The following checklist summarizes QAPP requirements for model development projects. (Separate guidance describes QAPP Requirements for Application/Use of Existing [Previously Validated] Models.) Specifically, this guidance focuses on algorithm development and testing. If the project scope includes the development of software applications, the “Requirements for Software and Application Development Projects” should be consulted for additional QAPP requirements. More comprehensive guidance on developing QAPPs for modeling projects is provided in the EPA/240/R-02/007 report titled “Guidance for Quality Assurance Project Plans for Modeling ([EPA QA/G-5M](https://www.epa.gov/quality/agency-wide-quality-system-documents#guidance)).” The completed checklist will be entered into QA Track with the approved QAPP by the QA Manager when final.

## B.1 MODEL DESIGN

| **Yes** | **No** | **N/A** | **Requirement** | **Notes** |
| --- | --- | --- | --- | --- |
| ☐ | ☐ | ☐ | Describe the conceptual model, including key processes, system compartments, system boundaries, temporal and spatial scales, and fluxes into and out of the problem domain. |  |
| ☐ | ☐ | ☐ | If the project builds upon a previously developed model, describe the existing model and identify what modifications and enhancements are needed to meet project objectives. |  |
| ☐ | ☐ | ☐ | Describe how the model development fits into a larger project and its relationship to related efforts (e.g., field or lab studies, software or application development, etc) with separate QAPPs, if applicable. |  |

## B.2 MODEL DEREVATION

| **Yes** | **No** | **N/A** | **Requirement** | **Notes** |
| --- | --- | --- | --- | --- |
| ☐ | ☐ | ☐ | Describe the mathematical representation of the processes of interest. For mechanistic models, state the governing equation and describe what each term in the equation represents. For empirical/statistical models, identify the attributes that will be considered for inclusion in the model based on their hypothesized effect on the modeled outcome. |  |
| ☐ | ☐ | ☐ | Describe the statistical and/or numerical approaches that will be used to derive, implement, and parameterize/calibrate the model. |  |
| ☐ | ☐ | ☐ | For empirical/statistical models (e.g., regression, classification or clustering), describe the calibration/training dataset that will be used to derive fixed model parameters (e.g., regression coefficients or weights). |  |
| ☐ | ☐ | ☐ | Identify potential data sources of measured/observed values. State the criteria that will be used to assess whether or not the reported data are of sufficient quality. Describe procedures for identifying outliers and handling outliers or missing data (imputation procedures). |  |
| ☐ | ☐ | ☐ | Describe the calibration procedures (e.g., weighting functions, optimization algorithms, etc.), and state the goodness-of-fit criteria for acceptance of the model parameter value. |  |
| ☐ | ☐ | ☐ | For mechanistic models, describe any procedures that will be used to check for numerical errors (e.g., checks for mass balance errors or violations of boundary conditions). |  |

## B.3 VALIDATION, VERIFICATION, AND TESTING

| **Yes** | **No** | **N/A** | **Requirement** | **Notes** |
| --- | --- | --- | --- | --- |
| ☐ | ☐ | ☐ | Describe the verification procedures that will be used to assess whether model algorithms are performing as expected. |  |
| ☐ | ☐ | ☐ | Describe the validation procedures that will be used to assess whether model results are representative of measured or observed data. |  |
| ☐ | ☐ | ☐ | Identify potential data sources of measured/observed values. State the criteria that will be used to assess whether or not the reported data are of sufficient quality. |  |
| ☐ | ☐ | ☐ | Describe procedures for identifying outliers and handling outliers or missing data (imputation procedures). |  |
| ☐ | ☐ | ☐ | Describe any additional testing that will be conducted, e.g., comparison of model accuracy or computational efficiency against existing models. |  |
| ☐ | ☐ | ☐ | Describe any procedures that will be used for model parameter sensitivity analysis. |  |
| ☐ | ☐ | ☐ | Describe any procedures that will be used to evaluate the impact of parameter uncertainty on model results |  |
| ☐ | ☐ | ☐ | Describe any procedures that will be used to assess the impact of tuning parameters or spatial/temporal discretization on model results. |  |
| ☐ | ☐ | ☐ | Describe the level of internal and external peer review that is needed for the model. |  |

## B.4 DOCUMENTATION

| **Yes** | **No** | **N/A** | **Requirement** | **Notes** |
| --- | --- | --- | --- | --- |
| ☐ | ☐ | ☐ | Specify the requirements, format and location for project documentation. |  |
| ☐ | ☐ | ☐ | Include model development documentation that may include derivations of governing equations and descriptions of calibration datasets and procedures. |  |
| ☐ | ☐ | ☐ | Include model performance assessment documentation that may include model input/output files used for verification, verification and testing; and quantitative or qualitative analysis of model performance. |  |
| ☐ | ☐ | ☐ | Include a description of documentation related to the development of scripts and/or source code to implement the model should specify the programming environment and version used, and identify any code repositories (e.g., Bitbucket and GitHub) used to archive and document coding issues and their resolution. If applicable, see “Requirements for Software and Application Development Projects” for additional QAPP requirements related the development of software applications. |  |
| ☐ | ☐ | ☐ | Describe how model assumptions, constraints and applicability domain will be documented in associated publications and user guidance materials. |  |

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