APPENDIX D

AIR DISPERSION AND DEPOSITION MODELING

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Air Dispersion and Deposition Modeling for the Siemens Water Technologies Corp. Carbon Reactivation Facility in Parker, Arizona

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LIST OF ABBREVIATIONS

AZMET	Arizona Meteorological Network
ft	Feet
HHRAP	Human Health Risk Assessment Protocol published in 2005 by USEPA
ISCST3	Industrial Source Complex Short-Term 3 air model
km	Kilometer
MPRM	Meteorological Processor for Regulatory Models
NLCD	National Land Cover Data
NWS	National Weather Service
PDT	Performance Demonstration Test
SWT	Siemens Water Technologies Corp.
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

1.0 INTRODUCTION

This appendix documents the air dispersion and deposition modeling performed to support the human health and ecological risk assessment for the Siemens Water Technologies Corp. (SWT) Carbon Reactivation Facility ("Facility"). The risk assessment, and dispersion and deposition modeling, were performed according to a U.S. Environmental Protection Agency (USEPA) approved Risk Assessment Workplan ("Workplan") developed in 2003, updated by agreement with the USEPA to include elements of more recent 2005 USEPA guidance for risk assessments of waste combustion facilities.

The air modeling conducted for the Facility was prepared using methodologies outlined in an appendix to the 2003 Workplan entitled "Air Dispersion and Deposition Modeling Protocol Report." The modeling was also consistent with the procedures found in USEPA's 2005 guidance entitled "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities" (HHRAP). The modeling approach was approved in advance by USEPA prior to initiation of this work.

The air modeling analysis for the Facility consisted of modeling stack emissions from the carbon reactivation furnace stack (RF-2) and fugitive air emissions from the outdoor hopper (H-1). The air model used was the most recent version of the Industrial Source Complex Short-Term model available from the USEPA (ISCST3, Version 02035). This model was developed and approved by USEPA. The ISCST3 model was run using unitized (i.e., 1.0 gram per second) emission rates. These unit emission rates were used to calculate hourly and annual average unitized concentrations and deposition rates. Chemical-specific concentrations and deposition rates can be calculated by multiplying the unitized results by chemical-specific emission rates. Consistent with USEPA guidance in HHRAP, modeling results for the stack were calculated to address three types of stack emission characteristics consisting of vapor phase emissions, particle phase emissions distributed by particle mass, and particle phase emissions distributed by particle surface area.

The remainder of this appendix provides additional details about the dispersion and deposition modeling performed for this project.

2.0 FACILITY LOCATION AND LAND USE

The SWT Facility is located at 2523 Mutahar Road, approximately 1 mile southeast of Parker in La Paz County, Arizona. Figure 2-1 presents a portion of the Parker, Arizona 7.5' United States Geological Survey (USGS) quadrangle showing the location of the site and the surrounding terrain. The site is approximately located at Latitude 34^o 07' 57" N and Longitude 114^o 16' 15" W, North American Datum of 1927.

The ISCST3 model includes dispersion coefficients which vary depending upon whether an area is characterized as primarily rural or urban. This classification was determined for the Facility area by conducting a land use analysis consistent with the procedures contained in the A.H. Auer paper "Correlation of Land Use and Cover with Meteorological Anomalies" (Auer, 1978). This procedure characterizes the uses of various industrial, commercial, residential, and agricultural/natural areas within a 3 km radius circle centered on the site being evaluated. Essentially, if more than 50 percent of the area within this circle is designated I1, I2, C1, R2, and R3 (industrial, light industrial, commercial, and compact residential), urban dispersion parameters should be used; otherwise, the modeling should use rural dispersion parameters.

According to standard USEPA modeling procedures, the land use classification was performed using the most recent available USGS National Land Cover Data (NLCD).[1] In the NLCD, USGS identifies land cover classes based on Landsat Thematic Mapper satellite imagery with a spatial resolution of 30 meters and supplemented by various ancillary data where available. The analysis and interpretation of the satellite imagery is conducted by USGS using very large image mosaics. For this project, the most recent NLCD, from 1992, was obtained for Arizona and its land cover data were used to determine surface characteristics within 3 km of the Facility. A TRC-developed land cover tabulation program was used to read the NLCD tag image file format (TIFF) image file and to extract and sum the land cover categories for each 30 m by 30 m grid cell within each of 12 adjacent 30 degree sectors around the Facility location. The results of this analysis are tabulated in Table 2-1 and are shown in Figure 2-2.

[1] The land cover datasets are provided on the USGS Internet website at http://edcsgs9.cr.usgs.gov/pub/data/landcover/states/.

Figure 2-1: Site Location Map

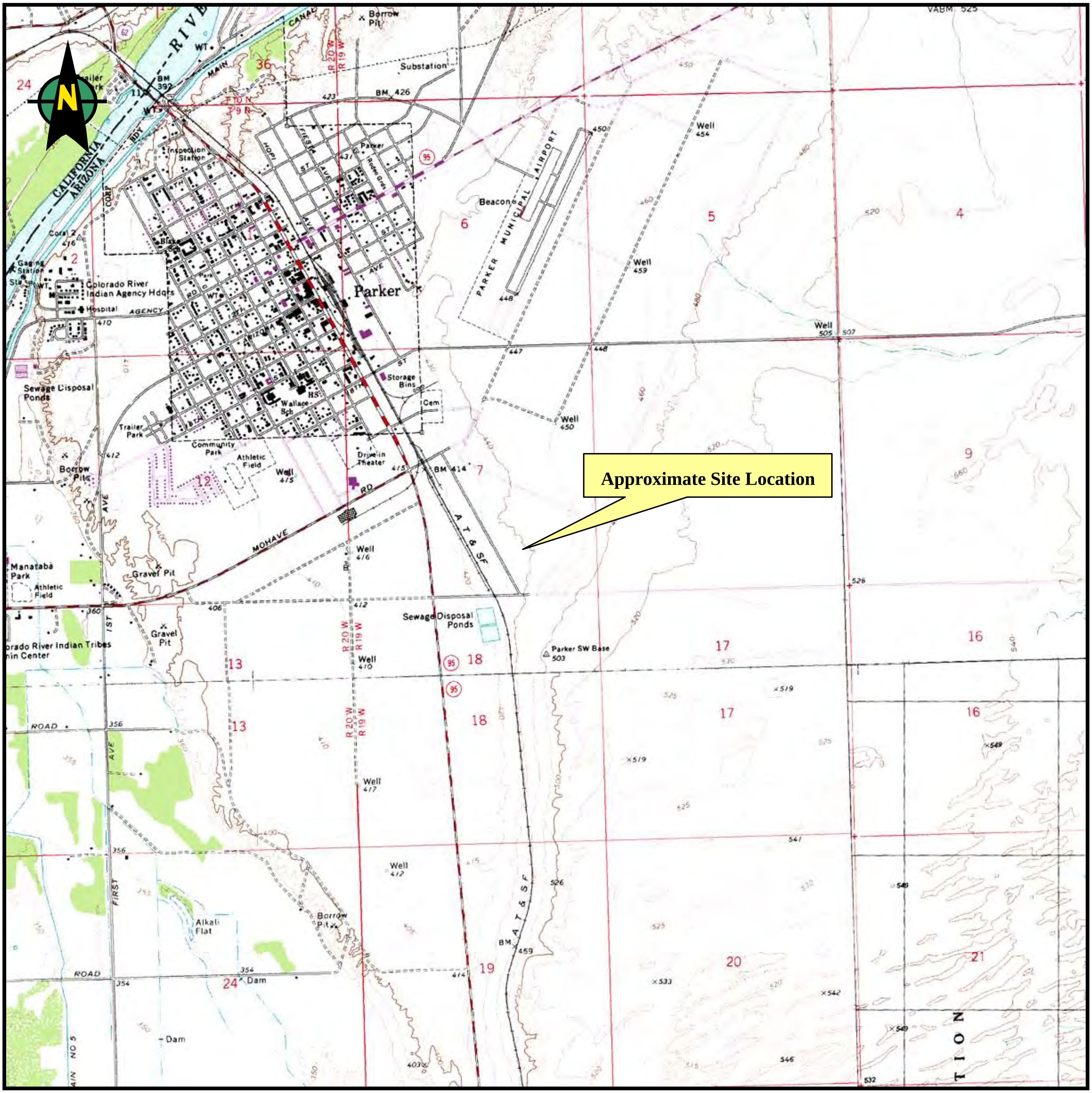
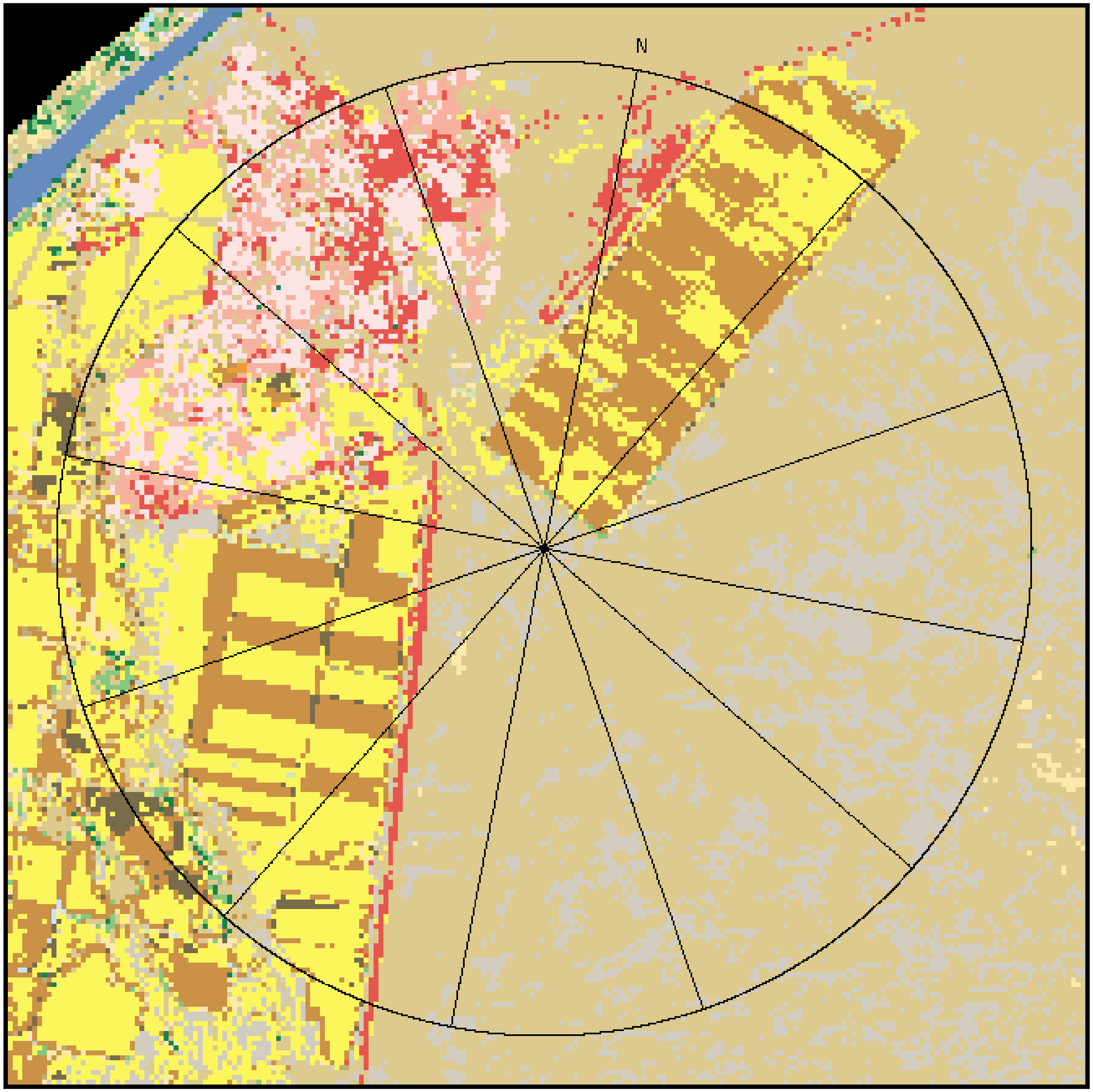


Figure 2-2: Land Use within 3-Kilometers of Facility Site



National Land Cover Dataset Classification System Legend

Color Key	RGB Value	Class Number and Name
	102, 140, 190	11 - Open Water
	255,255,255	12 - Perennial Ice/Snow
	253, 229, 228	21 - Low Intensity Residential
	247, 178, 159	22 - High Intensity Residential
	231, 86, 78	23 - Commerical/Industrial/Transportation
	210, 205, 192	31 - Bare Rock/Sand/Clay
	175, 175, 177	32 - Quarries/Strip Mines, Gravel Pits
	83, 62, 118	33 - Transitional
	134, 200, 127	41 - Deciduous Forest
	26, 129, 78	42 - Evergreen Forest
	212, 231, 177	43 - Mixed Forest
	220, 202, 143	51 - Shrubland
	187, 174, 118	61 - Orchards/Vineyards
	253, 233, 170	71 - Grasslands/Herbaceous
	252, 246, 93	81 - Pasture/Hay
	202, 145, 71	82 - Row Crops
	121, 108, 75	83 - Small Grains
	244, 238, 203	84 - Fallow
	240, 156, 054	85 - Urban/Recreational Grasses
	201, 230, 249	91 - Woody Wetlands
	144, 192, 217	92 - Emergent Herbaceous Wetlands

Approximately 88 percent of the land use surrounding the Facility is classified as agricultural rural, uncultivated, or undeveloped rural (A2, A3, or A4, respectively) according to the Auer classification technique. These classifications are considered rural and thus rural dispersion coefficients were used in the air modeling analysis. While there are some uncertainties in the USGS NLCD land classifications, the overall results are generally consistent with the land uses in the Facility area.

Table 2-1: Auer Land-Use Classifications within 3-Kilometers of the Facility

Description	Percentage within 3-km of Facility	Auer Classification
Open Water	0.0%	Rural
Perennial Ice/Snow	0.0%	Rural
Low Intensity Residential	5.0%	Urban
High Intensity Residential	2.9%	Urban
Commercial/Industrial/Transportation	3.7%	Urban
Bare Rock/Sand/Clay	12.1%	Rural
Quarries/Strip Mines, Gravel Pits	0.0%	Rural
Transitional	0.0%	Rural
Deciduous Forest	0.2%	Rural
Evergreen Forest	0.1%	Rural
Mixed Forest	0.1%	Rural
Shrubland	46.9%	Rural
Orchards/Vineyards	0.2%	Rural
Grasslands/Herbaceous	0.9%	Rural
Pasture/Hay	16.3%	Rural
Row Crops	10.8%	Rural
Small Grains	0.7%	Rural
Fallow	0.0%	Rural
Urban/Recreational Grasses	0.0%	Rural
Woody Wetlands	0.0%	Rural
Emergent Herbaceous Wetlands	0.0%	Rural

Source of land use data: USGS, National Land Cover Data, 1992.

The site is located at approximately 442 feet (ft) above mean sea level near the river plain of the Colorado River. There are terrain features in the vicinity of the plant that rise above stack top. The nearest location where terrain rises above stack top is approximately 2.6 kilometers to the east-southeast of the Facility. As such, terrain heights were included in the modeling analysis.

3.0 SOURCE DATA AND MODELING PARAMETERS

3.1 Source Parameters

The Facility emission sources included in the modeling analysis were stack air emissions from the carbon reactivation furnace stack and fugitive air emissions from the outdoor hopper. For the stack, which is considered a point source, the ISCST3 model requires the location coordinates, base elevation, and stack parameters including height, diameter, exit gas velocity, and exit gas temperature. The modeled stack parameters were based upon actual stack dimensions and measurements collected from the stack, as presented in Table 3-1.

The outdoor hopper is used for the unloading of bulk containers of spent carbon received at the facility. The hopper is a three-walled building with a fixed roof and heavy plastic sheeting on the front unloading face. During the unloading process, some fugitive air emissions may escape through the plastic sheeting. This source was treated as a volume source in ISCST3 to account for the negligible plume rise associated with fugitive air emissions consistent with USEPA modeling guidelines. The modeled source parameters for a volume source consist of location coordinates, a release height, and the initial lateral and vertical dimensions of the source. The initial lateral and vertical dimensions are based upon the length and height of the source and are calculated using formulas in the ISCST3 Users Guide. The initial lateral dimension is calculated by dividing the source length by 4.3 and the initial vertical dimension is calculated by dividing the source height by 2.15. The volume source parameters for fugitive air emissions from the outdoor hopper are shown in Table 3-1.

As stated earlier, the emission rates used as inputs to the ISCST3 model were set at a unitized value of 1.0 gram per second. For a given source, ISCST3 modeled concentrations and deposition rates are directly proportional to emission rate, and thus modeled unitized concentrations and deposition rates can be adjusted to chemical-specific concentrations and deposition rates by multiplying by the chemical-specific emission rate. For the stack source, the emission rate was assumed to be "on" 24 hours per day, 365 days per year. For the outdoor hopper volume source, the emission rate was assumed to be "on" 365 days per year, for the 7-hour period daily from 7 AM - 2 PM. The emission period was based on the time during typical facility operations that spent carbon may be unloaded at the outdoor hopper.[2] Accordingly, the ISCST3 modeling for the volume source included the HROFDAY card to account for the specific times of operation.

Table 3-1: Modeled Emission Source Parameters

Point Source	UTM Location Coordinates (NAD27)		Stack Height (above grade)	Stack Inner Diameter	Stack Gas Exit Velocity	Stack Gas Exhaust Temperature
	East	North				
Reactivation Furnace Stack (a)	751,678.4	3,780,000.4	110.0 ft 33.5 m	1.65 ft 0.502 m	57.0 ft/sec 17.37 m/sec	170.0 °F 349.82 K
Volume Source	**UTM Location Coordinates (NAD27)**		**Release Height (above grade)**	**Initial Lateral Dimension**	**Initial Vertical Dimension**	**Exhaust Temperature**
	East	**North**				
Fugitive Air Emissions from Outdoor Hopper (b)	751,663.2	3,780,031.4	7.59 ft 2.31 m	4.20 ft 1.28 m	7.05 ft 2.15 m	NA

(a) Stack height and diameter were based on facility engineering drawings. Stack exit velocity and exit temperature were based on the averages of measurements collected from the facility from February to April, 2007, and were provided by M. McCue, Director of Plant Operations.
(b) Parameters were based on facility engineering drawings.

3.2 Deposition Modeling Parameters

The modeling analysis for the furnace stack included modeling of both dry and wet deposition rates, consistent with HHRAP guidance and the project Workplan. Accordingly, the modeling calculated four possible types of deposition: dry deposition of particles, wet deposition of particles, dry deposition of gases, and wet deposition of gases. (Note that the modeling for the fugitive air emissions volume source included calculation of ambient air concentrations, but did not include deposition modeling as described in the risk assessment report and in the project Workplan.)

[2] Personal communication with M. McCue, Director of Plant Operations, May 7, 2007.

The source inputs needed to model deposition rates in ISCST3 include the particle size distribution of stack emissions and scavenging ratios for modeling wet deposition. The particle size distribution was based on test data collected from the facility stack during the comprehensive Performance Demonstration Test (PDT) conducted in March 2006. Scavenging ratios, which are multiplied by the vertically integrated air concentration in ISCST3 to predict wet deposition rates, were identified based on HHRAP guidance and using the facility-specific particle size distribution.

3.2.1 Vapor Phase Stack Emissions Modeling

ISCST3 modeling of wet and dry deposition of vapor phase emissions from the stack requires a dry deposition velocity and liquid and ice scavenging coefficients. The values recommended in HHRAP were utilized in this analysis, specifically a dry deposition velocity of 0.5 centimeters per second and wet vapor scavenging coefficients of 1.7×10^{-4} $s^{-1}/mm\text{-}h^{-1}$ for the liquid phase and 0.6×10^{-4} $s^{-1}/mm\text{-}h^{-1}$ for the ice phase. (Note that the ice phase was not relevant for this specific geographical location.)

3.2.2 Particle Phase Stack Emissions Modeling

Wet and dry deposition modeling of particles requires information on the size distribution of emitted particles from the stack, which was based on facility-specific measurements collected from the stack. Consistent with HHRAP guidance, the measured particle size distribution was treated in two different ways in the ISCST3 model. A mass-weighted particle size distribution was used to represent emissions of metals (except mercury) that would form particles in the reactivation unit combustion area. A surface area-weighted size distribution was used 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 mass-weighted particle size distribution was calculated using Equation 3-1 from HHRAP and is shown in Table 3-2. Based on the mean particle diameters shown in Table 3-2, individual wet vapor scavenging coefficients for each particle diameter were then determined, following HHRAP guidance, using the curves developed by Jindal and Heinold (1991) which are located in the ISCST3 Users Guide.

Table 3-2: Particle Size Distribution by Mass for the Furnace Stack

Mean Particle Diameter (um)	Lower Bound of Category (um)	Upper Bound of Category (um)	Percent by Mass
0.34	0.1	0.5	6.9
0.78	0.5	1	2.4
3.39	1	5	34.8
7.77	5	10	17.9
65.25	10	100	38.0

The surface area weighted particle size distribution was also based upon the measured particle size distribution along with HHRAP guidance for apportioning the distribution by surface area. The results of weighting the particle size distribution by surface area according to the HHRAP methodology are shown in Table 3-3. Based on the mean particle diameters in this distribution, individual wet vapor scavenging coefficients for each particle diameter were determined, following HHRAP guidance, using the curves developed by Jindal and Heinold (1991) which are located in the ISCST3 Users Guide.

Table 3-3: Particle Size Distribution by Surface Area for the Furnace Stack

Mean Particle Diameter (um)	Fraction of Total Mass	Proportion of Available Surface Area	Relative Proportion of Surface Area	Fraction of Total Surface Area
0.34	0.069	17.693	1.221	0.556
0.78	0.024	7.724	0.185	0.084
3.39	0.348	1.769	0.616	0.280
7.77	0.179	0.772	0.138	0.063
65.25	0.38	0.092	0.035	0.016

3.3 Modeling Output Files

Taking into account the different types of stack emissions that were modeled, as prescribed in HHRAP and described above, the ISCST3 model runs provided nine different types of outputs that were used in the stack emissions risk assessment, as follows:

- Ambient air concentrations of mass-weighted particles
- Ambient air concentrations of surface area-weighted particles
- Ambient air concentrations of gases
- Dry deposition of mass-weighted particles
- Dry deposition of surface area-weighted particles
- Dry deposition of gases
- Wet deposition of mass-weighted particles
- Wet deposition of surface area-weighted particles
- Wet deposition of gases

For the fugitive air emissions source, the ISCST3 model runs provided ambient air concentrations which were used in the risk assessment. For this source, all emissions were modeled as vapors, which is conservative because no plume depletion due to the deposition of particles is assumed to occur and thus air concentrations will tend to be overestimated for compounds that may be present in a particle phase. Also, because of the nature of the spent carbon material, it is not feasible to measure a particle size distribution for inhalable particles from the fugitive emissions source that was modeled.

The ISCST3 model was run to calculate unitized annual average modeling results and 1-hour average modeling results at all of the modeled off-site receptor locations beyond the property boundary (see next section for discussion of receptor grids). These outputs were specified in the Workplan and were consistent with the needs of the risk assessment. In addition, for the worker evaluation in the risk assessment requested by USEPA Region 9, the ISCST3 model was also run to calculate unitized 8-hour average results at a series of on-site receptor locations.

4.0 MODELING OVERVIEW

4.1 Good Engineering Practice Stack Height Analysis

The USEPA provides specific guidance for determining good engineering practice (GEP) stack height and for determining whether building downwash will occur in the "Guidance for Determination of Good Engineering Practice Stack Height" (Technical Support Document for the Stack Height Regulations, EPA-450/4-80-023R, June, 1985). GEP is defined as "the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, or nearby structures, or nearby terrain obstacles." The GEP definition is based on the observed phenomenon of atmospheric flow in the immediate vicinity of a structure. It identifies the minimum stack height at which significant adverse aerodynamics (downwash) are avoided.

The USEPA GEP stack height regulations specify that the formula GEP stack height be calculated in the following manner:

$$H_{GEP} = H_B + 1.5L$$

where: H_B = the height of adjacent or nearby structures, and
L = the lesser dimension (height or projected width of the adjacent or nearby structures)

A GEP analysis was performed for the carbon reactivation furnace stack located at the Facility. Figure 4-1 includes a general plot plan of the facility while Figure 4-2 shows the locations and heights of buildings included in the GEP analysis as well as the locations of the modeled emission sources. The furnace stack, with a height of 110 ft above grade, is below the formula GEP stack height of 130 ft, which is based upon the height and projected width of the controlling structure, the carbon reactivation furnace building. Based on the configuration of the Facility, the ISCST3 model included directional dependent building dimensions. These dimensions were calculated using the USEPA approved Building Profile Input Program (BPIP, version 04112).

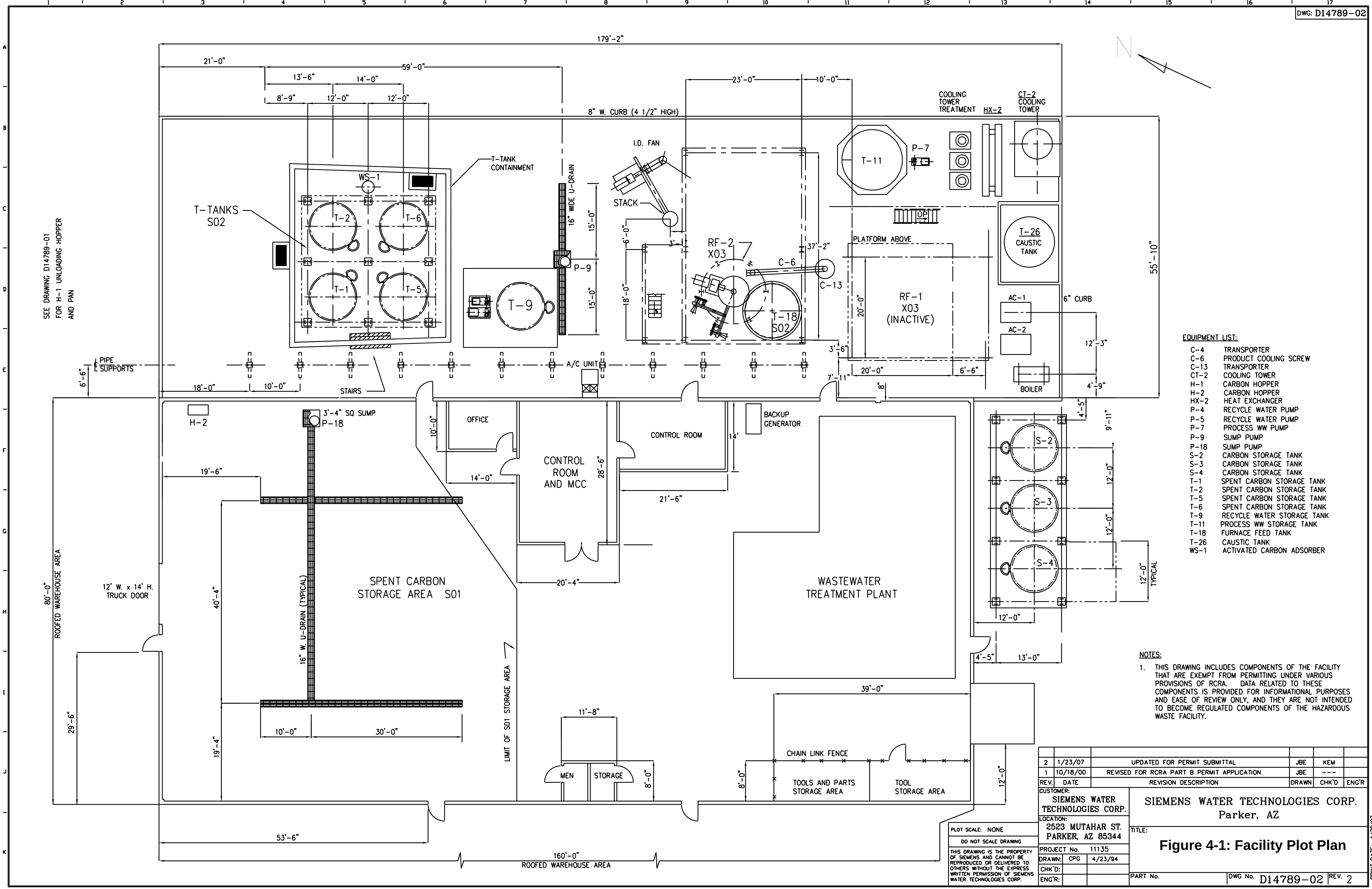
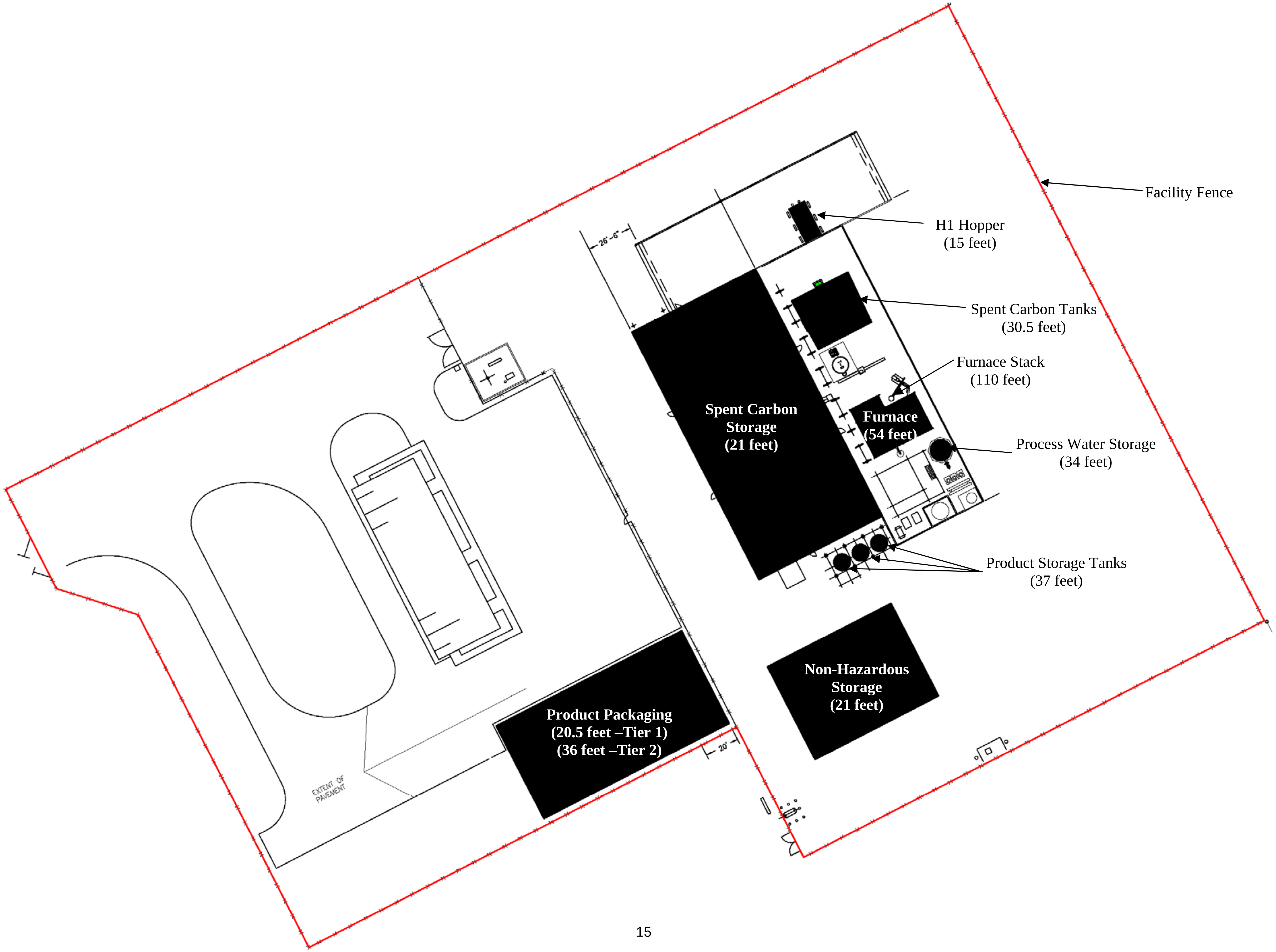


Figure 4-1: Facility Plot Plan

Figure 4-2: Facility Site Plan with Building Heights



4.2 Model Selection

The USEPA-developed and approved ISCST3 model (Version 02035) was used to calculate the air concentrations and deposition rates for use in the risk assessment. The ISCST3 model was specified in the USEPA-approved Workplan. As noted earlier, default model options for the stack and volume emission sources were used in the ISCST3 model along with rural dispersion coefficients. For the stack source, direction-specific downwash parameters were also used. The ISCST3 model was considered appropriate for this analysis as it is capable of modeling short-term and long-term average air concentrations, wet and dry deposition rates, and dispersion in rural areas, and it includes algorithms to address terrain and building wake effects.

4.3 Meteorological Data

For any modeling analysis conducted using the ISCST3 model, two meteorological datasets are required: 1) hourly surface data, and 2) upper air sounding data. According to the USEPA "Guideline on Air Quality Models (Revised)" (2005), the meteorological data used in a modeling analysis should be selected based on its spatial and climatological representativeness of a facility site and its ability to accurately characterize the transport and dispersion conditions in the area of concern. The spatial and climatological representativeness of the meteorological data are dependent on four factors:

1. The proximity of the meteorological monitoring site to the area under consideration;
2. The complexity of the terrain;
3. The locational characteristics of the meteorological monitoring site; and
4. The period of time during which data were collected.

Following the air modeling protocol in the Workplan, hourly surface measurments were obtained from the Parker, Arizona meteorological monitor operated by the Arizona Meteorological Network (AZMET). The Parker meteorological data station is approximately 32 km southwest of the Facility. Concurrent twice daily mixing heights were obtained from upper air data collected at the Flagstaff Pulliam Airport operated by the National Weather Service (NWS). A concurrent 5-year dataset from 2001 through 2005 was obtained for the two meteorological stations.

The two meteorological data sets from 2001-2005 were then processed with the USEPA Meteorological Processor for Regulatory Models (MPRM, Version 99349). The resulting meteorological file is then suitable for use in ISCST3 to model both air concentrations and wet and dry deposition rates. The basic meteorological parameters utilized by ISCST3 for predicting ambient air concentrations are wind direction and wind speed, ambient air temperature, atmospheric stability category, and rural and urban mixing heights. The additional parameters required to predict wet and dry deposition rates are the friction velocity, the Monin-Obukhov length (an indicator of atmospheric turbulence), the surface roughness length, the solar radiation, and the precipitation amount each hour. A wind rose for the 5-year meteorological record from 2001-2005 is presented in Figure 4-3. As the figure shows, the predominant wind directions for the facility site are northerly and southerly.

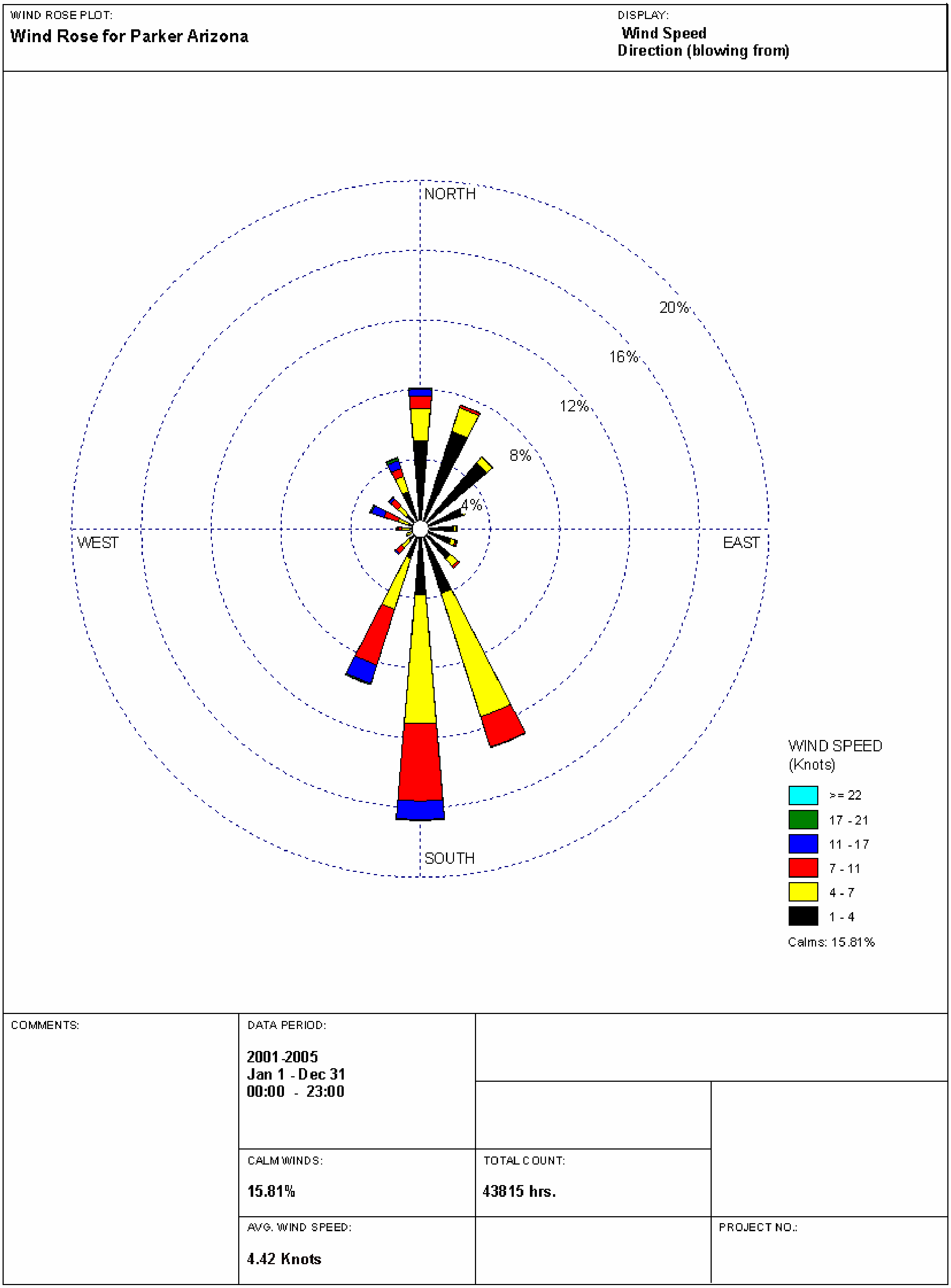
4.4 Land Cover Analyses

The MPRM meteorological processor, in addition to requiring both surface and upper-air meteorological data, requires surface parameters at the meteorological data measurement site to develop a complete ISCST3 meteorological dataset suitable for modeling deposition rates. These parameters are the minimum Monin-Obukhov length, the surface roughness length at the meteorological data measurement site and the Facility site, the noontime albedo, the Bowen ratio, the anthropogenic heat flux, and the fraction of net radiation absorbed at the surface.

For the minimum Monin-Obukhov length, the anthropogenic heat flux and the fraction of net radiation absorbed at the ground, the recommended values listed in HHRAP were used. Specifically, a minimum Monin-Obukhov length of 2 meters was assumed consistent within an open rural landuse, an anthropogenic heat flux of 0.0 watts per square meter was assumed consistent with a rural land use and a fraction of net radiation absorbed by the ground of 0.15 was assumed for a rural land use.

For the remainder of the required parameters (i.e., surface roughness length at the meteorological measurement site and the Facility site, the noontime albedo, and the Bowen ratio), land cover determinations were required. These determinations were made using the 1992 NLCD dataset created by USGS for Arizona.

Figure 4-3: Parker Arizona Wind Rose (2001-2005)



The TRC-developed land cover tabulation program was applied to the Parker Meteorological station to extract and sum land cover categories for each 30 m by 30 m grid cell within each of 12 adjacent 30 degree sectors within a 3-km radius of the station. Basic land cover statistics are illustrated for the Parker meteorological monitoring site in Figure 4-4. The data are presented in tabular form in Table 4-1, which indicates the number of cells by sector (12) and land cover type (8). It should be noted that, for the purposes of this analysis, quarries/strip mines/gravel pits were assumed to be desert shrubland; mixed forests were split 50/50 between coniferous and deciduous forests; and, urban/recreational grasses were assumed to be grassland. Tables 4-2 and 4-3, respectively, provide a breakdown of the 21 land use types in the 1992 NLCD data set and how they were related to the eight (8) MPRM land use categories.

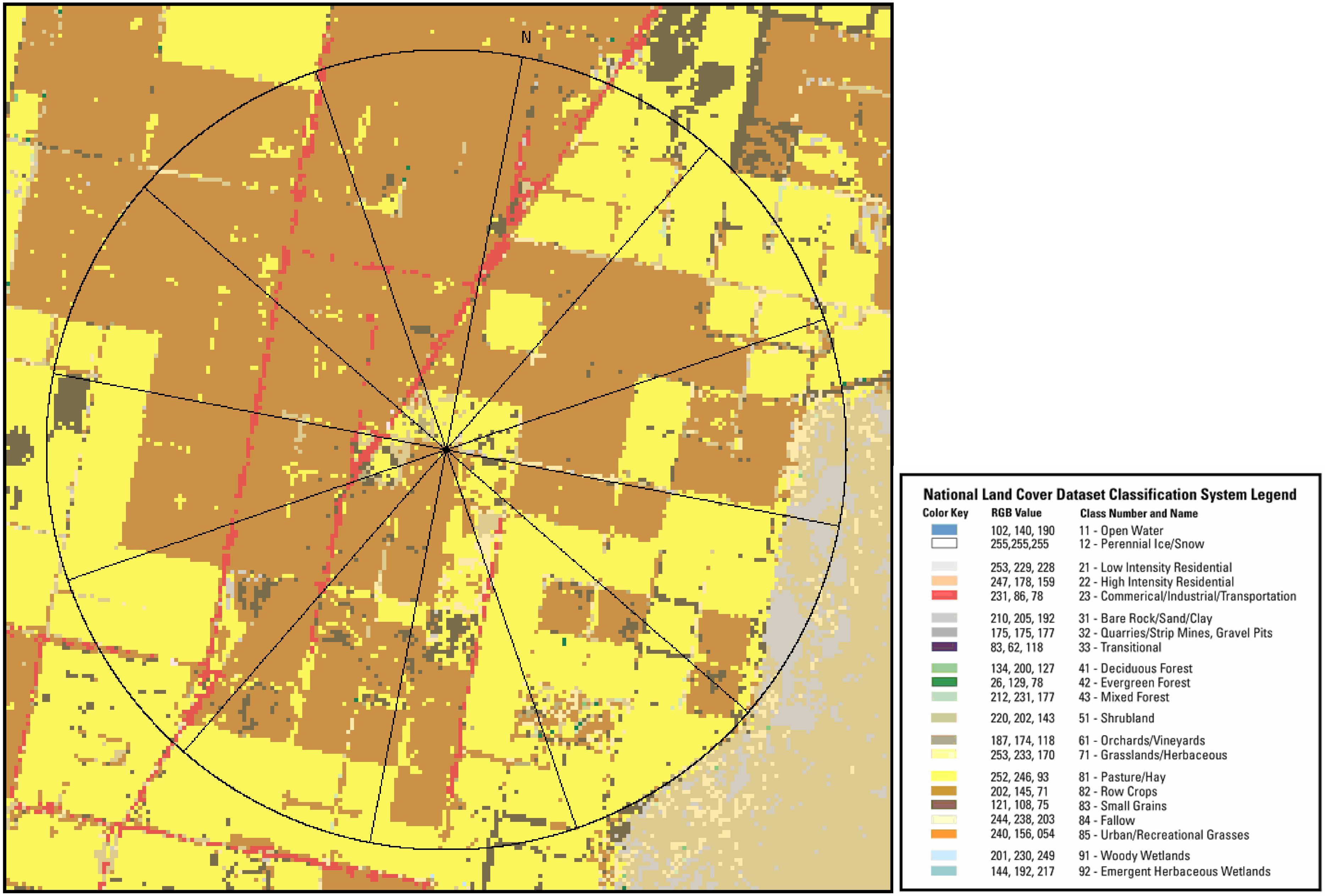
Table 4-1: Parker Arizona Meteorological Station Land Cover Statistics

MPRM Land Use Category	Sector											
	1	2	3	4	5	6	7	8	9	10	11	12
	Cells											
Water	0	0	0	0	0	0	0	0	0	0	0	0
Deciduous Forest	0	4	2	1	5	1	2	0	0	1	0	0
Coniferous Forest	0	4	1	1	10	2	3	0	0	1	0	2
Swamp	1	0	0	0	0	0	0	0	0	0	0	0
Cultivated Land	1,175	1,355	1,351	858	605	1,097	1,685	1,302	1,597	2,180	2,296	2,426
Grassland	1,288	1,201	883	1,318	1,901	1,473	906	1,130	898	369	165	119
Urban	116	0	0	0	11	48	10	134	67	48	109	57
Desert Shrubland	38	46	389	441	79	6	12	44	65	20	40	22

Source: USGS. Arizona National Land Cover Dataset. 1992 Data.

MPRM requires that three surface characteristics (albedo, Bowen ratio, and roughness length) be specified for the surface meteorological measurement site (i.e., the Parker AZMET monitor). USEPA default values for these three surface characteristics for the range of land cover classifications were obtained from HHRAP. Albedo, Bowen ratio, and roughness lengths were then weighted according to the eight MPRM land cover classifications (for each month and each sector). Generally, winter is classified as December, January, and February; spring is classified as March, April, and May; summer is classified as June, July, and August; and autumn is classified as September, October, and November. However, given the climate in the Parker area of Arizona, which doesn't experience northern U.S. winter conditions, autumn default values were substituted for winter values.

Figure 4-4: Land Use within 3-Kilometers of Parker Meteorological Monitoring Station



A summary table by season and sector for each of the required surface parameters is located in Table 4-4. These surface characteristics, in conjunction with the meteorological data, were processed using MPRM to create an ISCST3-ready meteorological data file for use in modeling wet and dry deposition rates.

Table 4-2: 1992 National Land Cover Dataset (NLCD) Land Cover Types

NLCD Type	Description
11	Open Water
12	Perennial Ice/Snow
21	Low Intensity Residential
22	High Intensity Residential
23	Commercial/Industrial/Transportation
31	Bare Rock/Sand/Clay
32	Quarries/Strip Mines, Gravel Pits
33	Transitional
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Shrubland
61	Orchards/Vineyards
71	Grasslands/Herbaceous
81	Pasture/Hay
82	Row Crops
83	Small Grains
84	Fallow
85	Urban/Recreational Grasses
91	Woody Wetlands
92	Emergent Herbaceous Wetlands

Table 4-3: Comparison of USGS National Land Cover Dataset (NLCD) Land Cover Types to USEPA's Meteorological Processor for Regulatory Models (MPRM) Land Use Categories

NLCD Types	MPRM Land Use Category
11,12	Water
41 + ½(43)	Deciduous Forest
42 + ½(43)	Coniferous Forest
91,92	Swamp
61,82,83	Cultivated Land
71,81,84,85	Grassland
21,22,23	Urban
31,32,33,51	Desert Shrubland

Table 4-4: Summary of Meteorological Processor for Regulatory Models (MPRM) Surface Characteristics

Season	Sector	Albedo	Bowen Ratio	Surface Roughness Length (Parker Met. Site)	Surface Roughness Length (Facility Site)	Monin-Obukhov Length	Fraction of Net Radiation Absorbed by Ground	Anthropogenic Heat Flux	Leaf Area Index
1	1	0.19	0.98	0.08	0.11	2.00	0.15	0.00	2.00
1	2	0.19	0.93	0.04	0.26	2.00	0.15	0.00	2.00
1	3	0.20	1.59	0.07	0.30	2.00	0.15	0.00	2.00
1	4	0.21	1.74	0.07	0.30	2.00	0.15	0.00	2.00
1	5	0.20	1.09	0.04	0.30	2.00	0.15	0.00	2.00
1	6	0.19	0.90	0.05	0.30	2.00	0.15	0.00	2.00
1	7	0.19	0.83	0.04	0.24	2.00	0.15	0.00	2.00
1	8	0.19	0.99	0.09	0.12	2.00	0.15	0.00	2.00
1	9	0.19	0.97	0.07	0.18	2.00	0.15	0.00	2.00
1	10	0.18	0.81	0.06	0.47	2.00	0.15	0.00	2.00
1	11	0.18	0.85	0.09	0.66	2.00	0.15	0.00	2.00
1	12	0.18	0.79	0.07	0.43	2.00	0.15	0.00	2.00
2	1	0.16	0.42	0.09	0.12	2.00	0.15	0.00	2.00
2	2	0.16	0.39	0.05	0.26	2.00	0.15	0.00	2.00
2	3	0.18	0.73	0.08	0.30	2.00	0.15	0.00	2.00
2	4	0.19	0.81	0.09	0.30	2.00	0.15	0.00	2.00
2	5	0.17	0.46	0.06	0.30	2.00	0.15	0.00	2.00
2	6	0.16	0.38	0.06	0.30	2.00	0.15	0.00	2.00
2	7	0.15	0.35	0.04	0.24	2.00	0.15	0.00	2.00
2	8	0.16	0.42	0.09	0.13	2.00	0.15	0.00	2.00
2	9	0.16	0.42	0.07	0.20	2.00	0.15	0.00	2.00
2	10	0.15	0.35	0.05	0.48	2.00	0.15	0.00	2.00
2	11	0.14	0.38	0.08	0.66	2.00	0.15	0.00	2.00
2	12	0.14	0.34	0.06	0.43	2.00	0.15	0.00	2.00
3	1	0.19	0.76	0.19	0.22	2.00	0.15	0.00	2.00

Table 4-4: Summary of Meteorological Processor for Regulatory Models (MPRM) Surface Characteristics

Season	Sector	Albedo	Bowen Ratio	Surface Roughness Length (Parker Met. Site)	Surface Roughness Length (Facility Site)	Monin-Obukhov Length	Fraction of Net Radiation Absorbed by Ground	Anthropogenic Heat Flux	Leaf Area Index
3	2	0.19	0.70	0.16	0.28	2.00	0.15	0.00	2.00
3	3	0.21	1.12	0.18	0.30	2.00	0.15	0.00	2.00
3	4	0.20	1.24	0.17	0.30	2.00	0.15	0.00	2.00
3	5	0.19	0.83	0.14	0.30	2.00	0.15	0.00	2.00
3	6	0.19	0.70	0.16	0.30	2.00	0.15	0.00	2.00
3	7	0.19	0.63	0.17	0.27	2.00	0.15	0.00	2.00
3	8	0.19	0.77	0.20	0.21	2.00	0.15	0.00	2.00
3	9	0.19	0.73	0.19	0.27	2.00	0.15	0.00	2.00
3	10	0.20	0.60	0.20	0.51	2.00	0.15	0.00	2.00
3	11	0.20	0.64	0.23	0.67	2.00	0.15	0.00	2.00
3	12	0.20	0.58	0.21	0.45	2.00	0.15	0.00	2.00
4	1	0.19	0.98	0.08	0.11	2.00	0.15	0.00	2.00
4	2	0.19	0.93	0.04	0.26	2.00	0.15	0.00	2.00
4	3	0.20	1.59	0.07	0.30	2.00	0.15	0.00	2.00
4	4	0.21	1.74	0.07	0.30	2.00	0.15	0.00	2.00
4	5	0.20	1.09	0.04	0.30	2.00	0.15	0.00	2.00
4	6	0.19	0.90	0.05	0.30	2.00	0.15	0.00	2.00
4	7	0.19	0.83	0.04	0.24	2.00	0.15	0.00	2.00
4	8	0.19	0.99	0.09	0.12	2.00	0.15	0.00	2.00
4	9	0.19	0.97	0.07	0.18	2.00	0.15	0.00	2.00
4	10	0.18	0.81	0.06	0.47	2.00	0.15	0.00	2.00
4	11	0.18	0.85	0.09	0.66	2.00	0.15	0.00	2.00
4	12	0.18	0.79	0.07	0.43	2.00	0.15	0.00	2.00

Notes: 1. Season 1 is winter (treated as autumn for the Parker area), Season 2 is spring, Season 3 is summer, and Season 4 is autumn .

4.5 Modeled Receptor Grid

A 20 km-by-20 km Cartesian receptor grid with the following receptor spacing was used in the ISCST3 modeling analyses to calculate off-site concentrations and deposition rates:

1. Fine/near grid: Receptors every 100 m out to 3 km; and
2. Coarse/full grid: Receptors every 500 m from 3 km to 10 km.

Receptors were also placed along the Facility fence line every 25 m.

The ISCST3 model requires receptor data consisting of location coordinates and ground-level elevations. The receptor generating program, AERMAP (Version 06341), was used to develop a complete receptor grid to a distance of 10 kilometers from the Facility. AERMAP uses digital elevation model (DEM) data obtained from the United States Geological Survey (USGS). 7.5 minute DEM files were obtained for an area covering at least 10 kilometers in all directions from the proposed facility. AERMAP was then run with these DEM files to determine the representative elevations for each receptor.

Figure 4-5 shows the complete modeled receptor grid overlaid onto the DEM ground-level elevation contours, including both the coarse/full grid and the fine/near grid. Figure 4-6 shows the fine/near receptor grid overlain onto a topographic map of the Facility area.

A separate receptor grid was also developed to model on-site air concentrations from the fugitive emissions hopper volume source for the on-site worker evaluation performed in the risk assessment at the request of USEPA Region 9. This Cartesian receptor grid included on-site receptors every 50 ft excluding locations where buildings are present.

Figure 4-5: Modeled Receptor Grid (Full Grid)

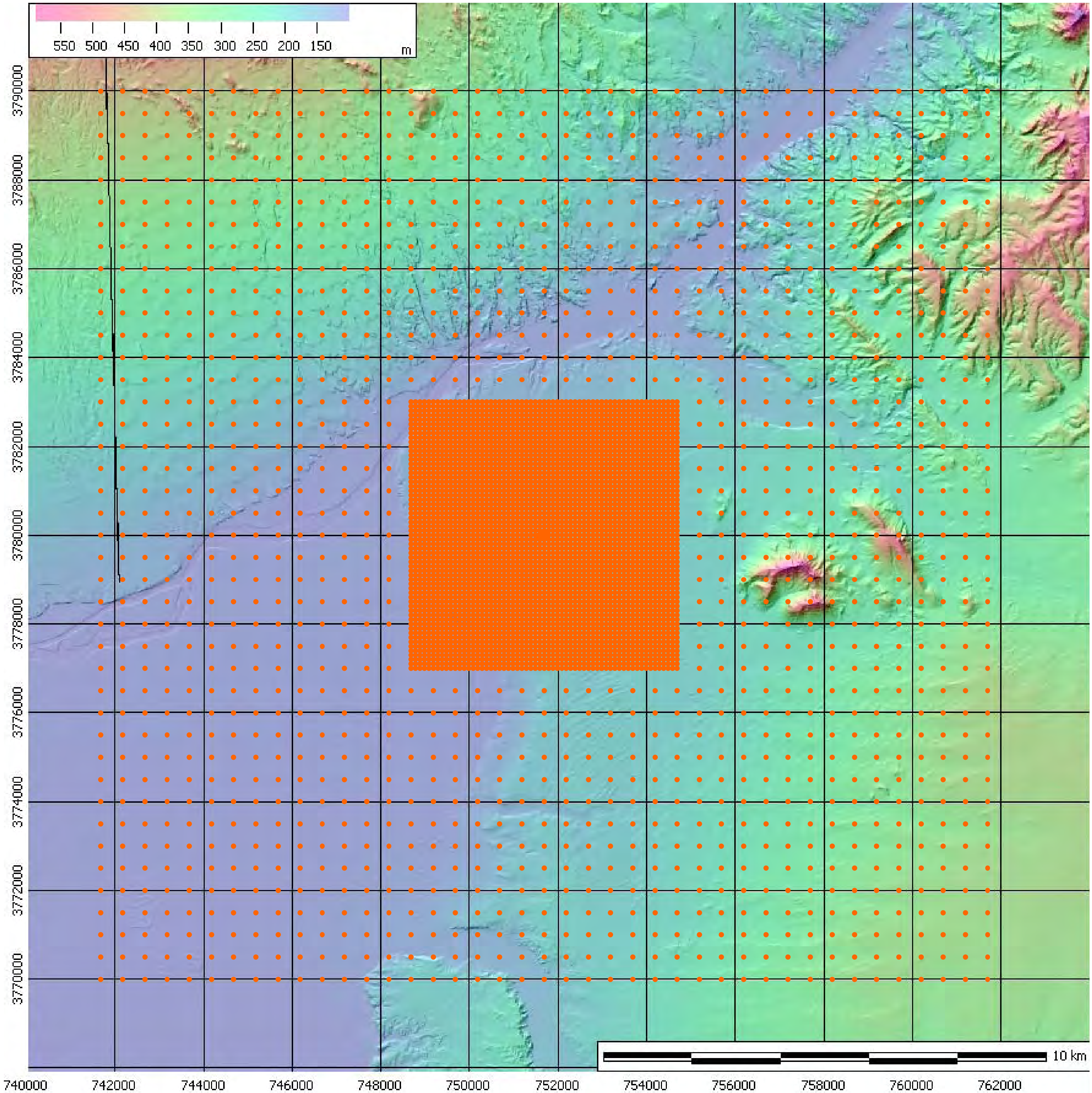
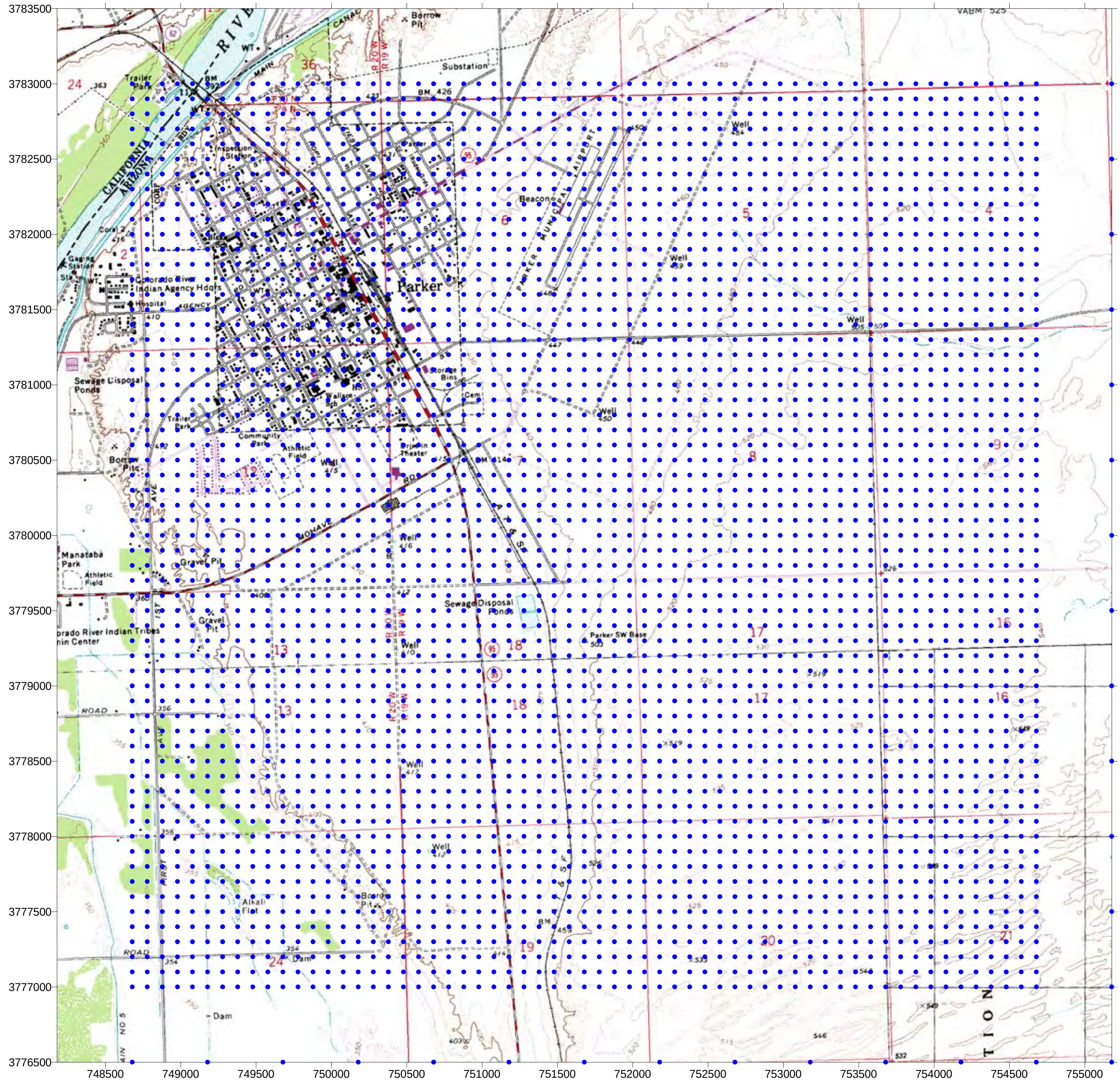


Figure 4-6: Modeled Receptor Grid (Near Grid)



Note: Coordinates in UTM Zone 11, NAD27

5.0 MODELING RESULTS

The ISCST3 modeling results used in the risk assessment included unitized annual average and 1-hour average ambient air concentrations at off-site receptor grid points beyond the property boundary for the stack and fugitive air emissions sources. Off-site unitized annual average deposition rates for the stack source were also used in the risk assessment. Finally, unitized 8-hour average ambient air concentrations associated with the fugitive emissions source at on-site receptor locations were used in the worker evaluation.

Appendix E, referenced in the main risk assessment report, provides figures illustrating the unitized annual average ISCST3 modeled ambient air concentrations and deposition rates associated with the stack source. These isopleth figures are overlain on a USGS topographical map of the Facility area. As the figures show, the maximum unitized annual average air concentrations and deposition rates occur near to, and to the north and south of, the stack, consistent with the predominantly northerly and southerly winds in the Parker area.

The detailed ISCST3 modeling input and output files associated with this project are included in a modeling appendix. These files include the ISCST3 input and output files, plotfiles, BPIP input and output files, and the meteorological data used in the analysis. These files are voluminous and thus are provided on a separate CD.

APPENDIX TO
AIR DISPERSION AND DEPOSITION MODELING REPORT

ISCST3 MODELING INPUT AND OUTPUT FILES
(ON CDROM)