WORKING DRAFT RISK ASSESSMENT WORKPLAN FOR THE WESTATES CARBON ARIZONA, INC. CARBON REACTIVATION FACILITY PARKER, ARIZONA

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WORKING DRAFT RISK ASSESSMENT WORKPLAN

1.0 INTRODUCTION

The Westates Carbon Arizona, Inc. (Westates) facility is a carbon reactivation facility located in La Paz County, Arizona. The facility is located just outside the Town of Parker in an industrial park owned by the Colorado Indian River Tribes. The facility reactivates spent carbon, which has been previously used to remove pollutants from water and gases, into a reactivated carbon product, which is then resold for additional pollution control uses. The spent carbon is reactivated by heating it to very high temperatures under controlled conditions.

Activated carbon is used in treatment equipment to remove impurities from water, air and food. For carbon systems to remain effective, the carbon must be replaced regularly. Once carbon begins to approach its capacity to adsorb or filter impurities, it is recycled. Applications for activated carbon systems include improving the taste and quality of drinking water, treating industrial wastewater, purifying materials used in production processes (including foods and medicines), controlling air emissions, and decontaminating groundwater in environmental cleanup sites.

Spent carbon is accepted at the facility from a variety of sources, many of which are Fortune 500 companies as well as state and federal agencies. Westates customers include Arizona Public Service, General Electric, Boeing, Hewlett Packard, nearly every USEPA Region, the Arizona Department of Environmental Quality, the Arizona Department of Transportation, Los Angeles County Fire Department, Nestle, General Motors and DuPont.

In 1990 and 1991, Westates negotiated a lease agreement with the Colorado River Indian Tribes (CRIT) and obtained the necessary permits to locate the facility in an industrial park on the CRIT Reservation. Before construction began, an environmental assessment was completed and a “Finding of No Significant Impact” was approved by the Bureau of Indian Affairs. The facility’s Part A permit application was submitted in August 1991, in accordance with Federal U.S. Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) requirements. The facility has been operating since August 1992 under a variety of regulatory programs, including the Part A interim status regulations at 40 CFR Part 265 and USEPA regulations under the Clean Air Act's Benzene National Emission Standards for Hazardous Air Pollutants (NESHAPs) (Subpart FF of 40 CFR Part 61). The facility is also subject to regulations issued by the Occupational Safety and Health Administration (OSHA). The Part B RCRA permit application was submitted to USEPA in January 1995.

In August 2001, USEPA requested that Westates prepare a performance demonstration test plan and a risk assessment workplan as part of the process for completing its review of the RCRA facility permit application (USEPA 2001a). The review of this permit application is being conducted in accordance with the requirements for a Miscellaneous Unit under Subpart X of 40 CFR Part 264. In its August letter, USEPA identified a variety of general requirements for the risk assessment workplan as well as specific requirements for the human health and ecological risk assessments.[1] In response to

[1] Risk assessments conducted for combustion sources to date have rarely included a full-scale ecological risk assessment such as that being requested by USEPA for this project.

USEPA's request, Westates selected CPF Associates, Inc. to prepare the risk assessment workplan. CPF Associates is an independent scientific research and consulting firm located in the Washington, D.C. area and has no affiliation with Westates other than its contract to conduct the risk assessment for the Parker facility.

The first version of the Working Draft Risk Assessment Workplan was submitted to USEPA in June 2002 (CPF 2002). Comments on the Workplan were received from USEPA in March 2003 (USEPA 2003a). A revised Workplan was submitted to USEPA in May 2003 incorporating USEPA's comments (CPF 2003). Additional comments on the Workplan were received from USEPA in September 2003 (USEPA 2003b). This current document has been revised from the May 2003 Workplan document in response to USEPA's September 2003 comments.

This document is referred to as a "working draft" risk assessment workplan because Westates and CPF are continuing to work with CRIT to obtain site-specific information that will be considered in developing a final workplan for this study. This working draft workplan was prepared at the request of USEPA which preferred to develop this plan earlier in the process instead of waiting until all the site-specific risk assessment information had been obtained. Thus some of the information in this workplan may change as a result of continuing dialogue with CRIT.

Site-specific data will be obtained through an information sharing process that was developed by CRIT to ensure confidentiality of sensitive tribal information. Under this process, CPF first submits an information request on behalf of Westates to CRIT. CRIT will then either respond to the information request directly or will provide a contact from whom the requested information may be obtained. The types of additional information that will be compiled from CRIT and considered for use in the risk assessment will include, but not be limited to, data related to potential subsistence farming, fishing and hunting activities, types of livestock raised in the area, sources of feeds used for locally raised livestock, agricultural planting schedules, and management and distribution of both irrigation water and drinking water for both the Town of Parker as well as the Reservation. Information also will be requested on fishing locations used regularly in the area, the extent to which fish caught locally are ingested, and the types of fish ingested. Information related to confidential tribal practices, such as practices that use plants for medicinal or ceremonial purposes, or the gathering of plants for cultural practices, will be compiled by CRIT. Potential risks associated with confidential tribal practices or confidential tribal information will be evaluated separately by CRIT. CRIT's outline of this information sharing process is presented in Appendix A. An information request was submitted to CRIT in June 2002. The information gathering effort with CRIT is expected to continue throughout the risk assessment process. As a result, information from CRIT that will be considered in the risk assessment is not provided in this Workplan but rather will be presented in the final risk assessment document. At future stages of the risk assessment effort, however, as requested by USEPA (2003b), USEPA risk assessment reviewers will wish to examine a number of site-specific variables obtained through the CRIT information sharing process.

This working draft workplan represents the first step in the Part B permitting risk assessment process. It describes the approaches that will be used to perform the Westates facility risk assessment. It also discusses approaches that will be used to incorporate dispersion and deposition modeling results and performance demonstration test data in the risk assessment. The purpose of this working draft workplan is to provide USEPA Region IX, CRIT and other stakeholders with a general overview of Westates' intended risk assessment approach for the facility, to facilitate communication between Westates, USEPA, CRIT and other stakeholders on risk assessment issues for the facility, and to obtain regulatory review and approval of proposed risk assessment methods prior to performing the risk assessment for this project.

This risk assessment is being performed to comply with USEPA permit requirements and will analyze specific sets of assumptions that are, collectively, expected to overestimate potential risks. The risk assessment will, therefore, calculate the potential for health risks to be present under specific assumptions and will not calculate actual health impacts.

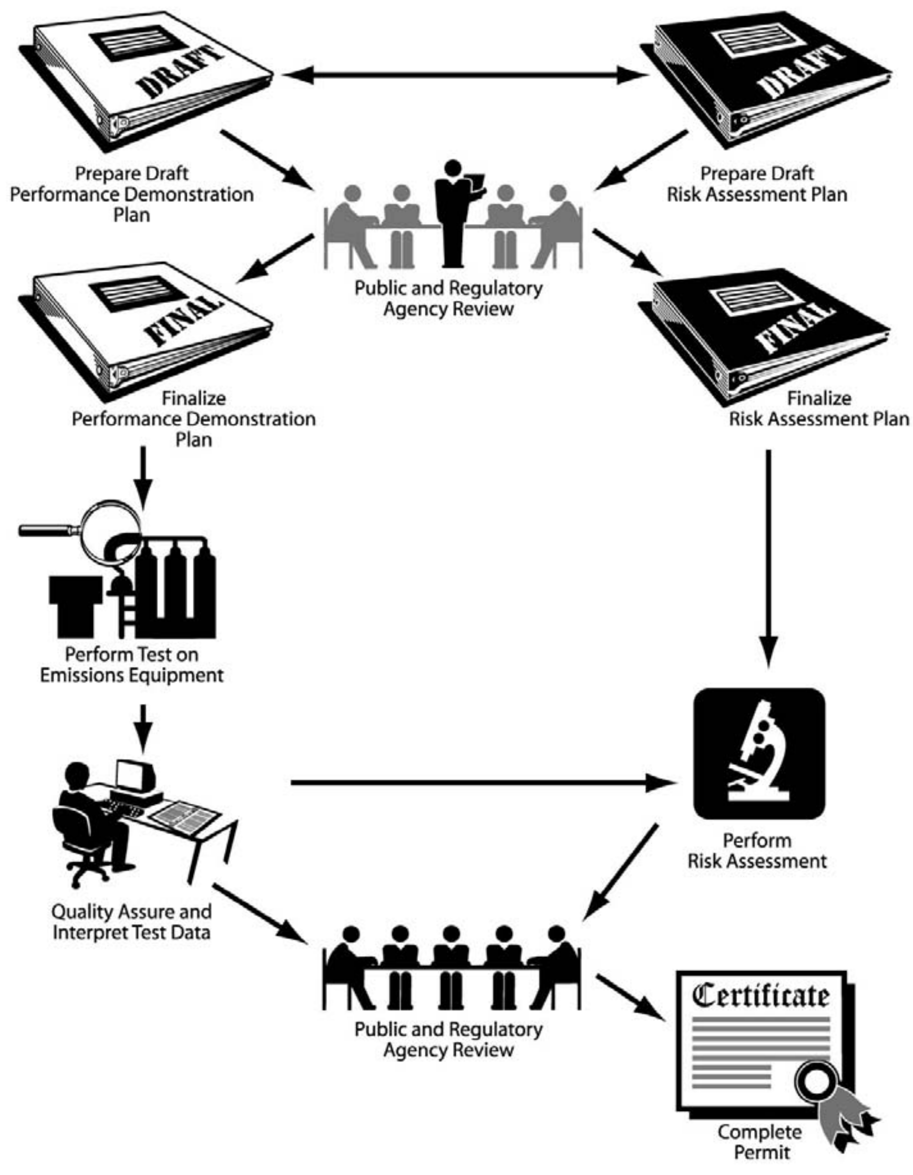
The risk assessment is only one activity that will be undertaken as part of the RCRA permitting process for the Westates facility. Other important elements of this process that are intimately related to the risk assessment include: site visits (conducted in November 2001 and January and April 2002); preliminary meetings with USEPA and CRIT (conducted in January 2002); a public open house (conducted in April 2002); development of a working draft performance demonstration test plan for the facility (submitted to USEPA in May 2002) (Focus 2002a); and approval, conduct and quality assurance of the performance demonstration test. The relationship between the performance demonstration test and the risk assessment activities is shown in Figure 1.

The remainder of this document presents:

- A general discussion of the facility and the facility area,
- An overview of the risk assessment process,
- A discussion of proposed methods for the human health risk assessment,
- A discussion of proposed methods for the ecological risk assessment,
- A brief summary of quality assurance procedures, and
- A listing of references cited in this document.

Figure 1

Flow Chart of the Westates RCRA Permit Process



2.0 FACILITY AND AREA DESCRIPTION

2.1 Site Setting

2.1.1 Facility Location

The Westates facility is located in an industrial park approximately 1 mile southeast of Parker, Arizona, a town situated along the Colorado River in western Arizona on the California border (Figure 2). Parker is about 170 miles west of Phoenix and 250 miles east of Los Angeles. Parker and the Westates facility are both located within the 269,000-acre CRIT Reservation, which includes areas in both Arizona and California (Figure 3). Parker is an independent incorporated community surrounded by the reservation lands. The reservation extends about 5 miles north of the Westates facility and about 40 miles south of the facility. The majority of the CRIT reservation (225,995 acres) is located in Arizona.

2.1.2 Climate and Geography

The Westates facility is located in the Lower Colorado River Valley subdivision of the Sonoran desert. This subdivision is the largest, hottest, and driest subdivision of the Sonoran desert. Precipitation is extremely limited throughout the year. Based on long-term climate data measurements from Parker for 1961-1990, the average annual rainfall is 4.5 inches, with roughly 35% of this occurring in the winter (December-February) and 29% occurring in the fall (September-November). The average annual temperature is 73°F, with average monthly temperatures ranging from a low of roughly 53°F in December and January to an average monthly high of approximately 90°F or more in July and August. The average daily maximum temperature from June through September is between 103 °F and 110 °F. Summer highs may exceed 120°F, and annual rainfall in the driest sites averages less than 3 inches (WRCC 2002, Phillips and Comus 2000).

The land within about 10 miles of the facility is comprised of low arid desert and river bottom with some mountain ranges (Arizona Department of Commerce 2001a). The terrain throughout the study area consists mostly of broad, flat valleys with widely scattered, small mountain ranges of almost barren rock. There are also some tracts of sand dunes located south of Parker. Figure 4 presents several aerial photographs of the landscape in the facility vicinity.

2.1.3 Water Resources

The Colorado River is the primary perennial water body in the region. This is a highly regulated river with flow controlled by a series of dams constructed as part of the Colorado River Storage Project (CRSP). Irrigation water provided by canals off of the Colorado River results in productive agricultural land. The Headgate Rock Dam located just upstream from Parker and completed in 1941 provides water for the irrigation of Parker Valley reservation farmlands and forms the small body of water called Lake Moovalya impounded behind Headgate Rock Dam north of Parker (Wilson and Rojeski 1998).

Figure 2
Westates Facility Location

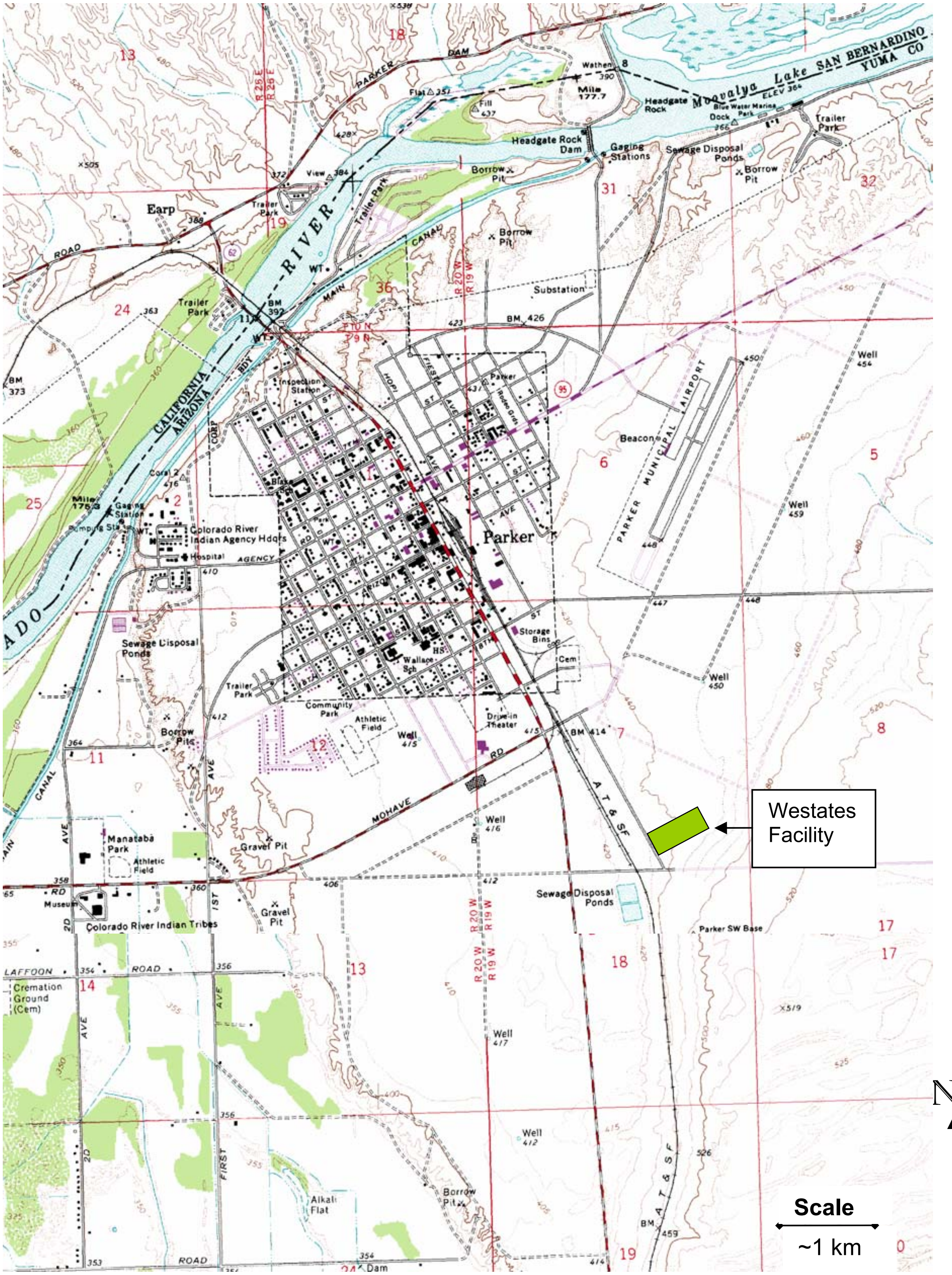


Figure 3

Colorado River Indian Tribes Reservation Map

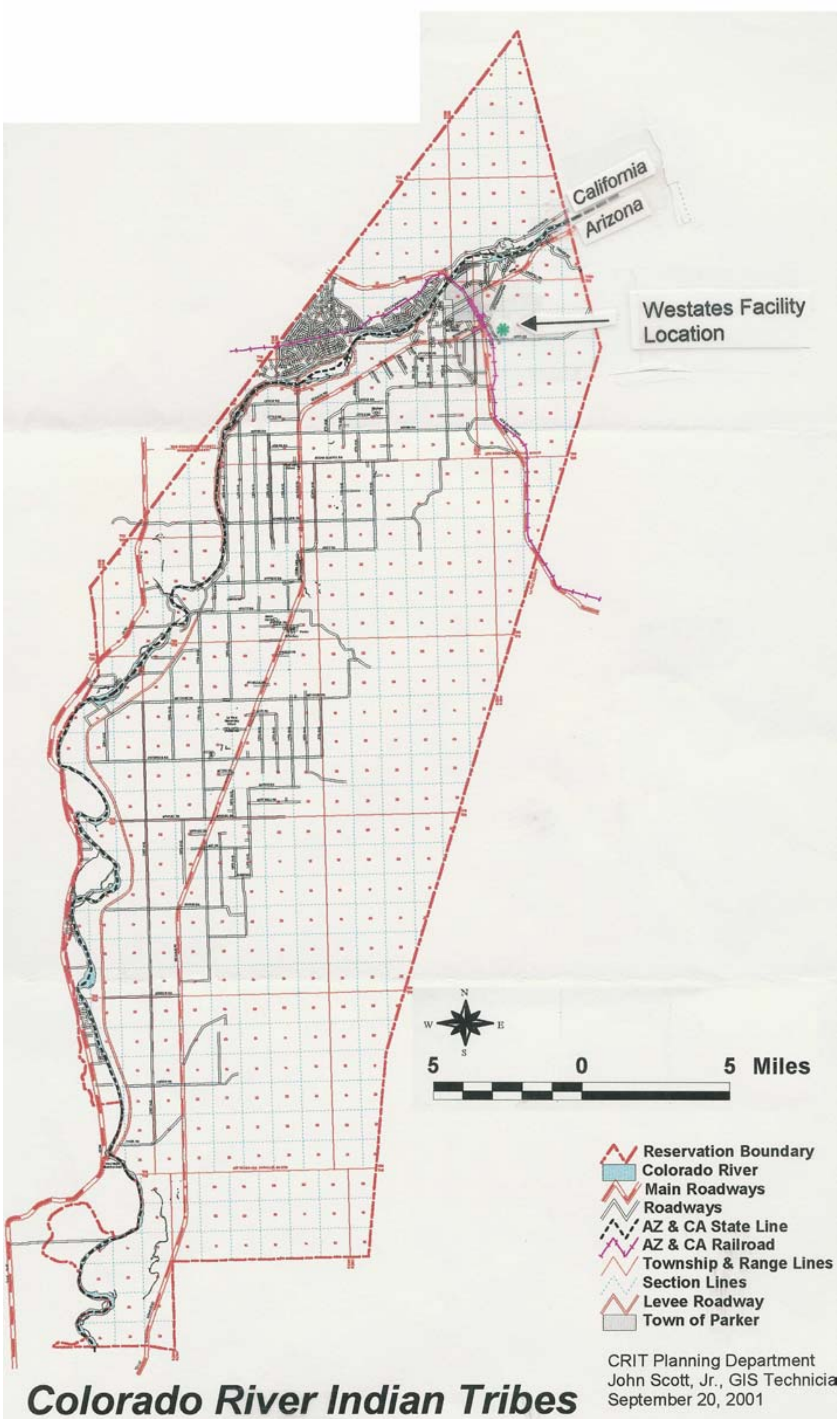


Figure 4

Landscape in the Westates Facility Area

The much larger Parker Dam is located about 15 miles upriver from the Town of Parker. This dam forms Lake Havasu and provides water to southern California via the 242-mile long Colorado River Aqueduct and to areas east of Parker (e.g., Phoenix) via the 190-mile long Granite Reef Aqueduct, the main artery for the Central Arizona Project (CAP). Roughly 1 billion gallons of water per day are pumped from the Parker Dam into the Colorado River Aqueduct for southern California destinations (AZ 2002). A 3.7 mile stretch of the Colorado River Aqueduct passes through the northwest corner of the study area that is the focus of this assessment. The area along the Colorado River between the two dams has an established recreation and tourism industry and includes marinas, lodging, restaurants, and mobile home parks. Facilities for swimmers, boating and water-skiers are found along the shoreline (Arizona Department of Commerce 2001, Wilson and Rojeski 1998).

Water management at both dams to support power generation results in substantial variation in river flow on both a daily and seasonal basis. In general, river flows increase with power demands, with flows greatest in the day compared to night, and in the summer compared to winter (Fitzpatrick 2002).

The main irrigation canal exiting Headgate Rock Dam is divided and sub-divided as it flows generally southwest through Parker Valley in the reservation. These canals are man-made structures, are typically concrete-lined and are drained annually. A canal referred to as the "main drain" emerges just to the south of Mohave Road next to the main irrigation canal. The main drain receives discharge water from the local publicly owned treatment works (POTW) and continues for roughly 15 miles to the southwest through Parker Valley, ultimately discharging into the Colorado River. Excess water from many of the irrigation canals empties into the main drain, increasing the volume and flow of water in the main drain as it travels southwestward to the river discharge location.

2.1.4 Land Use

The economy of the Reservation is centered in four areas: agriculture; recreation, especially along the 90-mile north-south stretch of the Colorado River that runs through the CRIT Reservation; government; and light industry (Arizona Department of Commerce 2001a). The economy of Parker is based primarily on tourism, retail trade and services. Parker also serves as the trade and business center for the Reservation (Arizona Department of Commerce 2001b).

Bureau of Indian Affairs crop reports for CRIT for 2000 and 1999 show that a total of approximately 75,000-76,000 acres of land in Parker Valley were irrigated and used for commercial agriculture. The primary crops grown were alfalfa hay (accounting for roughly 67% of the total farmed land), cotton lint (12%-17% of the total land), Sudangrass and Bermudagrass hay (4%-11% of the total land), wheat (6%-9% of the total land), and dry onions (roughly 3% of the total land). Less than 1% of this land was farmed by Indians on Indian-owned land. Roughly 25% of this land was leased and farmed by Indians, and approximately 74% of the land was leased and farmed by non-Indians (BIA 1999, 2000).

CRIT's Blue Water Resort and Casino, located on the banks of the Colorado River about 1 mile north of Parker, also is important to the local economy. CRIT also established a 140-acre industrial park with air, rail and highway access just south of Parker in 1970 to attract businesses to the area (McVey 2002). According to local officials, it is not likely that airport property will be used for either residential or farming purposes, especially given the fact that the airport has recently received approval to extend its runway further south (Kelly 2001, Laffoon 2001). The Westates facility is located in the industrial park. A map of the land uses in the immediate vicinity of the Westates facility, including depiction of the industrial park, is shown in Figure 5.

The CRIT 1,042-acre Ahakhav Preserve, located about 3 miles southwest of Parker along the Colorado River, was established in 1995 to conserve a portion of backwater and riparian habitat on the Reservation. The preserve includes about 250 acres of restored aquatic habitat and is used to propagate a variety of native plant species (CRIT 2002, CRIT-Ahakhav 2002).

2.2 Demographic Information

The Colorado Indian Reservation was established in 1865 and is home to the Mohave, Chemehuevi, Hopi and Navajo peoples. The Town of Parker is fully enclosed within the borders of the Reservation but has its own separate government.

Population data from the 2000 U.S. Census for CRIT and Parker are provided in Table 1. The populations of the Reservation and Parker are 9,201 and 3,140, respectively. Roughly one-third of the population of both areas is less than 20 years old. Approximately 20% of the Reservation population, and 12% of the Town of Parker population, is 60 years or older. The 2000 census data show that roughly one-quarter of the population on the Reservation and in Parker classified themselves as American Indian in the 2000 census.

In addition to recreational activities associated with the Colorado River, people in the area hunt and fish. Hunters and anglers using the CRIT Reservation are required to obtain permits, which are available from a number of locations in the area. Anglers fish for trout, bass, catfish, crappie and bluegill, among other species, in both the river and along some of the canals. Popular hunted species include dove, quail, waterfowl and rabbit (CRIT 2002).

2.3 Ecological Setting

The study area provides terrestrial and aquatic habitat for a variety of wildlife species. The principal habitats of the study area are identified in Figures 6 and 7 and described below.

2.3.1 Terrestrial Habitats and Wildlife

The terrain throughout the Parker and CRIT Reservation area consists mostly of broad, flat valleys with widely scattered, small mountain ranges of almost barren rock. There is also a tract of sand dunes located south of Parker. The principal terrestrial habitats of the study area are (1) creosote bush scrub, (2) agricultural land, and (3) riparian corridors.

Figure 5

Peripheral Land Use Study: Colorado River Indian Tribes Lands

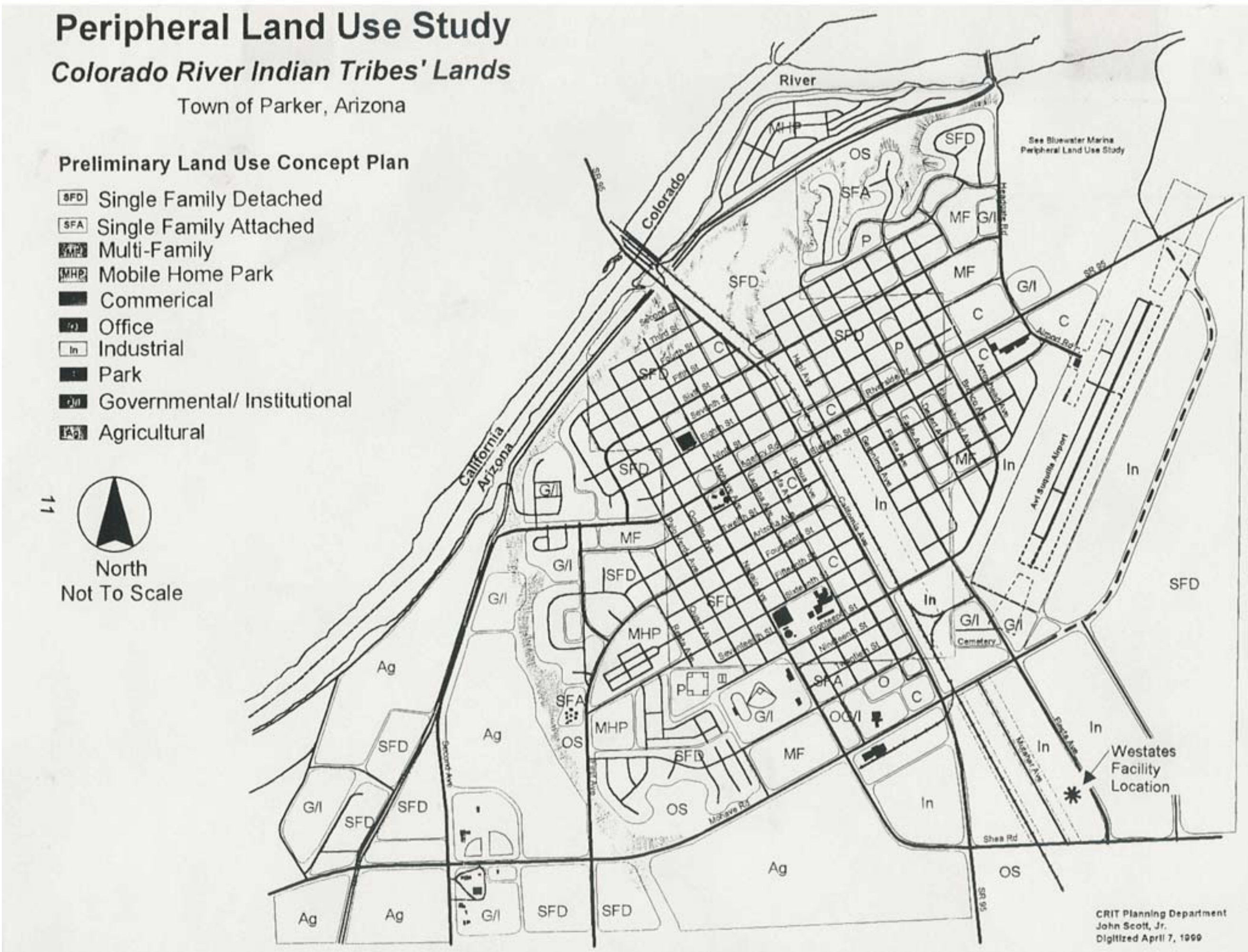


Table 1

**Population Information for the
Colorado River Indian Reservation and Parker, Arizona**

Information	Colorado Indian Reservation		Parker	
	Number	Percentage of total population	Number	Percentage of total population
Population				
Total population	9,201	100%	3,140	100%
Male	4,653	50.6%	1,521	48.4%
Female	4,548	49.4%	1,619	51.6%
Age Distribution				
Under 5 years	666	7.2%	239	7.6%
5-9 years	715	7.8%	270	8.6%
10-14 years	777	8.4%	321	10.2%
15-19 years	739	8.0%	299	9.5%
20-34 years	1,565	17.0%	535	17.0%
35-59 years	2,921	31.7%	1,089	34.7%
60-74 years	1,190	12.9%	262	8.3%
75 years and over	628	6.8%	125	4.0%
Race				
White	4,957	53.9%	1,948	62.0%
Black/African American	120	1.3%	59	1.9%
American Indian/Alaska Native	2,292	24.9%	725	23.1%
Asian	48	0.5%	27	0.9%
Native Hawaiian/Pacific Islander	8	0.1%	5	0.2%
Two or more races	331	3.6%	142	4.5%
Other	1,445	15.7%	234	7.5%
Hispanic or Latino (of any race)	2,940	32.0%	935	29.8%

Source: US Census, Census 2000.

2.3.1.1 Creosote Bush Scrub

Creosote bush scrub is the dominant habitat within the Parker area. This habitat occurs in valleys of the region, and is comprised primarily of creosote bush and white bursage[2], which are the two most drought-tolerant perennial plants in North America (Phillips and Comus 2000). Other species common to the creosote bush scrub habitat of the region include burro brush, brittlebush, cholla and other *Opuntia* species, *Lycium* spp., salt bush (desert holly), yucca, and dalea (USFWS 1994).

Common mammals of the creosote bush flats in the Parker area include kangaroo rats, pocket mouse, cactus mouse, black-tailed jackrabbit, cottontail, and badger (Priest 2002). The area also supports a relatively low-density population of mule deer (Henry 2002). A small population of bighorn sheep uses the Buckskin Mountains (located in the northeastern portion of the study area) and contiguous mountains outside of the study area (Henry 2002). A variety of reptiles and several species of amphibians also likely occur in the study area. Amphibians and reptiles of the region's creosote bush flats include Couch's spadefoot, Colorado River toad, Sonoran green toad, whiptails, and a variety of lizards and snakes (Phillips and Comus 2000). Fringed-toed lizard might occur in the sand dune habitat south of Parker (Henry 2002).

Common birds of the creosote bush scrub include dove, Gambel's quail, black-throated sparrow, horned lark, thrasher, towhee, gnatcatcher, and red-tailed hawk (Priest 2002, Rosenberg et al. 1991). Other species observed in the creosote bush scrub during a brief site visit in January 2002 include roadrunner, turkey vulture, Cooper's hawk, American kestrel, and common raven. Many of the bird species of the desert scrub habitat are permanent residents whose populations exhibit marked seasonal fluctuations in abundance, with numbers usually highest in late summer and lowest in late winter (Rosenberg et al. 1991).

2.3.1.2 Agricultural Land

Agricultural land represents the second largest habitat type within the area. A large portion of the Reservation located along the Colorado River valley south of the town of Parker is farmed. As noted above, alfalfa is the principal crop, although other crops include cotton lint and hay (BIA 1999, 2000).

Area crops provide a food source to wildlife and are an important habitat for migratory and wintering bird species. Winter bird populations in the agricultural areas of the study area can be quite large, with the greatest number and variety in areas where weedy margins and earthen canals are interspersed with cultivated fields (Rosenberg et al. 1991). Margins may attract wintering sparrows, phoebes, loggerhead shrike, and American kestrel. Hawks, pipits, and sparrows are also common. In addition, geese and waterfowl frequent the farm fields during the winter (Henry 2002). Wintering sandhill cranes also use the farm fields in the study area (Henry 2002, AGFD 2002a). Cranes begin arriving on wintering areas in late September and leave to return to breeding areas in mid-to-late February (AGFD 2002a). Other species may use the farm fields as a stopover during migration. Shorebirds have historically used the agricultural fields south of Parker during July and August, and burrowing owl are a common resident in agricultural areas throughout Parker Valley (Rosenberg et al. 1991) . Species observed

[2] Common species names are used in the text. Appendix B provides scientific names.

on agricultural land during a brief January 2002 site visit include American kestrel, common raven, northern mockingbird, mourning dove, Brewer's blackbird, brown-headed cowbird, house finch, and house sparrow. Small mammals, primarily kangaroo rats, mice, and rabbits are also likely common in the areas agricultural areas, with greatest numbers likely occurring near grain storage or processing areas. Reptiles and some amphibians also may occur to some degree, though their abundance would not be expected to be great in the monotypic agricultural areas that provides little appropriate habitat for these species.

2.3.1.3 Riparian corridors

Riparian areas are narrow strips of lush vegetation along rivers, streams and washes. These areas contain sufficient year-round water to support the growth of trees. Common trees of the riparian areas of the region include mesquite, ironwood, cottonwood, willow, paloverde, and non-native salt-cedar (Watts and Watts 1974, ASP 2001).

Within the area, pockets of riparian habitat occur primarily along the Colorado River. Riparian areas begin on the western shore of the river just north of the town of Parker and continue in fragmented fashion, primarily along the eastern shore, for the length of the River within the study area. Some riparian areas might also occur along desert washes. The riparian areas of the study area are primarily scrub areas, with some marsh and forested areas interspersed. A dense thicket of screwbean mesquite, salt cedar, and scrubby willows occurs adjacent to the River on the CRIT Ahahkav Tribal Preserve, just south of Parker. Palustrine emergent marshes also occur in this area, where levees have maintained some backwater areas.

The riparian corridors will support the greatest diversity of plants and animals of any study-area habitat type. More than 150 species of birds have been recorded for Buckskin Mountain State Park, located in a riparian area just outside the study area approximately 11 miles north of Parker (ASP 2000). More than 275 bird species have been listed in Bill Williams National Wildlife Refuge 17 miles north of Parker (USGS 2001), where the largest tract of cottonwood-willow riparian forest in the region occurs. A one-hour walk in one of the study area's riparian areas in January 2002 yielded more than 30 species representing several major avian groups including grebes, cormorants, waterfowl, raptors (vultures, hawks, falcons), wading birds, coot, gulls, woodpeckers, and passerines. White-winged and mourning doves also likely occur in this area, as these species are known to reach high breeding densities in screwbean mesquite-salt cedar habitats of the region (Rosenberg et al. 1991). In addition, during late summer and autumn, the seed pods of the screwbean mesquite ripen and fall and provide an abundant food source for many wildlife species including large coveys of Gambel's Quail which move into these woods from other riparian and desert areas to feed heavily on these seeds (Rosenberg et al. 1991).

2.3.2 Aquatic Habitats and Wildlife

The three principal aquatic habitats in the facility area are (1) the Colorado River, (2) riparian backwaters, and (3) man-made water supply canals and aqueducts.

2.3.2.1 Colorado River

The Colorado River is the primary perennial water body in the region. As described earlier, this is a highly regulated river with flow controlled in the Parker area by both the Parker Dam and the Headgate Rock Dam.

Both dams likely have a substantial impact on the aquatic habitat and wildlife of the study area. In addition to contributing to regional loss of riparian habitat due to flood control, water management to support power generation at both Parker and Headgate Rock dams results in substantial variation in river flow on both a daily and seasonal basis. In general, river flows increase with power demands, with flows greatest in the day compared to night, and in the summer compared to winter (Fitzpatrick 2002). These daily and seasonal water discharges create a highly variable aquatic environment that frequently changes in its physical and chemical characteristics. This type of environment can be stressful for certain species of aquatic life that are not adapted to such variable environments. Possible causes of stress associated with water releases include temperature changes due to differences in the temperature of the released water compared to the receiving waters, rapid expansion and loss of physical habitat, and significant changes in the substrate characteristics of the riverbed as a result of scouring. The likely result is a decrease in the overall abundance and diversity of aquatic life inhabiting the mainstem of the Colorado River.

In fact, native fish have been extirpated from the lower Colorado River. Non-native game species are the dominant fish species in the river near Parker (Janisch 2002). Channel catfish and largemouth bass are the most fished game species. Other prevalent non-native game fish include smallmouth bass, green sunfish, bluegill, carp, and striped bass. Flathead catfish, yellow bullhead, and redear sunfish occur less frequently. Non-game species of the study area consists principally of fathead minnow, golden shiner, red shiner, and threadfin shad (Janisch 2002).

Common invertebrates of the region include caddisflies, mayflies, dipterans, and chironomids (Fitzpatrick 2002). However, the native benthic community is potentially limited by substrate conditions and water fluctuations in the river. Benthic community diversity and abundance are most likely greatest in backwaters of the study area, where the substrates consist of a greater proportion of sand and silt and where water level fluctuations are not as significant (Fitzpatrick 2002). The mainstem of the river, which is subject to daily and seasonal scouring, is less likely to support a substantial benthic community.

Birds of the open water likely include resident populations of double crested cormorant, pied-billed grebe, and American coot. However, by far the greatest numbers of birds use the open water of the river in the winter, when seasonal populations of waterfowl hit their peak (Rosenberg et al. 1991). The deep river channel in the vicinity of Deer Island outside of the study area downriver from Parker often hosts large numbers of waterfowl in the winter (Rosenberg et al. 1991).

No aquatic mammals occur in the Lower Colorado River (Phillips and Comus 2000). None of the region’s amphibians are likely to occur in the mainstem of the Colorado River.

2.3.2.2 Riparian Backwaters

Pools and canals in the riparian areas along the Colorado River provide additional aquatic habitat in the study area. These areas could support fish and aquatic insects, as well as amphibians, such as the Colorado River toad and leopard frog, which may breed in permanent pools associated with these areas.

2.3.2.3 Water Supply Canals, Aqueducts, and the Main Drain

Water supply canals and aqueducts are the other principal regional water bodies. The main drain, comprised principally of effluent from the local POTW, provides additional aquatic habitat.

These water bodies are man-made structures, are often concrete-lined or have steep constructed banks and overall, provide habitat of limited ecological value. In addition, some of the canals in the study area are drained annually and therefore do not support mature aquatic communities or permanent benthic communities. These water bodies do contain fish and other aquatic life however. In addition, grebes, cormorants, and ducks, and heron use these areas to forage (Rosenberg et al. 1991). These canals also likely provide some drinking water for some of the regions larger wildlife, such as deer or coyote.

2.3.3 Endangered, Threatened and Special Concern Species

County-specific information developed by the U.S. Fish and Wildlife Service identifies several endangered and threatened (ET) species as occurring in La Paz and San Bernardino Counties, in which the study area lies (Table 2). Of these, only bald eagle, southwestern willow flycatcher, and Yuma clapper rail are potentially present in the natural habitats of the study area (Fitzpatrick 2002, Walker 2002), with bald eagle being a rare to uncommon winter visitors usually limited to a lone immature bird (Rosenberg et al. 1991). Desert tortoise can occur in the study area, but only the Mojave population is classified as threatened, and neither this population nor its critical habitat extends into the study area (CDFG 2002, Walker 2002, USFWS 1994). Two grow-out facilities for bonytail chub are located in the general region, but outside the study area; this species does not occur in natural habitats of the area (Fitzpatrick 2002)[3].

In addition to these federally listed species, several species classified as special concern by the Arizona or California Natural Heritage Programs have been previously recorded in the study area. Table 3 lists these special concern species for the study area (AGFD 2002b, CDFG 2002).

2.4 Facility Description

The Westates facility is comprised of spent carbon unloading systems, a spent carbon handling system, one reactivation unit, air pollution control equipment, a natural gas fired boiler, an activated carbon handling system, and an activated carbon product storage area. Table 4 lists the key spent carbon process equipment used at the facility to

[3] Fish from the grow-out facilities are stocked at Lake Havasu, above Parker Dam.

Table 2

Listed Endangered and Threatened Species of La Paz and San Bernardino Counties and Likely Presence in the Facility Area

Species	Status	County in which Listed	Likely Present in Facility Area? (a, b)
Birds			
Bald eagle	T	LaPaz, San Bernardino	yes
Southwestern willow flycatcher	E	LaPaz	yes
Yuma clapper rail	E	LaPaz, San Bernardino	yes
Brown pelican	E	La Paz	no (c)
Western snowy plover	E	San Bernardino	no
Least Bell's vireo	E	San Bernardino	no
Reptiles			
Desert tortoise, Mojave population	T	San Bernardino	no
Amphibians			
Arroyo toad	E	San Bernardino	no
California red-legged frog	T	San Bernardino	no
Fish			
Bonytail chub	E	LaPaz, San Bernardino	no
Desert pupfish	E	LaPaz	no
Gila topminnow	E	LaPaz	no
Razorback sucker	E	LaPaz, San Bernardino	no
Mojave tui chub	E	San Bernardino	no
Plants			
Parish's daisy	T	San Bernardino	no
Lane Mountain milk vetch	E	San Bernardino	no
Cushenberry buckwheat	E	San Bernardino	no
Cushenberry milkvetch	E	San Bernardino	no

E = endangered
T = threatened

(a) Sources: Fitzpatrick (2002), Walker (2002).
(b) The facility area of focus for this risk assessment will be a 20 km-by-20 km square (12.4 mile-by-12.4 mile square) with the facility at its center. Section 4.2.2.1 discusses the definition of this study area.
(c) May occur accidentally in facility area, such as after large coastal storms. Otherwise not expected. (Fitzpatrick 2002).

Table 3

Rare and Special Concern Species Potentially Occurring in the Facility Area as Identified by Arizona and California Natural Heritage Programs

Birds
Southwestern willow flycatcher Yuma clapper rail Western yellow-billed cuckoo Elf owl Burrowing owl [(a)] Gila woodpecker Yellow-breasted chat
Mammals
Cave myotis Colorado valley woodrat Greater western mastiff bat
Fish
Bonytail chub Razoback sucker
Reptiles
Sonoran desert tortoise Mojave fringe-toed lizard
Plants
Scaly sandplant Glandular ditaxis

Sources: CDFG (2002), AGFD (2002).
(a) Listed as a special concern species for the State of California.
(Basis: Personal communication, M. Blevins (EPA Region IX), May 19, 2003.

Table 4

Summary of Key Spent Carbon Process Equipment Used at the Westates Facility

Spent Carbon Process Equipment	Unit Designation	Process
Spent carbon unloading		
Spent carbon hoppers	H-1	This hopper is used for unloading of bulk containers of spent carbon received at the facility. H-1 is a three-walled building with fixed-roof and heavy plastic sheeting on the front unloading face. Unloading occurs in a metal hopper which is surrounded by a concrete containment area. A sump in the containment area directs washdown water to the recycle water tank T-9.
	H-2	This hopper is used for unloading of containerized spent carbon (drums, vessels, supersacks, etc.) received at the facility. It is located inside the spent carbon storage and warehouse building. Wash down water in vicinity of H-2 is directed to recycle water tank T-9.
Baghouse for hoppers	BH-2	This fabric filter baghouse is used to filter air exhausted from hoppers H-1 and H-2.
Carbon adsorber	WS-2	This carbon adsorption system is used to clean air exhausted from spent carbon hoppers H-1 and H-2 after passing through the baghouse.
Spent carbon storage tanks and feed hopper		
Spent carbon storage tanks	T-1, T-2, T-5 and T-6	These tanks are used to store spent carbon received from the unloading hoppers. Spent carbon is fed from these storage tanks to the furnace feed hopper (T-18) by use of an eductor.
Furnace feed hopper	T-18 (a)	This feed hopper is for carbon slurry which is fed to the reactivation unit (RF-2) via a screw conveyor and a weigh belt.
Carbon adsorbers	WS-1	Carbon adsorption system used for passive vapor venting from spent carbon storage tanks T-1, T-2, T-5 and T-6, and recycle water tanks T-9 and T-12.
	WS-3	Carbon adsorption system used for passive vapor venting from the furnace feed hopper T-18.

Table 4 (Continued)

Summary of Key Spent Carbon Process Equipment Used at the Westates Facility

Spent Carbon Process Equipment	Unit Designation	Process
Spent carbon reactivation		
Reactivation unit	RF-2 (a)	Multiple hearth reactivation furnace used to reactivate spent carbon.
Afterburner	AB-2	Exhaust gas from the reactivation furnace travels through this high-temperature afterburner prior to passing through a series of air pollution control equipment (venturi scrubber, packed-bed scrubber and wet electrostatic precipitator).
Reactivated carbon		
Product-side baghouse	BH-1	This fabric filter baghouse is used to filter air exhausted from the reactivated carbon conveyance system and packaging operations.
Water tanks		
Primary recycle water tank	T-9	The primary recycle water tank is used to facilitate transport of spent carbon from the hoppers to the storage tanks and to the furnace feed hopper T-18. This tank obtains makeup water from a city water source and also collects wash down water from containment areas associated with hoppers H-1 and H-2.
Excess recycle water tank	T-12	This secondary recycle water tank holds rainwater collected within the containment pad and excess recycle water. As the amount of recycle water exceeds the plant's needs, it is discharged from tank T-12 through a carbon adsorption system to the final holding and discharge water tank T-11.
Holding and discharge water tank	T-11	Water collected in this tank includes scrubber water blow down, cooling water blow down, boiler blow down and excess recycle water from tank T-12. Water from tank T-11 is continuously discharged to the POTW.

(a) The original reactivation furnace (RF-1) and its associated afterburner (AB-1), its furnace feed hopper (T-8) and its associated carbon adsorption system for hopper T-8 (WS-2) were taken out of service in 1996.

reactivate carbon. A brief description of this equipment and the reactivation process is provided below. This information was compiled from facility documents, interviews with facility personnel, and a facility visit (e.g., RUST 1995, McCue 2001, Chavond-Barry 1994). Figure 8 provides an aerial view of the Westates facility showing many of the equipment features at the plant.

2.4.1 Spent Carbon Description and Processing

Granular activated carbon (GAC) is widely used in the U.S. and worldwide to remove unwanted chemicals from both water and air. It is typically manufactured from coal or coconut shell. GAC's unique physical structure (extensive internal pores that create a large surface area) produces its excellent adsorptive capacity for a wide variety of organic chemicals.[4]

"Spent carbon" is the term used to describe GAC that has been taken out of service after it has been used to remove organic chemicals from water or gases. GAC is typically taken out of service well before its saturation capacity (i.e., before it contains the highest amount of compounds that can theoretically be adsorbed).

The process of removing previously adsorbed compounds from spent carbon is commonly referred to as carbon reactivation. The most effective method for reactivating spent carbon is by heating it to very high temperatures under controlled conditions. The reactivation process essentially recycles GAC rather than requiring additional mining or harvesting of raw materials to produce a completely new GAC product.

The Westates facility is designed to process approximately 2,760 pounds/hour (roughly 12,000 tons/year) of spent carbon. The 2,760 pounds/hour design value was based on the assumption that this material would contain roughly 13% total organic compounds, 43.5% dry spent carbon, and 43.5% water. The spent carbon received at the facility, however, contains substantially less organic compounds than the design value. Roughly 95% of the spent carbon received at the facility from 1997-2001 contained less than 1.5% organic compounds by weight. Approximately 50% of the spent carbon received at the plant contained less than 0.004% organic compounds (equivalent to a concentration of less than 40 parts per million or 40 ppm) and roughly 25% of the spent carbon contained less than 0.00000004% organic compounds (i.e., < 0.0004 ppm). The facility is designed to produce at least 5,250 tons/year of reactivated carbon product from the spent carbon. The actual production rate, based on data from January 2000 through October 2001, was 4,380 tons/year.

Spent carbon is received at the facility in a variety of sealed containers, including barrels or roll-off containers or in bulk by the truckload. Almost all of the spent carbon received at the facility is comprised of granules or pellets. Powdered activated carbon is not accepted at the facility (nor was the system designed to handle spent carbon as a powder). Roughly 60% of the spent carbon is received wet, that is, it has been used to remove pollutants from liquids and is usually saturated with moisture at about 50% water by weight. The remaining 40% of spent carbon is received dry, that is, it has been used to remove pollutant from gases and is typically less than 5% moisture by weight.

[4] Adsorption is defined as the condensation of gases, liquids, or dissolved substances on the surface of a solid. The molecules are held on the surface of the solid by physical forces and/or chemical reaction (Chavond-Barry 1994).

Figure 8

Aerial View of Westates Facility

More than half of the spent carbon received at the plant (approximately 58%) is not classified as a RCRA hazardous material based on data from the past five years of facility operation. The generators of this spent carbon have used the material for a variety of pollution control activities. Some examples include the maintenance of clean rooms at computer equipment manufacturing facilities, pollution control at petroleum refineries and chemical manufacturing facilities, air monitoring during airport construction, and air cleaning at truck and train depots.

Less than half of the spent carbon received at the Westates facility (approximately 42%) is designated as RCRA hazardous waste. This spent carbon has been used to treat materials that are classified as hazardous waste (e.g., air and water that is treated with carbon at environmental cleanup sites). Roughly 11% of the total spent carbon received at the facility (or 46% of the spent carbon classified as hazardous) has been used for hazardous waste site cleanup efforts. Spent carbon that has been used to treat classified hazardous wastes is required to be regulated as a hazardous waste. As described above, this means that the Westates facility is strictly regulated under USEPA's RCRA program.

All spent carbon generators must provide Westates with a profile for each unique type and source of spent carbon that may be sent to the facility. These profiles, which are maintained in a centralized location by Westates, describe the source of the spent carbon, how it has been used, and its chemical composition. Some generators may have more than one unique type of spent carbon that is sent to Westates, and thus may submit more than one profile to Westates. For example, a petroleum refinery may send one type of spent carbon that has been used to control vapor emissions from fuel storage tanks as well as a different spent carbon that has been used to remove organic compounds from water. Westates currently has approximately 1,500 unique spent carbon profiles.

2.4.2 Spent Carbon Storage

The spent carbon storage areas consist of a container storage area and several storage tanks. All self-contained units containing spent carbon (barrels or roll-off containers) are unloaded and stacked inside the storage and warehouse building and then emptied directly into an indoor hopper feed unit (H-2). Larger bulk loads of spent carbon (e.g., bulk shipments by truck) are unloaded in a separate hopper building (H-1); this is a three-walled structure with a fixed-roof and heavy plastic sheeting on the front open face.

Once in the hoppers, spent carbon is immediately directed to one of four spent carbon storage tanks (T-1, T-2, T-5 and T-6) and then on to the furnace feed hopper (T-18) which feeds spent carbon into the reactivation unit (reactivation unit 2 or RF-2)[5]. A water eductor jet pump is used in the piping at the bottom of the hoppers to move the spent carbon into the storage tanks. All of these tanks and the furnace feed hopper have been constructed and are managed in accordance with USEPA's benzene NESHAPS Subpart FF requirements (Subpart FF of 40 CFR Part 61). The vessels are all fixed-roof, closed-

[5] Note that the first reactivation unit (RF-1) at the facility, which began operations in 1991, was shut down in June of 1996 after the newer unit (RF-2) was permitted for operation. Accordingly, spent carbon furnace feed hopper T-8 and its carbon adsorber (WS-4) are no longer in use.

vent systems that passively route all organic vapors to activated carbon adsorbers (WS-3 for the furnace feed hopper T-18 and WS-1 for tanks T-1, T-2, T-5, T-6, T-9 and T-12).

2.4.3 Spent Carbon Reactivation

Spent carbon received at the Westates facility is reactivated by heating the material to a high temperature in a multiple hearth furnace. Spent carbon is sent to the multiple hearth furnace (RF-2) from the furnace feed hopper (T-18). It is introduced into the top of the reactivation furnace where it travels down through four hearths. Final dewatering of the carbon occurs in the top hearth, after which the carbon is heated to increasingly high temperatures as it travels down through the natural gas-fired zones of the bottom three hearths.

Exhaust gases generated during the reactivation process are directed through a high-temperature afterburner (secondary combustion chamber designated as AB-2), to maximize destruction of organic compounds. USEPA RCRA Part 264 regulations require that a permitted high temperature furnace plus afterburner system destroy at least 99.99% of the organics present on the spent carbon (technically this is referred to as a destruction and removal efficiency or DRE of at least 99.99%). Tests at Westates show the DRE is more than 99.9998%; this means that the system destroys at least 50 times more organics than required by USEPA.

After the afterburner, exhaust gases pass through a rapid quench system that cools combustion gases to prevent the formation of polychlorinated dioxins and furans[6], and then through a series of air pollution control equipment that minimizes potential emissions into the air. The air pollution controls consist of a venturi scrubber for removal of particulate matter and other compounds that tend to be associated with particulates (e.g., inorganic compounds), a wet electrostatic precipitator used to remove particulate matter, and a packed bed scrubber used to remove acid gases and organic compounds. The exhaust gases released from the stack are mostly comprised of water vapor and nitrogen, but may also contain trace quantities of constituents found in the spent carbon or new compounds resulting from chemical reactions taking place during the reactivation process. Compounds present in trace quantities can include acid gases such as hydrogen chloride, products of incomplete combustion such as polychlorinated dioxins and furans (or PCDDs/PCDFs), nitrogen oxides, carbon monoxide, and metals that either adhere to or combine with small particles called particulate matter.

2.4.4 Recycle and Other Water Management

Recycled water is used at the facility to facilitate transport of spent carbon from the hoppers to the storage tanks (T-1, T-2, T-5 and T-6) and ultimately to the furnace feed hopper (T-18). Tank T-9 is the primary recycle water tank for the reactivation facility. Tank T-9 obtains water from the Town of Parker, and also collects wash down water from both the containment area outside of the hopper building (H-2) and the unloading

[6] Polychlorinated dioxins and furans are a class of chemicals known as polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). There are 75 PCDDs and 135 PCDFs, with each individual compound referred to as a congener. Only 7 of the 75 PCDD congeners and 10 of the 135 PCDFs are considered to be toxic; these are compounds with chlorine molecule substitutions at the 2, 3, 7, and 8 positions on the compound. In this document, the mixture of polychlorinated dioxins and furans are referred to as "PCDDs/PCDFs".

area inside the spent carbon unloading warehouse (i.e., adjacent to H-1). A secondary recycle water tank, Tank T-12, holds rainwater and excess recycle water. As the amount of recycle water exceeds the plant's needs, it is discharged from tank T-12 through an activated carbon adsorber system to tank T-11, the final holding and discharge tank.

Tank T-11 collects water from various sources at the facility including scrubber water blow down, cooling water blow down, and boiler blow down, in addition to excess recycle water. Tank T-11 is not used to store any spent carbon.

Water from tank T-11 is continuously discharged to the local publicly owned treatment works (POTW) via an underground enclosed pipe. The water in tank T-11 is annually monitored for total volatile organic (VO) compounds to confirm that average VO concentrations in water remain less than 500 mg/L (i.e., < 500 parts per million or ppm) which is the trigger level at which USEPA's RCRA Subpart CC tank air emission requirements would apply. Tank T-11 water is also monitored for benzene annually to confirm that the discharge water contains less than 10 mg/L benzene, the trigger level at which USEPA's Subpart FF benzene NESHAP air emission requirements would apply. Annual monitoring results for benzene in the facility's discharge water confirm that benzene concentrations are less than 0.002 mg/L.

The local POTW is jointly owned by the Town of Parker and CRIT, and is referred to as the Colorado River Sewage System Joint Venture (the "Joint Venture"). The POTW receives water from more than 1,000 residential, commercial and industrial sources in the area, and discharges roughly 842,000 gallons per day. The POTW outfall is in the "main drain" which emerges just south of Mohave Road near the POTW and continues for roughly 15 miles to the southwest through Parker Valley, ultimately discharging into the Colorado River. As noted above, the excess water from some irrigation canals empties into the main drain as it travels to the river discharge location.

The POTW has a National Pollutant Discharge Elimination System (NPDES) permit (USEPA 2001b) which includes risk-based standards for five metals (beryllium, cadmium, lead, mercury and selenium), cyanide and bis(2-ethylhexyl)phthalate. These compounds were identified by USEPA as needing permit limits based on its review of discharge monitoring records from the POTW, toxicity studies on the POTW discharge, and a review of Westates' discharge data (USEPA 2001c). The discharge limits for these compounds are based on the most stringent applicable water quality standards (WQS) developed by the State of Arizona for protection of human health and the environment for designated uses of the water where the POTW discharge is regulated. For the purposes of permitting, USEPA has assumed that the designated water uses of the Colorado River in the vicinity of Parker shall also apply to the main drain. The types of water uses considered by USEPA are fish consumption, full-body contact, domestic water supply, agricultural irrigation, agricultural livestock, and warmwater aquatic life and wildlife. USEPA applied the most stringent WQS for these uses to the NPDES permit to ensure that the POTW's discharge is health protective. The final set of WQS applied to the NPDES permit are based on the following water uses, which are associated with the most stringent WQS: fish consumption (beryllium), warmwater aquatic life and wildlife (chronic WQS for cadmium, lead, mercury, selenium and cyanide, and acute WQS for lead, mercury, selenium and cyanide), full body contact (acute WQS for beryllium, cadmium and bis(2-ethylhexyl) phthalate), and drinking water (bis(2-ethylhexyl) phthalate; note that drinking water is not one of the designated water uses noted in USEPA (2001c) for the main drain).

The Westates facility has a permit issued by the Joint Venture that regulates its discharge to the POTW. Westates' is permitted to discharge up to 150,000 gallons of water per day to the POTW. Westates' discharge water is transported to the POTW via an underground pipe, and consequently, is not exposed to the ambient outdoor environment until it enters the POTW. According to the POTW's discharge fact sheet, Westates' inflow to the plant is roughly 118,000 gallons per day. Westates' wastewater thus accounts for about 14% of the total water flow discharged by the POTW (USEPA 2001c). Westates' permit with the POTW requires that the facility's wastewater be monitored for a variety of parameters. Continuous monitoring is conducted to determine the wastewater flow rate, its pH level, total dissolved solids and water temperature. Monthly monitoring is performed for total suspended solids and chemical oxygen demand. Westates monitors for total toxic organic compounds on an annual basis.

2.4.5 Reactivated Carbon Product

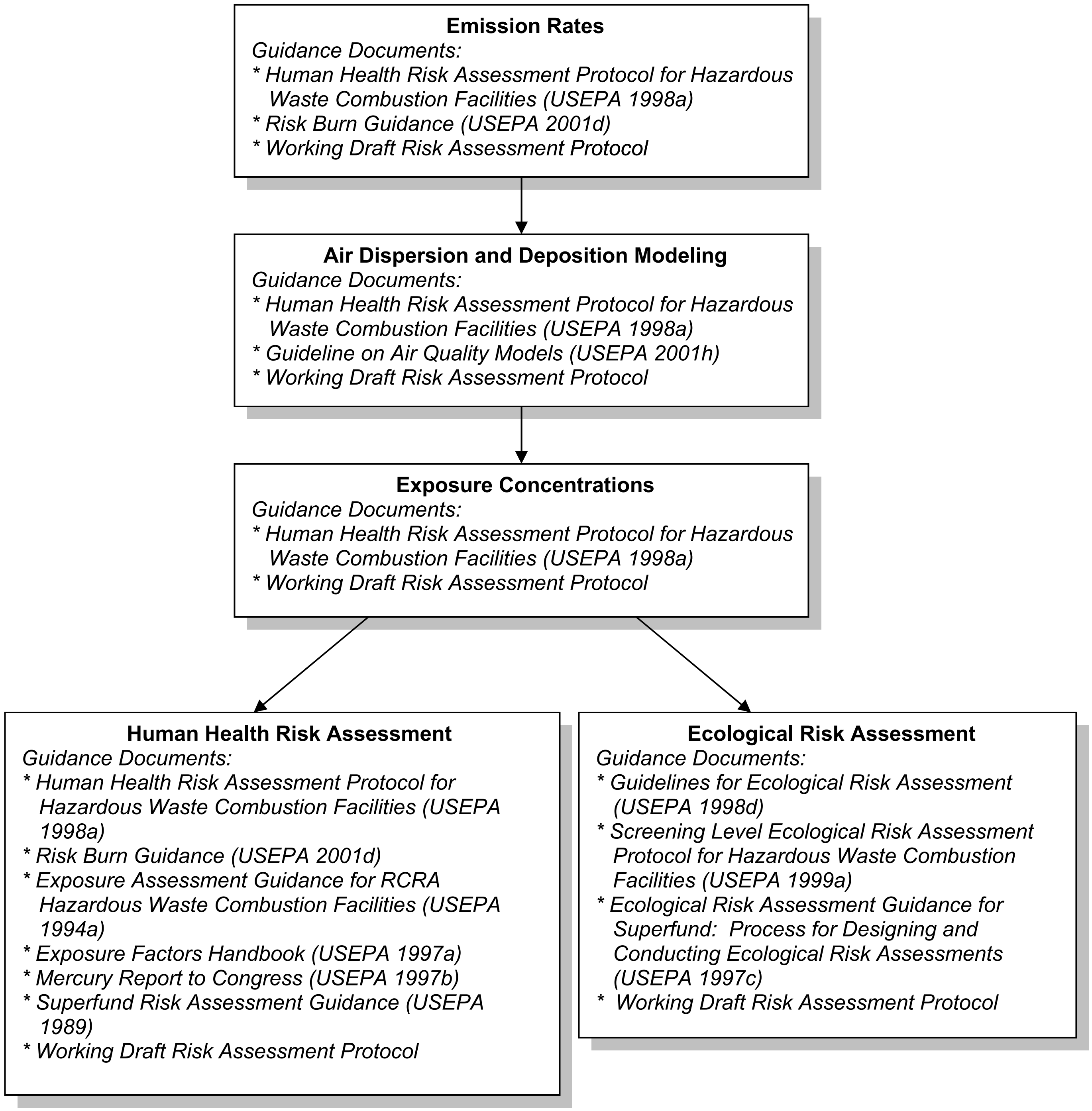
Reactivated carbon exiting the furnace is directed though a closed piping system to a storage and warehouse building that is physically separate from, but adjacent to, the RCRA-regulated spent carbon processing area. The piping feeds the reactivated carbon to a tank and then a screw feeder directs the material through a screening process in which the product is divided into four different size categories. The size-separated product is fed to an automated bagging system located inside the warehouse which produces sealed totes of product ready for resale. The reactivated carbon product produced at the Westates facility is no longer subject to RCRA regulations.

3.0 RISK ASSESSMENT OVERVIEW

The remainder of this document describes the approaches that will be used to conduct the human health and ecological risk assessment. These portions of the risk assessment share some common elements. As shown in Figure 9, these common elements are chemical emission rates, air dispersion and deposition modeling and fate and transport modeling used to calculate exposure concentrations in environmental media such as soil, plants and animals. The common elements, and the human health and ecological portions of the risk assessment, will rely on a variety of regulatory guidance documents in addition to the methods described in this working draft risk assessment protocol. The guidance documents that will be considered are also shown in Figure 9.

Figure 9

Overview of Risk Assessment Process and Guidance Documents



4.0 HUMAN HEALTH RISK ASSESSMENT APPROACH

This section describes the approach that will be used to perform the human health risk assessment for the Westates facility. There are a number of USEPA guidance documents that are relevant for this type of study and that will be used in accordance with USEPA requests. The primary guidance that will be relied upon is USEPA's Draft *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (HHRAP)(USEPA 1998a). Other USEPA sources of information and guidance that may be relied upon for the human health risk assessment include: USEPA's *Risk Burn Guidance* (USEPA 2001d), USEPA=s *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities* (USEPA 1994a), USEPA's *Exposure Factors Handbook* (USEPA 1997a), USEPA's *Mercury Report to Congress* (USEPA 1997b), and USEPA's *Risk Assessment Guidance for Superfund* (USEPA 1989). Data gaps may be filled or additional information may be obtained from other published scientific reports. Consistent with the guidance outlined in these documents, site-specific data will be included in many cases in place of standardized default assumptions. The basis for each site-specific value used in the analysis will be provided in the risk assessment.

All of the algorithms used to calculate environmental concentrations, exposures and potential risks associated with stack emissions will be obtained directly from USEPA's HHRAP, except where specifically noted in the risk assessment. The risk assessment will also include a complete list of all citations relied upon, fully referenced tables summarizing the input parameters used to calculate environmental concentrations and the exposure parameters for each pathway and receptor, the air dispersion and deposition modeling results, and a description of how the modeling results were used in the risk assessment.

The key steps in a human health risk assessment are based on the logical flow of information through the risk assessment process and are supported by USEPA guidance and the U.S. National Academy of Sciences. A flow chart of this process is shown in Figure 10. The key individual steps consist of:

- Hazard Identification
- Exposure Assessment
- Risk Characterization
- Discussion of Uncertainties

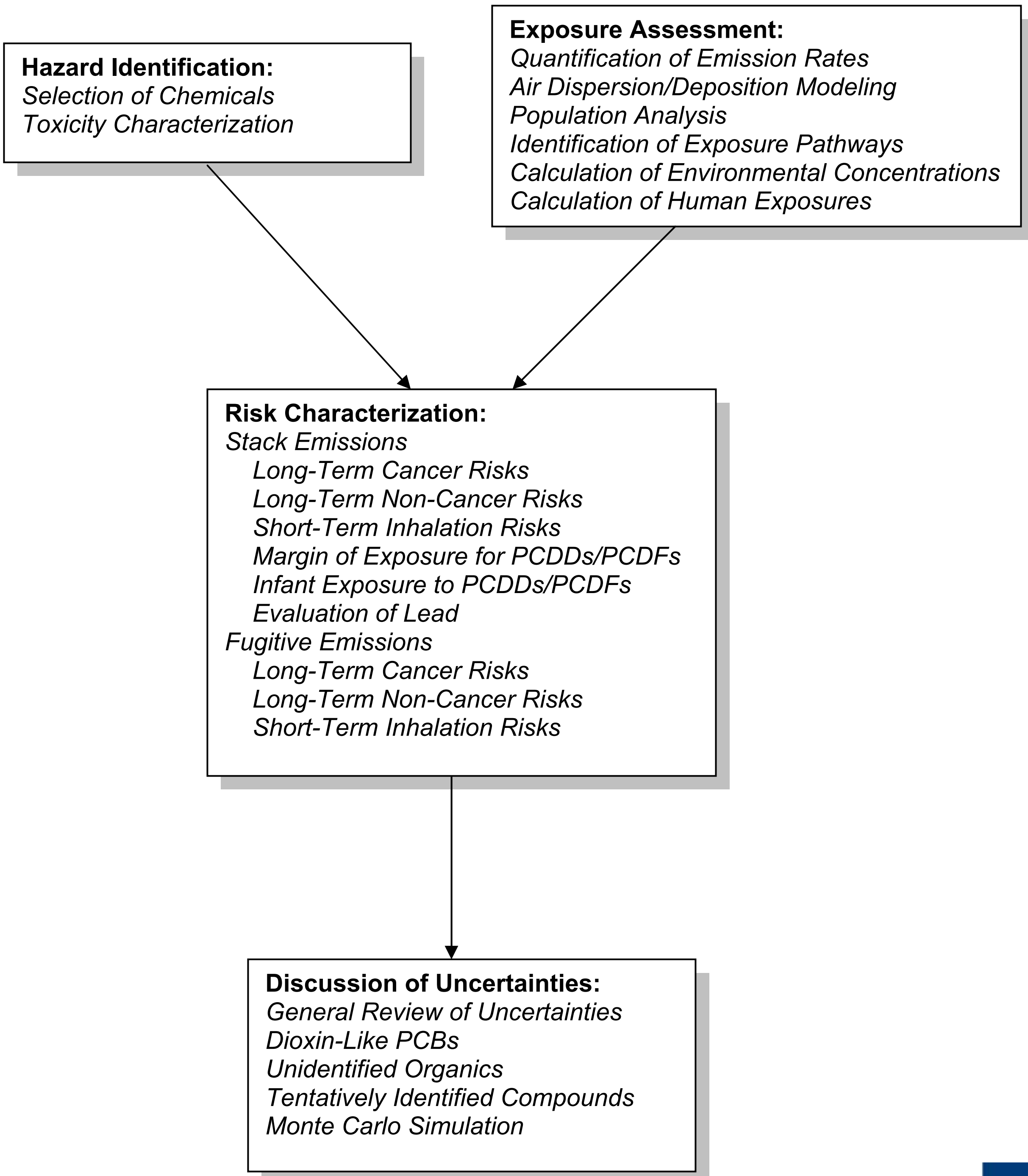
The approaches that will be used to perform each of these steps for the Westates reactivation facility are described below. In addition, discussions related to other issues identified by USEPA Region IX or raised by the community (e.g., fugitive emissions, potential worker health issues) will also be discussed later in this section.

4.1 Hazard Identification

The Hazard Identification presents the selection of chemicals for evaluation as well as the toxicity data for each selected chemical.

Figure 10

Flow Chart of the Human Health Risk Assessment Process for the Westates Facility



4.1.1 Selection of Chemicals of Potential Concern for Stack Emissions

This section outlines the proposed approach for selecting chemicals of potential concern (COPC) for quantitative evaluation in the human health risk assessment. The COPCs will be selected from an extensive list of over 200 compounds that will be analyzed for during the performance demonstration test. This list encompasses a wide range of compounds that could be present in stack gas emissions, including compounds potentially present in spent carbon as well as new compounds that may result from chemical reactions taking place during the reactivation process (e.g., acid gases such as hydrogen chloride, and products of incomplete combustion such as PCDDs/PCDFs).

Table 5 presents the list of compounds potentially present in spent carbon and the list of compounds that will be addressed in the performance demonstration test. For each compound, the table shows whether it may potentially be present in spent carbon and whether it will be specifically analyzed for in the stack-sampling program. Compounds potentially present in spent carbon were identified from several data sources: monthly composite samples collected from spent carbon; information submitted by Westates to USEPA for the Agency's toxic release inventory (TRI) program; and the facility's November 1995 RCRA Part B Permit Application. Not all of the chemicals shown in this table as being potentially present in spent carbon have actually been present in spent carbon, but it is considered possible that they might be present.

USEPA's (1998a) guidance provides a method for selecting chemicals. For example, this method indicates that compounds potentially present in the feed to the combustion unit should be included in the quantitative risk assessment. In accordance with USEPA (2003) comments, this risk assessment will follow the USEPA (1998a) guidance for selecting chemicals to be evaluated. It is important to recognize, however, that only a subset of evaluated compounds accounts for the majority of risks calculated in these types of analyses. Just a few examples supporting this finding are as follows:

- In USEPA's risk assessment for the DuPont Dow Elastomers combustion facility (USEPA 2001e), 9 of the more than 110 chemicals that were evaluated accounted for roughly 95% of the excess lifetime cancer risks for all receptors evaluated in the risk assessment. Eight compounds (including one already counted for cancer risk) accounted for roughly 95% of the non-cancer hazard index results for all receptors.

- In a risk assessment performed by USEPA for the Angus Chemical Company (USEPA 2000), 13 chemicals out of the more than 120 compounds considered accounted for roughly 95% of the excess lifetime cancer risks and 8 (including 2 already counted for cancer risk) accounted for roughly 95% of the non-cancer hazard index results for all evaluated receptors.

- USEPA's risk assessment for the DSM Copolymer facility (USEPA 2001f) showed that, for all receptors, roughly 95% of the excess lifetime cancer risks were accounted for by 8 compounds and roughly 95% of the non-cancer hazard index was accounted for by 5 compounds out of over 120 compounds evaluated.

Table 5
List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
Metals				
Aluminum	7429-90-5	N	Y	M29
Antimony	7440-36-0	Y	Y	M29
Arsenic	7440-38-2	Y	Y	M29
Barium	7440-39-3	Y	Y	M29
Beryllium	7440-41-7	Y	Y	M29
Cadmium	7440-43-9	Y	Y	M29
Chromium	7440-47-3	Y	Y	M29
Chromium VI (Cr6+)	7440-47-3	Y	Y	M0061
Cobalt	7440-48-4	Y	Y	M29
Copper	7440-50-8	Y	Y	M29
Lead [(b)]	7439-92-1	Y	Y	M29
Manganese	7439-96-5	Y	Y	M29
Mercury	7439-97-6	Y	Y	M29
Nickel	7440-02-0	Y	Y	M29
Selenium	7782-49-2	Y	Y	M29
Silver	7440-22-4	Y	Y	M29
Thallium	7440-28-0	Y	Y	M29
Vanadium	7440-62-2	Y	Y	M29
Zinc	7440-66-6	Y	Y	M29
Inorganic Gases and Criteria Pollutants				
Carbon Monoxide gas	630-08-0	N	Y	CEMS
Chlorine	7782-50-5	N	Y	M26A
Hydrogen chloride	7647-01-0	N	Y	M26A
Nitrogen oxides	10102-44-0 & 10024-97-2	N	Y	CEMS
Particulate matter (TSP)		N	Y	M26A
Particle size distribution		N	Y	Cascade Impactor
Sulfur dioxide	9/5/7449	N	Y	CEMS
Organics				
1-Butanol	71-36-3	Y	V TIC	Not in EPA Risk Guidance
1-Hexane	110-54-3	Y	V TIC	Not in EPA Risk Guidance
1,1 Dichloroethane	75-34-3	Y	Y	M0030
1,1 Dichloroethene	75-35-4	Y	Y	M0030
1,1,1 Trichloroethane	71-55-6	Y	Y	M0030
1,1,2 Trichloroethane	79-00-5	Y	Y	M0030
1,1,2,2 Tetrachloroethane	79-34-5	Y	Y	M0030
1,2-Dibromo-3-chloropropane	96-12-8	N	Y	M0010-Pesticide

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [a] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
1,2 Dibromoethane	106-93-4	Y	Y	M0030
1,2 Dichlorobenzene	95-50-1	Y	Y	M0010-SV
1,2 Dichloroethane	107-06-2	Y	Y	M0030
1,2 Dichloroethene	540-59-0	Y	Y	M0030
1,2 Dichloropropane	78-87-5	Y	Y	M0030
1,2,3 Trichloropropane	96-18-4	Y	Y	M0030
1,2,4-Trichlorobenzene	120-82-1	N	Y	M0010-SV
1,2,4 Trimethylbenzene	95-63-6	Y	V TIC	Not in EPA Risk Guidance
1,2-Dichloroethene (cis)	156-59-2	Y	Y	M0030
1,2-Dichloroethene (trans)	156-60-5	Y	Y	M0030
1,3 Dichlorobenzene	541-73-1	Y	Y	M0010-SV
1,4 Dichlorobenzene	106-46-7	Y	Y	M0010-SV
1,3-Dinitrobenzene	99-65-0	N	Y	M0010-SV
2,3,4,6 Tetrachlorophenol	58-90-2	Y	SV TIC	Not in EPA Risk Guidance
2-Butanol	78-92-2	Y	N	Not in EPA Risk Guidance
2-Butanone	78-93-3	N	Y	M0030
2-Butoxyethanol	111-76-2	Y	N	Not in EPA Risk Guidance
2-Chloronaphthalene	91-58-7	N	Y	M0010-SV
2-Chlorophenol	95-57-8	N	Y	M0010-SV
2-ethyl-1-Methylbenzene	611-14-3	Y	SV TIC	Not in EPA Risk Guidance
2-Hexanone	591-78-6	N	Y	M0030
2-methoxy-1-Propanol		Y	N	Not in EPA Risk Guidance
2-Methylnaphthalene	91-57-6	Y	Y	M0010-PAH
2-Methylphenol (o-Cresol)	95-48-7	Y	Y	M0010-SV
2-Nitroaniline	88-74-4	N	Y	M0010-SV
2-Nitrophenol	88-75-5	N	Y	M0010-SV
2,2'-oxybis (1-Chloropropane)	108-60-1	N	Y	M0010-SV
2,4-Dichlorophenol	120-83-2	N	Y	M0010-SV
2,4-Dimethylphenol	105-67-9	N	Y	M0010-SV
2,4-Dinitrophenol	51-28-5	N	Y	M0010-SV
2,4-Dinitrotoluene	121-14-2	N	Y	M0010-SV
2,4,5-Trichlorophenol	95-95-4	N	Y	M0010-SV
2,4,6-Trichlorophenol	88-06-2	N	Y	M0010-SV
2,6-Dinitrotoluene	606-20-2	N	Y	M0010-SV
3,3'-Dichlorobenzidine	91-94-1	N	Y	M0010-SV
3-/4-Methylphenol (m&p Cresol)	108-39-4 & 106-44-5	Y	Y	M0010-SV
3-Nitroaniline	99-09-2	N	Y	M0010-SV

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
4-Bromophenyl-phenyl ether	101-55-3	N	Y	M0010-SV
4-Chloroaniline	106-47-8	N	Y	M0010-SV
4-Chloro-3-methylphenol	59-50-7	N	Y	M0010-SV
4-Chlorophenyl-phenyl ether	7005-72-3	N	Y	M0010-SV
4,4'-DDD	72-54-8	N	Y	M0010-Pesticide
4,4'-DDE	72-55-9	N	Y	M0010-Pesticide
4,4'-DDT	50-29-3	N	Y	M0010-Pesticide
4-ethyl-1-Methylbenzene	622-96-8	Y	SV TIC	Not in EPA Risk Guidance
4,6-Dinitro-2-methylphenol	534-52-1	N	Y	M0010-SV
4-Nitroaniline	100-01-6	N	Y	M0010-SV
4-Nitrophenol	100-02-7	N	Y	M0010-SV
Acenaphthalene	208-96-8	Y	Y	M0010 SV PAH
Acenaphthene	83-32-9	Y	Y	M0010 SV PAH
Acenaphthylene	208-96-8	Y	Y	M0010-PAH
Acetone	67-64-1	Y	Y	M0030
Acrylic Acid	79-10-7	Y	N	Not in EPA Risk Guidance
Acrylonitrile	107-13-1	Y	Y	M0030
Aldrin	309-00-2	Y	Y	M0010-Pesticide
Aniline	62-53-3	Y	Y	M0010-SV
Anthracene	120-12-7	N	Y	M0010-PAH
Benzene	71-43-2	Y	Y	M0030
Benzo(a)Anthracene	56-55-3	Y	Y	M0010-PAH
Benzo(b)fluoranthene	205-99-2	Y	Y	M0010-PAH
Benzo(k)fluoranthene	207-08-9	N	Y	M0010-PAH
Benzo(g,h,i)perylene	191-24-2	N	Y	M0010-PAH
Benzo(a)pyrene	50-32-8	N	Y	M0010-PAH
Benzo(e)pyrene	192-97-2	N	Y	M0010-PAH
Benzoic Acid	65-85-0	N	Y	M0010-SV
Benzyl alcohol	100-51-6	N	Y	M0010-SV
α-BHC	319-84-6	N	Y	M0010-Pesticide
β-BHC	319-85-7	N	Y	M0010-Pesticide
γ-BHC (Lindane)	58-89-9	N	Y	M0010-Pesticide
δ-BHC	319-86-8	Y	Y	M0010-Pesticide
Bis(2-chloroethoxy) methane	111-91-1	N	Y	M0010-SV
Bis-(2-chloroethyl) ether	111-44-4	N	Y	M0010-SV
Bis(2-ethylhexyl) phthalate	117-81-7	N	Y	M0010-SV
Bromochloromethane	74-97-5	N	Y	M0030
Bromodichloromethane	75-27-46	Y	Y	M0030
Bromoform	75-25-2	N	Y	M0030
Bromomethane	74-83-9	N	Y	M0030

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
Butane	106-97-8	Y	Y	M0040
Butyl Acetate	123-86-4	Y	N	Not in EPA Risk Guidance
Butylbenzylphthalate	85-68-7	N	Y	M0010-SV
Carbon Disulfide	75-15-0	N	Y	M0030
Carbon Tetrachloride	56-23-5	Y	Y	M0030
Chlorobenzene	108-90-7	Y	Y	M0030
Chlorobenzilate	510-15-6	N	Y	M0010-Pesticide
α-Chlordane	5103-71-9	N	Y	M0010-Pesticide
β-Chlordane	5103-74-2	N	Y	M0010-Pesticide
Chlordane - mixed isomers	57-74-9	N	Y	M0010-Pesticide
Chlorodibromomethane	124-48-1	N	Y	M0030
Chloroethane	75-00-3	Y	Y	M0030
Chloroform	67-66-3	Y	Y	M0030
Chloromethane	74-87-3	Y	Y	M0030
Chrysene	218-01-9	Y	Y	M0010-PAH
Cresol	1319-77-3	Y	Y	M0010 SV as o,m,p-methylphenol
Cumene	98-82-8	Y	V TIC	Not in EPA Risk Guidance
Diallate	2303-16-4	N	Y	M0010-Pesticide
Dibenzofuran	132-64-9	Y	Y	M0010-SV
Dibenzo(a,h)anthracene	53-70-3	N	Y	M0010-PAH
Dibromomethane	74-95-3	N	Y	M0030
Di-n-butylphthalate	84-74-2	N	Y	M0010-SV
Dichlorodifluoromethane	75-71-8	N	Y	M0030
Dicyclopentadiene	77-73-6	Y	SV TIC	Not in EPA Risk Guidance
Dieldrin	60-57-1	N	Y	M0010-Pesticide
Diethyl phthalate	84-66-2	N	Y	M0010-SV
Dimethylphthalate	131-11-3	N	Y	M0010-SV
Di-n-octyl phthalate	117-84-0	N	Y	M0010-SV
Dioxane	123-91-1	Y	Y	M0010 SV as 1,4-Dioxane
Diphenylamine	122-39-7	N	Y	M0010-SV
Endosulfan I	959-98-8	N	Y	M0010-Pesticide
Endosulfan II	33213-65-9	N	Y	M0010-Pesticide
Endosulfan sulfate	1031-07-8	N	Y	M0010-Pesticide
Endrin	72-20-8	N	Y	M0010-Pesticide
Endrin aldehyde	7421-93-4	N	Y	M0010-Pesticide
Endrin ketone	53494-70-5	N	Y	M0010-Pesticide
Ethanol	64-17-5	Y	N	Not in EPA Risk Guidance
Ethyl Acetate	141-78-6	Y	N	Not in EPA Risk

Table 5

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Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
				Guidance
Ethylbenzene	100-41-4	Y	Y	M0030
Ethylene Glycol	107-21-1	Y	N	Not in EPA Risk Guidance
Fluoranthene	206-44-0	Y	Y	M0010-PAH
Fluorene	86-73-7	N	Y	M0010-PAH
Freon 113	76-13-1	Y	Y	M0030
Heptachlor	76-44-8	N	Y	M0010-Pesticide
Heptachlor epoxide	1024-57-3	N	Y	M0010-Pesticide
Hexachlorobenzene	118-74-1	N	Y	M0010-SV
Hexachlorobutadiene	87-68-3	N	Y	M0010-SV
Hexachlorocyclo-pentadiene	77-47-4	N	Y	M0010-SV
Hexachloroethane	67-72-1	N	Y	M0010-SV
Indeno(1,2,3-cd)pyrene	193-39-5	N	Y	M0010-PAH
Iodomethane	74-88-4	N	Y	M0030
Isobutane	75-28-5	Y	N	Not in EPA Risk Guidance
Isodrin	465-73-6	N	Y	M0010-Pesticide
Isopar C		Y	N	Not in EPA Risk Guidance
Isophrone	78-59-1	N	Y	M0010-SV
Isopropyl Alcohol	67-63-0	Y	N	Not in EPA Risk Guidance
m&p-Xylenes	108-38-3 &106-42-3	Y	Y	M0030
Methanol	67-56-1	Y	N	Not in EPA Risk Guidance
Methoxychlor	72-43-5	Y	Y	M0010-Pesticide
Methyl ethyl ketone	78-93-3	Y	N	Screen using spent carbon data
Methyl Isobutyl ketone	108-10-1	Y	N	Screen using spent carbon data
Methyl methacrylate	80-62-6	Y	TIC	M0030
methyl tert-butyl ether	1634-04-4	Y	N	Screen using spent carbon data
Methylene chloride	75-09-2	Y	Y	M0030
Methylnaphthalene	28804-88-8	Y	Y	M0010-PAH
Naphthalene	91-20-3	Y	Y	M0010 SV PAH
n-Hexane	110-54-3	Y	Y	M0040
Nitrobenzene	98-95-3	Y	Y	M0010-SV
N-nitrosodimethylamine	62-44-2	N	Y	M0010-SV
N-Nitrosodiphenylamine	86-30-6	N	Y	M0010-SV
N-Nitroso-di-n-propylamine	621-64-7	N	Y	M0010-SV
o-Xylene	95-47-6	Y	Y	M0030
Pentachlorobenzene	608-93-5	N	Y	M0010-SV

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [a] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
Pentachlorophenol	87-86-5	Y	Y	M0010-SV
Pentachloronitrobenzene	82-68-8	N	Y	M0010-SV
Perylene	198-55-0	N	Y	M0010-PAH
Phenanthrene	85-01-8	Y	Y	M0010-PAH
Phenol	108-95-2	Y	Y	M0010-SV
Polychlorinated Biphenyls	1336-36-3	Y	Y	M0010 PCB
Propylbenzene	103-65-1	Y	TIC	Not in EPA Risk Guidance
Propylene glycol monomethyl ether acetate	107-98-2	Y	N	Not in EPA Risk Guidance
Propylene oxide	75-56-9	Y	N	Not in EPA Risk Guidance
Pyrene	129-00-0	N	Y	M0010-PAH
Styrene	100-42-5	Y	Y	M0030
Tetrachloroethane	630-20-6 & 79-34-5	Y	Y	M0030
Tetrachloroethylene	127-18-4	Y	Y	M0030
Tetrahydrofuran	109-99-9	Y	TIC	Not in EPA Risk Guidance
Toluene	108-88-3	Y	Y	M0030
Total hydrocarbons	NA		Y	CEMS
Toxaphene	8001-35-2	N	Y	M0010-Pesticide
Trichloroethylene	79-01-6	Y	Y	M0030
Trichlorofluoromethane	75-69-4	Y	Y	M0030
Triethylamine	121-44-8	Y	TIC	Not in EPA Risk Guidance
Tris(hydroxymethyl) Aminomethane		Y	N	Not in EPA Risk Guidance
Vinyl Acetate	108-05-4	N	Y	M0030
Vinyl Chloride	75-01-4	Y	Y	M0030
Xylene	1330-20-7	Y	Y	M0030
Dioxins and Furans				
2,3,7,8-TCDD	1746-01-6	N	Y	M0023A
Total TCDD	NA	N	Y	M0023A
2,3,7,8-TCDF	51207-31-9	N	Y	M0023A
Total TCDF	NA	N	Y	M0023A
1,2,3,7,8-PeCDD	40321-76-4	N	Y	M0023A
Total PeCDD	NA	N	Y	M0023A
1,2,3,7,8-PeCDF	57117-41-6	N	Y	M0023A
2,3,4,7,8-PeCDF	57117-31-4	N	Y	M0023A
Total PeCDF	NA	N	Y	M0023A
1,2,3,6,7,8-HxCDD	57653-85-7	N	Y	M0023A
1,2,3,4,7,8-HxCDD	39227-28-6	N	Y	M0023A
1,2,3,7,8,9-HxCDD	19408-74-3	N	Y	M0023A

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)
Total HxCDD	NA	N	Y	M0023A
1,2,3,6,7,8-HxCDF	57117-44-9	N	Y	M0023A
1,2,3,4,7,8-HxCDF	70648-26-9	N	Y	M0023A
1,2,3,7,8,9-HxCDF	72918-21-9	N	Y	M0023A
2,3,4,6,7,8-HxCDF	60851-34-5	N	Y	M0023A
Total HxCDF	NA	N	Y	M0023A
1,2,3,4,6,7,8-HpCDD	35822-39-4	N	Y	M0023A
Total HpCDD	NA	N	Y	M0023A
1,2,3,4,6,7,8-HpCDF	67562-39-4	N	Y	M0023A
1,2,3,4,7,8,9-HpCDF	55673-89-7	N	Y	M0023A
Total HpCDF	NA	N	Y	M0023A
Total OCDD	3268-87-9	N	Y	M0023A
Total OCDF	39001-02-0	N	Y	M0023A
Polychlorinated Biphenyls [(c)]				
3,4,3',4'-Tetrachlorobiphenyl	32598-13-3	ND	Y	M0023A
3,4,4',5-tetrachlorobiphenyl	70362-50-4	ND	Y	M0023A
2,3,4,3',4'-Pentachlorobiphenyl	32598-14-4	ND	Y	M0023A
2,3,4,5,4'-Pentachlorobiphenyl	74472-37-0	ND	Y	M0023A
2,4,5,3',4'-Pentachlorobiphenyl	31508-00-6	ND	Y	M0023A
3,4,5,2',4'-Pentachlorobiphenyl	65510-44-3	ND	Y	M0023A
3,4,5,3',4'-Pentachlorobiphenyl	57465-28-8	ND	Y	M0023A
2,3,4,5,3',4'-Hexachlorobiphenyl	38380-98-4	ND	Y	M0023A
2,3,4,3',4',5'-Hexachlorobiphenyl	68782-90-7	ND	Y	M0023A
2,4,5,3',4',5'-Hexachlorobiphenyl	52663-72-6	ND	Y	M0023A
3,4,5,3',4',5'-Hexachlorobiphenyl	32774-16-6	ND	Y	M0023A
2,3,4,5,3',4',5'-Heptachlorobiphenyl	39635-31-9	ND	Y	M0023A
Monochlorobiphenyls	NA	ND	Y	M0023A
Dichlorobiphenyls	NA	ND	Y	M0023A
Trichlorobiphenyls	NA	ND	Y	M0023A
Tetrachlorobiphenyls	NA	ND	Y	M0023A
Pentachlorobiphenyls	NA	ND	Y	M0023A
Hexachlorobiphenyls	NA	ND	Y	M0023A
Heptachlorobiphenyls	NA	ND	Y	M0023A
Octachlorobiphenyls	NA	ND	Y	M0023A
Nonachlorobiphenyls	NA	ND	Y	M0023A
Decachlorobiphenyls	NA	ND	Y	M0023A

Totals - number of compounds…	255	Compounds or compound classes listed in table
	111	Potentially present in spent carbon
	18	Not included in performance demonstration test sampling methods
	237	Included in performance demonstration test sampling methods

Table 5

List of Chemicals Addressed in the Performance Demonstration Test and Considered in the Risk Assessment for the Westates Facility

Constituent	CAS NO.	Potentially Present in Spent Carbon [(a)] (Y/N)	Included in Stack Sampling (Y/N)	Notes (e.g., EPA sampling method)

Notes:

CEMS = continuous emission monitoring system.

ND = No Data

NA = not applicable

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

SV = semi-volatile

V = volatile

TIC = tentatively identified compound that will be identified if present in sample.

[(a)] Identification of compounds based on: 1) "Spent Carbon Feed Metal Results Summary", monthly composites, July 1994 - July 2001. 2) TRI information 1998 through 2000. 3) RCRA Part B Permit Application, November 1995, Table C-2.

[(b)] This compound is also a Clean Air Act Criteria Pollutant.

[(c)] Information on presence in spent carbon is only available for total PCBs.

- When the results of these studies are considered together, focusing on the receptors with the highest risk results, the number of risk-driving compounds (i.e., accounting for at least 95% of the highest total risk result for a receptor) was no more than 10 for excess lifetime cancer risk and no more than 5 for non-cancer risk results.

The chemical selection approach outlined in USEPA (1998a) guidance will likely result in the selection of most of the more than 200 compounds being addressed in the performance demonstration test, even though only a few of these will account for the vast majority of the calculated risk results. Additionally, as will be discussed later, organic compounds that are not identified or carried through the risk assessment will be addressed using total organic emissions information collected during the performance demonstration test. Moreover, the performance test burn data will be evaluated to determine if any additional compounds should be added to the list of selected chemicals for the risk assessment. Compounds could be added to reflect tentatively identified compounds (TICs) found during the performance demonstration test that might contribute substantially to potential risks.

4.1.2 Toxicity Characterization

4.1.2.1 Chronic Health Effects Criteria

The toxicity data used to evaluate chronic, long-term risks includes cancer slope factors for predicting excess lifetime cancer risks and reference doses (RfDs) for predicting the potential for long-term non-cancer effects. Both cancer and non-cancer effects for each selected chemical will be examined (depending upon the availability of toxicity data). The toxicity of each selected chemical and chemical class will be evaluated using currently available USEPA, Agency for Toxic Substances and Disease Registry (ATSDR) and other scientifically recognized data reported in USEPA's Integrated Risk Information System (IRIS) and USEPA's Health Effects Assessment Summary Tables (HEAST). If these two databases do not report values for a chemical, values from Agency for Toxic Substances and Disease Registry profiles, World Health Organization (WHO) monographs, or values provided by USEPA Region IX, will be used. If no toxicological data are available from any of these sources for a compound, this compound will be discussed in the uncertainty section of the risk assessment.

For lead, USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA 1994b) will be used if predicted environmental concentrations exceed the screening levels noted in USEPA (1998b). The use of the IEUBK model is consistent with USEPA’s currently recommended approach for evaluating potential risks from lead.

In order to evaluate potential risks from exposure to the mixtures of PCDDs/PCDFs commonly found in the environment, toxic equivalency factors (TEFs) are used to relate the toxicity of each 2,3,7,8-congener to the toxicity of 2,3,7,8-TCDD, the most well-studied and most toxic congener among the PCDDs/PCDFs. The TEFs allow evaluation of a mixture by expressing its toxicity in terms of 2,3,7,8-TCDD toxic equivalence (TEQ). The TEFs currently recommended for use by USEPA and specified by WHO (1998) and Van den Verg et al (1998) will be used in the risk assessment (see Table 6). In this system, the TEF for 2,3,7,8-TCDD is 1.0 and the other congeners have TEF values ranging from 1.0 to 0.00001. For example, the TEF for 2,3,7,8-TCDF is 0.1, which

Table 6

Toxic Equivalency Factors for PCDDs/PCDFs for the Human Health Risk Assessment

PCDD/PCDF Congener	Toxic equivalency factors
PCDDs	
2,3,7,8-TCDD	1
1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8,9-OCDD	0.0001
PCDFs	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDF	0.01
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.0001

Source: WHO (1998).

means that the potential toxicity of 2,3,7,8-TCDF is considered to be 10 times lower than that for 2,3,7,8-TCDD. To apply the TEF concept, the TEF of each congener present in a mixture is multiplied by its respective concentration or exposure and the products are summed to obtain the total TCDD toxic equivalence (TEQ) of the mixture. In the Westates human health risk assessment, the TEFs will be applied at the point when exposures are calculated; all fate and transport modeling will be performed on the individual congeners.

If PCBs are selected as chemicals of potential concern (based on the screening process described in Section 4.1.1), their potential risks will be based on measured emissions of total PCBs during the performance demonstration test and the application of toxicity criteria for PCBs as a class that most closely reflect the distribution of PCBs found in the stack gas. For example, the toxicity criteria that could be selected to represent total PCBs include the non-cancer RfD for Aroclor 1254 and the upper-bound cancer slope factor for a "high risk and persistence" tier, as provided by USEPA for use with food chain pathways of exposure (USEPA 2002a). The potential risks associated with "dioxin-like" PCBs will be addressed in the uncertainty section of the risk assessment (see Section 4.5.2).

4.1.2.2 Acute Health Effects Criteria

In addition to long-term toxicity data, the potential for short-term acute effects from emissions to air will be evaluated using acute reference air concentrations. These concentrations, representing the short-term level in air above which adverse effects may occur, will be derived from the published literature in accordance with USEPA's (1998a) guidance. This guidance provides a hierarchy of sources from which acute reference air concentrations can be compiled.

4.2 Stack Emissions Exposure Assessment

The key steps involved in a combustion source stack emissions exposure assessment consist of:

- quantification of stack emissions,
- air dispersion and deposition modeling,
- population analysis,
- identification of exposure pathways,
- evaluation of environmental concentrations, and
- calculation of human exposures.

A brief discussion is provided below of each of these steps.

<u>4.2.1 Stack Emission Rates</u>

4.2.1.1 Long-Term Emission Rates

One of the most important inputs to a combustion source exposure assessment is the chemical emission rate. Emission rates should ideally reflect releases associated with actual facility operations. In this risk assessment, however, conservative assumptions will be made in identifying emission rates, particularly in cases where emission rate performance standards are (or may be) specified in the facility's RCRA permit. As a result, the emission rates that will be used will not likely represent actual facility emissions. Rather they will be more likely to reflect high-end values[7] that may rarely, if ever, occur during operations of the facility.

Stack emission rates of the selected compounds from the reactivation unit stack will be identified based on a consideration of the performance test results, existing and proposed permit conditions, and actual and hypothetical chemical feed rates and conservative destruction and removal efficiencies (DREs). The basis for each chemical's emission rate will be explained in the risk assessment.

Existing or proposed RCRA permit limits, or existing or proposed maximum achievable control technology (MACT) standards under the Clean Air Act, will be selected as emission rates for some of the selected chemicals (e.g., hydrogen chloride, chlorine, PCDDs/PCDFs, and a number of metals). These permit limit emission rates will be compared to the results of the performance demonstration test to ensure that they are higher than the levels actually measured during the test.

Emission rates for some chemicals that could be present in spent carbon but are not measured specifically during the performance demonstration test will be based on spent carbon feed rate data in conjunction with an assumed DRE. RCRA regulations require that the facility achieve a DRE of 99.99%. The DREs measured at the facility have been shown to be at least an order of magnitude higher than the minimum DRE value, ranging as high as 99.9998%. Emission rates for the risk assessment will be calculated using measured DRE data from the performance demonstration test. Chemical-specific feed rates will be based on long-term average concentrations in the spent carbon received at the facility in conjunction with spent carbon feed rates.

Many of the emission rates (e.g., for volatile and semi-volatile products of incomplete combustion) will be based on performance demonstration test results. These emission rates will be calculated generally following USEPA (1998a) guidance. The average emission rate measured during the facility performance demonstration test will be used in the risk assessment. Emission rates will be calculated based on the arithmetic average of results across multiple test runs.[8] The data from multiple runs will also be generally reviewed to determine if the results are extremely variable across runs. This section of the risk assessment will also discuss the representativeness of the spent carbon used during the performance demonstration test relative to long-term operating conditions.

In the event a non-detect result from the performance demonstration test will be relied on, the non-detect result will be evaluated following USEPA (1998a) guidance, however, one-half the detection limit will be used, consistent with standard risk assessment

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[7] USEPA risk assessment guidance differentiates between a high-end and a central tendency exposure case (USEPA 1992). The high-end is intended to reflect a reasonable upper estimate of potential exposures. It is generally calculated by combining a number of high-end parameters together, including an upper estimate of emissions. The central tendency is intended to reflect typical exposures, and accordingly may rely on measured facility emissions during normal operating conditions.

[8] Example calculation of average emission rate from performance demonstration test results: ERavg = (ERrun1 + ERrun2 + ERrun3) / 3, where ER = emission rate and all emission rates are in units of g/sec.

practice. Additional investigation may be conducted to determine the validity of samples that may be reported with unusually high detection limits (e.g., re-evaluation of laboratory results).

Some sampling methods used in the performance demonstration test have several different fractions that are analyzed (e.g., for semi-volatile organic compounds). The emission rate reported for each chemical measured by this type of sampling train will reflect the results from all relevant sampling fractions. Moreover, these results will be summarized in the performance demonstration test report differently, depending upon whether the compound was detected in all fractions, detected in some fractions, or not detected in any fractions. The method for summarizing these data will explicitly show which of these three types of results (all detects, some detects, or no detects) were observed from the stack test samples.

Emission rates for mercury will be identified for three forms of mercury: particulate phase divalent mercury, vapor phase divalent mercury and vapor phase elemental mercury. Each of these mercury species needs to be quantified in stack gas emissions in order to apply the environmental modeling equations in USEPA (1998a) guidance. The speciation of mercury will be determined by analyzing the separate components of the sampling train that will be used during the performance demonstration test to sample for mercury. It will be assumed that the particulate matter and front half rinse results represent divalent particulate mercury, the acidified impinger solution result represents divalent vapor phase mercury, and the potassium permanganate solution result represents elemental vapor mercury (USEPA 2001d).

Emission rates measured during a performance demonstration test are likely to overestimate long-term facility emissions under normal operating conditions and, therefore, overestimate potential long-term facility risks. Emission rates set at levels even higher than those measured during a performance test (e.g., emission rates based on permit limits) are similarly expected to overestimate potential risks. The general approach described above is intended to ensure that the chemical emission rates generally reflect high-end emission rates. To place these high-end emission rates in perspective, more realistic long-term emission rates, intended to more closely reflect actual anticipated long-term operating conditions, may be developed for those chemicals driving the risk assessment results. The analysis of more realistic emission rates, and their impact on potential risks, will be provided in the Discussion of Uncertainties section of the risk assessment. The purpose of developing this second set of emission rates will be to put the high end risks (e.g., which may be based on permit limits which are much higher than performance demonstration test measurements) into better perspective.

4.2.1.2 Upset Scaling Factors

USEPA (1998a) guidance indicates that upset conditions need to be addressed in the risk assessment. USEPA (2001a) also requested that the risk assessment workplan address upset scenarios as well as start-up and shut-down conditions. Accordingly, stack emission rates will be adjusted upwards to reflect the potential impact of upset conditions (via the use of an upset scaling factor). The equation used to incorporate this parameter into the calculation of long-term emission rates for the risk assessment will be:

ER_{RA} = $ER_{SE} * U_{SF}$

where

ER_{RA} = Emission rate for input to risk assessment (g/sec),
ER_{SE} = Emission rate based on stack emissions (g/sec), and
U_{SF} = Upset scaling factor (unitless).

Westates will derive upset scaling factors to account for the potential impact of upsets in the risk assessment. The method that will be used to identify upset scaling factors will incorporate historical data on upsets at the facility over the past several years that have the potential to affect stack emission rates. The historical data will be used to determine the percentage of the annual operating time of the Westates facility that upset conditions may occur. Examples of upset conditions that will be considered include incidents that can trigger automatic waste feed cutoffs, such as power outages, failure of the wet electrostatic precipitator, failure of the scrubber pump, and plugging of the quench and venturi spray systems. The risk assessment will describe the types of failures considered in this analysis, as well as the percentage of operating time affected by each type of failure. The percentage of operating time under upset conditions will then be combined with an assumed factor of 10 emissions increase, in accordance with USEPA (1998a) guidance. The factor of 10 value is based on a default approach for nonhazardous waste incinerators presented by the California Air Resources Board (1990) in which emissions were assumed to increase by a factor of 10 during upsets.

Different upset scaling factors will be developed for organic compounds, metals and acid gases because emissions of each of these types of compounds may be affected by different types of upset conditions. A detailed description of the information used to develop the scaling factors will be provided in the risk assessment.

The upset scaling factor will not reflect startup or shutdown conditions for the reactivation unit because under these conditions, emissions associated with spent carbon will not occur. During startup, there is no spent carbon in the reactivation furnace. Startup procedures involve increasing the temperature of the reactivation furnace and afterburner over a period of roughly 33 hours using natural gas only. Spent carbon is not introduced into the multiple hearth furnace until temperatures have reached their required levels. As a result, upset emissions associated with spent carbon do not occur during start up conditions. Shut down procedures involve shutting off spent carbon feed to the furnace and waiting until all spent carbon has been cleared from all hearths before starting to cool down the furnace. The amount of time needed to clear the furnace hearths of spent carbon is roughly 1 hour. After all spent carbon is cleared from the furnace, temperatures in the furnace are slowly lowered to ambient temperature over a period of roughly 32 hours. Since the required high temperatures are maintained in the furnace, and the air pollution control equipment is continuously operated, until all spent carbon is cleared, upset emissions associated with spent carbon do not occur during normal shut down conditions.

4.2.1.3 Short-Term Emission Rates

In addition to long-term emission rates, short-term emission rates will also be compiled for use in an acute inhalation risk analysis . The short-term emission rates will be intended to reflect a one-hour period of time rather than a long-term, multi-year time period. Two sets of short-term emission rates will be developed, one assuming an upset condition occurs during the one-hour period evaluated in the acute risk analysis and the other assuming no upset occurs during that one hour. For the assumed upset condition, the short-term emission rate will be calculated as follows:

$$(ER_{SE} * (1\text{-upset duration})) + (ER_{SE} *10* \text{ upset duration})$$

where the upset duration equals the fraction of an hour that an upset condition could occur based on historical facility operating data.

4.2.2 Air Dispersion and Deposition Modeling

Air dispersion and deposition modeling is required in order to calculate chemical concentrations and ultimately human exposures from stack emissions. A separate draft protocol describing these modeling efforts is under development for this project and will be provided in Appendix C (Focus 2002b). The reader may refer to this protocol (to be submitted shortly) for detailed information on the modeling approach. This section focuses on how the modeling results will be incorporated into the risk assessment.

4.2.2.1 Model Application

The general application of modeling results in the risk assessment is outlined in Table 7 and summarized below:

- Long-term chronic risks will be calculated using annual average modeling results. Annual average ambient air concentrations and annual average deposition rates will be used to calculate concentrations in a variety of environmental media relevant to the risk assessment. The specific equations that will use these modeling results as inputs and that will be used to calculate environmental concentrations will be obtained from USEPA (1998a).

- Short-term acute inhalation risks will be predicted using 1-hour average modeling results.

Both dry and wet deposition are important components in the facility's risk assessment. The risk assessment will consider four possible sources of deposition, consistent with USEPA (1998a) guidance:

- Dry deposition of particles,
- Wet deposition of particles,
- Dry deposition of gases, and
- Wet deposition of gases.

The currently recommended model for combustion source analyses by USEPA will be used in the risk assessment, referred to as the Industrial Source Complex Short-Term 3 (ISCST3) model (USEPA 1998a, USEPA 2001h). Stack gas input data used in this model (e.g., stack gas exit velocity, stack gas exit temperature) will be determined based on long-term facility operating data and will reflect normal operating conditions for both annual average and 1-hour average air concentrations.

Table 7

Proposed Use of Dispersion and Deposition Modeling Results in the Westates Facility Risk Assessment

Exposure Pathway	Type of Environmental Concentration Calculated	Modeling Result Used
Air Dispersion Model		
Long-term chronic risks from inhalation of airborne compounds	Concentration in ambient air	Annual averages
Long-term chronic risks from produce ingestion	Concentration in plants resulting from vapor phase uptake of compounds from air	Annual averages
Short-term inhalation risks	Concentration in ambient air	1-hour averages
Deposition Model		
Long-term chronic risks from indirect pathways (e.g., animal, produce and soil ingestion)	Concentrations in ground-level and aquatic media (e.g., plants, water, fish, soil) resulting from deposition of compounds	Annual averages

USEPA (2001a) requested that the workplan describe the locations from which meteorological data will be obtained for use in the modeling. Meteorological data used in the ISCST model will be obtained from the nearest, most representative monitoring stations available. Surface meteorological data (e.g., wind direction, wind speed) will be obtained from measurements collected by the Arizona Meteorological Network (AZMET) in Parker. Upper air data (e.g., mixing heights) will be obtained from measurements collected at the National Weather Service (NWS) station at Flagstaff Pulliam Airport. Additional information on the meteorological data is provided in the draft air modeling protocol in Appendix C (Focus 2002b).

Wet and dry deposition modeling requires information on the size distribution of particles within the stack. Accordingly, particle size distribution data recently measured from the Westates' facility will be used in the modeling (see the Air Modeling Protocol for additional information on the particle size distribution measurements). The particle size distribution will be treated in two different ways in the ISCST model, consistent with USEPA (1998a) guidance. A mass-weighted particle size distribution will be used to represent emissions of metals (except mercury) that would form particles in the reactivation unit combustion area. A surface area-weighted size distribution will also be developed to reflect organic compounds and mercury that most likely exit the combustion area as gases and then adsorb onto the surface of already-formed particles.

The ISCST model will be used to calculate concentrations and deposition rates across a area that extends out 10 km (6.2 miles) from the facility in the north, south, east and west directions; this produces a 20 km-by-20 km square study area with the facility stack at its center. A 10 km distance was identified based on modeling of emissions from numerous combustion sources that was conducted to support USEPA's proposed Maximum Achievable Control Technology (MACT) standard for hazardous waste combustors (RTI 1996). These model results showed that the maximum impacts for air concentration occurred within the first 3 km downwind of the stack. The maximum deposition impacts (i.e., wet plus dry deposition) occurred within 100 meters for 10 of the 11 combustors modeled and at 700 meters for the 11th facility. Moreover, the modeling results showed that deposition rates decreased by at least 100 times within the first 10 km for the evaluated combustion facilities.

A grid of more than 4,000 receptors will be constructed and evaluated within the study area. The grid points will be closely and evenly spaced at 100 m (328 foot) intervals out to 3 km from the facility to ensure that potential maximum impacts are identified. From 3 km to 10 km, the grid points will be evenly spaced at 500 m (1,600 foot) intervals. A description of the receptor grids to be used in the modeling is provided in the Draft Air Modeling Protocol (see Appendix C). Additional receptors will be added if necessary to address specific locations that may be relevant to the risk assessment (e.g., schools, hospital).

The air dispersion and deposition modeling will be performed, consistent with USEPA (1998a) guidance using a unitized (1 g/sec) emission rate and, therefore, the model output will be expressed in units of $\mu g/m^3$ per 1 g/sec for air concentrations and g/m^2-year per 1 g/sec for deposition rates. Figures will be presented in the risk assessment displaying isopleths of the normalized air concentrations and deposition rates (i.e., results for a 1 g/sec emission rate) across the entire 20 km-by-20 km modeling domain. Chemical-specific concentrations and deposition rates will then be calculated by multiplying the normalized results by the chemical-specific emission rates. The set of modeling results ultimately used in the risk assessment will be presented in the risk assessment report.

4.2.2.2 Deposition Modeling Issues

The level of scientific support and validation for predicting wet deposition in ISCST3 and dry gas phase deposition is notably different from that for predicting dry deposition of particles. The algorithms in ISCST3 used to predict dry deposition rates for particles are based on a well-understood process and have been evaluated in detail (USEPA 1993, 1994c). In contrast, the wet deposition algorithms in ISCST3 have not received the same level of verification to support their use in a regulatory context. The wet deposition algorithms in ISCST3 have not undergone detailed scientific peer review, nor have they been validated or calibrated. Rather, the methods used to predict wet deposition in combustion source risk assessments are simple approximations that contain large uncertainties. The approach provided by USEPA (1998a) to predict wet deposition of gases assumes that the scavenging coefficient for a very small particle applies identically to all vapor phase chemicals, even though wet deposition of gases is a predominantly chemical-specific process. USEPA (1998a) also proposes a default deposition velocity of 3 cm/sec for predicting dry deposition of gases. There are, however, very significant uncertainties in deposition velocities for gases, spanning at least four orders of magnitude (Sehmel 1984).

The USEPA (1998a) approach for incorporating dry and wet gas phase deposition in a risk assessment introduces much uncertainty and is likely to produce important biases. These modeling uncertainties increase the potential for misinterpretation of risks, a result of particular concern given that the risk assessment is being considered in a regulatory evaluation.

Deposition modeling uncertainties will be addressed by presenting and comparing the wet and dry deposition rates used in the risk assessment for the most important risk assessment outcomes. In the event that one of the unvalidated, uncertain deposition algorithms is found to drive the risk assessment results, this deposition source will be further examined quantitatively and qualitatively in the uncertainty section of the risk assessment.

4.2.3 Population Analysis

The next step in the exposure assessment involves identifying populations in the facility area through demographic and land use data, and information on population activity patterns. Some local information has already been compiled for this project through site visits and contacts with local officials. However, a substantial amount of information still needs to be obtained through the CRIT information sharing process outlined above. After additional site-specific information has been compiled, these data sources will be used to complete the population analysis and identify exposure pathways for evaluation in the risk assessment.

4.2.4 Identification of Exposure Pathways

The next exposure assessment step will be the selection of a set of exposure pathways for evaluation in the risk assessment. This list of pathways will be selected based on site-specific information, current USEPA (1998a) recommendations and USEPA's (2001a) request that the risk assessment consider exposure due to subsistence fishing, hunting and agriculture. For example, USEPA (1998a) dictates to a large extent the types of receptors and exposure pathways that may be considered in a combustion source risk assessment. USEPA's (1998a) default exposure pathways include inhalation of air, and ingestion of soil, produce, beef, chicken, eggs, fish, dairy milk, and pork. The risk assessment will, however, only address USEPA default pathways or subsistence pathways that are applicable to the facility area based on site-specific information.

The selection of pathways will consider actual land use conditions as well as plausible future land uses, and will take into account the location of irrigation systems and land use zoning for industrial and airport land uses (e.g., see Figure 5). Additionally, a game ingestion exposure pathway will also likely be evaluated, based on existing knowledge of the facility area and population activity patterns.

Table 8 provides a matrix of example exposure pathways and receptors that may be included in the Westates risk assessment. This matrix addresses several adult and child receptors (resident, hunter, livestock farmer, fisher and breast-fed infant) as well as a number of exposure pathways. This list will be revisited and finalized after additional site-specific information has been compiled. Site-specific information is in the process of being obtained through the information sharing process with CRIT, and through contacts with other local officials.

Table 8

Example Exposure Pathways And Receptors That May be Considered in the Westates Risk Assessment

Exposure Pathway	Receptor				
	Adult and Child Resident	Adult and Child Resident/ Game Hunter	Adult and Child Fisher	Adult and Child Livestock Farmer	Breast-Fed Infant (a)
Inhalation	✓	✓	✓	✓	
Incidental Soil Ingestion	✓	✓	✓	✓	
Ingestion of Locally-Grown Produce	✓	✓	✓	✓	
Ingestion of Fish			✓		
Ingestion of Local Game		✓			
Ingestion of Locally-Raised Livestock				✓	
Ingestion of Breast-milk					✓

(a) A breast-fed infant exposure to PCDD/PCDFs will be evaluated for each adult receptor consistent with USEPA (1998a) guidance.

4.2.5 Calculation of Environmental Concentrations

The next step will be the calculation of chemical concentrations in each environmental medium of interest. These are referred to as exposure point concentrations. For example, concentrations will be predicted in soil, agricultural crops, local game, fish, and human breast milk. Except where otherwise noted in the risk assessment, all equations used to calculate environmental concentrations will be obtained from USEPA (1998a). The models and input parameters used to calculate environmental concentrations will be documented in the risk assessment. The input parameters used in USEPA (1998) equations will in many cases be based on the default values provided in USEPA (1998a). Site-specific information will, however, be used in place of the default inputs where relevant information is available. The type of site-specific information may include, for example, meteorological data, such as precipitation and evapotranspiration rates, environmental characteristics, such as soil density, and waterbody characteristics, such as water temperature and water flow rate. USEPA's (1998) algorithms for calculating environmental concentrations do not address individual events (such as a short intense rainfall) but rather address representative conditions over a longer time frame (e.g., annual).

Another example of a site-specific parameter is the emission period. A facility emissions period of 30 years will be evaluated based on the fact that there are 10 more years on the facility's current lease with a 20 year option for a subsequent lease. Accordingly, in applying the USEPA (1998) equations to calculate environmental concentrations, a 30-year emission period will be used where these equations rely on a total time period of emissions.

The risk assessment will calculate exposure point concentrations to reflect plausible exposure conditions specific to the facility area. Accordingly, the specific location or locations for each receptor will be determined once the air dispersion and deposition modeling has been completed in conjunction with an examination of land use patterns and zoning information (see Figure 5) in the facility area. For example, concentrations in game will be calculated for the areas across which game are actually found and hunted rather than at a single hypothetical maximum impact point. For the fish ingestion pathway, information on fishing locations, the extent to which locally-caught fish are ingested, and the types of fish ingested will be used to identify a waterbody for detailed evaluation in the risk assessment, assuming this pathway is carried through the analysis. Site-specific information will also be used to identify the acreage of land required to produce locally-raised agricultural crops used as feed for livestock rather than calculating livestock feed concentrations based on deposition modeling results at a single maximum point. The location evaluated for a residence will be based on the maximum modeling results calculated among those areas currently used for residential purposes or zoned for residential uses. The location evaluated for a farmer will similarly be based on the maximum modeling results calculated among those areas currently used for farming purposes or zoned for farming purposes and with existing or likely future access to irrigation water. A figure will be provided that indicates the locations of the reactivation unit stack, the facility boundary, and the receptor locations considered in the calculation of exposure point concentrations.

4.2.6 Calculation of Human Exposures

The last exposure assessment step is the calculation of human exposures in the facility area for each pathway. These calculations will rely on the methods laid out in USEPA (1998a). The information needed to accomplish this will be the predicted environmental exposure point concentrations, rates of exposure for each pathway (e.g., food ingestion rates, soil ingestion rates), and data on body weight, exposure frequency (i.e., days/year exposed) and exposure duration (i.e., total years exposed). The exposure assumptions will be derived to address both children and adults, consistent with current USEPA (1998a) guidance. One set of input parameter values will be used for each pathway, based on site-specific data where available, information in the scientific literature, and considering regulatory guidance (e.g., USEPA 1998a).

4.3 Fugitive Emissions Exposure Assessment

USEPA (2001a) requested that Westates' risk analysis address fugitive emissions potentially associated with the carbon reactivation facility including waste unloading, handling and processing. This section provides an overview of potential sources of fugitive emissions related to spent carbon at the facility in addition to a discussion of regulatory requirements, and engineering and institutional controls that are in place to minimize potential fugitive emissions. This discussion is used to identify the potential fugitive emission source related to spent carbon considered most likely to impact ambient air and thus proposed for detailed evaluation. This section also describes the exposure assessment approach that will be used to quantitatively evaluate the selected fugitive emissions source.

4.3.1 Potential for Fugitive Emissions from the Westates Facility

Processes involving spent carbon at the Westates facility that have the potential for fugitive particulate and volatile organic compound (VOC) emissions include:

- Handling of spent carbon containers received at the facility,
- Spent carbon unloading operations,
- Storage of spent carbon at the facility,
- Reactivation of spent carbon, and
- Production and bagging of reactivated carbon.

Potential fugitive emissions from each of these activities are reduced through standard work practices, facility design, and air pollution control (APC) devices. In addition, the intrinsic highly adsorptive nature of spent carbon results in very low partitioning of contaminants from the carbon to the atmosphere.

Potential fugitive emission sources at the facility are addressed by the USEPA under:

- the National Emission Standard for Benzene Waste Operations, Subpart FF of 40 CFR Part 61 (part of USEPA's program addressing National Emission Standards for Hazardous Air Pollutants or NESHAPs),

- the Resource Conservation and Recovery Act (RCRA) Subpart CC, [9] and
- the Potential to Emit Transition Policy for Part 71 Implementation (part of USEPA's Clean Air Act program).

4.3.1.1 Spent Carbon Containers

All containers received at the facility that contain spent carbon classified as hazardous waste under RCRA and all containers of spent carbon received from a facility that is regulated under the benzene NESHAP rule must be managed in accordance with strict USEPA requirements. These requirements include assuring that the spent carbon containers are completely sealed; this is initially accomplished by the spent carbon generators through both visual inspections of containers and VOC monitoring around the seals of containers. Then upon arrival at the Westates facility, containers are again visually inspected for proper seals.

The Westates facility currently stores sealed containers of spent carbon for up to one year, although most such containers are typically unloaded into the unloading hopper H-2 within about one month. These containers are also visually inspected during routine quarterly plant inspections. Rolloff containers and slurry trucks unload spent carbon at the time of delivery into hopper H-1. Supersacks and other smaller containers unloaded at H-1 may be stored for up to one year but are usually unloaded within about one to three months. Although not required, similar practices are typically followed for non-RCRA classified spent carbon as well.

4.3.1.2 Spent Carbon Unloading

Engineering and work practices during unloading operations at the facility's two hoppers are designed to limit the potential for fugitive dust emissions. Moreover, at no time other than when spent carbon is being unloaded into one of the hoppers is spent carbon exposed directly to the ambient environment. The two spent carbon hoppers are considered in the Part 71 Implementation program, but are not specifically regulated under the benzene Subpart FF standard or RCRA Subpart CC.

Roughly 52% of the spent carbon unloaded at hopper H-1 and 47% of the spent carbon unloaded at hopper H-2 is wet (saturated at roughly 50% moisture content by weight) and, therefore, do not generate fugitive dusts. Moreover, only a very small percentage of the dry spent carbon may be fine particulates. Powdered activated carbon is not accepted at the facility.

[9] USEPA's air emission control standards under RCRA for certain hazardous waste management units (tanks and containers) are generally known as the Subpart CC standards, found at 40 CFR Parts 264 and 265. USEPA has also developed national emissions standards for hazardous air pollutants (NESHAPS) under the Clean Air Act specifically for benzene, known as the National Emission Standard for Benzene Waste Operations, Subpart FF of 40 CFR Part 61. RCRA waste management units that are operated in compliance with the Subpart FF standards are generally exempt from the RCRA Subpart CC standards (because the practices used to control potential benzene emissions will also control other volatile organic compound emissions, meeting the Subpart CC requirements as well. See 40 CFR 264.1080(b)(7) and 40 CFR 265.1080(b)(7)). (See 40 CFR 264.1080 and 40 CFR 265.1080 for Subpart CC standards and 40 CFR 61.340 for Subpart FF standards.)

A hand-held water spray hose is used at H-1 as the material exits the containers to minimize potential dust emissions during unloading of dry spent carbon as well as to facilitate transfer of the spent carbon from the hopper through the piping system to the storage tanks. A hand-held water spray is also occasionally used to minimize dust emissions while unloading at hopper H-2 inside the spent carbon storage building.

An exhaust ventilation system is used for both hoppers, drawing roughly 2,500 cubic feet per minute of air from several ducts inside the hoppers through a fabric filter baghouse (BH-2) and then a carbon adsorber (WS-2). Particulate matter collected in the baghouse is periodically emptied into a container and placed in the RCRA-regulated debris bin maintained on site. Waste in the debris bin is sent to the RCRA-regulated Aptus, Utah incinerator facility every 60-90 days.

4.3.1.3 Spent Carbon Storage and Furnace Feed Hopper

All spent carbon storage tanks and the furnace feed hopper used at the facility are regulated under the benzene NESHAP Subpart FF air emission regulation which effectively minimizes potential VOC emissions. Although this regulation focuses on controlling benzene emissions, it ultimately achieves control of all VOC emissions. The tanks used to store spent carbon, as well as the furnace feed hopper and the water recycle tanks, have been constructed and are managed to comply with these regulations. The spent carbon storage tanks (tanks T-1, T-2, T-5, T-6), the furnace feed hopper (T-18) and the primary and secondary water recycle tanks (T-9 and T-12) are all fixed-roof, closed-vent storage vessels from which all vapors are passively routed through activated carbon adsorbers. The control efficiency of the carbon adsorbers is at least 95% for organic compounds and at least 98% for benzene. The carbon in these systems is changed over every 40 days for the adsorber that vents tanks T-1, T-2, T-5, T-6, T-9 and T-12. The adsorber that serves the furnace feed hopper T-18 is changed every 38 days. The changeout time for each of these adsorbers has been set based on engineering calculations to assure that the carbon does not approach its maximum collection efficiency.

The holding and discharge water tank, tank T-11, which is used for water and not spent carbon, is subject to recordkeeping and monitoring requirements, but is exempt from the RCRA Subpart CC and benzene Subpart FF air emission control requirements. Under Subpart CC, a tank in which the entering material has an average VOC concentration less than 500 mg/L (i.e., < 500 parts per million by weight or ppmw) is exempt from the RCRA Subpart CC air emission control requirements (40 CFR 265.1082(c)). In accordance with this program, annual monitoring of the material in tank T-11 is conducted and has indicated that the average VOC concentration in the water is less than 500 mg/L. Tank T-11 water is also monitored for benzene annually and has to date been found to contain less than 10 mg/L benzene, the trigger level at which USEPA's Subpart FF benzene NESHAP air emission requirements would be needed.

Process equipment (e.g., piping, valves, flanges, hatches, etc.) is also regularly monitored and inspected to minimize potential fugitive emissions in accordance with the facility's RCRA compliance program and the benzene NESHAP Subpart FF requirements. Annual air monitoring, in accordance with Subpart FF, is conducted to measure any VOC emissions from tanks, the furnace feed hopper, carbon adsorbers, piping, and other equipment involved in the handling of spent carbon. The Westates monitoring program examines more than 80 potential emission locations at the facility (e.g., flanges, equipment doors, valves, carbon adsorber outlets, etc.). An instrument reading, using USEPA's Method 21, of more than 500 parts per million by volume (ppmv) in air above background is used as a trigger under Subpart FF indicating unacceptable VOC emissions. Measurements made on process equipment (e.g., piping, valves, flanges, hatches, etc.) have exceeded the 500 ppmw trigger only once from 1995 through 2001 (the hatch of recycle water tank T-9 had been left ajar).[10] In this instance, the hatch was immediately closed. Other than this instance, the measured VOC concentrations at process equipment potential emission locations using Method 21 have typically been no more than 1-10 ppmv above background levels.

Visual inspections of facility equipment and processes also occur on a daily, weekly, quarterly and bi-annual basis. The inspection forms used by Westates to conduct these inspections are included in Appendix D. On a daily basis, for example, all drums, vessels and bags are checked for leaks, corrosion, and complete closure and the storage tank systems are checked to ensure that there are no valve leaks, no cracks in piping, no corrosion, that overfill protection systems are functioning and that all monitoring equipment is functioning. Dust collection systems are checked weekly for leaks and to assure adequate pressure drop. A detailed inspection of all seals, inlets and outlets of pumps and valves is performed on a monthly basis. Visual inspections are also conducted to search for cracks, holes, loose connections or gaps in all fixed-roofs, seals, access doors, ductwork, piping, connections and all other openings of equipment used to manage spent carbon. These openings are required to be maintained in a closed, sealed position at all times when spent carbon is present except when it is necessary to use the opening for sampling or removal, or for equipment inspection, maintenance or repair.

4.3.1.4 Spent Carbon Reactivation

Potential emissions associated with spent carbon reactivation are routed through the facility's air pollution control (APC) equipment and then discharged through the facility stack. The high temperature reactivation process and APC employed at the facility are extremely effective in minimizing and removing potential pollutants from the exhaust stack gases. As noted in Section 4.2, potential risks associated with stack emissions will be considered in the risk assessment. Fugitive emissions from the reactivation furnace are, however, prevented by the design of the process which utilizes a totally sealed system. Facility inspection procedures also ensure the integrity of the equipment.

4.3.1.5 Production and Bagging of Reactivated Carbon

Potential fugitive dusts associated with production and bagging of reactivated carbon are controlled through the use of an exhaust system which draws air from the product piping and bagging equipment to the product-side baghouse (BH-1). Not only are product bags connected with tight seals to the bagging equipment while filling, but the piping inserted into bags being filled exhausts air to baghouse BH-1. Almost the entire reactivated carbon product consists of small pellets or granules. Based on data from January 2000 to October 2001, only 3.7% of the reactivated product was screened into the smallest "fines" category (i.e., close to powdered activated carbon). Of this percentage,

[10] VOC concentrations greater than 500 ppmw have been observed using the Method 21 sampling not for process equipment but rather in the immediate vicinity of spent carbon barrels at the moment they are opened for unloading and during unloading.

approximately 88% is fed directly to bagging equipment with the remainder (powdered activated carbon) collected in the product-side baghouse fabric filters. The baghouse is shaken periodically, and then a rotary valve scrapes the product directly from the filters into supersacks that are tightly sealed onto the base of the baghouse. When full, the supersacks are manually closed and sealed. This process produces roughly one bag of fine powdered activated carbon per week. The reactivated carbon product is no longer subject to RCRA regulations.

4.3.1.6 Potential Fugitive Emissions from Other Sources

All spent carbon received at the facility is maintained inside sealed containers which are regularly inspected until they are unloaded. Spent carbon is never stored in storage piles anywhere at the facility. The only time spent carbon is ever exposed to the ambient air is during unloading. Once unloaded into the hoppers, all spent carbon is maintained in a slurry form (roughly 44% water) and is enclosed in process equipment (e.g., storage tanks) until it is sent to the combustion system.

All roads used by vehicles transporting spent carbon and reactivated carbon at the facility are paved, thereby minimizing potential fugitive dust emissions. Since spent carbon remains containerized until unloading, fugitive dust emissions that could potentially occur from vehicle movement would only contain native soils, not spent carbon. In addition, the length of paved road segments used by vehicles at the facility is very limited (no more than about 1/4 mile) and vehicle speeds are kept very slow at all times on facility roads (typically less than 5 miles per hour). These factors all limit the likelihood of fugitive dust emissions of soil due to vehicular traffic at the facility. Vehicles carrying spent carbon occasionally wait on the shoulder of the paved facility driveway for their turn to unload their spent carbon; in this case, the vehicle will be at a standstill except when pulling off or on the pavement. The potential for fugitive dust emissions of soil from non-paved surfaces is, therefore, negligible due to the infrequent need for vehicles to pull over while waiting their turn coupled with the fact that the vehicles on the driveway shoulder are not moving except when pulling off or on the paved surface.

4.3.2 Exposure Assessment for Fugitive Emissions

4.3.2.1 Potential Fugitive Emission Sources Selected for Evaluation

The requirements of the benzene Subpart FF regulations minimize potential fugitive volatile organic emissions associated with spent carbon containers and spent carbon storage and process equipment. The combustion process effectively destroys VOCs on spent carbon, thus fugitive VOC emissions will not occur during production and bagging of reactivated carbon. Spent carbon is only exposed to the ambient air during unloading, and there is thus some potential for fugitive VOC emissions during this activity. The potential impact of fugitive VOC emissions in outdoor ambient air will be lower for unloading activities at the indoor hopper compared to the outdoor hopper because the indoor environment will hinder release and dispersion of potential VOC emissions into the outdoor environment.

Fugitive dust emissions associated with spent carbon may occur during unloading of dry spent carbon at the hoppers. Fugitive dust emissions associated with reactivated carbon could potentially occur during production and bagging activities. At all other points in the facility's process, spent carbon and reactivated carbon are maintained in enclosed systems with no contact with the ambient air. Also, after unloading until combustion, all spent carbon is maintained in a slurry form and will not generate fugitive dusts. There is, however, a potential for spent carbon fugitive dust emissions to occur during unloading of dry spent carbon at the two hoppers even though these emissions are reduced through the use of an exhaust system at the hoppers as well as through the use of a water spray during unloading. Fugitive dust emissions during production and bagging of reactivated carbon are minimized by routing all product through a well-controlled piping and bagging system equipped with highly localized air emission controls at the point of potential dust generation. Thus, fugitive dust emissions associated with reactivated carbon are likely to be negligible.

Based on the discussion provided above, the potential fugitive emission source related to spent carbon considered most likely to impact ambient air is the unloading of spent carbon at the outdoor hopper. Thus, this fugitive emission source will be addressed in the risk assessment, focusing on both fugitive dust emissions as well as fugitive VOC emissions.

4.3.2.2 Selection of Chemicals of Potential Concern

A subset of compounds that may be present in spent carbon and that are likely to account for the majority of risks will be selected for quantitative evaluation. This selection process will consider data on each compound's concentration in spent carbon, the frequency and magnitude of spent carbon deliveries containing the volatile compounds, the compound's tendency to volatilize into ambient air during unloading (e.g., based on Henry's law constant) and the potential toxicity of the compound. Those volatile compounds that tend to be present at the highest concentrations, unloaded the most frequently, considered to be more toxic than other VOCs (based on the toxicity data described above) and most likely to volatilize into air will be selected for detailed evaluation in the risk assessment. In addition, fugitive emissions of dust associated with spent carbon unloading at the outdoor hopper will also be quantitatively evaluated.

4.3.2.3 Fugitive Emission Rates

Emission rates of dust and volatile organics present in spent carbon will be calculated using historical spent carbon unloading data. Published USEPA methods for calculating emission rates during material unloading (e.g., USEPA 1995b) will be used to predict these emission rates.

4.3.2.4 Air Dispersion Modeling

Air dispersion modeling is required in order to calculate chemical concentrations and ultimately human exposures from fugitive emissions. The fugitive emissions analysis will be limited to the inhalation pathway of exposure and thus deposition modeling will not be required. The draft protocol describing the modeling effort for this project is provided in Appendix A (Focus 2002b).

The ISCST model will be used to calculate ambient air concentrations associated with fugitive emissions. Fugitive emissions during spent carbon unloading will be treated as a volume source in the ISCST model. Long-term chronic risks will be calculated using annual average modeling results whereas short-term acute inhalation risks will be predicted using 1-hour average modeling results. The meteorological data used to model the dispersion of stack emissions will also be applied to model the dispersion of fugitive emissions. The set of receptor grid points used for stack emissions modeling will also be applied for the fugitive emissions modeling.

The modeling will be performed using a unitized (e.g., 1 g/sec) emission rate and, therefore, the model output will be expressed in units of $\mu g/m^3$ per 1 g/sec for air concentrations. Chemical-specific concentrations will then be calculated by multiplying the normalized results by the chemical-specific emission rates.

4.3.2.5 Identification of Exposure Pathways

The next exposure assessment step will be the selection of a set of exposure pathways for evaluation in the fugitive emissions portion of the risk assessment. The most important exposure pathway for this type of emissions source is direct inhalation. Indirect exposures due to deposition of fugitive emissions and subsequent incorporation into human foods are unlikely to be important due to the configuration of the fugitive emissions source and the type of compounds that will most likely be emitted. For example, the types of compounds of most concern in fugitive emissions (e.g., volatile compounds) do not tend to be taken up into foods which limits potential exposures via indirect pathways. Also, maximum impacts from fugitive emissions will tend to occur very close to the facility where the land is not used for farming or raising livestock. Therefore, the fugitive emissions risk analysis will focus on the inhalation pathway of exposure.

4.3.2.6 Calculation of Environmental Concentrations

Chemical concentrations in ambient air will be calculated, as described above, using USEPA's ISCST model. The model will be applied to calculate both long-term annual average concentrations as well as short-term 1-hour average concentrations. The specific location or locations at which concentrations will be calculated will be determined by considering land use patterns and zoning information (e.g., see Figure 5) in the facility area. For example, long-term inhalation risks for a residence will be calculated based on an examination of maximum modeling results among those areas currently used for residential purposes or zoned for residential uses.

4.3.2.7 Calculation of Human Exposures

Inhalation exposures will be calculated using the methods laid out in USEPA (1998a). These calculations will used the modeled ambient air concentrations, inhalation rates, and data on body weight, exposure frequency (i.e., days/year exposed) and exposure duration (i.e., total years exposed). The exposure assumptions will be derived to address both children and adults, consistent with current USEPA (1998a) guidance.

4.4 Risk Characterization

The next part of the risk assessment is referred to as risk characterization. In this part of the assessment, potential risks associated with the Westates facility will be addressed.

4.4.1 Stack Emissions

4.4.1.1 Chronic Long-Term Risks

Chronic long-term risks associated with stack emissions will be calculated by combining the exposure estimates with toxicity values for cancer and non-cancer effects. Cancer risks reflect the upper bound probability that an individual may develop cancer over a 70-year lifetime under the assumed exposure conditions. The risks are referred to as "upper bound" because they are unlikely to be underestimated and, in fact, may range from as low as zero to the upper bound value. Cancer risks will be calculated separately for each chemical and summed across chemicals for each exposure pathway. Risks will be added across pathways as relevant for specific hypothetical population groups that are evaluated (e.g., adult resident, child resident). The cancer risks will be evaluated relative to the USEPA (1998b) target risk level of $1x10^{-5}$. A cancer risk of $1x10^{-5}$ means that an individual could have, at most, a one in 100,000 chance of developing cancer over a 70-year lifetime under the evaluated exposure conditions. In comparison, each person in the U.S. has a background risk of developing cancer over a lifetime of about one in three.

The potential for non-cancer health effects will be determined by comparing the calculated exposures with non-cancer reference doses (RfDs). A hazard quotient will be calculated for each chemical by dividing its exposure by its reference dose. Each chemical and pathway will be evaluated separately, with results added across chemicals for similar target organs and health effect endpoints. The sum of a number of hazard quotients is referred to as a hazard index. The hazard index results will also be added across pathways as relevant. Each final hazard index result, therefore, will reflect exposure to mixtures of chemicals with similar health effects through multiple exposure pathways. This result will be evaluated against the USEPA (1998b) target level of 0.25. This target hazard index level is quite conservative; in many other environmental regulatory programs the target hazard index level is 1.0.

4.4.1.2 Margin of Exposure for PCDD/PCDFs

The USEPA has not developed a non-cancer reference dose for PCDD/PCDFs. As an alternative, a margin of exposure approach developed by USEPA will be applied to compare the calculated doses in the risk assessment to typical background U.S. exposure levels (Canter et al. 1998). This analysis is consistent with USEPA's (2001a) request that a margin of exposure analysis be conducted to assess PCDDs/PCDFs. In this analysis, the maximum PCDD/PCDF toxic equivalent (TEQ) average daily doses predicted for the hypothetical child and adult receptors in the risk assessment associated with stack emissions will be compared to typical background levels. The background exposure levels will be based on published estimates prepared by USEPA (e.g., Schaum et al. 1999, USEPA 1998a). Recognizing that there are important uncertainties inherent in USEPA's estimates, the current average background exposure levels are on the order of 0.6 pg TEQs/kg-day for an adult and 2 pg TEQs/kg-day for a young child (1-5 years old) (Schaum et al. 1999). These background exposure levels were calculated using the toxic equivalency factors for PCDD/PCDFs recommended for use by USEPA and developed by the World Health Organization (WHO 1998).

4.4.1.3 Infant Exposure to PCDD/PCDFs

Risk assessment methodologies have not been developed to quantitatively evaluate the potential risks to a breast-fed infant from exposure to PCDD/PCDFs using traditional regulatory cancer and non-cancer risk approaches. As described above, however, infant exposures to PCDD/PCDFs will be calculated as an adjunct to all of the adult exposure scenarios evaluated for stack emissions. Hypothetical infant exposures will be evaluated following an approach presented in USEPA (1998a). In this method, the average daily dose to PCDD/PCDFs, expressed as 2,3,7,8-TCDD toxic equivalents (TEQs), from breast milk ingestion is calculated and then compared to a comparison background level. The comparison level that will be used in this analysis is an average infant intake level of 60 pg/kg-day for 2,3,7,8-TCDD TEQs based on USEPA (1998a). It is very important to recognize, however, that the method specified for use in this risk assessment is a default regulatory approach; it does not reflect actual knowledge of the potential health effects, if any, of short-term exposure via breast-milk ingestion on an infant.

4.4.1.4 Acute Short-Term Risks

The potential for short-term acute inhalation risks associated with stack emissions will also be evaluated in the risk assessment, consistent with USEPA (1998a). This will be accomplished by comparing modeled short-term, 1-hour average air concentrations with the acute reference air concentrations in a manner similar to the evaluation of non-cancer risks. The evaluation will focus on the maximum modeled 1-hour average air concentrations predicted beyond the facility boundary. (One-hour average air concentrations at any other off-site location and for any other hour of the year will be lower than the maximum values.)

An acute hazard quotient will be calculated by dividing each chemical's modeled 1-hour average air concentration by its acute reference concentration.[11] Quotients below one are not expected to result in health effects. Quotients above one indicate a potential for health effects, but actual health effects are still unlikely to occur because safety factors are incorporated in the acute reference air concentrations. Acute hazard quotients will also be summed for similar health effects endpoints.

4.4.1.5 Evaluation of Lead

Potential risks from exposure to lead will initially be evaluated by comparison with screening levels for soil and air, as described in USEPA (1998b). These screening levels are 100 mg/kg in soil and 0.2 $\mu g/m^3$ in air.

4.4.1.6 Comparison to Risk-Based Standards and Criteria

This part of the risk assessment will compare the calculated environmental concentrations to available standards and criteria. Specifically, calculated ambient air concentrations will be compared with National Ambient Air Quality Standards (NAAQS),

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[11] For example, HQ_{acute} = (1-hr average air concentration in $\mu g/m^3$)/(acute reference air concentration in $\mu g/m^3$).

calculated ambient air concentrations and soil concentrations will be compared with USEPA Region IX risk-based concentrations for air and soil, and calculated water concentrations will be compared with ambient water quality criteria.

4.4.2 Fugitive Emissions

4.4.2.1 Chronic Long-Term Risks

Chronic long-term risks associated with fugitive emissions during spent carbon unloading will be calculated by combining the inhalation exposures with toxicity values for cancer and non-cancer effects. The methodology described above for evaluating chronic risks from stack emissions will also be applied for fugitive emissions.

The same receptor locations (e.g., for a resident) will be evaluated for both stack and fugitive emissions, thereby allowing an evaluation of the potential risks associated with both stack and fugitive emissions combined. Should the location of the maximum modeling results among those areas currently used for residential purposes or zoned for residential uses differ between stack and fugitive emissions, potential inhalation risks will be calculated at the location where the combined risks would be higher.

4.4.2.2 Acute Short-Term Risks

The potential for short-term acute inhalation risks associated with fugitive emissions will also be evaluated in the risk assessment. This will be accomplished by comparing predicted short-term, 1-hour average air concentrations with the acute reference air concentrations in a manner similar to the evaluation of non-cancer risks. The methodology described above for evaluating acute risks from stack emissions will also be used to evaluate fugitive emissions.

4.4.2.3 Comparison to Risk-Based Standards and Criteria

This part of the risk assessment will compare the calculated ambient air concentrations associated with fugitive emissions to available standards and criteria. Specifically, calculated ambient air concentrations will be compared with National Ambient Air Quality Standards (NAAQS) and USEPA Region IX risk-based concentrations for air.

4.4.3 Wastewater Discharge from Westates to the Joint Venture

USEPA (2001a) requested that the risk assessment address the potential for exposure via surface water from Westates' wastewater discharge to the POTW. It is important to recognize, however, that Westates' discharge water is transported to the POTW via an underground pipe, and consequently, is not exposed to the ambient outdoor environment until it enters the POTW. Moreover, wastewater discharge from Westates is regulated by an industrial wastewater discharge permit granted to Westates from the POTW in accordance with the Clean Water Act, whereas air emissions are regulated by an air permit granted by USEPA in accordance with the completely separate USEPA RCRA program.

The risk assessment will include an analysis of the potential incremental impact of Westates' wastewater on chemical concentrations in the water that will be discharged by the POTW. As requested by USEPA, the analysis of POTW discharge will include the calculation of potential risks from ingestion of fish caught in the main drain associated with the incremental impact of Westates discharge to the POTW and these potential risks will be considered in conjunction with the risks calculated according to this protocol for the facility's air emissions.

In order to evaluate the incremental impact of Westates' wastewater on the POTW's discharge, we will rely on a combination of analytical chemistry and modeling. The analytical chemistry efforts will look at chemical concentrations in Westates' wastewater discharge (e.g., metals, organic compounds) and water quality parameters (e.g., hardness, pH, alkalinity, total suspended solids, total solids, and settleable solids). Chemicals that have been detected in Westates' wastewater discharge (and are not present due to external laboratory contamination) will be considered for evaluation. The modeling will rely on mathematical methods approved by the USEPA and will take into account the effect of the POTW treatment process on compounds present in Westates' wastewater discharge and the partitioning of compounds between dissolved and particulate phases in the main drain. The results will be evaluated by comparison with risk-based AWQC applicable to the designated water uses assumed for the main drain, consistent with USEPA's approach for the POTW permit.

The uptake of chemicals from the main drain into fish and the associated potential risks associated with fish ingestion will also be addressed, as requested by USEPA. This analysis will begin by identifying a representative portion of the main drain that is known to be regularly fished (for edible fish) where risks will be evaluated. Then, using USEPA approved methods, calculations will be performed to predict chemical concentrations in the selected portion of the main drain, potential fish tissue concentrations associated with these water concentrations, and then associated potential human health risks from fish ingestion. The modeling of concentrations in the selected portion of the main drain will take into account the impact of water overflow from irrigation canals into the drain. Information on fishing locations, the extent to which fish caught from the main drain are ingested, the types of fish ingested, and the impact of water overflow from irrigation canals on water flow in the main drain will be obtained from CRIT through the information sharing process described earlier in this document. As requested by USEPA, the potential risks from fish ingestion due to Westates' contribution to the POTW discharge will also be considered in conjunction with the risks calculated as part of the facility's RCRA air emissions risk assessment.

4.4.4 Worker Health and Safety

USEPA (2001a) requested that the risk assessment workplan address exposure to workers within the Westates facility. In response to this request, this section presents a summary of worker health and safety protections in place at the plant.

Westates has a well-developed worker health and safety program operating in compliance with the Occupational Health and Safety Act (OSHA). This program includes training, medical monitoring, industrial hygiene sampling and use of personal protective equipment.

Table 9 lists the elements of Westates' worker protection program. This program includes an extensive training program to ensure worker safety in areas ranging from use of personal protective equipment to minimize potential chemical exposures, to fall

Table 9
Westates Carbon Arizona, Inc. Facility Worker Protection Program

1. **USFilter Corporate EH&S Manual**

2. **Local Training Programs**
   40-Hour Hazwoper Training (new employees)
   Hazard Communication (Computer)
   Confined Space (Computer)
   Lock Out/Tag Out (Computer)
   Bloodborne Pathogens (Computer)
   Fire Extinguisher
   Contingency Plan
   Personal Protection Equipment (Computer)
   Back Safety (Computer)
   Respiratory Protection (Computer)
   Forklift Training (Computer)
   Hot Work
   First Aid (Every Other Year)
   HM-181 (Computer)
   Hearing Protection (Computer)
   Electrical Safety (Computer)
   Laboratory Safety (Computer)
   Fall Protection
   8-Hour Hazwoper Refresher
   Hazardous Debris Management
   Burn Prevention
   Acid and Caustic Handling

3. **Annual Employee Physicals**
   General Physical
   Blood Workup
   EKG
   Hearing Test
   Pulmonary Function Test

4. **Annual Employee IH Monitoring** (organics, dust, noise)

5. **Annual Respirator Fit Test**

6. **Monthly Employee Safety Meetings**

7. **Monthly Safety Committee Meetings**

8. **Company Furnished Items:** Split Lockeroom, Showers, Soap, Towels, Work clothes, Steel-Toed Safety Shoes, Safety Glasses, Gloves, etc.

9. **Safety Bonus Program** - $300/Year w/o Lost Workday Injury - $25/Q w/o a recordable injury.

10. **Plant Safety Record**: 2773 Days w/o a Lost Workday Injury (Last LT- June 16, 1994). One Recordable Injury In Last 5 Years.

and back protection to minimize the chance of accidental injury or muscle strain. All employees must undergo 40 hours of training related to hazardous waste operations when initially hired, plus an 8-hour refresher course each year. All employees are required to attend regularly scheduled safety meetings and are also required to pass an additional safety test each month. All workers involved in spent carbon unloading operations wear respirators in addition to protective clothing. Workers wear company-supplied shirts, pants and steel-toe boots, hard hat, and safety glasses. When handling any spent carbon (whether it is classified as non-hazardous or hazardous), a half-face respirator with organic and dust control cartridges is worn by workers. This practice has been followed since 1992. All employees also receive physicals prior to the start of work and annually thereafter, including the performance of blood testing, EKGs, hearing tests, and pulmonary function tests.

Industrial hygiene (IH) monitoring is conducted each year for a wide variety of organic compounds and dust in air to ensure that adequate personal protective equipment is being used at the facility. The IH monitoring also evaluates noise conditions at the plant. The annual IH surveys monitor workplace breathing zone concentrations of organic compounds and particulate matter among workers employed in a variety of tasks at the facility, for example workers unloading and sampling spent carbon containers, lab technicians and facility assistant managers. The results of all the IH surveys since 1993 have shown air concentrations either below quantitation limits or typically 100 or more times below occupational permissible exposure limits (PELs), with one exception. The only exception occurred during the December 1999 IH survey when a spent carbon load containing a high level of benzene (roughly 60,000 ppm in spent carbon) was being unloaded at the outdoor hopper H-2. Three of the five personal samples collected during this survey had time-weighted-average (TWA) benzene levels equal to or just above the PEL, ranging from 1.0 to 2.2 parts per million in air (ppm) versus the PEL of 1 ppm. These air samples were collected from individuals who were working inside hopper H-2 during the unloading of the spent carbon load. (These workers were wearing personal protective equipment, including respirators, in accordance with the facility's worker protection program as described above). Results for the other 15 organic compounds tested during the December 1999 IH survey were all either below the quantification limit or more than 100 times below their corresponding PELs. Results for the more than 35 other IH air samples analyzed for benzene since 1993 were either below the detection limit or ranged from 4-28 times lower than the 1 ppm PEL.

Westates operates in full compliance with OSHA and follows a comprehensive worker health and safety program, as described above. Workers employed in activities involving spent carbon wear personal protective equipment to prevent exposure to chemical compounds, plus all workers follow the facility's detailed safety training program. Potential risks to workers are being minimized through these programs.

In response to USEPA comments on the revised May 2003 Workplan (USEPA 2003b), a risk analysis consistent with OSHA and NIOSH methods will be performed in which workplace air concentrations will be compared to workplace permissible exposure limits. Based on the discussion of potential fugitive emissions provided above, the worker analysis will focus on spent carbon unloading, the activity for which potential impacts associated with dust and volatile organic compounds (VOCs) from spent carbon are expected to be highest. For this activity, both modeled air concentrations and available employee industrial hygiene air measurements will be evaluated.

4.5 Discussion of Uncertainties

All risk assessments involve the use of assumptions, judgment and incomplete data to varying degrees. This results in uncertainty in the final estimates of risk. In accordance with standard risk assessment practice, this section of the analysis will present a discussion of key uncertainties affecting the risk assessment. It will also present the methods and results from a quantitative uncertainty analysis.

4.5.1 General Review of Uncertainties

The results of any risk assessment inherently reflect uncertainty because of the many complexities involved in the analysis. This risk assessment, for example, will involve the integration of many steps, each of which is characterized by some uncertainty. These steps include:

- the calculation of chemical emission rates,
- the modeling of potential air concentrations and deposition rates associated with chemical emissions,
- the calculation of chemical concentrations in the environment (e.g., soil, beef, local game, and fish) using mathematical models in conjunction with many chemical/physical properties and assumed or site-specific information about the environment in the facility area,
- the calculation of potential exposures to humans through multiple pathways using a combination of default and site-specific exposure parameters, and
- the calculation of potential risks using toxicity information derived in some instances from human data but predominantly derived from experimental data produced from animal studies.

The risk assessment results that will be presented will reflect the combination of all of these potential sources of uncertainty.

There are two types of uncertainty generally associated with a risk assessment that will be discussed - one is referred to as variability and the other is a more technical definition of uncertainty.

- Variability results from differences in physical or biological processes, such as the natural differences in how much people weigh or how much they eat. Variability generally cannot be reduced by doing additional research but it can be addressed by incorporating information on the range of values that might be present in a population. In this risk assessment, many single point estimates will be used for parameters that are known to vary across the population and, as a result, the risk results will not reflect potentially important elements of variability. Some of the uncertainties in the risk assessment resulting from variability will, however, be addressed through a Monte Carlo simulation (see the Monte Carlo Simulation section below).

- Uncertainty stems from imperfect knowledge of the true value of a variable or model, and is generally reducible through additional research or analysis work (i.e., better data and better models). Uncertain elements in this risk assessment will include chemical-specific input parameters (e.g., emission rates, biotransfer factors, cancer slope factors), input parameters describing the physical environment (e.g., animal feed ingestion rates, the dry deposition velocity of gases, and soil and surface water characteristics), and mathematical models (e.g., ISCST, and fate and transport equations embodied in USEPA's HHRAP). Some of these uncertainties may be addressed in the Monte Carlo simulation (e.g., chemical emission rates). For the most part, however, these types of uncertainty are complex and difficult to evaluate in a quantitative manner.

The risk assessment will include a table that summarizes the key assumptions used in the analysis. This table will also indicate whether each assumption will tend to underestimate and/or overestimate potential risks. Additional discussions may be provided for key assumptions that significantly affect the risk results, for example assumptions used to develop chemical emission rates.

4.5.2 Examination of Dioxin-Like PCBs

Measurements of co-planar PCBs, compounds believed to have "dioxin-like" properties, will be collected during the performance demonstration test (see Focus 2002a). The purpose of this section of the risk assessment will be to present an evaluation of the potential impact of the measured co-planar PCB emissions on the risk assessment results.

The World Health Organization (WHO 1998) has developed toxic equivalency factors (TEFs) for certain co-planar PCBs that relate the potential toxicity of each co-planar PCB to 2,3,7,8-TCDD (see Toxicity Characterization section above for a discussion of TEFs). For example, the PCB congener 3,4,3',4'-tetrachlorobiphenyl has been assigned a TEF of 0.0001 by WHO, which means that this PCB compound is believed to be 10,000 times less toxic than TCDD. These TEFs will be used to calculate potential excess lifetime cancer risks for co-planar PCBs.

The approach used to perform this evaluation will involve several steps. First, emission rates of co-planar PCBs based on the performance demonstration test will be determined. Second, the potential lifetime average daily dose for each co-planar PCB will be calculated by multiplying the lifetime average daily dose already calculated for total PCBs by the ratio of the measured performance test emission rate for the co-planar PCB divided by the emission rate for total PCBs. The total PCB lifetime average daily dose will be based on the receptor and exposure pathway that is found to dominate the risk results for PCDD/PCDFs. This will provide the most conservative indication of the potential impact of co-planar PCBs on the risk assessment. The average daily dose for each co-planar PCB will then be multiplied by its WHO TEF to calculate the TCDD toxic equivalent (TEQ) dose for each co-planar PCB. After this, the sum of all the co-planar PCB TEQ doses will be calculated. Finally, the cancer slope factor for TCDD will be multiplied by the total co-planar TEQ dose to calculate the associated potential excess lifetime cancer risk.

The resulting excess lifetime cancer risk associated with co-planar PCBs will be presented in this section of the risk assessment. These risks will be considered in conjunction with the excess lifetime cancer risks calculated for the other evaluated compounds, including PCDDs/PCDFs, for the risk-driving selected receptor and exposure pathway. This information will be used to determined the extent to which co-planar PCB risks affect the overall results of the risk assessment.

There are a variety of uncertainties that are associated with an analysis of this type. For example, the assumption that a co-planar PCB compound's potency is directly proportional to the potency of 2,3,7,8-TCDD, that this relationship can be quantified based on a TEF, and that potential risks can be calculated using a toxicity value for TCDD has not been proven (WHO 1998, USEPA 1994d, Safe 1994, Ahlborg et al. 1994).

4.5.3 Unidentified Organic Compounds

Total organics measurements will be collected during the performance demonstration test (see Focus 2002a). These measurements will provide information on total volatile organic compounds, total semi-volatile organic compounds and total non-volatile organic compounds. These data will be used to derive a total organic emissions factor that is intended to reflect the potential impact of total organic compounds not specifically selected for evaluation in the risk assessment. The TOE factor is defined as the ratio of the total organic compound emission rate divided by the sum of the emission rates for organic compounds actually evaluated in the risk assessment. Current methods recommended by USEPA will be used to derive this factor, though it should be noted that there are very important uncertainties associated with this method as discussed in USEPA (1998a). The TOE factor will be used to determine the extent to which emissions of unidentified organics may affect the overall results of the risk assessment.

4.5.4 Tentatively Identified Compounds

Tentatively identified compounds (TICs) in stack emissions will be evaluated as part of the performance demonstration test. A description of the methods that will be used to identify TICs is provided in Focus (2002a). In general, these methods will focus on identifying those TICs present in the largest amounts in the collected stack samples and for which a chemical-specific identification can be made with confidence. In this section of the risk assessment, the potential impact of these compounds on the risk assessment results will be evaluated. Factors that will be considered in the evaluation of TICs include their potential emission rates relative to other compounds already evaluated in the risk assessment and potential toxicity based on data available for the specific TIC or structurally similar compounds. It should also be recognized that the evaluation of total organic emissions, as described above, will also account for organic compounds not already evaluated in the risk assessment.

4.5.5 Monte Carlo Simulation

The risk assessment methods discussed above are expected to produce calculations of high-end exposures and risks using one set of input assumptions describing high-end emission rates, environmental conditions and human exposure patterns. These input assumptions will be conservatively selected, meaning that the potential risks will be unlikely to be underestimated. Emission rates calculated based on the performance demonstration test, for example, will not be expected to reflect actual operating conditions and are likely to overestimate potential risks. Although the risks calculated using the one set of input assumptions are expected to be conservative, they still will not completely portray the full range of possible risks, nor the inherent uncertainty that may be associated with stack emissions. Risks can vary over orders of magnitude because of the heterogeneity in environmental concentrations, parameter values and populations.

Potential variations in risk will be addressed through the performance of a probabilistic risk assessment using Monte Carlo simulations. A Monte Carlo simulation provides a probability distribution of risks rather than a single value whose probability is not known. The analysis allows discrete risk results to be put into perspective, and also allows identification of risks at specified percentiles (e.g., the 90th percentile). The use of Monte Carlo simulations in risk assessments has been recommended by USEPA (1998c) and the U.S. Science Advisory Board. This type of analysis can provide additional information for regulatory decision makers as well as provide greater assurances of a facility's safety.

Monte Carlo simulations will be conducted to supplement the risk analyses presented in the main part of the report. These simulations will focus on the one or two chemicals and one or two exposure pathways that are found to dominate the risk results. A detailed description of each simulation, its methods and its input parameters will be provided in the risk assessment, including the input parameter distributions and their sources. For example, a simulation might be performed to address the range of potential risks within the area where a livestock farm could plausibly be located (e.g., where there is adequate supply of land, vegetation and water). Such a simulation would incorporate all the deposition and air modeling results predicted within the area under study (but beyond the facility boundary). The simulation would also include some parameters that reflect the variability in the likelihood and magnitude of potential exposures.

The Monte Carlo simulations will follow the general principles outlined in USEPA (1998c). Distributions for input parameters will be identified, as available, from the published literature or based on emissions data from the facility. For example, distributions could be developed to reflect the variability in the fraction of locally-raised livestock used as a food source, and food ingestion rates. All distributions will be presented in the risk assessment report. Potential correlations between distributional parameters (e.g., body weight and ingestion rates) will be taken into account where adequate data are available to describe this relationship. The simulations will be performed using the program Crystal Ball® (Decisioneering 1996), which is an add-on to Excel 2000®. A total of 10,000 iterations will be performed for each simulation to ensure stability in the final risk distribution. Summaries of the simulation data, including all results and input distributions, will be provided in an appendix to the risk assessment report.

5.0 ECOLOGICAL RISK ASSESSMENT APPROACH

An ecological risk assessment will be conducted to determine the potential effects of modeled emissions on ecological receptors within the study area. The overall approach will be consistent with USEPA's guidelines for ecological risk assessment (USEPA 1998d) and will incorporate elements from other relevant USEPA ecological risk assessment guidance, including the peer-review draft of USEPA's combustion source ecological risk assessment guidance (USEPA 1999a) and USEPA's Superfund process document (USEPA 1997c).

This section of the workplan identifies the receptors and exposure pathways to be the focus of the risk assessment and details the procedures for characterizing ecological exposures, toxicity, and risk. All of the species identified in USEPA's letter to Westates (USEPA 2001a) have been considered in the development of this workplan. A subset of these has been selected for evaluation, considering a number factors including likely presence in the study area. This section of the workplan also reflects more recent comments from USEPA (2003) on the first version of this Risk Assessment Workplan which was submitted to USEPA in June 2002. Though no site-specific species field surveys have been conducted, the information on species presence summarized here and earlier in Section 2.3 is derived from site visits, data on local and regional ecology obtained from authoritative field guides and natural history publications (e.g., Rosenberg et al. 1991, Phillips and Comus 2000) and from communications with the US Fish and Wildlife Service (Fitzpatrick 2002, Walker 2002), and the Arizona and California Natural Heritage Programs (AGFD 2002b, CDFG 2002), as well as conversations with other state, federal, and local representatives familiar with the ecology of the study area. Additional information on study-area-specific ecology that may be gathered from on-going communications with CRIT will be included in the final risk assessment, if different from that presented here.

This workplan is not intended to present an exhaustive list of fish and wildlife species present in the area or to target all possible receptors or exposure pathways for quantitative analysis. Rather, the focus is to identify key species and pathways that are representative of potential risks in each of the study area's habitats so that any potential ecological impacts associated with carbon reactivation operations at the Westates facility can be appropriately characterized.

5.1 Problem Formulation

Problem formulation is the process by which the receptors, endpoints, and pathways to be the focus of the risk assessment are identified. The foundation of problem formulation is an understanding of the predicted relationships between ecological entities and the chemicals to which they may be exposed. From this foundation, the particular receptors and endpoints to be the focus of the assessment are defined. This section outlines the ecological problem formulation for the Westates ecological risk assessment.

5.1.1 Chemical Sources

As discussed earlier in this document (see Section 2.4.3), some chemicals may be released from the stack as a result of the carbon reactivation process. Compounds present in trace quantities in stack gas can include acid gases such as hydrogen chloride, products of incomplete combustion such as PCDDs/PCDFs, nitrogen oxides, carbon monoxide, and metals that either adhere to or combine with small particles called particulate matter. This ecological risk assessment will evaluate potential risks associated with these stack emissions.

A previous section of this document (Section 4.3.1) discussed the potential for fugitive emissions at the Westates facility. The potential for ecological effects from fugitive releases of volatile organic compounds is, however, negligible. First, volatile organic compounds would be the chemicals most likely to be released, and these compounds have very low toxicity to terrestrial plants and animals. Additionally, the concentrations of organic chemicals in ambient air due to fugitive emissions would be reduced to extremely low levels during transport to ecological habitats, which are located beyond the facility boundary. Low concentrations coupled with low toxicity would not result in any increased ecological risks. For these reasons, potential ecological effects of fugitive emissions will not be evaluated in the risk assessment.

5.1.2 Environmental Transport

Once released to the air, chemicals can be dispersed throughout the study area. Chemicals in the air will eventually deposit to the land or water surfaces within the study area. Chemicals deposited to land can remain on the land surface and eventually could be transported into the soil column along with infiltrating precipitation or into area washes and eventually the Colorado River along with precipitation runoff. Given the low precipitation within the study area, these latter transport processes will be infrequent. Some portion of the land-deposited chemicals could be transported to plants, either directly as a result of particle deposition or via gas exchange across leaf stomata, or indirectly via root uptake of surface deposited chemicals that have been incorporated into the soil matrix.

Chemicals reaching the Colorado River will be dispersed in the water column. Some chemicals will sorb to particulate matter and deposit to bed sediments. However, as mentioned above high volume water releases from Parker Dam and Headgate Rock dam during power generation activities could result in some scouring of bed sediments, and at a minimum is likely to wash any surface deposited sediments down-river where they will be diluted with other sediments from outside the study area. Therefore, sediment deposition and accumulation in the River sediments of the study area is not expected to be significant. Some chemicals could deposit and remain in the bed sediments of the riparian backwaters of the area, given that these areas would be less subject to scouring effects from high volume dam releases.

Chemicals in all environmental compartments are subject to degradation via chemical (e.g., hydroloysis), microbial, and physical (e.g., phytolysis) processes. The rate and extent of these processes will be chemical specific and dependent upon environmental conditions.

5.1.3 Exposure Pathways

A variety of exposure pathways exist by which plants and animals of the region might be exposed to chemicals released to the environment. Potential exposure pathways are discussed below and pathways are selected for evaluation.

5.1.3.1 Terrestrial Wildlife

Potential exposure pathways in terrestrial wildlife include inhalation of airborne chemicals, dermal contact with chemicals deposited onto the soil, and ingestion of contaminated surface water, soil, sediment, or food. Of these, potential dietary exposures via the foodweb are typically associated with the greatest potential wildlife risks. USEPA's draft guidance for combustion facility ecological risk assessment (USEPA 1999a) emphasizes dietary (food web) exposure pathways as being important for terrestrial wildlife exposure. In addition, the collective scientific literature also indicates that dietary exposures are the only important route of chemical accumulation in terrestrial (air-breathing) species (Carey et al. 1998). Consequently, the ecological risk assessment will include an evaluation of potential dietary exposures and risks in terrestrial wildlife species. Potential exposures will be evaluated for wildlife inhabiting creosote scrub, agricultural and riparian habitats.

Some chemicals will not accumulate in wildlife food, however, and therefore, overall dietary exposures may be reduced relative to chemicals that do accumulate in the foodweb. In these instances, however, wildlife could still be exposed to chemicals present on soil or sediment as a result of incidental (i.e., while foraging or preening) or intentional (i.e., grit ingestion by birds) ingestion of soil/sediment. For this reason, soil/sediment ingestion pathways also will be considered in this assessment.

Surface water ingestion is unlikely to be a significant exposure pathway for much of the terrestrial wildlife in the study area. Most desert animals have evolved strategies to reduce or even eliminate the need to ingest free-standing water. In fact some rodents, such as the pocket mice and kangaroo rats that are common in the study area, are independent of any free water. The kangaroo rat, for example, has evolved mechanisms to obtain all their water from the dry, high carbohydrate-content seeds and from dry seeds that absorb atmospheric moisture while stored in underground burrows (Phillips and Comus 2000). Other animals that do not have regular access to free water consume juicy animals and succulent plants and their fruits. Some of the larger animals in the study area, such as mule deer, big horn sheep and coyote, do require periodic free water (Phillips and Comus 2000). Although, the study area populations of these animals are small (Henry 2002), surface water ingestion will be evaluated for these species at the request of USEPA (2003b). Surface water ingestion also will be evaluated for other terrestrial receptor species at the request of USEPA (2003b), although exposures via this pathway are not likely to be important compared to dietary or sediment ingestion exposures.

Inhalation and dermal exposures also will not be evaluated in the risk assessment for several reasons. First, few inhalation toxicity data are available to support risk evaluation of inhalation exposures in terrestrial wildlife species. Further, detailed analysis of soil-based exposure pathways in terrestrial species conducted by USEPA (2000b) has documented that inhalation and dermal pathways are generally associated with negligible exposures in wildlife species when compared to dietary and soil ingestion exposures. Therefore, inhalation and dermal exposure pathways are not expected to be important exposure pathways in study area wildlife.

5.1.3.2 Terrestrial Plants

Plants in the study area could be exposed to chemicals directly as a result of particle deposition onto leaf surfaces or via gas exchange across leaf stomata, or indirectly via root uptake of surface deposited chemicals that have been incorporated into the soil matrix.

Chemicals deposited on the leaves of desert plants are most likely to remain adsorbed to the waxy cuticles common to many of these species (e.g., creosote bush, succulents) or be blown or washed off and re-deposited to the land surface. Few chemicals are likely to be absorbed across the waxy/resinous leaf cuticle and reach internal plant tissue, and therefore, particle deposition is not expected to be a significant uptake exposure pathway for desert plants. In addition, few if any toxicity data exist which would permit an evaluation of these potential toxic effects of these types of exposures in plants. Therefore, potential impacts in plants from exposure via particle deposition will not be evaluated in this risk assessment.

Gaseous uptake through the stomata also is likely to be limited to a large degree in the desert environment given that stomata are often closed to reduce water loss. In fact, some desert plants stop all transpiration during dry conditions and keep stomata closed until precipitation occurs, whereas other plants drop leaves (i.e., the gas exchange surface) entirely during dry periods (Phillips and Comus 2000). In addition, few toxicity data are available that would permit an evaluation of the potential adverse effects from vapor phase exposures in plants. Therefore, gaseous uptake and exposure in plants will not be evaluated in this risk assessment.

Root uptake can occur but will be dependent upon the depth of the root system in relation to the depth that has been reached by chemicals leaching from the surface soil. Some species of desert shrubs such as creosote bush and trees such as mesquite have deep root systems (Phillips and Comus 2000). Though water-soluble surface-deposited chemicals might reach these deeper rooting depths, less-soluble chemicals are substantially less likely to do so. Root uptake of surface deposited chemicals is likely to be proportionally greater in succulents and annuals, which have shallow root systems. However, many desert annuals only occur for brief periods of time (e.g., on the order of a few weeks) following rain events (Phillips and Comus 2000), and therefore the overall exposure timeframe in these species is very small. Nevertheless, root uptake in plants will be evaluated in this risk assessment as it is likely to be the most significant exposure pathway for desert plants and because some toxicity data exist with which to evaluate the potential phytotoxic effects of soil-associated chemicals. This pathway will be evaluated for all terrestrial habitats.

5.1.3.3 Aquatic Life

Aquatic life can be exposed to the chemicals via a number of pathways, with respiration (i.e., uptake over the gills) typically the most significant exposure pathway (USEPA 1993b). In aquatic plants, root and leaf uptake are the principal exposure pathways. These pathways will be collectively evaluated in this risk assessment by utilizing aquatic life toxicity criteria that were developed to be protective of aquatic species exposed to ambient water concentrations via all pathways.

Aquatic life also can be exposed directly or indirectly to chemicals in sediments. Potential aquatic life sediment exposures will be evaluated in this risk assessment by utilizing whole-sediment-based aquatic life toxicity values that are reflective of multiple exposures via all pathways. These exposures will be evaluated for riparian backwater habitats. Benthic community exposures and risks also will be evaluated for the mainstem of the river and for the Main Drain or a representative canal or aqueduct, at the request of USEPA (2003b). However, it is likely that benthic habitats in the mainstem of the River are likely limited due to scouring, and in the aqueducts, canals, and Main Drain where limited sediment is likely to be present due to construction/design (these are periodically drained and cleaned).

5.1.4 Receptors and Endpoints For Evaluation

As apparent from the description of regional ecology, a variety of receptor species occur in the study area. For this risk assessment, risks will be evaluated for a subset of all possible receptor species, focusing on key species that are representative of potential risks in each of the study area's habitats.

Receptor species are selected based on consideration of the following factors:

- **Habitat associations and distribution**. Representative receptors are selected based on their known or expected use of each of the study area's habitats. Species that expected to be distributed throughout a study area habitat are selected in lieu of species with more limited, localized distribution.[12]

- **Taxa.** Representatives of major taxa (e.g., birds, mammals, reptiles, plants) are selected for each habitat, as applicable.

- **Population status.** Endangered, threatened, and special concern (ETSC) species are most often selected as receptors if potentially present. These species are more susceptible to chemical impacts given the already stressed condition of their populations. Abundance will be considered for non-ETSC species, with selection preference given to species that are abundant in the study area, given that these species have a demonstrated preference for study area habitats, and therefore have a higher potential for exposure.

- **Ecological significance.** The overall role of the species in the habitat ecology is considered.

- **Exposure potential.** Species with the potential for greatest exposure are selected. Position in the food web, foraging method and residency status (for birds) are considered. In general, carnivorous species located at the top of the food-web have the potential for greatest exposure, given that some chemicals can accumulate in animal food. Also, species that probe, dig, or otherwise contact soil during foraging have increased exposure potential. Year-round residents potentially have greater exposure than migratory species.

[12] USEPA (2001a) identified peregrine falcon as a potential species of concern for the ecological risk assessment. However, conversations with state and local wildlife agencies and information from Rosenberg et al. (1991) do not indicate that it is a common species in the area.

- **Toxicant sensitivity/data availability.** Species that are known or suspected to have a higher toxicant sensitivity are selected when possible.

- **Societal value.** Species valued by the local or regional populations are selected.

Table 10 identifies the species and pathways to be evaluated in this risk assessment. This information may change as a result of continuing dialogue with CRIT*.*

The goal of the assessment will be to determine if chemical exposures occurring as a result of stack emissions from the Westates Carbon facility could result in adverse effects in the ecological populations and communities of the study area. For terrestrial systems, ecological populations have been selected as the receptors of concern, and the overall assessment endpoint is maintenance of the long-term health and reproductive capacity of these populations. The measures of effect (measurement endpoints) for these receptors are alteration of reproduction and survival for wildlife and alteration of survival and growth for plants. For aquatic life, the assessment endpoint is maintenance of species abundance and diversity within the study area aquatic community. The measures of effect are alterations of growth, reproduction, or survival in individual species, or changes in community structure, abundance, or diversity in benthic communities. If endangered or threatened species are selected as receptors for the assessment, the assessment endpoint will be reproduction and survival of individual organisms, rather than the population, as specified by USEPA (2003a). The measures of effect will be the same as identified above for other receptor species.

5.2 Risk Analysis Method

Ecological risks will be evaluated using a predictive hazard quotient approach. Under this approach, exposures are calculated for each receptor species or group and receptor-specific toxicity reference values (TRVs) are developed. This section outlines the procedures to be used to quantify chemical exposure and toxicity for each of the selected receptors. Then, the approaches to be used to calculate hazard quotients and describe overall ecological risk are discussed.

5.2.1 Selection of Chemicals for Evaluation

The first step in the quantitative risk analysis will be selection of chemicals of potential concern (COPCs) for more detailed assessment. This will be done once the performance demonstration test has been completed and analytical results are available. USEPA guidance will be followed to identify the COPCs, as discussed earlier in Section 4.

Once the comprehensive COPC list is generated, the available ecotoxicological literature will be reviewed to determine if toxicity data exist to support quantitative estimates of risk. COPCs for which toxicity data exist will be quantitatively evaluated in the risk assessment. COPCs for which no toxicity data exist will be evaluated qualitatively in the risk assessment. Qualitative assessment methods may include evaluation of toxicity for structurally similar chemicals, evaluation of toxicity for broad chemical classes, and evaluation of persistence, fate, and transport.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment

a. Creosote Bush Scrub

Receptor	Taxa	Reason for Selection	Exposure Medium & Exposure Route	
			Soil	**Diet**
Badger	mammal	Common in study area. Carnivorous species. Member of mustelid family, which often demonstrates a greater sensitivity to toxicants than other mammals. Digs and forages in soil. Carnivorous habit will result in greater dietary exposures than other common mammals of this habitat (e.g., jackrabbit, pocket mice).	ingestion	ingestion
Gambel's quail	bird	Common to abundant study area resident. Most important game resource in the lower Colorado River Valley (Rosenberg et al. 1991). Toxicity data available for some chemicals. Exposures will be representative of that in other seed eaters of this habitat (e.g., dove, sparrow).	ingestion	ingestion
Great horned owl	bird	Fairly common resident throughout Parker Valley. Carnivorous.	ingestion	ingestion
Desert tortoise	reptile	Species of special concern in Arizona. Potentially distributed throughout desert scrub habitat of study area.	ingestion	ingestion
Creosote bush	plant	Dominant vegetative species in desert scrub habitat. Wide-spread throughout study area. Important plant to native people, and single most widely and frequently used medicinal herb in the Sonoran desert (Phillips and Comus 2000).	root uptake	na

na = not applicable to this receptor.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment

b. Agricultural Areas

Receptor	**Taxa**	**Reason for Selection**	**Exposure Medium & Exposure Route**	
			Soil	**Diet**
Gambel's quail	bird	Common to abundant study area resident. Most important game resource in the lower Colorado River Valley (Rosenberg et al. 1991). Toxicity data available for some chemicals. Exposures will be representative of that in other seed eaters of this habitat (e.g., dove, sparrow).	ingestion	ingestion
Burrowing owl	bird	Common resident of agricultural areas in Parker Valley (Rosenberg et al. 1991). Special concern species in the State of California. Carnivorous.	ingestion	ingestion
Alfalfa	plant	Principal crop in agricultural lands of study area. Toxicity data available for some grass species. Other crops less important economically.	root uptake	na

na = not applicable to this receptor.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment

c. Riparian Corridors

Receptor	**Taxa**	**Reason for Selection**	**Exposure Medium & Exposure Route**	
			Soil	**Diet**
Southwestern willow flycatcher	bird	Federally endangered. Carnivorous (Insectivorous) species. Presence historically documented in study area. Entire study area population limited to riparian areas. This species will be representative of potential exposures in other insectivorous birds of this habitat.	na	ingestion
Gambel's quail	bird	Common to abundant study area resident. Most important game resource in the lower Colorado River Valley (Rosenberg et al. 1991). Toxicity data available for some chemicals. Screwbeam mesquite of riparian habitats important seasonal food source for this species. Exposures will be representative of that in other seed eaters of this habitat (e.g., dove, sparrow). Other birds in this habitat are less important economically.	ingestion	ingestion
Screwbean mesquite	plant	Ecologically important plant of study area riparian areas, providing food for resident seed eaters. Part of re-vegetation efforts by CRIT to reestablish riparian vegetation in the area. Mesquite is an important and sacred tree in the Mohave religious tradition. Exposures will be representative of that in other woody vegetation of the corridor.	root uptake	na

na = not applicable to this receptor.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment
d. Colorado River

Receptor	Taxa	Reason for Selection	Exposure Medium & Exposure Route		
			diet	surface water	sediment
Double-crested cormorant	bird	Year-round resident. Piscivorous. Some data suggest a potentially greater sensitivity to some toxicants.	ingestion	ingestion	ingestion
Aquatic community	fish, invertebrates, amphibians, plants	Year-round residents. Some fish and amphibian species important recreationally. Aquatic community is inclusive of all potential aquatic receptors.	ne (1)	all exposure routes	all exposure routes

ne = not evaluated

(1) aquatic life dietary exposures will be considered as part of overall evaluation of surface water quality.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment

e. Riparian Backwaters

Receptor	Taxa	Reason for Selection	Exposure Medium & Exposure Route		
			diet	surface water	sediment
Yuma clapper rail	bird	Federally endangered. Carnivorous (invertivorous) species. Presence historically documented in study area. Entire study area population limited to riparian areas.	ingestion	ingestion	ingestion
Aquatic community	fish, invertebrates, amphibians, plants, benthic invertebrates	Year-round residents. Some fish and amphibian species important recreationally. Aquatic community is inclusive of all potential aquatic receptors. Exposure in benthic invertebrates assessed separately from water column species to evaluate potential impacts of chemicals that partition preferentially to sediments.	ne (1)	all routes	all routes

na = not applicable to this receptor.
ne = not evaluated

(1) aquatic life dietary exposures will be considered as part of overall evaluation of surface water quality.

Table 10
Ecological Receptors and Exposure Pathways to be Evaluated in the Ecological Risk Assessment

f. Canals, Aqueducts, Main Drain

Receptor	**Taxa**	**Reason for Selection**	**Exposure Medium & Exposure Route**		
			diet	**surface water**	**sediment**
Double-crested cormorant	bird	Year-round resident. Piscivorous. Some data suggest a potentially greater sensitivity to some toxicants.	ingestion	ingestion	ingestion
Mule deer	Mammal	Year-round resident. Could ingest surface water from these areas. Requested by USEPA.	na	Ingestion	na
Aquatic community	fish, invertebrates, amphibians, plants	Year-round residents. Some fish and amphibian species important recreationally.	ne (1)	all routes	all routes

na = not applicable to this receptor in this habitat.

ne = not evaluated

(1) aquatic life dietary exposures will be considered as part of overall evaluation of surface water quality.

Toxicity data and ecological benchmarks will be compiled from existing compilations of ecological criteria, screening benchmarks, or toxicity values published by the Arizona Department of Environmental Quality (ADEQ), USEPA, or research organizations.

Chronic toxicity data sources will be preferentially used, but absent appropriate chronic toxicity data, acute toxicity data will be used. Chronic toxicity values will be estimated from acute values by dividing the acute value by 100, as recommended in USEPA (1999a) guidance.

The toxicological data sources to be consulted are listed below in order of preference. These data sources will be consulted in the order listed. If a benchmark is available from a preferred source, benchmarks will not be compiled from the other listed data sources, unless a review of the benchmark reveals data quality concerns.

Birds & Mammals

- CalTox database (CEPA 2002)
- USEPA (1999a)
- Sample et al. (1996)
- Schafer et al. (1983), Schafer and Bowles (1985)
- Hazardous substance data bank (HSDB)

Reptiles

- CalTox database (CEPA 2002)
- Reptile and Amphibian Toxicity Literature (RATL) database (EC 2002)

Plants

- USEPA (1999a)
- Efromyson et al. (1997)

Aquatic Life – Surface Water

- ADEQ water quality standards
- USEPA (2002c)
- USEPA (1996b)
- Mayer and Ellersieck (1986)
- USEPA (2002b)

Aquatic Life – Sediment

- USEPA (1999a)
- NOAA (1999)
- MacDonald (1994)

5.2.2 Exposure Assessment

Once the COPCs have been selected, exposures will be calculated for each of the selected receptors in each of the selected habitats. Air dispersion, deposition and fate and transport modeling conducted to support the human health risk assessment will also be used in the ecological risk assessment to calculate the annual average concentration of each chemical in each habitat as a result of stack emissions. Environmental media concentrations will be calculated using the mathematical equations presented in USEPA (1998a) unless otherwise noted. Bioaccumulation in the foodweb will be calculated using standard USEPA models (if available), or models published by other ecological risk assessment organizations (e.g., Oak Ridge National Laboratory). This might be supplemented by a targeted literature search to identify uptake factors or models specific to the receptors of the study area.

To be consistent with the available toxicity data, exposures of terrestrial wildlife will be expressed as dosage (mg/kg bw); exposures in terrestrial plants, aquatic life, and benthic invertebrates will be expressed as concentration in the exposure medium (i.e., soil, water column and sediment, respectively). Published wildlife exposure factor databases will be searched to identify exposure factor values. Likely exposure factor data sources include the CalTox database developed by the California Environmental Protection Agency (CEPA 2002) which contains information on several of the selected receptor species, USEPA's Wildlife Exposure Factors Handbook (USEPA 1993c), and USEPA's (1999a) combustion ecological risk assessment guidance. Detailed species profiles prepared by the USFWS (e.g., 1994, 2001) also will be consulted. Targeted literature searches might be conducted to support these sources. If species-specific exposure factors are not available for certain receptors, factors from ecologically and/or physiologically similar species will be used, as appropriate.

5.2.3 Toxicity Assessment

Toxicity reference values (TRVs) will be developed for each receptor or receptor group. TRVs are the estimated dose or exposure level at which no adverse effects are expected to occur. Consistent with the assessment endpoints selected for this evaluation, TRVs for terrestrial wildlife will be based on toxicity studies in which effects on reproduction or survival are measured, since these endpoints are relevant to an assessment of population level effects. For aquatic life, TRVs will be based on toxicity studies that examine alterations in growth, reproduction, or survival in individual species, or changes in community structure, abundance, or diversity in benthic species.
The hierarchy of toxicological data sources identified in the COPC selection section will be used to derive TRVs. TRVs will be derived based on no-observable and lowest-observable adverse effect levels (NOAEL, LOAEL) if available. Acute data will be used to derive chronic TRVs, if no chronic data are available. TEFs for fish and wildlife from WHO (1998) will be used to evaluate the toxicity of PCDD/PCDF mixtures. These TEFs are listed in Table 11. The TRV for dioxin/furans will be based on 2,3,7,8-TCDD. The TEFs listed in Table 11 will be applied to predicted dose for each receptor to express dose in 2,3,7,8-TCDD equivalents. These will then be summed to calculate the total dose of 2,3,7,8-TCDD equivalents in the receptor. Then, the TRV for 2,3,7,8,-TCDD will be used to assess risk.

A two-tiered analysis approach will be adopted for the toxicological assessment. Initially, published benchmarks and other toxicity values summarized in the identified toxicological data sources will be used to assess risks. If risks are predicted using these screening benchmarks and toxicity values, a Tier II analysis will be conducted. The Tier II analysis will consist of an initial data quality review of the published benchmark or toxicity value to determine and verify its quality. The methods of Durda and Preziosi

Table 11

Toxic Equivalency Factors for PCDDs/PCDFs for the Ecological Risk Assessment

PCDD/PCDF Congener	Toxic equivalency factors		
	Mammals	Fish	Birds
PCDDs			
2,3,7,8-TCDD	1	1	1
1,2,3,7,8-PeCDD	1	1	1
1,2,3,4,7,8-HxCDD	0.1	0.5	0.05
1,2,3,7,8,9-HxCDD	0.1	0.01	0.01
1,2,3,6,7,8-HxCDD	0.1	0.01	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.001	<0.001
1,2,3,4,6,7,8,9-OCDD	0.0001	--	--
PCDFs			
2,3,7,8-TCDF	0.1	0.05	1
1,2,3,7,8-PeCDF	0.05	0.05	0.1
2,3,4,7,8-PeCDF	0.5	0.5	1
1,2,3,4,7,8-HxCDF	0.1	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01	0.01
1,2,3,4,6,7,8,9-OCDF	0.0001	0.0001	0.0001

"--" = No TEF because of lack of data.

Source: WHO (1998).

(2000) and others will be used to conduct this data quality review. Next, a focused literature search will be conducted to determine if additional toxicological literature exist to support more definitive risk estimates. An effort will be made to identify toxicological studies that evaluated effects in the chosen receptor species. The collective toxicological data will then be used to conduct a Tier II risk analysis. Any TRVs derived from the additional data will be derived based on the methods of Sample et al. 1996 for terrestrial wildlife, and Efroymson and Suter 1997 for plants. Chronic low-effect or no-effect concentrations (for surface water) or threshold and probable effect levels (for sediments) will be identified for aquatic life.

5.2.4 Risk Estimation and Description

Risks will be quantified using the hazard quotient approach. A hazard quotient (HQ) is the ratio of predicted exposure to predicted toxicity. In general, hazard quotients less than 1 indicate that adverse effects from chemical-specific exposures are unlikely, whereas hazard quotients greater than one indicate adverse effects are possible. For this screening-level assessment, we will use a HQ threshold of 0.25, rather than 1.0 to characterize potential risks, to be consistent with USEPA Region IX guidance on this issue (USEPA 2003). Potential cumulative toxicity will be assessed by summing the HQs for all chemicals to calculate the hazard index (HI). If an HI greater than 0.25 is calculated for any receptor-habitat combination, HIs will be re-calculated consistent with USEPA guidance, by summing only HQs for those chemicals that act via a similar mechanism of action.

5.2.5 Uncertainty Analysis

All risk assessments involve the use of assumptions, judgment and incomplete data to varying degrees. This results in uncertainty in the final estimates of risk. Key sources of uncertainty in the risk assessment include:

- the calculation of chemical emission rates,
- the modeling of potential air concentrations and deposition rates associated with chemical emissions,
- the calculation of chemical concentrations in the environment (e.g., soil, sediment, wildlife food) using mathematical models in conjunction with many chemical/physical properties and assumed or site-specific information about the environment in the facility area,
- the calculation of potential ecological exposures through multiple pathways using a combination of default and site-specific exposure parameters, and
- the calculation of potential risks using toxicity information derived in most instances from experimental data on species other than the site-specific receptors of concern.

Consistent with standard ecological risk assessment practice, the ecological risk assessment will address these key sources of uncertainty to provide perspective on the findings of the risk assessment. Uncertainty in the ecological risk assessment will be addressed qualitatively and possibly quantitatively (e.g., using alternate risk calculations or sensitivity analyses).

In addition, the potential impact of emissions of co-planar PCBs on the risk results will be evaluated. This analysis will rely on the same methods outlined earlier in Section 4.5.2 for the human health risk assessment and will incorporate co-planar PCB TEFs for fish and wildlife developed by WHO (1998). Coplanar PCBs will be assessed in a manner similar to that described for dioxins/furans, except that the TEFs used will be those developed by the WHO for coplanar PCBs and that risks will be calculated only for the risk driving pathways. This is parallel to the approach adopted in the human health risk assessment, as described in Section 4.5.2.

Tentatively identified compounds (TICs) in stack emissions will be evaluated as part of the performance demonstration test. A description of the methods that will be used to identify TICs is provided in Focus (2002a). In general, these methods will focus on identifying those TICs present in the largest amounts in the collected stack samples and for which a chemical-specific identification can be made with confidence. In this section of the risk assessment, the potential impact of these compounds on the risk assessment results will be evaluated. Factors that will be considered in the evaluation of TICs include their potential emission rates relative to other compounds already evaluated in the risk assessment and toxicological data if readily available. If no toxicity data are available, the evaluation will be limited to a discussion of the relative emissions and potential fate of these compounds.

Unidentified organic compounds will be addressed as described above in Section 4.5.3. The total organics emissions (TOE) factor will be used to determine the extent to which emissions of unidentified organics may affect the overall results of the ecological risk assessment.

Other factors to be addressed in the uncertainty analysis in response to USEPA (2003b) comments on the draft workplan are: (1) a discussion of the influence of monsoons on chemical fate and transport, and (2) potential risks associated with chemicals excluded from quantitative evaluation due to a lack of toxicity data.

6.0 QUALITY ASSURANCE PROCEDURES

Risk assessments use data from many different sources in numerous mathematical equations. This multiple-chemical, multiple-pathway combustion source risk assessment is expected to include over 25,000 individual calculations using dozens of input parameters. A rigorous quality assurance (QA) program will, therefore, be followed to provide credibility and confidence in the risk assessment. This program will include elements such as evaluation of input data for accuracy and relevance to the task at hand, and retention and organization of documents containing data and risk calculations. In addition, the risk calculations will be independently quality assured (QA) by trained scientists who will not be performing the quantitative analysis.

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