Wetland Water Balance
Linking hydrogeological processes to ecological effect
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Outline
• Background
• Wetland-scale processes
• Water balance approach
• Hydrogeological inputs & ecological assessment
• Summary
**Background**

- Approach based on existing methods and research
  - Armstrong (1993)
  - Gowing and Spoor (1998)
  - Gasca & Acreman (1999)
  - EA/NE Hydro-ecological guidelines (2004), etc

- Aim: to integrate these into a practical and adaptable tool
  - Habitats Directive assessments
  - WLMPs
  - Habitat Creation
  - ....

- Illustrated by: Arun Valley SPA Sustainability Study

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**Wetland-scale processes**

- Evapotranspiration
- Precipitation
- River inflows
- Outflows to & passing from south catchment
- Groundwater inflows
- Groundwater outflows
Water balance: open water

Open water: volumes to levels

Cross-sectional area \times \text{ditch length} = WL_1

Cross-sectional area \times \text{ditch length} = WL_2

(Cross-sectional area \times \text{ditch length}) + \text{Field storage (from DEM)} = WL_3

Storage (S) = aW^2 + bW + c
Open water: volume-level data needs

For over-bank storage: DEM

For ditches and permanent ponds/lakes: topographic transects

Ditch – field water table interactions

Includes water-table level dependent evapotranspiration (same basis as MODFLOW EVT)
Open water model calibration

Open water model calibration plot (actual vs modelled)

Open water model parameters

Open water model sensitivity buttons

Water table model parameters

Water table model sensitivity buttons

Quality control of open water model output

Sluice level data used in historic predictions

Historical model prediction

Buttons linking to other parts of the model

Water table model calibration

With groundwater models it is hardly ever possible to get to this type of wetland water table representation
Hydrogeological inputs and ecological assessment

e.g. Arun Valley SPA, Pulborough Brooks SSSI

Pulborough Brooks Hydrogeology
Ditch level sensitivity to seepage rates

**Marginal seepage**

GW levels predicted by empirical model, but rates of seepage uncertain. Attempts to measure rates unsuccessful/equivocal. Sensitivity studies using wetland model used to constrain upper limit of seepage rate.

Simplified water balance results

(a) Ditch water balance
Hydro-ecology assessment

Wet grassland

Water table requirements expressed in terms of long term average water table depths (bgl) for months through the year.

Based on monitoring data from research sites, regimes for different communities (MG13 in our case) identified:

Green: target regime

Amber: if experienced for most years community change is likely

Red: if experienced one year community change is likely

Hydro-ecology assessment

Ditch communities
Applications

- Chippenham Fen
  - Environment Agency
  - Groundwater abstraction
- Heath Lake
  - Environment Agency
  - Hydrology and water quality study
- Wallers Haven
  - South East Water
  - Surface water abstraction
- Pevensey Levels
  - Environment Agency
  - Water Level Management Plan
- Pulborough Brooks
  - Southern Water
  - Groundwater abstraction
- Bembridge Lagoons
  - Environment Agency
  - Hydrology and water quality study
- Hilsea Lines
  - Environment Agency
  - Fisheries and water quality study
- Hale Manor Farm
  - Environment Agency
  - Reservoir design
- Heath Lake
  - Environment Agency
  - Hydrology and water quality study
- Pulborough Brooks
  - Southern Water
  - Groundwater abstraction

Summary

- Focus on wetland scale processes
- Understanding gained from 12-18 months monitoring data can be hindcast over longer periods
- Ecological requirements can be specified and compliance assessed
- Use wetland water balances to bridge the gap from hydrogeological impacts to ecological effects!

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