



Prepared for:

Environment Agency for England and Wales

## National Groundwater Modelling System

Release Documentation

Release 105330\_NGMS\_1.1

December, 2007

<b>CLIENT:</b> Environment Agency, UK						
<b>TITLE:</b> National Groundwater Modelling System Release Document NGMS 1.1 (software version development build)						
<b>REFERENCES:</b> EA Contract Reference Number 11915 EA Purchase Order Number 30153426						
VER.	ORIGINATOR		DATE	REMARKS	REVIEW	APPROVED BY
0.9	Ververs & Gijsbers		09/07/2007			
1.0	Gijsbers		05/09/2007		Ververs	
1.1	Gijsbers		November 2007		Ververs	
<b>PROJECT IDENTIFICATION:</b>			Q4415			
<b>KEYWORDS:</b>			Delft FEWS, National Groundwater Modelling System, NGMS			
<b>NUMBER OF PAGES</b>			13			
<b>STATUS:</b> <input type="checkbox"/> PRELIMINARY <input type="checkbox"/> DRAFT <input checked="" type="checkbox"/> FINAL						

## Preface

The document describes NGMS release 1.1, based on development build of DelftFEWS. The Master Controller is based on stable release 2007/02 (buildnr. 16492).

The release documentation includes the following information:

- software functionality changes and extensions
- general configuration issues
- regional application issues



## Contents

<b>1</b>	<b>Introduction .....</b>	<b>1—1</b>
<b>2</b>	<b>Software functionality .....</b>	<b>2—1</b>
2.1	New in this Software Release .....	2—1
2.1.1	Operator Client .....	2—1
2.1.2	FEWS Modules .....	2—2
2.1.3	Config Manager .....	2—2
2.1.4	Admin Interface & Master Controller .....	2—2
2.1.5	Various .....	2—3
2.1.6	Module Adapter .....	2—3
2.2	Known bugs .....	2—3
2.2.1	NGMS-Modflow Module Adapter interaction .....	2—3
2.2.2	Scenario Editor .....	2—4
2.2.3	Time series display .....	2—4
2.3	Outstanding issues .....	2—4
2.3.1	Operator Client .....	2—4
2.3.2	FEWS Modules .....	2—5
2.3.3	Admin Interface & Master Controller .....	2—6
<b>3</b>	<b>Configuration issues .....</b>	<b>3—1</b>
3.1	Workflow issues .....	3—1
3.2	State issues .....	3—2
3.3	Synchronization .....	3—3
3.3.1	Configuration distribution .....	3—3
3.3.2	Model data retrieval .....	3—3
3.3.3	Approved and non-approved runs .....	3—4
3.4	Budget computations .....	3—4
<b>4</b>	<b>Regional application issues .....</b>	<b>4—1</b>
4.1	General .....	4—1
4.2	Anglian/YNN .....	4—1
4.3	Southern/TI .....	4—1
4.4	Midlands/WMW .....	4—2
4.5	Thames/KV .....	4—2
4.6	SouthWest/HA .....	4—2

4.7 Wales/WYE ..... 4—3



# I Introduction

This document provides information regarding the NGMS release 1.1, based on development build. This version will be shipping to the EA on December, 3, 2007.

This document describes:

- software functionality incorporated
- software functionality outstanding
- configuration functionality incorporated
- configuration functionality outstanding
- regional issues



## 2 Software functionality

### 2.1 New in this Software Release

In the next sections the new features being useful for NGMS will be described. Most developments for Dutch water boards line up nicely with NGMS requests.

#### 2.1.1 Operator Client

A selection of useful software improvements and new features during the last few months:

Component	(NGMS related ISSUE nr) Feature	Developed for
Explorer	(1115) Added some F12 functions to file menu	NGMS
	(107) Search facility in filter panels (press Shift and type search string, for wildcards press Shift and start with *)	Dutch Waterboards
	(106) Tooltip in filters	Dutch Waterboards
	Message panel minimizer	Dutch Waterboards
	facilities to hide/show displays or buttons within displays based on user and authorisation settings	Dutch Waterboards
Time Series Display	(102) Windows Minimizer	Dutch Waterboards
	(107) Search facility in shortcuts (press Shift and type search string, for wildcards press Shift and start with *)	Dutch Waterboards
	(106) Tooltip in shortcuts	Dutch Waterboards
	Accommodate table positioned above graph	Dutch Waterboards
	(1096) *Moving average and duration curves, can be selected via combobox, incl. descriptive table	NGMS/Dutch Waterboards
	(1040) Longitudinal profile updates (chainage, tooltip)	NGMS
Spatial Display	(97) Tooltips in folders	Dutch Waterboards
	(1049) Smoothed contour lines	NGMS
Scenario editor	(998) Ability to define time series table with proper stress periods	NGMS

Component	(NGMS related ISSUE nr) Feature	Developed for
	(998) Added buttons for new, copy as new, save, save as, and lock scenarios	NGMS
System monitor	(1008) Show login profile	NGMS
Plugin interface	Standardized interface protocol for plug-ins added to the system	general purpose investment
Config Editor	Edit facility to update locations, location sets, IdMaps and validation rules	Dutch Waterboards

\* functionality available and tested for other applications. Not yet configured for NGMS

### 2.1.2 FEWS Modules

The following bug fixes and new features have been implemented:

Component	Feature	Developed for
Core	JDBC-driver to open up locations, parameters and scalar time series (imports and approved runs) to external software components*	Dutch water boards
Statistics	(277) Added basic statistics functionality, used by time series display	NGMS/Dutch Waterboards
massBalance	(1046) Module to derive budgets for sub-grid (or polygon) from grid time series**	NGMS

\* This driver may be used to connect with Oracle Business Objects or Crystal reports

\*\* unit tests available. Not yet configured for and tested within NGMS

### 2.1.3 Config Manager

The following enhancements and bug fixes have been implemented...

Component	Action
	Minor bug fixes

### 2.1.4 Admin Interface & Master Controller

The following enhancements and bug fixes have been implemented...

Component	Feature	Developed for
-----------	---------	---------------

Master Controller	MC-webservice completed as additional data access protocol (next to JMS)	US-NWS
Synchronisation	approaching test phase	general purpose investment (NGMS will benefit later as it enables more interactive driven)

### 2.1.5 Various

The following enhancements and bug fixes have been implemented...

Component	Feature	Developed for
Database	support for Postgress	US-NWS (used by test infrastructure of NGMS and EA-T46 project)

### 2.1.6 Module Adapter

Component	Feature	Developed for
Modflow Module Adapter	bug fixes: <ul style="list-style-type: none"> <li>▪ none</li> </ul>	NGMS

## 2.2 Known bugs

### 2.2.1 NGMS-Modflow Module Adapter interaction

A variety of tests have shown that the interaction between the NGMS-software and the Modflow Module Adapter works under many test conditions, but it is not yet 100% reliable under all test conditions. The following situations still need to be improved:

- stress period updating
- skipping 'new' wells which are included in the export but do not have any dta associated with them.

Given the unreliability of this feature, the data processing of new wells has been excluded in this configuration.

## 2.2.2 Scenario Editor

The dates shown when in the table editor when specifying a new time series are not always as expected. Sometimes dates are shown relative to the current system time, some times not.

## 2.2.3 Time series display

The introduction of the duration curve functionality resulted in breaking the axis-setting for a longitudinal profile. Extensive zooming is needed in a longitudinal profile to finally get a view on the data.

## 2.3 Outstanding issues

The following major software enhancements are outstanding for NGMS. Issues without an number are not on the implementation list yet as additional clarification or agreement is needed.

### 2.3.1 Operator Client

Component	Feature	Remark
Spatial Display	(96) classification rendering (i.e. add button which automatically adjust classification breaks based on data values within zoom extent)	preferred over toggling pre-defined sets of class breaks
	(111) Double click should add time series to existing graph	for discussion (given advantages of current situation)
	(1043) Accommodate multi-line segments in cross section	
	(1050) Save crosssection locally for reuse	
	(1051) Allow dragging polygon to derive budgets for grid cells incorporated	uses massBalance algorithms
	(1124) accommodate color categorization within one shapefile	
	(1125) GIS-tooltips overrules tooltip of grid timeseries	
	(1126) animation speed	
	(1127) set end time of animation	
Scenario Editor	Geology/borehole viewer	for discussion/design
	Distinction between public / private scenarios	for discussion
	(1236) new abstraction: allow specification of abstraction pattern for 1 year to be repeated	

Component	Feature	Remark
	(1053) facilities to hide/show scenario modification and dispatch buttons based on user and authorisation settings	
ForecastManager	(1009) re-download option (with other login profile)	
	(1052) manage access to taskruns/workflows based on authorisation	for discussion how to authorize
	(1117) ability to delete task run by authorized persons	
	(1233) filter runlist based on selected field	
Manual Forecast or taskRunDialog*	facilities to hide/show displays or buttons within displays based on user and authorisation settings	
ScenarioEditor (1053)	facilities to hide/show scenario modification and dispatch buttons based on user and authorisation settings	
Filter (1056) TimeSeriesDisplay (1054) GridDisplay (1055)	(1053, 1054, 1055, 1056) facilities to filter the locations/grids shown based on the user and its authorisation settings	for discussion NGMS

\* The TaskRunDialog might be an easier display to operate compared to the Manual Forecast display. Evaluation is needed.

### 2.3.2 FEWS Modules

The following major enhancements are outstanding for NGMS...

Component	(ISSUE NR) Feature	Remark
Core	(876) Just-in-time reading of grid data from the database (not before hand)	<ul style="list-style-type: none"> <li>▪ will Kennet Valley post-processing in one workflow (currently run is split in two)</li> <li>▪ will improve performance of spatial animations</li> </ul>
	(1014) Extend authentication to workflows	
	(1117) Delete task run	only if reliable method available
	(1097) Accommodate static grids	

Component	(ISSUE NR) Feature	Remark
Transformation	(1048) basic statistics on grids	review if current seasonal/annual based functionality needs extension
	update GIS-maps from the EA-server	manual procedure will be proposed to CIS, to be discussed

NB. It is expected that the new synchronisation opportunities will accommodate better on-demand synchronisation of portions of the database.

### 2.3.3 Admin Interface & Master Controller

The following enhancements are under development.

Component	Feature	Developed for
Admin Interfaces		
Synchronisation	refactored functionality, approaching test phase	general purpose investment (NGMS will benefit later as it enables more interactive driven)

## 3 Configuration issues

### 3.1 Workflow issues

The following workflows are included:

Workflow	Contents	Run
XX_import	import historic observation data (if place in the proper FSS-folder) imports aquifer properties	once via Manual Forecast display
XX_default_scenarios	runs the default scenarios (Historic, Naturalized, recent Actual, fully Licenced) <ul style="list-style-type: none"> <li>▪ runs the Modflow model</li> <li>▪ derives the tributary inflows to the main river branches</li> <li>▪ interpolates grid data to points and profiles</li> <li>▪ compares the results against the Naturalized run</li> </ul>	once via Manual Forecast display
XX_modified_Historic	what-if scenario for the Historic run: <ul style="list-style-type: none"> <li>▪ runs the Modflow models</li> <li>▪ retrieves transient model inputs (recharge, abstractions) and model results</li> <li>▪ derives the tributary inflows to the main river branches</li> <li>▪ interpolates grid data to points and profiles</li> <li>▪ compares the results against the default Calibrated Historic run</li> </ul>	defined but not accessible in the Scenario Editor
XX_modified_RecentActual	what-if scenario for the RecentActual run: <ul style="list-style-type: none"> <li>▪ changes abstraction rates of the default RecentActual run</li> <li>▪ runs the Modflow model</li> <li>▪ retrieves transient model results</li> <li>▪ derives the tributary inflows to the main river branches</li> <li>▪ interpolates grid data to points and profiles</li> <li>▪ compares the results against the default Recent Actual run</li> </ul>	multiple runs via the Scenario Editor

Workflow	Contents	Run
XX_modified_FullyLicenced	what-if scenario for the FullyLicenced run: <ul style="list-style-type: none"> <li>▪ changes abstraction rates of the default FullyLicenced run</li> <li>▪ add new abstractions to the FullyLicenced run</li> <li>▪ runs the Modflow model</li> <li>▪ retrieves transient model results</li> <li>▪ derives the tributary inflows to the main river branches</li> <li>▪ interpolates grid data to points and profiles</li> <li>▪ compares the results against the default FullyLicenced run</li> </ul>	multiple runs via the Scenario Editor
XX_modified_LongTermAverage	what-if scenario for the LongTermAverage run: <ul style="list-style-type: none"> <li>▪ changes abstraction rates of the default LongTermAverage run</li> <li>▪ add new abstractions to the LongTermAverage runs</li> <li>▪ accommodates choice of recharge files</li> <li>▪ runs the Modflow model</li> <li>▪ retrieves transient model results</li> <li>▪ derives the tributary inflows to the main river branches</li> <li>▪ interpolates grid data to points and profiles</li> <li>▪ compares the results against the default LongTermAverage run</li> </ul>	multiple via the Scenario Editor. NB: choice of recharge files not yet configured in Scenario Editor

**Important notes:**

- The scenario editor has not yet been configured to define or run a modified-historic scenario
- The scenario editor has been configured to add new abstractions for demo purposes. However, the appropriate workflow to feed these new abstractions to the model didn't pass the test in time. Therefore, new abstractions are not yet fed into the model run. In other words, a modified scenario only computes the results of modifications to new abstractions.

**3.2 State issues**

For each model, the following model states have been computed and placed in a separate Modflow input file (the BAS file) for selection and use in the Scenario Editor. The data associated to each state is model dependent.

- InitialCold: the initial state of the model as provided
- InitialWarm: initial heads (typically 01-01-1970)
- MostRecent: most recent heads computed with provided model runs.



- DryConditions: heads from selected date representing dry hydrological conditions (date is model dependent)
- WetConditions heads from selected date representing wet hydrological conditions (date is model dependent)
- AvgConditions heads from selected date representing average hydrological conditions (date is model dependent)

**Important notes:**

- Factory tests have been conducted for runs starting from an InitialCold state only.
- Stress period patterns in all BAS files (i.e. accounting for differences in month lengths) start from January, even while the heads account for a different moment. The workflow to update the recharge data and stress periods (accounting for leap years etc.) based on the selected state has not passed the factory-test in time. Therefore, selection of states other than the InitialCold state may result in strange date patterns due to difference in the length of a month.
- In release 105330\_NGMS\_1.1 no priority has been given to resolve this issue

### 3.3 Synchronization

#### 3.3.1 Configuration distribution

This release uses the 2007/01 facility to distribute and update configurations from the central database. This allows the system administrators to automatically distribute of configuration patches or GIS-file updates via the systems synchronization protocols.

As a result, of this distribution method, each deletion of a localDatastore will require a full download of the configuration.

#### 3.3.2 Model data retrieval

The model data retrieval is based on three synchronisation profiles, each having a different scope of data being included. The 0.9 release bug, which prevented synchronization of grids of non-approved runs, has been fixed.

Table 3.1 provides an overview of the type of data included in each synchronization profile.

Table 3.1 Data contents of snchronization profiles

Profile	Minimal	Custom (Merged Grids)	Custom (Head Details)	Custom (Flow details)	Full
<b>Data types</b>					
Point locations <ul style="list-style-type: none"> <li>▪ Observation boreholes</li> <li>▪ Gauging stations</li> <li>▪ Abstraction wells</li> <li>▪ SW laterals</li> </ul>	×	×	×	×	×
GW units	×	×	×	×	×

Accretion Profiles	×	×	×	×	×
Aquifer properties	×	×	×	×	×
Recharge		×			×
Surface water flows		×			×
Upper GW table		×			×
Total cell flows		×			×
Heads for individual layers			×		×
Cell flows for individual layers				×	×

Table 3.2 provides an indication of the data set size for the default\_scenarios workflow for each of the models included.

Table 3.2 Estimated data set sizes for the default\_scenarios workflow

Model	Minimum	Custom (merged grids only)	Full
WMW			1 Gb
TI			
KV			
YNN			11 Gb

### 3.3.3 Approved and non-approved runs

Approved runs have a green triangle. They are synchronised automatically to all users who log on. The amount of data being synchronised depends on the profile chosen at logon.

Non approved runs have to be downloaded manually.

To prevent that people have to wait for hours when logging on, it is recommended that only one successful XX\_default\_scenarios workflow is approved per model. All other runs should be downloaded manually. Please be aware that whatif-scenarios can only be compared against an approved XX\_default\_scenarios run.

If a model run has been downloaded with minimal profile and one would like to view spatial plots, the user should delete its database and log on again with a custom or full profile. Please allow for sufficient time to synchronize.

NB acquiring the download times should be one of the main purposes of the tests to be conducted.

## 3.4 Budget computations

For the budget computations, we've used the methods as described in Table 3.3. Since the horizontal flows are not properly computed, the zone budget algorithm of Modflow has been incorporated in the software. However, the configuration has not yet been adapted to use this functionality.

Table 3.3 Budget calculation method

<b>Parameter</b>	<b>Method</b>
Storage change	Sum (proportional) values of all grid cells in the polygon, skipping missing values
Cell flows	Sum (proportional) values of all grid cells in the polygon, skipping missing values
SW laterals (abstractions and discharges)	Sum (proportional) values of all grid cells in the polygon, skipping missing values
GW abstractions	Sum of all abstractions in the polygon
Recharge	area average (m/d) * area surface (m <sup>2</sup> )

Missing values may occur if the polygon representing the GW unit outreaches the model grid.

## 4 Regional application issues

### 4.1 General

What-if scenarios are conducted with the recharge and GW abstractions being provided by the NGMS-database. Intermediate tests have shown that this input resulted in inappropriate Modflow runs, with 'Not available' values appearing from stress period 3. The problems were caused by a data compression which was set too tight for those input values. Hence the parameter settings have been adjusted to prevent undesirable impacts of data compression.

### 4.2 Anglian/YNN

Outstanding configuration issues:

- GIS-files: wetlands (to be provided)
- model documentation (to be provided)
- (new) update configuration for mass balance/GW budget computation
- (new) migrate to equidistant daysOfMonth time stepping to accommodate duration curves

Checks on model outputs are highly desirable. Inspection of factory test results has shown that some observation boreholes have been placed in layer 1 while the model only has active cells in layer 2-6.

Changes compared to release 105330\_NGMS\_1.0:

- location information has been updated for unnamed licences
- adaptation of parameters (naming and compression rates)

### 4.3 Southern/TI

Outstanding configuration issues:

- GIS-files: wetlands (to be provided)
- model documentation (to be provided)
- (new) update configuration for mass balance/GW budget computation
- (new) migrate to equidistant daysOfMonth time stepping to accommodate duration curves

Limited factory test are conducted on LongTermAverage run,  
Checks on model outputs are highly desirable.

Changes compared to release 105330\_NGMS\_1.0:

- minor update of location information
- adaptation of parameters (naming and compression rates)

## 4.4 Midlands/WMW

Outstanding configuration issues:

- GIS-files: wetlands (to be provided)
- model documentation (to be provided)
- (new) update configuration for mass balance/GW budget computation
- (new) migrate to equidistant daysOfMonth time stepping to accommodate duration curves

Checks on model outputs are highly desirable. Some river flows seem to deviate a bit from the original data provided.

Changes compared to release 105330\_NGMS\_1.0:

- minor update of location information
- adaptation of parameters (naming and compression rates)

## 4.5 Thames/KV

After the familiarization workshop, it appeared that the results of the West Berkshire Groundwater Study had not been included in the model provided. The data has been provided and incorporated.

Outstanding configuration issues:

- the mapping between the new WBGWS data and the WEL/STR-files provided are not 100% correct yet
- GIS-files: wetlands (has been provided, to be included)
- model documentation (has been provided, to be included)
- (new) update configuration for mass balance/GW budget computation
- (new) migrate to equidistant daysOfMonth time stepping to accommodate duration curves

Checks on model outputs are highly desirable.

Changes compared to release 105330\_NGMS\_1.0:

- defined output for every stress period instead of every step
- added West Berkshire Groundwater Study information
  - updated locations (abstractions, discharges)
  - replaced Modflow files
- minor update of location information
- adaptation of parameters (naming and compression rates)

## 4.6 SouthWest/HA

ESI has developed the first version of the SouthWest-application with the Hampshire Avon model. Some minor parts of the configuration have not yet been completed.

Outstanding configuration issues:

- horizontal and upwards flows are not included

- derivation of tributary inflows
- what-if scenarios for modified recent actual
- GIS-files (have been provided, to be included)
- model documentation (has not been provided, to be included)
- (new) update configuration for mass balance/GW budget computation
- (new) migrate to equidistant daysOfMonth time stepping to accommodate duration curves

Checks on model outputs are highly desirable.

Changes compared to release 105330\_NGMS\_1.0:

- new application

## 4.7 Wales/WYE

Based on the database provided for the Wye catchment, an initial application for Wales has been developed. Given the queries on inconsistencies on the data provided, it is recommended to obtain data from WISKI to be incorporated in the system.

Outstanding configuration issues:

- time series data to be provided from WISKI
- GIS-files (have been provided, to be included)
- documentation (have been provided, to be included)

Checks and instructions for further development on this application are highly desirable.

Changes compared to release 105330\_NGMS\_1.0:

- new application