Penta Wood
Site Specific Sustainable Remediation System Evaluation

Prepared for:
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LIST OF ACRONYMS

ACA	ammonia copper arsenate
ACZA	ammonia, copper II oxide, zinc and arsenate
AST	aboveground storage tank
bgs	below ground surface
CAMU	corrective action management unit
CO_2e	Carbon dioxide equivalents
DAF	dissolved air flotation
FS	feasibility study
g/cm^3	grams per cubic centimeter
GAC	granular activated carbon
gpm	gallons per minute
HDPE	high density polyethylene
Hp	horse power
kW	kilowatt
kWh	kilowatt hours
LEL	lower exposure limit
LNAPL	light non-aqueous phase liquid
m^2	square meters
NPL	National Priorities List
O&G	oil and grease
O&M	operation and maintenance
P&T	pump and treatment
PCP	pentachlorophenol
ppb	parts per billion
psi	pounds per square inch
PV	photovoltaics
PVC	polyvinylchloride
PWP	Penta Wood Products
RA	remedial action
RDVF	rotary drum vacuum filter
RI	remedial investigation
ROD	Record of Decision
ROI	radius of influence
RPO	remedial process optimization
SACM	Superfund Accelerated Cleanup Model
scfm	standard cubic feet per minute
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VFD	variable frequency drive
WDNR	Wisconsin Department of Natural Resources
WDOJ	Wisconsin Department of Justice
WisDOT	Wisconsin Department of Transportation
WPDES	Wisconsin Pollutant Discharge Elimination System

1.0 INTRODUCTION

The purpose of this document is to provide a Site Specific Sustainable Remediation System Evaluation for the Penta Wood site located west of Siren, Wisconsin. To evaluate current site conditions, and effects of potential changes, a sustainability baseline was created that included a current carbon footprint, energy usage, operational costs and contaminant mass removal. A limited remedial process optimization (RPO) was conducted for the site to identify major items that could be addressed to improve the sustainability and efficiency of the existing remedial system, and to reduce operation and maintenance (O&M) costs. An alternative energy evaluation was conducted to see if alternative energy could be used to offset current energy usage at the site. Potential sustainable activities were evaluated to enhance reduction of contaminant levels and lower costs. Three sustainable activities were selected and a sustainability matrix was generated outlining costs and benefits of each activity in terms of various sustainability metrics, such as the increase or decrease in carbon footprint, energy usage, resource usage, waste generation and cost. The purpose of the sustainability matrix is to provide/quantify effects of potential changes in terms of the sustainability metrics.

This document was generated using information provided by the Wisconsin Department Natural Resources (WDNR) and the current system operator, CH_2M Hill. Information included utility and O&M costs, monitoring reports and as-built drawings, where available. A site walk and interviews with the WDNR site project manager were conducted on June 2, 2009.

2.0 SITE DESCRIPTION

The Penta Wood Products (PWP) site is a former wood treating facility located on Daniels 70 (former State Route 70), approximately 2 miles west of the Village of Siren in the Town of Daniels, Burnett County, Wisconsin. A site plan, illustrating site features, is included in Figure 2-1. PWP operated for 39 years, beginning in 1953 and ceasing operations in 1992 due to the financial inability of the facility to comply with Wisconsin Department of Justice (WDOJ) requirements. PWP operations actively used approximately 80 acres of a 120 acre parcel. Approximately 40 undeveloped acres, consisting mainly of forest land, was sold after the facility closed in May 1992. The PWP property is located in a rural agricultural and residential area and is bordered by forested areas to the east, west, and north. Daniels 70 forms the southern border of the property, with the exception of 8 acres located south of Daniels 70.

Former site buildings consisted of a main treatment building, oil/water separator building, and various other buildings including sawmills, garages, and storage sheds. The PWP site also included an unlined drainage ditch (gully) where wastewater was discharged, a wastewater lagoon, and wood chip pile. A wetland area is located off-site approximately 400 feet north of the lagoon.

When PWP began operation in 1953, raw timber was cut into posts and telephone poles and treated by dipping into open tanks of pentachlorophenol (PCP) solution or by introducing the PCP into the wood under vacuum. In 1956, a pressure-treatment vessel was installed which used a 5 percent to 7 percent PCP solution in a No. 2 fuel oil carrier. In 1975, a second pressure-treatment process was added which used chemonite, a water-born salt treatment consisting of ammonia, copper II oxide, zinc, and arsenate (ACZA).

During operation, PWP historically disposed of wastes on-site. PCP/oil and metals contaminated wastewater from the oil/water separator tank was directed to the gully and discharged into the lagoon located on the northeast corner of the property. PCP/oil and metals contaminated wastewater was also discharged into a wood chip pile, located in the northwest corner of the property. WDNR inspections conducted during the 1970s noted several large spills, stained soil, and poor operating practices at the facility. During a large fire that destroyed the treatment building circa 1979, PWP released approximately 10,000 gallons of the PCP/oil mixture to the oil/water separator. The oil/water separator overflowed and discharged to the gully and lagoon. In 1988, the WDNR closed the on-site potable supply well due to high PCP concentrations detected in water samples. In 1989, the Wisconsin Department of Transportation (WisDOT) detected high levels of PCP in surface soil samples collected in the south Daniels 70 right of way. WDNR inspections, conducted in June 1989, revealed ongoing discharges of PCP contaminated wastes to on-site soils. In addition, erosion around the lagoon area resulted in PCP contamination of surface water and sediments of the wetland area. Assessments of the site revealed on-site soil and groundwater were contaminated with PCP, arsenic, copper, and zinc from the on-site wood treating operations.

The WDOJ filed a preliminary injunction against PWP in 1991 for raw material storage, waste handling practices, and Wisconsin Pollutant Discharge Elimination System (WPDES) violations leading the facility to voluntarily close in May 1992. In April 1993, the United States Environmental Protection Agency (USEPA) initiated site assessment activities. Due to high permeability surficial soils, precipitation on-site flowed rapidly downward through the soil carrying contaminants to the groundwater aquifer. Spills and poor waste handling practices over time resulted in soil contamination from ground surface to a depth of over 100 feet to the groundwater table. The PCP/oil mixture spread as light non-aqueous phase liquid (LNAPL) on the groundwater table over an estimated 4-acre area.

Between April 1994 and June 1996, USEPA conducted short-term removal actions including removal of approximately 29 aboveground storage tanks (ASTs) and 6 underground storage tanks (USTs) which were filled with PCP and ACZA contaminated sludge, 393 drums of PCP contaminated oil and sludge, 21,500 gallons of PCP contaminated liquids, 18,800 gallons of PCP and ammonia copper arsenate (ACA) contaminated liquids, 51 drums of contaminated sludge, 773 tons of contaminated surface soils, and 9 drums of asbestos containing wastes. Approximately 4,800 tons of arsenic contaminated soil was excavated and treated with cement and used to construct a 4-acre bio-pad for potential treatment of PCP contaminated soils. The site was listed on the National Priorities List (NPL) in June 1996.

A remedial investigation (RI) and feasibility study (FS) was completed in May 1998. The Record of Decision (ROD) was signed in September 1998 identifying remedial alternatives for both soil and groundwater contamination. The remedial design was completed in November 1999 and remedial action (RA) was completed in September 2000. The RA included demolition of buildings, consolidation of PCP and arsenic contaminated soils in a 7-acre corrective action management unit (CAMU), installation of a groundwater pump and treatment (P&T) system, installation of biovent wells, capping the CAMU, security fencing, and natural attenuation monitoring.

A total of 10 soil borings were advanced for construction of the remedial system. Seven borings were constructed as dual-purpose bioventing/free product recovery and groundwater extraction wells. Two borings were constructed as biovent only wells. The borings were 16 inches in diameter to facilitate a 6-inch diameter groundwater extraction well and a 4-inch diameter bioventing/free product recovery well, installed in the same borehole. The system was designed to create drawdown in the groundwater extraction wells, thus, providing hydraulic containment and maximizing LNAPL thickness for recovery by the biovent/free product recovery wells. Impacted groundwater would be treated on-site and discharged to the infiltration basin. Free product would be removed for off-site disposal. Bioventing on-site was not anticipated to start until after LNAPL was no longer being effectively removed. Initially, the P&T system's main components consisted of an oil/water separator, bag filters, organoclay, and granular activated carbon (GAC). P&T system operation began in September 2000 and was shut down in September 2001 resulting from emulsified oil in the groundwater repeatedly fouling the GAC. Additional pretreatment was required before the existing system would operate properly. During 2001 and 2002 treatability studies and a pilot test were conducted to determine site-specific design parameters for pretreatment. Design work and construction were completed in 2003 and the pretreatment system became operational in February 2004. The pretreatment system included an oil/water separator, chemical addition for coagulation and flocculation, dissolved air flotation (DAF), dewatering with a rotary drum vacuum filter, and associated storage tanks.

The property is currently owned by Penta Wood Products. The responsibility for remedial operation will be transferred from the USEPA to the WDNR in 2014.

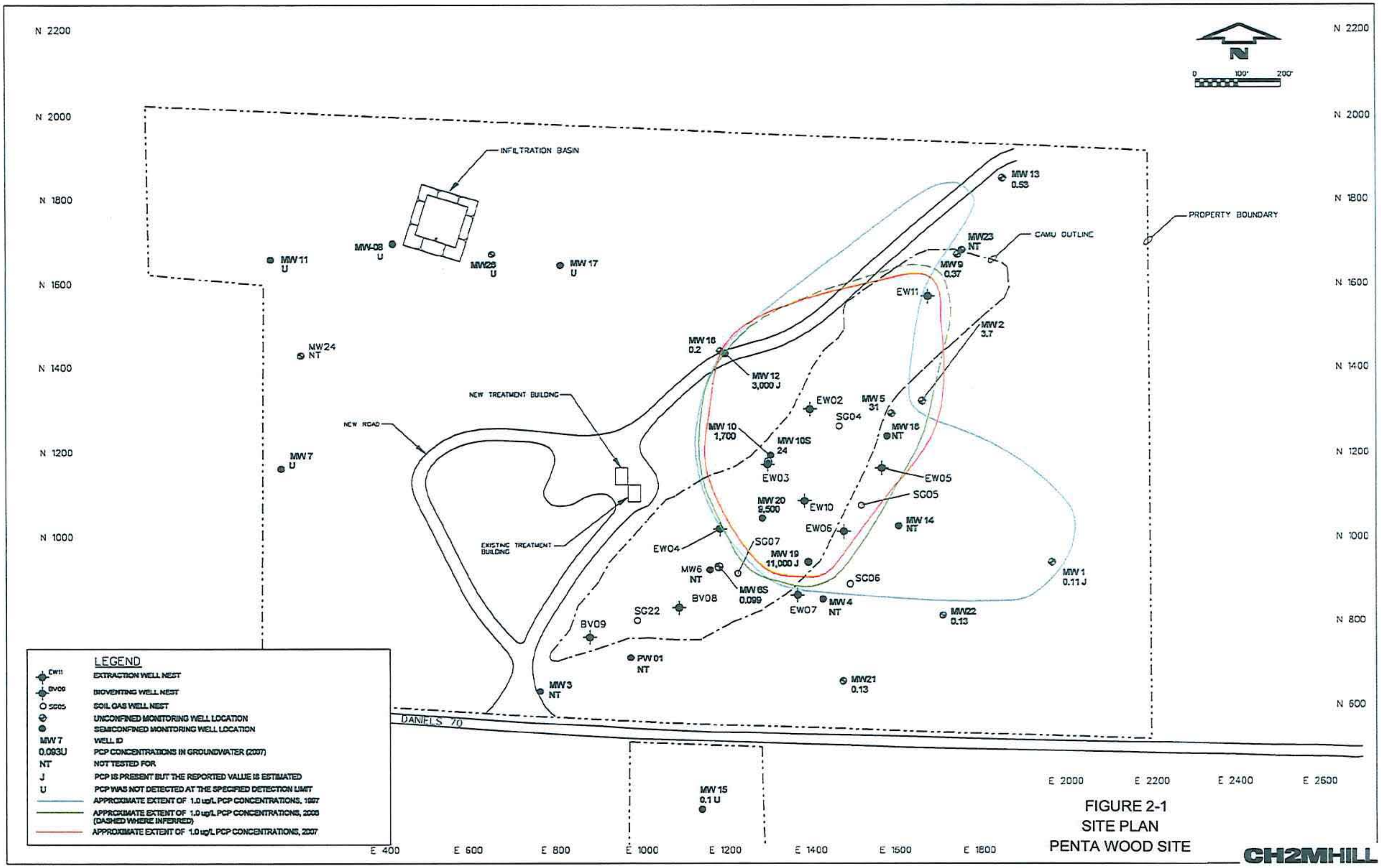

FIGURE 2-1
SITE PLAN
PENTA WOOD SITE

3.0 CURRENT CONDITIONS

The current remedial approach at the PWP site is O&M of three remedial subsystems (groundwater P&T, LNAPL removal, and bioventing) in coordination with long-term groundwater monitoring to evaluate natural attenuation. Each of the three subsystems can operate independent of the other two. Only the groundwater P&T and LNAPL recovery systems were operated initially due to potential adverse effects of the biovent system, while significant thickness of free product is present. The USEPA and WDNR have determined that the impacted groundwater, LNAPL, and other waste generated at the site are F032-listed hazardous wastes. The remedial approach was designed to reach treatment goals in 30 years.

The P&T system is contained in two attached metal frame buildings. The original system was housed in a 30- by 42-foot building. The pretreatment components added in 2003 are located in a 52- by 67-foot building. Both buildings were designed and built with curbs for secondary containment and storage tanks to contain spills. The primary components of the current P&T system consists of an oil-water separator, free product storage tank, chemical conditioning with ferric sulfate and polymer addition, DAF, rotary drum vacuum filter (RDVF), bag filters, a 2,500-pound GAC vessel, two 10,000-pound GAC vessels, sodium hydroxide addition for pH adjustment, associated tanks and piping, and discharge to an on-site infiltration gallery. The system was designed for a groundwater extraction rate of 120 gallons per minute (gpm) and currently operates at approximately 90 gpm.

Eight groundwater extraction wells were designed to depress the water table and capture the area of PCP contaminated groundwater with concentrations exceeding 1,000 parts per billion (ppb). LNAPL pumps are installed in six biovent wells and one product recovery well. Groundwater is extracted at a rate of approximately 10 to 12 gpm per well. Each groundwater extraction well is fitted with a 2 horsepower (Hp) electrical submersible pump (Grundfos Model 16S20-18). Each pump is equipped with a variable frequency drive (VFD) and is housed in a control cabinet located in the treatment building. The VFD controls pump speed and flow rates. LNAPL is extracted with top-loading pneumatic pumps (QED Hammerhead) from the dual-purpose wells. Groundwater conveyance piping is a 2-by 3-inch diameter dual-wall high-density polyethylene (HDPE) pipe and free product conveyance piping is 1- by 2-inch diameter dual-wall HDPE pipe. Groundwater wells were constructed with 20-foot screens located about 20 feet below the groundwater table. Biovent wells are constructed of Schedule 80 polyvinyl chloride (PVC) and were designed with 60-foot screened intervals extending from 40 feet above the groundwater table to 20 feet below the groundwater table. Groundwater exists at approximately 100 below ground surface (bgs).

The DAF unit was installed to improve the performance of the GAC. The DAF unit provides removal of total suspended solids (TSS) and free and emulsified oil and grease (O&G) from the groundwater and oil/water separator waste streams. The RDVF is used to dewater "float" from the DAF unit on a diatomaceous earth precoat with a surface area of 56.5 square feet. The RDVF was sized to operate 4 to 8 hours per day, three times per week and has a 4- to 6-gpm vacuum pump seal water demand. After "float" from the DAF unit is fed to the RDVF basin, the "float" adheres to the surface of the precoat under vacuum. Solids remaining on the precoat are scraped off with a blade and fall into a dumpster where it is stored until transported off-site for disposal.

The 2,500-pound GAC prefilter vessel removes residual particulates from treatment water so that the 10,000-pound GAC vessels function more efficiently. The 2,500-pound GAC prefilter vessel is backwashed on an as-needed basis to flush the GAC vessel of particulate buildup. GAC prefilter effluent is then treated by two 10,000-pound GAC vessels before discharge to the infiltration gallery.

Compressed air is required for operation of several treatment system components in addition to operation of LNAPL pneumatic recovery pumps. The current total estimated air demand is 36 standard cubic feet per minute (scfm) at 105 pounds per square inch (psi). Two compressors currently exist on-site. The original 7.5 Hp compressor, capable of supplying 24 scfm at 110 psi, was undersized after the addition of pretreatment equipment. A 20 Hp compressor, capable of supplying 70 scfm at 110 psi, was added to operate the additional equipment. The two compressors are connected to a common manifold. The original compressor is currently not in use, but can be used if additional air demand is necessary in the future.

The bioventing system was designed as "follow-up" to the LNAPL recovery effort. The objective of the bioventing system is to enhance aerobic degradation of PCP contaminated soil by injecting air into the unsaturated zone above the groundwater table. The bioventing system consists of nine injection wells, a 75-Hp centrifugal blower, connecting piping, and associated controls. Design airflow rates ranged for 200 to 500 scfm (per well) at a pressure of approximately 50 inches of water. Biovent well locations were based on a 125-foot design radius of influence (ROI). The blower is capable of providing up to a total of 5,000 scfm at 55 inches of water and currently set up to provide a total of 4,000 scfm. The system can accommodate additional wells, if expansion is required. Biovent system piping consists of a 12-inch diameter HDPE intake pipe, a 16-inch diameter HDPE manifold, which supplies 6-inch and 8-inch diameter HDPE header pipes. The 6-inch and 8-inch diameter HDPE header pipes reduce to 4-inch diameter flexible pipe at each of the biovent wells.

The bioventing system was started in September 2007 after LNAPL was no longer being consistently removed. An evaluation indicated that LNAPL recovery could not be substantially improved and only a small percentage of remaining LNAPL would likely be recovered. The area requiring bioventing extends from the surface in the central area of the CAMU to a depth approximately 10 feet below the groundwater table. The volume of contaminated soil to be biovented has been estimated to be approximately 400,000 cubic yards.

During biovent system startup, several objectives needed to be met including evaluating the presence of methane or other explosive gases and risks, evaluating temperature changes in the subsurface and risks, and determining effects on LNAPL thickness or spreading of the plume. Startup monitoring demonstrated that there was not an explosive hazard and methane levels generally were not a concern. Methane present in the shallow subsurface appeared to be escaping through ground surface and not migrating laterally. However, it was determined that the biovent system should be shut down during winter months when the ground surface is frozen (impervious layer), introducing the risk of lateral migration. During bioventing, subsurface temperatures did not change enough to cause concern. Monitoring also demonstrated that LNAPL thickness did not change during biovent operation and the LNAPL plume did not spread.

The bioventing system was shut down in November 2007 for winter and restarted in May 2008. The bioventing system was again shut down in November 2008 and restarted in May 2009.

Flow rates at the biovent wells have generally ranged from 100 to 450 scfm (per well) during operation with higher flow rates set in the deeper wells. During operation, soil gas monitoring was conducted on four nests of shallow, intermediate, and deep monitoring wells, four perimeter monitoring wells, and one additional shallow monitoring well. Readings were collected for oxygen, carbon dioxide, temperature, lower explosive limit (LEL), and methane. During operation, oxygen, carbon dioxide, temperature, LEL, and methane readings have ranged from 0 to 22.9 percent, 0 to 28.5 percent, 24 to 84 degrees Fahrenheit, 0 to 100 percent, and 0 to 17.9 percent, respectively. Soil gas measurements were also collected to evaluate the ROI of the system. Pressure readings have ranged from 0.1 to 2.4 inches of water.

AECOM reviewed the 2008 Annual Report, dated November 2009, and prepared by CH_2M Hill for this site-specific evaluation. During 2008, the P&T system extracted over 18.1million gallons of groundwater with pumping rates generally ranging from 15 to 76 gpm with an average of 56 gpm, while the system was operating. The effective extraction rate, including time when wells were not operating, was 36 gpm. PCP influent concentrations during 2008 ranged from 2,200 to 4,400 ppb with an average concentration of 3,255 ppb. The estimated PCP mass removed during 2008 was approximately 492 pounds, bringing the total PCP mass removed, from the dissolved phase, since 2000 to 7,028 pounds. This is estimated to be a 90 percent total reduction, based on the estimated mass prior to system startup.

For 2008, the volume of liquid waste captured by the oil/water separator was used to estimate the volume of LNAPL removed and resulting mass of PCP removed. Based on the roughly 5,854 gallons of liquid waste removed it, was estimated that one-half, or 2,815 gallons, of LNAPL were removed. Assuming a LNAPL density of 0.84 grams per cubic centimeter (g/cm^3), and a PCP concentration of 5 percent, it was estimated that 986 pounds of PCP present in LNAPL was removed during 2008. An estimated 5,824 pounds of PCP have been removed by LNAPL recovery since 2004.

GAC change-out occurred every 16 to 20 weeks during the first half of 2008. Changes to operating procedures and pH adjustment have significantly increased the lifespan of the GAC since 2007. Approximately 50,000 pounds of GAC are consumed per year at the site which equates to three to four carbon change-outs per year.

During 2008 approximately 211,400 pounds of filter cake, 70,007 pounds of carbon, 28,036 pounds of LNAPL, and 3,176 pounds of miscellaneous debris was generated at the PWP site.

Groundwater monitoring at the site is conducted on a semiannual basis. The spring sampling event consists of sampling at five monitoring wells, five residential wells, and one on-site potable well. The fall sampling event consists of sampling at 14 monitoring wells, five residential wells, and one on-site potable well. Water level and LNAPL measurements are conducted to determine groundwater flow direction(s) in the unconfined and confined aquifers and determine remaining LNAPL thickness. Monitoring data continues to show that the P&T system is maintaining hydraulic control (capture) and the plume boundary is gradually decreasing. LNAPL thickness appears to be increasing in the central area of the CAMU where the depression induced from pumping is greatest.

There are five residences within 1,000 feet of the PWP site which have potable wells. Annual sampling of the private wells has demonstrated that the contaminate plume has remained on-site.

4.0 BASELINE EVALUATION

A baseline analysis was conducted for the PWP site. The baseline is a quantification of the current site conditions using various sustainability metrics. This allows costs and benefits of potential changes to the remedial system to be measured using the same set of sustainability metrics.

4.1 CARBON FOOTPRINT

The PWP operated as a wood treating facility from 1953 until 1992, when it closed. The PWP site was placed in the Superfund Accelerated Cleanup Model (SACM) pilot program in 1993. The site is currently in a long-term O&M mode with groundwater P&T, free product recovery and biovent systems being active at the site. An analysis of site operations has identified applicable items associated with Scope 1 (direct discharge), Scope 2 (electricity) and Scope 3 (other indirect) at the site.

Scope 1 items identified at the site are propane usage for the heating the treatment buildings during winter months. Approximately 18,000 to 24,000 pounds of propane are used to heat the facility during winter months. This information is taken directly from utility bills provided by the remedial system operator.

Scope 2 items consist of electricity consumed by the treatment equipment, tank heaters and lighting. This information is taken directly from utility bills provided by the remedial system operator.

Scope 3 items consist of diesel fuel used by trucks to haul hazardous waste and activated granulated carbon to and from the site, unleaded gas used by O&M personnel at the site. For Scope 3, it was assumed two site visits per year were required for site sampling with mobilization from Milwaukee. It is also assumed that a full time operator is at the site approximately 50 hours per week and the operator makes an average of six trips per week with the round trip mileage to the site being 20 miles. Disposal of hazardous waste, which includes spent cake, filter cake and free product, is also included in Scope 3 items. Hazardous wastes are shipped by North Shore Environmental to Pollution Control Industries in Chicago, Illinois which in turn sends the waste to Ross Incineration Services in Grafton Ohio. Based on information provided by the operator, approximately 13 transport loads of hazardous material are sent to Ross Incineration for disposal. The round trip distance from the PWP site to Ross Incineration is approximately 1,500 miles. Hazardous materials incineration is included in the carbon footprint as actual combustion of the materials and do not include the energy (natural gas/electricity) used as an ignition source or as fuel for the incinerator.

Fugative methane emissions generated by anaerobic digestion of organic contaminants at the site, in the vicinity of the CAMU, have a significant impact on the environmental footprint of the remedial action at the site. The volume of fugitive methane emitted could not be quantified, and thus are not included in the carbon footprint analysis for the site. It is anticipated that this fugitive methane will be emitted from the site for a prolonged period of time due to the presence of oil soaked wood chips within the CAMU. Bioventing efforts are underway to try to mitigate methane generation by injecting air into the vadose zone.

The total annual carbon footprint generated by the PWP site is estimated to be 482.98 tons carbon dioxide equivalents (CO_2e). The carbon footprint analysis is included in Appendix A.

4.2 ENERGY

Electric service at the site is provided by Northwestern Wisconsin Electric and is required to operate the remedial equipment, provide indoor lighting and supplemental heating in the treatment building and heat the outdoor chemical storage tanks. Propane for the site is primarily used to heat the buildings.

For the 12-month time period from January to December 2008 the total costs for electricity was $51,227. The total average monthly cost for electricity is approximately $4,269. Total electrical service requirements for the January to December 2009 operational year equals energy consumption of approximately 465,126 kilowatt hours (kWh). Average monthly energy consumption is approximately 38,761 kWh and total costs average $0.110 per kWh for 2008.

For the 4-month time period from January to April 2009 the total costs for electricity was $17,690. The total average monthly cost for electricity is approximately $4,423. Total electrical service requirements for the January to April 2009 time period equals energy consumption of approximately 173,960 kWh. Average monthly energy consumption is approximately 43,490 kWh and total costs average $0.101 per kWh for 2009.

For the 12-month time period from January to December 2008 the total costs for propane was $48,804 for 21,270 gallons. The total average monthly cost for propane is approximately $4,067 for average monthly usage of 1,418 gallons of propane. The propane tank was filled 15 times during 2008. Average propane costs for 2008 are $2.29 per gallon.

For the 4-month time period from January to April 2009 the total costs for propane was $38,116.98 for 16,410 gallons. The total average monthly cost for propane is approximately $9,529.25 for average monthly usage of 1,368 gallons of propane. The propane tank was filled 12 times so far during 2009. Average propane costs so far for 2009 are $2.32 per gallon.

4.3 OPERATIONAL COSTS

Total operational costs, including electricity and propane, associated with the treatment system operation and monitoring includes consultant costs, bag filters, chemical additives, GAC replacement and disposal, telephone service, filter cake disposal, LNAPL disposal, analytical costs, maintenance and equipment costs, etc. Costs provided by the operator show that $1,221,000 was expended to operate the PWP system in 2008 and $1,158,000 was expended to operate the PWP system in 2009.

A detailed breakdown of operational costs was not provided for operational years 2008 and 2009. The detailed breakdown for operating year 2006 (reported in the Draft Penta Wood Products Remedial Action Optimization Report, February 2006) indicated that the largest cost component was discharge and disposal costs, which were projected to be approximately $538,000 in 2006. Other projected costs were project management and reporting $156,736, O&M Labor $120,100, groundwater sampling labor $37,800, consumables (GAC, chemicals) $156,301, laboratory costs $34,700 and other(parts, maintenance etc.) $83,975. Given that total operation and maintenance costs in 2006 and 2009 are similar the detailed cost breakdown should be similar as well.

4.4 CONTAMINANT MASS REMOVAL

The remedial system at the PWP site has removed approximately 7,028 pounds of dissolved phase PCP from groundwater and an additional 5,824 pounds of PCP entrained in the LNAPL through December 2008. Approximately 29,500 gallons of free product (Fuel Oil No. 2) had been collected and disposed of through the end of December 2008.

5.0 LIMITED REMEDIAL PROCESS OPTIMIZATION STUDY

The limited RPO is a specific process that examines overall remedial system effectiveness, including incremental changes and/or system replacement to include considerations of new technologies, as well as alternative regulatory approaches. Optimization must be implemented within the confines of the existing site decision document.

The purpose of the limited RPO study is to identify possible changes to the site or remedial system that would significantly improve the system with regards to overall remedial sustainability. This includes decreasing the costs of operating the system and/or increasing the efficiency of LNAPL or PCP impacted water removal. The limited RPO study is based on the analysis of documents and information provided by the site operator and WDNR, as well as information obtained during the site walk conducted June 2, 2009. These documents may not include the most current site information and many recent optimization studies that are currently underway or are considered draft.

The following RPO recommendations were based on the assumption that the current technology will continue to be employed as the site remedy for an additional 30 years. This value was selected for the purpose of comparing remedial options based on an estimate of cleanup time presented in the ROD.

5.1 REROUTE GROUNDWATER EXTRACTION INFLUENT AROUND DAF TANK

Evaluate rerouting the groundwater influent header to bypass the coagulant reaction tank, the flocculant reaction tank and DAF unit and flow directly into the DAF pump tank. The purpose of the DAF process, as stated in the O&M Manual, is to remove TSS and emulsified O&G from the influent stream prior to processing the water through a series of granular activated carbon units, after which the effluent pH is adjusted and the water is discharged to the reinfiltration basin. The on-site operator has done on-site jar testing and determined that emulsified oil is present in "micels" in the total influent collected from the groundwater extraction system, and thus, the influent needs to be run through the DAF system. Analysis of individual extraction wells could be conducted to determine if emulsified oil is present in water extracted from all extraction wells or just wells closer to the original source area. Sampling influent from individual groundwater extraction wells would also allow for the adjustment of the remedial system so pumping rates could be increased from wells that have the highest contaminant concentrations.

Rerouting the influent from groundwater extraction wells without emulsified oil around the DAF unit would significantly decrease the through-put on the DAF unit. This should result in a corresponding reduction in the $FeSO_4$ coagulant, the cationic polymer and drying agent. The change would also result in a significant reduction in the "filter cake" hazardous waste generated by the process. GAC lifespan should not be affected as the dissolved phase PCP concentration should remain constant.

5.2 BIOVENTING SYSTEM MODIFICATION

The current bioventing system consists of nine biovent (injection) wells, a 75-Hp centrifugal blower, connecting piping, and associated controls. Seven of the injection wells are located within the lateral extent of the CAMU. Two of the injection wells are located just outside the

CAMU boundary. Well locations are shown on Figure 2-1. The blower is currently operating at a total flow rate of 4,000 scfm, or about 450 scfm per well.

An analysis of collected data indicates there are only a few locations were the vadose zone is depleted of oxygen to the point where it would impact aerobic microbial activity. These points, specifically SG22 and SG07S, correlate with the location of the on-site CAMU. Oxygen concentrations at other monitoring points indicate some reduction in oxygen concentrations, but concentrations are sufficient to support aerobic degradation of contaminants. With the exception of biovent wells in the vicinity of SG22 and SG07S, consider modifying system operation to pulse the biovent system on an as needed basis based on results of vapor point monitoring. A smaller blower should be considered for points that require constant air injection.

Evaluate the potential for adding additional vent wells CAMU to prevent the vadose zone from being depleted of oxygen.

5.3 EVALUATE INSTALLATION OF PRECOALESCING TANK PRIOR TO OIL WATER SEPARATOR

Evaluate placement of a precoalescing tank prior to the oil/water separator that would receive total fluids from the free product removal system. The tank would provide additional residence time to allow the emulsified O&G to coalesce. It also would provide a steadier stream of influent into the oil water separator. Currently, water is pulsed into the oil/water separator as the pneumatic pumps fill and discharge to the separator. The pulsing tends to increase the emulsification of O&G in the influent.

5.4 CREATE WIND BREAK AROUND EXTERIOR TANKS

Currently $FeSO_4$ and NaOH storage tanks are kept outside of the treatment facility and exposed extremely cold and windy conditions during winter months. These tanks must be kept at minimum temperatures of 72 and 52 degrees Fahrenheit, which require a great deal of electricity to maintain these temperatures during winter months. Examine the feasibility of creating a windbreak around the tanks to shelter the tanks from the elements.

5.5 METHANE GENERATION UNDER CAMU

Based on the amount of organic material left in place within the CAMU, it is apparent that the generation of methane will be an issue even after the remediation system has been shut down. Any methane generated would eventually be emitted to the atmosphere. Methane has a high global warming potential and thus any methane emitted would have a significant effect on the sustainability/environmental footprint of the remediation.

Evaluate methods for creating a passive venting system in this area that could supply oxygen to the vadose zone in sufficient quantities to keep the vadose zone from going anaerobic. This potentially could be accomplished by installing small windmills such as those used to aerate ponds which could be modified to inject air into the vadose zone.

6.0 ALTERNATIVE ENERGY ANALYSIS

An alternative energy analysis was conducted at the PWP site. The analysis includes the evaluation of solar power, wind power and geothermal heating.

6.1 SOLAR ENERGY

Solar energy can be used through several methods including direct or indirect heating and lighting systems, photovoltaics (PV), or concentrating solar power. The NERL National Photovoltaic Resource Map indicates that in the vicinity of the site PV power averages about 3.0 kWh m^2/day. The average electric power consumption on-site is about 465,000 kWh/yr for 2008, or about 1,274 kWh/day. To meet the electrical demand of the PWP site as currently configured, a PV system with an average efficiency of about 2.5 percent would require a collector area of about 17,000 m^2 to meet the site's average demand. To account for peak demand and to generate power to be stored for periods when the PV system cannot meet the average demand, you might need two to three times that much output (or about 930 - 1,395,000 kWh/day). Any power generated that was not used or stored on-site would be exported to the utility grid and would generate income for the state. The majority of the site is clear of trees or any obstructions that obstruct or shadow the photovoltaic cells. Due to the size of the photovoltaic array needed to provide electricity for the site, putting up a solar array would be cost prohibitive.

6.2 WIND ENERGY

Conduct a wind resource assessment to determine the potential for using wind energy. The Wisconsin Focus on Energy Wind Resource Map indicates that, in the vicinity of the site, the wind power density at an altitude of 40 meters is 200-300 W/m^2. The average electric power consumption on-site is about 465,000 kWh/yr, or about 53 kW. A wind turbine or turbines, with a constant output of about 53 kW, could meet the site's average demand. To account for peak demand and to generate power to be stored for periods when the wind turbine cannot meet the average demand, you might need two to three times that much output (or about 106 to 159 kW). Installation of a 100 kW wind turbine, which would produce approximately 140,000 kWh of electricity per year at the site, would cost approximately $300,000, and have a payback period of 28 years without any incentives included. Any power generated that was not used or stored on-site would be exported to the utility grid and would generate income for the state.

The most significant concern with a wind power system is the proximity of nearby homes and the potential height restrictions due to proximity to the nearby local airport.

6.3 GEOTHERMAL HEATING

Currently the PWP site uses approximately 22,000 pounds of propane to provide heat to the building during winter months as well as using electric space heaters in select locations. The remediation system as currently configured pumps at a rate of approximately 60 gpm which would be a sufficient throughput to use geothermal heating to offset heating costs during winter months. A detailed analysis of the building and heating system would need to be conducted to determine if it was feasible and cost effective to install a heat exchange unit that would use the thermal energy in the extracted groundwater to heat the building.

7.0 POTENTIAL SUSTAINABLE ACTIVITIES

Currently, Penta Wood Products Inc. is listed in the tax records as the owner of record at the site. Penta Wood Products Inc. is no longer a viable entity. Some recommended sustainable activities may require permission by the property owner. It is unclear whether the EPA, WDNR or Burnett County would require permission prior to implementing these activities.

Implementing the recommended RPOs will result in a more effective and efficient remedial system and achieve objectives quicker and at a lower cost (i.e., sustainable). In addition to the items mentioned in the RPO section of this document, some additional sustainable activities that may be considered are discussed below.

7.1 RECYCLING USED EQUIPMENT

As the remediation equipment at the site is taken offline, the equipment should be salvaged or recycled dependent upon condition. Although the market for used remedial equipment is small, the equipment could be sold and reused by another consultant at a different site. If reuse is not possible, the equipment should be recycled and/or properly disposed of.

7.2 REPURPOSING FACILITY

The PWP site is located in a rural area. Once remediation has been completed, the site building and site could be reused for commercial or industrial purposes. It is unlikely that the parcel can be redeveloped for residential use or parkland due to the presence of the CAMU at the site.

7.3 USE SITE TO GENERATE ALTERNATIVE ENERGY

As mentioned in the Alternative Energy evaluation, the PWP site has potential for generating wind power to sell back to the utility. Project managers from Northwestern Wisconsin Electric, which provide electric service to the site, indicated that the PWP site is one of only two sites within their service area that would be suitable for the production of wind power. North West Wisconsin Electric also indicated that the infrastructure required to put power back into the grid was located close to the PWP site and connection to the grid would require relatively little work. There is an airport nearby and an evaluation would need to be conducted to determine the maximum height of the windmills. A feasibility study would need to be conducted prior to implementing any alternative energy options at the site.

8.0 SUSTAINABILITY MATRIX

A sustainability matrix was created that compared sustainability metrics for the current operational baseline verses three potential modifications that could be made to the system. The selected options are rerouting the groundwater extraction well influent, installation of passive venting system and the installation of wind turbines to offset electricity usage at the site as well as to provide energy to the grid after site closure. The sustainability matrix for the PWP site is presented in Table 8-1.

It should be noted that the best or most applicable sustainable alternative at the site may be a combination of the proposed options. In addition to the alternatives presented in the matrix, other RPO recommendations should be considered for implementation after being fully evaluated.

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Table 8-1
Sustainability Matrix Penta Wood Products Site

	Baseline[3]		Option 1 Rerouting 20 percent of Influent Around DAF		Option 2 Installing Passive Soil Venting in CAMU Area		Option 3 Installation of 100 kW Wind Turbine	
Sustainability Metrics[1,2]	**Annual**	**Life Cycle**	**Annual**	**Life Cycle**	**Annual**	**Life Cycle**	**Annual**	**Life Cycle**
System Optimization (Qualitative)	All groundwater influent is being routed through the DAF system and the biovent system operates continuously for approximately 7 months per year.		Would decrease filter cake production by 20 percent. Would not increase the effectiveness of the extraction system.		Passive venting would eliminate the need to operate the biovent blower which consumes approximately 200,000 kW of energy per year.		Will not increase the effectiveness of the remedy but would offset electric usage at the site by 140,000 kW per year.	
Restoration Timeframe (yrs)	NA	25	NA	25	NA	25	NA	25
Carbon Footprint/Air Emissions								
Tons CO_2e	482.98	12,074.50	475.6	11,890.30	482.06	12,051.50	482.29	12,057.30
Energy Usage								
Electricity (kWh)	456,126	11,403,150	456,126	11,403,150	256,126	6,403,150	306,126	7,653,150
Propane (Pounds)	21,270.20	531,755	21270.2	531,755	21,270.20	531,755	21,270.20	531,755
Cost								
O&M Cost (dollars)	$1,221,000	$30,525,000	$1,183,000	$29,575,500	$1,201,000	$30,025,000	$72,870	$1,821,750
Cost of Modification (dollars)	NA	NA	NA	$10,000	NA	$30,000 to $50,000	NA	$300,000
Cost per Ton CO_2e Reduced (dollars)	NA	NA	$1,351.00	$54.00	$54,347.00	$2,173.90	$508,474	$20,338
Land & Ecosystems								
Community Benefits (qualitative)	NA	NA	Reduction in hazardous waste produced.		Reduction in fugitive methane emitted. Would operate beyond lifespan of the extraction system as methane generation will be an ongoing problem at this site.		Generation of renewable power will offset energy usage at the site. Power can still be generated and fed back to the grid after site is closed.	
Materials & Waste Generation								
Reduced Filter Cake Generation (pounds)	NA	NA	42,280	1,057,000	NA	NA	NA	NA

[1] Metrics may be either qualitative not applicable (NA) or quantitative based on available information and scope of project.

[2] Metrics may be added or deleted based on site specific conditions.

[3] Baseline: As the system is currently being operated.

* Assume upper limit costs are used for cost per ton CO_2e reduced.

APPENDIX A

CARBON FOOTPRINT ANALYSIS

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Carbon Footprint Calculations   Baseline Calculation

Penta Wood Products
8682 State Road 70
Siren, WI 54872

Scope 1

					Emission Factors			Mass			CO_2e Greenhouse Gas Potentials 1	25	310	Total		
Gaseous Fuels Burned On-Site	Year	Usage (gallons/yr)	Heat Content (mmBtu/barrel)	Usage (TJ/yr)	kg CO_2/TJ	kg CH_4/TJ	kg N_2O/TJ	kg CO_2	kg CH_4	kg N_2O	kg CO_2e/kg CO_2	kg CO2e/kg CH_4	kg CO2e/kg N_2O	kg CO2e	lb CO2e	ton CO2e
Propane	2008	21,270.2	3.849	2.057	79,600	10	0.6	163,704.43	20.57	1.23	163,704.43	514.15	382.53	164,601.10	362,877.20	181.44
		See Note 1	*See Note 4*		*See Note 2*	*See Note 2*	*See Note 2*									

Scope 2

				Emission Factors			Mass			CO_2e Greenhouse Gas Potentials 1	25	310	Total		
Purchased Electricity	Year	Usage (kWh)	Usage (GWh)	lb CO_2/GWh	lb CH_4/GWh	lb N_2O/GWh	lb CO_2	lb CH_4	lb N_2O	lb CO_2e/lb CO_2	lb CO_2e/lb CH_4	lb CO_2e/lb N_2O	kg CO_2e	lb CO_2e	ton CO_2e
	2008	456,126	0.456126	1.74	27.46	27.55	0.79	12.53	12.57	0.79	313.13	3895.54	1,909.41	4,209.47	2.10
		See Note 1		*See Note 3*	*See Note 3*	*See Note 3*									

Scope 3

										CO_2e Greenhouse Gas Potentials 1	25	310			
Sampling/O&M/ Vehicle Usage/Waste Disposal	Year	Usage (miles/yr)	Usage (gal/yr)	kg CO_2/gallon	kg CH_4/gallon	kg N_2O/gallon	kg CO_2	kg CH_4	kg N_2O	kg CO_2e/kg CO_2	kg CO2e/kg CH_4	kg CO2e/kg N_2O	kg CO_2e	lb CO_2e	ton CO_2e
Unleaded Gasoline- Sampling	2008	1,200	66.67	8.81	0.0036	0.0004	587.33	0.24	0.03	587.33	6.07	8.18	601.59	1,326.50	0.66
Unleaded Gasoline- O&M	2008	6,240	346.67	8.81	0.0036	0.0004	3,054.13	1.26	0.14	3054.13	31.57	42.56	3,128.26	6,897.82	3.45
Diesel - Fuel Hauling	2008	3,600	450	10.15	0.000041	0.000038	4,567.50	0.02	0.02	4567.50	0.46	5.36	4,573.32	10,084.16	5.04
Diesel-Filter Cake	2008	10,500	1313	10.15	0.000041	0.000038	13,321.88	0.05	0.05	13321.88	1.34	15.62	13,338.84	29,412.14	14.71
Diesel-Carbon Disposal	2008	6,000	750	10.15	0.000041	0.000038	7,612.50	0.03	0.03	7612.50	0.77	8.93	7,622.19	16,806.94	8.40
Fuel Oil No 2 Incineration	2008		3760	22.383			84,160.08			84160.08			84,160.08	185,572.98	92.79
			Generation(pounds/yr)	kg CO_2/pound											
Filter Cake Incineration	2008		211400	0.113			23,888.20			23888.20			23,888.20	52,673.48	26.34
Pentachlorophenol Incineration in Oil	2009		492	10.9			5,362.80			5362.80			5,362.80	11,824.97	5.91
Pentachlorophenol Incineration on Oil	2009		986	10.9			10,747.40			10747.40			10,747.40	23,698.02	11.85
Carbon Disposal Incineration	2009		69515	1.7			118,175.50			118175.50			118,175.50	260,576.98	130.29
											See Note 3	*See Note 3*			

Totals		
kg CO_2e	lb CO_2e	ton CO_2e
438,108.69	965,960.66	482.98

Note

Conversions: *1 barrel = 42 gallons*
1 MMBTU = 0.00105506 TJ
1,000 kWh = 1.0E+6 GWh
1 gallon No. 2 Fuel oil = 7.2 lbs

Source Notes: *1. Utility usage reported by NSP.*
(Intergovem
3. EPA (Environmental Protection Agency) eGRIDweb Parent Company Owner-based Level Emissions Profile- Xcel Energy Inc. Pollutant Output Emission Rates, 2005.
4. EPA (Environmental Protection Agency) Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobil Combustion Sources, Appendix B, Table B-3: Factors for Calculating CO_2 Emissions for LPG Use.

Notes and Assumptions: *1. A twenty mile round trip to the site for the operator 6 times per week 52 weeks a year.*
2. A sampling crew will be mobilized from Milwaukee twice per year to conduct monitoring well sampling.
3. All hazardous waste (Oil, filter cake and expended GAC) is hauled to Grafton Ohio for incineration at 1500 miles per round trip.
4. Based on a stoichiometrical relationship 1 pound of GAC produces 1.7 kg of CO_2 when combusted assuming complete combustion.
5. The combustion of 1 metric tonne of Diatomaceous Earth emits 250 kg (0.113 kg/pound) of CO_2 including the energy used to combust the material.
6. Based on a stoichiometrical relationship 1 pound of Pentachlorophenol produces 24 pounds or 10.9 kg of CO_2 when combusted assuming complete combustion.
7. Weight of dissolved phase pentachlorophenol was subtracted from GAC disposal weight.
8. Weight of pentachlorophenol dissolved in oil was subtracted from weight of the No. 2 Fuel oil that was disposed.
9. Fuel Oil No. 2 emits 22.83 kg of CO2 per gallon when fully combusted per US Energy Information Administration.

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Carbon Footprint Calculations Option 1, Rerouting 20 Percent of Groundwater Around DAF Unit

Penta Wood Products
8682 State Road 70
Siren, WI 54872

Scope 1

Gaseous Fuels Burned On-Site	Year	Usage (gallons/yr)	Heat Content (mmBtu/barrel)	Usage (TJ/yr)	Emission Factors: kg CO_2/TJ	kg CH_4/TJ	kg N_2O/TJ	Mass: kg CO_2	kg CH_4	kg N_2O	CO_2e Greenhouse Gas Potentials: 1 — kg CO_2e/kg CO_2	25 — kg CO2e/kg CH_4	310 — kg CO2e/kg N_2O	Total: kg CO2e	lb CO2e	ton CO2e
Propane	2008	21,270.2	3.849	2.057	79,600	10	0.6	163,704.43	20.57	1.23	163,704.43	514.15	382.53	164,601.10	362,877.20	181.44
		See Note 1	See Note 4		See Note 2	See Note 2	See Note 2									

Scope 2

Purchased Electricity	Year	Usage (kWh)	Usage (GWh)	Emission Factors: lb CO_2/GWh	lb CH_4/GWh	lb N_2O/GWh	Mass: lb CO_2	lb CH_4	lb N_2O	CO_2e Greenhouse Gas Potentials: 1 — lb CO_2e/lb CO_2	25 — lb CO_2e/lb CH_4	310 — lb CO_2e/lb N_2O	Total: kg CO_2e	lb CO_2e	ton CO_2e
	2008	456,165	0.456165	1.74	27.46	27.55	0.79	12.53	12.57	0.79	313.16	3,895.88	1,909.58	4,209.83	2.10
		See Note 1		See Note 3	See Note 3	See Note 3									

Scope 3

Sampling/O&M/ Vehicle Usage/Waste Disposal	Year	Usage (miles/yr)	Usage (gal/yr)	kg CO_2/gallon	kg CH_4/gallon	kg N_2O/gallon	kg CO_2	kg CH_4	kg N_2O	CO_2e Greenhouse Gas Potentials: 1 — kg CO_2e/kg CO_2	25 — kg CO2e/kg CH_4	310 — kg CO2e/kg N_2O	kg CO_2e	lb CO_2e	ton CO_2e
Unleaded Gasoline- Sampling	2008	1,200	66.67	8.81	0.0036	0.0004	587.33	0.24	0.03	587.33	6.07	8.18	601.59	1,326.50	0.66
Unleaded Gasoline- O&M	2008	6,240	346.67	8.81	0.0036	0.0004	3,054.13	1.26	0.14	3,054.13	31.57	42.56	3,128.26	6,897.82	3.45
Diesel - Fuel Hauling	2008	3,600	450.00	10.15	0.000041	0.000038	4,567.50	0.02	0.02	4,567.50	0.46	5.36	4,573.32	10,084.16	5.04
Diesel-Filter Cake	2008	9,000	1,125.00	10.15	0.000041	0.000038	11,418.75	0.05	0.04	11,418.75	1.15	13.39	11,433.29	25,210.40	12.61
Diesel-Carbon Disposal	2008	6,000	750.00	10.15	0.000041	0.000038	7,612.50	0.03	0.03	7,612.50	0.77	8.93	7,622.19	16,806.94	8.40
Fuel Oil No 2 Incineration	2008		3,760.00	22.383			84,160.08			84,160.08			84,160.08	185,572.98	92.79
			Generation(pounds/yr)	kg CO_2/pound											
Filter Cake Incineration	2008		169,120.00	0.113			19,110.56			19,110.56			19,110.56	42,138.78	21.07
Pentachlorophenol Incineration in Oil	2009		492.00	10.9			5,362.80			5,362.80			5,362.80	11,824.97	5.91
Pentachlorophenol Incineration on Oil	2009		986.00	10.9			10,747.40			10,747.40			10,747.40	23,698.02	11.85
Carbon Disposal Incineration	2009		69,515.00	1.7			118,175.50			118,175.50			118,175.50	260,576.98	130.29
											See Note 3	See Note 3			

Totals: kg CO_2e	lb CO_2e	ton CO_2e
431,425.67	951,224.59	475.61

Note

Conversions: 1 barrel = 42 gallons
1 MMBTU = 0.00105506 TJ
1,000 kWh = 1.0E+6 GWh
1 gallon No. 2 Fuel oil = 7.2 lbs

Source Notes: 1. Utility usage reported by NSP.
(Intergovern
3. EPA (Environmental Protection Agency) eGRIDweb Parent Company Owner-based Level Emissions Profile- Xcel Energy Inc. Pollutant Output Emission Rates, 2005.
4. EPA (Environmental Protection Agency) Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobil Combustion Sources, Appendix B, Table B-3: Factors for Calculating CO_2 Emissions for LPG Use.

Notes and Assumptions: 1. A twenty mile round trip to the site for the operator 6 times per week 52 weeks a year.
2. A sampling crew will be mobilized from Milwaukee twice per year to conduct monitoring well sampling.
3. All hazardous waste (Oil, filter cake and expended GAC) is hauled to Grafton Ohio for incineration at 1500 miles per round trip.
4. Based on a stoichiometrical relationship 1 pound of GAC produces 1.7 kg of CO_2 when combusted assuming complete combustion.
5. The combustion of 1 metric tonne of Diatomaceous Earth emits 250 kg (0.113 kg/pound) of CO_2 including the energy used to combust the material.
6. Based on a stoichiometrical relationship 1 pound of Pentachlorophenol produces 24 pounds or 10.9 kg of CO_2 when combusted assuming complete combustion.
7. Weight of dissolved phase pentachlorophenol was subtracted from GAC disposal weight.
8. Weight of pentachlorophenol dissolved in oil was subtracted from weight of the No. 2 Fuel oil that was disposed.
9. Fuel Oil No. 2 emits 22.83 kg of CO2 per gallon when fully combusted per US Energy Information Administration.

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Carbon Footprint Calculations — Option 2, Installing Passive Venting in CAMU Area

Penta Wood Products
8682 State Road 70
Siren, WI 54872

Scope 1

Gaseous Fuels Burned On-Site	Year	Usage (gallons/yr)	Heat Content (mmBtu/barrel)	Usage (TJ/yr)	Emission Factors: kg CO_2/TJ	Emission Factors: kg CH_4/TJ	Emission Factors: kg N_2O/TJ	Mass: kg CO_2	Mass: kg CH_4	Mass: kg N_2O	CO_2e Greenhouse Gas Potentials 1: kg CO_2e/kg CO_2	25: kg CO2e/kg CH_4	310: kg CO2e/kg N_2O	Total: kg CO2e	Total: lb CO2e	Total: ton CO2e
Propane	2008	21,270.2	3.849	2.057	79,600	10	0.6	163,704.43	20.57	1.23	163,704.43	514.15	382.53	164,601.10	362,877.20	181.44
		See Note 1	*See Note 4*		*See Note 2*	*See Note 2*	*See Note 2*									

Scope 2

Purchased Electricity	Year	Usage (kWh)	Usage (GWh)	Emission Factors: lb CO_2/GWh	Emission Factors: lb CH_4/GWh	Emission Factors: lb N_2O/GWh	Mass: lb CO_2	Mass: lb CH_4	Mass: lb N_2O	CO_2e Greenhouse Gas Potentials 1: lb CO_2e/lb CO_2	25: lb CO_2e/lb CH_4	310: lb CO_2e/lb N_2O	Total: kg CO_2e	Total: lb CO_2e	Total: ton CO_2e
	2008	256,126	0.256126	1.74	27.46	27.55	0.45	7.03	7.06	0.45	175.83	2187.44	1,072.18	2,363.72	1.18
		See Note 1		*See Note 3*	*See Note 3*	*See Note 3*									

Scope 3

Sampling/O&M/ Vehicle Usage/Waste Disposal	Year	Usage (miles/yr)	Usage (gal/yr)	kg CO_2/gallon	kg CH_4/gallon	kg N_2O/gallon	kg CO_2	kg CH_4	kg N_2O	CO_2e Greenhouse Gas Potentials 1: kg CO_2e/kg CO_2	25: kg CO2e/kg CH_4	310: kg CO2e/kg N_2O	kg CO_2e	lb CO_2e	ton CO_2e
Unleaded Gasoline- Sampling	2008	1,200	66.67	8.81	0.0036	0.0004	587.33	0.24	0.03	587.33	6.07	8.18	601.59	1,326.50	0.66
Unleaded Gasoline- O&M	2008	6,240	346.67	8.81	0.0036	0.0004	3,054.13	1.26	0.14	3054.13	31.57	42.56	3,128.26	6,897.82	3.45
Diesel - Fuel Hauling	2008	3,600	450	10.15	0.000041	0.000038	4,567.50	0.02	0.02	4567.50	0.46	5.36	4,573.32	10,084.16	5.04
Diesel-Filter Cake	2008	10,500	1313	10.15	0.000041	0.000038	13,321.88	0.05	0.05	13321.88	1.34	15.62	13,338.84	29,412.14	14.71
Diesel-Carbon Disposal	2008	6,000	750	10.15	0.000041	0.000038	7,612.50	0.03	0.03	7612.50	0.77	8.93	7,622.19	16,806.94	8.40
Fuel Oil No 2 Incineration	2008		3760	22.383			84,160.08			84160.08			84,160.08	185,572.98	92.79
			Generation(pounds/yr)	kg CO_2/pound											
Filter Cake Incineration	2008		211400	0.113			23,888.20			23888.20			23,888.20	52,673.48	26.34
Pentachlorophenol Incineration in Oil	2009		492	10.9			5,362.80			5362.80			5,362.80	11,824.97	5.91
Pentachlorophenol Incineration on Oil	2009		986	10.9			10,747.40			10747.40			10,747.40	23,698.02	11.85
Carbon Disposal Incineration	2009		69515	1.7			118,175.50			118175.50			118,175.50	260,576.98	130.29
		--	--	--	--	--	--		--	--	0	--	0.00	0.00	0.00
											See Note 3	*See Note 3*			

Totals: kg CO_2e	Totals: lb CO_2e	Totals: ton CO_2e
437,271.46	964,114.91	482.06

Note

Conversions:
1 barrel = 42 gallons
1 MMBTU = 0.00105506 TJ
1,000 kWh = 1.0E+6 GWh
1 gallon No. 2 Fuel oil = 7.2 lbs

Source Notes:
1. *Utility usage reported by NSP.*
(Intergovern
3. *EPA (Environmental Protection Agency) eGRIDweb Parent Company Owner-based Level Emissions Profile- Xcel Energy Inc. Pollutant Output Emission Rates, 2005.*
4. *EPA (Environmental Protection Agency) Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobil Combustion Sources, Appendix B, Table B-3: Factors for Calculating CO_2 Emissions for LPG Use.*

Notes and Assumptions:
1. *A twenty mile round trip to the site for the operator 6 times per week 52 weeks a year.*
2. *A sampling crew will be mobilized from Milwaukee twice per year to conduct monitoring well sampling.*
3. *All hazardous waste (Oil, filter cake and expended GAC) is hauled to Grafton Ohio for incineration at 1500 miles per round trip.*
4. *Based on a stoichiometrical relationship 1 pound of GAC produces 1.7 kg of CO_2 when combusted assuming complete combustion.*
5. *The combustion of 1 metric tonne of Diatomaceous Earth emits 250 kg (0.113 kg/pound) of CO_2 including the energy used to combust the material.*
6. *Based on a stoichiometrical relationship 1 pound of Pentachlorophenol produces 24 pounds or 10.9 kg of CO_2 when combusted assuming complete combustion.*
7. *Weight of dissolved phase pentachlorophenol was subtracted from GAC disposal weight.*
8. *Weight of pentachlorophenol dissolved in oil was subtracted from weight of the No. 2 Fuel oil that was disposed.*
9. *Fuel Oil No. 2 emits 22.83 kg of CO2 per gallon when fully combusted per US Energy Information Administration.*

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Carbon Footprint Calculations   Option 3, Installation of Wind Power to Offset Energy Usage

Penta Wood Products
8682 State Road 70
Siren, WI 54872

Scope 1

					Emission Factors			Mass			CO_2e Greenhouse Gas Potentials			Total		
											1	25	310			
Gaseous Fuels Burned On-Site	Year	Usage (gallons/yr)	Heat Content (mmBtu/barrel)	Usage (TJ/yr)	kg CO_2/TJ	kg CH_4/TJ	kg N_2O/TJ	kg CO_2	kg CH_4	kg N_2O	kg CO_2e/kg CO_2	kg CO2e/kg CH_4	kg CO2e/kg N_2O	kg CO2e	lb CO2e	ton CO2e
Propane	2008	21,270.2	3.849	2.057	79,600	10	0.6	163,704.43	20.57	1.23	163,704.43	514.15	382.53	164,601.10	362,877.20	181.44
		See Note 1	*See Note 4*		*See Note 2*	*See Note 2*	*See Note 2*									

Scope 2

				Emission Factors			Mass			CO_2e Greenhouse Gas Potentials			Total		
										1	25	310			
Purchased Electricity	Year	Usage (kWh)	Usage (GWh)	lb CO_2/GWh	lb CH_4/GWh	lb N_2O/GWh	lb CO_2	lb CH_4	lb N_2O	lb CO_2e/lb CO_2	lb CO_2e/lb CH_4	lb CO_2e/lb N_2O	kg CO_2e	lb CO_2e	ton CO_2e
	2008	306,126	0.306126	1.74	27.46	27.55	0.53	8.41	8.43	0.53	210.16	2614.47	1,281.49	2,825.16	1.41
		See Note 1		*See Note 3*	*See Note 3*	*See Note 3*									

Scope 3

										CO_2e Greenhouse Gas Potentials					
										1	25	310			
Sampling/O&M/ Vehicle Usage/Waste Disposal	Year	Usage (miles/yr)	Usage (gal/yr)	kg CO_2/gallon	kg CH_4/gallon	kg N_2O/gallon	kg CO_2	kg CH_4	kg N_2O	kg CO_2e/kg CO_2	kg CO2e/kg CH_4	kg CO2e/kg N_2O	kg CO_2e	lb CO_2e	ton CO_2e
Unleaded Gasoline- Sampling	2008	1,200	66.67	8.81	0.0036	0.0004	587.33	0.24	0.03	587.33	6.07	8.18	601.59	1,326.50	0.66
Unleaded Gasoline- O&M	2008	6,240	346.67	8.81	0.0036	0.0004	3,054.13	1.26	0.14	3054.13	31.57	42.56	3,128.26	6,897.82	3.45
Diesel - Fuel Hauling	2008	3,600	450	10.15	0.000041	0.000038	4,567.50	0.02	0.02	4567.50	0.46	5.36	4,573.32	10,084.16	5.04
Diesel-Filter Cake	2008	10,500	1313	10.15	0.000041	0.000038	13,321.88	0.05	0.05	13321.88	1.34	15.62	13,338.84	29,412.14	14.71
Diesel-Carbon Disposal	2008	6,000	750	10.15	0.000041	0.000038	7,612.50	0.03	0.03	7612.50	0.77	8.93	7,622.19	16,806.94	8.40
Fuel Oil No 2 Incineration	2008		3760	22.383			84,160.08			84160.08			84,160.08	185,572.98	92.79
			Generation(pounds/yr)	kg CO_2/pound											
Filter Cake Incineration	2008		211400	0.113			23,888.20			23888.20			23,888.20	52,673.48	26.34
Pentachlorophenol Incineration in Oil	2009		492	10.9			5,362.80			5362.80			5,362.80	11,824.97	5.91
Pentachlorophenol Incineration on Oil	2009		986	10.9			10,747.40			10747.40			10,747.40	23,698.02	11.85
Carbon Disposal Incineration	2009		69515	1.7			118,175.50			118175.50			118,175.50	260,576.98	130.29
		--	--	--	--	--	--		--	--	0	--	0.00	0.00	0.00
											See Note 3	See Note 3			

Totals		
kg CO_2e	lb CO_2e	ton CO_2e
437,480.77	964,576.35	482.29

Note

Conversions: 1 barrel = 42 gallons
1 MMBTU = 0.00105506 TJ
1,000 kWh = 1.0E+6 GWh
1 gallon No. 2 Fuel oil = 7.2 lbs

Source Notes: 1. Utility usage reported by NSP.
(Intergovern
3. EPA (Environmental Protection Agency) eGRIDweb Parent Company Owner-based Level Emissions Profile- Xcel Energy Inc. Pollutant Output Emission Rates, 2005.
4. EPA (Environmental Protection Agency) Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance, Direct Emissions from Mobil Combustion Sources, Appendix B, Table B-3: Factors for Calculating CO_2 Emissions for LPG Use.

Notes and Assumptions: 1. A twenty mile round trip to the site for the operator 6 times per week 52 weeks a year.
2. A sampling crew will be mobilized from Milwaukee twice per year to conduct monitoring well sampling.
3. All hazardous waste (Oil, filter cake and expended GAC) is hauled to Grafton Ohio for incineration at 1500 miles per round trip.
4. Based on a stoichiometrical relationship 1 pound of GAC produces 1.7 kg of CO_2 when combusted assuming complete combustion.
5. The combustion of 1 metric tonne of Diatomaceous Earth emits 250 kg (0.113 kg/pound) of CO_2 including the energy used to combust the material.
6. Based on a stoichiometrical relationship 1 pound of Pentachlorophenol produces 24 pounds or 10.9 kg of CO_2 when combusted assuming complete combustion.
7. Weight of dissolved phase pentachlorophenol was subtracted from GAC disposal weight.
8. Weight of pentachlorophenol dissolved in oil was subtracted from weight of the No. 2 Fuel oil that was disposed.
9. Fuel Oil No. 2 emits 22.83 kg of CO2 per gallon when fully combusted per US Energy Information Administration.