If a screening analysis indicates that potential adverse air quality impacts will take place, or the facility is too complex to undergo a screening analysis, a refined air quality impact analysis will be required. Refined air quality analyses utilize real-world meteorological data inputs, comprehensive receptor grids and site-specific source characterizations.

40 CFR Part 51, Appendix W, “The Guideline on Air Quality Models” provides a comprehensive list of preferred/recommended models and modeling techniques that should be used when conducting air quality analyses for permitting purposes. The most recent version of the recommended air quality model should be used unless prior approval for the use of an alternate version or alternate model has been obtained from the department’s Air Pollution Control Program. The Environmental Protection Agency maintains a website, the Support Center for Regulatory Atmospheric Modeling (SCRAM) Dispersion Modeling | TTN - Support Center for Regulatory Atmospheric Modeling | US EPA, that provides links to the preferred/recommended models that are currently in use.

The following sections briefly describe each data element that is required in order to complete a refined air quality impact analysis. For detailed information on specific modeling procedures, please refer to the Source Characterizations website.

**Modeled Emission Rates**

The construction permit engineer is responsible for the approval of all emission estimates that are used in ambient air quality impact analyses within the State of Missouri. All emission estimates should be based upon the use of maximum, hourly emissions or federally enforceable limits (for existing sources) contained within construction permits, operating permits or other enforceable mechanisms such as consent decrees, state requirements, or federal requirements. In the absence of limits, potential to emit calculations should be used to determine compliance with each applicable air quality standard.

When determining hourly emission estimates, it is important to understand the processes that are occurring and which operating scenario results in the worst case ambient impact. For example, the emission estimates for a boiler that primarily combuts natural gas with a fuel oil backup, must consider which fuel results in the worst case, hourly emission estimates. Depending on the pollutant being considered, the primary fuel may not result in the maximum, hourly emission rate.

In addition, combustion sources may be required to consider reduced operating loads. Again, the operating load that produces the worst case ambient impact must be used to establish compliance with the air quality standards.

Lastly, any emission limits applied to the new source or modification must be clearly described and must include a detailed account of all assumptions used in the calculation of the emission estimates. Likewise, any model assumptions made through the application of the EMISFACT keyword within the model input file, should be noted. *Any limits that are noted will become a special condition within the construction permit.*
Source Characterizations

The construction permit applicant is required to provide the methodology that will be used to characterize emission releases within the ambient air quality impact analysis. AERMOD, the preferred air quality model for refined dispersion analyses, allows the user to input three differing release types: point, volume and area sources.

The point source algorithm should be used to characterize emissions from stacks, exhaust fans, cooling towers and non-passive, isolated vents. Any restriction to vertical flow due to the presence of rain caps or horizontal stacks should be accounted for by reducing the exit velocity to 0.001 meters per second in the model input file.

The volume source algorithm should be used to model fugitive emission releases, with the exception of haul roads and storage piles, which are not vented through a stack such as conveyor drop points, truck receiving pits, crushers, sawing, etc. Additionally, any emission release vented inside an enclosed structure, without a stack, should be characterized as a volume source with release parameters equivalent to the size of the openings that allow for the escape of fugitive emissions.

Lastly, area source emission releases result from haul road traffic and outdoor storage piles. All haul road releases should be modeled according to the recommended area source configuration procedures outlined in the March 2, 2012 Environmental Protection Agency report entitled “Haul Road Workgroup Final Report Submission to EPA-OAQPS.”

Detailed information on the assignment of release parameters can be found on the Source Characterizations website. Permit applicants are encouraged to review the procedures outlined in the Point Source, Volume Source, and Area Source documents because they contain preferred characterization methodologies that can directly impact the results obtained from the ambient air quality impact analysis.

Receptor Grid and Terrain Elevations

When conducting an ambient air quality impact analysis, the applicant is required to determine the impact that each emission source will have beyond the facility’s property boundary. Refined air quality models, such as AERMOD, require the user to input an x- and y-coordinate at regular intervals where modeled impacts are to be calculated. A receptor grid is comprised of multiple, x- and y-coordinates, receptors, which are placed at varying intervals around the facility.

The receptor grid developed for input into the air quality model should be resolved enough to identify the area of maximum impact from fugitive and point source releases and should encompass the full extent of the maximum impact area due to the new source or modification. Receptors should be placed at 50-meter intervals along the property boundary in ambient air. Near field receptors should be located at 100-meter intervals with emphasis placed upon each area of maximum impact that is identified. As the distance from the property increases, the
Refined Model Analysis

The spacing of the outer grid should become less refined; refer to the procedures outlined in the Receptor Grids, Terrain and Location Data document.

For purposes of dispersion modeling, ambient air is defined as that portion of the atmosphere, external to buildings, to which the general public has access as referenced in the following document, Property Boundaries and Ambient Air Determinations. Typically, ambient air occurs at or beyond the fence line of a facility. Public roadways, railroads and waterways are all considered ambient air regardless of their location in relation to the facility.

National Elevation Data (NED) in the GeoTIFF format from the United States Geological Survey should be processed through the AERMAP program in order to obtain the base elevation for each receptor and source within the modeling domain. In addition, the hill height scale for each receptor should be extracted as required by the AERMOD system in order to determine terrain influences within the modeling domain.

Meteorological Data

The AERMOD dispersion model will accept hourly, meteorological data from the National Weather Service or from on-site measurement systems. If National Weather Service data is used in an ambient air quality impact analysis, site selection should be based upon the climatological, spatial and temporal representativeness of the National Weather Service site compared to the facility site. In other words, are the meteorological conditions at the facility site similar to the meteorological conditions that are occurring at the measurement site? Data representativeness is critical and is directly dependent upon proximity, instrument site, topography and land use.

Staff from the Construction Permit Modeling Unit will provide AERMOD ready meteorological data inputs and an evaluation of the surface characteristics surrounding the facility site if National Weather Service measurements are going to be used in the ambient air quality impact analysis. In order to process the meteorological data request, the applicant must provide the UTM coordinates for the facility center in the NAD83 datum, UTM Zone 15. 40 CFR Part 51 Appendix W, "The Guideline on Air Quality Models", recommends the use of a five year data period to ensure that the worst case meteorological conditions have been accounted for in the compliance determination.

If the facility is going to collect site specific meteorological measurements, a study must be conducted for a minimum period of one year and will require the submittal of a Quality Assurance Project Plan to the Air Quality Monitoring Unit prior to the commencement of data collection. At a minimum, the plan must address what variables are going to be collected, system specifications such as instrument accuracy, a site plot plan and missing data procedures.

For additional information on meteorological considerations, please refer to the following document; Meteorological Data.
Background Concentrations & Interactive Source Inventories

Background concentrations are an integral part of the overall air quality within a region and should be included in all National Ambient Air Quality Standards compliance determinations. Background air quality is comprised of three differing elements: natural sources of pollution that are not explicitly modeled, nearby sources that are not being considered within the construction permit application and unidentified sources that are not included within the emission inventory system maintained by the State of Missouri.

Existing air quality data is used to determine the impact from natural sources and unidentified sources that are not explicitly modeled for compliance purposes. If possible, data collected near the facility by the department’s Air Pollution Control Program will be provided for inclusion into the ambient air quality impact analysis. If the facility is located within a region where no air quality measurements have been taken, a regional background site will be chosen and provided to the applicant for inclusion into the modeling study.

The remainder of the background concentration will be accounted for through the inclusion of existing sources within the region that could have a significant impact within the radius of influence from the proposed source or modification. The Construction Permit Modeling Unit will provide a model ready interactive (existing background sources) source input file to the applicant. All interactive source inputs should be explicitly modeled. If the air quality analysis is being conducted for an existing source, site-specific information for each emission unit at the facility should be provided by the applicant, refer to the following document: Background Concentrations.

Increment Consumption

In addition to determining compliance with the National Ambient Air Quality Standards, applicants are required to determine compliance with the Prevention of Significant Deterioration (PSD) increment standards. The PSD increment standards are the maximum ambient concentration increase that can occur above a baseline. When the amount of “new” pollution exceeds the increment standards, significant deterioration has occurred. In order to determine the amount of increment consumed, the applicant must consider the emissions increase due to the new source or modification in addition to off-site emissions increases since the baseline date.

The amount of increment consumed should be determined through the inclusion of existing sources within the region that could have a significant impact within the radius of influence from the proposed source or modification. The Construction Permit Modeling Unit will provide a model ready interactive (increment consumers) source input file to the applicant. All interactive source inputs should be explicitly modeled. If the air quality analysis is being conducted for an existing source, site-specific information for each emission unit at the facility should be provided by the applicant.
Building Downwash
The presence of buildings can affect plume rise and the initial dispersion of pollutants within the atmosphere. Turbulent wake zones can be created around buildings that force pollutants to the ground instead of allowing them to freely rise within the atmosphere. Building downwash can be defined as the effect on pollution from nearby stacks that occurs when wind flows over and around buildings.

In order to account for building downwash parameters within the refined dispersion model, the Environmental Protection Agency developed a preprocessor, BPIP PRIME, in order to calculate enhanced plume dispersion coefficients due to turbulent wakes and to calculate reduced plume rise caused by the combination of the descent of streamlines on the leeward side of buildings and the increased entrainment within the wake. Additionally, PRIME addresses both the near and far field wake zones produced downwind of a building or group of structures.

The information needed to execute BPIP PRIME is the heights and locations of structures, which may contribute to building downwash and the stack locations in relation to these structures. Based upon the facility configuration, the model will determine if a stack is subject to wake effects from a surrounding structure or structures. If structure wake effects are evident, flags are set to indicate which stacks are affected by building wake zones. Once it is determined that a stack is influenced by a structure, BPIP will calculate the building heights and widths to be included in the dispersion model so that building downwash effects can be considered, refer to the following document for additional guidance; Building Downwash & Good Engineering Practice Stack Height.

Good Engineering Practice Stack Height
The Clean Air Act states that a stack should be high enough to ensure that its emissions do not result in excessive ground level pollutant concentrations in the area surrounding the stack due to downwash effects caused by the source itself, nearby structures, or complex terrain. It also states that the stack shall not exceed two and one-half times the height of the obstructing source unless a demonstration can be made that this is necessary. According to 40 CFR 51,1(ii), good engineering practice (GEP) stack height is the greater of 65 meters (measured from base of the stack) or the height of the nearby structure (measured from base of stack) plus 1.5 times the lesser dimension of the nearby structure. Any stack built prior to December 30, 1970 is grandfathered and is exempt from the GEP stack height requirements.

If a proposed, or existing stack, exceeds the criteria noted above, the GEP stack height should be used to determine compliance with the air quality standards, not the actual stack height; refer to the following document for additional guidance; Building Downwash & Good Engineering Practice Stack Height.

Again, this document merely provides a summary of the data elements that are required to be incorporated into a refined air quality impact analysis. Detailed information on specific modeling procedures are located on the Source Characterizations website and should be reviewed prior to the submittal of a modeling protocol.