



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

FEB 10 2016

MEMORANDUM

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

SUBJECT: Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Donlin Mine Compliance Demonstration

FROM: George Bridgers, Model Clearinghouse Director
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A handwritten signature in dark ink, appearing to read "George M. Bridgers".

TO: Janis Hastings, Acting Director
Office of Air, Waste, and Toxics

INTRODUCTION

In response to your December 1, 2015 concurrence request memorandum, the Model Clearinghouse has reviewed Region 10's position on the proposed use of the ADJ_U* Beta option in the AERMET meteorological processor (version 15181) for the Donlin Gold Limited Liability Company (DGLLC) mine facility located on the western slopes of the Kuskokwin Mountains in the Yukon-Kuskokwin region of southwestern Alaska. The ADJ_U* Beta option was incorporated in AERMET to address concerns regarding potential underprediction of the surface friction velocity (u^*) during low-wind/stable conditions that could contribute to overprediction of ambient air impacts by the AERMOD dispersion model (version 15181) for some applications. We also take this opportunity to address use of the POINTCAP and POINTHOR Beta options in the AERMOD dispersion model (version 15181) for capped and horizontal releases which are present at the Donlin mine facility.

MODEL CLEARINGHOUSE RESPONSE

Application of ADJ_U* Beta Option in AERMET

Appendix W, Section 3.2.2 provides three different conditions for which an alternative model is approvable. These three conditions are briefly summarized as:

- 1) The alternative and preferred model provide equivalent estimates;
- 2) The alternative model outperforms the preferred model when comparing the results to actual air quality data; or
- 3) The preferred model is less appropriate or there is no preferred model for the given scenario.

In reviewing the December 1, 2015 concurrence request memorandum from Region 10 and the attached material from Alaska Department of Environmental Conservation (ADEC), we note that Region 10 and Alaska were following the second condition¹ for the basis of this alternative model approval. The Model Clearinghouse concurs that a well-reasoned justification was thoroughly documented and demonstrates that the ADJ_U* Beta option in AERMET selected for the Donlin mine facility compliance demonstration performs better for the given application, i.e., surface mining operations, than the default regulatory version of AERMET.

As noted in Section 2.3, Donlin Project Characteristics, provided by DGLLC in their August 25, 2015 submittal to ADEC, the primary concern regarding ambient pollutant impacts is expected to be associated with fugitive emissions of particulate matter from sources with low release heights. Since ambient impacts from such sources are likely to be highest during periods of low wind speeds and stable atmospheric conditions, the ADJ_U* Beta option in AERMET is clearly relevant to this application. Furthermore, given the location of the proposed project in Alaska, the frequency of low-wind/stable conditions is expected to be higher than usual for the DGLLC site.

Region 10's alternative model demonstration includes a thorough summary of relevant model evaluation results supporting use of the ADJ_U* Beta option for this application, including appropriate citation of the peer-reviewed literature of Qian and Venkatram (2010)² and a 1993 evaluation of PM-10 concentrations for the Cordero Rojo mine located in eastern Wyoming. Results from the Cordero Rojo evaluation are especially relevant for this alternative model request since Donlin and Cordero Rojo both involve low-level fugitive emissions associated with surface mining operations. The Cordero Rojo evaluation results are also important since they demonstrate that improvement in model performance with the ADJ_U* Beta option is statistically significant for a similar source. In addition to the Cordero Rojo evaluation results, Region 10's alternative model demonstration cites significant improvements in model performance with the ADJ_U* Beta option for two 1974 tracer studies conducted by NOAA at Idaho Falls, ID and Oak Ridge, TN. Both of these NOAA studies involved near-ground tracer releases with arcs of samplers located at 100, 200, and 400m from the release location, and are therefore relevant to application of the ADJ_U* Beta option for the Donlin mine facility. The relevance of these 1974 tracer studies for evaluating model performance is enhanced since uncertainties in emissions and source characteristics are minimized.

DGLLC also provided a series of application-specific model sensitivities for the Donlin mine facility that demonstrate the impact of the ADJ_U* Beta option on various meteorological variables output by AERMET. While these sensitivity analyses do not constitute a site-specific evaluation of model performance, they do demonstrate the impact of the ADJ_U* Beta option on key meteorological parameters that are relevant to the dispersion of low-level fugitive emissions, such as u^* and the mechanical mixing height. Therefore, these model sensitivity analyses do

¹ Appendix W to 40 CFR, Part 51, Section 3.2.2.b(2).

² Qian, W. and A. Venkatram. 2010. "Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions." *Boundary-Layer Meteorology* (2011) 138:475–491 DOI 10.1007/s10546-010-9565-1. Published online December 3, 2010. Accessed August 24, 2015. <http://link.springer.com/content/pdf/10.1007%2Fs10546-010-9565-1.pdf>.

provide further evidence of the relevance and appropriateness of the ADJ_U* Beta option for this application.

The material provided by DGLLC and additional agreements with ADEC and Region 10 also clearly demonstrate that a model evaluation protocol was established in coordination with ADEC and related consultation with EPA. Through engagements between the region and the Model Clearinghouse, DGLLC made appropriate adjustments to their methods and procedures such that an alternative model demonstration would be approvable by the permit reviewing authority and Regional Office. This satisfies additional recommendations³ in Appendix W for the second condition regarding alternative model approvals.

Finally, we note in the September 17, 2015 letter from ADEC that DGLLC agreed to exclude the sigma-theta turbulence parameter when processing the site-specific meteorological data with the ADJ_U* Beta option based on EPA's concerns that application of this Beta option with turbulence data may introduce a bias toward underprediction. Recent evaluations by EPA based on AERMOD evaluation databases provides support for this recommendation, and we concur with this decision for this alternative model approval. We also concur with the decision to not include any of the LOW_WIND Beta options in AERMOD based on similar concerns and the lack of further model performance evaluation to justify the use of a LOW_WIND Beta option for this particular application.

Additional Consideration: Application of POINTCAP and POINTHOR Beta Options in AERMOD

Although not explicitly requested by Region 10 in their concurrence request memorandum, we are also addressing the use of the POINTCAP and POINTHOR Beta options for capped and horizontal releases in AERMOD, since the Donlin mine facility includes a significant number of capped stacks subject to downwash and a few capped stacks not subject to downwash, and we have proposed changing these to regulatory default options under the July 29, 2015 proposed revisions to Appendix W. The POINTCAP and POINTHOR Beta source type options were developed in 2006 and incorporated in version 06341 of AERMOD to address concerns regarding anomalously high concentrations that occurred following the procedure recommended in the July 9, 1993 Model Clearinghouse Memorandum (included as Appendix D in the AERMOD User's Guide Addendum) for capped and horizontal stacks that are subject to building downwash using the PRIME algorithm. The POINTCAP and POINTHOR options also account for differences between AERMOD and ISC regarding vertical profiles of meteorological parameters.

The 1993 Model Clearinghouse Memorandum recommended that the exit velocity for horizontal and capped stacks be set to a value of 0.001 m/s. The MCH procedure also recommended turning off stack-tip downwash for horizontal stacks that are not capped, and reducing the stack height by three times the actual stack diameter for capped stacks, which is the maximum amount of stack tip downwash applied within the model. The 1993 MCH recommendation for capped and horizontal stacks falls under the category of source characterization, rather than an alternative model. However, the 1993 MCH approach, based on modifying the inputs to the

³ Appendix W to 40 CFR, Part 51, Section 3.2.2.d.

model, is not appropriate for use with AERMOD due to differences in the profiling of meteorological variables between AERMOD and ISCST (the recommended model in 1993). More importantly, the MCH procedure does not account for the complex numerical plume rise formulation associated with the PRIME downwash algorithm that was first incorporated in version 02222 of AERMOD. As noted above, application of the 1993 MCH procedure for sources subject to building downwash influences using the PRIME downwash algorithm in AERMOD has resulted in anomalously high concentrations.

Given these issues regarding application of the MCH procedure for capped and horizontal stacks, Section 6.1 of the AERMOD Implementation Guide was updated on September 27, 2005 to caution that “*capped and horizontal stacks that are subject to building downwash should not be modeled using an effective stack diameter to simulate the restriction to vertical flow since the PRIME algorithms use the stack diameter to define the initial plume radius which, in turn, is used to solve the conservation laws.*” As noted above, the POINTCAP and POINTHOR Beta options were incorporated in the EPA’s subsequent release of version 06341 of AERMOD to address these concerns regarding anomalously high concentrations that occurred following the MCH procedure. The Beta options for capped/horizontal sources in AERMOD are generally consistent with the 1993 MCH procedure but were developed to explicitly address the issues associated with applying the 1993 MCH procedure for capped and horizontal stacks subject to building downwash using the PRIME downwash algorithm, and also account for differences in the profiles of meteorological variables between AERMOD and ISCST for capped and horizontal stacks without building downwash. Therefore, the Model Clearinghouse agrees with their use for the Donlin mine facility compliance demonstration and further recommend use of POINTCAP and POINTHOR options as the best available options for all capped and horizontal stacks subject or not subject to downwash, consistent with our proposed revisions to Appendix W.

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