E-03
WEST SITE								
INGEST	1.2E+00	1.7E-03	1.2E-01	1.3E-04	2.4E+00	3.3E-03	2.4E-01	2.7E-04
INHALA	1.8E-02	2.1E-03	6.0E-03	6.8E-04	2.3E-02	2.7E-03	8.0E-03	8.8E-04
HAZARD	1.2E+00	3.8E-03	1.3E-01	8.1E-04	2.4E+00	6.0E-03	2.5E-01	1.2E-03

TABLE C-1 (Continued)

MOSS AMERICAN SITE
TRESPASS SCENARIO

CARCINOGENIC RISK COMPARISONS

	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED
EAST SITE				
INGEST	3.0E-04	2.5E-06	5.0E-06	6.3E-08
INHALA	3.0E-06	2.2E-07	7.0E-08	6.3E-08
TOTAL	3.0E-04	2.7E-06	5.1E-06	1.3E-07
WEST SITE				
INGEST	5.0E-04	6.9E-06	2.0E-05	2.1E-07
INHALA	3.0E-06	6.7E-07	2.0E-07	3.0E-08
TOTAL	5.0E-04	7.6E-06	2.0E-05	2.4E-07

TABLE C-2

MOSS AMERICAN SITE
RECREATION SCENARIO

TOTAL NON-CARCINOGENIC RISK COMPARISONS

	ADULT		ADULT		CHILD		CHILD	
	MEI *ORIGINAL	MEI **REVISED	AEI ORIGINAL	AEI REVISED	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED
INGEST	2.9E-01	7.5E-04	2.3E-01	4.6E-04	5.9E-01	1.5E-03	4.6E-01	9.2E-04
HAZARD	2.9E-01	7.5E-04	2.3E-01	4.6E-04	5.9E-01	1.5E-03	4.6E-01	9.2E-04

TOTAL CARCINOGENIC RISK COMPARISONS

	MEI *ORIGINAL	MEI **REVISED	AEI ORIGINAL	AEI REVISED
INGEST	1.0E-04	2.3E-06	2.0E-05	4.6E-07
TOTAL	1.0E-04	2.3E-06	2.0E-05	4.6E-07

* CHILD TOTAL RISK VALUES ARE FROM CH2M HILL TABLE M-31, STREAM REACH 5; ADULT VALUES ARE FROM TABLE M-32, STREAM REACH 5.

** WESTON'S TOTAL RISK VALUES ARE DERIVED FROM USING THE HIGHEST CONCENTRATION FROM ALL STREAM REACHES AND ITS CORRESPONDING GEOMETRIC MEAN.

TABLE C-3

MOSS AMERICAN SITE
RESIDENTIAL DEVELOPMENT SCENARIO

NON-CARCINOGENIC RISK COMPARISONS

	ADULT		ADULT		CHILD		CHILD	
	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED
EAST SITE								
INGEST	9.9E-02	6.6E-01	5.3E-02	2.9E-02	9.3E-01	6.2E+00	4.9E-01	2.5E-01
HAZARD	9.9E-02	6.6E-01	5.3E-02	2.9E-02	9.3E-01	6.2E+00	4.9E-01	2.5E-01
WEST SITE								
INGEST	1.3E+00	1.2E+00	5.4E-02	2.3E-02	1.2E+01	1.1E+01	5.0E-01	2.2E-01
HAZARD	1.3E+00	1.2E+00	5.4E-02	2.3E-02	1.2E+01	1.1E+01	5.0E-01	2.2E-01

TABLE C-3 (Continued)

MOSS AMERICAN SITE
RESIDENTIAL DEVELOPMENT SCENARIO

CARCINOGENIC RISK COMPARISONS

	MEI ORIGINAL	MEI REVISED	AEI ORIGINAL	AEI REVISED
EAST SITE				
INGEST	2.0E-02	1.9E-03	2.0E-04	6.9E-05
TOTAL	2.0E-02	1.9E-03	2.0E-04	6.9E-05
WEST SITE				
INGEST	4.0E-02	2.2E-03	3.0E-04	4.9E-05
TOTAL	4.0E-02	2.2E-03	3.0E-04	4.9E-05

APPENDIX D

SPECIFIC COMMENTS ON THE FEASIBILITY STUDY

APPENDIX D

D.1 TEXT

EXECUTIVE SUMMARY

Figure 2 - Typo: Not addes, but added. Also, no dates are shown in parentheses, although the note states that dates are shown.

Page 2 - Nature and Extent of Contamination - Soil - Last sentence.

"Observations during the RI are inconclusive..." The extent of vertical contamination must be determined before adequate cost estimates for the proposed alternatives can be made. Also, have the costs of additional studies to determine the extent of vertical contamination been included in the cost estimates for each alternative? What are the technical, financial, and time-to-complete implications of unknown vertical contamination? If volumes radically increase, is the proposed plan feasible?

Figure 3 - The observed areal extent of soil contamination does not fully encompass the historic drip rack area (cf. Figure 2), so the areal extent is probably larger than suggested. Why was the entire drip rack area not sampled? Given the very long treatment periods which may be required using slurry biotreatment, how much longer will this potential additional soil volume require to be treated? Is the technology still practical given the additional uncertainty?

Page 3 - Not 5,900 mg/kg total PAH in sediments but 590,000 mg/kg.

Page 6 - Alternative 3A - First paragraph - Second sentence --

"This alternative would remove..." How will visible traces of creosote be determined? Based upon WESTON's first-hand inspection of the entire Little Menomonee River bed from the site to the Menomonee River, no visible contamination was observed. Furthermore, the measured concentrations of PAHs in sediments during the RI are not great enough to indicate visible contamination. Furthermore, normal stream flow, alternate scouring, and deposition of sediments over the past approximate 15 years make it very unlikely that creosote/PAH contamination will be visible downstream of the site. Therefore, what will be the criteria for sediment removal if, as suggested by the data, no contamination is visible?

Page 7 - According to Executive Summary, Alternative 3B specifically excludes discharge to POTW. This exclusion is not considered in the body of the report.

Page 8 - Alternative selection in the FS use seven criteria -- apparently all given equal weight. The NCP requires use of "overall protection of human health and the environment" and "compliance with ARARs" as "threshold criteria" -- or, minimum requirements that are evaluated first on a pass-fail basis. The other five criteria are to be used as "balancing criteria."

Table 1 (page 3 of 3) - Estimated cost -- Clarify why Alternatives 3A and 3B provide significant levels of protection over Alternative 5.

Table 1 (page 3 of 3) - Overall protection of human health and the environment - Second sentence -- "Those alternatives that most reliably protect ... are ... 5 and 6...." This statement seems to contradict the last sentence of the Estimated Cost section, which implies that Alternatives 6, 3A, and 3B are most protective.

CHAPTER 1

Page 1 - Other sources (HMC July 1989) list the date of final approval of the Moss-American site for the NPL as September 1984. What is the correct date?

Table 1-1, Page 2 of 5 - "Pond dredgings are reportedly mixed with clay and disposed of in four trenches on property east of river." The FS did not identify the present location of this material. The FS therefore, apparently does not address remediation of this material.

Table 1-1, page 2 of 5 - "500 yards of riverbed...are dredged by Kerr-McGee. 1,700 feet of riverbed ... are dredged later in the year. Dredgings are reportedly placed along west bank of river." Again, the FS did not identify the present location and ultimately, may not address remediation. Only 650 linear feet of dredged material were assumed in the volume calculations according to Figure C-3.

Figure 1-3 - Note states that figure shows approximate date of initial use in parentheses. No dates are shown.

Figures 1-5 through 1-8 - No particular effort appears to have been made to determine the present status of dredgings disposed on site in 1971.

Page 1-6 - Verification of Flow

Low Bound	High Bound

Low Bound

$Q = kiA$

$= 10^{-4} \frac{cm}{sec}\ 0.015 \frac{ft}{ft}\ 2100\ ft\ 5\ ft$

$= 0.232$ gpm

High Bound

$Q=kia$

$= 10^{-3} \frac{cm}{sec}\ 0.026 \frac{ft}{ft}\ 2100\ ft\ 10\ ft$

$= 8.04$ gpm

Using the assumptions presented in the FS, the flow range is calculated as 0.2 to 8 gpm, rather than 2 to 10 gpm forecast by the FS.

Page 1-6 - Verification of stream slope using USGS quad map from brown Deer Road to Mill Road,

Length = 18,400 ft = 3.54 mi
U.S. EL = 720 ft
D.S. EL = 705 ft

$\text{Slope} = \frac{15\ ft}{3.54\ mi} = 4\ ft/mi$

Calculated 4 ft/mi instead of 2.5 ft/mi in FS.

Page 1-6 - Second paragraph - Fifth sentence -- "Although observations made during the RI..." Statement indicates that hydraulic relationship between groundwater and river are not well understood. How will this affect the groundwater operable unit alternatives?

Page 1-7 - Decision not to sample east of river may not be warranted given that dredging has been conducted in river. Not sampling this area may have resulted in underestimation of contaminated soil volumes.

Page 1-7 - Decision not to sample in northwest portion of site may not be warranted because drip tracks extended well into northwest portion of site. Soil volumes may, therefore be underestimated. Why did RI not evaluate northwest portion of site? What are the technical, time, and cost implications with regard to evaluation of alternatives?

Page 1-7 - Nature and Extent of Contamination - First paragraph - Last sentence -- "The RI determined background..." Appendix J on the Feasibility Study presents background levels for sediments only. Where are background soil and groundwater levels presented?

Page 1-7 - Nature and Extent of Contamination - Soil - First paragraph - Ninth sentence -- "The limited information obtained..." Is the cost of additional investigation included in the cost estimates for the alternatives? How sensitive is the remedy selection to wide variation in treatment volumes? Why was no sensitivity analysis performed as part of the cost effectiveness evaluation?

Page 1-7 - Nature and Extent of Contamination - Soil - Second paragraph - Last sentence -- "Deep soil contamination...." How do the proposed alternatives address deep soil contamination? How is the location of deep soil contamination determined? What were the implications of the potential deep soil contamination on the evaluation of alternatives?

Page 1-7 - Nature and Extent of Contamination - Soil - Third paragraph - Second sentence -- "Therefore the wooded area...." Does this mean that the decision has been made not to propose additional investigation east of the river?

Page 1-8 - Groundwater monitoring is admitted to be inadequate to determine areal extent of contamination.

Page 1-8 - Northeast Landfill - Last sentence -- "The extent of the northern unit..." Are additional studies proposed to define the northern unit?

Page 1-8 - Groundwater - First paragraph - Fourth sentence.

"Because of the nature of activities..." Has the cost of the proposed additional investigations been included in the cost estimate for each alternative and if so, what are the estimated cost of the additional studies?

CHAPTER 2

Page 2-2 - The FS states that floodplain soils are part of the soil operable unit and that the floodplain soils have not been investigated. Given this major data gap, how can the FS accurately evaluate alternatives for the soils? It is understood that the floodplain soils may be treated as a separate operable unit FS at some later date. According to the NCP, selection of an operable unit remedial alternative should be consistent with the overall long-range management of the site. The FS infers that management of floodplain soils could be incorporated into the recommended alternative. The unknown concentration, location, volume, and risk associated with floodplain contamination could greatly alter the evaluation and relative ranging of alternatives.

Page 2-3 - The FS states that the 10^{-6} target concentrations are below detection limits, but that 10^{-6} risk could trigger excavation or covering. This significant data gap means that areas of remediation are not based on clear analytical evidence.

Table 2-1 - Arsenic is misspelled. Indeno (1,2,3-cd) pyrene is misspelled. Note (a) should also reference Table N-1, which provides D.L.s for inorganics. Detection limit for benzo(a)pyrene is missing. It should be 0.33. mg/kg. Benzo (g,h,i) perylene is misspelled. Dibenzo (a,h) anthracene is misspelled. If background concentrations for carcinogens are taken equal to detection limit, benzene and benzo(a)pyrene background concentrations can also be set to 0.005 and 0.330 respectively. The highest observed concentration of pentachlorophenol in subsurface soil was 0.7 mg/kg according to RI. 2,3,7,8-TCDD was not reported for subsurface soil. The geometric mean for toluene is 0.170 according to RI. The geometric means presented as surface and subsurface soils are actually calculated from "development east" and "development west" scenarios which are not drawn from the same sample set. The 2,400 mg/kg 10^{-4} risk concentration for arsenic is actually the 10^{-4} risk concentration for benzene, not arsenic. The various PAH 10^{-4} risk concentrations reported as 6087 mg/kg are actually 6.1 not 6087.

Page 2-3 - Because target concentrations lie at or below the detection limit, the areas exceeding the targets are inherently based on estimation, even if a sufficient number of sample locations have been investigated.

Page 2-3 - Soil Operable Unit - First paragraph - Last sentence -- "The floodplain soil issue will be..." Has the cost for additional investigation been included in the cost estimates for the alternatives? Will further characterization affect the selection of the appropriate remedy? Will the parallel riverbed be excavated in contaminated soil?

Page 2-3 - Third paragraph - Fifth sentence -- "Actual areas and volumes of..." Has the cost of verifying volumes of contamination been included in the cost estimates for the alternatives? What will the impact of increased soil volumes have on alternative selection?

Page 2-4 - Sediment Operable Unit - Third paragraph - Last sentence -- "Actual areas and volumes would..." Has the cost of verifying volumes of contamination been included in the cost estimates for the alternatives? What will the impact of increased remedial volumes have on alternative selection?

Page 2-4 - The discussion of river sediment does not acknowledge the certain eventuality that the river will periodically overflow and redistribute sediments inside and outside the low-flow channel; therefore, the analysis is incomplete and probably introduces a downward bias in the contaminant volume.

Table 2-3 - Chrysene is misspelled. Benzo(g,h,i)perylene is misspelled.

Page 2-5 and Figure 2-2 - The area of groundwater contamination is not defined, as a perimeter of clean wells is not established. Instead, the determination of contaminated area is based on the authors' conceptual estimate. No justifications in fact can be provided for the size or shape, for instance, of the 60,000 ft^2 kidney-shaped area of contamination at MW-11S.

CHAPTER 3

Page 3-4 - As suggested, an incinerator is not the only separate unit that triggers "placement." A tank, such as a slurry bioreactor, also triggers "placement."

Page 3-11 - The text correctly notes that "the actual river realignment would require a detailed design study to assess the river hydraulics, effects on the wetland environment, and the effects on existing parkland and utilities." The cost estimates apparently do not provide for such a study and implementation of mitigation. Is wetland mitigation feasible in light of the proposed construction approach which will initially destroy most of the floodplain wetlands? How long will it take to return wetlands to a condition comparable with today?

Page 3-14 - The treatability variance will require design for removal to 0.5 ppm for each K001 PAH. Using the contaminant concentrations and reaction rate constants provided in the FS, months of reaction time may be required. This exceptionally long reaction time may render bioslurry treatment infeasible. Has the FS not made use of data from the treatability study?

Page 3-14 - There is no reason to treat Northwest Landfill treatment residue disposal issues any differently than disposal of any other treatment residue at the Moss-American site if out-of-ground technologies such as bioreactors are used. Both areas of contamination (AOC) trigger land disposal regulations because both sets of soil are passed through treatment vessels, and treatment in a container triggers placement (and thereby LDRs) even if soil is returned to its original AOC.

Page 3-14 - The three-to-four year operational duration is unrealistically optimistic. It is based on a 15 day retention time in the treatment unit (see p. H-8) for a target PAH reduction of 95 percent. The FS (Appendix K) shows reduction has taken 13 to 150 days in bench scale tests to read a reduction of 90 percent. Even further, the cleanup target is more stringent than the FS assumes. In order to obtain a treatability variance for K001 PAHs, either 99.9% removal or 0.5 ppm is required in design, depending on initial concentrations. Given a realistic reaction rate and the proper design cleanup target, it is clear that cleanup duration may be measured in decades, not years if the contemplated reactor system is used.

Page 3-16 - The cleanup durations and residence times are unrealistically low. Benzo(a)pyrene, for example, shows only slight tendencies to degrade in land treatment. Since soil would be landfarmed in one-foot-thick layers rather than the cookie sheets used in the bench-scale tests, contact with air would be diminished and treatment times would be increased. Furthermore, as with the bioslurry alternative, treatment requirements to comply with the treatability variance have been misapplied.

Page 3-18 - The same comments regarding the feasibility of slurry bioreactors that were directed at Alternative 3A also apply to Alternatives 4 and 5.

CHAPTER 4

Page 4-3 - The treatment durations for Alternatives 3 through 5 appear grossly understated based on previously identified considerations.

Page 4-4 - The reduction in long-term risk is dependent on the accuracy of conclusions of the risk assessment. Refer to review comments on the risk assessment.

Page 4-5 - A maximum 95 percent reduction in PAH concentration is anticipated, but as previously discussed, the treatability variance requires design for 99.9 percent removal of K001 PAHs.

Page 4-6 - Discovery of contamination in the proposed new river bed channel alignment would not only make implementation "complicated." Lack of data to indicate the implementability of river relocation is a serious deficiency. It is conceivable that the new river alignment would generate significant volume of soil requiring special handling and management as a result of the placement and mixture rules.

The statement that all alternatives use demonstrated technologies is not accurate. No full-scale slurry bioreactor system has been reported in the literature for treatment of PAH-contaminated soil. Slurry bioreactors might indeed be implementable, and a goal of the NCP is to encourage use of innovative technologies, but it is inaccurate to suggest that the implementability of slurry bioreactors is of no concern. These systems are not proven. Given the discouraging results of the bench scale test, how could the bioreactor be considered implementable?

D.2 APPENDICES

APPENDIX A, PAGE A-7, FIRST PARAGRAPH -- What will the impact on cost be if a waiver cannot be obtained?

APPENDIX C, PAGE C-3, SECOND PARAGRAPH, THIRD SENTENCE -- What are the +\- error bounds associated with the contaminated soil and sediment volume estimates?

APPENDIX C, PAGE C-5, VISIBLY CONTAMINATED SOILS -- How is visibly contaminated soil defined?

APPENDIX C, PAGE C-5, VISIBLE PURE PHASE IN SOIL -- Not shown in Table C-2.

APPENDIX C, PAGE C-6, FLOOD PLAIN SOILS -- What is the estimated cost of the proposed flood plain soil contamination study and when will it be conducted?

APPENDIX E, PAGE 3-2, FIRST PARAGRAPH -- "Although no groundwater contamination..." Are additional groundwater investigations proposed for the area east of the river? If so, what is the estimated cost and when will they be conducted?

PAGE E-4 -- SECOND PARAGRAPH -- "The time required to reduce the concentration..." If cleanup time cannot be predicted, what is the basis for the 10 and 100 year cleanup times used in the cost-effectiveness analysis? How sensitive is the cost-effectiveness analysis to cleanup duration? Why was a sensitivity analysis not conducted as part of the cost effectiveness evaluation?

PAGE F-3 -- THIRD PARAGRAPH -- "As shown in Table F-2,..." It is not clear how Table F-2 shows that total PAHs could potentially exceed effluent guidelines.

APPENDIX H, PAGE H-2 -- The FS states "Half-lives observed in treatability tests ... are presented in table H-4." Table H-4 actually shows first-order degradation constants, not half-lives.

APPENDIX H, PAGE H-3 -- The land treatment approach is a batch process and would, therefore, be more sensitive to concentrations of any toxic or inhibitory constituents in the waste.

As discussed in comments to Appendix K, significant degradation of carcinogenic PAHs was not achieved in soil pan testing. Therefore successful treatment of contaminated soils could not be projected on the basis of these data alone.

As discussed in comments to Appendix K, land treatment is an area-intensive approach. More stringent cleanup criteria, lower achievable kinetics or the potential for significant quantities of additional soil requiring treatment necessitate a significantly larger treatment area. As presented in the FS, there would appear to be little if any additional space available for expanded land treatment, and the only alternative would be to further extend the remediation period. Has the effect of these variables been considered in terms of the evaluation criteria of implementability, acceptance, and cost?

APPENDIX H, TABLE H-4 -- The numbers reported under the headings "Reported in Literature" actually belong under the headings "Treatability Study Results" and vice versa. Why have values from unsaturated soil systems been cited? These values have little relevance to the Moss-American site.

APPENDIX H, PAGE H-7 -- APPLICATION AND LIMITATION -- FIRST PARAGRAPH -- "The contaminated soil is silty sand..." Since there is a question as to the suitability of much of the soil for slurry biotreatment, shouldn't the simple settleability tests already have been conducted in the RI phase?

APPENDIX I, TABLE I-3, ALTERNATIVE 3A

FIELD PILOT STUDY

The stated assumptions, which include "purchase and construct five test cells, sprinklers, tilling equipment," and "routine analysis for nutrients, moisture content, Ph, etc.," apply to Alternative 3B (land treatment) rather than 3A. It is not apparent why data reduction and reporting require Level D work.

SLURRY BIOREACTOR SYSTEM

The stated cost of the bioreactors does not appear to be appropriate based upon the comments to Alternative 3A reactor design. The potential need for treatment of soil washwater has been discussed in comments to Alternative 3A. Since the conceptual flow scheme as presented does not incorporate such treatment, capital and operating costs for this step are assumed to not be included in the cost estimate. How much will treatment of washwater add to the estimate?

In this alternative, the cost of the actual operation of the treatment system are included under the overall category, "Capital Cost During Operation." By contrast, operation of the land treatment system under Alternative 3B is represented as an "Operation and Maintenance Cost," along with site inspection, groundwater treatment, and groundwater sampling activities.

The assumption of 50 percent salvage value is considered to be optimistic, particularly for limited application and possibly high wear equipment such as slurry bioreactors. In fact, significant demobilization costs for the treatment system may be encountered, largely or completely off setting the assumed salvage value. If no net salvage value is assumed for the bioreactors alone, the capital cost of the slurry biotreatment system would nearly double. What will the impact of a lower salvage value have on alternative ranking? Does a market for used Superfund equipment actually exist?

The costs for instrumentation (12 percent of equipment cost) and electrical and mechanical (20 percent of equipment cost) appear to be based upon only one bioreactor and are therefore low. Actual costs, based upon stated percentage factors are $191,100 and $318,500.

APPENDIX J, PAGE J-4, FIRST PARAGRAPH, LAST SENTENCE -- "Should background levels be used as..." What is the estimated cost of a more in-depth evaluation of appropriate background levels.

APPENDIX K, PAGE K-2 -- RESPIRATION SCREENING

The objectives of respiration screening included the determination of the presence of active microbial populations, the evaluation of degradation rates, and the identification of beneficial amendments and modifications. However, no actual respiration data are presented in the report. The generalized interpretation of respirometry results does not provide sufficient information to address these objectives. Why is no respiration data provided?

The report acknowledges that some of the observed increases in respiration rate resulting from amendment addition may not indicate increased degradation rates for contaminants, and in fact suggests without showing supporting data that "respiration of organic contaminants in those samples may have actually been lower than in non-manure-amended samples " (page K-8). The report also states (page K-3) that "nutrient addition may speed up respiration in soils, but the respiration rates in the sediment samples were not significantly increased," again without providing data, and without attempting to relate these results to contaminant degradation.

APPENDIX K, PAGE K-7 -- The treatability study suggests that the addition of amendments may prove useful in solid phase treatment scenarios, at least for their beneficial effects on soil/sediment texture and physical characteristics. It may ultimately be determined that other amended treatment schemes, such as thermophilic composting, may have some value in terms of degradation rates. At the same time, the increase in the total value of materials which results from such amendment addition should be considered in the economic analysis of alternatives. For area-intensive treatment processes such as landfarming or composting which are sensitive to the total volume of material to be processed, a significant increase in volume resulting from amendment addition may reduce the net throughput of the treatment facility and thus offset increased degradation rates. The total volume of material requiring redisposal may also be a concern.

APPENDIX K, FIGURE K-1 THROUGH K-6 -- It would also be useful to plot the curves corresponding to the calculated degradation rates on the figures showing experimental data.

APPENDIX K - FIGURE K-2 -- This figure appears to indicate an increase in contamination concentrations between day 28 and day 56. This apparent anomaly presumably results from the use of detection limit values for contaminants not detectable at the given limit in the summation of total contaminant levels from Table K-4, where elevated detection limits were presented for indenopyrene and benzoperylene at 56 days (as well as for dibenzoanthracene at both 0 and 56 days). If this interpretation is correct, a comment in the text to this effect is recommended to resolve the apparent anomaly. If another explanation applies, it should be indicated.

APPENDIX K, PAGE K-3 -- It would be useful to note certain experimental conditions such as agitation intensity for shaker flask studies, water addition quantities for pan studies and temperature (presumably the ambient laboratory temperature) at which the tests were conducted. These data may be of use in a qualitative fashion in interpreting the results of the testing. Were these data collected? If so, what were they?

APPENDIX E

REVIEW COMMENTS ON THE ENVIRONMENTAL ASSESSMENT

REVIEW COMMENTS OF THE ENVIRONMENTAL ASSESSMENT
(RI AND FS)
MOSS-AMERICAN SITE
MILWAUKEE, WISCONSIN

Prepared For:

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August 1990

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SECTION 1

INTRODUCTION AND BACKGROUND

At the request of Kerr-McGee Chemical Corporation, a team of experts from the Life Systems Department of Roy F. Weston, Inc. (WESTON) undertook a three-day field study of the Little Menomonee River and its associated floodplain wetlands in Milwaukee and Ozaukee Counties, Wisconsin. The purpose was to provide additional information and expert opinion relative to the proposed remedial alternative of relocation of the Little Menomonee River channel. In addition, the team was requested to review the available RI/FS documents and comment in the light of their field visit. As an aid to this commentary a member of the field team visited appropriate agencies in order to acquire and assemble any readily available background information relevant to the Little Menomonee River watershed.

SECTION 2

FIELD INVESTIGATIONS

2.1 THE RIVER - GENERAL BIOLOGY

The field team walked the river bank on 13 June 1990, from the Moss-American site at Brown Deer Road to the confluence of the Little Menomonee with the Menomonee River at Hampton Road, a distance of over 5 miles. The reach above the Moss-American site was observed on 14 and 15 June 1990 up to Friestadt Road.

The field team was struck by the lushness of the vegetation, almost impenetrable at times, which grows right up to the banks of the river. In order to follow the bank, the team had to use deer trails and woodchuck trails and it was obvious that from Brown Deer Road to the confluence with the Menomonee at Hampton Road, access was limited primarily to bridge crossings. The team was particularly alert for signs of use of the river for fishing and found only a fish bobber at the C&NW railroad crossing below Appleton Avenue. Elsewhere signs of use were absent, an observation that may have some relevance to the Human Risk Assessment scenario described in the RI report.

In the course of the three days on the river the team established a bird list of 42 species as shown in Table 2-1. This should be regarded as an underestimate of the likely number of birds using the watershed since it was established by casual observation rather than exhaustive search. It does, however, reflect the quality of the wetland associated with the floodplain.

It was also clear during the river walk that the floodplain was frequently inundated. The channelized nature of the river coupled with stormwater runoff from the surrounding urban developments clearly cause the river to rise and fall rapidly. The team was able to observe this phenomenon as a result of overnight storms on 13 and 14 June. This has likely been a significant factor in the dispersion of polyaromatic hydrocarbons (PAHs) downstream with the sediment under storm flow conditions. Even under modest flow conditions the river carries a high sediment load. Much of the sediment clearly enters the river via intermittent side-streams, concrete flumes, and road run-off from the surrounding urban areas. Sediment runoff is certainly a source of PAH contribution to the river.

2.2 THE WETLANDS

2.2.1 Introduction

An inventory of wetland plants collected during the field survey is shown in Table 2-2. As with the bird list this should be regarded

Table 2-1

Birds of the Little Menomonee River Watershed

Common Name	Scientific Name
Killdeer	Charadrius vociferus
Spotted Sandpiper	Actitis macularia
Solitary Sandpipe	Tringa solitaria
Mallard	Anas platyrhynchos
Mourning Dove	Zenaida macroura
American Crow	Corvus brachyrhynchos
Northern Raven	Corvus corax
Robin	Turdus migratonus
Blue Jay	Cyanocitta cristata
Barn Swallow	Hirundo rustica
Phoebe	Sayornis phoebe
Eastern Wood Pewer	Contopus virens
Willow Flycatcher	Empidonax trailii
Great Crested Flycatcher	Myiarchus crinitus
Downy Woodpecker	Picoides pubescens
Hairy Woodpecker	Picoides villosus
Warbling Vireo	Vireo gilvus
House Wren	Troglodytes aedon
Carolina Wren	Thryothorus ludovicianus
Black-Capped Chicadee	Parus atricapillus
Tufted Titmouse	Parus bicolor
Great Horned Owl	Bubo virginianus
Catbird	Dumetella carolinensis
Hooded Warbler	Wilsonia citrina
Yellow Warbler	Dendroica petechia
Connecticut Warbler	Oporornis agilis
Northern Oriole	Icterus galbula
Redwinged Blackbird	Agelaius phoeniceus
Common Grackle	Quiscalus quiscula
Indigo Bunting	Passerina cyanea
Cardinal	Cardinalis cardinalis
American Goldfinch	Carduelis tristis
House Finch	Carpodacus mexicanus
House Sparrow	Passer domesticus
Song Sparrow	Melospiza melodia
Chipping Sparrow	Spizella passerina
Field Sparrow	Spizella pusilla
Cowbird	Melottirus ater ater
Meadowlark	Asturnella magna
Kinglet	Regulus sp.
Starling	Sturnus vulgaris vulgaris
Chimney Swift	Choetura pelagica

as an underestimate of the flora since it was established by casual collection rather than exhaustive search. Nonetheless, it confirms a well-developed and diverse wetland.

As a consequence of the river walk the team became acutely aware of the implications for the wetland of constructing a new channel for the river and backfilling the existing channel. Recognizing the size and type of machinery needed to accomplish the task, substantial work would be required to provide secure access for heavy equipment. It is also quite obvious that in the process of digging the new channel and in the process of transferring spoil to backfill in the existing channel, that substantial damage will be done to the floodplain and associated wetland. In addition, the team found numerous black willow trees, many as big as any seen in their previous experience, that will be a significant impediment even to the largest machinery.

As a part of the information search, the team reviewed the proposed course of the new stream channel. There are a number of areas where this course will be very close to the existing channel and, for obvious reasons, the new channel will return to the old stream bed.

2.2.2 Regulatory Issues

Under Section 404 of the Clean Water Act, the Army Corps of Engineers (COE) has jurisdiction over wetlands, with program oversight by the Environmental Protection Agency (EPA). Early in 1989, the four Federal agencies involved in wetland identification, the COE, EPA, Fish and Wildlife Service (FWS) and the Soil Conservation Service (SCS), reached agreement on the technical criteria for identifying and delineating wetlands and agreed to merge the existing published methods (COE, EPA, SCS) into a single wetlands delineation manual. This manual defined three technical criteria which are mandatory and which must all be met for an area to be identified as wetland. These criteria are:

- Hydrophytic vegetation.
- Hydric soils.
- Wetland hydrology.

The FS report does not appear to address these regulations nor consider their implications for the remedial actions proposed and in particular the relocation of the river channel. Specifically, no wetland/floodplain assessment was proposed.

2.2.3 Background Data

As part of the field investigation of the river and its floodplain, a qualitative examination of the riparian and floodplain areas was performed for the purpose of estimating the presence of wetlands

Table 2-2

Common Flora of the Little Menomonee River Floodplain

Common Name	Scientific Name	Indicator Category[1,2]
Pasture Gooseberry	*Ribes cynosbati*	FAC
Virginia Rose	*Rosa virginiana*	FAC
Butter-and-Eggs	*Linaria vulgaris*	UPL
Skullcap	*Scutellaria sp.*	OBL-FAC
Rush	*Scirpus sp.*	OBL-FACW
Cow Parsip	*Heracleum maximum*	FACU
Dufted Vetch	*Vicia cracca*	UPL
Everlasting Pea	*Lathyrus latifolius*	UPL
Goldenrod	*Solidago sp.*	
Common Evening Prirose	*Oenothera biennis*	FACU
Dames Rocket	*Hesperis matronalis*	UPL
Yarrow	*Achillea millefolium*	FACU
Smooth Gooseberry	*Ribes hirtellum*	FAc
Swamp Oak	*Quercus bicolor*	FACW
Tostarian Honeysuckle	*Lonicera tartarica*	FACU
Milkweed	*Asclepias sp.*	OBL-FACU
Slippery Elm	*Ulmus rubra*	FAC
Thimbleberry	*Rubus occidentalis*	UPL
Northern Dwarf Cherry	*Prunus depressa*	UPL
Cat Grape	*Vitis palmata*	NI
Downey Juneberry	*Amelanchier arborea*	FAC
Cottonwood	*Popular deltoides*	FAC
Box Elder	*Acer negundo*	FAC
Sorrel	*Oxalis sp.*	FACE
Waterleaf	*Hydroplyllum sp.*	FAC
Red Maple	*Acer rubrum*	FAC
Black Bindweed	*Convolvulvus sp.*	FAC
Tussock Sedge	*Carex stricta*	OBL
Twin Leaf	*Jeffersonia diphylla*	UPL
Solomon's Seal	*Polygonatum sp.*	FACU
False Solomon's Seal	*Smilacina racemosa*	FACU
Horsetail	*Equisetum sp.*	FAC-OBL
Red-Osier Dogwood	*Cornus stolonifera*	FACW
Bittersweet Nightshade	*Solanum dulcamara*	FAC
Lilac	*Syringa sp.*	UPL
Hawthorn	*Crataegus sp.*	
Smooth Juneberry	*Amelanchier laevis*	UPL
Red Raspberry	*Rubus idaeus*	FAC
Rough Avens	*Geum laciniatum*	FAC
Leafy Spurge	*Euphorbia esula*	UPL
Oxeye Daisy	*Chrysanthemum parthenium*	UPL

Table 2-2 (Cont.)

Common Flora of the Little Menomonee River Floodplain

Common Name	Scientific Name	Indicator Category[1,2]
Peppermint	Mentha piperita	FACW
Rugosa Rose	Rosa rugosa	FACU
Reed Canary Grass	Phalaris arundinaceae	FACW
Wild Lettuce	Lactuca cf. canadensis	FACU
Great Ragweed	Ambrosia trifida	FAC
Mayweed	Anthemis cotula	FACU
Curled Dock	Rumex crispus	FACU
Great Burdock	Arctium lappa	FAC
Common Clotbur	Xanthium chinense	UPL
Tall Nettle	Urtica procera	FACU
Blackberry	Rubus alleghaniensis	FACU
Smooth Rose	Rosa blanda	FACU
Low Vetchling	Lathyrus pusillus	FAC
Larger Blue Flag	Iris versicolor	OBL
Manna Grass	Glyceria sp.	FAC-OBL
Jewelweed	Impatiens sp.	FACW
Violet	Viola sp.	
Meadow Grass	Poa sp.	FAC
Black Willow	Salix nigra	FACW

[1]Indicator Categories

Obligate Wetland (OBL). Occur almost always (estimated probability >99 percent) under natural conditions in wetlands.

Facultative Wetland (FACW). Usually occur in wetlands (estimated probability 67 to 99 percent), but occasionally found in nonwetlands.

Facultative (FAC). Equally likely to occur in wetlands or nonwetlands (estimated probability 34 to 66 percent).

Facultative Upland (FACU). Usually occur in nonwetlands (estimated probability 67 to 99 percent), but occasionally found in wetlands (estimated probability 01 to 33 percent).

Obligate Upland (UPL). Occur almost always (estimated probability >99 percent) under natural conditons in nonwetlands.

[2]Source: Reed, Porter B., Jr. National List of Plant Species that Occur in Wetlands: North Plains (Region 4). Biological Report 88 (26.4) May 1988. U.S. Department of Interior, Washington, D.C.

that meet the Federal criteria in the areas to be disturbed by the rerouting project. Data collected during the field effort were augmented by the following sources of information:

1) Steingraeber, J.A. and Charles A. Reynolds. Soil Survey of Milwaukee and Waukesha Counties, Wisconsin. U.S. Department of Agriculture, Soil Conservation Service 1971.

2) Wisconsin Department of Natural Resources, Wisconsin State Wetlands, Inventory Maps, date unknown.

3) U.S. Department of Agriculture, Soil Conservation Service Hydric Soils of the United States, 1987.

4) Cowardin, Lewis M., Virginia Cartes, Francis C. Golet, and Edward T. LaRoe. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. 1979.

The Little Menomonee River originates in Ozaukee County and flows generally south to its confluence with the Menomonee River just downstream of the State Route 100 crossing. Between the former 2Moss-American site and the mouth, a distance of approximately 5 miles, there are 11 road crossings. In this reach the floodplain appears to be defined in most places by roads. The historic (pre-channelization) floodplain appears to vary in width between several hundred feet in the vicinity of the road crossings to well over one thousand feet in some of the more open areas. As mentioned in Section 2.1, the sides of the channel in certain reaches have been bermed presumably from dredge spoils taken from the river during channelization.

2.2.4 Flora

Common plants occurring in the riparian and floodplain areas in the 5-mile reach were recorded and their wetland status investigated (Table 2-2) to describe the general ecology of the affected reach and to assess the potential for jurisdictional wetlands by determining the presence of hydrophytic vegetation. Hydrophytic vegetation is defined as macrophytic plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a results of excessive water content. Table 2-2 clearly shows that among the plants collected, most were plants that usually occur in wetlands, but occasionally are found in non-wetlands. Although plant collecting efforts at the site were generally concentrated within 100 feet of the river channel, obligate hydrophytic vegetation (i.e., vegetation that only occurs in wetlands) was observed in some areas not shown as being wetlands on the state wetlands inventory map, and also observed to occur sympatrically with hydric soils as depicted in the Milwaukee and Waukeska Counties soil surveys.

2.2.5 Soils

Between the site boundary and the confluence with the Menomonee River the following soil mapping units fall inside the Little Menomonee River floodplain:

- Colwood silt loam.
- Sebewa silt loam.
- Ashkum silty clay loam.
- Pistakee Silt loam.
- Matherton silt loam.
- Wet alluvial land.
- Pell silt loam.

Of these soils, Colwood, Ashkum, Matherton, Pistakee and Pella silt loams are considered hydric by the Soil Conservation Service. A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Sebewa silt loam and wet alluvial land are considered to have hydric inclusions, which means that some part of the mapping unit may have inclusions of hydric soils. In the case of wet alluvial land, it is likely that most if not all of this soil mapping unit is hydric. Found in the floodplain between Granville Road and State Route 145 crossings, a distance of approximately one mile, wet alluvial land soil occurring on both sides of the river and the wet alluvial land is bordered distally from the river by hydric soil mapping units in many places. Sebewa silt loam occupies the Little Menomonee River floodplain between the mouth and State Route 145 crossing, a distance of just over three miles. Soils in the floodplain of this area were examined with the aid of a hand auger and a Munsell soil color chart to determine chroma color and the presence of mottling in the upper 18 inches of soil. Chroma refers to the color strength and purity of the soil. Chromas of two or less are considered low chromas and are often diagnostic of hydric soils. Hydric mineral soils that are saturated for substantial periods of the growing season, but are unsaturated for some time, commonly develop mottles. Results of the hand augering revealed soils having low chroma colors and mottles in the upper 18 inches, indicating part or all of this floodplain area is hydric and likely meets the Federal criteria for wetlands.

2.2.6 State Wetlands

Wisconsin's Wetland Inventory maps identify extensive wetlands area along the Little Menomonee River between the former Moss-American site and the confluence with the main stem Menomonee River. These wetlands and their general distribution are as follows:

- Forested, broad-leaved deciduous, wet soil, palustrine wetlands; occurs regularly on both sides of the river channel between the mouth and the site.

- Forested, broad-leaved deciduous-emergent/wet meadow narrow leaved persistent, wet soil palustrine wetlands; occurs on the west side of the river channel at the confluence with the main stem Menomonee.

- Emergent/wet meadow narrow-leaved persistent wetlands; occurs as a single wetlands unit along the west side of the floodplain upstream of the mouth near the lower Route 100 crossing.

- Scrub/shrub, broad-leaved deciduous, wet soil, palustrine wetlands; occurs on both sides of the floodplain as a single wetlands unit just upstream of the Silver Spring crossing.

- Forested, broad-leaved deciduous/scrub shrub, broad leaved deciduous, wet soils palustrine wetlands; occurs in several areas on both sides of the river channel between the U.S. 41 crossing and the former Moss-American site.

- Emergent, persistent, wet soils, palustrine wetlands; occurs in a single location on the west side of the floodplain between U.S. 41 and U.S. 45 crossings.

- Scrub/shrub, broad-leaved deciduous/emergent, persistent, wet soil, palustrine wetlands; occurs on the west side of the river channel at the Good Hope Road crossing and also on both sides of the river channel at the Calumet Road crossing.

2.2.7 Summary

Based on this review of the state Wetlands Inventory mapping and the SCS soil survey, augmented by observations made during the field visit, it appears that the state wetlands maps underestimate the true extent of wetlands that would meet the unified Federal criteria and that would be affected by the proposed rerouting. Furthermore, the state wetlands maps do not depict wetlands smaller than 2 acres, nor do the maps always depict the river channel proper as wetlands, both of which also serve to underestimate the expected acreage of wetlands.

The purpose of state and Federal wetlands inventory mapping is to locate areas having a high probability of wetlands. These maps are typically used in conjunction with soil survey data by field personnel prior to and during a wetlands delineation to guide field efforts. However, ultimate definition of wetlands boundaries for jurisdictional determination is necessary if dredge or fill material is to be placed in the wetlands, and can only be achieved through the unified Federal methodology, which requires on-site verification of the three technical criteria described above: soils, vegetation, and hydrology.

The feasibility study (FS) report, page B6, assumes that the construction corridor for the new alignment would be 100 feet wide and involve clearing of wetlands. The estimates of disturbed acreage in Table B-2 totals 67 acres and is based on the State Wetlands Inventory, which the field team believes underestimates the amount of wetland present in the Primary Environmental Corridor. The acreage of disturbed wetland is more likely to be 100 acres or more.

In addition, the State of Wisconsin regulates wetlands under Wisconsin Administrative Code Sec. NR115.03. As such, all uses of wetlands and shorelands are prohibited by the state except those otherwise permitted by the Shoreland Management Regulations or by an amendment to the local zoning ordinance. Thus, both Federal and State review of the wetlands impact and mitigation plan would be necessary to be in compliance with the site-specific ARARs. (Permit review by the COE was omitted in Appendix A of the Feasibility Study report, p. A-5; Location-Specific ARARS).

As stated in the Public Comment Feasibility Study report, all alternatives (except no action) include significant construction affecting wetlands adjacent to or downstream of the site. Under Executive Order 1190, Federal agencies involved with actions at contaminated sites are required to conduct remediation efforts in a manner minimizing the destruction, loss, or degradation of wetlands. Reconstruction of the Little Menomonee River channel, however, will include significant wetlands impacts which must receive prior approval from the COE, which the FS report did not mention. The COE is required to "mitigate" adverse environmental impacts under the National Environmental Policy Act, the Fish and Wildlife Coordination Act, and the Section 404(b)(1) guidelines (National Wildlife Federation, 1989). To show mitigation there are three steps which must be taken:

- Avoidance of impacts.
- Minimization of impacts.
- Compensation for impacts which cannot be avoided.

In the context of Section 404, avoiding impacts means staying out of the wetland or other waters of the United States. This would not be possible in the proposed re-routing corridor area since much of the Little Menomonee floodplain appears to be wetlands. Compensation for wetlands impacts usually means restoring converted wetlands, enhancing degraded wetland, or creating wetlands. Indeed, in the FS report, minimization of construction activities in existing wetlands was noted as a means for mitigating riparian habitat destruction in the design of the new r er channel. However, no discussion was given as to how the g deline was incorporated in the selection of the new alignment. rther, the proposed re-routing does nothing towards meeting y of the conditions for compensation of wetlands impacts, namely restoring converted wetlands, enhancing degraded wetlands, o creating wetlands since the new alignment is apparently containe entirely within existing wetlands and past studies have not showi hat the earlier channelization effort converted floodplain wetl s into uplands.

Finally, the promise of creating new wetlands bypas the avoidance and minimization steps of mitigation because it d not satisfy the Section 404 (b)(1) guidelines. Also, because we nds creation is a new technology it does not always replace n al wetlands functions and values successfully (National Wi fe Federation, 1989).

The FS report section dealing with construction of the new r channel also contains numerous unknowns that will significa impact cost. Likewise, the cost of the permitting process and implications of wetland impacts in relation to current regulatic does not appear to be factored in.

2.3 INVERTEBRATE FAUNA

2.3.1 General Observations

The field team spent 14 June 1990 and the morning of 15 June 1990, sampling at stations above, at, and below the Moss-American site, including stations in the Menomonee River above and below the confluence of the Little Menomonee River (Figure 2-1). The stations were chosen so as to provide an indication of any differences that might be attributable to contamination originating from the Moss-American site and to the influence of river bed structure. For the latter objective sample stations were established in both riffle and channelized parts of the river. Sampling was accomplished using a kicknet and disturbing approximately one square yard of river bottom upstream of the net for 20 seconds. Three replicate samples were taken at each station and washed into individual labeled polyethylene ziploc bags where they were preserved with 70 percent alcohol. Conditions of stream depth, flow rate, substrate, bankside vegetation and water temperature were noted at each station.

In the course of the sampling, the team was alert for any evidence of creosote deposits disturbed by wading and kicking. No such evidence was found with the exception of the unnamed side creek flowing from the Moss-American site into the Little Menomonee just downstream of the railroad bridge below Brown Deer Road. Wading in this tributary produced oily brown material that may have been creosote or its derivatives. Elsewhere, oily sheens that were seen

FIGURE 2-1 **BENTHIC MACROINVERTEBRATE SAMPLING LOCATIONS ON THE MENOMONEE AND LITTLE MENOMONEE RIVERS, OZAUKEE AND MILWAUKEE COUNTIES, WISCONSIN. JUNE 14 - 15, 1990**

were attributed by the field team to the natural products of anaerobic decay. No organic chemical odor was associated with these sheens. In some locations, notably at bridge crossings, organic odors were detected that clearly originated with domestic sewage, lending credence to reported instances of overflow and treatment bypass discharges.

2.3.2 Analysis of Benthos Data

A total of 4,905 organisms representing 52 taxa were collected from the Little Menomonee and Menomonee Rivers. Analysis of this benthos data included computation of similarity, diversity and biotic indices and statistical comparison (ANOVA) of the numbers of organisms and total taxa for the several stations sampled (Table 2-3).

Based on this data there is no discernable effect that could be attributed directly to PAH discharges from the Moss-American site.

The greatest similarity, 96.2 percent, was found between the two channelized sections (Stations 3 and 5) sampled in the Little Menomonee River. The next highest similarity, 87.8 percent, was found between Station 2, at the Moss-American site, and Station 6 on the Menomonee above the confluence of the Little Menomonee. Biotic index values (Hilsenhoff, 1982) are suggestive of fair to poor water quality due to the significant organic pollution load from agricultural and urban runoff.

Diversity indices (Shannon-Wiener, 1949) are indicative of fair diversity throughout the study area (i.e., indices in the range >2.0 but <3.0) except at the stations in the channelized sections, stations 3 and 5, where the indices were 1.9 and 0.9, respectively. This is consistent with the expectation that bottom structure significantly influences the benthos community. The highest diversity was found at Station 2 at the Moss-American site which also exhibited the presence of the most mayflies (Ephemeroptera), considered to be the most pollution-intolerant order of aquatic insects. Specifically, there were statistically significant more Ephemeroptera than at any other station sampled in the Little Menomonee.

Statistical comparison of the total numbers of organisms found at each station showed that Station 4 had significantly more organisms and more taxa than any other station sampled in the Little Menomonee.

Although the differences could not be shown to be statistically significant, Station 7 in the Memomonee, below the confluence of the Little Menomonee, had substantially more organisms (1199) than the upstream station (Station 6) in the Menomonee (733). The downstream station did have significantly more taxa and

Table 2-3

Diversity and Biotic Indices

Station Number	Shannon-Weiner Diversity Index	Hilsenhoff Biotic Index
1	2.8	3.2
2	2.8	3.6
3	1.9	3.4
4	2.5	3.9
5	0.9	3.1
6	2.3	3.8
7	2.5	4.1

Ephemeroptera (mayflies). These data suggest that the Little Menomonee is not adversely affecting the benthos of the Menomonee.

SECTION 3

COMMENTS ON RI REPORTS VOLUMES 1 AND 2

3.1 RISK ASSESSMENT

Based on the three days spent by the field team in and around the river the exposure scenario relative to the recreational use of the river appears overly conservative. At a time of year that it might be expected for local residents to make recreational use of the river, no evidence could be found, even at the road bridge crossings, that would support a scenario for ingestion of 0.1 g/day of sediment for 40 days/year for 10 years. The vegetation cover renders the river virtually inaccessible for much of the reach downstream of the site to the Menomonee River. Furthermore, the acknowledged patchy nature of the PAH contamination and absence of obvious releases and the odor of supposed deposits, even when wading, also brings into question the acute exposure to PAHs assumed by the risk scenarios relating to the river.

The bike paths laid out through the park appeared well used but there was no evidence of casual access to the river leading from these paths through the dense vegetation.

The repeated references in the Administrative Record to the single incident 20 years ago of skin contact leading to what is variously described as "skin burns" and "skin irritations" overplay the importance of this potential effect. On the basis of the field team visit it seems a very unlikely exposure scenario in the present day.

The uncertainties summarized on Pages 4-9 and 4-10 of the RI are significant and seriously compromise the risk assessment irrespective of the validity of the scenarios used. This is an inadequate basis on which to determine the most appropriate remedial action.

On Page 4-10, paragraph 3, the report recognizes the incident in which children in 1971 received "skin burns" on contact with river sediment. The report then attributes this to phenolic compounds and notes that these were rarely identified in this RI. The report then connects this event with the site and ignores the lack of evidence. The evidence is that the potential for such events related to river sediments is minimal at worst. Thus, the statement in paragraph 3, Page 4-11, is unacceptable and unsupportable.

On Page 4-10, paragraph 4, the hypothesis of synergistic action of PAHs is introduced. This needs more adequate evidence before it can be introduced as a justification for conservatism.

3.2 ECOLOGICAL FATE AND EFFECTS

The impact of discharges to the river other than those from the Moss-American site is acknowledged in the RI report Volume 1, Page 4-9, and in the data analyses presented in the RI report Volume 2, notably Figure B-1. However, this RI data, the published information on PAH fate and effects, and the implications of the general structure of the river is insufficiently evaluated.

It is clear from the site visit, supported by the reports of Warzyn (1985) and Price (1989), that the greatest impediment to the Little Menomonee reaching its full biological potential is the channelization. These reports of Warzyn and Price also acknowledge the organic inputs from urban runoff, agricultural runoff and sewage overflow, bypass, or poor treatment.

The pattern of organic inputs to the Little Menomonee that is clearly evident in the RI Report Volume 2, Figure B1, bears further examination. The data clearly shows additional inputs associated with each road or rail crossing of the river and the PAH concentrations tend to follow this pattern. While it cannot be denied that the PAHs originating from the Moss-American site are a significant factor in the sediment samples analyzed, the ATSDR Tox Profile on PAHs (02/16/90) clearly indicates the potential for additional inputs at road crossings. This data and its implications should be more thoroughly analyzed.

The data summarized in the ATSDR report indicate that PAHs are substantially biodegradable and can be metabolized by a wide range of aquatic organisms. The aquatic toxicity of PAHs is summarized in the U.S. Fish and Wildlife Service Biological Report 85(1.11) (1987) and shows that under pristine conditions the acute effect levels (LC50) is generally in the range 0.3 to 3.0 mg/l with occasional outliers in the >100 mg/l range. It should be remembered that when these materials are absorbed to sediment they are largely unavailable to fish. This absorption renders them less toxic. Thus, the statements in paragraph 3, Page 4-9, RI Report Volume 1, are inappropriate since they make unsupported connections between Little Menomonee River sediment concentrations and other systems and studies. This has the effect of biasing opinion.

SECTION 4

COMMENTS ON FS REPORT

4.1 ALTERNATIVE REMEDIAL ACTIONS

On Page 5 the report states, that:

> "The site-specific goals for sediment in the river include minimizing the downstream migration of contaminated sediments and minimizing acute and chronic effects on aquatic life posed by contaminated sediments. The volume of sediment that has carcinogenic PAH concentrations that exceed background levels is estimated to be 26,000 cubic yards."

Further, the clean-up goal stated in Table 2-1 for soil is 0.061 ppm(mg/kg) and in Table 2-3 for sediments is 4 ppm (ug/kg). Note that Table 2-3 also states the clean-up target for total carcinogenic PAHs is 4 ppm (mg/kg) which seems at odds with individual PAH targets. This latter target suggests, based on analysis of the confirmatory samples and the proportion of each carcinogenic PAH species, the following individual targets:

Benzo-a-anthracene	1.2 mg/kg (ppm)
Chrysene	0.92 mg/kg
Benzo-b-fluoranthene	0.56 mg/kg
Benzo-k-fluoranthene	0.48 mg/kg
Benzo-a-pyrene	0.56 mg/kg
Indeno-2,3,4,-cd-pyrene	0.16 mg/kg
Dibenzo-ah-anthracene	0.01 mg/kg
Benzo-g,h,i-perylene	0.08 mg/kg

The question should be addressed as to the attainability of test targets, especially in the light of the potential for other inputs via urban runoff and atmospheric deposition. Background concentrations of PAHs for rural, agricultural and urban soils for the United States and other countries are quoted in the ATSDR review (2/90) page 148, Table 5-5. Average concentration ranges derived from the table show total PAHs to be approximately 12 to 200 mg/kg for rural soil, 49 to 162 mg/kg for agricultural soil, and 25 to 583 mg/kg for urban soil. Concentration ranges for individual carcinogenic PAHs were found to be (mg/kg):

	Rural	Agricultural	Urban
Benzo-a-anthracene	0.005-0.02	0.0956-0.110	0.169-59.0
Benzo-a-pyrene	0.002-1.3	0.046-0.9	0.165-0.220
Benzo-b-fluoranthene	0.02-0.03	0.058-0.22	15.0-62.0
Benzo-e-pyrene	---	0.053-0.13	0.06-14.0
Benzo-g,h,i-perylene	0.01-0.07	0.06	0.9-47.0
Benzo-k-fluoranthene	0.01-0.11	0.008-0.25	0.3-26.0
Chrysene	0.038	0.078-0.12	0.251-0.64
Indeno-1,2,3-cd-pyrene	0.01-0.015	0.063-0.1	8.0-61.0

The report also notes that elevated concentrations can be found near complex road interchanges, e.g., in Switzerland 4 to 8 ppm (mg/kg) close to the road and up to 2.3 ppm in an area removed from the road.

Individual PAHs have been detected in urban run-off in the range 0.3 to 10 ppb (ug/kg) with concentrations of most PAHs above 1 ppb (U.S. Nationwide Urban runoff program; ATSDR, p. 146).

In addition, airborne PAHs may deposit on foliage and enter the river via leaf drop in the fall. The IJC Menomonee River Watershed Study (EPA 905/4-79-029-1,B, and C) showed deposition over Lake Michigan in the 0.1 to 4.2 ug/m^3 range and concentrations in the microlayer of 0.15 to 0.45 ug/l (ppb).

The purpose of introducing these data is to indicate that the proposed target levels of clean-up in an urban area may be optimistic no matter what remedial action is taken due to the contributions from atmospheric deposition and solids transport in urban, agricultural and rural run-off.

It is incumbent on the RI/FS to demonstrate, unequivocally, that a remedial action of the magnitude proposed will solve the problem. Without direct information on the PAH levels in the floodplain and the levels contributed via runoff this is a "blind" step.

It also seems obvious that, recognizing the biodegradability of PAHs, once the inputs are stopped natural degradation processes will reduce residual contamination to background levels over a period of time.

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HAZARDOUS WASTE MANAGEMENT

COMMENTS SUBMITTED BY MILWAUKEE COUNTY IN RESPONSE TO PUBLIC COMMENT FEASIBILITY STUDY REPORT

Moss-American Site
Milwaukee, Wisconsin

WA 15-5LM7.0/Contract No. 68-W8-040

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COMMENT NO. 1: THE FACTUAL BACKGROUND OF THE SITE SHOULD BE MORE THOROUGHLY DOCUMENTED AND EVALUATED BEFORE A REMEDIAL ALTERNATIVE IS SELECTED.

DISCUSSION

The Remedial Investigation and Feasibility Study (RI/FS) reflects that the Little Menomonee River has been dredged many times in the past, and in some instances the dredged materials were deposited in the areas of the site that are going to be the subject of the remedial alternative selected for the site. Milwaukee County has not been able to determine from the materials in the administrative record whether any tests or analyses of the dredged materials were performed at the time of the dredging. Nor does there appear to be documentation in the administrative record to show the persons or agencies who actually conducted and participated in the dredging operations and disposal of the dredged materials at the site. Before a remedial alternative is selected, it is important that previously dredged materials be characterized and their placement or disposal at the site be located as precisely as possible.

Milwaukee County has specific concerns respecting the following activities reported in the Remedial Investigation Report:

> National attention was brought to the site in 1971 . . . . Dredgings from the settling ponds were landfilled in a field east of the river and the ponds were backfilled with clean soil. River dredgings were spread and buried along the west bank of the river.

It is unclear from the report whether the dredging of the ponds and the river were undertaken at separate times or as part of a single project. It is also unclear from the report where exactly the materials were placed, under what authority the placement was authorized and/or who authorized the placement of the materials at those locations.

Specific information on the characteristics and management of the contaminated dredged materials should be available from the Wisconsin Department of Natural Resources. As the agency responsible for administering the State of Wisconsin's ownership interest in the Little Menomonee River for the "public trust," the Department would have had direct supervision and control over all dredging operations. The stream could not have been dredged and the dredgings could not have been disposed of on the site or on the west bank of the stream without permission and supervision of the operations by the State and the Department. See, e.g., State v. Trudeau, 139 Wis. 2d 91, 101-105, 408 N.W.2d 337 (1987). See also Edelstein, Gary A., "Guidelines for Instream and Riparian Habitat Mitigation for the Little Menomonee River/Moss American Site," (January 30, 1989), with "Attachment A" and "Attachment B."

The RI Report indicates that similar dredgings were performed by Industrial Bio-Test Laboratories, Inc. in 1973, by Rexnord in 1973, and by EPA in 1973. No citations are provided to indicate whether formal reports were prepared with respect to each of the activities or whether such reports are in the administrative record that will be considered in selecting the remedial alternative for the site.

These matters are of substantial concern to Milwaukee County because it has no specific information as to how the State of Wisconsin or the Department of Natural Resources administered the State's ownership interest in the Little Menomonee River prior to 1978. Milwaukee County first acquired portions of the site by gift and quit claim deed in 1978 (Attachment 2) when it was forced to settle a lawsuit it had commenced against the former site owner (for damage to downstream County Park property) after a lawsuit subsequently commenced by U.S. EPA was dismissed due to falsification of data generated by NEIC (<u>see</u> Attachment 1). No on-site operations have been conducted on the property after it was acquired by Milwaukee County in 1978.

If, as suggested in other comments, Milwaukee County's and the public's interests in the riparian rights and public trust in the Little Menomonee River are to be the subject of a "taking" during the course of performing the chosen remedial alternative, it is important to determine that the newly created stream and stream bed will not be subject to equal or greater contamination than the current stream and stream bed.

COMMENT NO. 2: THE DATA BEING RELIED ON TO SELECT A REMEDIAL ALTERNATIVE AND ASSESS THE RISKS OF THE SITE SHOULD BE CLARIFIED TO AVOID SUBSEQUENT DISPUTES.

DISCUSSION

Milwaukee County has substantial concerns that the use of invalid or scientifically questionable data may have been used as a basis to prepare the initial Hazard Ranking Score ("HRS") for the site or to prepare the RI/FS. There appears to be a substantial issue as to whether the data generated only during the RI is of sufficient quantity or quality to support the conclusions of the RI Report or the evaluation of alternatives in the FS Report. See, e.g., Edelstein, Gary A., Kraft, George J. and Bangert, Suzanne, "Moss-American (Kerr McGee) Draft Remedial Investigation (RI)," (November 14, 1989). Nor is it clear what data was utilized to prepare the initial HRS.

Milwaukee County is concerned that all of the data being relied on be unquestionably valid. Milwaukee County has already had one experience with data being invalidated (see Attachment 1).

Before public funds are expended on the selected remedial alternative, a careful review and sensitivity analysis should be performed on the underlying data and resulting conclusions for the HRS, the RI Report, and the FS Report. If the sensitivity analysis indicates that any of the administrative findings or conclusions leading up to the selection of the remedial alternative was not supported by sufficient, verified data, then the necessary data should be generated prior to selection of the remedial alternative. It seems pointless to select a remedial alternative or expend public funds on the performance of remediation if there is going to be a subsequent dispute concerning the validity of the data supporting the findings and conclusions pursuant to which the work was performed.

COMMENT NO. 3: THE DISCUSSION OF ARAR'S FAILS TO ACCOUNT FOR SIGNIFICANT ISSUES INVOLVED WITH MOVING A NAVIGABLE STREAM.

DISCUSSION

Milwaukee County obtained title to certain portions of the site by quit claim deed on June 21, 1978. See Attachment 2. Part of the property quit claimed to Milwaukee County includes the property through which the Little Menomonee River traverses the site. By all accounts, the Little Menomonee River is a navigable river or stream which is part of the Menomonee River watershed that discharges to Lake Michigan.

The identification of applicable or relevant and appropriate requirements (ARAR's), FS Report, "Appendix A," appears to have failed to consider the number of ARAR's that may be applicable to the "preferred alternative" set forth in the FS Report.

Milwaukee County has substantial concerns about how the "preferred alternative" may be implemented in light of issues concerning the following: (1) who actually owns the stream bed and the stream; (2) what is the public's interest in the stream as it presently exists, and how are those interests to be protected; (3) who or what is the agency or entity that will be required to consent or perhaps exercise condemnation authority to remove the current stream and move it to a new location; and (4) what permit, requirements or exemptions will have to be obtained in order to otherwise carry out the "preferred alternative."

Under the Wisconsin Constitution and the Northwest Ordinance, navigable waters in Wisconsin are impressed with a so-called "public trust." The "public trust" is considered to be owned by the State of Wisconsin and administered in trust for the public, and it applies to all waters of the State that are "navigable-in-fact." Waters of the State are navigable-in-fact if they are usable for commercial navigation or for recreational purposes and are capable of floating any boat, skiff or canoe of the shallowest draft. See Muench v. Public Service Commission, 261 Wis. 492, 53 N.W.2d 514 (1952).

It is not entirely clear in Wisconsin as to how the various ownership interests in a navigable river or stream are divided between the owners of abutting property with riparian rights and the State, which owns and administers the interest in the "public trust." General statements made in some reported decisions suggest that title to the bed underlying all navigable waters in the State is "vested and continues in the State of Wisconsin in trust for the use of the public." Wisconsin Environmental Decade v. Department of Natural Resources, 85 Wis. 2d 518, 526, 271 N.W.2d 69 (1978). See also State v. Trudeau, 139 Wis. 2d 91, 101-105, 408 N.W.2d 337 (1987). In other cases, however, it is indicated that while the State does not technically "own" the bed of navigable streams, the owner of property abutting the banks of a navigable water has merely a "qualified title" to the bed of a stream or river to the center or "thread" of the stream or river, subject to the State's superintending easement to exercise and protect the public trust in navigable waters. Muench, 261 Wis. at 501-502; Yates v. City of Milwaukee, 77 U.S. 497, 19 L.Ed. 984 (1871); Munninghoff v. Wisconsin Conservation Commission, 255 Wis. 252, 259, 39 N.W.2d 712 (1949); Angelo v. Railroad Commission, 194 Wis. 543, 549-51, 217 N.W. 570 (1928). A general discussion of these various rules can be found in the Department of Natural Resources' "Water Regulation Handbook."

There is a substantial issue as to whether the Department of Natural Resources must issue a permit to change the course of the Little Menomonee River or, in the alternative, whether permission to excavate and backfill the current stream must be sought from the Wisconsin Legislature. The primary authority to administer the "public trust" in navigable waterways for the protection of the public's rights rests with the Wisconsin Legislature, which has the power of regulation to effectuate the purposes of the public trust. State v. Bleck, 114 Wis. 2d 454, 465, 338 N.W.2d 492 (1983).

COMMENT NO. 4: ANOTHER ISSUE THAT MUST BE CONSIDERED IN CONNECTION WITH THE "PREFERRED ALTERNATIVE" IS THE IMPAIRMENT AND/OR TRANSFER OF RIPARIAN RIGHTS.

Regardless of who actually owns the stream, it is clear that Milwaukee County has "riparian rights" as a consequence of its ownership of the property abutting the stream. These riparian rights include the use of the shoreline of the property, the reasonable use of the water itself, and the right to use the stream for swimming, boating, or other recreational activities. Bleck, 114 Wis. 2d at 466; Munninhoff, 255 Wis. at 258. Riparian rights constitute "property" in and of themselves, Yates, 19 L.Ed. at 986, and the riparian rights may be divested to a third party without conveying title to the property itself.

If, in fact, Milwaukee County has valid title to the bed of the Little Menomonee River, it would appear that Milwaukee County would obtain full title to the property after the "public trust" in the Little Menomonee River is removed by the backfilling of the current channel. In the process, however, Milwaukee County's riparian rights in the current stream channel would appear to be destroyed. When a new stream channel is created under the "preferred alternative," it is clear that the new stream channel will be impressed with the "public trust" associated with any navigable waterway. Village of Pewaukee v. Savoy, 103 Wis. 271, 79 N.W. 436 (1899). It is unclear, however, whether Milwaukee County would lose title to the property underlying the new channel of the stream. It is possible that Milwaukee County would lose title to the real property taken up by the new stream channel, but have the benefit of the riparian rights associated with the new stream.

To make matters more complex, the preferred alternative may involve considerations of the federal "Navigational Servitude." The "Navigational Servitude" arises out of the general power of congress, "to regulate commerce within foreign Nations, and among the several States . . . ," provided for in the Commerce Clause of the United States Constitution, Sec. 8, Cl. 3.

The basic theory of the "Navigational Servitude" is that under the Commerce Clause, the federal government has an overriding right, in the nature of a "dominant servitude" or easement, to protect the public right of navigation in the interests of interstate commerce. United States v. Commodore Park, 324 U.S. 386, 390-91 (1945). See generally Note, the National Servitude and the Fifth Amendment, 26 Wayne L. Rev. 1505 (1980). The doctrine of "Navigational Servitude" applies to any navigable waters that are accessible from the several states.

Since the Little Menomonee River is part of the watershed that discharges to Lake Michigan, which is bordered by several states, the Little Menomonee River is arguably accessible from states other than Wisconsin. It may be doubtful, however, whether the second part of the "Navigational Servitude" test can be met--that use of the river can be shown to affect interstate commerce. See, e.g., Kaiser Aetna v. United States, 444 U.S. 164, 174-75 (1979). Thus, it is doubtful that the "Navigational Servitude" interest of the federal government is superior to the interests of the State of Wisconsin or Milwaukee County in the Little Menomonee River. Cf. Scranton v. Wheeler, 179 U.S. 141, 163 (1900); Commodore Park, supra, 324 U.S. at 390-91; United States v. Chandler-Dunbar W.P. Co., 229 U.S. 53, 62 (1913).

From the foregoing it can be determined that although the State of Wisconsin has a substantial ownership interest in the Little Menomonee River, and although Milwaukee County clearly has riparian property rights; it is nonetheless unclear which governmental entity is responsible for either consenting to or issuing a permit for the work contemplated by the "preferred alternative." What is clear is that there will be a significant realignment of property interests if the "preferred alternative" is selected. These questions should be clarified before selection of a remedial alternative so that implementation of the selected remedial alternative is not bogged down in disputes over who owns what or which governmental entity is responsible for issuing which permit.

COMMENT NO. 5: THE IMPLEMENTATION OF THE PREFERRED ALTERNATIVE MAY REQUIRE THE EXERCISE OF CONDEMNATION POWERS OR THE PAYMENT OF COMPENSATION WHICH HAS NOT BEEN ACCOUNTED FOR IN THE COST ESTIMATES FOR THE FS REPORT.

Under Wisconsin law the destruction of riparian rights or the creation of a burden on real property resulting from the impressment of real property with a "public trust" constitutes a "taking." See, e.g., Yates v. City of Milwaukee, 77 U.S. 597, 19 L.Ed. 984, 986 (1871). Cf. Commodore Park, supra, 324 U.S. at 390-91 (no "taking" occurred when the property was impressed with a federal "navigational servitude"). If it turns out that the State of Wisconsin is the owner of the stream bed (see, e.g., State v. Trudeau, supra), then the filling of the current channel and the creation of a new channel on property owned by Milwaukee County would also constitute a "taking" under State law. See, e.g., Zinn v. State, 112 Wis. 2d 417, 421-26, 334 N.W.2d 67 (1983).

Even though EPA may be engaged in an appropriate exercise of its jurisdiction to remediate contaminated sites, the creation of a new navigable waterway on previously dry land constitutes a "taking" under the standards set forth in Nollan v. California Coastal Commission, 483 U.S. 825 (1987). Such a permanent physical occupation of property is virtually a per se taking under the rule of Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982). In Pumpelly v. Green Bay Co., 13 Wall. (80 U.S.) 166 (1872), the court ruled that a "taking" occurs by virtue of the flooding of real property when the flooding is a permanent invasion rather than a temporary condition and not merely consequential damage due to the construction of a public improvement: "[W]here real estate is actually invaded by superinduced additions of water, earth, sand or other material, . . . so as to effectually destroy or impair its usefulness, it is a taking . . . ." Id. at 181. See also Sanguinetti v. United States, 264 U. S. 146, 149 (1924); United States v. Kansas City Life Ins. Co., 339 U.S. 799 (1950).

These are not insubstantial issues for Milwaukee County. The past dredging operations and disposal of dredged materials on the property Milwaukee County now owns, under the direction and control of the State of Wisconsin and the Department of Natural Resources, and the lack of information concerning the characteristics of the contaminated dredged materials or the locations at which the dredged materials were disposed of raises substantial concerns for Milwaukee County as to whether the new stream channel might not intercept contaminants from prior dredging operations that would create a new or worsened problem. Milwaukee County does not want to have natural areas, wetlands, or existing riparian rights that may be enjoyed by the citizens of Milwaukee County destroyed and replaced by a new stream that has no value for the public.

If, in fact, riparian rights, natural areas, or wetlands are to be destroyed by the implementation of the preferred alternative, but will not be replaced by natural resources of the same or greater value to the public in their potential future use and enjoyment of the area, Milwaukee County has the responsibility on behalf of its constituents to seek appropriate compensation. Accordingly, the natural resources that are to be obliterated under the preferred alternative should be valued in accordance with the CERCLA criteria for natural resources' damages, and such values should be compared against the values of the resulting natural resources under the preferred alternative. If there is a difference between the respective values, the difference in values should be reflected in the costs that have been estimated for implementing the proposed alternative.

Milwaukee County does not wish to impede the proper remediation of the site to the extent that: (a) the remediation is actually justified by reliable and verified data; and (b) the remediation does not destroy the existing natural areas and wetlands without making provisions for their replacement. Milwaukee County has substantial questions concerning the environmental integrity of the new stream channel that is to be created by the preferred alternative, and it has questions with respect to whether or not the new stream channel might not be susceptible to the same kind of problems as the existing stream channel.

COMMENT NO. 6: THE "PREFERRED ALTERNATIVE" MAY INVOLVE SUBSTANTIAL DELAYS NECESSARY TO COMPLY WITH VARIOUS REVEIW PROCEDURES.

DISCUSSION

By all accounts, it appears that the Little Menomonee River is bordered by wetlands. It does not appear that the RI Report or the FS Report contains the data necessary to develop a delineation of the wetlands in a manner consistent with the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (January, 1989). Until an appropriate delineation has been conducted, the type of permit required under Section 404 of the Clean Water Act cannot be readily determined; nor, can the degree of mitigation be determined which would be required by the "Memorandum of Agreement Between the Environmental Protection Agency and the Department of Army Concerning the Determination of Mitigation Under the Clean Water Act Sec. 404(b)(1) Guidelines," February 7, 1990. It is also unclear whether U.S. EPA or the Corps of Engineers would be the "lead agency" on any permit that was required.

Since the State of Wisconsin has a separate wetland protection program that is not coextensive with the federal program, a separate permit may be required from the Department of Natural Resources. The Department of Natural Resources would also be required to comply with the standards and criteria set forth in NR 1.95, Wis. Admin. Code. Given the strong policy statements set forth in NR 1.95, Wis. Admin.

Code, concerning the "limiting factor" of wetlands with respect to projects impacting them, it is uncertain how the Department of Natural Resources' review under the regulations and applicable guidelines would be resolved.

The permits and approvals required for filling the existing river bed and excavating a new river bed in potential wetlands would certainly appear to require compliance with the National Environmental Policy Act (NEPA) as well as the Wisconsin Environmental Policy Act (WEPA), § 1.11, Wis. Stats. Since the issues respecting wetlands and impacts to flora or fauna are somewhat different than the issues to be resolved with the technical justification for the "preferred alternative," the public review and comment procedures that are part of the RI/FS process may not be sufficient to comply with NEPA or WEPA. Compliance with all of the applicable regulatory and environmental review procedures may indeed involve substantial delays as well as substantial administrative costs if the "preferred alternative" is selected as the final remedy. The administrative costs associated with such review procedures do not appear to have been accounted for in the cost estimates for the "preferred alternative."

Before a remedial alternative is selected, all of the applicable review procedures and their associated costs should be clearly specified and calculated. Time delays and increased costs may be a substantial factor in the considerations to select the remedial alternative.

COMMENT NO. 7: INCORPORATION BY REFERENCE OF TECHNICAL COMMENTS.

Milwaukee County is extremely concerned that all aspects of this project be fully evaluated and not subject to subsequent criticism or attack (see, e.g., Attachment 1). Accordingly, Milwaukee County incorporates hereby by reference as though more fully set forth at length the technical comments prepared by Roy F. Weston, Inc., 3 Hawthorne Parkway, Vernon Hills, Illinois. See Weston, "Review Comments on Public Comments Draft RI and FS -- Moss American Site, Milwaukee, Wisconsin" (July 1990). Milwaukee County further incorporates by reference such technical or scientific comments as may be submitted by the Chicago & Northwest Railroad.

Respectfully submitted this 3rd day of August, 1990.

ROBERT G. OTT
Corporation Counsel

FRIEBERT, FINERTY & ST. JOHN, S.C.
Robert H. Friebert
William S. Roush, Jr.

Special Counsel to Milwaukee County

GEORGE E. RICE

Special Counsel to Milwaukee County

The case *sub judice,* while found in favor of the defendants, was not, in its institution or maintenance, an unfounded, meritless, frivolous, or vexatious action. Accordingly, no award of attorneys' fees will be made against the plaintiffs.

Judgment will be entered by separate order.

UNITED STATES of America, Plaintiff,

v.

MOSS-AMERICAN, INC., Defendant.

No. 75-C-277.

United States District Court,
E. D. Wisconsin.

March 3, 1978.

Government brought action for damages and injunctive relief against an alleged polluter. On defendant's motion to dismiss and for costs and attorney's fees, the District Court, Myron L. Gordon, J., held that: (1) dismissal of the action was justified on the basis of a government agent's admission that he sought to build a case with falsified evidence and attempted to cover up such falsification, and (2) defendant was entitled to an award of costs but not an award of attorney's fees.

Dismissed.

1. Federal Civil Procedure 🔑1741

Neither federal rule of civil procedure relating to a party's wilful refusal to make deposition, nor rule permitting dismissal of action for failure of plaintiff to prosecute or comply with rules, required dismissal of action for damages and injunctive relief brought by United States against alleged polluter on basis of admission made by government investigator, at deposition, that he had sought to build case on basis of falsified evidence and attempted to cover up such falsification. Fed.Rules Civ.Proc. rules 37(d), 41(b), 28 U.S.C.A.

2. Federal Civil Procedure 🔑1741

It is within inherent equitable powers of district court to dismiss action when just determination of action has been seriously thwarted by plaintiff's wilful misconduct.

3. United States 🔑40

Government cannot disavow responsibility for conduct of one of its agencies nor conduct of agency employee because government must be treated as one entity.

4. Constitutional Law 🔑305(2)

Dismissal without hearing on merits of Government's suit for damages and injunctive relief against alleged polluter, because of government agent's admission that he sought to build case with falsified evidence and attempted to cover up such falsification, would not violate due process since underlying circumstances were of Government's own creation.

5. Federal Civil Procedure 🔑1741

Government is held to high standard of conduct in civil litigation, its dominant purpose being to assist court in arriving at just and true resolution.

6. Federal Civil Procedure 🔑1741

Dismissal of Government's suit for damages and injunctive relief against alleged polluter was justified on basis of government agent's admission that he sought to build case with falsified evidence and attempted to cover up such falsification.

7. Federal Civil Procedure 🔑2728, 2737.5

Upon dismissal, due to Government misconduct, of suit for damages and injunctive relief against alleged polluter, defendant polluter was entitled to award of costs, but would not be awarded attorney's fees. 28 U.S.C.A. § 2412.

William J. Mulligan, U. S. Atty. by Charles H. Bohl, Asst. U. S. Atty., Milwaukee, Wis., for plaintiff.

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Quarles & Brady, Frank J. Daily, Milwaukee, Wis., for defendant.

DECISION and ORDER

MYRON L. GORDON, District Judge.

The defendant has filed a motion to dismiss and for costs and attorney's fees pursuant to Rules 37(d) and 41(b), Federal Rules of Civil Procedure. The motion is based on allegations of substantial misconduct by government agents during the discovery proceedings held in this case. The motion to dismiss and for costs will be granted, but the request for attorney's fees will be denied.

This is an action for damages and injunctive relief by the United States against Moss-American, Inc., because of the defendant's alleged pollution of the Little Menomonee River in violation of 33 U.S.C. §§ 407 and 1311. The government alleges that effluent wastes from the defendant's Milwaukee plant entered the river either directly or by "leaching," or percolating, through the earthen floors of the plant adjacent to the river. The defendant terminated its operations at the plant after the commencement of this litigation.

In April, 1977, personnel from the Environmental Protection Agency's National Enforcement Investigations Center (NEIC) in Denver conducted field tests and took samples from the Little Menomonee River. Because the defendant opposed testing on its property, the government moved for an order compelling the defendant to permit the taking of core and surface samples.

In a decision and order dated July 20, 1977, I resolved this discovery dispute by appointing a special master, pursuant to the court's general equity powers, to supervise the proposed inspection and taking of samples. In September and October, 1977, NEIC personnel conducted tests on the defendant's property under the special master's supervision.

Between December 13 and 16, 1977, the defendant conducted oral depositions of several of the NEIC personnel. One of the individuals deposed, James Steinfeld, had participated in both the April, 1977, testing of the river and the master-supervised tests which took place in September and October, 1977.

Mr. Steinfeld was questioned under oath for a complete afternoon on December 14, 1977. The following morning, before the deposition reconvened, Mr. Morrin, an Environmental Protection Agency attorney, acting as Mr. Steinfeld's counsel, advised the defendant's counsel that he should question Mr. Steinfeld about misconduct in connection with the collection of samples during the field tests. Mr. Morrin explained that Mr. Steinfeld wished to disclose some matters that were worrying him.

Upon such questioning, Mr. Steinfeld admitted that after the April, 1977, field tests, he had placed a sample taken from one area of the Little Menomonee River with samples taken from another area of the river in order to complete a sampling which otherwise would have been incomplete. The substituted sample was labeled with a falsified tag, and, in order to cover up the substitution, the location from which the substituted sample was taken was not entered in the field records. The government concedes that "the sample involved was a material sample needed in order to draw a meaningful conclusion concerning one of the objectives of the field study . . . ."

It was also revealed at the Denver depositions that the original tags on the sample bottles from the field tests were destroyed and replaced because they had become soiled. The defendant asserts that proper laboratory procedure requires that the original soiled tags be saved to permit a subsequent comparison. Because the original tags were destroyed, the defendant argues that an inference is raised that alterations had been made.

This misconduct was brought to the court's attention in communications from the assistant United States attorney in this case and from the defendant's counsel upon their return from Denver.

Although Mr. Steinfeld's transcribed deposition has not yet been filed with the court, there is no apparent dispute as to the above description of the deposition testimony. In his communication to the court, the assistant United States attorney also informed the court and the defendant's counsel that certain documents and photographic slides which should have been disclosed to the defendant in response to a prior request for production of documents had been found in Mr. Steinfeld's work area. The government also represented in such letter that it would rely on no evidence from the NEIC.

The defendant has accused the government agents of other misconduct during the course of the discovery in this case, but the government disputes these accusations. I am unable to make any findings on the present record as to these additional allegations. I therefore treat the defendant's motion as based on the admitted misconduct which has been described above.

On this factual background, I turn to the issue whether the extreme sanction of dismissal of the government's case with prejudice is warranted because of the conduct of one of the plaintiff's agents; conduct which both parties describe as "shocking and possibly criminal."

The defendant relies on Rules 37(d) and 41(b) as authority for dismissal of this action. Rule 41(b) reads, in part:

> "For failure of the plaintiff to prosecute or to comply with these rules or any order of court, a defendant may move for dismissal of an action or of any claim against him."

The government contends that Rule 41(b) is inapplicable because its agent's misconduct has not violated any specific federal rule or any order of this court.

The government also argues that Rule 37(d) was not designed to cover this situation since it provides sanctions only for a party's failure to *comply* with a properly propounded discovery request. In this case, the party against which the sanction is sought was the party that *initiated* the discovery proceeding in question.

[1, 2] I agree that neither Rule 37(d) nor Rule 41(b) specifically applies to the instant situation, but I believe that it is within the inherent equitable powers of this court to dismiss an action when a just determination of the action has been seriously thwarted by a plaintiff's willful misconduct. *Link v. Wabash Railroad Co.*, 370 U.S. 626, 630–31, 82 S.Ct. 1386, 8 L.Ed.2d 734 (1962), affirming 291 F.2d 542 (7th Cir. 1961); *Van Bronkhorst v. Safeco Corp.*, 529 F.2d 943, 951 (9th Cir. 1976); *Rohauer v. Eastin-Phelan Corporation*, 499 F.2d 120 (8th Cir. 1974).

Although Rule 37(d) is technically inapplicable to the instant motion, there is no doubt that misconduct during the discovery process is at the core of the motion. Accordingly, Rule 37(d) is not irrelevant to the question before me.

The parties have cited numerous cases in which district courts have dismissed or declined to dismiss cases because of various defaults by plaintiffs. None of these cases bear sufficient similarity to this case to be of significant assistance. Generally speaking, the Supreme Court has been reluctant to sustain district court dismissals under Rule 37(d) in the absence of willful noncompliance or bad faith. *National Hockey League v. Metropolitan Hockey Club, Inc.*, 427 U.S. 639, 96 S.Ct. 2778, 49 L.Ed.2d 747 (1976); *Societe Internationale v. Rogers*, 357 U.S. 197, 212, 78 S.Ct. 1087, 2 L.Ed.2d 1255 (1958). The court of appeals for this circuit has limited the dismissal of actions for even serious neglects. *Vac-Air, Inc. v. John Mohr & Sons*, 471 F.2d 231 (7th Cir. 1973).

In my opinion, the misconduct of the government's agent constituted blatant bad faith and evinced a willful disregard of the government's duty in carrying out the discovery process. Unlike *Vac-Air*, the offensive conduct here is intentional, not neglectful. It is conduct that offends our basic notions concerning the fair judicial resolution of disputes.

Understandably, the government attempts to disassociate itself from Mr. Steinfeld's acts by stressing that "the party

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guilty of misconduct was an employee of a governmental agency, which agency was involved in an investigative capacity." I cannot accept this effort to minimize the central role played by the Environmental Protection Agency, the NEIC and its employees in this litigation. The purpose of the Environmental Protection Agency is

> ". . . to permit coordinated and effective governmental action to assure the protection of the environment by abating and controlling pollution on a systematic basis." 40 C.F.R. § 1.3

The NEIC provides technical support for agency investigations and related enforcement matters. In a very real sense, the Environmental Protection Agency and the NEIC are the most closely interested units of the federal government to the subject matter of this case. Moreover, it is undisputed that the falsified sample was evidence material to the factual issues in this case. Thus, misconduct by an employee of Mr. Steinfeld's status cannot be treated as having only marginal importance.

[3] More basically, however, the government cannot disavow responsibility for the conduct of one of its agencies nor the conduct of an agency employee because the government must be treated as one entity. As the Court stated in *S & E Contractors, Inc. v. United States,* 406 U.S. 1, 10, 92 S.Ct. 1411, 1417, 31 L.Ed.2d 658 (1972):

> "A citizen has the right to expect fair dealing from his government . . . and this entails in the present context treating the government as a unit rather than as an amalgam of separate entities."

[4] The government also argues that the dismissal of this case would unfairly penalize members of the public who were harmed by the defendant's alleged pollution of the Little Menomonee River. Assuming that such pollution could be proved, the dismissal of this case would be unfortunate. However, the public is obliged to accept the adverse consequences which may accrue in any civil or criminal case in which its interests are improperly represented by the federal government. The government's argument that a dismissal without a hearing on the merits of its cause may violate due process is without merit since the underlying circumstances are of its own creation. *Rohauer v. Eastin-Phelan Corporation,* supra, 499 F.2d at 122.

I also find insufficient the government's representation that it will not rely on any evidence gathered by the NEIC and that it will offer no testimony of NEIC employees. The defendant persuasively argues that this self-imposed sanction is really no penalty at all since the NEIC data and witnesses have already been thoroughly discredited by the testimony adduced at the December depositions.

[5, 6] After giving careful thought to the parties' arguments, I am convinced that no sanction less than dismissal of the plaintiff's case will have sufficient punitive or deterrent impact. To permit this case to go forward based on the government's representation of future good faith might encourage litigants, or their agents, to use improper trial tactics until discovered. The government is held to a high standard of conduct in civil litigation, its dominant purpose being to assist the court in arriving at a just and true resolution. *United States v. Choctaw County Board of Education,* 310 F.Supp. 804, 810 (S.D.Ala.1969). In this case, a government agent sought to build a case with falsified evidence and attempted to cover up such falsification. He also withheld material from both the government's attorney and the defendant's attorney which should have been disclosed during discovery. The government's willful failure to meet its high standard of conduct in this case justifies, in my judgment, the dismissal of its case.

[7] The defendant has also requested that it be awarded costs including attorney's fees. Section 2412 of Title 28 authorizes an award of costs to the prevailing party in an action by or against the government, except as otherwise specifically provided by statute. However, that section specifically precludes an award of attorney's fees and expenses against the government. The defendant has cited no statute

or other persuasive authority which would permit an award of attorney's fees in this case. Accordingly, costs will be allowed to the defendant, but its request for attorney's fees will be denied.

Therefore, IT IS ORDERED that the defendant's motion for dismissal of this action be and hereby is granted.

IT IS ALSO ORDERED that the defendant's motion for an award of its costs in this action be and hereby is granted, but its request for attorney's fees and expenses be and hereby is denied.

IT IS FURTHER ORDERED that this action be dismissed, with prejudice.

Joni J. WHEELER et al.

v.

Charles SHOEMAKER et al.

Civ. A. No. 76-0506.

United States District Court, D. Rhode Island.

March 3, 1978.

Plaintiffs brought medical malpractice action against doctor and hospital, and defendant moved to refer action to medical liability mediation panel. The District Court, Pettine, Chief Judge, held that: (1) congressional grant of diversity jurisdiction prohibited reference of plaintiff's medical malpractice action to State Malpractice Commission which was created by state legislature to review merits of all malpractice actions brought in state courts, in view of fact that Commission was essentially an adjunct of state court, and reference to Commission would be tantamount to vesting original jurisdiction in state court and would thus defeat purpose of grant of diversity jurisdiction, and (2) district court would not establish reference procedure for medical malpractice action similar to Rhode Island's Malpractice Commission, in view of fact that federal interests in preserving jury's role, in the fairness of judicial process, and in controlling administrative burdens imposed upon federal judiciary outweighed legitimate state interests in reforming malpractice litigation and stabilizing health care management and insurance rates.

Motion denied.

1. Federal Courts ⟹281

Diversity jurisdiction was designed primarily to give out-of-state suitors the option of an impartial forum, free from any bias local courts might exercise in favor of in-state parties. 28 U.S.C.A. § 1332.

2. Federal Courts ⟹428

Congressional grant of diversity jurisdiction prohibited reference of plaintiff's medical malpractice action to state medical liability mediation panel which was created by state legislature to review merits of all malpractice actions brought in state courts, in view of fact that panel was essentially an adjunct of state court, and reference to panel would be tantamount to vesting original jurisdiction in state court and would thus defeat purpose of grant of diversity jurisdiction. 28 U.S.C.A. § 1332; Gen.Laws R.I.1956, § 10-19-1 et seq.

3. Federal Civil Procedure ⟹1877

Federal rule providing that reference to a master appointed by court is only appropriate in exceptional circumstances which, in jury context, are limited to reference of "complicated" issues did not cover proceedings of state medical liability mediation panel which was created by state legislature to review merits of all malpractice actions brought in state courts, since such panel was intended to function as mandatory preliminary forum of adjudication as compared to master who merely assists jury with respect to a very limited area of disputes in a very limited number of cases. Fed.Rules Civ.Proc. rule 53(b), 28 U.S.C.A.

DOCUMENT NO.

QUIT CLAIM DEED
STATE BAR OF WISCONSIN -- FORM 3
THIS SPACE RESERVED FOR RECORDING DATA

RECORDED 6/27/78
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KERR-McGEE CHEMICAL CORPORATION, a corporation organized under the laws of the State of Delaware, Grantor

quit-claims to MILWAUKEE COUNTY, a municipal corporate body organized under the laws of the State of Wisconsin, Grantee

the following described real estate in Milwaukee County, State of Wisconsin:

RETURN TO

Tax Key No. ....

AS DESCRIBED IN DETAIL ON EXHIBIT 1 WHICH IS ATTACHED HERETO AS PAGE 2.

Grantee agrees that it will not assert, seek or claim any easement (by necessity or otherwise) or ownership or other interest over, through or on the real property owned by Grantor and not included in the description above, by reason of this grant.

This is not homestead property.
(is) (is not)

Dated this 21st day of June, 1978.

KERR-McGEE CHEMICAL CORPORATION

..........(SEAL) By: J. L. Rainey (SEAL)

• .... • J. L. Rainey, President

..........(SEAL) Carter G. Dudley (SEAL)

• .... • Carter G. Dudley, Assistant Secretary

AUTHENTICATION

Signatures authenticated this .... day of ...., 19......

....

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TITLE: MEMBER STATE BAR OF WISCONSIN
(If not, ...
authorized by § 706.06, Wis. Stats.)

THIS INSTRUMENT WAS DRAFTED BY

Frank J. Daily, Esq.

(Signatures may be authenticated or acknowledged. Both are not necessary.)
The use of witnesses is optional.

ACKNOWLEDGMENT

STATE OF OKLAHOMA
} ss.
OKLAHOMA County.

Personally came before me, this 21st day of June the above named J. L. Rainey, President, and Carter G. Dudley, Assistant Secretary,

to me known to be the person S who executed the foregoing instrument and acknowledged the same.

• [signature]

Notary Public Oklahoma County, OK.
My Commission is permanent. (If not, state expiration date: ...., 19....)

*Names of persons signing in any capacity should be typed or printed below their signatures.

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ATTACHMENT 2

QUIT CLAIM DEED

STATE BAR OF WISCONSIN
FORM No. 3 — 1977

DESCRIPTION

PARCEL A

That part of the Northwest 1/4 of Section 8, Township 8 North, Range 21 East, in the City of Milwaukee, County of Milwaukee, State of Wisconsin, bounded and described as follows: Commencing at the Northeast corner of said 1/4 Section; thence due South along the East line of said 1/4 Section 298.13 feet to the point of intersection with the Southerly line of the Chicago and North Western Transportation Company right of way, said point being the point of beginning of the land to be described; continuing thence due South along the East line of said 1/4 Section, 1062.39 feet to the point of intersection with the Northerly line of the Chicago, Milwaukee, St. Paul and Pacific Railroad right of way; thence North 70°33'33" West along said Northerly right of way line, 689.30 feet to the point of intersection with a line which is parallel with and 650.00 feet West of (as measured at right angles from) the East line of said 1/4 Section; thence due North and parallel with the East line of said 1/4 Section, 874.73 feet to the point of intersection with the Southerly line of the Chicago and North Western Transportation Company right of way; thence South 86°19'00" East along said Southerly right of way line, 651.34 feet to the point of beginning, containing 14.453 Acres of land more or less.

PARCEL B

That part of the Northeast 1/4 of Section 8, Township 8 North, Range 21 East, in the City of Milwaukee, County of Milwaukee, State of Wisconsin, bounded and described as follows: Commencing at the Northwest corner of said 1/4 Section; thence due South along the West line of said 1/4 Section 298.13 feet to the point of intersection with the Southerly line of the Chicago and North Western Transportation Company right of way, said point being the point of beginning of the land to be described; thence South 86°19'00" East along said Southerly right of way line, 1328.18 feet to a point; thence South 0°00'27" East, 911.06 feet to a point; thence South 88°36'11" West, 150.00 feet to a point; thence South 0°00'27" East, 594.11 feet to a point in the Northerly line of the Chicago, Milwaukee, St. Paul and Pacific Railroad right of way, said point being on a curve whose radius is 2341.33 feet and is to the Southwest; thence Northwesterly along said Northerly right of way line and along the arc of said curve 866.69 feet, the chord of which bears North 63°12'58" West, 861.76 feet to a point; thence North 70°33'33" West along said Northerly right of way line, 430.94 feet to the point of intersection with the West line of said 1/4 Section; thence due North along the West line of said 1/4 Section, 1062.39 feet to the point of beginning, containing 36.912 Acres of land more or less.