State of Montana
Department of Environmental Quality

Draft Environmental Impact Statement for the Holcim (US) Inc., Tire Burning Proposal

July 2006

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EXECUTIVE SUMMARY

Introduction

Holcim (US) Inc. (Holcim) has proposed to burn whole tires as fuel in its portland cement kiln at Trident, MT, and has applied for a modification to its air quality permit to allow tire burning and for a solid waste license to store tires on its property. The Trident plant is in Gallatin County near the Missouri Headwaters, approximately five miles northeast of Three Forks, MT (Figure ES-1).

The Department of Environmental Quality (DEQ) prepared a draft environmental impact statement (DEIS) to explain the proposal, the possible consequences of the proposal, and the information and decisions involved in addressing the permits Holcim needs to use tires as fuel.

The executive summary provides an overview of the DEIS. Some aspects of the DEIS, such as the discussions of property values and the human health and ecological risk assessments, are involved. Members of the public expressed an interest in these issues, so DEQ took special care to explain them. A list of acronyms has been included to assist readers, along with the names of DEQ persons who helped prepare the DEIS.
Holcim's current air quality permit authorizes combustion of up to 100 percent natural gas, 100 percent coal, 100 percent petroleum coke, or any combination of these fuels. Holcim's primary objective for seeking a modification of its existing air quality permit is to realize reductions in fuel and operating costs. The mid-kiln combustion of tires would supplement up to 15 percent of the required fuel for Holcim's kiln.

Holcim submitted an application to modify its air quality permit on October 3, 2001. Between October 2001 and March 2003, DEQ conducted reviews and requested supplemental information and clarifications from Holcim. On March 24, 2003, DEQ issued a Preliminary Determination for the modification to the air quality permit and an Environmental Assessment (EA) pursuant to the Montana Environmental Policy Act (MEPA). A public hearing was held in Manhattan, MT, on April 29, 2003. Numerous comments were received during the public comment period (March 24 through May 30, 2003). DEQ considered these comments and issued a revised EA on August 15, 2003. This EIS was prepared to comply with DEQ's determination that an EIS was required and with MEPA.

An application to incinerate tires requires DEQ to determine whether the projected emissions and ambient concentrations from the proposed fuel would constitute no more than a negligible risk to the public health, safety, and welfare, and to the environment. If DEQ determines that Holcim's applications meet the requirements of the Montana's laws and regulations, the solid waste license will be issued and the air quality permit will be modified. Conditions may be applied to reduce or eliminate environmental impacts.

Interested persons should keep in mind that until Holcim can do a "test burn," the DEQ is relying on technical information, engineering specifications, and information from other cement plants that are currently burning tires to project what the emissions will be. This information has proven to be reliable in the past.

For Holcim to do a test burn, it needs to modify its current Montana air quality permit. That is one of the major issues the DEIS addresses. Holcim submitted scientific and technical information to comply with the Clean Air Act of Montana. If DEQ decides the information demonstrates that Holcim can be expected to operate in compliance with air quality requirements, Holcim's permit will be modified. Holcim could then do a test burn to determine if the actual emissions from using tires as a fuel meet the requirements of the permit.

Purpose and Benefits

The primary purposes for burning tires are to lower operating costs and to increase operational flexibility. Holcim would be able to use different fuels or combinations of fuels.

Issues Identified During Scoping

The issues and concerns raised during public scoping are cumulative effects, particularly when considered with Holcim's use of smelter slag as an iron source in its kiln, alternatives, air emissions and dispersion modeling, public health, ecological risk, solid waste, and socioeconomics. Table ES-1 contains more detailed lists of issues.

Alternatives

DEQ considered several alternatives in the EIS.

Alternatives Considered and Eliminated

These alternatives were eliminated from further consideration because they did not meet the stated purpose and benefits of the Proposed Action, or were found to be unreasonable based on technical, logistical, and regulatory considerations, economics, potential resource impacts, and feasibility:

- Alternative fuels, such as municipal wastes;
- Conversion from wet to dry kiln;
- Alternative emission control technologies;
- Off-site tire storage; and
- Reduction in the percent of tires used.

No Action Alternative

Under the No Action Alternative, the tire storage facility and the conveyor system to the kiln would not be constructed. DEQ would not issue the solid waste license and would not modify the air quality permit.

Selected Alternative

The rules implementing MEPA (ARM 17.4.617) require that DEQ indicate a preferred alternative, if one has been identified. Stating a preference at this time is not a final decision. The preferred alternative could change in response to public comment on the Draft EIS, new information that becomes available, or new analysis that might be needed in preparing the Final EIS. At this time, DEQ does not have a preferred alternative. DEQ has tentatively selected the Proposed Action, which would be modified by permit conditions.

Rationale

Holcim has demonstrated compliance with all applicable statutes and rules, as required for permit issuance. Conditions and limitations contained in the permit ensure the facility can operate in compliance with all applicable rules and regulations. Slag use will be limited to no more than 15,000 metric tons (16,535 tons) in a "rolling" 12-month time period (a continuous 12-month period), and DEQ will encourage Holcim to find other sources of iron.

Therefore, the No Action Alternative would not be appropriate and would not provide the cost savings that is the goal of the Proposed Action.

Affected Environment

In 2000, the unincorporated portion of the Gallatin County had the most residents (31,470 people), with Bozeman having the next largest population. Forecasts for the county show its population will continue to increase for the next 30 years.

Gallatin County's services industry contained the most employees in both 2000 and in 1990 and also had the largest increase in employment during the decade. The largest concentrations of employment in that sector were in health, business, and legal services. Retail trade was the second largest industry. The manufacturing of talc and cement are the main industries in Three Forks.

Monitoring of groundwater around the Trident plant has been conducted semi-annually since 1992. Monitoring shows no trends in water quality for that period.

Existing air quality in Gallatin County is classified as attainment or in compliance with national or state standards (National Ambient Air Quality Standards [NAAQS] and Montana Ambient Air Quality Standards [MAAQS]). PM_{10} (particulate matter with an aerodynamic diameter of 10 microns or less) is a problematic pollutant for many parts of Montana, including the Gallatin Valley. PM_{10} comes from industrial sources, agricultural activities, forest fires, mining, road dust, and residential wood smoke. The PM_{10} areas of most concern in Gallatin County are Bozeman and Belgrade.

Several common wildlife species occur in the vicinity of the Trident facility, including bald eagle, cottontail rabbit, great blue heron, red fox, and red-tailed hawk. Special status species occurring within 10 km of the cement plant or having protection under the Endangered Species Act (ESA) include bald eagle (Threatened) and lynx (Threatened). Great blue heron rookeries are found just south of the Trident plant on the Gallatin and Jefferson rivers. No special status fish are documented. The State Historic Preservation Office records indicate that there are no recorded historic or archeological sites within the project site.
Seven certified organic producers were identified within the study area. An organic Community Supported Agriculture (CSA) fruit and vegetable farm was also identified in the study area.

Interstate 90, a principal arterial, is the primary east-west highway and provides access to Bozeman and Billings to the east, and Butte and Missoula to the west; it passes approximately

four miles south of the plant. Secondary Highways S-205 and S-286 are classified as major collector roads by the Montana Department of Transportation.

Impacts of the Selected Alternative

Potential impacts to the following resource areas were identified and are summarized in Table ES-2.

Air Quality

Holcim's air quality permit application included a demonstration of compliance with the applicable MAAQS and NAAQS for the criteria pollutants. Criteria pollutants would remain approximately the same, except that carbon monoxide would increase, but would still comply with MAAQS and NAAQS.

Modeling of hazardous air pollutants (HAP) indicates that annual average impacts would be highest at the boundary of the facility and then decrease. Some HAP emissions from the kiln, such as mercury, would increase, while others would remain approximately the same. Most kiln dust HAPs emissions would decrease.

Human Health Risk Assessment

Metals, and to a lesser degree, organic constituents, are predicted to accumulate in soils as a result of continued long-term emissions. Polycyclic aromatic hydrocarbon (PAH) levels are expected to approach the detection limit within 10 years, but reach a dynamic equilibrium and not increase in concentration with future emissions.

Acute and chronic exposure and hazards are below levels of concern. Lead exposures from emissions under baseline and cumulative conditions are below background levels. Cancer risk varies for the different scenarios evaluated. The highest risk is for a subsistence lifestyle scenario (persons who grow food on their property) at the facility property boundary. The most important exposure pathways would be mother's milk and beef ingestion. The lowest risks are for residents in Three Forks, Manhattan, and Belgrade who obtain their food from supermarkets.

There would be low risks from the consumption of fish from local rivers. Risk from eating fish from lakes and ponds, is strongly affected by assumptions regarding the location and configuration of water bodies. Risks from consumption of locally hunted big game are also low.

Risks for most residents are "negligible." In the analysis of individual chemicals, at the worst-case location, the risk from dioxin for the baseline condition and cumulative condition at both the average and high-end exposure levels is negligible.

Ecological Risk Assessment

The ecological risk assessment (ERA) found that 1) under either the No Action or Proposed Action alternative, air emissions from the Trident facility may pose a potential ecological hazard to some species at the point of maximum air concentrations; 2) any ecological risks would be restricted to small areas and would not have a significant impact on the overall ecological health

of the broader region surrounding the Trident facility; and 3) there is very little difference in ecological risk between the two alternatives.

Concentrations of chemicals of potential concern (COPC) in streams and lakes (including reservoirs, ponds, and wetlands) would be within Montana surface water quality standards and are therefore unlikely to pose any danger to aquatic life in streams even at the study area boundary where concentrations would be highest.
Estimated COPC concentrations in soils for the broader area surrounding the facility do not exceed any screening-level criteria for soils.

Land Use

Land uses in the local area would continue to be farming, ranching, and livestock grazing. The proposed use of tires would occur within a previously disturbed mining/industrial cement manufacturing facility.

The project would not result in a loss of recreational opportunities to the public. Recreational opportunities would continue on land in the vicinity of the plant, along the Missouri River, and within the Missouri Headwaters State Park.

Socioeconomics

Additional equipment would generate $14,200 in real property tax, which represents a 4 percent increase in Holcim's 2004 tax bill. About three-fourths of that tax (about $10,720) would go to Gallatin County, with the balance of that tax (about $3,480) going to the State of Montana.

There are four privately operated tire-only landfills in the State of Montana. The impact of Holcim using waste tires as fuel cannot be determined until Holcim secures a contract with a scrap tire supply source. The impact of the proposed project on existing tire-only landfills would depend on the source of scrap tires.

Holcim, or its tire contractor, could acquire scrap tires within Montana in two ways. The first would be from the existing tire-only landfills, and the impact on those landfill operations would be minimal. Secondly, Holcim, or its tire contractor, could compete for tires with the tire-only landfills. The impact of that competition would be significant. Acquiring scrap tires in state would have a direct adverse impact on revenue generated at the four facilities with secondary impacts on employment and wages at the tire-only landfills as well as property taxes attributable to those landfills.

Property Values

Property values appear resilient, particularly when there is sustained population growth. The value of large parcels in agricultural use is more likely to be affected by production and transaction factors (like availability of water and the costs of mortgage financing) than subtle changes in air quality. Property values in rural areas would be most affected by local employment opportunities.

Rural land values in the Gallatin Valley have appreciated. Land value within a 10-km radius of the Holcim/Trident plant might be lower, but not because of any influence by the plant, but because of poor soils or lack of water.

The evaluation and analysis also found that there is no empirical evidence to support concerns that property values would be adversely affected by the proposed change in the fuel mix at the Holcim/Trident cement plant.

Cumulative Impacts

Cumulative impacts result from the incremental impact of the Proposed Action when added to other past and present actions, and future actions under state review. Holcim has been using ASARCO smelter slag in its kiln as an iron source for the cement. Slag emissions were included in the analysis for the human health risk assessment and the ecological risk assessment.

Compliance with Air Quality Standards

The addition of tires to the kiln fuel mix is expected to cause an increase in carbon monoxide (CO) emissions, while emissions of the other criteria pollutants would remain the same or decrease. The CO emissions would still comply with MAAQS and NAAQS.

Cumulative Impacts for Risk Assessment

Some HAP emissions would increase while others would decrease or remain about the same.

Human Health Effects

- **Acute (short-term) Noncarcinogenic Hazards -** The quantitative assessment of acute hazards indicated no known risk from acute exposure to ground-level air concentrations. These results were applicable to both the general population and facility workers.

- **Chronic (long-term) Noncarcinogenic Hazards -** The hazard indices for both the average and high-end exposures were below the amount considered as not acceptable, indicating no expected hazard from chronic exposure.

- **Blood-Lead Levels -** The predicted blood-lead levels in children due to exposures to lead are below the standard used by EPA.

- **Carcinogenic Risks -** The change in risk at the facility property boundary (the worst-case location), which represents the aggregate of all pollutants, is at Montana's "negligible risk level."

Land Use

NorthWestern Energy is building a 161-kV transmission line from the Three Rivers Substation, north of Three Forks, to the Jackrabbit Substation, west of Bozeman and south of Belgrade. Additional industrial projects were not identified in the vicinity of the plant site.

Transportation

The Proposed Action would increase traffic and vehicle-related air emissions in the plant area. Traffic could also increase in the area as a result of transporting livestock to a proposed concentrated animal feeding operation. Because the Missouri Headwaters State Park is located near the facility, seasonal traffic volume variations would be expected in the area due to park visitors. Visitation to the park has also increased in the last few years and is expected to further increase as a result of the Lewis and Clark Expedition Bicentennial. Cumulative impacts in the area would occur as a result of increased traffic associated with the Proposed Action in conjunction with increases in traffic associated with the Lewis and Clark Expedition Bicentennial.

Water, Soil, and Wildlife

Prior to the mid-1970s, the drainage and destruction of wetlands were accepted practices in the United States and were even encouraged by specific government policies. Past and present activities include Holcim and its predecessors operating a portland cement plant at the current location for nearly 100 years. In addition, a century or more of agricultural and mining activities have affected water quality and water use in the area, as well as soils.

The ERA found that COPC concentrations in soils and water, following 100 years accumulation from Holcim's emissions, would exceed, or be within an order of magnitude, of toxicity reference values (TRVs) for several representative species or food groups of species. Continued emissions of these COPCs would increase impact levels associated with Holcim emissions.

The project would not destroy or degrade any wildlife habitat nor directly result in any mortality of individual animals. Indirectly, increased traffic would pose a danger for wildlife crossing highways. This includes both game and non-game species. This is not likely to have a substantial effect on local populations. There are no other existing facilities or anticipated projects in the vicinity that would contribute to potential effects associated with COPC deposition.

Conclusions

With the proposed permit limits on the number of tires that can be burned and the amount of slag that can be added to the kiln, carbon monoxide emissions will increase slightly and the other criteria pollutant emissions will be unchanged or will decrease. HAP emissions will also be controlled. Under these limits, the total risks from burning tires and adding slag are essentially identical to the risks associated with the present operation without tires.

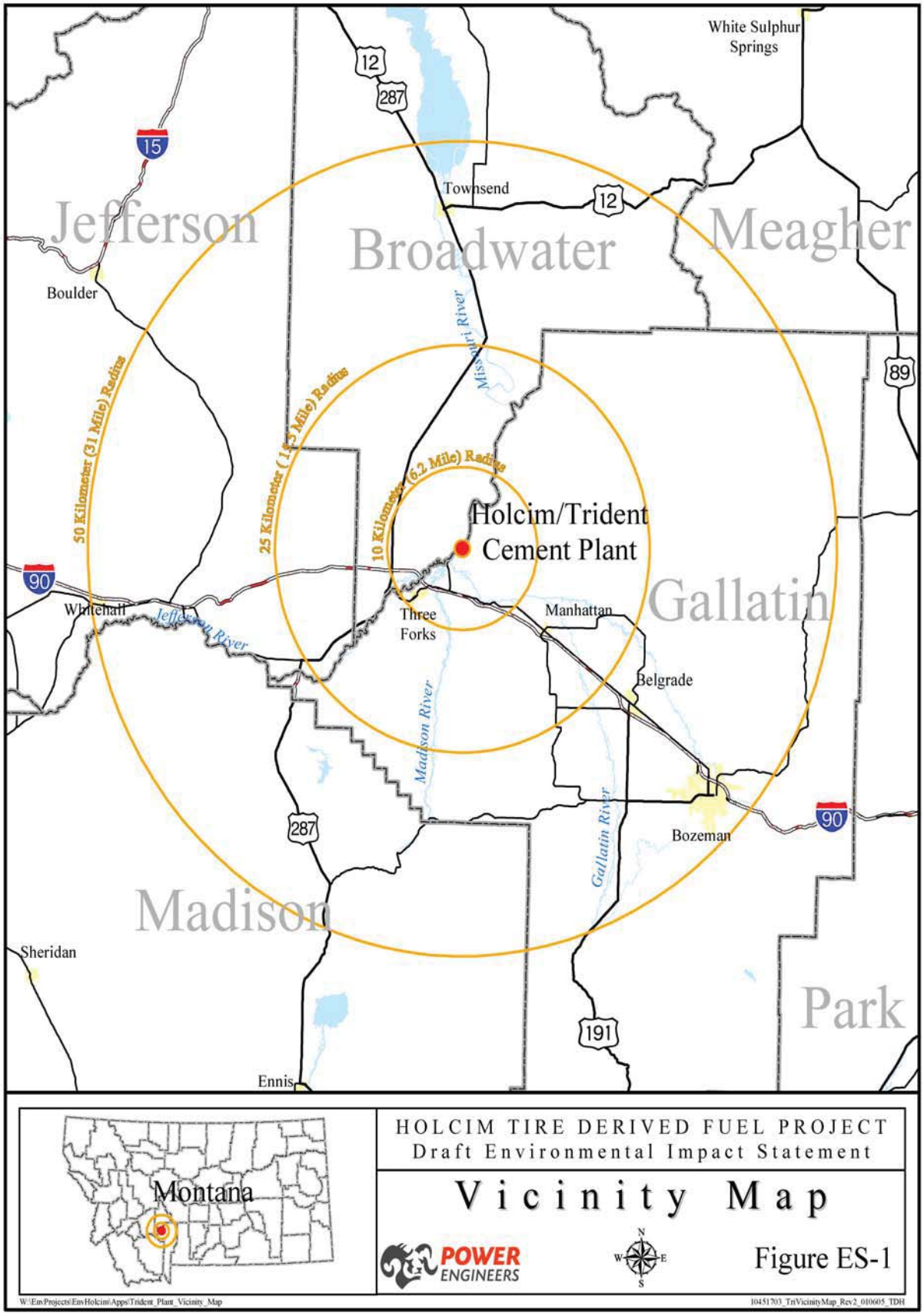
White Sulphur Springs
12
287
15
Townsend
12
Jefferson
Broadwater
Meagher
Boulder
Missouri River
89
50 Kilometer (31 Mile) Radius
25 Kilometer (15.5 Mile) Radius
10 Kilometer (6.2 Mile) Radius
Holcim/Trident Cement Plant
90
Whitehall
Jefferson River
Three Forks
Manhattan
Gallatin
Belgrade
Madison River
287
Gallatin River
Bozeman
90
Madison
Sheridan
191
Park
Ennis
Montana
HOLCIM TIRE DERIVED FUEL PROJECT
Draft Environmental Impact Statement
Vicinity Map
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Figure ES-1
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Table ES-1 Issues Identified During Scoping

Cumulative Effects • Existing criteria and hazardous air pollutants (HAPs) or other non-regulated pollutant emissions • Existing emissions from the Trident facility • Other area sources combined with the proposal to use tires as a fuel source in the cement kiln
Alternatives • Other methods of current tire disposal • Alternative ways to recycle tires; potential for conversion from a wet-process kiln to a dry-process kiln • A No Action Alternative
Air Emissions and Dispersion Modeling • Health risks from current emissions, plus emissions from tire combustion • Ways to decrease hazardous air emissions • New air dispersion modeling • Transparency of the air emissions analysis • Information presented from existing small wet-process kilns • Need for a complete existing emissions inventory for criteria pollutants, as well as HAPs • A thorough independent analysis of Best Available Control Technology (BACT) options • Evaluate and consider the effects of kiln combustion efficiency on volatile organic compounds (VOCs), PAHs, dioxins, and products of incomplete combustion (PIC) and these effects on human health • Holcim Trident facility's regulatory compliance history; the proposed modifications to the facility; upset conditions for both acute and chronic exposures; emissions from glass combustion; data for pollutants of concern; the need for a backup system for controlling particulates when the electrostatic precipitator (ESP) is not operating • Emissions from the Luzenac talc mill, a major source of emissions in the immediate area

Public Health • Potential for short- and long-term impacts on public health; risk assessment should consider the cumulative risk of baseline (existing emissions) plus tires • Human exposure to dioxin and other hazardous air pollutants
Ecological Risk • The potential for economic impacts and water quality impacts from air dispersion and runoff on Arctic grayling reintroduction • Impacts to water quality • Potential pathways for hazardous air emissions to impact aquatics in Missouri headwaters • Potential bioaccumulation risks to humans from ingestion of fish and meat from local game populations • Potential impacts to the great blue heron rookery, bald eagle nests, and other resident species near Holcim's Trident facility • Impacts to animals larger than the red fox (e.g., deer and antelope)
Solid Waste • Potential for tire moisture and infectious disease vectors • Older tires • Holcim's fire suppression plan • Importation of tires from other states
Socioeconomics • Tax incentives and the impact of such incentives on state and county tax revenues • Economic impacts to business, tourism, building construction, and agricultural, livestock, and dairy operations • Impacts to property values • Emissions and deposition impacts on organic farming

Table ES-2 Summary of Impacts

	Proposed Action	No Action
Air Quality	Some HAPs emissions from the kiln, such as mercury, would increase, some would decrease, and others would remain about the same.	No change from existing emissions.
	Most kiln dust HAPs emissions would decrease.	No change from existing emissions.
	Criteria pollutants would remain about the same, except that CO would increase but would still comply with MAAQS and NAAQS.	No change from existing emissions.
	Peak 1-hour dispersion coefficients (ratio between ambient concentration and emission rate) would decrease by a factor of 100 from the plant property boundary to Bozeman. Annual average dispersion coefficients would decrease by the same factor.	Same as the Proposed Action.
Human Health Risk	Non-cancer hazard quotients and indices would be less than 1.0.	Same as the Proposed Action.
	Blood lead levels at the worst-case location would be 12 percent of EPA's recommended limit.	Same as the Proposed Action.
	Cancer risk for individual pollutants at the worst-case location (plant property boundary) would not exceed 1 x 10^{-6} under the average exposure scenario. Cancer risk for individual pollutants and the aggregate of all pollutants would not exceed Montana's negligible risk level for communities in the Three Forks to Bozeman area under the average and high-end exposure scenarios.	Same as the Proposed Action.
	Cancer risk from eating 74 pounds per year of fish caught locally from rivers (high-end exposure scenario) would be below 1 x 10^{-6}.	Essentially the same as the Proposed Action.
	Cancer risk from eating a substantial amount of fish caught from local ponds over a lifetime could result in risk of greater than 1 x $10^{-6}$for individual pollutants (principally dioxin and PCBs), depending o the location, configuration, and hydrologic properties of the pond.	Essentially the same as the Proposed Action.
	Cancer risk from eating, over a lifetime, as much as 126 pounds per year of deer killed in the area would be below 1 x 10^{-6}.	Essentially the same as the Proposed Action.
Ecological Risk	Hazard index for carnivorous birds (e.g., red-tailed hawk) would be as high as 7 at the worst-case location, and the hazard index for avian omnivore (e.g., robin) would be as high as 1, depending on input assumptions. Hazard index at the worst-case location for all other plant and animal groups would be less than 1. For the area surrounding the facility, hazard indices for all species are below 1, indicating no hazard to the broader ecosystem.	Same as Proposed Action except robin would be 1.0.
Transportation	Daily truck trips would increase by 3.6 per day (1,300 per year), about 0.5% of current traffic level.	No additional truck traffic.
Property Taxes	An additional $10,720 for Gallatin County and $3,480 for the state.	No change in property tax revenue.

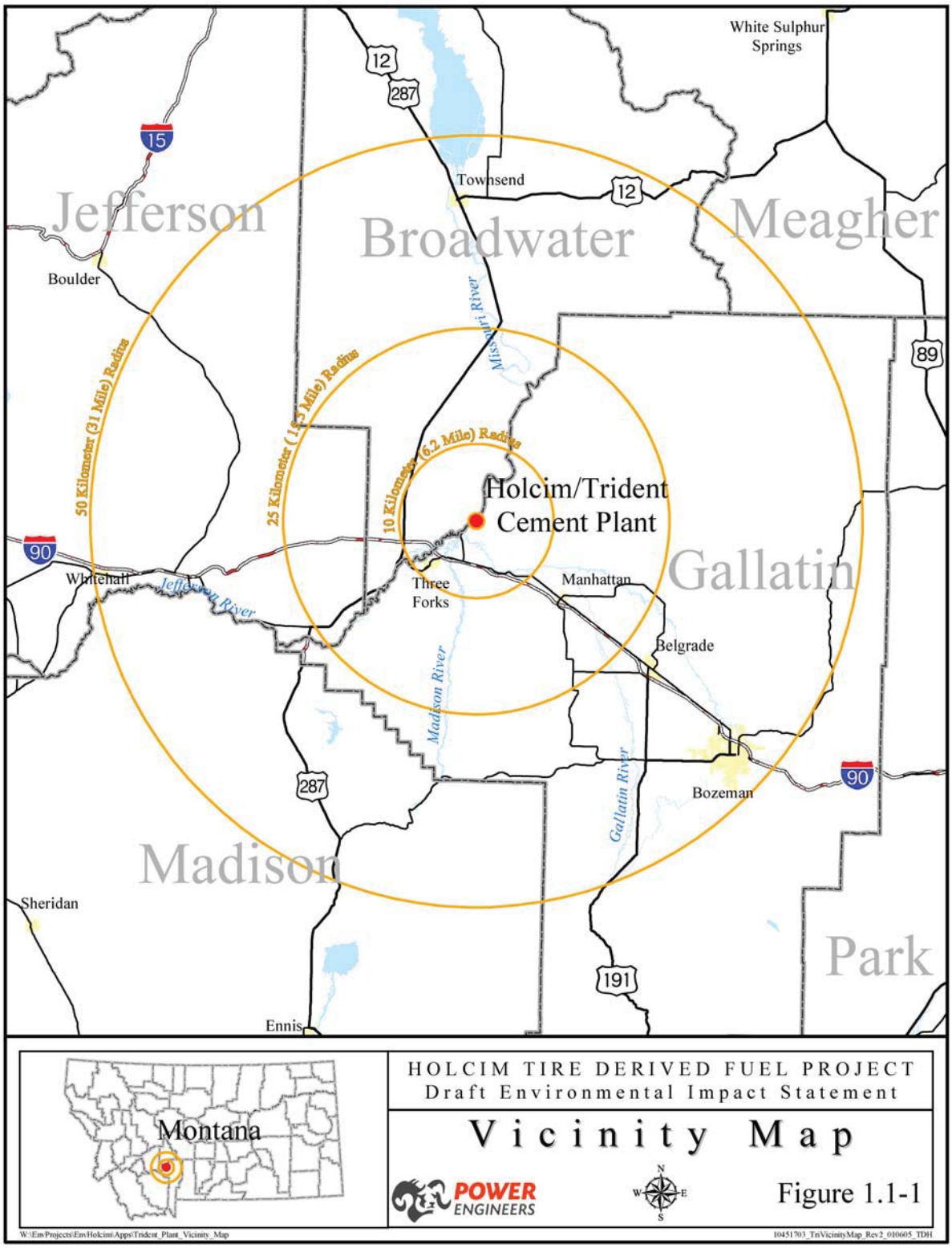
CHAPTER 1
PURPOSE AND BENEFITS

1.1 Introduction

This chapter describes the Montana Department of Environmental Quality (DEQ) actions regarding Holcim (US) Inc.'s (Holcim) proposed mid-kiln combustion of tires to supplement up to 15 percent of the required fuel for the kiln at its portland cement manufacturing facility in Trident, Montana. The public participation process and issues of concern raised during scoping for this environmental impact statement (EIS) are summarized.

Holcim requested a modification to its current Montana Air Quality Permit #0982 to allow the mid-kiln combustion of whole tires at its Trident facility. The tires would replace up to 15 percent of the traditional fuels used by the plant. Holcim's current air quality permit authorizes combustion of up to 100 percent natural gas, 100 percent coal, 100 percent petroleum coke, or any combination of these fuels. Holcim's primary objective for seeking a modification of its existing air quality permit is to realize reductions in fuel and operating costs of approximately 3 percent per year (DEQ 2001). The Holcim Trident facility is in Gallatin County near the Missouri Headwaters, approximately 5 miles northeast of Three Forks, Montana. A map showing the location of the Trident facility and surrounding area is presented as Figure 1.1-1.

Figure 1.1-1 VICINITY MAP



1.2 History of Application Review and Need for EIS

Holcim submitted an application to modify Permit #0982 on October 3, 2001, to DEQ's Air Resources Management Bureau, Permitting and Compliance Division. Between October 2001 and March 2003, DEQ conducted reviews and requested supplemental information and clarifications from Holcim. On March 24, 2003, DEQ issued a Preliminary Determination for the modification to Permit #0982 and a Draft Environmental Assessment (EA) pursuant to the Montana Environmental Policy Act (MEPA; Title 75, Chapter 1, MCA) and its implementing rules (ARM 17.4.601 *et seq.*). A public hearing on the Preliminary Determination and the Draft EA was held in Manhattan, Montana, on April 29, 2003.

Numerous comments were received during the public comment period (March 24 through May 30, 2003). DEQ considered these comments and issued a Final EA on August 15, 2003. In the final EA, DEQ concluded that an EIS would be required for the project. The rationale for this decision was presented in the Final EA and summarized as follows (DEQ, August 15, 2003):

- An environmental impact statement (EIS) is required because the potential impacts from the proposed project, in conjunction with current Holcim activities, may significantly affect the quality of the human environment. Public comment also identified cumulative impacts as a major issue regarding this proposed project. MEPA requires that this cumulative impact analysis be conducted before a decision can be made on the permit applications (Solid Waste License and Modification to Air Permit).
- In summary, the use of TDF [tire-derived fuel] at Holcim's Trident Facility is a major issue for the surrounding area and for Montana. An EIS would enable the Department to more completely identify and disclose the potential cumulative impacts on human health and the environment from Holcim's facility, determine whether any of those impacts are significant, and, if so, identify any potential measures for mitigating those impacts. Therefore, an EIS is required for Holcim's application to use TDF at its Trident Facility.

1.3 Proposed Agency Action

DEQ is considering two permitting actions. The first action would be to issue Holcim a solid waste management system license for the storage of tires prior to incineration under the Montana Solid Waste Management Act (75-10-221, MCA). Because Holcim would collect and store waste tires, which are defined as a solid waste under 75-10-203(11)(a), MCA, the Trident plant would be considered a Class III Resource Recovery facility under the Montana Solid Waste Management Act. The second action would be to modify Holcim's existing Permit #0982 to allow for mid-kiln combustion of tires at the Trident facility with conditions on the use of smelter slag as an iron source.

Holcim submitted its application to incinerate tires under the requirements of 75-2-215, MCA. Under these requirements, DEQ may not issue an air quality permit unless it determines that the proposed use of tires as fuel would constitute no more than a negligible risk to the public health, safety, and welfare, and to the environment.
If DEQ determines that Holcim's applications meet the requirements of the Montana Solid Waste Management Act, the federal Clean Air Act, and the Clean Air Act of Montana and their implementing rules, the solid waste license will be issued and the air quality permit will be modified. Conditions may be applied to reduce or eliminate environmental impacts.

This EIS has been prepared to comply with MEPA and with DEQ's determination that an EIS is needed.

1.4 Existing Operations

Holcim operates a "wet process" kiln, in which the raw kiln feed material is blended with water to promote homogenization. The mixture is fed into the kiln as slurry rather than as dry ingredients. The kiln is fired by injection of fuel at the lower end to maintain a combustion zone with very high temperatures. Currently Holcim uses a combination of coal, natural gas, syncoal (defined as a process consisting of thermal treatment coupled with physical cleaning to upgrade high moisture low rank coal) and petroleum coke as fuel (Holcim, 2004). See Section 2.2 for a description of the cement-making process.

1.5 Proposed Changes to Use Tires as Fuel

Holcim is proposing to combust tires as fuel in the Trident kiln. The proposal would substitute whole tires for up to 15 percent of the total heat input, on a British thermal unit (Btu) basis. The proposed physical changes include the development of an on-site tire storage area and modification of the kiln to allow for the insertion of tires.

Tires would be delivered and stored in trailers in the quarry prior to delivery to the kiln. A maximum of 15,000 tires would be stored on site at any given time. The tires would be unloaded from the trailers onto a conveyor automatically with a trailer lift. The conveyor would feed the tires to a mechanism that would insert one tire at a time into the kiln at specified time intervals. A gate would be installed into the kiln shell that would allow tires to be dropped into the calcining zone of the kiln. Holcim has projected that 1,137,539 tires could be combusted each year. This equates to a maximum estimate of 94,795 tires, or 950 tons, each month. Holcim has estimated the cost of facility improvements to combust tires as fuel at $1,000,000 (Holcim, 2004).

1.6 Purpose and Benefits

Holcim stated that the primary purpose in seeking approval for the mid-kiln combustion of whole tires is to realize lower operating costs and to increase operational flexibility (Holcim, 2004). The current annual average fuel cost at the Trident facility for burning coal, natural gas, and coke is $1,450,000 (Ralph Denoski, personal communication). Incineration of up to 1,137,539 tires per year as a supplemental fuel would result in an annual cost savings of up to $250,000 or 17 percent of the total fuel costs for the facility. Holcim would have the operational flexibility to use different fuels or combinations of fuel at its discretion or based on fuel availability and costs.

Holcim stated that the combustion of tires would allow it to reduce production costs to a level comparable to other facilities, maintain its existing share of the portland cement market, and create a use for a waste material (Bison, 2000).

Several recent studies evaluated the use of tires as a fuel alternative or to supplement other fuels (UC Davis, 1996; EQC, 1998). The Montana Environmental Quality Council (EQC) study cites statistics from the Scrap Tire Management Council (STMC) that indicate the most significant growth market for tires has been as fuel for incineration. In 1996, approximately 152 million of

the estimated 266 million tires generated in the U.S. were incinerated as supplemental fuel at 107 facilities. These facilities included 36 cement kilns, 23 pulp and paper facilities, 15 electric utilities, and 33 other industrial and electric generating facilities.

Tires have been used as fuel since the 1970s in North America, Europe, and Japan, according to the California Integrated Waste Management Board (CIWMB, 1992: 24-27). Tires have several properties that make them attractive for potential energy usage. They contain 12,000 to 16,000 Btu/pound, depending upon composition and whether or not steel has been removed (CIWMB, 1992: 11-12). An 18-pound tire contains the energy equivalent of approximately 2 gallons of gasoline. In comparison, bituminous coal has a slightly lower heat and energy value, ranging from 11,000 to 13,000 Btu/pound. Tires also have lower moisture content than coal.

Cement kilns burned nearly 30 percent of the total number of tires used for fuel in 1996 (STMC, 1996; STMC, 1997). An Environmental Protection Agency (EPA) report (EPA, 1991) concluded that cement kilns appear to be particularly suitable for the incineration of tires for several reasons. The combustion at high temperatures and long fuel retention times may minimize the need and expense for additional air emission controls other than control for particulates. Kilns require large quantities of fuel, and are capable of being easily modified to include tires in the fuel stream. Cement kiln facilities near Montana that burn tires as supplemental fuel include the Ash Grove Cement kilns in Inkom, Idaho; Durkee, Oregon; Leamington, Utah; and Seattle, Washington. Ten Holcim facilities nationwide are using tires as fuel, including facilities at: Devil's Slide, Utah; Seattle; and Portland, Oregon. Presently, forty-three cement kilns are permitted to burn tires in the United States. No permit application for this use has been denied.

Other reasons and advantages that have been cited for using tires as fuel in cement kilns include:

- Burning whole tires can be attractive economically by reducing fuel costs. Many existing systems can accommodate tire fuel without significant facility modifications. Costs associated with the modifications to burn whole tires in cement kilns are minor in most cases. The cost of tires as fuel can be 70 to 90 percent less than the cost of the primary fuel, depending on geographical location (EPA, 1993). EPA reports cost savings to several cement manufacturers from using tires as a fuel supplement. In one case, tire costs were 34 percent of the cement manufacturer's coal cost on a dollar per Btu basis.
- Cement kiln processes operate at high temperatures and with long residence times and kiln turbulence — conditions that usually minimize the production of metal or other toxic residues. The objective when burning tires in cement kilns is to achieve nearly complete combustion of all organic materials in the fuel so that the complex organic compounds do not become part of the air emissions.
- Non-combustible tire components (e.g., metals) become part of the cement clinker and reportedly do not contribute to air emissions or to waste ash (CIWMB, 1992:24-27).
- Nitrogen oxide (NO_x) emissions usually decrease when tires are burned (CIWMB, 1992:24-27).
- Tires are used in place of coal because they have higher energy by weight (California EPA, 2002).
- Kilns can in some cases charge a disposal fee that is lower than the fee at landfills.
- The steel belts in the tires offer a source of iron needed in the cement making process (California EPA, 2002).

1.7 Regulatory Requirements and Health Guidelines

1.7.1 Regulatory Requirements

An environmental review pursuant to MEPA must be prepared whenever a state agency may take an action that could affect the human environment and that is not exempt from review by statute or rule. State actions include issuance of permits and licenses. The principal purpose of this EIS is to disclose the primary, secondary, and cumulative impacts of permitting Holcim to store and combust whole tires. The EIS also identifies potential alternatives and mitigation measures. Section 1.3 describes the permitting action that DEQ is considering. A decision on the air quality permit modification and the solid waste management license will not be made until the completion of the Final EIS.

In addition to this EIS, there are a number of regulatory requirements under state statutes and rules and EPA regulations that pertain to the proposed modification at Holcim's Trident facility.

Table 1.7-1 Regulatory Requirements of EPA and State of Montana

Rule Citation	Description
ARM 17.8.101 *et seq.*	General Provisions (Clean Air Act of Montana)
ARM 17.8.212	Ambient Air Quality Standards
ARM 17.8.304	Visible Air Contaminants
ARM 17.8.308	Particulate Matter, Airborne
ARM 17.8.309	Particulate Matter, Fuel Burning Equipment
ARM 17.8.310	Particulate Matter, Industrial Process
ARM 17.8.322	Sulfur Oxide Emissions- Sulfur-in-Fuel
ARM 17.8.340 40 CFR 60 Subpart F	New Source Performance Standards (NSPS)
ARM 17.8.342 40 CFR 63 Subpart LLL	Maximum Achievable Control Technology (MACT)
ARM 17.8.402	Stack Heights and Dispersion Techniques
ARM 17.8.501 *et seq.*	Air Quality Permit Application, Operation, and Open Burning Fees
ARM 17.8.740 *et seq.*	Permit for Construction and Operation of Air Contaminant Sources
ARM 17.8.752	Best Available Control Technology (BACT)
ARM 17.8.759	Public Review of Permit Application
ARM 17.8.801 *et seq.*	Prevention of Significant Deterioration (PSD)
ARM 17.8.1201 *et seq.*	Operating Permit Program
75-2-215, MCA	Incinerator Permitting
ARM 17.50.505	Standards for Solid Waste Management Facilities
ARM 17.50.508	Application for Solid Waste Management System License
ARM 17.50.509	Operation and Maintenance Plan Requirements
75-10-216, MCA	Waste Tire Disposal Sites – Financial Assurance Required
75-10-221, MCA	Solid Waste Permitting

1.7.2 Health Risk Assessment Guidelines

A risk assessment was completed by DEQ to support the development of the EIS. The following information was used as methodology for the development of the risk assessment.

EPA and ATSDR

The Agency for Toxic Substances Disease Registry (ATSDR) in conjunction with the EPA has provided information regarding content and use of health risk assessments (ATSDR, 2005). An excerpt of the information is provided in the following paragraphs:
A risk assessment is an analysis that uses information about toxic substances at a site to estimate a theoretical level of risk for people who might be exposed to these substances. The information comes from scientific studies and environmental data from a site. A risk assessment provides a comprehensive scientific estimate of risk to persons who could be exposed to hazardous materials present at a site.

Risk assessments, prepared by EPA and other agencies, are used to determine if levels of toxic substances at hazardous waste sites pose an unacceptable risk as defined by regulatory standards and requirements. The risk assessment helps regulatory officials determine hazardous site cleanup strategies that will ensure overall protection of human health and the environment.

> A risk assessment does not measure the actual health effects that hazardous substances at a site have on people. Risk assessments often are conducted without considering actual or possible exposure. Conservative safety margins are built into a risk assessment analysis to ensure protection of the public. Therefore, people will not necessarily become sick even if they are exposed to materials at higher dose levels than those estimated by the risk assessment. In other words, during the risk assessment analysis, the most vulnerable people (e.g., children and the elderly) are carefully considered to make sure all members of the public will be protected.

The risk assessment helps answer these three questions for people who might be exposed to hazards at a site:

Under what circumstances might I and my family and neighbors be exposed to hazardous substances at this site?

Is it possible that we might be exposed to hazardous substances at levels higher than those determined to be safe?

If the levels of hazardous substances are higher than regulatory standards, how low do the levels have to be for the risk to fall within regulatory standards?

A memorandum prepared by D.R. Clay at the EPA (EPA, 1991) describes the role of the baseline risk assessment in Superfund remedy selection. The memorandum states that EPA may use the results of the baseline risk assessment to determine whether a release or threatened release poses an unacceptable risk to human health or the environment that warrants remedial action and to determine if a site presents an imminent and substantial danger. The memorandum further states that where the baseline risk assessment indicates that a cumulative site risk to an individual using reasonable maximum exposure assumptions for either current or future land use exceeds the 10^{-4} (1 in 10,000) lifetime excess cancer risk, action under CERCLA is generally warranted at the site. EPA uses the general 10^{-4} to 10^{-6} risk range as a "target range" within which the agency strives to manage risks as part of a Superfund cleanup.

California EPA

The California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA) states in *"A Guide to Health Risk Assessment"* (OEHHA, 2004) that regulators assume that a 1 in 1 million (10^{-6}) risk of cancer from lifelong exposure to a chemical is an "acceptable risk level" because the risk is extremely low compared to the overall cancer rate. If a standard for a chemical was set at the 1 in 1 million risk level, it would mean that no more than one additional cancer, beyond what would normally occur in a population, would potentially occur in a population of 1 million people over a 70-year lifespan.

Administrative Rules of Montana

ARM 17.8.770 requires a human health risk assessment for the modification to Holcim's air quality permit. Specifically:

> An applicant for a Montana air quality permit for an incineration facility subject to 75-2-215, MCA, shall submit a human health risk assessment protocol and a human health risk assessment as part of the application. The human health risk assessment must demonstrate that the ambient concentrations of pollutants resulting from emissions from the incineration facility subject to 75-2-215, MCA, constitute no more than a negligible risk to the public health, safety, and welfare and to the environment.

A negligible risk to the public health is defined in ARM 17.8.740 as follows:

> Negligible risk to the public health, safety, and welfare and to the environment means an increase in excess lifetime cancer risk of less than 1.0×10^{-6}, for any individual pollutant, and 1.0×10^{-5}, for the aggregate of all pollutants, and an increase in the sum of the non-cancer hazard quotients for all pollutants with similar toxic effects of less than 1.0, as determined by a human health risk assessment conducted according to ARM 17.8.767.

1.8 Public Participation

As described in Section 1.2, Holcim submitted the initial application for modification of Permit #0982 on October 3, 2001, and DEQ held a public information meeting at Manhattan High School on December 18, 2001. The public scoping period for the EIS extended from December 17, 2003, to January 23, 2004. DEQ held a public scoping meeting on January 20, 2004, at the Manhattan Elementary School. About 100 people attended the scoping meeting, and about 1,500 comments were received during the scoping period.

Both oral and written comments were submitted at the two public meetings. Interested persons, groups and local and state government agencies also submitted comment letters and e-mail messages. DEQ prepared a scoping summary report that summarizes by topic substantive comments received from December 2001 through the EIS scoping period. The comments were reviewed and considered in the development of the list of issues addressed in this EIS.

1.9 Issues to be Addressed

Concerns have been raised regarding the use of tires as fuel in cement kilns. There are environmental health concerns about the potential increase in emissions of criteria pollutants, such as CO, and particulates, HAPs, and toxic air pollutants, such as PAHs, dioxins, and furans. The type and amount of emissions produced by burning tires with coal and other fuels depend on the completeness of combustion (combustion efficiency), which is dependent on temperature, residence time in the kiln, oxygen levels, and the degree of turbulent mixing within the kiln. Although the temperature and residence time are high in cement kilns, there are often unknowns regarding potential changes in the temperature gradient inside a kiln associated with physical and operational modifications to handle the burning of tires. If not properly designed and operated, the kiln may not achieve the combustion efficiency needed to fully burn the tire fuel. As long as there are no changes in the location, percentage, or manner in which the tires are fed into the

kiln, the emissions should not vary any more than what would be expected with coal. All of these factors can also affect the quality of the cement. Consistent quality of cement is important to the company to maintain its customers, so management has a stake in maintaining the *status quo* (BCPH, 2003). Incomplete combustion could increase emissions of PAHs and toxic organic compounds, such as dioxins and furans. Process upsets, equipment malfunctions, and any periods when pollution control equipment is not on line can also increase emissions.

The specific emissions from a given cement kiln burning tires also depend upon some combination of the following:

- Type of cement process (wet or dry) and the pollution control methods and technologies used
- Percent substitution of whole tires for the principal fuel
- Point in the process at which tires are fed into the kiln
- Quality (including moisture and metal content) and form (chips or whole tires) of the tire fuel

The following is a summary list by category of issues raised by the public:

Cumulative Impacts

- Except for dioxin, the analyses presented by Holcim in the application to modify the existing air permit and evaluated in the EA were based only on the emissions from the use of tires for fuel and did not consider existing criteria and HAPs or other non-regulated pollutant emissions.
- The cumulative analysis should consider existing emissions from the Trident facility and other area sources combined with the proposal to use tires as a fuel source in the cement kiln.
- Air modeling should consider existing emissions and tire fuel emissions. Deposition isopleths (mapped distribution of potential pollutant deposition) should be prepared for cumulative emissions.
- The health risk assessment and ecological risk assessment should consider cumulative emissions and predict cumulative impacts.

Alternatives

- Alternatives to burning tires should be considered.
- How are tires currently disposed of in Montana?
- Other ways to recycle tires besides burning them as fuel in cement kilns should be considered.
- Evaluate conversion from a wet-process kiln to a dry-process kiln.
- Evaluate a No Action Alternative: the existing operation would continue without granting the permit modification and without burning tires.

Air Emissions and Dispersion Modeling

- Consider current emissions plus emissions from combustion of tires when assessing health and environmental risks.
- Analyze ways to decrease hazardous air emissions.
- Conduct new air dispersion modeling.

- The characterization of emissions from sources other than the stack is inadequate. Consider emissions from the clinker cooler and other sources.
- The air emissions analysis needs to be made transparent.
- Information should be presented from existing small wet-process kilns.
- There should be a complete existing emissions inventory for criteria pollutants as well as HAPs.
- Undertake a thorough independent analysis of available BACT options.
- Evaluate effects of kiln combustion efficiency on VOCs, PAHs, dioxins, and products of incomplete combustion (PIC). Consider these effects in the human health risk assessment.
- Consider the Holcim Trident facility's regulatory compliance history.
- Present specifications for the proposed modifications to the Trident facility to allow the use of tires as fuel.
- Conduct a thorough review of impacts and emissions from operations under upset conditions for both acute and chronic exposures.
- Emissions from glass combustion need to be considered along with the other emissions.
- Holcim's emissions from tire burning evaluated in the EA were predicted through the use of data from other cement plants of varying sizes and different process, using a variety of fuel types. Data were not presented for many pollutants of concern.
- There should be a backup system for controlling particulates when the electrostatic precipitator (ESP) is not operating.
- Consider in the cumulative emissions inventory and analysis emissions from the Luzenac talc mill, a major source of emissions in the immediate area.

Public Health

- Evaluate potential for short- and long-term impacts on public health.
- The original health risk assessment only considered the tire emission increment. The risk assessment should consider the cumulative risk of baseline (existing emissions) plus tires.
- There should be a comprehensive and transparent analysis of human exposure to dioxin and other hazardous air pollutants.

Environmental Impacts and Ecological Risk Assessment

- Perform the ecological risk assessment again.
- Assess the potential for economic impacts and water quality impacts from air dispersion and runoff on Arctic grayling reintroduction.
- Assess whether the Proposed Action will impact water quality.
- Assess the potential pathways for hazardous air emissions from tire combustion to impact aquatics in Missouri headwaters.
- Evaluate the potential bioaccumulation risks to humans from ingestion of fish and meat from local game populations.
- Evaluate the potential impacts to the great blue heron rookery, bald eagle nests, and other resident species near Holcim's Trident facility.
- The ecological risk assessment did not consider impacts to animals larger than the red fox (e.g., deer and antelope).

Solid Waste

- Discuss Holcim's plan for excluding tires with moisture and infectious disease vectors.
- Discuss whether older tires will be excluded from incineration.

- Present and evaluate Holcim's fire suppression plan.
- Evaluate importation of tires from other states.

Socioeconomics

- Discuss whether Holcim will receive tax incentives and the impact of such incentives on state and county tax revenues.
- Consider whether there would be economic impacts to business, tourism, building construction, and agricultural, livestock, and dairy operations.
- Evaluate the potential for impacts to property values.
- Evaluate whether emissions and deposition will have impacts on organic farming.

CHAPTER 2
DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 Overview

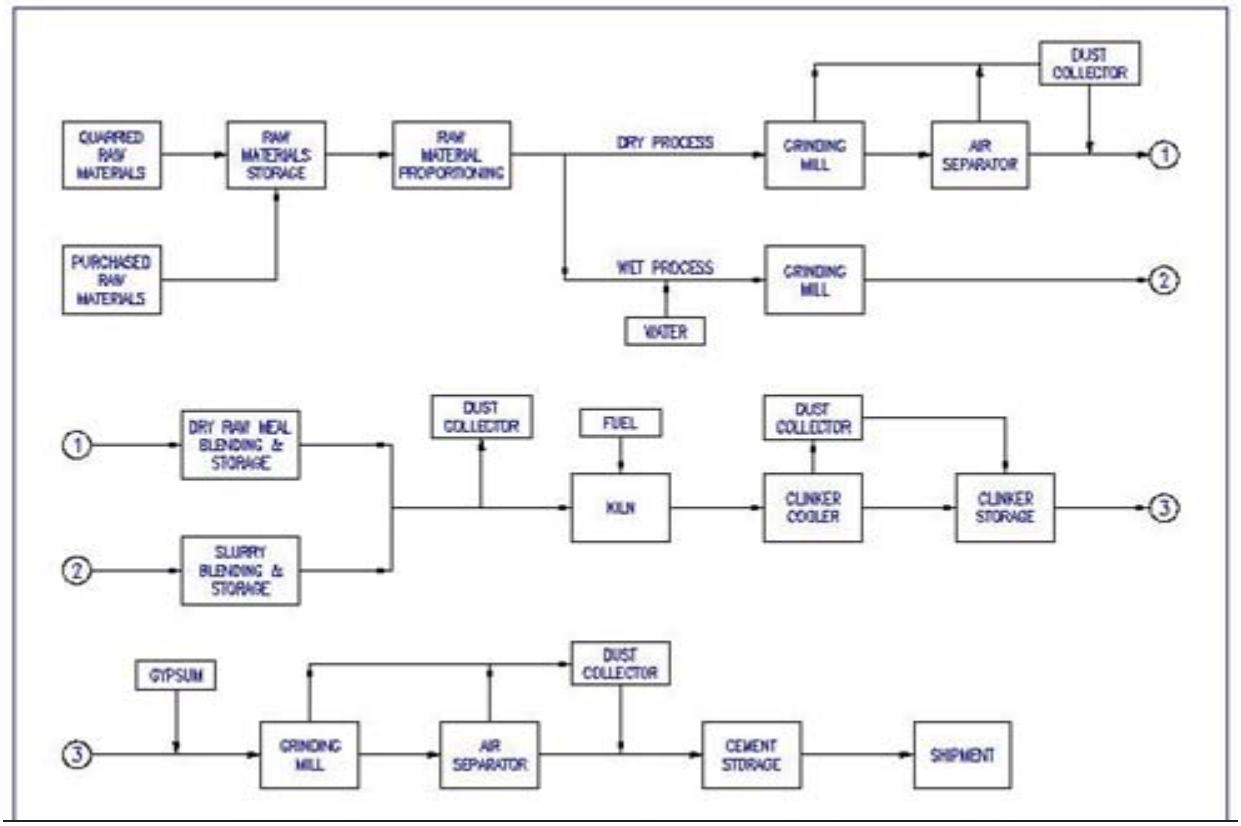
This section describes the Proposed Action and the process of developing and selecting reasonable alternatives. Each potential alternative was evaluated considering the purpose and benefits of the Holcim proposal to use tires as fuel. The alternatives were also evaluated in terms of their ability to meet technical, environmental, and economic feasibility criteria. A range of alternatives was evaluated and placed into the following categories:

- Proposed Action describes the Holcim proposal to use whole tires as fuel and the activities needed to implement it.
- No Action alternative discusses the current situation by assuming the air quality permit would not be modified and tires would not be burned in the kiln. DEQ would not license the site as a Class III resource recovery facility.
- Alternatives Considered and Eliminated describes the alternatives examined but eliminated from detailed study. Alternatives considered but eliminated include using processed tires, other waste as fuel, other fuels, conversion from a wet to dry kiln process, alternative pollution control technologies, alternative tire storage, and reduction in the percentage of tires used as fuel.

2.2 Existing Facilities and Operations

Holcim uses a combination of limestone, shale, and sandstone from its quarry, glass as a sand substitute, and iron components (iron ore and ASARCO smelter slag) to produce portland cement at the Trident facility. A basic flow diagram of the manufacturing process is provided in Figure 2.2-1 (Air & Waste Management Association, 1992). The rock is blasted, loaded into trucks, conveyed to the primary crusher, and transported to the storage silos or to a ground stockpile. The raw materials are conveyed from the primary crusher and delivered by enclosed conveyors to selected storage silos. From these silos, the raw materials are conveyed to the raw ball mill where they are ground with water to form a slurry and sent to a storage tank. From the tank, the slurry is sent to the kiln for high temperature processing into clinker. There is a precipitator on the exit end of the kiln that discharges to a screw conveyor then to a dust storage silo. The dust storage silo has a dustless unloader. The ash is disposed of in the quarry (DEQ, 2004).

Figure 2.2-1 Basic Process Flow Diagram



Source (AWMA, 1992)

The 450-foot-long rotary kiln is inclined at a 3 percent slope (Figure 2.2-2). Slurry with an average water content of 33 percent is pumped into the uphill, cooler end of the kiln. The kiln is rotated and the slurry is gravity-fed towards the hot end of the kiln, gradually increasing in temperature until it reaches the burning zone. As temperatures increase along the length of the kiln, water is evaporated and complex chemical processes occur at different stages resulting in the raw material being calcined to become clinker (Figure 2.2-3). The clinker is then cooled and sent to either the clinker storage bins or the clinker storage silos for processing. The clinker is processed with 5 percent gypsum and 1 percent mineral components and then conveyed to the finish mills to be ground into portland cement. The cement is then conveyed from each finish mill cooler to storage silos or stock bins. From bulk storage silos, cement is loaded into rail cars for distribution. From the stock bins, the cement is conveyed to packer bins where it is loaded into bags and then the bags are conveyed into rail cars or trucks for distribution (DEQ, 2004a).

Holcim operates a wet process kiln using a combination of coal, syncoal, coke, and natural gas as fuel. The kiln is fired by injection of fuel at the lower end to maintain a combustion zone with very high temperatures. The fuel consumption for the wet process kiln is approximately 5.71 million Btu per ton of clinker produced (Holcim, 2004).

Figure 2.2-2 Typical Wet Process Cement Kiln

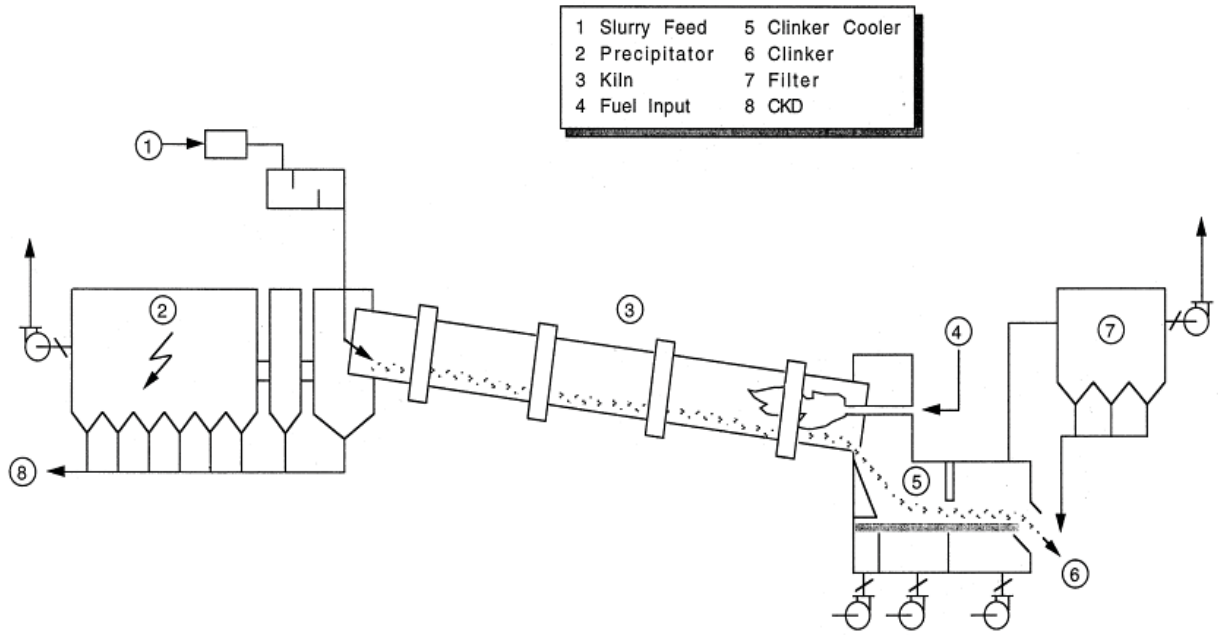


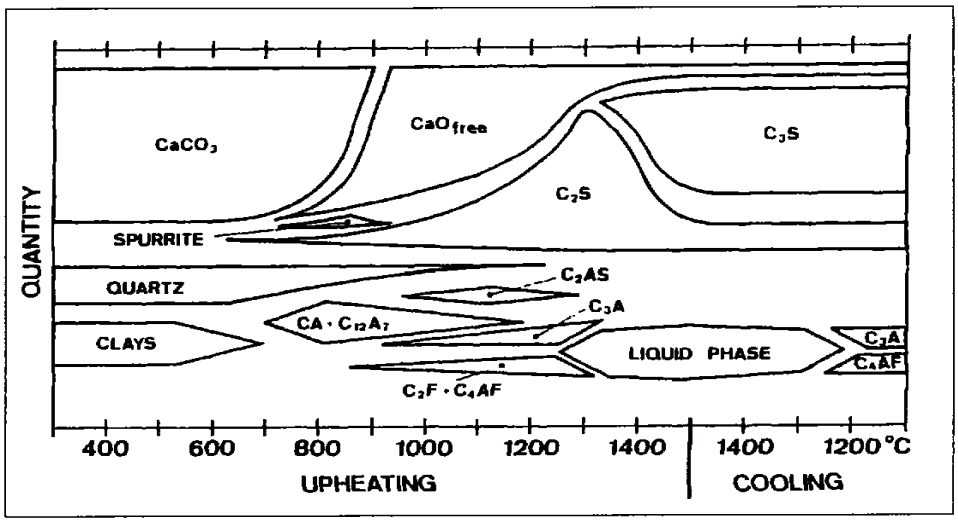
Figure 2.2-3 Analysis of Cement Manufacturing Process

Analysis of Wet vs. Dry Cement Manufacturing Process
Prepared by Holcim
November 1, 2004

There are five stages in manufacturing clinker:

- Drying - >100 C
- Preheating 100 - 850 C
- Calcining 600-900 C
- Sintering 800-1450 C
- Cooling 1450 - 1100 C

In these five processes the following physical and chemical reactions occur:



Kilns are typically classified according to the moisture content of the raw feed. Whether clinker is manufactured in a wet or dry process, the required reactions are the same. The diagram shows the associated reactions.

2.3 Proposed Action

The Holcim Trident facility is located in Gallatin County near the Missouri Headwaters, approximately 5 miles northeast of Three Forks, Montana. The site is located in the NE¼ of Section 9, SE¼ of Section 4, SW¼ of Section 3 and NW¼ of Section 10, Township 2 North, and Range 2 East (Latitude 45° 56" 40.58', longitude 111° 28" 37.14'). The site is north of Interstate 90, off State Routes 286 and 205.

The site is approximately 1,320 acres of private land. Of this, about 1 to 2 acres in the quarry would be used for tire storage. No additional land outside the existing fenced area would be used. Figure 2.3-1 shows the general layout of the existing Trident plant and the approximate locations of proposed tire-related facilities, including the storage trailers, kiln gate, and proposed conveyance system. Major existing components of the Trident plant are also identified.

Whole tires require special consideration when receiving or storing them on site. Whole tires, due to their shape, can retain up to two gallons of water and are ideal breeding grounds for mosquitoes and rodents. To avoid these potential storage problems, only trailer load shipments of

whole tires would be accepted. Whole tires would not be removed from the on-site trailers except to load them onto a conveyor feed system leading to the kiln. No scrap tires would be dumped or loosely stored on site. The trailers in which the whole tires would be stored would be intact, closed top van trailers.

Tires would be delivered and stored in trailers in the quarry prior to delivery to the kiln. Each trailer would hold about 1,000 tires. The 10 to 15 trailers would be parked in rows and would be spaced at least 50 apart to prevent fire spread. An area about 200 feet wide around the quarry would be kept free of vegetation.

The tires would be unloaded from the trailers into a bin automatically with a trailer lift. A conveyor would feed the tires from the bin to a mechanism that would insert one tire at a time into the kiln, at specified time intervals. A gate would be installed into the mid-kiln shell that would allow tires to be dropped in the calcining zone of the kiln. Holcim has projected that 1,137,539 waste tires could be combusted each year. This equates to a maximum estimate of 94,795 tires, or 950 tons, each month. No more than one week's supply of tires would be stored onsite at one time. Holcim has estimated the cost of facility improvements to combust tires as fuel at $1,000,000 (Holcim, 2004).

The potential for fire is minimal, since tires will not auto-ignite until 1800°F. A fire prevention/fire-fighting plan has been devised in cooperation with the local fire chief and is described in Section 2.3.3. Water for fire suppression would be supplied to the tire storage area with a charged waterline and hydrant or a holding tank at the storage area.

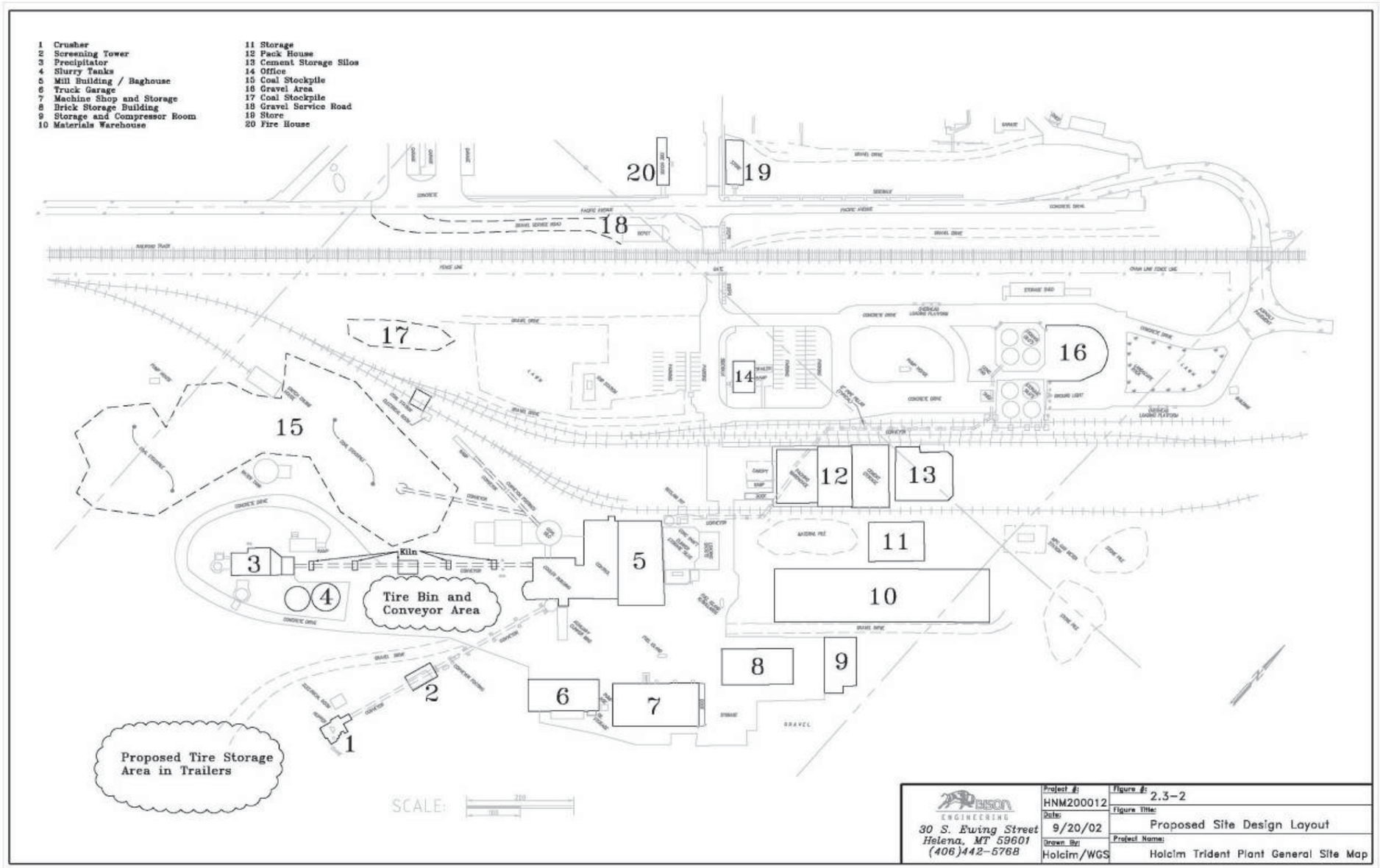


Figure 2.3-1 Holcim Site Layout

2.3.1 Project Facilities

Holcim proposes to substitute whole tires for up to 15 percent of the total heat input, on a Btu basis, provided by the mix of fuels used to fire the kiln. Proposed physical changes involve on-site tire storage and modification of the kiln to allow for the insertion of tires (Holcim, 2004).

The kiln modification would be constructed in accordance with state and federal building codes and standards. Occupational Safety and Health Administration standards would apply to overall operations. Other regulations and design codes would be followed, as applicable. Holcim provided draft design drawings, procurement specifications, and combustion modifications with sufficient information to disclose impacts.

Equipment and systems such as water storage tanks and a storm water detention pond would be located near the kiln and cement block complex. Existing administration offices and the control room, warehouse, and gatehouse would remain unchanged with the Proposed Action.

The equipment associated with the Proposed Action would be small compared to most industrial equipment found at cement manufacturing facilities. The control room, electronics area, and electrical switching equipment would be located in existing buildings.

Project Lands

The tire storage trailers and the conveyor would occupy previously disturbed land.

Roads and Parking Areas

The cement plant access road (approximately 3.9 miles long) is asphalt. Roads around the immediate vicinity of the Trident facility are designed to carry heavy equipment. Other service and maintenance roads within the Trident facility would be surfaced with crushed rock, and would be designed for heavy haul trucks. A 0.5-acre construction parking lot and storage area covered with crushed rock would be provided for construction trailers, tools, vehicles, equipment, and material.

Plant Buildings and Structures

Figure 2.3-1 shows the facility site layout, including plant buildings and structures.
The design of the project is based on receiving tires for the kiln via a conveyor from the quarry. Using conveyors instead of a loader, train or other tire transport, reduces dust from handling and the potential to introduce rocks and other foreign material into the kiln. Conveyor systems are considered good engineering practice methods providing efficiency, reliability, and dust minimization.

Operations and Maintenance

Holcim has stated that it would not likely employ additional people for the initial operations nor would there be an increase in employees during normal operations. DEQ indicated in the revised EA (DEQ 2003) that additional peripheral jobs could be created from the transfer and storage of the waste tires.

The cement kiln would be operated 24 hours per day to provide maximum product output throughout the year. Cement plant operations are currently monitored by a Continuous Emission Monitoring System (CEMS) for NOx, sulfur dioxide (SO_2), and opacity. CEMS for carbon monoxide (CO) would be added before tires would be added to the kiln. The Startup, Shutdown, and Malfunction (SSM) plan describes the operations and maintenance scenarios associated with an SSM sequence. Holcim provided this SSM document (December 2004) at DEQ's request. The SSM plan is required by the Portland Cement Maximum Achievable Control Technology (MACT) rules at 40 CFR 63 Subpart LLL.

Planned maintenance would be coordinated with overhauls to reduce the impact of having units shut down for maintenance.

2.3.2 System Design

The system design consists of a kiln gate, conveyor and associated peripheral systems, tire storage areas, and material handling. Approximate locations are shown in Figure 2.3-1.

Kiln Gate, Conveyor and Associated Systems

Tires would be delivered by rail or truck (DEQ, 2001). Incoming enclosed trailers of tires would be weighed at the plant scales (shipping silos). Should tires arrive through rail transport, it is uncertain how the tires would be weighed on the rail car. The purchasing agreements and shipping logistics have not been decided pending DEQ's permitting decision. Trailers would be driven through the plant to the quarry floor, and rail cars would use the spur line. The offloading and placement of the trailers have not been designed at this time. Tires would be stored in enclosed trailers.

Trailers would deliver the whole tires to the bin. Tires would be fed from the bin to a conveyor one at a time via a standard tire feed arrangement common to most whole tire burning kilns. They would be sorted to meet size specifications; it is uncertain how the facility would deal with this issue. The conveyors would then deliver whole tires to the kiln.

Air Emission Control Equipment and Facilities

The air emissions control equipment and kiln operations would not change with the proposed combustion of whole tires as fuel.

The ash particulates generated during the combustion process would be removed by an existing electrostatic precipitator (ESP) and fabric filter (FF), or "baghouse", system. Ash from the baghouse would accumulate in separate hoppers and would be carried by truck to the disposal area in the quarry or would be reused in the cement making process. An induced draft fan would move the flue gas through the kiln and create a negative pressure ensuring fugitive emissions do not occur at the tire injection point.

Storm Water and Monitoring Plans

The Holcim cement facility does not have a Storm Water Pollution Prevention Plan. All storm water discharges would need to meet the requirements of the facility's storm water Montana Pollutant Discharge Elimination System permit (DEQ, 2004). A monitoring plan has been

issued through DEQ's Environmental Management Bureau, and ground water monitoring systems for the quarry currently exist. These systems are required for the life of the facility. No additions to the monitoring system have been suggested or would be added because of the Proposed Action.

Solid Waste Disposal

Solid waste would consist primarily of fly ash from the ESP. Fly ash would consist of incombustible coal material entrained in the flue gas exhaust. Fly ash would be collected in the ESP and trucked to the on-site quarry.

2.3.3 Material Handling

Tire Handling System

A description of the tire handling facility was provided by Holcim (Feb. 11, 2004), based upon similar Holcim facilities. Figure 2.3-1 shows the approximate locations of the equipment and storage area. A single conveyor belt would deliver tires from the bins to the feeder system. A day's supply of tires would be as large as 31 tons, assuming injection of 3,117 tires per day at 20 to 25 pounds per tire. The feeder system would be about 12 feet high and cover about 2500 square feet.

Fire Safety Plan

Tire fires generate air pollutants and have the potential to produce oils as a fire progresses and some of the tires melt. The amount and type of air pollutants produced depend on the fire conditions. In general, as the burn rate and temperature of the fire increases, the amount of organic pollutants decreases. Some potentially harmful air pollutants that could be emitted include benzene, toluene, xylene, and a variety of polycyclic aromatic hydrocarbons. A standard car tire could produce approximately two gallons of oil. This oil would have to be contained to prevent runoff and possible pollution of surface water or groundwater.

The floor of the quarry would be sloped to a bermed area that would be large enough to contain the oil from melted tires as well as the fire fighting liquids. If there were a fire, the resulting liquids could be separated and treated or disposed of as appropriate.

Since the Holcim plant operates 24 hours per day, seven days per week, the tire storage area would be monitored during each work shift. Because tire fires are increasingly difficult to extinguish as time passes, Holcim personnel would be the first responders to any fire at the tire storage area. They would work to extinguish or contain the fire until the local volunteer fire department arrived. A tire fire would be fought according to a time sensitive plan.

During the initial stage of the fire, 0 to 15 minutes, individual tires would be burning, but the fire would not have extended to the rest of the tires in the trailer. At this time, the fire may be extinguished with water, foam, or wetting agents. Equipment would be used to remove burning tires if possible. Single or small groups of burning tires are relatively easily extinguished with sprayed water or foam or submersion in water. Equipment operators would be contacted to move other trailers away from the burning trailer, and the local volunteer fire department would be contacted.

During the next period, 15 to 30 minutes into the fire, the flame spread would be approximately 2 square feet every 5 minutes. Extinguishing the fire would become increasingly difficult. Plant personnel and/or fire fighters would continue to use water mist and foam to attempt to limit or remove oxygen from the fire and to cool the burning tires. Focus would continue to be on removing other trailers from the area. Workers would continue to attempt to remove burning tires from the mass. Other workers would begin to build an earthen berm around the burning tires separated from the main mass. Material for the berm would come from material stockpiled on the quarry floor. Fire fighters would apply foam to oil runoff streams and any other trailers that might be in danger of catching fire. At this point, soil might be brought in to be pushed over the burning mass. The need for plant evacuation would be carefully evaluated.

After 60 minutes of burning, the fuel consumption and heat production would begin to equalize. Combustion would become more efficient and produce enough heat to consume most combustible material. The downward pressure of the burning tire mass would tend to cause added runoff and increase the production of oil. A clay–like ash crust would be forming on the burning mass, preventing water from penetrating. At this stage, workers would finish removing trailers that are not involved in the fire. Berms would be bulldozed around the burning trailers to further contain runoff. If the fire were not extinguished by this time, the burning trailers would be allowed to continue to burn completely, so they could be buried at a later time. Removal, separation, treatment, and disposal of the runoff could begin.

If necessary, evacuation of plant personnel would follow Holcim's "Emergency Action Plan." Any public evacuation necessary in the area would be directed by the Gallatin County Sheriff's Department.

In the event of a fire, plant personnel would be familiar with the fire contact list which would include the Three Forks Volunteer Fire Department, Three Forks Police Department, Gallatin County Sheriff's Office; the Holcim plant manager, control room operator, safety manager, quarry manager, and environmental manager; Roadermel Construction for earth moving equipment, and Emerald Services for oil removal; DEQ's emergency response duty officer, Gallatin County Health Department, and Gallatin County Disaster and Emergency Services duty officer.

2.3.4 Construction

Project Schedule

DEQ expects that the construction schedule, from the start of contractor mobilization on site and preparatory foundation work, including startup, would take about six months. The exact time frame would depend upon the level of automation to be designed and the proposed tire feed rate. The installation of the kiln hardware depends on the normal annual kiln maintenance shut down period, and would be completed within a two-week period. All other construction is presumed to be contingent upon equipment purchases and design completion.

Construction Activities

The installation of the foundations and structures would be required for new equipment. Foundation construction would consist of excavation, form erection, reinforcement installation, concrete placement, and backfilling. During this stage, underground piping and electrical conduit would be installed between the building foundations. Major construction equipment used during this stage would consist of medium-sized mobile cranes, backhoes, dump trucks, concrete pumps, and concrete delivery trucks. Heavy material and equipment deliveries can be made by truck or railroad car during the next phase.

Structural steel erection would begin when foundations are sufficiently complete. Large cranes would be used to unload the steel members and raise them to their final location.

Other major equipment would begin arriving at the Trident facility for erection during the next construction phase, including storage bins, kiln gate, and conveyors.

Major equipment would be placed and interconnected mechanically and electrically during the next stage. Major construction equipment used during this stage would consist of medium-sized mobile cranes, flatbed trucks, welding machines, portable power generators and air compressors, and cable pulling equipment.

Access Road Construction

The cement plant site has many existing trails, roads and rail lines near the facility. Spur road construction and existing road and rail network upgrades would need to occur in order to allow access of covered trailers and equipment into the proposed storage site. This may involve re-grading. Equipment to construct the access roads would include hand tools, bulldozers, graders, and crew-haul vehicles. The road construction would probably be done by Holcim employees. Standard design techniques such as installing water bars and dips to control erosion should be included. In addition, measures should be taken to minimize rainwater ponding in low lying locations.

2.3.5 Mitigation Measures

DEQ cannot require mitigation measures without a request from the project proponent, unless they are regulatory requirements to ensure compliance with a permit (75-1-201(5)(b), MCA). Mitigation measures are discussed in section 4.11. Holcim may request that any or all of the mitigation measures be placed in the solid waste or air quality permits. If Holcim chooses not to include a mitigation measure in one of the permits, it may decide to perform the proposed mitigation voluntarily.

2.4 Alternatives Considered and Eliminated

DEQ has identified several alternatives to the project. Alternative fuels, production process, pollution control technologies, storage sites, and reduction in the percentage of tires to be used were considered. The alternatives described in this section were eliminated from further consideration because they did not meet the stated purpose and benefits of the Proposed Action or were found to be unreasonable for detailed analysis based on selection criteria. The screening criteria consisted of technical, logistic, economic, and regulatory considerations, potential

resource impacts, and reasonable/feasible criteria. A summary of the alternatives considered and eliminated is provided in Table 2.4-1.

2.4.1 Fuels

Alternative fuels include synthetic fuels (shale oil or tar sands), methane, biomass such as refuse derived fuel (RDF) and municipal solid waste (MSW), and processed tires (chunk, shredded, or crumb rubber, with or without the steel removed). They have all been successfully used as fuels in cement manufacturing, steam generation for electricity, and other industrial processes (EPA, 1997) but would not be feasible as the primary fuel for the Trident plant.

Tar sands, methane, RDF, MSW, and processed tires do not all compare favorably to coal. Whole and processed tires are the only fuels that have higher heating values and less moisture content than coal. Whole and processed tires contain more carbon, about as much sulfur as medium-sulfur coal, but much less fuel-bound nitrogen.

The logistics associated with tar sands, methane, and biomass fuels are restrictive, as no transportation systems are currently in place or would be available in the near future. While transportation of any of these fuel types would add to fuel costs, no studies have been completed to quantify these transportation costs.

The EPA has stated that using anything other than coal reduces air impacts. Whole tires also provide some added ingredients to the cement manufacturing process. Replacing whole tires with processed tires would require segregating, processing, chipping, and storing various tires and parts of tires. Processed tires would require complex burner management systems and would create additional waste streams. Therefore, processed tires as a fuel alternative was considered unreasonable economically and not feasible to meet the purpose and benefits of the project and therefore eliminated from further consideration.

All other alternative fuels considered here were eliminated from further consideration because they are not feasible due to a lack of production capacity, higher production and transportation costs, logistics, and required facility modifications. They also would not meet the purpose and benefits of the Proposed Action.

2.4.2 Conversion from Wet to Dry Kiln

Conversion of the kiln from a wet process to a dry process was considered. Holcim's Trident facility uses a wet kiln design. Many cement plants in the United States and other countries use the dry process because of its lower energy requirements (AWMA, 1992).

The essential difference between a wet process cement kiln and a dry process preheater cement kiln is the medium used to mix the powdered raw materials prior to heating and the consequent degree of moisture in the materials entering the kiln. In the wet method, water is added to the raw materials during milling to promote thorough mixing, and the mixture is added to the kiln as slurry containing 30 to 40 percent water. In the dry method, the powders are generally blended in a silo using compressed air.

If the material entering the kiln is wet, it stays cooler relatively longer. This in turn requires a longer kiln to provide sufficient residence time. Additional fuel is needed to drive off the water. One reason to choose the wet process is if the starting materials have high moisture content to begin with. The wet process was the dominant technology, presumably because, in the age of abundant cheap energy, it was cheaper to burn more fuel and add length to the kiln than to add extra devices. An advantage of wet kilns over dry kilns is that the feed is blended more uniformly and dust losses are smaller (Portland Cement Association, 2004).

Newer kilns use the dry method. There is a substantial energy saving involved, as well as a higher production rate. Several subtypes of the dry method have evolved in recent years. In the earlier versions, the kilns were shortened to take advantage of the shorter residence time required. Since hot air emerged from the upper end of the kiln at a higher temperature than with the wet method, it became advantageous to capture the heat and use it to run utility boilers to generate electricity, resulting in a cost savings for the plant as a whole. Alternatively, the kiln could be lengthened, and heat exchangers could be added to the upper end to retain more of the flame's heat inside the process area. This would increase the heat transfer efficiency.
The advantages of the dry process became more apparent with the addition of pretreatment equipment to condition the powdered raw materials before their introduction to the kiln. One pretreatment method uses suspension "preheaters" to transfer heat from the kiln exhaust gases to the incoming material, which both improves heat transfer and promotes good mixing. Another kind of pretreatment equipment, called a "precalciner", pumps even more heat into the pretreatment phase, often combining some additional fuel with preheated air from the clinker cooling stage. The precalciner system is the most energy efficient arrangement with the highest production rate and the shortest kiln. It is slowly replacing earlier technologies. These alternatives were eliminated as they are connected with the dry process kiln and are not compatible with the present wet kiln process. Holcim has stated that the primary purpose in seeking approval for combustion of whole tires to supplement 15 percent of the required fuel input for the kiln is to realize lower operating costs and to increase operational flexibility (Holcim, 2004).

A wet process kiln uses considerably more energy to remove water from the slurry compared to a dry-process kiln where raw materials are fed into the kiln as crushed solids. Average energy use in a wet-process kiln is 4.5 million Btu per ton of clinker produced. Average energy use in a dry-process kiln is 3.5 to 4.0 million Btu per ton of clinker produced but can be lower if a suspension preheater and precalciner are used (2.9 to 3.4 million Btu/ton). Holcim reports its current energy use is 5.71 million Btu/ton of clinker (Holcim, 2004).

In addition to reductions in energy consumption with a dry kiln, the dry process also has lower NO_x, SO_2, particulates, and carbon dioxide (CO_2) emissions.

Conversion of the wet process kiln at Trident to a dry process kiln would be expensive. Holcim's Devil's Slide plant in Utah was converted in 1998 at a cost of $133 million. Using a producer price index of 10 percent to convert to 2004 dollars, conversion of the Trident kiln would cost about $146 million.

The modification to a dry kiln was not considered reasonable due to the increased costs associated with the major capital equipment requirements. This alternative was eliminated because it would not meet the stated purpose and benefits of the project.

2.4.3 Off-Site Tire Storage

An off-site tire storage facility was considered and eliminated.

Alternative locations for tire storage were viewed as logistically not suitable to the purpose and benefits of the project. Alternative sites are not close enough to major transportation routes (i.e., both interstate highways and railroad systems) to allow for the transitional storage, transport and receipt of tires. Tire transportation from off-site storage would be more expensive.

Other locations that were adjacent to the plant were considered, evaluated and eliminated as potential tire storage sites; these sites were not accessible or close to the kiln, unavailable for purchase, and did not have adequate topography and drainage. The economics of the project are based on the availability of an abundant supply of tires on-site in the immediate vicinity of the kiln.

The proposed tire storage site location in the quarry is the best available option from both an environmental and an economic standpoint.

The off-site tire storage facility alternative was eliminated because it was not logistically reasonable or economically feasible to meet the needs as a fuel supply for the facility.

2.4.4 Reduction in Percentage of Tires Used

In a recent tire burning emissions report by the California Air Resources Board to the California Legislature, it was found that in 2001, the State of California permitted 11 facilities to burn tires (CARB, 2002). Only four of these facilities burned tires. The tires were burned as supplemental fuel, usually 10 percent tire to 90 percent coal. About 5.4 million tires were burned in this manner in 2001. In general, tires and coal emit the same levels of criteria pollutants when burned, except for nitrogen oxides. Toxic air pollutants included acetaldehyde, benzene, dioxins, formaldehyde, furans, hexavalent chromium, other heavy metals, and PAHs. The CARB report concluded that the levels of toxics emitted for units burning the 10 percent tire and 90 percent coal fuel mixture did not constitute a significant increase in the health risk to the exposed public (CARB, 2002). Reduction in the use of waste tires to 10 percent of supplemental fuel also reduces nitrogen oxides.

The proposed reduction of tire usage was eliminated because the recent risk assessment concluded that the levels of toxics associated with the proposed action did not exceed Montana's negligible risk level. Therefore, this alternative was eliminated for economic reasons, as it would not meet the purpose and benefits of reducing fuel costs for the facility.

Table 2.4-1 Screening Criteria of Alternatives Considered and Eliminated

	Alternative Fuels						
Screening Criteria	**Synthetic Fuels (e.g., shale oil, tar sands, etc.)**	**Coal Bed Methane**	**Biomass**	**Processed Tires**	**Dry Process Kiln**	**10% Tire Use as Fuel**	**Off-Site Tire Storage**
Technical	Technically feasible, but would not be feasible under current design. Insufficient fuel for proposed load.	Technically feasible, but would not be feasible under current design. Source not readily available.	Technically feasible, however no RDF or MSW feasible under current design and for this type of facility. Design is totally different and tied to biomass supplies.	Technically feasible.	Processes would require re-design. Major Modifications would be needed. Efficiency would increase.	10% would require less storage area.	Technically feasible.
Logistics	There are no conveyances available for fuel supply.	A conveyance would have to be built to the nearest commercial transportation pipeline.	There are no conveyances available for fuel supply.	Would require completely new facility modification and design and handling logistics to burn TDF.	Would require completely new facility design. This system would burn less fuel for same BTU output.	Similar to the Proposed Action.	Requires a new assessment of access roads and accessible land.
Economics	Economics of the facility would rely upon an abundant supply of fuel in the immediate vicinity, of which there are none.	Economics of the facility would rely upon an abundant supply of fuel in the immediate vicinity, of which there are none.	Economics of the fuel types are infeasible and cost prohibitive.	No cost analyses were performed for this type of design change.	Conversion would cost about $146 million.	Would not be as cost efficient as the Proposed Action in reducing fuel costs at the facility.	Assume costs are similar or somewhat higher because of additional logistics to coordinate tire solid waste storage.

Regulatory Considerations	No expected changes in regulation except that new emission rates would have to be calculated and modeled.	No expected changes in regulation except that new emission rates would have to be calculated and modeled.	No expected changes in regulation except that new emission rates would have to be calculated and modeled.	No expected changes in regulation except that new emission rates would have to be calculated and modeled.	No expected changes in regulation except that new emission rates would have to be calculated and modeled.	New emission rates would have to be calculated and modeled.	Solid waste permit would need to be modified to accommodate logistics and handling of whole tires on a new site as well as a closure plan.
Potential Resource Impacts	Air impacts would be new and could affect SO_2.	Air impacts would be minimized due to gaseous fuels.	Air impacts would be minimized and new impacts would be associated with RDF and MSW.	Similar to Proposed Action after air quality mitigation.	Air emissions would be similar to Proposed Action.	Similar impacts to using 15% tires as fuels.	Could aggravate exposure to groundwater impacts as this may be different than the quarry.
Reasonable/ Feasible	Not economically feasible because of deliverability and would not meet the stated purpose and benefits for the Proposed Action.	Not economically feasible because of deliverability and would not meet the stated purpose and benefits for the Proposed Action.	Not reasonable because of fuel transportation costs and increased cost of logistics, and would not meet the stated purpose and benefits for the Proposed Action.	Not reasonable because increased costs and additional waste streams would make the project infeasible, thus not meeting the stated purpose and benefits for the Proposed Action.	Not reasonable because increased costs would make the project infeasible, thus not meeting the stated purpose and benefits for the Proposed Action.	Similar to the Proposed Action.	Not logistically reasonable or economically feasible to meet the needs as a fuel supply for the facility.

2.5 Alternatives to the Proposed Action

2.5.1 No Action Alternative

Under the No Action Alternative, the tire storage facility and the conveyor system to the kiln would not be constructed. DEQ would not issue the Solid Waste License and would not modify Permit #0982. Existing operations would continue as described in Section 2.2.

2.6 Comparison of Alternatives

The only alternative to the Proposed Action that has been compared is the No Action Alternative described above. Table 2.6-1 presents a summary comparison of the impacts. Further details of the impacts are presented in Chapter 4.

2.7 Selected Alternative

The rules implementing MEPA (ARM 17.4.617) require that DEQ indicate a preferred alternative, if one has been identified. Stating a preference at this time is not a final decision. The preferred alternative could change in response to public comment on the Draft EIS, new information that becomes available, or new analysis that might be needed in preparing the Final EIS. At this time, DEQ does not have a preferred alternative. DEQ has tentatively selected the Proposed Action, which would be modified by permit conditions.

2.7.1 Rationale

Holcim has demonstrated compliance with all applicable statutes and rules , as required for permit issuance. Conditions and limitations contained in the permit (Appendix C) would ensure the facility could operate in compliance with all applicable rules and regulations. Slag use would be limited to no more than 15,000 metric tons (16,535 tons) in a rolling 12-month time period, and DEQ would encourage Holcim to find other sources of iron.

Therefore, the No Action Alternative would not be appropriate and would not provide the cost savings that is the goal of the Proposed Action.

Table 2.6-1 Summary of Impacts

	Proposed Action	No Action
Air Quality	Some HAPs emissions from the kiln, such as mercury, would increase, some would decrease, and others would remain about the same.	No change from existing emissions.
	Most kiln dust HAPs emissions would decrease.	No change from existing emissions.
	Criteria pollutants would remain about the same, except that CO would increase but would still comply with MAAQS and NAAQS.	No change from existing emissions.
	Peak 1-hour dispersion coefficients (ratio between ambient concentration and emission rate) would decrease by a factor of 100 from the plant property boundary to Bozeman. Annual average dispersion coefficients would decrease by the same factor.	Same as the Proposed Action.
Human Health Risk	Non-cancer hazard quotients and indices would be less than 1.0.	Same as the Proposed Action.
	Blood lead levels at the worst-case location would be 12 percent of EPA's recommended limit.	Same as the Proposed Action.
	Cancer risk for individual pollutants at the worst-case location (plant property boundary) would not exceed 1 x 10^{-6} under the average exposure scenario. Cancer risk for individual pollutants and the aggregate of all pollutants would not exceed Montana's negligible risk level for communities in the Three Forks to Bozeman area under the average and high-end exposure scenarios.	Same as the Proposed Action.
	Cancer risk from eating 74 pounds per year of fish caught locally from rivers (high-end exposure scenario) would be below 1 x 10^{-6}.	Essentially the same as the Proposed Action.
	Cancer risk from eating a substantial amount of fish caught from local ponds over a lifetime could result in risk of greater than 1 x $10^{-6}$for individual pollutants (principally dioxin and PCBs), depending o the location, configuration, and hydrologic properties of the pond.	Essentially the same as the Proposed Action.
	Cancer risk from eating, over a lifetime, as much as 126 pounds per year of deer killed in the area would be below 1 x 10^{-6}.	Essentially the same as the Proposed Action.
Ecological Risk	Hazard index for carnivorous birds (e.g., red-tailed hawk) would be as high as 7 at the worst-case location, and the hazard index for avian omnivore (e.g., robin) would be as high as 1, depending on input assumptions. Hazard index at the worst-case location for all other plant and animal groups would be less than 1. For the area surrounding the facility, hazard indices for all species are below 1, indicating no hazard to the broader ecosystem.	Same as Proposed Action except robin would be 1.0.
Transportation	Daily truck trips would increase by 3.6 per day (1,300 per year), about 0.5% of current traffic level.	No additional truck traffic.
Property Taxes	An additional $10,720 for Gallatin County and $3,480 for the state.	No change in property tax revenue.

CHAPTER 3
AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the existing environmental conditions that could be affected by the Proposed Action or alternatives to the Proposed Action. The Proposed Action is described in detail in Chapter 2, and Figure 1.1-1 provides a project location map. This chapter will describe the environmental conditions of the project area relative to natural, social, and cultural resources. The descriptions of the affected environment provide a basis to evaluate potential impacts of the Proposed Action and the No Action Alternative in Chapter 4. The methods and study areas used to inventory existing environmental conditions varied among the resources and are summarized in each resource section. Specific resources evaluated in this chapter include:

- Air Quality
- Soils
- Water Quality
- Wildlife
- Vegetation and Wetlands
- Fisheries and Aquatics
- Land Use
- Transportation and Public Services
- Cultural Resources
- Socioeconomics

3.2 Air Quality

The air quality inventory establishes the baseline conditions by which several important issues identified during the scoping process will be analyzed. For example, risks to human health and to the environment are determined by the way certain incremental or cumulative emission constituents would be transported away from the plant during operations. These impacts and risks are identified in Chapter 4.

The emission of air pollutants is regulated under both federal and Montana state laws and administrative rules. The federal Clean Air Act (CAA) and the subsequent Clean Air Act Amendments of 1990 (CAAA) require the EPA to identify National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. The CAA and CAAA established NAAQS for six pollutants known as “criteria” pollutants. Primary NAAQS and Montana Ambient Air Quality standards (MAAQS) are established at a level designed to protect public health with an adequate margin of safety. Secondary NAAQS have also been established, “based on criteria requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of [the] pollutant in the ambient air" (EPA).
In addition to the MAAQS and NAAQS, EPA has provided an additional level of air quality protection under the regulations of the Prevention of Significant Deterioration (PSD) program.

The PSD regulations contain "PSD Increments," which are maximum allowable increases above the baseline ambient concentration. The PSD Increments are 20-40 percent of the NAAQS for the specific pollutant and averaging period. Areas of the state that are subject to the PSD program are described in Section 3.2.2.6.

Section 3.2.2.1 describes the local meteorological conditions in the Trident area and the greater Gallatin Valley. Types and general sources of regulated air pollutants are described in Section 3.2.2.2. Ambient air quality standards, ambient air quality monitoring data, and other local pollution sources are described in Sections 3.2.2.3 and 3.2.2.4. Section 3.2.2.5 discusses air pollutant emissions from portland cement plants in general, and Holcim's Trident plant in particular. Regulatory requirements specific to the Trident facility are discussed in Section 3.2.2.6, and Section 3.2.2.7 summarizes the recent compliance history of the Trident facility.

3.2.1 Inventory Methods

Temperature and precipitation data for the study area were obtained from the Western Regional Climate Center (WRCC). These data include mean temperature and precipitation levels by month from 1971 through 2000. This 30-year period is the current standard for identifying long-term average temperature and precipitation levels in the United States.

Wind speed and direction in the Trident area were determined by data collected at the Holcim site between April 1, 2000 and March 31, 2001, and from DEQ's monitoring data. The Trident meteorological monitoring site was installed by Holcim to collect data for air dispersion modeling. The station measured hourly average wind speed, wind direction, and ambient air temperature.
Wind conditions in the Gallatin Valley were determined from data collected by the National Oceanic and Atmospheric Administration (NOAA) and Federal Aviation Administration (FAA) Automated Surface Observing System (ASOS) station located at the Bozeman-Belgrade airport. ASOS data from April 1, 2000 through March 31, 2001 have been included to allow direct comparison with the Trident wind data collected by Holcim.

Data from monitoring particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) from Bozeman and Belgrade for the past ten years have been included in this chapter for background information. The data were collected by DEQ and are posted on EPA's ambient air monitoring data website.

3.2.2 Inventory Results

Local Meteorology

Meteorological data are provided for both the Trident area and the Gallatin Valley, which lies southeast of Trident. The Gallatin Valley is home to agricultural production and urban populations. Data from the Bozeman-Belgrade airport are used to represent the meteorological conditions of the Gallatin Valley. Temperature, precipitation, wind speed, and wind direction data are available for both Trident and Belgrade.

Local topographic variations impact the meteorology and climatic conditions at Trident and Belgrade. Trident lies along the Missouri River, in a valley formed by the river bluffs to the west

and the Horseshoe Hills to the east. The bluffs are roughly 400 feet higher than the river valley and strongly influence the wind patterns along the Missouri River valley.

Belgrade is approximately 20 miles southeast of Trident, near the center of the Gallatin Valley. The Gallatin Valley is aligned southeast to northwest, and is approximately 12 miles wide and 20 miles long. Wind directions in the Gallatin Valley are dominated by prevailing southeasterly winds from the high elevations of the Gallatin Range.

Wind Speed and Direction

The Trident meteorological station was located on the Holcim property 1,228 feet (374 meters) southwest of the kiln stack. The purpose of the monitoring station was to provide data for kiln stack modeling; therefore, meteorological sensors were located at the same elevation as the kiln exhaust. Elevation at the Holcim meteorological station was 4,132 feet above mean sea level (ft msl), and the height of the meteorological tower was 33 feet (10 meters) above the ground. Elevation of the wind speed and wind direction sensors was 4,165 ft msl. Elevation at the kiln stack base is 4,035 ft msl, and the kiln stack height is 130 feet, resulting in a kiln stack exhaust elevation of 4,165 ft msl (Holcim, 2004).

Bluffs along the west bank of the Missouri River across from the Holcim facility rise to elevations of nearly 4,500 ft msl. The hills east and southeast of the facility are also 4,500 ft msl or higher. Wind patterns recorded at Holcim's meteorological station show the influences of this confining terrain, causing the wind to follow the Missouri River in a southwest-northeast orientation. Figure 3.2-1 contains a wind rose showing the monitored wind patterns at the Holcim site. The wind rose shows the frequency of winds from each of 16 cardinal directions (north, north-northeast, northeast, etc.). The length of each 'petal' indicates the frequency of winds blowing from that direction. As described in the legend, the bands in the petals indicate the frequency of the listed wind speeds.

The wind rose for the Holcim site shows a strong southwest-northeast orientation of the wind pattern, as would be expected due to the topography of the monitoring site. As shown in the figure, about 25 percent of the hourly average wind directions were from the southwest and about 13 percent of the hourly average wind directions were from the north-northeast. The strongest (highest velocity) winds were from the north-northeast, as shown by the relatively large dark section at the end of the north-northeast petal of the wind rose. The dark sections indicate wind speeds greater than 10.8 meters per second (m/s) or 24 miles per hour (mph).

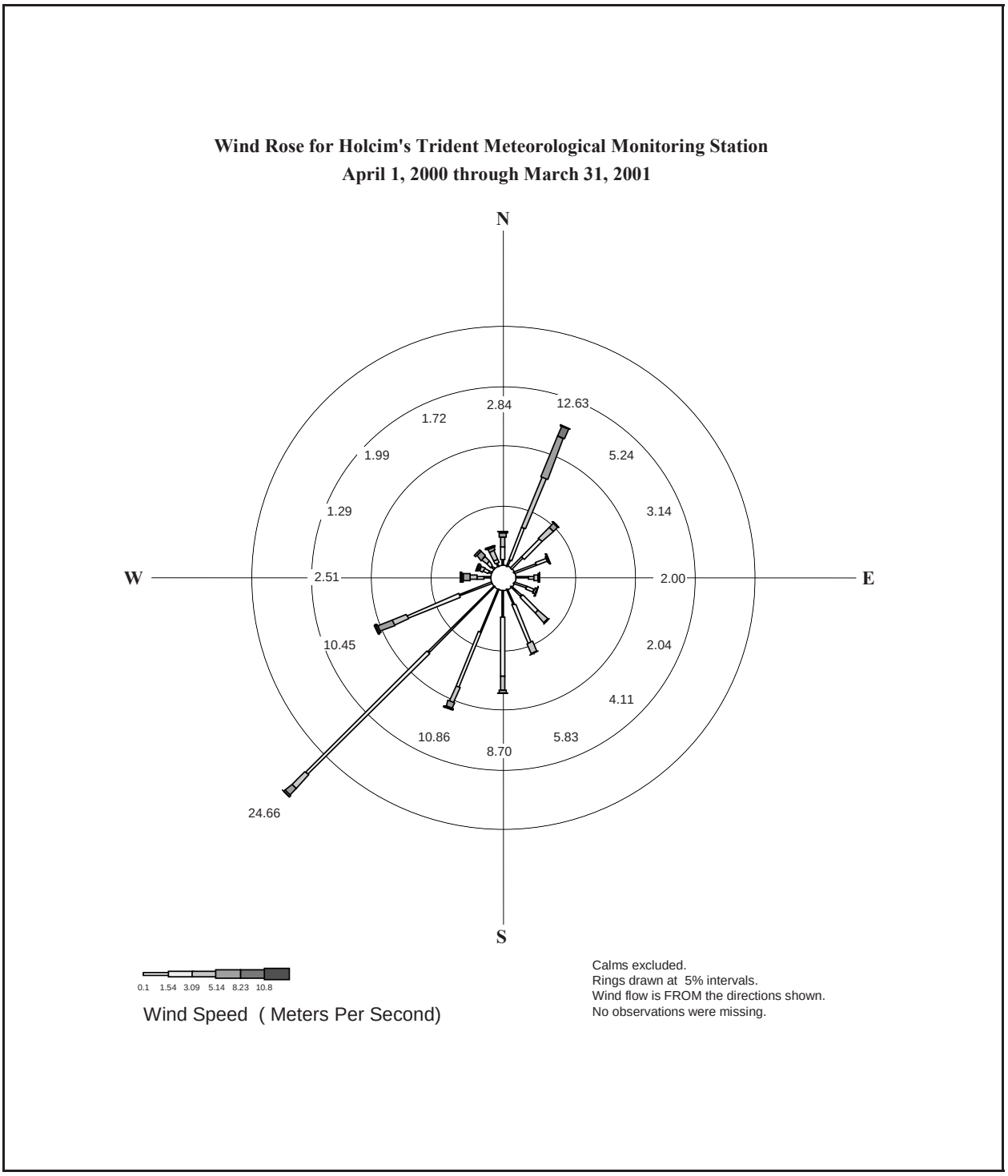


Figure 3.2-1 Wind Rose for Holcim's Trident Meteorological Monitoring Station

Wind conditions in the Gallatin Valley are represented by data collected by the NOAA/FAA ASOS station located at the Bozeman-Belgrade airport. ASOS is an automated observing system being sponsored by the FAA, NOAA, and the Department of Defense. ASOS provides weather observations including: temperature, dew point, wind speed and direction, altimeter setting, visibility, sky condition, and precipitation. Automated observing systems are designed to

provide pilots and other users with airport weather observations, when they are needed. The site identification number for the Belgrade airport ASOS station is WBAN #24132 and the call sign for the site is BZN (WRCC).

Elevation of the ASOS station site is 4,427 ft msl and the meteorological tower is 33 ft, making the elevation of the wind speed and direction sensors 4,460 ft msl. Topography surrounding the Bozeman-Belgrade airport is generally flat, sloping gently toward the Horseshoe Hills to the north. The foothills of the Gallatin Range lie 14 miles southeast of Belgrade, and the north-south trending Bridger Mountains are located about 8 miles east of Belgrade.

Figure 3.2-2 is a wind rose showing the monitored wind patterns at the Bozeman-Belgrade Airport ASOS station during the period corresponding to the Holcim monitoring at Trident. The dominant wind pattern is from the southeast, indicating prevalent winds from the high elevations of the Gallatin Range. As shown in the figure, about 12 percent of the hourly wind direction readings were from the southeast and about 12 percent were from the south-southeast. The strongest (highest velocity) winds were from the west and northwest, as indicated by the dark sections at the ends of those petals of the wind rose.

Data reported on the WRCC website for the BZN ASOS station are based on unedited surface data designed to provide information primarily for aircraft. Data from the ASOS station would not be suitable for computer simulated air dispersion modeling due to the unreliability of automated cloud cover observations and an unrepresentative number of calm wind hours reported. Hourly wind speed and direction readings are based on a 2-minute average just prior to the observation time. The ASOS station makes additional readings between the scheduled hourly readings, as needed, to indicate changes in weather conditions. The wind speed is reported in knots, and the wind direction is reported to the nearest 10 degrees. If the wind direction varies by 60 degrees or more during the 2-minute evaluation period, it is reported as variable (VRB). The variable readings were replaced with the average of the readings before and after the variable reading and only the scheduled hourly readings were used for developing the wind rose.

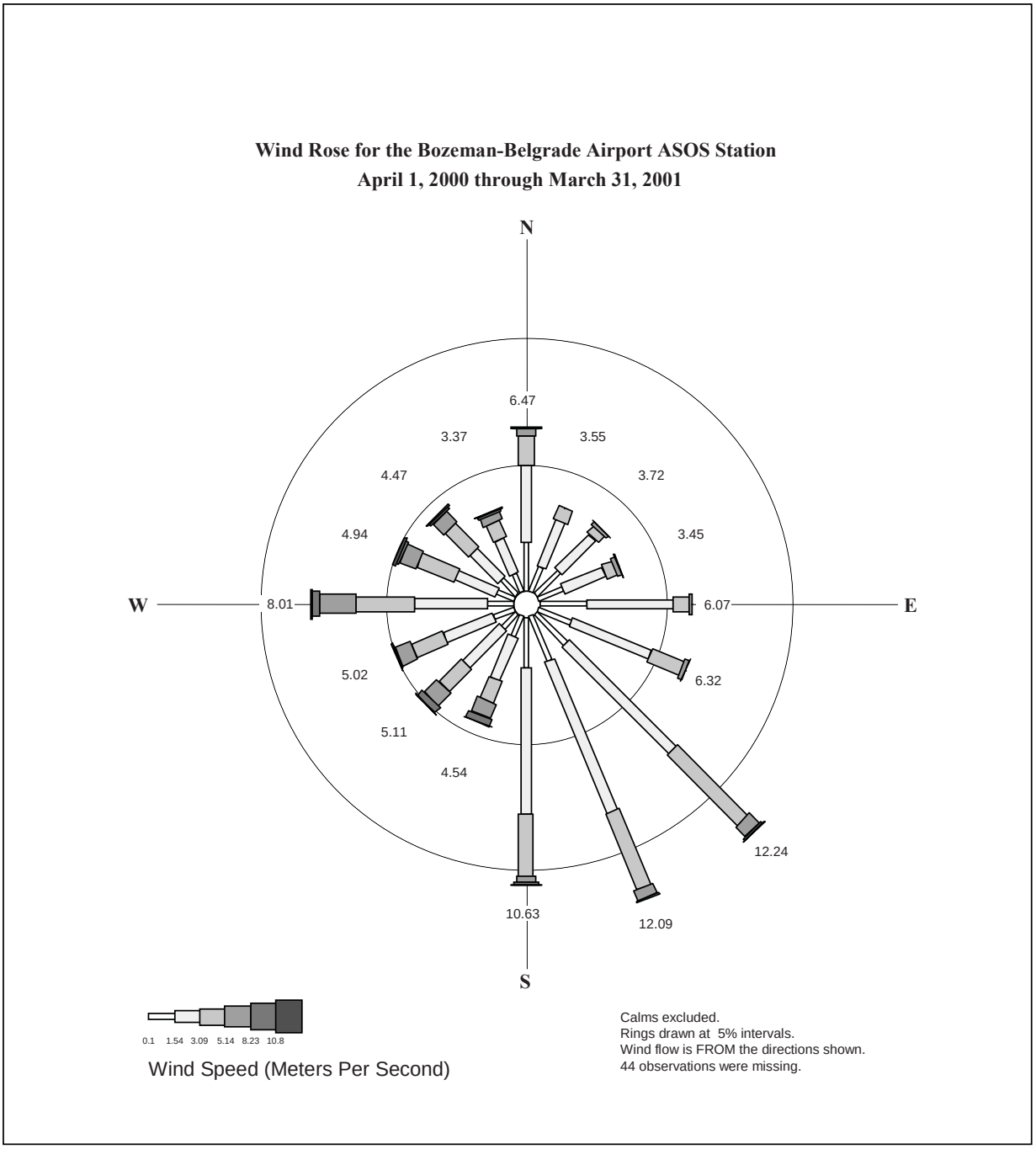


Figure 3.2-2 Wind Rose for the Bozeman-Belgrade Airport ASOS Station

Temperature and Precipitation

The NOAA Cooperative Observer Network has had observers located at both Trident and Belgrade since 1948. The observers record daily temperature and precipitation, which are used by National Climatic Data Center (NCDC) to develop monthly normals. The most recent period of record spans the years from 1971 through 2000.

The data in Tables 3.2-1 and 3.2-2 show that temperatures are generally lower at the Belgrade airport than at the Trident observation site. The mean daily temperature recorded at Trident during the period of record varied from a maximum of 68.5 degrees Fahrenheit (°F) in July, to a minimum of 22.9°F in January. The mean daily temperature recorded at Belgrade during the same period varied from a maximum of 65.3°F in July, to a minimum of 18.6°F in January. Annual precipitation for the period of record is almost two inches more at Belgrade than at Trident. Mean annual precipitation for the 30-year period of record was 12.85 inches at Trident and 14.71 inches at Belgrade. The heaviest precipitation amounts at both sites occurred in the months of May and June.

Table 3.2-1 Trident, Montana Temperature & Precipitation Summary/Period of Record: 1971-2000

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature (degrees F)													
Max	34.0	40.6	48.8	58.8	68.2	77.5	85.5	85.2	73.8	60.9	43.5	35.0	59.3
Min	11.8	17.1	24.3	31.06	39.7	46.9	51.4	49.7	40.3	31.7	21.1	12.7	31.5
Mean	22.9	28.9	36.6	45.1	54.0	62.2	68.5	67.5	57.1	46.21	32.3	23.9	45.4
Precipitation (inches)													
Max	1.34	1.54	1.88	2.44	5.50	5.47	5.57	2.76	3.50	2.68	1.31	0.95	5.57
Min	0.01	0.00	0.11	0.00	0.73	0.40	0.02	0.00	0.01	0.00	0.00	0.04	0.00
Mean	0.37	0.29	0.71	1.15	2.33	2.16	1.50	1.18	1.41	0.92	0.54	0.29	12.85*

Note:* Total Annual Precipitation
Source: NOAA, Western Regional Climate Center, 2004

Table 3.2-2 Belgrade, Montana Temperature & Precipitation Summary Period of Record: 1971-2000

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature (degrees F)													
Max	29.6	36.1	44.6	55.1	64.4	74.2	83.6	82.9	70.7	57.8	40.3	30.6	55.8
Min	7.6	13.5	21.0	29.0	37.1	43.8	48.8	47.6	38.5	28.8	17.1	8.0	28.4
Mean	18.6	24.8	32.8	42.1	50.8	59.0	66.2	65.3	54.6	43.3	28.7	19.3	42.1
Precipitation (inches)													
Max	1.69	1.52	2.36	2.69	6.20	4.68	4.62	2.17	3.17	3.17	1.64	1.61	6.20
Min	0.07	0.09	0.39	0.22	0.73	0.27	0.09	0.17	1.43	0.01	0.18	0.09	0.01
Mean	0.60	0.54	1.02	1.40	2.49	2.41	1.19	1.14	0.04	1.11	0.81	0.57	14.71*

Note: * Total Annual Precipitation
Source: NOAA, Western Regional Climate Center, 2004

Air Pollutants

Human activities and natural events generate gaseous and particulate air pollution. The most common form of air pollution is particulate matter or dust. Particulate matter can become airborne due to wind erosion, soil tilling, and vehicle traffic on paved and unpaved roads. Smoke from forest fires, agricultural burning, industrial sources and residential heating is also an important source of particulate matter pollution.

Most gaseous pollutants are generated by combustion activities. Combustion of organic fuels containing hydrogen and carbon results in the formation of carbon dioxide (CO_2) and water vapor. Incomplete combustion of carbon results in the formation of carbon monoxide (CO). Volatile organic compounds (VOCS) can be emitted as a result of unburned fuel or can be formed in the combustion process. Combustion causes the formation of nitrogen oxides (NO_x) emissions due to oxidation of nitrogen in the combustion air and in the fuel. Sulfur dioxide (SO_2) is also formed as a result of the oxidation of sulfur in the fuel during the combustion process. Combustion sources can emit trace amounts of hazardous air pollutants (HAPs), including organic compounds and hazardous metals compounds. The HAPs can be a portion of the unburned fuel or raw material or can be generated during combustion.

Criteria Air Pollutants

NAAQS and MAAQS for criteria air pollutants have been established based on health-based criteria. The gaseous criteria pollutants are CO, SO_2, ozone, and nitrogen dioxide (NO_2). Lead (Pb) and particulate matter (PM) are solid or particulate phase criteria pollutants. Ozone is formed in the environment as a result of photochemical reactions involving other pollutants. VOC emissions are regulated because they can contribute to the formation of ozone. Criteria pollutants are important because they endanger public health and the environment, are widespread throughout the U.S., and come from a variety of sources.
Federal and state air quality standards have been established for two sizes of particulate matter: particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) and particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$). States and other agencies are gathering $PM_{2.5}$ data to determine the existing ambient concentrations of this particulate size fraction.

Hazardous Air Pollutants

HAPs, also known as air toxics, are those pollutants that are known or suspected to cause cancer or other serious health or environmental effects (EPA Toxics). HAPs are emitted in much lower quantities than the more common criteria air pollutants and are generally not found in the ambient environment in measurable amounts. EPA has identified 188 HAPs, which are included on the Hazardous Air Pollutants List (as defined in Section 112(b) of the CAA). The formation and emissions of HAPs from industrial sources are regulated through the National Emission Standards for Hazardous Air Pollutants (NESHAPs).

According to EPA's Air Toxics website, "people exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of getting cancer or experiencing other serious health effects. These health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, respiratory, and other

health problems. In addition to exposure from breathing air toxics, some toxic air pollutants such as mercury, can deposit onto soils or surface waters, where they are taken up by plants and ingested by animals and are eventually magnified up through the food chain. Like humans, animals may experience health problems if exposed to sufficient quantities of air toxics over time."

DEQ has identified general source categories of HAPs in Montana. Point sources include the oil and gas industry, mineral extraction and processing, chemical and cement plants, and the wood products industry. Area wide sources include dry cleaners, gas stations, residential woodstoves, and fireplaces and motor vehicle repair/refinishing facilities. Mobile sources include tailpipe emissions from automobiles, trains, and airplanes.

The main source of HAPs emissions from a portland cement plant is the kiln. Emissions originate from the burning of fuels and heating of feed materials. HAPs are also emitted from the grinding, cooling, and materials handling steps in the manufacturing process (EPA, March 2002).

Opacity

Opacity is a measure of the visibility of an air contaminant plume. Visible emissions can result from fugitive sources such as road dust, field tilling, or smoke. Visible emissions can also result from industrial sources, including material handling equipment and combustion sources. Although there is no numerical correlation between excess opacity and excess particulate emissions, increased opacity generally indicates increased particulate matter emissions. Causes of exceeded opacity can include start up, shutdown, process upsets, problems with air pollution control equipment or electrical power surges.

Opacity is defined in Montana's air quality regulations as "the degree, expressed in percent, to which emissions reduce the transmission of light and obscure the view of an object in the background (ARM 17.8.101(27))." Opacity does not include the steam vapor from a point source. If steam is present, the opacity can be measured only at the point in the plume where the steam dissipates. It is possible to measure stack gas opacity inside a large stack if the temperature is high enough to prevent water vapor from condensing within the stack.

Ambient Air Quality Standards

The MAAQS and NAAQS are listed in Table 3.2-3. These standards may not be exceeded in areas where the general public has access. National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health. National secondary standards are the levels of air quality necessary to protect the public welfare from known or anticipated adverse effects of a regulated air pollutant (40 CFR 50).

Table 3.2-3 Montana and National Ambient Air Quality Standards

Pollutant	Time Period	Federal (NAAQS)	Montana (MAAQS)	Standard type
Carbon Monoxide	Hourly Average	35 ppm [1 2] (40,000 µg/m^3)	23 ppm [b] (26,450 µg/m^3)	Primary
	8-hour Average	9.0 ppm [1] (10,000 µg/m^3)	9.0 ppm [b] (10,350 µg/m^3)	Primary
Hydrogen Sulfide	Hourly Average	- -	0.05 ppm [b]	- -
Lead	90-day Average	- -	1.5 µg/m^3 [c]	- -
	Quarterly Average	1.5 µg/m^3 [c]	- -	Primary & Sec.
Nitrogen Dioxide	Hourly Average	- -	0.30 ppm [b] (564 µg/m^3)	- -
	Annual Average	0.053 ppm [d] (100 µg/m^3)	0.05 ppm [e] (94 µg/m^3)	Primary & Sec.
Ozone	Hourly Average	0.12 ppm [f] (235 µg/m^3)	0.10 ppm [b] (196 µg/m^3)	Primary & Sec.
	8-hour Average	0.08 ppm [g] (157 µg/m^3)	- -	Primary & Sec.
PM_{10}	24-hour Average	150 µg/m^3 [k]	150 µg/m^3 [k]	Primary & Sec.
	Annual Average	50 µg/m^3 [l]	50 µg/m^3 [l]	Primary & Sec.
$PM_{2.5}$	24-hour Average	65 µg/m^3 [m]	- -	Primary & Sec.
	Annual Average	15 µg/m^3 [n]	- -	Primary & Sec.
Sulfur Dioxide	Hourly Average	- -	0.50 ppm [h] (1300 µg/m^3)	- -
	3-hour Average	0.50 ppm [a] (1300 µg/m^3)	- -	Secondary
	24-hour Average	0.14 ppm [a,i] (365 µg/m^3)	0.10 ppm [b,j] (262 µg/m^3)	Primary
	Annual Average	0.03 ppm [d] (80 µg/m^3)	0.02 ppm [e] (52 µg/m^3)	Primary

Notes:
[1] Federal violation when exceeded more than once over any 12 consecutive months.
[2] ppm parts per million
[3] µg/m micrograms per cubic meter
[a] Federal violation when exceeded more than once per calendar year.
[b] State violation when exceeded more than once over any 12 consecutive months.
[c] Not to be exceeded (ever) for the averaging time period as described in the state and/or federal regulation.
[d] Federal violation when the annual arithmetic mean concentration for a calendar year exceeds the standard.
[e] State violation when the arithmetic average over any four consecutive quarters exceeds the standard.
[f] Applies only to nonattainment areas designated before the 8-hour standard was approved in July, 1997. Montana has none.
[g] Federal violation when 3-year average of the annual 4th-highest daily max. 8-hour concentration exceeds standard.
[h] State violation when exceeded more than eighteen times in any 12 consecutive months.
[i] Federal standard is based upon a calendar day (midnight to midnight).
[j] State standard is based upon 24-consecutive hours (rolling).
[k] State and federal violation when more than one expected exceedance per calendar year, averaged over 3-years.
[l] State and Federal violation when the 3-year average of the arithmetic means over a calendar year at each monitoring site exceed the standard.
[m] Federal violation when 3-year average of the 98th percentile values at each monitoring site exceed the standard.
[n] Federal violation when 3-year average of the spatially averaged calendar year means exceed the standard.
Sources: MAAQS: ARM 17.8.201 et seq., Ambient Air Quality, NAAQS: Title 40 CFR 50.

Existing Air Quality

DEQ monitors ambient levels of criteria pollutants in areas where the department determines there may be a potential for elevated ambient concentrations of a particular pollutant. The monitoring data are used to determine whether air quality in the area complies with the MAAQS and NAAQS. If monitoring data show that a violation of the MAAQS or NAAQS has occurred, the area may be designated as a non-attainment area. Air quality in Gallatin County is classified as attainment for all criteria pollutants. The closest nonattainment area to Trident is the city of Butte, which is nonattainment for PM_{10}.

Air Quality Monitoring Data

PM_{10} is a problematic pollutant for many parts of Montana, including the Gallatin Valley. Sources of PM_{10} include industrial sources, motor vehicles, agricultural activities, forest fires, mining, road dust, and residential wood smoke. The PM_{10} areas of most concern in Gallatin County are within the towns of Bozeman and Belgrade (DEQ, July 2003).

DEQ has monitored PM_{10} and $PM_{2.5}$ in Bozeman and Belgrade for several years. Only the Belgrade monitoring station is currently being operated. Ambient samples for PM_{10} and $PM_{2.5}$ are taken every 3 days during fall and winter and every 6 days the rest of the year. Running all samplers on the same days allows reviewing agencies to determine which data were affected by an event that caused an anomalous reading. For example, high PM_{10} readings were flagged and omitted from both the Belgrade and Bozeman data sets on August 16, 2000, due to effects from forest fire smoke (EPA AirData).

A comparison of PM_{10} and $PM_{2.5}$ monitoring data from the year 2000 revealed a ratio between $PM_{2.5}$ and PM_{10} readings of 0.43. This indicates that 43 percent of the particulate matter smaller than 10 microns was smaller than 2.5 microns. According to DEQ, this indicates a normal ratio of smoke ($PM_{2.5}$) to dust (PM_{10}) (DEQ, July 2003). The most recent available ten years of data from the Bozeman and Belgrade PM_{10} monitors, which shows a decreasing trend, are summarized in Table 3.2-4.

Table 3.2-4 Gallatin Valley 24-hour Average PM_{10} Particulate Monitoring Data ($\mu g/m^3$)

Location	Year	Highest Reading	Second-Highest	Annual Average	No. of Samples
Belgrade	1991	127	123	55.5	32
	1992	133	131	43.5	108
	1993	137	121	45.2	118
	1994	93	81	36.9	94
	1995	148	124	33.4	97
	1996	74	74	28.3	111
	1997	81	65	27.6	107
	1998	72	71	29.0	113
	1999	70	62	25.2	105
	2000	65	65	23.6	90
	2001*	65	53	29.8	30
Bozeman	1991	122	108	29.5	103
	1992	56	54	22.9	118
	1993	58	47	23.7	108
	1994	53	52	23.1	87
	1995	101	72	20.7	95
	1996	46	43	21.7	110
	1997	104	53	20.6	102
	1998	68	57	19.3	113
	1999	51	40	17.9	89
	2000	46	42	18.6	76
	2001*	43	42	18.9	25

Note: * 2001 is a partial year.
Source: EPA AirData Website

Other Air Pollution Sources

Existing air quality in the Gallatin Valley is impacted by area source activities, such as vehicles, road dust, residential wood burning and agriculture. Existing industrial sources, including Holcim, also impact air quality. The influence of these sources is reflected in the ambient air quality data reported for Gallatin County. Industrial sources located within 50 km of the Holcim plant that currently hold a Montana air quality permit are listed in Table 3.2-5. EPA's facility emissions web site was used to identify emissions sources in Gallatin County (EPA AirData).

Neighboring Madison and Broadwater counties each have one permitted industrial emission source, both of which are located more than 50 km from the Holcim site.

Table 3.2-5 Gallatin County Industrial Emissions Sources

Facility Name	Location	Type of Source	Actual Emissions[1]	
Luzenac America	Sappington	Talc Processing Plant	CO – 0.94 tpy VOC – 0.19 tpy PM_{10} – 9.67 tpy	NO_x – 3.23 tpy SO_2 – 0.15 tpy
Luzenac America	Three Forks	Talc Processing Plant	CO – 4.3 tpy VOC – 0.52 tpy PM_{10} – 32.2 tpy	NO_x – 10.5 tpy SO_2 – 0.24 tpy
Montana State University	Bozeman	Central Heating Plant	CO – 0.51 tpy VOC – 0.88 tpy PM_{10} – 1.92 tpy	NO_x – 20.0 tpy SO_2 – 0.09 tpy
JTL Group	Belgrade	Portable Aggregate Crushing and Screening Plant	CO – 42.5 tpy VOC – 19.8 tpy PM_{10} – 40.0 tpy	NO_x – 3.12 tpy SO_2 – 24.4 tpy

Note: [1] Reported emissions in tons per year (tpy),
Source: (obtained from www.epa.gov/air/data/neidb.html for the most recent available year, 1999)

Table 3.2-5 lists actual emissions reported to DEQ and ultimately to EPA. EPA maintains emissions data for reference years to allow comparison of source data. The most recent year of data available from EPA is 1999. Emissions from industrial sources in Gallatin County are quite low and are not expected to impact the same receptors as the Holcim emissions. The primary source of emissions from talc processing and aggregate crushing is fugitive particulate matter. NO_x and CO are generated from burning natural gas and/or diesel for heating.

Holcim Trident Emissions

Portland cement manufacturing generates emissions of criteria pollutants, greenhouse gases, and HAPs. The primary source of criteria pollutant emissions is from the combustion of fuel to heat the cement kiln. Holcim is permitted to use coal, syncoal, petroleum coke and natural gas as fuels. Holcim is also allowed to use iron ore or ASARCO smelter slag for the iron component of the raw materials. For this EIS, current maximum potential emissions for Holcim's permitted production limit of 425,000 tons of clinker per year are called 'baseline' emissions. Maximum potential emissions while burning tires at the permitted production limit are called 'cumulative' emissions. Emission inventories also include HAP emissions from the addition of glass and smelter slag.

Criteria Pollutants

SO_2 emissions from cement kilns may be generated from oxidation of sulfur compounds in the raw materials and from sulfur in the fuel. The alkaline nature of the cement provides for direct absorption of SO_2 into the product, thereby mitigating the quantity of SO_2 emissions in the exhaust stream. Depending on the process and the source of the sulfur, SO_2 absorption ranges from about 70 percent to more than 95 percent (EPA, AP-42 Section 11.6).

NO_x is generated during fuel combustion by oxidation of chemically bound nitrogen in the fuel and by thermal fixation of nitrogen in the combustion air. CO is formed as a product of incomplete combustion of carbon in the fuel. VOC emissions may also result from incomplete combustion of the fuel or may form in the combustion process. Baseline potential annual criteria pollutant emissions from the Trident kiln are listed in Table 3.2-6.

Table 3.2-6 Baseline Potential Annual Kiln Emissions

Criteria Pollutants and CO_2	Maximum Potential Kiln Emission Rate
SO_2	543 tons/year
NO_x	6,868 tons/year
CO	121 tons/year
PM_{10}	164 tons/year
VOC	10 tons/year
Lead	0.15 ton/year
CO_2	446,250 tons/year

Source: Criteria Pollutant Emissions, DEQ Air Quality Permit 0982-10; Holcim 2004. CO_2 emissions estimate, AP-42 Section 11.6.

Table 3.2-6 also lists the estimated maximum CO_2 emission rate from the kiln, based on the applicable EPA emission factor (EPA, AP-42 Section 11.6). CO_2 emissions from portland cement manufacturing are generated by two mechanisms. Combustion of the fuels for generation of heat for the cement kiln releases substantial quantities of CO_2. CO_2 is also generated through calcining of limestone or other calcium carbonate material. There are no federal, state, or local air quality regulations addressing the emissions of CO_2 or other greenhouse gases. Estimates of greenhouse gas emissions are used primarily for emissions inventory purposes.

Hazardous Air Pollutants

Cement kiln emissions include residual organic compounds from the fuel or products of incomplete combustion, some of which are HAPs. Raw material feeds and fuel also contain trace amounts of heavy metals that may be emitted as particulate or vapor-phase HAPs (AP-42 Section 11.6). Holcim estimated baseline HAP emissions for use in its health risk assessment as described in Appendix A. The baseline inventory represents potential emissions from currently allowed kiln fuels and feeds. It contains estimated emissions from use of permitted fuels, with recycled glass used as a source of silicate in the kiln feed and iron ore or smelter slag as a source of iron. Baseline HAP emissions estimates (see 4.3.2.1, second paragraph) are listed in Table 3.2-7 using units of pounds of emission per year (lb/yr).

Table 3.2-7 Baseline Potential Annual Kiln HAP Emissions

Compound	Baseline (lb/yr)	Compound	Baseline (lb/yr)
Acetaldehyde	4,178	Chloroethane (ethyl chloride)	28.6
Acrolein	98.3	Formaldehyde	10,846
Trichloroethene	3.26	Hydrogen chloride	6,380
Antimony	3.52	Hydrogen fluoride	197
Arsenic	6.04	Lead	128
Benzene	9,237	Manganese	156
Beryllium	1.49	Mercury	102
Bis (2-ethylhexyl)phthalate	429	4-Methyl phenol	56.6
Bromomethane (Methyl Bromide)	43.2	Methylene chloride	366
1,3 Butadiene/Butadiene	31.0	Naphthalene	572
2-Butanone (MEK)	8.94	Nickel	15.8
Butylbenzylphthalate	0.53	Nitrobenzene	13.5
Cadmium	9.10	4-Nitrophenol	287
Carbon Disulfide	1,141	Phenol	930
Carbon Tetrachloride	3.35	Phosphorus	32.2
Chlorine	5,272	Selenium	75.8
Chlorobenzene	67.9	Styrene	2,373
Chloromethane (Methyl chloride)	436	1,1,1 Trichloroethane	1.61
Chromium (total)	13.90	Toluene	11,546
Chromium 6	2.42	Vinyl chloride	93.7
Cobalt	9.18	Xylenes, total	8,567
Di-n-Butyphthalate	13.4	Zinc[(1)]	4,943
1,4 Dichlorobenzene	13.4	TCDD Eq. [(2)]	0.0000074
Dichloromethane	394	Total PCBs	3.88
Dimethyl Phthalate	18.6	PAH- Total	756
2,4-Dinitrophenol	101	PAH-Non-carcinogenic totals	183
Ethylbenzene	1,945	PAH-Carcinogenic totals**	573

Note: [(1)] Zinc is not a HAP but is a common constituent in tires.
[(2)] The TCDD eq. baseline value is based on Holcim's 2000 stack test, increased proportionally from actual to potential production.
Source: Appendix B

Regulatory Requirements

EPA has approved the State of Montana to implement many of the requirements of the federal CAA. Montana has developed and maintains an air pollution control plan referred to as the State Implementation Plan, or SIP. The Montana SIP explains how Montana will ensure compliance with standards as required under the CAA. In general, the SIP is the collection of programs, policies, orders, and laws that Montana uses to attain and maintain the primary and secondary NAAQS.

Montana Air Quality Permits

Holcim currently operates under Montana Air Quality Permit #0982-10, which was final on December 4, 2001, and Montana Air Quality Operating Permit #OP0982-00, which was final on

July 26, 2001. These permits contain all of the applicable state and federal air quality regulations and permit conditions governing the operation of the cement plant. Holcim is required to submit a Montana Air Quality Permit Application when proposing to construct, install, modify, or change the operation of the facility beyond certain thresholds (ARM 17.8.740 *et. seq.*). Modifications approved by DEQ and placed in the air quality permit are then incorporated into the operating permit through ARM 17.8.1201 *et seq*.

Holcim's air quality permits incorporate applicable federal regulatory programs, including the New Source Performance Standards (NSPS) and NESHAPs. Operating Permit #OP0982-00, alone, contains 290 facility-specific permit conditions in addition to 57 general permit conditions. Permit #0982-10 contains emission limits and operating requirements for stationary equipment at the facility. Current kiln emission limits include PM_{10}, SO_2, NO_x, and opacity limits. As a condition of Permit #0982-10, Holcim is required to install and operate continuous emissions monitoring systems (CEMS) to continuously analyze and record the emissions of NO_x and SO_2 from the kiln stack.

Emissions from the Holcim kiln are limited to less than 20 percent opacity during normal operation and less than 10 percent opacity when using post-consumer recycled glass. The opacity limits require an averaging period of six consecutive minutes. Holcim has installed a Continuous Opacity Monitoring System (COMS) to improve monitoring of opacity from the kiln. The COMS is not required currently by any regulation or permit condition and is not certified. Holcim uses the COMS for informational purposes. The compliance-determining method for opacity at Holcim is currently EPA Reference Method 9.

Glass Recycling/Slag Use

Holcim's air quality permits allow the facility to use post-consumer recycled glass as a source of silica in the kiln. The glass replaces silica that would otherwise be obtained from a mine. Holcim began to use the glass in 1999 after DEQ's Air, Energy and Pollution Prevention Bureau requested that Holcim and other facilities in the area consider incorporating recycled post-consumer glass into their process. Holcim's air quality permit allows the use of up to 800 tons of recycled glass during any rolling 12-month period.

Permitting for the use of recycled glass in the kiln feed was subject to the Montana incinerator regulations and negligible risk standards (ARM 17.8.770). Holcim submitted an emission inventory that identified 5.13 pounds per year (lb/yr) of HAPs being emitted as a result of using post-consumer recycled glass. Holcim also submitted a health risk assessment that demonstrated that this proposal constituted a negligible risk to human health and the environment.

DEQ set the 800 ton-per-year glass limit based upon the fact that Holcim did not expect to use more than that amount. Holcim's Permit #0982 contains an alternative operating scenario for firing using 800 tons of post-consumer recycled container glass. The alternative scenario limits the opacity to less than 10 percent while glass is being used in the kiln. Holcim is not required to use recycled glass in the cement kiln and may discontinue the practice at any time.
Iron is an ingredient in portland cement. Holcim's air quality operating permit allows the use of iron ore as a source of iron in the kiln. It can also use up to 15,000 metric tons (16,535 tons) of slag from the ASARCO smelter in East Helena during any rolling 12-month period as an iron

source. The ore or smelter slag makes up 2 to 4 percent of the kiln feed, depending on the iron content.

Montana Negligible Risk Standard

Holcim has applied for a modification to Permit #0982 to allow the use of tires as a supplemental fuel. It submitted the application for a permit modification under the incinerator permit requirements of 75-2-215, MCA. Regulations in ARM 17.8.770 require that an applicant for a Montana Air Quality Permit for an incineration facility subject to 75-2-215, MCA, shall submit a human health risk assessment protocol and a human health risk assessment as part of the application. Holcim submitted a human health risk assessment with the air quality permit application requesting permission to use tires as fuel (Holcim, 2004).

The human health risk assessment must include an emissions inventory listing potential emissions of all pollutants specified in the CAA HAPs list. It must also include a characterization of emissions and ambient concentrations of air pollutants, including HAPs, from any existing emitting unit at the facility. The human health risk assessment must demonstrate that the ambient concentrations of pollutants resulting from emissions from the incineration facility constitute no more than a negligible risk to the public health, safety, and welfare, and to the environment (ARM 17.8.770).

NESHAPs

Under the CAA Amendments of 1990, EPA is required to regulate emissions of 188 listed HAPs. EPA has identified industries, including portland cement manufacturing, that are potentially major sources of air toxics. "Major" sources are those that emit 10 tons/year or more of a single HAP or 25 tons/year or more of a combination of HAPs. For listed categories of major sources, the CAA requires EPA to develop standards that require the application of stringent air pollution controls (EPA, March 2002).

The standards that EPA developed are known as NESHAPs. EPA issued the final NESHAPs for portland cement manufacturing in June 1999, with amendments in March 2002. That rule required the application of Portland Cement Maximum Achievable Control Technology (PC MACT) for cement plants that are major sources (EPA, March 2002). The NESHAPs for Portland Cement Plants are included in the Code of Federal Regulations (CFR) Title 40, Part 63, Subpart LLL.

Permit #0982-10 requires that Holcim comply with the limitations of the NESHAPs for portland cement plants. The permit limits the emissions of dioxins (certain by products of combustion) and furans (flammable liquids used as solvents) and requires monitoring of the kiln outlet temperature and source testing to verify compliance with the dioxin and furan limits. Dioxin and furan limits are expressed as tetrachlorodibenzo-p-dioxin equivalent (TCDD eq.).
The Trident facility is designated as an area source for purposes of PC MACT requirements. In order to qualify as an area source, the source must not be a major source as defined above. Holcim intends to maintain its area source status after completion of the Proposed Action by limiting individual and total HAP emissions. Holcim completed testing to determine if emissions of HAPs and HCl could re-designate the facility as an area source. Results of the

testing indicated that it was an area source for the purposes of determining the applicability of PC MACT.

PSD Classification

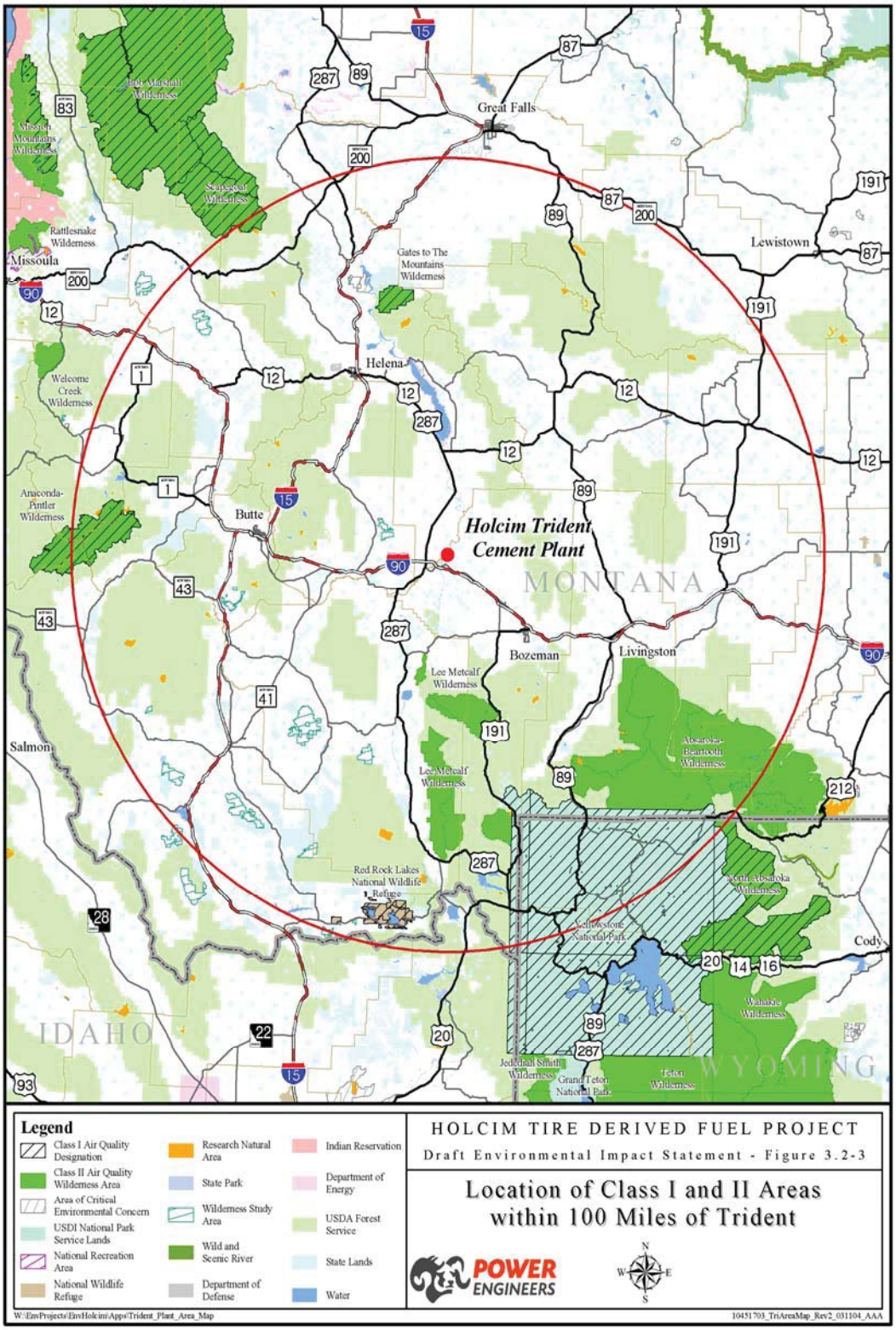
Montana's air quality permitting regulations include implementation of the federal Prevention of Significant Deterioration (PSD) program. Montana regulations covering the PSD program are contained in ARM 17.8.801 *et seq.* PSD regulations contain provisions for designating Class I, Class II, or Class III areas. Most of Montana is designated Class II, although there are a number of Class I areas. There are no Class III areas in Montana.

The area surrounding the Trident facility is a designated Class II area as defined by the PSD program. The PSD Class II designation allows for moderate growth or degradation of air quality within certain limits above baseline air quality. Large industrial sources proposing construction or modification must demonstrate that the proposed emissions would not cause significant deterioration of air quality in all areas.

The air quality regulations for PSD Class I and Class II areas contain limits on the allowable increases in PM_{10}, NO_x, and SO_2 impacts. Ambient air quality standards are the same for Class I and Class II areas. The PSD permitting regulations also include protection of air quality related values (AQRV) in mandatory federal Class I areas, including but not limited to visibility. The PSD Class I designation provides the most protection for air quality in specific national parks, wilderness areas, and Indian reservations. The standards for significant deterioration are much more stringent for Class I areas than for Class II areas. Some Montana wilderness areas are designated Class II areas. Figure 3.2-3 shows the Class I areas and Class II wilderness areas within 100 miles of the Trident site.

The closest Class I area is Yellowstone National Park, with the nearest boundary approximately 62 miles (100 km) south of Trident. Other Class I areas located within 100 miles of Trident include the Gates of the Mountains Wilderness Area, located 67 miles (108 km) northwest of the site, the Anaconda-Pintler Wilderness Area 86 miles west of the site, the Red Rock Lakes National Wildlife Refuge 92 miles south-southwest of the site, and the Scapegoat Wilderness Area 98 miles northwest of the site. The Class I North Absaroka Wilderness Area in Wyoming is 98 miles southeast of the site. The Absaroka-Beartooth Wilderness Area north of Yellowstone National Park is a Class II wilderness area. The northernmost boundary of the Absaroka-Beartooth Wilderness Area is 54 miles southeast of Trident. The northern unit of the Class II Lee Metcalf Wilderness Area is 38 miles south of Trident.

Figure 3.2-3 Class I and II Areas Location Map



Human Health Risk Evaluations for Incinerators

ARM 17.8.770 requires that:

> *An applicant for a Montana air quality permit for an incineration facility subject to 75-2-215, MCA, shall submit a human health risk assessment protocol and a human health risk assessment as part of the application. The human health risk assessment must demonstrate that the ambient concentrations of pollutants resulting from emissions from the incineration facility subject to 75-2-215, MCA, constitute no more than a negligible risk to the public health, safety, and welfare and to the environment.*

According to 75-2-215, MCA (Solid or hazardous waste incineration -- additional permit requirements):

> *Until the department has issued an air quality permit pursuant to* 75-2-211 *that includes the conditions required by this section, a person may not construct, install, alter, or use a solid or hazardous waste incinerator or a boiler or industrial furnace subject to the provisions of* 75-10-406, *except as provided in subsection (2). … The department may not issue a permit to a facility described in subsection (1) until:*
>
> > *(a) the owner or operator has provided to the department's satisfaction:*
> >
> > > *(i) a characterization of emissions and ambient concentrations of air pollutants, including hazardous air pollutants, from any existing emission source at the facility; and*
> > >
> > > *(ii) an estimate of emissions and ambient concentrations of air pollutants, including hazardous air pollutants, from the incineration of solid or hazardous waste or the use of hazardous waste as fuel for a boiler or industrial furnace, as proposed in the permit application or modification; ….*
> >
> > *(d) the department has reached a determination that the projected emissions and ambient concentrations will constitute a negligible risk to the public health, safety, and welfare and to the environment; ….*

A "negligible risk to the public health, safety, and welfare, and to the environment" is referred to as the negligible risk standard and is defined in 17.8.740(10) as follows:

> *Negligible risk to the public health, safety, and welfare and to the environment" means an increase in excess lifetime cancer risk of less than* 1.0×10^{-6}*, for any individual pollutant, and* 1.0×10^{-5}*, for the aggregate of all pollutants, and an increase in the sum of the non-cancer hazard quotients for all pollutants with similar toxic effects of less than 1.0, as determined by a human health risk assessment conducted according to ARM* 17.8.767. *The department shall also consider environmental impacts identified in any environmental analysis conducted pursuant to the Montana Environmental Policy Act, Title 75, chapter 1, parts 1 through 3, MCA, in determining compliance with all applicable rules or*

other requirements requiring protection of public health, safety, and welfare and the environment"

ARM 17.8.770 describes the requirements for the human health risk assessment.
The applicant must submit a human health risk assessment protocol detailing the human health risk assessment procedures. At a minimum, the human health risk assessment protocol must include: a description of the pollutants considered in the analysis; methods used in compiling the emission inventory; ambient dispersion models and modeling procedures used; toxicity values for each pollutant; exposure pathways and assumptions; any statistical analysis applied; and any other information necessary for the department to review the adequacy of the human health risk assessment.

The health risk assessment must be performed in accordance with accepted human health risk assessment practices, or state or federal guidelines in effect at the time the human health risk assessment is performed, and must address impacts on sensitive populations. The human health risk must be calculated using the emitting unit's potential to emit. Enforceable limits or controls may be considered. DEQ may impose additional requirements for the human health risk assessment, on a case-by-case basis, if it reasonably believes that the type or amount of material being incinerated, the proximity to sensitive populations, short-term emissions variations, acute health impact, or the local topographical or ventilation conditions require a more detailed health risk assessment to adequately define the potential public health impact.

Holcim Compliance History

DEQ performs regular reviews of the Holcim facility reports to verify compliance with the conditions and limitations of Holcim's air quality permits and applicable air quality programs. Compliance information for the past three years can be viewed on EPA's Enforcement & Compliance History Online (ECHO). ECHO lists the facility's compliance status in four categories: Section 63 NESHAPs, Title V Operating Permit, SIP, and NSPS. Aside from the recycled glass violations described below, Holcim was in compliance in all four categories in the 11 calendar quarters from January 2003 through September 2005.

Holcim submits semi-annual monitoring reports to DEQ, containing the results of required monitoring and testing at the facility. No violations have been recorded in the past two years based on NO_x and SO_2 CEMS readings and stack testing. Violations associated with glass recycling are described below. Holcim also submits Facility Upset Reports. DEQ regularly reviews the Facility Upset Reports.

DEQ conducts site visits of the Holcim facility as necessary. The latest air quality field inspection was conducted on August 31, 2005. DEQ also observed source testing at Holcim in October 2005, August 2005, December 2004, and August 2004. Results of the field inspection and source testing indicate that Holcim is in compliance with the conditions and limitations of Holcim's air quality permits and applicable air quality programs.

Kiln Malfunctions Affecting Emissions

Malfunctions are defined in ARM 17.8.110 as follows:

> "*Malfunction" means any sudden and unavoidable failure to operate in a normal manner by air pollution control equipment, process equipment, or a process that affects emissions. A failure caused entirely or in any part by poor maintenance, careless operation, poor design, or any other preventable upset condition or preventable equipment breakdown is not a malfunction.*

DEQ must be notified of all malfunctions expected to exceed any emission limitation or to continue more than 4 hours. Holcim submits initial upset reports to DEQ by facsimile or telephone within 24 hours of an upset. Initial upset reports must identify the emission point, list the cause of the upset, and describe corrective actions taken. Within 1 week after an upset has been corrected, Holcim is required to submit a detailed Facility Upset Report that verifies that the upset has been corrected, describes the cause of the upset and preventative steps taken, and states whether or not the upset was caused by poor maintenance, careless operation, or another preventable condition. Each Facility Upset Report is reviewed individually to determine if an upset is a reportable malfunction, if any violation occurred, and if enforcement action is warranted.

Review of Holcim's 2002 through 2004 upset reports revealed that many of the reported upsets exceeded the opacity limit. Causes of these upsets include process problems, mechanical or electrical failures, and production start-up and shut down.

Excess Opacity

Holcim voluntarily installed an uncertified COMS to continuously monitor the opacity of the kiln stack exhaust. The COMS measures opacity and can report opacity for essentially any averaging time. Holcim submits Facility Upset Reports to DEQ for opacity values that exceed 20 percent. DEQ historically compiled a 12-month average of total reported opacity exceedances for the Holcim cement kiln. During the calendar year from January 2002 through December 2002, Holcim reported excess opacity for a total of 6.3 percent of the kiln operating hours. By using the COMS data, Holcim reported a number of opacity events that did not last the 6-minute averaging period. Only opacities that are greater than 20 percent when averaged over 6 consecutive minutes are violations. Without these additional reports, the excess opacity total would be lower. Holcim now reports when the opacity limit is exceeded for 6 minutes or longer. DEQ reviews the opacity data quarterly.

By regulation, Holcim's opacity must be less than 20 percent averaged over 6 consecutive minutes during regular operations and less than 10 percent averaged over 6 consecutive minutes when the kiln is processing recycled glass in the raw mix (ARM 17.8.304(2) and 17.8.316(3)). Based on the information gained from the COMS, Holcim has made a number of changes in kiln operations, resulting in a reduction in the frequency of opacity exceedances. During the calendar year from January 2003 through December 2003, Holcim reported excess opacity for a total of 2.51 percent of the kiln operating hours (DEQ Files).

Table 3.2-8 shows the percentage of operating time by quarter that Holcim reported upsets for the kiln in 2004 and 2005.

Table 3.2-8. Holcim 2004-2005 Kiln Upsets on a Percentage of Operating Time Basis

Quarter	Kiln Upsets
1st Quarter 2004	**0.31% of operating time**
2nd Quarter 2004	**1.48% of operating time**
3rd Quarter 2004	**2.13% of operating time**
4th Quarter 2004	**1.9% of operating time**
1st Quarter 2005	**3.8% of operating time**
2nd Quarter 2005	**0.75% of operating time**
3rd Quarter 2005	**0.65% of operating time**
4th Quarter 2005	**Not available**

Recycled Glass Violations

On two occasions, Holcim reported that it had used more than 800 tons of recycled glass during a rolling 12-month reporting period. Holcim first exceeded the 800-ton limit in January 2001 and remained in violation until June 2001. DEQ issued a violation letter and an administrative order on consent and collected a penalty of $2,400 on January 12, 2003.

The second violation of the 800-ton limit occurred in October 2002 and continued through May 2003. DEQ issued a violation letter and Holcim paid a penalty of $41,600 on April 16, 2004. After the second case of Holcim exceeding its glass-recycling limit, EPA assigned Holcim the designation of High Priority Violator (HPV), as reported on the ECHO website. The violation was resolved on or around April 15, 2004, and the HPV status now shows the facility in compliance.

Slag

DEQ sampled ASARCO smelter slag at the smelter and at Holcim's plant. The samples were analyzed for total metals, volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls, chlorides, and pH. Metals, chlorides, and pH were detectable at the reporting limits of the analytical methods used.

DEQ estimated the amount of slag that would be needed to meet the iron requirements to produce 425,000 tons of clinker and determined the amount of metals that would be introduced to the kiln. DEQ assumed that 95 percent of the metals would be captured in the product and 5

percent would go to the ESP. The amounts of metals found in the slag samples were used in the risk assessment model.

Holcim has agreed to limit its use of smelter slag to 15,000 metric tons during any rolling 12-month time period until DEQ makes its decision on permitting the use of tires as fuel.

3.3 Soils

This section describes the soils within the 50-km (31.06-mile) study area. Emphasis has been placed on farmland designation, because emissions from the Holcim cement plant have the potential to affect produce from area farms and ranches and, thereby, affect human health through ingestion (refer to Chapter 4 for the human health risk). Complete soil series descriptions may be found at the Natural Resources Conservation Service (NRCS) web site (NRCS, 2004).

Chemicals of Potential Concern (COPC) deposited on soils can be ingested directly by most organisms by virtue of their burrowing (e.g., earthworms, hares), or other means. Herbivores may consume soil attached to vegetation and roots. Carnivores ingest soils through consumption of ground-nesting prey, licking or cleaning their feet, licking mineral deposits, or eating soil that contains urine or other attractants. Thus, the soil medium may play an important role in the food chain, and COPCs deposited on the ground and vegetation can affect organisms throughout the food web.

3.3.1 Inventory Methods

Soils were mapped using both the State Soil Geographic (STATSGO) and the Soil Survey Geographic (SSURGO) databases from the NRCS. STATSGO data are meant to be used at very large scales as an overview of soil types; therefore, they were used only for graphical purposes. SSURGO data are the most accurate available and were used for prime farmland analysis. Written descriptions in Section 3.3.2.3 are derived from NRCS (formerly the Soil Conservation Service [SCS]) soil surveys for Broadwater and Gallatin counties (SCS, 1977; NRCS, 2002). These two sources were organized differently, and in ways that precluded merging the soils descriptions. This arrangement facilitated use of the advantages of each organizational concept, using the Broadwater County descriptions to describe soils by where they are found in the landscape (bottomlands, terraces), and using the Gallatin County descriptions for soils favorable for farming.

3.3.2 Inventory Results

Section 3.3.2.1 provides general soil descriptions segregated by where they are found in the landscape (i.e., bottomlands, terraces, etc.), which is how they are organized in the soil survey for Broadwater County. These descriptions include soil formation, parent material, geomorphology, soil texture, and uses. Section 3.3.2.2 gives an estimate of the relative acreage of different soils within 10 km (6.21 miles) of Trident. Section 3.3.2.3 describes designated prime farmland soils from the soil survey for Gallatin County, which is organized by land use.

Soils Characteristics

Bottom Land

These soils are formed in material deposited by the Missouri River and its tributaries and include the Villy-Toston-Rivra association. Most of these soils have slopes of 1 to 5 percent, making them nearly level to gently sloping and gently undulating, deep, poorly drained to moderately well drained soils on low terraces and flood plains. Most of the area has an irregular surface because of past and present stream channels on the flood plain (SCS, 1977).

The surface layer for these soils is light-gray to grayish-brown silty clay loam and silt loam, between two and seven inches thick, or light brownish-gray to grayish-brown gravelly loam, about four inches thick. The underlying material is stratified light-gray to gray silty clay loam and silt loam; very pale brown or light-gray to gray silty clay loam to silt loam; or light brownish-gray very gravelly sand. The seasonal high water table is at a depth between 20 and 72 inches.

This soil association is used mainly for pasture and hay. Some areas are drainable, but the areas near the streams generally do not drain well.

Intermediate Terraces and Fans

These soils are formed in material deposited by water and wind, and are comprised of the three associations in Table 3.3-1. The soils have slopes of 0 to 35 percent, and are nearly level to steep, deep, well-drained soils on terraces, fans, mountain foot slopes, and uplands. These areas are smooth except where intermittent streams dissect the landscape. These soil associations can be used for irrigated and dry farmed cropland, rangeland, and pasture.

Table 3.3-1 Soils on Intermediate Terraces and Fans

Soil Associations	Surface Layer Colors and Textures
Amesha-Brocko-Mussel	Light gray to brownish gray loams to silt loams.
Radersburg-Hilger-Scravo	Grayish brown to dark grayish brown very cobbly loam to extremely stony loam.
Chinook-Amesha	Grayish brown sandy loam to brownish gray loam.

Source: SCS, 1977; NRCS, 2002

High Terraces and Fans

These soils are in four soil associations and formed in material deposited by water and in material weathered in place from bedrock. The soils have slopes of 2 to more than 35 percent, and are gently sloping and rolling to steep, moderately deep to deep, well-drained soils located on fans and high fans, terraces, benches, ridges, side slopes of uplands, and on mountainous uplands. Deep, intermittent and perennial streams dissect this landscape. Sharp ridges, deep canyons and fans are common. North-facing slopes are uniformly timbered, but grassland park areas are common along ridges and on the upper parts of south-facing slopes. Rock outcrops can be visible above the timber in some areas. These soil associations can be used for dry farmed

winter wheat and barley, irrigated crops, pasture, hay, range, timber, woodland grazing, and wildlife habitat.

Table 3.3-2 Soils on High Terraces and Fans

Soil Associations	Surface Layer Colors and Textures
Sappington-Martinsdale	Grayish brown to dark grayish brown clay loam.
Passcreek-Bridger-Rooset	Grayish brown, dark grayish brown, brown or pale brown channery* silt loam, cobbly loam, or extremely stony loam.
Lake Creek-Whitore-Loberg	2-3 inches of forest litter over light brownish gray, grayish brown or light gray channery* loam, channery silt loam or very stony loam.
Musselshell-Crago	Brownish gray to light brownish gray cobbly loam.

Note: *A descriptive term used for thin and flat limestone, sandstone, or schist fragments up to 15 cm (6 inches) in length.
Source: SCS, 1977; NRCS, 2002

Shale and Sandstone Uplands

The soils on shale and sandstone uplands are in the Abor-Cabbart-Delphill soil association and formed in material weathered in place from clay shale, sandstone, and siltstone. These soils have slopes of 2 to 35 percent and range from shallow to moderately deep. They are found on undulating to rolling sedimentary uplands that are frequently dissected by intermittent streams. The drainageways are shallow to deep and have moderately steep to steep side slopes. These soils have a surface layer of grayish-brown, calcareous silty clay, grayish-brown loam or light brownish-gray loam, respectively. The underlying material is either light brownish-gray, partially weathered clay shale or very pale brown clay loam. This association is used mainly for dry land small grains and range (SCS, 1977; NRCS, 2002).

Mountainous Uplands

These soils are in two soil associations and formed in material weathered from argillite, limestone, and igneous rock and in material that has moved down slope from the source. They have slopes of 9 to 60 percent and range from shallow to deep. These soils are found in a complex landscape consisting of smooth and round to sharp and narrow ridge tops and side slopes that range from sloping to very steep, including some steep-walled canyons. Much of this area is drained by a branching pattern of smooth, grassed drainage ways, and areas of rock outcrop are common. Bedrock is at an approximate depth of between 8 and 50 inches. These soil associations are used mainly for range. Some areas are used for timber production and for year-round recreation (SCS, 1977; NRCS, 2002).

Table 3.3-3 Soils on Mountainous Uplands

Soil Associations	Surface Layer Colors and Textures
Tropal-Rencot-Tolman	Grayish brown gravelly loam, pale brown channery loam, or brown channery loam, respectively.
Cheadle-Nielsen-Ess	Dark brown stony loam, dark brown gray channery loam, very dark grayish brown stony loam, respectively.

Source: SCS, 1977; NRCS, 2002

Soils within 10 Kilometers of Trident

All STATSGO soils occurring within the 10-km (6.21-mile) radius of the Trident plant are shown below in Table 3.3-4. Descriptions of these soil mapping associations can be found in Section 3.3.2.1, above, or at the NRCS web site (NRCS, 2004).

Table 3.3-4 Soils Within 10-km (6.2 mi) Radius of Trident Plant

Soil Mapping Unit	Acreage	Percent
Amesha-Brocko-Musselshell	11,729	15.1
Brocko-Amesha-Crago Variant	843	1.1
Brocko-Floweree-Rothiemay	431	0.6
Busby-Brocko-Crago Variant	2,227	2.9
Busby-Kalsted-Cetrack	85	0.1
Neen-Trudau-Rivra	1,225	1.6
Brocko-Pensore-Rock Outcrop	12,531	16.2
Pensore-Tolman-Rock Outcrop	15,035	19.4
Rentsac-Brocko-Crago Variant	11,727	15.1
Rivra-Cardwell-Ryell	21,176	27.3
Whitore-Hanson-Whitecow	502	0.6
Total Acres/Percent	**77,511**	**100**

Source: STATSGO, 2004

Prime Farmland

Prime farmland is described as follows (NRCS, 2002):

> *Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. … Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources, and farming these soils results in the least damage to the environment.*
>
> *Prime farmland soils may presently be used as cropland, pasture, forest land, or for other purposes. … Urban or built-up land, public land, and water areas cannot be considered prime farmland.*

Prime farmland is emphasized because of its importance for both environmental consideration and for human health consideration. It is also emphasized in this section because of its dual significance in assessing impacts from Holcim's proposed permitting changes, and because prime farmland is generally located on bottomlands with gentle slopes and available moisture. These tend to be the areas of highest human population concentrations as well.

Prime farmland designations were identified using the 1:24,000 scale SSURGO soils database from the NRCS. Complete data were not available for the entire regional 50-km (31.06-mile)

area but were available for the 10-km (6.21-mile) area. Acreages based on all available data for the regional area are presented below in Table 3.3-5.

Table 3.3-5 Regional Prime Farmland Acreage (within 50 km [31.06 miles]) of Trident

Farmland Classification	Regional Area Acreage	Regional Area Percentage
Prime Farmland	43,071	2.2
Prime Farmland if Irrigated	171,031	8.8
Farmland of Statewide Importance	174,611	9.0
Not Prime Farmland	1,306,067	67.4
Total Acres of Available Data	1,694,780	87.5
Total Acres in Regional Area	**1,937,790**	**100.0**

Source: NRIS, 2004

Designated prime farmland is located mainly southeast of Trident, with some smaller areas east and north. Farmland that is "prime if irrigated" and "farmland of statewide importance" (as defined in USDA-NRCS, 2002) is distributed throughout the region within 50 km (31.06 miles) of Trident. Virtually all of these designated soils are bottomlands or stream terraces. While there is no designated prime farmland within 10 km (6.21 miles) of the Trident plant, substantial acreage of "prime if irrigated" and "farmland of statewide importance" occurs within 10 km (6.21 miles) of Trident. More information about any of the soil series represented below can be found at the NRCS web site (NRCS, 2004).

3.4 Water Resources

Holcim's Trident cement plant is on the banks of the Missouri River. It is approximately 1.6 km (1 mile) downstream from Missouri Headwaters State Park, where the Jefferson, Madison, and Gallatin rivers meet to form the Missouri River.

Hydrology is documented in this chapter as follows: water quantity, water quality, groundwater, and water use. Related information about streams and lakes is found in Section 3.7, Fisheries and Aquatics.

Existing data were used to characterize current water quality conditions in the study area. The Holcim cement plant has been in operation since approximately 1910. No water quality or quantity data from before the plant's operation were found. Water use and water quality impacts from general population growth, industry, agriculture, and distant sources have acted on the study area to various degrees. Consequently, it is beyond the scope of this document to try to isolate sources of impacts and their magnitude over the period of the plant's operation.
In addition to being habitat for fish and other aquatic organisms, surface water is used to irrigate crops throughout the region, and domestic livestock often get drinking water directly from surface sources, as do wildlife. Although most domestic water supplies are now from groundwater, humans have direct contact with surface water through recreation and consumption

of locally caught fish. Thus the medium of water plays a critical role in both human and ecological health.

3.4.1 Inventory Methods

All inventory data are from published sources, including electronic files from Natural Resource Information System (NRIS). The NRIS files were accessed in February and March of 2004 and were authored by the U.S. Geological Survey (USGS), EPA, Montana Bureau of Mines and Geology (MBMG), DEQ, Montana Fish, Wildlife and Parks (MFWP), and other agencies.

3.4.2 Inventory Results

Water Quantity

The types of natural and man-made water bodies in the local and regional area of the Holcim plant are shown in Table 3.4-1.

Within 10 km of Trident, the National Hydrography database (NRIS, 2004) shows seven lakes, with a combined surface area of 87 acres, the largest being 39.8 acres and the smallest being 2.8 acres (average 12.4 acres). Within 50 km of Trident the database shows 53 lakes with a combined surface area of 5,900 acres (average 111 acres), including about 3,374 acres of Canyon Ferry Reservoir. If Canyon Ferry is omitted, the average surface area goes down to 48.6 acres with Willow Creek Reservoir being the largest (713 acres) and an un-named pond being the smallest at 0.85 acres (NRIS, 2004).

Table 3.4-1 Hydrography

Category	Within 10 km (6.21 mi) of Trident	Within 50 km (31.06 mi) of Trident
Perennial Streams	123 miles	2,178 miles
Intermittent Streams	159 miles	2,708 miles
Canal, Ditch, or Aqueduct	7 miles	753 miles
Lakes	87 acres	5,900 acres
Lake Shoreline	6 miles	68 miles

Source: National Hydrography database/NRIS, 2004

Table 3.4-2 lists drainage areas for the Madison, Jefferson, Gallatin, and Missouri rivers as measured for nearby USGS gaging stations. The drainage areas for these rivers are extensive. Proximity to the Continental Divide, combined with the number of mountain ranges and area of high country, accounts for the relatively high volume of water from these drainages. Where precipitation may be limited to 12 inches/year in western Montana valleys, it can be upwards of 50 inches/year in the high country fewer than ten miles away.

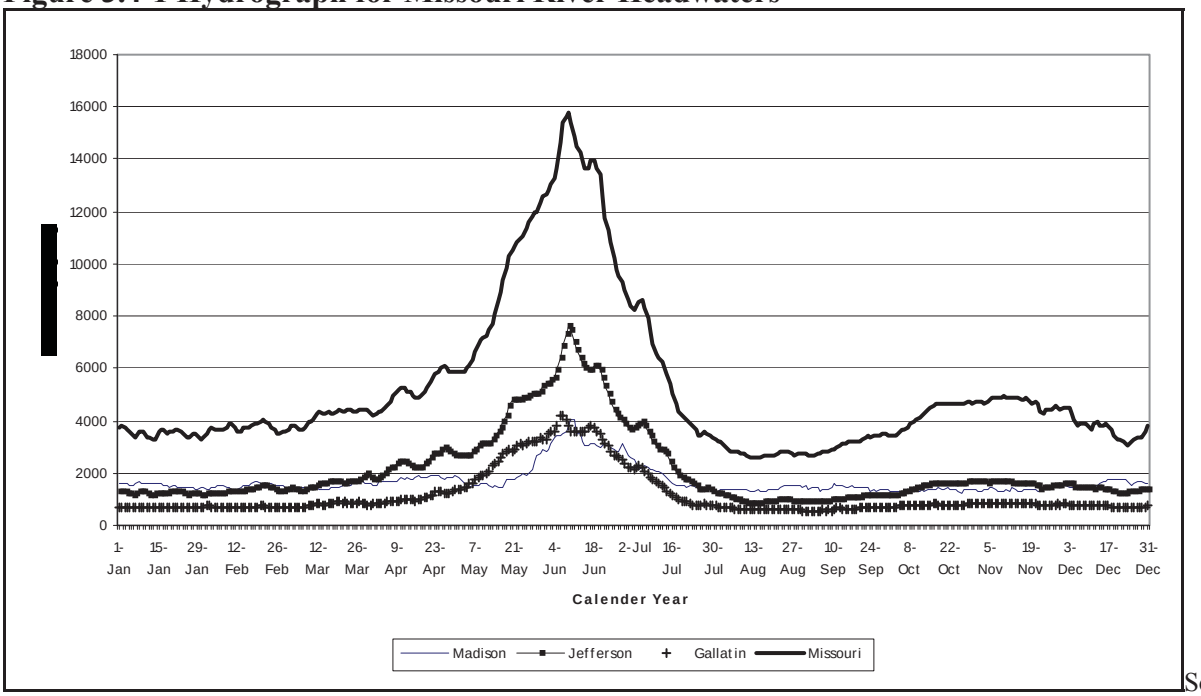
Table 3.4-2 Drainage Area for Missouri River Headwaters

River	USGS Station Name	Station Number	Drainage Area (sq mi)	Annual Mean Streamflow (cfs)[1]
Jefferson River	Jefferson River near Three Forks	06036650	9,532	2090
Madison River	Madison River at Three Forks	06042600	2,531	1709
Gallatin River	Gallatin River at Logan	06052500	1,795	1163
Missouri River	Missouri River at Toston	06054500	14,669	5208

Note: [1] based on average for 1991--2000, except the Madison River, which is for station 06042500 (Madison River near Three Forks, for 1942--1949 which are the most recent calendar years available.
Source: USGS, 2004

Figure 3.4-1 is a hydrograph for each of the four USGS gaging stations used in Table 3.4-2 above. It is derived from daily average data for calendar years 1994-2003, except for the Madison River, where the most recent data were used (1942-1949 from station number 06042500, “Madison River near Three Forks”).

Figure 3.4-1 Hydrograph for Missouri River Headwaters



Source: USGS, 2004.

Several inferences can be made from the hydrographs and corresponding drainage areas. First, the size and timing of the annual peak flows are indicative of snowmelt-dominated mountain streams. Also noteworthy is the hydrograph for the Jefferson River, which goes virtually dry at the end of the irrigation season, even though its drainage area is almost four times larger than the Madison River's and five times larger than the Gallatin River's. Section 3.7, Fisheries and Aquatics, contains additional information on area streams.

Surface Water Quality

The water quality of the study region is influenced by many factors. Because of geothermal activity in the Madison River headwaters and at other locations in the study region, some tributaries naturally contribute chemical compounds and elevated temperatures that exceed state and federal water quality standards. In addition, there is evidence that irrigation with Madison River water, which has high levels of arsenic, leads to concentration of arsenic in some aquifers along the river but reduced levels in others (Sonderegger and Sholes, 1988). Surface return flows and drains from irrigation, septic systems, and storm water all contribute water of variable quality to area streams seasonally, continually, or as a result of storm events. Consequently, water quality can vary significantly over short distances and times.

A number of streams within the study area are on the state 303(d) list of streams with impaired functionality, although some are on the list primarily because there are not enough data to demonstrate their functionality. The 303(d) list developed through the EPA's efforts to improve water quality beyond what could be achieved solely by reducing point-source or "end-of-pipe" contaminant sources. Established under the federal Clean Water Act, Section 303, the program establishes TMDLs, or Total Maximum Daily Loads, as a calculation of the maximum amount of

a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. Standards are based on identified beneficial uses for each water body, such as drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. Table 3.4-3 lists ten of the streams closest to the Trident plant and their beneficial use support status. The table is from the DEQ Environet database as queried on through NRIS. Probable causes of impairment vary widely, but the most frequently listed are dewatering, flow alteration, and riparian degradation. Agriculture is listed as a probable source of impairment in most cases. For the Madison, Jefferson, and Missouri rivers, as well as Willow Creek, metals are listed as a probable cause of impairment and abandoned mining and associated activities as a probable source. For the Jefferson River, Madison River, and Willow Creek, thermal modification from low flows also is listed as a probable cause of impairment.

Table 3.4-3 Area Streams of the Montana 303(d) List

Water Body		Beneficial Uses[1]					
Number	Name	Agriculture	Aquatic Life Support	Cold Water Fishery - Trout	Drinking Water Supply	Industrial	Primary Contact (Recreation)
MT41F001_010	Madison R (45.8 mi)	F	P	P	NS	F	F
MT41G001_010	Jefferson R (83.6 mi)	F	NS	NS	NS	P	P
MT41G002_080	Willow Cr (17.6 mi)	F	NS	F	F	F	P
MT41H001_010	Gallatin R (50.5 mi)	F	P	NS	F	P	NS
MT41H002_010	Camp Cr (26.9 mi)	F	P	P	F	F	P
MT41H003_020	East Gallatin R (14.6 mi)	NA	NA	NA	NA	NA	NA
MT41H003_100	Dry Cr (16.21 mi)	F	P	P	F	F	NS
MT41I001_011	Missouri R (21 mi) headwaters to Toston Dam	NA	NA	NA	NA	NA	NA
MT41I002_120	Sixteenmile Cr (46.6 mi)	NA	NA	NA	NA	NA	NA
MT41I001_012	Missouri R (24.4 mi) Toston Dam to Canyon Ferry Reservoir	F	P	P	NS	P	F

- Note: [1]Key to Table:
- F=Fully Supporting T=Threatened P=Partial
  NS=Not Supporting NA=Not Assessed
- Source: DEQ, 2004

Table 3.4-3 demonstrates both a broad range of lost or reduced functionality in area rivers and an insufficient quantity of information about the extent and sources of the contamination. Placement of a stream on the 303(d) list, or the presence of contamination in a stream, does not lessen water quality standards applicable to the stream; in fact, listing on the 303(d) list triggers a process designed to improve water quality and restore beneficial uses wherever possible.

MFWP includes Canyon Ferry Reservoir and Willow Creek Reservoir in its Fish Consumption Advisory due to mercury levels in fish tissue from those water bodies (MFWP, 2004). PCBs were not detected in fish from either reservoir.

One method of determining where a contaminant is entering a stream is to sample water quality both upstream and downstream of suspected sources. If the suspected source is contributing a pollutant to the stream, then concentrations (and/or loads) of that compound should be higher downstream of the source than they are upstream.

The Madison River and upper Missouri River have been rigorously tested for water quality because the headwaters of the Madison River in Yellowstone National Park includes a number of geothermal springs that contribute exceptionally high quantities of arsenic, making it unusable as a drinking water source without treatment to remove the toxic element. The current Montana human health standard for arsenic in surface water is 10 micrograms/liter (µg/L) (DEQ, 2006). In the lower Madison River, arsenic concentrations range from 27 to 113 µg/L. As far downstream as the Helena Valley, arsenic concentrations in the Missouri River range from 1.1 to 22 µg/L (USGS, 2001a). Table 3.4-4 lists arsenic concentrations and loads at several stations from the Madison River below Ennis Lake to the Missouri River at Virgelle (below Great Falls). On three occasions that represent high, base, and low flow conditions, samples were taken at multiple stations at close time intervals to determine if arsenic was being added to, or removed from (i.e., through sedimentation), the water through this area that includes the Holcim Trident plant location. Several of these studies included samples from the Gallatin and Jefferson rivers that showed arsenic to be below detectable limits on those rivers, thus removing them as significant sources of additional arsenic. In the study cited (USGS, 1997), dissolved arsenic concentrations were compared to total recoverable arsenic, which includes both dissolved arsenic and arsenic on suspended sediment. The two values were very similar, indicating little or no arsenic is adsorbing onto sediment or settling out of the water column.

Arsenic load was determined by multiplying concentration by discharge, then applying conversion factors to obtain pounds/day. While arsenic load increased below the Trident plant for one sample series, it was reduced in the two other series. Therefore, the results are inconclusive relative to the Holcim cement plant as a source of arsenic into the Missouri River and its tributaries.

Table 3.4-4 Arsenic Concentrations and Loads on the Madison and Upper Missouri Rivers

Source: USGS, 1997; DEQ, 2006

Station ID	Station Name	Sample Date	Discharge (cfs)	Concentration (µg/L)	Load (lb/day)
6041000	Madison River below Ennis Lake	5/28/93	6,290	59	1,997
6042600	Madison River @ Three Forks	5/28/93	5,650	57	1,733
6054500	Missouri River @ Toston	5/25/93	13,300	18	1,289
6041000	Madison River below Ennis Lake	8/18/93	1,830	56	552
6042600	Madison River @ Three Forks	8/19/93	1,700	54	494
6054500	Missouri River @ Toston	8/23/93	5,930	20	638
6041000	Madison River below Ennis Lake	8/24/94	1,120	94	567
6041500	Madison River near Norris	8/24/94	1,150	98	607
6042600	Madison River @ Three Forks	8/25/94	960	95	491
6054500	Missouri River @ Toston	8/16/94	1,200	65	420
	DEQ-7 Acute Aquatic Standard		High Flow	340	
	DEQ-7 Chronic Aquatic Standard		Base Flow	150	
	DEQ-7 Bioconcentration Factor		Low Flow	44	

Additional water quality data are available for streams within the 10- and 50-km (6.21- and 31.06-mile) radii of the Trident plant; however, no other agency sample series includes sites above and below the Holcim cement plant that would provide meaningful data on the plant as a potential source of surface water contamination.

Another way to characterize water quality is over time, to determine if there are any temporal trends. Table 3.4-5 summarizes USGS water quality samples from the Toston station, approximately 14 miles downstream of the Trident plant. Toston is one of the few stations with over thirty years of water quality sampling on record. Here again, the sampling has been sporadic and, for the reasons described below, inconclusive.

For many of the constituents studied, the majority of samples were below the detection limit for the sampling methodology used, and those limits have changed over time as analytical instruments and methods improved. With cadmium, for example, the detection limit for filtered samples (dissolved) was 2 µg/L before August 1979, when the detection limit improved to 1 µg/L. The detection limit for unfiltered (total recoverable) cadmium was 20 µg/L before December 1978, then 2 µg/L until July 1982, 1 µg/L until November 1999, and since then has been 0.1 µg/L. For this reason, samples below the detection limit were not valued at half the detection limit, as is sometimes the practice, when calculating averages or computing trends. In other words, the averages in the table do not take into account the many samples that were below the detection limit. The standard for cadmium is based on an unfiltered sample (which should

equal dissolved plus suspended), but, perhaps because of the high detection limit for the laboratory method used, the unfiltered samples were all within the standard while the filtered samples (dissolved only) were higher.

Table 3.4-5 Water Quality at Toston

		Samples		Sample Dates		Concentration (µg/L)		
Compound	**Medium[1]**	**Total**	**<Detect**	**First**	**Last**	**Max**	**Average**	**State Limit[2]**
Arsenic	unf	122	0	3/16/73	5/21/02	69	31.0	150
Arsenic	filt	135	0	3/16/73	8/7/95	100	36.9	
Arsenic	susp	31	9	12/26/73	9/8/82	20	4.1	
Cadmium	unf	46	39	3/16/73	5/21/02	0	0.0	0.097[3]
Cadmium	filt	74	71	3/16/73	8/20/91	3	2.0	
Cadmium	susp	24	10	12/26/73	2/24/81	10	2.5	
Chromium	unf	47	33	8/23/73	5/21/02	30	6.5	11[4]
Chromium	filt	76	65	8/23/73	8/20/91	10	2.0	
Chromium	susp	31	0	12/26/73	8/25/81	20	4.0	
Copper	unf	42	12	3/16/73	5/21/02	190	30.4	2.85[3]
Copper	filt	74	48	3/16/73	8/20/91	10	3.5	
Copper	susp	35	1	12/26/73	5/25/81	190	20.8	
Lead	unf	47	44	3/16/73	5/21/02	5	3.0	0.545[3]
Lead	filt	75	61	3/16/73	8/20/91	6	1.4	
Lead	susp	30	10	12/26/73	7/17/82	95	13.2	
Manganese	unf	39	0	3/16/73	9/8/82	270	60.8	--
Manganese	filt	86	34	3/16/73	8/16/91	30	11.8	
Manganese	susp	34	0	1/26/73	9/8/82	240	53.8	
Mercury	unf	40	28	3/16/73	9/18/82	1.5	0.20	0.91
Mercury	filt	76	62	3/16/73	8/20/91	0.4	0.08	
Mercury	susp	33	0	12/26/73	11/5/81	1.5	0.08	
Zinc	unf	47	7	3/16/73	5/2/02	90	29.9	37[3]
Zinc	filt	74	49	3/16/73	8/20/91	40	11.2	
Zinc	susp	30	3	12/26/73	9/8/82	80	23.3	

- Notes: [1]unf = unfiltered water; filt = filtered water (dissolved); susp = suspended sediment;
  [2]Aquatic Standard, Chronic (DEQ DEQ-7, 2006)
  [3] @25 mg/L hardness
  [4] for hexavalent Cr (VI), 27.7 for Cr (III) @ 25 mg/L hardness (samples were not separated by valence)
  Source: USGS, 2004

Consequently, the data are insufficient to determine more than the following:

1) There are no discernible trends over time; and

2) Water quality in the Missouri River at Toston occasionally exceeds the chronic aquatic standards (DEQ, 2004) for chromium, copper, lead, mercury, zinc, and probably cadmium.

Whether these high concentrations are due to natural or anthropogenic sources cannot be determined from available data.

The table points out one other aspect of the data, which is whether the constituent is primarily in a dissolved state or mobilized as suspended sediment (through sorption onto sediment particles). With arsenic, for example, average concentrations in filtered and unfiltered samples are very similar, while concentrations on suspended sediment are low. This suggests that arsenic remains dissolved in the water column. For manganese, on the other hand, concentrations in the unfiltered water and suspended sediment are similar, while concentrations in the filtered water samples are substantially lower. This suggests that manganese tends to sorb onto larger particles, which, in turn, are more likely to settle into the stream bed.

Groundwater

The study area is a mountainous region with deep deposits of valley fill or alluvium. Although groundwater may be found in useful quantities in bedrock crevices, it is the river valley alluvium that provides the most reliable, productive aquifer in the study area. Table 3.4-6 shows well depths and yields for 353 wells within 10 km (6.21 miles) of the Trident plant that are listed in the MBMG Ground Water Information Center (GWIC) database. Records with incomplete or no data were removed. The table shows highly productive alluvial aquifers at shallow and relatively shallow depths in the immediate area.

Table 3.4-6 GWIC Database Wells within 10 Kilometers of Trident, Montana

Depth (in feet)	Total No. of Wells	Yield (gpm) 1-25	26-50	51-100	>100	Maximum Yield (Well depth in feet)
1-50	151	51	50	16	34	3 @ 1,000 (21)
51-100	84	58	22	3	1	280 (62)
101-200	75	46	13	5	11	600 (135)
201-300	28	16	3	3	4	700 (300)
301-400	11	4	1	3	3	1500 (320)
>400	4	4	0	0	0	25 (520)

Source: MBMG, 2004

Monitoring of groundwater around the Trident plant has been conducted semi-annually since 1992, according to an unpublished report by Bison Engineering. Results presented in the monitoring report show no trends in water quality for the period of record. Depth to water in the monitoring wells near the facility ranged from 4.75 feet to 13 feet below ground surface in 2000 (Bison 2001).

Water Use

Table 3.4-7 lists public water supplies within 10 km (6.21 miles) of Trident. “Class” in the table refers to community public water systems (C), non-community non-transient systems (primarily for residents, industrial use, or employees) (P), and non-community transient systems (primarily for visitors/customers) (N). Within 50 km (31.06 miles) of Trident, NRIS lists 165 additional

permits, including one from surface water (Golden Sunlight Mine), two blended sources, and four purchased from municipal water systems.

Table 3.4-7 Public Water Supply

Class	Source	Name	City	Resident Population[1]	Nonresident Population[1]
N	Groundwater	Land O Magic Supper Club	Manhattan	0	80
P	Groundwater	Holnam Incorporated Cement	Three Forks	17	85
P	Groundwater	Holnam Incorporated Cement	Three Forks	17	85
N	Groundwater	Headwaters Picnic Area	Bozeman	0	75
N	Groundwater	Headwaters Campground	Bozeman	0	50
C	Groundwater	Three Forks, City of	Three Forks	1,800	30
C	Groundwater	Three Forks, City of	Three Forks	1,800	30
C	Groundwater	Three Forks, City of	Three Forks	1,800	30
C	Groundwater	Three Forks, City of	Three Forks	1,800	30
C	Groundwater	Three Forks, City of	Three Forks	1,800	30
N	Groundwater	Steer Inn Restaurant & Lounge	Three Forks	50	0
N	Groundwater	Town Pump #0350	Three Forks	0	100
N	Groundwater	Town Pump #0350	Three Forks	0	100
P	Groundwater	Wheat Montana Bakery	Three Forks	90	90
N	Groundwater	Prairie Schooner	Three Forks	0	50
N	Groundwater	Sharky's Travel Shop	Three Forks	0	200
N	Groundwater	Fort Three Forks Motel and RV Park	Three Forks	0	40

Note: [1]resident systems are for people living or working at the facility, while non-resident population is the general public
Source: NRIS, 2004

Within 8 km (4.97 miles) of Trident, the Montana Department of Natural Resources and Conservation (DNRC) water rights database shows 328 records. Table 3.4-8 summarizes the database by use category and maximum flow rate. The table is only an approximation of water use because the database may list the same right several times for different uses, repeating the quantity. Duplicates for the same use were eliminated from the database prior to summary for the table. The table indicates that the highest water use by volume is for fish and wildlife, with irrigation a distant second, and all other uses minor by comparison.

Table 3.4-8 Water Use

Use Type	Number of Rights	Maximum Flow (cfs)
Commercial	12	27.9
Domestic	95	4.4
Fish & Wildlife	20	12,507.6
Industrial	8	4.1
Institutional	1	0.07
Irrigation	88	353.2
Lawn & Garden	24	1.1
Municipal	3	1.0
Stock	77	3.3

Source: NRIS, 2004

Table 3.4-9 shows Holcim's water rights for the Trident plant. All of these are designated as industrial use, in Gallatin County, and groundwater source rights. Note that one cfs equals 448.8 gpm.

Table 3.4-9 Holcim's Water Rights

Water Right	Priority Date	Rate (gpm)	Volume (acre feet/year)	Well Depth (feet)
41I 19251400	4/27/67	150	200	37
41I 19251500	1/31/72	425	5	31
41I 4971700	3/21/83	600	150	No Data
41I 19251600	6/1/08	150	200	20
41I 19251700	6/1/30	250	200	130
41I 19251800	6/1/30	150	200	20

Source: NRIS, 2004

3.5 Wildlife

The 50-km (31.06-mile) study area is inhabited by several wildlife species, including birds and big game. Several special status species are also found within the area, including mammals, insects, birds, and bird rookeries. Special status plant species are discussed in Section 3.6 and special status aquatic species are discussed in Section 3.7.

The EPA protocol for screening-level ecological risk assessments describes the complexity of ecological systems and habitats as follows (EPA, 1999):

> *Information obtained during exposure setting characterization should be used to develop one or more habitat-specific food web(s) that represent communities and guilds of receptors potentially exposed to emissions from facility sources. Food webs are interlocking patterns of food chains, which are the straight-line transfer of energy from a food source (e.g., plants) to a series of organisms feeding on the source or on other organisms feeding on the food source (Odum 1971). While energy and, therefore, transfer of a compound in a food chain, is not always linear, it is assumed in this guidance that energy and, thus, compounds, are always transferred to a higher trophic level. The importance of a food chain as an exposure pathway primarily depends on receptor dietary habits, the receptors in the food chain, and other factors including bioavailability and depuration of the compound evaluated.*

The EPA protocol recommends the following steps:

- Identify habitats surrounding the facility (e.g., freshwater aquatic, forest, shortgrass prairie, agricultural/cropland, scrub/shrub, etc);
- Identify media (e.g. soil, sediment, water) for each habitat-specific food web;
- Identify trophic levels that include (at a minimum) producers, primary consumers, secondary consumers, and carnivores;
- Divide guilds (e.g., herbivorous mammals, omnivorous birds, as per EPA, 1999) into classes and communities; and

Identify major dietary interactions (e.g., lynx feeding on hares feeding on vegetation).
Each of the habitat-types listed in the first bullet above is present within the 50-km (31.06-mile) study area. Shortgrass prairie and agriculture dominate the 10-km (6.21-mile) study area surrounding the facility.

An exhaustive analysis of the wildlife within the study area, including fisheries and terrestrial and avian species, is outside the scope of this EIS. Media and species representative of the primary habitats and guilds are used in this EIS as a basis for judging impacts.

3.5.1 Inventory Methods

Data on habitat for wildlife species were downloaded from Natural Resource Information System (NRIS, 2004) unless otherwise stated. Special status species information was procured from the Montana Natural Heritage Program (MNHP; Miller, 2004).

Vegetation cover types are reflective of general wildlife habitat conditions within the study area. Cover types are described in Section 3.6.2. Locations of species and habitats are described below in Section 3.5.2.

3.5.2 Inventory Results

General Species

Several common species occur in the vicinity of the Trident facility including bald eagle, cottontail rabbit, great blue heron, red fox, and red-tailed hawk (DEQ, 2003; Bison Engineering, 2002). Table 3.5-1 identifies species distributions and/or suitable habitat that occur within the 10-km (6.21-mile) and 50-km (31.06-mile) study areas.

Table 3.5-1 Species and Habitat within the Two Study Areas

Species	10-km Area	50-km Area
Antelope *Antilocapra americana*	Range directly adjacent to plant	Winter range and general distribution – majority of west half is mapped habitat 12,308 acres of winter range 793,780 acres of overall distribution**
Bald eagle *Haliaeetus leucocephalus*	Nests reported close to Holcim site (DEQ, 2003). Two bald eagle nests are located just south of Clarkston and approximately 8 to 9 km north of the plant.	Several nests along Missouri, Gallatin and Jefferson rivers.
Bighorn sheep *Ovis canadensis*	None	Winter range and general distribution 39,536 acres of winter range west of Townsend 12,108 acres of overall distribution**
Black bear *Ursus americanus*	Covers entire area	Covers entire area 1,937,790 acres of overall distribution
Cottontail rabbit *Sylvilagus* spp	Found in area of Holcim/Trident (Bison Engineering, 2002)	Suspected to occur
Elk *Cervus elaphus*	None	Much habitat, including crucial winter and summer range areas* 58,521 acres of crucial winter range 40,969 acres of crucial summer range all acres occurring in the northern 1/3 of the 50-km radius 877,020 acres of overall distribution**
Great blue heron *Ardea herodias*	Rookeries reported near Holcim site (Miller, 2004).	Rookeries along Missouri, Gallatin, and west of Willow Creek Reservoir (Miller , 2004)
Hungarian partridge *Perdix perdix*	Covers almost entire area	Covers approximately half of study area 1,007,324 acres of overall distribution
Moose *Alces alces*	Some winter range (Nov 15 to Mar 1)	Winter range and general distribution 72,731 acres of winter range on the eastern and southern periphery of the 50-km radius 212,101 acres of overall distribution**
Mountain goat *Oreamnos americanus*	None	Winter range and general distribution 13,148 acres of winter range along the Bridger Range (east) and on the southern periphery of the 50-km radius
Mule deer *Odocoileus hemionus*	Winter range and general distribution surrounds plant	Winter range and general distribution 1,159,082 acres of winter range throughout the 50-km radius 786,847 acres of overall distribution**
Pheasant habitat *Phasianus colchicus*	Habitat surrounding plant	Overall and fair habitat 246,885 acres
Red fox *Vulpes vulpes*	Reported as occurring at Holcim site (DEQ, 2003)	Assume distribution through wider area
Red-tailed hawk *Buteo jamaicensis*	Reported occurring at Holcim site (DEQ, 2003)	Assume distribution through wider area
Ruffed grouse *Bonasa umbellus*	None	494,071 acres of overall distribution

Table 3.5-1 Species and Habitat within the Two Study Areas (Cont.)

Species	10-km Area	50-km Area
Sage grouse *Centrocercus urophasianus*	Distribution directly east of plant	Distribution directly east of plant 57,162 acres of overall distribution
Sharp-tailed grouse *Tympanuchus phasianellus*	Range inside 10-km boundary	Large amount of range 1,081,514 acres of overall distribution
Turkey *Meleagris gallopavo*	Occupied and potential habitat	Occupied and potential habitat 111,185 acres of occupied habitat 19,380 acres of potential habitat
Whitetail deer *Odocoileus virginianus*	Habitat surrounds plant	Habitat abundant and roughly paralleling water bodies 954,168 acres of overall distribution

- Note: *Elk crucial winter range is defined as that area where 90 percent of the population concentrates during heavy snowpack or low temperatures.
- **Overall distribution in this table refers to distribution as outside seasonal distribution. Seasonal distribution is not applicable or recorded for several species in the MTFWP databases - including ruffed grouse.
- Source: NRIS, 2004; Miller, 2004

Special Status Species

The MNHP database was queried for special status species that occur within the 50-km (31.06-mile) study area of the Trident facility (Miller, 2004). Special status species occurring within the 10-km (6.21-mile) zone having protection under the Endangered Species Act (ESA) include bald eagle (Threatened) and lynx (Threatened); they are discussed in detail in the following sections. In addition to special status species, the MNHP report contained locations of great blue heron and double-crested cormorant rookeries. The rookeries are important to local breeding populations of these species. All Species of Concern occurring within the 50-km (31.06-mile) study area are identified in Table 3.5-2.

Table 3.5-2 Special Status Species Occurring Within 50 km of Facility

Common Name	Scientific Name	Global Rank	State Rank	USFWS Status	USFS Status	BLM Status
American white pelican	*Pelecanus erythrorhynchos*	G3	S3B	None	None	None
Bald eagle (nests)	*Haliaeetus leucocephalus*	G4	S3B, S3N	LT	Sensitive	Special Status
Caspian tern	*Sterna caspia*	G5	S2B	None	None	None
Flammulated owl	*Otus flammeolus*	G4	S3B	None	Sensitive	Special Status
Forster's tern	*Sterna forsteri*	G5	S2B	None	None	None
Great blue heron (rookeries)	*Ardea herodias*	NA	SNR	None	None	None
Northern goshawk	*Accipiter gentilis*	G5	S3S4	None	Sensitive	Special Status
Agapetus caddisfly	*Agapetus montanus*	G2	S2	None	None	None
Brown's microcylloepus riffle beetle	*Microcylloepus browni*	G1	S1	None	None	None
Last best place damselfly	*Enallagma optimolocus*	G1G3	S1S3	None	None	None
Stonefly	*Isocapnia crinita*	GU	S2	None	None	None
Warm spring zaitzevian riffle beetle	*Zaitzevia thermae*	G1	S1	C	None	None
Western pondhawk	*Erythemis collocata*	G5	S1S1	None	None	None
Fringed myotis	*Myotis thysanodes*	G4G5	S3	None	None	None
Lynx	*Lynx canadensis*	G5	S3	LT	None	None
Townsend's big-eared bat	*Corynorhinus townsendii*	G4	S2S3	None	None	Special Status

- Notes: **C** Candidate – Those taxa for which sufficient information on biological status and threats exists to propose to list them as threatened or endangered. Their consideration in environmental planning and partnerships is encouraged; however, none of the substantive or procedural provisions of the ESA apply to candidate species.
- **G1 S1** At high risk because of extremely limited and potentially declining numbers, extent, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
- **G2 S2** At risk because of very limited and potentially declining numbers, extent, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
- **G3 S3** Potentially at risk because of limited and potentially declining numbers, extent, and/or habitat, even though it may be abundant in some areas.
- **G4 S4** Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.
- **G5 S5** Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.
- **B** Breeding – Rank refers to the breeding population of the species in Montana.
- **N** Nonbreeding – Rank refers to the non-breeding population of the species in Montana.
- **NA** Not applicable. Item is a biological feature rather than species with an assigned ranking (Miller, 2004)
- **LT** Listed threatened – Any species likely to become an endangered species within the fore seeable future throughout all or a significant portion of its range (16 U.S.C. 1532 (20)).
- **PT** Proposed threatened – Any species for which a proposed rule has been published in the Federal Register to list the species as threatened.
- **SNR** State not ranked. Listed as a biological feature rather than a species designation (Miller, 2004).
- Source: Adapted from MNHP, 2004; Miller, 2004

Canada Lynx

The Canada lynx is listed as Threatened by the USFWS pursuant to the ESA (16 U.S.C. 1531 *et seq.*). The description of habitat within this section discusses lynx habitat generally. It is not necessarily a description of lynx habitat available inside the study area. Lynx habitat exists at the southern end of the 50-km study zone, just east of Norris, Montana. The majority of this habitat is forested, grassland, and shrubland cover.

Habitat Description

Canada lynx habitat principally includes subalpine and boreal forest types, including subalpine fir *(Abies lasiocarpa)*, Engelmann spruce *(Picea engelmannii)*, lodgepole pine *(Pinus contorta)*, and aspen *(Populus tremuloides)* forests (Koehler and Aubry, 1994; Stinson, 2001). Douglas-fir *(Pseudotsuga menziesii)* and grand fir *(Abies grandis)* are considered to be lynx habitat only where they occur within a matrix of subalpine fir habitat types.

Lynx require two distinct forest structural types. The species habitat requirements include both early successional forests that support high densities of snowshoe hare (principal prey) and late successional forests for denning and the rearing of young (Butts, 1992; Koehler and Aubry, 1994). Studies have shown that snowshoe hare populations reach their highest densities in stands that provide dense cover and large quantities of browse that is accessible above the snow pack (Koehler and Britell, 1990). These characteristics typically occur in conifer stands that are between 15 and 30 years old (Koehler and Aubry, 1994). High quality denning habitat is limited to mature forest, which provides the coarse woody debris needed for thermal cover and protection for the young (Koehler and Aubry, 1994). Other important features of denning habitat include minimal human disturbance, proximity to early succession foraging habitat, and access to travel corridors to permit females to move kittens to alternative den sites and gain suitable access to prey (Koehler and Aubry, 1994).

Behavior

Lynx utilize areas with high canopy closure to move between denning and foraging habitats (Koehler, 1990). Although they will cross openings over 100 meters (328 ft) in width, they do not forage in these areas (Koehler, 1990). Female lynx typically remain near their mothers' home ranges, while juvenile males tend to disperse (Koehler and Aubry, 1994). When prey is scarce, even resident adult lynx may move long distances. Record distances include 688 and 438 miles (1,100 and 700 km) in the Yukon (Ward and Krebs, 1985) and 203 miles (325 km) in western Montana (Brainerd, 1985).

Canada lynx prefer to forage in early seral forests that contain an abundance of snowshoe hares (Koehler and Aubry, 1994). Although they utilize other small prey, such as grouse and squirrels, snowshoe hares comprise the bulk of the lynx diet (Brand et al., 1976).

Bald Eagle

The bald eagle is listed as Threatened under the ESA, and is a Species of Special Concern in Montana. The bald eagle also receives protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-711). MNHP identified 13 bald eagle records within the 50-km (31.06-mile) study zone. These occurrences

are generally clustered along the Missouri River between Toston and Townsend and the lower end of the Jefferson River, with a few dispersed occurrences along the Madison River.

Habitat Description

Bald eagles are closely associated with open water and adjacent riparian and upland habitats. Bald eagles nest in large, dominant trees, usually within line of sight of a body of water. Eagles typically build large stick nests in the fork of a tree and occasionally on cliffs (Montana Bald Eagle Working Group [MBEWG], 1991; Rodrick and Milner, 1991; Groves et al., 1997). Outside the breeding season they are often associated with concentrations of prey such as spawning fish or migratory waterfowl. Proximity to water, availability of prey, and availability of large trees for nesting, perching, and roosting are the three most important habitat requisites (MBEWG, 1991; Rodrick and Milner, 1991; Groves et al., 1997).

Behavior

Bald eagles usually forage from perches in large trees or snags, taking live fish or waterfowl. They also feed on small rodents and carrion. Eagles roost in large trees, and in winter often prefer to roost in conifers and other sheltered sites.

Human disturbance can affect eagles during both the nesting and wintering seasons. Eagles may react to people passing near nests, perches, or roosts, whether on foot or in a vehicle. They may also react to loud noises and activities such as operation of heavy equipment. If the disturbance occurs frequently it can disrupt nesting, feeding, or roosting activities and force eagles to desert a nesting territory or move to less desirable habitats (Knight and Knight, 1984; Magaddino, 1989; Stalmaster, 1987). Disruption of winter feeding can stress birds at a vulnerable time of year. In open areas, 50 percent of wintering eagles flush at human activities within 500 feet (152 m), but 98 percent tolerate activity at 1,000 feet (305 m) (Stalmaster and Newman, 1978). The birds' response depends on the timing, intensity, and frequency of disturbance. Reaction to disturbance also depends on the sensitivity of individual eagles and their habituation. Some individual birds display more tolerance than others, particularly to existing levels of activity (Stalmaster, 1987). The ultimate measures of sensitivity to and tolerance of disturbance are nest success, productivity, and survival (MBEWG, 1991).

Distribution and Population Trend

Breeding and wintering bald eagles occur along reservoirs, lakes, and major rivers. Several bald eagle nest territories exist in the project area along I-90. Breeding and wintering bald eagles live along rivers, reservoirs, lakes, and sloughs adjacent to the project area. In the vicinity of the project area, bald eagles nest and winter on the Missouri, Jefferson, and Madison rivers (Miller, 2004). Populations in Montana have steadily increased over the last two decades, reflecting the national trend, and the nesting population in the state is one of the most productive in the western United States (USDI, 1994). The number of known nesting pairs in Montana increased from 12 in 1978 to 265 in 1999 (MFWP, 2000; Flath, 2000).

3.6 Vegetation and Wetlands

This section describes vegetation cover and farmland within both the 10-km (6.21-mile) and 50-km (31.06-mile) study areas.

3.6.1 Inventory Methods

A three-tiered analysis was used to document existing vegetative and wetland conditions in the study area. Landscape use/life form classifications were first mapped to show broad scale landscape use patterns that can dramatically influence vegetation composition and structure. Cover types were then more narrowly defined into vegetation type, by species and life form. Third, a search of Montana Species of Special Concern was used to locate records of sensitive species (MNHP, 2004). Three such species have been identified within the 10-km (6.21-mile) study area: Ute ladies' tresses (*Spiranthes diluvialis*), annual Indian paintbrush (*Castilleja exilis*), and mealy primrose (*Primula incana*). Discussion of these species and their habitats is provided in Section 3.6.2.3.

3.6.2 Inventory Results

Vegetation

The data for vegetative land cover types were obtained from the Montana Gap Analysis Program (MT-GAP). MT-GAP data were created from Landsat TM imagery and ancillary biophysical data. The various cover types are quantified in Table 3.6-1, followed by detailed descriptions of the seven most common cover types.

Table 3.6-1 Percentage of Land Cover Type in 50-km (31.06 miles) Study Area

Land Cover Type	Percentage
Urban or Developed Lands	**0.43**
Agricultural	**19.10**
Agricultural Lands – Dry	9.62
Agricultural Lands – Irrigated	9.48
Grasslands	**46.85**
Altered Herbaceous	0.04
Very Low Cover Grasslands	7.71
Low/Moderate Cover Grasslands	35.28
Moderate/High Cover Grasslands	1.83
Montane Parklands and Subalpine Meadows	2.00
Shrublands	**10.50**
Mixed Mesic Shrubs	1.02
Mixed Xeric Shrubs	0.20
Salt-Desert Shrub/Dry Salt Flats	0.03
Sagebrush	8.97
Mesic Shrub – Grassland Associations	0.21
Xeric Shrub – Grassland Associations	0.08
Forest Lands	**18.47**
Low Density Xeric Forest	0.53
Mixed Broadleaf Forest	0.89
Lodgepole Pine	1.87
Limber Pine	1.23
Ponderosa Pine	1.17
Douglas-fir	5.55
Rocky Mountain Juniper	1.02
Douglas-fir/Lodgepole Pine	0.71
Mixed Whitebark Pine Forest	0.17
Mixed Subalpine Forest	1.28
Mixed Xeric Forest	3.94
Mixed Broadleaf and Conifer Forest	0.11
Water	**0.48**
Riparian Types	**3.07**
Conifer Riparian	0.29
Broadleaf Riparian	0.49
Mixed Broadleaf and Conifer Riparian	0.09
Graminoid and Forb Riparian	0.80
Shrub Riparian	0.79
Mixed Riparian	0.61
Barren Lands	**1.09**
TOTAL	**100.00**

Source: Fisher et al., 1998

Low/Moderate Cover Grasslands (35.28 Percent of Study Area)

Low/moderate cover grasslands is the most common land cover type in the study area. This cover type is widely scattered throughout most of the study area except the Gallatin Valley where agricultural use is the dominant land cover type. Low/moderate cover grasslands are characterized as:

> *Grasslands with total grass cover from 20-70 percent. Dominated by short to medium height grasses and forbs. Grasslands with production ranges from 300 to 1,800 lb/ac. Includes rangelands and non-irrigated pastures (Fisher et al., 1998).*

The most common native species found on these low to moderate cover grasslands include:

- Arrowleaf balsamroot (*Balsamorhiza sagittata*)
- Bluebunch wheatgrass (*Pseudoroegneria spicata*)
- Blue grama (*Bouteloua gracilis*)
- Sedge species (*Carex* spp.)
- Green needlegrass (*Nassella viridula*)
- Idaho fescue (*Festuca idahoensis*)
- Lupine (*Lupinus* spp.)
- Needle and thread grass (*Hesperostipa comata*)
- Western wheatgrass (*Pascopyrum smithii*)

Agricultural Lands/Dry (9.62 Percent of Study Area)

Typical species on dry agricultural lands include hay and other crops. This cover type is non-irrigated. The majority of dry agricultural lands in the study area occur in the Gallatin Valley. Agricultural land in Montana can be generally categorized as cropland, hay meadow, irrigated hay meadow, or tame pasture. Cereal grain crops are grown on cropland. Hay meadows usually occur on low-lying, gentle topography such as floodplains or terraces where mowing equipment can operate. These sites are mostly seeded to alfalfa and/or introduced grasses such as smooth brome and timothy. Irrigated hay meadows are similar to hay meadows; however, they are artificially supplied with water seasonally. Tame pasture generally designates areas of introduced grasses that are moderately to heavily grazed and often contain a variety of weedy forb species, including noxious weeds in some areas.

Agricultural Lands/Irrigated (9.48 Percent of Study Area)

Organic farms are discussed in the Land Use section of this chapter.
The majority of irrigated agricultural lands are in the Gallatin Valley and their species composition consists of crop species and hay. See discussion above for a complete description of agricultural land in Montana.

Sagebrush (8.97 Percent of Study Area)

The sagebrush cover type is widely scattered throughout most of the study area, except for the Gallatin Valley. The MT-GAP Analysis Land Cover Atlas describes this cover type as:

> *Shrublands dominated by sagebrush (Artemisia spp.) with 20 to 80 percent cover. Associated grass and forb species include bluebunch wheatgrass, blue grama, Idaho fescue, and western wheatgrass (Fisher et al., 1998).*

Common sagebrush species in the region include:

- Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*)
- Black sagebrush (*Artemisia nova*)

Very Low Cover Grasslands (7.71 Percent of Study Area)

This cover type is distributed throughout the study area. Semi-desert grasslands, with total grass cover from 10 to 30 percent cover, are areas dominated by short grasses and forbs and typically have a high amount of bare soil (20 to 60 percent cover). Grasslands have production ranges of 50 to 300 pounds per acre (lb/ac) and are usually associated with alkaline soils and/or disturbed sites (Fisher et al., 1998).
Common species include:

- Blue grama
- Clubmoss (*Selaginella densa*)
- Hood's phlox (*Phlox hoodii*)
- Missouri goldenrod (*Solidago missouriensis*)
- Prairie June grass (*Koeleria pyramidata*)
- Sandberg bluegrass (*Poa secunda*)
- Sun sedge (*Carex heliophila*)
- Threadleaf sedge (*Carex filifolia*)

Douglas-fir (5.55 Percent of Study Area)

Douglas-fir *(Pseudotsuga menziesii)* is the most common conifer throughout the study area and is distributed in the forested stringers. Associated shrub species include ninebark *(Physocarpus malvaceus)*, shiny-leaf spiraea *(Spiraea betulifolia)*, and snowberry *(Symphoricarpos* spp.).

Associated grass and forb species include bluebunch wheatgrass, Idaho fescue, and pinegrass *(Calamagrostis rubescens)* (Fisher et al., 1998).

Mixed Xeric Forest (3.94 Percent of Study Area)

The mixed xeric forest cover type is widely distributed throughout. Xeric is an ecological term used to define dry conditions. This type is predominately Douglas-fir and ponderosa pine (*Pinus ponderosa*) stands with components of Rocky Mountain juniper *(Juniperus scopularum)*. Associated shrub species include ninebark, shiny-leaf spirea, and snowberry (Fisher et al., 1998).

Wetlands

National Wetland Inventory (NWI) data were downloaded from the NRIS database. NWI data were developed through a combination of aerial photography interpretation, soils series analysis, and field checking. Mapping is incomplete in the study area and has only occurred in the southeastern section in the Gallatin Valley and portions of the Madison Valley. Based on this incomplete mapping, the NWI identifies 155 acres of wetlands within 10 km (6.21 miles) of Trident and 5,849 acres within the 50-km (31.06-mile) zone.

Streamside Types

The majority of wetland and riparian sites in the study area occur at streams and rivers. Many of the intermittent and perennial streams also support a fringe of freshwater emergent vegetation wetland (Cowardin et. al., 1979). Wetlands and riparian areas adjacent to streams and rivers support a range of vegetation types. Streamside types occur all along the Gallatin, Madison, Missouri, Jefferson, and Boulder rivers.

Springs, Seeps, Marshes, and Wet Meadows

Springs, seeps, marshes, and wet meadows are wetlands, as classified by Cowardin et al. (1979). All of these types are widely distributed throughout the study area. Most of these areas are dominated by herbaceous vegetation, although shrub and forest dominated sites are also common. These sites are primarily slope wetlands as classified by Brinson (1993), with a few sites classified as depressional wetlands with no drainage outlet.

The Nebraska sedge (*Carex nebrascensis*) and bluejoint reedgrass (*Calamagrostis canadensis*) types are the most common herbaceous types. Other common herbaceous types include beaked sedge (*Carex rostrata*), panicled bulrush (*Scirpus microcarpus*), redtop (*Agrostis gigantea*), arrowleaf groundsel (*Senecio triangularis*), common cattail (*Typha* spp.), reed canarygrass (*Phalaris arundinacea*), and slender sedge (*Carex gracilior*).

Alder types, both mountain alder (*Alnus viridis* ssp. *crispa*) and Sitka alder (*Alnus viridis* ssp. *sinuata*) are the most common shrub types at springs and seeps. Less common shrub types include redosier dogwood (*Cornus sericea*), and Drummond willow (*Salix drummondiana*)/beaked sedge.

Species of Concern

There are several Montana Plant Species of Special Concern within the 50-km (31.06-mile) study area (Table 3.6-2). Ute ladies' tresses, a plant listed as Threatened under the ESA, has been recorded within the 10-km (6.21-mile) study boundary. Plant species and habitat descriptions of plants within the 10-km boundary are noted below in this section.
In Montana, the rarity of a plant species is classified under several federal and state designations. Species of Special Concern and their ranking system are described as follows:

> *Taxa are evaluated and ranked by the Heritage Program on the basis of their global (range-wide) status and their state-wide status according to a standardized procedure used by all Natural Heritage Programs. These ranks are used to determine protection and data collection priorities and are revised as new information becomes available.*
>
> *The international network of Natural Heritage Programs employs a standardized ranking system to denote global (G – range-wide) and state (S) status. Species are assigned numeric ranks ranging from 1 (critically imperiled) to 5 (demonstrably secure), reflecting the relative degree to which they are "at-risk" (MNHP, 2004).*

For example, annual Indian paintbrush is ranked G5 S2. Globally the species is secure, while in Montana it is imperiled because of rarity, or because of other factors making it vulnerable to extirpation.

Table 3.6-2 Montana Plant Species of Special Concern inside 50-km (31.06 miles) Study Area

Species	Global Rank	State Rank	USFWS Status	USFS Status	BLM Status	Proximity
Annual Indian paintbrush *Castilleja exilis*	G5	S2	None	None	None	Inside 10 km
Austin's knotweed *Polygonum douglasii* ssp. *austinae*	G5T4	S2	None	Sensitive	Sensitive	Inside 50 km
Dwarf purple monkey flower *Mimulus nanus*	G5	S1	None	None	None	Inside 50 km
Hall's rush *Juncus hallii*	G4G5	S2	None	Sensitive	Sensitive	Inside 50 km
High-arctic buttercup *Ranunculus hyperboreus*	G5	S1	None	None	None	Inside 50 km
Long-styled thistle *Cirsium longistylum*	G2	S2	None	Sensitive	Sensitive	Inside 50 km
Many-ribbed sedge *Carex multicostata*	G5	S1	None	None	Watch	Inside 50 km
Mealy primrose *Primula incana*	G4G5	S2	None	None	Watch	Inside 10 km
Slender wedgegrass *Sphenopholis intermedia*	G5	S1	None	None	Watch	Inside 50 km
Small dropseed *Sporobolus neglectus*	G5	S1	None	None	Watch	Inside 50 km
Small yellow lady's-slipper *Cypripedium parviflorum*	G5	S3	None	Sensitive	Watch	Inside 50 km
Tapertip onion *Allium acuminatum*	G5	S1	None	Sensitive	Sensitive	Inside 50 km
Ute ladies' tresses *Spiranthes diluvialis*	G2	S2	Listed Threatened	None	Watch	Inside 10 km

- Notes: Global Rank/State Rank:
- **G1 S1** At high risk because of extremely limited and potentially declining numbers, extent, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
- **G2 S2** At risk because of very limited and potentially declining numbers, extent, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
- **G3 S3** Potentially at risk because of limited and potentially declining numbers, extent, and/or habitat, even though it may be abundant in some areas.
- **G4 S4** Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.
- **G5 S5** Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.
- Source: MTNHP is part of the Natural Heritage Program network, which uses a standardized set of rankings. MTNHP, 2004

Ute ladies' tresses

Ute ladies' tresses is one of three plant species listed as Threatened by the USFWS in Montana, and the only one found in the study area. This species is a perennial orchid, which blooms in August to early September. Ute ladies' tresses occurs in meandered wetlands and swales in broad, open valleys (MNHP, 2000) and in broadleaf forests and graminoid and shrub-dominated riparian areas, at elevations of 4,050 to 5,080 feet (1,234 to 1,548 m) (MNHP, 2000). It is the only orchid species in Montana that is restricted to grassland. Among plants with a Rocky Mountain distribution, it is among the few species confined to low elevations (Heidel, 1998). Two locations have been recorded to the southwest of Three Forks and another is found west of Manhattan (see Map-8). One location has been recorded along the Missouri River between Townsend and Toston. This species is also found in restricted areas in the interior western United States.
Ute ladies' tresses occur in Montana in highly restricted microhabitats in shallow, meandered wetlands. Within these wetlands, the species lives in small pockets of sparse, highly calcareous meadow (Heidel, 1998).

Soils are a critical determining factor in assessing potential habitat for this species, especially in its Montana occurrences. The MNHP has identified and mapped four distinct soil types that correlate highly with Ute ladies' tresses habitat in Montana. The four soil types are: the Neen and Villy soil series in the seven western occurrences (in Beaverhead, Jefferson, and Madison counties), and the Fairway and the Saypo series among the three eastern occurrences (Gallatin County).

Soils supporting Ute ladies' tresses populations are generally high in nutrients and organic matter; however, they are low in phosphorus when compared to average values for agricultural soils.

The MNHP has documented 11 occurrences of this species in Montana (MNHP, 2000). Ute ladies' tresses was listed as a Threatened plant species under the Endangered Species Act in 1992 (57 FR 2053). Ute ladies' tresses colonizes early successional riparian habitat. A localized decline may result from continued changes in stream channel position and encroachment of later successional vegetation. Its habitat in Montana is not directly associated with riverine succession. Rather, the occurrences are along shallow wetlands set back from rivers in open, broad valleys. In these areas, the vegetation is usually sparse and short when compared to the vegetation in surrounding wetlands

Annual Indian paintbrush

Annual Indian paintbrush is listed as a Species of Special Concern with MNHP. A record of the species covers a large part of the 10-km (6.21-mile) study area. This is because the MNHP reports some occurrences at a broad scale to discourage plant enthusiasts from visiting these sites if they are particularly sensitive or on private land. It is possible this plant is very near the Holcim/Trident cement plant. Annual Indian paintbrush is found primarily in alkaline marshes and meadows, mostly at lower elevations, throughout the intermountain region from central Washington and eastern Oregon to southern Montana and western Wyoming, south to northwestern New Mexico, northern Arizona, Nevada, and adjacent California. Its flowering period is from late June through September.

Mealy primrose

Mealy primrose is listed with MNHP as a Species of Special Concern. A record covers a large part of the 10-km (6.21–mile) study area, in the same area as annual Indian paintbrush. Mealy primrose is found on stream banks and in moist meadows in the Rocky Mountains from Colorado and Utah to northern Canada. It is also known to occur in southeast Idaho. Its flowering period is from May to July.

3.7 Fisheries and Aquatics

Both cold water and warm water fisheries are found within the 50-km (31.06-mile) study area. Warm water fisheries are located primarily in Canyon Ferry Lake on the northern border of the 50-km (31.06-mile) study area. Major fish-bearing streams in the area include the Missouri, Gallatin, Jefferson, and Madison rivers. Several small tributaries are found within the 10-km (6.21-mile) study area, but none are known to be fish bearing streams.

3.7.1 Inventory Methods

Montana Fisheries Information System (MFISH) (MFISH, 2004) and biologist interviews were used to obtain fish presence, summarized in Section 3.7.2 below.

3.7.2 Inventory Results

Fish

The study area receives high sport fishing use. Consumption of fish opens a potential exposure pathway of toxins to humans. Table 3.7-1 documents fish presence on major stream reaches within the study area. Westslope cutthroat trout occur only on tributaries to these sampled reaches and are therefore not represented in this table.

Three Montana Fish Species of Special Concern are known to occur within the 50-km (31.06-mile) study area: arctic grayling, westslope cutthroat trout, and Yellowstone cutthroat trout (MNHP, 2004; Byorth, 2004; AFS, 2004). Arctic grayling reintroduction is occurring in the area around Three Forks and is further discussed in the section on the Missouri River.

Missouri River

In the study area, the Missouri River reach is classified as having “outstanding” to “high” Fisheries Resource Values by MFWP (MFISH, 2004). The river is considered periodically dewatered (MFISH, 2004). A passage barrier exists at Toston Dam which separates distinct populations. Stocked rainbow trout from Canyon Ferry Reservoir migrate as far upstream as Toston Dam (Spoon, 2004).

Table 3.7-1 Fish Presence on Major Stream Reaches within Study Area

Species Name	Missouri River Above Toston Dam	Missouri River Canyon Ferry Lake to Toston Dam	Gallatin River	Jefferson River	Madison River
Arctic grayling *(Thymallus arcticus montanus)**			Rare		Rare
Brook trout *(Salvelinus fontinalis)*			Rare		Rare
Brown trout *(Salmo trutta)*	Common	Common	Abundant	Common	Rare to abundant
Burbot *(Lota lota)*	Rare	Rare		Rare	
Common carp *(Cyprinus carpio)*	Abundant	Abundant		Common	Rare
Flathead chub *(Hybopsis gracilis)*	Rare	Rare		Rare	
Largemouth bass *(Micropterus salmoides)*	Rare	Rare			
Longnose dace *(Rhinichthys cataractae)*	Common	Common	Rare	Common	Abundant
Longnose sucker *(Catostomus catostomus)*	Common	Common	Common	Common	Abundant
Mottled sculpin *(Cottus bairdi)*	Common	Common	Abundant to common	Common	Abundant
Mountain sucker *(Catostomus platyrhynchus)*	Rare	Rare	Rare	Rare	Rare
Mountain whitefish *(Prosopium williamsoni)*	Common	Common	Abundant	Abundant	Common
Northern pike *(Esox lucius)*		Rare			
Rainbow Trout *(Oncorhynchus mykiss)*	Common	Common	Abundant	Rare	Rare
Redside shiner *(Richardsonius balteatus)*				Rare	
Stonecat *(Noturus flavus)*	Rare	Rare			Rare
Utah chub *(Gila atraria)*					Rare
White sucker *(Catostomus commersoni)*	Common	Common	Common	Common	Abundant
Yellowstone cutthroat trout *(Oncorhynchus clarki bouvieri)**			Rare		Rare

- Note: * Montana Species of Special Concern (MNHP, 2004)
- Source: MFISH, 2004; Byorth, 2004

The key sport fish in this river is brown trout. The biggest limiting factors for fish habitat are water flow and temperature. Long lasting drought has had substantial impacts to trout populations, resulting in numbers today that are approximately one-third of what they were in the mid-1980s (Spoon, 2004).

MFISH was used to gather data for the Missouri River within Broadwater and Gallatin counties. Data are reported for two reaches of the stream: above Toston Dam (river mile [rm] 2,295.6 to 2,312.4) and above the inlet of Canyon Ferry Lake up to the Toston Dam (rm 2,251.4 to

2,295.5). Surveys in 1999 reported fish occurrence from rm 2282.8 to 2285.2 from Toston to Crow Creek as follows: 28 brown trout, 5 suckers, 2 common carp, and approximately 260 mountain whitefish (MFISH, 2004). Surveys immediately downstream from the proposed project site (rm 2305.5 to 2310.2) found 86 rainbow trout [1979], 33 brown trout [1982], and 419 trout (species unnamed) [1976] (MFISH, 2004). Brown trout populations have decreased substantially since the 1970s below the Toston dam. Despite downward trends in brown trout, this stream is still widely regarded by MFWP as a strong fishery. A survey in the immediate area of the Holcim/Trident plant in 2001 was conducted from the Gallatin River confluence approximately 2.5 miles downstream (Spoon, 2004). This survey documented 620 mountain whitefish, 108 white suckers, 39 brown trout, and 54 rainbow trout. This was a boat, electro-shock survey; therefore, it did not produce sculpin or dace. No arctic grayling were found during the 66 minutes of sampling.

The confluence area at Three Forks has been the site of an arctic grayling reintroduction effort within the last five years. This reintroduction has been only partially successful, most likely due to environmental stress induced by low flows and water temperature (Spoon, 2004). The only success with grayling introduction to date has been in the lower Gallatin River.

Crow Creek

Flowing out of the Elkhorn Mountains, located west of Toston and Townsend, Crow Creek is classified as having "substantial" Fisheries Resource Value. From rm 0.0 to rm 14.9 is considered an area of "chronic dewatering" (MFISH, 2004). Fish species present include: Brook trout, brown trout, mottled sculpin, mountain whitefish, and rainbow trout. Several tributaries to Crow Creek contain westslope cutthroat trout and are the focus points of cutthroat population restoration by MFWP (Spoon, 2004).

Canyon Ferry Lake

The tip of this 33,534-acre reservoir is on the northern edge of the 50-km (31.06-mile) study area. The Missouri River flows into it. Though managed as trout water, MFWP does not assign a Fisheries Resource Value to this water body. The lake receives a high amount of fishing pressure with 106,810 days of angling use for the year of 2002 (MFISH, 2004). An aggressive stocking program exists for Canyon Ferry Lake. Numbers of rainbow trout and brown trout have declined rapidly since the mid-1980s probably as a result of planted walleye, which have increased substantially from the same time period.

Gallatin River

The Gallatin River is an approximately 100-mile blue ribbon trout stream and provides an economic benefit for the region. Fisheries resource values of "high" to "outstanding" exist from rm 0 to 85.4 and "limited" from 85.5 upward.

Total numbers of trout have been fairly stable over the past 20 years, although there was a population slump in the mid-1990s. A light infection of whirling disease exists in the Gallatin drainage (MWDTF, 2004). MFWP has not seen huge population declines as a result of whirling disease, but deformities are obvious (Byorth, 2004). The main limiting factor to quality fish habitat is water temperature (Byorth, 2004). Dewatering is also a concern. The MFWP considers the lower 34 miles to suffer from chronic dewatering and rm 34 to rm 43 to suffer from periodic dewatering associated with irrigation and an extended drought. Arctic grayling

reintroduction has occurred here, and at least one grayling was found during routine surveys in the mid-1990s (Byorth, 2004). Of the Missouri, Gallatin, Jefferson, and Madison rivers, the Gallatin is the only one where there has been a measured success of the arctic grayling introduction program (Spoon, 2004).

Cottonwood Creek

This 11-mile tributary of the Gallatin River, is located inside the study area, and is considered to be of limited fisheries value with no fish species present, although it is managed by MFWP as "trout water" (MFISH, 2004). It is not considered by MFWP to be dewatered or suffering from low or non-existent flows.

Rey Creek

Rey Creek is located within the 10-km study zone. This stream is assumed by MFWP to contain brown trout and rainbow trout, is managed as trout water, and is classified as having "substantial" Fisheries Resource Value (MFISH, 2004). It is not considered by MFWP to be dewatered.

Jefferson River

The Jefferson River is classified as having "substantial" to "high" Fisheries Resource Values. From rm 0.0 to 74.09 it is considered by MFWP to be chronically dewatered (MFISH, 2004). Fish counts have declined from approximately 600 per mile to 200 per mile in the past 20 years. Fourteen of the last 20 years have had drastically low flows and high temperatures creating stressful conditions for fisheries (Spoon, 2004).

Boulder River

Boulder River, located approximately 20 miles west of the Trident facility, is classified by MFISH as containing "substantial" to "moderate" Fisheries Resource Values. It is not considered by MFWP to be dewatered. It is known to contain: brook trout, brown trout, longnose dace, longnose sucker, mottled sculpin, mountain whitefish, rainbow trout, and white sucker.

Willow Creek Reservoir

No Fisheries Resource Value is assigned to Willow Creek Reservoir by the MFWP, but it does contain brown trout, longnose sucker, rainbow trout, and white sucker.

Madison River

The Madison River is managed as "trout water" by MFWP and is classified as having "outstanding" Resource Fisheries Value. It is not considered by MFWP to be dewatered. Rainbow trout numbers in the Madison River plummeted substantially from late 1970 to 1994. Whirling disease was diagnosed in 1994, and studies suggest it has had a severe biological impact on fisheries in the Madison (Roulson, 2002). Although whirling disease is mainly evident downstream of Ennis, it is not currently at levels inducing catastrophic losses (Byorth, 2004). The Madison fishery provides an economic benefit to the region by drawing anglers from out of state. A user survey in the mid-90s reported 90 percent of anglers to be non-residents.

Special Status Species

No special status fish are documented to occur within 10 km (6.21 miles) of the Holcim facility. Byorth (2004) reported finding an arctic grayling in the Gallatin River, but the location was not noted. The three special status species identified in Table 3.7-2 below are believed to occur within the 50-km (31.06-mile) radius. MFWP is currently focusing westslope cutthroat restoration efforts in the Elkhorn Mountain Range. Restoration is currently occurring in Little Keiser and Eureka Creeks, both of which are in the Crow Creek drainage (Spoon, 2004).

Table 3.7-2 Special Status Fish Species within 50-km (31.06 miles) study area

Common Name	Scientific Name	Global Rank	State Rank	USFWS Status	USFS Status	BLM status	Proximity
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	G4T2	S2	None	None	Special Status	Shields River Drainage on the far west side
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	G4T3	S2	None	None	Special Status	Hall Creek (tributary to Crow Creek) in northwest corner
Arctic grayling	*Thymallus arcticus montanus*	G5T1Q	S1	C	None	Special Status	Gallatin River (Byorth, 2004)

- Notes: Global Rank/State Rank:
- **G1 S1** At high risk because of extremely limited and potentially declining numbers, extent, and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
- **G2 S2** At risk because of very limited and potentially declining numbers, extent, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
- **G3 S3** Potentially at risk because of limited and potentially declining numbers, extent, and/or habitat, even though it may be abundant in some areas.
- **G4 S4** Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern.
- **G5 S5** Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.

Source: MFWP, 2004

Aquatic Invertebrates

Aquatic communities in rivers and streams are composed of assemblages of plants and animals reflective of their environment. The environment that shapes these assemblages consists of the chemical composition of the water column, physical stream environment, and interactions of the aquatic and plant communities. Table 3.7-3 shows that there were 20 to 33 aquatic invertebrate species at sites sampled in rivers connected to the project study area when sampled in 2000 and 2001. Biotic indices suggest that the upper Gallatin River has better aquatic habitats than the Jefferson or Missouri River sample sites. Lower biotic indices reflecting higher water quality were calculated from sampling in the Jefferson River in 1978 (Oswald, 1979), suggesting some deterioration of water quality may have occurred since that time. The composition of the

communities sampled reflects impairments of these waters, as certain species can increase or decrease as specific natural or impaired components of their habitats change.
Aquatic macroinvertebrates include insects that spend most of their life cycles as larva living in stream sediments. The most common are mayflies (*Ephemeroptera* spp.), stoneflies (*Plecoptera* spp.), and caddis flies (*Tricoptera* spp.).

Table 3.7-3 Aquatic Macroinvertebrate Communities in Rivers Associated with Project Area

Location	Site ID	Taxa Richness*	EPT Richness**	Biotic Index	Impairment
Jefferson R near Three Forks	M08JEFFR01	32	16	4.81	Warm water and sediments
Missouri R near Toston	M09MISSR01	26	9	4.97	Warm water and nutrients
Gallatin R	G1 Downstream of Yellowstone National Park (YNP)	26	16	1.57	Unimpaired
Gallatin R	G2 below Taylors Fork	20	14	1.12	Unimpaired
Gallatin R	G3 Above West Fork	26	16	2.00	Unimpaired
Gallatin R	G4 below West Fork	27	14	2.77	Unimpaired
Gallatin R	G5 Greek Cr CG	32	17	2.70	Elevated Nutrients
Gallatin R	G6 Above Spanish Cr	33	18	2.50	Unimpaired
Gallatin R Near Logan	M05GALLR01	28	13	4.50	Warm water and sediment

- Notes: * Total Taxa present, ** Taxa present of the orders Ephemeroptera, Plecoptera, and Tricoptera
- Source: Bollman, 2001, 2002a, 2002b, 2002c, 2002d

Headwaters of streams connected to the project study area have invertebrate populations reflective of unimpaired watersheds, and downstream populations indicate increasing stream impairments as they approach the project area. These impairments have been attributed to increased water temperature, sediments and nutrient enrichment (Bollman, 2001, 2002a, 2002b, 2002c, 2002d; Oswald, 1979).

3.8 Land Use

This section characterizes land use in a 50-km (31.06-mile) study area surrounding the plant. More specific discussion of land use is provided for the 10-km (6.21-mile) study area surrounding the plant, where warranted.

The 50-km (31.06-mile) study area falls within the counties of Gallatin, Broadwater, Jefferson, Madison, and Meagher. Private land dominates the study area. Public land is owned and managed by the Bureau of Land Management (BLM), Bureau of Reclamation (BOR), United States Forest Service (USFS), United States Department of Agriculture (USDA), Montana University System, Montana Department of Transportation (MDT), MFWP, DNRC, and various local governments.

Nearby population centers include the incorporated areas of Bozeman, Belgrade, Manhattan, Three Forks (Gallatin County), Townsend (Broadwater County), and Whitehall (Jefferson County). Prominent land uses include commercial, industrial, public and institutional, farms and ranches, rural residences, communication sites, airport/airstrips, roads and highways, utility rights-of-way for electrical power lines and telephone lines, oil and gas production and pipelines, mining, rangeland and agriculture (crops and livestock), and recreation.

3.8.1 Inventory Methods

The land use inventory was conducted between January and April of 2004. Existing data, containing land cover and uses, were obtained from the NRIS GIS. The NRIS acts as a clearinghouse for GIS databases. National Aerial Photograph Program (NAPP) 1: 20,000 scale 1995 black and white aerial photography was also used. Federal, state, and local land resource agencies were also contacted during this time to update official information and to solicit further input. The information collected within the study areas was organized into three inventory categories: (1) Land Ownership/Jurisdiction, (2) Land Use, and (3) Parks, Recreation, and Preservation Areas.

3.8.2 Inventory Results

Land Ownership and Jurisdiction

The 50-km (31.06-mile) study area covers 1,929,652 acres. Table 3.8-1 shows land surface ownership/jurisdiction in acres for the study area. The incorporated areas within the study area are the cities of Bozeman, Belgrade, Three Forks, and Townsend, and the towns of Manhattan and Whitehall.

Table 3.8-1 Land Ownership and Jurisdiction – 50-km (31.06 miles) Study Area

Land Ownership/Jurisdiction	Total Acres
Bureau of Land Management	118,882
Bureau of Reclamation	2,900
U.S. Forest Service	193,704
United States Department of Agriculture	32
Montana University System	1,774
Montana Department of Transportation	23
Montana Fish, Wildlife & Parks	6,015
Montana Department of Natural Resources and Conservation	89,852
Private	1,516,470
TOTAL	**1,929,652**

Source: Montana State Library/NRIS

Land surface ownership/jurisdiction within the 10-km (6.21-mile) study area is shown in Table 3.8-2. The only incorporated area within this study area is the City of Three Forks.

Table 3.8-2 Land Ownership and Jurisdiction – 10-km (6.21 miles) Study Area

Land Ownership/Jurisdiction	Total Acres
Bureau of Land Management	4,469
Montana Department of Transportation	23
Montana Fish, Wildlife & Parks	952
Montana Department of Natural Resources and Conservation	4,174
Private	67,351
TOTAL	**76,969**

Source: Montana State Library/NRIS

Existing Land Uses

Agriculture

Agriculture (crops and livestock) is a predominant land use within the 50-km (31.06-mile) study area. Agricultural land refers to pasture and irrigated and dry croplands. Some Montana state trust land is also leased for agricultural purposes.

Crops grown at any one location in the study area vary, and occasionally lands are fallow for water conservation and weed control. Specific irrigation methods (center pivot, wheel line, and flood) also vary depending on soil properties, topography, and cost. Principle crops include wheat, barley, and hay. Data on the crop types grown in the study area were obtained from the Montana Department of Agriculture.

Livestock includes cattle (beef and milk cows), sheep and lambs, and one large confinement swine operation. Livestock and crop sales are a large source of cash receipts by agricultural producers. Milking operations also provide an important percentage of revenue of all dairy sales in Montana.

Irrigated and non-irrigated 2002 harvested acreage for all crops in the five study area counties is found in Table 3.8-3. Information on crops planted and harvested for these counties in 2002 is provided in Table 3.8-4. The number of head of livestock for these counties in 2002 is also provided in Table 3.8-5.

Table 3.8-3 2002 County Estimates – Irrigated and Non-irrigated Harvested Crop Acreage

County	Irrigated Harvested Acres	Non-irrigated Harvested Acres
Gallatin	82,610	70,800
Broadwater	34,120	34,000
Jefferson	19,700	4,700
Madison	74,310	9,400
Meagher	37,100	26,700

Source: 2003 Montana Agricultural Statistics, 2001-2002 County Estimates

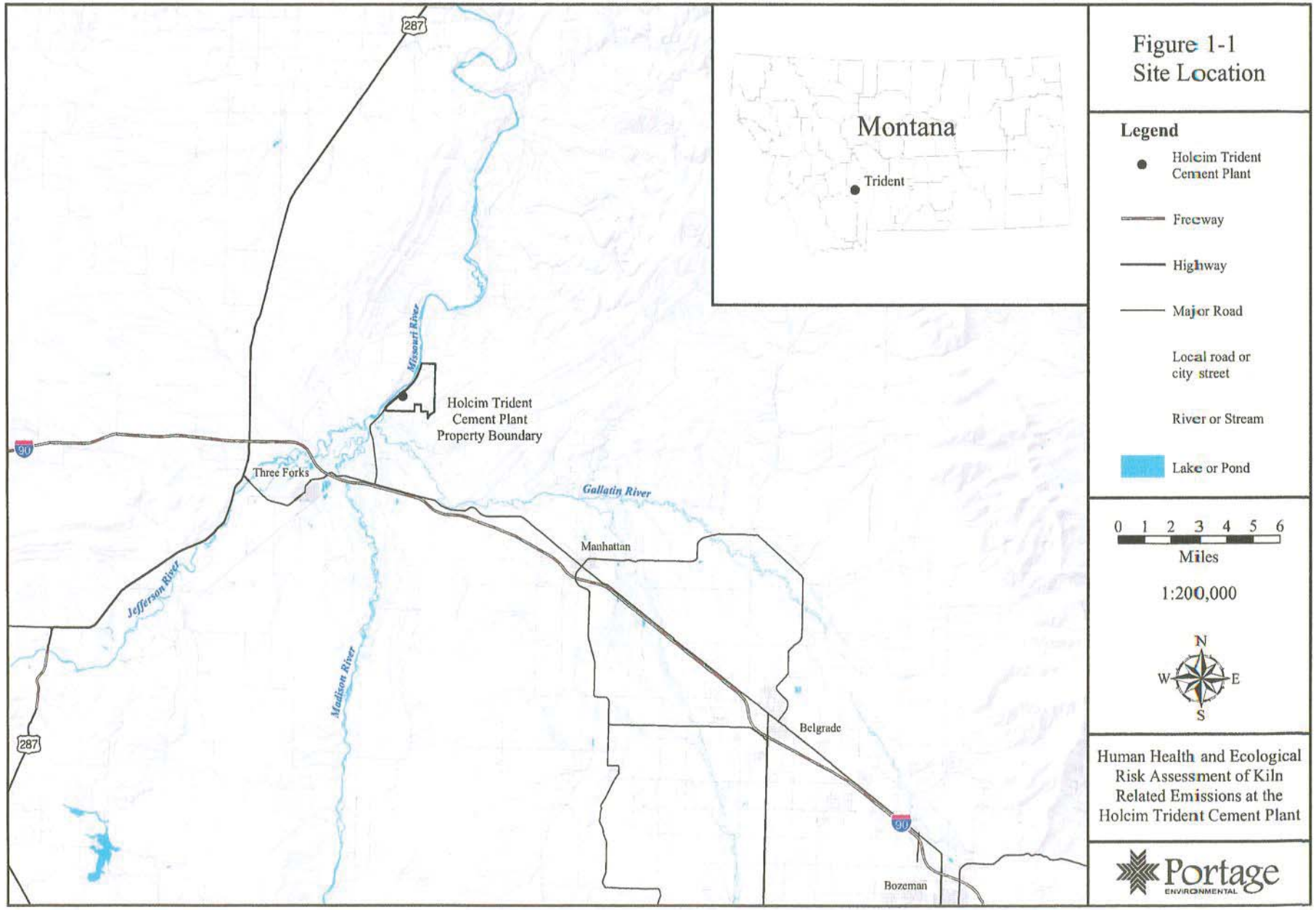
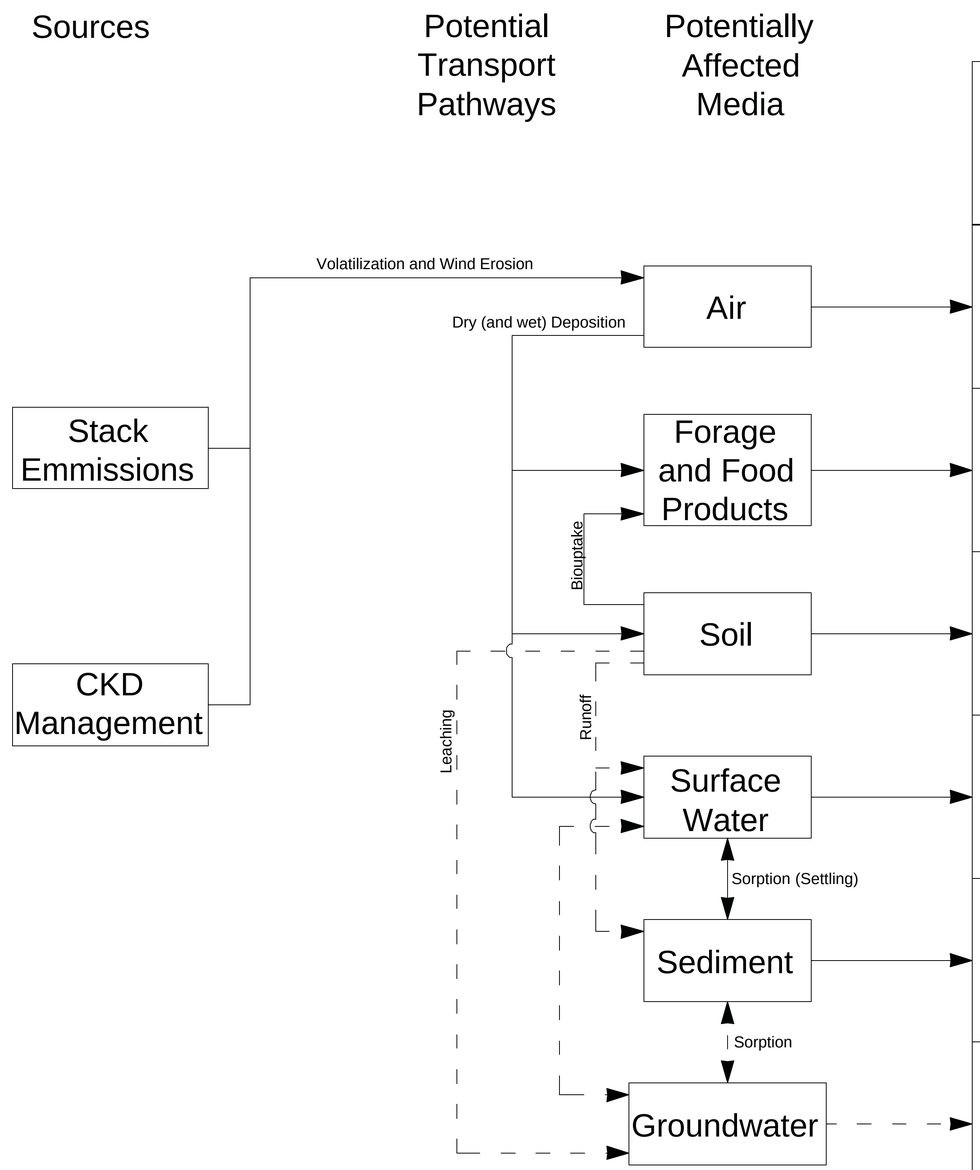


Figure 1-1
Site Location

Human Health and Ecological Risk Assessment of Kiln Related Emissions at the Holcim Trident Cement Plant



Potential Receptors

Holcim Worker	Recreation User	Future Potential Resident	Existing Resident	Ecosystem
(INH)	(INH)	INH	INH	INH
NE	(ING)	ING	ING	ING*
(ING) (DERM)	(ING) (DERM)	ING DERM	ING DERM	ING DERM
NE	(ING) (DERM)	ING DERM	ING DERM	ING DERM
NE	(ING) (DERM)	(ING) (DERM)	(ING) (DERM)	ING DERM
NE	(ING) (DERM)	(ING) (DERM)	(ING) (DERM)	(ING) (DERM)

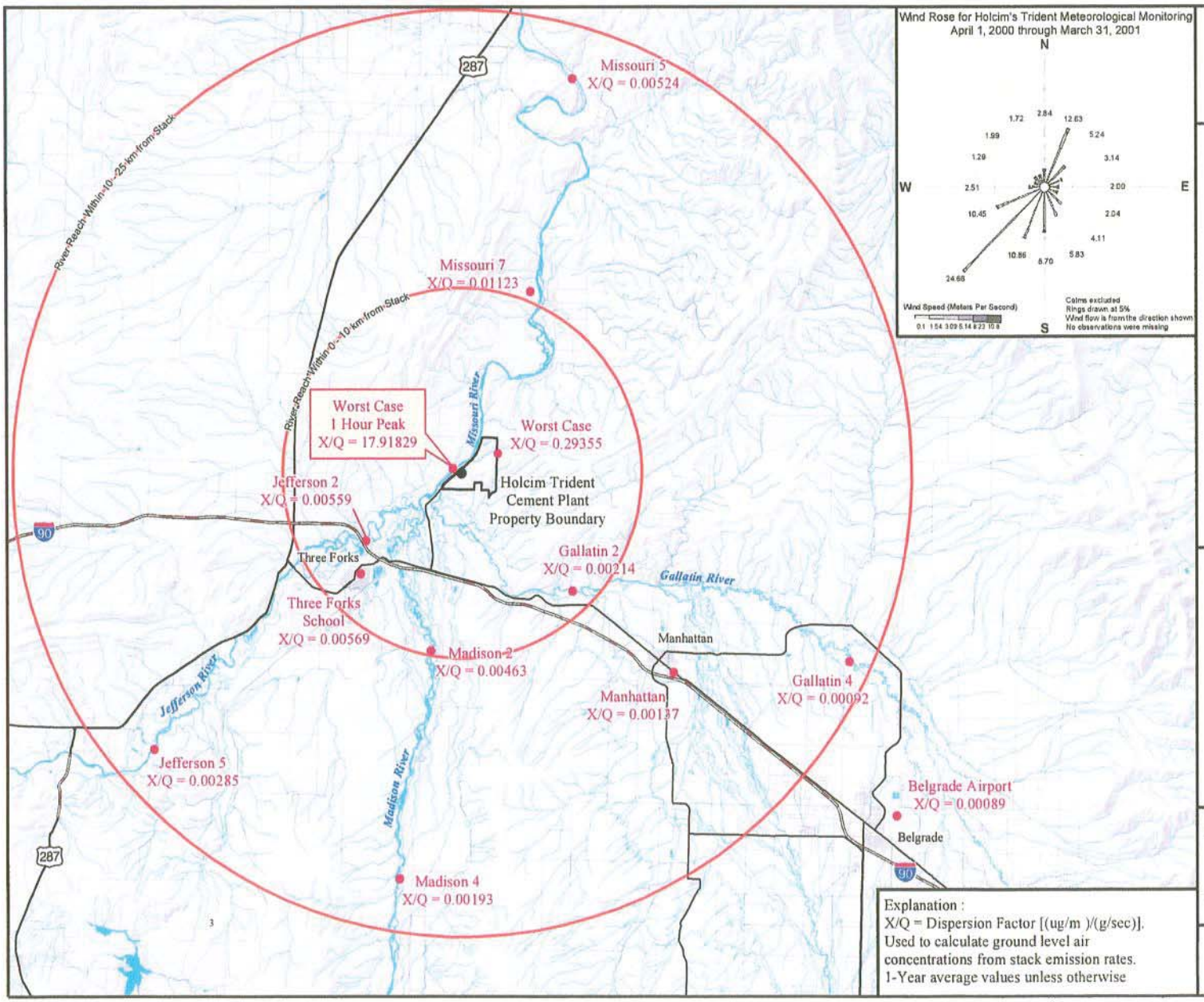
LEGEND:

INH - Inhalation
ING - Ingestion
DERM - Dermal Absorption
NE - No Exposure

() - Potentially complete yet minor pathway that is evaluated qualitatively or semi-quantitatively
* - See food web model

——— Transport pathways evaluated quantitatively
– – – Transport pathways evaluated qualitatively

Figure 2-1. Conceptual Site Model



Explanation :
X/Q = Dispersion Factor [(ug/m)/(g/sec)].
Used to calculate ground level air concentrations from stack emission rates.
1-Year average values unless otherwise

Figure 2-2
Key Receptor Locations

Legend

- Holcim Trident Cement Plant
- Key Receptor
- Freeway
- Highway
- Major Road
- Local road or city street
- River or Stream
- Lake or Pond

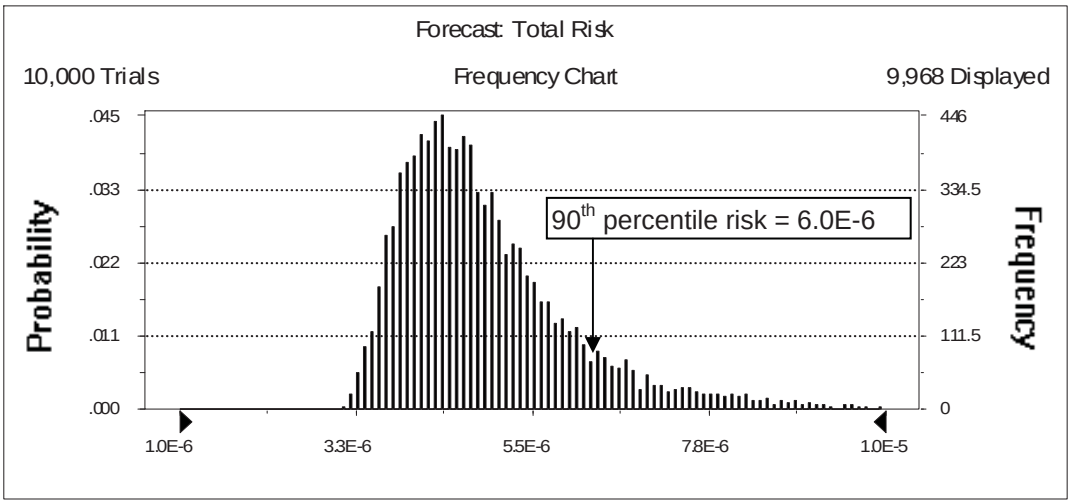
0 1 2 3 4 5 6
Miles

1:200,000

N
W E
S

Human Health and Ecological Risk Assessment of Kiln Related Emissions at the Holcim Trident Cement Plant

Portage ENVIRONMENTAL



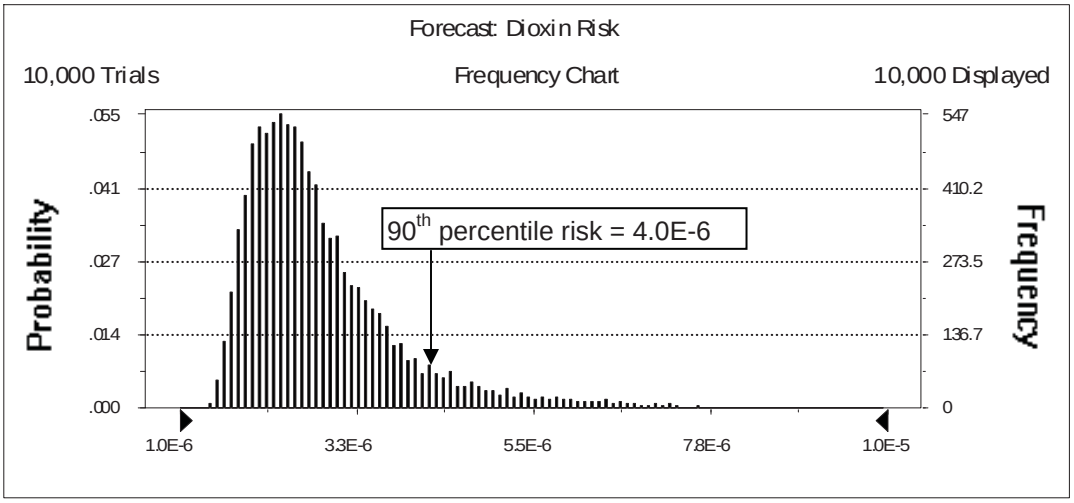


Figure 2-3. Population Distribution of Carcinogenic Risks for Worst Case Location Cumulative Condition

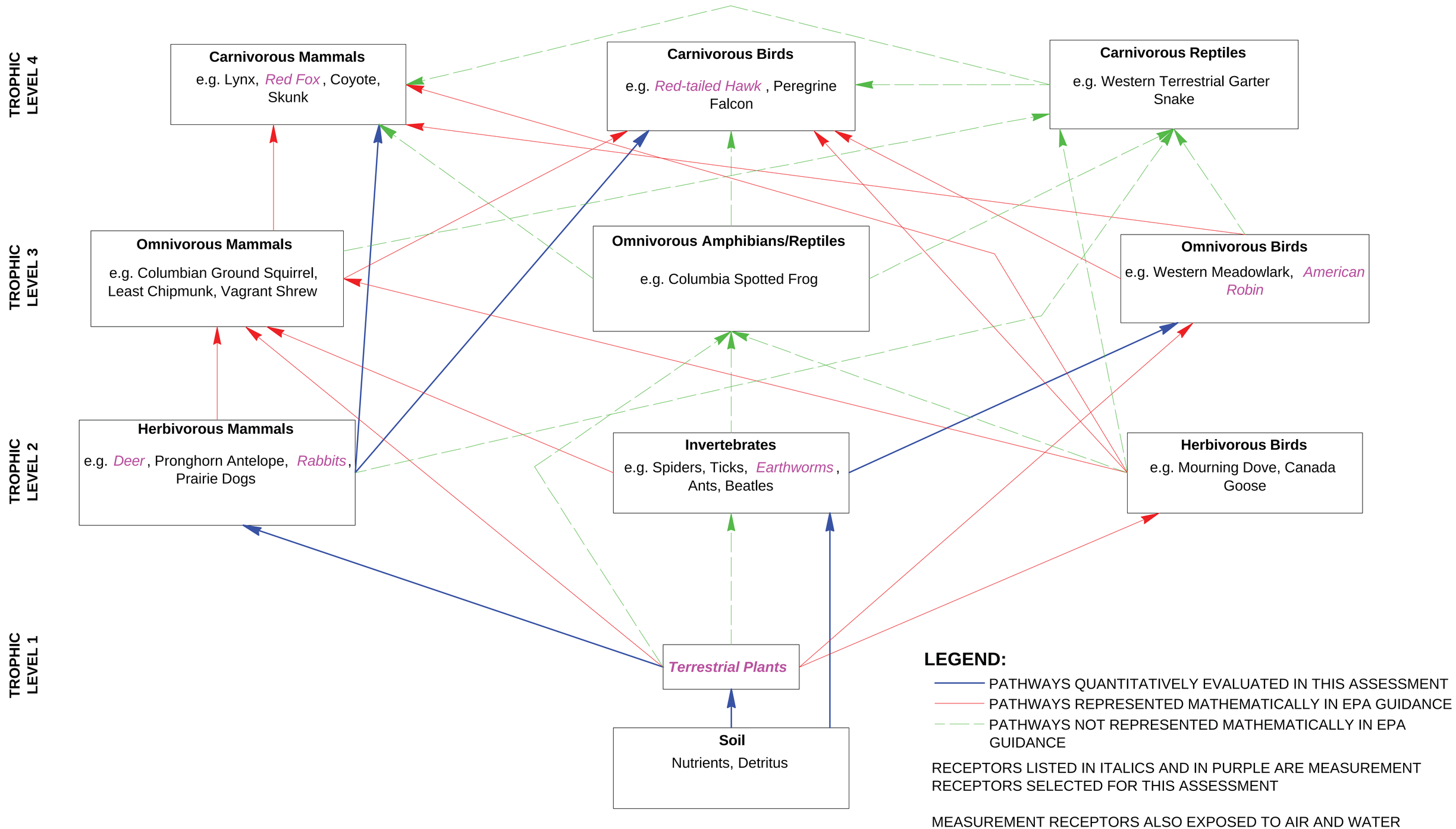


Figure 3-1. Holcim Terrestrial Food Web.

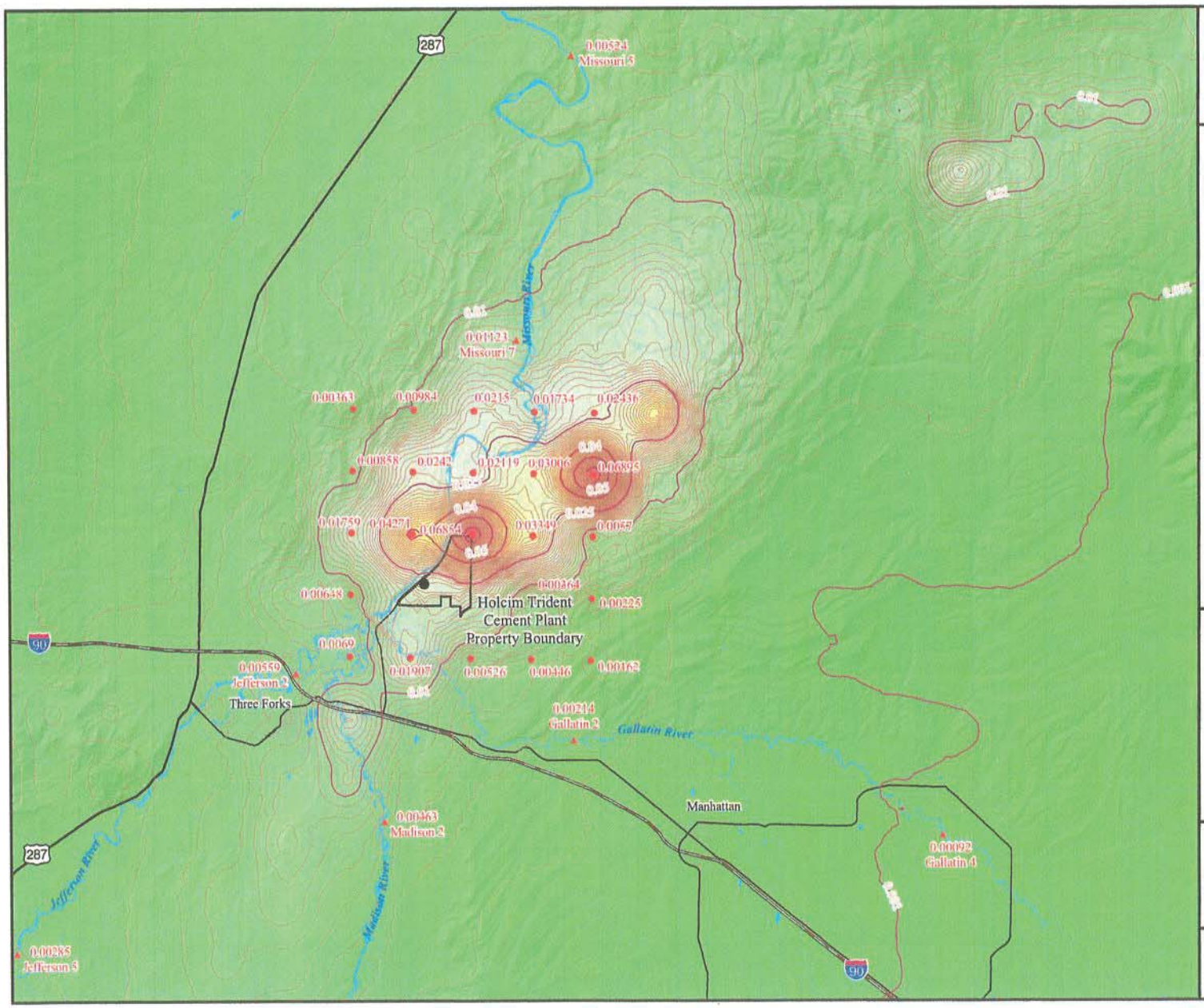


Figure 3-2
Terrestrial Receptor Locations

Legend

- Holcim Trident Cement Plant
- Terrestrial Receptor
- River Receptor
- Freeway
- Highway
- Major Road
- Local road or city street
- Lake or Pond
- River or Stream

Isopleths

- Numbered Contour
- Contour

Dispersion Coefficient (X/Q) 1 Year Average Value

High : 0.066163

Low : 0.000130

0 1 2 3 4 5

Miles

1:150,000

N W E S

Human Health and Ecological Risk Assessment of Kiln Related Emissions at the Holcim Trident Cement Plant

Portage ENVIRONMENTAL

Table 2-1. Acute Hazards Assessment

Compound	Peak 1-hour (ug/m^3)[1]		Upset Mult. Kiln (1-hr)[2]	Acute Criteria (ug/m^3)	Avg Time (hrs)	Source[3]	Hazard Quotent	
	Baseline	Cumulative					Baseline	Cumulative
Acetaldehyde	1.08E+00	1.53E-01	1	3.60E+05	8	OSHA	0.0000	0.0000
Acrolein	2.53E-02	2.53E-02	1	1.90E-01	1	CEPA	0.1333	0.1333
Trichloroethene	8.39E-04	7.11E-03	1	6.79E+05	1	ERPG-1	0.0000	0.0000
Antimony	7.61E-02	7.71E-02	83.8	1.49E+03	--	TEEL-1	0.0001	0.0001
Arsenic	1.31E-01	9.42E-02	83.8	3.00E+01	--	TEEL-1	0.0044	0.0031
Benzene	2.38E+00	1.95E+00	1	1.60E+05	1	ERPG-1	0.0000	0.0000
Beryllium	3.22E-02	2.42E-02	83.8	9.95E+00	--	TEEL-1	0.0032	0.0024
Bis (2-ethylhexyl)phthalate	1.11E-01	1.37E-01	1	5.00E+03	8	OSHA	0.0000	0.0000
Bromomethane (Methyl Bromide)	1.11E-02	7.39E-03	1	3.90E+03	1	CEPA	0.0000	0.0000
1,3 Butadiene/Butadiene	8.00E-03	2.06E-02	1	NA	NA	NA	--	--
2-Butanone (MEK)	2.30E-03	2.14E-03	1	1.30E+04	1	CEPA	0.0000	0.0000
Butylbenzylphthalate*	1.37E-04	1.37E-04	1	NA	NA	NA	--	--
Cadmium	1.97E-01	7.61E-02	83.8	2.99E+01	--	TEEL-1	0.0066	0.0025
Carbon Disulfide	2.94E-01	4.14E-02	1	3.11E+03	1	ERPG-1	0.0001	0.0000
Carbon Tetrachloride	8.63E-04	8.63E-04	1	1.26E+03	1	ERPG-1	0.0000	0.0000
Chlorine	1.36E+00	1.64E+00	1	2.10E+02	1	CEPA	0.0065	0.0078
Chlorobenzene	1.75E-02	1.77E-02	1	3.45E+05	--	TEEL-1	0.0000	0.0000
Chloromethane (Methyl chloride)	1.12E-01	4.65E-02	1	2.07E+05	--	TEEL-1	0.0000	0.0000
Chromium (total)*	3.00E-01	2.31E-01	83.8	1.49E+02	--	TEEL-1	0.0020	0.0015
Chromium 6	5.23E-02	2.80E-02	83.8	1.50E+02	--	TEEL-1	0.0003	0.0002
Cobalt	1.98E-01	1.23E-01	83.8	1.00E+02	8	OSHA	0.0020	0.0012
Di-n-Butyphthalate*	3.46E-03	3.46E-03	1	1.50E+04	--	TEEL-1	0.0000	0.0000
1,4 Dichlorobenzene	3.45E-03	2.28E-02	1	6.61E+05	--	TEEL-1	0.0000	0.0000
Dichloromethane	1.01E-01	7.00E-01	1	NA	NA	NA	--	--
Dimethyl Phthalate	4.80E-03	4.80E-03	1	5.00E+03	8	OSHA	0.0000	0.0000
2,4-Dinitrophenol	2.60E-02	3.84E-03	1	9.79E+02	--	TEEL-1	0.0000	0.0000
Ethylbenzene	5.01E-01	7.71E-01	1	5.43E+05	--	TEEL-1	0.0000	0.0000
Chloroethane (ethyl chloride)	7.36E-03	7.36E-03	1	2.60E+06	8	OSHA	0.0000	0.0000
Formaldehyde	2.80E+00	3.52E+00	1	9.40E+01	1	CEPA	0.0297	0.0374
Hydrogen chloride	8.45E+00	8.89E+00	5.14	2.10E+03	1	CEPA	0.0040	0.0042
Hydrogen fluoride	2.60E-01	4.02E-01	5.14	2.40E+02	1	CEPA	0.0011	0.0017
Lead	2.76E+00	2.80E+00	83.8	3.81E+01	--	TEEL-1	0.0724	0.0736
Manganese	3.38E+00	9.36E+00	83.8	5.00E+03	8	OSHA	0.0007	0.0019
Mercury	1.34E-01	1.81E-01	5.14	7.38E+01	--	TEEL-1	0.0018	0.0025
4-Methyl phenol	1.46E-02	1.14E-02	1	NA	NA	NA	--	--
Methylene chloride	9.43E-02	4.56E-01	1	1.40E+04	1	CEPA	0.0000	0.0000
Naphthalene	1.48E-01	1.19E-01	1	7.86E+04	--	TEEL-1	0.0000	0.0000
Nickel	3.43E-01	4.32E-01	83.8	6.00E+00	1	CEPA	0.0571	0.0721
Nitrobenzene	3.49E-03	3.74E-03	1	1.51E+04	--	TEEL-1	0.0000	0.0000
4-Nitrophenol	7.40E-02	7.40E-02	1	NA	NA	NA	--	--
Phenol	2.40E-01	1.53E-01	1	3.85E+04	1	ERPG-1	0.0000	0.0000
Phosphorus	6.97E-01	8.68E-01	1	1.00E+02	8	OSHA	0.0070	0.0087
Selenium	1.64E+00	1.02E+00	83.8	5.81E+02	--	TEEL-1	0.0028	0.0018
Styrene	6.12E-01	1.22E+00	1	2.10E+04	1	CEPA	0.0000	0.0001
1,1,1 Trichloroethane	4.16E-04	3.29E-03	1	NA	NA	NA	--	--
Toluene	2.98E+00	4.51E+00	1	3.70E+04	1	CEPA	0.0001	0.0001
Vinyl chloride	2.42E-02	4.31E-02	1	1.80E+05	1	CEPA	0.0000	0.0000
Xylenes, total	2.21E+00	3.59E+00	1	2.20E+04	1	CEPA	0.0001	0.0002
Zinc	1.07E+02	4.45E+01	83.8	1.00E+03	8	OSHA	0.1068	0.0445
TCDD Eq.	2.43E-06	2.43E-06	17.7	NA	NA	NA	--	--
Total PCBs	1.00E-03	9.42E-04	1	NA	NA	NA	--	--
PAH- Total	1.95E-01	1.45E-01	1	1.00E+03	--	TEEL-1	0.0002	0.0001
PAH-Non-carcinogenic totals	1.95E-01	1.44E-01	1	NA	NA	NA	--	--
PAH-Carcinogenic totals	1.14E-04	3.22E-04	1	NA	NA	NA	--	--
TOTAL HAZARD INDEX							0.44	0.40

[1]Highest 1-hour modeled concentration for worst case receptor, includes consideration of upset conditions.

[2]Upset Multiplier - factor used to account for a possible ESP shutdown when estimating peak 1-hour concentrations.

[3]In order of preference selected: CEPA - Air Toxics Hot Spots Program Risk Assessment Guidelines, Part 1, The Determination of Acute Referen Exposure Levels for Airborne Toxicants, California EPA, 1999, 1-hour values. AEGL-1 Level 1 Acute Exposure Guidelines for 1-hour exposure d National Advisory Committe, 1997. ERPG-1 Level 1 Emergency Response Planning Guidelines Levels, Subcommittee on Consequence Assessn Protective Guidelines, 1997. ATEL-1 Level 1 Acute Toxicity Exposure Levels, California EPA 1996 were not used due to the more recent CEPA Protocol for Hazardous Waste Combustion Facilities Table A-4, July 1998, TEEL-1 Level 1 Temporary Emergency Exposure Limits, Subcommitte on Consequence Assessment and Protective Guidelines, 1997. OSHA - Time Weight Average Permissible Exposure Level, 29CFR1910.1000.

NA - Not Available

* Butylbenzylphthalate emissions are only from glass. Di-n-butylphthalate emissions include glass, total chromium emissions include glass.

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Table 2-1

Table 3-1. Soil Toxicity Criteria (mg/kg)

Deposition COPC	Regional Average Soil Concentration[1]		Highest Receptor Soil Concentration[1]		Detection Limit[2]	Geometric Mean U.S. Background[3]	Human Health PRG[4]	Toxicity Reference Values[5]				Preliminary Remediation Goals[6]			Ecological Screening Values[7]
	Baseline	Cumulative	Baseline	Cumulative				Plants	type	Invertebrates	type	General	Basis	Plants	EPA Region 4
Antimony	4.44E-04	4.50E-04	1.01E-01	1.02E-01	NR	NR	31	0.5	not specified	NR		5	plant	5	3.5
Arsenic	7.63E-04	5.50E-04	1.73E-01	1.25E-01	5.0	NR	0.39	1	corn	0.25	earthworm	9.9	shrew, plant	10	10
Beryllium	1.76E-04	1.32E-04	3.97E-02	2.98E-02	5.0	1	150	0.1	not specified	NR		10	plant	10	1.1
Cadmium	1.07E-03	4.15E-04	2.42E-01	9.39E-02	1.0	NR	37	0.2	spruce	10	earthworm	4	plant, woodcock	4	1.6
Chromium (+6)	2.85E-04	1.53E-04	6.46E-02	3.45E-02	NR	NR	30	0.018	lettuce	0.2	earthworm	NR		NR	NR
Chromium (+3)	1.75E-03	1.35E-03	3.97E-01	3.05E-01	5.0	37	10000	NR		NR		0.4	earthworm	1	0.4
Cobalt	1.15E-03	7.18E-04	2.61E-01	1.63E-01	5.0	7	900	NR		NR		20	plant	20	20
Lead	1.61E-02	1.64E-02	3.65E+00	3.71E+00	5.0	16	400	4.6	senna	100	earthworm	40.5	woodcock	50	50
Manganese	1.97E-02	5.47E-02	4.46E+00	**1.24E+01**	**5.0**	340	1800	NR		NR		NR		500	100
Mercury*	7.08E-04	9.57E-04	**1.60E-01**	**2.17E-01**	1.0	NR	23	0.349	barley	NR		**0.00051****	woodcock	0.3	**0.1**
Methylmercury*	1.45E-05	1.95E-05	3.27E-03	4.42E-03	NR	NR	NR	NR		2.5	earthworm	NR		NR	0.67
Nickel	2.00E-03	2.53E-03	4.53E-01	5.72E-01	5.0	14	1600	24	bush bean	100	earthworm	30	plant	30	30
Phosphorus	3.45E-03	4.41E-03	7.81E-01	9.98E-01	NR	NR	1.6	NR		NR		NR		NR	NR
Selenium	9.55E-03	5.95E-03	**2.16E+00**	**1.35E+00**	5.0	NR	390	**0.05**	alfalfa	7.7	earthworm	**0.21**	mouse	**1**	**0.81**
Zinc	6.24E-01	2.54E-01	**1.41E+02**	**5.75E+01**	**5.0**	**44**	2300	**0.9**	barley	199	earthworm	**8.5**	woodcock	**50**	**50**
Acrolein	1.34E-05	1.34E-05	3.04E-03	3.04E-03	NR	NR	0.1	NR		NR		NR		NR	NR
Dinitrophenol, 2,4-	1.32E-04	1.94E-05	2.98E-02	4.39E-03	1.65	NR	120	NR		NR		20	plant	20	20
4-Nitrophenol	1.75E-06	1.75E-06	3.97E-04	3.97E-04	0.33	NR	NR	NR		NR		7	earthworm	NR	7
Nitrobenzene	1.21E-05	1.29E-05	2.73E-03	2.93E-03	0.33	NR	20	NR		NR		NR		NR	40
Phenol	4.67E-05	2.97E-05	1.06E-02	6.73E-03	0.33	NR	3700	NR		NR		30	earthworm	70	0.05
Napthalene	7.18E-04	5.79E-04	**1.63E-01**	**1.31E-01**	0.33	NR	56	NR		NR		NR		NR	**0.1**
Acenapthene	--	--	--	--	0.33	NR	56	NR		NR		20	plant	20	20
Total PAH	0.001	0.001	0.333	0.247	0.33	NR	56/0.062***	1.2	wheat	25	woodlouse	NR		NR	1
Dioxin	9.3E-09	9.3E-09	2.1E-06	2.1E-06	1.0E-07	NR	3.96E-06	NR		0.5	earthworm	3.15E-06	shrew	NR	NR
PCBs	1.23E-05	1.15E-05	2.78E-03	2.61E-03	0.33	NR	0.22	10	soybean	2.5	earthworm	0.371	shrew	40	0.02

[1]Average predicted soil concentrations over a 100 year period of facility operations. Regional refers to the broader area surrounding the Facility. Highest Receptor refers to the point of maximum observed ground level air concentration.
[2]Detection Limit - From Engergy Laboratories, Inc, Analytical Services, 1999
[3]U.S. Background - Elemental Compostion of Surficial Materials in the Conterminous United States, USGS, 1971
[4]PRG - Preliminary Remediation Goals, EPA Region 9, Residential (http://www.epa.gov/region09/waste/sfund/prg/files/02table.pdf)
[5]TRV - Screening Level Ecological Risk Assessment Protocol, Appendix E, Table E-5 (Terrestrial Plants) and Table E-6 (Soil Invertebrates), EPA, 1999
[6]Preliminary Remediation Goals for Ecological Endpoints. General values from Efroymson (August 1997) which considers lowest value for wildlife, plants and soil invertebrates. Plant values from Efroymson (Nov. 1997) which considers phytotoxicity.
[7]Region 4 values from http://www.epa.gov/reg5rcra/ca/ESL.pdf with no basis listed, Region 5 values from http://www.epa.gov/reg5rcra/ca/ESL.pdf
*Dry land soils assumed to be 98% Hg^{2+} and 2% MHg, per Table B-1-1, Screening Level Ecological Risk Assessment Protocol, EPA, 1999
**Background value recommended for mercury in place of risk-based value
***Non-carcinogenic and carcinogenic values respectively. The total for carcinogenic constituents does not exceed the carcinogenic value (see Appendix A and B).
NR - Not Reported
Bolded chemical names indicate excedance of one or more comparison values

Table 3-2. Surface Water Toxicity Criteria (ug/L)

Deposition COPC	River Water Concentration[1]		Lake Water Concentration[1]		Montana Aquatic Life Standard[2]			Toxicity Reference Values[3]	Preliminary Remediation Goal[4]		EPA Region IV Surface Water Screening Values[5]
	Baseline	Cumulative	Baseline	Cumulative	Chronic	Trigger	Reporting Value		Value	Basis	
Antimony	0.000001	0.000001	0.000243	0.000246	NR	NR	3	30	30	aquatic	160
Arsenic	0.000001	0.000001	0.000416	0.000300	150	NA	3	150	190	piscivore	190
Beryllium	1.95E-07	1.47E-07	0.000079	0.000060	NR	NR	1	0.66	0.66	aquatic	530
Cadmium	0.000001	4.62E-07	0.000483	0.000187	0.27	0.1	0.1	2.2	1.1	aquatic	0.66
Chromium (+6)	3.18E-07	1.69E-07	0.000129	0.000069	86.2	NR	5	11	11	aquatic	11
Chromium (+3)	0.000002	0.000002	0.000957	0.000735	NR	1	1	NR	210	aquatic	117
Cobalt	0.000001	0.000001	0.000630	0.000392	NR	NR	NR	NR	23	aquatic	NR
Lead	0.000019	0.000019	0.008797	0.008942	3.18	0.1	3	2.5	3.2	aquatic	1.32
Manganese	0.000023	0.000065	0.010766	0.029860	NR	NA	5	NR	120	aquatic	NR
Mercury[6]	0.000001	0.000006	0.000236	0.002121	0.91	NA	0.6	0.77	1.3	aquatic	0.012*
Methylmercury[6]	1.15E-07	0.000001	0.000042	0.000374	NR	NR	NR	0.0028	0.0026	piscivore	NR
Nickel	0.000002	0.000003	0.001093	0.001379	52.2	0.5	20	52	160	aquatic	87.71
Phosphorus	0.000005	0.000006	0.002221	0.002770	nutrient	1	1	NR	NR		NR
Selenium	0.000011	0.000007	0.005216	0.003249	5	0.6	1	5	0.39	piscivore	5
Zinc	0.000740	0.000288	0.340558	0.125755	119.8	5	10	118	110	aquatic	58
Acrolein	0.000005	0.000005	0.001659	0.001659	NR	0.7	20	NR	NR		2.1
Dinitrophenol, 2,4-	0.000005	0.000001	0.001707	0.000251	NR	13	50	NR	NR		6.2
4-Nitrophenol	0.000013	0.000013	0.004850	0.004849	NR	2.4	NR	NR	300	aquatic	82.8
Nitrobenzene	0.000001	0.000001	0.000229	0.000245	NR	0.45	NR	66.8	NR		270
Phenol	0.000043	0.000028	0.015705	0.009990	NR	100	10	NR	110	aquatic	256
Napthalene	0.000027	0.000022	0.009658	0.007783	NR	0.04	10	NR	12	aquatic	62
Total PAH	0.000009	0.000005	0.003107	0.001689	NR	NR	NR	0.014	NR		NR
Dioxin	3.25E-11	3.25E-11	1.26E-08	1.26E-08	NR	NA	1	3.80E-06	NR		NR
PCBs	1.81E-07	1.71E-07	0.000066	0.000062	0.014	NA	1	0.19	0.0019	piscovore	0.014

[1]Average predicted surface water concentrations in the during facility operations
[2]From Circular WQB-7, Chronic Aquatic Life and Trigger Value. Trigger Values are used to determine if a given increase in the concentration of toxic parameters is significant or non-significant as per the non-degradation rules.
Hardness of 100 for hardness dependent criteria (Cd, Cr, Pb, Ni, Zn)
[3]TRV - Screening Level Ecological Risk Assessment Protocol, Appendix E, Table E-1 (Freshwater), EPA, 1999
[4]Lowest of Ambient Water Quality Criteria or piscivorous wildlife health based values, Efroymson (August, 1997)
[5]Derived from Ambient Water Quality Criteria or lowest reported effect level.
[6]85% inorganic mercury and 15% methylmercury per Table B-1-1 of Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, EPA, 1999.
*Based on the marketability of fish, other health-based values may be used.
Nutrient - A plant nutrient, excessive amounts of which may cause violations of ARM 17.30.637 (1)(e).
NR - Not Reported
NA - Not Applicable

Table 3-3. Sediment Toxicity Criteria (mg/kg dry weight)

Deposition COPC	River Sediment Concentration[1]		Lake Sediment Concentration[1]		TRV[2]	PRG[3]	ESV[4]	
	Baseline	Cumulative	Baseline	Cumulative			Region 4	Region 5
Antimony	2.83E-11	2.87E-11	1.30E-08	1.32E-08	64	NR	12	NR
Arsenic	4.33E-11	3.12E-11	1.99E-08	1.44E-08	6	42	7.24	9.79
Beryllium	5.26E-13	3.95E-13	2.14E-10	1.60E-10	NR	NR	NR	NR
Cadmium	1.01E-11	3.93E-12	4.11E-09	1.59E-09	0.6	4.2	NR	0.99
Chromium (+6)	--	--	--	--	26	NR	NR	NR
Chromium (+3)	--	--	--	--	NR	159	52.3	43.4
Cobalt	2.32E-11	1.45E-11	1.07E-08	6.66E-09	NR	NR	NR	50
Lead	--	--	--	--	31	110	30.2	35.8
Manganese	--	--	--	--	NR	NR	NR	NR
Mercury*	1.04E-09	1.04E-09	4.72E-07	4.80E-07	0.2	0.7	0.13	0.174
Methylmercury*	3.97E-10	1.10E-09	1.83E-07	5.07E-07	0.2	NR	NR	NR
Nickel	2.71E-11	2.44E-10	9.82E-09	8.84E-08	16	38.5	15.9	22.7
Phosphorus	1.38E-12	1.24E-11	5.00E-10	4.50E-09	NR	NR	NR	NR
Selenium	6.39E-12	8.06E-12	2.94E-09	3.71E-09	0.1	NR	NR	NR
Zinc	--	--	--	--	110	270	124	121
Acrolein	4.70E-11	4.70E-11	1.70E-08	1.70E-08	NR	NR	NR	1.52E-06
Dinitrophenol, 2,4-	2.06E-09	3.03E-10	7.45E-07	1.10E-07	NR	NR	NR	0.0062
4-Nitrophenol	1.02E-08	1.02E-08	3.68E-06	3.68E-06	NR	NR	NR	NR
Nitrobenzene	4.18E-10	4.48E-10	1.51E-07	1.62E-07	1.3	NR	NR	0.0086
Phenol	1.19E-08	7.61E-09	4.33E-06	2.75E-06	NR	0.032	NR	0.0491
Napthalene	4.64E-07	3.74E-07	1.68E-04	1.35E-04	NR	0.39	0.33	0.176
Total PAH	9.16E-05	4.94E-05	3.31E-02	1.79E-02	0.17	13.66	1.684	NR
Dioxin	2.05E-09	2.05E-09	7.95E-07	7.95E-07	0.00041	NR	2.50E-06	NR
PCBs	4.92E-10	4.92E-10	1.91E-07	9.34E-04	0.05	0.18	0.033	0.0598

[1]Average predicted sediment concentrations based on river water concentrations

[2]Toxicty Reference Value - Screening Level Ecological Risk Assessment Protocol, Appendix E, Table E-3 (Freshwater Sediments), EPA, 1999

[3]Preliminary Remediation Goals for Ecological Endpoints, Efroymson (August, 1997)

[4]Ecological Screening Values - Region 4 values from http://www.epa.gov/reg5rcra/ca/ESL.pdf with no basis listed, Region 5 values from http://www.epa.gov/reg5rcra/ca/ESL.pdf

*Wetland soils assumed to be 85% Hg^{2+} and 15% MHg, per Table B-1-1, Screening Level Ecological Risk Assessment Protocol, EPA, 1999

NR - Not Reported

-- No Koc value to support calculating sediment concentration

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT OF KILN-RELATED EMISSIONS AT THE HOLCIM TRIDENT CEMENT PLANT

- DRAFT -

VOLUME 1 OF 2

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GLOSSARY OF RISK ASSESSMENT TERMINOLOGY

TERM	DEFINITION
Cancer Slope Factor	A plausible upper-bound estimate of the probability of a response per unit intake of a constituent over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer over a lifetime as a result of exposure to a particular level of a potential carcinogen.
Chronic Reference Dose (RfD)	An estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a maximum daily exposure level for the human population, including sensitive sub-populations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (as a Superfund program guideline, seven years to lifetime).
Constituents of Potential Concern	Chemicals that are potentially site-related and whose data are of sufficient quality for use in the quantitative risk assessment.
Dose	A quantity of constituent exposure occurring at one time.
Excess Lifetime Cancer Risk	Upper-bound estimate of the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen; calculated as the product of the cancer slope factor and exposure dose.
Exposure	Contact of an organism with a constituent or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism and available for absorption.
Exposure Pathway	The course a constituent or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to constituents or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs for the source, a transport/exposure medium (e.g., air) or media (in cases of inter-media transfer) must also be included.

GLOSSARY OF RISK ASSESSMENT TERMINOLOGY (CONTINUED)

TERM	DEFINITION
Exposure Point	A location of potential contact between an organism and a constituent or physical agent.
Exposure Route	The way a constituent or physical agent comes in contact with an organism (i.e., by ingestion, inhalation, dermal contact).
Hazard Index (HI)	The sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. Separate HIs are calculated to assess non-carcinogenic effects from chronic, subchronic, and shorter duration exposures.
Hazard Quotient (HQ)	The ratio of a single substance exposure level over a specified time period (e.g., chronic) to a reference dose for that substance derived from a similar exposure period.
Integrated Risk Information System (IRIS)	A U.S. Environmental Protection Agency (EPA) database containing verified reference doses and cancer slope factors and up-to-date health risk and EPA regulatory information for numerous constituents.
Qualitative Evaluation	A descriptive assessment of potential risks and hazards associated with exposure.
Quantitative Evaluation	A numerical estimate of potential risks and hazards associated with exposure.
Receptor	Individual or population potentially exposed to constituents at an exposure point. An integral component of the exposure pathway.
Toxicity Factor	A numerical expression of a constituent's dose-response relationship that is used in risk assessments. The most common are RfDs and cancer slope factors.
Upper Confidence Level	The percent likelihood that the arithmetic mean concentration for a constituent lies below the target concentration. A high level of confidence (95 percent) is used to compensate for the uncertainty involved in representing site conditions with a finite number of samples.

ACRONYMS

AERMOD	AMS/EPA Regulatory Model
ARM	Administrative Rules of Montana
CAPCOA	California Air Pollution Control Officers Association
CKD	cement kiln dust
COPC	constituent of potential concern
DEQ	Montana Department of Environmental Quality
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESP	electrostatic precipitator
GIRAS	Geographic Information Retrieval and Analysis System
GIS	Geographic Information System
HAP	hazardous air pollutant
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
IRIS	Integrated Risk Information System
LOAEL	lowest observed adverse effect level
NESHAP	National Emission Standard for Hazardous Air Pollutants
NOAEL	no observed adverse effect level
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PC-MACT	Portland Cement Maximum Achievable Control Technology
RfD	reference dose
SLERA	screening level ecological risk assessment

EXECUTIVE SUMMARY

Objectives

This risk assessment concerns Holcim's Portland Cement Manufacturing Facility (hereinafter Facility) in Trident, Montana. The Facility is presently permitted to burn up to 100 percent natural gas, up to 100 percent coal, up to 100 percent coke, or any combination of these. Holcim is also permitted to burn up to 800 tons per year of post consumer recycled glass and to use slag as a raw material because of its iron content.

Holcim is proposing to augment up to 15 percent of the total heat input into the kiln by the mid-kiln addition of whole passenger and light truck tires (termed Whole Tires). The proposal is described in *An Application for Alteration to Montana Air Quality Permit #0982-11* (Bison and Kleinfelder 2004a).

Prior risk assessments were performed by Holcim as part of their application to comply with the Administrative Rules of Montana (ARM 17.8.770), which requires that the change in risk from exposure to hazardous air pollutants (HAPs) associated with the proposed action be below negligible risk levels. Negligible risk is defined in ARM 17.8.740 as an increase in the excess lifetime cancer risk of less than 1×10^{-6} for any individual carcinogen, an increase in the excess lifetime cancer risk of less than 1×10^{-5} for the aggregate of all carcinogens, and an increase in the sum of the non-cancer hazard quotient of less than 1.0. The prior risk assessments demonstrated compliance with ARM 17.8.770; however, an environmental impact statement (EIS) was deemed necessary to support any decision to modify Holcim's permit.

As a technical report supporting the EIS, this assessment evaluates risks to human health and the environment associated with currently permitted operations (the baseline condition) and with proposed operation alterations (the cumulative condition) at the Facility.

Emissions Estimates and Dispersion Modeling

The assessment first involves estimating ground-level air concentrations for the baseline and current condition. This work is the subject of a separate report (Lorenzen 2004), and it is summarized in this assessment. The determination of Ground-level air concentrations involves estimating emission rates and performing dispersion modeling. Stack emission rates are based on data available from thirteen other facilities. The data from these other facilities are statistically evaluated to determine stack emission rates for the Trident Facility. Corrections are made to the emission rates to account for Facility upsets (based on a 2-year record of upsets at the Facility) and wind dispersion of cement kiln dust. Emission rate were also increased to incorporate the use of slag and glass as feed materials in the Facility's kiln.

Dispersion modeling is used to estimate Ground-level air concentrations from emission estimates. Dispersion modeling is performed using AERMOD software, an EPA approved model. Ground-level air concentrations are estimated for the worst case 1-hour peak

location, worst case annual average location, locations in or near Three Forks, Manhattan, and Belgrade, and at receptor points located on the Jefferson, Madison, Gallatin and Missouri Rivers. Locally, the wind generally blows from the southwest to the northeast, following the Missouri River. The annual average worst-case location is therefore located along the Holcim property boundary, northeast of the stack.

Human Health Risk Assessment Methodology

Ground-level air concentrations are used as inputs into risk assessment models that predict the transport of constituents of potential concern in the environment and the resulting exposure to people, plants and animals. The Air Toxics Hot Spots model developed by California EPA (2003) was selected for use over the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities developed by EPA (1998) because of its relative simplicity and health protectiveness. The California EPA model also provides an agency approved methodology for conducting a stochastic evaluation of the distribution of risk across the population, a feature not provided in EPA's model. The California EPA model is used to predict constituent concentrations in soil, surface water, and a variety of domestic and wild food products. The model also estimates potential exposure of people to the constituents in each of these media. The most important distinction between the two models as applies to this risk assessment is the inclusion of the dioxin exposure via the mother's milk pathway in the California EPA model. This pathway is not included in the EPA model, and it produces the highest predicted contributor to carcinogenic risk.

Very few changes are made to the default assumptions in the California EPA risk assessment model. The concentrations of constituents in soil are based on a 100-year period of operation in accordance with EPA (1999a) guidance, rather the default value of 70 years recommended by the California EPA model. Constituents emitted from the Facility will accumulate in soil until rates of decay (i.e. half-life) equilibrate with deposition rates. Since metals have the longest half-life, metals are predicted to increase throughout the 100-year period. However, even after 100 years of operation, metals concentrations are expected to be below detection limits achievable using routine analytical methods and to be below screening level risk-based concentrations established by EPA Region 9. Zinc is an exception, with concentrations predicted to exceed detection limits within 10 years but to remain below risk-based screening levels for well over 100 years. Information from EPA is used in other cases where data is not provided by the California EPA model. For example, several parameters necessary to model the transport of mercury in the environment were obtained from EPA guidance.

The resulting exposures, in terms of an average daily dose, are compared to toxicity factors developed by EPA to determine risks. The potential for acute risk from short-term exposure is also evaluated. Lead exposure is evaluated as a special case, using the EPA Integrated Exposure and Uptake Biokinetic model.

Human Health Risk Assessment Results

Acute risk and risk from potential lead exposure at their respective worst case locations are predicted to be below levels of concern. Carcinogenic risks are evaluated for a variety of exposure scenarios because there is no "bright line" below which it is generally agreed there is no concern from exposure, and because even very low levels of exposure can result in unacceptable risk.

People working and living in different locations and with different lifestyles are expected to have different levels of exposure and risk. Lifestyle factors relevant to this assessment include water and food ingestion rates, source of food (grocery store, gardens, fish and game from the area around the Facility), and hygiene habits that influence incidental soil ingestion rates. The range of risks estimates are as follows:

Location and Lifestyle Related Variability in Risk for the Cumulative Condition

Exposure Scenario	Average Exposure	High-End Exposure
Worst-case Location	2×10^{-6}	1×10^{-5}
Three Forks, Manhattan, Belgrade*	2×10^{-9}	4×10^{-7}
River Fish (consumption only)	2×10^{-8}	2×10^{-8}
Pond Fish (consumption only)**	5×10^{-7}	6×10^{-6}
Big Game (consumption only)**	5×10^{-9}	3×10^{-7}

Note: a risk of 2×10^{-6} can also be expressed as 2 cancers in 1,000,000 people exposed for a lifetime.
*Average scenario is based on non-ingestion pathways and air concentrations at the Belgrade airport, while the high-end exposure is based on the most likely scenario risks for Three Forks residents who ingest some foods produced from the area around the Facility.
*Pond fish risks are highly dependent upon the location of the pond and pond characteristics that affect the potential for accumulation of COPCs. Big game risks are dependent upon the size of the area around the facility over which animal exposure is averaged.

Stochastic evaluations of risk for the worst case exposure location are provided using Monte Carlo methodology. The results of these evaluations show how risks are distributed across the population and reveal the degree of protectiveness associated with the high-end risk estimate. Monte Carlo calculates a range of outputs based on a range of inputs. The input ranges are described as distributions and are part of the California EPA model.

As expected, the Monte Carlo analysis indicates that risks are lognormally distributed. Most people have exposure and risk that approximates the average exposure, while a few people have risks estimated by the high-end exposure. For this assessment, the high-end exposure estimates are expected to be protective of 100 percent of the people, while risks at the 90th percentile of the distribution are nearly half as high as the high-end (i.e. 100 percentile) exposure.

A discussion is provided regarding the uncertainty and variability of both the exposure estimates and the toxicity factors used to calculate risk. By adhering to an agency-

approved methodology while accounting for site-specific factors where possible, the results of this assessment may be compared with risks estimated using the same methodology at other sites. In this manner, this risk assessment is intended to provide a consistent and health protective basis for understanding risks and making decisions.

The results of this risk assessment indicate that a vast majority of the people in the area are predicted to experience risks that are at levels at or below the range that is generally considered to be acceptable (1×10^{-4} to 1×10^{-6}). These risks are the incrementally increased risk of getting cancer as a result of lifetime exposure to COPCs from the site. The background rate of cancer from all sources (natural and anthropogenic) is 1 in 3. Certain types of land use and lifestyles in close proximity to the Facility would result in larger incrementally increased cancer risk than would be experienced by the general population; for example subsistence living or concentrated agricultural operations such as feed lots, green houses, fish farms, or organic farms.

Ecological Risk Assessment Methodology

The ecological risk assessment uses the aforementioned human health risk assessment model to predict the transport of chemicals in the environment. Additional considerations in the ecological risk assessment include: the area over which exposure should be evaluated to provide ecologically meaningful results, the soil depth used to determine COPCs concentrations, and the need to select wildlife species that are representative of the area.

Exposure is evaluated at the point of worst-case annual average Ground-level air concentrations and over a 36-square mile area surrounding the facility. The selection of a 36-square mile area is subjective and considers: recognition that ecological risk is more concerned with ecosystem health than the health of individual organisms, the desire to select a large enough area that if affected would result in significant ecological impacts to the area, and the desire to include areas of highest potential ground-level air concentrations.

The soil depth was varied to reflect a range of values recommended by the California EPA and EPA. A soil depth of 0.15 meters and a soil bulk density of 1,333 kg/m^3 is used for calculating soil concentrations in the default models used in this ecological risk assessment; a value defined by California EPA guidance (2003) for agricultural exposure pathways in the human health risk assessment. Conversely, U.S. EPA guidance (1999a) suggests 0.01-meter soil depth be used for untilled soil and 0.2-meter depth be used for tilled soil. EPA also assumes a different soil bulk density of 1,500 kg/m^3. This assessment evaluated risks based on both a 0.01 meter depth and a 0.15 meter depth.

Environmental media concentrations predicted using the procedures described above are input into a site-specific food web model developed in accordance with EPA (1999a) guidance. Focusing on the terrestrial environment, species were selected to represent various types of species that may exist in the area, giving consideration to: species for which there is toxicity information, species of special economic value, rare species, species of interest to the public, and species in various trophic levels of the food web.

Bioconcentration is assessed quantitatively in the model, while bioaccumulation is assessed qualitatively. Toxicity factors were obtained from a variety of literature sources in accordance with EPA (1999a) guidance, relying in part on toxicity factors provided in Holcim's application. Risks to species in the aquatic environment are assessed using ambient water quality criteria.

In general terms, ecological hazards are characterized by dividing media concentrations or exposed dose by the appropriate standard or toxicity factor for each constituent. A hazard quotient (HQ) value greater than 1.0 is obtained if the media concentration or exposed dose exceeds the standard or toxicity factor, implying a potential hazard. The HQs are summed for all constituents to determine the hazard index (HI), thereby accounting for synergistic effects in a simplified manner. While the HI is provided based on the HQs for all COPCs as a simplified screening tool, it is only meaningful for evaluating risk from exposure to multiple COPCs that have similar toxic effects.

Ecological Risk Assessment Results

Potential hazards in the terrestrial environment may exist for small herbivorous and omnivorous birds such as robins and meadowlarks that have home territories of limited range in areas of highest ground-level air concentrations. The highest HI was 1.0, which occurred for the baseline condition at the worst case receptor when using California EPA soil depth and soil bulk density assumptions. An HI of 1.0 was also calculated for the baseline condition in the 36-square mile area surrounding the Facility when using EPA soil depth and soil bulk density assumptions. Metals are the primary contributors to the elevated HI, although no single metal has a hazard quotient greater than 1.0. A review of the toxic endpoints for each COPC that contributed substantially to the HI is not provided in this assessment.

Avian carnivores may also be at risk from exposure to dioxin in soil. The HIs may be above or below 1.0 depending on the assumptions used to determine soil mixing depth and soil bulk density. Dioxin emissions are set equal to their regulatory limit (0.2 lb/hr), while the average test data for the Facility indicates dioxin emission rates that are nearly 100 times lower (0.00207 lbs/hr) (Lorenzen 2004, Appendix C). If the actual emission rates were used in the model, the HI for avian carnivores would be much less than 1.0.

HIs for terrestrial species other than birds were below 1.0 for all scenarios evaluated. Potential hazards in river systems are also very low because of the large dilution associated with flowing water.

Potential hazards in lakes, ponds, and reservoirs will vary greatly depending upon the location of the water body, the size and depth of the water body, and the number of times per year the water volume in the water body changes. This assessment evaluated water concentrations in a pond that may be considered typical of water bodies in the Three Forks Area. The risk assessment focuses on risk to aquatic life, namely fish. Comparisons of predicted water quality to water quality standards are provided to support an assessment of aquatic ecosystems generally, including higher trophic level organisms. Predicted surface water concentrations for all constituents are below Montana Aquatic Life Standards

(Table 3-2). Therefore, hazards to aquatic life in most water bodies in the Three Forks Area are expected to be below levels of potential concern.

Potential hazards (HQs greater than 1) may occur for aquatic life and invertebrates in shallow ponds that have minimal water recharge and that may now, or in the future, be located in close proximity to the Facility. Potential aquatic life toxicity in lakes and ponds may reduce food abundance for higher trophic level organisms and thereby more broadly affect general ecosystem health. The river ecosystem may off-set any such reduced food abundance.

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT OF KILN-RELATED EMISSIONS AT THE HOLCIM TRIDENT CEMENT PLANT

1. SCOPING

1.1 OBJECTIVE

The objective of this assessment is to evaluate risks to human health and the environment associated with currently permitted operations and with proposed operation alterations at Holcim's Portland Cement Manufacturing Facility (hereinafter Facility) in Trident, Montana (Figure 1-1). The information provided by this risk assessment is intended to support an Environmental Impact Statement (EIS) prepared in accordance with the Montana Environmental Policy Act (75-1-101 et seq., 1971).

Holcim is already permitted to burn up to 100 percent natural gas, up to 100 percent coal, up to 100 percent coke, or any combination of these. Holcim is also permitted to burn up to 800 tons per year of post consumer recycled glass. Holcim also uses slag as a raw material because of its iron content. This permitted condition is referred to in this report as the baseline condition.

Holcim is proposing to augment up to 15 percent of the total heat input into the kiln by the mid-kiln addition of whole passenger and light truck tires (termed Whole Tires). The proposal is described in *An Application for Alteration to Montana Air Quality Permit #0982-11* (Bison and Kleinfelder 2004a). This proposed operation alteration is referred to in this report as the cumulative condition.

1.2 ORGANIZATION AND APPROACH

The remainder of Section 1 identifies the rationale supporting the general approach to completing the risk assessment. Section 2 presents the human health risk assessment and Section 3 presents the ecological risk assessment. The risk assessment calculations supporting the text are provided in appendices that comprise Volume II of the report.

This assessment is based on estimated ground-level air concentrations. These ground-level air concentrations are input into human health and ecological risk assessment models to determine exposure and risk. Calculations used to estimate ground-level air concentration based on Facility emissions are provided in Attachment A. The emissions inventory and dispersion modeling that are used to determine the ground-level air concentrations are described in detail in a separate report (Lorenzen 2004).

For both the human health and ecological risk assessment, risks are evaluated for both a baseline condition (no Whole Tires) and a cumulative condition (including Whole Tires). A "default" assessment has been completed that explicitly shows all equations, model input assumptions, and calculations. Printouts of the "default" assessment are provided in

Volume II, Attachments B through F. The attachments present all the equations used in the risk assessment, and are intended to allow a reviewer to reproduce the calculations. Accordingly, the body of this report does not describe the model and calculations in detail. Rather, the body of this report places emphasis in two areas: presenting a conceptual site model that supports a quantitative assessment of exposure, and presenting the results and conclusions of the risk assessment. Considerable emphasis is placed on evaluating variability and uncertainty. Variability is principally addressed by using the risk assessment model to evaluate a range of exposure assumptions that represent the different types of exposure conditions that may be experienced by different individuals who work, live and play in and around the Facility and in nearby communities. Calculations for this kind of sensitivity analysis are not provided in the attachments because the printing and organizing of the numerous model perturbations is considered infeasible.

As a technical report in support of an EIS, this report is oriented toward supplying information for scientists and engineers to use in developing the EIS. Therefore, the presentation is condensed, avoiding general descriptions of the risk assessment process.

1.3 PRIOR RISK ASSESSMENTS

1.3.1 Prior Risk Assessment in Support of the Permit Application

Holcim's application includes a human health risk assessment and a Screening Level Ecological Risk Assessment (SLERA) addressing the maximum anticipated change in risk associated with the proposed action. The risk assessment was performed to comply with the Administrative Rules of Montana (ARM 17.8.770), which requires that the change in risk from exposure to hazardous air pollutants (HAPs) associated with the proposed action be below negligible risk levels. Negligible risk is defined in ARM 17.8.740 as an increase in the excess lifetime cancer risk of less than 1×10^{-6} for any individual carcinogen, an increase in the excess lifetime cancer risk of less than 1×10^{-5} for the aggregate of all carcinogens, and an increase in the sum of the non-cancer hazard quotient (HQ) of less than 1.0.

The prior risk assessment in support of the permit application was based on emissions data for 13 other cement kilns that have measured stack emissions rates (in grams/second) before and after use of Whole Tires. These 13 facilities provide the known data available to support the assessment. The difference in emissions rates before and after use of Whole Tires was calculated for each HAP at each facility. For constituents with three or fewer data points (i.e. three or fewer facilities with measured emissions rates for a constituent before and after use of Whole Tires), the maximum difference in emissions rates was used to represent the estimated change in emission rates at the Holcim's Facility. If more than three data points were available, the lower of either the maximum value or the 95 percent confidence interval value was used to represent the maximum estimated emission rate for the Facility. Only data showing an increase in a constituent's emission rate after use of Whole Tires were used in the 95 percent upper confidence level calculations. Predicted COPCs emission rates resulting from the addition of glass, but not slag, into the kiln were included in the assessment.

Dispersion modeling software (AERMOD) used the predicted difference in emissions rates from use of Whole Tires to predict Ground-level ambient air concentrations at various locations of potential concern around the Facility. A California Air Pollution Control Officers Association (CAPCOA)-based model (CAPCOA 1993) was then used to estimate human health exposure and risk. A SLERA was also completed. The original application and risk assessment (Bison and Kleinfelder 2001) was extensively reviewed by the Montana Department of Environmental Quality (DEQ) and underwent public review and comment. All revisions resulting from the reviews were incorporated into the final permit application in 2004 (Bison and Kleinfelder 2004a).

The prior risk assessment in support of the permit application concluded that risks for the proposed action complied with the negligible risk rule. A Preliminary Determination on Permit Application (DEQ 2003) was prepared in response to the completed application.

1.3.2 Prior Risk Assessment in Support of the EIS

In response to DEQ's decision to complete an EIS addressing the proposed action, Holcim also prepared and submitted to DEQ - under their own initiative - both human health (Bison and Kleinfelder 2004b) and screening level ecological risk assessments (Bison and Kleinfelder 2004c). These risk assessments were prepared using the same emission inventory data for the 13 other facilities, the same AERMOD dispersion models, and the same risk assessment models that were used in the permit application. However, rather than assess risk based on the change in emission rates associated with the proposed action (as was done to support the permit application), risks were assessed based on total estimated emission rates before (i.e., baseline condition) and after (i.e., cumulative condition) use of Whole Tires.

The revised objectives of the new risk assessment in support of the EIS necessitated a different approach for using the emissions data from the 13 facilities. Because the previous risk assessment evaluated risks related to the difference in a constituent's emission rate before and after use of Whole Tires, data could not be used unless a constituent's emission rate was measured both before and after used of Whole Tires. Unfortunately, the facilities did not always measure the same list of HAPs before and after the use of Whole Tires. A second major difference was that the prior risk assessment was focused on evaluating risk for only those constituents that had positive increase in emission rates after use of Whole Tires for a facility, while the new assessment including data for constituents with reduced emission rates after use of Whole Tires.

For these reasons, the air emission rates, and accordingly the estimated risks for the baseline and cumulative conditions, cannot be directly compared to the change in risk determined in the risk assessment for the proposed action. In other words, one cannot subtract the baseline risk from the cumulative risk provided by the risk assessment done in support of the EIS and expect to get the same change in risk value that was determined in the risk assessment done in support of the permit application. The emissions data for the 13 facilities was used differently between the two risk assessments.

The risk assessment in support of the EIS concluded that human health risks for the cumulative condition (1×10^{-6}) were below risks for the baseline condition (3×10^{-6}). The human health hazard indexes (HIs) were 0.7 for the baseline condition and 0.5 for the cumulative condition. All HIs for all receptors in the ecological assessments were below 1.0. The highest HI in the ecological assessment was for the red-tailed hawk under the baseline condition (0.6).

The DEQ determined that an additional assessment prepared by the department was needed to support the EIS. This risk assessment satisfies that need.

1.4 EMISSION INVENTORY SUMMARY

This risk assessment relies on emissions inventory and dispersion modeling results developed in accordance with procedures described in a separate technical report (Lorenzen 2004). The ground-level air concentrations established in the Lorenzen report are used in this risk assessment to calculate multi-media (e.g., soil, water, food, and wildlife) concentrations and estimate risks. The ground-level air concentrations are presented in Attachment A. The principle emission inventory and dispersion modeling issues germane to both the human health and ecological risk assessments are summarized below.

1.4.1 Constituents of Potential Concern

ARM 17.8.770 requires that the risk assessment include an inventory listing potential emissions for all Federal Clean Air Act (42 USC 7401 et seq., 1970) HAPs. The emissions inventory addresses all HAPs for which data from other facilities was identified. This risk assessment therefore evaluates as constituents of potential concern (COPCs) only those HAPs included in emissions inventory and dispersion modeling.

Additional consideration was given to constituents of expressed concern by the public. A public scoping meeting was held in Manhattan, Montana, on January 20, 2004, to learn about public concerns with the proposed action. The concerns expressed (DEQ, 2004) were reviewed to identify COPC to the public. COPCs mentioned were: various metals (cadmium, chromium, lead, and mercury mentioned specifically), volatile organics, dioxin, and polycyclic aromatic hydrocarbons (PAHs). Each of these constituents is a HAPs for which emission data from other facilities was available to support this risk assessment.

1.4.2 Facility Upsets

For the purposes of this risk assessment, a Facility upset is defined as any condition that results in shutdown of the electrostatic precipitator (ESP). Under this condition, increased emissions would occur for constituents associated with particulate matter that would normally be captured by the ESP. The ESP removes particulate matter from the air stream. COPCs that are less volatile or otherwise tend to bind onto or within the particulate matter, such as most metals and less volatile organics constituents, are thereby also removed. Consideration of Facility upsets are quantitatively incorporated into the

emissions inventories and dispersion models for long-term and short-term exposure. This approach precludes the need for a separate analysis addressing the upset condition.

1.4.3 Cement Kiln Dust

Cement kiln dust (CKD) is a byproduct resulting from cement production. The management of this material throughout the Facility is incorporated into the emissions inventory, dispersion modeling, and risk assessment for the long-term (chronic) exposure scenario. Short-term kiln upsets do not cause an instantaneous change in contaminant concentrations in the CKD, so modeling of acute (short-term) risks is limited to changes in kiln emissions only.

1.4.4 Glass and Slag

Glass has been evaluated in the previous risk assessments and will therefore continue to be evaluated in this risk assessment. Three HAPs, chromium and butylbenzylphthlate and di-n-butlyphthlate, exist in glass at higher levels than are known to exist in other existing fuels permitted for use. The emission rate estimates for these three HAPs are increased to reflect the use of glass.

In addition to glass, Holcim uses slag as a source of iron in the kiln. To support this risk assessment, DEQ incorporated slag use into the emission rate estimates. The incorporation of slag addition into the kiln resulted in increased modeled emission rate estimates for antimony, arsenic, chromium, cobalt, lead, manganese, nickel, phosphorus, selenium, and zinc.

1.5 RISK ASSESSMENT MODEL SELECTION

1.5.1 California versus EPA Models for Human Health Risk Assessment

The risk assessments conducted to date for the Facility have been completed in general accordance with the risk assessment methods developed by the CAPCOA Air Toxics “Hot Spots” Program (CAPCOA 1993). The risk assessment methods were developed specifically for use in evaluating risks associated with air emissions from industrial facilities. A revised risk assessment guidance document was published in August 2003 (California EPA 2003).

Several technical changes and updates were made to the 2003 risk assessment model. For example: the vine produce category was expanded to protected and unprotected produce categories, the weathering constant used to determine deposition onto produce was revised, several pollutant-specific default values such as fish bioconcentration factors and soil half-life were revised, and default assumptions such as the fraction of produce ingestion that is homegrown were added. The net effect of these and other changes on the overall protectiveness of the model is unknown, and is expected to vary depending on site-specific conditions.

The U.S. Environmental Protection Agency (EPA) has developed a Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1998). While the

Holcim cement kiln is not a hazardous waste combustion facility, this protocol provides another established model which could be adapted for use in evaluating risk at the Facility.

There are numerous differences in how exposure is mathematically predicted between the California EPA and U.S. EPA models. There are no known quantitative comparisons of the relative risk levels estimated by the U.S. EPA and California EPA models. Some of the major differences between the two models and the implications to this risk assessment include:

- The California EPA model includes consideration of dioxin and polychlorinated biphenyl (PCB) exposure through mother's milk, while the U.S. EPA model does not. Otherwise, the food ingestion pathways are the same for the two models. The risks predicted by exposure to dioxin in mother's milk, under the assumptions incorporated into the California EPA model, frequently produces the highest source of risk to exposed individuals. The inclusion of this pathway may in many cases make the California EPA ore health protective then the U.S. EPA model.

- The U.S. EPA model considers wet and dry deposition from air to soil and water for all constituents, while the California EPA model only considers dry deposition for non-volatile constituents. Also, the EPA model considers runoff from soils to water during rainfall, which is not included in the California model. The inclusion of COPC transport pathways for wet deposition adds a substantial number of additional calculations to the model. Because of the dry nature of the area surrounding the Facility, the effect of wet deposition on soil concentrations is expected to be small relative to that predicted by dry deposition. Concerning predicted surface water concentrations, most of the water in the Missouri River is derived from unaffected upgradient sources. There is minimal soil-to-water runoff from the area under investigation that may potentially impact flow and water quality. Therefore, little benefit would be derived for this project from the extra COPC transport pathways included in the U.S. EPA model.

- Two important factors affecting predicted COPC soil concentrations are the assumed depth into which COPCs are expected to mix in soil and the bulk density of the soil. The U.S. EPA assumes a 20 cm mixing depth for tilled agricultural, a mixing depth of 1 cm for untilled soil, and a soil bulk density of 1500 kg/m^3. The California EPA model assumes a 15 cm mixing depth for all food related pathways (regardless of tilling practices), a mixing depth of 1 cm for direct contact pathways, and a soil bulk density of 1300 kg/m^3. There are many other factors in each of the models, some of which are constituent specific, that complicate this comparison. However, all else being equal, the U.S. EPA factors identified will result in lower predicted COPC exposure then would be predicted if using the California EPA factors. On balance, the California EPA model is likely to predict higher levels of COPC exposure.

- The California EPA model includes stochastic methods for assessing population variability (California EPA 2000) that are not included in the U.S. EPA model. The unavoidable uncertainty and variability in performing a risk assessment can result in a

range of opinions about the correct model input factors to use in the risk assessment. Stochastic approaches for estimating risk can be used to more fully disclose the potential risk implications of various model input assumptions. This mathematical approach allows ranges of values to be used for specific model inputs that are based on the known inherent variability. Using Monte Carlo simulation methods, these ranges of input values are propagated through the model to produce a range of risk estimates rather than a single risk estimate. The availability of an agency approved protocol for evaluating and presenting variability in risk using stochastic methods allows the California EPA model to be more effective in evaluating and communicating risk results.

In summary judgment, the California EPA model is less mathematically complex and more likely to produce risk estimates for this project that are more health protective. The California model also provides the added benefit of approved model inputs for stochastic analysis for evaluating and communicating variability in exposure and risk. This risk assessment uses the updated California guidance (California EPA 2003) to construct a spreadsheet-based model. The risk assessment spreadsheet model was developed independently. It does not use electronic information contained in previous risk assessments submitted by Holcim.

1.5.2 EPA's Lead Model

The U.S. EPA has developed an approach for evaluating risk from exposure to lead that is different from other constituents. For lead, subtle neurological changes have been correlated with blood-lead concentration. Children are believed to be most susceptible. The EPA has developed the Integrated Exposure and Uptake Biokinetic Model (IEUBK) for lead in children (EPA 1994a, 2004a), which estimates blood-lead levels based on multiple routes of exposure. The IEUBK is used in this assessment.

1.5.3 Ecological Risk Assessment Models

The State of California has not developed guidelines for evaluating ecological risk within the "Hot Spots" program. The U.S. EPA has developed a Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (EPA 1999a). This guidance essentially adopts the same fate and transport models for estimating environmental concentrations for constituents that are used in EPA's human health guidelines (EPA 1998), but provides additional guidance related to ecological receptor selection, bio-uptake modeling, toxicity assessment, and risk characterization. Similarly, this assessment generally uses the California EPA models for estimating environmental concentrations for constituents, and the EPA (1999a) guidance for evaluating other relevant aspects of the ecological risk assessment.

The ecological risk assessment model developed for this assessment is derived from an electronic version of the SLERA previously submitted to DEQ by Holcim (Bison and Kleinfelder 2004c). Many revisions were made however. Major changes include selecting toxicity factors from different sources in many cases, revised methods for calculating body burdens, inclusion of deer as a new receptor in response to expressed public concern

about game species, and inclusion of additional COPCs such as methyl mercury. The incentive behind these changes is to supply new and independent perspective of the potential ecological risks. A comparison of the results of this ecological risk assessment with the previous ecological risk assessment provided by Holcim in support of the EIS can provide a range of understanding regarding the potential ecological risks.

2. HUMAN HEALTH RISK ASSESSMENT

The first three sections of the human health risk assessment (Sections 2.1 to 2.3) are focused on explaining the basis for the quantitative evaluation. Section 2.1, Exposure Assessment, evaluates the fate and transport of constituents in the environment and establishes the routes by which people may be exposed to the constituents. For each exposure scenario calculations are made regarding the exposed dose, which is expressed as milligrams of constituent ingested per kilogram body weight per day (mg/kg/day). Section 2.2, Toxicity Assessment, identifies quantitative measures of toxicity for each COPC that are comparable to the dose. Section 2.3, Risk Characterization, calculates risk by comparing exposure under the various exposure scenarios to toxicity.

More qualitative aspects of the assessment are addressed in Section 2.4, Uncertainty and Variability. Section 2.5, Summary and Conclusions, integrates both the quantitative and qualitative aspects of the risk assessment into a concise summary in support of informed risk management decision-making.

2.1 EXPOSURE ASSESSMENT

This exposure assessment describes how constituents emitted from the facility are transported through the environment, and it identifies the types and magnitudes of exposure that are occurring or may plausibly occur in the future. An exposure pathway defines the mechanisms by which a constituent comes into contact with a person. A complete exposure pathway requires all of the following:

- A source of release into the environment
- A transport mechanism for constituent release and migration from the source
- Contact with a receptor
- A mechanism for constituent intake into the body.

Figure 2-1 provides a conceptual model illustrating the fate and transport of constituents in the environment upon release from the Facility. The rationale supporting the conceptual model is described in the subsections that follow. How the conceptual site model is used to identify relevant equations and input assumptions in the risk assessment model is also explained. The approach used is to integrate site descriptions with descriptions about how exposure is quantitatively evaluated. Not all details of the quantitative model are discussed. Rather, emphasis is placed on describing those areas of the model where site-specific considerations are required as inputs to the model or where site-specific considerations result in deviations from default assumptions contained in the model.

2.1.1 Emission Sources and Primary Transport Mechanisms

Two types of emissions from the Facility are evaluated in this assessment: stack emissions and fugitive emissions resulting from CKD management. The stack location is shown on

Figure 2-2. Chemicals in the gas stream within the stack are either in gaseous form or are associated with particulate matter. The gas stream is normally treated using an ESP, which removes a vast majority of the particulate matter and the constituents associated with the particulate matter. The gas stream is then released from the stack at a height of 39.62 meters.

The ESP operation is occasionally interrupted due to unpredictable causes such as fuel feed rate problems and equipment malfunction, resulting in uncontrolled particulate emissions. Increased particulate emissions resulting from assumed ESP upset duration and frequency are integrated into emissions estimates used in this assessment.

CKD is the particulate matter removed from the gas stream by the ESP. CKD is managed on-site in various ways that can release small amounts of fugitive dust. This assessment considers CKD emission from: dust discharge from the end of the kiln, dust discharge during silo loading and unloading, road dust emissions, dust generated during material spreading and material dumping operations, and windblown dust from piles.

Once emitted, the dispersion of COPCs is dictated by wind speed and direction. A wind rose describing prevailing wind directions and speeds based on a meteorological station at the Facility is provided in Figure 2-2. The facility is located on the banks of the Missouri River where the river flows into a canyon. The wind rose indicates that predominant local wind direction is from the southwest to northeast, following the river canyon. On average and over the long term, ambient air concentrations of emitted COPCs are expected to be greater downwind of the Facility.

The methodology for estimating emission rates and conducting the dispersion modeling is described in detail in a separate technical report (Lorenzen 2004). In summary, emission rates for all HAPs except dioxin are based on data provided by Holcim regarding measured emissions before and after use of Whole Tires at 13 other cement plants nationally (Bison and Kleinfelder 2004a). Dioxin is the only constituent-specific HAP with a federally mandated emission limit applicable to the Facility[1]; therefore, dioxin emissions are based on U.S. EPA Portland Cement Maximum Achievable Control Technology (PC-MACT) emission limits for dioxin.

Numerous differences between cement plants can affect HAPs emission rates, such as kiln type, combustion temperature, fuel type, stack height, oxygen content, type of emission control equipment used, and other variables. As a check on the validity of the emission rate estimates, stack testing at the Facility was conducted in 2002 and 2003 for dioxins/furans, PAHs, hydrogen chloride and 12 metals (including lead, mercury and arsenic). The stack test results were compared to the estimated emission rates for the cumulative condition and to emissions estimated using AP-42 factors. Dioxin/furan results

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[1] More specifically, EPA (1999b) established emission limitations for particulate matter (as a surrogate for HAP metals), dioxins/furans, and total hydrocarbons (as a surrogate for organic HAPs, including polycyclic organic matter). Emission rate limitations for these parameters are incorporated into DEQ's Preliminary Determination on Permit Application (DEQ 2003).

were compared to the PC-MACT limit. This comparison indicated that the emissions estimated for the cumulative condition exceeded test data results and that Dioxin/furan emissions are less than the PC-MACT limit (Lorenzen 2004, Appendix C). These findings provide a measure of confidence that the emission rate estimates using in this assessment conservatively estimate future potential emission rates at the Facility.

The emission rates used in this risk assessment are corrected to account for ESP upset using an upset multiplier. The upset multipliers used to estimate the annual average emission rates are derived based on an average of 81.6 hours per year of upsets, an estimated 99.4 percent particulate removal efficiency, and estimates for the percent of the emissions that are associated with particulate (100% for metals, 20 percent for dioxin/furans, and 5 percent for mercury, hydrogen fluoride and hydrogen chloride). The upset multipliers for the 1-hour peak emission rates use the same assumptions, but also assume as a reasonable worst case assumption that the upset lasts for 30 minutes. The average length of an upset was 13.2 minutes. Values for particulate removal efficiency, the percent of emissions associated with particulate, and upset duration were obtained from information submitted by Holcim (Bison and Kleinfelder 2004a). Metals derived from slag use were assumed to partition 95% into clinker and 5% to the ESP (i.e. stack emissions and CKD). The formulas used are provided in Appendix A.

Ground-level air concentrations at various receptor points surrounding the Facility are estimated from stack and CKD emission rates using an air dispersion model (AERMOD). The dispersion model incorporates a variety of climatic variables, such as wind speed and direction. The modeling addresses 80 COPCs. CKD is expected to contain 17 of the COPCs which have the type of physical/chemical characteristics that would cause them to sorb with particulate matter in the stack. Ground-level air concentrations for COPCs in the CKD are determined using individual model runs with three CKD emission points plus the kiln. Ground-level air concentrations for COPCs not in the CKD are modeled using only the kiln stack emission point.

Dispersion coefficients are generated by the AERMOD model runs for each receptor point. The dispersion coefficients are expressed in units of micrograms/cubic meter per grams/second [($\mu g/m^3$)/(g/sec)], which is defined as χ/Q (chi over Q) with χ representing the ground-level concentration and Q representing the kiln emission rate.

The calculations for determining annual average ground-level air concentrations for the highest modeled receptor points (for the 1-hour acute and 1-year chronic conditions) are provided in Attachment A. The dispersion coefficients determined for key receptor locations used in this human health risk assessment are shown on Figure 2-2.

2.1.2 Secondary Transport Pathways and Affected Media

2.1.2.1 Deposition

Once in the air, constituents are released onto soil, water, and vegetation (animal forage and human food crops) through wet and dry deposition. Different constituents will deposit at different rates depending on certain physical characteristics such as vapor pressure (i.e.,

volatility), tendency for particulate sorption (either during emissions or from particulate binding after emissions), climatic conditions, and other variables.

California EPA guidance (2003) assumes that volatile emissions are not deposited onto land to a significant enough degree to warrant inclusion of the pathway. Also, California EPA guidance does not account for wet deposition processes, even though wet deposition (during rainfall) has the potential to remove constituents from the air much more quickly. Given the dry nature of the area surrounding the Facility, excluding this pathway is not believed to substantially underestimate deposition over the long term.

California EPA guidance (2003) assumes an average dry deposition rate for all non-volatile constituents of 0.02 meters/second for controlled sources (applicable for emissions containing less than 2.5 microns) and 0.05 meters/second for uncontrolled sources. A higher deposition rate is used for uncontrolled sources because of the increased particulate matter associated with untreated air emissions.

These default assumptions are supported by general knowledge of emission characteristics of cement kilns generally. Section 7 of Risk Burn Guidance for Hazardous Waste Combustion Facilities (EPA 2001) states:

> "For cement kilns equipped with ESPs or fabric filters, a technical support document to the hazardous waste combustor MACT rule uses a particle-size mass distribution estimate of 50% < 2.5 microns and 85% < 10 microns. This distribution compares favorably with the distribution provided in Table 7-2 for sources equipped with ESPs or fabric filters. The estimate is based on the distributions for Portland cement kilns provided in AP-42 of 45 to 64% < 2.5 microns and 85% < 10 microns, as well as distribution data for three hazardous waste burning cement kilns ranging from 50 to 75% < 2.5 microns and 70 to 90% < 10 microns."

This assessment uses the 0.02 meters/second deposition rate, even though the upset emissions (when the ESP is offline) are integrated into the emission estimates. This is not believed to substantially affect deposition estimates because the ESP is only offline a small percent of the time (81.6 hours per year based on Facility data for 2000 and 2001; see modeling results using recommended inventory in Attachment A). While a substantial portion of the metals released to the ambient environment are estimated to result from upset conditions, the particle sizes of metals are generally small. On Page 161 of the Risk Burn Guidance for Hazardous Waste Combustion Facilities, EPA (2001) states, "The larger particles were shown to be porous, carbonaceous cenospheres resulting from poor carbon burnout." Therefore, use of the controlled deposition rate as a simplifying assumption applicable to all sources of emissions is deemed appropriate.

As shown in Attachment A, consideration of the upset condition (described in Section 2.1.1) affects the annual average ground-level air concentrations for metals much more than other parameters. Annual kiln emission rates for particulate metals, including periods of uncontrolled emissions due to upset conditions, are estimated to be 2.54 times higher than the fully controlled annual emission rate. Emission rates for dioxin/furans are 1.31

times higher when upsets are factored in and emissions of mercury, hydrogen fluoride and hydrogen chloride are 1.08 times higher.

2.1.2.2 Soil Accumulation

Continued deposition onto soils over a long period of time may contribute to accumulation. In general terms, the rate of accumulation is dependent on the physical characteristics of both the constituents and the soil, and other site factors like stormwater runoff and leaching to groundwater. Runoff into surface soil and soil to groundwater leaching are pathways that are not addressed by California EPA guidance. Accordingly, many of the constituent characteristics that would affect the transport of constituents into other media are not accounted for in the model. This is not believed to be a major factor at this site because of the dry nature of the area.

Natural degradation is accounted for in the model based on estimates of the soil half-life. Attachments B-1 and C-1 show, for baseline and cumulative conditions respectfully, the calculations used to determine soil concentrations and graphically show how concentrations for select parameters vary over time. Metals have the longest half-lives. Considering lead in the baseline condition for example, predicted soil concentrations after 70 years of deposition (4.7021 mg/kg) are about seven times greater than after 10 years of deposition (0.6428 mg/kg). The increase over time is less for organic constituents, which have shorter half-lives. For example, PAH concentrations are predicted to increase for the first ten years, after which concentrations remain constant.

Because soil concentrations change over time, the selection of the time interval used in the risk assessment can affect the resulting estimates of risk. California EPA (2003) default assumptions consider a 70-year time period for determining soil concentrations, and U.S. EPA (1998; Table B-1-1) suggests 100 years "unless site-specific information is available indicating that this assumption is unreasonable." This assessment uses the average concentration over a 100-year period of Facility operation as the soil concentration input value for COPCs throughout the risk assessment.

Consistent with California EPA (2003) guidance, residential soil concentrations are used for the soil ingestion and dermal pathways. Residential soil concentrations are based on a model default soil depth value of 0.01 meters. Lower soil concentrations for agricultural pathways (produce and animal products) are used based on the model's default soil depth value of 0.15 meters.

2.1.2.3 Water Concentrations

Wet and dry deposition processes may also result in the addition of constituents into surface water, although only the dry deposition pathway is included in the California EPA model. Water bodies may also receive constituents from stormwater runoff and discharge of any contaminated groundwater into surface water. Methods for estimating constituent transport by these mechanisms are not included in the California EPA model. Exclusion of these pathways is not expected to affect the predicted concentrations in water significantly because of the dry nature of the area.

The area surrounding the Facility contains rivers, wetlands, and lakes. It is plausible that privately constructed ponds also exist in the area or could be constructed in the future. Therefore, this assessment quantitatively assesses dry deposition into both rivers and lakes.

River Water Concentrations. For rivers, dispersion modeling was performed in a broad area along the waterways of concern. Receptor locations were selected along the river to represent 0 to 10-km and 10 to 25-km stretches of river in all directions, as shown on Figure 2-2. This distance from the Facility accounts for most of the total air mass of constituents that are available for deposition. More distant X/Q values in all directions are orders of magnitude below the worst-case location value (0.29355).

An estimate was made of the total surface area within the 25-km radius that is covered with water. The estimation was made by using Geographic Information System (GIS) layers and attribute tables from: "USGS National Land Cover for Montana, Vector Format" (http://nris.state.mt.us/nadi/nris/nlcd/nlcdvector.html, derived from 30-meter Landsat thematic mapper data), and "Montana 1:250,000 Scale Land Use from USGS" (http://nris.state.mt.us/nsdi/nris/lu25/lu25s.html, derived from U.S. Geographic Survey [USGS] Geographic Information Retrieval And Analysis System [GIRAS] files).

Within 10 km upstream of Trident, both data sources show open water (including streams, reservoirs, and wetlands) as being approximately 1 percent of the total surface area. When the analysis area is a doughnut-shaped area extending from 10 km to 25 km in all directions (which is close to Toston), open water goes down to approximately 0.1 percent of the total surface area, and streams/canals comprise about 0.035 percent of the area, the remainder being in wetlands and reservoirs. This assessment assumes 1 percent of the landmass as rivers within 10 km; assuming that ponds and wetlands in the Three Forks area are hydrologically connected to the river system. Rivers that are beyond 10 km are assumed to comprise 0.035 percent of land mass.

To calculate water concentrations, estimates of water volume for the various river segments and the number of times the water volume changes or is turned over per year are required. Water volume in a given river segment is estimated based on USGS flow rate and mean velocity data, determined as follows:

$$\text{Flow (Q)} = \text{Velocity (v)} \times \text{Cross-Sectional Area (A)}$$

or, upon rearranging,

$$A = Q/v$$

Since Volume (V) equals the Cross-sectional Area (A) times the Length of River (L), solving for A and substituting in the above equation provides:

$$V/L = Q/v$$

or,

$$V = Q/v \times L$$

Stated verbally, the volume of water in a segment of river represented by a receptor equals the quotient of the flow rate divided by the mean velocity times the river segment length.

Volume changes are based on USGS flow data. A review of the GIS layers indicates that the winding river flow length is approximately twice that of linear distance between two river points. For example, there is 20 km of river length from 0 to 10 km downstream of the Facility. Additional details about the calculations are explained and the results presented in the water concentration calculations (Attachment B-2 for baseline condition; Attachment C-2 for cumulative condition).

The risk assessment selects the most downgradient receptor point for evaluation. The approach used very conservatively assumes no loss of COPCs as the water moves downstream. Stated differently, upgradient stream reaches already receive COPCs before the water moves into the next downstream reach where additional COPCs are received. Therefore, the final river concentration for a COPC is the sum of the predicted river concentrations for that COPC in each stream reach.

Lake/Pond Water Concentrations. Calculations to predict water concentrations in lakes are not nearly as complex. However, numerous lake or pond locations and configurations can be conceived that will affect the predicted concentrations of COPCs.

The Three Forks Area has the highest air dispersion coefficient values in the valley region located south of the Facility. The area presumably has many oxbow and/or pothole ponds. Private ponds may also be located in the area. Accordingly, the dispersion coefficient value for Jefferson 2 (X/Q = 0.00559) was selected to evaluate risks in ponds. Additionally, the water concentration calculations for the cumulative condition (Attachment C-2) were modified to consider a 100,000-gallon pond, as follows:

- Surface area is 126 m^2 and depth is 3 m, for a volume of 378,501 liters.
- Volume change is set to one change over per year. No buildup of water concentrations as a result of multi-year emissions was accounted for, under the assumption that all lakes and ponds regularly receive fresh water inputs.

Selecting a shallow pond with little change over leads to predicted COPC concentrations that are strongly biased toward a maximum likely concentration. Locating the pond further downriver and closer to the stack will increase predicted COPC concentrations, while locating the pond further upstream and away from the stack will decrease predicted COPC concentrations. Keeping the pond equidistant from the stack, but moving it away from the upwind direction from the stack will result in higher predicted COPC concentrations in the water.

2.1.2.4 Concentrations in Food Products

The land around the Facility is arid grassland. Ongoing and future potential typical site use includes grazing, grain production, and wildlife use.

Default model assumptions were used wherever possible to estimate the concentration of COPCs in the edible portions of a wide range of food products. California EPA (2003) guidance recommends a default value of 50 percent for the percent of feed obtained by grazing for beef and dairy cattle. However, the more health protective default values provided by EPA (1998) guidance were used. Beef cattle are assumed to obtain 75 percent of feed from grazing, and dairy cattle are assumed to obtain 65 percent of feed from grazing. California EPA guidance also did not provide a specific method for calculating COPC concentrations in forage; consequently, soil to forage transfer coefficients provided by EPA (1998) guidance were used. Animals were assumed to obtain drinking water from the point of highest impact on the Missouri River.

2.1.2.5 Sediment Concentrations

Once in the water, constituents can further partition into aquatic sediments. Minimal exposure of people to river, lake or pond sediments is expected. People are mostly likely to be exposed to COPCs in sediments while swimming or wading (without the use of waders). This kind of activity can only be done during the summer, and expect for the warmest of ponds, can only be done for limited amounts of time. Any exposure via this mechanism is expected to be very small relative to other routes of exposure included in the human health risk assessment. Quantitative estimates of COPC concentrations in sediments and the corresponding assessments of risk are therefore not provided.

2.1.3 Existing and Potential Receptors

The Facility is located in a rural area. Nearby communities are shown on Figure 2-2. Much of the area surrounding the Facility is private land. While agriculture is likely to be the predominant site use in the area for the foreseeable future, residential development could occur. Also, the area supports a good abundance of fish and wildlife that provide recreational fishing and hunting opportunities for the general public. The Three Forks Area is an important landmark in the Lewis and Clark expedition, attracting tourists to the area.

Based on site knowledge and expressed public concern, four general types of exposed population groups (termed receptors) are included in this assessment: Holcim workers, existing residents, future potential residents, and recreational site users. The California EPA model evaluates residents as a time-weighted exposure during childhood and adult years. Within each general category there is variability of individual behavior. Some blending of these four general types of receptors is done to ensure that reasonable maximum exposure conditions are represented in the assessment and to support a quantitative assessment of population variability in exposure and risk. The subsections that follow explain the rationale supporting the approach used for evaluating receptor exposure and risk. Important model inputs for quantitative exposure assessment are also identified.

2.1.3.1 Short-Term Exposure by Holcim Workers and Residents

Employees and contractors who work at the plant site are exposed to Facility emissions. While working, workers are exposed to contaminants in air and soil. Other pathways of exposure (e.g., food, surface water, sediment, and groundwater) may occur on a limited basis; however, these pathways are evaluated much more conservatively (i.e., in a more health protective manner) for residential receptors. Similarly, long-term exposure to air and surface soil are addressed more conservatively for the residential pathways. Therefore, for workers this assessment focuses on assessing short-term exposure via inhalation. Worker exposure is typically evaluated based on an 8-hour work day, with additional consideration given to peak concentrations immediately dangerous to health.

While Facility emissions rates remain fairly constant during operations, ground-level air concentrations can vary due to changes in climatic conditions. Varying climatic conditions can create short-term concentrations that are much higher than annual average concentrations. High concentrations over the short-term may create potential acute risks to both workers (on Holcim property) and future potential residents (off Holcim property). Consistent with both U.S. EPA (1998) and State of California guidance (California EPA 2003), acute risk to human health is evaluated for the location with the maximum modeled 1-hour concentration.

For this project, the maximum 1-hour concentration is located off Holcim property along an adjacent hillside at approximately the elevation of the stack (Figure 2-2). Therefore, standards appropriate for residents and the general population are used to evaluate potential toxicity. While workers are assumed to be generally healthy adults, the general population can include individuals with potentially greater susceptibility to adverse effects from exposure to contaminants. Therefore, the toxicity factors used to evaluate off-site acute exposure are potentially lower for some constituents than standards for protection of workers. The use of higher exposure concentrations and potentially lower toxicity factors for evaluating hazards at the point of maximum 1-hour concentrations results in a worst-case assessment of risk that is protective of both workers and residents. Therefore, short-term hazards to workers are not assessed directly, but may be inferred to be equal to or less than the estimated hazards for the worst-case location.

2.1.3.2 Existing and Future Potential Long-Term Residential Exposure

Existing and future potential residents are of greatest concern regarding long-term potential exposure to COPCs. Long-term worker exposure and risk is expected to be less then residential exposure in this assessment for several reasons:

- Compared with worker exposure, residential exposure considers exposure to children and adults. The default assumptions used to estimate exposure result in greater predicted levels of exposure in children then in adults, thereby resulting in greater risk estimates for residents.

- Residential exposure assumptions involve longer exposure frequencies, longer exposure durations, and include a larger number of exposure pathways such as food

and drinking water pathways. These assumptions result in increase exposure and risk for residents.

- Kiln stack emissions disperse away from the center of the facility due to stack height, exhaust temperature and plume momentum. COPC concentrations resulting from the kiln emissions are expected to be greatest at elevated terrain that could be impacted by the plume, as represented by receptors along the property boundary and beyond. Exposure to COPCs from CKD is greatest within the plant area, but is significantly less than exposure due to kiln stack emissions.

Because residential exposure is only expected to occur outside the Facility, long-term exposure only considers off-Facility property areas. Two general categories of residents are evaluated, existing residents in nearby communities (Three Forks, Belgrade, and Manhattan) and future potential residents at the location of maximum impact (the property boundary for the Facility as shown on Figure 2-2). Getting all of one's food from one location is consistent with a subsistence lifestyle scenario. While recognizing that the future potential for someone to engage in a subsistence lifestyle adjacent to the Facility is remote, this scenario is included to provide an assessment of the absolute worst-case exposure scenario. Evaluating each of these different types of residential receptors provides an understanding for how risk varies with distance in different directions from the Facility.

Consistent with California EPA (2003) guidance, long-term exposure is evaluated based on the dispersion modeling results for the annual average constituent concentrations in air at ground level. Ground-level air concentrations are used to predicted constituent concentrations in air, food products, surface soil, and surface water. Minor exposure pathways are not evaluated. Exposure to constituents in aquatic sediment is possible, but predicted concentrations are much lower than in surface soils. Similarly, any potential groundwater contamination is expected to be much lower than predicted surface water concentrations. Moreover, methods for determining groundwater concentration are not included in the California EPA model (presumably because exposure via this pathway does not typically make a significant difference to total exposure). Accordingly, exposure to constituents in sediment and groundwater are not quantitatively evaluated.

Existing residential exposures within established communities are predicted based on the ground-level air concentration at the closest receptor point to that community. The ground-level air concentration also affects exposure via dermal and incidental soil ingestion pathways. However, existing community residents may obtain water and food products that are raised (at some hypothetical future time) at the worst-case annual average location. In this way, exposure via inhalation, soil ingestion, and dermal adsorption is separated and evaluated independently from exposure via other food pathways.

Individuals within a community will experience varying degrees of exposure. Examples of factors that influence this variability include: distance from the Facility, factors affecting incidental soil ingestions such as cleanliness, pica (i.e., childhood soil ingestion) tendencies, body weight (into which a given exposure is averaged to determine dose),

food ingestion preferences, and many others. Therefore, exposure estimates are provided to represent an average type person's exposure and a high-end estimate of a person's exposure. Furthermore, a full distribution of individual variability for certain model input parameters are used to support a stochastic analysis. The stochastic analysis is performed using Crystal Ball software. To minimize controversy, the stochastic analysis is limited to only those model input factors supported by California EPA guidance (2003). The distributions used in the model are shown in the Crystal Ball reports in Attachments B-4 (baseline condition) and C-4 (cumulative condition). The same distributions are used in each case.

2.1.3.3 Recreational User

Various recreational opportunities exist in the area surrounding the Facility, such as fishing, hunting, swimming, and dirt biking. Public concern was expressed (DEQ 2004) regarding potential health effects from consumption of potentially contaminated fish and game. This assessment therefore quantitatively evaluates risks resulting from consumption of locally caught fish and game products.

Activities like swimming and dirt biking can result in increased contact with COPCs in soil and water. Exposure to COPCs via the drinking water pathway is included in this assessment. In comparison to drinking water, swimming will provide only marginally increased levels of exposure. Dirt biking and other activities that result in unusually high levels of soil contact are likely to result in increase exposure to COPCs. The soil ingestion rates used in this assessment represent reasonable worst case soil ingestion rates for individuals within a community over an extended period of time. A variety of high and low soil contact activities affecting soil ingestion rates are inherent to the default soil ingestion rates used in this assessment. However, the extent to which an individual engages frequently in an activity that results in high levels of contact with impact soil, risks can be qualitatively understood to be higher than those predicted by this assessment.

Fish Exposure Assumptions. This risk assessment endeavors to include those individuals who may catch and consume large amounts of fish in the area around the Facility. No studies of fish consumption rates in Montana are known. The California EPA (2003) default assumption for high-end fish consumption is 1.35 grams of fish per kilogram of a person's body weight per day. Expressing fish consumption by kilograms body weight allows the model to integrate exposure over a lifetime, considering ingestion during both childhood and adult years. The default assumption rate is equivalent to 74 pounds of fish per year for an adult (average adult body weight is 70 kilograms). This value is believed to be reasonably protective of a resident who catches and consumes fish locally on a frequent basis.

Venison Exposure Assumptions. Risks from consumption of deer that graze in the area around the Facility are assessed using the default model for the cumulative condition, modified as follows:

- Ground-level air concentrations for COPCs are averaged for a region around the Facility, per the methodology used in the Ecological Risk Assessment (Section 3.1.1.2).

- Inhalation, water ingestion, and feed ingestion rates established in California EPA guidance for cattle were modified to reflect the appropriate assumptions for deer. The rates are the same ones used for deer in the Ecological Risk Assessment (inhalation 13.76 m^3/day; water ingestion 3.7 l/day; feed ingestion 1.74 kg/day).

- The diet of a deer is assumed to be 100 percent from grazing, rather than the EPA default values of 75 percent grazing and 25 percent feed that are used for cattle.

- The same transfer coefficients used to predict meat concentrations from feed concentrations for cattle are used for deer. Biouptake and accumulation is largely controlled by the lipophilic (fat solubility) characteristics of individual constituents. As game has less fat than domestic animals, the assessment of ingestions through domestic animal ingestion is expected to be protective of game ingestion.

Human food ingestion rates based on beef consumption were not changed for the assessment of venison consumption. In particular, the assessment assumes a high-end consumption rate for venison of 6.97 grams per kilogram body weight per day. For an average 70-kilogram adult, this equates to 1.07 pounds of venison ingested per day or 391 pounds per year. In the absence of any known studies of game ingestion rates in Montana, the high-end meat consumption rate is believed to be protective of an individual who subsists largely on locally hunted game. The average exposure assumes 126 pounds of venison consumed per year.

2.1.4 Chronic Exposure to Lead

Concentrations of lead in blood have been used extensively in evaluating lead toxicity. Accordingly, EPA has established a methodology for evaluating exposure to lead based on predicting blood-lead levels (EPA 1994a). Since children are considered to be more sensitive to lead exposure, EPA's IEUBK model estimates blood-lead concentrations in young children (six years of age and younger) based on multimedia exposure (e.g., air, food, water, soil, and alternate media).

The EPA's model includes default values for exposure to lead in food, air, and water. These background levels are based on national studies of the distribution of lead contamination in these media. This assessment substitutes the model's default values for food and air with site-specific values predicted using the exposure assessment described above for the worst-case future potential residential scenario. Background levels of water in the EPA's default model are mostly associated with lead used in solder of older plumbing. Since older plumbing in the study area may contain this source of lead, the additional lead obtained from predicted surface water concentrations is added to this background level. Site-specific soil lead concentrations for the worst-case annual average location are also included in the model.

2.2 TOXICITY ASSESSMENT

This section describes the approach used to evaluate the toxic properties of contaminants of potential concern. A fundamental principle of toxicology is that dose determines the toxic properties (or perhaps nutritional benefit) of a constituent. The toxic properties of a constituent can change depending on the dose received. Accordingly, toxicity factors (cancer slope factors for carcinogens and chronic reference doses for systemic toxins) have been developed by the EPA to support quantitative risk assessment.

2.2.1 Cancer Slope Factors

A cancer slope factor is the upper bound estimate of the probability of a cancer response per unit intake of a constituent averaged over a lifetime. It is derived based on the relationship of exposure (dose) to cancer rates (response) in laboratory studies using animals or epidemiological studies of human exposure. Various statistical regression methods are used to evaluate the dose versus cancer rate data and calculate the slope factor. Once established, the slope factors are used to extrapolate the observations in experimental studies to lower levels of exposure typically observed in environmental investigations such as this one.

It is not conclusively known whether the relationship between dose and cancer rates observed in experimental studies is preserved when extrapolated to much lower concentrations typically observed at project sites such as this one. The development and use of slope factors for risk assessment is a policy position by the EPA in the absence of complete scientific information. The slope factor is typically set at the 95 percent upper confidence level of the dose-response relationship to provide a margin of safety against the unknown. However, the EPA has long acknowledged that actual toxicity may be much lower, and may be as low as zero (EPA 1986).

2.2.2 Chronic Reference Doses

All toxic effects other than cancer are evaluated using a reference dose approach. Unlike the cancer slope factor, implicit in the use a reference dose is that there is a concentration below which no toxic effects are known to occur. Uncertainty factors are used to make toxicity factors more protective when confronted with uncertainty, such as extrapolating observed experimental results in animals to potential effects in people. Reference doses are developed based on both acute (short-term) and chronic (long-term) exposure. Generally, as the exposure period of interest gets longer, the value of the chronic reference dose becomes lower relative to the acute reference dose. Reference doses are intended to be protective of the most sensitive adverse effect known, and provide margins of safety against the unknown.

This assessment applies the most current toxicity factors developed by the EPA. Cancer slope factors and chronic reference doses developed by the State of California are not used. The slope factors and chronic reference doses used in this assessment are presented in Attachments B (baseline condition) and C (cumulative condition). The same factors are used in both assessments. The EPA toxicity factors were obtained from the Integrated

Risk Information System (IRIS) at www.epa.gov/iris. Chemical specific information regarding toxicity characteristics and the basis for development of the toxicity factors are described on IRIS.

2.2.3 Acute Reference Doses

The State of California has developed acute reference dose values (California EPA 1999) specifically for comparison with exposure estimates determined using the California EPA exposure model applied in this risk assessment. This assessment uses the acute reference doses developed by the State of California where they are available for the 1-hour exposure duration. Various other sources of acute reference doses are used as necessary in order of priority as recommended by EPA guidance (1998). In a few cases, standards developed for application to the general population were not available. In these cases, OSHA standards, applicable to workers over an 8-hour work day, were used. By comparing 1-hour exposure concentrations to the 8-hour standard, a margin of safety is integrated into the assessment. The acute reference doses used in this assessment are provided in Table 2-1.

2.3 RISK CHARACTERIZATION

This section of the report presents the quantitative results of the human health risk assessment. The methodology used to calculate risks is described in Section 2.3.2. The quantitative results of the human health risk assessment are presented beginning with Section 2.3.3.

2.3.1 Methodology

In the most general sense, risks are quantified by comparing exposure rates quantified in Section 2.1 with the quantitative toxicity factors presented in Section 2.2. The mathematical approach used to quantify risks from chronic exposure to carcinogens is different from the approach used to quantify other types of hazards.

2.3.1.1 Carcinogenic Risk

For carcinogenic constituents, an estimated excess lifetime cancer risk is calculated using:

$$\text{Risk} = I \times SF$$

where:

I = Chemical Intake; the estimated exposure level in mg/kg/day averaged over a lifetime

SF = Slope Factor; the upper bound estimate of the probability of a cancer response per unit intake of a constituent averaged over a lifetime in 1/(mg/kg/day).

All carcinogenic risks are reported to only one significant figure, consistent with the inherent level of accuracy of a risk assessment.

2.3.1.2 Guidelines for Acceptable Risks

ARM 17.8.740 defines a negligible risk for carcinogens as an increase in the excess lifetime cancer risk of less than 1×10^{-6} for any individual carcinogen and 1×10^{-5} for the aggregate of all pollutants. This standard is intended to apply to the change in risk associated with the change in emissions resulting from the incineration activities. It does not necessarily apply to the total risk from all Facility emissions.

Regarding constituent spills onto soil and water, federal guidelines contained in the National Contingency Plan (EPA 1990) of "acceptable" upper bound cancer risks to protect human health, including sensitive individuals, range from 1×10^{-4} to 1×10^{-6} (a 1 in 10,000 to 1 in 1,000,000 probability of developing cancer due to lifetime exposure to a carcinogen).

For air toxics, EPA has not generally defined risk levels that represent acceptable or unacceptable regulatory thresholds. However, EPA has made case-specific determinations such as the 1989 Benzene National Emission Standard for Hazardous Air Pollutants (NESHAP) that set up a two-part, risk-based decision framework. First, it set an upper limit of acceptability of 1 in 10,000 lifetime cancer risk for highly exposed individuals. Second, it set a target of protecting the greatest number of persons possible to an individual lifetime risk level no higher than approximately 1 in 1,000,000. In addition, these determinations called for considering other health and risk factors, including the uncertainty in the risk assessment, in making an overall judgment on acceptability. The EPA cautions, however, that such case-specific determinations are not designed to be definitive tools for determining acceptable risk levels because of the case-specific limitations in data and methods. In addition, the Benzene NESHAP assessment estimates average population exposures rather than the exposures experienced by the most exposed individuals. Therefore, it contains significant uncertainties (e.g., emissions levels, exposure concentrations, and toxicity) and lacks the level of refinement that would enable us to adequately assess the highest exposures found in localized "hot spots."

The EPA's National Air Toxics Assessment Program assessed exposure to the entire United States-based population based on data obtained in 1996. This assessment concluded that the entire United States population is estimated to exceed a cancer risk level of 1 in 100,000 due to background sources alone (www.epa.gov/ttn/atw/nata/risksum.html). These background sources include natural sources and uncontrollable anthropogenic sources such as international emission and global transport.

All cancer risks presented and discussed in this assessment are the incremental increased risk from exposure to constituents; they are in addition to the lifetime background risk of 1 in 3 for every American to contract cancer (DHHS 1990). Background causes of cancer include both inherited genetic and environmental (anthropogenic and natural) causes.

2.3.1.3 Synergistic Effects

Risks from individual COPCs are summed to determine the total risk. The total risk is provided as a measure of the potential synergistic effects resulting from exposure to multiple constituents. This approach is believed to be conservative (i.e., health protective), as indicated by a recent Presidential/Congressional Commission on Risk Assessment and Risk Management (1997):

> "The combined effects of exposure to constituents in a mixture are determined by how individual components of the mixture affect the biological processes involved in toxicity. Components of a mixture can affect biological processes in many ways. For example, anything that affects the absorption, distribution, metabolism, or elimination of a constituent will affect the amount of that constituent that is available to react with DNA or other cellular targets. Because interactions leading to synergism or antagonism are the result of reactions of many molecules at many cellular sites, a mathematical dose-response model of a synergistic or antagonistic response that depends on such mechanisms is most likely nonlinear at low doses. Such logic strongly suggests that any disease process that depends on such interactions is only marginally important at low exposure levels. Only at high doses of one or more mixture components - such as cigarette smoke, alcohol, and some substances in occupational exposures - is the combined effect likely to be detectably greater than the sum of the individual effects."

2.3.1.4 Acute and Chronic Non-carcinogenic Hazards

The potential for adverse health effects from short-term, acute exposures and for chronic exposures to non-carcinogens are determined by comparing estimated intake values (I) with reference doses (RfDs), both expressed in units of mg/kg/day. The RfDs are threshold levels below which no adverse effects are expected to occur. This relationship is mathematically described as follows:

$$\text{Hazard Quotient} = I/RfD$$

If intake exceeds the reference dose, the HQ will exceed 1.0, indicating a potential for adverse health effects. For simultaneous exposure to multiple constituents with similar toxic effects, a HI is calculated as the sum of constituent-specific HQs. HQs and HIs are generally reported to only one significant figure, consistent with the inherent level of accuracy of a risk assessment.

2.3.2 Acute Hazards

The quantitative assessment of acute hazards is provided in Table 2-1. All HQs and the total HI are well below 1.0, indicating no known risk from acute exposure to ground-level air concentrations at the worst case location for the 1-hour peak concentration. These results are applicable to both the general population and Facility workers.

The HI is intended as an estimate of the synergistic effects from exposure to multiple constituents. Only those constituents that result in similar constituent effects have the potential for synergy. Summing all HQs provides a simple but likely overstated assessment of the potential synergistic hazards.

Four significant figures are shown for HQs and two significant figures are shown for the HI to support a relative comparison of baseline versus cumulative hazards and to reveal major contributors to the HI. When rounded to one significant figure, acute hazard estimates for the baseline and cumulative conditions are indistinguishable.

2.3.3 Chronic Non-Carcinogenic Hazards

The evaluations of chronic exposure to non-carcinogenic COPCs are based on the 1-year annual average worst case ground-level air concentrations. Chemical-specific human health hazard quotients are presented in Attachments B-4 (baseline condition) and C-4 (cumulative condition). The estimated chronic non-carcinogenic HIs are:

	Average Exposure	**High-End Exposure**
Baseline Condition	0.05	0.1
Cumulative Condition	0.1	0.2

All HQs and the total HI are well below 1.0, indicating no known risk from chronic exposure. The assessment considers a multi-pathway exposure assessment to a future potential resident located at the Facility boundary.

The same principles discussed for the acute hazard assessment apply to the chronic hazard assessment. The HIs likely over estimate the true hazard by summing the HQs for all constituents. Also, results should only be considered accurate to one significant figure. The different HIs derived from the assessment should not be interpreted to imply different degrees of hazard. Any result below 1.0 indicates there is no hazard.

2.3.4 Blood-Lead Levels

The IEUBK model run reports, which document the input parameters and predicted blood-lead levels, are provided in Attachment D. Input values are based on predicted lead concentrations in media and food at the worst-case location. Lead concentrations in vegetables are based on the average of root and leafy vegetables. Lead concentrations in fruits are the average of predicted lead concentrations in protected and exposed produce categories. Concentrations of lead in meat are based on predicted concentrations in beef.

Applying these assumptions, the predicted blood-lead levels in children are:

- Baseline Condition geometric mean of 1.2 µg/dL with 0% exceeding 10 µg/dL
- Cumulative Condition geometric mean of 1.2 µg/dL with 0% exceeding 10 µg/dL.

The change in lead emissions for the cumulative condition did not result in significantly different blood-lead concentrations at the number of significant figures reported above. Predicted blood-lead concentrations are below the 10 µg/dL blood-lead standard established by the U.S. Center for Disease Control (CDC 1991), a level below which no special actions are recommended. The EPA (1994b) recommends that residential soil concentrations not exceed a level such that a typical child would have greater than 5 percent chance of exceeding 10 µg/dL blood.

2.3.5 Carcinogenic Risks

Exposure and risk to carcinogens is evaluated more thoroughly than for non-carcinogens. To support an understanding for how predicted risks vary under different types of exposure assumptions, risks to residents are evaluated for the following conditions:

- Risks at the Worst-case Location – evaluates risk for the most exposed type of receptor, an individual living a subsistence type of lifestyle at the location of the worst case ground-level air concentration.
- Population Distribution of Risks – evaluates the distribution of risk among individuals within a community based on Ground-level air concentrations at worst-case location and a stochastic analysis involving different exposure assumptions.
- Risks in Nearby Communities – evaluates risks to individuals living in certain established communities around the Facility.
- Risks from Locally Caught Fisk and Game – evaluates risk to individuals who hunt and fish in the area surrounding the Facility.

The evaluations of chronic exposure to carcinogenic COPCs are based on the 1-year annual average ground-level air concentrations at different locations as appropriate for each type of exposure.

2.3.5.1 Risks at the Worst-Case Location

The worst-case location is at the Facility's property boundary. Model "default"[2] exposure assumptions are used. The application of default exposure assumptions at this location is consistent with a subsistence lifestyle scenario. The future potential resident is assumed to work and live at this location and raise a large percentage of his or her food from this location. Water is assumed to come from the worst-case receptor location on the Missouri River.

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[2] The only deviation from default model assumptions is the use of the average soil concentrations over 100 years after emissions per EPA guidance (1999a), rather than 70 years as recommended by California EPA guidance (2003). Metals concentrations are most affected. For example, cadmium concentrations for the cumulative condition (Attachment C) are estimated to be 0.066 mg/kg between 0 and 70 years, and 0.094 between 0 and 100 years.

Detailed results are presented in Attachment B-4 (baseline condition) and Attachment C-4 (cumulative condition). A summary of the total cancer risks and the cancer risks for constituents with risks exceeding 1×10^{-6} are:

Worst-Case Location Risks

	Average Exposure	High-End Exposure
Baseline Condition		
Dioxin	1×10^{-6}	8×10^{-6}
Total*	2×10^{-6}	1×10^{-5}
Cumulative Condition		
Dioxin	1×10^{-6}	8×10^{-6}
Total*	2×10^{-6}	1×10^{-5}

*Total – the sum of risks for all COPCs.

Total risks are dominated by predicted exposure to dioxin. For the baseline condition, dioxin risk is greatest for the mother's milk pathway (3.0×10^{-7}) followed by the beef ingestion pathway (2.6×10^{-7}) and other food ingestion pathways. An important consideration in reviewing these results is that the mother's milk pathway is not a component of EPA's (1998) risk assessment methodology. Exposure via mother's milk is highly dependent upon assumptions regarding the half-life of dioxin in the mother, a factor that has not been studied extensively.

The food pathway dominating the risk estimates are a function of estimated soil concentrations. The results of this assessment should be considered in light of other soil criteria. Table 3-1 compares soil concentrations with preliminary remediation goals based on residential exposure developed by EPA Region 9 (which includes California). Criteria such as these are often used when investigating soil contamination issues as an initial step in determining whether additional investigation and/or risk assessment is necessary. All predicted soil concentrations at the location of the highest annual average ground-level air concentrations are below EPA Region 9 Preliminary Remediation Goals based on residential exposure.

2.3.5.2 Population Distribution of Risks

Individuals within a population will have different body weights, inhalation rates, ingestion rates and other factors that affect the potential for exposure to COPCs. By inputting the known range of such values for different individuals in to the risk assessment model, stochastic analysis can be used to calculate the distribution of risks for individuals within a population.

Crystal Ball is the software used to conduct the stochastic analysis for both the baseline and cumulative condition. The Crystal Ball reports documenting the model inputs and outputs for the baseline and cumulative conditions are provided in Attachments B-4 and C-4. Figure 2-3 presents the results of the stochastic risk analysis for the cumulative condition.

EPA (2004b) recommends risk management decisions be made for population risks in the 90th to 99.9^{th} percentile range. In so doing, "EPA seeks to protect 'sensitive populations,' segments of the general population that are at greater risk, either because of particular sensitivity to the toxic effects of certain constituents or because they experience higher exposures than the general population, as children do."

If everyone in the community were to experience exposure based on the constituent concentrations at the worst-case location, the stochastic model as applied for the cumulative condition in this assessment indicates the following distribution of risk within the population:

Percentile	Risk Level
50%	5×10^{-6}
90%	6×10^{-6}
95%	7×10^{-6}
100%	1×10^{-5}

The above results indicate a strongly lognormal distribution of risk. The risk level at the 90th percentile is one-half the risk level at the 100th percentile (5×10^{-6} is exactly one-half of 1×10^{-5}).

Comparing the point estimate of risk with the stochastic estimate of risk can help elucidate the degree of conservatism that is built into the point estimate approach. The point estimate approach for the cumulative condition at the worst-case location estimated a risk of 1×10^{-5} (Section 2.3.5.1). This risk level is at the 100 percentile level of the stochastic analysis, indicating that high-end risk estimates provided by the point estimate approach generates risk estimates that are protective of nearly everyone in the population.

The stochastic analysis is based on inter-individual variability in behavior in the following areas: food consumption rates, inhalation rates, water ingestion rates, and mother's milk consumption rates. California EPA has not defined within their guidance distributions for incidental soil ingestion rates, dermal absorption, and exposure duration. However, distributions for other pathways have been defined by others (AIHC 1994). Studies of incidental soil ingestion indicate a strongly lognormal distribution. A few children exhibit pica tendencies (eat dirt) or exhibit other hygiene characteristics that result in higher incidental dirt ingestion, while a majority have much lower estimates of soil ingestion rates. Dermal absorption rates can be expected to vary among the population depending on the amount of clothing worn and overall skin health. Duration of residence (incorporated into the model as exposure duration) is another population distribution that is known to be lognormally distributed; although, residence duration is much longer in rural areas than in urban areas. As more model input parameters are incorporated into the stochastic analysis, the net effect mathematically is to increase the magnitude of the peak in the distribution and lengthen the tail of the distribution. In other words, the 50th percentile value would not likely change but the 90th percentile value would likely decrease and the 100th percentile value would likely increase.

2.3.5.3 Risks in Nearby Communities

Focusing on worst-case location provides an upper-bound evaluation of risk to residents. Risks will reduce as ground-level air concentrations reduce with distance from the Facility. This section of the report quantifies the risks at different receptor points located near established communities.

Under the exposure assumptions used in the default model, COPC exposure via food ingestion results in the highest risk levels. Risks to residents in various communities will not change if it is assumed that foods are obtained from the location of maximum impact. Therefore, the evaluation of risks in nearby communities begins by first evaluating non-food related exposure pathways, based on ground-level air concentrations at receptor points near each community. Default model assumptions for non-food related pathways are unchanged. Using this approach, the cumulative condition risks are:

Cumulative Condition Risks for Non-Ingestion* Pathways in Various Communities

	Average Exposure	High-End Exposure
Worst-Case Location	7×10^{-7}	3×10^{-6}
Three Forks School	2×10^{-8}	5×10^{-8}
Manhattan	4×10^{-9}	1×10^{-8}
Belgrade Airport	2×10^{-9}	9×10^{-9}

*Includes inhalation, dermal absorption and soil ingestion pathways based on predicted soil concentrations for each community.

Risks are substantially different across communities when considering only non-food pathways. This scenario is applicable to community residents without gardens who obtain food through supermarkets. Under these assumptions, risks are 100 to 1,000 times smaller in the communities than for the future potential worst-case receptor (Section 2.3.5.1). Among the communities evaluated, risks are highest for residents in or near Three Forks.

The Three Forks receptor location is used to evaluate exposure via all pathways, including the food pathways. The most likely existing and future potential scenario arguably involves cattle grazing and/or grain production (protected produce) in the general area surrounding the Facility and exposure via other food pathways (e.g., garden produce, other meats, inhalation, incidental soil ingestion, and dermal exposure) based on ground-level air concentrations at the respective communities. The methodology used to evaluate ground-level air concentrations to which cattle and grain are exposed is identical to the procedure used to evaluate ecological exposure (Section 3.1.1.2). The methodology is based on the average concentration in a 36-mile region surrounding the Facility.

Estimated risks for the Three Forks School receptor under the cumulative condition are:

Most Likely Scenario Cumulative Condition Risks for Three Forks Residents

	Average Exposure	High-End Exposure
Beef*	2×10^{-8}	1×10^{-7}
Protected Produce*	7×10^{-10}	6×10^{-9}
Mother's Milk*	2×10^{-8}	2×10^{-7}
Other Foods**	1×10^{-8}	9×10^{-8}
Inhalation**	7×10^{-9}	3×10^{-8}
Dermal**	3×10^{-10}	1×10^{-8}
Soil Ingestion**	8×10^{-9}	2×10^{-8}
Water Ingestion**	7×10^{-11}	4×10^{-10}
Total	$\mathbf{7 \times 10^{-8}}$	$\mathbf{5 \times 10^{-7}}$

*Based on average Ground-level concentrations over a region surrounding the Facility. Grain (used for bread) is considered to be a Protected Produce. Mother's Milk calculations are only performed for dioxin and PCBs, and the results are most controlled by beef and poultry ingestion; therefore, exposure assumptions used to estimate beef exposure are used for Mother's Milk.
**Based on ground-level air concentrations at the Three Forks School.

Aggregate risk from exposure to all COPCs for this scenario is below 1×10^{-5}. The highest risk for any one constituent is from exposure to dioxin based on beef ingestion and mother's milk ingestion, which equals 3×10^{-7} for the high-end exposure scenario and 4 x 10^{-8} for the average exposure scenario. Risk estimates for exposure to dioxin, and total risks, would increase if a smaller area of concern were used to evaluate beef ingestion. The highest predicted risk for a smaller area would not exceed the risk predicted for the worst-case receptors (Section 2.3.5.1). Risk estimates for exposure to dioxin, and total risks, would decrease if a larger area of concern were used to evaluate beef ingestion.

2.3.5.4 Risks from Locally Caught Fish and Game

This section of the assessment evaluates risks associated with the consumption of fish and game obtained from the area around the Facility. In proportion to the amount of fish and game that is ingested, the risks associated with fish and game ingestion will replace the risks estimated for beef ingestion in other scenarios evaluated by this assessment.

River Fish. COPC concentrations in fish in rivers are estimated based on predicted COPC concentrations at the most downstream and worst-case receptor location on the Missouri River. Risks from fish consumption are much lower than risks for other pathways (cumulative condition risk is 2×10^{-8} for the high-end exposure scenario and 1×10^{-9} for the average scenario).

Lake/Pond Fish. Risks from fish consumption in lakes and ponds are based on a pond in the Three Forks area with size and water flow assumptions as presented in Section 2.1.2.3. The estimated risk for the high-end fish consumption rate is 6×10^{-6}, and the estimated risk for the average fish consumption rate is 5×10^{-7}. About 60 percent of the risk is due

to dioxin exposure (3×10^{-6}) and about 40 percent of the risk is due to PCB exposure (2×10^{-6}), based on the high-end exposure scenario.

Locally Hunted Game. Risks from the consumption of game will vary depending on the total amount of meat an individual typically consumes and the percentage of the game meat that is derived from locally hunted deer that graze in areas surrounding the Facility. Accounting for these variables, the predicted risks associated with the cumulative condition are as follows:

Cumulative Condition Risk from Consumption of Local Deer

	Average Exposure	High-End Exposure
15% meat from area*	5×10^{-9}	4×10^{-8}
100% meat from area	4×10^{-8}	3×10^{-7}

*Model default value for beef ingestion.

Essentially all of the risk is predicted to occur as a result of exposure to dioxin.

2.4 UNCERTAINTY AND VARIABILITY

In the context of this risk assessment, uncertainty is defined as a lack of precise knowledge of the true risks, while variability is defined as the inherent heterogeneity in risks across space, time, or among individuals. While uncertainty can be reduced with increased information, variability cannot.

An assessment of variability is integrated into the characterization of carcinogenic risks (Section 2.3.5). The variability assessment considers the distribution of risk in a population using stochastic analysis, and it evaluates risks spatially for different communities and lifestyles. A range of exposure assumptions is considered. The intent is to show how different exposure assumptions affect risk estimates, and to present a range of exposure assumptions from which risk management decisions can be made.

Uncertainty is inherent in every model input factor used in this and other risk assessments to varying degrees. The usefulness of risk assessment in light of this uncertainty is debated. By adhering to an agency-approved methodology while accounting for site-specific factors where possible, the results of this assessment may be compared with risks estimated using the same methodology at other sites. In this manner, this risk assessment is intended to provide a consistent basis for understanding risks and making decisions.

Some elements of uncertainty cannot be addressed on a project-specific basis. Most important in this regard concerns the cancer slope factors. As stated in Section 2.3, there are many unknowns regarding the biological processes that control carcinogenic risk at low concentrations. The EPA policy in this regard has been to conservatively estimate cancer slope factors for use in risk assessments based on what is scientifically known, allowing a margin of safety for the unknown. As dioxin is an important COPC in this assessment, it should be recognized that EPA is conducting a reassessment of dioxin toxicity. The results of this reassessment are not expected until 2006.

There are also many areas of uncertainty regarding this exposure assessment. Emission estimates are largely based on data from other facilities (Lorenzen 2004). The observed stack emission rates at other facilities for many parameters may range over three orders of magnitude. By selecting the upper bound estimate of the emission rate, this assessment endeavors to provide a conservative estimate of emission rates for Holcim. At a 95 percent level of confidence, by definition we would expect true emission rates to be lower than the predicted rates for 19 out of every 20 COPCs. This statistical approach likely provides a conservative estimate of the total risk. The emission estimates were compared to stack test results for select COPCs and found to be conservative (Lorenzen 2004). However, other statistical considerations are involved when trying to observe the change in risk for before and after use of Whole Tires. The data set used to estimate emissions shows considerable variability in COPC emissions between facilities. When variability of COPC emission between facilities is significantly greater than the variability in emissions associated with Whole Tires, the ability to observe relatively small changes in emission rates for before and after use of Whole Tires are obscured.

Additional uncertainty is inherent in estimating the emission rates for certain COPCs associated with glass and slag use at Holcim, since it is unknown if these materials were used at the other facilities. Emission rate estimates were increased for the relevant COPCs to account for this uncertainty.

Chemical fate and transport modeling is also subject to many areas of uncertainty. The models used to predict COPC concentrations in environmental media and the resulting exposure levels are largely theoretical and have not been validated. Any efforts to do so would be difficult because of the need to account for the many site-specific factors. Site-specific soil concentrations depend on such factors as grains size, percent organic matter, temperature, rainfall, wind conditions, and other factors. Biouptake depends on nutritional status, quality of pasture (as relates to soil ingestion for grazing animals), the types of food consumed, various physiological characteristics such as percent body fat, and other factors. For example, the default soil bulk density value is 1,333 kg/m^3, which is similar to bulk density values for top soils and other low-density materials. Dry sand and gravel has a bulk soil density in the range of 1,930 kg/m^3, and some other types of soil have even higher soil bulk densities. Substituting a bulk density of 1,930 kg/m^3 into the model would reduce soil concentrations and risks by about 30 percent. To account for these kinds of uncertainty, the default model uses a combination of average and upper bound estimates of model input factors such that the resulting exposure and risk estimates will likely predict a reasonable upper limit estimate of exposure and risk, providing a reasonable degree of protection against the unknown.

Some of the uncertainty in this risk assessment could be reduced on this project through site investigations of actual ground-level air concentrations, soil concentrations, water and sediment concentrations, and/or concentrations in plants and animals. Any such site investigation would be complicated significantly by the low levels of media concentrations predicted by the exposure assessment, as shown in Attachments B (baseline condition) and C (cumulative condition). In soils for example, estimates for the baseline condition (Attachment B-1) indicate that after 70 years of accumulation soil concentrations for all constituents, except zinc, would be below levels that can be

routinely detected. Zinc accumulation in soil is estimated to be measurable in less than 10 years of accumulation for both the baseline and cumulative conditions, and exceed median background levels for the conterminous United States within 20 years of accumulation. PAH concentrations in soil are estimated to be nearly equal to the detection limit in the baseline condition within the first 10 years of accumulation and then achieve equilibrium with natural decay processes. Because of measurement precision and accuracy limitations at this level, it is unlikely that a soil survey could identify PAH accumulations in soil. A comparison of the predicted soil concentrations with routine detection limits and background concentrations in the United States is provided in Table 3-1.

2.5 SUMMARY AND CONCLUSIONS

This assessment evaluated exposure to HAPs emitted from the stack and other sources of CKD managed at the Holcim Cement Plant in Trident, Montana. The assessment considered emissions without the use of Whole Tires (baseline condition) and with the use of Whole Tires (cumulative condition). Principle findings are:

- Metals, and to a lesser degree organic constituents, are predicted to accumulate in soils as a result of continued long-term Facility emissions. Accumulated concentrations after 70 years of emissions are expected to be below routinely detectable levels for nearly all COPCs. Zinc is expected to accumulate to detectable levels under both the baseline and cumulative conditions within 10 years. Under the baseline scenario only, PAH levels are expected to approach the detection limit within 10 years, but reach a dynamic equilibrium and not increase in concentration with future emissions.

- Acute and chronic exposure and hazards are below levels of concern. The HI for acute exposure under high-end exposure assumptions at the worst-case location is 0.4 for both the baseline and cumulative conditions. The HI for chronic exposure under high-end exposure assumptions at the worst-case location is 0.2 for the baseline condition and 0.3 for the cumulative condition.

- Lead exposures resulting from Facility emissions under baseline and cumulative conditions are below background levels of exposure used by the EPA to evaluate lead exposure nationally. Predicted blood-lead levels at the worst-case receptor location are far below the 10 µg/dL blood-lead level of concern.

- The total risk for the cumulative condition is essentially identical to the estimated risks for the baseline condition when appropriately expressed using one significant figure (e.g., 1×10^{-5} for high-end exposure at the worst-case location).

- Cancer risk varies for the different scenarios evaluated. The highest risk is for a subsistence lifestyle scenario at the Facility property boundary (cumulative condition risk of 1×10^{-5} for the high-end exposure condition and 2×10^{-6} for the average exposure condition). The lowest risks are for residents in Three Forks, Manhattan, and Belgrade who obtain their food from supermarkets (cumulative condition risk ranging

from 2×10^{-9} for the average exposure condition at the lowest exposure location to 5×10^{-8} for the high-end exposure condition at the highest exposure location). Risks for the most likely scenario, residents in Three Forks who obtain some food products from the general area around the Facility, either domestic or wild game, have higher estimated risks (cumulative condition risk of 7×10^{-8} for the average exposure condition and 4×10^{-7} for the high-end exposure condition).

- Total risk is dominated by consumption of predicted levels of dioxin in beef and mother's milk, and to a lesser extent by consumption of poultry and dairy products.

- Consumption of fish from local rivers produces much lower risk estimates. Risk from river fish consumption for the cumulative condition high-end exposure estimate, which assumes 74 pounds per year of fish ingestion, is 2×10^{-8}. Risk from exposure to fish in lakes in ponds is strongly affected by assumptions regarding the location and configuration of the pond. This assessment evaluated a pond in Three Forks, which resulted in a cumulative condition high-end risk estimate of 6×10^{-6} and average risk estimate of 5×10^{-7}. About 60 percent of this risk is due to predicted dioxin exposure and about 40 percent of the risk is due to predicted PCB exposure.

- Risks from consumption of locally hunted big game are estimated to range from 5×10^{-9} for average meat consumption rates assuming 15 percent of meat ingestion is derived from the site to 3×10^{-7} for the high-end meat consumption rates and assuming 100 percent of the meat is obtained from areas nearby the Facility. Essentially all the risk is attributed to predicted dioxin exposure.

- Stochastic analysis indicates that the risks to residents are lognormally distributed. Risks for most residents are approximated by the median exposure condition, with relatively few residents described by the high-end risk estimates. Stochastic analysis of the worst-case exposure scenario (i.e. the subsistence lifestyle at the Facility boundary) for the cumulative condition indicates a median risk of 5×10^{-6}. The high-end risk estimate derived using the point-estimate approach results in risk estimates that are near the 100th percentile of the distribution (cumulative condition risk of 1×10^{-5}), while risks at the 90th percentile level are about half as large (cumulative condition risk of 6×10^{-6}).

In consideration of the above findings, a vast majority of the people in the area are predicted to experience risks that are at levels at or below the range that is generally considered to be acceptable (1 in 10,000 to 1 in 1,000,000). These risks are the incrementally increased risk of cancer as a result of lifetime exposure to COPCs from the site. The background rate of cancer from all sources (natural and anthropogenic) is 1 in 3. Certain types of land use and lifestyles in close proximity to the Facility will result in larger incrementally increased cancer risk than would be experienced by the general

population; for example subsistence living or concentrated agricultural operations such as feed lots, green houses, fish farms, or organic farms.[3]

[3] Standards regarding constituent quality of organic foods are restricted to pesticide and herbicide residues. The inclusion of organic farms in this category assumes that consumers of organic produce would not want food products exposed to anthropogenic constituents at levels above background levels or levels that can be detected using standard analytical methods.

3. ECOLOGICAL RISK ASSESSMENT

The organization of the ecological risk assessment is similar to the human health risk assessment, with the quantitative assessment consisting of three primary parts. Section 3.1, Exposure Assessment, evaluates the fate and transport of constituents in the environment and establishes the routes by which organisms may be exposed to the COPCs. For terrestrial ecological receptors, calculations are made regarding the exposed dose, which is expressed as milligrams of constituent ingested per kilogram body weight per day (mg/kg/day). Section 3.2, Toxicity Assessment, identifies quantitative measures of toxicity for each COPC that are comparable to the dose. Section 3.3, Risk Characterization, calculates risk by comparing exposure under the various exposure scenarios to toxicity. The remaining two sections provide further evaluation of the results. Section 3.4, Uncertainty and Variability, addresses more qualitative aspects of the assessment. Section 3.5, Summary and Conclusions, integrates both the quantitative and qualitative aspects of the risk assessment into a concise summary in support of informed risk management decision-making.

3.1 EXPOSURE ASSESSMENT

The fate and transport of COPCs emitted from the Facility is identical to the process described for the human health exposure assessment (Section 2.1 and Figure 2-1). There are two primary differences when considering ecological risk: food web considerations and area of exposure. The area of exposure affects how media concentrations (e.g., air, soil, and food) are determined. Additionally, ecological species to be used in the quantitative assessment must be selected. Since it is not feasible to quantitatively evaluate all species that may exist in the area, species must be selected to represent the various types of species existing in the area which are of potential concern.

3.1.1 Terrestrial Exposure Assessment

Arid grassland and dry-land farming is the dominant type of ecosystem surrounding the Facility. Habitat characterized by cottonwood trees and various shrubs predominate along the major area rivers. Wetlands occur in the Three Forks Area.

3.1.1.1 Species Selection and Food Web Considerations

Figure 3-1 presents a food web for the terrestrial area around the Facility. The various guilds (e.g., carnivorous mammals) and food web relationships are based on the shortgrass prairie model developed by EPA (1999a) (Figure 3-1). The example species are based on a general understanding of species common to Montana and the area.

The food web provides a summary of the various types of species that could be evaluated. The selection of species and food web pathways for quantitative evaluation is based on the following:

- Selecting species representative of the range of species that potentially exist at the site.

- Selecting species for which there is sufficient exposure and toxicity information to support quantitative analysis. Note that reptiles were not selected for quantitative assessment because there is limited data to support an evaluation of risk to these organisms. Also note that no example species are listed for terrestrial plants. This reflects the fact that species-specific toxicity information is not available for native plants in the area of this project. Most plant toxicity information is obtained from studies conducted on agricultural crops.

- Consideration for rare species, species of special economic value, or species of interest to the general public.

  - Section 3 of the EIS (DEQ 2005) identifies rare species that may exist in a 50 km radius of the Holcim Facility. Those species potentially existing in the area and listed as threatened by the U.S. Fish and Wildlife service are the Bald Eagle, Lynx and Ute ladies' tresses (a plant). The Bald Eagle and Lynx are designated as "Threatened" under the Endangered Species Act. Many other species of special concern for one or more reasons are identified in the EIS. These can be generally summarized to include: seven species of carnivorous, insectivorous or piscivorous birds; six species of aquatic insects; three mammal species (Fringed myotis – a type of bat, Lynx and Townsend's big-eared bat), thirteen plant species, and three fish species (Yellowstone cutthroat trout, Westslope cutthroat trout and artic grayling). The terrestrial species of special concern are represented by a surrogate species of the same trophic level as shown in Figure 3-1, as per EPA guidance (EPA, 1999a). Aquatic species are not selected for quantitative assessment, for reasons explained in Section 3.1.2.

  - Public scoping (DEQ 2004) identified several species of special economic value and interest to the general public, including fish, plants, deer, and antelope. Fish and plants were previously evaluated by Bison and Kleinfelder (2004c) and are also selected for evaluation in this assessment. The deer was selected for evaluation in this assessment in addition to rabbits (which had been previously evaluated, Bison and Kleinfelder 2004c) to represent larger herbivorous mammals. This selection was made because of public interest in maintaining the health of game species. Also, the deer is potentially more susceptible to adverse effects from exposure to COPCs because it is much larger than the rabbit (see toxicity factor discussion, Section 3.3.2). The assessment of potential risks to deer is considered representative of risks to antelope.

- Consideration for organisms in higher trophic levels to account for bioconcentration and bioaccumulation of COPCs. Bioconcentration refers to the ratio of concentrations in animal food items to concentrations in environmental media. Bioaccumulation refers to the magnification of constituent concentrations in organisms within the food chain. Each is considered separately.

  - To minimize unnecessary complexity in the evaluation of bioconcentration, only a subset of the food pathway models available from EPA guidance are included in this assessment. This approach is based on the fact that an organism can only eat a

fixed quantity of food per day. If, as assumed in this assessment, all of the fox's diet is proportioned to the rabbit, then it would not be correct to also consider exposure through consumption of robins. This exposure assessment uses bioconcentration factors provided in EPA guidance (1999a) to estimate body burdens of species (e.g., ingested prey hazard index assessment for the red-tailed hawk, Attachments E-4 and F-4).

- Bioaccumulation is not quantitatively accounted for in this assessment (e.g., herbivorous mammal to omnivorous mammal to carnivorous mammal and/or carnivorous birds) to reduce further assessment complexity. Incorporation of this pathway would result in higher quantitative estimates of risk to Trophic Level 4 species. However, a cursory examination of this pathway (Section 3.3.2.3) indicated that risks would not exceed levels of concern. Therefore, bioaccumulation is addressed qualitatively.

3.1.1.2 Air Concentrations

Risks are calculated based on ground-level air concentrations at the worst-case receptor location and for a broader region around the Holcim Facility. For the default model provided in Attachments E and F, media concentrations are determined based on the average ground-level air concentrations over approximately a 36-square mile region surrounding the Holcim Facility. An average dispersion coefficient value of 0.01945 was derived by averaging dispersion coefficient values for the receptor points shown on Figure 3-2. The following considerations went into selecting a 36-square mile region:

- Ecological risk assessment is principally concerned with overall ecosystem health and vitality. Potential ecological risk to a small group of organisms in a small area represented by the maximum exposure point may not be a useful measure of risk at the ecosystem level. Use of the maximum exposure point to determine media concentrations is a valid simplification only if risks are below levels of potential concern.

- Terrestrial animals will move freely about the area surrounding the Facility. The territory size will vary by species and based on habitat quality. The red fox home territory ranges from 57 to 170 hectares, while the robin's home territory is less than 1 hectare. One hundred hectares is equivalent to 0.386 square miles.

- Using a contour map of the dispersion coefficients, an area of uniform shape was defined that surrounded the Facility and included the areas of highest potential ground-level air concentrations.

The selection of the area over which exposure should be averaged is subjective. The intent is to show how risks change between the worst-case location and the broader area surrounding the Facility more generally. Soil and forage concentration calculations and results are provided in Attachment E-1 (baseline condition) and Attachment F-1 (cumulative condition).

3.1.1.3 Soil and Forage Concentrations

Soil and animal forage concentrations were calculated using the same model as described for the human health risk assessment. The soil calculations are provided in Attachment E-1 (baseline condition) and F-1 (cumulative condition), and forage concentration calculations are provided in Attachment E-3 (baseline condition) and F-3 (cumulative condition).

Concentrations are the average predicted concentrations over 100 years of Facility operation. A soil depth of 0.15 meters is used for calculating soil concentrations in the default models used in this ecological risk assessment; a value defined by California EPA guidance (2003) for agricultural exposure pathways in the human health risk assessment. Conversely, U.S. EPA guidance (1999a) suggests 0.01-meter soil depth be used for untilled soil and 0.2-meter depth be used for tilled soil. EPA also assumes a different soil bulk density of 1,500 kg/m^3. The implications of these different assumptions are quantitatively evaluated in Section 3.3.2.2.

3.1.1.4 Water Concentrations

Predicted water concentrations are significantly higher in lakes than in rivers. The concentration in lakes is dependent upon many assumptions about lake size, depth, location, and number of volume changes per year. Other factors that may affect predicted exposure concentrations include evaporation and accumulation of COPCs in sediments. This assessment conservatively assumes that wildlife get all their drinking water from lakes. Lake water concentrations are based on deposition rates for the Jefferson 2 river receptor and lake dimension assumptions described in Section 2.1.2.3.

3.1.2 Aquatic Exposure Assessment

Upstream of the Facility, the Madison, Jefferson, and Gallatin Rivers come together to form the headwaters to the Missouri River. The Three Forks Area, where the rivers converge, has a myriad of small lakes, ponds, and wetlands. The rivers, lakes, and ponds in the area are best described as cold water fisheries.

Consistent with EPA (1999a) guidance, risks to fish and aquatic invertebrates in the area rivers and lakes are evaluated by comparison of COPC concentrations in water and sediments to their respective media standards.

A food web and species-specific risk assessment for higher trophic level organisms in the aquatic environment is not included with this risk assessment. Such a food web would consider fish-eating birds such as an osprey, wading bird such as a sandpiper, and aquatic mammals such as a beaver, among other possible types of species. Water quality standards have been applied extensively in the regulation of ambient water quality. The toxicological basis underlying the development of the standards has a strong orientation toward aquatic life in cold water systems; although there is limited consideration for higher trophic level species. To address this bias, risks to higher trophic level organisms are addressed qualitatively in the Summary and Conclusions (Section 3.5).

3.2 TOXICITY ASSESSMENT

Ecological toxicity assessment involves a considerable amount of variability. There are multiple sources of toxicity values, with the source of the toxicity value changing depending on the media of concern and species of concern. This toxicity assessment is approached in two ways to provide a more diverse perspective on potential ecological toxicity and risk. A screening level-type assessment is provided that involves a comparison of predicted media concentrations to media standards. Also, toxicity reference dose values are selected for use in a more rigorous site-specific risk assessment.

3.2.1 Media Criteria

Tables 3-1 through 3-3 present predicted media concentrations and compares them to routine detection limits, average background concentrations, and a selection of screening level criteria. Some screening criteria are specific to certain types of species, such as plants or invertebrates. Other criteria apply to terrestrial systems in general, considering all trophic levels. The approach used to develop the more general screening level values is to base the criteria on the exposure pathway (e.g., shrew) that provides the lowest soil concentration. Similarly, criteria for plants are based on those species, among those tested, that are more sensitive to the constituent of concern. Using this approach, the criteria are thought to be protective of plants generally. The bases (i.e., type of organism) used to develop the criteria are listed in the tables where such information is provided with the published value.

Screening level criteria are not regulatory standards that must be complied with, nor are they a definitive measure of ecological harm. They are generally used as a simple and conservative method for identifying a potential for harm and the need for more detailed evaluation.

A discussion of the findings provided by Tables 3-1 through 3-3 is reserved for Section 3.3, Risk Characterization.

3.2.2 Toxicity Factors

The toxicity factors selected for use in the ecological risk assessment are derived from Bison and Kleinfelder (2004c), with some exceptions as described in part below. References for the toxicity factors are provided in Attachments E-4 and F-4.

The evaluation of risk to plants, invertebrates, and aquatic life involves a direct comparison to media standards (EPA 1999a). This approach is identical to the media standards approach presented in Section 3.2.1 except that only a single toxicity factor is used in the hazard assessment. It is often, but not always, one of the values provided in the media comparison tables (Tables 3-1 through 3-3).

The evaluations of risk to birds and terrestrial animals are based on calculations of dose from exposure to COPCs in air, water, soil, and diet. Toxicity reference values based on dose (i.e., milligrams taken into the body per kilogram body weight) are used to support

this kind of assessment. Toxicity factors are generally derived from toxicity studies conducted in a laboratory. Toxicity information is rarely available for the species of interest. Moreover, the toxicity data supporting the standard may include: no observed adverse effect levels (NOAELs), lowest observed adverse effect levels (LOAELs), median lethality levels, or other types of data. EPA guidance (1999a) establishes protocols for the selection of preferred toxicity data and the selection of uncertainty factors. Uncertainty factors are used for species extrapolations and when extrapolating no observed effect levels from other kinds of data. The uncertainty factors used in this assessment are shown in Attachments E-4 and F-4.

A protocol has been developed for adjusting toxicity reference values when extrapolating between species that is based on body weight (Sample et al. 1996). Using this approach, toxicity factors are lowered (i.e. made more stringent) for species with larger body weights. According to Sample et al., "Smaller animals have higher metabolic rates and are more resistant to toxic constituents because of more rapid rates of detoxification." This assessment used this approach to adjust toxicity factors.

EPA guidance (1999a) does not include exposure or toxicity assessment via inhalation because adequate data to support inhalation toxicity assessment for wildlife species have not been developed. This assessment does assess the inhalation pathway using toxicity factors developed for exposure from ingestion pathways. This approach is a carryover from the approach used by Bison and Kleinfelder (2004c). In all cases, exposure received from inhalation is much lower than exposure estimated for other pathways. The inclusion or exclusion of this pathway does not significantly change the HI results for this assessment.

3.3 RISK CHARACTERIZATION

This section of the report presents the quantitative results of the ecological risk assessment. Section 3.3.1 provides a screening level evaluation of risk based on a comparison of predicted COPC concentrations in environmental media with generic media-based criteria. The site-specific ecological risk assessment results are presented in Section 3.3.2.

3.3.1 Screening Level Comparison to Media Criteria

Soils. Average soil concentrations for the broader area surrounding the Facility do not exceed any comparison criteria provided in Table 3-1. For the location of highest predicted soil concentrations, manganese exceeds the detection limit, but not screening level health criteria. Again for the location of highest predicted soil concentrations, soil concentrations of inorganic mercury, selenium, and naphthalene for both the baseline and cumulative conditions are below detection limits and exceed some but not all of the screening level health criteria. Predicted concentrations of zinc at the worst case location greatly exceed detection limits and several criteria.

Surface Waters and Sediments. As shown in Table 3-2 (surface water) and Table 3-3 (sediments), estimated surface water and sediment concentrations for rivers and lakes are substantially below all comparison values.

3.3.2 Hazard Indexes

The potential for adverse ecological health effects from exposure to COPCs are determined by comparing estimated intake values (I) with reference doses (RfDs), both expressed in terms of mg/kg/day. The RfDs are threshold concentrations below which no adverse effects are expected to occur. This relationship is mathematically described as follows:

Hazard Quotient = I/RfD

If intake exceeds the reference dose, the HQ will exceed 1.0, indicating a potential for adverse health effects. For simultaneous exposure to multiple constituents with similar toxic effects, a HI is calculated as the sum of constituent-specific HQs. HQs and HIs are generally reported to only one significant figure, consistent with the inherent level of accuracy of a risk assessment.

3.3.2.1 Hazard Indexes Using California EPA Assumptions

Calculations supporting the derivation of the HIs are provided in Attachments E-4 (baseline condition) and F-4 (cumulative condition). A summary of the findings are:

Ecological Hazard Indexes

	Worst-Case Receptor		Area Around Facility	
	Baseline Condition	**Cumulative Condition**	**Baseline Condition**	**Cumulative Condition**
Terrestrial Plants	0.4	0.3	0.03	0.02
Aquatic Life – Rivers	NA	NA	0.0007	0.0007
Aquatic Life – Lakes	NA	NA	0.3	0.3
Aquatic Invertebrates – Rivers	NA	NA	0.0006	0.0003
Aquatic Invertebrates – Lakes	NA	NA	0.2	0.1
Terrestrial Invertebrates	0.4	0.3	0.03	0.02
Small Herbivores (rabbit)	0.08	0.06	0.04	0.04
Large Herbivores (deer)	0.03	0.03	0.01	0.01
Avian Carnivores (hawk)	7	7	0.4	0.4
Mammalian Carnivores (fox)	0.01	0.007	0.0008	0.0006
Avian Omnivores and Herbivores (robin)	1	1	0.08	0.07

NA – Not applicable. The Worst Case Receptor does not apply to a location containing a water body.

Results are rounded to one significant figure to preclude overstating the inherent accuracy of the assessment. Cumulative condition hazards are slightly below baseline condition hazards for most types of organisms. Most HIs are below 1.0, indicating no ecological

hazard. Applying California EPA assumptions, the above results indicate that at the worst-case receptor there is a potential for impacts to small birds with limited home territory range. Potential hazard to carnivorous birds at the worst-case location is also indicated, with the risk entirely due to dioxin exposure via soil ingestion. Further discussion of these hazards follows the presentation of hazards using select EPA assumptions.

3.3.2.2 Using Select EPA Exposure Assumptions

The EPA (1999a) recommends that soil concentrations be based on deposition and mixing within the top 0.01 meter of soil, compared with 0.15 meters used by the California EPA for evaluating agricultural exposure. The EPA also assumes a different soil bulk density value (1,500 kg/m^3) than the California EPA (1,333 kg/m^3). Applying these assumptions produces much higher HIs, as shown for the area around the Facility below.

Terrestrial Ecological Hazard Indexes for the Area Around the Facility Using Select EPA Assumptions*

	Baseline Condition	Cumulative Condition
Terrestrial Plants	0.4	0.2
Terrestrial Invertebrates	0.4	0.2
Small Herbivores (rabbit)	0.08	0.05
Large Herbivores (deer)	0.3	0.2
Avian Carnivores (hawk)	6	6
Mammalian Carnivores (fox)	0.009	0.006
Avian Omnivores and Herbivores (robin)	1	0.8

*Soil depth changed from 0.15m to 0.01m and soil bulk density changes from 1,333 kg/m^3 to 1,500 kg/m^3.

Under these assumptions, hazards to all terrestrial species except carnivorous birds and omnivorous and herbivorous birds are below levels of potential concern. A potential impact to omnivorous and herbivorous birds are implicated within the area surrounding the Facility. Exposure to various metals via earthworm ingestion contributes most to the HI. Note that no single HQ (Attachments E and F) exceeds 1. Adding the HQs for all constituents to obtain a HI is only appropriate for constituents with similar types of toxic effects. An evaluation of the different ecological toxicity endpoints is not provided with this assessment. The HQ and HI for the hawk is entirely a function of exposure to dioxin via soil ingestion (if dioxin exposure via soil ingestion is set to 0, the HQ goes to 0.07 for the Baseline condition).

3.3.2.3 Bioaccumulation Considerations

Bioaccumulation of COPCs in carnivores is not incorporated into the HIs. EPA guidance (1999a) accounts for bioaccumulation by using food chain multipliers. The food chain multipliers are based on the octanol/water partition coefficient (which describes the constituent's tendency to partition into fat) of a constituent and the trophic level of the organism. The highest food chain multiplier for any constituent and trophic level is 27. The lowest is less than 1. Since linear algebraic equations are used to calculate dose and

toxicity, use of a food chain multiplier would result in no more than a 27-fold increase in the HI. This food chain multiplier only applies to the dose and hazard calculations for the food ingestion pathway, where trophic level 3 organisms (Figure 3-1) may be ingested. For carnivores, soil ingestion pathways provide the greatest estimated exposure. A review of the hazard quotients for the prey ingestion pathways indicates that conclusions regarding carnivore hazards would remain unchanged if quantitative estimates of food chain biomagnification were performed.

3.3.2.4 Aquatic Life Considerations

Hazards to aquatic life and aquatic invertebrates in rivers are far below levels of potential concern. For ponds, lakes, and reservoirs, hazards to aquatic life and aquatic invertebrates are strongly controlled by certain assumptions such as: the location of the pond, the ratio of surface area to water depth, and the number of volume changes per year. The highest HQs are for PAHs and methyl mercury.

The hazards associated with ponds may extend beyond fish and invertebrates to other species such as wading birds, ospreys, and beavers. These higher trophic level impacts are not assessed using a risk assessment methodology. Risks to higher trophic level organisms would be strongly dependent upon assumptions regarding the percent of food consumed in ponds versus rivers.

Numeric water quality standards have been established by the DEQ in accordance with the Montana Water Quality Act (75-5-101 et seq., 1967). The numeric standards are intended to protect the present and future most beneficial uses of state waters. As part of a broad regulatory program for managing water quality in Montana, these numeric standards are used to protect aquatic life generally, including higher trophic level organisms. As shown in Table 3-2, water concentrations predicted by the assumptions of this assessment are below Montana's numeric standards and other comparison criteria[4]. Similarly, sediment concentrations predicted by this assessment are below select comparison criteria. Numeric regulatory standards for constituents in sediments have not been established.

3.4 UNCERTAINTY AND VARIABILITY

As in the human health risk assessment, uncertainty is defined as a lack of precise knowledge regarding the true risk, while variability is defined as the inherent heterogeneity in risk across space, time, or among individuals. While uncertainty can be reduced with increased information, variability cannot.

Ecological risk assessment inherently involves greater uncertainty and variability than human health risk assessment. There are multitudes of different organisms that interact within a complex food web. When compared to human health assessments, there are generally fewer supporting studies and greater uncertainty regarding certain exposure

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[4] For purposes of this report, the term standard refers to a legal requirement or numeric value, while the term criteria generally refers to risk-based values published in agency guidance.

factors such as soil ingestion rates for various wildlife species. Moreover, efforts to relate numeric risk estimates to observable ecological impacts are confounded by a host of natural factors affecting ecological health, such as climate conditions and food abundance.

The use of both media standards and risk assessment methods is intended to provide a more thorough examination of potential risks across species. Also, media standards and toxicity factors are established based on no observed effect levels, generally involving toxicity to the most sensitive species for which there is data. Margins of safety are used where there is limited information. Using these procedures, the toxicity criteria are intended to be protective of most species, most of the time.

Reductions in ecological risk assessment uncertainty may not be possible through field investigations of constituent concentrations. Except for zinc in soil, all constituent concentrations predicted by this assessment are below routine detection limits (Tables 3-1 through 3-3).

3.5 SUMMARY AND CONCLUSIONS

Potential hazards may exist for small herbivorous and omnivorous birds such as robins and meadowlarks that have home territories of limited range in areas of highest ground-level air concentrations. Metals are the primary contributors to the elevated HI, although no single metal has an HQ greater than 1.0.

Avian carnivores may also be at risk from exposure to dioxin in soil. The HIs may be above or below 1.0 depending on the assumptions used to determine soil mixing depth and soil bulk density. Dioxin emissions are set equal to the PC-MACT limit (0.2 lb/hr), while the average test data for the Facility indicates dioxin emission rates that are nearly 100 times lower (0.00207 lbs/hr) (Lorenzen 2004, Appendix C). If the actual emission rates were used in the model, the HI for avian carnivores would be much less than 1.0.

Potential hazards in river systems are very low because of the large dilution associated with flowing water. Potential hazards in lakes, ponds, and reservoirs will vary greatly depending upon the location of the water body, the size and depth of the water body, and the number of times per year the water volume in the water body changes. The assessment evaluated water concentrations in a pond that may be considered typical of water bodies in the Three Forks Area. The risk assessment focuses on risk to aquatic life, namely fish. Comparisons of predicted water quality to water quality standards are provided to support an assessment of aquatic ecosystems generally, including higher trophic level organisms. Predicted surface water concentrations for all constituents are below Montana Aquatic Life Standards (Table 3-2). Therefore, hazards to aquatic life in most water bodies in the Three Forks Area are expected to be below levels of potential concern.

Potential hazards (HQs greater than 1) may occur for aquatic life and invertebrates in shallow ponds that have minimal water recharge and that may now, or in the future, be located in close proximity to the Facility. Potential aquatic life toxicity in lakes and ponds may reduce food abundance for higher trophic level organisms and thereby more broadly

affect general ecosystem health. The river ecosystem may off-set any such reduced food abundance.

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FIGURES

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WATER CONCENTRATION CALCULATIONS

The ecological risk assessment uses the same water concentration calculations as the human health risk assessment. See Attachment B-2. Attachment E-2 has no page inserts.

ATTACHMENT E-3

FORAGE CONCENTRATION CALCULATIONS

ATTACHMENT E-4

DOSE AND RISK CALCULATIONS

ATTACHMENT F

ECOLOGICAL RISK ASSESSMENT CALCULATIONS

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The ecological risk assessment uses the same water concentration calculations as the human health risk assessment. See Attachment C-2. Attachment F-2 has no page inserts.

ATTACHMENT F-3

FORAGE CONCENTRATION CALCULATIONS

ATTACHMENT F-4

DOSE AND RISK CALCULATIONS

Air Quality Technical Analysis Report

Review of Submittals Supporting the Holcim (US) Inc. Tires Combustion Proposal

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1. Introduction

Holcim Cement Company (Holcim) is proposing to use tires as fuel in their Trident cement kiln. Montana Department of Environmental Quality (DEQ) is in the process of preparing an Environmental Impact Statement (EIS) to identify potential impacts from the proposed project.

Holcim is currently authorized to burn natural gas, coal, petroleum coke, or any combination of these as a fuel for the kiln. The permit application requests the mid-kiln combustion of whole waste tires for up to 15 percent of the total fuel heat input to the kiln (on a Btu basis). Burning tires for fuel will change the amount and composition of air contaminant emissions from the cement kiln stack and may affect the concentration of contaminants in the cement kiln dust (CKD).

1.1 Objective

The objective of this Air Quality Technical Analysis Report is to report on the third-party review of Holcim's tire-burning emissions estimates and air quality impact analyses. Lorenzen Engineering, Inc. has worked with DEQ and DEQ's risk assessment contractor throughout the EIS process. The results and conclusions presented in this report have been discussed with other members of the EIS team.

This report is intended to supplement material that is already part of the public record and does not repeat information available in the original documents. Holcim has estimated the total emissions from the kiln using the current fuel mix, the total potential emissions using tires as a supplemental fuel, and the change in emissions due to tire combustion. Holcim has also prepared and submitted computerized air dispersion modeling results to show ambient air contaminant concentrations resulting from the cement plant.

1.2 Materials Reviewed

Holcim has been working with DEQ since 2001 to obtain a Montana air quality permit alteration allowing them to proceed with their tire-burning proposal. In January 2004, Holcim compiled all of the relevant application submittals into a single document titled *"Application for Alteration to Air Quality Permit #0982-10"* (ref. 1). The compilation provides a clear record of information submitted by Holcim and decisions made regarding the proposed project. This report will refer to the permitting compilation (ref. 1) rather than referring to earlier submittals.

Holcim submitted additional information regarding emissions inventory and air dispersion modeling during the EIS review process. The additional submittals are included as appendices to this report. Expanded emissions inventories are included in Appendices A and B. A comparison of Holcim's estimated emissions and source test data is contained in Appendix C. Appendix D is Holcim's final modeling report. Holcim provided the modeling files electronically and they were verified as part of the review process. Holcim's final modeling results have been used to generate illustrative figures for this report.

1.3 Organization of Report

This technical analysis report includes a critical review of the contaminant emissions information provided by Holcim both in the original permit application materials and in subsequent submittals. It examines the source of emissions information and the methodology used to estimate emissions from the Trident kiln. Emissions estimates from the current fuel mix and the proposed fuel mix are included in this report.

Dispersion modeling review in this report includes evaluation of the choice of model, applicability of the meteorological data and treatment of terrain features. The report also includes graphical representations of the modeling results.

The Air Quality Technical Analysis Report is organized in the following main sections:

1. Introduction
2. Data Adequacy Review
3. Review of Emissions Inventory Methods
4. Criteria Pollutant Emissions Inventory
5. Hazardous and Toxic Air Pollutant Emissions Inventory
6. Air Dispersion Modeling Review
7. Conclusions and Recommendations
8. References

2. Data Adequacy Review

The first step in the EIS air quality analysis was review of the project file and all information submitted in support of the permit application. The purpose of this data adequacy review was to determine whether sufficient information existed in the project file for a complete evaluation of impacts from the tire-burning proposal.

Following the data adequacy review, DEQ requested additional information from Holcim to be used to complete the EIS. Scoping comments relating to air quality were also reviewed and information has been included in this report to address these comments.

2.1 Emissions Inventory Data Adequacy Review

Holcim submitted emissions inventory information for criteria pollutants, hazardous air pollutants (HAPs) and other toxic air pollutants that are commonly related to tire burning in kilns.

2.1.1 Criteria Pollutant Emissions Inventory

Holcim submitted emissions estimates for total kiln criteria pollutant emissions as well as emission changes resulting from the tire-burning proposal. Gaseous criteria air pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), ozone and nitrogen dioxide (NO_2). Lead (Pb) and particulate matter smaller than 10 microns (PM_{10}) are solid or particulate phase criteria pollutants. Volatile organic compounds (VOC) are regulated because they lead to the formation of ozone in the atmosphere.

The criteria pollutant emissions inventory was found to be adequate for EIS review and no additional information was requested. Criteria pollutant emissions are regulated through Montana's air quality permitting process. Holcim has conducted emissions tests on the cement kiln stack, as required by DEQ, to determine the emissions of criteria air pollutants. Emissions from the Trident facility have been estimated by DEQ and Holcim and are included in Holcim's proposed pre-construction permit #0982-11 (ref. 2).

2.1.2 HAP and Air Toxic Emissions Inventory

Holcim estimated HAPs emissions from tire burning for use in their health risk assessment (ref. 1). The HAPs and air toxics information was also used in DEQ's subsequent risk study titled, "*Human Health and Ecological Risk assessment of Kiln-Related Emissions at the Holcim Trident Cement Plant* (ref. 3)."

The risk assessment considers all HAPs as chemicals of potential concern (COPCs) (ref. 3). Holcim added zinc to the risk assessment calculations, even though it is not a HAP and is exempt from consideration under Montana regulations. Holcim chose to include zinc because it is a known constituent in tires and was noted as a potential concern by the interested public (ref. 1).

Holcim initially estimated only the incremental increase in HAP emissions resulting from the addition of tires to the kiln fuel stream. Although the original emissions inventory produced conservative estimates of the emissions increase, it did not provide information about the total

HAP emissions from the kiln. Through the data adequacy review, it became clear that additional inventory information would be needed for a complete review of the change in plant emissions resulting from the proposed project. Scoping comments indicated that the public was interested in the emissions resulting from all kiln raw material feeds as well as coal, coke and tire combustion. In addition to mined limestone, silica and shale, Holcim uses recycled glass as a silica source and recycled smelter slag as an iron source.

Based on public comment and review of reference materials, DEQ determined that a risk assessment based only on the incremental change in emissions is not adequate. In a health consultation prepared for a similar project in Colorado, the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR) reached the same conclusion (ref. 4). ATSDR reviewed the risks from that project and found that the regulatory agency "had analyzed stack test data with and without the burning of tires at other cement kilns and calculated the percent change in emissions." In their report, ATSDR stated, "It is not the percent of change that is significant – it is the dose of a particular chemical that is important. … We do not agree with the comparative risk methodology used in the report to determine if the stack emissions would adversely affect public health (ref. 4)."

DEQ requested that Holcim provide an emissions inventory to include total kiln emissions, including emissions from tire burning. In response, Holcim developed an emission inventory for the kiln emissions using all currently permitted fuels and kiln feeds. The existing inventory (without tires) is referred to as the "baseline" inventory and is included in Appendix A of this report. Appendix A also includes a memo provided by Holcim explaining the emissions inventory procedures.

The baseline inventory represents potential emissions from currently allowed kiln fuels and feeds. It contains estimated emissions from use of coal and coke as fuel, with recycled glass used as a source of silicate in the kiln feed. Holcim provided two versions of the baseline inventory, one with a typical production rate of 315,000 tons of clinker per year and one with the maximum allowable production rate of 425,000 tons of clinker per year. The baseline emissions inventory is based on the 425,000-ton allowable production rate.

Holcim also provided a "cumulative" emissions inventory using allowed kiln raw material feeds and using tires as 15% of the total fuel stream. The cumulative emissions inventory and accompanying memo are included in Appendix B of this report. The cumulative emission inventory includes estimated emissions from the use of coal, coke and tires as fuel, and all approved kiln feed materials. The cumulative inventory represents the maximum potential emissions of HAPs from the kiln with the use of tires as fuel. The cumulative emissions inventory is based on a maximum annual production rate of 425,000 tons of clinker.

Following submittal of the baseline and cumulative emissions inventories, the EIS team concluded that the HAPs emissions inventory information was adequate for the EIS review.

2.2 Additional Information Provided by Holcim

In addition to the revised emissions inventories, DEQ requested that Holcim provide the following information to allow the EIS team to fully evaluate the emissions inventory. All the data was provided and was used in the air quality technical analysis.

- Design and operation information for the particulate control equipment for the Trident kiln,
- HAP stack test results for the Holcim kiln.
- Coal analyses for the Holcim coal fuel.
- Petroleum coke analyses for the Holcim coke fuel.
- Analyses of the emissions from adding recycled glass to the kiln.
- Chemical analyses of the smelter slag used for iron-substitute in the kiln.

The EIS team concluded that the additional submittals provide adequate information for a full EIS review.

2.3 Dispersion Modeling Adequacy Review

Computerized air dispersion modeling was used to estimate the impacts of the plant emissions on ambient concentrations of air contaminants. The adequacy review includes evaluation of the dispersion model selection, based on the criteria established in EPA's Guideline on Air Quality Models. The choice and quality of meteorological data was reviewed to determine its applicability to the air quality impact area.

In their October 2001 submittal, Holcim used EPA's Industrial Source Complex (ISC3) model to model the changes in kiln emissions resulting from tire burning. During the next few years, EPA worked on establishing the AERMOD model as a preferred model for air quality permit application modeling. In May 2002, Holcim submitted revised kiln modeling using the then-current version of AERMOD. In February 2003, Holcim submitted additional modeling including the cement kiln dust (CKD) handling sources as well as the kiln in the AERMOD model. When EIS review began in January 2004, EPA had updated the AERMOD model and the version used by Holcim was no longer available (see www.epa.gov/ttn/scram). As a result, DEQ requested that Holcim perform the additional modeling using the most current AERMOD version.

DEQ requested that Holcim model the total baseline emissions and the total cumulative emissions from the facility. Previous HAPs modeling had only included the incremental change in emissions from tire burning. DEQ also requested that Holcim extend the modeling impact grid beyond the original 10 km radius around the plant. The additional modeling request made it necessary for Holcim to update the modeling files to the latest version of EPA's recommended model. Holcim provided the modeling files in electronic format so they could be duplicated and used as needed during the EIS review. Following submission of the additional modeling, the EIS team concluded that the modeling data is adequate for a complete EIS review.

3. Review of Emissions Inventory Methods

Holcim estimated criteria pollutant and HAPs emissions from the Trident kiln using a variety of methodologies. Kiln criteria pollutant emissions were obtained from source tests and existing permit limits. Estimates of HAP emissions are much harder to develop because the emissions are small, difficult to test, and less data is available. Holcim gathered a database of source tests from other cement kilns using tires as fuel and used the data to estimate HAPs from the Trident kiln.

The emissions inventory review will include a review of the methodology used by Holcim to arrive at their emissions estimates. The HAPs emissions estimation methodology will be reviewed in detail because of the uncertainty associated with HAPs emissions estimates. The assumptions and calculations used to account for the effects of kiln upsets on emissions are described in detail in Section 3.3.

3.1 Emissions Estimation Methodology

Common methods of determining emissions from an existing or proposed facility or process are listed below. Discussion of the appropriateness of using each approach for criteria pollutant and HAPs follows.

- Use of EPA emission factors.
- Calculation of material balance for a specific compound.
- Use of source test data from similar sources.
- Source testing of an existing source or permitted process.
- Continuous emissions monitoring system (CEMS).

EPA has developed emission factors for numerous industries and processes that produce air pollution. The emission factors are contained in EPA's Compilation of Air Pollutant Emission Factors, commonly referred to as AP-42. The Introduction to AP-42 discusses the relative reliability of the emissions estimate methodologies listed above (ref. 5).

AP-42 Section 11.6 contains criteria pollutant emission factors for portland cement kilns as well as total particulate matter (PM) emission factors for various material handling operations throughout the process. AP-42 also contains HAPs and air toxics emission factors for 26 particulate compounds (including metals) and 44 gaseous compounds. The factors in AP-42 are appropriate for estimating emission from traditional fuels such as coal and natural gas but may not be appropriate for kilns using tire-derived fuel (TDF). The EPA AP-42 emission factors have been used for reference in establishing the emissions inventory for the proposed project.

A material balance (or mass balance) approach may provide reliable average emission estimates for specific sources. In general, material balances are appropriate for use in situations where a high percentage of material is lost to the atmosphere. Calculation of emissions through mass balance is frequently used for estimation of SO_2 emission, based on a number of simplifying assumptions (ref. 5). Sulfur content of fuel is readily measured, and SO_2 emissions are estimated based on an assumption that all of the sulfur in the fuel is oxidized. Mass balance calculations for

trace contaminants such as gaseous and particulate phase HAPs are not feasible due to the small amounts of these contaminants in the fuel stream and the gas stream.

Holcim has used source test data from similar sources to develop an extensive database for emissions from cement kilns burning tires or TDF. The datasets are shown in the emissions inventories in Appendix A and Appendix B. Holcim used the source test database primarily for development of HAP emissions factors, but also used it as a reference source for criteria pollutant estimates.

Holcim has performed source tests on the Trident cement kiln for criteria pollutants including CO, NO_2, SO_2 and PM_{10}. They are also operating continuous emissions monitoring systems (CEMS) for NO_2 and SO_2. The source tests and CEMS provide the most reliable emissions information, but are limited to the baseline case. Changes in criteria pollutant emissions due to tire burning have been estimated from other sources.

3.2 Tire-burning Emissions Inventory Database

Typically, emission inventory development relies heavily on AP-42 as the primary source of emission factors. As Holcim stated in the permit application, AP-42 does not specifically address emissions from Portland cement kilns using TDF in the fuel mix. Therefore, Holcim needed to obtain emission factors for HAPs from TDF combustion from other sources. The approach Holcim took to developing the TDF emission factors was similar to the approach used by EPA in developing the AP-42 emission factors.

Holcim relied largely on source test data from other sources to estimate HAPs emissions from the proposed project. In developing the emissions inventory for the cement kiln while burning tires, Holcim compiled source test data from a number of cement kilns. The sources had been tested while burning tires or TDF as part of the fuel stream. Many of the sources in the database also performed baseline testing without tires during the same testing period.

The source test database used for this analysis included 13 source tests from 11 kilns using tires or TDF for a portion of the fuel. The database includes both baseline tests (without TDF) and cumulative tests (with TDF). TDF use ranged from 7% to 33% of the fuel, on a heat basis. The baseline fuels used were coal, coal and coke, coal and oil, coal and waste oil, and coal and hazardous waste. The data set included tests from seven dry process kilns and four wet process kilns. TDF was reported to be in the form of chipped tires for six of the tests, whole tires for four of the tests, and not specified in the other test reports. According to the permit application, the emissions inventory did not include any facility that exactly matched the Trident kiln's operating parameters [long, wet kiln; coal/coke baseline fuel; mid-kiln introduction of whole tires; tires as 15 heat-percent of fuel mix; electrostatic precipitator (ESP) emission control] (ref. 1). Nonetheless, the emissions testing data set contains a large number of samples and provides enough information to ensure that a conservative emissions estimate has been developed.

Holcim has developed the emissions inventory for their tire-burning proposal in a manner similar to that used by EPA to develop the AP-42 emission factors. When developing emission factors for use in AP-42, EPA compiled source test data from numerous source tests at Portland cement plants (ref. 7). EPA converted all the source test results to units of pound per ton of clinker. EPA

used 71 stack tests, dated from 1971 to 1992 to develop the emissions factors in the current version of AP-42 Section 11.6. EPA rated the source tests based on available knowledge about the tests and the sources. After discarding tests with low quality ratings, EPA averaged the remaining results to develop the AP-42 emission factors.

Holcim took a more detailed approach to analyze the tire-burning stack test data set, including all the tests with available data for each compound. Data sets with more than two data points allowed calculation of an upper 95% confidence limit (UCL) for the data set, which was used to project emissions at Trident. For data sets with less than two data points, the maximum data point was used to project emissions at Trident. For data sets where the 95% UCL exceeded the maximum data point, the maximum point was used to project emissions at Trident. More detailed information about the method used to process the source test data can be found in Holcim's permit application (ref. 1) and the memos in Appendices A and B.

Holcim used a methodology similar to EPA's for standardizing the source test results. Instead of standardizing the test results based on clinker production Holcim standardized the source test results based on fuel usage. This is an appropriate basis for comparison because the primary source of HAPs from the kiln is from fuel combustion, and Holcim was attempting to isolate the impacts from changing the fuel mix.

Source testing has been performed on the Holcim Trident kiln for most of the criteria pollutants and some of the HAP compounds. The testing was performed with the kiln operating under currently permitted conditions without using tires as fuel. Montana's air quality regulations do not allow Holcim to conduct a test burn with tires until they obtain an air quality permit allowing them to burn tires. Therefore, it is not possible to obtain source-specific emission test data for the Trident kiln while burning tires.

Holcim has performed source tests on the Trident stack to measure emissions of 13 HAPs, copper (a non-HAP) and dioxins/furans. Data from Holcim's site-specific stack tests has been used to verify the emissions estimates obtained through the database. Holcim has submitted a table comparing stack test results, database projected emission rates and AP-42 emission rates. The table and a memo explaining the data are contained in Appendix C.

Holcim's database projected cumulative emissions are all higher than the Trident source test data. The database values are close enough to the test results to provide confidence in the analysis, but are high enough to provide conservative estimates of emissions. The database projected cumulative emissions are comparable to values calculated using AP-42 emission factors. This comparison provides confidence that the database-projected emission rates for other HAPs are within an acceptable range.

3.3 Estimating Emissions from Kiln Upsets

Holcim developed a methodology for estimating potential HAP emissions from tire combustion during Trident kiln upsets. An upset is assumed to cause the ESP to be off-line and particulate phase HAP emissions are assumed to be uncontrolled until the ESP is back online. The duration of an average upset was estimated based on the duration of upset events that occurred during 2000 and 2001. The average duration of an upset was 13.2 minutes, but DEQ has recommended

that the duration of an upset be set to 30 minutes in an hour for the analysis of short term impacts from upsets (ref. 1)

The total annual duration of upset conditions was estimated based on the average of the hours of upsets that occurred during 2000 and 2001. The kiln experienced 110 hours of upsets during 2000 and 53 hours of upsets during 2001, resulting in an average of 81.6 hours of upsets over the two-year period. The number and duration of upsets has been reduced since 2001, partially due to the use of a continuous opacity monitoring system (COMS) on the kiln stack.

Assumed upset conditions were used to develop an 'upset multiplier' for each HAP. The upset multiplier for a 1-hour averaging period is different from the upset multiplier for the annual averaging period. The upset multiplier is applied to the modeled impact to produce a conservative ambient concentration value for use in the risk assessment. The upset multipliers have not been applied to the emissions estimates discussed later in this report.

DEQ and Holcim have assumed an ESP collection efficiency of 99.4%. When the ESP is not running, the particulate matter control efficiency is assumed to drop from 99.4% to 0%. ESP efficiency for particulate matter control is reviewed in Section 4.4 of this report. Control efficiency for gaseous emissions (other than SO_2) is always 0% because the ESP does not control gaseous emissions.

Emission rates provided in the emissions inventory are controlled emission rates. The following equation is used to determine the uncontrolled kiln emission rate for particulate matter.

controlled rate = uncontrolled rate * (100% - 99.4%)
uncontrolled rate = controlled rate / (100% - 99.4%)
uncontrolled rate = controlled rate * 166.67

The particulate matter hourly upset multiplier (UM_1) to account for a ½ hour upset during the hour is calculated as follows:

UM_1 = [controlled rate * ½ hr + uncontrolled rate * ½ hr] / (1 hr)
= controlled rate * .5 + (controlled rate * 166.67 * .5)
= controlled rate * 83.8

The particulate matter annual upset multiplier (UM_A) to account for 81.6 hours of upset during a year is calculated as follows:

UM_A = [controlled rate * (8760 hr – 81.6 hr) + uncontrolled rate * 81.6 hr] / (8760 hr)
= [controlled rate * 8678.4 hr + controlled rate * 166.67 * 81.6 hours] / (8760 hr)
= controlled rate * 2.54

The particulate HAP emissions that are controlled by the ESP include volatile metals, semi-volatile metals, non-particulate metals, inorganic compounds and organic compounds (ref. 1).

<u>Volatile metals</u>: Mercury

An ESP upset only affects the particulate portion of the volatile metal emissions while the gaseous portion of the volatile metal emissions remains the same. Mercury is assumed to be 5%

particulate phase and 95% gaseous phase when it reaches the ESP. The upset multipliers for mercury are calculated as follows:

UM_1 = gaseous emissions + particulate emissions * 83.8
= (95% * controlled emission rate) + (5% * controlled rate * 83.8)
= 5.14 * controlled rate

UM_A = gaseous emissions + particulate emissions * 2.54
= (95% * controlled rate) + (5% * controlled rate * 2.54)
= 1.08 * controlled rate

Semi-volatile metals: antimony, lead, cadmium, selenium and zinc (non-HAP)
Non-volatile metals: chromium, arsenic, nickel, manganese

Holcim assumed the semi-volatile and non-volatile metals are 100% particulate matter and are controlled by the ESP. An ESP upset will affect the total emissions of these metals, and the appropriate upset multipliers are as follows:

UM_1 =100% * controlled rate * 83.8
UM_A =100% * controlled rate * 2.54

Inorganic HAPs: hydrogen chloride, hydrogen fluoride

Holcim assumed 95% of the hydrogen chloride and hydrogen fluoride emissions are gaseous and 5% are particulate matter. Therefore the upset multipliers for these compounds will be the same as for mercury.

Organic HAPs: dioxin/furan (TCDD eq.)

Holcim assumed 80% of the dioxin/furan emissions are gaseous phase and 20% are particulate phase. Therefore, 20% of the dioxin/furan emissions are particulate phase and would be affected by an ESP upset. The upset multipliers for dioxin/furan are calculated as follows:

UM_1 = gaseous emissions + particulate emissions * 83.8
= (80% * controlled rate) + (20% * controlled rate * 83.8)
= 17.6 * controlled rate

UM_A = gaseous emissions + particulate emissions * 2.54
= (80% * controlled rate) + (20% * controlled rate * 2.54)
= 1.31 * controlled rate

The ESP does not control emissions of gaseous HAPs. Emissions of these HAPs are not affected by ESP upsets. The upset multipliers for gaseous pollutants are equal to one (1.0).

4. Criteria Pollutant Emissions Inventory

This section will evaluate the estimated criteria pollutant emissions changes resulting from use of tires as fuel. Criteria pollutant emissions are regulated through Montana's air quality permitting process. Maximum potential emissions from the Trident facility while using tire-derived fuel (ref. 1) are listed in Table 1.

TABLE 1
Potential Annual Kiln Criteria Pollutant Emissions

Pollutant	Baseline Emission Rate tons/year	Cumulative Emission Rate tons/year
SO_2	543	543
NOx	6,868	6,868
CO	121	310
PM_{10}	164	164
VOC	6	6
Lead	0.15	0.15

Source: Holcim, 2004

Fuel combustion is the primary source of criteria pollutants. CO is emitted as a result of incomplete combustion of carbon in fuel. Combustion of tires as fuel in the kiln is expected to cause an increase in CO emissions. VOCs can be emitted as a result of unburned fuel or can be formed in the combustion process.

Combustion causes the formation of NOx emissions due to oxidation of nitrogen in the combustion air and in the fuel. VOC and NOx emissions are not expected to increase as a result of tire burning. In fact, NOx has been show to decrease significantly as a result of replacing a portion of the coal or coke fuel with tires.

SO_2 is formed as a result of the oxidation of sulfur in the fuel during the combustion process. Because tires have lower sulfur content than coal, SO_2 emissions are expected to decrease when a portion of the fuel is replaced with tires.

4.1 Carbon Monoxide

Holcim has estimated that kiln CO emissions will increase significantly as a result of tire burning. Holcim estimates that addition of tires to the fuel mix would increase potential kiln CO emissions from 121 to 310 tons per year. During the permit review process, Holcim increased the estimated CO emissions beyond the value presented in the original permit application. The Holcim permit application states: "Analysis of available CO test data from other facilities shows that when combusting tires, some facilities realize an increase in CO emissions while some facilities realize a decrease in CO emissions. However, more recent data from facilities with wet kilns indicates that tire combustion may result in a significant increase in CO emissions (ref. 1)."

Review of the literature and available source test data shows a mix of results and interpretations on the CO emissions issue. The data shows that combustion of TDF does not consistently lead to an increase in CO emissions, but combustion of whole tires can cause an increase in CO

emissions. Because Holcim is proposing combustion of whole tires, an estimated increase in CO emissions is appropriate. Holcim's baseline CO emission rate for the Trident kiln is 0.769 pounds per ton of clinker (lb/ton). The proposed allowable CO emission rate for the kiln is 1.461 lb/ton, which is equivalent to a concentration of 200 parts per million (ppm) in the stack gas. The AP-42 CO emission factor for wet process cement kilns is 0.12 lb/ton, based on a single source test result (ref. 6). The AP-42 emission factor has a rating of D, indicating that it is not a well-supported emission factor.

The estimated increase of 189 tons per year exceeds the Prevention of Significant Deterioration (PSD) significant increase level of 100 tpy. Therefore, the proposed tire-burning project is subject to PSD requirement for Best Available Control Technology (BACT) review. Holcim has submitted a top-down CO BACT analysis to meet the PSD requirements. DEQ has reviewed and approved the BACT analysis.

4.2 Sulfur Dioxide

No increase in sulfur dioxide emissions is projected from the tire-burning project. Studies have shown that sulfur oxide emissions are reduced as a result of burning tires in kilns (ref. 8). SO_2 emissions from cement kilns are generated from oxidation of sulfur compounds in the raw materials and from sulfur in the fuel. The alkaline nature of the cement provides for direct absorption of SO_2 into the product, thereby mitigating the quantity of SO_2 emissions in the exhaust stream. Depending on the process and the source of the sulfur, SO_2 absorption ranges from about 70 % to more than 95 % (ref. 6). Estimated SO_2 control efficiency for Holcim's Trident kiln is 87% (ref. 2).

The amount of SO_2 generated in the kiln is proportional to the SO_2 content of the fuel burned. Holcim has provided DEQ with sulfur content information for their coal and petroleum coke fuel sources (ref. 11). According to the analysis attached to Holcim's air quality pre-construction permit #0982-10, petroleum coke has a sulfur content of 5.3% by weight (ref. 2). Sulfur content of the coal delivered to the Holcim plant is generally less than 1% by weight (ref. 11). Sulfur content of tires ranges from 1 to 3 percent by weight (ref. 8). Holcim's SO_2 permit limit is 124 pounds per hour (lb/hr) and will not change as a result of the proposed action.

In the permit application (ref. 1), Holcim provided a review of the potential SO_2 emissions from a range of cement kilns. Emissions were broken down into categories, including dry kilns, wet kilns, kilns burning whole tires, kilns burning TDF with coal and coke as baseline fuels, and kilns burning TDF with coal as the baseline fuels. Overall, the kiln emissions showed an 18% reduction in SO_2 emissions due to substitution of 10-20% of the fuel with tires. SO_2 emissions from dry kilns showed an increase of 20%, while SO_2 emissions from wet kilns showed a decrease of 32%. Use of whole tires inserted at mid-kiln showed a 2% increase in SO_2 emissions, based on a very small number of test results (ref. 1).

4.3 Nitrogen Oxides

Substitution of tires and TDF for baseline fuels consistently causes a reduction in NOx emissions (ref. 8). Total NOx emissions for all the tests in the database showed lower NOx emissions on a production basis than the NOx allowed at Holcim. The data summarized in the air quality permit application shows that the NOx emissions were reduced by 23% for all kilns, and were reduced

in every category. The proposed permit would limit the allowable NOx emissions to 1350 lb/hr, on a 1-hour average basis. Holcim operates a NOx continuous emissions monitor and reports the hourly readings to DEQ.

4.4 Particulate Matter and ESP Efficiency

Particulate matter emissions from the Holcim kiln are controlled by an ESP and will not be affected by the tire-burning proposal. The air quality permit limits kiln particulate matter emissions to 0.77 lb/ton clinker (ref. 2). The source test data set showed that the PM_{10} emissions were reduced or unchanged by the use of tires for fuel (ref. 1).

An evaluation of Holcim's ESP efficiency is included in the EIS review for two reasons. The review must establish whether the particulate control equipment at Holcim is generally comparable to the control equipment for sources in the emissions inventory database. This is important because it helps determine whether the database is applicable to the Trident kiln. Second, the collection efficiency of the Trident kiln was evaluated to determine the validity of calculations included in the permit application materials. DEQ and Holcim have assumed an ESP collection efficiency of 99.4% (ref. 1). This value was used to estimate the amount of particulate HAPs, primarily metals, present in the CKD.

Holcim provided the following description of the ESP used on the Trident kiln:

> *Trident's Electrostatic Precipitator is a Wheelabrator-Frye unit and was installed in 1972. The precipitator is one chamber wide and two fields deep in the direction of gas flow, creating two individual collecting cells. Each individual collecting cell contains 79 collecting plates spaced 10" apart, creating 78 gas passages. Collecting plates that measure 30' tall and 14.5' wide, are formed by nine strip plates that are suspended from a common beam at the upper end and are stabilized by a shock bar at the lower end. These shock bars are individually struck by tumbling hammers during each cleaning cycle. Rigid discharge electrode grids are suspended in each gas passage and are cleaned by a lift-and-drop hammer system. The electrical energization for this unit is supplied through two Westinghouse Transformer /rectifier sets. Both units are rated at: 1 phase, 60 hertz, 480 primary volts, 267 primary amps, 45 kV, 2000 mA (communication from Holcim).*

The electrostatic precipitation process consists of three fundamental steps: (1) particle charging, (2) particle collection, and (3) removal of the collected dust from the collection plates. Once a particle is charged, it migrates toward the collection surface. An indicator of particle movement toward the collection electrode is called the particle migration velocity.

Specific collecting area (SCA) is a parameter used to compare ESPs and roughly estimate their collection efficiency. SCA is the total collector plate area divided by gas volume flow rate (ref. 9). The Holcim ESP has two fields in series. Gas from the kiln passes through the first field where it is cleaned. The gas from the first field is further cleaned in the second field before exiting the stack.

The total collection area for each field in the Holcim ESP is 67,860 square feet (ft^2), and the gas flow rate through the ESP is 170,265 actual cubic feet per minute (acfm). SCA for each field is equal to 398 ft^2/1000 acfm. According to EPA's ESP reference, an SCA of 400 ft^2/1000 acfm is a medium SCA value. Therefore, one field of the Holcim ESP provides a medium SCA. Use of two fields in series increases the SCA to 800 ft^2/1000 acfm, compared to a 'large' SCA value of 900 ft^2/1000 acfm. This SCA comparison indicates that the Holcim 2-field ESP is a medium to high efficiency ESP.

The Handbook of Air Pollution Control Engineering and Technology (ref. 10) provides typical migration velocities for various ESP applications. The listed migration velocity for a wet process cement kiln is 0.33 to 0.37 feet per second (fps). Efficiency of a precipitator under ideal conditions can be estimated using the Deutsch-Anderson Equation (ref. 10):

$$E = 1 - e^{(-wA/Q)}$$

Where: E = collection efficiency of the precipitator
A = the effective collecting plate area of the precipitator (ft^2)
Q = gas flow rate through the precipitator (acfs)
e = base of natural logarithm = 2.718
w = migration velocity (ft/s)

Based on the above equation, the efficiency of a single field of the Holcim ESP would be greater than 99.9%. This calculation does not account for the variables including re-entrainment and rapping. The use of two fields in series provides additional particulate removal.

Based on this rough analysis, it is clear that the Holcim ESP efficiency is comparable to other ESPs used in the cement industry. Particulate emission control, including particulate metals, is expected to be equivalent to the particulate control at the facilities from which the emission estimates were made. Holcim's assumption of 99.4% control efficiency for the ESP is found to be valid and appropriately conservative.

5. Hazardous and Toxic Air Pollutant Emissions Inventory

Combustion sources can emit trace amounts of HAPs including organic compounds and hazardous metals compounds. The HAPs can either be a portion of the unburned fuel or raw material, or can be generated during combustion. Holcim's baseline and cumulative emissions inventory identified and quantified HAPs that have a potential to increase as a result of the tire-burning project. Methodology used to develop the emission inventory was reviewed in Section 3 of this report. This section addresses emissions estimates for specific HAPs.

The EIS team has recommended that DEQ adjust the allowable emissions increases in the Holcim permit based on review of the additional information submitted in support of the EIS. The original proposed permit limits were based on the estimates of the incremental increase in emissions from tire burning and did not reflect a comparison of the baseline and cumulative emissions estimates.

The original emission estimates, and the baseline and cumulative emissions are shown in Table 2, Section 5.4. The baseline emissions inventory refers to the emissions from the cement kiln without tires as a fuel supplement. Baseline kiln fuels are coal and petroleum coke. The Trident kiln is permitted to burn natural gas, but Holcim has no plans to use natural gas fuel. Emissions of criteria and HAPs from natural gas would be lower than emissions from other fuels.

Baseline kiln emissions also include the emissions from kiln feed. The primary kiln feed is limestone from the Holcim quarry. There are no alternative sources of calcium for the kiln. Silica is needed for the cement process and is mined on-site. Holcim has the option to use post-consumer recycled glass for the silica source in the kiln. Baseline and cumulative kiln emissions include recycled glass emissions. During the EIS review, it came to light that Holcim uses smelter slag as a source of iron in the cement raw materials mix. No additional emissions or changed emissions have been identified as a result of slag use.

5.1 Incremental HAPs Increase from Burning Tires

The initial emissions inventory is reviewed here because it was used by DEQ to establish the allowable HAP emission rates in the draft air quality permit (ref. 2). The purpose of Holcim's original emission inventory was to determine worst-case potential impacts from the addition of tires to the kiln fuel stream. Holcim gathered emissions test data from cement kilns that used whole tires and TDF as part of the fuel stream. Emissions data were contained in at least one of the tests for 165 different compounds or groups of compounds. Of the compounds in the testing database, 65 were HAPs as defined in the list of HAPs identified in Section 112(b) of the federal Clean Air Act.

Each pollutant-specific potential increase was determined by identifying the emissions test with the greatest increase between the with-tire and without-tire cases. If the test results showed that the with-tire case was higher than the without-tire case, the difference was listed as positive. If the test results showed that the with-tire case was lower than the without-tire case, the difference was listed as negative.

Holcim initially reported only the emission rate change for each HAP but not the entire kiln emission. Holcim tabulated the emissions differences for the source tests that had data for both the baseline case and the cumulative case. They selected the highest increase and reported it as the maximum predicted increase of that pollutant. This approach is highly conservative and meets the needs of the air permitting requirements.

5.2 Expanded Emissions Inventory

Holcim produced both a baseline emission inventory and a cumulative emission inventory using the entire database. In this case, the data was not limited to source test reports containing both baseline and cumulative emissions for a particular pollutant. The baseline data for each HAP was evaluated to establish an appropriate baseline emission factor. Likewise, the cumulative (with tires) data for each HAP was evaluated to establish an appropriate cumulative emission factor. This approach resulted in a larger number of data points available for many of the HAPs.

Holcim is permitted to use recycled glass as a kiln feed and the glass emissions are included in the baseline and cumulative inventories. None of the database source tests are known to include recycled glass. The glass was accounted for by adding the estimated potentia1 emissions from glass to both inventories. When Holcim applied for the permit to allow the use of recycled glass, they completed a screening level risk assessment. Estimated HAPs emissions resulting from the glass were as follows:

Chromium (total), uncontrolled: 9.6 lb/yr
Chromium (total), controlled by ESP, 99.4% control: 0.0576 lb/yr
Di-n-Butylphthalate: 0.272 lb/yr
Butylbenzylphthalate: 0.053 lb/yr

5.3 Recommended Adjustments in Emissions Inventory

Emissions estimates for some of the pollutants were adjusted based on the emissions inventory review. Each emissions inventory change is discussed below.

Formaldehyde

Holcim used the database to estimate emissions of formaldehyde from the kiln with and without tire fuels. Four stack test results were available for the baseline inventory and five stack tests were available for the cumulative inventory. The original increase estimate showed a formaldehyde increase of 2.18 lb/hr or 9.55 tons per year (tpy). Comparison of the baseline and cumulative inventories, however, indicated a decrease in formaldehyde emissions of 4.74 lb/hr. This wide discrepancy in the formaldehyde emissions values triggered further review.

Examination of the database showed that the formaldehyde stack test results varied widely. Emissions from the four stack tests used to estimate the baseline emissions were 7.36, 0.026, 1.23, and 0.21 lb/hr. The value of 7.36 lb/hr appears to be an outlier and is not consistent with other data. Statistical evaluation of the baseline formaldehyde emissions data with the outlier removed showed that the 95% UCL value would be 1.24 lb/hr.

The data set for the cumulative emissions case ranged from 0.0054 lb/hr to 2.4 lb/hr, with a 95% UCL value of 1.56 lb/hr. The estimated increase due to burning tires is the difference between the cumulative and baseline emissions estimates, or 0.32 lb/hr.

Dioxin/Furan

Dioxin/furan limits are expressed as 2,3,7,8-tetrachlorodibenzo-p-dioxin equivalent (TCDD eq.). Table 2 includes dioxins/furans under the TCDD group heading. The TCDD eq. baseline value is based on Holcim's 2000 stack test, corrected from actual to maximum potential production using a ratio of the potential and actual production rates. The TCDD cumulative value assumes a 60% increase for tires, based on review of data. Dioxin/furan emissions estimates are included in the emissions inventory but are not carried forward into the risk assessment.

DEQ has determined that both the baseline and cumulative risk assessment analyses should be based on the PC-MACT regulatory dioxin/furan limit. Dioxin and furan emissions are regulated under the PC-MACT rules. PC-MACT sets the dioxin/furan emissions limit for all fuels at 0.2 ng/dscm toxicity equivalent quotient (TEQ) for temperatures above 400 degrees F (ref. 12). Using the maximum kiln production and projected kiln flow rate, the allowed dioxin/furan emissions are 7.66 E-09 g/sec TEQ at Trident (ref. 1).

Mercury

Data used by Holcim to develop the highest possible increase in emissions due to tire burning yielded a high mercury emissions increase estimate. The estimated maximum potential increase in mercury as a result of burning tires was estimated to be 1.02E-2 lb/hr or 89 lb/yr. Comparison of the baseline and cumulative emission inventories shows a lower potential increase. The comparison is shown in Table 2.

Using the database analysis, Holcim estimated that baseline mercury emissions would be 4.21E-2 lb/hr (369 lb/yr). The cumulative mercury emissions from the database were 1.42E-2 lb/hr (124 lb/year), a reduction of 245 lb/yr. This discrepancy in the emissions data indicated that further review of the mercury data was warranted.

The emissions database includes ten stack tests for both baseline and cumulative mercury emissions. The data set includes one test where the baseline mercury emissions were 1.31E-01 lb/hr, while the cumulative emissions were 6.99E-06 lb/hr. Both these values are outside the range of all other test data, and have been eliminated from the analysis. The statistical analysis has been repeated using only nine stack test results. The adjusted baseline 95% UCL emission rate is 1.16E-02 lb/hr (102 lb/yr) and the adjusted cumulative 95% UCL emission rate is 1.57E-02 lb/hr (137 lb/yr). The mercury increase from burning tires is estimated to be 35 lb/yr, which is a 34% increase over the adjusted baseline emission rate of 102 lb/yr.

The adjusted mercury increase of 34% is comparable to results found at other facilities. For example, the ATSDR study in Colorado (ref. 4) showed an increase of 29% mercury while burning 19.2% tires. The EIS review has resulted in a recommendation that DEQ change the allowable mercury increase in the permit from the current 89 lb/yr to 35 lb/yr.

Manganese

Holcim's original emissions increase estimate for manganese was 7.9E-02 lb/hr. The manganese emissions in the baseline and cumulative emissions inventories were 1.02E-02 lb/hr and 4.18E-02 lb/hr respectively. The difference between the baseline and cumulative emissions rates was 3.16E-02 lb/hr, which is equivalent to 277 lb/yr. The EIS review has resulted in a recommendation that DEQ change the allowable manganese increase in the permit from the current 691 lb/yr to 277 lb/yr.

Other Compounds

The EIS review resulted in the following recommended emission inventory changes for compounds that were present in one case but not the other.

- Acrolien, dimethyl phthalate: recommend using the baseline value for the cumulative value
- 4-nitrophenol: recommend using the cumulative value for the baseline value

5.4 Summary of HAPs Emission Estimates

The scoping comments included questions about the differences in emissions between cement kilns burning whole tires and TDF. The database used to estimate HAPs emissions included both TDF and whole tires as fuel. No differences in the emissions were noted between the two fuel types. Questions were also raised about the emissions differences between wet process cement kilns and dry process cement kilns. Holcim has addressed the differences in the permit application materials as they relate to criteria pollutants (ref. 1). No apparent differences were noted in the HAPs emissions database between the two kiln types.

Scoping comments indicated concerns about the age and condition of tires being burned in the kiln. In particular, there was a concern about tires containing pesticides, presumably from the tire piles being sprayed to control mosquitoes. It is not possible to isolate every variable while burning tires for fuel in cement kilns, but the breadth of the database provides some assurance that most variables are present. The database of kiln emissions tests spans more than a decade and includes tests from kilns in several states. It is expected that a wide range of tire ages and conditions were used in the source tests and any differences in emissions are reflected in the test results.

All of the HAPs emissions estimates have been compiled in Table 2 for comparison purposes. HAPs for which the source test results were below the detection limit are excluded from the table. Changes in the emissions inventory for formaldehyde, mercury etc., as discussed above, are included in Table 2.

The column titled "original" is Holcim's initial estimate of the emissions increase due to tire burning. The "baseline" and "cumulative" columns are the total kiln emissions. The values in the "difference" column are calculated by subtracting the baseline value from the cumulative value. A negative difference indicates that a decrease in emissions of that pollutant is predicted.

TABLE 2
Estimated Kiln HAP Emissions

Compound	Original lb/hr	Baseline lb/hr	Cumulative lb/hr	Difference lb/hr
Acetaldehyde	-4.09E-01	4.77E-01	6.79E-02	-4.09E-01
Acrolien		1.12E-02	1.12E-02	
Trichloroethene	2.78E-03	3.72E-04	3.15E-03	2.78E-03
Antimony	5.13E-06	3.43E-04	3.48E-04	5.13E-06
Arsenic	7.15E-05	5.79E-04	3.87E-04	-1.92E-04
Benzene	2.10E-01	1.05E-00	8.62E-01	-1.92E-01
Beryllium	8.17E-06	1.70E-04	1.28E-04	-4.23E-05
Bis (2-ethylhexyl)phthalate	1.17E-02	4.90E-02	6.07E-02	1.17E-02
Bromomethane (Methyl Bromide)	-1.66E-03	4.93E-03	3.27E-03	-1.66E-03
1,3 Butadiene/Butadiene	-2.29E-03	3.54E-03	9.11E-03	5.57E-03
2-Butanone (MEK)	-7.08E-05	1.02E-03	9.49E-04	-7.16E-05
Butylbenzylphthalate*		6.05E-05	6.05E-05	
Cadmium	5.01E-04	1.04E-03	4.02E-04	-6.36E-04
Carbon Disulfide	-1.12E-01	1.30E-01	1.83E-02	-1.12E-01
Carbon Tetrachloride		ND	3.82E-04	3.82E-04
Chlorine	1.24E-01	6.02E-01	7.25E-01	1.24E-01
Chlorobenzene	6.56E-04	7.75E-03	7.85E-03	1.02E-04
Chloromethane (Methyl chloride)	5.31E-03	4.97E-02	2.06E-02	-2.91E-02
Chromium (total)*	1.09E-05	1.51E-03	1.14E-03	-3.67E-04
Chromium 6	5.11E-05	2.76E-04	1.48E-04	-1.29E-04
Cobalt	-3.94E-04	8.47E-04	4.52E-04	-3.95E-04
Di-n-Butyphthalate*		1.53E-03	1.53E-03	
1,4 Dichlorobenzene	8.57E-03	1.53E-03	1.01E-02	8.55E-03
Dichloromethane	-2.71E-02	4.49E-02	3.10E-01	2.65E-01
Dimethyl Phthalate		2.13E-03	2.13E-03	
2,4-Dinitrophenol		1.15E-02	1.70E-03	-9.84E-03
Ethylbenzene	1.43E-01	2.22E-01	3.41E-01	1.19E-01
Chloroethane (ethyl chloride)		3.26E-03	ND	
Formaldehyde	2.18E-00	1.24E-00	1.56E-00	3.19E-01
Hydrogen chloride	5.98E-01	7.28E-01	7.66E-01	3.82E-02
Hydrogen fluoride	1.22E-02	2.24E-02	3.47E-02	1.22E-02
Lead	1.48E-02	1.45E-02	1.47E-02	2.41E-04
Manganese	7.89E-02	1.02E-02	4.18E-02	3.16E-02
Mercury	1.02E-02	1.16E-02	1.56E-02	4.05E-03
4-Methyl phenol	-1.41E-03	6.46E-03	5.04E-03	-1.42E-03
Methylene chloride	2.26E-01	4.18E-02	2.02E-01	1.60E-01
Naphthalene	1.85E-02	6.53E-02	5.26E-02	-1.27E-02
Nickel	1.84E-03	1.79E-03	2.27E-03	4.74E-04
Nitrobenzene	1.13E-04	1.54E-03	1.66E-03	1.12E-04
4-Nitrophenol		ND	3.28E-02	
Phenol	-3.85E-02	1.06E-01	6.76E-02	-3.86E-02
Phosphorus	9.05E-04	3.35E-03	4.26E-03	9.08E-04
Selenium	-3.97E-07	8.63E-03	5.37E-03	-3.26E-03
Styrene	2.68E-01	2.71E-01	5.39E-01	2.68E-01
1,1,1 Trichloroethane	7.22E-04	1.84E-04	1.46E-03	1.27E-03
Toluene	1.10E-00	1.32E-00	2.00E-00	6.78E-01
Vinyl chloride	8.41E-03	1.07E-02	1.91E-02	8.40E-03

Compound	Original lb/hr	Baseline lb/hr	Cumulative lb/hr	Difference lb/hr
Xylenes, total	7.50E-01	9.78E-01	1.59E-00	6.13E-01
Zinc	1.43E-02	5.45E-01	2.16E-01	-3.29E-01
TCDD Eq.	2.41E-07	8.46E-10	1.35E-09	5.08E-10
Total PCBs	1.84E-04	4.43E-04	4.17E-04	-2.58E-05
PAH- Total	1.89E-02	8.63E-02	6.41E-02	-2.23E-02
PAH-Non-carcinogenic totals	2.79E-04	2.09E-02	1.13E-02	-9.64E-03
PAH-Carcinogenic totals	1.87E-02	6.54E-02	5.28E-02	-1.26E-02

Note: ND indicates that the compound concentration was found to be lower than the detection limit of the test.

6.0 Air Dispersion Modeling Review

Holcim has submitted air dispersion modeling to predict the impacts of the proposed tire-burning project on ambient concentrations of criteria pollutants and HAPs. Holcim submitted the final modeling for tire combustion on May 10, 2004. The modeling memo for the revised modeling is included in Appendix D. Holcim provided DEQ with electronic modeling input and output files for use in the EIS review.

6.1 AERMOD Modeling System

Holcim's final modeling of the Trident plant was performed using EPA's AERMOD model. The following is a brief description of the AERMOD modeling system provided on EPA's website: "The AERMOD is actually a modeling system with three separate components: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD Terrain Preprocessor), and AERMET (AERMOD Meteorological Preprocessor). AERMOD includes a treatment of dispersion in the presence of intermediate and complex terrain that improves on that currently in use in ISCST and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS). To the extent practicable, the structure of the input or the control file for AERMOD is the same as that for the ISCST3. At this time, the AERMOD contains the same algorithms for building downwash as those found in the ISCST3 model. The AERMET is the meteorological preprocessor for the AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters. The AERMAP is a terrain preprocessor designed to simplify and standardize the input of terrain data for the AERMOD. Input data include receptor terrain elevation data. The terrain data may be in the form of digital terrain data that is available from the U.S. Geological Survey. Output includes, for each receptor, location and height scale, which are elevations used for the computation of air flow around hills (see www.epa.gov/ttn/scram)."

Holcim performed the final modeling using AERMOD version 03273, AERMET Version 03273 and AERMAP version 03107. EPA sets the version number for each model version based on the year and Julian day of issue. Montana DEQ has reviewed and approved Holcim's choice of models. DEQ and Holcim have agreed that additional revisions of the AERMOD modeling will not be required if EPA updates the AERMOD model during the EIS review process.

6.2 AERMET Meteorological Data Processing

The AERMET program creates the meteorological input file for AERMOD using cloud cover data, surface meteorological data and upper air data. National Weather Service (NWS) surface meteorological data can be substituted for on-site data in the event there are no on-site data to use. If the on-site profiles of wind or temperature are missing, AERMET uses NWS data to create the profile of wind and/or temperature. No surface temperature, wind direction or wind speed data were missing from the Holcim data set. AERMET used the Great Falls, Montana NWS surface data only for cloud cover values.

Upper air observations are made by the NWS using radiosonde technology. The closest upper air station to the Trident site is at the Great Falls airport. The radiosonde is a small, expendable instrument package that is suspended below a 6-foot (2-meter) wide balloon filled with hydrogen

or helium. As the radiosonde rises at about 1,000 feet/minute (300 meters/minute), sensors on the radiosonde measure profiles of pressure temperature and relative humidity. These sensors are linked to a battery powered radio transmitter that sends the sensor measurements to a ground receiver.

The AERMOD model requires hourly surface meteorological data parameters. Holcim's meteorological monitoring station was located on the Holcim property 1228 feet (374 meters) southwest of Holcim's cement kiln stack (ref. 1). DEQ has reviewed Holcim's meteorological station siting and data collection methods and has approved the meteorological data set for use in compliance modeling.

The meteorological sensors were located at the same elevation as the kiln exhaust. Elevation at the Holcim meteorological station was 4,132 feet above mean sea level (ft msl) and the height of the meteorological tower was 33 ft (10 meters). Elevation of the wind speed and wind direction sensors was therefore 4,165 ft msl. Elevation at the kiln stack base is 4,035 ft msl, and the kiln stack height is 130 ft, resulting in a kiln stack exhaust elevation of 4,165 ft msl (ref. 1).

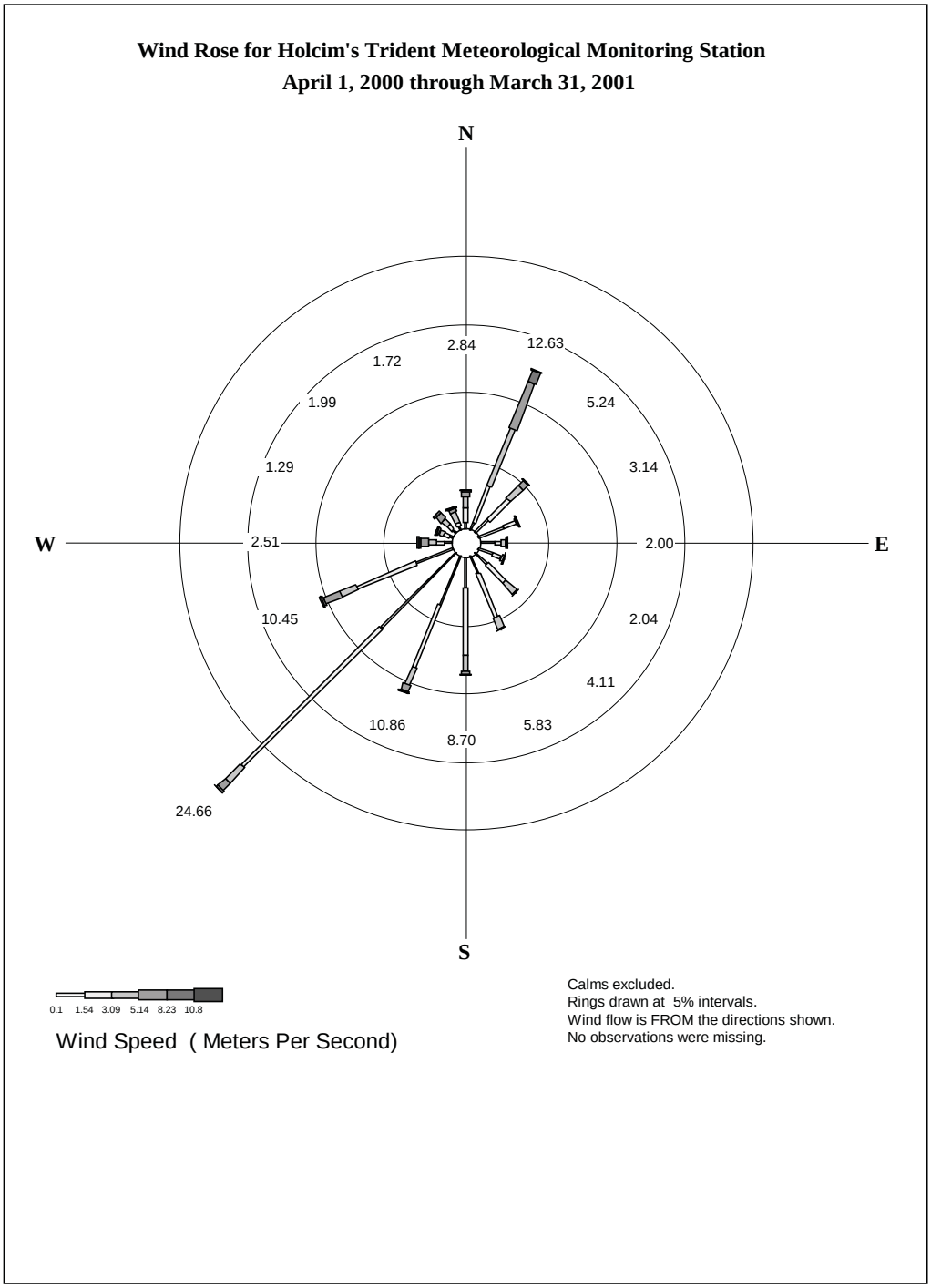
Bluffs along the west bank of the Missouri River across from the Holcim facility rise to elevations of nearly 4,500 ft msl. The hills east and southeast of the facility are also 4,500 ft or higher. Wind patterns recorded at Holcim's meteorological station show that this confining terrain causes the wind to follow the Missouri River in a southwest-northeast orientation. Figure 1 is a wind rose showing the monitored wind patterns at the Holcim location. The wind rose shows the frequency of winds from each of 16 cardinal directions (north, north-northeast, northeast, etc.). The length of each "petal" indicates the frequency of winds blowing from that direction. As described in the legend, the bands in the petals indicate the frequency of the listed wind speeds.

The wind rose for the Holcim site shows a strong southwest-northeast orientation of the wind pattern, as would be expected due to the topography of the monitoring site. As shown in Figure 1, 25% of the hourly average wind directions were from the southwest and 13% of the hourly average wind directions were from the north-northeast. The strongest (highest velocity) winds were from the north-northeast, as shown by the relatively large dark section at the end of the north-northeast petal of the wind rose. The dark section indicates wind speeds greater than 10.8 meters per second (m/s) or 24 miles per hour (mph).

6.3 Sources and Modeling Parameters

The air dispersion modeling protocol for the final modeling is described in detail in Holcim's modeling memo in Appendix D. Holcim modeled the kiln criteria pollutant and HAP emissions. They also modeled CKD fugitive dust sources including silo loading, silo unloading and the CKD monofill. The kiln is a point source with a vertical stack and a buoyant high-temperature plume. The CKD sources are fugitive dust sources released near ground level and at ambient temperature. Emissions from the CKD sources have little momentum and do not impact receptors far beyond the plant boundary. CKD emissions are particulate matter and may contain trace amounts of HAPs. Partitioning of HAPs into the CKD was described in detail in the permit application materials (ref. 1). The partitioning can be viewed in Section 6.4 of this report.

FIGURE 1
Wind Rose for Holcim's Trident Meteorological Monitoring Station



Source: Lorenzen Engineering, Inc.

Downwash caused by influences of buildings on the kiln plume were modeled using EPA procedures and software. Downwash results from wake effects as the plume encounters buildings and can result in higher pollutant concentrations in the building wake. AERMOD was run with EPA's regulatory default options.

Compliance with the ambient air quality standards requires that sources evaluate the impacts of other sources that could potentially affect the same area. Holcim's criteria pollutant compliance demonstration did not include modeling of other sources. As part of the EIS review, industrial sources located within 30 miles (50 km) of the Holcim plant have been identified and are listed in Table 3. EPA's facility emissions web site (see www.epa.gov/air) was used to identify emissions sources in Gallatin County. Neighboring Madison and Broadwater Counties each have one industrial emission source, both of which are located more than 50 km from the Holcim site.

TABLE 3
Gallatin County Industrial Emissions Sources

Facility Name	Location	Type of Source	Actual Emissions[1]	
Luzenac America	Sappington	Talc Processing Plant	CO – 0.94 tpy VOC – 0.19 tpy PM_{10} – 9.67 tpy	NOx – 3.23 tpy SO_2 – 0.15 tpy
Luzenac America	Three Forks	Talc Processing Plant	CO – 4.3 tpy VOC – 0.52 tpy PM_{10} – 32.2 tpy	NOx – 10.5 tpy SO_2 – 0.24 tpy
Montana State University	Bozeman	Central Heating Plant	CO – 0.51 tpy VOC – 0.88 tpy PM_{10} – 1.92 tpy	NOx – 20.0 tpy SO_2 – 0.09 tpy
JTL Group	Belgrade	Portable Aggregate Crushing and Screening Plant	CO – 42.5 tpy VOC – 19.8 tpy PM_{10} – 40.0 tpy	NOx – 3.12 tpy SO_2 – 24.4 tpy

(1) Reported emissions obtained from EPA's air data web site for the most recent available year, 1999.

Table 3 lists actual emissions reported to DEQ and ultimately to EPA. EPA maintains emissions data for reference years to allow comparison of source data. The most recent year of data available from EPA is 1999.

The EIS review concluded that there is no need to model the off-site sources because their emissions are not expected to measurably impact the Holcim peak impact receptors. Emissions from industrial emissions sources in Gallatin County are quite low and are not expected to impact the same terrain as the Holcim emissions. The primary source of emissions from talc processing and aggregate crushing is fugitive particulate matter. NOx and CO are generated from burning natural gas and/or diesel for heating.

6.4 Modeling Receptors

AERMOD uses receptors with location and elevation programmed into the modeling files. Location is denoted with Universal Transverse Mercator (UTM) coordinates. UTM coordinates are oriented north/south and east/west with coordinates in units of meters. Modeling receptors are typically placed in a grid pattern. Smaller grid spacing provides more refined modeling results, but requires a large amount of computer resources. Upon completion of initial modeling, it is customary to add a refined receptor grid at very close spacing around highest impact

receptors. Figures 2 and 3 are surface maps showing the modeling receptor grids. Holcim used the following modeling grids in their final modeling analysis:

- **Property Boundary Receptors**. Receptors located along the Holcim property boundary at a spacing of approximately 50 meters, shown in Figure 2.
- **Fine Receptor Grid**. Receptors extend at least 2.5 km in all directions from the cement plant at a spacing of 100 meters, shown in Figure 2.
- **5-km Grid**. Receptors extend from the fine receptor grid out to a distance of 5 km from the plant at a spacing of 250 meters. The inner edge of the 5-km grid is visible on Figure 2.
- **10-km Grid**. Receptors extend from the 5-km grid out to a distance of 10 km from the plant at a spacing of 500 meters.
- **Refined Grid**. Receptors surrounding the points of highest impact from the fine grid and boundary modeling. Spacing of the refined grids is 50 meters. The largest refined grid is located northwest of the kiln location along the Missouri River bank. A smaller refined grid is located on the northeast plant boundary. Refined receptors can be seen in Figure 2.
- **Expanded Grid**. Holcim has provided an expanded modeling grid extending 33 km west, 39 km east, 50 km south and 32 km north of the plant. The expanded grid has a spacing of 2,500 meters and is shown on Figure 3.

Figure 2 shows the terrain and receptors within approximately 3 km of the cement kiln stack. Location of the kiln stack is indicated on the figure. The surface map in Figure 2 was created using the receptor elevation data from the AERMOD input files. Figure 2 shows that there are no receptors located within the Holcim property boundary.

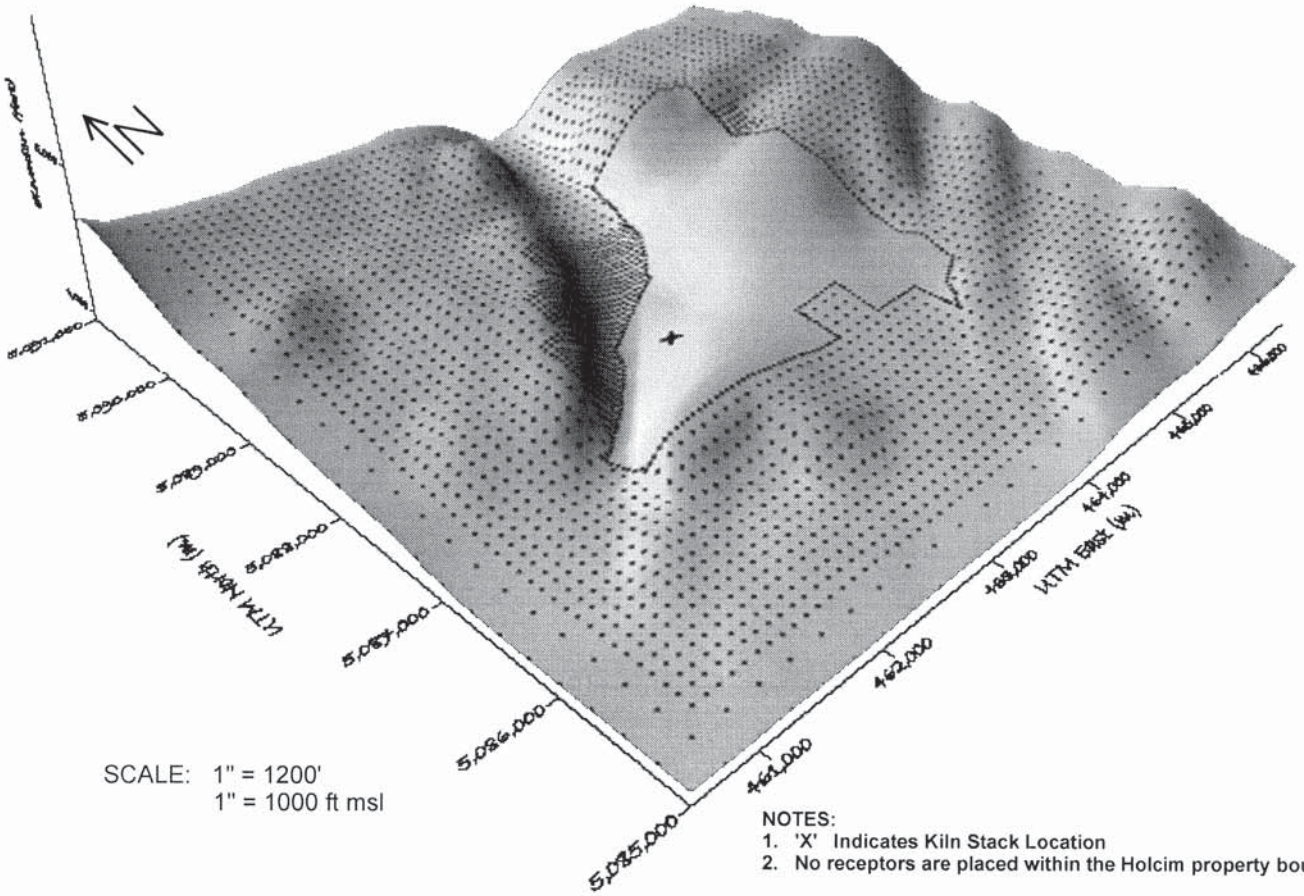
Figure 3 is a surface map of the entire expanded modeling domain. Approximate locations of towns and the Holcim site are shown for reference. Elevations for the surface map are the elevations used in the AERMOD modeling. The modeling receptor grid has been overlain onto the surface map to show the extent of the modeling.

During the EIS review, receptors were added along the Madison, Jefferson and Gallatin Rivers upstream of Trident and along the Missouri River downstream of Trident. DEQ's risk assessment contractor used the concentrations at the river receptors to calculate aquatic impacts for the risk assessment. Results at various river receptors are shown on Figure 2-2 of the risk assessment report (ref. 3).

6.5 Summary of Modeling Results

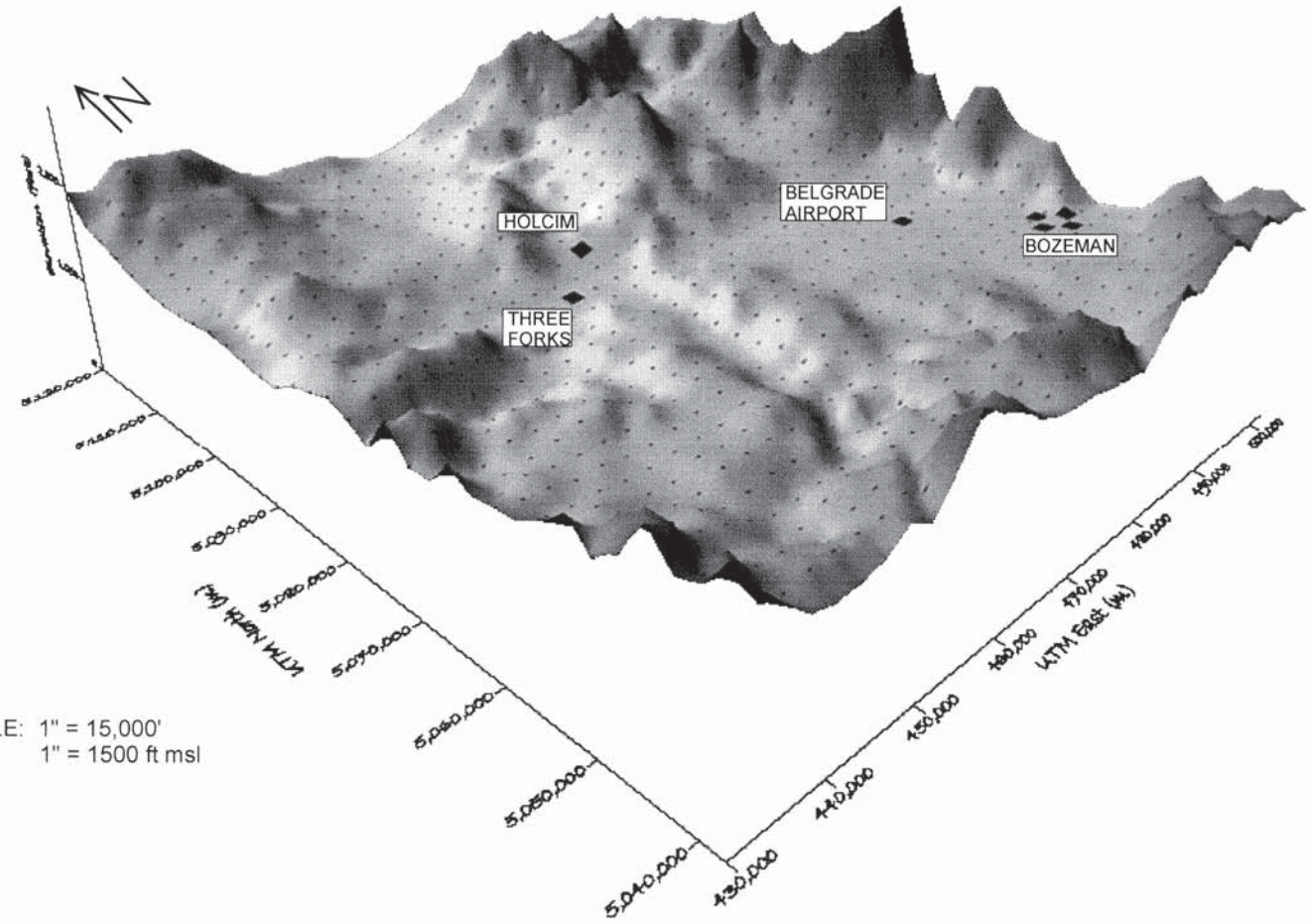
Modeling results for criteria pollutant impacts were not changed by any of the findings of the EIS review. Holcim demonstrated compliance with all ambient standards. Results of their modeling are summarized in Appendix D. The EIS review did not result in changes to any criteria pollutant emission rates or modeling parameters. Therefore the criteria pollutant modeling results are unchanged. Peak modeled impacts of criteria pollutants occur at or near the Holcim property boundary. Modeled impacts drop off with distance from the source, so compliance only needs to be demonstrated at the point of peak impact.

FIGURE 2
Fine Receptor Grid and Boundary Receptors
Overlain on Terrain Surface



NOTES:
1. 'X' Indicates Kiln Stack Location
2. No receptors are placed within the Holcim property boundary.

FIGURE 3
Expanded Modeling Terrain
and Receptor Grid



SCALE: 1" = 15,000'
1" = 1500 ft msl

HAPs modeling results are more complex than the criteria pollutant results. The risk assessment required concentration information at a variety of receptor locations in addition to the point of highest impact. The scoping comments showed that there is interest in knowing the HAP pollutant impacts at population centers such as Bozeman.

Ambient concentrations of pollutants emitted from both the kiln and the CKD sources were modeled in separate modeling runs for each pollutant to determine peak impacts. Ambient concentrations of pollutants emitted only from the kiln were determined from a single model run using only the kiln source. Kiln emissions were modeled to develop a dispersion coefficient for each modeling receptor. The dispersion coefficient is a ratio of the ambient concentration and the emission rate. It is denoted by X/Q and expressed in units of micrograms per cubic meter per gram per second [($\mu g/m^3$)/(g/s)].

Figure 4 shows annual average concentration isopleths and Figure 5 shows 1-hour average concentration isopleths. The isopleths represent lines of equal concentration or equal dispersion coefficient. The figures are graphic representations of the ambient concentrations resulting from modeling an emission rate of 1.0 gram per second (g/s) from the kiln over the extended modeling domain. Modeling results from a single source will follow the same pattern for every pollutant.

The isopleths in Figure 4 illustrate how annual average impacts decrease from a peak X/Q of 0.29 ($\mu g/m^3$)/(g/s) at the boundary of the facility to less than 0.001 ($\mu g/m^3$)/(g/s) at receptors in Belgrade and Bozeman. The annual impact pattern closely resembles the pattern from the wind rose. The X/Q value is used as shown in the following example:

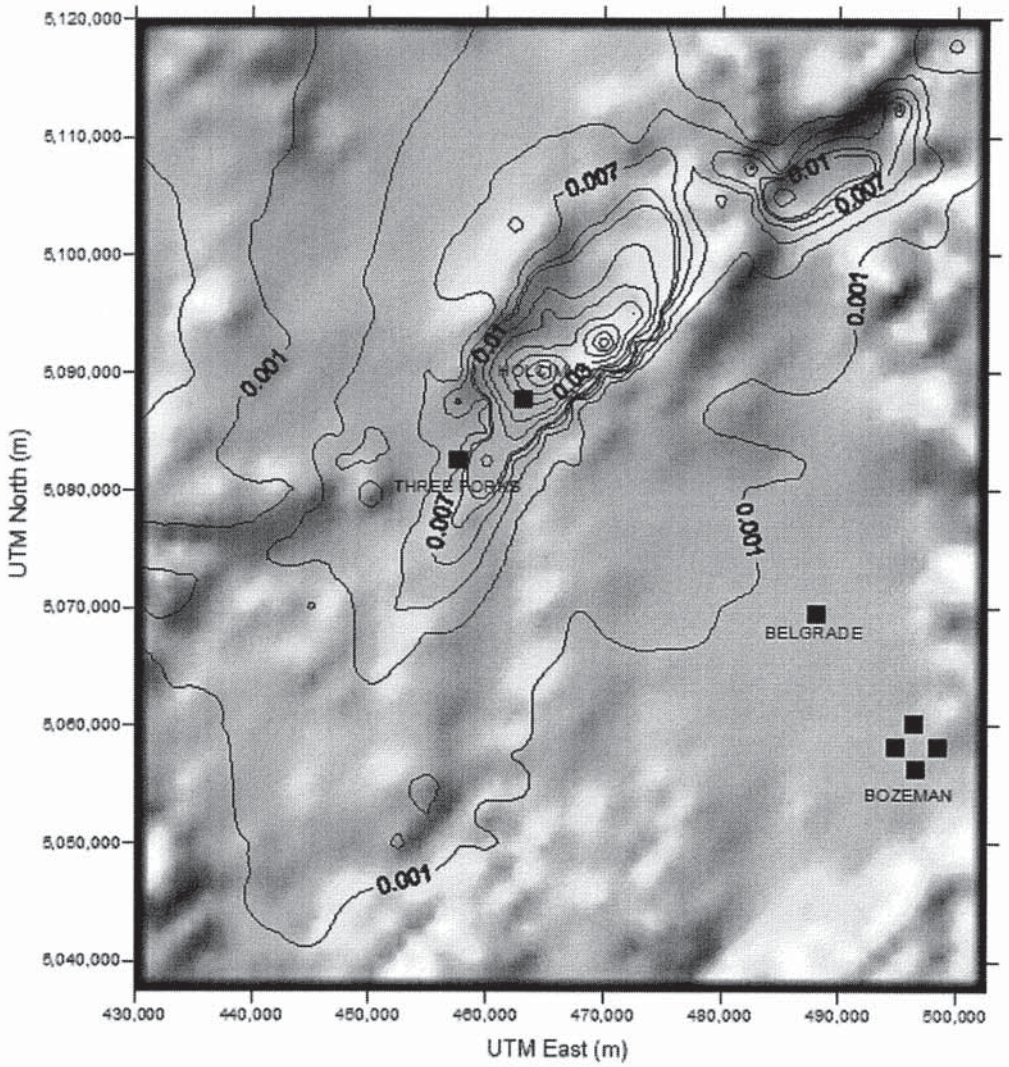
Cumulative mercury emission rate: 1.97E-03 g/s
Annual X/Q at Bozeman: 0.0005 ($\mu g/m^3$)/(g/s)
Annual Mercury Impact at Bozeman:
1.97E-03 g/s * 0.0005 ($\mu g/m^3$)/(g/s) = 9.85E-07 $\mu g/m^3$
Peak Annual X/Q at Plant Boundary: 0.29 ($\mu g/m^3$)/(g/s)
Peak Annual Mercury Impact at Plant Boundary:
1.97E-03 g/s * 0.29 ($\mu g/m^3$)/(g/s) = 5.71E-04 $\mu g/m^3$

Figure 5 shows the peak 1-hour impacts at each receptor over the period of a year. Peak 1-hour impacts occur when the wind is blowing toward the impacted receptor. Therefore the pattern of the isopleths in Figure 5 is more rounded and does not closely match the pattern of the wind rose. The difference between peak 1-hour impacts at the plant boundary and at distance receptors is not as great as for the annual averaging period. Impacts decrease from a peak X/Q of 17.92 ($\mu g/m^3$)/(g/s) at the boundary of the facility to 0.11 ($\mu g/m^3$)/(g/s) at receptors in Bozeman.

Expanded terrain modeling does not include impacts from CKD dust sources. Fugitive dust sources have low buoyancy and impact receptors in the immediate vicinity of the plant. Impacts of these sources on distant receptors would be negligible and they were excluded from the expanded terrain modeling to limit model run time.

N

FIGURE 4
Annual Average Dispersion Coefficients
Overlain on Shaded Relief

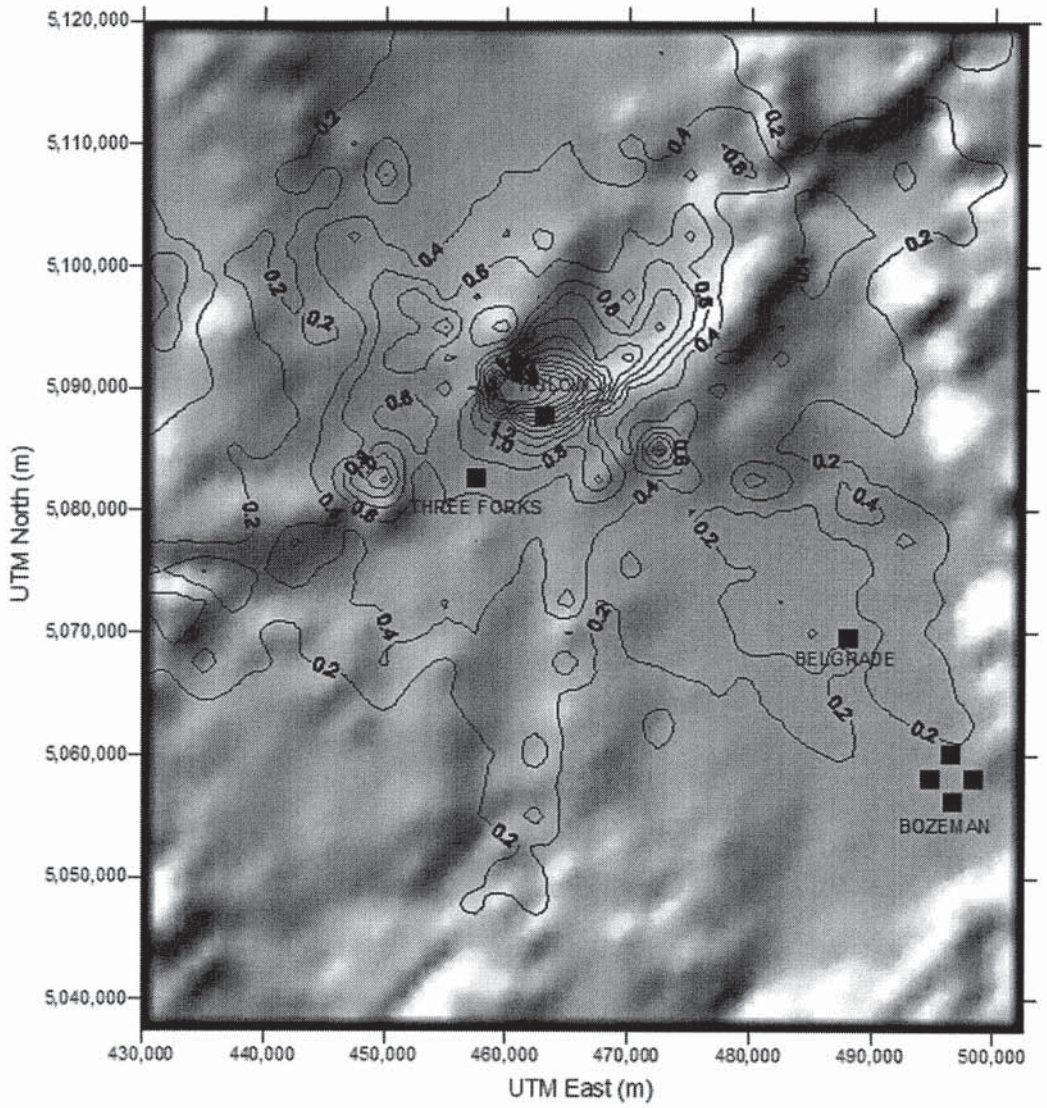


SCALE: 1" = 13,750'

NOTES:
1. Isopleths are lines of equal concentration.
2. Peak annual dispersion coefficient near boundary is 0.29 (ug/m3)/(g/s).
3. Annual average dispersion coefficient at Bozeman is 0.0005 (ug/m3)/(g/s).

N

FIGURE 5
Peak 1-hour Average Dispersion Coefficients
Overlain on Shaded Relief



SCALE: 1" = 13,750'

NOTES:
1. Isopleths are lines of equal concentration.
2. Peak 1-hour dispersion coefficient near boundary is 17.92 (ug/m3)/(g/s).
3. Peak 1-hour dispersion coefficient at Bozeman is 0.11 (ug/m3)/(g/s).

Table 4: Peak Model Results

Modeling Results at Peak Receptor
(ug/m³)/(g/s)
Annual 0.29355
1-hour 17.91829

Compound	425 Base	Cumulative	Particulate	Upset Multiplier	Amount to CKD (g/s)		Amount to Kiln (g/s)		Annual Peak (ug/m3)		Upset Mult.	1-hour Peak (ug/m3)	
	g/s	g/s	%	Annual Only	Baseline	Cumulative	Baseline	Cumulative	Baseline	Cumulative	Kiln (1-hr)	Baseline	Cumulative
Acetaldehyde	6.01E-02	8.55E-03	0%	1.00	0.00E+00	0.00E+00	6.01E-02	8.55E-03	1.76E-02	2.51E-03	1	1.08E+00	1.53E-01
Acrolein	1.41E-03	1.41E-03	0%	1.00	0.00E+00	0.00E+00	1.41E-03	1.41E-03	4.15E-04	4.15E-04	1	2.53E-02	2.53E-02
Trichloroethene	4.68E-05	3.97E-04	0%	1.00	0.00E+00	0.00E+00	4.68E-05	3.97E-04	1.37E-05	1.16E-04	1	8.38E-04	7.11E-03
Antimony	4.32E-05	4.38E-05	100%	2.54	7.20E-03	7.31E-03	1.10E-04	1.12E-04	3.34E-05	3.41E-05	83.8	6.49E-02	6.59E-02
Arsenic	7.29E-05	4.67E-05	100%	2.54	1.22E-02	8.12E-03	1.85E-04	1.24E-04	5.97E-05	3.82E-05	83.8	1.10E-01	7.32E-02
Benzene	1.33E-01	1.09E-01	0%	1.00	0.00E+00	0.00E+00	1.33E-01	1.09E-01	3.90E-02	3.19E-02	1	2.38E+00	1.95E+00
Beryllium	2.15E-05	1.61E-05	100%	2.54	3.58E-03	2.69E-03	5.46E-05	4.10E-05	1.68E-05	1.26E-05	83.8	3.22E-02	2.42E-02
Bis (2-ethylhexyl)phthalate	6.18E-03	7.65E-03	0%	1.00	0.00E+00	0.00E+00	6.18E-03	7.65E-03	1.81E-03	2.25E-03	1	1.11E-01	1.37E-01
Bromomethane (Methyl Bromide)	6.21E-04	4.12E-04	0%	1.00	0.00E+00	0.00E+00	6.21E-04	4.12E-04	1.82E-04	1.21E-04	1	1.11E-02	7.39E-03
1,3 Butadiene/Butadiene	4.46E-04	1.15E-03	0%	1.00	0.00E+00	0.00E+00	4.46E-04	1.15E-03	1.31E-04	3.37E-04	1	8.00E-03	2.06E-02
2-Butanone (MEK)	1.29E-04	1.20E-04	0%	1.00	0.00E+00	0.00E+00	1.29E-04	1.20E-04	3.77E-05	3.51E-05	1	2.30E-03	2.14E-03
Butylbenzylphthalate*	7.62E-06	7.62E-06	0%	1.00	0.00E+00	0.00E+00	7.62E-06	7.62E-06	2.24E-06	2.24E-06	1	1.37E-04	1.37E-04
Cadmium	1.31E-04	5.07E-05	100%	2.54	2.18E-02	8.44E-03	3.33E-04	1.29E-04	1.03E-04	3.97E-05	83.8	1.97E-01	7.61E-02
Carbon Disulfide	1.64E-02	2.31E-03	0%	1.00	0.00E+00	0.00E+00	1.64E-02	2.31E-03	4.82E-03	6.78E-04	1	2.94E-01	4.14E-02
Carbon Tetrachloride	4.82E-05	4.82E-05	0%	1.00	0.00E+00	0.00E+00	4.82E-05	4.82E-05	1.41E-05	1.41E-05	1	8.63E-04	8.63E-04
Chlorine	7.58E-02	9.14E-02	0%	1.00	0.00E+00	0.00E+00	7.58E-02	9.14E-02	2.23E-02	2.68E-02	1	1.36E+00	1.64E+00
Chlorobenzene	9.76E-04	9.89E-04	0%	1.00	0.00E+00	0.00E+00	9.76E-04	9.89E-04	2.87E-04	2.90E-04	1	1.75E-02	1.77E-02
Chloromethane (Methyl chloride)	6.27E-03	2.60E-03	0%	1.00	0.00E+00	0.00E+00	6.27E-03	2.60E-03	1.84E-03	7.62E-04	1	1.12E-01	4.65E-02
Chromium (total)*	1.90E-04	1.44E-04	100%	2.54	3.17E-02	2.40E-02	4.83E-04	3.66E-04	1.49E-04	1.13E-04	83.8	2.85E-01	2.16E-01
Chromium 6	3.46E-05	1.86E-05	100%	2.54	5.81E-03	3.10E-03	8.86E-05	4.73E-05	2.73E-05	1.46E-05	83.8	5.23E-02	2.80E-02
Cobalt	1.07E-04	5.70E-05	100%	2.54	1.76E-02	9.50E-03	2.71E-04	1.45E-04	8.35E-05	4.47E-05	83.8	1.60E-01	8.56E-02
Di-n-Butyphthalate*	1.93E-04	1.93E-04	0%	1.00	0.00E+00	0.00E+00	1.93E-04	1.93E-04	5.67E-05	5.67E-05	1	3.46E-03	3.46E-03
1,4 Dichlorobenzene	1.93E-04	1.27E-03	0%	1.00	0.00E+00	0.00E+00	1.93E-04	1.27E-03	5.68E-05	3.73E-04	1	3.45E-03	2.26E-02
Dichloromethane	5.66E-03	3.91E-02	0%	1.00	0.00E+00	0.00E+00	5.66E-03	3.91E-02	1.66E-03	1.15E-02	1	1.01E-01	7.00E-01
Dimethyl Phthalate	2.68E-04	2.68E-04	0%	1.00	0.00E+00	0.00E+00	2.68E-04	2.68E-04	7.86E-05	7.86E-05	1	4.80E-03	4.80E-03
2,4-Dinitrophenol	1.45E-03	2.14E-04	0%	1.00	0.00E+00	0.00E+00	1.45E-03	2.14E-04	4.27E-04	6.29E-05	1	2.60E-02	3.84E-03
Ethylbenzene	2.80E-02	4.30E-02	0%	1.00	0.00E+00	0.00E+00	2.80E-02	4.30E-02	8.21E-03	1.26E-02	1	5.01E-01	7.71E-01
Chloroethane (ethyl chloride)	4.11E-04	4.11E-04	0%	1.00	0.00E+00	0.00E+00	4.11E-04	4.11E-04	1.21E-04	1.21E-04	1	7.36E-03	7.36E-03
Formaldehyde	1.56E-01	1.96E-01	0%	1.00	0.00E+00	0.00E+00	1.56E-01	1.96E-01	4.58E-02	5.76E-02	1	2.80E+00	3.52E+00
Hydrogen chloride	9.16E-02	9.66E-02	5%	1.08	9.66E-02	1.02E-01	9.66E-02	1.04E-01	2.90E-02	3.05E-02	5.14	8.45E+00	8.89E+00
Hydrogen fluoride	2.83E-03	4.37E-03	5%	1.08	2.98E-03	4.60E-03	3.06E-03	4.70E-03	8.96E-04	1.38E-03	5.14	2.60E-01	4.02E-01
Lead	1.82E-03	1.85E-03	100%	2.54	3.04E-01	3.09E-01	4.64E-03	4.71E-03	1.43E-03	1.45E-03	83.8	2.74E+00	2.78E+00
Manganese	1.29E-03	5.27E-03	100%	2.54	2.14E-01	8.78E-01	3.27E-03	1.34E-02	1.01E-03	4.13E-03	83.8	1.93E+00	7.92E+00
Mercury	1.46E-03	1.97E-03	5%	1.08	1.54E-03	2.07E-03	1.57E-03	2.12E-03	4.61E-04	6.23E-04	5.14	1.34E-01	1.81E-01
4-Methyl phenol	8.14E-04	8.35E-04	0%	1.00	0.00E+00	0.00E+00	8.14E-04	8.35E-04	2.39E-04	2.56E-04	1	1.48E-02	1.14E-02
Methylene chloride	5.27E-03	2.54E-02	0%	1.00	0.00E+00	0.00E+00	5.27E-03	2.54E-02	1.55E-03	7.47E-03	1	9.43E-02	4.58E-01
Naphthalene	8.23E-03	6.63E-03	0%	1.00	0.00E+00	0.00E+00	8.23E-03	6.63E-03	2.42E-03	1.95E-03	1	1.48E-01	1.19E-01
Nickel	2.26E-04	2.86E-04	100%	2.54	3.77E-02	4.76E-02	5.75E-04	7.27E-04	1.77E-04	2.24E-04	83.8	3.40E-01	4.29E-01
Nitrobenzene	1.95E-04	2.09E-04	0%	1.00	0.00E+00	0.00E+00	1.95E-04	2.09E-04	5.71E-05	6.13E-05	1	3.49E-03	3.74E-03
4-Nitrophenol	4.13E-03	4.13E-03	0%	1.00	0.00E+00	0.00E+00	4.13E-03	4.13E-03	1.21E-03	1.21E-03	1	7.40E-02	7.40E-02
Phenol	1.34E-02	8.51E-03	0%	1.00	0.00E+00	0.00E+00	1.34E-02	8.51E-03	3.93E-03	2.50E-03	1	2.40E-01	1.53E-01
Phosphorus	4.22E-04	5.37E-04	100%	2.54	7.04E-02	8.95E-02	1.07E-03	1.37E-03	3.30E-04	4.22E-04	83.8	6.35E-01	8.06E-01
Selenium	1.09E-03	6.77E-04	100%	2.54	1.81E-01	1.13E-01	2.77E-03	1.72E-03	8.53E-04	5.30E-04	83.8	1.63E+00	1.02E+00
Styrene	3.41E-02	6.79E-02	0%	1.00	0.00E+00	0.00E+00	3.41E-02	6.79E-02	1.00E-02	1.99E-02	1	6.12E-01	1.22E+00
1,1,1 Trichloroethane	2.32E-05	1.84E-04	0%	1.00	0.00E+00	0.00E+00	2.32E-05	1.84E-04	6.82E-06	5.40E-05	1	4.16E-04	3.29E-03
Toluene	1.66E-01	2.52E-01	0%	1.00	0.00E+00	0.00E+00	1.66E-01	2.52E-01	4.86E-02	7.38E-02	1	2.98E+00	4.51E+00
Vinyl chloride	1.35E-03	2.41E-03	0%	1.00	0.00E+00	0.00E+00	1.35E-03	2.41E-03	3.96E-04	7.07E-04	1	2.42E-02	4.31E-02
Xylenes, total	1.23E-01	2.01E-01	0%	1.00	0.00E+00	0.00E+00	1.23E-01	2.01E-01	3.62E-02	5.89E-02	1	2.21E+00	3.59E+00
Zinc	6.87E-02	2.72E-02	100%	2.54	1.14E+01	4.54E+00	1.75E-01	6.93E-02	5.39E-02	2.13E-02	84	1.03E+02	4.09E+01
TCDD Eq.	7.66E-09	7.66E-09	20%	1.31	9.56E-09	9.56E-09	1.00E-08	1.00E-08	2.94E-09	2.94E-09	17.6	2.41E-08	2.41E-08
Total PCBs	5.58E-05	5.26E-05	0%	1.00	0.00E+00	0.00E+00	5.58E-05	5.26E-05	1.64E-05	1.54E-05	1	1.00E-03	9.42E-04
PAH- Total	1.09E-02	8.07E-03	0%	1.00	0.00E+00	0.00E+00	1.09E-02	8.07E-03	3.19E-03	2.37E-03	1	1.95E-01	1.45E-01
PAH-Non-carcinogenic totals	1.09E-02	8.05E-03	0%	1.00	0.00E+00	0.00E+00	1.09E-02	8.05E-03	3.19E-03	2.36E-03	1	1.95E-01	1.44E-01
PAH-Carcinogenic totals	6.38E-06	1.80E-05	0%	1.00	0.00E+00	0.00E+00	6.38E-06	1.80E-05	1.87E-06	5.28E-06	1	1.14E-04	3.22E-04

7. Conclusions and Recommendations

This Technical Analysis Report summarized activities performed as part of the EIS air quality review process. The review process began with a data adequacy review and reading of public scoping comments related to air quality. Additional information has been added to the technical analysis and will be included in the EIS to respond to concerns raised during public scoping. DEQ has requested that Holcim provide additional emissions inventory and modeling information to provide adequate data for the EIS process.

Holcim provided the additional information and analyses that DEQ requested, all of which is included as appendices to this report. The technical analysis included evaluation of Holcim's emission inventory methodology and results. The methodology used to develop emission factors from the source test database was found to be consistent with EPA practices. The criteria pollutant emissions inventory was found to be adequate for EIS review and no additional information was requested.

The emissions inventory review identified a number of HAPs emissions estimates that needed reevaluation, as described in this report. Changes in the levels of formaldehyde to be used in the risk assessment were recommended. The review also identified limits in the draft air quality permit that needed to be reevaluated. The permit contains limits for the additional amounts of the following pollutants as a result of tire burning: cadmium, hexavalent chromium, lead, arsenic, beryllium, manganese, mercury and PAHs. Recommendations were made for changing the permit limits for mercury and manganese.

Review of the modeling protocol showed that the choice of model, meteorological data and source parameters were appropriate. Public comments have indicated that expansion of the modeling domain would provide useful information. DEQ requested that Holcim review the modeling to expand the modeling domain. Because the AERMOD version for previous modeling was no longer available, Holcim updated the modeling using the most current version of the model. Modeling results have been reviewed and found to be appropriate. The results have been presented graphically in this report to help clarify the modeling process.

Appendix A: Baseline Emissions Inventory

(Attached document, titled "Baseline Emissions Analysis for Combustion of Permitted Solid Fuels", was originally submitted by Holcim to DEQ on April 30, 2004.)

Holcim Trident Plant

Baseline Emissions Analysis for Combustion of Permitted Solid Fuels
April 30, 2004

Background:

On behalf on Holcim (US) Inc. (Holcim), Bison Engineering, Inc. (Bison) has prepared an analysis of baseline air emissions from the Trident plant while burning currently permitted solid fuels. This analysis provides information to support an Environmental Impact Statement (EIS) being prepared by the Montana Department of Environmental Quality (MDEQ). The EIS is being prepared in conjunction with a proposed air quality permit to allow combustion of tires as fuel in the Holcim Trident Cement Kiln. Holcim previously provided an analysis of cumulative emissions for the Trident kiln while combusting a combination of tires and permitted solid fuels.

This analysis utilizes the initially submitted database of source testing data compiled for the air permit application for combusting tires as a fuel. Instead of focusing on the incremental emission changes projected to result from the addition of tires to the current fuel mix as required by MCA 75-2-215 and ARM 17.8.770, this analysis uses the database to project the baseline emissions considering currently permitted solid fuels at Trident. Two baseline emission cases are projected: representative actual emissions and maximum allowable emissions.

The database contains emission data from cement plants across the country that have been tested for specific pollutants of concern before and after combusting tires as a fuel. As outlined in the Compilation of Air Permit Application Submittals for Tires Combustion (compilation document, submitted to the DEQ on January 22, 2004) (see Appendix 4, Table 3-3), data from ten cement plants were compiled in the database and used to project a worst-case estimate of the change in emissions (from the addition of tires to the permitted fuel mix) for the human health risk analysis. Emission data was compiled for 77 compounds of potential concern; this data set primarily focused on available emissions data for the hazardous air pollutants (HAPs) designated by the Federal Clean Air Act. The database was used to conservatively project the incremental emission change due to tire combustion.

Methodology:

The methodology used in projecting baseline emissions from the Trident kiln is similar to that used in the air permit application. As explained in the compilation document, Section 7.3, emissions data before and after combusting tires was converted into pounds per million Btu (lbs/MMBtu) based on heat input to that cement kiln. The original analysis for the air permit application evaluated the difference between

emissions values (in lbs/MMBtu) before and after tires combustion and scaled this emissions change to the Trident kiln based on its maximum heat input at full production.

For this baseline analysis, the emissions before tire combustion in lbs/MMBtu are similarly scaled to Trident based on heat input to the kiln. Two cases are addressed: representative actual emissions and maximum allowable emissions. Representative actual emissions are scaled based on the 1999-2000 average clinker production level of 315,754 tons/year (this value can be found in the compilation document in Section 3.1.1). The years 1999-2000 were selected to be consistent with the air permit application and because they are representative of Holcim's recent operations.

To determine maximum allowable emissions, the amount of clinker production allowed by Trident's current air quality permit (425,000 tons/year) is used to scale the emissions to the Trident kiln. In both cases, the clinker production level is converted to kiln heat input as described in Appendix 4, Section 3.2 of the compilation document.

A spreadsheet for each case is presented that calculates emissions data in both tons/year and gram/second (g/sec) units for each emissions test. Data for each pollutant are then entered into summary spreadsheets for further analysis.

The "summary total spreadsheet" lists all evaluated pollutants in the database, presents the average and maximum data point for each pollutant, and provides the individual data points calculated from each emission test.

The "HAPs Summary spreadsheet" lists all of the evaluated HAPs, the source test data from individual emissions tests, and average and maximum data points (and the statistical information for each data set).

Included in the "polycyclic aromatic hydrocarbons (PAHs) spreadsheet" are the PAH compound data from each emissions test and a "grouping" of compounds based on carcinogenicity.

HAPs Summary:

"The HAPs Summary spreadsheet" lists the evaluated HAP pollutants alphabetically along with their CAS#. For each pollutant, the average and high point for the baseline emissions data set is presented along with the count of data points in the data set. The data set average and standard deviation are used in a t-distribution (sometimes called a student t-distribution) to predict the 95% upper confidence limit (UCL) for that pollutant.

The HAPs Summary spreadsheet uses the following equation to calculate the 95% UCL:

95% UCL = Data set average + t-statistic(standard deviation)/(sample count)$^{0.5}$

Where: t-statistic is for a one tailed test at $t_{0.95}$.

Once the 95% UCL is calculated, the value to be used in the dispersion modeling/risk assessment analyses is the 95% UCL, or if the 95% UCL exceeds the maximum data point, the highest data point in the set is used.

The baseline emissions for dioxins and furans is copied from Appendix 14 in the compilation document. This value reflects the PC-MACT emissions limit for the Trident kiln, which applies regardless of the fuels being combusted in the kiln.

PAHs:

The "PAHs spreadsheet" sums the appropriate compounds for those designated as carcinogens and those contributing to non-cancer hazard. For purposes of emissions factor development, EPA has identified 16 PAH compounds for measurement; seven are designated as carcinogens and the remaining nine contribute to non-cancer hazard. The baseline emissions spreadsheet follows this approach by summing the following PAH compounds for determination of cancer risk and non-cancer hazard:

Cancer risk: Benz(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene.

Non-cancer hazard: Naphthalene, Acenaphthene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene.

Because compound specific toxicity data was available, naphthalene was separated out from the non-cancer PAHs and addressed as a separate compound for risk assessment analyses.

The PAHs spreadsheet sums the carcinogenic and non-cancer compounds for further analysis in the HAPs summary spreadsheet.

Comparison with Emissions Test Data:

An additional spreadsheet comparing actual emissions test data for key pollutants of concern from the Trident kiln to the projected baseline emissions numbers for those pollutants is also presented. This spreadsheet facilitates direct comparison of actual measured values from the Trident kiln stack to the database projections. Results provide confidence that database projections are conservative for use in health risk and environmental analyses.

Summary:

The baseline emissions spreadsheet evaluates emissions data for non-criteria pollutants from ten cement plants, and analyzes that data for use in predicting baseline emissions of non-criteria pollutants from the Trident kiln when combusting currently permitted fuels. Two baseline cases are evaluated (representative actual production,

and maximum allowable production). Similar to the approach used in the air quality permit application, the estimated baseline emissions are conservatively predicted by using the maximum data point or, where appropriate, the 95% UCL from the baseline emissions database. Actual emissions test data for select pollutants of concern is also presented to demonstrate the conservatism built into these analyses.

Helena (US) Inc.
Tilghman Plant: Tires to Fuel Project
HAP Emissions Study
Sensitive PTE Emissions Analysis - HAPs Summary

Note: ND = Not detected

Cas#	Pollutant	Sensitive Average (g/mm)	Sensitive High Point (g/mm)	Count	Average (g/mm)	Standard Deviation	1-Sided	MDL Lower Confidence Limit (LCL)	Value Used 95% LCL or Maximum High Point (g/mm)	Hancock, Clarksville, MO (g/mm)	Salt Creek Center, OH (g/mm)	Hammondsville Facility, MA (1994, TSD) (g/mm)	Sunoco, Middletown, CT (g/mm)	Lamar Partners Power Company, Grand Haven, MI (g/mm)	VPG PMC Lincoln, Dunkirk, OH (g/mm)	Southwestern, Hacienda, CA (g/mm)	Chalmette Refining Chalmette, LA (g/mm)	Wheelabrator, Lancaster Hazley, CA (g/mm)	VPG PMC Lincoln, Tamaqua, CA (g/mm)	HMT Dunlap @ 1.0 % TDF (g/mm)	HMT Dunlap @ 1.0 % TDF (g/mm)	Hammondsville Facility, MA (1994, TSD) (g/mm)
75-07-0	Acetaldehyde	4.07E-02	8.01E-02	1	6.01E-02				6.01E-02								8.01E-02	ND				
107-02-8	Acrolein	1.41E-02	1.41E-02	1	1.41E-02				1.41E-02								1.41E-02					
75-07-0	Trichloromethane	4.00E-03	4.00E-03	1	4.00E-03				4.00E-03								4.00E-03					
Compound	Antimony	2.00E-05	4.32E-05	3	2.86E-05	3.46E-05	2.00	5.99E-05	4.32E-05				ND				ND	1.07E-05		4.32E-05	4.32E-05	
Compound	Arsenic	3.00E-05	5.00E-05	3	3.00E-05	4.00E-05	2.01	7.20E-05	7.20E-05		ND	ND			4.00E-05	2.70E-05	ND	3.00E-05	2.70E-05	4.00E-05	5.00E-05	ND
71-43-2	Benzene	6.00E-03	3.61E-01	3	6.00E-03	6.00E-03	1.00	1.20E-01	1.20E-01			6.10E-03	3.61E-01	3.60E-02	7.00E-03	4.00E-03	4.00E-02	ND	4.20E-02			4.10E-03
100-44-7	Benzyl chloride	ND	ND	0													ND					
Compound	Beryllium	1.21E-06	3.00E-06	6	1.21E-06	0.00E-00	2.00	2.10E-06	2.10E-06	ND			ND		2.00E-06	2.00E-06	ND	3.04E-07	ND	1.77E-06	1.77E-06	
111-44-4	Bis (2-chloroethyl) ether	ND	ND	0								ND										ND
117-81-7	Bis (2-ethylhexyl)phthalate	6.10E-06	6.10E-03	3	6.10E-06	0.00E+00	6.34	6.10E-06	6.10E-06			6.10E-06										6.10E-06
75-25-2	Bromoform	ND	ND	0								ND										ND
74-83-9	Bromomethane (Methyl Bromide)	6.21E-04	6.21E-04	3	6.21E-04	0.00E+00	6.34	6.21E-04	6.21E-04			6.21E-04					ND					6.21E-04
106-99-0	1,3 Butadiene/Butadiene	4.40E-04	4.40E-04	3	4.40E-04	0.00E+00	6.34	4.40E-04	4.40E-04			4.40E-04	ND				ND					4.40E-04
78-93-3	2-Butanone (MEK)	1.20E-04	1.20E-04	3	1.20E-04	0.00E+00	6.34	1.20E-04	1.20E-04			1.20E-04										1.20E-04
Compound	Cadmium	6.07E-06	3.00E-04	11	6.07E-06	7.30E-06	1.01	1.31E-05	1.31E-05		7.00E-06	6.10E-06	ND	6.07E-06	1.00E-04	3.00E-04	4.07E-06	4.00E-06	6.07E-06	1.90E-04	1.90E-04	6.10E-06
75-15-0	Carbon Disulfide	1.04E-02	1.04E-02	2	1.04E-02	0.00E+00	6.34	1.04E-02	1.04E-02			1.04E-02										1.04E-02
56-23-5	Carbon Tetrachloride	ND	ND	0								ND					ND					ND
7782-50-5	Chlorine	7.00E-03	7.00E-03	1	7.00E-03				7.00E-03				7.00E-03									
108-90-7	Chlorobenzene	5.10E-04	1.00E-03	4	5.10E-04	3.30E-04	2.30	8.70E-04	8.70E-04			2.00E-04					5.10E-04		1.00E-03			4.04E-04
67-66-3	Chloroform	ND	ND	0								ND					ND		ND			ND
74-87-3	Chloromethane (Methyl chloride)	4.00E-03	6.27E-03	3	4.00E-03	2.07E-03	2.00	5.24E-03	6.27E-03			6.27E-03		1.12E-03			ND					6.27E-03
Compound	Chromium (total)	1.00E-04	3.70E-04	10	1.00E-04	0.10E-04	1.00	1.00E-04	1.00E-04	ND	1.00E-04	2.00E-04	2.70E-04	ND	8.27E-05	6.00E-05	2.00E-05	2.21E-05	1.40E-04	1.40E-04		1.00E-04
Compound	Cobalt	1.10E-05	4.12E-05	4	1.10E-05	1.07E-05	2.00	2.40E-05	2.40E-05						4.00E-07		4.12E-05	2.07E-05	2.70E-05			
Compound	Cobalt	3.00E-05	1.07E-04	2	6.00E-05	1.43E-05	6.34	1.00E-04	1.07E-04						9.00E-06				1.07E-04			
106-93-4	1,2 Dibromoethane (EDB)	ND	ND	0								ND										ND
84-74-2	Di-n-Butylphthalate	1.00E-04	1.00E-04	3	1.00E-04	0.00E+00	6.34	1.00E-04	1.00E-04			1.00E-04										1.00E-04
106-46-7	1,4 Dichlorobenzene	1.00E-04	1.00E-04	1	1.00E-04				1.00E-04			ND					1.00E-04					ND
91-94-1	3,3-Dichlorobenzidine	ND	ND	0								ND										ND
107-06-2	1,2 Dichloroethane (EDC)	ND	ND	0								ND							ND			ND
75-09-2	Dichloromethane	5.00E-03	5.00E-03	2	5.00E-03	0.00E+00	6.34	5.00E-03	5.00E-03			5.00E-03										5.00E-03
78-87-5	1,2-Dichloropropane	ND	ND	0								ND					ND					
542-75-6	1,3 Dichloropropene	ND	ND	0								ND										ND
121-14-2	Dinitrotoluene	2.00E-04	2.00E-04	2	2.00E-04	0.00E+00	6.34	2.00E-04	2.00E-04			2.00E-04										2.00E-04
51-28-5	2,4-Dinitrophenol	1.40E-03	1.40E-03	2	1.40E-03	0.00E+00	6.34	1.40E-03	1.40E-03			1.40E-03										1.40E-03
121-14-2	2,4-Dinitrotoluene	ND	ND	0								ND										ND
106-47-8	Dioxin/furans	3.00E-03	3.00E-03	4	3.00E-03	1.01E-03	2.00	2.00E-03	3.00E-03			1.12E-03	3.20E-03				3.00E-04					1.12E-03
75-00-3	Chloroethane (ethyl chloride)	4.11E-04	4.11E-04	2	4.11E-04	0.00E+00	6.34	4.11E-04	4.11E-04			4.11E-04					ND					4.11E-04
50-00-0	Formaldehyde	2.70E-01	3.20E-01	4	2.70E-01	4.20E-01	2.03	7.84E-01	7.84E-01						2.20E-01	3.20E-01	1.00E-01	ND	2.00E-03			
110-54-3	Hexane(n-hexane)	ND	ND	0								ND										ND
87-68-3	Hexachlorobutadiene	ND	ND	0								ND					ND					ND
77-47-4	Hexachlorocyclopentadiene	ND	ND	0								ND										ND
67-72-1	Hexachloroethane	ND	ND	0								ND										ND
7647-01-0	Hydrogen chloride	6.30E-02	1.00E-01	9	6.30E-02	4.00E-02	2.13	8.10E-02	8.10E-02				ND				3.00E-02	2.00E-02	1.00E-01	2.00E-02	6.00E-02	
7664-39-3	Hydrogen fluoride	2.00E-03	2.00E-03	1	2.00E-03				2.00E-03								2.00E-03					
78-59-1	Isophorone	ND	ND	0								ND										ND
Compound	Lead	1.30E-03	2.00E-03	11	1.20E-03	1.10E-03	1.01	1.90E-03	1.90E-03	1.70E-03	ND	1.47E-03	ND	1.01E-03	8.00E-04	6.70E-04	3.10E-04	3.40E-03	8.00E-04	2.00E-03	2.00E-03	1.47E-03
Compound	Manganese	3.04E-04	7.01E-03	3	6.04E-04	3.20E-04	1.00	1.30E-03	1.30E-03				7.00E-04		1.40E-03	2.90E-04	3.40E-04	1.90E-03	9.20E-04	1.01E-03	1.01E-03	
Compound	Mercury	3.37E-05	1.00E-07	10	3.37E-05	0.00E+00	1.00	3.31E-05	3.31E-05	4.27E-04			2.30E-04	1.00E-05	1.00E-02	1.00E-04	9.00E-04	8.00E-05	3.40E-05	3.00E-04	6.20E-04	
108-10-1	4-Methyl-2-Pentanone (MIBK)	ND	ND	0								ND										ND
108-44-0	4-Methyl phenol	6.14E-04	6.14E-04	3	6.14E-04	0.00E+00	6.34	6.14E-04	6.14E-04			6.14E-04										6.14E-04
75-09-2	Methylene chloride	3.00E-03	6.00E-03	6	3.00E-03	3.00E-03	2.13	5.37E-03	5.37E-03			6.00E-03	3.00E-03	2.10E-03					6.00E-03			3.00E-03
91-20-3	Naphthalene	5.00E-03	9.40E-03	7	5.00E-03	4.30E-03	1.03	8.20E-03	9.20E-03		8.00E-04	9.40E-03	7.00E-03				5.00E-03	7.14E-03	9.00E-04			9.40E-03
Compound	Nickel	1.32E-04	3.04E-04	5	1.32E-04	1.10E-04	1.00	2.30E-04	2.30E-04	ND			3.04E-04	1.00E-04	8.00E-04	4.40E-05	1.00E-04	1.31E-05	6.20E-05	1.07E-04	1.07E-04	
98-95-3	Nitrobenzene	1.00E-04	1.00E-04	3	1.00E-04	0.00E+00	6.34	1.00E-04	1.00E-04			1.00E-04										1.00E-04
100-02-7	4-Nitrophenol	ND	ND	0								ND										ND
88-75-5	2-Nitrophenol	ND	ND	0								ND										ND
121-14-2	Nitrosomorpholine	ND	ND	0								ND										ND
87-86-5	Pentachlorophenol	ND	ND	0								ND										ND
127-18-4	Perchloroethylene	ND	ND	0															ND			
108-95-2	Phenol	1.34E-02	1.34E-02	3	1.34E-02	0.00E+00	6.34	1.34E-02	1.34E-02			1.34E-02										1.34E-02
Compound	Phosphorus	4.22E-04	4.22E-04	1	4.22E-04				4.22E-04						ND		4.22E-04					
Compound	Selenium	5.70E-04	1.30E-03	9	5.70E-04	6.30E-04	2.01	1.60E-03	1.60E-03				ND	1.30E-03	1.00E-03	1.70E-03	ND	1.90E-07	ND	8.07E-04	8.07E-04	
108-42-6	Styrene	1.10E-02	2.41E-02	3	1.10E-02	1.20E-02	2.00	4.40E-02	2.41E-02			2.00E-04	2.41E-02				ND					4.00E-04
79-34-5	1,1,2,2 Tetrachloroethane	ND	ND	0								ND					ND					ND
120-82-1	1,2,4-Trichlorobenzene	ND	ND	0								ND					ND					ND
71-55-6	1,1,1 Trichloroethane	3.30E-03	3.30E-03	3	3.30E-03	0.00E+00	6.34	3.30E-03	3.30E-03			3.30E-03					ND		ND			3.30E-03
79-00-5	1,1,2 Trichloroethane	ND	ND	0								ND					ND					ND
79-01-6	Trichloroethylene	ND	ND	0															ND			
95-95-4	2,4,5-Trichlorophenol	ND	ND	0								ND										ND
88-06-2	2,4,6-Trichlorophenol	ND	ND	0								ND										ND
108-88-3	Toluene	6.70E-03	3.01E-01	8	6.70E-03	1.10E-01	2.13	1.00E-01	1.00E-01			1.01E-03	2.01E-01	6.11E-03			7.03E-03					7.51E-03
108-05-4	Vinyl acetate	ND	ND	0								ND										ND
75-01-4	Vinyl chloride	1.00E-04	1.30E-03	3	7.03E-04	6.07E-04	2.00	1.60E-03	1.30E-03			4.70E-04					ND		1.30E-03			4.70E-04
1330-20-7	Xylenes, total	6.47E-03	1.40E-01	4	4.47E-03	6.00E-03	2.00	1.20E-01	1.20E-01			1.40E-01	1.40E-01				1.04E-03					1.40E-03
Compound	Zinc	3.10E-03	1.04E-01	12	3.10E-03	7.00E-03	1.70	5.07E-03	5.07E-03	2.04E-03	6.31E-04	1.04E-01	6.31E-04		7.03E-04	1.00E-03	6.10E-04	4.00E-04	6.30E-04	2.70E-03	2.70E-03	1.04E-01
1746-01-6	TCDD Eq *	7.00E-09	7.00E-09	0					7.00E-09													
1336-36-3	Total PCBs	1.00E-06	8.00E-06	3	1.00E-06	3.10E-06	2.00	7.30E-06	8.00E-06						7.00E-07		9.00E-06		1.00E-06			
	PAH-Non-carcinogenic totals	1.22E-03	4.00E-03	7	1.22E-03	1.00E-03	1.03	2.04E-03	2.04E-03		6.04E-05	4.00E-03	ND		1.00E-04	2.00E-04	ND	1.70E-05	6.00E-04			4.04E-05
	PAH-Carcinogenic totals	1.70E-04	6.30E-04	5	3.37E-04	3.00E-04	1.00	7.00E-04	3.30E-04			ND	ND		8.01E-07	1.30E-04		7.77E-05	8.00E-05			ND

* TCDD Eq. is the optimized PB-MACT Unit

#	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	Pollutant	Projected Average	Projected High Point	Holnam-Clarksville, MO	Ash Grove-Durkee, OR	Holnam/Ideal-Seattle, WA (14% TDF)	Boxcrow-Midlothian, TX	Lehigh Portland Cement Company-Union Bridge, MD	1990 RMC Lonestar-Davenport, CA	Southwestern-Victorville, CA	California Portland-Colton, CA	Mitsubishi-Lucerne Valley, CA	1992 RMC Lonestar-Davenport, CA	1997 Dundee @ 15 % TDF	1997 Dundee @ 21 % TDF	Holnam/Ideal-Seattle, WA (11% TDF)
10	Dibenz(a,h)anthracene*	5.07E-06	1.01E-05			ND			1.01E-05	ND		2.42E-06	ND			ND
11	Dibenzofuran	1.09E-03	1.86E-03		8.47E-05	1.86E-03										1.33E-03
12	Dichlorobenzene	ND	ND										ND			ND
13	Dichloromethane	2.07E-02	3.91E-02			2.24E-03										3.91E-02
14	Dimethyl Phthalate	ND	ND			ND										ND
15	Di-N-Butylphthalate	ND	ND			ND										ND
16	Ethyl Toluene	8.33E-02	8.33E-02				8.33E-02									
17	Ethylbenzene	1.33E-02	5.12E-02			7.85E-04	5.12E-02				9.90E-04					9.76E-06
18	Ethylmethylbenzene	ND	ND				ND									ND
19	Fluoranthene	9.75E-06	2.77E-04			2.60E-04			4.48E-06	4.61E-06		1.27E-06	7.00E-06			2.77E-04
20	Fluorene	9.96E-06	1.86E-04			1.96E-04	ND				ND	1.50E-06	3.63E-06			1.95E-04
21	Formaldehyde	7.34E-02	3.02E-01						4.21E-02	5.75E-04	2.00E-02	2.22E-03	3.02E-01			
22	Hexachlorobenzene	ND	ND			ND										ND
23	Hexachlorobutadiene	ND	ND			ND					ND					ND
24	Hexachlorocyclopentadiene	ND	ND			ND										ND
25	Hexachloroethane	ND	ND			ND										ND
26	Hydrogen Chloride	6.66E-02	1.06E-01				ND				7.83E-02	1.83E-02	1.05E-01	6.17E-02	6.92E-02	
27	Hydrogen fluoride	4.37E-03	4.37E-03								4.37E-03					
28	Indeno(1,2,3-cd)pyrene*	1.14E-06	3.39E-06			ND			3.39E-06	3.52E-06		2.42E-06	ND			ND
29	Iron	8.83E-03	1.69E-02		2.90E-03		4.08E-03		1.26E-02				1.89E-02			
30	Isophorone	ND	ND			ND										ND
31	Lead	1.18E-03	3.96E-03	1.33E-03	ND	1.03E-03	ND	3.66E-03	4.36E-04	4.69E-06	1.88E-04	1.20E-06	6.20E-04	1.76E-03	2.72E-03	1.09E-03
32	Limonene	ND	ND				ND									
33	Magnesium	3.84E-03	6.39E-03						1.30E-03				6.39E-03			
34	Manganese	2.21E-03	1.36E-02				7.10E-04		8.04E-04	2.66E-04	3.75E-04	2.94E-06	4.95E-04	1.55E-03	1.35E-02	
35	Mercury	1.01E-03	4.52E-03	4.33E-04			1.77E-04	9.68E-04	8.81E-07	1.40E-03	1.62E-03	3.26E-06	4.52E-03	4.99E-04	6.22E-04	
36	Methyl Indene	9.94E-02	9.94E-02				9.94E-02									
37	Methylene Chloride	9.75E-01	3.91E-02			2.24E-03	4.88E-03	1.10E-03					1.48E-03			3.91E-02
38	Methylstyrene	6.21E-04	6.21E-04				6.21E-04									
39	Molybdenum	1.04E-04	1.76E-04						3.17E-06				1.76E-04			
40	Naphthalene	3.92E-03	1.03E-02		2.19E-04	4.42E-03	1.03E-02				6.10E-03	6.71E-06	1.40E-03			4.97E-03
41	Nickel	1.74E-04	5.71E-04		ND		2.66E-04	2.26E-04	5.71E-04	1.52E-06	5.46E-06	2.06E-06	5.76E-06	1.26E-04	2.46E-04	
42	Nitrobenzene	2.09E-04	2.09E-04			2.09E-04										ND
43	N-Nitrosodiphenylamine	ND	ND			ND										ND
44	NOX	5.56E+01	5.56E+01	5.56E+01												
45	PAH	6.86E-06	2.06E-05						2.06E-05	4.86E-06	ND	6.02E-07	1.19E-05			
46	Particulate Matter	1.29E+00	1.80E+00	6.64E-01										1.22E+00	1.80E+00	
47	Pentachlorophenol	ND	ND			ND										ND
48	Pentadiene	3.79E-02	3.79E-02				3.79E-02									
49	Perchloroethylene	ND	ND										ND			
50	Phenanthrene	5.55E-04	1.38E-03		8.47E-05	1.38E-03	ND					9.33E-06	2.36E-05			1.32E-03
51	Phenol	6.49E-03	8.51E-03			8.51E-03										4.47E-03
52	Phosphorous	5.37E-04	5.37E-04						ND		5.37E-04					
53	Pyrene	9.56E-05	1.98E-04			1.86E-04						4.54E-07	2.09E-05			1.98E-04
54	Selenium	3.39E-04	9.89E-04				ND	9.89E-04	7.54E-06	8.68E-06	ND	7.36E-07	ND	4.07E-04	6.22E-04	
55	Silicon	8.38E-02	1.61E-01						6.22E-03				1.61E-01			
56	Styrene	2.27E-02	6.79E-02			8.92E-05	6.79E-02				ND					4.62E-05
57	Sulfur Dioxide	5.86E+01	5.86E+01	5.86E+01												
58	Thallium	1.41E-05	1.41E-05				1.41E-05									
59	Titanium	3.95E-04	6.17E-04						1.74E-04				6.17E-04	ND		
60	Toluene	8.27E-02	3.98E-01			1.31E-03	3.98E-01	6.74E-03			8.77E-03					5.06E-04
61	Total Hydrocarbons	1.62E+01	1.62E+01	1.62E+01												
62	Trichlorobenzene	ND	ND										ND			
63	Trichloroethylene	ND	ND										ND			
64	Vanadium	2.81E-05	5.52E-05		ND		ND		1.07E-06				5.52E-05			
65	Vinyl Acetate	ND	ND			ND										ND
66	Vinyl Chloride	1.36E-03	2.41E-03			ND					3.09E-04		2.41E-03			ND
67	Xylenes, Total	8.14E-02	2.39E-01			2.56E-03	2.39E-01				4.31E-03					5.51E-04
68	Zinc	1.23E-02	8.98E-02	2.41E-03	9.07E-04	3.03E-02	6.21E-04		2.06E-04	1.40E-03	1.71E-03	8.37E-05	1.06E-03	2.96E-03	5.92E-03	9.99E-02
69	Zirconium	1.71E-06	1.71E-06						1.71E-06				ND			
70	TCDD Eq.*	7.66E-09	7.66E-09													
71	Total PCBs	2.85E-06	5.26E-05						2.39E-05		5.26E-05		3.06E-06			
72	PAH-Non-carcinogenic totals	6.62E-04	2.19E-03		8.47E-05	2.19E-03	ND		1.64E-05	1.29E-04	ND	1.62E-05	4.21E-05			2.16E-03
73	PAH-Carcinogenic totals	6.86E-06	2.06E-05			ND	ND		2.06E-05	4.86E-06		5.34E-07	1.18E-05			ND
74	* TCDD Eq. is the calculated PC-MACT Limit															

Appendix B: Cumulative Emissions Inventory

(Attached document, titled "Cumulative Emissions Analysis for Combustion of Tires and Permitted Solid Fuels", was originally submitted by Holcim to DEQ on March 3, 2004.)

Holcim Trident Plant

Cumulative Emissions Analysis for Combustion of Tires and Permitted Solid Fuels

Background:

On behalf on Holcim (US) Inc. (Holcim), Bison Engineering, Inc. (Bison) has prepared an analysis of cumulative air emissions from the Trident plant while burning tires as fuel in conjunction with currently permitted solid fuels.

This analysis further utilizes the initially submitted database of source testing data compiled for the air permit application for combusting tires as a fuel. Instead of focusing on the incremental emission changes projected to result from the addition of tires to the current fuel mix, this analysis uses the database to conservatively project the cumulative emissions considering both tires and currently permitted solid fuels at Trident.

The database contains emission data from cement plants across the country that have been tested for specific pollutants of concern before and after combusting tires as a fuel. As outlined in the Compilation of Air Permit Application Submittals for Tires Combustion (compilation document, submitted to the DEQ on January 22, 2004) (see Appendix 4, Table 3-3), data from ten cement plants were compiled in the database and used to project a worst-case estimate of the change in emissions (from the addition of tires to the permitted fuel mix) for the human health risk analysis. Emission data was compiled for 77 compounds of potential concern; this data set primarily focused on available emissions data for the hazardous air pollutants (HAPs) designated by the Federal Clean Air Act. The database was used to conservatively project the incremental emission change due to tire combustion.

Methodology:

The methodology used in projecting cumulative emissions from the Trident kiln is similar to that used in the air permit application. As explained in the compilation document, Section 7.3, emissions data before and after combusting tires was converted into pounds per million Btu (lbs/MMBtu) based on heat input to that cement kiln. The original analysis for the air permit application evaluated the difference between emissions values (in lbs/MMBtu) before and after tires combustion and scaled this emissions change to the Trident kiln based on its maximum heat input at full production.

For this cumulative analysis, the emissions after tire combustion in lbs/MMBtu were similarly scaled to Trident based on maximum heat input to the kiln. This data was presented in both tons/year and gram/second (g/sec) units for each emissions test. Data for each pollutant were then entered into summary spreadsheets for further analysis.

The "summary total spreadsheet" lists all evaluated pollutants in the database, presents the average and maximum data point for each pollutant, and provides the individual data points calculated from each emission test.

The "HAPs Summary spreadsheet" lists all of the evaluated HAPs, the source test data from individual emissions tests, and average and maximum data points (and the statistical information for each data set).

Included in the "polycyclic aromatic hydrocarbons (PAHs) spreadsheet" are the PAH compound data from each emissions test and a "grouping" of compounds based on carcinogenicity.

HAPs Summary:

"The HAPs Summary spreadsheet" lists the evaluated HAP pollutants alphabetically along with their CAS#. For each pollutant, the average and high point for the cumulative emissions data set is presented along with the count of data points in the data set. The data set average and standard deviation are used in a t-distribution (sometimes called a student t-distribution) to predict the 95% upper confidence limit (UCL) for that pollutant.

The HAPs Summary spreadsheet uses the following equation to calculate the 95% UCL:

95% UCL = Data set average + t-statistic(standard deviation)/(sample count)$^{0.5}$
Where: t-statistic is for a one tailed test at $t_{0.95}$.

Once the 95% UCL is calculated, the value to be used in the dispersion modeling/risk assessment analyses is the 95% UCL, or if the 95% UCL exceeds the maximum data point, the highest data point in the set is used.

The cumulative emissions for dioxins and furans is copied from Appendix 14 in the compilation document. This value reflects the PC-MACT emissions limit for the Trident kiln, which applies regardless of the fuels being combusted in the kiln.

PAHs:

The "PAHs spreadsheet" sums the appropriate compounds for those designated as carcinogens and those contributing to non-cancer hazard. For purposes of emissions factor development, EPA has identified 16 PAH compounds for measurement; seven are designated as carcinogens and the remaining nine contribute to non-cancer hazard. The cumulative emissions spreadsheet follows this approach by summing the following PAH compounds for determination of cancer risk and non-cancer hazard:

Cancer risk: *Benz(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene.*

Non-cancer hazard: *Naphthalene, Acenaphthene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene.*

Because compound specific toxicity data was available, naphthalene was separated out from the non-cancer PAHs and addressed as a separate compound for risk assessment analyses.

The PAHs spreadsheet sums the carcinogenic and non-cancer compounds for further analysis in the HAPs summary spreadsheet.

Summary:

The cumulative emissions spreadsheet evaluates emissions data for non-criteria pollutants from cement plants combusting tires as fuel, and analyzes that data for use in predicting cumulative emissions from the Trident kiln when combusting tires in addition to other permitted fuels. Similar to the approach used in the air quality permit application, the estimated cumulative emissions are conservatively predicted by using the maximum data point or, where appropriate, the 95% UCL from the cumulative emissions database.

Holcim (US) Inc.
Trident Plant: Tires as Fuel Project
HAP Emissions Study
Cumulative Emissions Analysis - Total Summary Note: ND = Not detected

Holcim Trident Potential MMBtu/year	2,426,750	Baseline MMBtu/hr	949	285	258	443	145	444	498	198	640	422	356	356	258
Holcim Trident Potential Production,	425,000	TDF MMBtu/hr	942	288	256	393	145	420	482	192	656	422	368	363	258

Pollutant	Projected Average (g/sec)	Projected High Point (g/sec)	Holnam-Clarksville, MO (g/sec)	Ash Grove-Durkee, OR (g/sec)	Holnam/Ideal-Seattle, WA (14% TDF) (g/sec)	Boxcrow-Midlothian, TX (g/sec)	Lehigh Portland Cement Company-Union Bridge, MD (g/sec)	1990 RMC Lonestar-Davenport, CA (g/sec)	Southwestern-Victorville, CA (g/sec)	California Portland-Colton, CA (g/sec)	Mitsubishi-Lucerne Valley, CA (g/sec)	1992 RMC Lonestar-Davenport, CA (g/sec)	1997 Dundee @ 16 % TDF (g/sec)	1997 Dundee @ 21 % TDF (g/sec)	Holnam/Ideal-Seattle, WA (11% TDF) (g/sec)
1 Acetaldehyde	4.28E-03	8.55E-03								8.55E-03	8.90E-09				
2 Acrolein	ND	ND								ND					
3 Trichloroethene	3.07E-04	3.87E-04								3.87E-04					
4 1,1,1 Trichloroethane	1.17E-04	1.84E-04			8.35E-05					1.84E-04		ND			1.14E-04
5 1,1,2 Trichloroethane	ND	ND			ND					ND					ND
6 1,1,2,2 Tetrachloroethane	ND	ND			ND					ND					ND
7 1,2 Dibromoethane (EDB)	ND	ND			ND										ND
8 1,2 Dichloroethane (EDC)	ND	ND			ND							ND			ND
9 1,2,4-Trichlorobenzene	ND	ND			ND					ND					ND
10 1,2-Dichlorobenzene	ND	ND			ND										ND
11 1,2-Dichloropropane	ND	ND			ND					ND					
12 1,3 Butadiene/Butadiene	4.62E-04	1.16E-03			1.87E-04	ND				1.16E-03					8.03E-06
13 1,3 Dichloropropene	ND	ND			ND										
14 1,3-Dichlorobenzene	ND	ND			ND										ND
15 1,4 Dichlorobenzene	1.27E-03	1.27E-03			ND					1.27E-03					ND
16 2,4,5-Trichlorophenol	ND	ND			ND										ND
17 2,4,6-Trichlorophenol	ND	ND			ND										ND
18 2,4-Dinitrophenol	ND	2.14E-04			ND										2.14E-04
19 2,4-Dinitrotoluene	ND	ND			ND										ND
20 2-Butanone (MEK)	9.28E-05	1.20E-04			1.20E-04										5.60E-05
21 2-Methyl Napthalene	1.30E-03	1.48E-03			1.48E-03										1.12E-03
22 2-Methyl Phenol	ND	ND			ND										ND
23 2-Nitrophenol	4.74E-03	4.78E-03			4.78E-03										4.70E-03
24 3,3-Dichlorobenzidine	ND	ND			ND										ND
25 4,6-Dinitro-2-methylphenol	ND	ND			ND										ND
26 4-Methyl Phenol	5.08E-04	6.38E-04			6.38E-04										3.80E-04
27 4-Methyl-2-Pentanone (MIBK)	ND	ND			ND										ND
28 4-Nitrophenol	3.30E-03	4.13E-03			2.48E-03										4.13E-03
29 Acenaphthalene	8.56E-05	1.71E-04			1.71E-04						4.48E-07	2.81E-06			1.88E-04
30 Acenaphthylene	1.90E-06	2.62E-06			ND	ND					2.62E-09	1.17E-06			ND
31 Aliphatic Compounds (lb/MMBtu)	ND	ND													
32 Aluminum	6.71E-03	1.84E-02				1.06E-03		4.55E-04				1.86E-02			
33 Anthracene	2.30E-06	5.33E-06			ND			5.28E-06	8.33E-06		5.54E-07	1.81E-06			ND
34 Antimony	2.95E-05	4.38E-05				ND				ND	2.19E-06		4.28E-05	4.38E-05	
35 Arsenic	2.68E-05	6.67E-05		2.54E-05	ND	ND		1.12E-05	8.68E-06	ND	1.08E-06	6.40E-05	6.14E-05	6.67E-05	ND
36 Barium	4.19E-04	7.97E-04		ND		ND		6.97E-05				7.97E-04	4.14E-04	3.97E-04	
37 Benzaldehyde	2.22E-02	2.32E-02				2.32E-02									
38 Benzene	5.22E-02	2.89E-01			4.00E-02	2.89E-01	3.90E-02	3.38E-02	1.09E-02	4.17E-02	7.62E-05	5.03E-02			1.43E-02
39 Benzo(a)anthracene*	1.97E-06	4.38E-06			ND			2.03E-06	4.38E-06		2.13E-07	2.38E-07			ND
40 Benzo(a)pyrene*	1.56E-06	4.21E-06			ND	ND		4.21E-06	4.68E-07		3.68E-09	ND			ND
41 Benzo(b)fluoranthene*	5.60E-06	5.60E-06			ND						5.60E-06	ND			ND
42 Benzo(g,h,i)perylene	1.91E-06	5.71E-06			ND			5.71E-06	1.33E-06		3.17E-09	ND			ND
43 Benzo(k)fluoranthene*	1.26E-06	1.26E-06			ND						1.26E-06	ND			ND
44 Benzoic Acid	ND	ND			ND										ND
45 Benzyl chloride	ND	ND								ND					
46 Beryllium	7.96E-06	1.75E-05	ND			ND		1.13E-05	3.61E-06	ND	5.25E-07	ND	1.70E-05	1.75E-05	
47 Bis (2-chloroethoxy)methane	ND	ND			ND										ND
48 Bis (2-chloroethyl) ether	ND	ND			ND										ND
49 Bis (2-Ethylhexyl)phthalate	6.23E-03	7.65E-03			7.65E-03										4.81E-03
50 Boron	5.32E-04	5.32E-04				5.32E-04									
51 Bromoform	ND	ND			ND										ND
52 Bromomethane (Methyl Bromide)	2.46E-04	4.12E-04			4.12E-04					2.11E-04					1.13E-04
53 Butyl Benzyl Phthalate	ND	ND			ND										ND
54 Cadmium	3.76E-05	6.96E-05		2.54E-05	1.95E-05	ND	6.94E-05	1.04E-05	1.09E-05	3.22E-05	6.71E-05	1.09E-05	5.34E-05	5.49E-05	4.94E-05
55 Carbon Disulfide	1.50E-03	2.31E-03			2.31E-03										5.86E-04
56 Carbon Monoxide	2.44E+01	2.44E+01	2.44E+01												
57 Carbon Tetrachloride	4.73E-05	4.82E-05			4.64E-05					ND					4.82E-05
58 Chloride	ND	ND													
59 Chloride (lb/hr)	2.38E-02	2.38E-02		2.38E-02											
70 Chlorine	9.14E-02	9.14E-02				9.14E-02									
71 Chlorobenzene	3.95E-04	1.11E-03			5.17E-06					3.97E-04		1.11E-03			2.32E-05
72 Chloroethane (Ethyl chloride)	ND	ND			ND					ND					ND
73 Chloroform	ND	ND			ND					ND		ND			ND
74 Chloromethane (Methyl chloride)	1.81E-03	2.58E-03			2.60E-03		1.79E-03			ND					1.94E-03
75 Chromium (total)	9.53E-05	2.44E-04		ND	1.01E-04	7.82E-06	2.15E-04	3.32E-05	8.61E-06	7.17E-05	8.88E-06	3.23E-05	1.25E-04	1.44E-04	2.58E-04
76 Chromium 6	9.82E-06	2.04E-05						5.24E-06		2.05E-05	4.27E-06	9.18E-06			
77 Chrysene*	6.02E-07	9.10E-07			ND						2.98E-07	9.10E-07			ND
78 Cobalt	4.54E-05	6.70E-05						3.37E-05				6.70E-05			
79 Copper	2.91E-04	6.43E-04		3.38E-04	3.88E-04	5.87E-05		7.96E-05				2.49E-04			6.43E-04

Appendix C: Emissions Factor Comparison

(Attached document, titled "Combustion of Tires and Permitted Solid Fuels, Comparison of Cumulative Emissions with Site-specific Emissions Test Data, was originally submitted by Holcim to DEQ on March 3, 2004.)

Holcim Trident Plant
Combustion of Tires and Permitted Solid Fuels
Comparison of Cumulative Emissions with Site-specific Emissions Test Data

On March 3, 2004, Bison Engineering, Inc. (Bison), on behalf of Holcim, provided a projection of cumulative air emissions from the Trident plant while burning tires as fuel in conjunction with Trident's currently permitted solid fuels.

In support of the projected cumulative emissions, Bison has prepared a spreadsheet that compares the projected emissions with actual emissions testing data from the Trident plant. The purpose of this spreadsheet is to provide assurance that projections of cumulative emissions from the Trident kiln, when burning tires and other permitted solid fuels, are reasonable.

The spreadsheet provides emissions test data for 14 hazardous air pollutants (HAPs), including dioxins/furans, and one non-regulated compound. The test data for 2002-2003 has been averaged and compared to the cumulative emission projections from the emissions database in Trident's permit application. Dioxins/furans emissions data for 2000, 2002 and 2003 is averaged and compared with the Portland Cement Maximum Achievable Control Technology (PC-MACT) emissions limit applicable to the Trident cement kiln.

As a secondary measure of proving the projected emissions are representative, another column has been added in the table to provide a calculated emissions level, based on maximum production at Trident (425,000 tons clinker/year), using EPA AP-42 emissions factors. These factors are presented on a pounds of pollutant per ton of clinker produced basis. The factors used were for kilns with electrostatic precipitator control devices, unless only data for a fabric filter-controlled kiln was available. Unlike the permit application emissions database, which contains emissions tests from ten cement plants, many of the AP-42 emissions factors are based on one emissions test. Further, the fuels combusted during the emission test(s) were not identified in the AP-42 factor references.

Data for polycyclic aromatic hydrocarbons (PAHs) are compiled from emissions test results and the database, and then standardized to EPA's list of 16 PAH compounds (listed in the previous cumulative emissions submittal). Some data sets had emissions data for all 16 compounds, while others had fewer compounds measured and/or detected.

A comparison of emissions test data with the projected cumulative emissions demonstrates that the projection methodology produces values that encompass test data (as expected); further, some margin is provided for emissions that may result from the combustion of tires. Review of the cumulative emissions package previously provided shows that many of the HAPs covered in this comparison, on average, will decrease when tires are added to the fuel mix. Nonetheless, this comparison should provide assurance to the reader that cumulative emissions have been conservatively estimated for use in evaluating potential cumulative environmental impacts of the Trident kiln when combusting tires.

Holcim Trident Plant
Combustion of Tires and Permitted Solid Fuels
Emissions Test Data Comparison with Cumulative and Baseline Projections for COPCs

Pollutant	Holcim (Trident) Test Data			Database Projected Baseline[g] Emissions (lbs/hr)	Database Projected Baseline[h] Emissions (lbs/hr)	Database Projected Cumulative Emissions (lbs/hr)	AP-42[c] Emissions (lbs/hr)
	2003 Test Data[a] (lbs/hr)	2002 Test Data[b] (lbs/hr)	Average 2002-03 Test Data (lbs/hr)				
HAPs							
Antimony	1.28E-04		1.28E-04	3.43E-04	2.55E-04	3.48E-04	
Arsenic	8.13E-05	2.55E-04	1.68E-04	5.79E-04	4.30E-04	3.87E-04	6.31E-04
Benzene	1.90E-01	3.20E-01	2.55E-01	1.06E+00	7.84E-01	8.70E-01	1.50E-01
Beryllium	1.79E-05		1.79E-05	1.71E-04	1.26E-04	1.28E-04	3.20E-05
Cadmium	8.87E-05	3.70E-04	2.29E-04	1.04E-03	7.72E-04	4.03E-04	4.03E-04
Chromium (total)	9.20E-04	8.90E-04	9.05E-04	1.50E-03	1.12E-03	1.14E-03	3.73E-04
Cobalt	3.43E-04	4.37E-04	3.90E-04	8.50E-04	6.30E-04	4.53E-04	
Hydrogen Chloride	1.50E-01		1.50E-01	7.30E-01	5.42E-01	7.67E-01	2.38E+00
Lead	1.94E-03	1.29E-02	7.42E-03	1.45E-02	1.07E-02	1.47E-02	3.44E-02
Manganese	1.59E-03	3.47E-03	2.53E-03	1.02E-02	7.58E-03	4.18E-02	4.17E-02
Mercury (total)	1.85E-03	3.40E-03	2.63E-03	4.22E-02	3.13E-02	1.42E-02	1.07E-02
Nickel	4.28E-04		4.28E-04	1.79E-03	1.33E-03	2.27E-03	
PAHs[d]	1.96E-02		1.96E-02	8.64E-02	6.42E-02	6.41E-02	3.71E-02
Non-regulated							
Copper	5.26E-04	8.47E-04	6.87E-04	1.56E-02	1.16E-02	4.31E-03	2.57E-01
HAPs with PC-MACT Emissions Limits							
Dioxins/Furans	2003 Test Data[a,e]	2002 Test Data[b,e]	2000 Test Data[a,f]	Average 2001-03 Test Data	PC-MACT Limit		
(ng/dscm)	1.65E-03	3.61E-04	4.20E-03	2.07E-03	2.00E-01		

[a] Testing on approx. 65/35% coal/coke fuels.
[b] Testing on approx. 75/25% coal/coke fuels.
[c] AP-42 Table 11.6-19, calculated at maximum production.
[d] PAHs include EPA group of 16 compounds.
[e] D/F test results as 2378-TCDD TEQ in nanograms/dscm @ 7% oxygen.
[f] Testing on approx. 82/18% syncoal/coke fuels.
[g] Using 425,000 tons clinker/year production limit.
[h] Using 315,754 tons clinker/year average production for 1999-2000.

Appendix D: Final Dispersion Modeling Protocol and Report

(Attached document, titled "Permit Application for Tires Combustion Dispersion Modeling Protocol and Report (updated)", was originally submitted by Holcim to DEQ on May 10, 2004.)

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Holcim (US) Inc. Trident Plant

Permit Application for Tires Combustion
Dispersion Modeling Protocol and Report (updated)
May 10, 2004

1.0 Introduction

This dispersion modeling protocol and report provides a third update of air dispersion modeling conducted in support of the Holcim Trident plant tires combustion air quality permit application. At the request of the Montana Department Environmental Quality (MDEQ), this latest round of modeling used the most up-to-date version of the AERMOD Model.

Previous modeling work was provided in support of the air permit application for tires combustion based on the models available at that time. The previous modeling work completed in support of the air permit application for tires combustion is described in the Compilation of Application Submittals for Tires Combustion (compilation document), dated January 2004. DEQ issued a completeness determination for the previous modeling submission on February 12, 2003.

The current modeling approach and outcome are explained in more detail in the following paragraphs. Modeling results are carried into a human health risk assessment (HRA) and screening level ecological risk assessment (SLERA) presented under separate cover. The compliance demonstration with ambient air quality standards presented in the compilation document has also been updated with the latest modeling results and is presented in Section 3.0.

2.0 Dispersion Modeling Protocol

The analytical method used for analysis of ambient air quality impacts from the proposal to combust tires in the Holcim Trident cement kiln was dispersion modeling as outlined by 40 CFR 51.166(l), which specifies the types of models to be used for PSD applications. Modeling discussed within this submittal was conducted in general accordance with the methodology outlined in the *New Source Review Workshop Manual.* Although the *New Source Review Workshop Manual* is a draft, rather than a final document, the methodology is widely used and accepted. This document and the guidance found in Appendix W of 40 CFR 51, Guideline on Air Quality Models, were used as references. In addition, recent EPA guidance on recommended air quality models was utilized in modeling work following the initial permit application submittal.

2.1 Model Selection

The dispersion model used to evaluate ambient air quality impacts from the Trident facility is the AMS/EPA Regulatory Model (AERMOD). The April 21, 2000, *Federal*

Register contains a proposed rule that when adopted will make AERMOD the recommended model for situations similar to those currently addressed using the ISC3 model. In addition, the Seventh Conference on Air Quality Modeling selected AERMOD as the recommended model for complex terrain. In order to follow the most current EPA air dispersion modeling guidelines, AERMOD was selected as the appropriate model for this modeling demonstration.

In the May 31, 2002 permit application submittal, AERMOD was used to characterize impacts of the Trident plant on ambient air quality (see compilation document for further discussion of the modeling protocol and report). MDEQ approved the use of AERMOD for modeling impacts of the Trident kiln in an August 26, 2002 letter.

AERMOD is appropriate for point, volume, and/or area sources; surface, near-surface, and elevated releases; rural or urban areas; simple and complex terrain; transport distances over which steady-state assumptions are appropriate (up to 50 km); and continuous toxic air emissions. AERMOD's regulatory default option includes the use of terrain elevation data, stack-tip downwash and building wake effects, and sequential date checking, and does not permit the use of the model in a screening mode. The regulatory option does not employ pollutant half-life or decay options except in the case of an urban source of sulfur dioxide where a four-hour half-life is applied. AERMOD processes sequential meteorological data to estimate concentrations for averaging times from one hour to the total period of meteorological data input.

AERMOD is designed to accept input data prepared by two specific pre-processor programs: AERMET and AERMAP. AERMET processes meteorological data that is available from the National Weather Service (NWS) through the National Climatic Data Center (NCDC), or from on-site data collection. AERMAP processes digital elevation data available from several different sources, including the U.S. Geological Survey (USGS) digital elevation model (DEM) files.

The AERMOD program and the two pre-processors AERMET and AERMAP have all been updated since the 5/31/02 permit application submittal. This round of dispersion modeling utilized the latest source code for AERMOD (Version 03273), AERMET (Version 03273), and AERMAP (Version 03107) which was provided by BEE-Line Software.

2.2 Meteorological Input Data

The AERMOD model requires hourly meteorological data. AERMET is designed to accept NWS 1-hour surface observations, NWS twice-daily upper air soundings, and any data that may be collected from an on-site meteorological measurement system. These data are processed in three steps. The first step extracts data from the archive data files (NWS and local file format) and performs various quality assessment checks. The second step merges all available surface and upper air data (both NWS and on-site). These merged data are stored together in a single file. The third step reads the merged meteorological data and estimates the boundary layer parameters needed by AERMOD. AERMET writes two files for input to AERMOD: a file of hourly boundary

layer parameter estimates and a file of multiple-level (when the data are available) observations of wind speed and direction, temperature, and standard deviation of the fluctuating components of the wind direction.

To address the model requirements for hourly meteorological data, two data sources were used. First, Holcim collected on-site hourly meteorological data at the Trident site (462,770 Easting, 5,087,572 Northing, Zone 12) from April 1, 2000, through March 31, 2001. Second, since the on-site station did not collect cloud cover or upper air data, NWS data from the nearest station with that data (Great Falls, Montana) was used. As specified by the AERMET documentation, the NWS upper air data was obtained from the NCDC where it had been compiled in TD 6301 U.S. Rawinsonde (AIRS) 6201 fixed-length records format. The NWS surface data was obtained from NCDC in TD 9956 DATSAV3 format output in 3280 fixed records variable-length record format.

The reformatted NWS data were combined with the local wind speed, wind direction, temperature, temperature difference, standard deviation of wind direction, and solar radiation data. Data at the MDEQ-approved on-site meteorological station were measured at a height of 9 meters, except for solar radiation, which was measured at a height of 5 meters and temperature, which was measured at both 2 meters and 9 meters. The meteorological data were recorded using a Campbell Scientific data logger.

For processing of the on-site data collected on the Trident plant site, hours of missing data were substituted according to the procedures specified in *Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models*, by Dennis Atkinson and Russell F. Lee, dated July 7, 1992. The data had only one significant period of missing data, which was due to a 10-hour power failure on December 16 and 17, 2000. For that period, linear interpolation was used to derive the appropriate temperature, and data from the previous day were substituted for wind and solar radiation. One hour of apparently erroneous data (April 26, 2000, 0100) was treated as a missing hour and substituted accordingly. In addition, 73 hours that showed slightly negative solar radiation values were changed to zero. An electronic file containing the meteorological data used in the model was provided in the January 31, 2002 application submittal.

According to the AERMOD output file, 1.7 percent of the hours were missing; investigation of the input meteorological data revealed that the NWS Great Falls upper air data had several days that were missing sounding data. No attempt was made to provide substitute values for the missing upper air data because of the small percentage of missing hours.

Seasonally characteristic values for surface roughness, Bowen ratio, and albedo obtained from EPA recommendations contained in the AERMET User's Guide were selected and incorporated into AERMET. AERMET created the surface and profile meteorological data files for AERMOD model execution.

An analysis of the meteorological data shows that winds are predominantly from the southwest and, to a lesser extent, from the north-northeast and from the southwest through the southeast. A wind rose illustrating wind direction and velocity frequency is provided as Appendix 5 in the compilation document.

2.3 Terrain Data

AERMAP processes terrain elevation data available from various sources in two different formats. The acceptable types of elevation data include the 7.5-minute Digital Elevation Model (DEM) files prepared by the USGS and the 1-degree (3 arc-second) format produced by the Defense Mapping Agency (DMA). Each 7.5-minute DEM file corresponds to a single 1:24,000-scale USGS quadrangle map. The 1-degree files correspond to the east or west half of a USGS 1:250,000-scale topographic map.

Two domain areas were calculated and used for this modeling demonstration. One domain covered the MDEQ-recommended 10 kilometer (km) receptor grid, and additional receptors located at the Holcim houses, along the Missouri River and County Road, at the nearest residence, and at the Three Forks School. A second domain was calculated for the large receptor grid that encompasses the Gallatin Valley. The smaller domain required twenty-four 7.5 minute DEM files and the large domain required an additional 106 (130 total) 7.5 minute DEM files. The larger domain required for this extended receptor grid extended 60 km to the west, 65 km to the east, 70 km to the south, and 60 km to the north.

All 7.5 minute DEM files were obtained from Micropath (www.micropath.com) and were processed by the BeeLine software overlay to the "chopped" format expected by the AERMAP preprocessor. The following is a list of the one hundred thirty 7.5 minute DEM files that were required for the modeling demonstrations.

45110C6.DEM EMIGRANT, MT
45110C7.DEM DAILEY LAKE, MT
45110C8.DEM LEWIS CREEK, MT
45111C1.DEM THE SENTINEL, MT
45111C2.DEM HIDDEN LAKE, MT
45111C3.DEM GALLATIN PEAK, MT
45111C4.DEM LONE MOUNTAIN, MT
45111C5.DEM FAN MOUNTAIN, MT
45111C6.DEM ENNIS, MT
45111C7.DEM EIGHTMILE CREEK, MT
45111C8.DEM VIRGINIA CITY, MT
45112C1.DEM ALDER, MT
45112C2.DEM LAURIN CANYON, MT
45110D6.DEM PRAY, MT
45110D7.DEM BIG DRAW, MT
45110D8.DEM FRIDLEY PEAK, MT
45111D1.DEM MOUNT BLACKMORE, MT
45111D2.DEM GARNET MOUNTAIN, MT
45111D3.DEM BEACON POINT, MT
45111D4.DEM WILLOW SWAMP, MT
45111D5.DEM CHERRY LAKE, MT
45111D6.DEM ENNIS LAKE, MT
45111D7.DEM LEONARD CREEK, MT
45111D8.DEM RAMSHORN MOUNTAIN, MT
45112D1.DEM COPPER MOUNTAIN, MT
45112D2.DEM SHERIDAN, MT
45110E6.DEM CHIMNEY ROCK, MT
45110E7.DEM BALD KNOB, MT
45110E8.DEM MOUNT ELLIS, MT
45111E1.DEM WHEELER MOUNTAIN, MT
45111E2.DEM GALLATIN GATEWAY, MT
45111E3.DEM RUBY MOUNTAIN, MT
45111E4.DEM CHERRY CREEK CANYON, MT
45111E5.DEM BEAR TRAP CREEK, MT
45111E6.DEM NORRIS, MT
45111E7.DEM MALTBYS MOUND, MT
45111E8.DEM POTOSI PEAK, MT
45112E1.DEM NOBLE PEAK, MT
45112E2.DEM OLD BALDY MOUNTAIN, MT
45110F6.DEM HOPPERS, MT
45110F7.DEM BOZEMAN PASS, MT
45110F8.DEM KELLY CREEK, MT
45111F1.DEM BOZEMAN, MT
45111F2.DEM BOZEMAN HOT SPRINGS, MT
45111F3.DEM ANCENEY, MT
45111F4.DEM MADISON PLATEAU, MT
45111F5.DEM NORRIS NE, MT
45111F6.DEM WILLOW CREEK RESERVOIR, MT
45111F7.DEM HARRISON, MT
45111F8.DEM PONY, MT

45112F1.DEM MANHEAD MOUNTAIN, MT
45112F2.DEM WATERLOO, MT
45110G8.DEM SADDLE PEAK, MT
45111G1.DEM MISER CREEK, MT
45111G2.DEM BELGRADE, MT
45111G3.DEM MANHATTAN, MT
45111G4.DEM MANHATTAN SW, MT
45111G5.DEM THREE FORKS SE, MT
45111G6.DEM WILLOW CREEK, MT
45111G7.DEM SAPPINGTON, MT
45111G8.DEM JEFFERSON ISLAND, MT
45112G1.DEM WHITEHALL, MT
45112G2.DEM VENDOME, MT
45110H6.DEM WILSALL, MT
45110H7.DEM SEDAN, MT
45110H8.DEM SACAGAWEA PEAK, MT
45111H1.DEM FLATHEAD PASS, MT
45111H2.DEM HORSESHOE CREEK, MT
45111H3.DEM NIXON GULCH, MT
45111H4.DEM LOGAN, MT
45111H5.DEM THREE FORKS, MT
45111H6.DEM MILLIGAN CANYON, MT
45111H7.DEM NEGRO HOLLOW, MT
45111H8.DEM DOHERTY MOUNTAIN, MT
45112H1.DEM BLACK BUTTE, MT
45112H2.DEM DRY MOUNTAIN, MT
46110A6.DEM COTTONWOOD RESERVOIR, MT
46110A7.DEM WALLROCK, MT
46110A8.DEM HATFIELD MOUNTAIN, MT
46111A1.DEM BLACKTAIL MOUNTAIN, MT
46111A2.DEM MAUDLOW, MT
46111A3.DEM ROY GULCH, MT
46111A4.DEM LOMBARD, MT
46111A5.DEM PLUNKET LAKE, MT
46111A6.DEM RADERSBURG SW, MT
46111A7.DEM WILLOW SPRINGS, MT
46111A8.DEM DUNN CREEK, MT
46112A1.DEM WILSON PARK, MT
46112A2.DEM RATIO MOUNTAIN, MT
46110B6.DEM WOLF HILL, MT
45110G6.DEM GOBBLERS KNOB, MT
45110G7.DEM GRASSY MOUNTAIN, MT
46110B7.DEM SIXTEEN NE, MT
46110B8.DEM SIXTEEN, MT
46111B1.DEM FRANCIS, MT
46111B2.DEM SIXMILE MOUNTAIN, MT
46111B3.DEM DEER PARK, MT
46111B4.DEM TOSTON, MT
46111B5.DEM PARKER, MT
46111B6.DEM RADERSBURG, MT
46111B7.DEM DEVILS FENCE, MT
46111B8.DEM TACOMA PARK, MT
46112B1.DEM BOULDER EAST, MT
46112B2.DEM BOULDER WEST, MT
46110C6.DEM HAMEN, MT
46110C7.DEM RINGLING, MT
46110C8.DEM BLACK BUTTE MOUNTAIN, MT
46111C1.DEM BATTLE MOUNTAIN, MT
46111C2.DEM SULPHUR BAR CREEK, MT
46111C3.DEM LIPPERT GULCH, MT
46111C4.DEM HOLKER, MT
46111C5.DEM TOWNSEND, MT
46111C6.DEM GIANT HILL, MT
46111C7.DEM CROW CREEK FALLS, MT
46111C8.DEM ELKHORN, MT
46112C1.DEM WICKES, MT
46112C2.DEM MOUNT THOMPSON, MT
46110D6.DEM CASTLE TOWN, MT
46110D7.DEM MANGER PARK, MT
46110D8.DEM CATLIN SPRING, MT
46111D1.DEM ALKALI LAKE, MT
46111D2.DEM MOUNT EDITH, MT
46111D3.DEM GURNETT CREEK EAST, MT
46111D4.DEM GURNETT CREEK WEST, MT
46111D5.DEM TOWNSEND NE, MT
46111D6.DEM WINSTON, MT
46111D7.DEM CASEY PEAK, MT
46111D8.DEM CLANCY, MT
46112D1.DEM JEFFERSON CITY, MT
46112D2.DEM CHESSMAN RESERVOIR, MT

2.4 Receptor Network

For this modeling evaluation, three Cartesian grid systems were generated around the Holcim property boundary:

- An MDEQ-recommended 10 km grid;
- A fine or "hotspot" grid for compliance demonstration; and
- A large grid covering the Gallatin Valley to evaluate predicted concentrations at some distance from the Trident plant.

The 10 km grid followed MDEQ modeling requirements specified in "Requirements for Submitting Air Dispersion Modeling Analysis" (12/04/02), with receptors spaced as follows:

- 50 m spacing along the facility fenceline.
- 100 m spacing from the proposed fenceline out to 1.0 km.
- 250 m spacing from 1.0 km to 3.0 km.
- 500 m spacing from 3 km to 10 km.

This receptor grid was used to identify the approximate locations of the highest annual and hourly predicted concentrations. Once these locations were identified for each of the averaging periods, a fine, "hotspot" grid was developed with 50 meter receptor spacing. The fine grid looked for higher concentrations in the vicinity of maximum impact receptors identified in the 10 km grid modeling.

A third receptor grid covering the entire Gallatin Valley was developed to demonstrate that predicted concentrations decline with distance from Trident. This receptor grid covered the large area described in Section 2.3 above and provides receptors in and around the population centers in the Gallatin Valley. Because of the large area, receptor spacing was set at 2.5 km to provide for reasonable model processing times.

An additional set of receptors was also modeled to address locations modeled in previous permit application submittals. These additional receptors are located within the Holcim property boundary along the public roads and at the company-owned homes. Receptors were also placed at the nearest offsite residence, along the Missouri River, and at the Three Forks School.

AERMAP was used to calculate the necessary hill height scale factors to pair with the base elevation for each of the receptor locations. The base elevations of the receptors, buildings, and sources were calculated by the Bee-Line software from data in the DEM files using linear interpolation of four adjacent points. The uniform horizontal spacing in the DEM files is 30 meters.

2.5 Building Effects

Building influences on stacks were considered by incorporating the EPA-developed software Building Profile Input Program with Plume Rise Model Enhancements (BPIP-PRIME) and the downwash algorithms in the model. The stack height used in the dispersion modeling was the actual stack height, which was less than the Good Engineering Practice (GEP) stack height default value of 65 meters. The source code for BPIP-PRIME was provided by BEE-Line software.

Nine buildings and 28 tanks representing the significant structures at Trident were included in the model analysis. The BPIP program uses actual building dimensions to calculate projected building widths, along the flow distance from the stack to the center of the upwind face of the projected buildings, and the across-flow distance from the stack to the center of the upwind face of the projected buildings.

2.6 Source and Emissions Data

HAPs Modeling

Four sources including the cement kiln stack, cement kiln dust (CKD) silo loading, CKD silo unloading, and CKD monofill were modeled for determination of hazardous air pollutants (HAPs) impacts on the surrounding ambient environment. The source parameters are shown in Table 2.6-1 below:

Table 2.6-1: Source Parameters

Point Source Parameters		
Parameter	**Trident Cement Kiln**	
UTM X (km)	463.075	
UTM Y (km)	5,087.789	
Base Elevation (m)	1,229.4	
Stack Height (m)	39.62	
Exit Temperature (K)	435.93	
Exit Velocity (m/s)	11.0	
Stack Diameter (m)	3.05	
Volume Source Parameters		
Parameter	**Silo Load**	**Silo Unloading**
UTM X (km)	463.083	463.084
UTM Y (km)	5087.785	5087.784
Base Elevation (m)	1,230.3	1,230.7
Release Height (m)	18.29	7.62
Horizontal Dimension (m)	0.07	0.07
Vertical Dimension (m)	4.25	1.77
Area Source Parameters		
Parameter	**CKD Monofill**	
UTM X (km)	463.454	
UTM Y (km)	5087.901	
Base Elevation (m)	1245.9	
Release Height (m)	1.52	
Easterly Length (m)	222.2	
Northerly Length (m)	992.4	
Angle from North	50	

An additional source, the end of kiln source, was not modeled because emissions rates were several orders of magnitude below the other sources and were inconsequential in comparison to the other sources in the model.

Emissions data for HAPs is provided under separate cover for baseline (both representative actual and maximum allowable production cases) emissions, and for cumulative emissions under maximum allowable kiln production. For HAPs predicted to be accumulated in CKD, emissions data were calculated in spreadsheets provided on

CD. Since the predicted emissions from the CKD were very small, it was necessary to scale up the emissions from the CKD sources by one million in order to model these substances. Subsequently, the predicted model concentrations have been reduced by dividing by one million.

Criteria Pollutant Compliance Demonstration

As with the prior modeling submission, to assess compliance of the Trident kiln with ambient air quality standards for criteria pollutants, modeling of the kiln stack was completed with a one gram per second (g/sec) emissions rate. Projected emissions rates with tires combustion (g/sec) were multiplied by the modeled impacts of the kiln stack to assess compliance with National and Montana Ambient Air Quality Standards (NAAQS and MAAQS).

Table 2.6-2 presents maximum emission rates for PM_{10}, SO_2 and NO_x based on the emission limitations in Air Quality Permit #0982-10, which are projected to remain the same for use of tire-derived fuel. Emission rates for CO, VOC and lead are estimated based on source test data and standard emission factors. Combustion of tires as fuel increases only the CO rate, which has been adjusted to reflect this fuel. These emission rates encompass the following assumptions:

- All of the particulate matter emitted has an aerodynamic diameter of 10 microns or less;
- Maximum clinker production is 425,000 tons per 12-month period; and,
- The kiln operates at full potential, that is, 8760 operating hours per 12-month period.

Table 2.6-2: Emissions Rates for Trident with Tires as Fuel

Pollutant	Emission Rates[a]			
	lb/ton clinker	(lb/hr)	(g/sec)	(tpy)
PM_{10}	0.77	37.4	4.71	164
SO_2		124	15.6	543
NO_x		1,568	197.6	6,868
CO	1.46	70.8	8.92	310
VOC	0.027	1.30	0.165	6
Lead	0.00071	0.034	0.004	0

[a]Maximum clinker production is assumed to be 425,000 tons per 12-month period. Continuous operation (8760 hours per year) is assumed.

3.0 Model Results

Results of the three AERMOD model runs, the runs with the 10 km receptor grid, the "fine" receptor grid, and the Gallatin Valley analysis, are documented on CDs included with this submittal. Results from the 10 km receptor and fine grids were used in the compliance demonstration for both NAAQS and MAAQS described below and in determining health and ecological risk. Model outputs for pollutants accumulating in CKD and for the remaining HAPs were input into the HRA and SLERA using the approach outlined in the compilation document.

Model results for the maximum impact receptors for each averaging period using a 1g/sec emissions rate are presented in Table 3.0-1. These data were combined with emissions rates in Table 2.6-2 to determine maximum impacts for comparison with ambient air quality standards. Model outputs for HAPs accumulating in CKD were carried directly into the HRA and SLERA. For the remaining HAPs, their emissions rate was multiplied by the 1 g/sec modeling output to determine the maximum predicted impact.

Table 3.0-1: Maximum Modeled Impacts

Period	Model Rank	Predicted Concentration (ug/m^3)	Easting (m)	Northing (m)
ANNUAL	1ST	0.294	465025	5089123.5
1-HR	2ND	12.662	462500	5088150
3-HR	2ND	4.772	462550	5088250
8-HR	2ND	3.081	462200	5087800
24-HR	2ND	1.674	465025	5089123.5

Depending on the form of the standard, the highest or second highest predicted concentrations were selected for comparison to the NAAQS and MAAQS after the addition of the appropriate background concentrations. The predicted concentrations and the NAAQS and MAAQS are shown in Table 3.0-2. These predicted concentrations include the AERMOD predicted values and the MDEQ background values.

The SO_2 1-hour MAAQS is to be compared to the 19th highest 1-hour concentration. Bee-Line software precludes the selection of the 19th highest, so, to simplify the modeling exercise, the 10th highest 1-hour concentration has been conservatively substituted for the 19th highest.

Predicted concentrations of NO_2 were determined as described in the compilation document; the annual NO_2 analysis used the ambient ratio method (ARM) and the NO_2 1-hour average used the ozone limiting method (OLM). Copies of ozone data from

Devil's Slide, Utah that were used in the OLM calculations are provided in Appendix 6 of the compilation document.

Table 3.0-1 shows that the predicted concentrations of criteria pollutants are all within the applicable NAAQS and MAAQS. It should be noted that ozone is modeled as VOC emissions and thus the predicted concentrations are of VOCs, which serve as a conservative estimate of ozone.

The MAAQS for lead is based on a 90-day average, while the NAAQS is based on a calendar quarter average. The tenth highest predicted 1-hour concentration has been selected for comparison with the NAAQS calendar quarter average and the MAAQS rolling 90-day average. This very conservative estimate shows that predicted lead concentrations are well within the standards.

Table 3.0-2: Predicted Concentrations Compared with Standards

Pollutant	Average Period	Background Concentration ($\mu g/m^3$)	Model Predicted Concentration ($\mu g/m^3$)	Model Predicted Concentration with Background ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	MAAQS ($\mu g/m^3$)
Carbon Monoxide (CO)	1-hour	1,725	113	1838	40,000[a]	26,450[a]
	8-hour	1,150	27	1177	10,000[a]	10,350[a]
Lead (Pb)	90-day	N/A	0.033[b]	0.033[b]	---	1.5
	quarterly	N/A	0.033[b]	0.033[b]	1.5	---
Nitrogen Dioxide (NO_2)	1-hour	75	2,372	404[c]	---	564[a]
	annual	6	58	49.5[c]	100	94
Ozone (O_3) (as VOC)	1-hour	N/A	2	2	235[d]	196[a]
Sulfur Dioxide (SO_2)	1-hour	35	130	165	---	1,300[e]
	3-hour	26	74	100	1,300[a]	---
	24-hour	11	26	37	365[a,f]	262[a,g]
	annual	3	5	8	80[a]	52[a]
Particulate Matter (PM_{10})	24-hour	30	8	38	150[h,i]	150[h,i]
	annual	8	1	9	50[j]	50[j]

[a] Not to be exceeded more than once per year.
[b] Tenth high 1-hour predicted concentration value used for conservative comparison with standard.
[c] These values obtained from the ozone limiting method procedure.
[d] Standard attained when expected number of days per calendar year with maximum hourly averages above standard are equal to or less than one.
[e] Not to be exceeded more than eighteen times in twelve months.
[f] Standard based on calendar day.
[g] Standard based on 24 consecutive hours.
[h] Standard attained when expected number of days per calendar year with maximum 24-hour averages above standard are equal to or less than one.
[i] Standard is average of expected exceedances for three consecutive years.
[j] Standard is average of expected means for three consecutive calendar years.
Note that predicted ozone concentrations are actually predicted concentrations of volatile organic compounds (VOCs).
Na: not applicable.

3.1 Model Files

AERMOD modeling files are being provided to MDEQ on CD. Model run parameters and a listing of AERMOD files is available in Table 3.1-1.

Table 3.1-1
Model Run Parameters

Parameter	Selected Value
AERMOD	
Control option	Regulatory default
Averaging periods	1hour 8 hour 3 hour 24 hour Period (annual)
Half-life/decay	No half-life No decay
Flagpole receptors	None
Source groups	CKDBase: Baseline potential, no tires at 425,000 tpy CKDPTE: Cumulative potential with tires at 425,000 tpy BASE315: Baseline actual, no tires at 315,754 tpy
Emission units	Default value: $\mu g/m^3$
Emission rate flag	None, no hourly emission file
Deposition	None
Receptors	Cartesian grids with 100 to 1000 meter spacing to define hot spots Cartesian grids at 50 meter spacing for hot spots Cartesian grids at 2,500 meter spacing for Gallatin Valley Discrete at 50 meter spacing and corners along fence line and roads and at homes within the fence line
Terrain	130 7.5 minute DEM files:
Boundaries	Fence line 9 plant buildings 28 silos, tanks, or stockpiles
Output options	Highest and second highest concentrations 10th highest for 1-hour average (Gram-sec only) At each receptor for each selected averaging period

Table 3.1-1 Continued **Model Run Parameters**	
AERMET	
Surface file	NWS data from Great Falls Station #000727750 Latitude: 111.22 West; longitude: 47.27 North Time zone adjustment: 0 (same zone as modeled area) Time period: 4/1/2000 to 3/31/2001 Sensor height: 6.1 m Format: NCDC 3280 (TD 9956), variable length abbreviated blocking factor: 1 (1 logical record per physical record)
Upper air file	NWS data from Great Falls Station #00004102 Latitude: 111.22 West; longitude: 47.27 North Time zone adjustment: 7 (relative to Greenwich time) Time period: 4/1/2000 to 3/31/2001 NCDC format: NCDC 6201 (TD 6301) 2876 character fixed Length blocking factor: 1 (1 logical record per physical record)
On-site file	Trident station: default #99999 Latitude: 111.48 West; longitude: 45.94 North Time zone adjustment: 0 (same zone as modeled area) Time period: 4/1/2000 to 3/31/2001 Sensor height: 10 m Format: (4(I2,1X),F9.1,F7.1,F10.1,F8.1,9X,F9.1,7X,F9.1) Selected parameters: month, day, year, hour, sensor height, wind speed, wind direction, standard deviation of wind direction, temperature, solar radiation
File preparation	Wind direction sectors: 1 Wind direction sector: 0 to 360 degrees Location: 77.72 W 40.89 N Time zone adjustment: 7 (relative to Greenwich) Method: substitute NWS data & randomize NWS wind directions NWS instrument height: wind 6.1 meters Frequency: seasonal

Season	Albedo	Bowen	Roughness
spring	0.300	5.000	0.300
summer	0.280	6.000	0.300
autumn	0.280	10.00	0.300
winter	0.450	10.00	0.150

Table Table 3.1-1 Continued Model Run Parameters		
AERMAP		
Calculations	Hill heights for receptors and elevations for sources, buildings, silos and stockpiles, and receptors calculated from DEM files	
Domains	EIS-10km:	Longitude 111.005 Latitude 45.755 to Longitude 111.745 Latitude 46.245, Zone 12
	EIS-Fine:	Longitude 111.005 Latitude 45.755 to Longitude 111.745 Latitude 46.245, Zone 12
	EIS-Large:	Longitude 110.635 Latitude 45.260 to Longitude 112.240 Latitude 46.490, Zone 12

The model input and output files are shown in Table 3.1-2.

Table 3.1-2

Model Input and Output Files

File Name	Description
B29HNM00.SFC B29HNM00.pfl	Holcim meteorological files for input to AERMOD (output of AERMET for input to AERMOD)
*.pip *.so	Building data input to BPIP-PRIME Building dimension data output by BPIP-PRIME (input to AERMOD)
DEQ.*	AERMAP files for the initial receptor grid configuration
EIS-Fine.*	AERMAP files for the fine receptor grid configuration
EIS-Large.*	AERMAP files for the Large receptor grid configuration
*.map *.mot *.rcf *.scf	AERMAP file for input to AERMOD List file associated with *.map file Receptor elevations and hill height scales obtained from DEM data Source elevations obtained from DEM data

EIS-10km_00_GRAM-SEC.* EIS-10km_00_ANTIMONY.* EIS-10km_00_ARSENIC.* EIS-10km_00_BERYLIUM.* EIS-10km_00_CADMIUM.* EIS-10km_00_CHROM-6.* EIS-10km_00_CHROMTOT.* EIS-10km_00_COBALT.* EIS-10km_00_D-F.* EIS-10km_00_HCL.* EIS-10km_00_HF.* EIS-10km_00_LEAD.* EIS-10km_00_MANGANES.* EIS-10km_00_MERCURY.* EIS-10km_00_NICKEL.* EIS-10km_00_PHOSPHOR.* EIS-10km_00_SELENIUM.* EIS-10km_00_ZINC.*	AERMOD input and output files for the initial receptor grid configuration with the surrogate emission rate of 1 g/sec.
EIS-Fine_00_GRAM-SEC.* EIS-Fine_00_ANTIMONY.* EIS-Fine_00_ARSENIC.* EIS-Fine_00_BERYLIUM.* EIS-Fine_00_CADMIUM.* EIS-Fine_00_CHROM-6.* EIS-Fine_00_CHROMTOT.* EIS-Fine_00_COBALT.* EIS-Fine_00_D-F.* EIS-Fine_00_HCL.* EIS-Fine_00_HF.* EIS-Fine_00_LEAD.* EIS-Fine_00_MANGANES.* EIS-Fine_00_MERCURY.* EIS-Fine_00_NICKEL.* EIS-Fine_00_PHOSPHOR.* EIS-Fine_00_SELENIUM.* EIS-Fine_00_ZINC.*	AERMOD input and output files for the fine receptor grid configuration with the surrogate emission rate of 1 g/sec.
EIS-large_00_GRAM-SEC.*	AERMOD input and output files for the large receptor grid configuration with the surrogate emission rate of 1 g/sec.
*.dta *.lst *.usf	AERMOD input data files AERMOD output list files AERMOD output summary files

AIR QUALITY PERMIT

Issued to: Holcim (US) Inc.
Trident Facility
4070 Trident Road
Three Forks, MT 59752

Permit: #0982-11
Application Received: 10/03/01
Application Complete: 02/12/03
Preliminary Determination Issued: 03/24/03
Supplementary Preliminary Determination
Issued: Date of DEIS
Department Decision Issued:
Permit Final:
AFS #031-0005

An air quality permit, with conditions, is hereby granted to Holcim (US) Inc. (Holcim) pursuant to Sections 75-2-204, 211, and 215 of the Montana Code Annotated (MCA), as amended, and the Administrative Rules of Montana (ARM) 17.8.740, *et seq.*, as amended, for the following:

Section I: Permitted Facilities

A. Plant Location

The Holcim cement manufacturing facility is located near the headwaters of the Missouri River in the Northeast ¼ of Section 9, Southeast ¼ of Section 4, Southwest ¼ of Section 3, and Northwest ¼ of Section 10, Township 2 North, Range 2 East, approximately 5 miles northeast of Three Forks in Gallatin County, Montana.

B. Current Permit Action

On October 3, 2001, Holcim submitted to the Montana Department of Environmental Quality (Department) an application for a modification to Montana Air Quality Permit #0982-10. The permit application requested that the mid-kiln combustion of whole tires be added to the list of potential fuels for the facility. The tires would comprise up to 15 percent of the total fuel heat input to the kiln on a British thermal unit (Btu) basis. Holcim is currently authorized to burn natural gas, coal, petroleum coke, or any combination of these fuels in the kiln. This project would entail some limited modification to the kiln shell and would require additional miscellaneous equipment to handle and store tires at the facility. Since Holcim applied for a solid waste incineration permit under 75-2-215, MCA, a human health risk assessment was required with the air quality application in accordance with ARM 17.8.770. In addition, analysis by Holcim determined that carbon monoxide (CO) emissions could potentially increase above the Prevention of Significant Deterioration (PSD) significance threshold; therefore, the PSD program applies and an emission limit was established for CO. The current permit action also changes the name on the permit from Holnam, Inc. to Holcim. The Department received the request for the name change on November 14, 2001. According to that letter, the change became effective on December 12, 2001. After Holcim's submittal of additional supporting information, the Department deemed the application to be complete on February 12, 2003.

On March 24, 2003, the Department issued a Preliminary Determination (PD) and draft Environmental Assessment (EA). On August 15, 2003, the Department issued a Final EA recommending that an Environmental Impact Statement (EIS) be completed for the project. The Montana Environmental Policy Act (MEPA) requires that a cumulative impact analysis be conducted before a decision can be made on the permit application. The Department determined that the preparation of an EIS would generate the information necessary to conduct this analysis. Therefore, an EIS was completed for this project. A complete list of the permitted equipment and additional project details are contained in the permit analysis.

Section II: Conditions and Limitations

A. Emission Control Requirements

Holcim shall install, operate, and maintain the following emission control equipment and practices.

1. Holcim shall operate and maintain baghouse(s) to control emissions from the Finish Mill #2 sources listed below (ARM 17.8.752).

   a. The air slide
   b. The clinker/gypsum feed belt via a booster fan
   c. The Finish Mill #2
   d. The bucket elevator
   e. The product separator

2. Holcim shall operate and maintain baghouse(s) to control emissions from the following coal and coke handling equipment (ARM 17.8.752).

   a. Screw conveyor from the coal/coke/crusher to the bucket elevator
   b. "Raw" coke storage silo
   c. Coke storage silo
   d. Two diverter valves
   e. Hammer mill
   f. Bucket elevator
   g. Coal storage silo
   h. Belt conveyor with weighing system at the base of the “raw” coke storage silo
   i. Coke grinding mill
   j. “Fine” coke storage silo (220-ton)

3. Holcim shall operate and maintain an electrostatic precipitator (ESP) and use proper design and combustion practices to control kiln emissions (ARM 17.8.752).

4. Holcim shall operate and maintain a baghouse to control clinker cooler emissions (ARM 17.8.749).

5. Holcim shall operate and maintain baghouse(s) to control emissions from the rock silos (ARM 17.8.749).

6. Holcim shall operate and maintain baghouse(s) to control emissions from crushing and screening (ARM 17.8.749).

7. Holcim shall operate and maintain a baghouse to control emissions at the clinker belt conveyor (ARM 17.8.749).

8. Holcim shall operate and maintain a baghouse to control emissions at the dustbin near the precipitator (ARM 17.8.749).

9. Holcim shall operate and maintain a baghouse to control emissions from the Portland cement silos (ARM 17.8.749).

10. Holcim shall operate and maintain a baghouse to control emissions from the Finish Mill #4 system (ARM 17.8.749).

11. Holcim shall operate, and maintain a baghouse to control emissions from the pozzolan material storage silo (ARM 17.8.752).

12. Holcim shall use and maintain enclosures around the pozzolan material system components listed below (ARM 17.8.752).

    a. Rotary feeder
    b. Weigh-belt conveyor
    c. Screw line (conveyor)

13. Holcim shall use water spray, as necessary, to maintain compliance with the opacity limitation in Section II.C.14 when handling landfilled cement kiln dust (CKD) (ARM 17.8.752).

14. Whenever process equipment is operating, Holcim shall use and maintain, as they were intended, conveyor covers, transfer point covers, or structural enclosures surrounding process equipment (ARM 17.8.749).

B. Operational Limitations

1. In the cement kiln, Holcim is authorized to burn up to 100% natural gas, up to 100% coal, up to 100% coke, up to 15% whole tires, or any combination of these fuels within the previously stated limits (ARM 17.8.749).

2. Holcim shall comply with the sulfur in fuel rule (ARM 17.8.322).

3. Holcim shall not use more than 50,000 tons of pozzolan material during any rolling 12-month time period (ARM 17.8.752).

4. The amount of post-consumer recycled container glass used by Holcim in the cement kiln is limited to 800 tons during any rolling 12-month time period (ARM 17.8.752).

5. Holcim shall not handle more than 85,000 tons of landfilled CKD during any rolling 12-month time period (ARM 17.8.752).

6. Holcim shall limit kiln production to 425,000 tons of clinker during any rolling 12-month time period (ARM 17.8.749).

7. Holcim shall limit clinker handling to 500,000 tons during any rolling 12-month time period (ARM 17.8.749).

8. Holcim shall combust only passenger and/or light truck tires as the tire-derived supplemental fuel for the kiln (ARM 17.8.749).

9. Holcim shall not combust tires in an amount that exceeds 15% of the total fuel heat input to the kiln (measured on a Btu basis) during any rolling 12-month time period (ARM 17.8.749).

10. Holcim shall not insert more than two tires into the kiln per kiln revolution (ARM 17.8.749).

11. Holcim shall not combust more than 1,137,539 tires during any rolling 12-month time period (ARM 17.8.749).

12. While tires are being combusted in the kiln, Holcim shall maintain the hourly average burning zone temperature of the kiln above 2,100 degrees Fahrenheit (°F). The burning zone temperature of 2,100° F shall be maintained for 30 minutes after the insertion of tires has stopped, unless a power surge, fuel feed malfunction, main drive failure, induced draft (ID) fan failure, or slurry feed failure prevents Holcim from maintaining this temperature. The burning zone temperature of the kiln shall be continuously monitored and recorded (ARM 17.8.749 and ARM 17.8.752).

13. In the event of an upset or malfunction of the air pollution control device for the kiln main stack that lasts 15 minutes or more, Holcim shall discontinue the insertion of tires into the kiln until the upset or malfunction condition is corrected and the air pollution control device for the kiln is functioning (ARM 17.8.749).

14. Holcim is authorized to use iron ore and ASARCO slag in the cement kiln. Holcim shall not use any other iron source without prior written approval from the Department (ARM 17.8.749).

15. Holcim shall limit the amount of ASARCO slag used in the cement kiln to 16,535 tons (15,000 metric tons) during any rolling 12-month time period (ARM 17.8.749).

C. Emission Limitations

1. Holcim shall not cause or authorize to be discharged into the atmosphere from the kiln, any stack emissions that:

   a. Contain particulate matter in excess of 0.77 pounds per ton (lb/ton) of clinker produced (ARM 17.8.749 and ARM 17.8.752).

   b. Contain oxides of nitrogen (NO_x) emissions in excess of 1,568 pounds per hour (lb/hr) averaged over any rolling 30-day period, calculated from seven a.m. to seven a.m. on a daily basis (ARM 17.8.749 and November 16, 2001, Board of Environmental Review (Board) Order).

   c. Contain sulfur dioxide (SO_2) emissions in excess of 124 lb/hr averaged over any rolling 30-day time period, calculated from seven a.m. to seven a.m. on a daily basis (ARM 17.8.749 and November 16, 2001, Board Order).

   d. Contain dioxins and furans in excess of 0.20 nanograms per dry standard cubic meter (ng per dscm) (8.7×10^{-11} grains per dry standard cubic foot (gr per dscf)) (toxicity equivalents (TEQ)) corrected to 7% oxygen, or dioxins and furans in excess of 0.40 ng per dscm (1.7×10^{-10} gr per dscf) (TEQ) corrected to 7% oxygen, when the average of the performance test run average temperatures at the inlet to the particulate matter control device is 204 degrees Celsius °C (400° F) or less (40 CFR 63.1343 and ARM 17.8.342).

   e. Contain VOC in excess of 2.25 lb/hr (ARM 17.8.749 and ARM 17.8.752).

   f. Exhibit an opacity of 20% or greater averaged over 6 consecutive minutes. Compliance with this condition shall be based on the data from the continuous opacity monitoring system (COMS) (ARM 17.8.749).

2. Once tires are combusted in the kiln, Holcim shall limit the hours of operation, the capacity, the emission rate, and/or the fuel consumption of the kiln such that the CO emissions from the kiln do not exceed 310 tons during any rolling 12-month time period. Any calculations used to establish CO emissions shall be approved by the Department in writing and shall be based on the CO emissions measured by the CO continuous emission monitoring system (CEMS) for the kiln, unless otherwise approved by the Department in writing (ARM 17.8.752).

3. Holcim shall not cause or authorize to be discharged into the atmosphere from the burning of tires in the kiln, emissions that contain:

   a. Arsenic (As) in excess of 7.15×10^{-5} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   b. Beryllium (Be) in excess of 8.17×10^{-6} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   c. Cadmium (Cd) in excess of 5.01×10^{-4} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   d. Total Chromium (Cr) in excess of 1.09×10^{-5} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   e. Dioxins and furans in excess of 6.00×10^{-9} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   f. Lead (Pb) in excess of 4.68×10^{-3} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   g. Manganese (Mn) in excess of 3.16×10^{-2} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   h. Mercury (Hg) in excess of 3.99×10^{-3} lb/hr (ARM 17.8.749 and ARM 17.8.752).

   I. Total Polycyclic Aromatic Hydrocarbons (PAH) in excess of 1.89×10^{-2} lb/hr (ARM 17.8.749 and ARM 17.8.752).

4. Holcim shall not cause or authorize to be discharged into the atmosphere any visible fugitive emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.308).

5. Holcim shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter (ARM 17.8.308(2)).

6. Holcim shall treat all unpaved portions of the haul roads, access roads, parking lots, and the general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precaution limitation in Section II.C.5 (ARM 17.8.749).

7. Holcim shall not cause or authorize to be discharged into the atmosphere visible emissions from any source installed on or before November 23, 1968, that exhibit an opacity of 40% or greater averaged over 6 consecutive minutes (ARM 17.8.304(1)).

8. Holcim shall not cause or authorize to be discharged into the atmosphere visible emissions from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.304(2)).

9. Holcim shall not cause or authorize the following to be discharged into the atmosphere, from the Finish Mill #2 baghouse:

    a. Particulate matter in excess of 0.02 gr/dscf (ARM 17.8.752); and

    b. Visible emissions that exhibit an opacity of 10% or greater averaged over 6 consecutive minutes (40 CFR Part 60, Subpart F and ARM 17.8.340).

10. Holcim shall not cause or authorize the following to be discharged into the atmosphere from the Dixie Mill baghouse(s):

    a. Particulate matter in excess of 0.02 gr/dscf (ARM 17.8.752); and

    b. Visible emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (40 CFR Part 60, Subpart F and ARM 17.8.340).

11. Holcim shall not cause or authorize the following to be discharged into the atmosphere from the coke system baghouse:

    a. Particulate matter in excess of 0.02 gr/dscf (ARM 17.8.752); and

    b. Visible emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (40 CFR Part 60, Subpart F and ARM 17.8.340).

12. Holcim shall not cause or authorize the following to be discharged into the atmosphere from the pozzolan material silo baghouse (ARM 17.8.752):

    a. Particulate matter in excess of 0.02 gr/dscf; and

    b. Visible emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

13. Holcim shall comply with all applicable requirements of ARM 17.8.340, which references 40 CFR Part 60, Standards of Performance for New Stationary Sources.

    a. Subpart F, Standards of Performance for Portland Cement Plants, applies to sources at Holcim including, but not limited to, the following:

        i. Finish Mill #2;
        ii. Finish Mill #4; and
        iii. Storage Silos #26 through 30.

    b. Holcim shall not cause or authorize to be discharged into the atmosphere from the Finish Mill #4 visible emissions that exhibit 10% opacity or greater (40 CFR Part 60, Subpart F and ARM 17.8.340).

    c. Holcim shall not cause or authorize to be discharged into the atmosphere from Storage Silos #26 through 30 visible emissions that exhibit 10% opacity or greater (40 CFR Part 60, Subpart F and ARM 17.8.340).

14. Holcim shall not cause or authorize to be discharged into the atmosphere visible emissions that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes when handling landfilled CKD (ARM 17.8.749).

15. Holcim shall comply with all applicable provisions of 40 CFR 63, Subpart LLL, National Emission Standards for Hazardous Air Pollutants (NESHAP) from the Portland Cement Manufacturing Industry. The Holcim Trident facility was designated an area source for the purposes of determining the applicability of Portland Cement Maximum Achievable Control Technology (PC MACT) (40 CFR 63, Subpart LLL and ARM 17.8.342).

D. Testing Requirements

1. Holcim shall conduct performance source tests on the kiln to determine compliance with the applicable particulate emission limit in Section II.C.1.a at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

2. Holcim shall use the data from the NO_x and SO_2 CEMS to monitor compliance with the NO_x and SO_2 emission limits in Section II.C.1.b and II.C.1.c (ARM 17.8.749 and November 16, 2001, Board Order).

3. Holcim shall use data from the CO CEMS to monitor compliance with the CO emission limit in Section II.C.2 (ARM 17.8.749).

4. Holcim shall use the data from the COMS to monitor compliance with the opacity limit contained in Section II.C.1.f. In the event the COMS is not operational, Holcim shall use visible emission observations to assess compliance with the opacity limit in Section II.C.1.f (ARM 17.8.749).

5. Holcim shall monitor compliance with the limit in Section II.C.1.d and the PC MACT dioxin and furans emission limits contained in 40 CFR 63, Subpart LLL, by conducting source tests on the kiln for dioxins and furans. The source tests shall be conducted under conditions representative of Holcim's maximum operating conditions and shall be conducted in accordance with the methodology described in 40 CFR 63, Subpart LLL. Holcim shall conduct these compliance source testing demonstrations for the kiln at least once every 30 months, unless otherwise approved by the Department in writing (ARM 17.8.105, ARM 17.8.749, and 40 CFR 63, Subpart LLL).

6. Within 180 days after Holcim first burns tires as a fuel in the kiln, Holcim shall conduct a source test on the kiln for VOC to demonstrate compliance with the limit in Section II.C.1.e and the PC MACT area source determination. The source test shall be conducted under conditions representative of Holcim's maximum operating conditions using tires as a fuel and according to an EPA approved method or according to another test method approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

7. Without using tires as a fuel in the kiln, Holcim shall conduct a source test on the kiln for As, Be, Cd, Cr (total), dioxins and furans, Pb, Mn, Hg, and PAH (total) to establish baseline emissions for these pollutants. The source test shall be conducted under conditions representative of Holcim's maximum operating conditions without using tires as a fuel and according to an EPA approved method or according to another test method approved by the Department in writing. Additional baseline source testing demonstrations for the kiln shall occur at least once per year thereafter or according to another testing/monitoring schedule as may be approved by the Department in writing. After three source tests have been performed to show a representative baseline, Holcim may request a review of the testing frequency (ARM 17.8.105 and ARM 17.8.749).

8. Within 180 days after Holcim first burns tires as a fuel in the kiln, Holcim shall conduct a source test on the kiln for As, Be, Cd, Cr (total), dioxins and furans, Pb, Mn, Hg, and PAH (total). The source test shall be conducted under conditions representative of Holcim's maximum operating conditions using tires as a fuel and according to an EPA approved method or according to another test method approved by the Department in writing. The measured emissions from the baseline testing required by Section II.D.7 shall be subtracted from the measured emissions while using tires as part of the fuel mixture, and the difference in emissions shall be used to monitor compliance with the As, Be, Cd, Cr (total), dioxins and furans, Pb, Mn, Hg, and PAH (total) limits in Section II.C.3. Additional compliance source testing demonstrations for the kiln shall occur at least once per year thereafter or according to another testing/monitoring schedule as may be approved by the Department in writing. After three consecutive source tests have been performed that demonstrate compliance with the permit limits, Holcim may request a review of the testing frequency (ARM 17.8.105 and ARM 17.8.749).

9. Holcim shall conduct visible emission observations to assess compliance with the opacity limit in Section II.C.9 for the Finish Mill #2 baghouse at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.340).

10. Holcim shall conduct particulate performance source tests on the Finish Mill #2 baghouse to determine compliance with the applicable particulate emission limit in Section II.C.9 at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105, ARM 17.8.749, and ARM 17.8.340).

11. Holcim shall conduct visible emission observations to assess compliance with the opacity limit in Section II.C.10 for the Dixie Mill baghouse at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

12. Holcim shall conduct particulate performance source tests on the Dixie Mill baghouse to determine compliance with the applicable particulate emission limit in Section II.C.10 at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

13. Holcim shall conduct visible emission observations to assess compliance with the opacity limit in Section II.C.11 for the coke system baghouse at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

14. Holcim shall conduct particulate performance source tests on the coke system baghouse to determine compliance with the applicable particulate emission limit in Section II.C.11 at least once every 5 years or according to another testing/monitoring schedule as may be approved by the Department in writing (ARM 17.8.105 and ARM 17.8.749).

15. All compliance source tests shall conform to the requirements of the Montana Source Test Protocol and Procedures Manual (ARM 17.8.106).

16. The Department may require further testing (ARM 17.8.105).

E. Continuous Monitoring System Requirements

1. Holcim shall install, operate, calibrate, and maintain the following:

   a. A CEMS for the measurement of SO_2 from the kiln stack (ARM 17.8.749 and November 16, 2001, Board Order).

   b. A CEMS for the measurement of NO_x from the kiln stack (ARM 17.8.749 and November 16, 2001, Board Order).

   c. A CEMS for the measurement of CO from the kiln stack. Within 180 days after Holcim first burns tires as a fuel in the kiln, Holcim shall install and calibrate the CO CEMS (ARM 17.8.749).

   d. A COMS for the measurement of opacity from the kiln stack. Within 180 days after Holcim first burns tires as a fuel in the kiln, Holcim shall install and calibrate the COMS (ARM 17.8.749).

   e. A flow monitoring system for the measurement of the volumetric flowrate from the kiln stack (ARM 17.8.749).

   f. A temperature monitoring system for the measurement of the burning zone temperature of the kiln (ARM 17.8.749).

2. All continuous monitors required by this permit shall be operated, excess emissions reported, and performance tests conducted in accordance with the requirements of 40 CFR Part 60, Appendix B (Performance Specifications #1, #2, #4, #4a, and #6) (ARM 17.8.749 and November 16, 2001, Board Order).

3. On-going quality assurance requirements for the CEMS must conform to 40 CFR Part 60, Appendix F (ARM 17.8.749).

4. Holcim shall inspect and audit the COMS annually. Holcim shall conduct these audits using the appropriate procedures contained in the performance specifications contained in 40 CFR 60, Appendix B (Performance Specification #1), and approved by the Department in writing (ARM 17.8.749).

5. Holcim shall maintain on site records of all measurements from the CEMS: CEMS performance testing measurements; CEMS performance evaluations; CEMS calibration checks and audits; and, any adjustments or maintenance performed on the CEMS. The records shall be retained on site for at least 5 years following the date of such measurements and reports. Holcim shall supply these records to the Department upon request (ARM 17.8.749).

6. Holcim shall provide to the Department reports from the NO_x, SO_2, and CO CEMS that conform to 40 CFR Section 60.7 (c). Holcim shall provide these reports on a quarterly basis for the first year after the CEMS are operating and the performance specification procedures have been approved in writing by the Department and semiannually thereafter (ARM 17.8.749 and November 16, 2001, Board Order).

7. Holcim shall maintain on site records of all measurements from the COMS, COMS performance testing measurements, COMS performance evaluations, COMS calibration checks and audits, and any adjustments or maintenance performed on the COMS. The records shall be retained on site for at least 5 years following the date of such measurements and reports. Holcim shall supply these records to the Department upon request (ARM 17.8.749).

8. Holcim shall maintain on site records of all calibration checks, audits, and adjustments or maintenance performed on the flow monitoring and temperature monitoring systems required in Section II.E.1.e and Section II.E.1.f (ARM 17.8.749).

F. Operational Reporting Requirements

1. Holcim shall supply the Department with annual production information for all emission points, as required by the Department in the annual emission inventory request. The request will include, but will not be limited to, all sources of emissions identified in the permit analysis. Production information must be gathered on a calendar-year basis and submitted to the Department by the date required in the emission inventory request. Information must be in the units required by the Department. This information may be used for calculating operating fees, based on actual emissions from the facility, and/or to verify compliance with permit limitations. Holcim shall submit the following information annually to the Department by March 1 of each year (ARM 17.8.505):

   a. the total tons of pozzolan material used;
   b. the amount of post-consumer recycled container glass used in the kiln;
   c. the amount of CKD excavated;
   d. the amount of clinker produced in the kiln;
   e. the amount of clinker handled;
   f. the number of tires used as fuel in the kiln; and
   g. the amount of ASARCO slag used in the kiln.

   This information may be submitted along with the annual emission inventory.

2. Holcim shall notify the Department of any construction or improvement project conducted pursuant to ARM 17.8.745(1), that would include a change in control equipment, stack height, stack diameter, stack flow, stack gas temperature, source location, or fuel specifications, or would result in an increase in source capacity above its permitted operation or the addition of a new emission unit. The notice must be submitted to the Department, in writing, 10 days prior to start up or use of the proposed de minimis change, or as soon as reasonably practicable in the event of an unanticipated circumstance causing the de minimis change, and must include the information requested in ARM 17.8.745(1)(d) (ARM 17.8.745).

3. Holcim shall document, by month, the amount of pozzolan material used in the pozzolan material system. By the 25th day of each month, Holcim shall total the amount of pozzolan material used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.3. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

4. Holcim shall document, by month, the amount of post-consumer recycled container glass used in the kiln. By the 25th day of each month, Holcim shall total the amount of recycled glass used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.4. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

5. Holcim shall document, by month, the amount of landfilled CKD handled. By the 25th day of each month, Holcim shall total the amount of CKD handled during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.5. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

6. Holcim shall document, by month, the amount of clinker produced. By the 25th day of each month, Holcim shall total the amount of clinker production during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.6. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

7. Holcim shall document, by month, the amount of clinker handling. By the 25th day of each month, Holcim shall total the amount of clinker handling during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.7. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

8. Holcim shall document, by day, the percentage of total fuel heat input that is provided to the kiln by the combustion of tires. By the 25th day of each month, Holcim shall total the percentage of total fuel heat input that was provided to the kiln by the combustion of tires during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.9. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

9. Holcim shall document, by month, the number of tires placed in the kiln for combustion. By the 25th day of each month, Holcim shall total the number of tires placed in the kiln during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.11. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

10. By the 25th day of each month, Holcim shall document the hourly average burning zone temperatures for the previous month. The monthly information will be used to verify compliance with the limitation in Section II.B.12. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

11. Holcim shall document the use of tires as a supplemental fuel source for the kiln during upset or malfunction conditions to monitor compliance with Section II.B.13. The records must include, but are not limited to, the date and time of the upset, type or category of upset, the duration of the upset, a description of whether or not the tires were removed from the feed and, if so, when they were removed, and when the tires were re-inserted (ARM 17.8.749).

12. Holcim shall document, by month, the amount of ASARCO slag used in the kiln. By the 25th day of each month, Holcim shall total the amount of ASARCO slag used for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.B.15. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

13. Holcim shall document, by month, the amount of CO emissions from the kiln. By the 25th day of each month, Holcim shall total the CO emission from the kiln during the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.C.2. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

14. Holcim shall document that conveyor covers, transfer point covers, or structural enclosures surrounding process equipment were maintained and in place during operation of process equipment. The records shall include all repair and maintenance activity to all conveyor covers, transfer point covers, or structural enclosures. The records must include, but are not limited to, the date, time, and action(s) taken for repair and maintenance (ARM 17.8.749).

15. All records compiled in accordance with this permit must be maintained by Holcim as a permanent business record for at least 5 years following the date of the measurement, must be available at the plant site for inspection by the Department, and must be submitted to the Department upon request (ARM 17.8.749).

Notification

1. Holcim shall provide the Department with the general engineering design specifications and a brief overview and discussion of the gate used to drop tires into the kiln in writing at least 15 days prior to commencement of construction of the kiln modification (ARM 17.8.749).

2. Holcim shall notify the Department within 24 hours after first using tires as a fuel for the kiln and provide written notification within 7 days after first using tires as a fuel for the kiln (ARM 17.8.749).

SECTION III: General Conditions

A. Inspection – Holcim shall allow the Department's representatives access to the source at all times for the purpose of making inspections or surveys, collecting samples, obtaining data, auditing any monitoring equipment (CEMS, COMS, and CERMS) or observing any monitoring or testing, and otherwise conducting all necessary functions related to this permit.

B. Waiver – The permit and all the terms, conditions, and matters stated herein shall be deemed accepted if Holcim fails to appeal as indicated below.

C. Compliance with Statutes and Regulations – Nothing in this permit shall be construed as relieving Holcim of the responsibility for complying with any applicable federal or Montana statute, rule or standard, except as specifically provided in ARM 17.8.740, *et seq.* (ARM 17.8.756).

D. Enforcement – Violations of limitations, conditions and requirements contained herein may constitute grounds for permit revocation, penalties or other enforcement as specified in Section 75-2-401, *et seq.*, MCA.

E. Appeals – Any person or persons jointly or severally adversely affected by the Department's decision may request, within 15 days after the Department renders its decision, upon affidavit setting forth the grounds therefore, a hearing before the Board. A hearing shall be held under the provisions of the Montana Administrative Procedures Act. The filing of a request for a hearing does not stay the Department’s decision, unless the Board issues a stay upon receipt of a petition and a finding that a stay is appropriate under Section 75-2-211(11)(b), MCA. The issuance of a stay on a permit by the Board postpones the effective date of the Department’s decision until conclusion of the hearing and issuance of a final decision by the Board. If a stay is not issued by the Board, the Department’s decision on the application is final 16 days after the Department’s decision is made.

F. Permit Inspection – As required by ARM 17.8.755, Inspection of Permit, a copy of the air quality permit shall be made available for inspection by Department personnel at the location of the permitted source.

G. Permit Fee – Pursuant to Section 75-2-220, MCA, failure to pay the annual operation fee by Holcim may be grounds for revocation of this permit, as required by that section and rules adopted thereunder by the Board.

H. Construction Commencement – Construction must begin within 3 years after permit issuance and proceed with due diligence until the project is complete or Permit #0982-11 shall expire. If the permit expires, Holcim shall not commence construction until Holcim has applied for and received a new air quality permit pursuant to Sections 75-204, 75-2-211, and 75-2-215, MCA, and ARM 17.8.740, et seq., as amended (ARM 17.8.762).

PERMIT ANALYSIS
Holcim (US) Inc.
Permit #0982-11

I. Introduction/Process Description

A. Permitted Equipment

Holcim (US) Inc. (Holcim) operates the following equipment at the Trident facility located in the Northeast ¼ of Section 9, Southeast ¼ of Section 4, Southwest ¼ of Section 3, and Northwest ¼ of Section 10, Township 2 North, Range 2 East, approximately 5 miles northeast of Three Forks in Gallatin County, Montana.

Source Description	Control Equipment	Efficiency
Disturbed Area – Fugitive	None	NA
Drilling	None	NA
Blasting	None	NA
Limestone, Sand, Shale Removal	None	NA
Transfer, Conveying, and Screening	None	NA
Raw Material Storage Piles	None	NA
Haul Roads – Fugitives	Dust suppression	85%
Primary Crusher	Fabric filter	99%
Crusher Screen	Fabric filter	99%
Raw Material Silo #1	Fabric filter	99%
Raw Material Silos #2 and 3	Fabric filter	99%
Raw Material Silos #4 and 5	Fabric filter	99%
Raw Material Silos #6 and 7	Fabric filter	99%
Coal/Coke Unload Fugitive	None	NA
Coal/Coke Transfer Handling Fugitive	None	NA
Coal Outside Storage Pile	None	NA
Coke Outside Storage Pile	None	NA
Coal Crusher	Fabric filter	99%
Coal Silo – Loading	Fabric filter	99%
Coal Silo - Unloading	Fabric filter	99%
Fluid Coke Silo – Loading	None	NA
Fluid Coke Silo Unloading	None	NA
Kiln	ESP	99.4%
Clinker Cooler	Fabric filter	99.8%
Inside Clinker Transfer	Fabric filter	99.8%
Gypsum/Clinker Storage Silo	Fabric filter	99%
Cement Kiln Dust (CKD) Storage Load	Fabric filter	99%
CKD Storage Unloading	Dust suppression	50%
Emergency Clinker Bins Loading	Fabric filter	99%
Emergency Clinker Storage Silo 1	None	NA
Emergency Clinker Storage Silo 2	None	NA
Emergency Clinker Storage Silo 3	None	NA
Emergency Clinker Storage Silo 4	None	NA
#2 Finish Mill	Fabric filter	99%
Clinker Transfer #2 Finish Mill	Fabric filter	99%
#3 Finish Mill Transfer	Fabric filter	99%
#3 Finish Mill	Fabric filter	99%
Clinker Transfer #4 Finish Mill	Fabric filter	99%
#4 Finish Mill Product Separator	Fabric filter	99.8%
#4 Finish Mill Vent	Fabric filter	99.8%
Finish Mill Materials Unloading System	Fabric Filter	98%
Masonry Storage Bins 1- 3	Fabric filter	95%
Cement Storage Silos 4 – 5	Fabric filter	99%
Cement Sack Machine #1	Fabric filter	98%
Cement Sack Machine #2	Fabric filter	98%
Cement Sack Machine #3	Fabric filter	98%
Cement Sack Machine #4	Fabric filter	98%
Cement Silos 1-7, 10, 11, 13	Fabric filter	99%
Cement Silos #8, 9, 12	Fabric filter	99%
Cement Transfer 1-13 to Bulk	Fabric filter	99%

Source Description	Control Equipment	Efficiency
Cement Storage Silo 14-25	Fabric filter	99%
Cement Storage Silo 26-30	Fabric filter	99%
Bulk Cement Transfer and Truck Loadout 1	Fabric filter	99%
Bulk Cement Transfer and Truck Loadout 2	Fabric filter	99%
Bulk Cement Rail Car Loadout	Fabric filter	99%
Diesel Fuel	None	NA
Gasoline	None	NA
Pozzolan Material Storage Silo	Fabric filter	99%
Rotary Feeder	Fabric filter	95%
Weighbelt Conveyor	Fabric filter	95%
Screw Line (conveyor)	Fabric filter	95%
Handling Landfilled CKD	Water spray	50%
Waste Oil Burner	None	NA

B. Facility Description

Holcim operates the Trident Portland cement manufacturing plant near Three Forks, Montana. The facility operates 24 hours per day and 365 days per year, with periods of routine maintenance. Raw materials, such as limestone, shale, and sandstone, are mined at the Trident site. Raw materials are mined or purchased, crushed, screened, and stored on-site in dedicated silos.

Measured amounts of each material are conveyed to the raw materials mill where water is added and the mixture is pulverized to a “fine” slurry. The slurry is sent to the kiln, where clinker is produced. Clinker is then sent to the clinker cooler and cooled from approximately 2,500 degrees Fahrenheit (° F) to 150° F and then transferred to storage silos or alternative storage sites if the silos are full. Clinker is mixed with 5% gypsum and pulverized to produce Portland cement. The cement enters a high efficiency air separator and is sent to a dust collector. Cement from the dust collector is sent to a cement cooler via an air slide and the cooled cement is then pneumatically conveyed to onsite cement storage silos.

C. Permit History

On April 27, 1971, the Ideal Cement Company received **Permit #282-072171**. This permit approved the construction of 10 pieces of control equipment, as follows:

1. An electrostatic precipitator to control kiln emissions sized for 300,000 cubic feet per minute (cfm) @ 700 °F, 15 grains per actual cubic feet perm minute (gr/acfm) inlet, 0.15 gr/acfm outlet, and 99.9% efficiency.

2. A pulsejet type baghouse to control clinker cooler emissions sized for 100,000 cfm @ 350 °F, 8.3: 1 air/cloth ratio, and Nomex bags.

3. Four Micro-pulsaire dust collectors on the rock silos as follows:

   A total of two @ 7.4:1 air/cloth ratio, 843 square feet (ft^2) cloth area, Model IF124
   A total of two @ 7.8:1 air/cloth ratio, 670 ft^2 cloth area

4. Two Micro-pulsaire dust collectors to control emissions from crushing and screening as follows:

   Crushing – Micro-pulsaire model IFI-48, 7200-cfm capacity fan
   Screening – Micro-pulsaire model IFI-24, 6400-cfm capacity fan

5. One small baghouse to control emissions at the clinker belt conveyor.

6. One small baghouse to control emissions at the dustbin near the precipitator.

On May 3, 1971, the Ideal Cement Company received **Permit #293-080471** to construct five pieces of equipment.

1. Primary Crusher, 450 tons per hour
2. Vibrating Screen, 6 ft x 12 ft, Missouri-Rodgers
3. Raw Mill, 11 ft x 34 ft, Bawl Mill, 2,000 hp, F.L. Smith
4. Kiln, 12 ft x 450 ft, Wet Process Rotary Kiln, F.L. Smith, 400 hp, kiln draft fan
5. Clinker Cooler, Folax Grates, F.L. Smith

Commitments to the construction of this equipment were made prior to August 17, 1971, so the equipment is not subject to 40 CFR 60, Subpart F, Standards of Performance for Portland Cement Plants.

On April 16, 1975, the Ideal Cement Company was issued **Permit #811-050475** to combust coal in the cement kiln.

On July 19, 1976, Ideal Basic Industries was issued **Permit #982** to construct four Portland cement storage silos. These silos were controlled by a baghouse.

On January 6, 1984, a modification to **Permit #811-050475** was issued to Ideal Basic Industries, that allowed the gas/coal-fired cement kiln to burn a coal (75%)/coke (25%) combination fuel. However, as a result of increases in oxides of nitrogen (NO_x) emissions observed from the August 1983 source tests, the Montana Department of Health and Environmental Sciences issued a letter on January 9, 1984, that stated they would grant a permit modification only if there were no increases in emissions. Therefore, additional NO_x source testing was completed in June and August of 1985 and July of 1986. Results of the July, 1986 testing showed that a major permit modification was not required. On June 25, 1986, an application was submitted from Ideal Basic Industries to burn up to 50% coke, but a permit was not issued.

On August 9, 1990, Holnam submitted Permit Application #0982-01 for the use of alternative fuels in the cement kiln. **Permit application #0982-01** was withdrawn.

On November 22, 1993, Holnam submitted Permit Application #0982-02 for the replacement of sections of the cement kiln. The changes proposed in the application were determined to be maintenance and did not require a permit change. **Permit application #0982-02** was withdrawn.

Permit #0982-03 was issued to Holnam on July 29, 1995. Holnam proposed to upgrade the existing cement Finish Mill #2 baghouse to a modern baghouse; replace the Finish Mill #2 air slide; replace two existing dust collectors on the coal/coke process with one unit; and construct a separate coke grinding, storage, and transport system with dust collection. The Finish Mill #2 baghouse, which replaced an existing baghouse, controlled the emission units listed below.

1. A replacement air slide
2. The clinker/gypsum feed belt via a booster fan
3. The Finish Mill #2
4. The bucket elevator
5. The product separator

The air slide which was totally enclosed and necessary for the transport of cement from the elevator to the product separator (air separator) was replaced along with two existing dust collectors on the coal/coke baghouse which controlled the equipment listed below.

1. A diverter valve at the top of the existing coal/coke storage silo
2. A 24-inch covered screw conveyor that transports the coke from the above diverter valve
3. A 290-ton "raw" coke storage silo
4. Two diverter valves
5. The hammermill
6. The bucket elevator
7. The coal/coke storage silo
8. The covered screw conveyor

The separate coke system transported coke on the existing path up to the point of delivery into the top of the coal/coke storage silo. At this point, the system incorporated a gate that discharged into a 290-ton capacity "raw" coke storage silo. Coal was diverted into the existing coal/coke storage silo. The proposed raw coke storage silo gravity fed onto a covered belt assembly, where the material was weighed before it was gravity fed into the coke-grinding mill. The ground coke fines were then evacuated from the coke-grinding mill via a 15,400-cfm fan that pneumatically transported the crushed coke to the proposed coke system baghouse where the gas and solid phases were separated. The ground "fine" coke material discharged from this dust collector into a 220-ton "fine" coke storage silo. Pneumatic transport of the fine coke particles from this silo to the kiln hood was facilitated by a coke blower system. The proposed coke system baghouse and fan controlled the equipment listed below.

1. A belt conveyor with weighing system at the base of the raw coke storage silo
2. A coke grinding mill
3. A 220-ton "fine" coke storage silo

The emission increase as a result of the changes was estimated at 10.84 tons/year of particulate matter.

On March 30, 1998, Holnam submitted a complete permit application proposing a pozzolan material (fly ash) system that included the following new equipment: pozzolan material storage silo with bin vent dust collector, rotary feeder, weighbelt conveyor, and screw line (conveyor). Holnam intended to introduce pozzolan material at the finish mill to produce Holnam Performance Cement (HPC). Controlled particulate matter under 10 microns (PM_{10}) emissions from the equipment were approximately 2.10 tons per year. The permit also updated the permit with current rule references. Permit #0982-03 had included conditions from Permits #282-072171, #293-080471, #811-050475, #982, and Modification #811-050475. Therefore, Permit #0982-04 also replaced these permits. **Permit #0982-04** replaced Permit #0982-03.

On April 29, 1998, Holnam submitted a modification request to allow Holnam to conduct a test burn that exceeded the operational limit to burn up to 25% petroleum coke. The amount of petroleum coke burned in the kiln was limited so that 15 tons per year of sulfur dioxide (SO_2) was not exceeded; therefore, this test burn was completed according to the Administrative Rules of Montana (ARM) 17.8.705(1)(q). However, as described in ARM 17.8.733(1)(c), the permit needed to be modified to allow the temporary burning of petroleum coke in excess of the permitted limitation. Holnam was required to comply with the sulfur-in-fuel requirements contained in ARM 17.8.322(6)(c) and to maintain records to demonstrate compliance with the petroleum coke limitation in Section II.F.1.b of Permit #0982-05. In addition, testing was required to determine emissions at the maximum rate of petroleum coke burned. **Permit #0982-05** replaced Permit #0982-04.

The Department received notification that test burning began on November 14, 1999, and concluded on November 14, 2000. Coke test burn air emission source testing was conducted November 1 through 14, 2000.

On December 12, 1998, Holnam submitted a modification request to remove the 99.9% particulate control efficiency requirement for the electrostatic precipitator (ESP) in Section II.A.4 of the permit. The change did not result in an increase in allowable particulate emission rates from the kiln. **Permit #0982-06** replaced Permit #0982-05.

Holnam proposed (in permit application #0982-07) to use 800 tons/year of post-consumer recycled container glass in the kiln and to handle 85,000 tons/year of landfilled cement kiln dust (CKD). Holnam submitted an emission inventory that identified 5.13 pounds/year of emissions of hazardous air pollutants (HAP) being emitted as a result of using post-consumer recycled container glass. Holnam submitted a health risk assessment that demonstrated that this proposal constituted a negligible risk to human health and the environment. In addition, handling 85,000 tons/year of landfilled CKD involved moving landfilled dust from the landfill with a front-end loader to a truck. A small portion of the CKD was sold for use in reclamation projects. Handling the CKD resulted in an emissions increase of approximately 23.8 tons per year of total particulate matter and 11.9 tons/year of PM_{10}. **Permit #0982-07** replaced Permit #0982-06.

On December 7, 1999, Holnam requested a permit modification to correct condition II.B.5, which was intended to limit the use of pozzolan material fed through the pozzolan material system. This was intended to be specific to the pozzolan material storage silo, rotary feeder, weighbelt conveyor, screw line, and bin vent dust collector, and not the entire facility. Also, condition II.E.3 was updated to reflect this correction. **Permit #0982-08** replaced Permit #0982-07.

On August 10, 2000, Holnam submitted a permit application to request federally enforceable permit conditions to limit potential particulate matter emissions. Holnam requested the federally enforceable conditions to ensure that the facility's potential emissions would be within the "area source" definition as defined in the Portland Cement Maximum Achievable Control Technology (PC MACT) standard. Although this permit action could have been accomplished through a permit modification, an alteration was requested by Holnam to allow the public to comment on the permit. De minimis changes were also added to the permit (Department Decision) during the comment period. **Permit #0982-09** replaced Permit #0982-08.

On February 20, 2001, the Department of Environmental Quality (Department) received a letter from Holnam requesting a de minimis change to Permit #0982-09 resulting from the recycling of CKD directly back into the kiln. The Department agreed that emissions from the transfer of CKD would be a de minimis change to Permit #0982-09. Holnam, therefore, was not required to obtain a permit alteration to commence with this project.

On April 6, 2001, Holnam submitted a complete permit application to the Department requesting a change in the fuel mixture to provide additional operational flexibility at the Trident facility. When the application was submitted, Holnam was authorized to burn up to 100% natural gas, up to 100% coal, up to 25% coke, or any combination of these fuels for the kiln, providing the coke limit is not exceeded. The modification of Permit #0982-09 would eliminate any limit on the amount of petroleum coke Holnam used as a fuel in its kiln, would place emissions limits on the amount of SO and NO_x emitted from the kiln and would mandate that Holnam monitor emissions of those pollutants through the use of continuous emissions monitors (CEMs).

Permit #0982-05 allowed Holnam to conduct a temporary test burn that exceeded the operational limit of 25% for petroleum coke at the facility. In November 2000, source testing was performed during the coke test burn to evaluate NO_x and SO_2 emissions as the coke feed exceeded 25%. The amount of emissions from the test burn was restricted to less than 15 tons per year of SO_2 in accordance with ARM 17.8.705(1)(q). Holnam was also required to comply with the sulfur-in-fuel requirements and maintain applicable records during the test. Analysis of the November 2000 source test data, provided by Holnam, suggested that NO_x and SO_2 emissions would not increase as a result of the increase in coke up to approximately 45% coke. However, in order to ensure that NO_x and SO_2 emissions from the kiln would not increase above significant levels, the Department established emission limits for NO_x and SO_2.

On April 11, 2001, Holnam submitted a request to modify preconstruction Permit #0982-09 to change or modify language in the permit. In general, requests included removal of detailed equipment names and facility documentation requirements for pozzolan material, post consumer recycled container glass, and amount of lime kiln dust handled from the "3rd day of each month" to the "10th day of each month." The Department included these changes in Permit #0982-10.

On June 19, 2001, The Sierra Club, Montana's Against Toxic Burning, and the Montana Environmental Information Center appealed Permit #0982-10. The appeal of Permit #0982-10 was dismissed by the Board of Environmental Review (Board) on November 16, 2001, based on a settlement between the petitioners and Holnam, and Permit #0982-10 was issued with modifications on December 04, 2001. **Permit #0982-10** replaced Permit #0982-09.

On November 14, 2001, the Department received written notification that Holnam, Inc. intended to officially change its name to Holcim on December 12, 2001. In a letter dated November 19, 2001, the Department approved the request to transfer under ARM 17.8.734(2) with all of Holcim's applicable permit conditions remaining the same.

D. Current Permit Action

On October 3, 2001, Holcim submitted an application to the Department for a modification to Montana Air Quality Permit #0982-1. The permit application requested that the mid-kiln combustion of whole tires be added to the list of potential fuels for the facility. The tires would comprise up to 15 percent of the total fuel heat input to the kiln on a British thermal unit (Btu) basis. Holcim is currently authorized to burn natural gas, coal, petroleum coke, or any combination of these as a fuel for the kiln. This project would entail some limited modification to the kiln shell and would require additional miscellaneous equipment to handle and store tires at the facility. Since Holcim applied for a solid waste incineration permit under 75-2-215, Montana Code Annotated (MCA), a human health risk assessment was required with the air quality application in accordance with ARM 17.8.770. In addition, analysis by Holcim determined that carbon monoxide (CO) emissions could potentially increase above the Prevention of Significant Deterioration (PSD) significance threshold; therefore, the PSD program applies CO from the project and an emission limit was established for CO. The current permit action also changes the name on the permit from Holnam, Inc. to Holcim. The Department received the request for the name change on November 14, 2001. According to that letter, the change became effective on December 12, 2001. After Holcim's submittal of additional supporting information, the Department deemed the application to be complete on February 12, 2003.

On March 24, 2003, a Preliminary Determination (PD) and draft Environmental Assessment (EA) were issued by the Department. On August 15, 2003, the Department issued a Final EA recommending that an Environmental Impact Statement (EIS) be completed for the project.

The Montana Environmental Policy Act (MEPA) requires that a cumulative impact analysis be conducted before a decision can be made on the permit application. The Department determined that the preparation of an EIS would generate the information necessary to conduct this analysis. Therefore, an EIS was completed for this project. In order to limit emissions and protect Montana's negligible risk standards, emissions limits for CO, volatile organic compounds (VOC), cadmium (Cd), total chromium (Cr), lead (Pb), arsenic (As), beryllium (Be), manganese (Mn), mercury (Hg), dioxins and furans, and total polycyclic aromatic hydrocarbons (PAH) were placed in Permit #0982-11. This permit also requires Holcim to install, operate, calibrate, and maintain a Continuous Opacity Monitoring System (COMS) on the kiln stack and limits the amount of ASARCO slag Holcim can use in the kiln on a rolling 12-month basis.

This supplemental PD contains information gathered during the EIS process and changes made to the permit since the initial PD was issued on March 23, 2003. For example, the supplemental PD requires Holcim to install, operate, calibrate, and maintain a Continuous Opacity Monitoring System (COMS) on the kiln stack and limits the amount of ASARCO slag that may be used in the kiln. All comments submitted on the initial PD have been reviewed by the Department and addressed by the Department in the supplemental PD, as appropriate. Furthermore, the supplemental PD will be attached to the draft EIS and open for public comment.

E. Additional Information

Additional information, such as applicable rules and regulations, Best Available Control Technology (BACT)/Reasonably Available Control Technology (RACT) determinations, air quality impacts, and environmental assessments, is included in the analysis associated with each change to the permit.

II. Applicable Rules and Regulations

The following are partial explanations of some applicable rules and regulations that apply to the facility. The complete rules are stated in the ARM and are available, upon request, from the Department. Upon request, the Department will provide references for locations of complete copies of all applicable rules and regulations or copies where appropriate.

A. ARM 17.8, Subchapter 1 - General Provisions, including, but not limited to:

1. ARM 17.8.101 Definitions. This rule includes a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.105 Testing Requirements. Any person or persons responsible for the emission of any air contaminant into the outdoor atmosphere shall, upon written request of the Department, provide the facilities and necessary equipment (including instruments and sensing devices) and shall conduct tests, emission or ambient, for such periods of time as may be necessary using methods approved by the Department.

3. ARM 17.8.106 Source Testing Protocol. The requirements of this rule apply to any emission source testing conducted by the Department, any source, or other entity as required by any rule in this chapter, or any permit or order issued pursuant to this chapter, or the provisions of the Clean Air Act of Montana, 75-2-101, *et seq.*, MCA.

Holcim shall comply with the requirements contained in the Montana Source Test Protocol and Procedures Manual, including, but not limited to, using the proper test methods and supplying the required reports. A copy of the Montana Source Test Protocol and Procedures Manual is available from the Department upon request.

4. ARM 17.8.110 Malfunctions. (2) The Department must be notified promptly by telephone whenever a malfunction occurs that can be expected to create emissions in excess of any applicable emission limitation, or to continue for a period greater than 4 hours.

5. ARM 17.8.111 Circumvention. (1) No person shall cause or permit the installation or use of any device or any means that, without resulting in reduction in the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant that would otherwise violate an air pollution control regulation. (2) No equipment that may produce emissions shall be operated or maintained in such a manner that a public nuisance is created.

B. ARM 17.8, Subchapter 2 - Ambient Air Quality, including, but not limited to:

1. ARM 17.8.204 Ambient Air Monitoring
2. ARM 17.8.210 Ambient Air Quality Standards for Sulfur Dioxide
3. ARM 17.8.211 Ambient Air Quality Standards for Nitrogen Dioxide
4. ARM 17.8.212 Ambient Air Quality Standards for Carbon Monoxide
5. ARM 17.8.220 Ambient Air Quality Standard for Settled Particulate Matter
6. ARM 17.8.221 Ambient Air Quality Standard for Visibility
7. ARM 17.8.222 Ambient Air Quality Standard for Lead
8. ARM 17.8.223 Ambient Air Quality Standard for PM_{10}

Holcim must maintain compliance with the applicable ambient air quality standards.

C. ARM 17.8, Subchapter 3 - Emission Standards, including, but not limited to:

1. ARM 17.8.304 Visible Air Contaminants. (1) This rule states that no person may cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed before November 23, 1968, that exhibit an opacity of 40% or greater averaged over 6 consecutive minutes. (2) This rule states that no person may cause or authorize emissions to be discharged into an outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

2. ARM 17.8.308 Particulate Matter, Airborne. (1) This rule states an opacity limitation of less than 20% for all fugitive emission sources and that reasonable precautions be taken to control emissions of airborne particulate. (2) Under this rule, Holcim shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter.

3. ARM 17.8.309 Particulate Matter Fuel, Burning Equipment. This rule states that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter caused by the combustion of fuel in excess of the amount determined by this rule.

4. ARM 17.8.310 Particulate Matter, Industrial Process. This rule states that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter in excess of the amount set forth in this rule.

5. ARM 17.8.322 Sulfur Oxide Emissions--Sulfur in Fuel. This rule states that no person shall burn liquid, solid, or gaseous fuel in excess of the amount set forth the in this rule.

6. ARM 17.8.340 Standard of Performance for New Stationary Sources. This rule incorporates, by reference, 40 CFR Part 60, Standards of Performance for New Stationary Sources (NSPS). Holcim is an NSPS affected facility under 40 CFR Part 60 and is subject to the requirements of the following subparts:

   40 CFR Part 60, Subpart A – The general provisions provided in 40 CFR Part 60 apply to all equipment or facilities subject to any subpart listed below.

   40 CFR Part 60, Subpart F – Standards of Performance for Portland Cement Plants. The provisions of this Subpart are applicable to the following affected facilities in Portland cement plants: kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, finished product storage, conveyor transfer points, bagging and bulk loading and unloading systems. Sources are subject to the requirements of this Subpart if the facility commences construction or modification of that source after August 17, 1971. This subpart shall apply to sources at Holcim, including, but not limited to, the following:

   a. Finish Mill #2
   b. Finish Mill #4
   c. Storage Silos #26 through 30

   Finish Mill #4 replaced Finish Mill #1 in 1988 and the product storage silos were installed in 1976. Since commencement of construction occurred after August 17, 1971, for both of these sources, 40 CFR 60, Subpart F applies. The replacement of the air slide in the Finish Mill #2 system was considered a modification of the Finish Mill #2 system. Since this modification occurred after August 17, 1971, 40 CFR Part 60, Subpart F is applicable to Finish Mill #2.

7. ARM 17.8.342 Emission Standards for Hazardous Air Pollutants for Source Categories. This rule incorporates, by reference, 40 CFR Part 63, National Emission Standards for Hazardous Air Pollutants (NESHAPs). The owner and operator of any stationary source or modification, as defined and applied in 40 CFR Part 63, shall comply with the standards and provisions of 40 CFR Part 63, as listed below:

   40 CFR Part 63, Subpart A – The general provisions provided in 40 CFR Part 63 apply to all equipment or facilities subject to any subpart listed below.

   40 CFR Part 63, Subpart LLL - NESHAPs for The Portland Cement Manufacturing Industry. The Holcim Trident Plant must comply with all applicable requirements of this Subpart. On October 14, 1999, the Department received initial notification designating the Trident Plant a major source. Holcim completed testing for the facility to determine if emissions of HAPs and hydrochloric acid (HCl) could be used to re-designate the facility as an area source. Holcim tested for VOCs as a surrogate for organic HAPs and HCl. Results of the testing indicated that the facility was an area source for the purposes of determining the applicability of PC MACT. Furthermore, Permit #0982-11 establishes a limit on VOC emissions to limit organic HAPs and assure that Holcim remains an area source. As an area source, the Trident Plant must meet specific limitations including a dioxin and furan emission limit for the kiln.

D. ARM 17.8, Subchapter 5 - Air Quality Permit Application, Operation and Open Burning Fees, including, but not limited to:

1. ARM 17.8.504 Air Quality Permit Application Fees. This rule requires that an applicant submit an air quality permit application fee concurrent with the submittal of an air quality permit application. A permit application is incomplete until the proper application fee is paid to the Department. Holcim submitted the appropriate permit application fee for the current permit action.

2. ARM 17.8.505 Air Quality Operation Fees. An annual air quality operation fee must, as a condition of continued operation, be submitted to the Department by each source of air contaminants holding an air quality permit, excluding an open burning permit, issued by the Department. The air quality operation fee is based on the actual or estimated actual amount of air pollutants emitted during the previous calendar year.

   An air quality operation fee is separate and distinct from an air quality permit application fee. The annual assessment and collection of the air quality operation fee, described above, shall take place on a calendar-year basis. The Department may insert into any final permit issued after the effective date of these rules, such conditions as may be necessary to require the payment of an air quality operation fee on a calendar-year basis, including provisions that pro-rate the required fee amount.

E. ARM 17.8, Subchapter 7 - Permit, Construction and Operation of Air Contaminant Sources, including, but not limited to:

1. ARM 17.8.740 Definitions. This rule is a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.743 Montana Air Quality Permits--When Required. This rule requires a facility to obtain an air quality permit or permit modification if they construct, alter or use any air contaminant sources that have the potential to emit (PTE) greater than 25 tons per year of any pollutant. Holcim has the PTE greater than 25 tons per year of SO_2, NO_x, CO, and PM_{10}; therefore, an air quality permit is required.

3. ARM 17.8.744 Montana Air Quality Permits--General Exclusions. This rule identifies the activities that are not subject to the Montana Air Quality Permit program.

4. ARM 17.8.745 Montana Air Quality Permits—Exclusion for De Minimis Changes. This rule identifies the de minimis changes at permitted facilities that are not subject to the Montana Air Quality Permit Program.

5. ARM 17.8.748 New or Modified Emitting Units--Permit Application Requirements. (1) This rule requires that a permit application be submitted prior to installation, alteration or use of a source. Holcim submitted the required permit application for the current permit action. (7) This rule requires that the applicant notify the public by means of legal publication in a newspaper of general circulation in the area affected by the application for a permit. Holcim submitted an affidavit of publication of public notice for the October 10, 2001, issue of the *Three Forks Herald*, a newspaper of general circulation in the Town of Three Forks in Gallatin County, as proof of compliance with the public notice requirements. In addition, in accordance with 75-2-215, MCA, Holcim submitted affidavits of publication for the second and third public notices as proof of compliance with the public notice requirements. The notices were published in the *Bozeman Daily Chronicle* on April 18, 2002, and March 20, 2002, in the *Three Forks Herald* on April 10, 2002, and March 27, 2002, in the *Manhattan-Churchill Times* on April 9, 2002, and the *Belgrade High Country Independent Press* on March 21, 2002.

6. ARM 17.8.749 Conditions for Issuance or Denial of Permit. This rule requires that the permits issued by the Department must authorize the construction and operation of the facility or emitting unit subject to the conditions in the permit and the requirements of this subchapter. This rule also requires that the permit must contain any conditions necessary to assure compliance with the Federal Clean Air Act (FCAA), the Clean Air Act of Montana, and rules adopted under those acts.

7. ARM 17.8.752 Emission Control Requirements. This rule requires a source to install the maximum air pollution control capability that is technically practicable and economically feasible, except that BACT shall be utilized. The required BACT analysis is included in Section III of this permit analysis.

8. ARM 17.8.755 Inspection of Permit. This rule requires that air quality permits shall be made available for inspection by the Department at the location of the source.

9. ARM 17.8.756 Compliance with Other Requirements. This rule states that nothing in the permit shall be construed as relieving Holcim of the responsibility for complying with any applicable federal or Montana statute, rule or board or court order, except as specifically provided in ARM 17.8.740, *et seq*.

10. ARM 17.8.759 Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those permit applications that do not require the preparation of an environmental impact statement.

11. ARM 17.8.760 Additional Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those applications that require an environmental impact statement.

12. ARM 17.8.762 Duration of Permit. An air quality permit shall be valid until revoked, amended, or modified, as provided in this subchapter, except that a permit issued prior to construction of a new or modified source may contain a condition providing that the permit will expire unless construction is commenced within the time specified in the permit, which may not be less than 1 year or more than 3 years after the permit is issued.

13. ARM 17.8.763 Revocation of Permit. An air quality permit may be revoked upon written request of the permittee, or for violations of any requirement of the Clean Air Act of Montana, rules adopted under the Clean Air Act of Montana, the FCAA, rules adopted under the FCAA, or any applicable requirement contained in the Montana State Implementation Plan (SIP).

14. ARM 17.8.764 Administrative Amendment to Permit. An air quality permit may be amended for changes in any applicable rules adopted by the Board or changes in operation at a source that do not result in an increase of emissions. The owner or operator of a facility may not increase the facility's emissions beyond permit limits unless the increase meets the criteria in ARM 17.8.745 for a de minimis change not requiring a permit, or unless the owner or operator applies for and receives another permit in accordance with ARM 17.8.748, ARM 17.8.749, ARM 17.8.752, ARM 17.8.755, and ARM 17.8.756, and with all applicable requirements in ARM Title 17, Chapter 8, Subchapters 8, 9, and 10.

15. ARM 17.8.765 Transfer of Permit. This rule states that an air quality permit may be transferred from one person to another if written notice of Intent to Transfer, including the names of the transferor and the transferee, is sent to the Department.

16. ARM 17.8.770 Additional Requirements for Incinerators. This rule specifies the additional information that must be submitted to the Department for incineration facilities subject to 75-2-215, MCA.

F. ARM 17.8, Subchapter 8 - Prevention of Significant Deterioration of Air Quality including, but not limited to:

1. ARM 17.8.801 Definitions. This rule is a list of applicable definitions used in this subchapter.

2. ARM 17.8.818 Review of Major Stationary Sources and Major Modifications--Source Applicability and Exemptions. The requirements contained in ARM 17.8.819 through 17.8.827 shall apply to any major stationary source and any major modification with respect to each pollutant subject to regulation under the FCAA that it would emit, except as this subchapter would otherwise allow.

   Holcim is a major stationary source because it has a PTE greater than 250 tons per year of a pollutant. This permitting action (#0982-11) will potentially increase CO emissions above the PSD significance threshold of 100 tons per year; therefore, PSD applies to this action. Based on the analysis of the potential increase in CO emissions, the Department established a CO emission limit of 310 tons per year in this permit.

G. ARM 17.8, Subchapter 12 - Operating Permit Program Applicability, including, but not limited to:

1. ARM 17.8.1201 Definitions. (23) Major Source under Section 7412 of the FCAA is defined as any stationary source having:

   a. PTE> 100 tons/year of any pollutant.

   b. PTE > 10 tons/year of any one HAP, PTE > 25 tons/year of a combination of all HAPs, or lesser quantity as the Board may establish by rule.

   c. PTE > 70 tons/year of PM_{10} in a serious PM_{10} nonattainment area.

2. ARM 17.8.1204 Air Quality Operating Permit Program Applicability. (1) Title V of the FCAA amendments of 1990 requires that all sources, as defined in ARM 17.8.1204(1), obtain a Title V Operating Permit. In reviewing and issuing Air Quality Permit #0982-11 for Holcim, the following conclusions were made.

   a. The facility's PTE is greater than 100 tons/year for several pollutants.

   b. The facility's PTE is less than 10 tons/year for any one HAP and less than 25 tons/year for all HAPs.

   c. This source is not located in a serious PM_{10} nonattainment area.

   d. This facility is subject to a current NSPS (40 CFR 60, Subpart F).

   e. This facility is subject to a current NESHAP standard (40 CFR 63, Subpart LLL).

   f. This source is not a Title IV affected source, nor a solid waste combustion unit.

   g. This source is not an EPA designated Title V source.

Based on these facts, the Department determined that Holcim is a major source of emissions as defined under Title V. Title V of the FCAA Amendments of 1990 requires that all sources, as defined in ARM 17.8.1204 (1), obtain a Title V Operating Permit. Holcim's operating permit became effective on July 26, 2001.

III. BACT Determination

A BACT determination is required for each new or altered source. Holcim shall install on the new or altered source the maximum air pollution control capability which is technically practicable and economically feasible, except that BACT shall be utilized.
The Department received comments that Holcim should consider converting the existing wet process kiln to a dry process kiln under the BACT analysis. The conversion of the kiln was not considered in the Department's BACT determination. Holcim's application requested that the mid-kiln combustion of whole tires be added to the list of potential fuels for the existing kiln. Historically, the U.S. Environmental Protection Agency and the Department have not viewed the BACT requirement as a means to re-define the design of the source when considering available control technologies. Converting Holcim's kiln would be re-defining the design of the source; therefore, the Department did not consider it in the BACT analysis. However, through the EIS process, the Department evaluated the impacts of converting the kiln from a wet process to a dry process. The cost to convert the Trident kiln would be approximately $146 million. Considering the potential emissions reductions and the cost for conversion, this option would be eliminated as economically unreasonable, even if considered in the BACT analysis.

The BACT analysis includes add-on controls such as regenerative thermal oxidizers (RTO) and regenerative catalytic oxidizers (RCO) for CO and RTO, RCO, and adsorption for HAP emissions. The Department reviewed the following control options, as well as previous BACT determinations for similar permitted sources in order to make the following pollutant specific BACT determinations. A summary of the analysis of these controls is shown below.

A. CO BACT Analysis

1. Identification of CO Control Strategies/Technologies

a. Oxidation

The process of oxidation breaks down and destroys the CO in the gas stream to form CO_2 and water vapor. Operational variables such as temperature, residence time, and turbulence of the system affect CO control efficiency. Incinerators and oxidizers have the potential for high CO control efficiency; however, this efficiency typically comes at the expense of increasing NO_x production. Furthermore, due to the high temperatures required for complete destruction, fuel costs would be expensive and fuel consumption would be excessive with oxidation units. To lower fuel usage, an RCO or RTO can be used to preheat contaminated process air in a heat recovery chamber.

<u>RCO</u>
Catalytic incineration takes place at temperatures between 600° F and 1,000° F. Typical catalyst systems used include metal oxides such as nickel oxide, copper oxide, manganese oxide, or chromium oxide. Noble metals such as platinum and palladium may also be used.

<u>RTO</u>
Thermal incineration takes place at temperatures between 1,450° F and 1,600° F.

b. Proper Design and Combustion

Reduction of CO would be accomplished by controlling the combustion temperature, residence time, and available oxygen. Normal combustion practice at Holcim involves maximizing the heating efficiency of the fuel in an effort to minimize fuel usage. The efficiency of fuel combustion also minimizes CO formation.

2. Eliminate Technically Infeasible Control Options

RCO is considered technically infeasible and not considered further in the BACT analysis due largely to the sensitivity of the catalyst material. Metal oxide catalysts deactivate from exposure to low levels of SO_2 and sulfur trioxide (SO_3). In addition, noble metal catalysts rapidly deactivate from exposure to particulate found in the kiln exhaust. RCO technology is generally limited to natural gas-fired combustion sources, which have only trace amounts of particulates and sulfur compounds in the flue gas.

3. **Rank Control Technologies by Control Effectiveness**

RTO control efficiency may range from 70 % to 95 %. A control efficiency of 90% was used in the BACT analysis submitted by Holcim.

Control Technology	% Control
RTO	90%
Proper Design and Combustion	--

4. Evaluate Remaining Control Technologies

a. Initially, Holcim provided a capital cost of approximately $3.6 million for an RTO to reduce CO emission levels from the kiln. Estimated annual operating costs were approximately $1.7 million for an RTO with a cost effectiveness of approximately $6,096 per ton. The BACT analysis was conducted in accordance with information from the Office of Air Quality Planning and Standards Cost Control Manual, 5th Edition, February 1996 (OAQPS Manual). Additional research conducted by Holcim revealed that there would be additional equipment cost incurred to pre-treat the kiln exhaust gas to reduce concentrations of SO_2 and particulate (i.e., a wet scrubber located upstream of the RTO). An RTO requires relatively low concentrations of SO_2 and particulate to function efficiently otherwise there will be considerable fouling and plugging of the RTO (RTO technology is normally used with a gas stream that contains very little particulate matter). Some metals and/or heavy dust loading deactivates the catalyst, reduces heat recovery efficiency, and shortens the catalyst replacement interval; thereby, reducing the availability of the RTO for the kiln. Installation and operation of the wet scrubber could also increase NO_x emissions at the facility. Including the additional costs associated with scrubber control, Holcim provided a capital cost of approximately $6.5 million for RTO to reduce CO emission levels from the kiln. With the annual operating costs of approximately $1.98 million for the RTO and an additional cost of $1.23 million for the scrubber, the cost effectiveness increased from approximately $6,096 per ton (without additional scrubber control) to $12,484 per ton.

b. An RTO can result in additional energy and environmental concerns such as: a potential increase in the amount of fuel used to increase gas temperatures; potential NO_x emissions increases; and the potential disposal of toxic spent catalyst.

Overall, the cost effectiveness of this technology is greater than industry norms, there are additional energy and environmental impacts associated with this technology, and based on a search of the EPA RACT/BACT/LAER Clearinghouse, no add-on BACT control for CO has been required previously on a cement kiln. For these reasons, RTO does not constitute BACT for this project.

5. Select CO BACT

a. Proper Design and Combustion

Reduction of CO would be accomplished by controlling the combustion temperature, residence time, and available oxygen. Normal combustion practice at Holcim involves maximizing the heating efficiency of the fuel in an effort to minimize fuel usage. The efficiency of fuel combustion also minimizes CO formation. Therefore, the Department determined that proper design and combustion constitutes BACT for CO. However, since PSD applies to this permit action, the Department established a CO limitation of 310 tons per year (based on a rolling 12-month time period).

B. HAPs BACT Analysis

1. Identification of HAP Control Strategies/Technologies

a. Oxidation

Similar to CO, the general process of oxidation breaks down and destroys organic compounds (i.e., HAP) in the gas stream to form CO_2 and water vapor. In a cement kiln, operational variables such as temperature, residence time, and turbulence affect HAP control efficiency. The two potential methods of incineration to control HAP emissions are direct thermal oxidation and catalytic oxidation. Incinerators/oxidizers have the potential for high HAP control efficiency (up to 99%); however, this efficiency typically comes at the expense of increasing NO_x production. As a result of the high temperatures required for complete destruction, fuel costs can be high and fuel consumption can be considerable with oxidation units. To lower fuel usage, a RTO or RCO can be used to preheat contaminated process air in a heat recovery chamber. Although cement kiln temperatures are generally greater than the temperatures required for RCO and RTO, the exhaust gas would need to be routed through the ESP to prevent fouling and damaging of the oxidation unit. As the exhaust gas exits the ESP, the temperature would be approximately 325° F and additional fuel would be required to reheat the exhaust gas stream prior to entering the RTO or RCO.

<u>RCO</u>
Catalytic incineration takes place at temperatures between 600° F and 1,000° F. Typical catalyst systems used include metal oxides such as nickel oxide, copper oxide, manganese oxide, or chromium oxide. Noble metals such as platinum and palladium may also be used.

<u>RTO</u>
Thermal incineration takes place at temperatures between 1,450° F and 1,600° F.

b. Adsorption

Adsorption is not a pollutant destruction method, but rather a concentration technology used to remove gaseous pollutants from low to medium concentration gas streams. Adsorption systems collect gaseous pollutants onto an adsorbent media with a large internal surface area. Common adsorbents include activated carbon, silica gel, activated alumina, synthetic zeolites, fuller's earth, and other clays. Adsorptive capacity of the solid for the gas tends to increase with the gas phase concentration, molecular weight, diffusivity, polarity, and boiling point. The adsorbed pollutants are then concentrated using thermal desorption and oxidized either on-site or by a separate contractor. The adsorption system evaluated by Holcim consisted of three carbon beds with two beds available for adsorbing and the third available for desorbing or on standby.

c. Proper Design and Combustion and Existing Particulate Control

Reduction of HAP emissions in the kiln would be accomplished by controlling the combustion temperature, residence time, and available oxygen. Normal combustion practice at Holcim involves maximizing the heating efficiency of the fuel in an effort to minimize fuel usage. The efficiency of fuel combustion also minimizes HAP formation. Furthermore, existing particulate control devices provide control of the HAP emissions (arsenic, cadmium, beryllium, chromium, manganese, lead, mercury, etc.) that are emitted as particulate.

2. Eliminate Technically Infeasible Control Options

Although technical complications exist for all post-kiln HAP control methods, RCO was the only technology eliminated as technically infeasible and not further considered in the BACT analysis. RCO is considered technically infeasible due largely to the sensitivity of the catalyst material. Metal oxide catalysts deactivate from exposure to low levels of SO_2 and sulfur trioxide (SO_3). Where as, noble metal catalysts rapidly deactivate from exposure to particulate found in the kiln exhaust. RCO technology is generally limited to natural gas-fired combustion sources, which have trace amounts of particulates and sulfur compounds in the flue gas.

3. Rank Control Technologies by Control Effectiveness

The control efficiency for an RTO or an adsorption system would be approximately 99%. The total gaseous HAP emission rate was estimated at 7.4 tons per year; therefore, a total of 7.3 tons could be removed.

Control Technology	% Control
RTO	99%
Adsorption	99%
Proper Design and Combustion and Existing Particulate Control	--

4. Evaluate Remaining Control Technologies

a. RTO technology would not likely be used exclusively for a cement kiln because the catalyst would be rapidly deactivated from the exposure to low levels of SO_2 and SO_3. In addition, a platinum/rhodium-based catalyst would also be rapidly deactivated by particulate emissions in the exhaust gas. An RTO would have a capital cost of

approximately $3.6 million and annual operating costs of approximately $1.9 million for the RTO which equates to a cost effectiveness of approximately $253,191 per ton.

Using RTO technology would result in additional potential environmental and energy concerns such as the additional fuel used to increase gas temperatures and the disposal of spent catalysts which are potentially toxic and subject to RCRA waste disposal regulations.

b. An Adsorption system would have a capital cost of approximately $659,224 for a carbon adsorption system and annual operating costs of approximately $410,870. Cost effectiveness for the system would be approximately $56,284 per ton.

Additional potential environmental and energy impacts could include additional energy required for pressure drop and steam production and the disposal of spent carbon.

Overall, the cost of both the RTO and adsorption technologies is greater than industry norms, there are additional energy and environmental impacts associated with these technologies, and based on a search of the EPA RACT/BACT/LAER Clearinghouse, no add-on BACT control for HAP emissions has been required on a cement kiln. For these reasons, RTO and adsorption do not constitute BACT for this project.

5. Select HAP BACT

Existing Particulate Control and Proper Design and Combustion

Reduction of HAP emissions in the kiln would be accomplished by controlling the combustion temperature, residence time, and available oxygen. Normal combustion practices at Holcim involve maximizing the heating efficiency of the fuel in an effort to minimize fuel usage. The efficiency of fuel combustion also minimizes HAP formation. Furthermore, existing particulate control devices provide control of HAP emissions (arsenic, cadmium, beryllium, chromium, manganese, lead, mercury, etc.) that are emitted as particulate. Therefore, the Department determined that proper design and combustion and the use of existing particulate control equipment would constitute BACT for HAP emissions. Based on the analysis done for 75-2-215, MCA and ARM 17.7.770, the Department also determined that the following emission limitations would demonstrate compliance with the negligible risk standard, limit HAP emissions, and constitute BACT for this project:

Pollutant	Emission Limit
PM	0.77 lb/ton of clinker
VOC	2.25 lb/hr
As	7.15×10^{-5} lb/hr
Be	8.17×10^{-6} lb/hr
Ca	5.01×10^{-4} lb/hr
Cr (total)	1.09×10^{-5} lb/hr
Pb	4.68×10^{-3} lb/hr
Mn	3.16×10^{-2} lb/hr
Hg	3.99×10^{-3} lb/hr
PAH (total)	1.89×10^{-2} lb/hr

The control options selected have controls and control costs comparable to other recently permitted similar sources and are capable of achieving the appropriate emission standards.

IV. 8Emission Inventory Summary

A. Potential CO Kiln Emissions Increase from burning whole tires:

Criteria Pollutant	Potential Emission Rate (lb/hr)	Potential Emissions (ton/year)
CO	43.15	189

Note: Maximum clinker production is 425,000 tons per 12-month period.
Continuous operation is assumed to be 8760 hours per year.

Since the potential CO emissions increase may be greater than the PSD significance threshold, the PSD program applies and the Department established a CO limit 310 tons per year.

B. Potential Criteria Pollutant Emissions from the Kiln including whole tires:

Pollutant	Emission Rates			
	lb/ton clinker	Lb/hr	g/sec	Tpy
PM_{10}	0.77	37.4	4.71	164
SO_2	2.55	124	15.6	543
NO_x	32.31	1,568	197.6	6,868
CO	1.46	70.8	8.92	310
VOC	0.046	2.25	0.283	9.86
Lead	0.0003	0.0147	0.0018	0.06

Note: Maximum clinker production is 425,000 tons per 12-month period. Continuous operation is assumed to be 8760 hours per year.

A complete particulate emissions inventory for the Trident facility is available, upon request, from the Department or available in Permit #0982-09.

C. Potential HAP Emissions from the Kiln including the addition of whole tires:

Pollutant	Baseline Emissions[a] (lb/hr)	Emissions from tires[b] (lb/hr)	Total[c] (lb/hr)	Total[c] (ton/yr)
As	2.26×10^{-4}	7.15×10^{-5}	2.98×10^{-4}	1.30×10^{-3}
Be	2.41×10^{-5}	8.17×10^{-6}	3.23×10^{-5}	1.41×10^{-4}
Ca	3.08×10^{-4}	5.01×10^{-4}	8.09×10^{-4}	3.54×10^{-3}
Cr (total)	1.22×10^{-3}	1.09×10^{-5}	1.23×10^{-3}	5.39×10^{-3}
Pb	9.98×10^{-3}	4.68×10^{-3}	1.47×10^{-2}	6.44×10^{-2}
Mn	3.40×10^{-3}	3.16×10^{-2}	3.50×10^{-2}	1.53×10^{-1}
Hg	3.54×10^{-3}	3.99×10^{-3}	7.53×10^{-3}	3.30×10^{-2}
PAH (total)	2.64×10^{-2}	1.89×10^{-2}	4.53×10^{-2}	1.98×10^{-1}

Note: Emissions based on maximum clinker production of 425,000 tons per 12-month period. Continuous operation is assumed to be 8760 hours per year.
a: Baseline emissions established from Trident source test data
b: Emission limit from Section II.C.3 of this Permit
c: Baseline emissions plus emissions from tires

V. Existing Air Quality

Holcim's Trident facility is located in the Northeast ¼ of Section 9, Southeast ¼ of Section 4, Southwest ¼ of Section 3, and Northwest ¼ of Section 10, Township 2 North, Range 2 East, approximately 5 miles northeast of Three Forks in Gallatin County, Montana.

Holcim submitted air dispersion modeling to predict the impacts of tire burning on ambient concentrations of criteria pollutants. Modeling of the Trident plant was performed using the most current version of EPA's AERMOD modeling system (version 03273). The modeling results were reviewed by the Department and demonstrated compliance with the National Ambient Air Quality Standards (NAAQS) and the Montana Ambient Air Quality Standards (MAAQS) for all criteria pollutants. The peak modeled impacts occur at or near the Holcim property boundary,

and modeled impacts drop off with distance from the source. Background concentration values were provided by DEQ. Complete results of the compliance modeling are listed in the table below.

Demonstration of Compliance with NAAQS and MAAQS

Pollutant	Avg. Period	Holcim Impact ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	TOTAL Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	MAAQS ($\mu g/m^3$)
NO_2	Annual	43.5[b]	6	**49.5**	100	94
	1-hour	329[b]	75	**404**	---	564[a]
SO_2	Annual	5	3	**8**	80	52
	24-hour	26	11	**37**	365[a]	262[a]
	3-hour	74	26	**100**	1,300[a]	---
	1-hour	130	35	**165**	---	1,300[c]
CO	8-hour	27	1,150	**1,177**	10,000[a]	26,450[a]
	1-hour	113	1,725	**1,838**	40,000[a]	10,350[a]
PM_{10}	Annual	1	8	**9**	50	50
	24-hour	8	30	**38**	150[a]	150[a]
O_3 (as VOC)	1-hour	2	N/A	**2**	235	196[a]
Lead	Quarter	0.033[d]	N/A	**0.033[d]**	1.5	---
	90-day	0.033[d]	N/A	**0.033[d]**	---	1.5

[a] Not to be exceeded more than once per year.
[b] These values obtained with the ozone limiting method procedure.
[c] Not to be exceeded more than 18 times in 12 months.
[d] Tenth high modeled 1-hour value used for conservative comparison with standard.

In addition to criteria pollutants, the potential impacts from hazardous air pollutants (i.e. constituents of potential concern (COPC)) for the proposed project were addressed in the EIS performed for this project. Conditions and limitations contained in Permit #0982-11 protect Montana's negligible risk standard. Therefore, the proposed project would not be expected to result in an excess lifetime cancer risk that exceeds 1.0×10^{-6} for any individual pollutant, or 1.0×10^{-5} for the aggregate of all pollutants.

VI. Taking or Damaging Implication Analysis

As required by 2-10-101 through 105, MCA, the Department conducted a private property taking and damaging assessment and determined there are no taking or damaging implications.

VII. Environmental Assessment

An EIS was completed for this project.

Permit Analysis Prepared By: Carson Coate
Date: March 16, 2006