Component	Core Role	Language / Runtime	Cartino2D Step	Status
R & RStudio	Master Driver & Orchestrator	R (4.4+)	All Steps (00–09, PreC2D)	Mandatory
TELEMAC-2D	2D Hydrodynamic numerical solver	Fortran / Python / MPI	Step 05 (Local & Remote)	Mandatory
GMSH	2D Unstructured finite-element mesher	C++ (64-bit binary)	Step 02 (Mesh generation)	Mandatory
PPutils	Selafin `.slf` creation & result raster extraction	Python	Steps 01, 02 & Step 07	Mandatory
Python	Runtime engine for PPutils scripts	Python 3 (`numpy`, `scipy`)	Steps 01, 02, 07	Mandatory
GRASS GIS	High-performance raster engine & culvert repair	GIS CLI (`grass84.bat`)	Step 01 & Step 08	Mandatory
QGIS & OSGeo4W	Headless GIS processing, GDAL utilities, styles & `.gpkg`	GIS CLI (`qgis_process`)	PreC2D, 00, 01, 02, 07–09	Mandatory
TauDEM	Hydrological terrain analysis (DEM conditioning)	C++ binaries (`.exe`) / MS-MPI	PreC2D	Mandatory
PSCP (PuTTY)	SSH/SCP encrypted bridge to HPC clusters	Windows CLI executable	Step 05 (Remote HPC runs)	Optional (HPC)
Fortran Routines	Custom user laws (rain, hydrograph interpolation)	Fortran 90	Steps 04 / 05	Built-in C2D
Rtools	C/C++/Fortran Windows compiler toolchain	Windows build tools	R geospatial compilation	Mandatory