Appendix C: Hydrological Modelling and Geospatial Data

C.1 Geospatial Reference Points for Giza Functional Hydrological Interfaces

Structure (Functional Reference Point)	Latitude (°N)	Longitude (°E)	Elevation (m)	Source / Notes
Khufu Causeway Terminus	29.9785	31.1400	60.1	Inferred from Nazlet el-Samman slope
Khafre Valley Temple	29.972565	31.137768	22.5	Preserved, U-shaped harbour basin evident
Menkaure Causeway Terminus	29.9721	31.1357	39.4	Estimated from slope and causeway remnant

- Geolocated using Google Earth Pro v7.3.6 and cross-validated with archaeological surveys[1,2], clipped to a 10km Giza extent.

C.2 Elevation Model and Hydrological Data

- **DEM Source**: NASA SRTM 1-arc second (approximately 30 m resolution)
- **Software**: QGIS 3.36, GRASS GIS 8.3
- **Processing**:
  - Sink filling: r.fill.dir
  - Watershed delineation: r.watershed (threshold: 1,000,000 m²)
  - Stream edge detection: r.stream.basins
  - Euclidean distance computation: r.grow.distance
  - Flood simulation: r.lake (levels approximating 63 m highstand and 50 m regression)
- **Epochs**:
  - 4400±200 BCE: Holocene highstand (approximately 63 m)[1]
  - 2500±30 BCE: Old Kingdom regression (approximately 50 m)[3]

- **Error Bounds**:
    - DEM vertical uncertainty: ±0.5 m
    - Lateral boundary error: ~30–50 m (impacting flood boundary precision)

C.3 Hydrological Accessibility and U-Shaped Basin Analysis

The U-shaped harbour basin of Khafre Valley Temple, potentially an unloading dock, was assessed for fluvial accessibility:

- At ~63m (4400±200 BCE highstand), the basin is fully inundated (0 m to floodplain), enabling direct barge docking.
- At ~50m (2500±30 BCE regression), the basin is >90 m from the floodplain, requiring portage.
- Khufu Causeway Terminus (60.1 m) and Menkaure Causeway Terminus (39.4 m) show direct access (15 m and 38 m) at 63m, with portage at 50m.

Accessibility Classification:

- ≤ 50 m: Direct Access (suitable for docking or barge transfer)
- 50–300 m: Short Portage (possible but logistically constrained)
- ≥ 300 m: Isolated (no practical fluvial access)

See Figure 3 for updated hydrological maps and Table 1 for distance data.

References

1. Kuper, R. & Kröpelin, S. Climate-controlled Holocene occupation in the Sahara: Motor of Africa's evolution. *Science* 313, 803–807 (2006).
2. Lehner, M. *The Complete Pyramids: Solving the Ancient Mysteries*. Thames & Hudson (1997).
3. Butzer, K. W. Early Hydraulic Civilization in Egypt. University of Chicago Press (1976).