

## Appendix 2. Evaluation of features of hydrodynamic model

| Model Features                          | POM                            | EFDC                           | FVCOM                     | ROMS                           | CH3D                          | GEMSS                          | UnTRIM                    | ADCIRC                       | SELFE                        |
|---|--------------------------------|--------------------------------|---------------------------|--------------------------------|-------------------------------|--------------------------------|---------------------------|------------------------------|------------------------------|
| <b>Grid system</b>                      | Structured (Quasi-curvilinear) | Structured (Quasi-curvilinear) | US (Mesh: T)              | Structured (Quasi-curvilinear) | Structured (Curvilinear)      | Structured (Quasi-curvilinear) | US (Mesh: OT,OQ)          | US (Mesh: T)                 | US (Mesh: T,Q)               |
| <b>Dimension</b>                        | 3D                             | 3D                             | 3D                        | 3D                             | 3D                            | 3D                             | 3D                        | 2D/3D                        | 3D                           |
| <b>Numerical method</b>                 | FDM                            | FDM                            | FVM                       | FDM                            | FDM                           | FDM                            | FDM & FVM                 | FEM                          | FEM                          |
| <b>Vertical grid</b>                    | Sigma-grid                     | Sigma-grid                     | Sigma-grid                | S- coordinate                  | Sigma-grid                    | Z-grid                         | Z-grid                    | Z-grid                       | Sigma-/Z-grid                |
| <b>Equation</b>                         | Differential (Mode splitting)  | Differential (Mode splitting)  | Integral (Mode splitting) | Differential (Mode splitting)  | Differential (Mode splitting) | N/A                            | Differential and integral | Integral with shape function | Integral with shape function |
| <b>Wetting/Drying</b>                   | NO                             | YES                            | YES                       | NO                             | YES                           | YES                            | YES                       | YES                          | YES                          |
| <b>High-order transport schemes</b>     | YES                            | YES                            | YES                       | YES                            | YES                           | YES                            | YES                       | YES                          | YES                          |
| <b>Conservation</b>                     | YES                            | YES                            | YES                       | YES                            | YES                           | YES                            | YES                       | NO                           | NO                           |
| <b>Meteorology force</b>                | MMS                            | MMS                            | MMS/MMO                   | MMO                            | MMS                           | MMS                            | MMS                       | MMS                          | MMS                          |
| <b>Source code availability</b>         | YES                            | YES                            | YES                       | YES                            | YES                           | YES                            | N/A                       | YES                          | YES                          |
| <b>Application areas</b>                | 3                              | 3                              | 3                         | 3                              | 3                             | 2                              | 2                         | 3                            | 2                            |
| <b>Peer review of model theory</b>      | 3                              | 3                              | 3                         | 3                              | 3                             | 3                              | 3                         | 3                            | 3                            |
| <b>Technical documentation</b>          | 3                              | 3                              | 3                         | 2                              | 2                             | 2                              | 2                         | 2                            | 2                            |
| <b>Active development or user group</b> | 3                              | 3                              | 3                         | 3                              | 2                             | 2                              | 2                         | 3                            | 2                            |

\*US: Unstructured, T: Triangle Mesh, Q: Quadrilateral Mesh, OT: Orthogonal Triangle Mesh, OQ: Orthogonal Quadrilateral Mesh, MMS: meteorology force from multiple stations, MMO: meteorological force from model output

\*Rating system: 3=excellent, 2=good, 1=can be adapted, 0 = not included

### Appendix 3. Evaluation of features of water quality modeling system (hydrodynamic and water quality model)

| Model Features              | CH3D-IMS                                    | CH3D & CE-QUAL-ICM                                   | EFDC (Tetra Tech)          | HEM-3D   | EFDC & WASP                   | EFDC & CE-QUAL-ICM                                   | RMA-10-WES & CE-QUAL-ICM          | ROMS                | GEMSS                                   | ECOM-si                       | DELFT 3D                            | MIKE3                             | FVCOM & NPZD                  |
|-----------------------------|---|--|----------------------------|--|-------------------------------|--|-----------------------------------|---------------------|---|-------------------------------|-------------------------------------|-----------------------------------|-------------------------------|
| Hydro-dynamic model         | CH3D  | CH3D-WES   | EFDC                       | EFDC   | EFDC                          | EFDC   | RMA-10-WES (2D)                   | POM                 | GLLVHT                                  | POM                           | DELFT-FLOW                          | MIKE-HD                           | FVCOM                         |
| Water quality model         | Built-in                                    | CE-QUAL-ICM  | Built-in                   | Built-in   | WASP                          | CE-QUAL-ICM  | CE-QUAL-ICM                       | Built-in            | Built-in                                | Built-in                      | DELFT_WAQ                           | MIKE-ECO Lab                      | Built-in (NPZD)               |
| Model coupling              | Internal                                    | External   | Internal                   | Internal   | External                      | External   | Internal                          | Internal            | Internal                                | Internal                      | Internal                            | Internal                          | Internal                      |
| Mesh consistence            | YES   | YES  | YES                        | YES  | YES                           | YES  | NO                                | YES                 | YES                                     | YES                           | YES                                 | YES                               | YES                           |
| Multiple Phytoplankton      | YES   | YES  | YES                        | YES  | YES                           | YES  | YES                               | NO                  | YES                                     | YES                           | YES                                 | YES                               | YES                           |
| Phytoplankton stoichiometry | Const.                                      | Const./Variable                                      | Const.                     | Const./Variable                                  | Const.                        | Const./Variable                                      | Const./Variable                   | Const.              | N/A                                     | N/A                           | N/A                                 | N/A                               | Const.                        |
| Sediment Oxygen Demand      | YES   | YES  | YES                        | YES  | YES                           | YES  | YES                               | N/A                 | YES                                     | YES                           | YES                                 | YES                               | YES                           |
| Water quality constituents  | N, P, Si, Phyt, Zoo, DO, S-W, CBOD, SS, SOD | N, P, Si, Phyt, Zoo, DO, COD, C, SS, T, PA, SAV, S-W | N, P, C, Phyt, DO, COD, SS | N, P, Si, Phyt, Zoo, DO, COD, C, SS, B, TAM, S-W | N, P, Si, Phyt, Zoo, DO, CBOD | N, P, Si, Phyt, Zoo, DO, COD, C, SS, T, PA, SAV, S-W | N, P, Phyt, Zoo, DO, SOD, CBOD, C | N, Phyt, Zoo, DO, D | N, P, Si, Phyt, Zoo, DO, COD, C, SS, T, | N, P, Si, Phyt, Zoo, DO, CBOD | N, P, Si, Phyt, DO, BOD, E-coli, SS | N, P, C, Phyt, Zoo, DO, D, SS, BV | N, P, Si, Phyt, DO, B, D, DOM |
| Source code availability    | NO  | YES  | NO                         | N/A  | YES                           | YES  | YES                               | NO                  | N/A                                     | N/A                           | NO                                  | NO                                | YES                           |
| Sediment Diagenesis         | 2   | 3  | 2                          | 2  | 1                             | 3  | 3                                 | 1                   | 3                                       | 2                             | 2                                   | 2                                 | 2                             |
| Application areas           | 3   | 3  | 2                          | 3  | 3                             | 3  | 2                                 | 3                   | 3                                       | 3                             | 3                                   | 3                                 | 1                             |
| Peer review of model theory | 2   | 3  | 2                          | 2  | 2                             | 3  | 3                                 | 3                   | 2                                       | 2                             | 2                                   | 2                                 | 2                             |
| Technical documentation     | 3   | 3  | 2                          | 3  | 3                             | 3  | 2                                 | 1                   | 2                                       | 3                             | 3                                   | 3                                 | 1                             |
| Active development          | 2   | 2  | 2                          | 2  | 2                             | 3  | 1                                 | 3                   | 2                                       | 2                             | 2                                   | 2                                 | 3                             |

\*N: Nitrogen, P: Phosphorous, Si: Silicate, Phyt: Phytoplankton, Zoo: Zooplankton, SS: Suspended Solids, B: Bacteria, D: Detritus, T: Toxic, C: Carbon, PA: Pathogen, S-W: Sediment and water column interaction, TAM: Total Active Metal, BV: Benthic Vegetation

\*Rating svstem: 3=excellent. 2=good. 1=can be adanted. 0 = not included